Print Form

**TOWN OF ERIE**
Community Development Department – Planning Division
645 Holbrook Street – PO Box 750 – Erie, CO 80516
Tel: 303.926.2770 – Fax: 303.926.2706 – Web: www.erieco.gov

# LAND USE APPLICATION

*Please fill in this form completely. Incomplete applications will not be processed.*

**STAFF USE ONLY**

FILE NAME:

FILE NO: DATE SUBMITTED: FEES PAID:

**PROJECT/BUSINESS NAME**: Colliers Hill (Phase II)

**PROJECT ADDRESS**:

**PROJECT DESCRIPTION**: A subdivision community of approximately 717 single family homes, eight (8) pocket parks, and other additional open space.

**LEGAL DESCRIPTION** *(attach legal description if Metes & Bounds)*

Subdivision Name: Colliers Hill

Filing #: Lot #: Block #: Section: Township: Range:

**OWNER** *(attach separate sheets if multiple)*

Name/Company: Daybreak Recovery Acquisition LLC
Contact Person: Mr. Jerry B. Richmond III
Address: 7200 S. Alton Way, Suite C - 400
City/State/Zip: Centennial, CO 80112
Phone: 303-267-6195 Fax:
E-mail: jrichmond@raintree.us.com

**AUTHORIZED REPRESENTATIVE**

Company/Firm: Norris Design
Contact Person: Brad Haigh
Address: 1101 Bannock Street
City/State/Zip: Denver, CO 80204
Phone: 303.892.1166 Fax:
E-mail: bhaigh@norris-design.com

**MINERAL RIGHTS OWNER** *(attach separate sheets if multiple)*

Name/Company: Anadarko Petroleum
Address: 635 N. 7th Ave.
City/State/Zip: Brighton, CO 80601

**MINERAL LEASE HOLDER** *(attach separate sheets if multiple)*

Name/Company: Anadarko Petroleum
Address: 635 N. 7th Ave.
City/State/Zip: Brighton, CO 80601

**LAND-USE & SUMMARY INFORMATION**

Present Zoning: LDR (PUD Overlay)
Proposed Zoning: LDR (PUD Overlay)
Gross Acreage: 348.92 acres
Gross Site Density (du/ac): 2.05 du/ac
# Lots/Units Proposed: 717
Gross Floor Area: N/A

**SERVICE PROVIDERS**

Electric: United Power
Metro District:
Water *(if other than Town)*:
Gas: Xcel
Fire District: Mountain View
Sewer *(if other than Town)*:

***PAGE TWO MUST BE SIGNED AND NOTARIZED***

| DEVELOPMENT REVIEW FEES | | | |
|---|---|---|---|
| **ANNEXATION** | | **SUBDIVISION** | |
| ☐ Major (10+ acres) | $ 4000.00 | ☐ Sketch Plan | $ 1000.00 + 10.00 per lot |
| ☐ Minor (less than 10 acres) | $ 2000.00 | ☑ Preliminary Plat | $ 2000.00 + 40.00 per lot |
| ☐ Deannexation | $ 1000.00 | ☐ Final Plat | $ 2000.00 + 20.00 per lot |
| **COMPREHENSIVE PLAN AMENDMENT** | | ☐ Minor Subdivision Plat | $ 2000.00 |
| ☐ Major | $ 3000.00 | ☐ Minor Amendment Plat | $ 1000.00 + 10.00 per lot |
| ☐ Minor | $ 1200.00 | ☐ Road Vacation (constructed) | $ 1000.00 |
| **ZONING/REZONING** | | ☐ Road Vacation (paper) | $ 100.00 |
| ☐ Rezoning | $ 1700.00 + 10.00 per acre | **SITE PLAN** | |
| ☐ PUD Rezoning | $ 1700.00 + 10.00 per acre | ☐ Residential | $ 1400.00 + 10.00 per unit |
| ☐ PUD Amendment | $ 1700.00 + 10.00 per acre | ☐ Non-Resi. (>10,000 sq. ft.) | $ 2200.00 |
| ☐ Major PD Amendment | $ 3700.00 + 10.00 per acre | ☐ Non-Resi. (>2,000 sq. ft.) | $ 1000.00 |
| ☐ Minor PD Amendment | $ 500.00 | ☐ Non-Resi. (<2,000 sq. ft.) | $ 200.00 |
| **SPECIAL REVIEW USE** | | ☐ Amendment (major) | $ 1100.00 |
| ☐ Major | $ 1000.00 | ☐ Amendment (minor) | $ 350.00 |
| ☐ Minor | $ 400.00 | **VARIANCE** | $ 600.00 |
| ☐ Oil & Gas | $ 1200.00 | **SERVICE PLAN** | $ 10,000.00 |

*All fees **include** both Town of Erie Planning & Engineering review. These fees **do not include** referral agency review fees, outside consultant review fees, or review fees incurred by consultants acting on behalf of staff. See Town of Erie Municipal Code, Title 2-10-5 for all COMMUNITY DEVELOPMENT FEES.*

The undersigned is fully aware of the request/proposal being made and the actions being initiated on the referenced property. The undersigned understand that the application must be found to be complete by the Town of Erie before the request can officially be accepted and the development review process initiated. The undersigned is aware that the applicant is fully responsible for all reasonable costs associated with the review of the application/request being made to the Town of Erie. Pursuant to Chapter 7 (Section 7.2.B.5) of the Unified Development Code (UDC) of the Town of Erie, applicants shall pay all costs billed by the Town for legal, engineering and planning costs incurred by staff, including consultants acting on behalf of staff, necessary for project review. By this acknowledgement, the undersigned hereby certify that the above information is true and correct.

Owner: _____ Date: 9/18/15

AUTH AGENT ~~Owner~~: _____ Date: 9/10/15

Applicant: _____ Date: _____

STATE OF ~~COLORADO~~ ~~NEW YORK~~ NewYork )
) ss.
County of NEW YORK )

The foregoing instrument was acknowledged before me this 18th day of September, 2015, by Jonathan Shumaker.

My commission expires: _____.
Witness my hand and official seal.

_____
Notary Public

STEPHANIE SCHULMAN
Notary Public, State of New York
No. 02SC6258887
Qualified in Westchester County
Commission Expires April 9, 2016

1101 Bannock Street
Denver, Colorado 80204
303.892.1166

NORRIS DESIGN

April 7, 2016

Town of Erie
Community Development Department – Planning Division
645 Holbrook Street
PO Box 750
Erie, Colorado 80516

Re: Colliers Hill Planning and Entitlements

This letter is being submitted on behalf of Daybreak Recovery Acquisition LLC, the "Property Owner," at your request, and hereby authorizes RainTree Investment Corporation and its representative, Jerry B. Richmond III, to submit planning and entitlement documents on our behalf.

Please note that, upon completion of the appropriate reviews and prior to submittal of a final plat, the Property Owner will sign the formal documents before any recordation of these documents will occur.

Please feel free to contact me if you have any questions or concerns.

Sincerely,

Mr. Jon Shumaker
Authorized Signatory for Daybreak Recovery Acquisition LLC
Cc: Michael McDonnell
Jerry B. Richmond III

1101 Bannock Street
Denver, Colorado 80204
303.892.1166

NORRIS DESIGN

April 7, 2016

Town of Erie
Community Development Department – Planning Division
645 Holbrook Street
PO Box 750
Erie, Colorado 80516

Re: Colliers Hill Planning and Entitlements

This letter is being submitted on behalf of Daybreak Metropolitan District No.2, the "Property Owner," at your request, and hereby authorizes RainTree Investment Corporation and its representative, Jerry B. Richmond III, to submit planning and entitlement documents on our behalf.

Please note that, upon completion of the appropriate reviews and prior to submittal of a final plat, the Property Owner will sign the formal documents before any recordation of these documents will occur.

Please feel free to contact me if you have any questions or concerns.

Sincerely,

Mr. Jerry B. Richmond III
Authorized Signatory for Daybreak Metropolitan District No.2

1101 Bannock Street
Denver, Colorado 80204
303.892.1166

NORRIS DESIGN

April 7, 2016

Town of Erie
Community Development Department – Planning Division
645 Holbrook Street
PO Box 750
Erie, Colorado 80516

Re: Colliers Hill Planning and Entitlements

This letter is being submitted on behalf of Daybreak Metropolitan District No.3, the "Property Owner," at your request, and hereby authorizes RainTree Investment Corporation and its representative, Jerry B. Richmond III, to submit planning and entitlement documents on our behalf.

Please note that, upon completion of the appropriate reviews and prior to submittal of a final plat, the Property Owner will sign the formal documents before any recordation of these documents will occur.

Please feel free to contact me if you have any questions or concerns.

Sincerely,

Jerry B. Richmond

Mr. Jerry B. Richmond III
Authorized Signatory for Daybreak Metropolitan District No.3

1101 Bannock Street
Denver, CO 80204
303.892.1166

NORRIS DESIGN
Planning | Landscape Architecture

April 7, 2016

Mr. Todd Bjerkaas
Town of Erie Community Development
645 Holbrook Street
Erie, Colorado 80506

Dear Mr. Bjerkaas,

With the following please find our letter of introduction and project description for the Colliers Hill Preliminary Plat No. 2. We look forward to working with you and the Town of Erie on the next phase of this great community.

## Proposed Project Description

The Second Preliminary Plat of Colliers Hill is a 400.74 acres located just north of the first phase of the Colliers Hill Master Plan, which is currently under construction. The Colliers Hill community is located two miles west of Interstate 25, between County Road 5 and County Road 3 (Colliers Blvd.). Colliers Hill Preliminary Plat No. 2 will create a residential community that provides a variety of homes and lot sizes. The community will integrate pedestrian friendly blocks with a system of expansive open spaces and internal parks.

The proposed application includes 726 single family detached dwelling units and a tract that will serve as the site for future paired homes. These home sites include lot sizes ranging from 5,170 sf to upwards of 15,835 sf. Multiple builders are proposed to have units within the development, all with their own variety of home sizes and architectural features. However, all homes within the development will adhere to the architecture standards in the approved PUD Overlay. All units are detached and will include at least a two car garage and two exterior parking spaces per driveway. Home design and front elevations will be varied to add to the diversity of the community.

Within the development, blocks are generally oriented north-south with homes oriented westward to take advantage of views of the Rocky Mountains. Blocks are planned to group similar home types together and create smaller sub-neighborhoods within the development. Cul-de-sacs are limited to promote continuous circulation throughout the community. Longer blocks are broken up with opens space pass-throughs to encourage pedestrian movement and add to the overall community trail system.

### Parks and Open Space-

The Preliminary Plat No. 2 community provides 40 acres of planned open space, a 7.0-acre Neighborhood Park with 1.02-acre private amenity, 3.5 acres of pocket parks, a 47 acre community park, and other additional undeveloped space; together equaling approximately 25% of the total Preliminary Plat No. 2 area. The 7.0-acre Neighborhood Park, 40 acres of open space and 47 acres of Community Park will be dedicated to the Town of Erie. 41.8 acres of open space, landscape buffer, and pocket park will be maintained by the HOA.

Three pocket parks are planned to provide a centrally located amenity space for residents within a 1/4 mile radius. This allows all residents to have close access to an organized, active amenity. The neighborhood park with private amenity and the community park will be submitted with future applications.

The large open space corridor located along the north-south drainageway is a part of the Community Park dedication per agreements made at the time of the PUD. This corridor will contain a variety of both active and passive uses including meandering trails, ponds, and parks. Community Park land dedication is identified in the Bridgewater Master Subdivision Final Plat as Tract 23. A portion of this dedication is within the drainageway and is included as a part of this Preliminary Plat. The remainder of the park will be included in future filings.

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A network of trails is also proposed to link the community together and to the proposed open space and park areas. The community trails will serve as major pedestrian circulation routes and will have will have and 8' paved path with an additional 4' of adjacent aggregate for a running trail. Enhanced landscape areas will be utilized along these trails to create a unique pedestrian experience separate from the suburban feel of the neighborhood blocks. Approximately 12,220 linear feet/miles of trail are proposed for the project, creating a fluid and accessible community.

## Project Location, Comprehensive Plan and Zoning Designations

The site is currently recommended as low density residential per the Town of Erie Comprehensive Master Plan in the Bridgewater PUD Overlay. This designation mostly refers to suburban type neighborhood developments, but also allows for a variety of housing options including: single family detached and attached homes, paired homes, and patio homes. The density of this recommended land use is 2-6 dwelling units per acre. The proposed density of the Colliers Hill community (phase II) had a less restrictive density than those recommendations with a density of approximately 1.8 dwelling units per acre (726 SFD units in 400.74 acres). The Preliminary Plat identifies the single-family detached homes included as a part of this current submission. The site plan for the paired homes will be submitted under separate cover.

The site is currently zoned low density residential with a planned unit development (PUD) overlay. The proposed plans of the Colliers Hill (phase II) development adhere to the requirements presented under the PUD overlay. However, changes are suggested for the paired homes parcel located northwest of the County Road 5 and Colliers Parkway intersection. These changes will be noted in a PUD amendment which will be submitted in tangent with the Site Plan for the paired homes and the overall Preliminary Plat application.

## Background / Past Approvals

The Preliminary Plat No. 2 is comprised of Tracts 8, 9, 10, 12, 13, 14, 23, and a portions of Tract 23 in the Colliers Hill Master Subdivision Final Plat. The site was approved for development in the Colliers Hill PUD overlay. Initial phases of development are currently under construction.

## Existing Conditions

### Existing Land Uses

The current land uses of the site include agricultural fields and oil/gas production sites. Landscaping, fencing, and berming will be utilized to buffer the well sites from the proposed community. The oil/gas production sites are operated by other ownership not associated with the owners of the Colliers Hill development.

### Adjacent Land Uses

Adjacent land uses to the site include:
To the North – agricultural fields and oil/gas production sites. Future phase III development of the Colliers Hill Master Plan will take place in the area directly northwest of the County Road 10 and County Road 5 intersection.

To the West – Mount Pleasant Cemetery, a twelve acre local cemetery, is located directly west of the intersection of County Road 3 (Colliers Blvd.) and the future Colliers Parkway. A regional trail is also located west of the site. Connections to this trail system are proposed as a part of this application. Vacant / agricultural land is also adjacent to the site's western boundary.

To the South – The initial phases of the Colliers Hill Master Plan are currently under construction directly south of the site. This application shares access with these initial phases with the boundary created by the future east-west collector, Colliers Parkway.

To the East – Erie High School is located directly east of the site, near the intersection of County Road 5 and the future Colliers Parkway. To the north of the school site is vacant/agricultural fields and oil/gas production/storage sites.

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Planning | Landscape Architecture

Other notable land uses that are near, but not directly adjacent to, the site include: the Downtown Erie core (.5 miles to the west), the Town of Erie Community Center and Park (1 mile to the southwest), and Interstate 25 (2 miles to the east).

Access-
The Colliers Hill community is located at the northwest corner of County Road 8 (Erie Parkway) and County Road 5. This is the second major intersection west of Interstate 25. This location situates the Colliers Hill community as a gateway benchmark for travelers entering the Town of Erie from the east.

The Filing No. 4 Preliminary Plat is accessed by four major collectors: County Road 5 (eastern boundary), County Road 10 (northern boundary), County Road 3 / Colliers Boulevard (western boundary), and the future Colliers Parkway (southern boundary). Other internal access and circulation will be provided by a system of internal collector and local roads. Alley roads will be proposed for the paired homes parcel with the Site Plan submittal.

Pedestrian access into the site is currently limited to a sidewalk along the western side of County Road 3 (Colliers Blvd.), however, future pedestrian circulation will be facilitated by a series of detached sidewalks and trails.

Topography-
The topography of the site gradually slopes from east to west, with the high point located, generally, near the intersection of County Road 5 and County Road 10. Gentle, rolling hills create vista points, while a drainage running north-south through the site creates intimate low-level areas. These lower levels will be utilized as a major open space and trail corridor as well as ideal detention opportunities.

Floodplains / Wetlands-
There are no known floodplains or wetlands on the site.

Vegetation-
The vegetation on site currently consists of agricultural grains (used for hay production) and small areas of native grasses. There are no trees or areas of notable vegetation on site.

Geological Features-
It has been found from grading operations conducted within the first phase of development that large boulders are located within the soil on site. Boulders excavated from the soil are to be moved to open spaces where they can serve as a distinguishing natural feature of the site.

We hope that this provides a comprehensive summary of the Colliers Hill Preliminary Plat No. 2. Feel free to contact me directly should you have any comments, questions and/or requests for additional information.

Sincerely,
Norris Design

Eva Mather
Principal

**First American Title Insurance Company - NCS**
**1125 17th Street, Suite 500**
**Denver, Colorado 80202**
Phone: **(303)876-1112** Fax:**(877)235-9185**

**DATE:** January 20, 2016
**FILE NUMBER:** NCS-750432-CO
**PROPERTY ADDRESS:** Colliers Hill Plat 2, Eire, CO
**OWNER/BUYER:** /
**YOUR REFERENCE NUMBER:** Bridgewater Master Subdivision
**ASSESSOR PARCEL NUMBER:**

**PLEASE REVIEW THE ENCLOSED MATERIAL COMPLETELY AND TAKE NOTE OF THE FOLLOWING TERMS CONTAINED THEREIN:**
**Transmittal:**
**Revision No.:**
**Schedule A:**
**Schedule B - Section 1 Requirements:**
**Schedule B - Section 2 Exceptions:**

Should you have any questions regarding these materials, please contact First American Title Insurance Company National Commercial Services at the above phone number. We sincerely thank you for your business.

| | | | |
|---|---|---|---|
| **TO:** | **First American Title Insurance Company National Commercial Services** | **TITLE OFFICER: Shari Jacobs** | |
| | **1125 17th Street, Suite 500** | **PHONE:** | **(303)876-1112** |
| | **Denver, Colorado 80202** | **FAX:** | **(877)235-9185** |
| | | **E-MAIL:** | **sjacobs@firstam.com** |
| | | **DELIVERY:** | **E-MAIL** |

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| | | | |
|---|---|---|---|
| **To:** | **RainTree Investment Corporation** | **ATTN:** | **Jerry Richmond** |
| | **7200 S. Alton Way, Suite C - 400** | **PHONE:** | **(303)267-6195** |
| | **Centennial, CO 80112** | **MOBILE:** | **(303)947-8672** |
| | | **FAX:** | |
| | | **E-MAIL:** | **jrichmond@raintree.us.com** |
| | | **DELIVERY:** | **E-MAIL** |

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| | | | |
|---|---|---|---|
| **To:** | **Beverly M. Carlson** | **ATTN:** | **First American Title Insurance Company National Commercial Services** |
| | **1125 17th Street, Suite 500** | **PHONE:** | **(303)876-1138** |
| | **Denver, CO 80202** | **MOBILE:** | **(720)775-8892** |
| | | **FAX:** | **(877)235-9185** |
| | | **E-MAIL:** | **bevcarlson@firstam.com** |
| | | **DELIVERY:** | **E-MAIL** |

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## ALTA Commitment Form

COMMITMENT FOR TITLE INSURANCE

Issued by

***First American Title Insurance Company***

First American Title Insurance Company, a Nebraska corporation ("Company"), for a valuable consideration, commits to issue its policy or policies of title insurance, as identified in Schedule A, in favor of the Proposed Insured named in Schedule A, as owner or mortgagee of the estate or interest in the land described or referred to in Schedule A, upon payment of the premiums and charges and compliance with the Requirements; all subject to the provisions of Schedules A and B and to the Conditions of this Commitment.

This Commitment shall be effective only when the identity of the Proposed Insured and the amount of the policy or policies committed for have been inserted in Schedule A by the Company.

All liability and obligation under this Commitment shall cease and terminate six (6) months after the Effective Date or when the policy or policies committed for shall issue, whichever first occurs, provided that the failure to issue the policy or policies is not the fault of the Company.

The Company will provide a sample of the policy form upon request.

IN WITNESS WHEREOF, First American Title Insurance Company has caused its corporate name and seal to be affixed by its duly authorized officers on the date shown in Schedule A.

***First American Title Insurance Company***

Dennis J. Gilmore
President

Jeffrey S. Robinson
Secretary

# COMMITMENT FOR TITLE INSURANCE FORM

Updated and amended 1-20-16

## SCHEDULE A

1. Effective Date: January 14, 2016 at 5:00 p.m.

   a. ALTA Owner's Policy (06-17-06) $0.00

   Proposed Insured:
   None

   b. ALTA Loan Policy (06-17-06) $0.00

   Proposed Insured:
   None

2. The estate or interest in the Land described or referred to in this Commitment is:

   Fee Simple

3. Title to the estate or interest in the Land is at the Effective Date vested in:

   Daybreak Recovery Acquisition LLC, a Delaware limited liability company, Daybreak Metropolitan District No. 2, a quasi-municipal corporation and Daybreak Metropolitan District No. 3, a quasi-municipal corporation, as their interests may appear of record

4. The Land referred to in this Commitment is described as follows:

   **See Exhibit "A" attached hereto and made a part hereof**

   For informational purposes only: Colliers Hill Plat 2,
   Eire, Colorado

.

## EXHIBIT A

Commitment No.: NCS-750432-CO

The land referred to in Schedule A is situated in the County of Weld, State of Colorado and is described as follows:

TRACTS 10, 12, 13, 14, 15, 16, 17, 22 AND 23 OF "BRIDGEWATER MASTER SUBDIVSION", TRACT 9B OF "BRIDGEWATER MASTER SUBDIVISION FIRST AMENDMENT", AND TRACT A OF "DAYBREAK FILING NO. 2B, LOCATED IN SECTION 17 AND THE NORTHEAST QUARTER OF SECTION 18, TOWNSHIP 1 NORTH, RANGE 68 WEST OF THE 6TH PRINCIPAL MERIDIAN, TOWN OF ERIE, COUNTY OF WELD, STATE OF COLORADO,

# COMMITMENT FOR TITLE INSURANCE FORM

# SCHEDULE B

## SECTION ONE

## REQUIREMENTS

The following requirements must be met:

1. Pay the agreed amounts for the interest in the land and/or the mortgage to be insured.

2. Pay us the premiums, fees and charges for the policy.

3. Payment of all taxes and assessments now due and payable.

4. LIMITATION OF LIABILITY FOR INFORMATIONAL REPORT

   IMPORTANT – READ CAREFULLY: THIS REPORT IS NOT AN INSURED PRODUCT OR SERVICE OR A REPRESENTATION OF THE CONDITION OF TITLE TO REAL PROPERTY. IT IS NOT AN ABSTRACT, LEGAL OPINION, OPINION OF TITLE, TITLE INSURANCE COMMITMENT OR PRELIMINARY REPORT, OR ANY FORM OF TITLE INSURANCE OR GUARANTY. THIS REPORT IS ISSUED EXCLUSIVELY FOR THE BENEFIT OF THE APPLICANT THEREFOR, AND MAY NOT BE USED OR RELIED UPON BY ANY OTHER PERSON. THIS REPORT MAY NOT BE REPRODUCED IN ANY MANNER WITHOUT FIRST AMERICAN'S PRIOR WRITTEN CONSENT. FIRST AMERICAN DOES NOT REPRESENT OR WARRANT THAT THE INFORMATION HEREIN IS COMPLETE OR FREE FROM ERROR, AND THE INFORMATION HEREIN IS PROVIDED WITHOUT ANY WARRANTIES OF ANY KIND, AS-IS, AND WITH ALL FAULTS. AS A MATERIAL PART OF THE CONSIDERATION GIVEN IN EXCHANGE FOR THE ISSUANCE OF THIS REPORT, RECIPIENT AGREES THAT FIRST AMERICAN'S SOLE LIABILITY FOR ANY LOSS OR DAMAGE CAUSED BY AN ERROR OR OMISSION DUE TO INACCURATE INFORMATION OR NEGLIGENCE IN PREPARING THIS REPORT SHALL BE LIMITED TO THE FEE CHARGED FOR THE REPORT. RECIPIENT ACCEPTS THIS REPORT WITH THIS LIMITATION AND AGREES THAT FIRST AMERICAN WOULD NOT HAVE ISSUED THIS REPORT BUT FOR THE LIMITATION OF LIABILITY DESCRIBED ABOVE. FIRST AMERICAN MAKES NO REPRESENTATION OR WARRANTY AS TO THE LEGALITY OR PROPRIETY OF RECIPIENT'S USE OF THE INFORMATION HEREIN.

# COMMITMENT FOR TITLE INSURANCE FORM

## SCHEDULE B

## SECTION TWO

## EXCEPTIONS

Schedule B of the policy or policies to be issued will contain exceptions to the following matters unless the same are disposed of to the satisfaction of the Company:

1. Any facts, rights, interests or claims which are not shown by the Public Records, but which could be ascertained by an inspection of the Land or by making inquiry of persons in possession thereof.

2. Easements, or claims of easements, not shown by the Public Records.

3. Discrepancies, conflicts in boundary lines, shortage in area, encroachments, and any facts which a correct survey and inspection of the Land would disclose, and which are not shown by the public records.

4. Any lien, or right to a lien, for services, labor or material heretofore or hereafter furnished, imposed by law and not shown in the Public Records.

5. Any and all unpaid taxes, assessments and unredeemed tax sales.

6. Right of way for County Roads 30 feet on either side of Section and Township lines, as established by the Board of County Commissioners recorded October 14, 1889 in Book 86 at Page 273

7. The interest of the Erie Coal Creek Ditch and Reservoir Company as conveyed by instrument recorded February 13, 1909 in Book 289 at Page 530.

8. Terms, conditions, provisions, obligations, easements and agreements as set forth in the Right of way easement granted to Public Service Company of Colorado by instrument recorded July 17, 1970 at Reception No. 1551487 in Book 629.

9. An easement for telecommunications system and incidental purposes granted to Mountain States Telephone and Telegraph Company, as set forth in an instrument recorded October 12, 1971 at Reception No. 1576620 in Book 655.

10. All oil, gas, minerals and other mineral rights as conveyed by instrument recorded November 30, 1972 at Reception No. 1602712 in Book 681.

11. All oil, gas, minerals and other mineral rights as conveyed in instrument recorded April 28, 1980 at Reception No. 1823501 in Book 902.

12. Terms, conditions, provisions, obligations, easements and agreements as set forth in the Deed granting right of way easement granted to Panhandle Eastern Pine Line Company, but reserving unto grantor the right to construct at any and all times and maintain roads, highways, railroad tracks, pipelines and telephone, telegraph and electric power pole and wire lines recorded November 21, 1980 at Reception No. 1842244 in Book 920.

    NOTE: Amendment of Deed recorded November 04, 2011, at Reception No. 3803734.

13. Terms, conditions, provisions, obligations, easements and agreements as set forth in the Deed granting right of way easement granted to Panhandle Eastern Pine Line Company, but reserving unto grantor the right to construct at any and all times and maintain roads, highways, railroad tracks, pipelines and telephone, telegraph and electric power pole and wire lines recorded January 27, 1981 at Reception No. 1848120 in Book 926.

14. Terms, conditions, provisions, obligations, easements and agreements as set forth in the Deed granting right of way easement granted to Union Rural Electric Association, but reserving unto grantor the right to construct at any and all times and maintain roads, highways, railroad tracks, pipelines and telephone, telegraph and electric power pole and wire lines recorded February 16, 1983 at Reception No. 1917642 in Book 989.

15. Terms, conditions, provisions, obligations, easements and agreements as set forth in the Deed granting right of way easement granted to Panhandle Eastern Pine Line Company, but reserving unto grantor the right to construct at any and all times and maintain roads, highways, railroad tracks, pipelines and telephone, telegraph and electric power pole and wire lines recorded August 8, 1983 at Reception No. 1936290 in Book 1004. Amendment to Deed recorded April 26, 2013 at Reception No. 3927485.

16. Terms, conditions, provisions, obligations, easements and agreements as set forth in the Easement Deed granting right of way easement granted to Vessels Oil and Gas Company, but reserving unto grantor the right to construct at any and all times and maintain roads, highways, railroad tracks, pipelines and telephone, telegraph and electric power pole and wire lines recorded February 13, 1986 at Reception No. 2042899 in Book 1103.

17. Terms, conditions, provisions, obligations, easements and agreements as set forth in the Easement Deed granting right of way easement granted to KN Front Range Gathering Company, but reserving unto grantor the right to construct at any and all times and maintain roads, highways, railroad tracks, pipelines and telephone, telegraph and electric power pole and wire lines recorded April 1, 1993 at Reception No. 2327121 in Book 1376.

18. Oil and Gas Lease recorded May 22, 1998 at Reception No. 2614558.

    NOTE: Affidavit of Production in connection therewith recorded December 18, 2000 at Reception No. 2813963.

19. Reservation of all oil, gas, minerals and other mineral rights as set forth in Special Warranty Deed recorded November 17, 2000 at Reception No. 2807516.

20. Terms, conditions, provisions, obligations and agreements as set forth in the Agreement for Compatible Development recorded November 17, 2000 at Reception No. 2807515.

21. Terms, conditions, provisions, obligations and agreements as set forth in the Surface Use Agreement recorded September 26, 2003 at Reception No. 3110572.

22. Terms, conditions, provisions, obligations, easements and agreements as set forth in the Right of Way Grant recorded November 12, 2004 at Reception No. 3235061.

23. Terms, conditions, provisions, obligations and agreements as set forth in the Surface Use Agreement evidenced by that certain Memorandum of Surface Use Agreement recorded August 25, 2005 at Reception No. 3316658 and Corrected Memorandum of Surface Damage and Release Agreement recorded November 1, 2010 at Reception No. 3729056.

24. Terms, conditions, provisions, obligations and agreements as set forth in the Surface Use Agreement as evidenced by that certain Memorandum of Surface Use Agreement recorded March 13, 2007 at Reception No. 3461612 and Corrected Memorandum of Surface Damage and Release Agreement recorded November 1, 2010 at Reception No. 3729057.

25. Terms, conditions, provisions, obligations, easements and agreements as set forth in the Right of Way Grant recorded September 20, 2007 at Reception No. 3505741.

26. The effect of Ordinance No. 30-2007 regarding Zoning recorded November 19, 2007 at Reception No. 3518315.

27. The effect of Ordinance 29-2007 regarding Annexation recorded November 19, 2007 at Reception No. 3518316.

28. Terms, conditions, provisions, obligations and agreements as set forth in the Annexation Agreement recorded November 19, 2007 at Reception No. 3518317, First Amendment recorded December 30, 2010 at Reception No. 3741841, Second Amendment recorded October 12, 2011, at Reception No. 3798317 and Third Amendment recorded January 23, 2013 at Reception No. 3904988.

    NOTE: Partial Assignment and Assumption of Annexation Agreement Rights and Obligations in connection therewith recorded June 13, 2013 at Reception No. 3955793.

29. Terms, conditions, provisions, obligations and agreements as set forth in the Grant of Permanent Avigation Easement recorded November 19, 2007 at Reception No. 3518318.

30. The effect of Bridgewater Annexation Map to the Town of Erie recorded November 19, 2007 at Reception No. 3518319.

31. The effect of Bridgewater Zoning Map recorded November 19, 2007 at Reception No. 3518320 and Amendment No. 1 recorded August 31, 2011, at Reception No. 3789471.

32. The effect of Bridgewater P.U.D. Overlay Map recorded November 19, 2007 at Reception No. 3518321 and Amendment No. 1 recorded August 31, 2011, at Reception No. 3789472 and Amendment No. 2 recorded May 29, 2013 at Reception No. 3935464.

33. Terms, conditions, provisions, obligations, easements and agreements as set forth in the Right of Way Grant recorded January 21, 2009 at Reception No. 3600584.

34. Terms, conditions, provisions, obligations, easements and agreements as set forth in the Right of Way Grant recorded February 19, 2009 at Reception No. 3606265.

35. Reservation of all minerals as set forth in Quitclaim Deed recorded April 14, 1971 at Reception No. 1565713.

36. Oil and Gas Lease recorded November 30, 1972 at Reception No. 1602713. Affidavit of Lease Extension recorded January 11, 1979 at Reception No. 1778417.

37. Notice of Oil and Gas Interests and Surface Use recorded January 23, 2001 at Reception No. 2820924.

38. Request for Notification of Surface Development recorded May 28, 2002 at Reception No. 2954711.

39. Any tax, lien, fee or assessment by reason of inclusion of subject property in the Bridgewater Metropolitan District No. 1, as evidenced by instrument recorded June 24, 2008 at Reception No. 3562679.

40. Any tax, lien, fee or assessment by reason of inclusion of subject property in the Bridgewater Metropolitan District No. 2, as evidenced by instrument recorded June 24, 2008 at Reception No. 3562680.

41. Any tax, lien, fee or assessment by reason of inclusion of subject property in the Bridgewater Metropolitan District No. 3, as evidenced by instrument recorded June 24, 2008 at Reception No. 3562681.

42. Ordinance No. 08-2011, Series 2011, for Rezoning, recorded August 31, 2011, at Reception No. 3789473.

43. Ordinance No. 09-2011, Series 2011, for PUD Overlay rezoning, recorded August 31, 2011, at Reception No. 3789474.

44. Terms, conditions, provisions, obligations, easements and agreements as set forth in the Surface Use Agreement recorded October 18, 2011, at Reception No. 3799568.

45. Terms, conditions, provisions, obligations, easements and agreements as set forth in the Surface Use Agreement recorded November 14, 2011, at Reception No. 3805168.

46. Easements, notes, covenants, restrictions and rights-of-way as shown on the plat of Bridgewater Master Subdivision, recorded December 13, 2011, at Reception No. 3811552.

    NOTE: Ordinance No. 18-2015 Series of 2015 in connection therewith recorded June 22, 2015 at Reception No. 4117798.

47. Any tax, lien, fee or assessment by reason of inclusion of subject property in the Northern Colorado Water Conservancy District, as evidenced by instrument recorded March 8, 2012 at Reception No. 3830699 and March 13, 2012 at Reception No. 3831541.

48. Terms, conditions, provisions, obligations and agreements as set forth in the Daybreak Filing No. 1A Development Agreement recorded May 29, 2013 at Reception No. 3935459.

49. Easements, notes, covenants, restrictions and rights-of-way as shown on the plat of Daybreak Filing No. 1A, recorded May 29, 2013 at Reception No. 3935455.

50. Terms, conditions, provisions, obligations and agreements as set forth in the Daybreak Metropolitan District Development Agreement recorded May 29, 2013 at Reception No. 3935463.

51. Covenants, conditions, restrictions and provisions as set forth in Master Declaration of Covenants, Conditions and Restrictions of Daybreak recorded May 29, 2013 at Reception No. 3935465, and First Amendment recorded April 28, 2014 at Reception No. 4012251, but omitting any covenant or restriction based on race, color, religion, sex, handicap, familial status, or national origin, and any and all amendments, assignments, or annexations thereto.

NOTE: Covenant to Annex Property in connection therewith recorded May 29, 2013 at Reception No. 3935454.

52. Terms, conditions, provisions, obligations, easements and agreements as set forth in the Right of Way Grant recorded February 7, 2013 at Reception No. 3908551.

53. Terms, conditions, provisions, obligations and agreements as set forth in the Covenant of Surface and Mineral Rights recorded August 13, 2013 at Reception No. 3955789.

54. Terms, conditions, provisions, obligations and agreements as set forth in the Daybreak Filing No. 2B Development Agreement recorded October 30, 2013 at Reception No. 3974459.

55. Easements, notes, covenants, restrictions and rights-of-way as shown on the plat of Daybreak Filing No. 2B, recorded October 30, 2013 at Reception No. 3974455.

NOTE: Affidavit of Correction in connection therewith recorded September 30, 2014 at Reception No. 4050035.

56. Terms, conditions, provisions, obligations and agreements as set forth in the Instrument recorded June 19, 2015 at Reception No. 4117584.

57. Terms, conditions, provisions, obligations, easements and agreements as set forth in the Grant of Permanent Access and Storm Drainage Facilities Easement Agreement recorded August 3, 2015 at Reception No. 4130002.

58. Existing leases and tenancies.

59. Terms, conditions, provisions, obligations, easements and agreements as set forth in the Grant of Easement recorded October 23, 2015 at Reception No.4152642.

60. Easements, notes, covenants, restrictions and rights-of-way as shown on the plat of Bridgewater Master Subdivision First Amendment, recorded November 3, 2015 at Reception No. 4155347.

**EXHIBIT B**
**Statement of Charges**

| | |
|---|---|
| Info Commitment | $ 750.00 |
| | $ |

# CONDITIONS

1. The term mortgage, when used herein, shall include deed of trust, trust deed, or other security instrument.

2. If the proposed Insured has or acquired actual knowledge of any defect, lien, encumbrance, adverse claim or other matter affecting the estate or interest or mortgage thereon covered by this Commitment other than those shown in Schedule B hereof, and shall fail to disclose such knowledge to the Company in writing, the Company shall be relieved from liability for any loss or damage resulting from any act of reliance hereon to the extent the Company is prejudiced by failure to so disclose such knowledge. If the proposed Insured shall disclose such knowledge to the Company, or if the Company otherwise acquires actual knowledge of any such defect, lien, encumbrance, adverse claim or other matter, the Company at its option may amend Schedule B of this Commitment accordingly, but such amendment shall not relieve the Company from liability previously incurred pursuant to paragraph 3 of these Conditions and Stipulations.

3. Liability of the Company under this Commitment shall be only to the named proposed Insured and such parties included under the definition of Insured in the form of policy or policies committed for and only for actual loss incurred in reliance hereon in undertaking in good faith (a) to comply with the requirements hereof, or (b) to eliminate exceptions shown in Schedule B, or (c) to acquire or create the estate or interest or mortgage thereon covered by this Commitment. In no event shall such liability exceed the amount stated in Schedule A for the policy or policies committed for and such liability is subject to the insuring provisions and Conditions and Stipulations and the Exclusions from Coverage of the form of policy or policies committed for in favor of the proposed Insured which are hereby incorporated by reference and are made a part of this Commitment except as expressly modified herein.

4. This Commitment is a contract to issue one or more title insurance policies and is not an abstract of title or a report of the condition of title. Any action or actions or rights of action that the proposed Insured may have or may bring against the Company arising out of the status of the title to the estate or interest or the status of the mortgage thereon covered by this Commitment must be based on and are subject to the provisions of this Commitment.

5. The policy to be issued contains an arbitration clause. All arbitrable matters when the Amount of Insurance is $2,000,000 or less shall be arbitrated at the option of either the Company or the Insured as the exclusive remedy of the parties. You may review a copy of the arbitration rules at http://www.alta.org/.

First American Title

**Privacy Information**

**We Are Committed to Safeguarding Customer Information**

In order to better serve your needs now and in the future, we may ask you to provide us with certain information. We understand that you may be concerned about what we will do with such information - particularly any personal or financial information. We agree that you have a right to know how we will utilize the personal information you provide to us. Therefore, together with our subsidiaries we have adopted this Privacy Policy to govern the use and handling of your personal information.

**Applicability**

This Privacy Policy governs our use of the information that you provide to us. It does not govern the manner in which we may use information we have obtained from any other source, such as information obtained from a public record or from another person or entity. First American has also adopted broader guidelines that govern our use of personal information regardless of its source. First American calls these guidelines its Fair Information Values.

**Types of Information**

Depending upon which of our services you are utilizing, the types of nonpublic personal information that we may collect include:

- Information we receive from you on applications, forms and in other communications to us, whether in writing, in person, by telephone or any other means;
- Information about your transactions with us, our affiliated companies, or others; and
- Information we receive from a consumer reporting agency.

**Use of Information**

We request information from you for our own legitimate business purposes and not for the benefit of any nonaffiliated party. Therefore, we will not release your information to nonaffiliated parties except: (1) as necessary for us to provide the product or service you have requested of us; or (2) as permitted by law. We may, however, store such information indefinitely, including the period after which any customer relationship has ceased. Such information may be used for any internal purpose, such as quality control efforts or customer analysis. We may also provide all of the types of nonpublic personal information listed above to one or more of our affiliated companies. Such affiliated companies include financial service providers, such as title insurers, property and casualty insurers, and trust and investment advisory companies, or companies involved in real estate services, such as appraisal companies, home warranty companies and escrow companies. Furthermore, we may also provide all the information we collect, as described above, to companies that perform marketing services on our behalf, on behalf of our affiliated companies or to other financial institutions with whom we or our affiliated companies have joint marketing agreements.

**Former Customers**

Even if you are no longer our customer, our Privacy Policy will continue to apply to you.

**Confidentiality and Security**

We will use our best efforts to ensure that no unauthorized parties have access to any of your information. We restrict access to nonpublic personal information about you to those individuals and entities who need to know that information to provide products or services to you. We will use our best efforts to train and oversee our employees and agents to ensure that your information will be handled responsibly and in accordance with this Privacy Policy and First American's Fair Information Values. We currently maintain physical, electronic, and procedural safeguards that comply with federal regulations to guard your nonpublic personal information.

**Information Obtained Through Our Web Site**

First American Financial Corporation is sensitive to privacy issues on the Internet. We believe it is important you know how we treat the information about you we receive on the Internet.

In general, you can visit First American or its affiliates' Web sites on the World Wide Web without telling us who you are or revealing any information about yourself. Our Web servers collect the domain names, not the e-mail addresses, of visitors. This information is aggregated to measure the number of visits, average time spent on the site, pages viewed and similar information. First American uses this information to measure the use of our site and to develop ideas to improve the content of our site.

There are times, however, when we may need information from you, such as your name and email address. When information is needed, we will use our best efforts to let you know at the time of collection how we will use the personal information. Usually, the personal information we collect is used only by us to respond to your inquiry, process an order or allow you to access specific account/profile information. If you choose to share any personal information with us, we will only use it in accordance with the policies outlined above.

**Business Relationships**

First American Financial Corporation's site and its affiliates' sites may contain links to other Web sites. While we try to link only to sites that share our high standards and respect for privacy, we are not responsible for the content or the privacy practices employed by other sites.

**Cookies**

Some of First American's Web sites may make use of "cookie" technology to measure site activity and to customize information to your personal tastes. A cookie is an element of data that a Web site can send to your browser, which may then store the cookie on your hard drive.

FirstAm.com uses stored cookies. The goal of this technology is to better serve you when visiting our site, save you time when you are here and to provide you with a more meaningful and productive Web site experience.

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**Fair Information Values**

**Fairness** We consider consumer expectations about their privacy in all our businesses. We only offer products and services that assure a favorable balance between consumer benefits and consumer privacy.

**Public Record** We believe that an open public record creates significant value for society, enhances consumer choice and creates consumer opportunity. We actively support an open public record and emphasize its importance and contribution to our economy.

**Use** We believe we should behave responsibly when we use information about a consumer in our business. We will obey the laws governing the collection, use and dissemination of data.

**Accuracy** We will take reasonable steps to help assure the accuracy of the data we collect, use and disseminate. Where possible, we will take reasonable steps to correct inaccurate information. When, as with the public record, we cannot correct inaccurate information, we will take all reasonable steps to assist consumers in identifying the source of the erroneous data so that the consumer can secure the required corrections.

**Education** We endeavor to educate the users of our products and services, our employees and others in our industry about the importance of consumer privacy. We will instruct our employees on our fair information values and on the responsible collection and use of data. We will encourage others in our industry to collect and use information in a responsible manner.

**Security** We will maintain appropriate facilities and systems to protect against unauthorized access to and corruption of the data we maintain.

## DISCLOSURE STATEMENT

Pursuant to C.R.S 30-10-406(3)(a) all documents received for recording or filing in the Clerk and Recorder's office shall contain a top margin of at least one inch and a left, right and bottom margin of at least one-half of an inch. The Clerk and Recorder will refuse to record or file any document that does not conform to the requirements of this section.

NOTE: If this transaction includes a sale of the property and the price exceeds $100,000.00, the seller must comply with the disclosure/withholding provisions of C.R.S. 39-22-604.5 (Non-residential withholding).

NOTE: Colorado Division of Insurance Regulations 3-5-1, requires that "Every title entity shall be responsible for all matters which appear of record prior to the time of recording whenever the title entity conducts the closing and is responsible for recording or filing of legal documents resulting from the transaction which was closed." Provided that First American Title Insurance Company conducts the closing of the insured transaction and is responsible for recording the legal documents from the transaction.

Pursuant to C.R.S. 10-11-122, the company will not issue its policy or policies of title insurance contemplated by this commitment until it has been provided a Certificate of Taxes due or other equivalent documentation from the County Treasurer or the County Treasurer's authorized agent; or until the Proposed Insured has notified or instructed the company in writing to the contrary.

The subject property may be located in a special taxing district. A Certificate of Taxes due listing each taxing jurisdiction shall be obtained from the County Treasurer or the County Treasurer's authorized agent. Information regarding special districts and the boundaries of such districts may be obtained from the Board of County Commissioners, the County Clerk and Recorder, or the County Assessor.

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NOTE: Pursuant to CRS 10-11-123, notice is hereby given:

This notice applies to owner's policy commitments containing a mineral severance instrument exception, or exceptions, in Schedule B, Section 2.

A. That there is recorded evidence that a mineral estate has been severed, leased, or otherwise conveyed from the surface estate and that there is a substantial likelihood that a third party holds some or all interest in oil, gas, other minerals, or geothermal energy in the property; and
B. That such mineral estate may include the right to enter and use the property without the surface owner's permission.

NOTE: Pursuant to Colorado Division of Insurance Regulations 3-5-1, Affirmative mechanic's lien protection for the Owner may be available (typically by deletion of Exception no. 4 of Schedule B, Section 2 of the Commitment from the Owner's Policy to be issued) upon compliance with the following conditions:

A. The land described in Schedule A of this commitment must be a single family residence which includes a condominium or townhouse unit.
B. No labor or materials have been furnished by mechanics or material-men for purposes of construction on the land described in Schedule A of this Commitment within the past 6 months.
C. The Company must receive an appropriate affidavit indemnifying the Company against un-filed mechanic's and material-men's liens.
D. The Company must receive payment of the appropriate premium.

E. If there has been construction, improvements or major repairs undertaken on the property to be purchased within six months prior to the Date of the Commitment, the requirements to obtain coverage for unrecorded liens will include: disclosure of certain construction information; financial information as to the seller, the builder and or the contractor; payment of the appropriate premium, fully executed Indemnity Agreements satisfactory to the company, and, any additional requirements as may be necessary after an examination of the aforesaid information by the Company.

No coverage will be given under any circumstances for labor or material for which the insured has contracted for or agreed to pay.

NOTE: Pursuant to C.R.S, 38-35-125(2) no person or entity that provides closing and settlement services for a real estate transaction shall disburse funds as a part of such services until those funds have been received and are available for immediate withdrawal as a matter of right.

NOTE: C.R.S. 39-14-102 requires that a real property transfer declaration accompany any conveyance document presented for recordation in the State of Colorado. Said declaration shall be completed and signed by either the grantor or grantee.

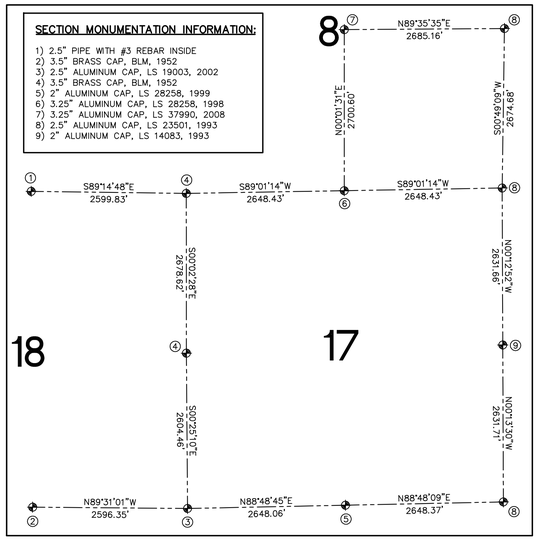
Nothing herein contained will be deemed to obligate the company to provide any of the coverages referred to herein unless the above conditions are fully satisfied.

**NOTE: Pursuant to CRS 10-1-128(6)(a), It is unlawful to knowingly provide false, incomplete, or misleading facts or information to an insurance company for the purpose of defrauding or attempting to defraud the company. Penalties may include imprisonment, fines, denial of insurance and civil damages. Any insurance company or agent of an insurance company who knowingly provides false, incomplete, or misleading facts or information to a policyholder or claimant for the purpose of defrauding or attempting to defraud the policyholder or claimant with regard to a settlement or award payable from insurance proceeds shall be reported to the Colorado division of insurance within the department of regulatory agencies.**

# ALTA/ACSM LAND TITLE SURVEY
# COLLIERS HILL PRELIMINARY PLAT NO. 2

TRACTS 10, 12, 13, 14, 15, 16, 17, 22 & 23, "BRIDGEWATER MASTER SUBDIVISON" AND TRACT 9B, "BRIDGEWATER MASTER SUBDIVISION, AND TRACT A, "DAYBREAK FILING NO. 2B" LOCATED IN SECTION 17 AND THE NORTHEAST QUARTER OF SECTION 18, TOWNSHIP 1 NORTH, RANGE 68 WEST OF THE 6TH PRINCIPAL MERIDIAN, TOWN OF ERIE, COUNTY OF WELD, STATE OF COLORADO

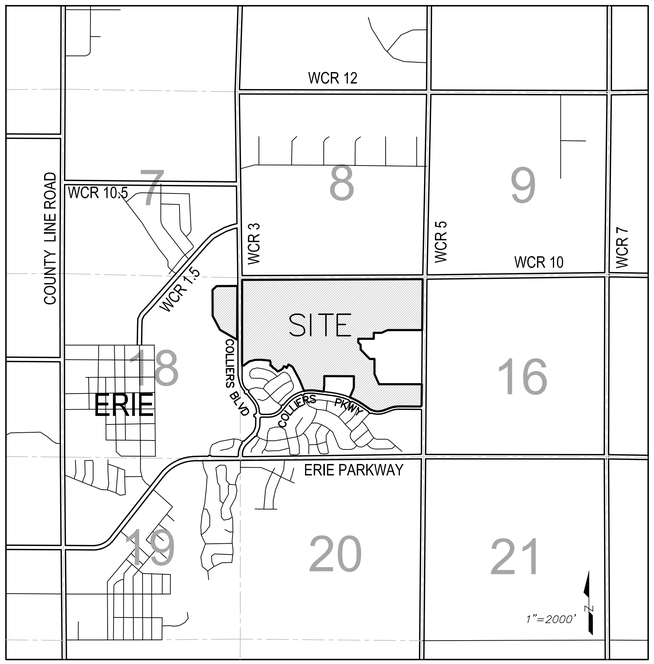





*SECTION LINE INFORMATION (NO SCALE)*

**PARCEL DESCRIPTION:**

TRACTS 10, 12, 13, 14, 15, 16, 17, 22 AND 23 OF "BRIDGEWATER MASTER SUBDIVISION"; TRACT 9B OF "BRIDGEWATER MASTER SUBDIVISION FIRST AMENDMENT", AND TRACT A OF "DAYBREAK FILING NO. 2B", LOCATED IN SECTION 17 AND THE NORTHEAST QUARTER OF SECTION 18, TOWNSHIP 1 NORTH, RANGE 68 WEST OF THE 6TH PRINCIPAL MERIDIAN, TOWN OF ERIE, COUNTY OF WELD, STATE OF COLORADO.




VICINITY MAP

**SURVEY CERTIFICATION:**

CERTIFIED TO:

RAINTREE INVESTMENT CORPORATION
DAYBREAK RECOVERY ACQUISITION LLC, A DELAWARE LIMITED LIABILITY COMPANY
FIRST AMERICAN TITLE INSURANCE COMPANY
AND THEIR RESPECTIVE SUCCESSORS AND ASSIGNS

THIS IS TO CERTIFY THAT THIS MAP OR PLAT AND THE SURVEY ON WHICH IT IS BASED WERE MADE IN ACCORDANCE WITH THE 2011 MINIMUM STANDARD DETAIL REQUIREMENTS FOR ALTA/ACSM LAND TITLE SURVEYS, JOINTLY ESTABLISHED AND ADOPTED BY ALTA AND NSPS, AND INCLUDES ITEMS 3, 4, 8 AND 11(a) OF TABLE A THEREOF. THE FIELD WORK WAS COMPLETED 01/18/2016.

DATE OF PLAT OR MAP: 01/20/2016

FOR AND ON BEHALF OF HURST AND ASSOCIATES:
BO BAIZE, COLORADO PLS NO. 37990
EMAIL ADDRESS: bo@hurst-assoc.com

**GENERAL NOTES:**

1. NOTICE: ACCORDING TO COLORADO LAW, YOU MUST COMMENCE ANY LEGAL ACTION BASED UPON ANY DEFECT IN THIS SURVEY WITHIN THREE YEARS AFTER YOU FIRST DISCOVER SUCH DEFECT. IN NO EVENT MAY ANY ACTION BASED UPON ANY DEFECT IN THIS SURVEY BE COMMENCED MORE THAN TEN YEARS FROM THE DATE OF THE CERTIFICATION SHOWN HEREON.

2. BASIS OF BEARINGS: BEARINGS ARE BASED ON THE WESTERLY LINE OF THE NORTHWEST QUARTER OF SECTION 17: S00°02'28"E BETWEEN THE NORTHWEST CORNER OF SECTION 17 BEING A 3.25" BRASS CAP MARKED BLM 1952 AND THE WEST QUARTER CORNER BEING A 3.25" BRASS CAP MARKED BLM 1952

3. UNLESS OTHERWISE NOTED, PROPERTY CORNERS WERE NOT SET DUE TO PLANNED GRADING AND AGRICULTURAL ACTIVITIES.

4. DATE OF LAST FIELD INSPECTION: 01/18/16. NO UNDERGROUND UTILITIES ARE SHOWN OTHER THAN GAS LINES WHOSE MARKINGS WERE OBSERVED AT TIME OF LAST FIELD INSPECTION. NOT ALL GAS LINES WERE MARKED.

5. NO BUILDINGS EXISTING ON THE SURVEYED PROPERTY.

6. EXCEPTION NO. 6 CITES RIGHT OF WAY FOR COUNTY ROADS ON EITHER SIDE OF SECTION AND TOWNSHIP LINES AS ESTABLISHED BY ORDER RECORDED 10/14/1889 IN BOOK 86 AT PAGE 273. ALL COUNTY ROADS ARE SHOWN AND ARE OUTSIDE THE SUBJECT PROPERTY AS DESCRIBED.

7. MINE SHAFT AND AIR SHAFT LOCATIONS ARE BASED ON THE BRIDGEWATER MASTER SUBDIVISION MASTER PLAT AND ARE APPROXIMATE. INFORMATION FOR SHAFTS IS FROM THE CTL THOMPSON REPORT CITED ABOVE.

8. WELL INFORMATION BASED ON FIELD LOCATION AND THE COLORADO OIL AND GAS CONSERVATION COMMISSION WEBSITE GIS ACCESSED ON 10/07/10.

9. SUBJECT PROPERTY IS LOCATED IN UNSHADED ZONE X (AREAS DETERMINED TO BE OUTSIDE THE 0.2% CHANCE FLOODPLAIN) PER FLOOD INFORMATION RATE MAPS 08013C0441J WITH A REVISION DATE OF 12/18/2012 AND 08013C0442J (NOT PRINTED).

10. TOTAL GROSS LAND AREA IS 400.74 ACRES.

11. THE SURFACE USE AGREEMENTS RECORDED 10/18/2011 AT RECEPTION NO. 3799568 (EXCEPTION NO. 44) AND RECEPTION NO. 3805168 (EXCEPTION NO. 45) CONTAINS EXHIBITS SHOWING OIL & GAS OPERATIONS AREAS WITHOUT ANY DIMENSIONING OR TIES TO ACCURATELY SHOW THEIR LOCATIONS. THE OIL & GAS OPERATIONS AREAS SHOWN ARE BASED ON THE "BRIDGEWATER MASTER SUBDIVISION" PLAT.

12. THERE IS CURRENTLY NO ROADWAY OR IMPROVEMENTS IN THE RIGHT OF WAY FOR COLLIERS PARKWAY ADJACENT TO SUBJECT PROPERTY. GRADING AND CONSTRUCTION ACTIVITIES ARE BEING CONDUCTED AT TIME OF SURVEY.

13. ALL LINEAR UNITS ARE IN U.S. SURVEY FEET.

**COMMITMENT NOTES:**

THIS SURVEY IS BASED UPON TITLE COMMITMENT NO. NCS-750432-CO, PREPARED BY FIRST AMERICAN TITLE INSURANCE COMPANY, WITH AN EFFECTIVE DATE OF JANUARY 14, 2016. THIS SURVEY DOES NOT CONSTITUTE A TITLE SEARCH OR EASEMENT RESEARCH BY HURST & ASSOCIATES. RATHER, ALL INFORMATION REGARDING DOCUMENTS AFFECTING THE PARCEL SHOULD BE OBTAINED FROM SAID COMMITMENT. THE FOLLOWING EXCEPTIONS APPEAR ON SCHEDULE B SECTION 2 OF THE COMMITMENT AND UNLESS NOTED, AFFECT THE SUBJECT PROPERTY. NUMBER IN PARENTHESES REFERS TO EXCEPTION NUMBER IN THE COMMITMENT.

DOCUMENTS LISTED AS EXCEPTION NUMBERS 10, 11, 18-20, 26-28, 30-32, 35-43, 47, 53, 54, 56-58 ARE BLANKET IN NATURE AND CANNOT BE SHOWN ON SURVEY.

DOCUMENTS LISTED AS EXCEPTION NUMBERS 48-51 ARE ASSOCIATED WITH DAYBREAK FILING 1A AND DO NOT AFFECT SUBJECT PROPERTY.

(EXCEPTIONS 1-5 - STANDARD EXCEPTIONS)

(6) RIGHT OF WAY FOR COUNTY ROADS 30 FEET ON EITHER SIDE OF SECTION AND TOWNSHIP LINES, AS ESTABLISHED BY THE BOARD OF COUNTY COMMISSIONERS FOR WELD COUNTY, RECORDED 10/14/1889 IN BOOK 86 AT PAGE 273. DOES NOT AFFECT; SEE GENERAL NOTE 6 FOR MORE INFORMATION

(7) DEED FOR A RIGHT OF WAY CONVEYED TO THE ERIE COAL CREEK DITCH AND RESERVOIR COMPANY RECORDED FEBRUARY 13, 1909, IN BOOK 289 AT PAGE 530. DOES NOT AFFECT; LOCATED IN DAYBREAK FILING NO. 1A TRACT A

(8) DEED FOR AN EASEMENT GRANTED TO PUBLIC SERVICE COMPANY OF COLORADO RECORDED 07/17/1970, AT R# 1551487. SHOWN, AFFECTS TRACTS 13, 14, 16 & 22

(9) DEED FOR AN EASEMENT GRANTED TO MOUNTAIN STATES TELEPHONE AND TELEGRAPH CO RECORDED 10/12/1971, AT R# 1576620. DOES NOT AFFECT, SHOWN; LOCATED IN DAYBREAK FILING NO. 1A TRACT A

(12) DEED FOR AN EASEMENT GRANTED TO PANHANDLE EASTERN PIPE LINE CO RECORDED 11/21/1980, AT R# 1842244 AND AMENDMENT RECORDED 11/04/2011 AT R# 3803734. SHOWN, AFFECTS TRACTS 13, 14, 16 & 22

(13) DEED FOR AN EASEMENT GRANTED TO PANHANDLE EASTERN PIPE LINE CO RECORDED 01/27/1981, AT R# 1848120. SHOWN; AFFECTS TRACT 13

(14) DEED FOR AN EASEMENT GRANTED TO UNION RURAL ELECTRIC ASSOCIATION INC RECORDED 02/16/1983, AT R# 1917642. SHOWN; LOCATED IN DAYBREAK FILING NO. 1A TRACT A & TRACT 13

(15) DEED FOR AN EASEMENT GRANTED TO PANHANDLE EASTERN PIPE LINE CO RECORDED 08/08/1983, AT R# 1936290 AND AMENDMENT RECORDED 04/26/2013 AT R# 3927485. SHOWN; AFFECTS TRACT 13 & DAYBREAK FILING NO. 2B TRACT A

(16) EASEMENT DEED TO VESSELS OIL AND GAS CO RECORDED 02/13/1986, AT R# 2042899. SHOWN; AFFECTS TRACTS 13, 14, 16, 22 & DAYBREAK FILING NO. 2B TRACT A

(17) EASEMENT DEED TO KN FRONT RANGE GATHERING CO RECORDED 04/01/1993, AT R# 2327121. SHOWN; LOCATED IN BRIDGEWATER MASTER TRACT 15

(21) MEMORANDUM OF SURFACE USE AGREEMENT RECORDED 09/26/2003 AT RECEPTION NO. 3110572. DOES NOT AFFECT; REFERS TO FACILITIES IN SECTION 8

(22) RIGHT OF WAY GRANT TO KINDER MORGAN INC RECORDED 11/12/2004, AT R# 3235061. SHOWN; AFFECTS TRACTS 15, 16, 17 & 23

(23) MEMORANDUM OF SURFACE USE AGREEMENT RECORDED 08/25/2005 AT R# 3316658 AND CORRECTED MEMORANDUM OF SURFACE DAMAGE AND RELEASE AGREEMENT RECORDED 11/01/2010 AT R# 3729056. DOES NOT AFFECT; REFERS TO FACILITIES IN SECTION 8

(24) MEMORANDUM OF SURFACE USE AGREEMENT RECORDED 03/13/2007 AT R# 3461612 AND CORRECTED MEMORANDUM OF SURFACE DAMAGE AND RELEASE AGREEMENT RECORDED 11/01/2010 AT R# 3729057. DOES NOT AFFECT; REFERS TO FACILITIES IN SECTION 8

(25) RIGHT OF WAY GRANT TO KERR-MCGEE GATHERING LLC RECORDED 09/20/2007, AT R# 3505741. DOES NOT AFFECT; SHOWN, LOCATED IN BRIDGEWATER MASTER TRACT 18

(29) PERMANENT AVIGATION EASEMENT AGREEMENT RECORDED 11/19/2007 AT R# 3518318. CANNOT SHOW; BLANKET EASEMENT

(33) RIGHT OF WAY GRANT TO KERR-MCGEE GATHERING LLC RECORDED 01/21/2009 AT R# 3600584. DOES NOT AFFECT, SHOWN; IS SAME DOCUMENT AS EXCEPTION NO. 25

(34) RIGHT OF WAY GRANT TO KERR-MCGEE GATHERING LLC RECORDED 02/19/2009 AT R# 3606265. SHOWN; AFFECTS TRACT 15

(44) SURFACE USE AGREEMENT RECORDED 10/18/2011 AT R# 3799568. DOES NOT AFFECT, SHOWN; LOCATED IN DAYBREAK FILING NO. 2A TRACT A AND BRIDGEWATER MASTER TRACT 18

(45) SURFACE USE AGREEMENT RECORDED 11/14/2011 AT R# 3805168. OIL & GAS OPERATIONS AREAS SHOWN; AFFECTS TRACTS 14, 16 & 22, SEE GENERAL NOTE 11

(46) BRIDGEWATER MASTER SUBDIVISION PLAT RECORDED 12/13/2011 AT R# 3811552 AND ORDINANCE NO. 18-2015 SERIES OF 2015 RECORDED 06/22/2015 AT R# 4117798. NOTHING TO SHOW, NO EASEMENTS CREATED BY PLAT THAT AFFECT PROPERTY

(52) RIGHT OF WAY GRANT RECORDED 02/07/2013 AT R# 3908551. DOES NOT AFFECT, SHOWN; IS LOCATED IN DAYBREAK FILING NO. 1A TRACT A

(55) DAYBREAK FILING NO. 2B PLAT RECORDED 10/30/2013 AT R# 3974455 AND AFFIDAVIT OF CORRECTION RECORDED 09/30/2014 AT R# 4050035. NOTHING TO SHOW, NO EASEMENTS CREATED BY PLAT THAT AFFECT PROPERTY

(57) GRANT OF PERMANENT ACCESS AND STORM DRAINAGE FACILITIES EASEMENT AGREEMENT RECORDED 08/03/2015 AT R# 4130002. SHOWN; AFFECTS TRACTS 10 & 23

(59) GRANT OF EASEMENT RECORDED 10/23/2015 AT R# 4152642. SHOWN; AFFECTS TRACT 23

(60) "BRIDGEWATER MASTER SUBDIVISION FIRST AMENDMENT" PLAT RECORDED 11/03/2015 AT R# 4155347. EASEMENT SHOWN; AFFECTS 9B

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| REVISIONS | | | |
|---|---|---|---|
| NO. | DESCRIPTION | DATE | BY |
| - | Original Survey | 09/23/15 | BB |
| 1 | Update per new extents, resubmittal | 01/20/16 | BB |

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Boulder, CO 80304
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ALTA/ACSM LAND TITLE SURVEY
COLLIERS HILL PRELIMINARY PLAT NO. 2
ERIE, COLORADO

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| DRAWN BY: BO | DESIGNED BY: | APPROVED BY: JJ | |
| JOB NUMBER: 2527-02 | | | |
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# ALTA/ACSM LAND TITLE SURVEY
# COLLIERS HILL PRELIMINARY PLAT NO. 2

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SHEET 2 OF 8

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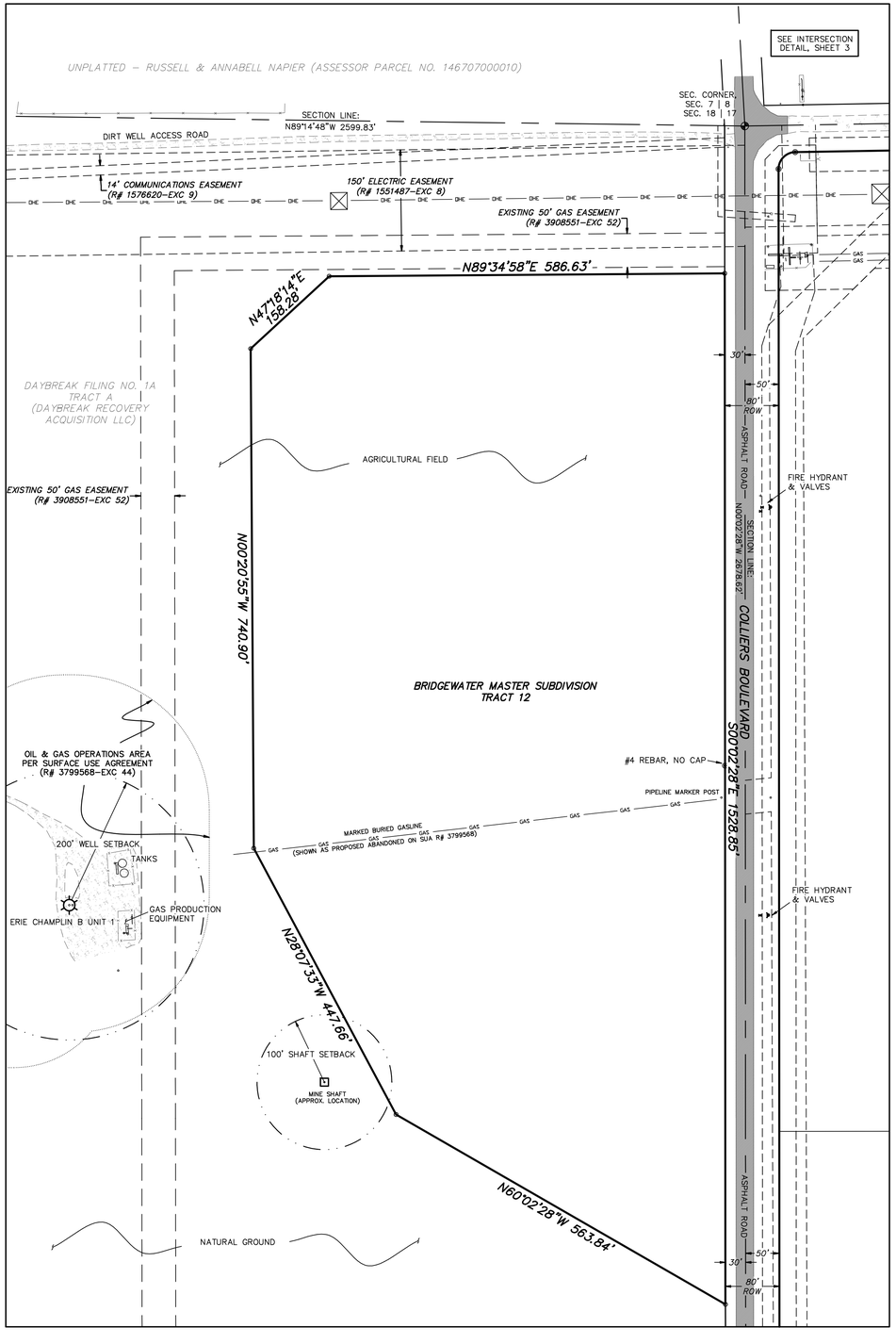
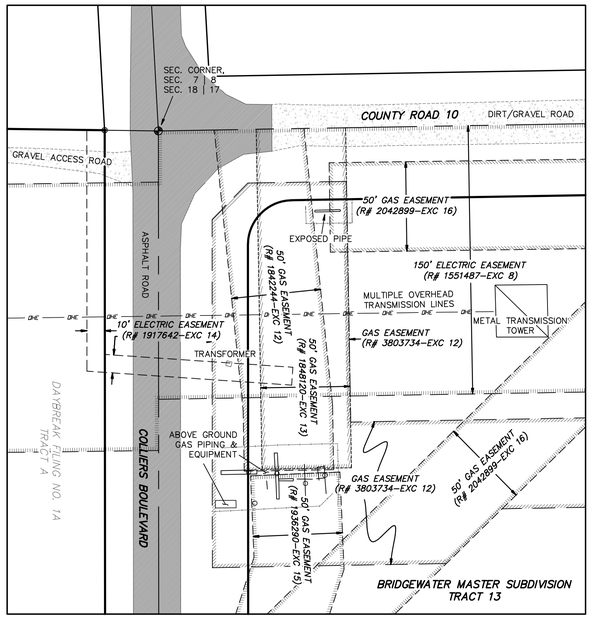
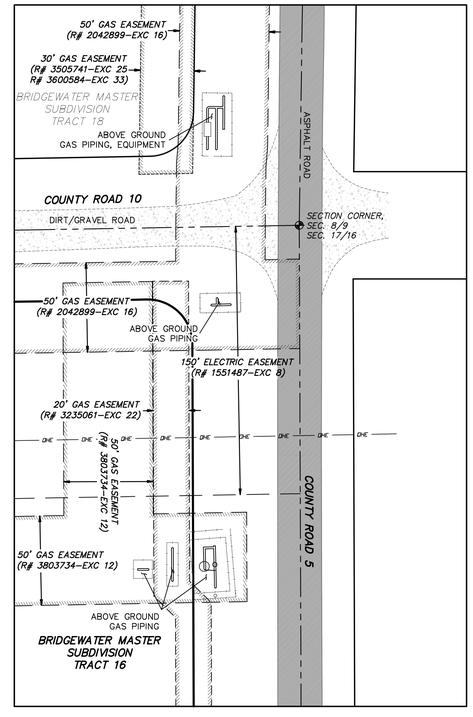
# ALTA/ACSM LAND TITLE SURVEY
# COLLIERS HILL PRELIMINARY PLAT NO. 2

SHEET 3 OF 8




COLLIERS BOULEVARD & COUNTY ROAD 10
INTERSECTION DETAIL (SCALE: 1"=40')




COUNTY ROAD 5 & COUNTY ROAD 10
INTERSECTION DETAIL (SCALE: 1"=40')

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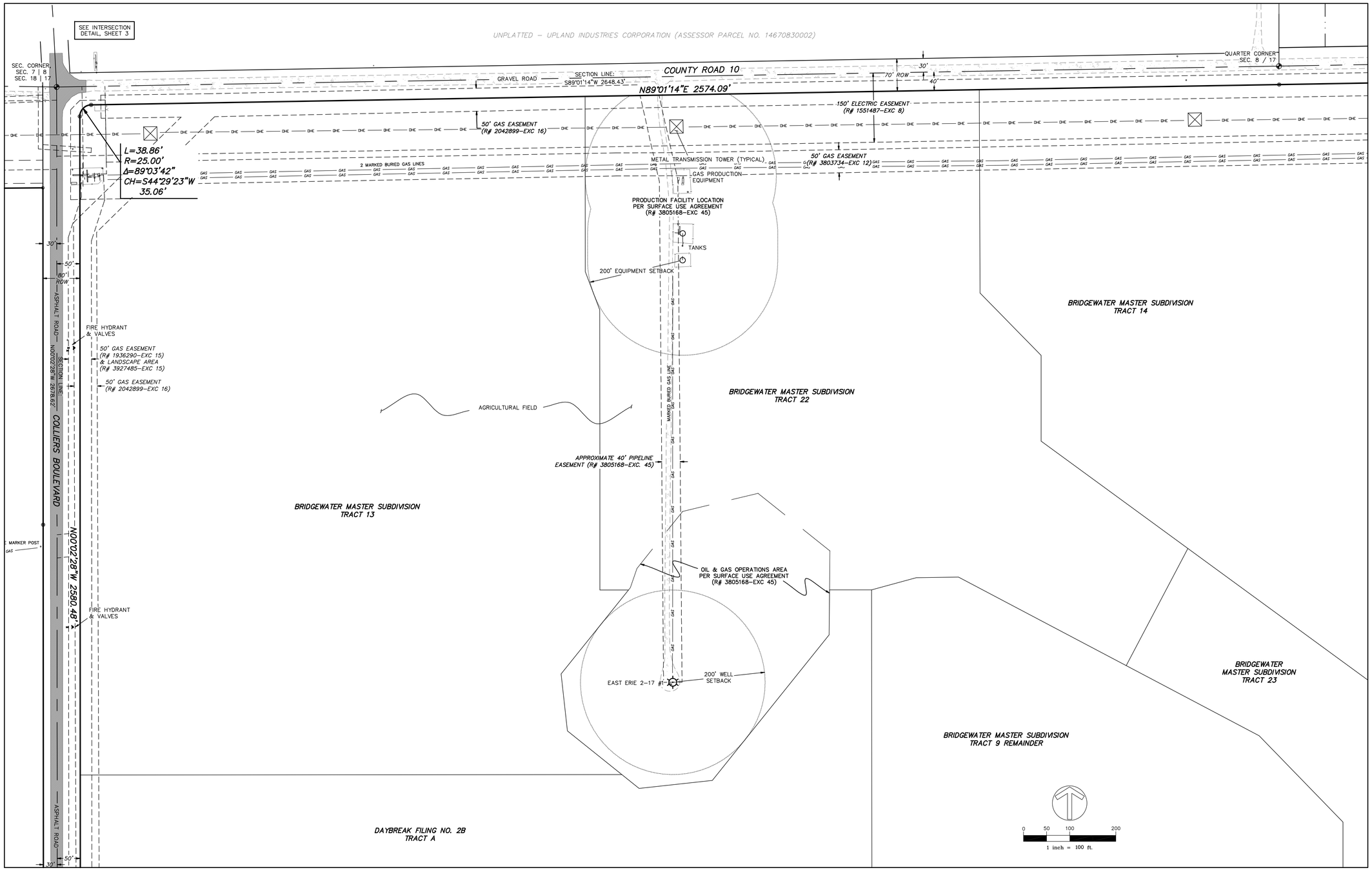
# ALTA/ACSM LAND TITLE SURVEY / COLLIERS HILL PRELIMINARY PLAT NO. 2

SHEET 4 OF 8

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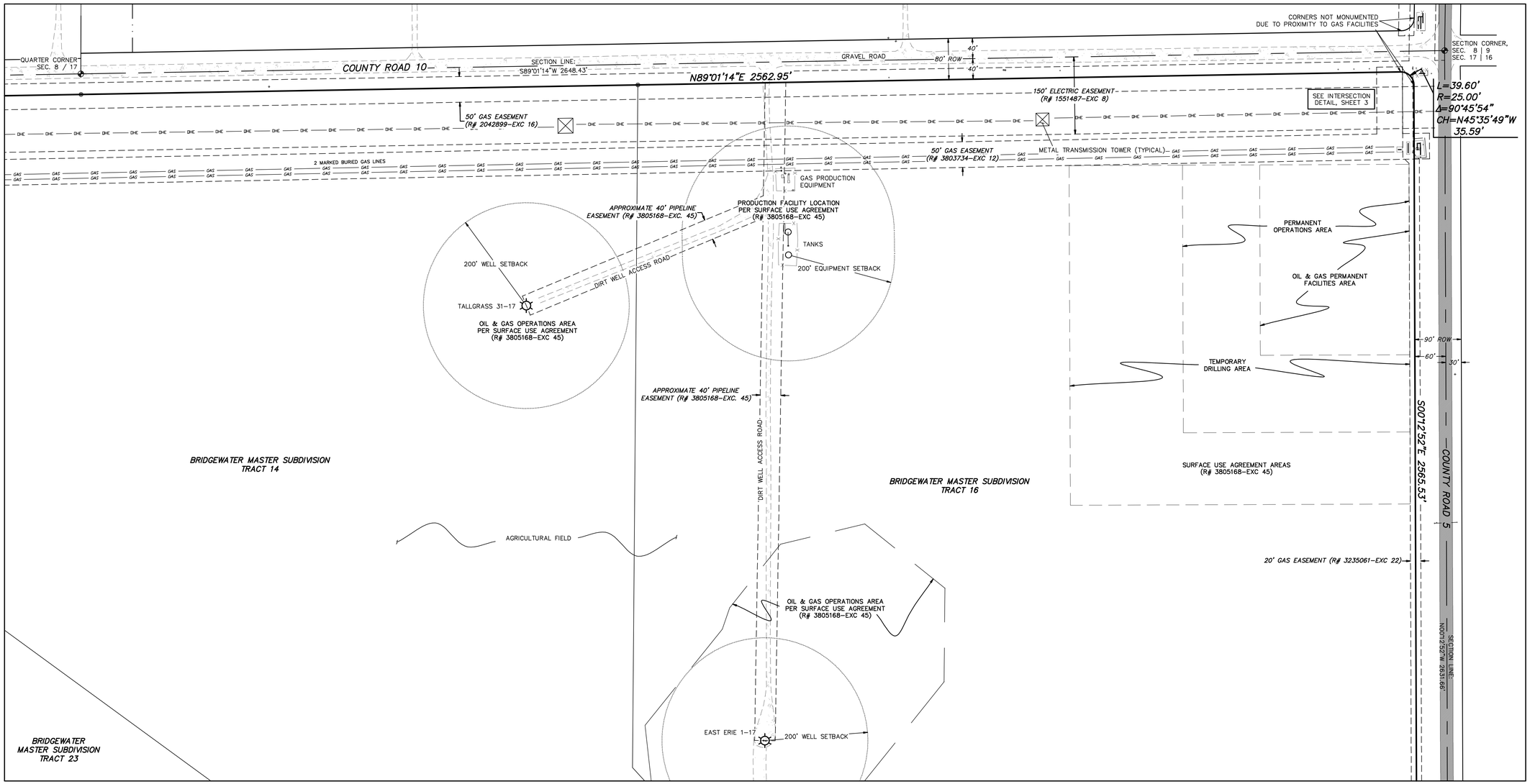
# ALTA/ACSM LAND TITLE SURVEY
# COLLIERS HILL PRELIMINARY PLAT NO. 2

SHEET 5 OF 8

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| APPROVED BY: JJ | |
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# ALTA/ACSM LAND TITLE SURVEY / COLLIERS HILL PRELIMINARY PLAT NO. 2

SHEET 6 OF 8

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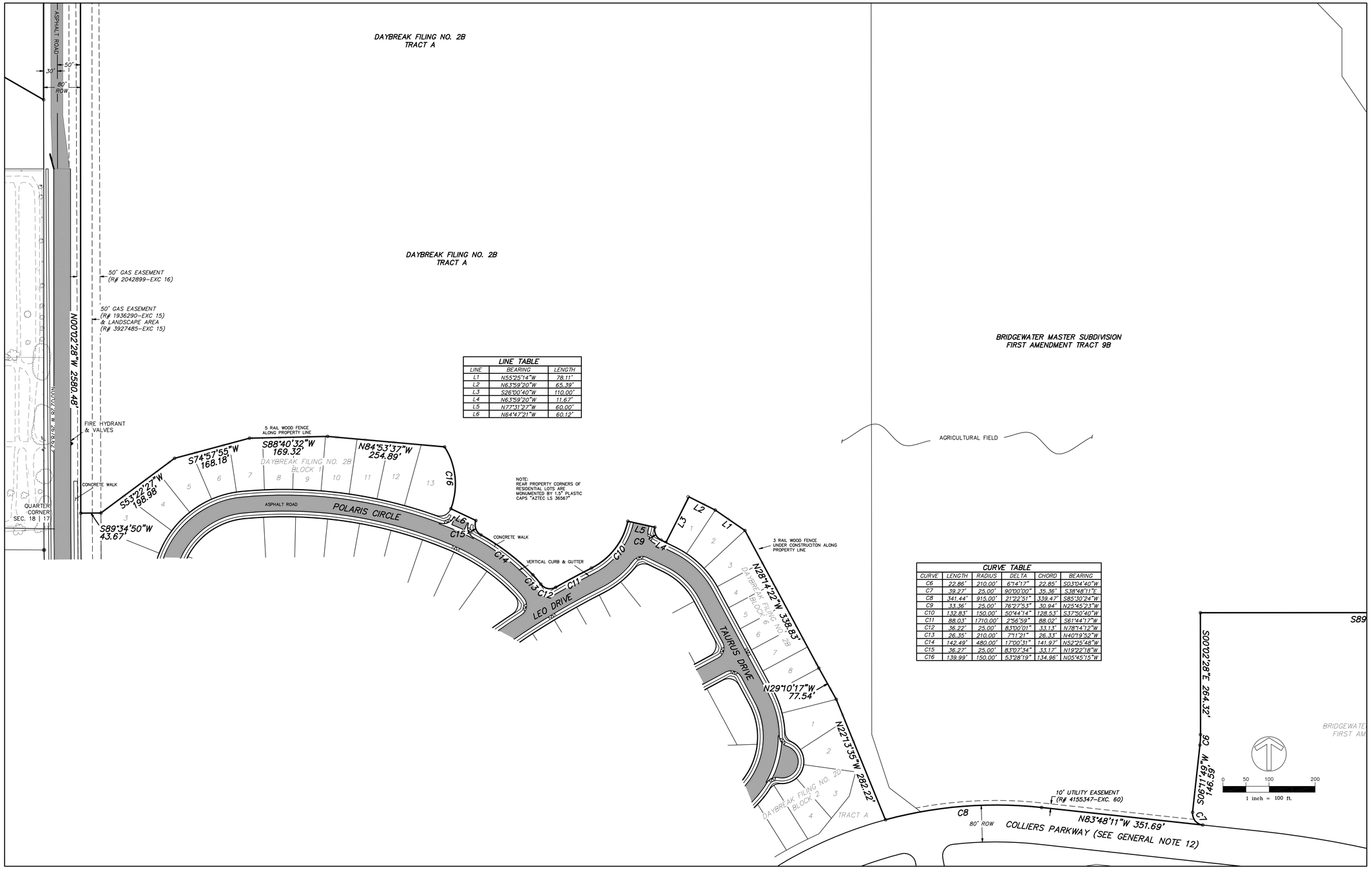


| LINE TABLE | | |
|---|---|---|
| LINE | BEARING | LENGTH |
| L1 | N55°25'14"W | 78.11' |
| L2 | N63°59'20"W | 65.39' |
| L3 | S26°00'40"W | 110.00' |
| L4 | N63°59'20"W | 11.62' |
| L5 | N77°31'27"W | 60.00' |
| L6 | N64°47'21"W | 60.12' |

| CURVE TABLE | | | | | |
|---|---|---|---|---|---|
| CURVE | LENGTH | RADIUS | DELTA | CHORD | BEARING |
| C6 | 22.86' | 210.00' | 6°14'17" | 22.85' | S03°04'40"W |
| C7 | 39.27' | 25.00' | 90°00'00" | 35.36' | S38°48'11"E |
| C8 | 341.44' | 915.00' | 21°22'51" | 339.47' | S85°30'24"W |
| C9 | 33.36' | 25.00' | 76°27'53" | 30.94' | N25°45'23"W |
| C10 | 132.83' | 150.00' | 50°44'14" | 128.53' | S37°50'40"W |
| C11 | 88.03' | 1710.00' | 2°56'59" | 88.02' | S61°44'17"W |
| C12 | 36.22' | 25.00' | 83°00'01" | 33.13' | N78°14'12"W |
| C13 | 26.35' | 210.00' | 7°11'21" | 26.33' | N40°19'52"W |
| C14 | 142.49' | 480.00' | 17°00'31" | 141.97' | N52°25'48"W |
| C15 | 36.27' | 25.00' | 83°07'34" | 33.17' | N19°22'18"W |
| C16 | 139.99' | 150.00' | 53°28'19" | 134.96' | N05°45'15"W |

Match to Sheet 7

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PLAT NO. 2
ERIE, COLORADO

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DESIGNED BY:
APPROVED BY: JJ
JOB NUMBER: 2527-02
DATE: 01/20/16
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# ALTA/ACSM LAND TITLE SURVEY
# COLLIERS HILL PRELIMINARY PLAT NO. 2

SHEET 7 OF 8

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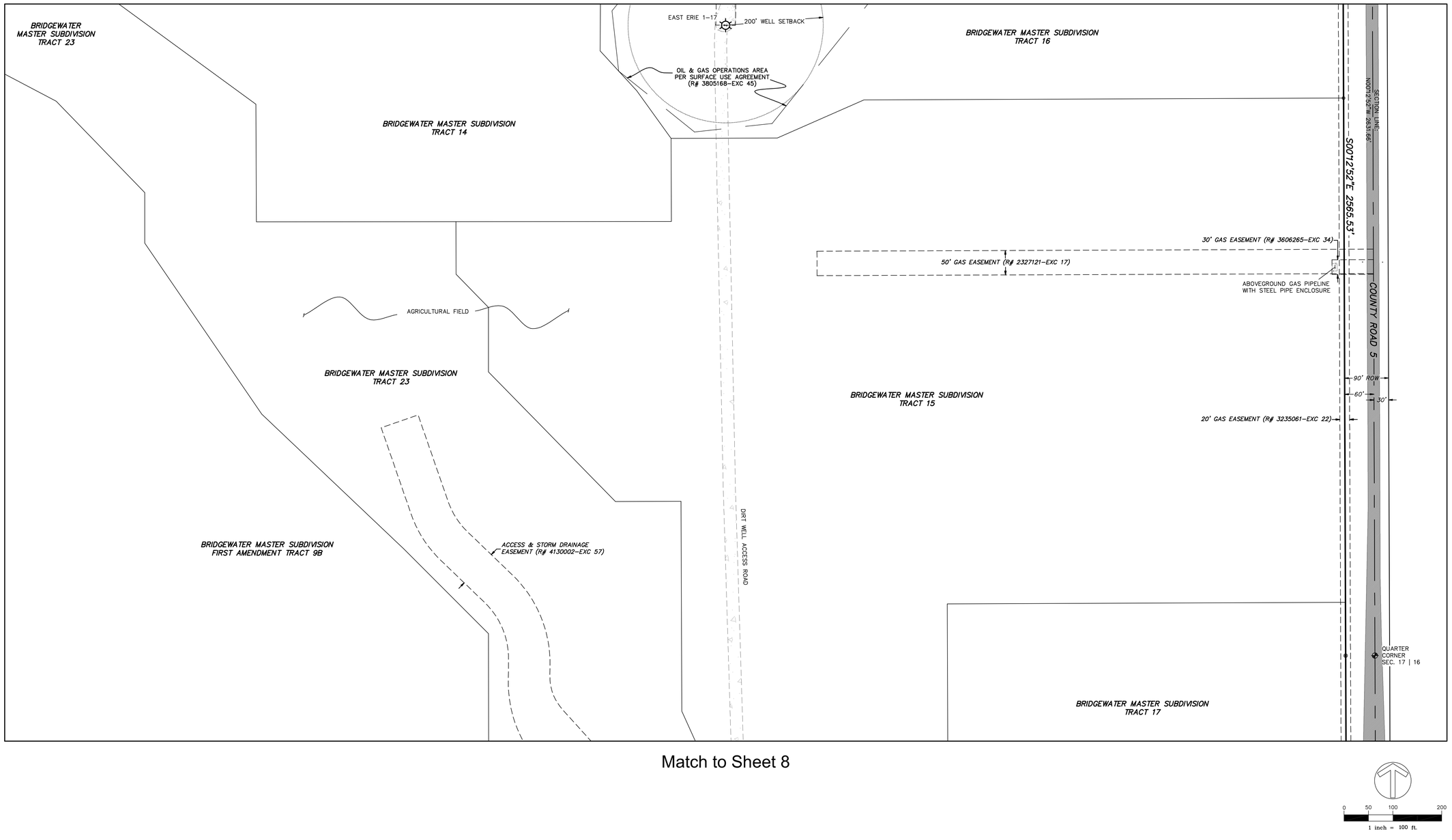


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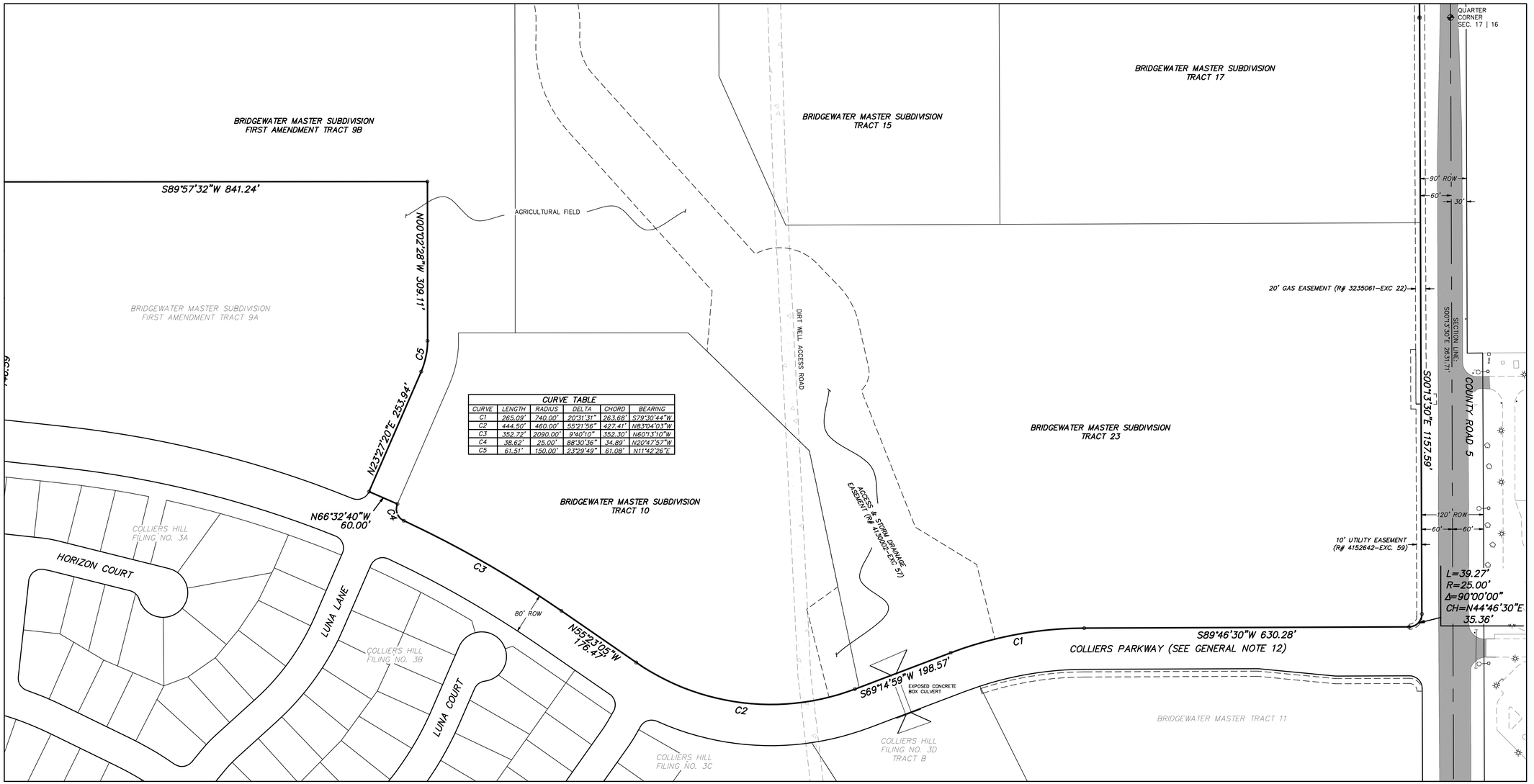
# ALTA/ACSM LAND TITLE SURVEY
# COLLIERS HILL PRELIMINARY PLAT NO. 2

SHEET 8 OF 8

Match to Sheet 7

Match to Sheet 6

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1 inch = 100 ft.

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APPROVED BY: JJ

JOB NUMBER: 2527-02

DATE: 01/20/16

SCALE: 1"=100'

SHEET NO: 8 OF 8

FILE LOCATION: G:\2527\SURVEY\CP-PRELIM PLAT NO 2 ALTA-SH 3-8

LSC TRANSPORTATION CONSULTANTS, INC.

1889 York Street
Denver, CO 80206
(303) 333-1105
FAX (303) 333-1107
E-mail: lsc@lscdenver.com

January 20, 2016

Mr. Jerry Richmond
Daybreak Recovery Acquisition, LLC
7200 S. Alton Way, Suite C-400
Centennial, CO 80112

Re: Colliers Hill Phase II
Traffic Impact Analysis
Erie, CO
(LSC #150950)

Dear Mr. Richmond:

In response to your request, LSC Transportation Consultants, Inc. has prepared this traffic impact analysis for the proposed Colliers Hill Phase II development. As shown on Figure 1, the site is located north of Erie Parkway, west of Weld County Road (WCR) 5, and south of WCR 10 in Erie, Colorado.

## REPORT CONTENTS

The report contains the following: the existing roadway and traffic conditions in the vicinity of the site including the lane geometries, traffic controls, posted speed limits, etc.; the existing weekday peak-hour traffic volumes; the existing daily traffic volumes in the area; the typical weekday site-generated traffic volume projections for the site; the assignment of the projected traffic volumes to the area roadways; an estimate of future background traffic, and any recommended roadway improvements to mitigate the site's traffic impacts.

## LAND USE AND ACCESS

The site is proposed to include 715 single-family detached homes, 108 single-family attached homes, and a 500-student elementary school. Access is proposed from several locations as shown in the conceptual site plan in Figure 2.

## ROADWAY AND TRAFFIC CONDITIONS

### Area Roadways

The major roadways in the site's vicinity are shown on Figure 1 and are described below.

- **Erie Parkway** is an east-west, two-lane arterial roadway south of the site. The intersections with Colliers Boulevard (WCR 3) and WCR 5 were recently signalized and have

existing auxiliary turn lanes. The posted speed limit in the vicinity of the site varies between 40 and 50 mph. The 2030 Roadway System Plan in the *Town of Erie 2008 Master Transportation Plan* shows Erie Parkway as a four-lane principal arterial. The *Buildout Roadway Network* shows a six-lane principal arterial.

- **Weld County Road 5** is a north-south, two-lane minor arterial roadway east of the site. The intersection with Erie Parkway was recently signalized. The posted speed limit in the vicinity of the site is 45 mph. The *Town of Erie 2008 Master Transportation Plan* shows a two-lane minor arterial in 2030 and a four-lane minor arterial by buildout. Erie High School is located east of WCR 5 just north of Erie Parkway. A traffic signal is currently being installed at the intersection of WCR 5/ Colliers Parkway/Erie High School.

- **Weld County Road 10** is an east-west, two-lane collector gravel roadway north of the site. The intersections with WCR 3 and WCR 5 are stop-sign controlled.

- **Colliers Parkway** is an east-west, two-lane collector roadway connecting Collier Boulevard (WCR 3) and WCR 5 and bisects the overall Colliers Hill site.

**Existing Traffic Conditions**

Figure 3 shows the existing lane geometries, traffic controls, posted speed limits, and traffic volumes in the site's vicinity on a typical weekday. The weekday peak-hour traffic volumes and daily traffic counts are from the attached traffic counts conducted by Counter Measures in September, 2015.

**2035 Background Traffic**

Figure 4 shows the estimated 2035 background traffic. The projected 2035 background traffic volumes are based on previous studies in the area for Colliers Hill Phase I (formerly known as Bridgewater Phase I), Morgan Hill, Summerfield, and Sunset with adjustments made for the current density planned in Colliers Hill Phase III.

**Existing and 2035 Background Levels of Service**

Level of service (LOS) is a quantitative measure of the level of congestion or delay at an intersection. Level of service is indicated on a scale from "A" to "F." LOS A is indicative of little congestion or delay and LOS F is indicative of a high level of congestion or delay. Attached are specific level of service definitions for signalized and unsignalized intersections.

The intersections in Figures 3 and 4 were analyzed as appropriate to determine the existing and 2035 background levels of service using Synchro Version 8. Table 1 shows the level of service analysis results. The level of service reports are attached.

- **WCR 10/Colliers Boulevard/WCR 3:** All movements at this unsignalized intersection currently operate at LOS "A" during the morning and afternoon peak-hours. By 2035, all movements are expected to operate at LOS "B" or better during both peak-hours.

- **Erie Parkway/Bonanza Drive/Colliers Boulevard:** This signalized intersection currently operates at an overall LOS "A" during the morning peak-hour and afternoon peak-hours. By 2035, the morning peak-hour is expected to operate at an overall LOS "C" and the afternoon peak-hour is expected to operate at LOS "B".

- **Colliers Parkway/Colliers Boulevard:** All movements at this roundabout currently operate at LOS "A" and are expected to do so through 2035.

- **WCR 5/Erie Parkway:** This signalized intersection currently operates at an overall LOS "B" during the morning peak-hour and LOS "A" during the afternoon peak-hour. By 2035, the intersection is expected to operate at LOS "D" during both peak-hours.

- **WCR 5/Colliers Parkway/High School Access:** All movements at this unsignalized intersection currently operate at LOS "A" during both peak-hours with the following exception: The westbound approach operates at LOS "F" during the morning peak-hour. A traffic signal is currently being installed at this intersection. By 2035, this intersection is expected to operate at an overall LOS "C" during the morning peak-hour and LOS "B" during the afternoon peak-hour.

- **WCR 5/Collector:** All movements at this unsignalized intersection are expected to operate at LOS "D" or better during the morning and afternoon peak-hours with the following exception: The eastbound left movement is expected to operate at LOS "F" during both peak-hours. Vehicles making this movement can alternatively exit the site north to WCR 10 and turn left onto WCR 5 from WCR 10 which has the potential to be signalized in the long term.

- **WCR 5/WCR 10:** All movements at this unsignalized intersection currently operate at LOS "C" or better. By 2035, several movements are expected to operate at LOS "E" or "F". Traffic signal control will likely be necessary once a traffic signal warrant is met.

**TRIP GENERATION**

Table 1 shows the estimated average weekday, morning peak-hour, and afternoon peak-hour trip generation for the proposed site based on the rates from *Trip Generation, 9th Edition, 2012* by the Institute of Transportation Engineers (ITE) for the proposed land use. The site was divided into Traffic Analysis Zones (TAZ) as shown in Table 2 and Figure 5.

The proposed land use is projected to generate about 7,595 vehicle-trips on the average weekday, with about half entering and half exiting during a 24-hour period. During the morning peak-hour, which generally occurs for one hour between 6:30 and 8:30 a.m., about 173 vehicles would enter and about 466 vehicles would exit the site. During the afternoon peak-hour, which generally occurs for one hour between 4:00 and 6:00 p.m., about 498 vehicles would enter and about 293 vehicles would exit.

**TRIP DISTRIBUTION**

Figure 6 shows the estimated directional distribution of the site-generated traffic volumes on the area roadways. The estimates were based on the location of the site with respect to the regional population, employment, and activity centers; and the site's proposed land use.

**TRIP ASSIGNMENT**

Figure 7 shows the estimated site-generated traffic volumes which are the directional distribution percentages (from Figure 6) applied to the trip generation estimate (from Table 2).

**2035 TOTAL TRAFFIC**

Figure 8 shows the 2035 total traffic which is the sum of the 2035 background traffic volumes (from Figure 4) and the site-generated traffic volumes (from Figure 7). Figure 8 also shows the recommended 2035 lane geometry and traffic control.

**PROJECTED LEVELS OF SERVICE**

The intersections in Figure 8 were analyzed to determine the 2035 total levels of service. Table 1 shows the level of service analysis results. The level of service reports are attached.

- **WCR 10/Colliers Boulevard/WCR 3:** All movements at this unsignalized intersection are expected to operate at LOS "C" or better during both peak-hours through 2035.

- **Erie Parkway/Bonanza Drive/Colliers Boulevard:** This signalized intersection is expected to operate at an overall LOS "C" during the morning and afternoon peak-hour through 2035.

- **Colliers Boulevard (WCR 3)/Local Access/Collector:** All movements at this unsignalized intersection are expected to operate at LOS "C" or better during the morning and afternoon peak-hours through 2035.

- **Colliers Parkway/Colliers Boulevard:** All movements at this roundabout are expected to operate at LOS "C" or better during the morning and afternoon peak-hours through 2035.

- **WCR 5/Erie Parkway:** This signalized intersection is expected to operate at an overall LOS "D" during the morning and afternoon peak-hours in 2035, with or without the addition of site traffic.

- **WCR 5/Colliers Parkway/High School Access:** By 2035, this signalized intersection is expected to operate at an overall LOS "C" during the morning peak-hour and LOS "B" during the afternoon peak-hour, with or without the addition of site traffic.

- **WCR 5/Collector:** All movements at this unsignalized intersection are expected to operate at LOS "D" or better during the morning and afternoon peak-hours with the following exception: The eastbound left movement is expected to operate at LOS "F" during both

peak-hours. Vehicles making this movement can alternatively exit the site north to WCR 10 and turn left onto WCR 5 from WCR 10 which has the potential to be signalized in the long term.

- **WCR 5/WCR 10:** The northbound and southbound movements at this unsignalized intersection are expected to operate at LOS "B" or better during both morning and afternoon peak-hours. By 2035, the eastbound and westbound movements are expected to operate at LOS "F" during both peak-hours. Traffic signal control will likely be necessary once a traffic signal warrant is met.

## CONCLUSIONS AND RECOMMENDATIONS

### Trip Generation

1. The site is projected to generate about 7,595 vehicle-trips on the average weekday, with about half entering and half exiting during a 24-hour period. During the morning peak-hour, about 173 vehicles would enter and about 466 vehicles would exit the site. During the afternoon peak-hour, about 498 vehicles would enter and about 293 vehicles would exit.

### Projected Levels of Service

2. All movements at the unsignalized intersections analyzed are expected to operate at LOS "D" or better during the morning and afternoon peak-hours with the following exceptions: The eastbound left movement at the WCR 5/Collector intersection is expected to operate at LOS "F" during both peak-hours. The eastbound and westbound approaches at the WCR 5/WCR 10 intersection are expected to operate at LOS "F" during both peak-hours. The WCR 5/WCR 10 intersection will likely need to be signalized by 2035 if traffic signal warrants are met. If signalized, the vehicles making the left-turn movement onto WCR 5 from the Collector intersection could alternatively turn left onto WCR 5 at WCR 10.

3. All signalized intersections analyzed are expected to operate at an overall LOS "D" or better during both morning and afternoon peak-hours.

### Conclusions

4. The impact of the Colliers Hill Phase II development site can be accommodated by the existing and proposed roadway network with the recommended improvements shown in Figure 8.

* * * * *

We trust our findings will assist you in gaining approval of the proposed Colliers Hill Phase II development. Please contact me if you have any questions or need further assistance.

Sincerely,

LSC TRANSPORTATION CONSULTANTS, INC.

By_____
Christopher S. McGranahan, PE, PTOE
Principal

COLORADO LICENSED
CHRISTOPHER S. MCGRANAHAN
39018
PROFESSIONAL ENGINEER

1-20-16

CSM/wc

Enclosures: Tables 1 and 2
Figures 1 - 8
Traffic Count Reports
Level of Service Definitions
Level of Service Reports

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**Table 1 (Page 1 of 2)**
**Intersection Levels of Service Analysis**
**Colliers Hill Update**
**Erie, CO**
**(LSC #150950; January, 2016)**

| Intersection Location | Traffic Control | Existing Traffic Level of Service AM | Existing Traffic Level of Service PM | 2035 Background Traffic Level of Service AM | 2035 Background Traffic Level of Service PM | 2035 Total Traffic Level of Service AM | 2035 Total Traffic Level of Service PM |
|---|---|---|---|---|---|---|---|
| WCR 10/Colliers Blvd./WCR 3 | TWSC | | | | | | |
| WB Approach | | A | A | -- | -- | -- | -- |
| WB Left | | -- | -- | B | B | B | C |
| WB Right | | -- | -- | A | A | B | B |
| SB Approach | | A | A | -- | -- | -- | -- |
| SB Left | | -- | -- | A | A | A | A |
| Critical Movement Delay | | 8.5 | 8.8 | 12.1 | 14.6 | 13.3 | 18.8 |
| Erie Parkway/Bonanza Drive/Colliers Blvd. | Signalized | | | | | | |
| EB Left | | A | A | B | C | C | D |
| EB Through | | A | A | B | B | B | B |
| EB Right | | A | A | A | B | B | B |
| WB Left | | A | A | B | B | B | B |
| WB Through | | A | A | B | B | C | C |
| WB Right | | A | A | A | B | B | B |
| NB Left | | C | C | D | D | D | D |
| NB Through/Right | | C | C | D | D | D | D |
| SB Left | | C | C | D | D | D | D |
| SB Through/Right | | C | C | -- | -- | -- | -- |
| SB Through | | -- | -- | D | D | D | D |
| SB Right | | -- | -- | D | D | D | C |
| Entire Intersection Delay (sec /veh) | | 5.8 | 5.6 | 20.4 | 19.0 | 25.4 | 25.8 |
| Entire Intersection LOS | | A | A | C | B | C | C |
| Colliers Blvd. (WCR 3)/Local Access/Collector | TWSC | | | | | | |
| NB Left | | -- | -- | -- | -- | A | A |
| EB Left/Through | | -- | -- | -- | -- | B | C |
| EB Right | | -- | -- | -- | -- | B | B |
| WB Left | | -- | -- | -- | -- | B | C |
| WB Through/Right | | -- | -- | -- | -- | B | B |
| SB Left | | -- | -- | -- | -- | A | A |
| Critical Movement Delay | | -- | -- | -- | -- | 13.1 | 17.5 |
| Colliers Parkway/Colliers Blvd. | Roundabut | | | | | | |
| EB Approach | | -- | -- | A | A | A | A |
| WB Approach | | A | A | A | A | A | A |
| NB Approach | | A | A | A | A | A | C |
| SB Approach | | A | A | A | A | A | B |
| Entire Intersection Delay (sec /veh) | | 3.8 | 3.6 | 6.5 | 8.6 | 8.2 | 12.3 |
| Entire Intersection LOS | | A | A | A | A | A | B |
| WCR 5/Erie Parkway | Signalized | | | | | | |
| EB Left | | B | A | E | D | E | D |
| EB Through/Right | | A | A | -- | -- | -- | -- |
| EB Through | | -- | -- | C | C | C | C |
| EB Right | | -- | -- | B | B | B | B |
| WB Left | | A | A | E | D | E | D |
| WB Through | | A | A | C | D | C | D |
| WB Right | | A | A | B | C | B | C |
| NB Left | | C | C | E | D | E | D |
| NB Through/Right | | C | C | -- | -- | -- | -- |
| NB Through | | -- | -- | D | D | D | D |
| NB R | | -- | -- | D | C | D | D |
| SB Left | | C | C | E | D | E | D |
| SB Through | | B | B | D | D | D | D |
| SB Right | | C | C | D | C | D | C |
| Entire Intersection Delay (sec /veh) | | 11.0 | 7.2 | 37.4 | 36.4 | 38.6 | 39.4 |
| Entire Intersection LOS | | B | A | D | D | D | D |

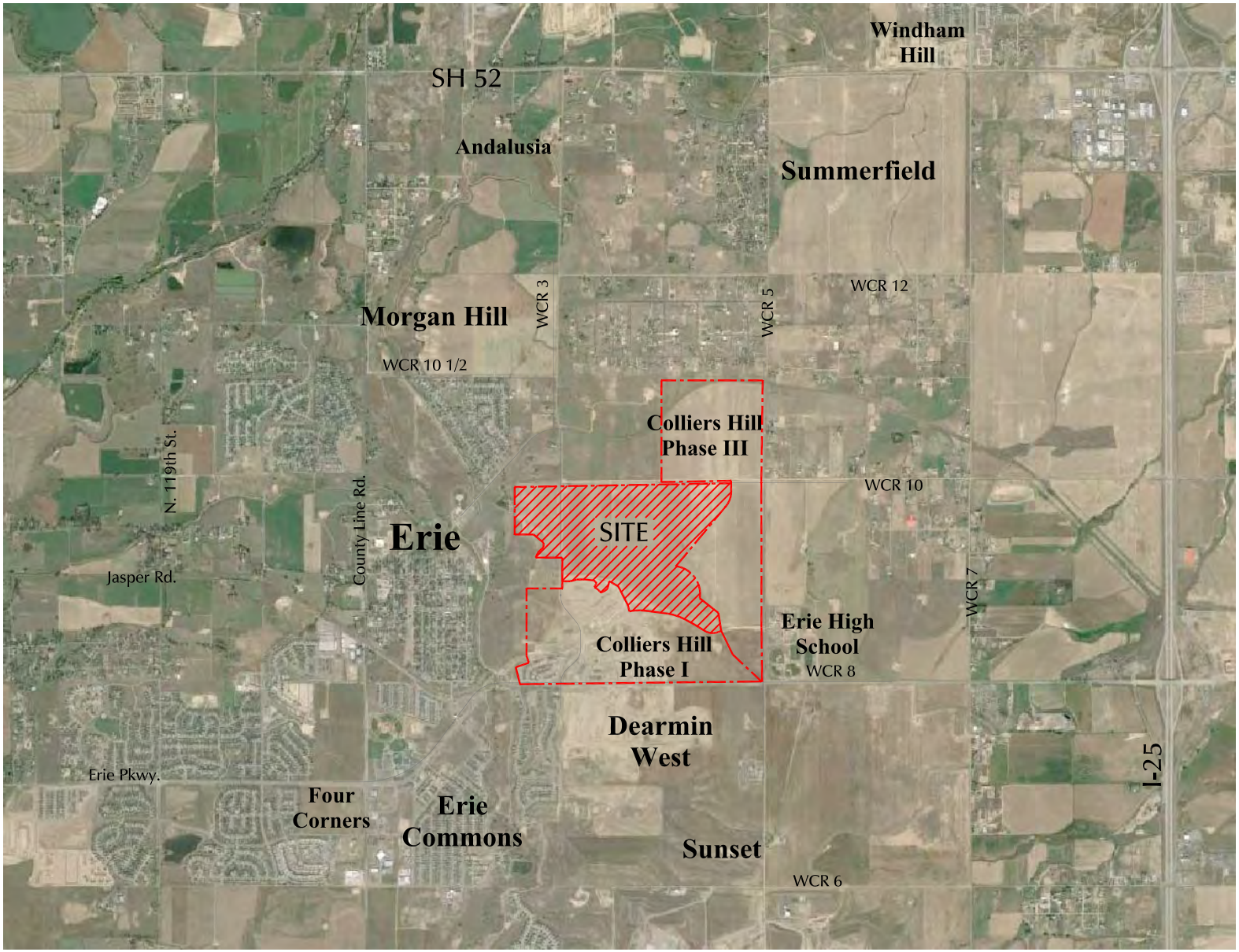
**Table 1 (Page 2 of 2)**
**Intersection Levels of Service Analysis**
**Colliers Hill Update**
**Erie, CO**
**(LSC #150950; January, 2016)**

| Intersection Location | Traffic Control | Existing Traffic Level of Service AM | Existing Traffic Level of Service PM | 2035 Background Traffic Level of Service AM | 2035 Background Traffic Level of Service PM | 2035 Total Traffic Level of Service AM | 2035 Total Traffic Level of Service PM |
|---|---|---|---|---|---|---|---|
| WCR 5/Colliers Parkway/High School Access | TWSC | | | | | | |
| NB Through | | A | A | -- | -- | -- | -- |
| EB Approach | | A | A | -- | -- | -- | -- |
| WB Approach | | F | A | -- | -- | -- | -- |
| SB Left | | A | A | -- | -- | -- | -- |
| Critical Movement Delay | | 75.5 | 9.9 | -- | -- | -- | -- |
| | Signalized | | | | | | |
| EB Left | | -- | -- | C | C | C | C |
| EB Through/Right | | -- | -- | C | C | C | C |
| WB Left | | -- | -- | D | C | D | C |
| WB Through/Right | | -- | -- | C | C | C | C |
| NB Left | | -- | -- | B | A | B | B |
| NB Through | | -- | -- | D | B | D | B |
| NB Right | | -- | -- | D | B | D | B |
| SB Left | | -- | -- | C | A | C | A |
| SB Through | | -- | -- | B | A | C | B |
| SB Right | | -- | -- | B | A | B | A |
| Entire Intersection Delay (sec /veh) | | -- | -- | 29.7 | 16.7 | 31.5 | 15.8 |
| Entire Intersection LOS | | -- | -- | C | B | C | B |
| WCR 5/Collector | TWSC | | | | | | |
| NB Left | | -- | -- | B | B | B | B |
| EB Left | | -- | -- | F | F | F | F |
| EB Right | | -- | -- | D | C | C | C |
| Critical Movement Delay | | -- | -- | 66.2 | >240 | 67.2 | >240 |
| WCR 5/WCR 10 | TWSC | | | | | | |
| NB Approach | with the | A | A | -- | -- | -- | -- |
| NB Left | potential | -- | -- | A | A | A | A |
| EB Approach | for | B | A | -- | -- | -- | -- |
| EB Left | signalization | -- | -- | E | F | F | F |
| EB Through/Right | by 2035 | -- | -- | E | F | F | F |
| WB Approach | | C | A | -- | -- | -- | -- |
| WB Left | | -- | -- | F | F | F | F |
| WB Through/Right | | -- | -- | E | F | F | F |
| SB Approach | | A | A | -- | -- | -- | -- |
| SB Left | | -- | -- | A | B | A | B |
| Critical Movement Delay | | 15.0 | 9.7 | 90.3 | >240 | 131.7 | >240 |

# Table 2
# ESTIMATED TRAFFIC GENERATION
# Colliers Hill Phase II
# Erie, CO
# (LSC #150950; January, 2016)

| | | Trip Generation Rates[1] | | | | | | Vehicle - Trips Generated | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Average | AM Peak Hour | | PM Peak Hour | | Internal | Average | AM Peak Hour | | PM Peak Hour | |
| Trip Generating Category | Quantity | Weekday | In | Out | In | Out | Reduction | Weekday | In | Out | In | Out |
| **TAZ A** | | | | | | | | | | | | |
| Single Family Detached [2] | 55 DU [3] | 9.52 | 0.188 | 0.563 | 0.630 | 0.370 | 0% | 524 | 10 | 31 | 35 | 20 |
| **TAZ B** | | | | | | | | | | | | |
| Single Family Detached | 124 DU | 9.52 | 0.188 | 0.563 | 0.630 | 0.370 | 0% | 1,180 | 23 | 70 | 78 | 46 |
| **TAZ C** | | | | | | | | | | | | |
| Single Family Detached | 135 DU | 9.52 | 0.188 | 0.563 | 0.630 | 0.370 | 0% | 1,285 | 25 | 76 | 85 | 50 |
| **TAZ D** | | | | | | | | | | | | |
| Single Family Detached | 102 DU | 9.52 | 0.188 | 0.563 | 0.630 | 0.370 | 0% | 971 | 19 | 57 | 64 | 38 |
| **TAZ E** | | | | | | | | | | | | |
| Single Family Detached | 84 DU | 9.52 | 0.188 | 0.563 | 0.630 | 0.370 | 0% | 800 | 16 | 47 | 53 | 31 |
| **TAZ F** | | | | | | | | | | | | |
| Single Family Detached | 90 DU | 9.52 | 0.188 | 0.563 | 0.630 | 0.370 | 0% | 857 | 17 | 51 | 57 | 33 |
| **TAZ G** | | | | | | | | | | | | |
| Single Family Detached | 116 DU | 9.52 | 0.188 | 0.563 | 0.630 | 0.370 | 0% | 1,104 | 22 | 65 | 73 | 43 |
| **TAZ H** | | | | | | | | | | | | |
| Single Family Detached | 9 DU | 9.52 | 0.188 | 0.563 | 0.630 | 0.370 | 0% | 86 | 2 | 5 | 6 | 3 |
| Single Family Attached [4] | 108 DU | 5.81 | 0.075 | 0.365 | 0.348 | 0.172 | 0% | 627 | 8 | 39 | 38 | 19 |
| **TAZ I** | | | | | | | | | | | | |
| Elementary School [5] | 500 Students | 1.29 | 0.248 | 0.203 | 0.074 | 0.077 | 75% | 161 | 31 | 25 | 9 | 10 |
| | | | | | | **Total Trips** | | **7,595** | **173** | **466** | **498** | **293** |

Notes:
(1) Source: *Trip Generation*, Institute of Transportation Engineers (ITE), 9th Edition, 2012
(2) Land Use No. 210 - Single-Family Detached Housing
(3) DU = Dwelling Unit
(4) Land Use No. 230 - Residential Condominium/Townhouse
(5) Land Use No. 520 - Elementary School




Approximate Scale
Scale: 1"= 4,000'

*Figure 1*

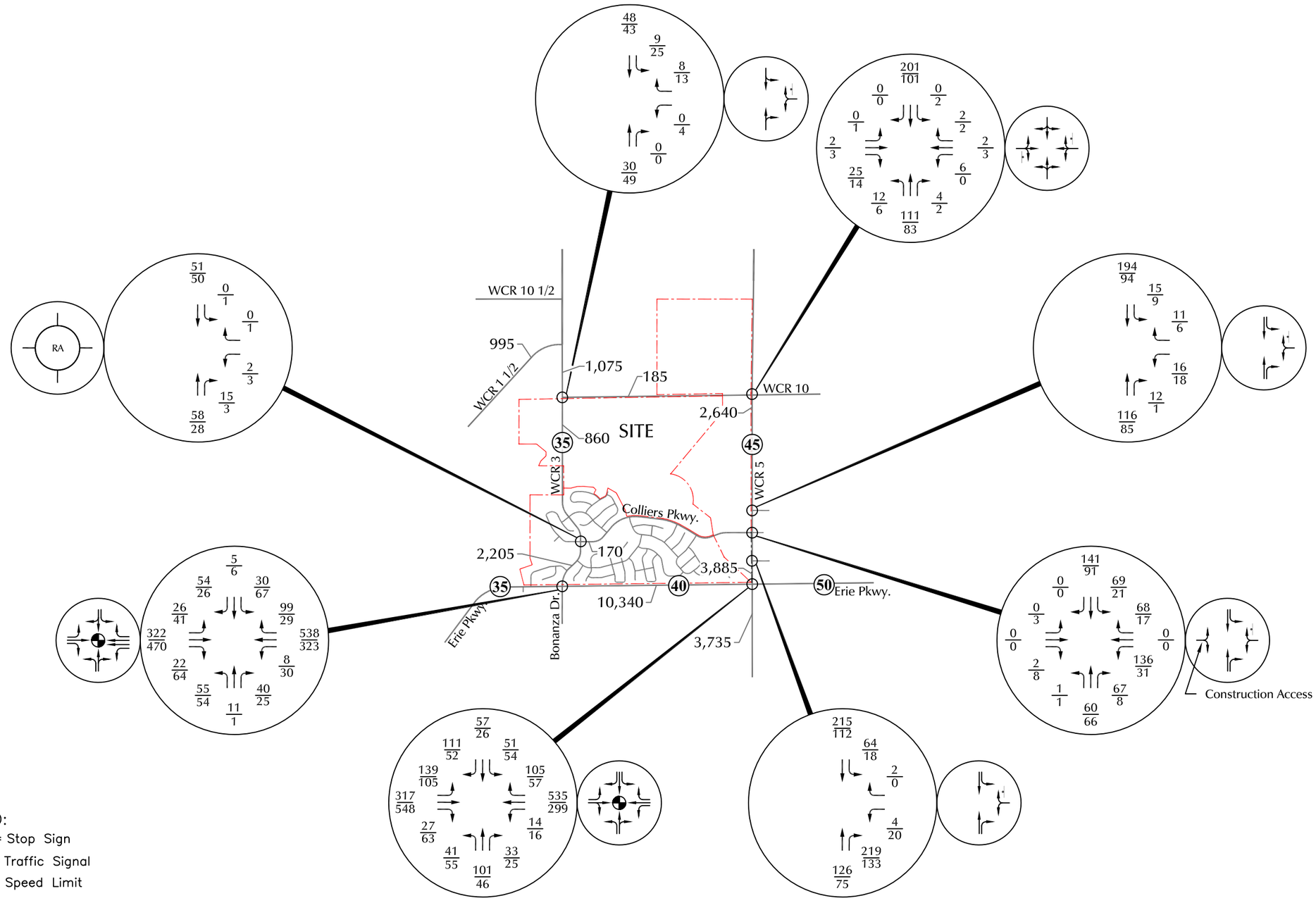
# *Vicinity Map*

Colliers Hill Phase II (LSC #150950)

*Figure 2*

# *Phase II Site Plan*

Colliers Hill Phase II (LSC #150950)




LEGEND:

- = Stop Sign
- = Traffic Signal
- (30) = Speed Limit
- (RA) = Roundabout
- 26/35 = AM Peak Hour Traffic / PM Peak Hour Traffic
- *1,000* = Average Daily Traffic

TRANSPORTATION CONSULTANTS, INC.

*Figure 3*

# *Existing Traffic, Traffic Control and Lane Geometry*

Colliers Hill Phase II (LSC #150950)

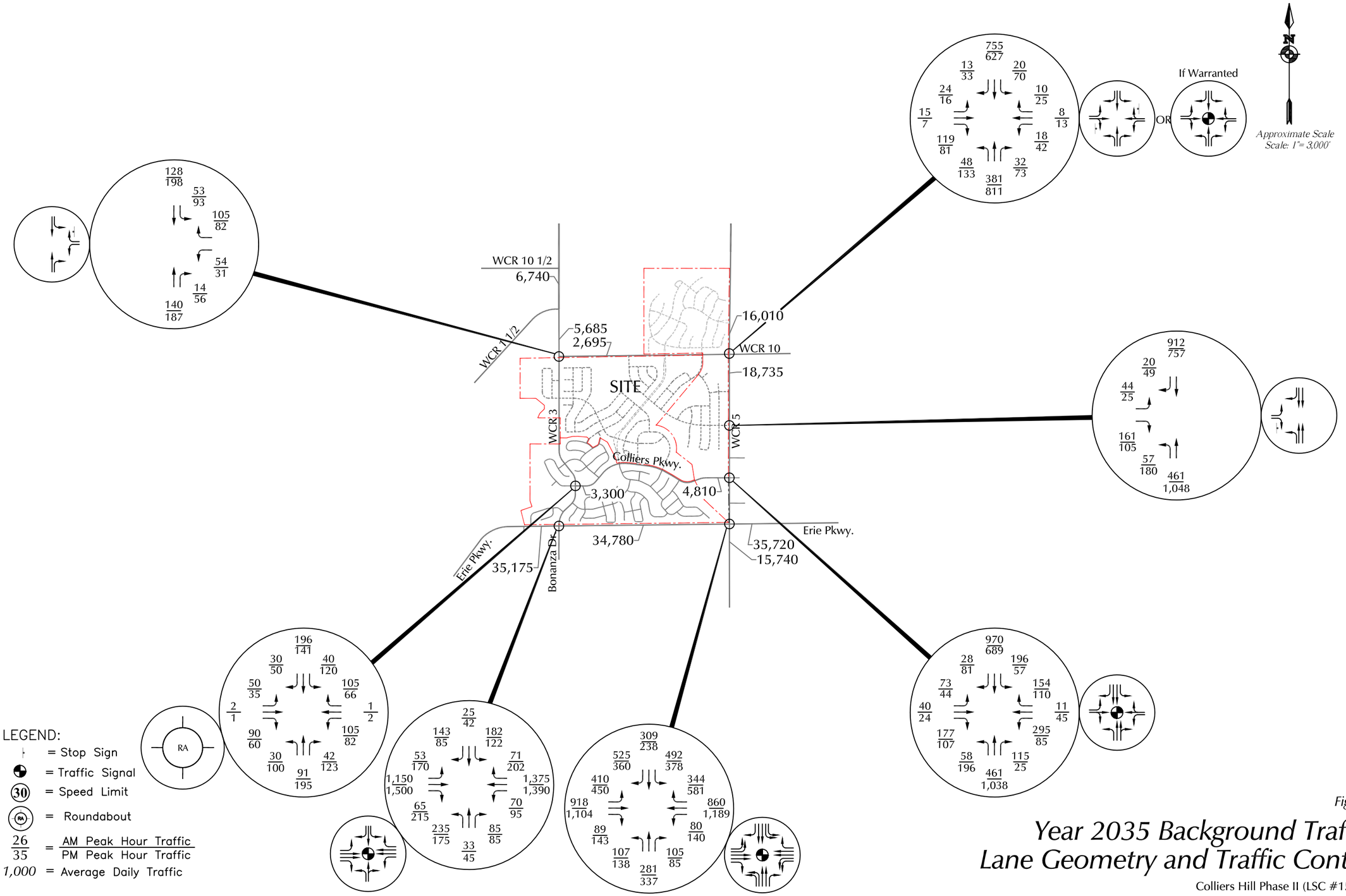



*Figure 4*

# *Year 2035 Background Traffic, Lane Geometry and Traffic Control*

Colliers Hill Phase II (LSC #150950)

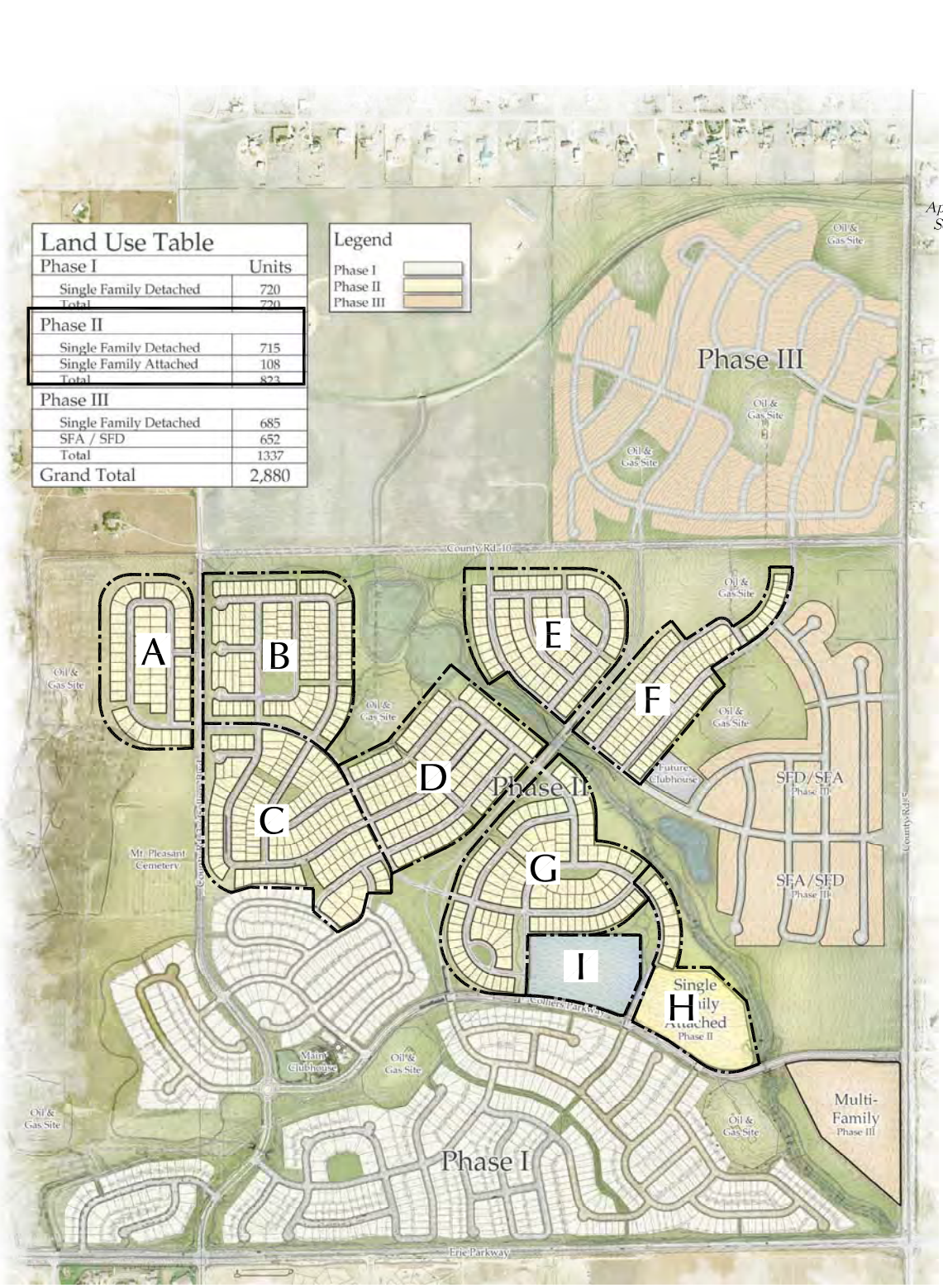
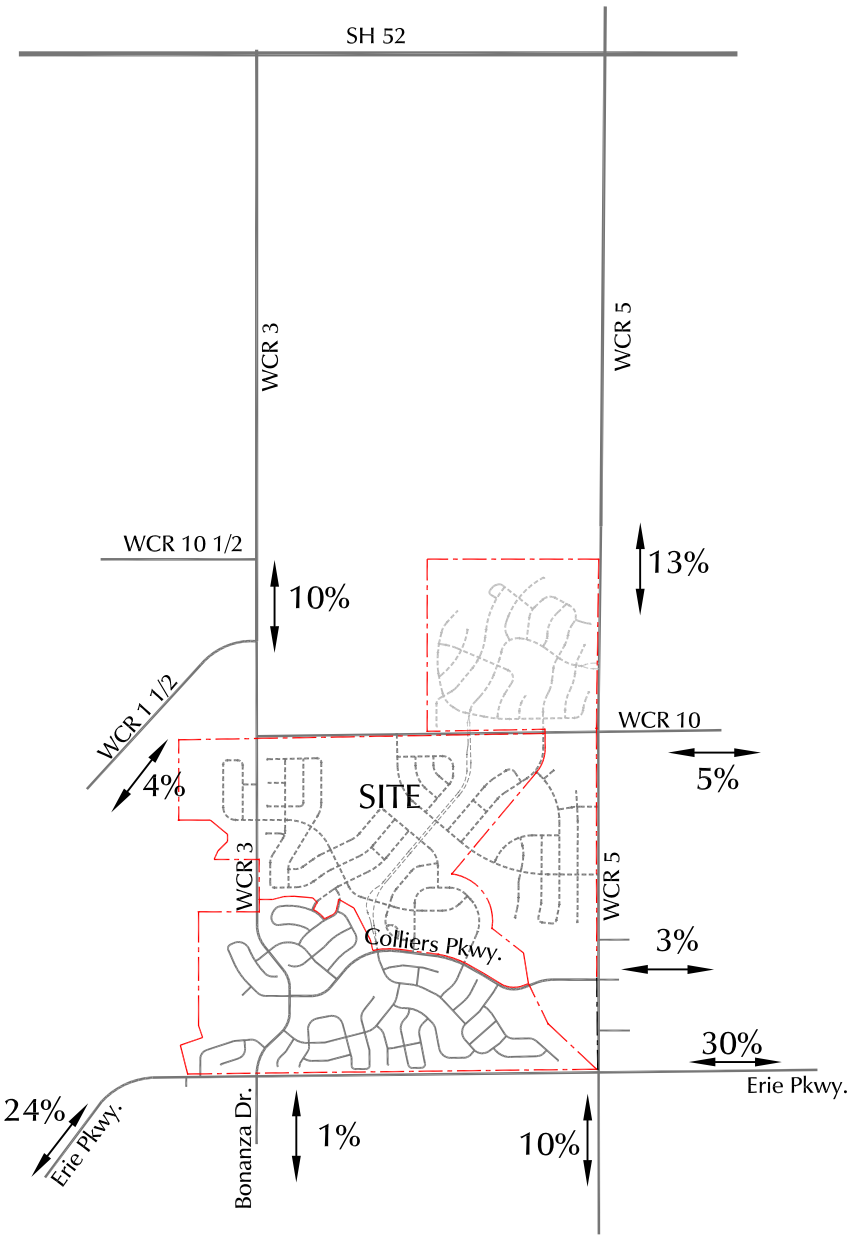



*Figure 5*

# *Phase II TAZ Map*

Colliers Hill Phase II (LSC #150950)

LSC TRANSPORTATION CONSULTANTS, INC.




Approximate Scale
Scale: 1"= 3,000'

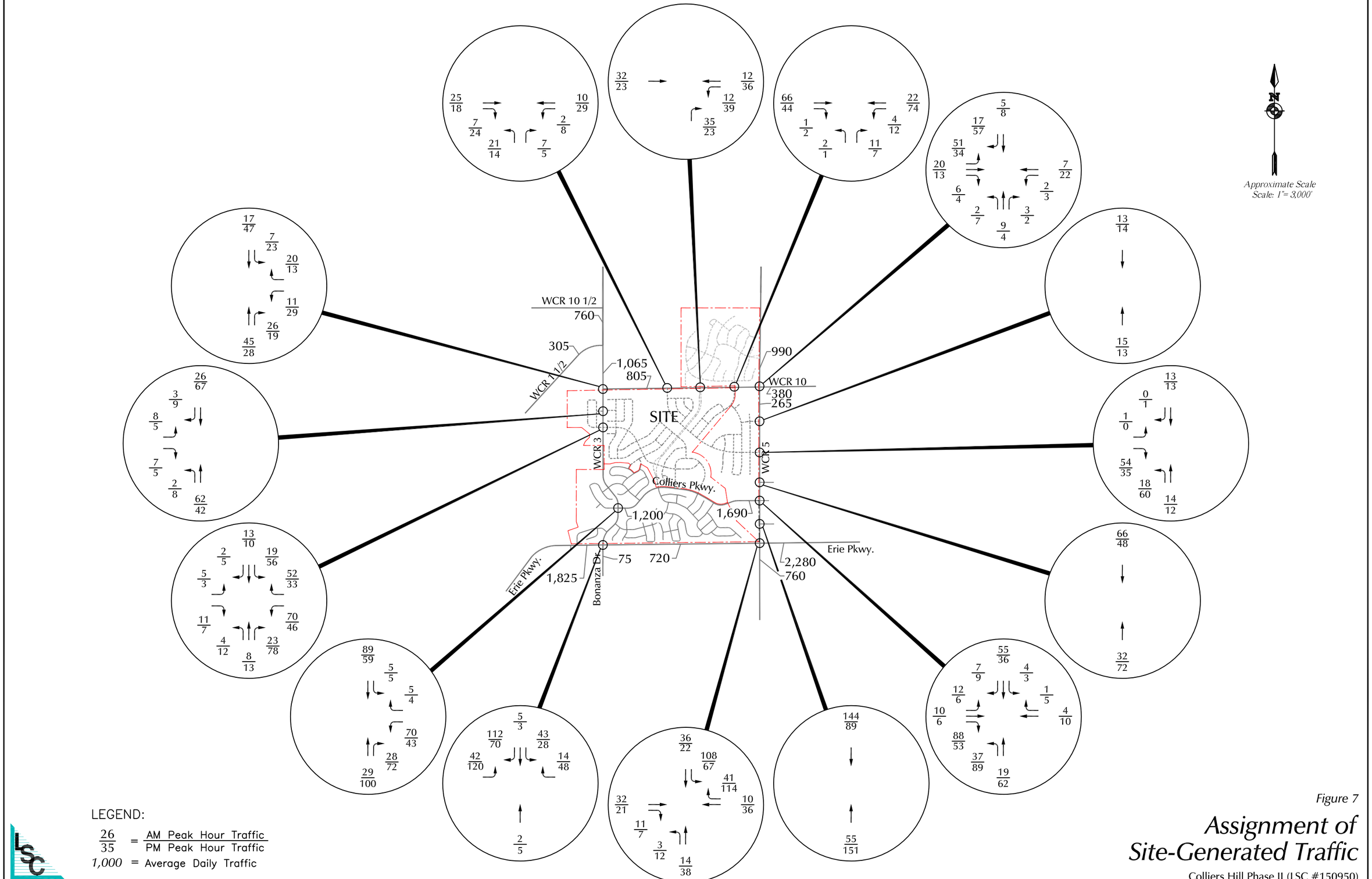
LEGEND:

65% = Percent Directional Distribution

*Figure 6*

# *Directional Distribution of Site-Generated Traffic*

Colliers Hill Phase II (LSC #150950)




LEGEND:

$\frac{26}{35}$ = $\frac{\text{AM Peak Hour Traffic}}{\text{PM Peak Hour Traffic}}$

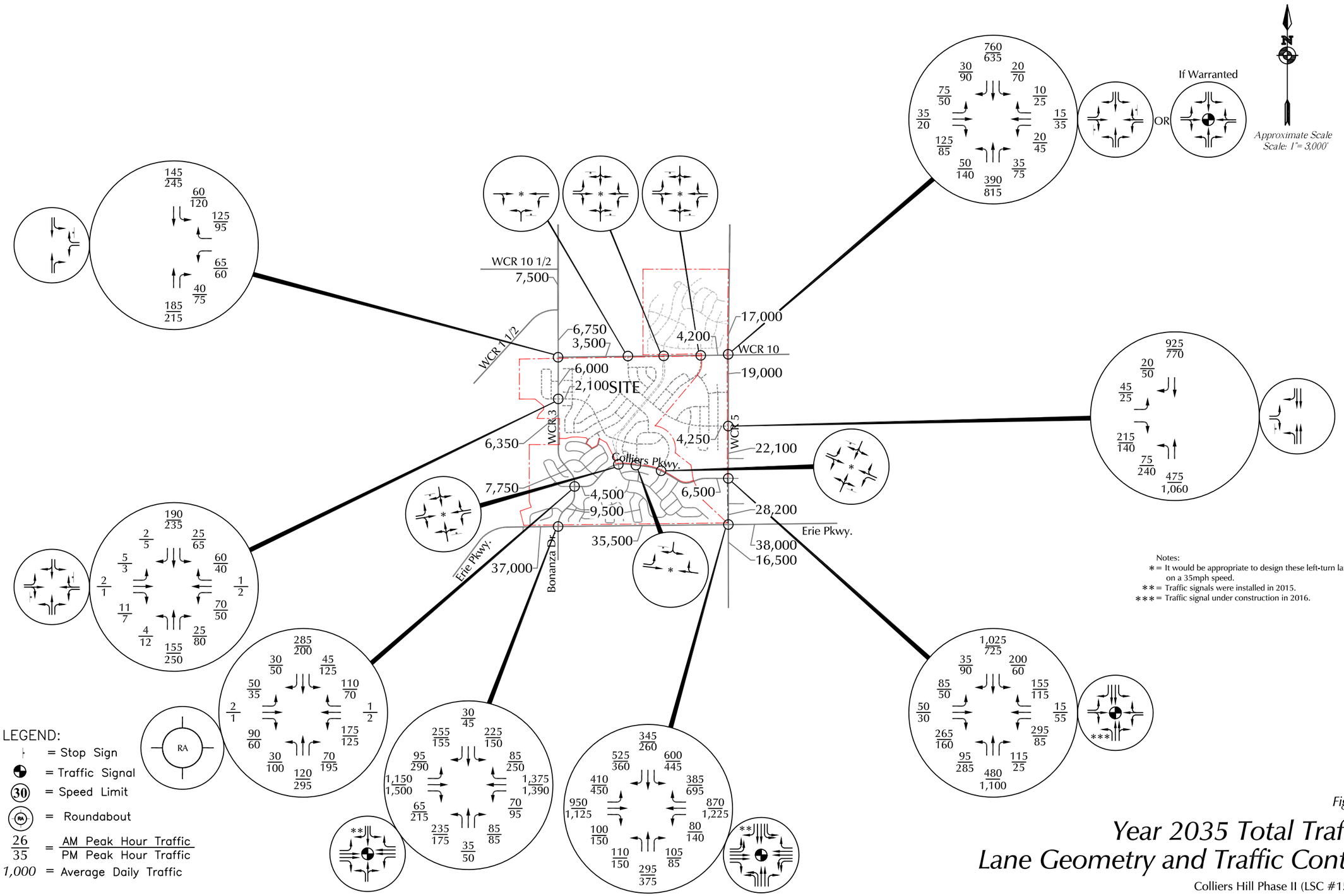
*1,000* = Average Daily Traffic

TRANSPORTATION CONSULTANTS, INC.

*Figure 7*

# *Assignment of Site-Generated Traffic*

Colliers Hill Phase II (LSC #150950)




Notes:
* = It would be appropriate to design these left-turn lanes based on a 35mph speed.
** = Traffic signals were installed in 2015.
*** = Traffic signal under construction in 2016.

LEGEND:
= Stop Sign
= Traffic Signal
30 = Speed Limit
RA = Roundabout
26/35 = AM Peak Hour Traffic / PM Peak Hour Traffic
*1,000* = Average Daily Traffic

LSC TRANSPORTATION CONSULTANTS, INC.

*Figure 8*

# *Year 2035 Total Traffic, Lane Geometry and Traffic Control*

Colliers Hill Phase II (LSC #150950)

**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: CR-5
E/W STREET: ERIE PKWY (CR-8)
CITY: ERIE
COUNTY: WELD

File Name : CR-5ERIE1
Site Code : 00000016
Start Date : 9/9/2015
Page No : 1

Groups Printed- VEHICLES

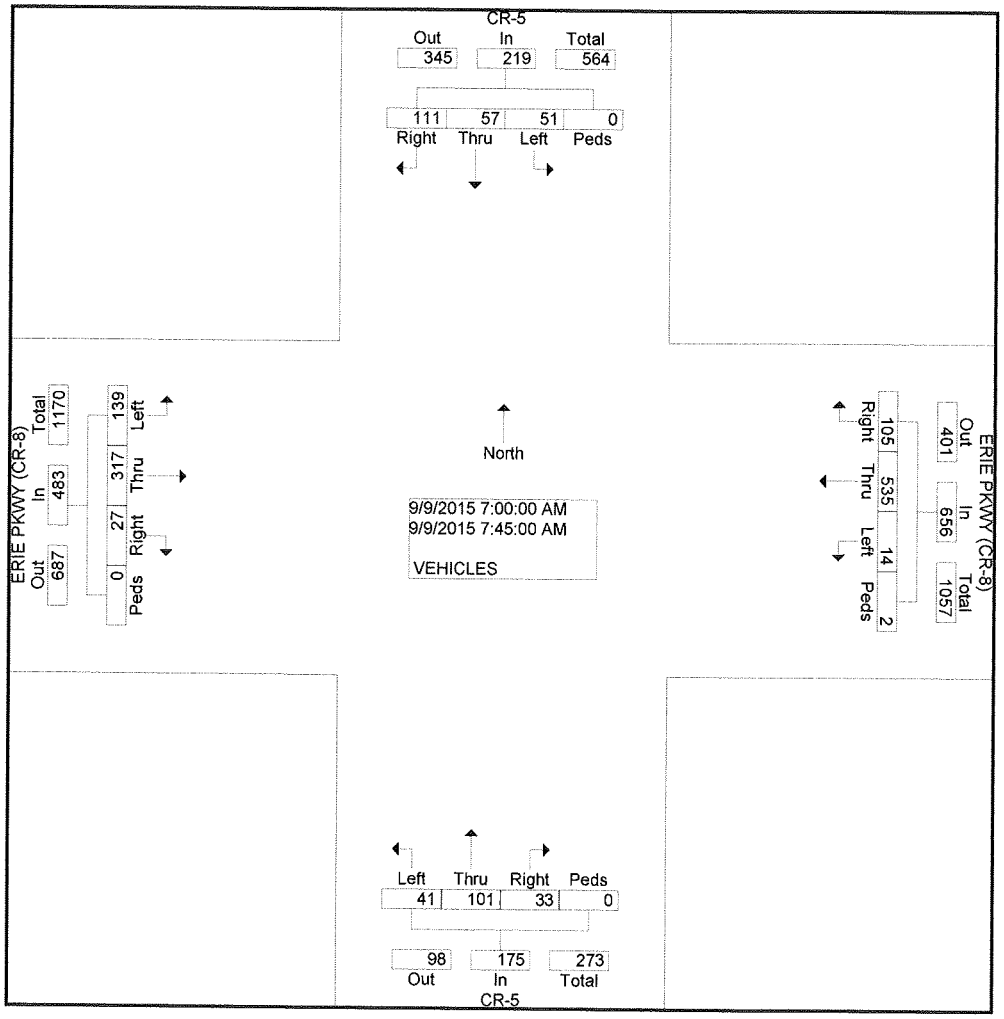
| | CR-5 Southbound | | | | ERIE PKWY (CR-8) Westbound | | | | CR-5 Northbound | | | | ERIE PKWY (CR-8) Eastbound | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Int. Total |
| Factor | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | |
| 07:00 AM | 25 | 23 | 42 | 0 | 2 | 107 | 53 | 0 | 4 | 59 | 9 | 0 | 101 | 84 | 6 | 0 | 515 |
| 07:15 AM | 16 | 18 | 49 | 0 | 2 | 124 | 42 | 2 | 8 | 27 | 8 | 0 | 29 | 85 | 10 | 0 | 420 |
| 07:30 AM | 6 | 6 | 9 | 0 | 2 | 179 | 5 | 0 | 12 | 8 | 7 | 0 | 2 | 68 | 1 | 0 | 305 |
| 07:45 AM | 4 | 10 | 11 | 0 | 8 | 125 | 5 | 0 | 17 | 7 | 9 | 0 | 7 | 80 | 10 | 0 | 293 |
| Total | 51 | 57 | 111 | 0 | 14 | 535 | 105 | 2 | 41 | 101 | 33 | 0 | 139 | 317 | 27 | 0 | 1533 |
| 08:00 AM | 4 | 8 | 11 | 0 | 7 | 85 | 3 | 0 | 10 | 6 | 1 | 0 | 4 | 51 | 6 | 0 | 196 |
| 08:15 AM | 2 | 13 | 8 | 3 | 11 | 76 | 2 | 0 | 13 | 7 | 6 | 0 | 5 | 54 | 9 | 1 | 210 |
| 08:30 AM | 4 | 5 | 6 | 0 | 8 | 81 | 4 | 0 | 17 | 5 | 6 | 0 | 7 | 44 | 7 | 0 | 194 |
| 08:45 AM | 4 | 8 | 13 | 0 | 8 | 52 | 3 | 0 | 8 | 13 | 8 | 1 | 13 | 54 | 9 | 0 | 194 |
| Total | 14 | 34 | 38 | 3 | 34 | 294 | 12 | 0 | 48 | 31 | 21 | 1 | 29 | 203 | 31 | 1 | 794 |
| 04:00 PM | 1 | 10 | 5 | 1 | 4 | 57 | 7 | 0 | 10 | 7 | 8 | 0 | 6 | 95 | 9 | 0 | 220 |
| 04:15 PM | 4 | 2 | 15 | 2 | 8 | 67 | 9 | 0 | 9 | 11 | 8 | 0 | 6 | 91 | 8 | 0 | 240 |
| 04:30 PM | 9 | 12 | 8 | 0 | 3 | 56 | 5 | 1 | 16 | 9 | 7 | 0 | 12 | 100 | 18 | 0 | 256 |
| 04:45 PM | 3 | 6 | 11 | 0 | 4 | 71 | 8 | 0 | 9 | 15 | 8 | 0 | 16 | 132 | 17 | 1 | 301 |
| Total | 17 | 30 | 39 | 3 | 19 | 251 | 29 | 1 | 44 | 42 | 31 | 0 | 40 | 418 | 52 | 1 | 1017 |
| 05:00 PM | 15 | 6 | 16 | 0 | 5 | 61 | 12 | 0 | 14 | 6 | 11 | 0 | 10 | 165 | 19 | 3 | 343 |
| 05:15 PM | 15 | 1 | 10 | 0 | 5 | 90 | 12 | 0 | 12 | 11 | 5 | 0 | 18 | 128 | 21 | 1 | 329 |
| 05:30 PM | 15 | 7 | 16 | 0 | 1 | 67 | 14 | 2 | 13 | 13 | 8 | 0 | 26 | 154 | 15 | 0 | 351 |
| 05:45 PM | 9 | 12 | 10 | 1 | 5 | 81 | 19 | 0 | 16 | 16 | 1 | 0 | 51 | 101 | 8 | 0 | 330 |
| Total | 54 | 26 | 52 | 1 | 16 | 299 | 57 | 2 | 55 | 46 | 25 | 0 | 105 | 548 | 63 | 4 | 1353 |
| Grand Total | 136 | 147 | 240 | 7 | 83 | 1379 | 203 | 5 | 188 | 220 | 110 | 1 | 313 | 1486 | 173 | 6 | 4697 |
| Apprch % | 25.7 | 27.7 | 45.3 | 1.3 | 5.0 | 82.6 | 12.2 | 0.3 | 36.2 | 42.4 | 21.2 | 0.2 | 15.8 | 75.1 | 8.7 | 0.3 | |
| Total % | 2.9 | 3.1 | 5.1 | 0.1 | 1.8 | 29.4 | 4.3 | 0.1 | 4.0 | 4.7 | 2.3 | 0.0 | 6.7 | 31.6 | 3.7 | 0.1 | |

**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: CR-5
E/W STREET: ERIE PKWY (CR-8)
CITY: ERIE
COUNTY: WELD

File Name : CR-5ERIE1
Site Code : 00000016
Start Date : 9/9/2015
Page No : 2

| | CR-5 Southbound | | | | | ERIE PKWY (CR-8) Westbound | | | | | CR-5 Northbound | | | | | ERIE PKWY (CR-8) Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour From 07:00 AM to 09:00 AM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Intersection | 07:00 AM | | | | | | | | | | | | | | | | | | | | |
| Volume | 51 | 57 | 111 | 0 | 219 | 14 | 535 | 105 | 2 | 656 | 41 | 101 | 33 | 0 | 175 | 139 | 317 | 27 | 0 | 483 | 1533 |
| Percent | 23.3 | 26.0 | 50.7 | 0.0 | | 2.1 | 81.6 | 16.0 | 0.3 | | 23.4 | 57.7 | 18.9 | 0.0 | | 28.8 | 65.6 | 5.6 | 0.0 | | |
| 07:00 Volume | 25 | 23 | 42 | 0 | 90 | 2 | 107 | 53 | 0 | 162 | 4 | 59 | 9 | 0 | 72 | 101 | 84 | 6 | 0 | 191 | 515 |
| Peak Factor | | | | | | | | | | | | | | | | | | | | | 0.744 |
| High Int. | 07:00 AM | | | | | 07:30 AM | | | | | 07:00 AM | | | | | 07:00 AM | | | | | |
| Volume | 25 | 23 | 42 | 0 | 90 | 2 | 179 | 5 | 0 | 186 | 4 | 59 | 9 | 0 | 72 | 101 | 84 | 6 | 0 | 191 | |
| Peak Factor | | | | | 0.608 | | | | | 0.882 | | | | | 0.608 | | | | | 0.632 | |

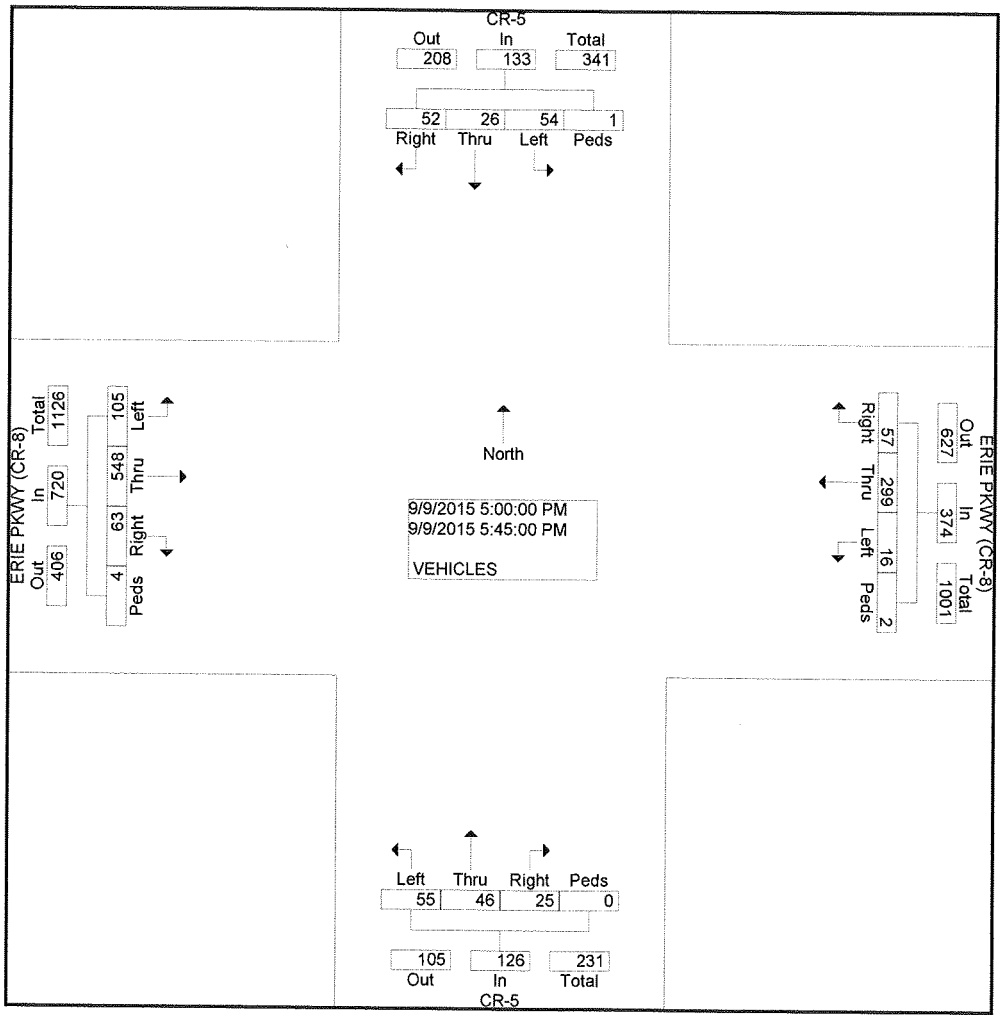


**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: CR-5
E/W STREET: ERIE PKWY (CR-8)
CITY: ERIE
COUNTY: WELD

File Name : CR-5ERIE1
Site Code : 00000016
Start Date : 9/9/2015
Page No : 2

| | CR-5 Southbound | | | | | ERIE PKWY (CR-8) Westbound | | | | | CR-5 Northbound | | | | | ERIE PKWY (CR-8) Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Intersection | 05:00 PM | | | | | | | | | | | | | | | | | | | | |
| Volume | 54 | 26 | 52 | 1 | 133 | 16 | 299 | 57 | 2 | 374 | 55 | 46 | 25 | 0 | 126 | 105 | 548 | 63 | 4 | 720 | 1353 |
| Percent | 40.6 | 19.5 | 39.1 | 0.8 | | 4.3 | 79.9 | 15.2 | 0.5 | | 43.7 | 36.5 | 19.8 | 0.0 | | 14.6 | 76.1 | 8.8 | 0.6 | | |
| 05:30 Volume | 15 | 7 | 16 | 0 | 38 | 1 | 67 | 14 | 2 | 84 | 13 | 13 | 8 | 0 | 34 | 26 | 154 | 15 | 0 | 195 | 351 |
| Peak Factor | | | | | | | | | | | | | | | | | | | | | 0.964 |
| High Int. | 05:30 PM | | | | | 05:15 PM | | | | | 05:30 PM | | | | | 05:00 PM | | | | | |
| Volume | 15 | 7 | 16 | 0 | 38 | 5 | 90 | 12 | 0 | 107 | 13 | 13 | 8 | 0 | 34 | 10 | 165 | 19 | 3 | 197 | |
| Peak Factor | | | | | 0.875 | | | | | 0.874 | | | | | 0.926 | | | | | 0.914 | |



**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: CR-5
E/W STREET: SOUTH ACCESS SCHOOL
CITY: ERIE
COUNTY: WELD

File Name : CR-5SOUT
Site Code : 00000001
Start Date : 9/9/2015
Page No : 1

Groups Printed- VEHICLES

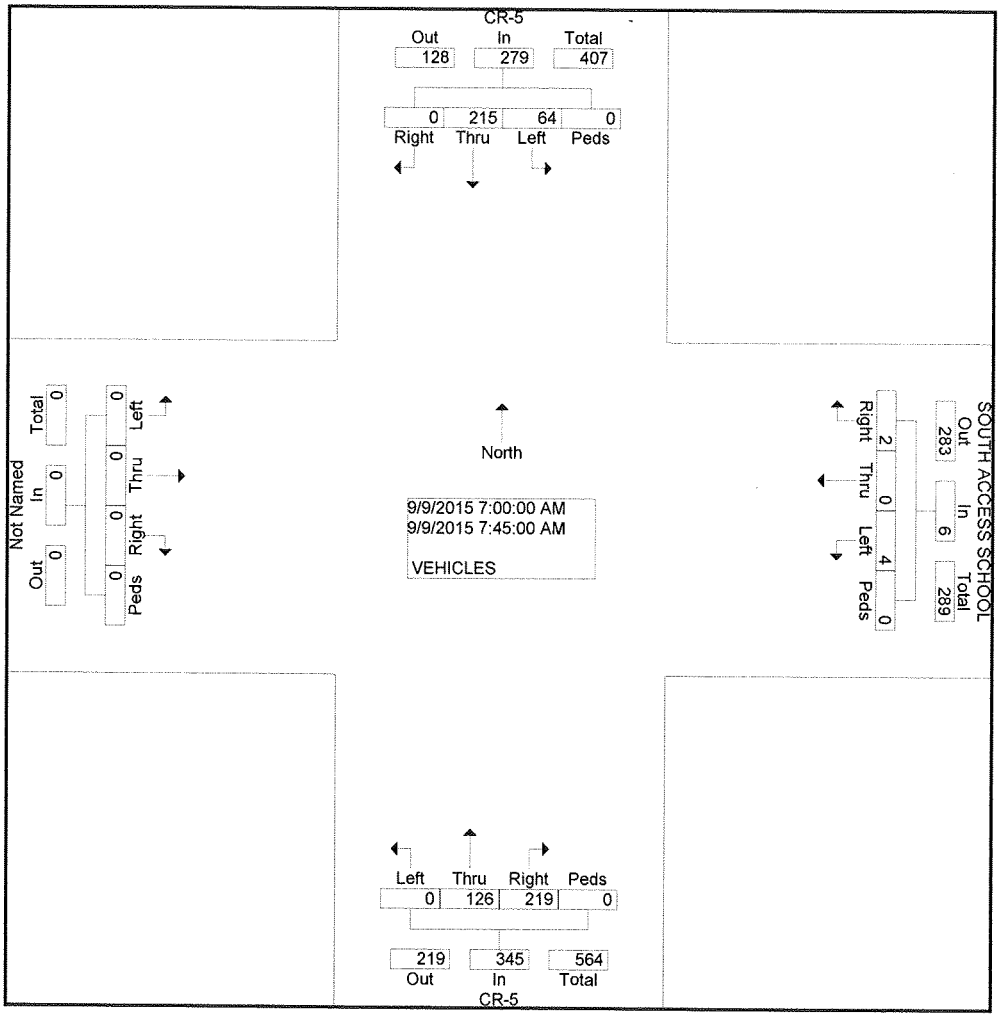
| | CR-5 Southbound | | | | SOUTH ACCESS SCHOOL Westbound | | | | CR-5 Northbound | | | | Eastbound | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Int. Total |
| Factor | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | |
| 07:00 AM | 40 | 89 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 69 | 144 | 0 | 0 | 0 | 0 | 0 | 344 |
| 07:15 AM | 22 | 82 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 27 | 71 | 0 | 0 | 0 | 0 | 0 | 204 |
| 07:30 AM | 1 | 19 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 37 |
| 07:45 AM | 1 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 4 | 0 | 0 | 0 | 0 | 0 | 45 |
| Total | 64 | 215 | 0 | 0 | 4 | 0 | 2 | 0 | 0 | 126 | 219 | 0 | 0 | 0 | 0 | 0 | 630 |
| 08:00 AM | 1 | 22 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 37 |
| 08:15 AM | 0 | 22 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 12 | 2 | 0 | 0 | 0 | 0 | 0 | 37 |
| 08:30 AM | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 2 | 0 | 0 | 0 | 0 | 0 | 31 |
| 08:45 AM | 4 | 19 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 14 | 15 | 0 | 0 | 0 | 0 | 0 | 58 |
| Total | 5 | 78 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 53 | 19 | 0 | 0 | 0 | 0 | 0 | 163 |
| 04:00 PM | 1 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 8 | 0 | 0 | 0 | 0 | 0 | 37 |
| 04:15 PM | 0 | 20 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 23 | 3 | 0 | 0 | 0 | 0 | 0 | 47 |
| 04:30 PM | 4 | 25 | 0 | 0 | 4 | 0 | 1 | 1 | 0 | 18 | 8 | 0 | 0 | 0 | 0 | 0 | 61 |
| 04:45 PM | 3 | 18 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 25 | 14 | 0 | 0 | 0 | 0 | 0 | 63 |
| Total | 8 | 79 | 0 | 0 | 7 | 0 | 2 | 1 | 0 | 78 | 33 | 0 | 0 | 0 | 0 | 0 | 208 |
| 05:00 PM | 5 | 29 | 0 | 0 | 8 | 0 | 0 | 1 | 0 | 17 | 11 | 0 | 0 | 0 | 0 | 0 | 71 |
| 05:15 PM | 3 | 22 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 22 | 19 | 0 | 0 | 0 | 0 | 0 | 70 |
| 05:30 PM | 7 | 35 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 24 | 29 | 0 | 0 | 0 | 0 | 0 | 98 |
| 05:45 PM | 3 | 26 | 0 | 0 | 5 | 0 | 0 | 2 | 0 | 12 | 74 | 0 | 0 | 0 | 0 | 0 | 122 |
| Total | 18 | 112 | 0 | 0 | 20 | 0 | 0 | 3 | 0 | 75 | 133 | 0 | 0 | 0 | 0 | 0 | 361 |
| Grand Total | 95 | 484 | 0 | 0 | 39 | 0 | 4 | 4 | 0 | 332 | 404 | 0 | 0 | 0 | 0 | 0 | 1362 |
| Apprch % | 16.4 | 83.6 | 0.0 | 0.0 | 83.0 | 0.0 | 8.5 | 8.5 | 0.0 | 45.1 | 54.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Total % | 7.0 | 35.5 | 0.0 | 0.0 | 2.9 | 0.0 | 0.3 | 0.3 | 0.0 | 24.4 | 29.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |

**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: CR-5
E/W STREET: SOUTH ACCESS SCHOOL
CITY: ERIE
COUNTY: WELD

File Name : CR-5SOUT
Site Code : 00000001
Start Date : 9/9/2015
Page No : 2

| | CR-5 Southbound | | | | | SOUTH ACCESS SCHOOL Westbound | | | | | CR-5 Northbound | | | | | Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour From 07:00 AM to 09:00 AM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Intersection | 07:00 AM | | | | | | | | | | | | | | | | | | | | |
| Volume | 64 | 215 | 0 | 0 | 279 | 4 | 0 | 2 | 0 | 6 | 0 | 126 | 219 | 0 | 345 | 0 | 0 | 0 | 0 | 0 | 630 |
| Percent | 22.9 | 77.1 | 0.0 | 0.0 | | 66.7 | 0.0 | 33.3 | 0.0 | | 0.0 | 36.5 | 63.5 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | | |
| 07:00 Volume | 40 | 89 | 0 | 0 | 129 | 1 | 0 | 1 | 0 | 2 | 0 | 69 | 144 | 0 | 213 | 0 | 0 | 0 | 0 | 0 | 344 |
| Peak Factor | | | | | | | | | | | | | | | | | | | | | 0.458 |
| High Int. | 07:00 AM | | | | | 07:00 AM | | | | | 07:00 AM | | | | | 6:45:00 AM | | | | | |
| Volume | 40 | 89 | 0 | 0 | 129 | 1 | 0 | 1 | 0 | 2 | 0 | 69 | 144 | 0 | 213 | | | | | | |
| Peak Factor | | | | | 0.541 | | | | | 0.750 | | | | | 0.405 | | | | | | |

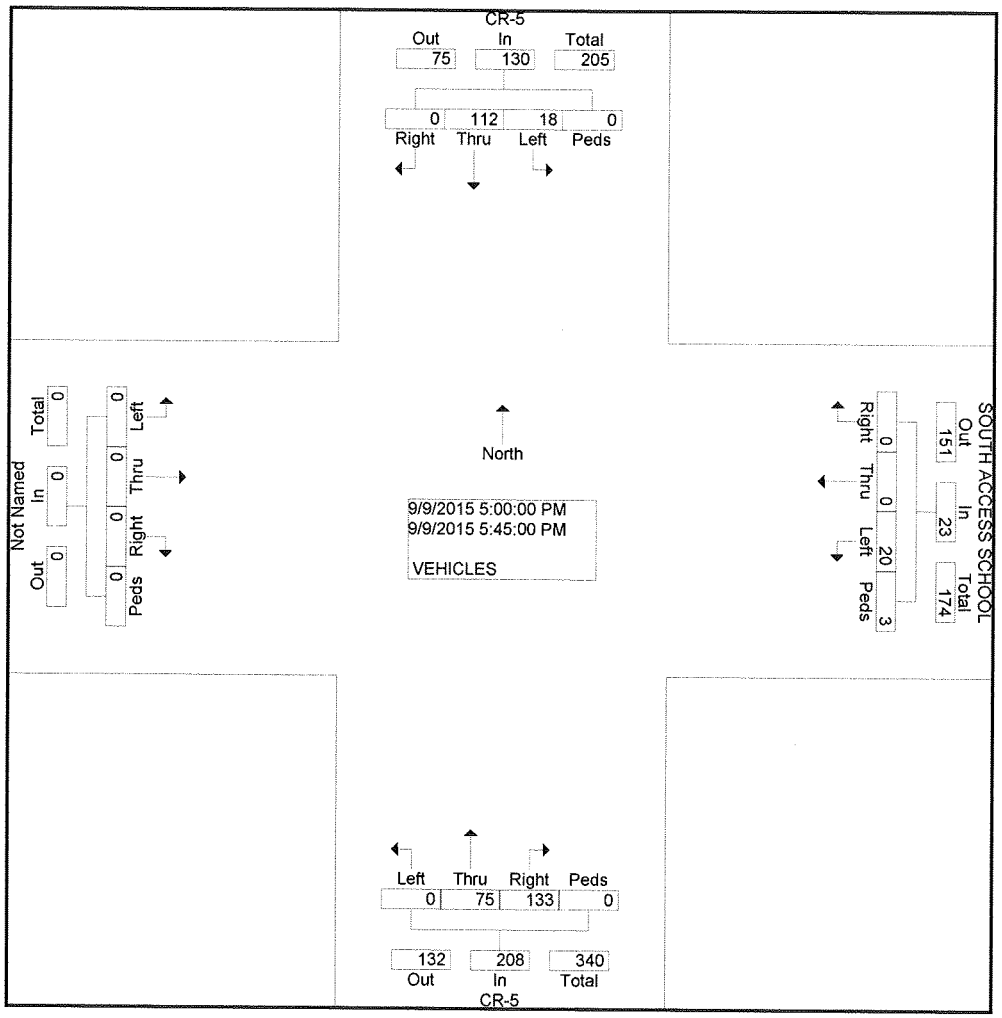


**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER,COLORADO
303-333-7409

N/S STREET: CR-5
E/W STREET: SOUTH ACCESS SCHOOL
CITY: ERIE
COUNTY: WELD

File Name : CR-5SOUT
Site Code : 00000001
Start Date : 9/9/2015
Page No : 2

| | CR-5 Southbound | | | | | SOUTH ACCESS SCHOOL Westbound | | | | | CR-5 Northbound | | | | | Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Intersection | 05:00 PM | | | | | | | | | | | | | | | | | | | | |
| Volume | 18 | 112 | 0 | 0 | 130 | 20 | 0 | 0 | 3 | 23 | 0 | 75 | 133 | 0 | 208 | 0 | 0 | 0 | 0 | 0 | 361 |
| Percent | 13.8 | 86.2 | 0.0 | 0.0 | | 87.0 | 0.0 | 0.0 | 13.0 | | 0.0 | 36.1 | 63.9 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | | |
| 05:45 Volume | 3 | 26 | 0 | 0 | 29 | 5 | 0 | 0 | 2 | 7 | 0 | 12 | 74 | 0 | 86 | 0 | 0 | 0 | 0 | 0 | 122 |
| Peak Factor | | | | | | | | | | | | | | | | | | | | | 0.740 |
| High Int. | 05:30 PM | | | | | 05:00 PM | | | | | 05:45 PM | | | | | | | | | | |
| Volume | 7 | 35 | 0 | 0 | 42 | 8 | 0 | 0 | 1 | 9 | 0 | 12 | 74 | 0 | 86 | | | | | | |
| Peak Factor | | | | | 0.774 | | | | | 0.639 | | | | | 0.605 | | | | | | |



**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: CR-5
E/W STREET: MIDDLE ACCESS TO SCHOOL
CITY: ERIE
COUNTY: WELD

File Name : CR-5MIDD
Site Code : 00000008
Start Date : 9/9/2015
Page No : 1

Groups Printed- VEHICLES

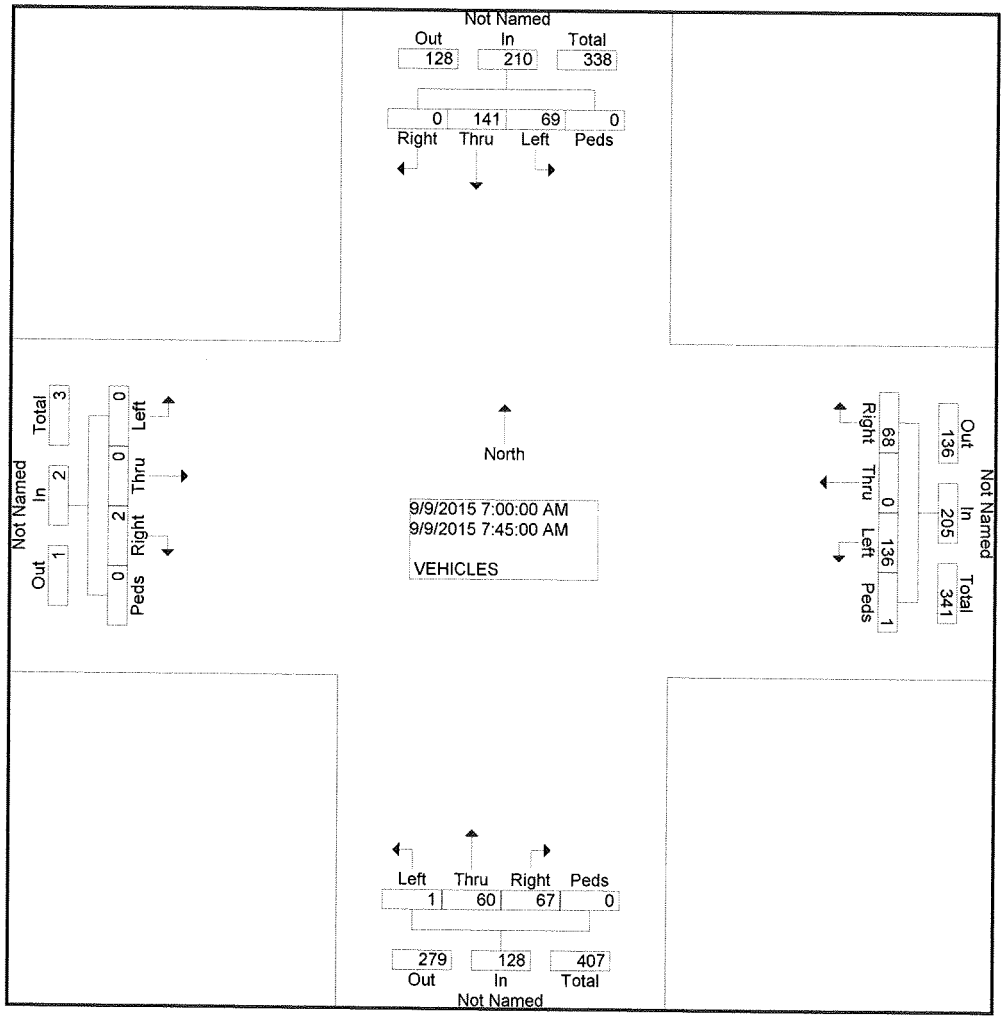
| | Southbound | | | | Westbound | | | | Northbound | | | | Eastbound | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Int. Total |
| Factor | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | |
| 07:00 AM | 43 | 53 | 0 | 0 | 76 | 0 | 36 | 0 | 0 | 30 | 40 | 0 | 0 | 0 | 0 | 0 | 278 |
| 07:15 AM | 24 | 44 | 0 | 0 | 60 | 0 | 28 | 0 | 0 | 3 | 25 | 0 | 0 | 0 | 0 | 0 | 184 |
| 07:30 AM | 1 | 20 | 0 | 0 | 0 | 0 | 3 | 1 | 1 | 13 | 1 | 0 | 0 | 0 | 0 | 0 | 40 |
| 07:45 AM | 1 | 24 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 14 | 1 | 0 | 0 | 0 | 2 | 0 | 43 |
| Total | 69 | 141 | 0 | 0 | 136 | 0 | 68 | 1 | 1 | 60 | 67 | 0 | 0 | 0 | 2 | 0 | 545 |
| 08:00 AM | 0 | 22 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 12 | 1 | 0 | 0 | 0 | 0 | 0 | 38 |
| 08:15 AM | 0 | 21 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 10 | 1 | 0 | 0 | 0 | 0 | 1 | 36 |
| 08:30 AM | 3 | 14 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 32 |
| 08:45 AM | 4 | 10 | 0 | 0 | 12 | 0 | 4 | 0 | 0 | 12 | 2 | 0 | 0 | 0 | 1 | 0 | 45 |
| Total | 7 | 67 | 0 | 0 | 15 | 0 | 7 | 0 | 3 | 46 | 4 | 0 | 0 | 0 | 1 | 1 | 151 |
| 04:00 PM | 2 | 15 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 32 |
| 04:15 PM | 2 | 17 | 0 | 0 | 3 | 0 | 1 | 0 | 0 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 46 |
| 04:30 PM | 0 | 19 | 0 | 0 | 10 | 0 | 3 | 1 | 0 | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 52 |
| 04:45 PM | 1 | 17 | 0 | 0 | 4 | 0 | 1 | 0 | 0 | 26 | 0 | 0 | 1 | 0 | 0 | 1 | 51 |
| Total | 5 | 68 | 0 | 0 | 19 | 0 | 6 | 1 | 0 | 80 | 0 | 0 | 1 | 0 | 0 | 1 | 181 |
| 05:00 PM | 1 | 25 | 0 | 0 | 9 | 0 | 5 | 1 | 0 | 16 | 1 | 0 | 0 | 0 | 0 | 2 | 60 |
| 05:15 PM | 2 | 15 | 0 | 0 | 9 | 0 | 6 | 0 | 0 | 20 | 2 | 0 | 0 | 0 | 1 | 0 | 55 |
| 05:30 PM | 1 | 30 | 0 | 0 | 7 | 0 | 4 | 0 | 1 | 23 | 0 | 0 | 1 | 0 | 5 | 0 | 72 |
| 05:45 PM | 17 | 21 | 0 | 0 | 6 | 0 | 2 | 2 | 0 | 7 | 5 | 0 | 2 | 0 | 2 | 1 | 65 |
| Total | 21 | 91 | 0 | 0 | 31 | 0 | 17 | 3 | 1 | 66 | 8 | 0 | 3 | 0 | 8 | 3 | 252 |
| Grand Total | 102 | 367 | 0 | 0 | 201 | 0 | 98 | 5 | 5 | 252 | 79 | 0 | 4 | 0 | 11 | 5 | 1129 |
| Apprch % | 21.7 | 78.3 | 0.0 | 0.0 | 66.1 | 0.0 | 32.2 | 1.6 | 1.5 | 75.0 | 23.5 | 0.0 | 20.0 | 0.0 | 55.0 | 25.0 | |
| Total % | 9.0 | 32.5 | 0.0 | 0.0 | 17.8 | 0.0 | 8.7 | 0.4 | 0.4 | 22.3 | 7.0 | 0.0 | 0.4 | 0.0 | 1.0 | 0.4 | |

**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: CR-5
E/W STREET: MIDDLE ACCESS TO SCHOOL
CITY: ERIE
COUNTY: WELD

File Name : CR-5MIDD
Site Code : 00000008
Start Date : 9/9/2015
Page No : 2

| | Southbound | | | | | Westbound | | | | | Northbound | | | | | Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour From 07:00 AM to 09:00 AM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Intersection | 07:00 AM | | | | | | | | | | | | | | | | | | | | |
| Volume | 69 | 141 | 0 | 0 | 210 | 136 | 0 | 68 | 1 | 205 | 1 | 60 | 67 | 0 | 128 | 0 | 0 | 2 | 0 | 2 | 545 |
| Percent | 32.9 | 67.1 | 0.0 | 0.0 | | 66.3 | 0.0 | 33.2 | 0.5 | | 0.8 | 46.9 | 52.3 | 0.0 | | 0.0 | 0.0 | 100.0 | 0.0 | | |
| 07:00 Volume | 43 | 53 | 0 | 0 | 96 | 76 | 0 | 36 | 0 | 112 | 0 | 30 | 40 | 0 | 70 | 0 | 0 | 0 | 0 | 0 | 278 |
| Peak Factor | | | | | | | | | | | | | | | | | | | | | 0.490 |
| High Int. | 07:00 AM | | | | | 07:00 AM | | | | | 07:00 AM | | | | | 07:45 AM | | | | | |
| Volume | 43 | 53 | 0 | 0 | 96 | 76 | 0 | 36 | 0 | 112 | 0 | 30 | 40 | 0 | 70 | 0 | 0 | 2 | 0 | 2 | |
| Peak Factor | | | | | 0.547 | | | | | 0.458 | | | | | 0.457 | | | | | 0.250 | |

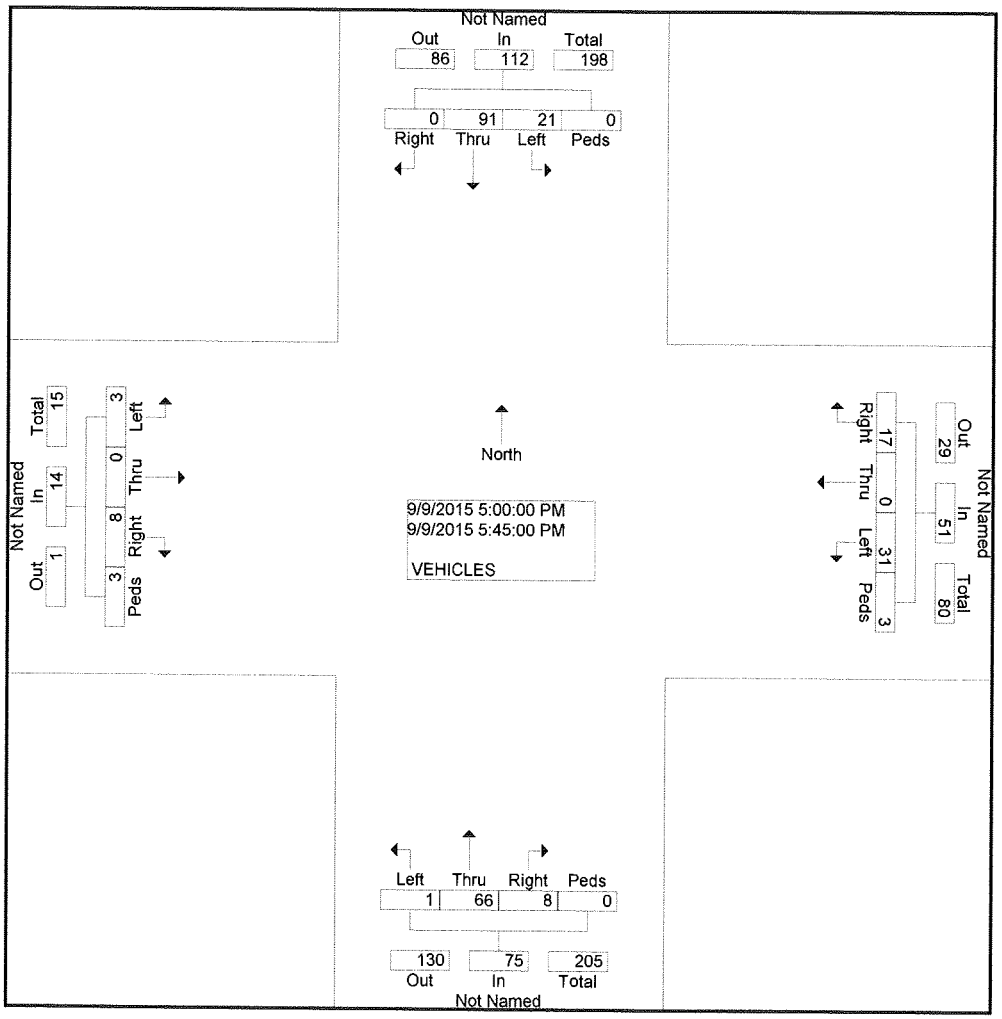


**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: CR-5
E/W STREET: MIDDLE ACCESS TO SCHOOL
CITY: ERIE
COUNTY: WELD

File Name : CR-5MIDD
Site Code : 00000008
Start Date : 9/9/2015


| | Southbound | | | | | Westbound | | | | | Northbound | | | | | Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Intersection | 05:00 PM | | | | | | | | | | | | | | | | | | | | |
| Volume | 21 | 91 | 0 | 0 | 112 | 31 | 0 | 17 | 3 | 51 | 1 | 66 | 8 | 0 | 75 | 3 | 0 | 8 | 3 | 14 | 252 |
| Percent | 18.8 | 81.3 | 0.0 | 0.0 | | 60.8 | 0.0 | 33.3 | 5.9 | | 1.3 | 88.0 | 10.7 | 0.0 | | 21.4 | 0.0 | 57.1 | 21.4 | | |
| 05:30 Volume | 1 | 30 | 0 | 0 | 31 | 7 | 0 | 4 | 0 | 11 | 1 | 23 | 0 | 0 | 24 | 1 | 0 | 5 | 0 | 6 | 72 |
| Peak Factor | | | | | | | | | | | | | | | | | | | | | 0.875 |
| High Int. | 05:45 PM | | | | | 05:00 PM | | | | | 05:30 PM | | | | | 05:30 PM | | | | | |
| Volume | 17 | 21 | 0 | 0 | 38 | 9 | 0 | 5 | 1 | 15 | 1 | 23 | 0 | 0 | 24 | 1 | 0 | 5 | 0 | 6 | |
| Peak Factor | | | | | 0.737 | | | | | 0.850 | | | | | 0.781 | | | | | 0.583 | |



**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: CR-5
E/W STREET: NORTH ACCESS SCHOOL
CITY: ERIE
COUNTY: WELD

File Name : CR-5NORT
Site Code : 00000002
Start Date : 9/9/2015
Page No : 1

Groups Printed- VEHICLES

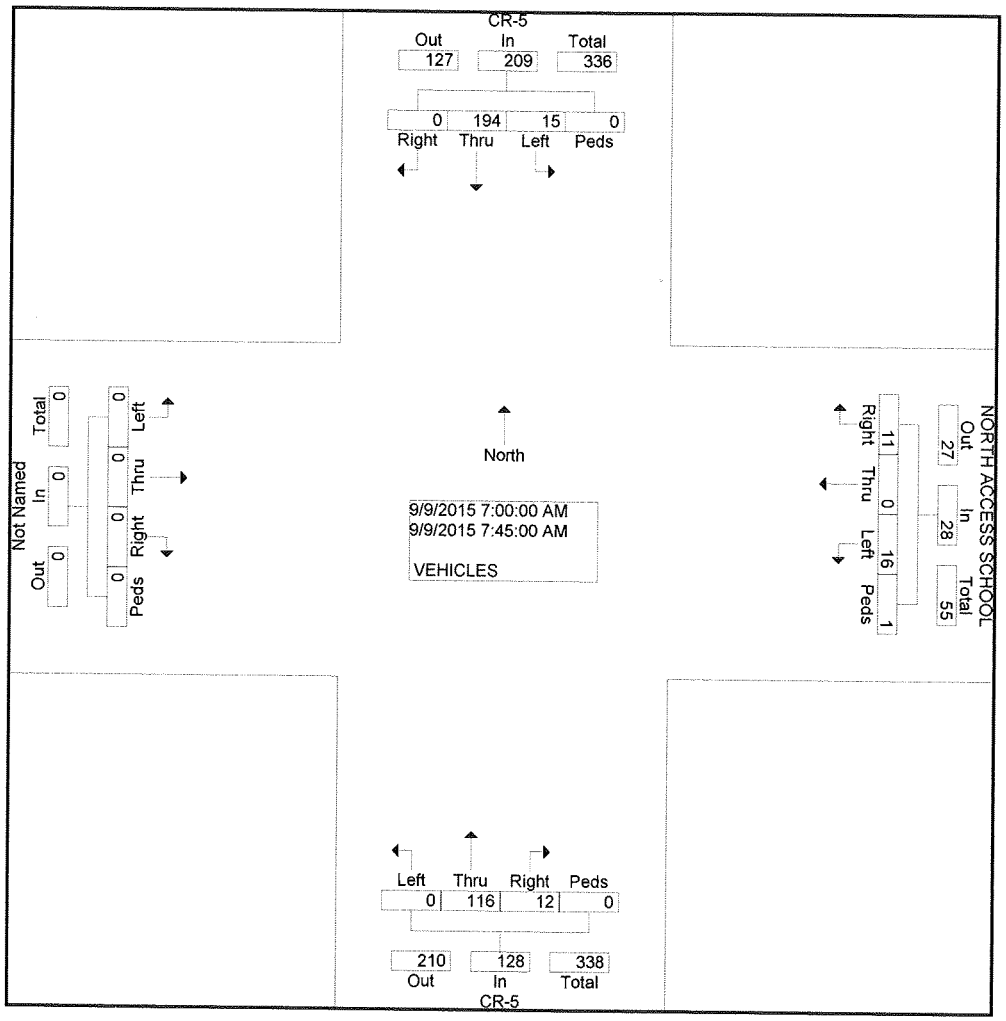
| | CR-5 Southbound | | | | NORTH ACCESS SCHOOL Westbound | | | | CR-5 Northbound | | | | Eastbound | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Int. Total |
| Factor | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | |
| 07:00 AM | 12 | 91 | 0 | 0 | 5 | 0 | 4 | 0 | 0 | 56 | 10 | 0 | 0 | 0 | 0 | 0 | 178 |
| 07:15 AM | 2 | 58 | 0 | 0 | 10 | 0 | 7 | 0 | 0 | 29 | 2 | 0 | 0 | 0 | 0 | 0 | 108 |
| 07:30 AM | 0 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 37 |
| 07:45 AM | 1 | 24 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 42 |
| Total | 15 | 194 | 0 | 0 | 16 | 0 | 11 | 1 | 0 | 116 | 12 | 0 | 0 | 0 | 0 | 0 | 365 |
| 08:00 AM | 0 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 36 |
| 08:15 AM | 2 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 1 | 35 |
| 08:30 AM | 1 | 17 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 11 | 1 | 0 | 0 | 0 | 0 | 0 | 31 |
| 08:45 AM | 1 | 13 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 31 |
| Total | 4 | 73 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 52 | 1 | 0 | 0 | 0 | 0 | 1 | 133 |
| 04:00 PM | 0 | 16 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 30 |
| 04:15 PM | 0 | 16 | 0 | 0 | 3 | 0 | 1 | 0 | 0 | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 44 |
| 04:30 PM | 2 | 18 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 21 | 1 | 0 | 0 | 0 | 0 | 0 | 45 |
| 04:45 PM | 0 | 17 | 0 | 0 | 1 | 0 | 2 | 1 | 0 | 27 | 1 | 0 | 0 | 0 | 0 | 0 | 49 |
| Total | 2 | 67 | 0 | 0 | 6 | 0 | 4 | 2 | 0 | 85 | 2 | 0 | 0 | 0 | 0 | 0 | 168 |
| 05:00 PM | 2 | 21 | 0 | 0 | 5 | 0 | 3 | 1 | 0 | 21 | 0 | 0 | 0 | 0 | 0 | 2 | 55 |
| 05:15 PM | 0 | 16 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 25 | 1 | 0 | 0 | 0 | 0 | 0 | 43 |
| 05:30 PM | 3 | 24 | 0 | 0 | 7 | 0 | 1 | 0 | 0 | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 63 |
| 05:45 PM | 4 | 33 | 0 | 0 | 5 | 0 | 2 | 2 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 1 | 58 |
| Total | 9 | 94 | 0 | 0 | 18 | 0 | 6 | 3 | 0 | 85 | 1 | 0 | 0 | 0 | 0 | 3 | 219 |
| Grand Total | 30 | 428 | 0 | 0 | 41 | 0 | 22 | 6 | 0 | 338 | 16 | 0 | 0 | 0 | 0 | 4 | 885 |
| Apprch % | 6.6 | 93.4 | 0.0 | 0.0 | 59.4 | 0.0 | 31.9 | 8.7 | 0.0 | 95.5 | 4.5 | 0.0 | 0.0 | 0.0 | 0.0 | 100.0 | |
| Total % | 3.4 | 48.4 | 0.0 | 0.0 | 4.6 | 0.0 | 2.5 | 0.7 | 0.0 | 38.2 | 1.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | |

**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: CR-5
E/W STREET: NORTH ACCESS SCHOOL
CITY: ERIE
COUNTY: WELD

File Name : CR-5NORT
Site Code : 00000002
Start Date : 9/9/2015


| | CR-5 Southbound | | | | | NORTH ACCESS SCHOOL Westbound | | | | | CR-5 Northbound | | | | | Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour From 07:00 AM to 09:00 AM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Intersection | 07:00 AM | | | | | | | | | | | | | | | | | | | | |
| Volume | 15 | 194 | 0 | 0 | 209 | 16 | 0 | 11 | 1 | 28 | 0 | 116 | 12 | 0 | 128 | 0 | 0 | 0 | 0 | 0 | 365 |
| Percent | 7.2 | 92.8 | 0.0 | 0.0 | | 57.1 | 0.0 | 39.3 | 3.6 | | 0.0 | 90.6 | 9.4 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | | |
| 07:00 Volume | 12 | 91 | 0 | 0 | 103 | 5 | 0 | 4 | 0 | 9 | 0 | 56 | 10 | 0 | 66 | 0 | 0 | 0 | 0 | 0 | 178 |
| Peak Factor | | | | | | | | | | | | | | | | | | | | | 0.513 |
| High Int. | 07:00 AM | | | | | 07:15 AM | | | | | 07:00 AM | | | | | 6:45:00 AM | | | | | |
| Volume | 12 | 91 | 0 | 0 | 103 | 10 | 0 | 7 | 0 | 17 | 0 | 56 | 10 | 0 | 66 | | | | | | |
| Peak Factor | | | | | 0.507 | | | | | 0.412 | | | | | 0.485 | | | | | | |

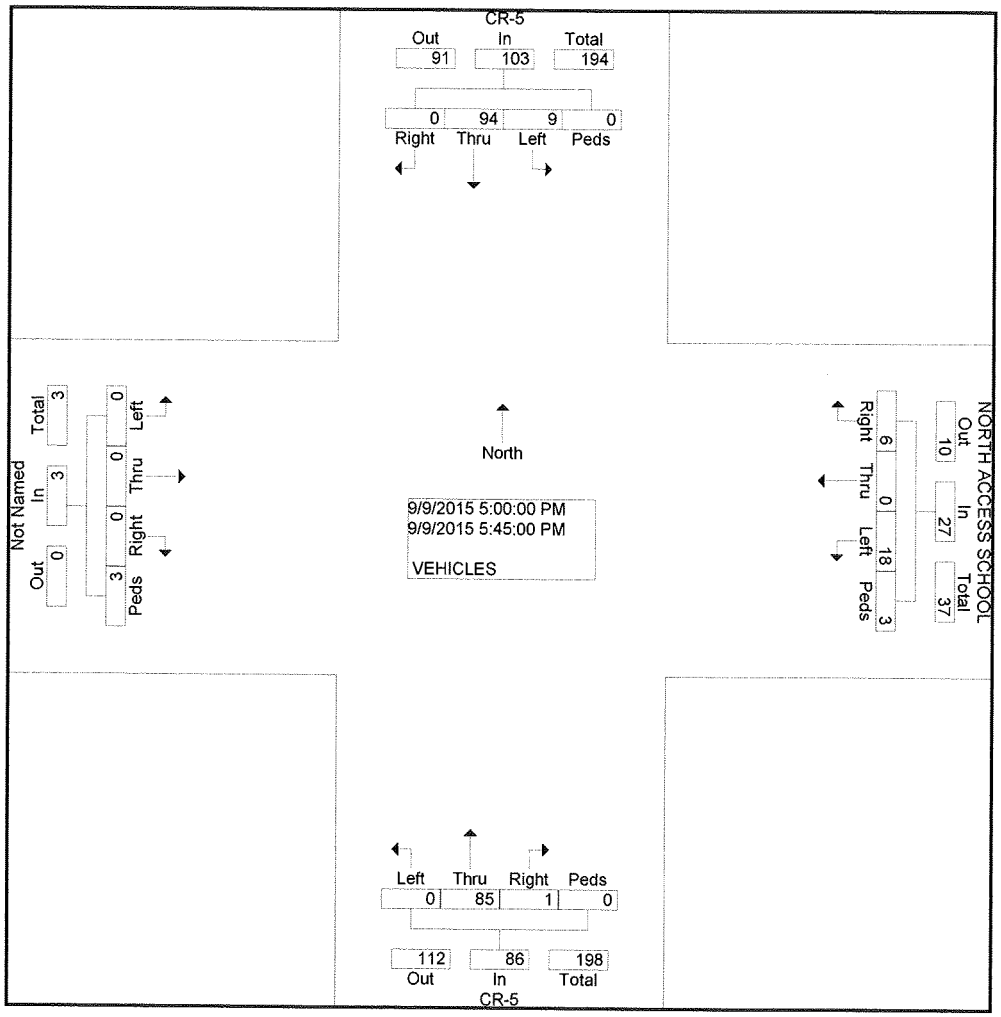


**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: CR-5
E/W STREET: NORTH ACCESS SCHOOL
CITY: ERIE
COUNTY: WELD

File Name : CR-5NORT
Site Code : 00000002
Start Date : 9/9/2015
Page No : 2

| | CR-5 Southbound | | | | | NORTH ACCESS SCHOOL Westbound | | | | | CR-5 Northbound | | | | | Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Intersection | 05:00 PM | | | | | | | | | | | | | | | | | | | | |
| Volume | 9 | 94 | 0 | 0 | 103 | 18 | 0 | 6 | 3 | 27 | 0 | 85 | 1 | 0 | 86 | 0 | 0 | 0 | 3 | 3 | 219 |
| Percent | 8.7 | 91.3 | 0.0 | 0.0 | | 66.7 | 0.0 | 22.2 | 11.1 | | 0.0 | 98.8 | 1.2 | 0.0 | | 0.0 | 0.0 | 0.0 | 100.0 | | |
| 05:30 Volume | 3 | 24 | 0 | 0 | 27 | 7 | 0 | 1 | 0 | 8 | 0 | 28 | 0 | 0 | 28 | 0 | 0 | 0 | 0 | 0 | 63 |
| Peak Factor | | | | | | | | | | | | | | | | | | | | | 0.869 |
| High Int. | 05:45 PM | | | | | 05:00 PM | | | | | 05:30 PM | | | | | 05:00 PM | | | | | |
| Volume | 4 | 33 | 0 | 0 | 37 | 5 | 0 | 3 | 1 | 9 | 0 | 28 | 0 | 0 | 28 | 0 | 0 | 0 | 2 | 2 | |
| Peak Factor | | | | | 0.696 | | | | | 0.750 | | | | | 0.768 | | | | | 0.375 | |



**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: CR-5
E/W STREET: CR-10
CITY: ERIE
COUNTY: WELD

File Name : CR-5CR10
Site Code : 00000013
Start Date : 9/9/2015
Page No : 1

Groups Printed- VEHICLES

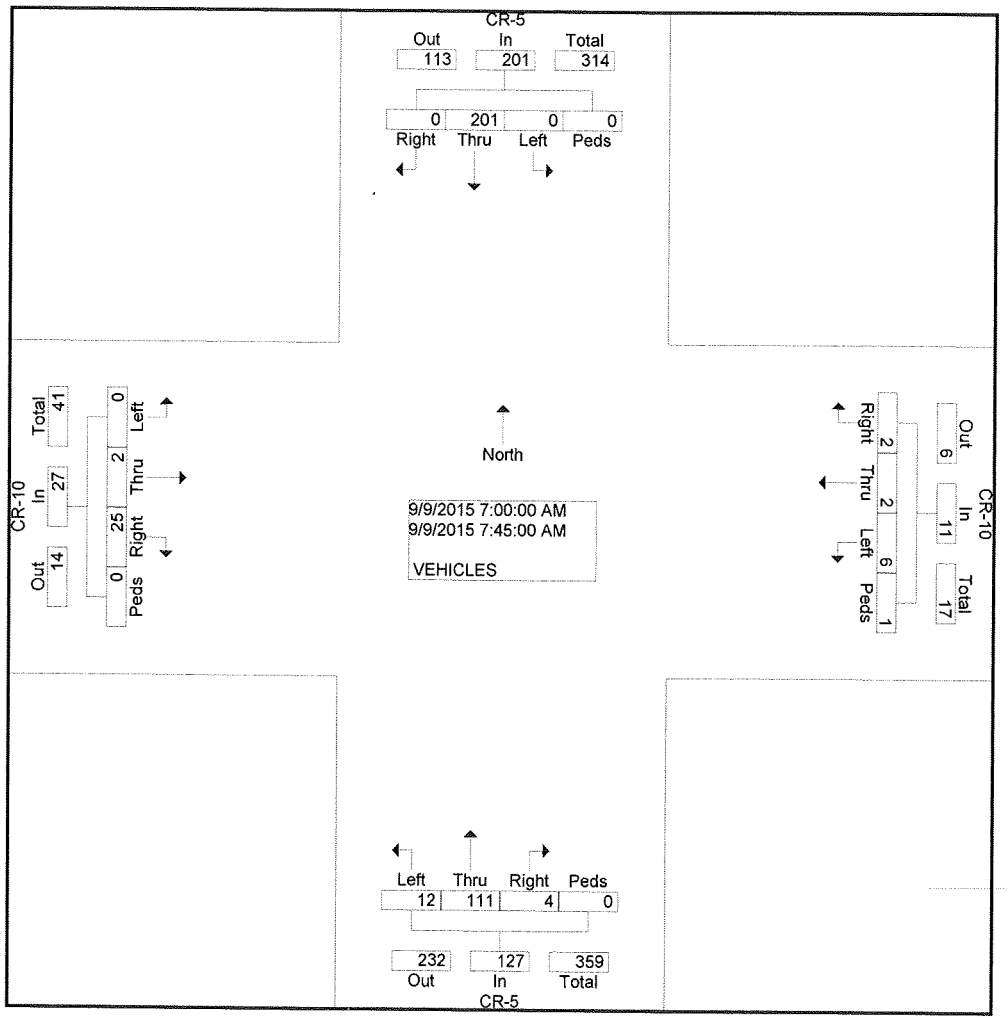
| | CR-5 Southbound | | | | CR-10 Westbound | | | | CR-5 Northbound | | | | CR-10 Eastbound | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Int. Total |
| Factor | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | |
| 07:00 AM | 0 | 100 | 0 | 0 | 2 | 0 | 1 | 0 | 7 | 51 | 2 | 0 | 0 | 1 | 15 | 0 | 179 |
| 07:15 AM | 0 | 57 | 0 | 0 | 2 | 0 | 1 | 0 | 4 | 32 | 0 | 0 | 0 | 0 | 6 | 0 | 102 |
| 07:30 AM | 0 | 20 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 14 | 1 | 0 | 0 | 0 | 4 | 0 | 42 |
| 07:45 AM | 0 | 24 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 14 | 1 | 0 | 0 | 1 | 0 | 0 | 43 |
| Total | 0 | 201 | 0 | 0 | 6 | 2 | 2 | 1 | 12 | 111 | 4 | 0 | 0 | 2 | 25 | 0 | 366 |
| 08:00 AM | 1 | 20 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 13 | 1 | 0 | 0 | 0 | 2 | 0 | 41 |
| 08:15 AM | 1 | 21 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 11 | 0 | 0 | 1 | 0 | 0 | 1 | 36 |
| 08:30 AM | 1 | 17 | 0 | 0 | 0 | 2 | 1 | 0 | 1 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 33 |
| 08:45 AM | 0 | 14 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 32 |
| Total | 3 | 72 | 1 | 0 | 1 | 5 | 3 | 0 | 1 | 51 | 1 | 0 | 1 | 0 | 2 | 1 | 142 |
| 04:00 PM | 3 | 14 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 12 | 1 | 0 | 0 | 1 | 1 | 0 | 34 |
| 04:15 PM | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 | 0 | 0 | 0 | 0 | 1 | 0 | 42 |
| 04:30 PM | 0 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22 | 0 | 0 | 0 | 0 | 1 | 0 | 43 |
| 04:45 PM | 0 | 16 | 0 | 0 | 0 | 2 | 1 | 0 | 1 | 26 | 2 | 0 | 0 | 1 | 0 | 1 | 50 |
| Total | 3 | 66 | 0 | 0 | 0 | 2 | 3 | 0 | 1 | 85 | 3 | 0 | 0 | 2 | 3 | 1 | 169 |
| 05:00 PM | 1 | 23 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 22 | 0 | 0 | 0 | 1 | 2 | 2 | 55 |
| 05:15 PM | 0 | 16 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 21 | 2 | 0 | 0 | 1 | 5 | 0 | 48 |
| 05:30 PM | 0 | 26 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 27 | 0 | 0 | 1 | 1 | 1 | 0 | 59 |
| 05:45 PM | 1 | 36 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 13 | 0 | 2 | 0 | 0 | 6 | 1 | 60 |
| Total | 2 | 101 | 0 | 0 | 0 | 3 | 2 | 0 | 6 | 83 | 2 | 2 | 1 | 3 | 14 | 3 | 222 |
| Grand Total | 8 | 440 | 1 | 0 | 7 | 12 | 10 | 1 | 20 | 330 | 10 | 2 | 2 | 7 | 44 | 5 | 899 |
| Apprch % | 1.8 | 98.0 | 0.2 | 0.0 | 23.3 | 40.0 | 33.3 | 3.3 | 5.5 | 91.2 | 2.8 | 0.6 | 3.4 | 12.1 | 75.9 | 8.6 | |
| Total % | 0.9 | 48.9 | 0.1 | 0.0 | 0.8 | 1.3 | 1.1 | 0.1 | 2.2 | 36.7 | 1.1 | 0.2 | 0.2 | 0.8 | 4.9 | 0.6 | |

**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: CR-5
E/W STREET: CR-10
CITY: ERIE
COUNTY: WELD

File Name : CR-5CR10
Site Code : 00000013
Start Date : 9/9/2015
Page No : 2

| | CR-5 Southbound | | | | | CR-10 Westbound | | | | | CR-5 Northbound | | | | | CR-10 Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour From 07:00 AM to 09:00 AM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Intersection | 07:00 AM | | | | | | | | | | | | | | | | | | | | |
| Volume | 0 | 201 | 0 | 0 | 201 | 6 | 2 | 2 | 1 | 11 | 12 | 111 | 4 | 0 | 127 | 0 | 2 | 25 | 0 | 27 | 366 |
| Percent | 0.0 | 100.0 | 0.0 | 0.0 | | 54.5 | 18.2 | 18.2 | 9.1 | | 9.4 | 87.4 | 3.1 | 0.0 | | 0.0 | 7.4 | 92.6 | 0.0 | | |
| 07:00 Volume | 0 | 100 | 0 | 0 | 100 | 2 | 0 | 1 | 0 | 3 | 7 | 51 | 2 | 0 | 60 | 0 | 1 | 15 | 0 | 16 | 179 |
| Peak Factor | | | | | | | | | | | | | | | | | | | | | 0.511 |
| High Int. | 07:00 AM | | | | | 07:00 AM | | | | | 07:00 AM | | | | | 07:00 AM | | | | | |
| Volume | 0 | 100 | 0 | 0 | 100 | 2 | 0 | 1 | 0 | 3 | 7 | 51 | 2 | 0 | 60 | 0 | 1 | 15 | 0 | 16 | |
| Peak Factor | | | | | 0.503 | | | | | 0.917 | | | | | 0.529 | | | | | 0.422 | |

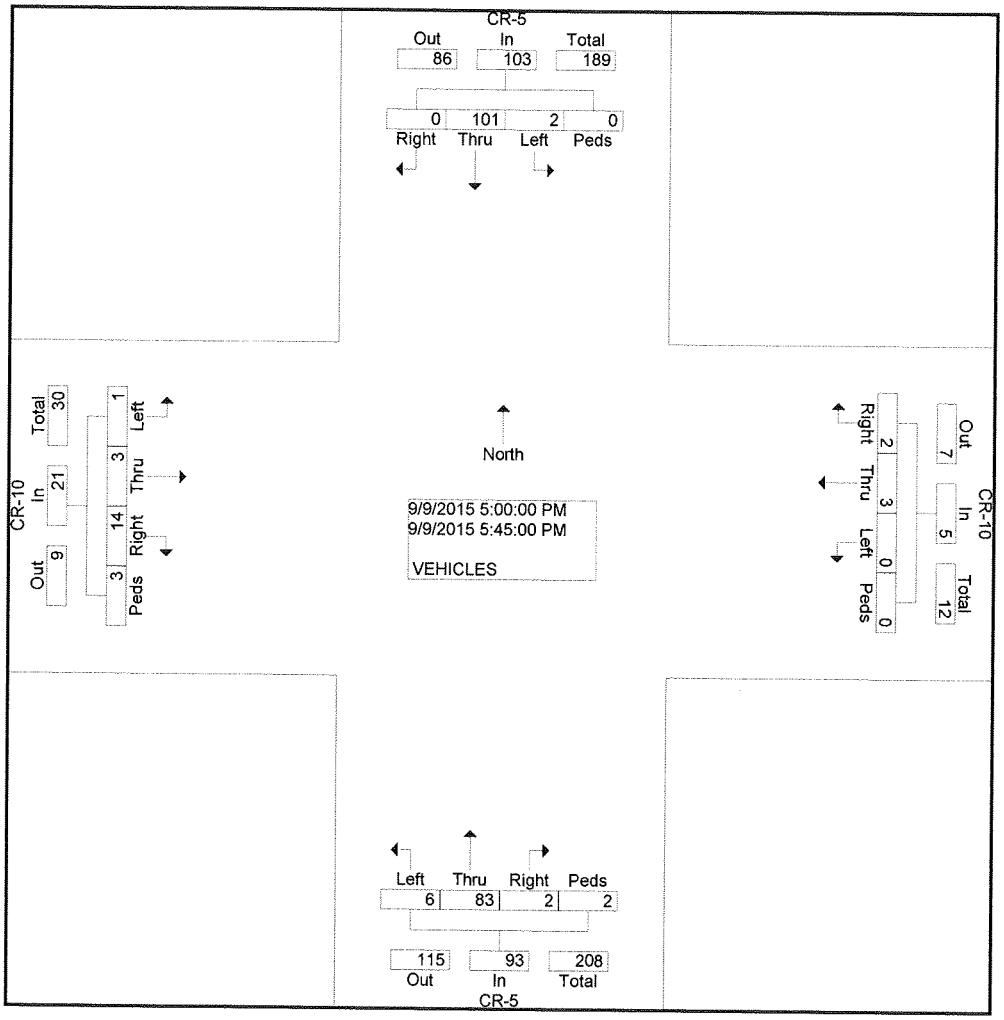


**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: CR-5
E/W STREET: CR-10
CITY: ERIE
COUNTY: WELD

File Name : CR-5CR10
Site Code : 00000013
Start Date : 9/9/2015
Page No : 2

| | CR-5 Southbound | | | | | CR-10 Westbound | | | | | CR-5 Northbound | | | | | CR-10 Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Intersection | 05:00 PM | | | | | | | | | | | | | | | | | | | | |
| Volume | 2 | 101 | 0 | 0 | 103 | 0 | 3 | 2 | 0 | 5 | 6 | 83 | 2 | 2 | 93 | 1 | 3 | 14 | 3 | 21 | 222 |
| Percent | 1.9 | 98.1 | 0.0 | 0.0 | | 0.0 | 60.0 | 40.0 | 0.0 | | 6.5 | 89.2 | 2.2 | 2.2 | | 4.8 | 14.3 | 66.7 | 14.3 | | |
| 05:45 Volume | 1 | 36 | 0 | 0 | 37 | 0 | 0 | 1 | 0 | 1 | 0 | 13 | 0 | 2 | 15 | 0 | 0 | 6 | 1 | 7 | 60 |
| Peak Factor | | | | | | | | | | | | | | | | | | | | | 0.925 |
| High Int. | 05:45 PM | | | | | 05:00 PM | | | | | 05:30 PM | | | | | 05:45 PM | | | | | |
| Volume | 1 | 36 | 0 | 0 | 37 | 0 | 2 | 0 | 0 | 2 | 2 | 27 | 0 | 0 | 29 | 0 | 0 | 6 | 1 | 7 | |
| Peak Factor | | | | | 0.696 | | | | | 0.625 | | | | | 0.802 | | | | | 0.750 | |



**COUNTER MEASURES INC.**

1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: COLLIERS BLVD (CR-3)
E/W STREET: ERIE PKWY (CR-8)
CITY: ERIE
COUNTY: WELD

File Name : COLLERIE
Site Code : 00000016
Start Date : 9/10/2015
Page No : 1

Groups Printed- VEHICLES

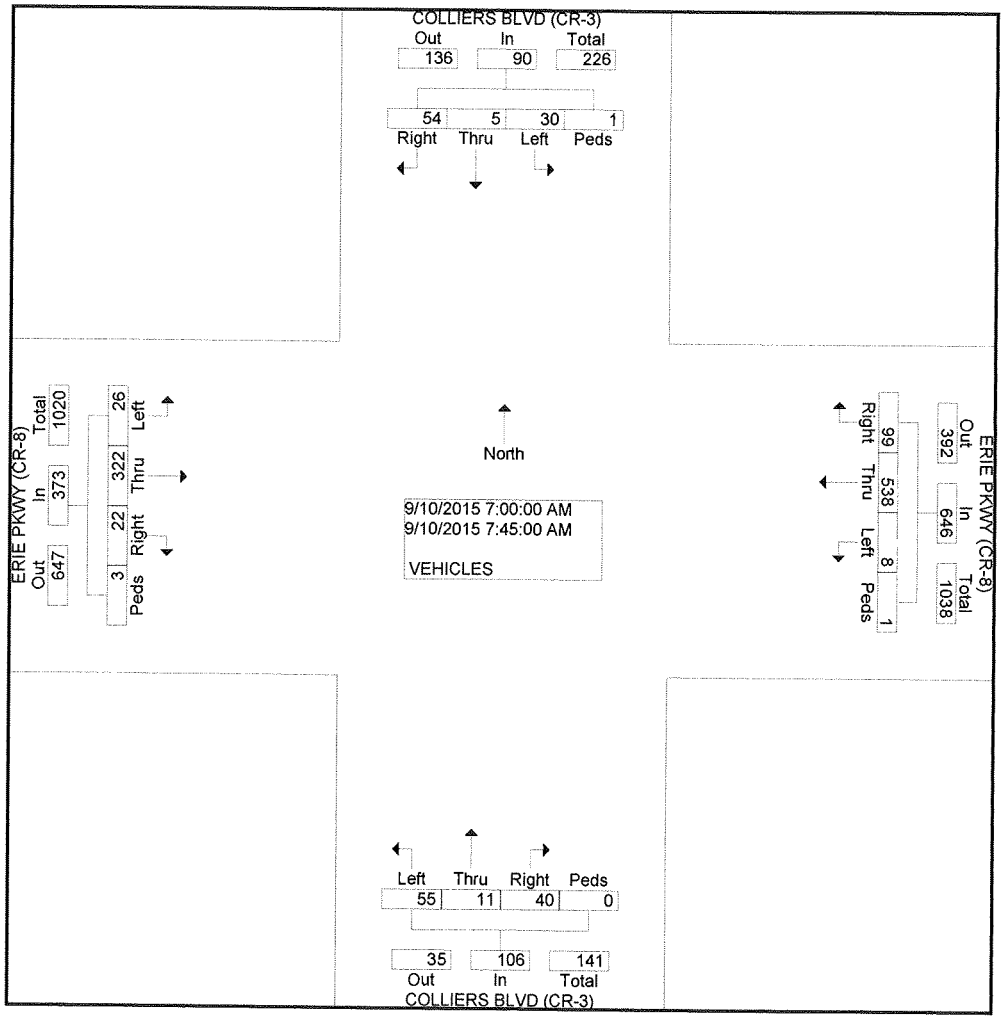
| | COLLIERS BLVD (CR-3) Southbound | | | | ERIE PKWY (CR-8) Westbound | | | | COLLIERS BLVD (CR-3) Northbound | | | | ERIE PKWY (CR-8) Eastbound | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Int. Total |
| Factor | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | |
| 07:00 AM | 9 | 2 | 13 | 1 | 2 | 109 | 24 | 0 | 12 | 3 | 18 | 0 | 8 | 113 | 4 | 1 | 319 |
| 07:15 AM | 7 | 1 | 13 | 0 | 4 | 171 | 28 | 0 | 15 | 5 | 12 | 0 | 1 | 83 | 6 | 0 | 346 |
| 07:30 AM | 5 | 1 | 13 | 0 | 0 | 139 | 21 | 0 | 12 | 3 | 5 | 0 | 10 | 67 | 3 | 0 | 279 |
| 07:45 AM | 9 | 1 | 15 | 0 | 2 | 119 | 26 | 1 | 16 | 0 | 5 | 0 | 7 | 59 | 9 | 2 | 271 |
| Total | 30 | 5 | 54 | 1 | 8 | 538 | 99 | 1 | 55 | 11 | 40 | 0 | 26 | 322 | 22 | 3 | 1215 |
| 08:00 AM | 9 | 0 | 13 | 0 | 3 | 112 | 20 | 0 | 18 | 2 | 8 | 0 | 3 | 46 | 6 | 0 | 240 |
| 08:15 AM | 11 | 1 | 13 | 1 | 3 | 99 | 22 | 0 | 13 | 4 | 4 | 0 | 13 | 75 | 5 | 0 | 264 |
| 08:30 AM | 8 | 0 | 12 | 1 | 1 | 90 | 8 | 0 | 12 | 1 | 6 | 0 | 10 | 44 | 4 | 2 | 199 |
| 08:45 AM | 4 | 0 | 10 | 0 | 1 | 62 | 11 | 0 | 11 | 0 | 4 | 0 | 9 | 62 | 4 | 1 | 179 |
| Total | 32 | 1 | 48 | 2 | 8 | 363 | 61 | 0 | 54 | 7 | 22 | 0 | 35 | 227 | 19 | 3 | 882 |
| 04:00 PM | 15 | 1 | 7 | 0 | 3 | 63 | 8 | 0 | 7 | 0 | 9 | 0 | 12 | 94 | 12 | 0 | 231 |
| 04:15 PM | 13 | 2 | 5 | 0 | 2 | 41 | 21 | 1 | 9 | 0 | 5 | 0 | 9 | 97 | 11 | 0 | 216 |
| 04:30 PM | 12 | 1 | 11 | 1 | 5 | 79 | 13 | 0 | 9 | 1 | 7 | 0 | 13 | 125 | 16 | 0 | 293 |
| 04:45 PM | 19 | 1 | 8 | 0 | 7 | 91 | 8 | 0 | 4 | 1 | 1 | 1 | 17 | 120 | 10 | 0 | 288 |
| Total | 59 | 5 | 31 | 1 | 17 | 274 | 50 | 1 | 29 | 2 | 22 | 1 | 51 | 436 | 49 | 0 | 1028 |
| 05:00 PM | 26 | 1 | 5 | 2 | 7 | 79 | 8 | 0 | 15 | 0 | 6 | 0 | 10 | 124 | 14 | 0 | 297 |
| 05:15 PM | 18 | 4 | 7 | 0 | 10 | 79 | 6 | 0 | 15 | 0 | 8 | 0 | 9 | 126 | 15 | 0 | 297 |
| 05:30 PM | 12 | 1 | 6 | 1 | 3 | 86 | 8 | 1 | 16 | 1 | 6 | 2 | 11 | 102 | 19 | 0 | 275 |
| 05:45 PM | 11 | 0 | 8 | 1 | 10 | 79 | 7 | 2 | 8 | 0 | 5 | 2 | 11 | 118 | 16 | 0 | 278 |
| Total | 67 | 6 | 26 | 4 | 30 | 323 | 29 | 3 | 54 | 1 | 25 | 4 | 41 | 470 | 64 | 0 | 1147 |
| Grand Total | 188 | 17 | 159 | 8 | 63 | 1498 | 239 | 5 | 192 | 21 | 109 | 5 | 153 | 1455 | 154 | 6 | 4272 |
| Apprch % | 50.5 | 4.6 | 42.7 | 2.2 | 3.5 | 83.0 | 13.2 | 0.3 | 58.7 | 6.4 | 33.3 | 1.5 | 8.7 | 82.3 | 8.7 | 0.3 | |
| Total % | 4.4 | 0.4 | 3.7 | 0.2 | 1.5 | 35.1 | 5.6 | 0.1 | 4.5 | 0.5 | 2.6 | 0.1 | 3.6 | 34.1 | 3.6 | 0.1 | |

**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: COLLIERS BLVD (CR-3)
E/W STREET: ERIE PKWY (CR-8)
CITY: ERIE
COUNTY: WELD

File Name : COLLERIE
Site Code : 00000016
Start Date : 9/10/2015
Page No : 2

| | COLLIERS BLVD (CR-3) Southbound | | | | | ERIE PKWY (CR-8) Westbound | | | | | COLLIERS BLVD (CR-3) Northbound | | | | | ERIE PKWY (CR-8) Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour From 07:00 AM to 09:00 AM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Intersection | 07:00 AM | | | | | | | | | | | | | | | | | | | | |
| Volume | 30 | 5 | 54 | 1 | 90 | 8 | 538 | 99 | 1 | 646 | 55 | 11 | 40 | 0 | 106 | 26 | 322 | 22 | 3 | 373 | 1215 |
| Percent | 33.3 | 5.6 | 60.0 | 1.1 | | 1.2 | 83.3 | 15.3 | 0.2 | | 51.9 | 10.4 | 37.7 | 0.0 | | 7.0 | 86.3 | 5.9 | 0.8 | | |
| 07:15 Volume | 7 | 1 | 13 | 0 | 21 | 4 | 171 | 28 | 0 | 203 | 15 | 5 | 12 | 0 | 32 | 1 | 83 | 6 | 0 | 90 | 346 |
| Peak Factor | | | | | | | | | | | | | | | | | | | | | 0.878 |
| High Int. | 07:00 AM | | | | | 07:15 AM | | | | | 07:00 AM | | | | | 07:00 AM | | | | | |
| Volume | 9 | 2 | 13 | 1 | 25 | 4 | 171 | 28 | 0 | 203 | 12 | 3 | 18 | 0 | 33 | 8 | 113 | 4 | 1 | 126 | |
| Peak Factor | | | | | 0.900 | | | | | 0.796 | | | | | 0.803 | | | | | 0.740 | |

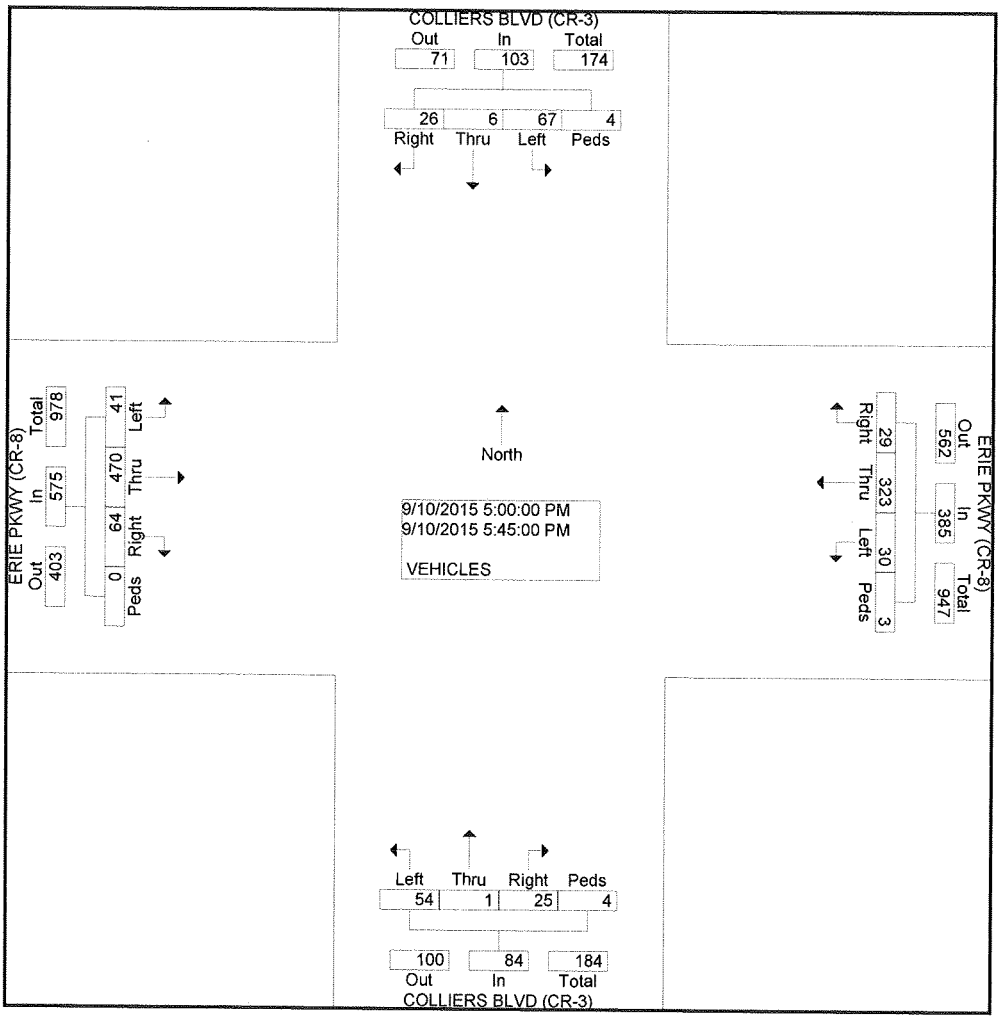


**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: COLLIERS BLVD (CR-3)
E/W STREET: ERIE PKWY (CR-8)
CITY: ERIE
COUNTY: WELD

File Name : COLLERIE
Site Code : 00000016
Start Date : 9/10/2015
Page No : 2

| | COLLIERS BLVD (CR-3) Southbound | | | | | ERIE PKWY (CR-8) Westbound | | | | | COLLIERS BLVD (CR-3) Northbound | | | | | ERIE PKWY (CR-8) Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour From 05:00 PM to 05:45 PM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Intersection | 05:00 PM | | | | | | | | | | | | | | | | | | | | |
| Volume | 67 | 6 | 26 | 4 | 103 | 30 | 323 | 29 | 3 | 385 | 54 | 1 | 25 | 4 | 84 | 41 | 470 | 64 | 0 | 575 | 1147 |
| Percent | 65.0 | 5.8 | 25.2 | 3.9 | | 7.8 | 83.9 | 7.5 | 0.8 | | 64.3 | 1.2 | 29.8 | 4.8 | | 7.1 | 81.7 | 11.1 | 0.0 | | |
| 05:15 Volume | 18 | 4 | 7 | 0 | 29 | 10 | 79 | 6 | 0 | 95 | 15 | 0 | 8 | 0 | 23 | 9 | 126 | 15 | 0 | 150 | 297 |
| Peak Factor | | | | | | | | | | | | | | | | | | | | | 0.965 |
| High Int. | 05:00 PM | | | | | 05:30 PM | | | | | 05:30 PM | | | | | 05:15 PM | | | | | |
| Volume | 26 | 1 | 5 | 2 | 34 | 3 | 86 | 8 | 1 | 98 | 16 | 1 | 6 | 2 | 25 | 9 | 126 | 15 | 0 | 150 | |
| Peak Factor | | | | | 0.757 | | | | | 0.982 | | | | | 0.840 | | | | | 0.958 | |



**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: COLLIERS BLVD (CR-3)
E/W STREET: COLLIER HILL PKWY
CITY: ERIE
COUNTY: WELD

File Name : COLLCOLL
Site Code : 00000008
Start Date : 9/10/2015
Page No : 1

Groups Printed- VEHICLES

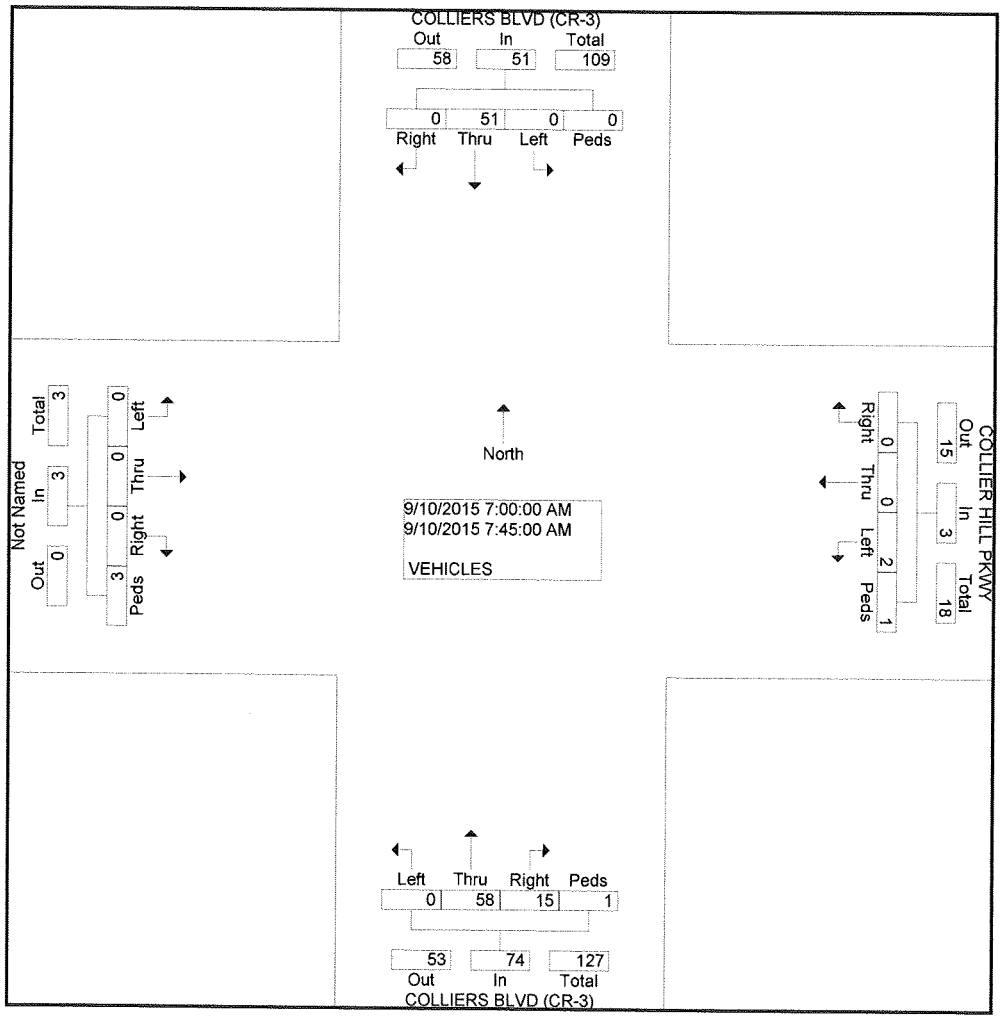
| | COLLIERS BLVD (CR-3) Southbound | | | | COLLIER HILL PKWY Westbound | | | | COLLIERS BLVD (CR-3) Northbound | | | | Eastbound | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Int. Total |
| Factor | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | |
| 07:00 AM | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 5 | 0 | 0 | 0 | 0 | 0 | 29 |
| 07:15 AM | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 7 | 0 | 0 | 0 | 0 | 3 | 39 |
| 07:30 AM | 0 | 12 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 15 | 1 | 0 | 0 | 0 | 0 | 0 | 29 |
| 07:45 AM | 0 | 15 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 14 | 2 | 1 | 0 | 0 | 0 | 0 | 34 |
| Total | 0 | 51 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | 58 | 15 | 1 | 0 | 0 | 0 | 3 | 131 |
| 08:00 AM | 1 | 11 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 12 | 4 | 0 | 0 | 0 | 0 | 0 | 33 |
| 08:15 AM | 0 | 7 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 17 | 4 | 0 | 0 | 0 | 0 | 0 | 30 |
| 08:30 AM | 0 | 10 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 25 |
| 08:45 AM | 0 | 8 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 6 | 3 | 0 | 0 | 0 | 0 | 0 | 19 |
| Total | 1 | 36 | 0 | 0 | 12 | 0 | 0 | 0 | 0 | 47 | 11 | 0 | 0 | 0 | 0 | 0 | 107 |
| 04:00 PM | 0 | 6 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| 04:15 PM | 1 | 9 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| 04:30 PM | 0 | 8 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 9 | 1 | 0 | 0 | 0 | 0 | 0 | 19 |
| 04:45 PM | 0 | 17 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 31 |
| Total | 1 | 40 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 26 | 1 | 0 | 0 | 0 | 0 | 0 | 75 |
| 05:00 PM | 0 | 8 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 8 | 1 | 0 | 0 | 0 | 0 | 0 | 19 |
| 05:15 PM | 1 | 18 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 27 |
| 05:30 PM | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 20 |
| 05:45 PM | 0 | 11 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 7 | 2 | 3 | 0 | 0 | 0 | 3 | 29 |
| Total | 1 | 50 | 0 | 0 | 3 | 0 | 1 | 3 | 0 | 28 | 3 | 3 | 0 | 0 | 0 | 3 | 95 |
| Grand Total | 3 | 177 | 0 | 0 | 24 | 0 | 1 | 4 | 0 | 159 | 30 | 4 | 0 | 0 | 0 | 6 | 408 |
| Apprch % | 1.7 | 98.3 | 0.0 | 0.0 | 82.8 | 0.0 | 3.4 | 13.8 | 0.0 | 82.4 | 15.5 | 2.1 | 0.0 | 0.0 | 0.0 | 100.0 | |
| Total % | 0.7 | 43.4 | 0.0 | 0.0 | 5.9 | 0.0 | 0.2 | 1.0 | 0.0 | 39.0 | 7.4 | 1.0 | 0.0 | 0.0 | 0.0 | 1.5 | |

**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: COLLIERS BLVD (CR-3)
E/W STREET: COLLIER HILL PKWY
CITY: ERIE
COUNTY: WELD

File Name : COLLCOLL
Site Code : 00000008
Start Date : 9/10/2015
Page No : 2

| | COLLIERS BLVD (CR-3) Southbound | | | | | COLLIER HILL PKWY Westbound | | | | | COLLIERS BLVD (CR-3) Northbound | | | | | Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour From 07:00 AM to 07:45 AM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Intersection | 07:00 AM | | | | | | | | | | | | | | | | | | | | |
| Volume | 0 | 51 | 0 | 0 | 51 | 2 | 0 | 0 | 1 | 3 | 0 | 58 | 15 | 1 | 74 | 0 | 0 | 0 | 3 | 3 | 131 |
| Percent | 0.0 | 100.0 | 0.0 | 0.0 | | 66.7 | 0.0 | 0.0 | 33.3 | | 0.0 | 78.4 | 20.3 | 1.4 | | 0.0 | 0.0 | 0.0 | 100.0 | | |
| 07:15 Volume | 0 | 12 | 0 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 7 | 0 | 24 | 0 | 0 | 0 | 3 | 3 | 39 |
| Peak Factor | | | | | | | | | | | | | | | | | | | | | 0.840 |
| High Int. | 07:45 AM | | | | | 07:45 AM | | | | | 07:15 AM | | | | | 07:15 AM | | | | | |
| Volume | 0 | 15 | 0 | 0 | 15 | 1 | 0 | 0 | 1 | 2 | 0 | 17 | 7 | 0 | 24 | 0 | 0 | 0 | 3 | 3 | |
| Peak Factor | | | | | 0.850 | | | | | 0.375 | | | | | 0.771 | | | | | 0.250 | |

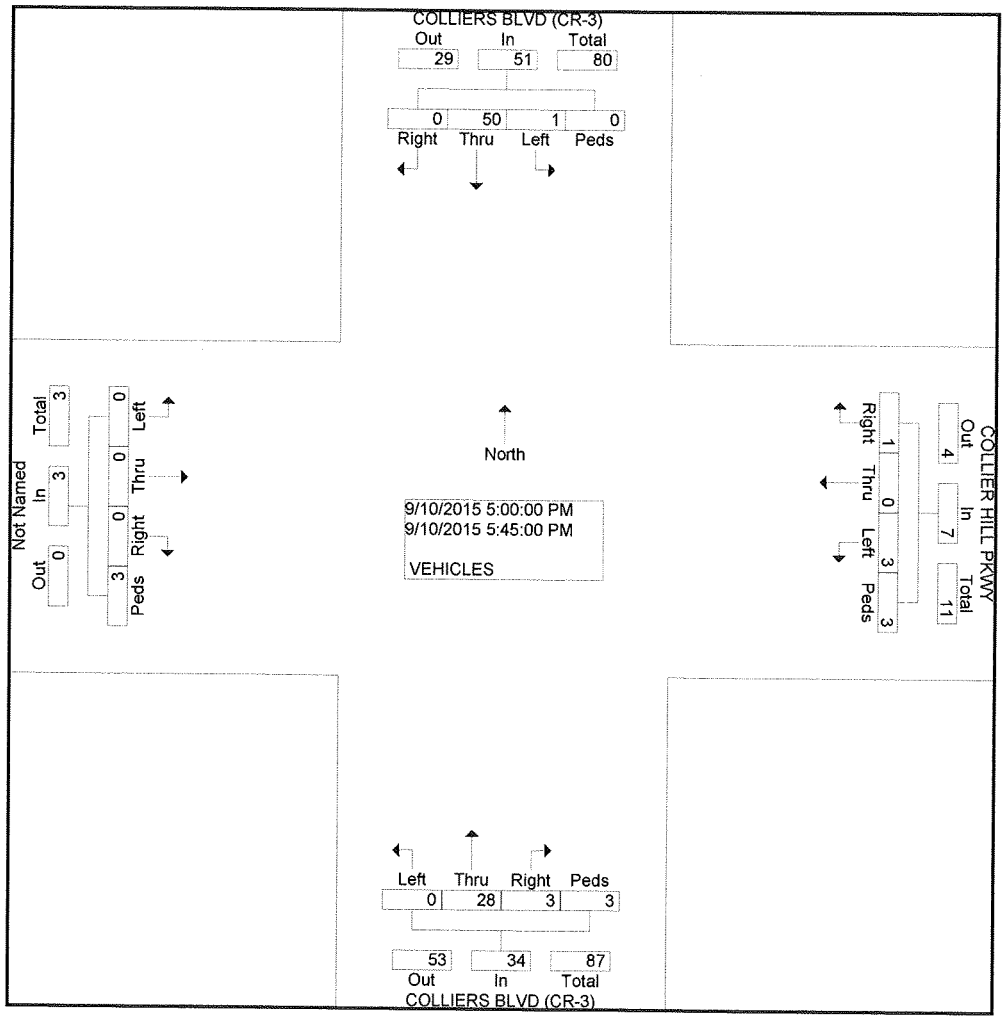


**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: COLLIERS BLVD (CR-3)
E/W STREET: COLLIER HILL PKWY
CITY: ERIE
COUNTY: WELD

File Name : COLLCOLL
Site Code : 00000008
Start Date : 9/10/2015
Page No : 2

| | COLLIERS BLVD (CR-3) Southbound | | | | | COLLIER HILL PKWY Westbound | | | | | COLLIERS BLVD (CR-3) Northbound | | | | | Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour From 05:00 PM to 05:45 PM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Intersection | 05:00 PM | | | | | | | | | | | | | | | | | | | | |
| Volume | 1 | 50 | 0 | 0 | 51 | 3 | 0 | 1 | 3 | 7 | 0 | 28 | 3 | 3 | 34 | 0 | 0 | 0 | 3 | 3 | 95 |
| Percent | 2.0 | 98.0 | 0.0 | 0.0 | | 42.9 | 0.0 | 14.3 | 42.9 | | 0.0 | 82.4 | 8.8 | 8.8 | | 0.0 | 0.0 | 0.0 | 100.0 | | |
| 05:45 Volume | 0 | 11 | 0 | 0 | 11 | 0 | 0 | 1 | 2 | 3 | 0 | 7 | 2 | 3 | 12 | 0 | 0 | 0 | 3 | 3 | 29 |
| Peak Factor | | | | | | | | | | | | | | | | | | | | | 0.819 |
| High Int. | 05:15 PM | | | | | 05:45 PM | | | | | 05:45 PM | | | | | 05:45 PM | | | | | |
| Volume | 1 | 18 | 0 | 0 | 19 | 0 | 0 | 1 | 2 | 3 | 0 | 7 | 2 | 3 | 12 | 0 | 0 | 0 | 3 | 3 | |
| Peak Factor | | | | | 0.671 | | | | | 0.583 | | | | | 0.708 | | | | | 0.250 | |



**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: COLLIERS BLVD (CR-3)
E/W STREET: CR-10
CITY: ERIE
COUNTY: WELD

File Name : COLLCR-10
Site Code : 00000001
Start Date : 9/10/2015
Page No : 1

Groups Printed- VEHICLES

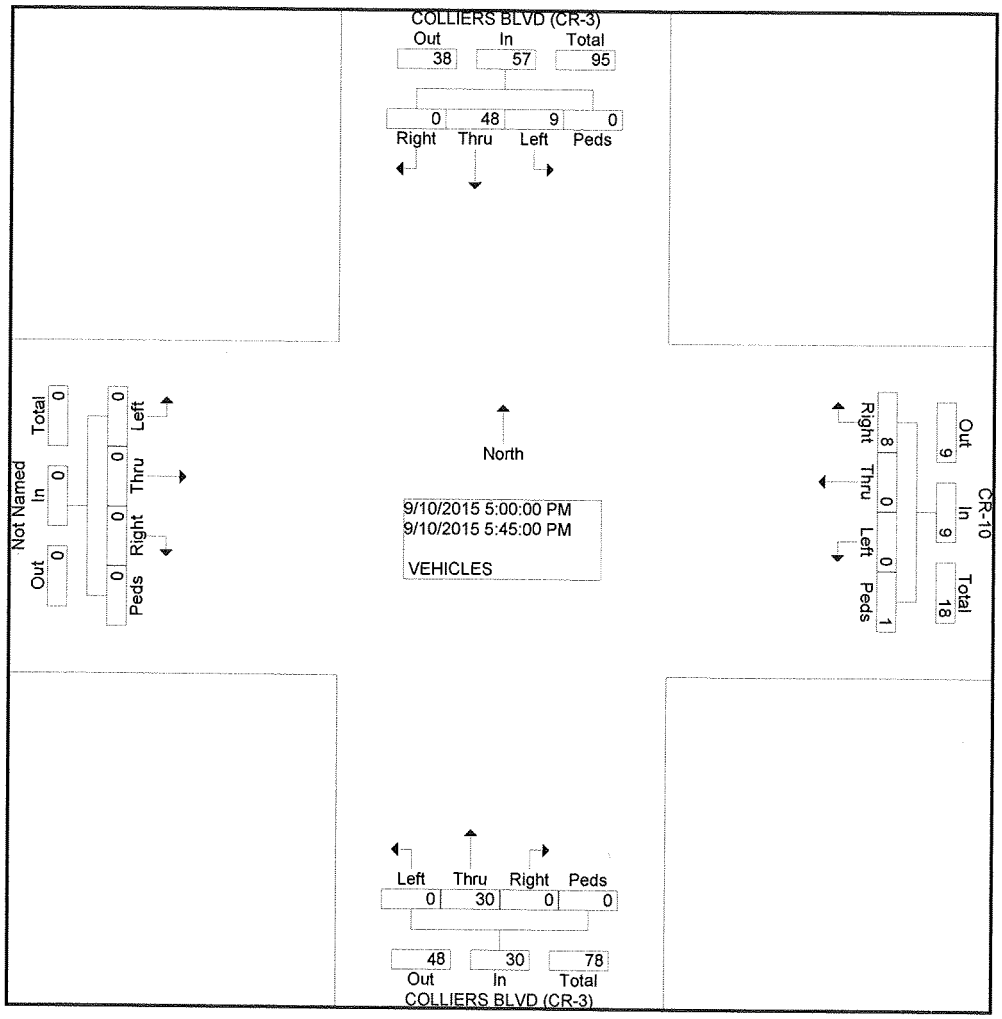
| | COLLIERS BLVD (CR-3) Southbound | | | | CR-10 Westbound | | | | COLLIERS BLVD (CR-3) Northbound | | | | Eastbound | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Left | Thru | Right | Peds | Int. Total |
| Factor | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | |
| 07:00 AM | 14 | 11 | 0 | 0 | 1 | 0 | 4 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 39 |
| 07:15 AM | 7 | 6 | 0 | 0 | 3 | 0 | 3 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 33 |
| 07:30 AM | 2 | 11 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 29 |
| 07:45 AM | 2 | 15 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 34 |
| Total | 25 | 43 | 0 | 0 | 4 | 0 | 13 | 1 | 0 | 49 | 0 | 0 | 0 | 0 | 0 | 0 | 135 |
| 08:00 AM | 1 | 8 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 18 |
| 08:15 AM | 0 | 4 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 19 |
| 08:30 AM | 0 | 8 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 19 |
| 08:45 AM | 2 | 7 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 18 |
| Total | 3 | 27 | 0 | 0 | 1 | 0 | 4 | 0 | 0 | 39 | 0 | 0 | 0 | 0 | 0 | 0 | 74 |
| 04:00 PM | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| 04:15 PM | 0 | 9 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |
| 04:30 PM | 1 | 6 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 17 |
| 04:45 PM | 2 | 13 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 28 |
| Total | 3 | 34 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 67 |
| 05:00 PM | 2 | 8 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 18 |
| 05:15 PM | 0 | 18 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 28 |
| 05:30 PM | 3 | 12 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 25 |
| 05:45 PM | 4 | 10 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 25 |
| Total | 9 | 48 | 0 | 0 | 0 | 0 | 8 | 1 | 0 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 96 |
| Grand Total | 40 | 152 | 0 | 0 | 5 | 0 | 30 | 2 | 0 | 143 | 0 | 0 | 0 | 0 | 0 | 0 | 372 |
| Apprch % | 20.8 | 79.2 | 0.0 | 0.0 | 13.5 | 0.0 | 81.1 | 5.4 | 0.0 | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Total % | 10.8 | 40.9 | 0.0 | 0.0 | 1.3 | 0.0 | 8.1 | 0.5 | 0.0 | 38.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |

**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: COLLIERS BLVD (CR-3)
E/W STREET: CR-10
CITY: ERIE
COUNTY: WELD

File Name : COLLCR-10
Site Code : 00000001
Start Date : 9/10/2015
Page No : 2

| | COLLIERS BLVD (CR-3) Southbound | | | | | CR-10 Westbound | | | | | COLLIERS BLVD (CR-3) Northbound | | | | | Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour From 05:00 PM to 05:45 PM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Intersection | 05:00 PM | | | | | | | | | | | | | | | | | | | | |
| Volume | 9 | 48 | 0 | 0 | 57 | 0 | 0 | 8 | 1 | 9 | 0 | 30 | 0 | 0 | 30 | 0 | 0 | 0 | 0 | 0 | 96 |
| Percent | 15.8 | 84.2 | 0.0 | 0.0 | | 0.0 | 0.0 | 88.9 | 11.1 | | 0.0 | 100.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | | |
| 05:15 Volume | 0 | 18 | 0 | 0 | 18 | 0 | 0 | 3 | 0 | 3 | 0 | 7 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 28 |
| Peak Factor | | | | | | | | | | | | | | | | | | | | | 0.857 |
| High Int. | 05:15 PM | | | | | 05:15 PM | | | | | 05:45 PM | | | | | | | | | | |
| Volume | 0 | 18 | 0 | 0 | 18 | 0 | 0 | 3 | 0 | 3 | 0 | 9 | 0 | 0 | 9 | | | | | | |
| Peak Factor | | | | | 0.792 | | | | | 0.750 | | | | | 0.833 | | | | | | |

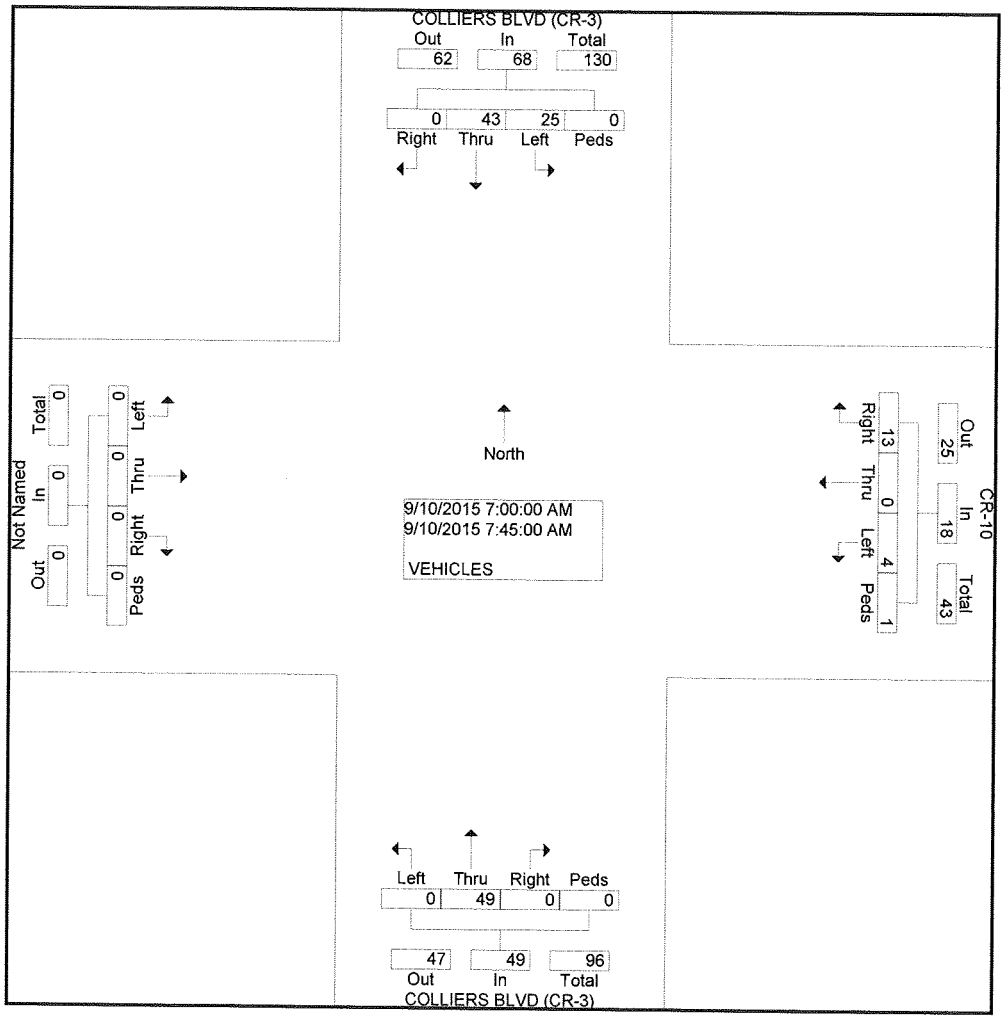


**COUNTER MEASURES INC.**
1889 YORK STREET
DENVER,COLORADO
303-333-7409

N/S STREET: COLLIERS BLVD (CR-3)
E/W STREET: CR-10
CITY: ERIE
COUNTY: WELD

File Name : COLLCR-10
Site Code : 00000001
Start Date : 9/10/2015
Page No : 2

| | COLLIERS BLVD (CR-3) Southbound | | | | | CR-10 Westbound | | | | | COLLIERS BLVD (CR-3) Northbound | | | | | Eastbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Left | Thru | Right | Peds | App. Total | Int. Total |
| Peak Hour From 07:00 AM to 09:00 AM - Peak 1 of 1 | | | | | | | | | | | | | | | | | | | | | |
| Intersection | 07:00 AM | | | | | | | | | | | | | | | | | | | | |
| Volume | 25 | 43 | 0 | 0 | 68 | 4 | 0 | 13 | 1 | 18 | 0 | 49 | 0 | 0 | 49 | 0 | 0 | 0 | 0 | 0 | 135 |
| Percent | 36.8 | 63.2 | 0.0 | 0.0 | | 22.2 | 0.0 | 72.2 | 5.6 | | 0.0 | 100.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | | |
| 07:00 Volume | 14 | 11 | 0 | 0 | 25 | 1 | 0 | 4 | 0 | 5 | 0 | 9 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 39 |
| Peak Factor | | | | | | | | | | | | | | | | | | | | | 0.865 |
| High Int. | 07:00 AM | | | | | 07:15 AM | | | | | 07:15 AM | | | | | 6:45:00 AM | | | | | |
| Volume | 14 | 11 | 0 | 0 | 25 | 3 | 0 | 3 | 0 | 6 | 0 | 14 | 0 | 0 | 14 | | | | | | |
| Peak Factor | | | | | 0.680 | | | | | 0.750 | | | | | 0.875 | | | | | | |



# COUNTER MEASURES INC.

1889 YORK STREET
DENVER,COLORADO 80206
303-333-7409

Location: ERIE PKWY W/O CR-5
City: ERIE
County: WELD
Direction: EASTBOUND-WESTBOUND

Site Code: 090816
Station ID: 090816

| Start Time | 09-Sep-1 Wed | EB | WB | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 12:00 AM | | 12 | 14 | | | | | | | 26 |
| 01:00 | | 3 | 8 | | | | | | | 11 |
| 02:00 | | 2 | 3 | | | | | | | 5 |
| 03:00 | | 14 | 10 | | | | | | | 24 |
| 04:00 | | 32 | 18 | | | | | | | 50 |
| 05:00 | | 116 | 43 | | | | | | | 159 |
| 06:00 | | 250 | 294 | | | | | | | 544 |
| 07:00 | | **466** | **776** | | | | | | | **1242** |
| 08:00 | | 280 | 444 | | | | | | | 724 |
| 09:00 | | 262 | 216 | | | | | | | 478 |
| 10:00 | | 208 | 226 | | | | | | | 434 |
| 11:00 | | 288 | 202 | | | | | | | 490 |
| 12:00 PM | | 246 | 212 | | | | | | | 458 |
| 01:00 | | 229 | 246 | | | | | | | 475 |
| 02:00 | | 304 | 384 | | | | | | | 688 |
| 03:00 | | 452 | 344 | | | | | | | 796 |
| 04:00 | | 526 | 335 | | | | | | | 861 |
| 05:00 | | **760** | **423** | | | | | | | **1183** |
| 06:00 | | 410 | 289 | | | | | | | 699 |
| 07:00 | | 213 | 198 | | | | | | | 411 |
| 08:00 | | 98 | 190 | | | | | | | 288 |
| 09:00 | | 60 | 122 | | | | | | | 182 |
| 10:00 | | 26 | 50 | | | | | | | 76 |
| 11:00 | | 10 | 24 | | | | | | | 34 |
| Total | | 5267 | 5071 | | | | | | | 10338 |
| Percent | | 50.9% | 49.1% | | | | | | | |
| AM Peak | - | 07:00 | 07:00 | - | - | - | - | - | - | 07:00 |
| Vol. | - | 466 | 776 | - | - | - | - | - | - | 1242 |
| PM Peak | - | 17:00 | 17:00 | - | - | - | - | - | - | 17:00 |
| Vol. | - | 760 | 423 | - | - | - | - | - | - | 1183 |
| Grand Total | | 5267 | 5071 | | | | | | | 10338 |
| Percent | | 50.9% | 49.1% | | | | | | | |
| ADT | | ADT 10,338 | | AADT 10,338 | | | | | | |

# COUNTER MEASURES INC.

1889 YORK STREET
DENVER,COLORADO 80206
303-333-7409

Location: CR-5 S/O ERIE PKWY
City: ERIE
County: WELD
Direction: NORTHBOUND-SOUTHBOUND

Site Code: 090817
Station ID: 090817

| Start Time | 09-Sep-1 Wed | NB | SB | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 12:00 AM | | 2 | 2 | | | | | | | 4 |
| 01:00 | | 0 | 4 | | | | | | | 4 |
| 02:00 | | 4 | 4 | | | | | | | 8 |
| 03:00 | | 0 | 2 | | | | | | | 2 |
| 04:00 | | 4 | 8 | | | | | | | 12 |
| 05:00 | | 10 | 22 | | | | | | | 32 |
| 06:00 | | 82 | 70 | | | | | | | 152 |
| 07:00 | | **220** | **154** | | | | | | | **374** |
| 08:00 | | 132 | 121 | | | | | | | 253 |
| 09:00 | | 108 | 120 | | | | | | | 228 |
| 10:00 | | 142 | 126 | | | | | | | 268 |
| 11:00 | | 126 | 136 | | | | | | | 262 |
| 12:00 PM | | 134 | 125 | | | | | | | 259 |
| 01:00 | | 122 | 157 | | | | | | | 279 |
| 02:00 | | **168** | **161** | | | | | | | **329** |
| 03:00 | | 162 | 152 | | | | | | | 314 |
| 04:00 | | 152 | 121 | | | | | | | 273 |
| 05:00 | | 130 | 118 | | | | | | | 248 |
| 06:00 | | 88 | 106 | | | | | | | 194 |
| 07:00 | | 44 | 66 | | | | | | | 110 |
| 08:00 | | 25 | 46 | | | | | | | 71 |
| 09:00 | | 17 | 28 | | | | | | | 45 |
| 10:00 | | 6 | 6 | | | | | | | 12 |
| 11:00 | | 1 | 2 | | | | | | | 3 |
| Total | | 1879 | 1857 | | | | | | | 3736 |
| Percent | | 50.3% | 49.7% | | | | | | | |
| AM Peak | - | 07:00 | 07:00 | - | - | - | - | - | - | 07:00 |
| Vol. | - | 220 | 154 | - | - | - | - | - | - | 374 |
| PM Peak | - | 14:00 | 14:00 | - | - | - | - | - | - | 14:00 |
| Vol. | - | 168 | 161 | - | - | - | - | - | - | 329 |
| Grand Total | | 1879 | 1857 | | | | | | | 3736 |
| Percent | | 50.3% | 49.7% | | | | | | | |
| ADT | | ADT 3,736 | | AADT 3,736 | | | | | | |

# COUNTER MEASURES INC.

1889 YORK ST
DENVER,COLORADO 80206
303-333-7409



**Location: CR-5 N/O ERIE PKWY**
**City: ERIE**
**County: WELD**
**Direction: NORTHBOUND-SOUTHBOUND**

**Site Code: 9814**

| Start Time | 09-Sep-15 Wed | NB | SB | Total |
|---|---|---|---|---|
| 12:00 AM | | 4 | 1 | 5 |
| 01:00 | | 1 | 1 | 2 |
| 02:00 | | 0 | 1 | 1 |
| 03:00 | | 1 | 2 | 3 |
| 04:00 | | 0 | 4 | 4 |
| 05:00 | | 5 | 6 | 11 |
| 06:00 | | 42 | 32 | 74 |
| 07:00 | | **408** | **263** | **671** |
| 08:00 | | 71 | 100 | 171 |
| 09:00 | | 84 | 78 | 162 |
| 10:00 | | 72 | 88 | 160 |
| 11:00 | | 118 | 138 | 256 |
| 12:00 PM | | 76 | 77 | 153 |
| 01:00 | | 97 | 125 | 222 |
| 02:00 | | 181 | **231** | **412** |
| 03:00 | | 138 | 138 | 276 |
| 04:00 | | 108 | 78 | 186 |
| 05:00 | | 150 | 140 | 290 |
| 06:00 | | **243** | 122 | 365 |
| 07:00 | | 76 | 85 | 161 |
| 08:00 | | 28 | 138 | 166 |
| 09:00 | | 35 | 56 | 91 |
| 10:00 | | 11 | 28 | 39 |
| 11:00 | | 3 | 2 | 5 |
| Total | | 1952 | 1934 | 3886 |
| Percent | | 50.2% | 49.8% | |
| AM Peak | | 07:00 | 07:00 | 07:00 |
| Vol. | | 408 | 263 | 671 |
| PM Peak | | 18:00 | 14:00 | 14:00 |
| Vol. | | 243 | 231 | 412 |
| Grand Total | | 1952 | 1934 | 388 |
| Percent | | 50.2% | 49.8% | |

ADT Not Calculated

# COUNTER MEASURES INC.

1889 YORK STREET
DENVER,COLORADO 80206
303-333-7409

Location: CR-5 S/O CR-10
City: ERIE
County: WELD
Direction: NORTHBOUND-SOUTHBOUND

Site Code: 090813
Station ID: 090813

| Start Time | 09-Sep-1 Wed | NB | SB | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 12:00 AM | | 5 | 2 | | | | | | | 7 |
| 01:00 | | 0 | 2 | | | | | | | 2 |
| 02:00 | | 0 | 1 | | | | | | | 1 |
| 03:00 | | 1 | 1 | | | | | | | 2 |
| 04:00 | | 0 | 4 | | | | | | | 4 |
| 05:00 | | 4 | 10 | | | | | | | 14 |
| 06:00 | | 30 | 66 | | | | | | | 96 |
| 07:00 | | **135** | **250** | | | | | | | **385** |
| 08:00 | | 60 | 86 | | | | | | | 146 |
| 09:00 | | 53 | 68 | | | | | | | 121 |
| 10:00 | | 82 | 76 | | | | | | | 158 |
| 11:00 | | 68 | 88 | | | | | | | 156 |
| 12:00 PM | | 74 | 68 | | | | | | | 142 |
| 01:00 | | 66 | 72 | | | | | | | 138 |
| 02:00 | | **140** | 98 | | | | | | | **238** |
| 03:00 | | 108 | 66 | | | | | | | 174 |
| 04:00 | | 100 | 72 | | | | | | | 172 |
| 05:00 | | 110 | **110** | | | | | | | 220 |
| 06:00 | | 92 | 99 | | | | | | | 191 |
| 07:00 | | 56 | 38 | | | | | | | 94 |
| 08:00 | | 84 | 20 | | | | | | | 104 |
| 09:00 | | 42 | 16 | | | | | | | 58 |
| 10:00 | | 8 | 2 | | | | | | | 10 |
| 11:00 | | 3 | 2 | | | | | | | 5 |
| Total | | 1321 | 1317 | | | | | | | 2638 |
| Percent | | 50.1% | 49.9% | | | | | | | |
| AM Peak | - | 07:00 | 07:00 | - | - | - | - | - | - | 07:00 |
| Vol. | - | 135 | 250 | - | - | - | - | - | - | 385 |
| PM Peak | - | 14:00 | 17:00 | - | - | - | - | - | - | 14:00 |
| Vol. | - | 140 | 110 | - | - | - | - | - | - | 238 |
| Grand Total | | 1321 | 1317 | | | | | | | 2638 |
| Percent | | 50.1% | 49.9% | | | | | | | |
| ADT | | ADT 2,638 | | AADT 2,638 | | | | | | |

# COUNTER MEASURES INC.

1889 YORK STREET
DENVER,COLORADO 80206
303-333-7409

Location: CR-10 W/O CR-5
City: ERIE
County: WELD
Direction: EASTBOUND-WESTBOUND

Site Code: 090812
Station ID: 090812

| Start Time | 09-Sep-1 Wed | EB | WB | Total |
|---|---|---|---|---|
| 12:00 AM | | 0 | 0 | 0 |
| 01:00 | | 0 | 0 | 0 |
| 02:00 | | 0 | 0 | 0 |
| 03:00 | | 0 | 0 | 0 |
| 04:00 | | 0 | 0 | 0 |
| 05:00 | | 1 | 0 | 1 |
| 06:00 | | 2 | 2 | 4 |
| 07:00 | | **28** | **16** | **44** |
| 08:00 | | 4 | 5 | 9 |
| 09:00 | | 1 | 2 | 3 |
| 10:00 | | 6 | 2 | 8 |
| 11:00 | | 7 | 5 | 12 |
| 12:00 PM | | 2 | 2 | 4 |
| 01:00 | | 5 | 6 | 11 |
| 02:00 | | 6 | 7 | 13 |
| 03:00 | | 6 | 5 | 11 |
| 04:00 | | 6 | 2 | 8 |
| 05:00 | | 13 | **13** | **26** |
| 06:00 | | **14** | 1 | 15 |
| 07:00 | | 2 | 4 | 6 |
| 08:00 | | 2 | 4 | 6 |
| 09:00 | | 1 | 2 | 3 |
| 10:00 | | 0 | 0 | 0 |
| 11:00 | | 1 | 1 | 2 |
| Total | | 107 | 79 | 186 |
| Percent | | 57.5% | 42.5% | |
| AM Peak | - | 07:00 | 07:00 | 07:00 |
| Vol. | - | 28 | 16 | 44 |
| PM Peak | - | 18:00 | 17:00 | 17:00 |
| Vol. | - | 14 | 13 | 26 |
| Grand Total | | 107 | 79 | 186 |
| Percent | | 57.5% | 42.5% | |
| ADT | | ADT 186 | AADT 186 | |

# COUNTER MEASURES INC.

1889 YORK STREET
DENVER,COLORADO 80206
303-333-7409

Location: CR-3 N/O CR-10
City: ERIE
County: WELD
Direction: SOUTHBOUND-NORTHBOUND

Site Code: 090809
Station ID: 090809

| Start Time | 09-Sep-1 Wed | SB | NB | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 12:00 AM | | 2 | 1 | | | | | | | 3 |
| 01:00 | | 1 | 0 | | | | | | | 1 |
| 02:00 | | 0 | 0 | | | | | | | 0 |
| 03:00 | | 1 | 0 | | | | | | | 1 |
| 04:00 | | 0 | 0 | | | | | | | 0 |
| 05:00 | | 6 | 2 | | | | | | | 8 |
| 06:00 | | 16 | 18 | | | | | | | 34 |
| 07:00 | | **68** | 58 | | | | | | | **126** |
| 08:00 | | 38 | **60** | | | | | | | 98 |
| 09:00 | | 26 | 35 | | | | | | | 61 |
| 10:00 | | 37 | 23 | | | | | | | 60 |
| 11:00 | | 24 | 30 | | | | | | | 54 |
| 12:00 PM | | 32 | 28 | | | | | | | 60 |
| 01:00 | | 24 | 22 | | | | | | | 46 |
| 02:00 | | 25 | 28 | | | | | | | 53 |
| 03:00 | | 30 | **52** | | | | | | | 82 |
| 04:00 | | 32 | 32 | | | | | | | 64 |
| 05:00 | | **77** | 50 | | | | | | | **127** |
| 06:00 | | 45 | 27 | | | | | | | 72 |
| 07:00 | | 24 | 29 | | | | | | | 53 |
| 08:00 | | 13 | 20 | | | | | | | 33 |
| 09:00 | | 12 | 8 | | | | | | | 20 |
| 10:00 | | 3 | 4 | | | | | | | 7 |
| 11:00 | | 3 | 7 | | | | | | | 10 |
| Total | | 539 | 534 | | | | | | | 1073 |
| Percent | | 50.2% | 49.8% | | | | | | | |
| AM Peak | - | 07:00 | 08:00 | - | - | - | - | - | - | 07:00 |
| Vol. | - | 68 | 60 | - | - | - | - | - | - | 126 |
| PM Peak | - | 17:00 | 15:00 | - | - | - | - | - | - | 17:00 |
| Vol. | - | 77 | 52 | - | - | - | - | - | - | 127 |
| Grand Total | | 539 | 534 | | | | | | | 1073 |
| Percent | | 50.2% | 49.8% | | | | | | | |
| ADT | | ADT 1,073 | | AADT 1,073 | | | | | | |

# COUNTER MEASURES INC.

1889 YORK ST
DENVER,COLORADO 80206
303-333-7409



**Location: CR-3 S/O CR-10**
**City: ERIE**
**County: WELD**
**Direction: SOUTHBOUND-NORTHBOUND**

**Site Code: 090811**

| Start Time | 09-Sep-15 Wed | SB | NB | Total |
|---|---|---|---|---|
| 12:00 AM | | 2 | 2 | 4 |
| 01:00 | | 1 | 0 | 1 |
| 02:00 | | 0 | 0 | 0 |
| 03:00 | | 1 | 0 | 1 |
| 04:00 | | 0 | 0 | 0 |
| 05:00 | | 4 | 1 | 5 |
| 06:00 | | 14 | 15 | 29 |
| 07:00 | | **43** | 48 | **91** |
| 08:00 | | 38 | **51** | 89 |
| 09:00 | | 18 | 32 | 50 |
| 10:00 | | 32 | 17 | 49 |
| 11:00 | | 16 | 21 | 37 |
| 12:00 PM | | 20 | 19 | 39 |
| 01:00 | | 24 | 14 | 38 |
| 02:00 | | 22 | 22 | 44 |
| 03:00 | | 24 | **46** | 70 |
| 04:00 | | 30 | 28 | 58 |
| 05:00 | | **59** | 36 | **95** |
| 06:00 | | 37 | 23 | 60 |
| 07:00 | | 18 | 21 | 39 |
| 08:00 | | 11 | 16 | 27 |
| 09:00 | | 10 | 6 | 16 |
| 10:00 | | 5 | 5 | 10 |
| 11:00 | | 1 | 5 | 6 |
| Total | | 430 | 428 | 858 |
| Percent | | 50.1% | 49.9% | |
| AM Peak | | 07:00 | 08:00 | 07:00 |
| Vol. | | 43 | 51 | 91 |
| PM Peak | | 17:00 | 15:00 | 17:00 |
| Vol. | | 59 | 46 | 95 |
| Grand Total | | 430 | 428 | 85 |
| Percent | | 50.1% | 49.9% | |

ADT Not Calculated

# COUNTER MEASURES INC.

1889 YORK ST
DENVER,COLORADO 80206
303-333-7409



**Location: CR1.5 W/O CR-3**
**City: ERIE**
**County: WELD**
**Direction: EASTBOUND-WESTBOUND**

**Site Code: 090810**

| Start Time | 09-Sep-15 Wed | EB | WB | Total |
|---|---|---|---|---|
| 12:00 AM | | 1 | 1 | 2 |
| 01:00 | | 0 | 0 | 0 |
| 02:00 | | 0 | 1 | 1 |
| 03:00 | | 0 | 0 | 0 |
| 04:00 | | 2 | 1 | 3 |
| 05:00 | | 4 | 2 | 6 |
| 06:00 | | 21 | 6 | 27 |
| 07:00 | | **49** | **59** | **108** |
| 08:00 | | 36 | 40 | 76 |
| 09:00 | | 29 | 25 | 54 |
| 10:00 | | 26 | 28 | 54 |
| 11:00 | | 34 | 30 | 64 |
| 12:00 PM | | 30 | 22 | 52 |
| 01:00 | | 28 | 26 | 54 |
| 02:00 | | 31 | 34 | 65 |
| 03:00 | | 42 | **43** | **85** |
| 04:00 | | 36 | 30 | 66 |
| 05:00 | | **50** | 34 | 84 |
| 06:00 | | 27 | 28 | 55 |
| 07:00 | | 35 | 31 | 66 |
| 08:00 | | 20 | 20 | 40 |
| 09:00 | | 13 | 6 | 19 |
| 10:00 | | 2 | 3 | 5 |
| 11:00 | | 4 | 4 | 8 |
| Total | | 520 | 474 | 994 |
| Percent | | 52.3% | 47.7% | |
| AM Peak | | 07:00 | 07:00 | 07:00 |
| Vol. | | 49 | 59 | 108 |
| PM Peak | | 17:00 | 15:00 | 15:00 |
| Vol. | | 50 | 43 | 85 |
| Grand Total | | 520 | 474 | 99 |
| Percent | | 52.3% | 47.7% | |
| ADT | | Not Calculated | | |

# COUNTER MEASURES INC.

1889 YORK ST
DENVER,COLORADO 80206
303-333-7409



**Location: COLLIERS PKWY E/O CR-3**
**City: ERIE**
**County: WELD**
**Direction: EASTBOUND-WESTBOUND**

**Site Code: 090806**

| Start Time | 09-Sep-15 Wed | EB | WB | Total |
|---|---|---|---|---|
| 12:00 AM | | 0 | 0 | 0 |
| 01:00 | | 0 | 0 | 0 |
| 02:00 | | 0 | 0 | 0 |
| 03:00 | | 0 | 0 | 0 |
| 04:00 | | 0 | 0 | 0 |
| 05:00 | | 1 | 1 | 2 |
| 06:00 | | 7 | 1 | 8 |
| 07:00 | | **15** | **7** | **22** |
| 08:00 | | 4 | 3 | 7 |
| 09:00 | | 9 | 5 | 14 |
| 10:00 | | 6 | 6 | 12 |
| 11:00 | | 6 | 5 | 11 |
| 12:00 PM | | **12** | 8 | **20** |
| 01:00 | | 8 | 7 | 15 |
| 02:00 | | 5 | **10** | 15 |
| 03:00 | | 5 | 10 | 15 |
| 04:00 | | 4 | 9 | 13 |
| 05:00 | | 1 | 4 | 5 |
| 06:00 | | 3 | 3 | 6 |
| 07:00 | | 1 | 1 | 2 |
| 08:00 | | 0 | 0 | 0 |
| 09:00 | | 0 | 0 | 0 |
| 10:00 | | 1 | 0 | 1 |
| 11:00 | | 0 | 0 | 0 |
| Total | | 88 | 80 | 168 |
| Percent | | 52.4% | 47.6% | |
| AM Peak | | 07:00 | 07:00 | 07:00 |
| Vol. | | 15 | 7 | 22 |
| PM Peak | | 12:00 | 14:00 | 12:00 |
| Vol. | | 12 | 10 | 20 |
| Grand Total | | 88 | 80 | 16 |
| Percent | | 52.4% | 47.6% | |

ADT Not Calculated

# COUNTER MEASURES INC.

1889 YORK ST
DENVER,COLORADO 80206
303-333-7409



**Location: CR-3 N/O ERIE PKWY**
**City: ERIE**
**County: WELD**
**Direction: NORTHBOUND-SOUTHBOUND**

**Site Code: 090805**

| Start Time | 09-Sep-15 Wed | NB | SB | Total |
|---|---|---|---|---|
| 12:00 AM | | 1 | 3 | 4 |
| 01:00 | | 1 | 0 | 1 |
| 02:00 | | 1 | 2 | 3 |
| 03:00 | | 0 | 3 | 3 |
| 04:00 | | 0 | 0 | 0 |
| 05:00 | | 5 | 11 | 16 |
| 06:00 | | 27 | 19 | 46 |
| 07:00 | | **153** | 76 | **229** |
| 08:00 | | 113 | 80 | 193 |
| 09:00 | | 80 | 62 | 142 |
| 10:00 | | 58 | 66 | 124 |
| 11:00 | | 80 | **99** | 179 |
| 12:00 PM | | 68 | 78 | 146 |
| 01:00 | | 66 | 57 | 123 |
| 02:00 | | **76** | 74 | 150 |
| 03:00 | | 70 | 84 | 154 |
| 04:00 | | 68 | 82 | 150 |
| 05:00 | | 64 | **123** | **187** |
| 06:00 | | 62 | 112 | 174 |
| 07:00 | | 45 | 33 | 78 |
| 08:00 | | 36 | 19 | 55 |
| 09:00 | | 16 | 13 | 29 |
| 10:00 | | 8 | 5 | 13 |
| 11:00 | | 5 | 1 | 6 |
| Total | | 1103 | 1102 | 2205 |
| Percent | | 50.0% | 50.0% | |
| AM Peak | | 07:00 | 11:00 | 07:00 |
| Vol. | | 153 | 99 | 229 |
| PM Peak | | 14:00 | 17:00 | 17:00 |
| Vol. | | 76 | 123 | 187 |
| Grand Total | | 1103 | 1102 | 220 |
| Percent | | 50.0% | 50.0% | |

ADT Not Calculated

# LEVEL OF SERVICE DEFINITIONS

**From *Highway Capacity Manual*, Transportation Research Board, 2010**

## SIGNALIZED INTERSECTION LEVEL OF SERVICE (LOS)

| LOS | Average Vehicle Delay sec/vehicle | Operational Characteristics |
|---|---|---|
| **A** | <10 seconds | Describes operations with low control delay, up to 10 sec/veh. This LOS occurs when progression is extremely favorable and most vehicles arrive during the green phase. Many vehicles do not stop at all. Short cycle lengths may tend to contribute to low delay values. |
| **B** | 10 to 20 seconds | Describes operations with control delay greater than 10 seconds and up to 20 sec/veh. This level generally occurs with good progression, short cycle lengths, or both. More vehicles stop than with LOS A, causing higher levels of delay. |
| **C** | 20 to 35 seconds | Describes operations with control delay greater than 20 and up to 35 sec/veh. These higher delays may result from only fair progression, longer cycle length, or both. Individual cycle failures may begin to appear at this level. Cycle failure occurs when a given green phase does not serve queued vehicles, and overflows occur. The number of vehicles stopping is significant at this level, though many still pass through the intersection without stopping. |
| **D** | 35 to 55 seconds | Describes operations with control delay greater than 35 and up to 55 sec/veh. At LOS D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, and high v/c ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable. |
| **E** | 55 to 80 seconds | Describes operations with control delay greater than 55 and up to 80 sec/veh. These high delay values generally indicate poor progression, long cycle lengths, and high v/c ratios. Individual cycle failures are frequent. |
| **F** | >80 seconds | Describes operations with control delay in excess of 80 sec/veh. This level, considered unacceptable to most drivers, often occurs with over-saturation, that is, when arrival flow rates exceed the capacity of lane groups. It may also occur at high v/c ratios with many individual cycle failures. Poor progression and long cycle lengths may also contribute significantly to high delay levels. |

# LEVEL OF SERVICE DEFINITIONS

**From *Highway Capacity Manual*, Transportation Research Board, 2010**

## UNSIGNALIZED INTERSECTION LEVEL OF SERVICE (LOS)

Applicable to Two-Way Stop Control, All-Way Stop Control, and Roundabouts

| LOS | Average Vehicle Control Delay | Operational Characteristics |
|---|---|---|
| **A** | <10 seconds | Normally, vehicles on the stop-controlled approach only have to wait up to 10 seconds before being able to clear the intersection. Left-turning vehicles on the uncontrolled street do not have to wait to make their turn. |
| **B** | 10 to 15 seconds | Vehicles on the stop-controlled approach will experience delays before being able to clear the intersection. The delay could be up to 15 seconds. Left-turning vehicles on the uncontrolled street may have to wait to make their turn. |
| **C** | 15 to 25 seconds | Vehicles on the stop-controlled approach can expect delays in the range of 15 to 25 seconds before clearing the intersection. Motorists may begin to take chances due to the long delays, thereby posing a safety risk to through traffic. Left-turning vehicles on the uncontrolled street will now be required to wait to make their turn causing a queue to be created in the turn lane. |
| **D** | 25 to 35 seconds | This is the point at which a traffic signal may be warranted for this intersection. The delays for the stop-controlled intersection are not considered to be excessive. The length of the queue may begin to block other public and private access points. |
| **E** | 35 to 50 seconds | The delays for all critical traffic movements are considered to be unacceptable. The length of the queues for the stop-controlled approaches as well as the left-turn movements are extremely long. There is a high probability that this intersection will meet traffic signal warrants. The ability to install a traffic signal is affected by the location of other existing traffic signals. Consideration may be given to restricting the accesses by eliminating the left-turn movements from and to the stop-controlled approach. |
| **F** | >50 seconds | The delay for the critical traffic movements are probably in excess of 100 seconds. The length of the queues are extremely long. Motorists are selecting alternative routes due to the long delays. The only remedy for these long delays is installing a traffic signal or restricting the accesses. The potential for accidents at this intersection are extremely high due to motorist taking more risky chances. If the median permits, motorists begin making two-stage left-turns. |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 1.4 |

| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Vol, veh/h | 0 | 8 | 30 | 0 | 9 | 48 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | Free | Free | Free |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 0 | - | - | - | - | - |
| Veh in Median Storage, # | 0 | - | 0 | - | - | 0 |
| Grade, % | 0 | - | 0 | - | - | 0 |
| Peak Hour Factor | 86 | 86 | 86 | 86 | 86 | 86 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 9 | 35 | 0 | 10 | 56 |

| Major/Minor | Minor1 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 112 | 35 | 0 | 0 | 35 | 0 |
| Stage 1 | 35 | - | - | - | - | - |
| Stage 2 | 77 | - | - | - | - | - |
| Follow-up Headway | 3.518 | 3.318 | - | - | 2.218 | - |
| Pot Capacity-1 Maneuver | 885 | 1038 | - | - | 1576 | - |
| Stage 1 | 987 | - | - | - | - | - |
| Stage 2 | 946 | - | - | - | - | - |
| Time blocked-Platoon, % | | | - | - | | - |
| Mov Capacity-1 Maneuver | 879 | 1038 | - | - | 1576 | - |
| Mov Capacity-2 Maneuver | 879 | - | - | - | - | - |
| Stage 1 | 987 | - | - | - | - | - |
| Stage 2 | 939 | - | - | - | - | - |

| Approach | WB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s | 8.5 | 0 | 1.2 |
| HCM LOS | A | | |

| Minor Lane / Major Mvmt | NBT | NBR | WBLn1 | SBL | SBT |
|---|---|---|---|---|---|
| Capacity (veh/h) | - | - | 1038 | 1576 | - |
| HCM Lane V/C Ratio | - | - | 0.009 | 0.007 | - |
| HCM Control Delay (s) | - | - | 8.5 | 7.3 | 0 |
| HCM Lane LOS | | | A | A | A |
| HCM 95th %tile Q(veh) | - | - | 0.027 | 0.02 | - |

| Notes |
|---|
| ~ : Volume Exceeds Capacity; $ : Delay Exceeds 300 Seconds; Error : Computation Not Defined |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (veh/h) | 26 | 322 | 22 | 8 | 538 | 99 | 55 | 11 | 40 | 30 | 5 | 54 |
| Number | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Adj Sat Flow veh/h/ln | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 190.0 | 186.3 | 186.3 | 190.0 |
| Lanes | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 0 | 1 | 1 | 0 |
| Cap, veh/h | 620 | 1328 | 1129 | 778 | 2656 | 1129 | 263 | 44 | 166 | 273 | 18 | 188 |
| Arrive On Green | 0.71 | 0.71 | 0.71 | 0.71 | 0.71 | 0.71 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 |
| Sat Flow, veh/h | 727 | 1863 | 1583 | 989 | 3725 | 1583 | 1329 | 344 | 1291 | 1341 | 144 | 1461 |
| Grp Volume(v), veh/h | 30 | 366 | 25 | 9 | 611 | 112 | 62 | 0 | 57 | 34 | 0 | 67 |
| Grp Sat Flow(s),veh/h/ln | 727 | 1863 | 1583 | 989 | 1863 | 1583 | 1329 | 0 | 1635 | 1341 | 0 | 1605 |
| Q Serve(g_s), s | 0.7 | 3.5 | 0.2 | 0.2 | 2.8 | 1.1 | 2.2 | 0.0 | 1.6 | 1.2 | 0.0 | 1.9 |
| Cycle Q Clear(g_c), s | 3.6 | 3.5 | 0.2 | 3.7 | 2.8 | 1.1 | 4.2 | 0.0 | 1.6 | 2.8 | 0.0 | 1.9 |
| Prop In Lane | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 0.79 | 1.00 | | 0.91 |
| Lane Grp Cap(c), veh/h | 620 | 1328 | 1129 | 778 | 2656 | 1129 | 263 | 0 | 210 | 273 | 0 | 206 |
| V/C Ratio(X) | 0.05 | 0.28 | 0.02 | 0.01 | 0.23 | 0.10 | 0.24 | 0.00 | 0.27 | 0.12 | 0.00 | 0.32 |
| Avail Cap(c_a), veh/h | 620 | 1328 | 1129 | 778 | 2656 | 1129 | 513 | 0 | 518 | 525 | 0 | 509 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 0.00 | 1.00 |
| Uniform Delay (d), s/veh | 3.1 | 2.6 | 2.1 | 3.3 | 2.5 | 2.2 | 21.9 | 0.0 | 19.9 | 21.1 | 0.0 | 20.0 |
| Incr Delay (d2), s/veh | 0.1 | 0.5 | 0.0 | 0.0 | 0.2 | 0.2 | 0.5 | 0.0 | 0.7 | 0.2 | 0.0 | 0.9 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile Back of Q (50%), veh/ln | 0.1 | 0.9 | 0.1 | 0.0 | 0.7 | 0.2 | 0.7 | 0.0 | 0.6 | 0.4 | 0.0 | 0.7 |
| Lane Grp Delay (d), s/veh | 3.3 | 3.1 | 2.2 | 3.3 | 2.7 | 2.4 | 22.4 | 0.0 | 20.5 | 21.3 | 0.0 | 20.9 |
| Lane Grp LOS | A | A | A | A | A | A | C | | C | C | | C |
| Approach Vol, veh/h | | 421 | | | 732 | | | 119 | | | 101 | |
| Approach Delay, s/veh | | 3.1 | | | 2.7 | | | 21.5 | | | 21.0 | |
| Approach LOS | | A | | | A | | | C | | | C | |

| Timer | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assigned Phs | | 4 | | | 8 | | | 2 | | | 6 | |
| Phs Duration (G+Y+Rc), s | | 40.0 | | | 40.0 | | | 10.5 | | | 10.5 | |
| Change Period (Y+Rc), s | | 4.0 | | | 4.0 | | | 4.0 | | | 4.0 | |
| Max Green Setting (Gmax), s | | 36.0 | | | 36.0 | | | 16.0 | | | 16.0 | |
| Max Q Clear Time (g_c+I1), s | | 5.6 | | | 5.7 | | | 6.2 | | | 4.8 | |
| Green Ext Time (p_c), s | | 7.7 | | | 7.7 | | | 0.6 | | | 0.7 | |

| Intersection Summary | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HCM 2010 Ctrl Delay | | | 5.8 | | | | | | | | | |
| HCM 2010 LOS | | | A | | | | | | | | | |

| Notes |
|---|

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 3.8 |
| Intersection LOS | A |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| Entry Lanes | 1 | 1 | 1 | 1 |
| Conflicting Circle Lanes | 1 | 1 | 1 | 1 |
| Adj Approach Flow, veh/h | 0 | 2 | 87 | 61 |
| Demand Flow Rate, veh/h | 0 | 2 | 88 | 62 |
| Vehicles Circulating, veh/h | 64 | 70 | 0 | 2 |
| Vehicles Exiting, veh/h | 0 | 18 | 64 | 70 |
| Follow-Up Headway, s | 3.186 | 3.186 | 3.186 | 3.186 |
| Ped Vol Crossing Leg, #/h | 0 | 0 | 0 | 0 |
| Ped Cap Adj | 1.000 | 1.000 | 1.000 | 1.000 |
| Approach Delay, s/veh | 0.0 | 3.4 | 3.9 | 3.7 |
| Approach LOS | - | A | A | A |

| Lane | Left | Left | Left | Left |
|---|---|---|---|---|
| Designated Moves | LTR | LTR | LTR | LTR |
| Assumed Moves | LTR | LTR | LTR | LTR |
| RT Channelized | | | | |
| Lane Util | 1.000 | 1.000 | 1.000 | 1.000 |
| Critical Headway, s | 5.193 | 5.193 | 5.193 | 5.193 |
| Entry Flow, veh/h | 0 | 2 | 88 | 62 |
| Cap Entry Lane, veh/h | 1060 | 1054 | 1130 | 1128 |
| Entry HV Adj Factor | 1.000 | 1.000 | 0.984 | 0.980 |
| Flow Entry, veh/h | 0 | 2 | 87 | 61 |
| Cap Entry, veh/h | 1060 | 1054 | 1112 | 1106 |
| V/C Ratio | 0.000 | 0.002 | 0.078 | 0.055 |
| Control Delay, s/veh | 3.4 | 3.4 | 3.9 | 3.7 |
| LOS | A | A | A | A |
| 95th %tile Queue, veh | 0 | 0 | 0 | 0 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (veh/h) | 139 | 317 | 27 | 14 | 535 | 105 | 41 | 101 | 33 | 51 | 57 | 111 |
| Number | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Adj Sat Flow veh/h/ln | 186.3 | 186.3 | 190.0 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 190.0 | 186.3 | 186.3 | 186.3 |
| Lanes | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| Cap, veh/h | 406 | 1106 | 93 | 625 | 1216 | 1033 | 324 | 271 | 90 | 265 | 377 | 320 |
| Arrive On Green | 0.65 | 0.65 | 0.65 | 0.65 | 0.65 | 0.65 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 |
| Sat Flow, veh/h | 637 | 1695 | 143 | 925 | 1863 | 1583 | 1149 | 1341 | 444 | 1198 | 1863 | 1583 |
| Grp Volume(v), veh/h | 188 | 0 | 464 | 19 | 723 | 142 | 55 | 0 | 181 | 69 | 77 | 150 |
| Grp Sat Flow(s),veh/h/ln | 637 | 0 | 1838 | 925 | 1863 | 1583 | 1149 | 0 | 1784 | 1198 | 1863 | 1583 |
| Q Serve(g_s), s | 13.1 | 0.0 | 6.5 | 0.5 | 12.2 | 1.9 | 2.3 | 0.0 | 5.0 | 3.0 | 1.9 | 4.6 |
| Cycle Q Clear(g_c), s | 25.3 | 0.0 | 6.5 | 7.0 | 12.2 | 1.9 | 4.2 | 0.0 | 5.0 | 8.0 | 1.9 | 4.6 |
| Prop In Lane | 1.00 | | 0.08 | 1.00 | | 1.00 | 1.00 | | 0.25 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 406 | 0 | 1199 | 625 | 1216 | 1033 | 324 | 0 | 361 | 265 | 377 | 320 |
| V/C Ratio(X) | 0.46 | 0.00 | 0.39 | 0.03 | 0.59 | 0.14 | 0.17 | 0.00 | 0.50 | 0.26 | 0.20 | 0.47 |
| Avail Cap(c_a), veh/h | 406 | 0 | 1199 | 625 | 1216 | 1033 | 424 | 0 | 518 | 370 | 540 | 459 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 12.6 | 0.0 | 4.5 | 6.1 | 5.4 | 3.7 | 20.1 | 0.0 | 19.5 | 23.1 | 18.3 | 19.4 |
| Incr Delay (d2), s/veh | 3.8 | 0.0 | 0.9 | 0.1 | 2.1 | 0.3 | 0.2 | 0.0 | 1.1 | 0.5 | 0.3 | 1.1 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile Back of Q (50%), veh/ln | 2.1 | 0.0 | 2.1 | 0.1 | 3.5 | 0.4 | 0.6 | 0.0 | 2.0 | 0.8 | 0.8 | 1.7 |
| Lane Grp Delay (d), s/veh | 16.4 | 0.0 | 5.4 | 6.2 | 7.6 | 3.9 | 20.3 | 0.0 | 20.6 | 23.6 | 18.6 | 20.4 |
| Lane Grp LOS | B | | A | A | A | A | C | | C | C | B | C |
| Approach Vol, veh/h | | 652 | | | 884 | | | 236 | | | 296 | |
| Approach Delay, s/veh | | 8.6 | | | 7.0 | | | 20.5 | | | 20.7 | |
| Approach LOS | | A | | | A | | | C | | | C | |
| **Timer** | | | | | | | | | | | | |
| Assigned Phs | | 4 | | | 8 | | | 2 | | | 6 | |
| Phs Duration (G+Y+Rc), s | | 40.0 | | | 40.0 | | | 15.2 | | | 15.2 | |
| Change Period (Y+Rc), s | | 4.0 | | | 4.0 | | | 4.0 | | | 4.0 | |
| Max Green Setting (Gmax), s | | 36.0 | | | 36.0 | | | 16.0 | | | 16.0 | |
| Max Q Clear Time (g_c+I1), s | | 27.3 | | | 14.2 | | | 7.0 | | | 10.0 | |
| Green Ext Time (p_c), s | | 5.2 | | | 8.9 | | | 1.5 | | | 1.2 | |
| **Intersection Summary** | | | | | | | | | | | | |
| HCM 2010 Ctrl Delay | | | 11.0 | | | | | | | | | |
| HCM 2010 LOS | | | B | | | | | | | | | |
| **Notes** | | | | | | | | | | | | |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 29.3 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vol, veh/h | 0 | 0 | 2 | 136 | 0 | 68 | 1 | 60 | 67 | 69 | 141 | 0 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Stop | Stop | Stop | Stop | Free | Free | Free | Free | Free | Free |
| RT Channelized | - | - | None | - | - | None | - | - | None | - | - | None |
| Storage Length | - | - | - | - | - | - | - | - | 0 | 315 | - | - |
| Veh in Median Storage, # | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Grade, % | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Peak Hour Factor | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 49 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 0 | 4 | 278 | 0 | 139 | 2 | 122 | 137 | 141 | 288 | 0 |

| Major/Minor | Minor2 | | | Minor1 | | | Major1 | | | Major2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conflicting Flow All | 765 | 696 | 288 | 698 | 696 | 122 | 288 | 0 | 0 | 122 | 0 | 0 |
| Stage 1 | 569 | 569 | - | 127 | 127 | - | - | - | - | - | - | - |
| Stage 2 | 196 | 127 | - | 571 | 569 | - | - | - | - | - | - | - |
| Follow-up Headway | 3.518 | 4.018 | 3.318 | 3.518 | 4.018 | 3.318 | 2.218 | - | - | 2.218 | - | - |
| Pot Capacity-1 Maneuver | 320 | 365 | 751 | 355 | 365 | 929 | 1274 | - | - | 1465 | - | - |
| Stage 1 | 507 | 506 | - | 877 | 791 | - | - | - | - | - | - | - |
| Stage 2 | 806 | 791 | - | 506 | 506 | - | - | - | - | - | - | - |
| Time blocked-Platoon, % | | | | | | | | - | - | | - | - |
| Mov Capacity-1 Maneuver | 252 | 329 | 751 | 327 | 329 | 929 | 1274 | - | - | 1465 | - | - |
| Mov Capacity-2 Maneuver | 252 | 329 | - | 327 | 329 | - | - | - | - | - | - | - |
| Stage 1 | 506 | 457 | - | 875 | 789 | - | - | - | - | - | - | - |
| Stage 2 | 684 | 789 | - | 455 | 457 | - | - | - | - | - | - | - |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| HCM Control Delay, s | 9.8 | 75.5 | 0.1 | 2.5 |
| HCM LOS | A | F | | |

| Minor Lane / Major Mvmt | NBL | NBT | NBR | EBLn1 | WBLn1 | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|
| Capacity (veh/h) | 1274 | - | - | 751 | 417 | 1465 | - | - |
| HCM Lane V/C Ratio | 0.002 | - | - | 0.005 | 0.998 | 0.096 | - | - |
| HCM Control Delay (s) | 7.83 | 0 | - | 9.8 | 75.5 | 7.718 | - | - |
| HCM Lane LOS | A | A | | A | F | A | | |
| HCM 95th %tile Q(veh) | 0.005 | - | - | 0.016 | 12.453 | 0.318 | - | - |

| Notes |
|---|
| ~ : Volume Exceeds Capacity; $ : Delay Exceeds 300 Seconds; Error : Computation Not Defined |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 1.5 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vol, veh/h | 0 | 2 | 25 | 6 | 2 | 2 | 12 | 111 | 4 | 0 | 201 | 0 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Stop | Stop | Stop | Stop | Free | Free | Free | Free | Free | Free |
| RT Channelized | - | - | None | - | - | None | - | - | None | - | - | None |
| Storage Length | - | - | - | - | - | - | - | - | - | - | - | - |
| Veh in Median Storage, # | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Grade, % | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Peak Hour Factor | 51 | 51 | 51 | 51 | 51 | 51 | 51 | 51 | 51 | 51 | 51 | 51 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 4 | 49 | 12 | 4 | 4 | 24 | 218 | 8 | 0 | 394 | 0 |

| Major/Minor | Minor2 | | | Minor1 | | | Major1 | | | Major2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conflicting Flow All | 667 | 667 | 394 | 690 | 663 | 222 | 394 | 0 | 0 | 225 | 0 | 0 |
| Stage 1 | 394 | 394 | - | 269 | 269 | - | - | - | - | - | - | - |
| Stage 2 | 273 | 273 | - | 421 | 394 | - | - | - | - | - | - | - |
| Follow-up Headway | 3.518 | 4.018 | 3.318 | 3.518 | 4.018 | 3.318 | 2.218 | - | - | 2.218 | - | - |
| Pot Capacity-1 Maneuver | 372 | 380 | 655 | 359 | 382 | 818 | 1165 | - | - | 1344 | - | - |
| Stage 1 | 631 | 605 | - | 737 | 687 | - | - | - | - | - | - | - |
| Stage 2 | 733 | 684 | - | 610 | 605 | - | - | - | - | - | - | - |
| Time blocked-Platoon, % | | | | | | | | - | - | | - | - |
| Mov Capacity-1 Maneuver | 361 | 371 | 655 | 323 | 373 | 818 | 1165 | - | - | 1344 | - | - |
| Mov Capacity-2 Maneuver | 361 | 371 | - | 323 | 373 | - | - | - | - | - | - | - |
| Stage 1 | 616 | 605 | - | 719 | 671 | - | - | - | - | - | - | - |
| Stage 2 | 708 | 668 | - | 561 | 605 | - | - | - | - | - | - | - |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| HCM Control Delay, s | 11.3 | 15 | 0.8 | 0 |
| HCM LOS | B | C | | |

| Minor Lane / Major Mvmt | NBL | NBT | NBR | EBLn1 | WBLn1 | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|
| Capacity (veh/h) | 1165 | - | - | 620 | 379 | 1344 | - | - |
| HCM Lane V/C Ratio | 0.02 | - | - | 0.085 | 0.052 | - | - | - |
| HCM Control Delay (s) | 8.154 | 0 | - | 11.3 | 15 | 0 | - | - |
| HCM Lane LOS | A | A | | B | C | A | | |
| HCM 95th %tile Q(veh) | 0.062 | - | - | 0.279 | 0.163 | 0 | - | - |

| Notes |
|---|
| ~ : Volume Exceeds Capacity; $ : Delay Exceeds 300 Seconds; Error : Computation Not Defined |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 2.5 |

| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Vol, veh/h | 4 | 13 | 49 | 0 | 25 | 43 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | Free | Free | Free |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 0 | - | - | - | - | - |
| Veh in Median Storage, # | 0 | - | 0 | - | - | 0 |
| Grade, % | 0 | - | 0 | - | - | 0 |
| Peak Hour Factor | 87 | 87 | 87 | 87 | 87 | 87 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 5 | 15 | 56 | 0 | 29 | 49 |

| Major/Minor | Minor1 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 163 | 56 | 0 | 0 | 56 | 0 |
| Stage 1 | 56 | - | - | - | - | - |
| Stage 2 | 107 | - | - | - | - | - |
| Follow-up Headway | 3.518 | 3.318 | - | - | 2.218 | - |
| Pot Capacity-1 Maneuver | 828 | 1011 | - | - | 1549 | - |
| Stage 1 | 967 | - | - | - | - | - |
| Stage 2 | 917 | - | - | - | - | - |
| Time blocked-Platoon, % | | | - | - | | - |
| Mov Capacity-1 Maneuver | 812 | 1011 | - | - | 1549 | - |
| Mov Capacity-2 Maneuver | 812 | - | - | - | - | - |
| Stage 1 | 967 | - | - | - | - | - |
| Stage 2 | 900 | - | - | - | - | - |

| Approach | WB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s | 8.8 | 0 | 2.7 |
| HCM LOS | A | | |

| Minor Lane / Major Mvmt | NBT | NBR | WBLn1 | SBL | SBT |
|---|---|---|---|---|---|
| Capacity (veh/h) | - | - | 956 | 1549 | - |
| HCM Lane V/C Ratio | - | - | 0.02 | 0.019 | - |
| HCM Control Delay (s) | - | - | 8.8 | 7.368 | 0 |
| HCM Lane LOS | | | A | A | A |
| HCM 95th %tile Q(veh) | - | - | 0.063 | 0.057 | - |

| Notes |
|---|
| ~ : Volume Exceeds Capacity; $ : Delay Exceeds 300 Seconds; Error : Computation Not Defined |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (veh/h) | 41 | 470 | 64 | 30 | 323 | 29 | 54 | 1 | 25 | 67 | 6 | 26 |
| Number | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Adj Sat Flow veh/h/ln | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 190.0 | 186.3 | 186.3 | 190.0 |
| Lanes | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 0 | 1 | 1 | 0 |
| Cap, veh/h | 863 | 1365 | 1160 | 691 | 2730 | 1160 | 264 | 6 | 160 | 269 | 31 | 139 |
| Arrive On Green | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Sat Flow, veh/h | 1015 | 1863 | 1583 | 853 | 3725 | 1583 | 1370 | 59 | 1533 | 1378 | 296 | 1332 |
| Grp Volume(v), veh/h | 42 | 485 | 66 | 31 | 333 | 30 | 56 | 0 | 27 | 69 | 0 | 33 |
| Grp Sat Flow(s),veh/h/ln | 1015 | 1863 | 1583 | 853 | 1863 | 1583 | 1370 | 0 | 1592 | 1378 | 0 | 1628 |
| Q Serve(g_s), s | 0.6 | 4.6 | 0.6 | 0.7 | 1.3 | 0.3 | 1.9 | 0.0 | 0.8 | 2.4 | 0.0 | 0.9 |
| Cycle Q Clear(g_c), s | 1.9 | 4.6 | 0.6 | 5.3 | 1.3 | 0.3 | 2.8 | 0.0 | 0.8 | 3.1 | 0.0 | 0.9 |
| Prop In Lane | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 0.96 | 1.00 | | 0.82 |
| Lane Grp Cap(c), veh/h | 863 | 1365 | 1160 | 691 | 2730 | 1160 | 264 | 0 | 166 | 269 | 0 | 170 |
| V/C Ratio(X) | 0.05 | 0.36 | 0.06 | 0.04 | 0.12 | 0.03 | 0.21 | 0.00 | 0.16 | 0.26 | 0.00 | 0.19 |
| Avail Cap(c_a), veh/h | 863 | 1365 | 1160 | 691 | 2730 | 1160 | 567 | 0 | 519 | 574 | 0 | 530 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 0.00 | 1.00 |
| Uniform Delay (d), s/veh | 2.2 | 2.4 | 1.8 | 3.3 | 1.9 | 1.8 | 21.4 | 0.0 | 20.0 | 21.5 | 0.0 | 20.1 |
| Incr Delay (d2), s/veh | 0.1 | 0.7 | 0.1 | 0.1 | 0.1 | 0.0 | 0.4 | 0.0 | 0.5 | 0.5 | 0.0 | 0.6 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile Back of Q (50%), veh/ln | 0.1 | 1.1 | 0.1 | 0.1 | 0.3 | 0.1 | 0.6 | 0.0 | 0.3 | 0.7 | 0.0 | 0.3 |
| Lane Grp Delay (d), s/veh | 2.3 | 3.1 | 1.9 | 3.5 | 2.0 | 1.8 | 21.8 | 0.0 | 20.5 | 22.0 | 0.0 | 20.7 |
| Lane Grp LOS | A | A | A | A | A | A | C | | C | C | | C |
| Approach Vol, veh/h | | 593 | | | 394 | | | 83 | | | 102 | |
| Approach Delay, s/veh | | 2.9 | | | 2.1 | | | 21.4 | | | 21.5 | |
| Approach LOS | | A | | | A | | | C | | | C | |

| Timer | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assigned Phs | | 4 | | | 8 | | | 2 | | | 6 | |
| Phs Duration (G+Y+Rc), s | | 40.0 | | | 40.0 | | | 9.1 | | | 9.1 | |
| Change Period (Y+Rc), s | | 4.0 | | | 4.0 | | | 4.0 | | | 4.0 | |
| Max Green Setting (Gmax), s | | 36.0 | | | 36.0 | | | 16.0 | | | 16.0 | |
| Max Q Clear Time (g_c+I1), s | | 6.6 | | | 7.3 | | | 4.8 | | | 5.1 | |
| Green Ext Time (p_c), s | | 6.2 | | | 6.2 | | | 0.5 | | | 0.5 | |

| Intersection Summary | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HCM 2010 Ctrl Delay | | | 5.6 | | | | | | | | | |
| HCM 2010 LOS | | | A | | | | | | | | | |

| Notes |
|---|

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 3.6 |
| Intersection LOS | A |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| Entry Lanes | 1 | 1 | 1 | 1 |
| Conflicting Circle Lanes | 1 | 1 | 1 | 1 |
| Adj Approach Flow, veh/h | 0 | 5 | 38 | 62 |
| Demand Flow Rate, veh/h | 0 | 5 | 39 | 63 |
| Vehicles Circulating, veh/h | 67 | 35 | 1 | 4 |
| Vehicles Exiting, veh/h | 0 | 5 | 66 | 36 |
| Follow-Up Headway, s | 3.186 | 3.186 | 3.186 | 3.186 |
| Ped Vol Crossing Leg, #/h | 0 | 0 | 0 | 0 |
| Ped Cap Adj | 1.000 | 1.000 | 1.000 | 1.000 |
| Approach Delay, s/veh | 0.0 | 3.3 | 3.5 | 3.7 |
| Approach LOS | - | A | A | A |

| Lane | Left | Left | Left | Left |
|---|---|---|---|---|
| Designated Moves | LTR | LTR | LTR | LTR |
| Assumed Moves | LTR | LTR | LTR | LTR |
| RT Channelized | | | | |
| Lane Util | 1.000 | 1.000 | 1.000 | 1.000 |
| Critical Headway, s | 5.193 | 5.193 | 5.193 | 5.193 |
| Entry Flow, veh/h | 0 | 5 | 39 | 63 |
| Cap Entry Lane, veh/h | 1057 | 1091 | 1129 | 1125 |
| Entry HV Adj Factor | 1.000 | 1.000 | 0.982 | 0.981 |
| Flow Entry, veh/h | 0 | 5 | 38 | 62 |
| Cap Entry, veh/h | 1057 | 1091 | 1109 | 1104 |
| V/C Ratio | 0.000 | 0.005 | 0.035 | 0.056 |
| Control Delay, s/veh | 3.4 | 3.3 | 3.5 | 3.7 |
| LOS | A | A | A | A |
| 95th %tile Queue, veh | 0 | 0 | 0 | 0 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (veh/h) | 105 | 548 | 63 | 16 | 299 | 57 | 55 | 46 | 25 | 54 | 26 | 52 |
| Number | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Adj Sat Flow veh/h/ln | 186.3 | 186.3 | 190.0 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 190.0 | 186.3 | 186.3 | 186.3 |
| Lanes | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| Cap, veh/h | 803 | 1169 | 135 | 584 | 1328 | 1129 | 294 | 146 | 79 | 262 | 240 | 204 |
| Arrive On Green | 0.71 | 0.71 | 0.71 | 0.71 | 0.71 | 0.71 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 |
| Sat Flow, veh/h | 1008 | 1640 | 190 | 788 | 1863 | 1583 | 1312 | 1138 | 616 | 1320 | 1863 | 1583 |
| Grp Volume(v), veh/h | 109 | 0 | 637 | 17 | 311 | 59 | 57 | 0 | 74 | 56 | 27 | 54 |
| Grp Sat Flow(s),veh/h/ln | 1008 | 0 | 1829 | 788 | 1863 | 1583 | 1312 | 0 | 1754 | 1320 | 1863 | 1583 |
| Q Serve(g_s), s | 2.1 | 0.0 | 7.7 | 0.5 | 2.9 | 0.6 | 2.0 | 0.0 | 1.9 | 2.0 | 0.6 | 1.6 |
| Cycle Q Clear(g_c), s | 5.0 | 0.0 | 7.7 | 8.2 | 2.9 | 0.6 | 2.7 | 0.0 | 1.9 | 4.0 | 0.6 | 1.6 |
| Prop In Lane | 1.00 | | 0.10 | 1.00 | | 1.00 | 1.00 | | 0.35 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 803 | 0 | 1304 | 584 | 1328 | 1129 | 294 | 0 | 226 | 262 | 240 | 204 |
| V/C Ratio(X) | 0.14 | 0.00 | 0.49 | 0.03 | 0.23 | 0.05 | 0.19 | 0.00 | 0.33 | 0.21 | 0.11 | 0.27 |
| Avail Cap(c_a), veh/h | 803 | 0 | 1304 | 584 | 1328 | 1129 | 542 | 0 | 556 | 510 | 590 | 502 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 3.4 | 0.0 | 3.2 | 5.0 | 2.5 | 2.2 | 20.6 | 0.0 | 20.0 | 21.8 | 19.5 | 19.8 |
| Incr Delay (d2), s/veh | 0.4 | 0.0 | 1.3 | 0.1 | 0.4 | 0.1 | 0.3 | 0.0 | 0.8 | 0.4 | 0.2 | 0.7 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile Back of Q (50%), veh/ln | 0.4 | 0.0 | 2.1 | 0.1 | 0.5 | 0.1 | 0.6 | 0.0 | 0.8 | 0.6 | 0.3 | 0.6 |
| Lane Grp Delay (d), s/veh | 3.7 | 0.0 | 4.5 | 5.1 | 2.9 | 2.2 | 21.0 | 0.0 | 20.9 | 22.2 | 19.7 | 20.5 |
| Lane Grp LOS | A | | A | A | A | A | C | | C | C | B | C |
| Approach Vol, veh/h | | 746 | | | 387 | | | 131 | | | 137 | |
| Approach Delay, s/veh | | 4.4 | | | 2.9 | | | 20.9 | | | 21.1 | |
| Approach LOS | | A | | | A | | | C | | | C | |

| Timer | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assigned Phs | | 4 | | | 8 | | | 2 | | | 6 | |
| Phs Duration (G+Y+Rc), s | | 40.0 | | | 40.0 | | | 10.5 | | | 10.5 | |
| Change Period (Y+Rc), s | | 4.0 | | | 4.0 | | | 4.0 | | | 4.0 | |
| Max Green Setting (Gmax), s | | 36.0 | | | 36.0 | | | 16.0 | | | 16.0 | |
| Max Q Clear Time (g_c+I1), s | | 9.7 | | | 10.2 | | | 4.7 | | | 6.0 | |
| Green Ext Time (p_c), s | | 6.9 | | | 6.9 | | | 0.7 | | | 0.7 | |

| Intersection Summary | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HCM 2010 Ctrl Delay | | | 7.2 | | | | | | | | | |
| HCM 2010 LOS | | | A | | | | | | | | | |

Notes

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 3 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vol, veh/h | 3 | 0 | 8 | 31 | 0 | 17 | 1 | 66 | 8 | 21 | 91 | 0 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Stop | Stop | Stop | Stop | Free | Free | Free | Free | Free | Free |
| RT Channelized | - | - | None | - | - | None | - | - | None | - | - | None |
| Storage Length | - | - | - | - | - | - | - | - | 0 | 315 | - | - |
| Veh in Median Storage, # | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Grade, % | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Peak Hour Factor | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 88 | 88 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 3 | 0 | 9 | 35 | 0 | 19 | 1 | 75 | 9 | 24 | 103 | 0 |

| Major/Minor | Minor2 | | | Minor1 | | | Major1 | | | Major2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conflicting Flow All | 238 | 228 | 103 | 233 | 228 | 75 | 103 | 0 | 0 | 75 | 0 | 0 |
| Stage 1 | 151 | 151 | - | 77 | 77 | - | - | - | - | - | - | - |
| Stage 2 | 87 | 77 | - | 156 | 151 | - | - | - | - | - | - | - |
| Follow-up Headway | 3.518 | 4.018 | 3.318 | 3.518 | 4.018 | 3.318 | 2.218 | - | - | 2.218 | - | - |
| Pot Capacity-1 Maneuver | 716 | 671 | 952 | 722 | 671 | 986 | 1489 | - | - | 1524 | - | - |
| Stage 1 | 851 | 772 | - | 932 | 831 | - | - | - | - | - | - | - |
| Stage 2 | 921 | 831 | - | 846 | 772 | - | - | - | - | - | - | - |
| Time blocked-Platoon, % | | | | | | | | - | - | | - | - |
| Mov Capacity-1 Maneuver | 693 | 660 | 952 | 706 | 660 | 986 | 1489 | - | - | 1524 | - | - |
| Mov Capacity-2 Maneuver | 693 | 660 | - | 706 | 660 | - | - | - | - | - | - | - |
| Stage 1 | 850 | 760 | - | 931 | 830 | - | - | - | - | - | - | - |
| Stage 2 | 902 | 830 | - | 825 | 760 | - | - | - | - | - | - | - |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| HCM Control Delay, s | 9.2 | 9.9 | 0.1 | 1.4 |
| HCM LOS | A | A | | |

| Minor Lane / Major Mvmt | NBL | NBT | NBR | EBLn1 | WBLn1 | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|
| Capacity (veh/h) | 1489 | - | - | 864 | 785 | 1524 | - | - |
| HCM Lane V/C Ratio | 0.001 | - | - | 0.014 | 0.069 | 0.016 | - | - |
| HCM Control Delay (s) | 7.42 | 0 | - | 9.2 | 9.9 | 7.4 | - | - |
| HCM Lane LOS | A | A | | A | A | A | | |
| HCM 95th %tile Q(veh) | 0.002 | - | - | 0.044 | 0.223 | 0.048 | - | - |

| Notes |
|---|
| ~ : Volume Exceeds Capacity; $ : Delay Exceeds 300 Seconds; Error : Computation Not Defined |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 1.2 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vol, veh/h | 1 | 3 | 14 | 0 | 3 | 2 | 6 | 83 | 2 | 2 | 101 | 0 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Stop | Stop | Stop | Stop | Free | Free | Free | Free | Free | Free |
| RT Channelized | - | - | None | - | - | None | - | - | None | - | - | None |
| Storage Length | - | - | - | - | - | - | - | - | - | - | - | - |
| Veh in Median Storage, # | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Grade, % | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Peak Hour Factor | 93 | 93 | 93 | 93 | 93 | 93 | 93 | 93 | 93 | 93 | 93 | 93 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 1 | 3 | 15 | 0 | 3 | 2 | 6 | 89 | 2 | 2 | 109 | 0 |

| Major/Minor | Minor2 | | | Minor1 | | | Major1 | | | Major2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conflicting Flow All | 219 | 217 | 109 | 225 | 216 | 90 | 109 | 0 | 0 | 91 | 0 | 0 |
| Stage 1 | 113 | 113 | - | 103 | 103 | - | - | - | - | - | - | - |
| Stage 2 | 106 | 104 | - | 122 | 113 | - | - | - | - | - | - | - |
| Follow-up Headway | 3.518 | 4.018 | 3.318 | 3.518 | 4.018 | 3.318 | 2.218 | - | - | 2.218 | - | - |
| Pot Capacity-1 Maneuver | 737 | 681 | 945 | 730 | 682 | 968 | 1481 | - | - | 1504 | - | - |
| Stage 1 | 892 | 802 | - | 903 | 810 | - | - | - | - | - | - | - |
| Stage 2 | 900 | 809 | - | 882 | 802 | - | - | - | - | - | - | - |
| Time blocked-Platoon, % | | | | | | | | - | - | | - | - |
| Mov Capacity-1 Maneuver | 730 | 678 | 945 | 713 | 679 | 968 | 1481 | - | - | 1504 | - | - |
| Mov Capacity-2 Maneuver | 730 | 678 | - | 713 | 679 | - | - | - | - | - | - | - |
| Stage 1 | 888 | 801 | - | 899 | 807 | - | - | - | - | - | - | - |
| Stage 2 | 891 | 806 | - | 864 | 801 | - | - | - | - | - | - | - |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| HCM Control Delay, s | 9.2 | 9.7 | 0.5 | 0.1 |
| HCM LOS | A | A | | |

| Minor Lane / Major Mvmt | NBL | NBT | NBR | EBLn1 | WBLn1 | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|
| Capacity (veh/h) | 1481 | - | - | 873 | 771 | 1504 | - | - |
| HCM Lane V/C Ratio | 0.004 | - | - | 0.022 | 0.007 | 0.001 | - | - |
| HCM Control Delay (s) | 7.441 | 0 | - | 9.2 | 9.7 | 7.397 | 0 | - |
| HCM Lane LOS | A | A | | A | A | A | A | |
| HCM 95th %tile Q(veh) | 0.013 | - | - | 0.068 | 0.021 | 0.004 | - | - |

| Notes |
|---|
| ~ : Volume Exceeds Capacity; $ : Delay Exceeds 300 Seconds; Error : Computation Not Defined |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 4.2 |

| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Vol, veh/h | 54 | 105 | 140 | 14 | 53 | 128 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | Free | Free | Free |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 200 | - | - | 200 | 200 | - |
| Veh in Median Storage, # | 0 | - | 0 | - | - | 0 |
| Grade, % | 0 | - | 0 | - | - | 0 |
| Peak Hour Factor | 90 | 90 | 90 | 90 | 90 | 90 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 60 | 117 | 156 | 16 | 59 | 142 |

| Major/Minor | Minor1 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 416 | 156 | 0 | 0 | 156 | 0 |
| Stage 1 | 156 | - | - | - | - | - |
| Stage 2 | 260 | - | - | - | - | - |
| Follow-up Headway | 3.518 | 3.318 | - | - | 2.218 | - |
| Pot Capacity-1 Maneuver | 593 | 890 | - | - | 1424 | - |
| Stage 1 | 872 | - | - | - | - | - |
| Stage 2 | 783 | - | - | - | - | - |
| Time blocked-Platoon, % | | | - | - | | - |
| Mov Capacity-1 Maneuver | 568 | 890 | - | - | 1424 | - |
| Mov Capacity-2 Maneuver | 568 | - | - | - | - | - |
| Stage 1 | 872 | - | - | - | - | - |
| Stage 2 | 751 | - | - | - | - | - |

| Approach | WB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s | 10.5 | 0 | 2.2 |
| HCM LOS | B | | |

| Minor Lane / Major Mvmt | NBT | NBR | WBLn1 | WBLn2 | SBL | SBT |
|---|---|---|---|---|---|---|
| Capacity (veh/h) | - | - | 568 | 890 | 1424 | - |
| HCM Lane V/C Ratio | - | - | 0.106 | 0.131 | 0.041 | - |
| HCM Control Delay (s) | - | - | 12.1 | 9.7 | 7.637 | - |
| HCM Lane LOS | | | B | A | A | |
| HCM 95th %tile Q(veh) | - | - | 0.352 | 0.45 | 0.129 | - |

| Notes |
|---|
| ~ : Volume Exceeds Capacity; $ : Delay Exceeds 300 Seconds; Error : Computation Not Defined |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (veh/h) | 53 | 1150 | 65 | 70 | 1375 | 71 | 235 | 33 | 85 | 182 | 25 | 143 |
| Number | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Adj Sat Flow veh/h/ln | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 190.0 | 186.3 | 186.3 | 186.3 |
| Lanes | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| Cap, veh/h | 225 | 2178 | 926 | 285 | 2189 | 930 | 387 | 57 | 146 | 318 | 228 | 243 |
| Arrive On Green | 0.03 | 0.58 | 0.58 | 0.03 | 0.59 | 0.59 | 0.11 | 0.12 | 0.12 | 0.11 | 0.12 | 0.12 |
| Sat Flow, veh/h | 1774 | 3725 | 1583 | 1774 | 3725 | 1583 | 1774 | 465 | 1188 | 1774 | 1863 | 1583 |
| Grp Volume(v), veh/h | 58 | 1250 | 71 | 76 | 1495 | 77 | 255 | 0 | 128 | 198 | 27 | 155 |
| Grp Sat Flow(s),veh/h/ln | 1774 | 1863 | 1583 | 1774 | 1863 | 1583 | 1774 | 0 | 1653 | 1774 | 1863 | 1583 |
| Q Serve(g_s), s | 1.4 | 21.9 | 2.0 | 1.8 | 28.9 | 2.2 | 11.0 | 0.0 | 7.7 | 10.1 | 1.3 | 9.6 |
| Cycle Q Clear(g_c), s | 1.4 | 21.9 | 2.0 | 1.8 | 28.9 | 2.2 | 11.0 | 0.0 | 7.7 | 10.1 | 1.3 | 9.6 |
| Prop In Lane | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 0.72 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 225 | 2178 | 926 | 285 | 2189 | 930 | 387 | 0 | 203 | 318 | 228 | 243 |
| V/C Ratio(X) | 0.26 | 0.57 | 0.08 | 0.27 | 0.68 | 0.08 | 0.66 | 0.00 | 0.63 | 0.62 | 0.12 | 0.64 |
| Avail Cap(c_a), veh/h | 272 | 2178 | 926 | 326 | 2189 | 930 | 387 | 0 | 412 | 318 | 464 | 444 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 1.00 | 0.65 | 0.65 | 0.65 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 12.7 | 13.6 | 9.4 | 10.7 | 14.8 | 9.3 | 36.7 | 0.0 | 43.5 | 35.3 | 40.8 | 41.4 |
| Incr Delay (d2), s/veh | 0.6 | 1.1 | 0.2 | 0.3 | 1.1 | 0.1 | 4.1 | 0.0 | 3.2 | 3.8 | 0.2 | 2.8 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile Back of Q (50%), veh/ln | 0.6 | 9.4 | 0.7 | 0.7 | 12.4 | 0.8 | 1.3 | 0.0 | 3.5 | 4.8 | 0.6 | 3.9 |
| Lane Grp Delay (d), s/veh | 13.3 | 14.7 | 9.6 | 11.0 | 16.0 | 9.4 | 40.7 | 0.0 | 46.8 | 39.1 | 41.0 | 44.2 |
| Lane Grp LOS | B | B | A | B | B | A | D | | D | D | D | D |
| Approach Vol, veh/h | | 1379 | | | 1648 | | | 383 | | | 380 | |
| Approach Delay, s/veh | | 14.3 | | | 15.4 | | | 42.8 | | | 41.3 | |
| Approach LOS | | B | | | B | | | D | | | D | |

| Timer | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assigned Phs | 7 | 4 | | 3 | 8 | | 5 | 2 | | 1 | 6 | |
| Phs Duration (G+Y+Rc), s | 7.3 | 65.0 | | 7.6 | 65.3 | | 15.0 | 16.8 | | 15.0 | 16.8 | |
| Change Period (Y+Rc), s | 4.0 | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | |
| Max Green Setting (Gmax), s | 6.0 | 61.0 | | 6.0 | 61.0 | | 11.0 | 26.0 | | 11.0 | 26.0 | |
| Max Q Clear Time (g_c+I1), s | 3.4 | 23.9 | | 3.8 | 30.9 | | 13.0 | 9.7 | | 12.1 | 11.6 | |
| Green Ext Time (p_c), s | 0.0 | 29.5 | | 0.0 | 24.9 | | 0.0 | 1.3 | | 0.0 | 1.2 | |

| Intersection Summary | |
|---|---|
| HCM 2010 Ctrl Delay | 20.4 |
| HCM 2010 LOS | C |

Notes

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 6.5 |
| Intersection LOS | A |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| Entry Lanes | 1 | 1 | 1 | 1 |
| Conflicting Circle Lanes | 1 | 1 | 1 | 1 |
| Adj Approach Flow, veh/h | 154 | 229 | 178 | 289 |
| Demand Flow Rate, veh/h | 157 | 233 | 182 | 295 |
| Vehicles Circulating, veh/h | 377 | 190 | 101 | 151 |
| Vehicles Exiting, veh/h | 69 | 93 | 433 | 272 |
| Follow-Up Headway, s | 3.186 | 3.186 | 3.186 | 3.186 |
| Ped Vol Crossing Leg, #/h | 0 | 0 | 0 | 0 |
| Ped Cap Adj | 1.000 | 1.000 | 1.000 | 1.000 |
| Approach Delay, s/veh | 6.9 | 6.5 | 5.3 | 6.9 |
| Approach LOS | A | A | A | A |

| Lane | Left | Left | Left | Left |
|---|---|---|---|---|
| Designated Moves | LTR | LTR | LTR | LTR |
| Assumed Moves | LTR | LTR | LTR | LTR |
| RT Channelized | | | | |
| Lane Util | 1.000 | 1.000 | 1.000 | 1.000 |
| Critical Headway, s | 5.193 | 5.193 | 5.193 | 5.193 |
| Entry Flow, veh/h | 157 | 233 | 182 | 295 |
| Cap Entry Lane, veh/h | 775 | 934 | 1021 | 972 |
| Entry HV Adj Factor | 0.981 | 0.983 | 0.978 | 0.979 |
| Flow Entry, veh/h | 154 | 229 | 178 | 289 |
| Cap Entry, veh/h | 760 | 918 | 999 | 951 |
| V/C Ratio | 0.203 | 0.249 | 0.178 | 0.304 |
| Control Delay, s/veh | 6.9 | 6.5 | 5.3 | 6.9 |
| LOS | A | A | A | A |
| 95th %tile Queue, veh | 1 | 1 | 1 | 1 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (veh/h) | 410 | 918 | 89 | 80 | 860 | 344 | 107 | 281 | 105 | 492 | 309 | 525 |
| Number | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Adj Sat Flow veh/h/ln | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 |
| Lanes | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 1 |
| Cap, veh/h | 515 | 1809 | 849 | 138 | 1401 | 885 | 174 | 560 | 301 | 629 | 1053 | 684 |
| Arrive On Green | 0.15 | 0.49 | 0.49 | 0.04 | 0.38 | 0.38 | 0.05 | 0.15 | 0.15 | 0.06 | 0.09 | 0.09 |
| Sat Flow, veh/h | 3442 | 3725 | 1583 | 3442 | 3725 | 1583 | 3442 | 3725 | 1583 | 3442 | 3725 | 1583 |
| Grp Volume(v), veh/h | 446 | 998 | 97 | 87 | 935 | 374 | 116 | 305 | 114 | 535 | 336 | 571 |
| Grp Sat Flow(s),veh/h/ln | 1721 | 1863 | 1583 | 1721 | 1863 | 1583 | 1721 | 1863 | 1583 | 1721 | 1863 | 1583 |
| Q Serve(g_s), s | 14.3 | 21.3 | 3.4 | 2.8 | 23.7 | 15.5 | 3.8 | 8.6 | 7.1 | 17.4 | 9.5 | 32.0 |
| Cycle Q Clear(g_c), s | 14.3 | 21.3 | 3.4 | 2.8 | 23.7 | 15.5 | 3.8 | 8.6 | 7.1 | 17.4 | 9.5 | 32.0 |
| Prop In Lane | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 515 | 1809 | 849 | 138 | 1401 | 885 | 174 | 560 | 301 | 629 | 1053 | 684 |
| V/C Ratio(X) | 0.87 | 0.55 | 0.11 | 0.63 | 0.67 | 0.42 | 0.67 | 0.54 | 0.38 | 0.85 | 0.32 | 0.83 |
| Avail Cap(c_a), veh/h | 608 | 1809 | 849 | 182 | 1401 | 885 | 334 | 560 | 301 | 821 | 1053 | 684 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.33 | 0.33 | 0.33 |
| Upstream Filter(I) | 0.79 | 0.79 | 0.79 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 47.0 | 20.5 | 13.0 | 53.5 | 29.4 | 14.4 | 52.8 | 44.5 | 40.0 | 51.7 | 41.2 | 35.0 |
| Incr Delay (d2), s/veh | 9.0 | 1.0 | 0.2 | 4.7 | 2.5 | 1.5 | 4.4 | 1.1 | 0.8 | 6.7 | 0.2 | 8.8 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile Back of Q (50%), veh/ln | 6.9 | 9.7 | 1.2 | 1.3 | 10.9 | 5.7 | 1.7 | 4.1 | 2.8 | 8.7 | 4.8 | 15.6 |
| Lane Grp Delay (d), s/veh | 56.1 | 21.4 | 13.2 | 58.3 | 32.0 | 15.9 | 57.2 | 45.6 | 40.8 | 58.4 | 41.3 | 43.8 |
| Lane Grp LOS | E | C | B | E | C | B | E | D | D | E | D | D |
| Approach Vol, veh/h | | 1541 | | | 1396 | | | 535 | | | 1442 | |
| Approach Delay, s/veh | | 30.9 | | | 29.3 | | | 47.1 | | | 48.6 | |
| Approach LOS | | C | | | C | | | D | | | D | |
| **Timer** | | | | | | | | | | | | |
| Assigned Phs | 7 | 4 | | 3 | 8 | | 5 | 2 | | 1 | 6 | |
| Phs Duration (G+Y+Rc), s | 20.9 | 59.0 | | 8.5 | 46.6 | | 9.7 | 21.0 | | 24.7 | 36.0 | |
| Change Period (Y+Rc), s | 4.0 | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | |
| Max Green Setting (Gmax), s | 20.0 | 55.0 | | 6.0 | 41.0 | | 11.0 | 16.0 | | 27.0 | 32.0 | |
| Max Q Clear Time (g_c+I1), s | 16.3 | 23.3 | | 4.8 | 25.7 | | 5.8 | 10.6 | | 19.4 | 34.0 | |
| Green Ext Time (p_c), s | 0.6 | 19.3 | | 0.0 | 11.6 | | 0.1 | 3.0 | | 1.3 | 0.0 | |
| **Intersection Summary** | | | | | | | | | | | | |
| HCM 2010 Ctrl Delay | | | 37.4 | | | | | | | | | |
| HCM 2010 LOS | | | D | | | | | | | | | |
| **Notes** | | | | | | | | | | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (veh/h) | 73 | 40 | 177 | 295 | 11 | 154 | 58 | 461 | 115 | 196 | 970 | 28 |
| Number | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Adj Sat Flow veh/h/ln | 186.3 | 186.3 | 190.0 | 186.3 | 186.3 | 190.0 | 186.3 | 186.3 | 190.0 | 186.3 | 186.3 | 186.3 |
| Lanes | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 2 | 0 | 1 | 2 | 1 |
| Cap, veh/h | 634 | 174 | 418 | 634 | 38 | 533 | 281 | 930 | 425 | 448 | 1797 | 764 |
| Arrive On Green | 0.36 | 0.36 | 0.36 | 0.36 | 0.36 | 0.36 | 0.01 | 0.13 | 0.13 | 0.13 | 0.48 | 0.48 |
| Sat Flow, veh/h | 1774 | 487 | 1169 | 1774 | 107 | 1493 | 1774 | 2423 | 1107 | 1774 | 3725 | 1583 |
| Grp Volume(v), veh/h | 79 | 0 | 272 | 590 | 0 | 330 | 63 | 385 | 346 | 392 | 1054 | 30 |
| Grp Sat Flow(s),veh/h/ln | 1774 | 0 | 1656 | 1774 | 0 | 1599 | 1774 | 1863 | 1667 | 1774 | 1863 | 1583 |
| Q Serve(g_s), s | 2.9 | 0.0 | 12.0 | 30.5 | 0.0 | 15.9 | 2.0 | 18.5 | 18.6 | 9.8 | 19.5 | 1.0 |
| Cycle Q Clear(g_c), s | 2.9 | 0.0 | 12.0 | 30.5 | 0.0 | 15.9 | 2.0 | 18.5 | 18.6 | 9.8 | 19.5 | 1.0 |
| Prop In Lane | 1.00 | | 0.71 | 1.00 | | 0.93 | 1.00 | | 0.66 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 634 | 0 | 592 | 634 | 0 | 572 | 281 | 715 | 640 | 448 | 1797 | 764 |
| V/C Ratio(X) | 0.12 | 0.00 | 0.46 | 0.93 | 0.00 | 0.58 | 0.22 | 0.54 | 0.54 | 0.87 | 0.59 | 0.04 |
| Avail Cap(c_a), veh/h | 634 | 0 | 592 | 670 | 0 | 604 | 331 | 715 | 640 | 602 | 1797 | 764 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.33 | 0.33 | 0.33 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 20.6 | 0.0 | 23.6 | 29.5 | 0.0 | 24.8 | 17.8 | 33.7 | 33.8 | 17.0 | 17.8 | 13.0 |
| Incr Delay (d2), s/veh | 0.1 | 0.0 | 0.6 | 19.2 | 0.0 | 1.2 | 0.4 | 2.9 | 3.3 | 10.7 | 1.4 | 0.1 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile Back of Q (50%), veh/ln | 1.3 | 0.0 | 5.0 | 16.8 | 0.0 | 6.5 | 0.9 | 9.8 | 8.9 | 5.6 | 8.7 | 0.4 |
| Lane Grp Delay (d), s/veh | 20.7 | 0.0 | 24.1 | 48.7 | 0.0 | 26.1 | 18.2 | 36.6 | 37.1 | 27.7 | 19.2 | 13.1 |
| Lane Grp LOS | C | | C | D | | C | B | D | D | C | B | B |
| Approach Vol, veh/h | | 351 | | | 920 | | | 794 | | | 1476 | |
| Approach Delay, s/veh | | 23.4 | | | 40.6 | | | 35.3 | | | 21.4 | |
| Approach LOS | | C | | | D | | | D | | | C | |

| Timer | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assigned Phs | | 4 | | | 8 | | 5 | 2 | | 1 | 6 | |
| Phs Duration (G+Y+Rc), s | | 38.1 | | | 38.1 | | 7.3 | 40.6 | | 16.7 | 50.0 | |
| Change Period (Y+Rc), s | | 4.0 | | | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | |
| Max Green Setting (Gmax), s | | 16.0 | | | 36.0 | | 6.0 | 31.0 | | 21.0 | 46.0 | |
| Max Q Clear Time (g_c+I1), s | | 14.0 | | | 32.5 | | 4.0 | 20.6 | | 11.8 | 21.5 | |
| Green Ext Time (p_c), s | | 1.3 | | | 1.5 | | 0.0 | 7.6 | | 0.9 | 13.8 | |

| Intersection Summary | | |
|---|---|---|
| HCM 2010 Ctrl Delay | | 29.7 |
| HCM 2010 LOS | | C |

Notes

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 5.3 |

| Movement | EBL | EBR | NBL | NBT | SBT | SBR |
|---|---|---|---|---|---|---|
| Vol, veh/h | 44 | 161 | 57 | 461 | 912 | 20 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | Free | Free | Free |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 200 | - | 200 | - | - | 200 |
| Veh in Median Storage, # | 0 | - | - | 0 | 0 | - |
| Grade, % | 0 | - | - | 0 | 0 | - |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 48 | 175 | 62 | 501 | 991 | 22 |

| Major/Minor | Minor2 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 1616 | 991 | 991 | 0 | - | 0 |
| Stage 1 | 991 | - | - | - | - | - |
| Stage 2 | 625 | - | - | - | - | - |
| Follow-up Headway | 3.518 | 3.318 | 2.218 | - | - | - |
| Pot Capacity-1 Maneuver | 114 | 299 | 698 | - | - | - |
| Stage 1 | 359 | - | - | - | - | - |
| Stage 2 | 534 | - | - | - | - | - |
| Time blocked-Platoon, % | | | | - | - | - |
| Mov Capacity-1 Maneuver | 104 | 299 | 698 | - | - | - |
| Mov Capacity-2 Maneuver | 104 | - | - | - | - | - |
| Stage 1 | 359 | - | - | - | - | - |
| Stage 2 | 487 | - | - | - | - | - |

| Approach | EB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s | 39.9 | 1.2 | 0 |
| HCM LOS | E | | |

| Minor Lane / Major Mvmt | NBL | NBT | EBLn1 | EBLn2 | SBT | SBR |
|---|---|---|---|---|---|---|
| Capacity (veh/h) | 698 | - | 104 | 299 | - | - |
| HCM Lane V/C Ratio | 0.089 | - | 0.46 | 0.585 | - | - |
| HCM Control Delay (s) | 10.659 | - | 66.2 | 32.7 | - | - |
| HCM Lane LOS | B | | F | D | | |
| HCM 95th %tile Q(veh) | 0.291 | - | 1.99 | 3.461 | - | - |

| Notes |
|---|
| ~ : Volume Exceeds Capacity; $ : Delay Exceeds 300 Seconds; Error : Computation Not Defined |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 5.9 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vol, veh/h | 24 | 15 | 119 | 18 | 8 | 10 | 48 | 381 | 32 | 20 | 755 | 13 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Stop | Stop | Stop | Stop | Free | Free | Free | Free | Free | Free |
| RT Channelized | - | - | None | - | - | None | - | - | None | - | - | None |
| Storage Length | 200 | - | - | 200 | - | - | 200 | - | 200 | 200 | - | 200 |
| Veh in Median Storage, # | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Grade, % | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Peak Hour Factor | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 27 | 17 | 132 | 20 | 9 | 11 | 53 | 423 | 36 | 22 | 839 | 14 |

| Major/Minor | Minor2 | | | Minor1 | | | Major1 | | | Major2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conflicting Flow All | 1423 | 1413 | 839 | 1488 | 1413 | 423 | 839 | 0 | 0 | 423 | 0 | 0 |
| Stage 1 | 883 | 883 | - | 530 | 530 | - | - | - | - | - | - | - |
| Stage 2 | 540 | 530 | - | 958 | 883 | - | - | - | - | - | - | - |
| Follow-up Headway | 3.518 | 4.018 | 3.318 | 3.518 | 4.018 | 3.318 | 2.218 | - | - | 2.218 | - | - |
| Pot Capacity-1 Maneuver | 114 | 138 | 366 | 102 | 138 | 631 | 796 | - | - | 1136 | - | - |
| Stage 1 | 340 | 364 | - | 533 | 527 | - | - | - | - | - | - | - |
| Stage 2 | 526 | 527 | - | 309 | 364 | - | - | - | - | - | - | - |
| Time blocked-Platoon, % | | | | | | | | - | - | | - | - |
| Mov Capacity-1 Maneuver | 99 | 126 | 366 | 55 | 126 | 631 | 796 | - | - | 1136 | - | - |
| Mov Capacity-2 Maneuver | 99 | 126 | - | 55 | 126 | - | - | - | - | - | - | - |
| Stage 1 | 317 | 357 | - | 498 | 492 | - | - | - | - | - | - | - |
| Stage 2 | 474 | 492 | - | 185 | 357 | - | - | - | - | - | - | - |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| HCM Control Delay, s | 36.9 | 57.2 | 1 | 0.2 |
| HCM LOS | E | F | | |

| Minor Lane / Major Mvmt | NBL | NBT | NBR | EBLn1 | EBLn2 | WBLn1 | WBLn2 | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|
| Capacity (veh/h) | 796 | - | - | 99 | 270 | 55 | 127 | 1136 | - | - |
| HCM Lane V/C Ratio | 0.067 | - | - | 0.18 | 0.584 | 0.242 | 0.21 | 0.02 | - | - |
| HCM Control Delay (s) | 9.847 | - | - | 49.2 | 35.5 | 90.3 | 40.7 | 8.232 | - | - |
| HCM Lane LOS | A | | | E | E | F | E | A | | |
| HCM 95th %tile Q(veh) | 0.215 | - | - | 0.619 | 3.396 | 0.828 | 0.752 | 0.06 | - | - |

| Notes |
|---|
| ~ : Volume Exceeds Capacity; $ : Delay Exceeds 300 Seconds; Error : Computation Not Defined |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 3.1 |

| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Vol, veh/h | 31 | 82 | 187 | 56 | 93 | 198 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | Free | Free | Free |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 200 | - | - | 200 | 200 | - |
| Veh in Median Storage, # | 0 | - | 0 | - | - | 0 |
| Grade, % | 0 | - | 0 | - | - | 0 |
| Peak Hour Factor | 90 | 90 | 90 | 90 | 90 | 90 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 34 | 91 | 208 | 62 | 103 | 220 |

| Major/Minor | Minor1 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 635 | 208 | 0 | 0 | 208 | 0 |
| Stage 1 | 208 | - | - | - | - | - |
| Stage 2 | 427 | - | - | - | - | - |
| Follow-up Headway | 3.518 | 3.318 | - | - | 2.218 | - |
| Pot Capacity-1 Maneuver | 443 | 832 | - | - | 1363 | - |
| Stage 1 | 827 | - | - | - | - | - |
| Stage 2 | 658 | - | - | - | - | - |
| Time blocked-Platoon, % | | | - | - | | - |
| Mov Capacity-1 Maneuver | 410 | 832 | - | - | 1363 | - |
| Mov Capacity-2 Maneuver | 410 | - | - | - | - | - |
| Stage 1 | 827 | - | - | - | - | - |
| Stage 2 | 608 | - | - | - | - | - |

| Approach | WB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s | 11.2 | 0 | 2.5 |
| HCM LOS | B | | |

| Minor Lane / Major Mvmt | NBT | NBR | WBLn1 | WBLn2 | SBL | SBT |
|---|---|---|---|---|---|---|
| Capacity (veh/h) | - | - | 410 | 832 | 1363 | - |
| HCM Lane V/C Ratio | - | - | 0.084 | 0.11 | 0.076 | - |
| HCM Control Delay (s) | - | - | 14.6 | 9.9 | 7.858 | - |
| HCM Lane LOS | | | B | A | A | |
| HCM 95th %tile Q(veh) | - | - | 0.274 | 0.367 | 0.246 | - |

Notes

~ : Volume Exceeds Capacity; $ : Delay Exceeds 300 Seconds; Error : Computation Not Defined

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (veh/h) | 170 | 1500 | 215 | 95 | 1390 | 202 | 175 | 45 | 85 | 122 | 42 | 85 |
| Number | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Adj Sat Flow veh/h/ln | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 190.0 | 186.3 | 186.3 | 186.3 |
| Lanes | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| Cap, veh/h | 264 | 2244 | 954 | 216 | 2166 | 920 | 347 | 66 | 124 | 262 | 168 | 241 |
| Arrive On Green | 0.06 | 0.60 | 0.60 | 0.04 | 0.58 | 0.58 | 0.11 | 0.11 | 0.11 | 0.09 | 0.09 | 0.09 |
| Sat Flow, veh/h | 1774 | 3725 | 1583 | 1774 | 3725 | 1583 | 1774 | 580 | 1090 | 1774 | 1863 | 1583 |
| Grp Volume(v), veh/h | 185 | 1630 | 234 | 103 | 1511 | 220 | 190 | 0 | 141 | 133 | 46 | 92 |
| Grp Sat Flow(s),veh/h/ln | 1774 | 1863 | 1583 | 1774 | 1863 | 1583 | 1774 | 0 | 1670 | 1774 | 1863 | 1583 |
| Q Serve(g_s), s | 3.9 | 31.3 | 7.0 | 2.4 | 28.9 | 6.8 | 9.4 | 0.0 | 8.3 | 6.8 | 2.3 | 5.3 |
| Cycle Q Clear(g_c), s | 3.9 | 31.3 | 7.0 | 2.4 | 28.9 | 6.8 | 9.4 | 0.0 | 8.3 | 6.8 | 2.3 | 5.3 |
| Prop In Lane | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 0.65 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 264 | 2244 | 954 | 216 | 2166 | 920 | 347 | 0 | 190 | 262 | 168 | 241 |
| V/C Ratio(X) | 0.70 | 0.73 | 0.25 | 0.48 | 0.70 | 0.24 | 0.55 | 0.00 | 0.74 | 0.51 | 0.27 | 0.38 |
| Avail Cap(c_a), veh/h | 469 | 2244 | 954 | 248 | 2166 | 920 | 347 | 0 | 429 | 303 | 478 | 505 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 1.00 | 0.45 | 0.45 | 0.45 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 18.1 | 14.2 | 9.4 | 14.9 | 14.9 | 10.3 | 34.1 | 0.0 | 43.5 | 37.4 | 43.0 | 38.7 |
| Incr Delay (d2), s/veh | 3.4 | 2.1 | 0.6 | 0.7 | 0.9 | 0.3 | 1.8 | 0.0 | 5.7 | 1.5 | 0.9 | 1.0 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile Back of Q (50%), veh/ln | 4.9 | 13.3 | 2.5 | 1.1 | 12.2 | 2.4 | 4.4 | 0.0 | 3.8 | 3.0 | 1.1 | 2.1 |
| Lane Grp Delay (d), s/veh | 21.5 | 16.3 | 10.0 | 15.7 | 15.8 | 10.6 | 35.9 | 0.0 | 49.1 | 39.0 | 43.9 | 39.7 |
| Lane Grp LOS | C | B | B | B | B | B | D | | D | D | D | D |
| Approach Vol, veh/h | | 2049 | | | 1834 | | | 331 | | | 271 | |
| Approach Delay, s/veh | | 16.1 | | | 15.2 | | | 41.6 | | | 40.0 | |
| Approach LOS | | B | | | B | | | D | | | D | |
| **Timer** | | | | | | | | | | | | |
| Assigned Phs | 7 | 4 | | 3 | 8 | | 5 | 2 | | 1 | 6 | |
| Phs Duration (G+Y+Rc), s | 10.3 | 65.0 | | 8.1 | 62.9 | | 15.0 | 15.5 | | 12.6 | 13.1 | |
| Change Period (Y+Rc), s | 4.0 | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | |
| Max Green Setting (Gmax), s | 18.0 | 61.0 | | 6.0 | 49.0 | | 11.0 | 26.0 | | 11.0 | 26.0 | |
| Max Q Clear Time (g_c+I1), s | 5.9 | 33.3 | | 4.4 | 30.9 | | 11.4 | 10.3 | | 8.8 | 7.3 | |
| Green Ext Time (p_c), s | 0.4 | 25.5 | | 0.0 | 17.1 | | 0.0 | 1.2 | | 0.1 | 1.3 | |
| **Intersection Summary** | | | | | | | | | | | | |
| HCM 2010 Ctrl Delay | | | 19.0 | | | | | | | | | |
| HCM 2010 LOS | | | B | | | | | | | | | |
| **Notes** | | | | | | | | | | | | |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 8.6 |
| Intersection LOS | A |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| Entry Lanes | 1 | 1 | 1 | 1 |
| Conflicting Circle Lanes | 1 | 1 | 1 | 1 |
| Adj Approach Flow, veh/h | 104 | 163 | 455 | 337 |
| Demand Flow Rate, veh/h | 106 | 166 | 464 | 344 |
| Vehicles Circulating, veh/h | 380 | 366 | 173 | 204 |
| Vehicles Exiting, veh/h | 168 | 271 | 313 | 328 |
| Follow-Up Headway, s | 3.186 | 3.186 | 3.186 | 3.186 |
| Ped Vol Crossing Leg, #/h | 0 | 0 | 0 | 0 |
| Ped Cap Adj | 1.000 | 1.000 | 1.000 | 1.000 |
| Approach Delay, s/veh | 6.2 | 7.0 | 9.9 | 8.2 |
| Approach LOS | A | A | A | A |

| Lane | Left | Left | Left | Left |
|---|---|---|---|---|
| Designated Moves | LTR | LTR | LTR | LTR |
| Assumed Moves | LTR | LTR | LTR | LTR |
| RT Channelized | | | | |
| Lane Util | 1.000 | 1.000 | 1.000 | 1.000 |
| Critical Headway, s | 5.193 | 5.193 | 5.193 | 5.193 |
| Entry Flow, veh/h | 106 | 166 | 464 | 344 |
| Cap Entry Lane, veh/h | 773 | 784 | 950 | 921 |
| Entry HV Adj Factor | 0.981 | 0.982 | 0.980 | 0.979 |
| Flow Entry, veh/h | 104 | 163 | 455 | 337 |
| Cap Entry, veh/h | 758 | 769 | 932 | 903 |
| V/C Ratio | 0.137 | 0.212 | 0.488 | 0.373 |
| Control Delay, s/veh | 6.2 | 7.0 | 9.9 | 8.2 |
| LOS | A | A | A | A |
| 95th %tile Queue, veh | 0 | 1 | 3 | 2 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (veh/h) | 450 | 1104 | 143 | 140 | 1189 | 581 | 138 | 337 | 85 | 378 | 238 | 360 |
| Number | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Adj Sat Flow veh/h/ln | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 |
| Lanes | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 1 |
| Cap, veh/h | 561 | 1797 | 863 | 216 | 1424 | 839 | 215 | 589 | 350 | 508 | 905 | 643 |
| Arrive On Green | 0.16 | 0.48 | 0.48 | 0.06 | 0.38 | 0.38 | 0.06 | 0.16 | 0.16 | 0.05 | 0.08 | 0.08 |
| Sat Flow, veh/h | 3442 | 3725 | 1583 | 3442 | 3725 | 1583 | 3442 | 3725 | 1583 | 3442 | 3725 | 1583 |
| Grp Volume(v), veh/h | 489 | 1200 | 155 | 152 | 1292 | 632 | 150 | 366 | 92 | 411 | 259 | 391 |
| Grp Sat Flow(s),veh/h/ln | 1721 | 1863 | 1583 | 1721 | 1863 | 1583 | 1721 | 1863 | 1583 | 1721 | 1863 | 1583 |
| Q Serve(g_s), s | 14.9 | 26.4 | 5.3 | 4.6 | 35.2 | 33.5 | 4.6 | 9.8 | 5.2 | 12.7 | 7.0 | 20.8 |
| Cycle Q Clear(g_c), s | 14.9 | 26.4 | 5.3 | 4.6 | 35.2 | 33.5 | 4.6 | 9.8 | 5.2 | 12.7 | 7.0 | 20.8 |
| Prop In Lane | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 561 | 1797 | 863 | 216 | 1424 | 839 | 215 | 589 | 350 | 508 | 905 | 643 |
| V/C Ratio(X) | 0.87 | 0.67 | 0.18 | 0.70 | 0.91 | 0.75 | 0.70 | 0.62 | 0.26 | 0.81 | 0.29 | 0.61 |
| Avail Cap(c_a), veh/h | 642 | 1797 | 863 | 353 | 1424 | 839 | 417 | 591 | 350 | 834 | 1042 | 701 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.33 | 0.33 | 0.33 |
| Upstream Filter(I) | 0.60 | 0.60 | 0.60 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 43.8 | 21.2 | 12.3 | 49.3 | 31.3 | 19.7 | 49.3 | 42.2 | 34.6 | 49.5 | 40.6 | 30.5 |
| Incr Delay (d2), s/veh | 7.3 | 1.2 | 0.3 | 4.2 | 10.0 | 6.2 | 4.0 | 2.0 | 0.4 | 3.1 | 0.2 | 1.3 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile Back of Q (50%), veh/ln | 7.0 | 11.8 | 0.1 | 2.1 | 17.2 | 12.9 | 2.1 | 4.7 | 0.0 | 6.1 | 3.5 | 8.9 |
| Lane Grp Delay (d), s/veh | 51.1 | 22.4 | 12.6 | 53.4 | 41.3 | 25.9 | 53.3 | 44.2 | 35.0 | 52.7 | 40.7 | 31.8 |
| Lane Grp LOS | D | C | B | D | D | C | D | D | C | D | D | C |
| Approach Vol, veh/h | | 1844 | | | 2076 | | | 608 | | | 1061 | |
| Approach Delay, s/veh | | 29.2 | | | 37.5 | | | 45.0 | | | 42.1 | |
| Approach LOS | | C | | | D | | | D | | | D | |
| **Timer** | | | | | | | | | | | | |
| Assigned Phs | 7 | 4 | | 3 | 8 | | 5 | 2 | | 1 | 6 | |
| Phs Duration (G+Y+Rc), s | 21.5 | 55.7 | | 10.7 | 45.0 | | 10.7 | 21.0 | | 19.8 | 30.1 | |
| Change Period (Y+Rc), s | 4.0 | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | |
| Max Green Setting (Gmax), s | 20.0 | 50.0 | | 11.0 | 41.0 | | 13.0 | 17.0 | | 26.0 | 30.0 | |
| Max Q Clear Time (g_c+I1), s | 16.9 | 28.4 | | 6.6 | 37.2 | | 6.6 | 11.8 | | 14.7 | 22.8 | |
| Green Ext Time (p_c), s | 0.6 | 18.7 | | 0.2 | 3.7 | | 0.2 | 2.5 | | 1.1 | 3.2 | |
| **Intersection Summary** | | | | | | | | | | | | |
| HCM 2010 Ctrl Delay | | | 36.4 | | | | | | | | | |
| HCM 2010 LOS | | | D | | | | | | | | | |
| **Notes** | | | | | | | | | | | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (veh/h) | 44 | 24 | 107 | 85 | 45 | 110 | 196 | 1038 | 25 | 57 | 689 | 81 |
| Number | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Adj Sat Flow veh/h/ln | 186.3 | 186.3 | 190.0 | 186.3 | 186.3 | 190.0 | 186.3 | 186.3 | 190.0 | 186.3 | 186.3 | 186.3 |
| Lanes | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 2 | 0 | 1 | 2 | 1 |
| Cap, veh/h | 372 | 88 | 257 | 372 | 101 | 246 | 516 | 2132 | 79 | 338 | 2131 | 906 |
| Arrive On Green | 0.21 | 0.21 | 0.21 | 0.21 | 0.21 | 0.21 | 0.05 | 0.40 | 0.40 | 0.04 | 0.57 | 0.57 |
| Sat Flow, veh/h | 1774 | 422 | 1224 | 1774 | 481 | 1174 | 1774 | 3569 | 133 | 1774 | 3725 | 1583 |
| Grp Volume(v), veh/h | 48 | 0 | 156 | 142 | 0 | 258 | 213 | 589 | 581 | 95 | 749 | 88 |
| Grp Sat Flow(s),veh/h/ln | 1774 | 0 | 1647 | 1774 | 0 | 1656 | 1774 | 1863 | 1839 | 1774 | 1863 | 1583 |
| Q Serve(g_s), s | 1.8 | 0.0 | 6.7 | 5.5 | 0.0 | 11.7 | 3.6 | 19.3 | 19.3 | 1.7 | 8.7 | 2.0 |
| Cycle Q Clear(g_c), s | 1.8 | 0.0 | 6.7 | 5.5 | 0.0 | 11.7 | 3.6 | 19.3 | 19.3 | 1.7 | 8.7 | 2.0 |
| Prop In Lane | 1.00 | | 0.74 | 1.00 | | 0.71 | 1.00 | | 0.07 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 372 | 0 | 345 | 372 | 0 | 347 | 516 | 1113 | 1099 | 338 | 2131 | 906 |
| V/C Ratio(X) | 0.13 | 0.00 | 0.45 | 0.38 | 0.00 | 0.74 | 0.41 | 0.53 | 0.53 | 0.28 | 0.35 | 0.10 |
| Avail Cap(c_a), veh/h | 463 | 0 | 430 | 684 | 0 | 638 | 526 | 1113 | 1099 | 503 | 2131 | 906 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.67 | 0.67 | 0.67 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 25.8 | 0.0 | 27.8 | 27.3 | 0.0 | 29.8 | 6.3 | 15.5 | 15.5 | 8.6 | 9.2 | 7.8 |
| Incr Delay (d2), s/veh | 0.2 | 0.0 | 0.9 | 0.6 | 0.0 | 3.2 | 0.5 | 1.8 | 1.8 | 0.5 | 0.5 | 0.2 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile Back of Q (50%), veh/ln | 0.8 | 0.0 | 2.8 | 2.5 | 0.0 | 5.1 | 1.2 | 9.4 | 9.3 | 0.6 | 3.5 | 0.7 |
| Lane Grp Delay (d), s/veh | 26.0 | 0.0 | 28.7 | 28.0 | 0.0 | 32.9 | 6.8 | 17.3 | 17.3 | 9.0 | 9.7 | 8.0 |
| Lane Grp LOS | C | | C | C | | C | A | B | B | A | A | A |
| Approach Vol, veh/h | | 204 | | | 400 | | | 1383 | | | 932 | |
| Approach Delay, s/veh | | 28.0 | | | 31.2 | | | 15.7 | | | 9.4 | |
| Approach LOS | | C | | | C | | | B | | | A | |

| Timer | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assigned Phs | | 4 | | | 8 | | 5 | 2 | | 1 | 6 | |
| Phs Duration (G+Y+Rc), s | | 20.8 | | | 20.8 | | 9.6 | 52.0 | | 7.5 | 50.0 | |
| Change Period (Y+Rc), s | | 4.0 | | | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | |
| Max Green Setting (Gmax), s | | 21.0 | | | 31.0 | | 6.0 | 41.0 | | 11.0 | 46.0 | |
| Max Q Clear Time (g_c+I1), s | | 8.7 | | | 13.7 | | 5.6 | 21.3 | | 3.7 | 10.7 | |
| Green Ext Time (p_c), s | | 2.7 | | | 3.1 | | 0.0 | 12.9 | | 0.1 | 18.4 | |

| Intersection Summary | | |
|---|---|---|
| HCM 2010 Ctrl Delay | | 16.7 |
| HCM 2010 LOS | | B |

Notes

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 6.4 |

| Movement | EBL | EBR | NBL | NBT | SBT | SBR |
|---|---|---|---|---|---|---|
| Vol, veh/h | 25 | 105 | 180 | 1048 | 757 | 49 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | Free | Free | Free |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 200 | - | 200 | - | - | 200 |
| Veh in Median Storage, # | 0 | - | - | 0 | 0 | - |
| Grade, % | 0 | - | - | 0 | 0 | - |
| Peak Hour Factor | 90 | 90 | 90 | 90 | 90 | 90 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 28 | 117 | 200 | 1164 | 841 | 54 |

| Major/Minor | Minor2 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 2405 | 841 | 841 | 0 | - | 0 |
| Stage 1 | 841 | - | - | - | - | - |
| Stage 2 | 1564 | - | - | - | - | - |
| Follow-up Headway | 3.518 | 3.318 | 2.218 | - | - | - |
| Pot Capacity-1 Maneuver | 36 | 365 | 794 | - | - | - |
| Stage 1 | 423 | - | - | - | - | - |
| Stage 2 | 190 | - | - | - | - | - |
| Time blocked-Platoon, % | | | | - | - | - |
| Mov Capacity-1 Maneuver | # 27 | 365 | 794 | - | - | - |
| Mov Capacity-2 Maneuver | # 27 | - | - | - | - | - |
| Stage 1 | 423 | - | - | - | - | - |
| Stage 2 | 142 | - | - | - | - | - |

| Approach | EB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s | 91.3 | 1.6 | 0 |
| HCM LOS | F | | |

| Minor Lane / Major Mvmt | NBL | NBT | EBLn1 | EBLn2 | SBT | SBR |
|---|---|---|---|---|---|---|
| Capacity (veh/h) | 794 | - | 27 | 365 | - | - |
| HCM Lane V/C Ratio | 0.252 | - | 1.029 | 0.32 | - | - |
| HCM Control Delay (s) | 11.054 | - | $ 393.4 | 19.4 | - | - |
| HCM Lane LOS | B | | F | C | | |
| HCM 95th %tile Q(veh) | 0.997 | - | 3.276 | 1.351 | - | - |

| Notes |
|---|
| ~ : Volume Exceeds Capacity; $ : Delay Exceeds 300 Seconds; Error : Computation Not Defined |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 23.3 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vol, veh/h | 16 | 7 | 81 | 42 | 13 | 25 | 133 | 811 | 73 | 70 | 627 | 33 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Stop | Stop | Stop | Stop | Free | Free | Free | Free | Free | Free |
| RT Channelized | - | - | None | - | - | None | - | - | None | - | - | None |
| Storage Length | 200 | - | - | 200 | - | - | 200 | - | 200 | 200 | - | 200 |
| Veh in Median Storage, # | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Grade, % | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Peak Hour Factor | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 18 | 8 | 90 | 47 | 14 | 28 | 148 | 901 | 81 | 78 | 697 | 37 |

| Major/Minor | Minor2 | | | Minor1 | | | Major1 | | | Major2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conflicting Flow All | 2070 | 2049 | 697 | 2098 | 2049 | 901 | 697 | 0 | 0 | 901 | 0 | 0 |
| Stage 1 | 852 | 852 | - | 1197 | 1197 | - | - | - | - | - | - | - |
| Stage 2 | 1218 | 1197 | - | 901 | 852 | - | - | - | - | - | - | - |
| Follow-up Headway | 3.518 | 4.018 | 3.318 | 3.518 | 4.018 | 3.318 | 2.218 | - | - | 2.218 | - | - |
| Pot Capacity-1 Maneuver | 40 | 56 | 441 | # 38 | 56 | 337 | 899 | - | - | 754 | - | - |
| Stage 1 | 354 | 376 | - | 227 | 259 | - | - | - | - | - | - | - |
| Stage 2 | 221 | 259 | - | 333 | 376 | - | - | - | - | - | - | - |
| Time blocked-Platoon, % | | | | | | | | - | - | | - | - |
| Mov Capacity-1 Maneuver | 22 | 42 | 441 | # 21 | 42 | 337 | 899 | - | - | 754 | - | - |
| Mov Capacity-2 Maneuver | 22 | 42 | - | # 21 | 42 | - | - | - | - | - | - | - |
| Stage 1 | 296 | 337 | - | 190 | 216 | - | - | - | - | - | - | - |
| Stage 2 | 158 | 216 | - | 232 | 337 | - | - | - | - | - | - | - |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| HCM Control Delay, s | 87.1 | $ 424.5 | 1.3 | 1 |
| HCM LOS | F | F | | |

| Minor Lane / Major Mvmt | NBL | NBT | NBR | EBLn1 | EBLn2 | WBLn1 | WBLn2 | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|
| Capacity (veh/h) | 899 | - | - | 22 | 157 | 21 | 50 | 754 | - | - |
| HCM Lane V/C Ratio | 0.164 | - | - | 0.539 | 0.661 | 1.481 | 1.156 | 0.103 | - | - |
| HCM Control Delay (s) | 9.791 | - | - | 289.4 | 64 | $ 639.8 | $ 308.6 | 10.323 | - | - |
| HCM Lane LOS | A | | | F | F | F | F | B | | |
| HCM 95th %tile Q(veh) | 0.586 | - | - | 1.567 | 3.739 | 4.106 | 5.166 | 0.344 | - | - |

| Notes |
|---|
| ~ : Volume Exceeds Capacity; $ : Delay Exceeds 300 Seconds; Error : Computation Not Defined |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 4.2 |

| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Vol, veh/h | 65 | 125 | 185 | 40 | 60 | 145 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | Free | Free | Free |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 200 | - | - | 200 | 200 | - |
| Veh in Median Storage, # | 0 | - | 0 | - | - | 0 |
| Grade, % | 0 | - | 0 | - | - | 0 |
| Peak Hour Factor | 90 | 90 | 90 | 90 | 90 | 90 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 72 | 139 | 206 | 44 | 67 | 161 |

| Major/Minor | Minor1 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 500 | 206 | 0 | 0 | 206 | 0 |
| Stage 1 | 206 | - | - | - | - | - |
| Stage 2 | 294 | - | - | - | - | - |
| Follow-up Headway | 3.518 | 3.318 | - | - | 2.218 | - |
| Pot Capacity-1 Maneuver | 530 | 835 | - | - | 1365 | - |
| Stage 1 | 829 | - | - | - | - | - |
| Stage 2 | 756 | - | - | - | - | - |
| Time blocked-Platoon, % | | | - | - | | - |
| Mov Capacity-1 Maneuver | 504 | 835 | - | - | 1365 | - |
| Mov Capacity-2 Maneuver | 504 | - | - | - | - | - |
| Stage 1 | 829 | - | - | - | - | - |
| Stage 2 | 719 | - | - | - | - | - |

| Approach | WB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s | 11.3 | 0 | 2.3 |
| HCM LOS | B | | |

| Minor Lane / Major Mvmt | NBT | NBR | WBLn1 | WBLn2 | SBL | SBT |
|---|---|---|---|---|---|---|
| Capacity (veh/h) | - | - | 504 | 835 | 1365 | - |
| HCM Lane V/C Ratio | - | - | 0.143 | 0.166 | 0.049 | - |
| HCM Control Delay (s) | - | - | 13.3 | 10.2 | 7.773 | - |
| HCM Lane LOS | | | B | B | A | |
| HCM 95th %tile Q(veh) | - | - | 0.497 | 0.595 | 0.154 | - |

| Notes |
|---|
| ~ : Volume Exceeds Capacity; $ : Delay Exceeds 300 Seconds; Error : Computation Not Defined |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (veh/h) | 95 | 1150 | 65 | 70 | 1375 | 85 | 235 | 35 | 85 | 225 | 30 | 255 |
| Number | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Adj Sat Flow veh/h/ln | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 190.0 | 186.3 | 186.3 | 186.3 |
| Lanes | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| Cap, veh/h | 208 | 2017 | 857 | 251 | 1987 | 844 | 419 | 91 | 221 | 384 | 352 | 365 |
| Arrive On Green | 0.04 | 0.54 | 0.54 | 0.03 | 0.53 | 0.53 | 0.10 | 0.19 | 0.19 | 0.10 | 0.19 | 0.19 |
| Sat Flow, veh/h | 1774 | 3725 | 1583 | 1774 | 3725 | 1583 | 1774 | 484 | 1172 | 1774 | 1863 | 1583 |
| Grp Volume(v), veh/h | 103 | 1250 | 71 | 76 | 1495 | 92 | 255 | 0 | 130 | 245 | 33 | 277 |
| Grp Sat Flow(s),veh/h/ln | 1774 | 1863 | 1583 | 1774 | 1863 | 1583 | 1774 | 0 | 1656 | 1774 | 1863 | 1583 |
| Q Serve(g_s), s | 2.9 | 26.5 | 2.5 | 2.2 | 35.8 | 3.3 | 11.0 | 0.0 | 7.9 | 11.0 | 1.7 | 18.7 |
| Cycle Q Clear(g_c), s | 2.9 | 26.5 | 2.5 | 2.2 | 35.8 | 3.3 | 11.0 | 0.0 | 7.9 | 11.0 | 1.7 | 18.7 |
| Prop In Lane | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 0.71 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 208 | 2017 | 857 | 251 | 1987 | 844 | 419 | 0 | 313 | 384 | 352 | 365 |
| V/C Ratio(X) | 0.50 | 0.62 | 0.08 | 0.30 | 0.75 | 0.11 | 0.61 | 0.00 | 0.42 | 0.64 | 0.09 | 0.76 |
| Avail Cap(c_a), veh/h | 227 | 2017 | 857 | 284 | 1987 | 844 | 419 | 0 | 376 | 384 | 423 | 426 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 1.00 | 0.62 | 0.62 | 0.62 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 19.2 | 18.1 | 12.6 | 14.7 | 20.8 | 13.2 | 34.6 | 0.0 | 40.8 | 35.4 | 38.3 | 41.0 |
| Incr Delay (d2), s/veh | 1.8 | 1.4 | 0.2 | 0.4 | 1.7 | 0.2 | 2.5 | 0.0 | 0.9 | 3.5 | 0.1 | 6.6 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile Back of Q (50%), veh/ln | 1.3 | 11.9 | 0.9 | 0.9 | 16.0 | 1.2 | 1.3 | 0.0 | 3.4 | 1.3 | 0.8 | 8.0 |
| Lane Grp Delay (d), s/veh | 21.1 | 19.6 | 12.8 | 15.1 | 22.5 | 13.4 | 37.2 | 0.0 | 41.7 | 38.9 | 38.4 | 47.6 |
| Lane Grp LOS | C | B | B | B | C | B | D | | D | D | D | D |
| Approach Vol, veh/h | | 1424 | | | 1663 | | | 385 | | | 555 | |
| Approach Delay, s/veh | | 19.3 | | | 21.7 | | | 38.7 | | | 43.2 | |
| Approach LOS | | B | | | C | | | D | | | D | |

| Timer | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assigned Phs | 7 | 4 | | 3 | 8 | | 5 | 2 | | 1 | 6 | |
| Phs Duration (G+Y+Rc), s | 8.8 | 65.9 | | 7.9 | 65.0 | | 15.0 | 25.6 | | 15.0 | 25.6 | |
| Change Period (Y+Rc), s | 4.0 | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | |
| Max Green Setting (Gmax), s | 6.0 | 61.0 | | 6.0 | 61.0 | | 11.0 | 26.0 | | 11.0 | 26.0 | |
| Max Q Clear Time (g_c+I1), s | 4.9 | 28.5 | | 4.2 | 37.8 | | 13.0 | 9.9 | | 13.0 | 20.7 | |
| Green Ext Time (p_c), s | 0.0 | 26.5 | | 0.0 | 19.9 | | 0.0 | 1.7 | | 0.0 | 0.9 | |

| Intersection Summary | |
|---|---|
| HCM 2010 Ctrl Delay | 25.4 |
| HCM 2010 LOS | C |

Notes

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 3.5 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vol, veh/h | 5 | 2 | 11 | 70 | 1 | 60 | 4 | 155 | 25 | 25 | 190 | 2 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Stop | Stop | Stop | Stop | Free | Free | Free | Free | Free | Free |
| RT Channelized | - | - | None | - | - | None | - | - | None | - | - | None |
| Storage Length | 200 | - | - | 200 | - | - | 200 | - | 200 | 200 | - | - |
| Veh in Median Storage, # | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Grade, % | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Peak Hour Factor | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 6 | 2 | 12 | 78 | 1 | 67 | 4 | 172 | 28 | 28 | 211 | 2 |

| Major/Minor | Minor2 | | | Minor1 | | | Major1 | | | Major2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conflicting Flow All | 483 | 449 | 212 | 456 | 450 | 172 | 213 | 0 | 0 | 172 | 0 | 0 |
| Stage 1 | 268 | 268 | - | 181 | 181 | - | - | - | - | - | - | - |
| Stage 2 | 215 | 181 | - | 275 | 269 | - | - | - | - | - | - | - |
| Follow-up Headway | 3.518 | 4.018 | 3.318 | 3.518 | 4.018 | 3.318 | 2.218 | - | - | 2.218 | - | - |
| Pot Capacity-1 Maneuver | 494 | 505 | 828 | 515 | 504 | 872 | 1357 | - | - | 1405 | - | - |
| Stage 1 | 738 | 687 | - | 821 | 750 | - | - | - | - | - | - | - |
| Stage 2 | 787 | 750 | - | 731 | 687 | - | - | - | - | - | - | - |
| Time blocked-Platoon, % | | | | | | | | - | - | | - | - |
| Mov Capacity-1 Maneuver | 448 | 493 | 828 | 497 | 492 | 872 | 1357 | - | - | 1405 | - | - |
| Mov Capacity-2 Maneuver | 448 | 493 | - | 497 | 492 | - | - | - | - | - | - | - |
| Stage 1 | 736 | 673 | - | 819 | 748 | - | - | - | - | - | - | - |
| Stage 2 | 724 | 748 | - | 704 | 673 | - | - | - | - | - | - | - |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| HCM Control Delay, s | 10.8 | 11.6 | 0.2 | 0.9 |
| HCM LOS | B | B | | |

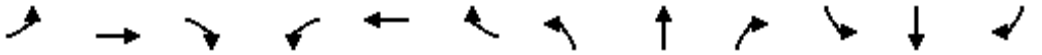
| Minor Lane / Major Mvmt | NBL | NBT | NBR | EBLn1 | EBLn2 | WBLn1 | WBLn2 | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|
| Capacity (veh/h) | 1357 | - | - | 448 | 696 | 497 | 716 | 1405 | - | - |
| HCM Lane V/C Ratio | 0.003 | - | - | 0.008 | 0.023 | 0.104 | 0.131 | 0.02 | - | - |
| HCM Control Delay (s) | 7.662 | - | - | 13.1 | 10.3 | 13.1 | 10.8 | 7.614 | - | - |
| HCM Lane LOS | A | | | B | B | B | B | A | | |
| HCM 95th %tile Q(veh) | 0.01 | - | - | 0.025 | 0.072 | 0.347 | 0.449 | 0.06 | - | - |

| Notes |
|---|
| ~ : Volume Exceeds Capacity; $ : Delay Exceeds 300 Seconds; Error : Computation Not Defined |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 8.2 |
| Intersection LOS | A |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| Entry Lanes | 1 | 1 | 1 | 1 |
| Conflicting Circle Lanes | 1 | 1 | 1 | 1 |
| Adj Approach Flow, veh/h | 154 | 311 | 239 | 392 |
| Demand Flow Rate, veh/h | 157 | 317 | 245 | 400 |
| Vehicles Circulating, veh/h | 560 | 222 | 107 | 229 |
| Vehicles Exiting, veh/h | 69 | 130 | 610 | 310 |
| Follow-Up Headway, s | 3.186 | 3.186 | 3.186 | 3.186 |
| Ped Vol Crossing Leg, #/h | 0 | 0 | 0 | 0 |
| Ped Cap Adj | 1.000 | 1.000 | 1.000 | 1.000 |
| Approach Delay, s/veh | 8.7 | 8.0 | 6.0 | 9.6 |
| Approach LOS | A | A | A | A |

| Lane | Left | Left | Left | Left |
|---|---|---|---|---|
| Designated Moves | LTR | LTR | LTR | LTR |
| Assumed Moves | LTR | LTR | LTR | LTR |
| RT Channelized | | | | |
| Lane Util | 1.000 | 1.000 | 1.000 | 1.000 |
| Critical Headway, s | 5.193 | 5.193 | 5.193 | 5.193 |
| Entry Flow, veh/h | 157 | 317 | 245 | 400 |
| Cap Entry Lane, veh/h | 645 | 905 | 1015 | 899 |
| Entry HV Adj Factor | 0.981 | 0.981 | 0.977 | 0.980 |
| Flow Entry, veh/h | 154 | 311 | 239 | 392 |
| Cap Entry, veh/h | 633 | 888 | 992 | 880 |
| V/C Ratio | 0.243 | 0.350 | 0.241 | 0.445 |
| Control Delay, s/veh | 8.7 | 8.0 | 6.0 | 9.6 |
| LOS | A | A | A | A |
| 95th %tile Queue, veh | 1 | 2 | 1 | 2 |



| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (veh/h) | 410 | 950 | 100 | 80 | 870 | 385 | 110 | 295 | 105 | 600 | 345 | 525 |
| Number | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Adj Sat Flow veh/h/ln | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 |
| Lanes | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 1 |
| Cap, veh/h | 514 | 1804 | 849 | 137 | 1396 | 932 | 178 | 451 | 255 | 736 | 1055 | 685 |
| Arrive On Green | 0.15 | 0.48 | 0.48 | 0.04 | 0.37 | 0.37 | 0.05 | 0.12 | 0.12 | 0.07 | 0.09 | 0.09 |
| Sat Flow, veh/h | 3442 | 3725 | 1583 | 3442 | 3725 | 1583 | 3442 | 3725 | 1583 | 3442 | 3725 | 1583 |
| Grp Volume(v), veh/h | 446 | 1033 | 109 | 87 | 946 | 418 | 120 | 321 | 114 | 652 | 375 | 571 |
| Grp Sat Flow(s),veh/h/ln | 1721 | 1863 | 1583 | 1721 | 1863 | 1583 | 1721 | 1863 | 1583 | 1721 | 1863 | 1583 |
| Q Serve(g_s), s | 14.4 | 22.5 | 3.9 | 2.8 | 24.2 | 16.8 | 3.9 | 9.4 | 7.4 | 21.3 | 10.7 | 32.2 |
| Cycle Q Clear(g_c), s | 14.4 | 22.5 | 3.9 | 2.8 | 24.2 | 16.8 | 3.9 | 9.4 | 7.4 | 21.3 | 10.7 | 32.2 |
| Prop In Lane | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 514 | 1804 | 849 | 137 | 1396 | 932 | 178 | 451 | 255 | 736 | 1055 | 685 |
| V/C Ratio(X) | 0.87 | 0.57 | 0.13 | 0.63 | 0.68 | 0.45 | 0.67 | 0.71 | 0.45 | 0.89 | 0.36 | 0.83 |
| Avail Cap(c_a), veh/h | 606 | 1804 | 849 | 182 | 1396 | 932 | 333 | 525 | 286 | 818 | 1055 | 685 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.33 | 0.33 | 0.33 |
| Upstream Filter(I) | 0.74 | 0.74 | 0.74 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 47.2 | 20.9 | 13.1 | 53.7 | 29.8 | 13.1 | 52.9 | 48.0 | 43.1 | 51.4 | 41.8 | 35.1 |
| Incr Delay (d2), s/veh | 8.6 | 1.0 | 0.2 | 4.7 | 2.7 | 1.6 | 4.4 | 3.7 | 1.2 | 10.7 | 0.2 | 8.7 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile Back of Q (50%), veh/ln | 6.9 | 10.1 | 1.4 | 1.3 | 11.2 | 5.9 | 1.8 | 4.6 | 3.0 | 11.1 | 5.4 | 15.6 |
| Lane Grp Delay (d), s/veh | 55.8 | 21.9 | 13.4 | 58.5 | 32.4 | 14.6 | 57.3 | 51.8 | 44.3 | 62.1 | 42.0 | 43.8 |
| Lane Grp LOS | E | C | B | E | C | B | E | D | D | E | D | D |
| Approach Vol, veh/h | | 1588 | | | 1451 | | | 555 | | | 1598 | |
| Approach Delay, s/veh | | 30.8 | | | 28.9 | | | 51.4 | | | 50.8 | |
| Approach LOS | | C | | | C | | | D | | | D | |

| Timer | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assigned Phs | 7 | 4 | | 3 | 8 | | 5 | 2 | | 1 | 6 | |
| Phs Duration (G+Y+Rc), s | 21.0 | 59.0 | | 8.5 | 46.6 | | 9.9 | 17.8 | | 28.3 | 36.2 | |
| Change Period (Y+Rc), s | 4.0 | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | |
| Max Green Setting (Gmax), s | 20.0 | 55.0 | | 6.0 | 41.0 | | 11.0 | 16.0 | | 27.0 | 32.0 | |
| Max Q Clear Time (g_c+I1), s | 16.4 | 24.5 | | 4.8 | 26.2 | | 5.9 | 11.4 | | 23.3 | 34.2 | |
| Green Ext Time (p_c), s | 0.6 | 19.7 | | 0.0 | 11.5 | | 0.1 | 2.3 | | 1.0 | 0.0 | |

| Intersection Summary | |
|---|---|
| HCM 2010 Ctrl Delay | 38.6 |
| HCM 2010 LOS | D |

Notes

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (veh/h) | 85 | 50 | 265 | 295 | 15 | 155 | 95 | 480 | 115 | 200 | 1025 | 35 |
| Number | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Adj Sat Flow veh/h/ln | 186.3 | 186.3 | 190.0 | 186.3 | 186.3 | 190.0 | 186.3 | 186.3 | 190.0 | 186.3 | 186.3 | 186.3 |
| Lanes | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 2 | 0 | 1 | 2 | 1 |
| Cap, veh/h | 629 | 150 | 433 | 629 | 50 | 518 | 285 | 947 | 416 | 448 | 1755 | 746 |
| Arrive On Green | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.02 | 0.13 | 0.13 | 0.14 | 0.47 | 0.47 |
| Sat Flow, veh/h | 1774 | 424 | 1223 | 1774 | 142 | 1463 | 1774 | 2457 | 1078 | 1774 | 3725 | 1583 |
| Grp Volume(v), veh/h | 92 | 0 | 388 | 590 | 0 | 340 | 103 | 395 | 357 | 400 | 1114 | 38 |
| Grp Sat Flow(s),veh/h/ln | 1774 | 0 | 1647 | 1774 | 0 | 1605 | 1774 | 1863 | 1672 | 1774 | 1863 | 1583 |
| Q Serve(g_s), s | 3.4 | 0.0 | 19.4 | 31.4 | 0.0 | 17.0 | 3.4 | 19.4 | 19.6 | 10.6 | 22.0 | 1.3 |
| Cycle Q Clear(g_c), s | 3.4 | 0.0 | 19.4 | 31.4 | 0.0 | 17.0 | 3.4 | 19.4 | 19.6 | 10.6 | 22.0 | 1.3 |
| Prop In Lane | 1.00 | | 0.74 | 1.00 | | 0.91 | 1.00 | | 0.64 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 629 | 0 | 584 | 629 | 0 | 569 | 285 | 718 | 645 | 448 | 1755 | 746 |
| V/C Ratio(X) | 0.15 | 0.00 | 0.66 | 0.94 | 0.00 | 0.60 | 0.36 | 0.55 | 0.55 | 0.89 | 0.63 | 0.05 |
| Avail Cap(c_a), veh/h | 629 | 0 | 584 | 654 | 0 | 592 | 302 | 718 | 645 | 586 | 1755 | 746 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.33 | 0.33 | 0.33 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 21.5 | 0.0 | 26.6 | 30.5 | 0.0 | 25.8 | 18.3 | 34.7 | 34.7 | 17.5 | 19.5 | 14.0 |
| Incr Delay (d2), s/veh | 0.1 | 0.0 | 2.9 | 21.0 | 0.0 | 1.6 | 0.8 | 3.0 | 3.4 | 13.1 | 1.8 | 0.1 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile Back of Q (50%), veh/ln | 1.6 | 0.0 | 8.4 | 17.6 | 0.0 | 7.0 | 1.5 | 10.5 | 9.5 | 6.0 | 9.9 | 0.5 |
| Lane Grp Delay (d), s/veh | 21.6 | 0.0 | 29.5 | 51.5 | 0.0 | 27.4 | 19.1 | 37.7 | 38.1 | 30.6 | 21.3 | 14.1 |
| Lane Grp LOS | C | | C | D | | C | B | D | D | C | C | B |
| Approach Vol, veh/h | | 480 | | | 930 | | | 855 | | | 1552 | |
| Approach Delay, s/veh | | 28.0 | | | 42.7 | | | 35.6 | | | 23.5 | |
| Approach LOS | | C | | | D | | | D | | | C | |

| Timer | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assigned Phs | | 4 | | | 8 | | 5 | 2 | | 1 | 6 | |
| Phs Duration (G+Y+Rc), s | | 38.6 | | | 38.6 | | 9.1 | 41.7 | | 17.4 | 50.0 | |
| Change Period (Y+Rc), s | | 4.0 | | | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | |
| Max Green Setting (Gmax), s | | 16.0 | | | 36.0 | | 6.0 | 31.0 | | 21.0 | 46.0 | |
| Max Q Clear Time (g_c+I1), s | | 21.4 | | | 33.4 | | 5.4 | 21.6 | | 12.6 | 24.0 | |
| Green Ext Time (p_c), s | | 0.0 | | | 1.2 | | 0.0 | 7.2 | | 0.8 | 13.6 | |

| Intersection Summary | | |
|---|---|---|
| HCM 2010 Ctrl Delay | | 31.5 |
| HCM 2010 LOS | | C |

Notes

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 4.4 |

| Movement | EBL | EBR | NBL | NBT | SBT | SBR |
|---|---|---|---|---|---|---|
| Vol, veh/h | 45 | 215 | 75 | 475 | 925 | 20 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | Free | Free | Free |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 200 | - | 200 | - | - | 200 |
| Veh in Median Storage, # | 0 | - | - | 0 | 0 | - |
| Grade, % | 0 | - | - | 0 | 0 | - |
| Peak Hour Factor | 90 | 90 | 90 | 90 | 90 | 90 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 50 | 239 | 83 | 528 | 1028 | 22 |

| Major/Minor | Minor2 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 1459 | 514 | 1028 | 0 | - | 0 |
| Stage 1 | 1028 | - | - | - | - | - |
| Stage 2 | 431 | - | - | - | - | - |
| Follow-up Headway | 3.52 | 3.32 | 2.22 | - | - | - |
| Pot Capacity-1 Maneuver | 120 | 505 | 671 | - | - | - |
| Stage 1 | 306 | - | - | - | - | - |
| Stage 2 | 623 | - | - | - | - | - |
| Time blocked-Platoon, % | | | | - | - | - |
| Mov Capacity-1 Maneuver | 105 | 505 | 671 | - | - | - |
| Mov Capacity-2 Maneuver | 105 | - | - | - | - | - |
| Stage 1 | 306 | - | - | - | - | - |
| Stage 2 | 546 | - | - | - | - | - |

| Approach | EB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s | 26.8 | 1.5 | 0 |
| HCM LOS | D | | |

| Minor Lane / Major Mvmt | NBL | NBT | EBLn1 | EBLn2 | SBT | SBR |
|---|---|---|---|---|---|---|
| Capacity (veh/h) | 671 | - | 105 | 505 | - | - |
| HCM Lane V/C Ratio | 0.124 | - | 0.476 | 0.473 | - | - |
| HCM Control Delay (s) | 11.124 | - | 67.2 | 18.4 | - | - |
| HCM Lane LOS | B | | F | C | | |
| HCM 95th %tile Q(veh) | 0.423 | - | 2.091 | 2.505 | - | - |

| Notes |
|---|
| ~ : Volume Exceeds Capacity; $ : Delay Exceeds 300 Seconds; Error : Computation Not Defined |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 19.4 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vol, veh/h | 75 | 35 | 125 | 20 | 15 | 10 | 50 | 390 | 35 | 20 | 760 | 30 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Stop | Stop | Stop | Stop | Free | Free | Free | Free | Free | Free |
| RT Channelized | - | - | None | - | - | None | - | - | None | - | - | None |
| Storage Length | 200 | - | - | 200 | - | - | 200 | - | 200 | 200 | - | 200 |
| Veh in Median Storage, # | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Grade, % | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Peak Hour Factor | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 83 | 39 | 139 | 22 | 17 | 11 | 56 | 433 | 39 | 22 | 844 | 33 |

| Major/Minor | Minor2 | | | Minor1 | | | Major1 | | | Major2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conflicting Flow All | 1447 | 1433 | 844 | 1522 | 1433 | 433 | 844 | 0 | 0 | 433 | 0 | 0 |
| Stage 1 | 889 | 889 | - | 544 | 544 | - | - | - | - | - | - | - |
| Stage 2 | 558 | 544 | - | 978 | 889 | - | - | - | - | - | - | - |
| Follow-up Headway | 3.518 | 4.018 | 3.318 | 3.518 | 4.018 | 3.318 | 2.218 | - | - | 2.218 | - | - |
| Pot Capacity-1 Maneuver | 109 | 134 | 363 | 97 | 134 | 623 | 792 | - | - | 1127 | - | - |
| Stage 1 | 338 | 361 | - | 523 | 519 | - | - | - | - | - | - | - |
| Stage 2 | 514 | 519 | - | 301 | 361 | - | - | - | - | - | - | - |
| Time blocked-Platoon, % | | | | | | | | - | - | | - | - |
| Mov Capacity-1 Maneuver | 89 | 122 | 363 | 42 | 122 | 623 | 792 | - | - | 1127 | - | - |
| Mov Capacity-2 Maneuver | 89 | 122 | - | 42 | 122 | - | - | - | - | - | - | - |
| Stage 1 | 314 | 354 | - | 486 | 482 | - | - | - | - | - | - | - |
| Stage 2 | 453 | 482 | - | 162 | 354 | - | - | - | - | - | - | - |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| HCM Control Delay, s | 111.6 | 77.7 | 1 | 0.2 |
| HCM LOS | F | F | | |

| Minor Lane / Major Mvmt | NBL | NBT | NBR | EBLn1 | EBLn2 | WBLn1 | WBLn2 | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|
| Capacity (veh/h) | 792 | - | - | 89 | 203 | 42 | 106 | 1127 | - | - |
| HCM Lane V/C Ratio | 0.07 | - | - | 0.624 | 1.013 | 0.353 | 0.332 | 0.02 | - | - |
| HCM Control Delay (s) | 9.888 | - | - | 97 | 115.5 | 131.7 | 55 | 8.259 | - | - |
| HCM Lane LOS | A | | | F | F | F | F | A | | |
| HCM 95th %tile Q(veh) | 0.226 | - | - | 2.93 | 8.941 | 1.207 | 1.3 | 0.06 | - | - |

| Notes |
|---|
| ~ : Volume Exceeds Capacity; $ : Delay Exceeds 300 Seconds; Error : Computation Not Defined |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 3.8 |

| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Vol, veh/h | 60 | 95 | 215 | 75 | 120 | 245 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | Free | Free | Free |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 200 | - | - | 200 | 200 | - |
| Veh in Median Storage, # | 0 | - | 0 | - | - | 0 |
| Grade, % | 0 | - | 0 | - | - | 0 |
| Peak Hour Factor | 90 | 90 | 90 | 90 | 90 | 90 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 67 | 106 | 239 | 83 | 133 | 272 |

| Major/Minor | Minor1 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 778 | 239 | 0 | 0 | 239 | 0 |
| Stage 1 | 239 | - | - | - | - | - |
| Stage 2 | 539 | - | - | - | - | - |
| Follow-up Headway | 3.518 | 3.318 | - | - | 2.218 | - |
| Pot Capacity-1 Maneuver | 365 | 800 | - | - | 1328 | - |
| Stage 1 | 801 | - | - | - | - | - |
| Stage 2 | 585 | - | - | - | - | - |
| Time blocked-Platoon, % | | | - | - | | - |
| Mov Capacity-1 Maneuver | 328 | 800 | - | - | 1328 | - |
| Mov Capacity-2 Maneuver | 328 | - | - | - | - | - |
| Stage 1 | 801 | - | - | - | - | - |
| Stage 2 | 526 | - | - | - | - | - |

| Approach | WB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s | 13.5 | 0 | 2.6 |
| HCM LOS | B | | |

| Minor Lane / Major Mvmt | NBT | NBR | WBLn1 | WBLn2 | SBL | SBT |
|---|---|---|---|---|---|---|
| Capacity (veh/h) | - | - | 328 | 800 | 1328 | - |
| HCM Lane V/C Ratio | - | - | 0.203 | 0.132 | 0.1 | - |
| HCM Control Delay (s) | - | - | 18.8 | 10.2 | 8.013 | - |
| HCM Lane LOS | | | C | B | A | |
| HCM 95th %tile Q(veh) | - | - | 0.748 | 0.454 | 0.334 | - |

| Notes |
|---|
| ~ : Volume Exceeds Capacity; $ : Delay Exceeds 300 Seconds; Error : Computation Not Defined |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (veh/h) | 290 | 1500 | 215 | 95 | 1390 | 250 | 175 | 50 | 85 | 150 | 45 | 155 |
| Number | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Adj Sat Flow veh/h/ln | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 190.0 | 186.3 | 186.3 | 186.3 |
| Lanes | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| Cap, veh/h | 348 | 2152 | 915 | 210 | 1811 | 770 | 366 | 79 | 135 | 296 | 225 | 409 |
| Arrive On Green | 0.14 | 0.58 | 0.58 | 0.05 | 0.49 | 0.49 | 0.10 | 0.13 | 0.13 | 0.10 | 0.12 | 0.12 |
| Sat Flow, veh/h | 1774 | 3725 | 1583 | 1774 | 3725 | 1583 | 1774 | 620 | 1056 | 1774 | 1863 | 1583 |
| Grp Volume(v), veh/h | 315 | 1630 | 234 | 103 | 1511 | 272 | 190 | 0 | 146 | 163 | 49 | 168 |
| Grp Sat Flow(s),veh/h/ln | 1774 | 1863 | 1583 | 1774 | 1863 | 1583 | 1774 | 0 | 1676 | 1774 | 1863 | 1583 |
| Q Serve(g_s), s | 12.1 | 34.7 | 7.7 | 3.0 | 37.0 | 11.3 | 9.7 | 0.0 | 8.8 | 8.4 | 2.5 | 9.3 |
| Cycle Q Clear(g_c), s | 12.1 | 34.7 | 7.7 | 3.0 | 37.0 | 11.3 | 9.7 | 0.0 | 8.8 | 8.4 | 2.5 | 9.3 |
| Prop In Lane | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 0.63 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 348 | 2152 | 915 | 210 | 1811 | 770 | 366 | 0 | 214 | 296 | 225 | 409 |
| V/C Ratio(X) | 0.91 | 0.76 | 0.26 | 0.49 | 0.83 | 0.35 | 0.52 | 0.00 | 0.68 | 0.55 | 0.22 | 0.41 |
| Avail Cap(c_a), veh/h | 406 | 2152 | 915 | 230 | 1811 | 770 | 366 | 0 | 413 | 308 | 459 | 607 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 1.00 | 0.35 | 0.35 | 0.35 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 32.4 | 16.7 | 11.0 | 17.4 | 23.5 | 16.8 | 34.9 | 0.0 | 44.0 | 35.9 | 41.9 | 32.5 |
| Incr Delay (d2), s/veh | 21.5 | 2.6 | 0.7 | 0.6 | 1.7 | 0.5 | 1.3 | 0.0 | 3.8 | 1.9 | 0.5 | 0.7 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile Back of Q (50%), veh/ln | 6.8 | 15.3 | 2.9 | 1.2 | 16.6 | 4.2 | 4.5 | 0.0 | 4.0 | 3.8 | 1.2 | 3.7 |
| Lane Grp Delay (d), s/veh | 53.9 | 19.3 | 11.7 | 18.0 | 25.2 | 17.3 | 36.3 | 0.0 | 47.8 | 37.8 | 42.4 | 33.2 |
| Lane Grp LOS | D | B | B | B | C | B | D | | D | D | D | C |
| Approach Vol, veh/h | | 2179 | | | 1886 | | | 336 | | | 380 | |
| Approach Delay, s/veh | | 23.5 | | | 23.7 | | | 41.3 | | | 36.3 | |
| Approach LOS | | C | | | C | | | D | | | D | |

| Timer | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assigned Phs | 7 | 4 | | 3 | 8 | | 5 | 2 | | 1 | 6 | |
| Phs Duration (G+Y+Rc), s | 18.5 | 65.0 | | 8.8 | 55.3 | | 15.0 | 17.5 | | 14.3 | 16.8 | |
| Change Period (Y+Rc), s | 4.0 | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | |
| Max Green Setting (Gmax), s | 18.0 | 61.0 | | 6.0 | 49.0 | | 11.0 | 26.0 | | 11.0 | 26.0 | |
| Max Q Clear Time (g_c+I1), s | 14.1 | 36.7 | | 5.0 | 39.0 | | 11.7 | 10.8 | | 10.4 | 11.3 | |
| Green Ext Time (p_c), s | 0.4 | 22.7 | | 0.0 | 9.6 | | 0.0 | 1.5 | | 0.0 | 1.5 | |

| Intersection Summary | |
|---|---|
| HCM 2010 Ctrl Delay | 25.8 |
| HCM 2010 LOS | C |

Notes

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 2.8 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vol, veh/h | 3 | 1 | 7 | 50 | 2 | 40 | 12 | 250 | 80 | 65 | 235 | 5 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Stop | Stop | Stop | Stop | Free | Free | Free | Free | Free | Free |
| RT Channelized | - | - | None | - | - | None | - | - | None | - | - | None |
| Storage Length | 200 | - | - | 200 | - | - | 200 | - | 200 | 200 | - | - |
| Veh in Median Storage, # | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Grade, % | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Peak Hour Factor | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 3 | 1 | 8 | 56 | 2 | 44 | 13 | 278 | 89 | 72 | 261 | 6 |

| Major/Minor | Minor2 | | | Minor1 | | | Major1 | | | Major2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conflicting Flow All | 736 | 712 | 264 | 717 | 715 | 278 | 267 | 0 | 0 | 278 | 0 | 0 |
| Stage 1 | 408 | 408 | - | 304 | 304 | - | - | - | - | - | - | - |
| Stage 2 | 328 | 304 | - | 413 | 411 | - | - | - | - | - | - | - |
| Follow-up Headway | 3.518 | 4.018 | 3.318 | 3.518 | 4.018 | 3.318 | 2.218 | - | - | 2.218 | - | - |
| Pot Capacity-1 Maneuver | 335 | 358 | 775 | 345 | 356 | 761 | 1297 | - | - | 1285 | - | - |
| Stage 1 | 620 | 597 | - | 705 | 663 | - | - | - | - | - | - | - |
| Stage 2 | 685 | 663 | - | 616 | 595 | - | - | - | - | - | - | - |
| Time blocked-Platoon, % | | | | | | | | - | - | | - | - |
| Mov Capacity-1 Maneuver | 298 | 335 | 775 | 324 | 333 | 761 | 1297 | - | - | 1285 | - | - |
| Mov Capacity-2 Maneuver | 298 | 335 | - | 324 | 333 | - | - | - | - | - | - | - |
| Stage 1 | 614 | 564 | - | 698 | 656 | - | - | - | - | - | - | - |
| Stage 2 | 636 | 656 | - | 575 | 562 | - | - | - | - | - | - | - |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| HCM Control Delay, s | 12.4 | 14.4 | 0.3 | 1.7 |
| HCM LOS | B | B | | |

| Minor Lane / Major Mvmt | NBL | NBT | NBR | EBLn1 | EBLn2 | WBLn1 | WBLn2 | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|
| Capacity (veh/h) | 1297 | - | - | 298 | 585 | 324 | 533 | 1285 | - | - |
| HCM Lane V/C Ratio | 0.01 | - | - | 0.007 | 0.017 | 0.114 | 0.122 | 0.056 | - | - |
| HCM Control Delay (s) | 7.804 | - | - | 17.2 | 11.3 | 17.5 | 12.7 | 7.968 | - | - |
| HCM Lane LOS | A | | | C | B | C | B | A | | |
| HCM 95th %tile Q(veh) | 0.031 | - | - | 0.023 | 0.052 | 0.383 | 0.415 | 0.178 | - | - |

| Notes |
|---|
| ~ : Volume Exceeds Capacity; $ : Delay Exceeds 300 Seconds; Error : Computation Not Defined |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 12.3 |
| Intersection LOS | B |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| Entry Lanes | 1 | 1 | 1 | 1 |
| Conflicting Circle Lanes | 1 | 1 | 1 | 1 |
| Adj Approach Flow, veh/h | 104 | 214 | 642 | 407 |
| Demand Flow Rate, veh/h | 106 | 219 | 654 | 415 |
| Vehicles Circulating, veh/h | 499 | 477 | 179 | 252 |
| Vehicles Exiting, veh/h | 168 | 356 | 426 | 444 |
| Follow-Up Headway, s | 3.186 | 3.186 | 3.186 | 3.186 |
| Ped Vol Crossing Leg, #/h | 0 | 0 | 0 | 0 |
| Ped Cap Adj | 1.000 | 1.000 | 1.000 | 1.000 |
| Approach Delay, s/veh | 7.1 | 9.2 | 15.6 | 10.2 |
| Approach LOS | A | A | C | B |

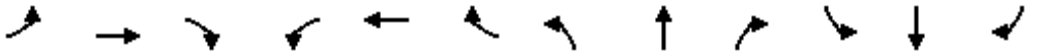
| Lane | Left | Left | Left | Left |
|---|---|---|---|---|
| Designated Moves | LTR | LTR | LTR | LTR |
| Assumed Moves | LTR | LTR | LTR | LTR |
| RT Channelized | | | | |
| Lane Util | 1.000 | 1.000 | 1.000 | 1.000 |
| Critical Headway, s | 5.193 | 5.193 | 5.193 | 5.193 |
| Entry Flow, veh/h | 106 | 219 | 654 | 415 |
| Cap Entry Lane, veh/h | 686 | 701 | 945 | 878 |
| Entry HV Adj Factor | 0.981 | 0.977 | 0.981 | 0.980 |
| Flow Entry, veh/h | 104 | 214 | 642 | 407 |
| Cap Entry, veh/h | 673 | 685 | 927 | 861 |
| V/C Ratio | 0.155 | 0.312 | 0.692 | 0.473 |
| Control Delay, s/veh | 7.1 | 9.2 | 15.6 | 10.2 |
| LOS | A | A | C | B |
| 95th %tile Queue, veh | 1 | 1 | 6 | 3 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (veh/h) | 450 | 1125 | 150 | 140 | 1225 | 695 | 150 | 375 | 85 | 445 | 260 | 360 |
| Number | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Adj Sat Flow veh/h/ln | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 | 186.3 |
| Lanes | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 1 |
| Cap, veh/h | 559 | 1782 | 863 | 215 | 1410 | 867 | 229 | 530 | 324 | 582 | 913 | 645 |
| Arrive On Green | 0.16 | 0.48 | 0.48 | 0.06 | 0.38 | 0.38 | 0.07 | 0.14 | 0.14 | 0.06 | 0.08 | 0.08 |
| Sat Flow, veh/h | 3442 | 3725 | 1583 | 3442 | 3725 | 1583 | 3442 | 3725 | 1583 | 3442 | 3725 | 1583 |
| Grp Volume(v), veh/h | 489 | 1223 | 163 | 152 | 1332 | 755 | 163 | 408 | 92 | 484 | 283 | 391 |
| Grp Sat Flow(s),veh/h/ln | 1721 | 1863 | 1583 | 1721 | 1863 | 1583 | 1721 | 1863 | 1583 | 1721 | 1863 | 1583 |
| Q Serve(g_s), s | 15.0 | 27.6 | 5.7 | 4.7 | 37.5 | 41.0 | 5.0 | 11.4 | 5.3 | 15.1 | 7.8 | 21.0 |
| Cycle Q Clear(g_c), s | 15.0 | 27.6 | 5.7 | 4.7 | 37.5 | 41.0 | 5.0 | 11.4 | 5.3 | 15.1 | 7.8 | 21.0 |
| Prop In Lane | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 559 | 1782 | 863 | 215 | 1410 | 867 | 229 | 530 | 324 | 582 | 913 | 645 |
| V/C Ratio(X) | 0.87 | 0.69 | 0.19 | 0.71 | 0.94 | 0.87 | 0.71 | 0.77 | 0.28 | 0.83 | 0.31 | 0.61 |
| Avail Cap(c_a), veh/h | 635 | 1782 | 863 | 349 | 1410 | 867 | 413 | 585 | 347 | 826 | 1032 | 696 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.33 | 0.33 | 0.33 |
| Upstream Filter(I) | 0.57 | 0.57 | 0.57 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 44.3 | 21.9 | 12.5 | 49.8 | 32.6 | 21.2 | 49.6 | 44.7 | 36.4 | 49.6 | 41.2 | 30.7 |
| Incr Delay (d2), s/veh | 7.3 | 1.3 | 0.3 | 4.2 | 14.0 | 11.7 | 4.1 | 5.6 | 0.5 | 5.0 | 0.2 | 1.3 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile Back of Q (50%), veh/ln | 7.0 | 12.4 | 0.1 | 2.1 | 19.0 | 17.9 | 2.3 | 5.7 | 0.0 | 7.5 | 3.9 | 9.1 |
| Lane Grp Delay (d), s/veh | 51.6 | 23.2 | 12.8 | 54.0 | 46.6 | 32.9 | 53.7 | 50.4 | 36.8 | 54.7 | 41.4 | 32.1 |
| Lane Grp LOS | D | C | B | D | D | C | D | D | D | D | D | C |
| Approach Vol, veh/h | | 1875 | | | 2239 | | | 663 | | | 1158 | |
| Approach Delay, s/veh | | 29.7 | | | 42.5 | | | 49.3 | | | 43.8 | |
| Approach LOS | | C | | | D | | | D | | | D | |

| Timer | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assigned Phs | 7 | 4 | | 3 | 8 | | 5 | 2 | | 1 | 6 | |
| Phs Duration (G+Y+Rc), s | 21.6 | 55.8 | | 10.8 | 45.0 | | 11.2 | 19.4 | | 22.3 | 30.5 | |
| Change Period (Y+Rc), s | 4.0 | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | |
| Max Green Setting (Gmax), s | 20.0 | 50.0 | | 11.0 | 41.0 | | 13.0 | 17.0 | | 26.0 | 30.0 | |
| Max Q Clear Time (g_c+I1), s | 17.0 | 29.6 | | 6.7 | 43.0 | | 7.0 | 13.4 | | 17.1 | 23.0 | |
| Green Ext Time (p_c), s | 0.6 | 18.2 | | 0.2 | 0.0 | | 0.2 | 2.0 | | 1.2 | 3.4 | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 2010 Ctrl Delay | | 39.4 | |
| HCM 2010 LOS | | D | |

Notes



| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (veh/h) | 50 | 30 | 160 | 85 | 55 | 115 | 285 | 1100 | 25 | 60 | 725 | 90 |
| Number | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Adj Sat Flow veh/h/ln | 186.3 | 186.3 | 190.0 | 186.3 | 186.3 | 190.0 | 186.3 | 186.3 | 190.0 | 186.3 | 186.3 | 186.3 |
| Lanes | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 2 | 0 | 1 | 2 | 1 |
| Cap, veh/h | 403 | 83 | 289 | 403 | 123 | 256 | 488 | 2087 | 73 | 333 | 2069 | 879 |
| Arrive On Green | 0.23 | 0.23 | 0.23 | 0.23 | 0.23 | 0.23 | 0.07 | 0.58 | 0.58 | 0.04 | 0.56 | 0.56 |
| Sat Flow, veh/h | 1774 | 366 | 1273 | 1774 | 539 | 1125 | 1774 | 3578 | 126 | 1774 | 3725 | 1583 |
| Grp Volume(v), veh/h | 54 | 0 | 224 | 142 | 0 | 284 | 310 | 622 | 616 | 100 | 788 | 98 |
| Grp Sat Flow(s),veh/h/ln | 1774 | 0 | 1638 | 1774 | 0 | 1664 | 1774 | 1863 | 1841 | 1774 | 1863 | 1583 |
| Q Serve(g_s), s | 2.0 | 0.0 | 10.1 | 5.6 | 0.0 | 13.2 | 6.0 | 17.3 | 17.3 | 2.0 | 9.9 | 2.4 |
| Cycle Q Clear(g_c), s | 2.0 | 0.0 | 10.1 | 5.6 | 0.0 | 13.2 | 6.0 | 17.3 | 17.3 | 2.0 | 9.9 | 2.4 |
| Prop In Lane | 1.00 | | 0.78 | 1.00 | | 0.68 | 1.00 | | 0.07 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 403 | 0 | 372 | 403 | 0 | 378 | 488 | 1087 | 1074 | 333 | 2069 | 879 |
| V/C Ratio(X) | 0.13 | 0.00 | 0.60 | 0.35 | 0.00 | 0.75 | 0.64 | 0.57 | 0.57 | 0.30 | 0.38 | 0.11 |
| Avail Cap(c_a), veh/h | 450 | 0 | 415 | 664 | 0 | 623 | 488 | 1087 | 1074 | 490 | 2069 | 879 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 25.5 | 0.0 | 28.6 | 26.9 | 0.0 | 29.8 | 7.7 | 10.8 | 10.8 | 8.8 | 10.4 | 8.7 |
| Incr Delay (d2), s/veh | 0.1 | 0.0 | 2.0 | 0.5 | 0.0 | 3.0 | 2.7 | 2.2 | 2.2 | 0.5 | 0.5 | 0.3 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile Back of Q (50%), veh/ln | 0.9 | 0.0 | 4.3 | 2.5 | 0.0 | 5.7 | 2.3 | 7.4 | 7.3 | 0.7 | 4.0 | 0.9 |
| Lane Grp Delay (d), s/veh | 25.6 | 0.0 | 30.6 | 27.4 | 0.0 | 32.8 | 10.4 | 13.0 | 13.0 | 9.3 | 10.9 | 9.0 |
| Lane Grp LOS | C | | C | C | | C | B | B | B | A | B | A |
| Approach Vol, veh/h | | 278 | | | 426 | | | 1548 | | | 986 | |
| Approach Delay, s/veh | | 29.7 | | | 31.0 | | | 12.5 | | | 10.6 | |
| Approach LOS | | C | | | C | | | B | | | B | |

| Timer | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assigned Phs | | 4 | | | 8 | | 5 | 2 | | 1 | 6 | |
| Phs Duration (G+Y+Rc), s | | 22.8 | | | 22.8 | | 10.0 | 52.3 | | 7.7 | 50.0 | |
| Change Period (Y+Rc), s | | 4.0 | | | 4.0 | | 4.0 | 4.0 | | 4.0 | 4.0 | |
| Max Green Setting (Gmax), s | | 21.0 | | | 31.0 | | 6.0 | 41.0 | | 11.0 | 46.0 | |
| Max Q Clear Time (g_c+I1), s | | 12.1 | | | 15.2 | | 8.0 | 19.3 | | 4.0 | 11.9 | |
| Green Ext Time (p_c), s | | 2.7 | | | 3.7 | | 0.0 | 14.6 | | 0.1 | 19.5 | |

| Intersection Summary | | |
|---|---|---|
| HCM 2010 Ctrl Delay | | 15.8 |
| HCM 2010 LOS | | B |

Notes

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 9.9 |

| Movement | EBL | EBR | NBL | NBT | SBT | SBR |
|---|---|---|---|---|---|---|
| Vol, veh/h | 25 | 140 | 240 | 1060 | 770 | 50 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | Free | Free | Free |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 200 | - | 200 | - | - | 200 |
| Veh in Median Storage, # | 0 | - | - | 0 | 0 | - |
| Grade, % | 0 | - | - | 0 | 0 | - |
| Peak Hour Factor | 90 | 90 | 90 | 90 | 90 | 90 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 28 | 156 | 267 | 1178 | 856 | 56 |

| Major/Minor | Minor2 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 2567 | 856 | 856 | 0 | - | 0 |
| Stage 1 | 856 | - | - | - | - | - |
| Stage 2 | 1711 | - | - | - | - | - |
| Follow-up Headway | 3.518 | 3.318 | 2.218 | - | - | - |
| Pot Capacity-1 Maneuver | 29 | 357 | 784 | - | - | - |
| Stage 1 | 416 | - | - | - | - | - |
| Stage 2 | 160 | - | - | - | - | - |
| Time blocked-Platoon, % | | | | - | - | - |
| Mov Capacity-1 Maneuver | # 19 | 357 | 784 | - | - | - |
| Mov Capacity-2 Maneuver | # 19 | - | - | - | - | - |
| Stage 1 | 416 | - | - | - | - | - |
| Stage 2 | 106 | - | - | - | - | - |

| Approach | EB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s | 120.2 | 2.2 | 0 |
| HCM LOS | F | | |

| Minor Lane / Major Mvmt | NBL | NBT | EBLn1 | EBLn2 | SBT | SBR |
|---|---|---|---|---|---|---|
| Capacity (veh/h) | 784 | - | 19 | 357 | - | - |
| HCM Lane V/C Ratio | 0.34 | - | 1.462 | 0.436 | - | - |
| HCM Control Delay (s) | 11.94 | - | $ 666.5 | 22.6 | - | - |
| HCM Lane LOS | B | | F | C | | |
| HCM 95th %tile Q(veh) | 1.511 | - | 3.822 | 2.135 | - | - |

| Notes |
|---|
| ~ : Volume Exceeds Capacity; $ : Delay Exceeds 300 Seconds; Error : Computation Not Defined |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 958.6 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vol, veh/h | 50 | 20 | 85 | 45 | 35 | 25 | 140 | 815 | 75 | 70 | 635 | 90 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Stop | Stop | Stop | Stop | Free | Free | Free | Free | Free | Free |
| RT Channelized | - | - | None | - | - | None | - | - | None | - | - | None |
| Storage Length | 200 | - | - | 200 | - | - | 200 | - | 200 | 200 | - | 200 |
| Veh in Median Storage, # | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Grade, % | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Peak Hour Factor | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 56 | 22 | 94 | 50 | 39 | 28 | 156 | 906 | 83 | 78 | 706 | 100 |

| Major/Minor | Minor2 | | | Minor1 | | | Major1 | | | Major2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conflicting Flow All | 2111 | 2078 | 706 | 2136 | 2078 | 906 | 706 | 0 | 0 | 906 | 0 | 0 |
| Stage 1 | 861 | 861 | - | 1217 | 1217 | - | - | - | - | - | - | - |
| Stage 2 | 1250 | 1217 | - | 919 | 861 | - | - | - | - | - | - | - |
| Follow-up Headway | 3.518 | 4.018 | 3.318 | 3.518 | 4.018 | 3.318 | 2.218 | - | - | 2.218 | - | - |
| Pot Capacity-1 Maneuver | # 37 | 53 | 436 | # 36 | 53 | 334 | 892 | - | - | 751 | - | - |
| Stage 1 | 350 | 372 | - | 221 | 253 | - | - | - | - | - | - | - |
| Stage 2 | 212 | 253 | - | 325 | 372 | - | - | - | - | - | - | - |
| Time blocked-Platoon, % | | | | | | | | - | - | | - | - |
| Mov Capacity-1 Maneuver | # 1 | 39 | 436 | # 13 | 39 | 334 | 892 | - | - | 751 | - | - |
| Mov Capacity-2 Maneuver | # 1 | 39 | - | # 13 | 39 | - | - | - | - | - | - | - |
| Stage 1 | 289 | 333 | - | 182 | 209 | - | - | - | - | - | - | - |
| Stage 2 | 131 | 209 | - | 213 | 333 | - | - | - | - | - | - | - |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| HCM Control Delay, s | $ 12207.4 | $ 995.1 | 1.3 | 0.9 |
| HCM LOS | F | F | | |

| Minor Lane / Major Mvmt | NBL | NBT | NBR | EBLn1 | EBLn2 | WBLn1 | WBLn2 | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|
| Capacity (veh/h) | 892 | - | - | 1 | 7 | 13 | 35 | 751 | - | - |
| HCM Lane V/C Ratio | 0.174 | - | - | 37.037 | 19.312 | 2.564 | 2.381 | 0.104 | - | - |
| HCM Control Delay (s) | 9.886 | - | | $ 22926.9 | $ 9270.5 | $ 1299.7 | $ 873.3 | 10.347 | - | - |
| HCM Lane LOS | A | | | F | F | F | F | B | | |
| HCM 95th %tile Q(veh) | 0.629 | - | - | 6.607 | 18.73 | 5.028 | 9.375 | 0.345 | - | - |

| Notes |
|---|
| ~ : Volume Exceeds Capacity; $ : Delay Exceeds 300 Seconds; Error : Computation Not Defined |

# PHASE 2 DRAINAGE REPORT
# COLLIERS HILL FILING 4
# ERIE, COLORADO

**Prepared For:**
Daybreak Recovery Acquisition, LLC
c/o Raintree Investments Corp.
7200 S. Alton Way
Suite C-400
Centennial, CO 80112

**Prepared By:**
Hurst and Associates, Inc.
2500 Broadway
Suite B
Boulder, Colorado 80304

Job Number 2527-02
September 14, 2015
Revised January 15, 2016

## ENGINEER'S CERTIFICATION

I hereby certify that this Phase 2 drainage report for the design of Colliers Hill Extension and Colliers Hill Filing 4 was prepared by me (or under my direct supervision) in accordance with the provisions of the *Town of Erie Standards and Specifications* for the owners thereof. I understand that the Town of Erie does not and will not assume liability for drainage facilities designed by others, including the designs presented in this report.

John W. Jorgenson, P.E.
Colorado License #22730

## TOWN ACCEPTANCE

This report has been reviewed and found to be in general compliance with the *Town of Erie Standards and Specifications for Design and Construction* and other Town requirements. **THE ACCURACY AND VALIDITY OF THE ENGINEERING DESIGN, DETAILS, DIMENSIONS, QUANTITIES, AND CONCEPTS IN THIS REPORT REMAINS THE SOLE RESPONSIBILITY OF THE PROFESSIONAL ENGINEER WHOSE STAMP AND SIGNATURE APPEAR HEREON.**

Accepted by: _____ _____
Deputy Public Works Director Date

## *I. GENERAL LOCATION AND DESCRIPTION*

Colliers Hill (formerly Daybreak and Bridgewater) is a 940 acre residential community located within Sections 8, 17 and 18, Township 1 North, Range 68 West. Sections 8, 17 and 18 are contiguous and located just east of Old Town Erie, north of Erie Parkway and west of Weld County Road 5. The proposed development has a maximum overall density of 2880 residential units. Filings 1, 2 and 3 are currently being developed. The remaining areas are undeveloped with native vegetation and crop land. This drainage report analyzes the drainage facilities required for Colliers Hill Filing 4 and the construction of the regional drainage channel between Colliers Parkway and WCR 10. This report analyzes the impact of storm events only, and is not intended to analyze effects of future irrigation, final lot grading or ground water conditions.

## *II. DRAINAGE BASINS*

Colliers Hill Filing 4 lies within Boulder Creek Drainage Basin. Colliers Hill Filing 4 does not lie within the 100-year floodplain per FIRM Maps 08013C0442J and 08013C0441J dated December 18, 2012. There are no designated wetlands within the proposed development.

Storm runoff from Colliers Hill Filing 4 drains to the proposed regional channel located within the open space area. Storm sewers will intercept the minor storm events and outfall into this channel. The proposed channel is located within the existing drainageway. All storm runoff is conveyed to the proposed regional detention pond located just south of WCR 10. The storm sewer will primarily be designed for the minor storm event except for the residential area west of WCR 3. The storm sewer for this area will convey the 100-year storm event across WCR 3 and will outfall into the regional detention pond.

The Colliers Hill development is located within the study area of the Erie Outfall Systems Planning Preliminary Design (OSP) prepared by Love and Associates, Inc., December, 2007. The drainage concept for Colliers Hill generally follows the concepts presented in the OSP. All upstream basins south of Erie Parkway are required to have upstream on-site detention. The drainage model (UDSWM) presented in the **Appendix F**

of this report uses the rates presented in the OSP for runoff calculations through the Colliers Hill site.

Upstream of Colliers Hill, OSP Basins 430, 431, and 432 will be conveyed under Erie Parkway using a 63"x98" HERCP (replacing an existing 66 inch CMP) and an existing 42 inch pipe. The pipe system will have adequate capacity to carry the upstream 100 year future runoff. A grass lined channel with grade control structures will be provided from this point through Colliers Hill to WCR 10. The temporary detention pond constructed with Colliers Hill Filing 3 located just north of Colliers Hill Parkway will be removed after regional detention is constructed. The regional detention will be constructed at the north end of Colliers Hill Filing 4 just south of Weld County Road 10. The OSP calls for two detention ponds within this reach which mimicked the original drainage concept plan for Colliers Hill presented in 2006. We believe using one larger pond is a more efficient design with the updated Colliers Hill development concept. Colliers Hill on-site Basins PA1, PA2, PA3 (OSP Basins 435,436,437,438) and upstream OSP Basins 430,431,432,433,434 all drain to this future regional pond. The pond is sized for these basins considering upstream detention and a small portion of OSP Basins 280 and 281. We think it is a much better design to direct the runoff from this basin west of WCR 3 to the regional detention due to the potential difficulty in preventing erosion along the steep hillside in the Town's space area. Directing developed runoff down this slope would require extensive drops, armoring or extensive piping to Coal Creek. The regional detention pond volume considers this area and the release rates are consistent with historic runoff rates.

## *III. DRAINAGE DESIGN CRITERIA*

For onsite and offsite basins greater than 90 acres, The Colorado Urban Hydrograph Procedure (CUHP) was used to determine storm runoff. The Rational Method was used to determine storm runoff for basins less than 90 acres. These methods are presented in *The Urban Drainage and Flood Control Criteria Manual* and *Town of Erie Design Standards*. The onsite streets, storm pipes, and inlets will be designed considering a 2-year minor storm event and a 100-year major storm event.

The onsite major basins, offsite basins, regional drainage channels, and regional detention pond were analyzed using The Urban Drainage Storm Water Management Model (UDSWM).

## *IV. DRAINAGE FACILITY DESIGN*

This regional detention pond is sized using the CUHP and SWMM Model in accordance with the OSP and the *Urban Storm Drainage Criteria Manual.* Full spectrum detention design as described in the *Urban Storm Drainage Criteria Manual, Volume 2* will be used. The excess Urban Runoff Volume (EURV) will be captured and released over approximately 72 hours. The EURV release rates simulate historic minor storm rates. The 100-year volume was determined by the SWMM Model using the release rate specified in the OPS. See **Appendix B**.

**Regional Detention Pond Characteristics**

| **EURV Vol.** | **100-Yr Vol.** | **100-Yr Release** |
|---|---|---|
| 17.5 ac-ft | 62.8 ac-ft | 92.3 cfs |

## *V. REGIONAL CHANNEL/GRADE CONTROL DESIGN*

The regional channel has been designed using the 100 year flow rates in the OSP and Colliers Hill Filing 4 Development. A low flow channel has been incorporated into the channel design. Details are shown in the Appendix. The low flow channel consists of a wetland bottom with riprap armored sideslopes that will carry the 2 year projected storm runoff. The drop structures are sloping riprap at 6:1 channel slopes with a maximum 4' grade difference. We investigated several drop structure configurations and decided the sloping drop is more appropriate for the natural open space area. A trail is incorporated in the open space with the channel and native vegetation. The drop structure design is the same as approved for Colliers Hill Filing 3. The drop structure is shown in the appendix. The regional channel north of Colliers Filing 4 will need to be constructed from WCR 10 to the RTD railroad culvert. The channel will not require drop structures.

## *VI. SUMMARY*

The Colliers Hill Filing 4 drainage facilities are designed to capture developed runoff and mimic the historical rates for minor and major storm events. The facilities generally conform to the Town of Erie's outfall system plan. All facilities will be designed using Urban Drainage and Town of Erie Criteria.

This report presents drainage facilities designed for storm events only. The facilities are not designed for any excess irrigation water or subsurface drainage.

## *VI. REFERENCES*


1. Town of Erie, Colorado. 2013. *Standards and Specifications for Design and Construction of Public Improvements.*
2. Urban Drainage and Flood Control District. June 2001, Revised April 2008. *Urban Storm Drainage Criteria Manual Volumes 1 and 2.*
3. Urban Drainage and Flood Control District. November 2010. *Urban Storm Drainage Criteria Manual Volume 3, Best Management Practices.*
4. Love & Associates, Inc. February 2007. *Erie and Adjacent Areas Outfall System Planning.*
5. Hurst & Associates, Inc. September 8, 2011. *Bridgewater Filing 1 Preliminary Drainage Report.*
6. Hurst & Associates, Inc. May 13, 2013. *Daybreak Filings 1 & 2 Final Drainage Report.*
7. Hurst & Associates, Inc. April 10, 2015 *Phase 3 Drainage Report Colliers Hill Filing 3 & Colliers Hill Parkway Extension.*


## *VII. APPENDICES*


Rational Method Runoff Analysis.....**Appendix A**

Regional Detention Pond .....**Appendix B**

Regional Drainage Channel .....**Appendix C**

Regional Channel Drop Structure .....**Appendix D**

CUHP Analysis.....**Appendix E**

UDSWM Analysis.....**Appendix F**

Historic Runoff Analysis.....**Appendix G**

Maps.....**Appendix H**


1. Vicinity Map
2. FIRM Map
3. Colliers Hill Filing 4 Drainage Plans (Map Pocket)
4. Colliers Hill Overall Drainage Plan (Map Pocket)

# APPENDIX A
# RATIONAL METHOD
# RUNOFF CALCULATIONS

## Basin Runoff Coefficients

Colliers Hill-Fil 4
Job # 2527-02

| Land Use | $C_2$ | $C_5$ | $C_{100}$ | % Imperviousness |
|---|---|---|---|---|
| Concrete & Asphalt | 0.87 | 0.88 | 0.93 | 100 |
| Roofs | 0.80 | 0.85 | 0.90 | 90 |
| Lawns / Landscaping | 0.05 | 0.15 | 0.50 | 0 |
| Amenity Area | 0.60 | 0.65 | 0.80 | 70 |
| Park | 0.10 | 0.18 | 0.45 | 7 |
| School | 0.45 | 0.50 | 0.70 | 50 |
| Single-Family Residential | 0.40 | 0.45 | 0.60 | 45 |

| Basin | Area (acres) | Concrete & Asphalt (acres) | Roof (acres) | Lawns (acres) | Amenity Area (acres) | Park (acres) | School (acres) | SFR (acres) | $C_2$ | $C_5$ | $C_{100}$ | % Imper-iousness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D1 | 1.53 | 0.23 | | 0.32 | | | | 0.98 | 0.40 | 0.45 | 0.63 | 43.7 |
| D2 | 1.60 | | | | | | | 1.60 | 0.40 | 0.45 | 0.60 | 45.0 |
| D3 | 0.92 | | | | | | | 0.92 | 0.40 | 0.45 | 0.60 | 45.0 |
| D4 | 2.34 | | | | | | | 2.34 | 0.40 | 0.45 | 0.60 | 45.0 |
| D5 | 1.67 | | | | | | | 1.67 | 0.40 | 0.45 | 0.60 | 45.0 |
| D6 | 1.29 | | | | | | | 1.29 | 0.40 | 0.45 | 0.60 | 45.0 |
| D7 | 1.33 | | | | | | | 1.33 | 0.40 | 0.45 | 0.60 | 45.0 |
| D8 | 1.98 | | | | | | | 1.98 | 0.40 | 0.45 | 0.60 | 45.0 |
| D9 | 5.76 | | | | | | | 5.76 | 0.40 | 0.45 | 0.60 | 45.0 |
| D10 | 2.65 | | | | | | | 2.65 | 0.40 | 0.45 | 0.60 | 45.0 |
| D11 | 2.52 | | | | | | | 2.52 | 0.40 | 0.45 | 0.60 | 45.0 |
| D12 | 0.77 | 0.39 | | 0.38 | | | | 0.77 | 0.87 | 0.97 | 1.32 | 95.7 |
| D12A | 0.80 | 0.28 | | 0.39 | | | | 0.13 | 0.39 | 0.45 | 0.67 | 42.2 |
| D13 | 0.60 | | | | | | | 0.60 | 0.40 | 0.45 | 0.60 | 45.0 |
| D14 | 1.20 | | | | | | | 1.20 | 0.40 | 0.45 | 0.60 | 45.0 |
| D15 | 1.97 | | | | | | | 1.97 | 0.40 | 0.45 | 0.60 | 45.0 |
| D15A | 1.07 | | | | | | | 1.07 | 0.40 | 0.45 | 0.60 | 45.0 |
| D16 | 1.56 | | | | | | | 1.56 | 0.40 | 0.45 | 0.60 | 45.0 |
| D17 | 1.66 | | | | | | | 1.66 | 0.40 | 0.45 | 0.60 | 45.0 |
| D18 | 1.62 | 0.19 | | 0.32 | | | | 1.11 | 0.39 | 0.44 | 0.62 | 42.6 |
| D19 | 3.11 | 0.28 | | 0.51 | | | | 2.32 | 0.38 | 0.44 | 0.61 | 42.5 |
| D20 | 3.24 | | | | | | | 3.24 | 0.40 | 0.45 | 0.60 | 45.0 |
| D21 | 1.58 | | | | | | | 1.58 | 0.40 | 0.45 | 0.60 | 45.0 |
| D22 | 2.63 | | | | | | | 2.63 | 0.40 | 0.45 | 0.60 | 45.0 |
| D23 | 0.97 | | | | | | | 0.97 | 0.40 | 0.45 | 0.60 | 45.0 |
| D24 | 2.99 | | | | | | | 2.99 | 0.40 | 0.45 | 0.60 | 45.0 |
| D25 | 1.29 | | | | | | | 1.29 | 0.40 | 0.45 | 0.60 | 45.0 |
| D26 | 0.85 | | | | | | | 0.85 | 0.40 | 0.45 | 0.60 | 45.0 |
| D27 | 1.59 | | | | | | | 1.59 | 0.40 | 0.45 | 0.60 | 45.0 |
| D28 | 2.72 | 0.48 | | 1.93 | | | | 0.31 | 0.23 | 0.31 | 0.59 | 22.8 |
| D29 | 0.99 | | | | | | | 0.99 | 0.40 | 0.45 | 0.60 | 45.0 |
| D30 | 3.77 | | | | | | | 3.77 | 0.40 | 0.45 | 0.60 | 45.0 |
| D31 | 1.86 | | | | | | | 1.86 | 0.40 | 0.45 | 0.60 | 45.0 |
| D32 | 3.30 | | | | | | | 3.30 | 0.40 | 0.45 | 0.60 | 45.0 |
| D33 | 1.61 | | | | | | | 1.61 | 0.40 | 0.45 | 0.60 | 45.0 |
| D34 | 0.89 | 0.17 | | 0.27 | | | | 0.45 | 0.39 | 0.44 | 0.63 | 42.1 |
| D35 | 0.96 | | | | | | | 0.96 | 0.40 | 0.45 | 0.60 | 45.0 |
| D36 | 1.33 | | | | | | | 1.33 | 0.40 | 0.45 | 0.60 | 45.0 |
| D37 | 2.21 | 0.04 | | 0.16 | | | | 2.01 | 0.38 | 0.44 | 0.60 | 42.7 |
| D38 | 1.21 | 0.13 | | 0.13 | | | | 0.95 | 0.41 | 0.46 | 0.62 | 46.0 |
| D39 | 1.21 | 0.40 | | 0.13 | | | | 0.68 | 0.52 | 0.56 | 0.70 | 58.1 |

| Basin | Area (acres) | Concrete & Asphalt (acres) | Roof (acres) | Lawns (acres) | Amenity Area (acres) | Park (acres) | School (acres) | SFR (acres) | $C_2$ | $C_5$ | $C_{100}$ | % Imper-iousness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D40 | 5.34 | 0.14 | | 1.21 | | | | 3.99 | 0.33 | 0.39 | 0.59 | 36.2 |
| D41 | 2.50 | 1.56 | | 0.94 | | | | | 0.56 | 0.61 | 0.77 | 62.4 |
| D42 | 2.08 | | | | | | | 2.08 | 0.40 | 0.45 | 0.60 | 45.0 |
| D43 | 3.03 | | | | | | | 3.03 | 0.40 | 0.45 | 0.60 | 45.0 |
| D44 | 2.29 | | | | | | | 2.29 | 0.40 | 0.45 | 0.60 | 45.0 |
| D45 | 0.38 | | | | | | | 0.38 | 0.40 | 0.45 | 0.60 | 45.0 |
| D46 | 4.98 | | | | | | | 4.98 | 0.40 | 0.45 | 0.60 | 45.0 |
| D47 | 2.04 | | | | | | | 2.04 | 0.40 | 0.45 | 0.60 | 45.0 |
| D48 | 1.32 | 0.11 | | 0.03 | | | | 1.18 | 0.43 | 0.48 | 0.63 | 48.6 |
| D49 | 1.41 | 0.13 | | 0.03 | | | | 1.25 | 0.44 | 0.48 | 0.63 | 49.3 |
| D50 | 0.56 | 0.26 | | 0.30 | | | | 0.56 | 0.83 | 0.94 | 1.30 | 91.2 |
| D51 | 0.83 | 0.28 | | 0.55 | | | | 0 | 0.33 | 0.40 | 0.65 | 33.9 |
| D52 | 2.21 | | | | | | | 2.21 | 0.40 | 0.45 | 0.60 | 45.0 |
| D53 | 2.99 | | | | | | | 2.99 | 0.40 | 0.45 | 0.60 | 45.0 |
| D54 | 0.54 | 0.19 | | 0.35 | | | | 0.54 | 0.74 | 0.86 | 1.25 | 80.6 |
| D55 | 0.29 | | | | | | | 0.29 | 0.40 | 0.45 | 0.60 | 45.0 |
| D56 | 3.32 | 0.08 | | 0.55 | | | | 2.69 | 0.35 | 0.41 | 0.59 | 39.0 |
| D57 | 2.28 | 0.62 | | 1.66 | | | | 2.28 | 0.67 | 0.80 | 1.22 | 72.2 |
| D57A | 9.83 | | | | | | 9.83 | | 0.45 | 0.50 | 0.70 | 50.0 |
| D58 | 3.30 | 0.16 | | 0.09 | | | | 3.05 | 0.41 | 0.46 | 0.61 | 46.5 |
| D59 | 2.14 | 0.16 | | 0.08 | | | | 1.89 | 0.42 | 0.47 | 0.62 | 47.5 |
| D60 | 3.91 | | | | | | | 3.9 | 0.40 | 0.45 | 0.60 | 45.0 |
| D61 | 2.81 | | | | | | | 2.81 | 0.40 | 0.45 | 0.60 | 45.0 |
| D62 | 3.38 | | | | | | | 3.38 | 0.40 | 0.45 | 0.60 | 45.0 |
| D63 | 2.13 | | | | | | | 2.13 | 0.40 | 0.45 | 0.60 | 45.0 |
| D64 | 4.80 | 1.16 | | 2.01 | | | | 1.63 | 0.37 | 0.43 | 0.64 | 39.4 |
| D65 | 0.26 | 0.22 | | 0.04 | | | | | 0.74 | 0.76 | 0.86 | 83.6 |
| E1 | 1.15 | 0.19 | | 0.31 | | | | 0.66 | 0.38 | 0.44 | 0.63 | 41.7 |
| E2 | 0.47 | | | | | | | 0.47 | 0.40 | 0.45 | 0.60 | 45.0 |
| E3 | 2.79 | | | | | | | 2.79 | 0.40 | 0.45 | 0.60 | 45.0 |
| E4 | 0.38 | | | | | | | 0.38 | 0.40 | 0.45 | 0.60 | 45.0 |
| E5 | 1.16 | | | | | | | 1.16 | 0.40 | 0.45 | 0.60 | 45.0 |
| E6 | 1.67 | | | | | | | 1.67 | 0.40 | 0.45 | 0.60 | 45.0 |
| E7 | 3.11 | | | | | | | 3.11 | 0.40 | 0.45 | 0.60 | 45.0 |
| E8 | 0.27 | | | | | | | 0.27 | 0.40 | 0.45 | 0.60 | 45.0 |
| E9 | 3.35 | | | | | | | 3.35 | 0.40 | 0.45 | 0.60 | 45.0 |
| E10 | 0.97 | | | | | | | 0.97 | 0.40 | 0.45 | 0.60 | 45.0 |
| E11 | 1.38 | 0.13 | | 0.05 | | | | 1.20 | 0.43 | 0.48 | 0.63 | 48.8 |
| E12 | 0.38 | 0.30 | | 0.08 | | | | | 0.70 | 0.73 | 0.84 | 79.6 |
| E13 | 0.18 | 0.15 | | 0.03 | | | | | 0.73 | 0.75 | 0.86 | 82.7 |
| E14 | 5.33 | 0.89 | | 3.84 | | | | 0.60 | 0.23 | 0.31 | 0.58 | 21.8 |
| E15 | 2.06 | 0.91 | | 1.15 | | | | | 0.41 | 0.47 | 0.69 | 44.1 |
| E16 | 2.74 | | | | | | | 2.74 | 0.40 | 0.45 | 0.60 | 45.0 |
| E17 | 5.42 | | | 4.53 | | | | 0.88 | 0.11 | 0.20 | 0.52 | 7.3 |
| E18 | 2.00 | 0.16 | | 1.84 | | | | | 0.12 | 0.21 | 0.54 | 8.1 |
| E19 | 1.09 | 0.08 | | 0.03 | | | | 0.99 | 0.43 | 0.47 | 0.62 | 47.9 |
| E20 | 0.82 | 0.59 | | 0.23 | | | | | 0.64 | 0.67 | 0.81 | 71.8 |
| E21 | 1.33 | | | | | | | 1.33 | 0.40 | 0.45 | 0.60 | 45.0 |
| E22 | 3.54 | | | | | | | 3.54 | 0.40 | 0.45 | 0.60 | 45.0 |
| E23 | 1.46 | 0.49 | | 0.96 | | | | | 0.33 | 0.40 | 0.65 | 33.8 |
| E24 | 0.47 | 0.09 | | 0.22 | | | | 0.16 | 0.32 | 0.39 | 0.61 | 34.0 |
| E25 | 5.38 | | | 1.80 | | | | 3.58 | 0.28 | 0.35 | 0.57 | 30.0 |

| Basin | Area (acres) | Concrete & Asphalt (acres) | Roof (acres) | Lawns (acres) | Amenity Area (acres) | Park (acres) | School (acres) | SFR (acres) | $C_2$ | $C_5$ | $C_{100}$ | % Imper-iousness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **E26** | 1.80 | | | | | | | 1.80 | **0.40** | **0.45** | **0.60** | **45.0** |
| **E27** | 2.06 | | | | | | | 2.06 | **0.40** | **0.45** | **0.60** | **45.0** |
| **E28** | 0.28 | 0.21 | | 0.07 | | | | | **0.66** | **0.70** | **0.82** | **75.0** |
| **E29** | 0.71 | 0.53 | | 0.18 | | | | | **0.67** | **0.70** | **0.82** | **75.0** |
| Total | 199.85 | 12.38 | 0.00 | 27.69 | 0.00 | 0.00 | 9.83 | 154.10 | 0.39 | 0.45 | 0.62 | 43.4 |

## Basin Times of Concentration Calculations

| Basin | $C_5$ | Overland Flow | | | Travel Time in Channel | | | | $T_c$ (mins) | $T_c$ Check | | Final $T_c$ (min = 5 mins) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Length (ft) | Slope (%) | $T_l$ (fig.3-1) (mins) | Length (ft) | Slope (%) | Velocity (ft/sec) (fig.3-2) | $T_t$ (mins) | | Total Length (ft) | $T_c$ = (L/180)+10 (mins) | |
| D1 | 0.45 | 50 | 2.0 | 6.6 | 960 | 1.0 | 2.0 | 8.0 | 14.6 | 1010 | 15.6 | **14.6** |
| D2 | 0.45 | 205 | 2.5 | 12.3 | 340 | 1.0 | 2.0 | 2.8 | 15.2 | 545 | 13.0 | **13.0** |
| D3 | 0.45 | 50 | 2.0 | 6.6 | 560 | 1.0 | 2.0 | 4.7 | 11.2 | 610 | 13.4 | **11.2** |
| D4 | 0.45 | 50 | 2.0 | 6.6 | 1210 | 1.0 | 2.0 | 10.1 | 16.6 | 1260 | 17.0 | **16.6** |
| D5 | 0.45 | 16 | 2.0 | 3.7 | 560 | 0.8 | 1.8 | 5.2 | 8.9 | 576 | 13.2 | **8.9** |
| D6 | 0.45 | 22 | 2.0 | 4.4 | 1140 | 1.9 | 2.7 | 7.0 | 11.4 | 1162 | 16.5 | **11.4** |
| D7 | 0.45 | 52 | 2.0 | 6.7 | 1140 | 1.9 | 2.7 | 7.0 | 13.7 | 1192 | 16.6 | **13.7** |
| D8 | 0.45 | 210 | 1.8 | 13.9 | 390 | 1.5 | 2.4 | 2.7 | 16.6 | 600 | 13.3 | **13.3** |
| D9 | 0.45 | 125 | 2.4 | 9.8 | 1175 | 2.1 | 2.8 | 7.0 | 16.8 | 1300 | 17.2 | **16.8** |
| D10 | 0.45 | 60 | 2.0 | 7.2 | 795 | 2.5 | 3.1 | 4.3 | 11.5 | 855 | 14.8 | **11.5** |
| D11 | 0.45 | 195 | 3.1 | 11.2 | 480 | 1.5 | 3.1 | 2.6 | 13.8 | 675 | 13.8 | **13.8** |
| D12 | 0.97 | 30 | 2.0 | 1.0 | 540 | 1.0 | 2.0 | 4.5 | 5.5 | 570 | 13.2 | **5.5** |
| D12A | 0.45 | 50 | 5.0 | 4.8 | 465 | 1.4 | 2.3 | 3.4 | 8.2 | 515 | 12.9 | **8.2** |
| D13 | 0.45 | 34 | 2.0 | 5.4 | 350 | 1.2 | 2.1 | 2.8 | 8.2 | 384 | 12.1 | **8.2** |
| D14 | 0.45 | 160 | 2.5 | 10.9 | 310 | 2.6 | 3.2 | 1.6 | 12.5 | 470 | 12.6 | **12.5** |
| D15 | 0.45 | 175 | 3.3 | 10.4 | 600 | 1.7 | 2.6 | 3.8 | 14.2 | 775 | 14.3 | **14.2** |
| D15A | 0.45 | 180 | 2.0 | 12.5 | 310 | 4.2 | 4.0 | 1.3 | 13.8 | 490 | 12.7 | **12.7** |
| D16 | 0.45 | 95 | 2.0 | 9.1 | 590 | 2.6 | 3.2 | 3.1 | 12.1 | 685 | 13.8 | **12.1** |
| D17 | 0.45 | 310 | 2.5 | 15.2 | 325 | 3.3 | 3.6 | 1.5 | 16.7 | 635 | 13.5 | **13.5** |
| D18 | 0.44 | 95 | 2.5 | 8.5 | 810 | 1.0 | 2.0 | 6.8 | 15.3 | 905 | 15.0 | **15.0** |
| D19 | 0.44 | 60 | 2.0 | 7.3 | 830 | 1.1 | 2.0 | 6.9 | 14.2 | 890 | 14.9 | **14.2** |
| D20 | 0.45 | 250 | 1.6 | 15.8 | 990 | 1.0 | 2.0 | 8.3 | 24.1 | 1240 | 16.9 | **16.9** |
| D21 | 0.45 | 85 | 8.0 | 5.4 | 905 | 1.7 | 3.2 | 4.7 | 10.1 | 990 | 15.5 | **10.1** |
| D22 | 0.45 | 115 | 2.5 | 9.2 | 600 | 1.5 | 2.4 | 4.2 | 13.4 | 715 | 14.0 | **13.4** |
| D23 | 0.45 | 50 | 2.0 | 6.6 | 625 | 1.3 | 2.2 | 4.7 | 11.3 | 675 | 13.8 | **11.3** |
| D24 | 0.45 | 213 | 1.2 | 16.1 | 455 | 1.0 | 2.0 | 3.8 | 19.9 | 668 | 13.7 | **13.7** |
| D25 | 0.45 | 50 | 2.0 | 6.6 | 520 | 0.9 | 1.9 | 4.6 | 11.1 | 570 | 13.2 | **11.1** |
| D26 | 0.45 | 60 | 2.0 | 7.2 | 455 | 1.0 | 2.0 | 3.8 | 11.0 | 515 | 12.9 | **11.0** |
| D27 | 0.45 | 130 | 2.3 | 10.1 | 405 | 1.3 | 2.2 | 3.1 | 13.2 | 535 | 13.0 | **13.0** |
| D28 | 0.31 | 160 | 1.6 | 15.3 | 665 | 1.4 | 2.3 | 4.8 | 20.1 | 825 | 14.6 | **14.6** |
| D29 | 0.45 | 50 | 2.0 | 6.6 | 700 | 1.5 | 2.4 | 4.9 | 11.4 | 750 | 14.2 | **11.4** |
| D30 | 0.45 | 120 | 2.4 | 9.6 | 820 | 1.1 | 2.0 | 6.8 | 16.4 | 940 | 15.2 | **15.2** |
| D31 | 0.45 | 50 | 2.0 | 6.6 | 1020 | 1.4 | 2.3 | 7.4 | 14.0 | 1070 | 15.9 | **14.0** |
| D32 | 0.45 | 190 | 3.9 | 10.2 | 630 | 1.1 | 2.0 | 5.3 | 15.5 | 820 | 14.6 | **14.6** |
| D33 | 0.45 | 50 | 2.0 | 6.6 | 945 | 1.7 | 2.6 | 6.1 | 12.6 | 995 | 15.5 | **12.6** |
| D34 | 0.44 | 150 | 3.0 | 10.0 | 120 | 3.0 | 3.4 | 0.6 | 10.6 | 270 | 11.5 | **10.6** |
| D35 | 0.45 | 50 | 2.0 | 6.6 | 555 | 2.8 | 3.3 | 2.8 | 9.4 | 605 | 13.4 | **9.4** |
| D36 | 0.45 | 240 | 2.6 | 13.2 | 120 | 1.0 | 2.0 | 1.0 | 14.2 | 360 | 12.0 | **12.0** |
| D37 | 0.44 | 215 | 3.2 | 11.9 | 315 | 2.3 | 3.0 | 1.8 | 13.6 | 530 | 12.9 | **12.9** |
| D38 | 0.46 | 30 | 2.0 | 5.0 | 600 | 1.4 | 2.3 | 4.3 | 9.3 | 630 | 13.5 | **9.3** |
| D39 | 0.56 | 50 | 2.0 | 5.5 | 835 | 1.8 | 2.7 | 5.2 | 10.6 | 885 | 14.9 | **10.6** |
| D40 | 0.39 | 295 | 2.0 | 17.3 | 835 | 1.8 | 2.7 | 5.2 | 22.5 | 1130 | 16.3 | **16.3** |
| D41 | 0.61 | 80 | 2.5 | 5.9 | 1120 | 1.9 | 2.7 | 6.9 | 12.8 | 1200 | 16.7 | **12.8** |
| D42 | 0.45 | 50 | 2.0 | 6.6 | 1145 | 1.8 | 2.7 | 7.1 | 13.6 | 1195 | 16.6 | **13.6** |
| D43 | 0.45 | 190 | 3.0 | 11.2 | 440 | 1.9 | 2.7 | 2.7 | 13.9 | 630 | 13.5 | **13.5** |
| D44 | 0.45 | 190 | 2.5 | 11.9 | 350 | 1.5 | 3.1 | 0.0 | 11.9 | 540 | 13.0 | **11.9** |

## Basin Times of Concentration Calculations

JOB #2527-020

| Basin | $C_5$ | Overland Flow | | | Travel Time in Channel | | | | $T_c$ (mins) | $T_c$ Check | | Final $T_c$ (min = 5 mins) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Length (ft) | Slope (%) | $T_i$ (fig.3-1) (mins) | Length (ft) | Slope (%) | Velocity (ft/sec) (fig.3-2) | $T_t$ (mins) | | Total Length (ft) | $T_c$ = (L/180)+10 (mins) | |
| **D45** | 0.45 | | | | | | | | | | | **5.0** |
| **D46** | 0.45 | 190 | 3.0 | 11.2 | 905 | 1.7 | 2.6 | 5.8 | 17.0 | 1095 | 16.1 | **16.1** |
| **D47** | 0.45 | 50 | 2.0 | 6.6 | 1290 | 1.7 | 2.6 | 8.3 | 14.8 | 1340 | 17.4 | **14.8** |
| **D48** | 0.48 | 50 | 2.0 | 6.3 | 945 | 1.7 | 2.6 | 6.1 | 12.3 | 995 | 15.5 | **12.3** |
| **D49** | 0.48 | 15 | 2.0 | 3.4 | 975 | 1.2 | 2.1 | 7.7 | 11.1 | 990 | 15.5 | **11.1** |
| **D50** | 0.94 | 80 | 1.5 | 2.3 | 120 | 1.4 | 2.3 | 0.9 | 3.2 | 200 | 11.1 | **5.0** |
| **D51** | 0.40 | 25 | 2.6 | 4.6 | 315 | 1.5 | 2.4 | 2.2 | 6.8 | 340 | 11.9 | **6.8** |
| **D52** | 0.45 | 50 | 2.0 | 6.6 | 700 | 1.5 | 2.4 | 4.9 | 11.4 | 750 | 14.2 | **11.4** |
| **D53** | 0.45 | 225 | 1.8 | 14.4 | 310 | 1.0 | 2.0 | 2.6 | 17.0 | 535 | 13.0 | **13.0** |
| **D54** | 0.86 | 50 | 2.0 | 2.4 | 365 | 3.5 | 3.7 | 1.6 | 4.1 | 415 | 12.3 | **5.0** |
| **D55** | 0.45 | 10 | 2.0 | 2.9 | 315 | 3.5 | 3.7 | 1.4 | 4.4 | 325 | 11.8 | **5.0** |
| **D56** | 0.41 | 115 | 3.4 | 8.8 | 785 | 1.0 | 2.0 | 6.5 | 15.4 | 900 | 15.0 | **15.0** |
| **D57** | 0.80 | 10 | 2.0 | 1.4 | 1075 | 2.4 | 3.0 | 6.0 | 7.3 | 1085 | 16.0 | **7.3** |
| **D57A** | 0.50 | 100 | 2.0 | 8.6 | 200 | 1.0 | 2.0 | 1.7 | 12.1 | 850 | 14.7 | **12.1** |
| | | | | | 550 | PIPE | 5.0 | 1.8 | | | | |
| **D58** | 0.46 | 50 | 2.0 | 6.4 | 1145 | 1.1 | 2.0 | 9.5 | 16.0 | 1195 | 16.6 | **16.0** |
| **D59** | 0.47 | 15 | 2.0 | 3.1 | 600 | 2.2 | 2.9 | 3.4 | 6.5 | 615 | 13.4 | **6.5** |
| **D60** | 0.45 | 50 | 2.0 | 6.6 | 1190 | 1.6 | 2.5 | 7.9 | 14.5 | 1240 | 16.9 | **14.5** |
| **D61** | 0.45 | 50 | 2.0 | 6.6 | 985 | 1.9 | 2.7 | 6.1 | 12.6 | 1035 | 15.8 | **12.6** |
| **D62** | 0.45 | 10 | 2.0 | 2.9 | 2355 | 1.6 | 2.5 | 15.7 | 18.6 | 2365 | 23.1 | **18.6** |
| **D63** | 0.45 | 95 | 2.7 | 8.2 | 1300 | 1.7 | 2.6 | 8.3 | 16.5 | 1395 | 17.8 | **16.5** |
| **D64** | 0.43 | 115 | 1.7 | 10.9 | 915 | 1.9 | 2.7 | 5.6 | 16.5 | 1030 | 15.7 | **15.7** |
| **D65** | 0.76 | 215 | 5.0 | 5.2 | 995 | 1.2 | 2.1 | 7.9 | 13.1 | 1210 | 16.7 | **13.1** |
| **E1** | 0.44 | 210 | 3.0 | 12.0 | 140 | 1.0 | 2.0 | 1.2 | 13.1 | 350 | 11.9 | **11.9** |
| **E2** | 0.45 | 50 | 2.0 | 6.6 | 280 | 1.0 | 2.0 | 2.3 | 8.9 | 330 | 11.8 | **8.9** |
| **E3** | 0.45 | 190 | 4.5 | 9.8 | 650 | 1.0 | 2.0 | 5.4 | 15.2 | 840 | 14.7 | **14.7** |
| **E4** | 0.45 | 1 | 1.0 | 1.2 | 1 | 1.0 | 1.0 | 0.0 | 1.2 | 2 | 10.0 | **5.0** |
| **E5** | 0.45 | 50 | 2.0 | 6.6 | 685 | 1.0 | 2.0 | 5.7 | 12.3 | 735 | 14.1 | **12.3** |
| **E6** | 0.45 | 205 | 3.0 | 11.6 | 390 | 2.5 | 3.1 | 2.1 | 13.7 | 595 | 13.3 | **13.3** |
| **E7** | 0.45 | 250 | 4.5 | 11.2 | 840 | 2.3 | 3.0 | 4.7 | 15.9 | 1090 | 16.1 | **15.9** |
| **E8** | 0.45 | | | | | | | | | | | **5.0** |
| **E9** | 0.45 | 190 | 3.0 | 11.2 | 750 | 1.0 | 2.0 | 6.3 | 17.4 | 940 | 15.2 | **15.2** |
| **E10** | 0.45 | 45 | 2.0 | 6.2 | 340 | 1.8 | 3.3 | 1.7 | 7.9 | 385 | 12.1 | **7.9** |
| **E11** | 0.48 | 50 | 2.0 | 6.2 | 970 | 1.0 | 2.0 | 8.1 | 14.3 | 1020 | 15.7 | **14.3** |
| **E12** | 0.73 | 20 | 2.0 | 2.4 | 455 | 2.4 | 3.0 | 2.5 | 4.9 | 475 | 12.6 | **5.0** |
| **E13** | 0.75 | | | | | | | | | | | **5.0** |
| **E14** | 0.31 | 1060 | 2.3 | 35.3 | 300 | 4.0 | 4.0 | 1.3 | 36.5 | 1360 | 17.6 | **17.6** |
| **E15** | 0.47 | 40 | 2.0 | 5.7 | 1400 | 2.5 | 3.1 | 7.5 | 13.2 | 1440 | 18.0 | **13.2** |
| **E16** | 0.45 | 125 | 2.8 | 9.3 | 750 | 3.5 | 3.7 | 3.4 | 12.7 | 875 | 14.9 | **12.7** |
| **E17** | 0.20 | 300 | 3.5 | 18.5 | 500 | 2.7 | 2.5 | 3.3 | 21.8 | 800 | 14.4 | **14.4** |
| **E18** | 0.21 | 495 | 3.0 | 24.7 | 255 | 2.2 | 2.9 | 1.5 | 26.2 | 750 | 14.2 | **14.2** |
| **E19** | 0.47 | 10 | 2.0 | 2.8 | 810 | 2.7 | 3.2 | 4.2 | 7.0 | 820 | 14.6 | **7.0** |
| **E20** | 0.67 | 10 | 2.0 | 1.9 | 1185 | 2.5 | 3.1 | 6.4 | 8.3 | 1195 | 16.6 | **8.3** |
| **E21** | 0.45 | 50 | 2.0 | 6.6 | 715 | 3.0 | 3.4 | 3.5 | 10.1 | 765 | 14.3 | **10.1** |
| **E22** | 0.45 | 50 | 2.0 | 6.6 | 985 | 2.1 | 2.8 | 5.9 | 12.4 | 1035 | 15.8 | **12.4** |
| **E23** | 0.40 | 50 | 2.0 | 7.1 | 885 | 1.7 | 2.6 | 5.7 | 12.8 | 935 | 15.2 | **12.8** |
| **E24** | 0.39 | 10 | 2.0 | 3.2 | 565 | 1.8 | 2.7 | 3.5 | 6.7 | 575 | 13.2 | **6.7** |
| **E25** | 0.35 | 425 | 3.1 | 19.1 | 1330 | 2.2 | 2.9 | 7.6 | 26.7 | 1755 | 19.8 | **19.8** |
| **E26** | 0.45 | 120 | 2.2 | 9.9 | 560 | 1.2 | 2.1 | 4.4 | 14.3 | 680 | 13.8 | **13.8** |

## Basin Times of Concentration Calculations

JOB #2527-020

| Basin | $C_5$ | Overland Flow | | | Travel Time in Channel | | | | $T_c$ (mins) | $T_c$ Check | | Final $T_c$ (min = 5 mins) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Length (ft) | Slope (%) | $T_i$ (fig.3-1) (mins) | Length (ft) | Slope (%) | Velocity (ft/sec) (fig.3-2) | $T_t$ (mins) | | Total Length (ft) | $T_c$ = (L/180)+10 (mins) | |
| **E27** | 0.45 | 123 | 2.7 | 9.3 | 735 | 1.0 | 2.0 | 6.1 | 15.4 | 858 | 14.8 | **14.8** |
| **E28** | 0.70 | 10 | 2.0 | 1.8 | 400 | 1.0 | 2.0 | 3.3 | 5.2 | 410 | 12.3 | **5.2** |
| **E29** | 0.70 | 15 | 2.0 | 2.2 | 1005 | 1.8 | 2.7 | 6.2 | 8.4 | 1020 | 15.7 | **8.4** |

## Basin Runoff Rates

Colliers Hill-Fil 4
Job # 2527-02

Town of Erie One-Hour Rainfall Depths

2-Year = 1.01 inches
5-Year = 1.43 inches
100-Year = 2.70 inches

**Intensity = 28.5 * $P_1$ / ((10 + $T_C$)$^{0.786}$)**

RA-3, USDCM Vol. 1

| Basin | Area (acres) | $C_2$ | $C_5$ | $C_{100}$ | $T_c$ (mins) | $I_2$ (in/hr) | $I_5$ (in/hr) | $I_{100}$ (in/hr) | $Q_2$ (cfs) | $Q_5$ (cfs) | $Q_{100}$ (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| D1 | 1.53 | 0.40 | 0.45 | 0.63 | 14.6 | 2.33 | 3.29 | 6.22 | 1.41 | 2.27 | 5.97 |
| D2 | 1.60 | 0.40 | 0.45 | 0.60 | 13.0 | 2.45 | 3.46 | 6.54 | 1.56 | 2.49 | 6.27 |
| D3 | 0.92 | 0.40 | 0.45 | 0.60 | 11.2 | 2.61 | 3.69 | 6.97 | 0.96 | 1.53 | 3.86 |
| D4 | 2.34 | 0.40 | 0.45 | 0.60 | 16.6 | 2.18 | 3.09 | 5.83 | 2.04 | 3.25 | 8.19 |
| D5 | 1.67 | 0.40 | 0.45 | 0.60 | 8.9 | 2.86 | 4.04 | 7.64 | 1.91 | 3.04 | 7.64 |
| D6 | 1.29 | 0.40 | 0.45 | 0.60 | 11.4 | 2.59 | 3.67 | 6.93 | 1.34 | 2.13 | 5.36 |
| D7 | 1.33 | 0.40 | 0.45 | 0.60 | 13.7 | 2.39 | 3.39 | 6.39 | 1.28 | 2.03 | 5.12 |
| D8 | 1.98 | 0.40 | 0.45 | 0.60 | 13.3 | 2.42 | 3.43 | 6.47 | 1.91 | 3.05 | 7.67 |
| D9 | 5.76 | 0.40 | 0.45 | 0.60 | 16.8 | 2.17 | 3.08 | 5.81 | 5.01 | 7.97 | 20.08 |
| D10 | 2.65 | 0.40 | 0.45 | 0.60 | 11.5 | 2.58 | 3.66 | 6.91 | 2.74 | 4.36 | 10.97 |
| D11 | 2.52 | 0.40 | 0.45 | 0.60 | 13.8 | 2.39 | 3.38 | 6.38 | 2.41 | 3.83 | 9.65 |
| D12 | 0.77 | 0.87 | 0.97 | 1.32 | 5.5 | 3.34 | 4.72 | 8.92 | 2.21 | 3.51 | 9.00 |
| D12A | 0.80 | 0.39 | 0.45 | 0.67 | 8.2 | 2.94 | 4.17 | 7.87 | 0.92 | 1.51 | 4.19 |
| D13 | 0.60 | 0.40 | 0.45 | 0.60 | 8.2 | 2.94 | 4.17 | 7.87 | 0.70 | 1.12 | 2.81 |
| D14 | 1.20 | 0.40 | 0.45 | 0.60 | 12.5 | 2.49 | 3.52 | 6.65 | 1.19 | 1.90 | 4.79 |
| D15 | 1.97 | 0.40 | 0.45 | 0.60 | 14.2 | 2.35 | 3.33 | 6.28 | 1.85 | 2.95 | 7.42 |
| D16 | 1.56 | 0.40 | 0.45 | 0.60 | 12.1 | 2.52 | 3.57 | 6.75 | 1.58 | 2.51 | 6.33 |
| D17 | 1.66 | 0.40 | 0.45 | 0.60 | 13.5 | 2.40 | 3.41 | 6.43 | 1.59 | 2.54 | 6.39 |
| D18 | 1.62 | 0.39 | 0.44 | 0.62 | 15.0 | 2.29 | 3.24 | 6.12 | 1.43 | 2.32 | 6.13 |
| D19 | 3.11 | 0.38 | 0.44 | 0.61 | 14.2 | 2.35 | 3.33 | 6.28 | 2.81 | 4.55 | 11.99 |
| D20 | 3.24 | 0.40 | 0.45 | 0.60 | 16.9 | 2.17 | 3.07 | 5.79 | 2.81 | 4.47 | 11.26 |
| D21 | 1.58 | 0.40 | 0.45 | 0.60 | 10.1 | 2.72 | 3.85 | 7.27 | 1.72 | 2.74 | 6.91 |
| D22 | 2.63 | 0.40 | 0.45 | 0.60 | 13.4 | 2.41 | 3.42 | 6.45 | 2.54 | 4.05 | 10.20 |
| D23 | 0.97 | 0.40 | 0.45 | 0.60 | 11.3 | 2.60 | 3.68 | 6.95 | 1.01 | 1.61 | 4.06 |
| D24 | 2.99 | 0.40 | 0.45 | 0.60 | 13.7 | 2.39 | 3.38 | 6.39 | 2.86 | 4.56 | 11.47 |
| D25 | 1.29 | 0.40 | 0.45 | 0.60 | 11.1 | 2.62 | 3.71 | 7.00 | 1.35 | 2.15 | 5.41 |
| D26 | 0.85 | 0.40 | 0.45 | 0.60 | 11.0 | 2.63 | 3.73 | 7.03 | 0.90 | 1.43 | 3.59 |
| D27 | 1.59 | 0.40 | 0.45 | 0.60 | 13.0 | 2.45 | 3.47 | 6.55 | 1.56 | 2.48 | 6.25 |
| D28 | 2.72 | 0.23 | 0.31 | 0.59 | 14.6 | 2.32 | 3.29 | 6.21 | 1.48 | 2.80 | 9.92 |
| D29 | 0.99 | 0.40 | 0.45 | 0.60 | 11.4 | 2.59 | 3.66 | 6.92 | 1.02 | 1.63 | 4.10 |
| D30 | 3.77 | 0.40 | 0.45 | 0.60 | 15.2 | 2.28 | 3.22 | 6.09 | 3.43 | 5.47 | 13.77 |
| D31 | 1.86 | 0.40 | 0.45 | 0.60 | 14.0 | 2.37 | 3.36 | 6.34 | 1.76 | 2.81 | 7.06 |
| D32 | 3.30 | 0.40 | 0.45 | 0.60 | 14.6 | 2.33 | 3.29 | 6.22 | 3.07 | 4.88 | 12.29 |
| D33 | 1.61 | 0.40 | 0.45 | 0.60 | 12.6 | 2.48 | 3.51 | 6.63 | 1.60 | 2.54 | 6.41 |
| D34 | 0.89 | 0.39 | 0.44 | 0.63 | 10.6 | 2.67 | 3.78 | 7.13 | 0.92 | 1.49 | 4.03 |
| D35 | 0.96 | 0.40 | 0.45 | 0.60 | 9.4 | 2.80 | 3.97 | 7.49 | 1.07 | 1.71 | 4.30 |
| D36 | 1.33 | 0.40 | 0.45 | 0.60 | 12.0 | 2.54 | 3.59 | 6.78 | 1.35 | 2.15 | 5.42 |
| D37 | 2.21 | 0.38 | 0.44 | 0.60 | 12.9 | 2.45 | 3.47 | 6.56 | 2.08 | 3.35 | 8.69 |
| D38 | 1.21 | 0.41 | 0.46 | 0.62 | 9.3 | 2.81 | 3.97 | 7.50 | 1.40 | 2.23 | 5.66 |
| D39 | 1.21 | 0.52 | 0.56 | 0.70 | 10.6 | 2.67 | 3.78 | 7.13 | 1.67 | 2.55 | 6.02 |

## Basin Runoff Rates

**Colliers Hill-Fil 4**
Job # 2527-02

Town of Erie One-Hour Rainfall Depths
2-Year = 1.01 inches
5-Year = 1.43 inches
100-Year = 2.70 inches

**Intensity = 28.5 * $P_1$ / ((10 + $T_C$)$^{0.786}$)** RA-3, USDCM Vol. 1

| Basin | Area (acres) | $C_2$ | $C_5$ | $C_{100}$ | $T_c$ (mins) | $I_2$ (in/hr) | $I_5$ (in/hr) | $I_{100}$ (in/hr) | $Q_2$ (cfs) | $Q_5$ (cfs) | $Q_{100}$ (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| D40 | 5.34 | 0.33 | 0.39 | 0.59 | 16.3 | *2.20* | *3.12* | *5.89* | **3.92** | **6.55** | **18.43** |
| D41 | 2.50 | 0.56 | 0.61 | 0.77 | 12.8 | *2.47* | *3.49* | *6.59* | **3.47** | **5.29** | **12.68** |
| D42 | 2.08 | 0.40 | 0.45 | 0.60 | 13.6 | *2.40* | *3.39* | *6.41* | **2.00** | **3.18** | **8.01** |
| D43 | 3.03 | 0.40 | 0.45 | 0.60 | 13.5 | *2.41* | *3.41* | *6.44* | **2.92** | **4.65** | **11.71** |
| D44 | 2.29 | 0.40 | 0.45 | 0.60 | 11.9 | *2.55* | *3.60* | *6.81* | **2.34** | **3.72** | **9.37** |
| D45 | 0.38 | 0.40 | 0.45 | 0.60 | 5.0 | *3.43* | *4.85* | *9.16* | **0.52** | **0.82** | **2.07** |
| D46 | 4.98 | 0.40 | 0.45 | 0.60 | 16.1 | *2.22* | *3.14* | *5.93* | **4.42** | **7.04** | **17.72** |
| D47 | 2.04 | 0.40 | 0.45 | 0.60 | 14.8 | *2.30* | *3.26* | *6.16* | **1.88** | **2.99** | **7.54** |
| D48 | 1.32 | 0.43 | 0.48 | 0.63 | 12.3 | *2.51* | *3.55* | *6.70* | **1.43** | **2.25** | **5.54** |
| D49 | 1.41 | 0.44 | 0.48 | 0.63 | 11.1 | *2.62* | *3.70* | *6.99* | **1.62** | **2.54** | **6.22** |
| D50 | 0.56 | 0.83 | 0.94 | 1.30 | 5.0 | *3.43* | *4.85* | *9.16* | **1.59** | **2.55** | **6.66** |
| D51 | 0.83 | 0.33 | 0.40 | 0.65 | 6.8 | *3.14* | *4.44* | *8.38* | **0.85** | **1.46** | **4.49** |
| D52 | 2.21 | 0.40 | 0.45 | 0.60 | 11.4 | *2.59* | *3.66* | *6.92* | **2.28** | **3.64** | **9.16** |
| D53 | 2.99 | 0.40 | 0.45 | 0.60 | 13.0 | *2.45* | *3.47* | *6.55* | **2.93** | **4.67** | **11.76** |
| D54 | 0.54 | 0.74 | 0.86 | 1.25 | 5.0 | *3.43* | *4.85* | *9.16* | **1.38** | **2.26** | **6.23** |
| D55 | 0.29 | 0.40 | 0.45 | 0.60 | 5.0 | *3.43* | *4.85* | *9.16* | **0.40** | **0.64** | **1.61** |
| D56 | 3.32 | 0.35 | 0.41 | 0.59 | 15.0 | *2.29* | *3.25* | *6.13* | **2.70** | **4.43** | **12.04** |
| D57 | 2.28 | 0.67 | 0.80 | 1.22 | 7.3 | *3.06* | *4.33* | *8.17* | **4.69** | **7.87** | **22.66** |
| D57A | 9.83 | 0.45 | 0.50 | 0.70 | 12.1 | *2.53* | *3.58* | *6.76* | **11.19** | **17.60** | **46.52** |
| D58 | 3.30 | 0.41 | 0.46 | 0.61 | 16.0 | *2.23* | *3.15* | *5.95* | **3.04** | **4.82** | **12.05** |
| D59 | 2.14 | 0.42 | 0.47 | 0.62 | 6.5 | *3.17* | *4.49* | *8.48* | **2.86** | **4.52** | **11.26** |
| D60 | 3.91 | 0.40 | 0.45 | 0.60 | 14.5 | *2.33* | *3.30* | *6.23* | **3.64** | **5.80** | **14.61** |
| D61 | 2.81 | 0.40 | 0.45 | 0.60 | 12.6 | *2.48* | *3.51* | *6.62* | **2.78** | **4.43** | **11.16** |
| D62 | 3.38 | 0.40 | 0.45 | 0.60 | 18.6 | *2.06* | *2.92* | *5.51* | **2.79** | **4.44** | **11.17** |
| D63 | 2.13 | 0.40 | 0.45 | 0.60 | 16.5 | *2.19* | *3.10* | *5.85* | **1.86** | **2.96** | **7.46** |
| D64 | 4.80 | 0.37 | 0.43 | 0.64 | 15.7 | *2.24* | *3.17* | *5.99* | **3.94** | **6.51** | **18.33** |
| D65 | 0.26 | 0.74 | 0.76 | 0.86 | 13.1 | *2.44* | *3.45* | *6.51* | **0.46** | **0.68** | **1.44** |
| E1 | 1.15 | 0.38 | 0.44 | 0.63 | 11.9 | *2.54* | *3.60* | *6.79* | **1.12** | **1.82** | **4.90** |
| E2 | 0.47 | 0.40 | 0.45 | 0.60 | 8.9 | *2.86* | *4.04* | *7.64* | **0.54** | **0.85** | **2.15** |
| E3 | 2.79 | 0.40 | 0.45 | 0.60 | 14.7 | *2.32* | *3.28* | *6.19* | **2.58** | **4.11** | **10.36** |
| E4 | 0.38 | 0.40 | 0.45 | 0.60 | 5.0 | *3.43* | *4.85* | *9.16* | **0.52** | **0.82** | **2.07** |
| E5 | 1.16 | 0.40 | 0.45 | 0.60 | 12.3 | *2.51* | *3.55* | *6.71* | **1.16** | **1.85** | **4.67** |
| E6 | 1.67 | 0.40 | 0.45 | 0.60 | 13.3 | *2.42* | *3.43* | *6.48* | **1.62** | **2.58** | **6.49** |
| E7 | 3.11 | 0.40 | 0.45 | 0.60 | 15.9 | *2.23* | *3.16* | *5.97* | **2.78** | **4.42** | **11.14** |
| E8 | 0.27 | 0.40 | 0.45 | 0.60 | 5.0 | *3.43* | *4.85* | *9.16* | **0.37** | **0.58** | **1.47** |
| E9 | 3.35 | 0.40 | 0.45 | 0.60 | 15.2 | *2.28* | *3.22* | *6.09* | **3.05** | **4.86** | **12.22** |
| E10 | 0.97 | 0.40 | 0.45 | 0.60 | 7.9 | *2.98* | *4.21* | *7.95* | **1.16** | **1.84** | **4.63** |

## Basin Runoff Rates

**Colliers Hill-Fil 4**
Job # 2527-02

Town of Erie One-Hour Rainfall Depths
2-Year = 1.01 inches
5-Year = 1.43 inches
100-Year = 2.70 inches

**Intensity = 28.5 * $P_1$ / ((10 + $T_C$)$^{0.786}$)** RA-3, USDCM Vol. 1

| Basin | Area (acres) | $C_2$ | $C_5$ | $C_{100}$ | $T_c$ (mins) | $I_2$ (in/hr) | $I_5$ (in/hr) | $I_{100}$ (in/hr) | $Q_2$ (cfs) | $Q_5$ (cfs) | $Q_{100}$ (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **E11** | 1.38 | 0.43 | 0.48 | 0.63 | 14.3 | *2.34* | *3.32* | *6.26* | **1.40** | **2.21** | **5.44** |
| **E12** | 0.38 | 0.70 | 0.73 | 0.84 | 5.0 | *3.43* | *4.85* | *9.16* | **0.92** | **1.35** | **2.94** |
| **E13** | 0.18 | 0.73 | 0.75 | 0.86 | 5.0 | *3.43* | *4.85* | *9.16* | **0.45** | **0.67** | **1.43** |
| **E14** | 5.33 | 0.23 | 0.31 | 0.58 | 17.6 | *2.12* | *3.01* | *5.68* | **2.57** | **4.91** | **17.66** |
| **E15** | 2.06 | 0.41 | 0.47 | 0.69 | 13.2 | *2.43* | *3.44* | *6.50* | **2.07** | **3.35** | **9.25** |
| **E16** | 2.74 | 0.40 | 0.45 | 0.60 | 12.7 | *2.48* | *3.51* | *6.62* | **2.72** | **4.33** | **10.91** |
| **E17** | 5.42 | 0.11 | 0.20 | 0.52 | 14.4 | *2.33* | *3.30* | *6.24* | **1.35** | **3.56** | **17.44** |
| **E18** | 2.00 | 0.12 | 0.21 | 0.54 | 14.2 | *2.35* | *3.33* | *6.30* | **0.55** | **1.40** | **6.74** |
| **E19** | 1.09 | 0.43 | 0.47 | 0.62 | 7.0 | *3.10* | *4.39* | *8.28* | **1.44** | **2.27** | **5.63** |
| **E20** | 0.82 | 0.64 | 0.67 | 0.81 | 8.3 | *2.93* | *4.15* | *7.83* | **1.53** | **2.29** | **5.18** |
| **E21** | 1.33 | 0.40 | 0.45 | 0.60 | 10.1 | *2.72* | *3.86* | *7.28* | **1.45** | **2.31** | **5.83** |
| **E22** | 3.54 | 0.40 | 0.45 | 0.60 | 12.4 | *2.50* | *3.54* | *6.68* | **3.54** | **5.64** | **14.19** |
| **E23** | 1.46 | 0.33 | 0.40 | 0.65 | 12.8 | *2.47* | *3.49* | *6.59* | **1.18** | **2.02** | **6.20** |
| **E24** | 0.47 | 0.32 | 0.39 | 0.61 | 6.7 | *3.15* | *4.46* | *8.42* | **0.48** | **0.81** | **2.43** |
| **E25** | 5.38 | 0.28 | 0.35 | 0.57 | 19.8 | *2.00* | *2.83* | *5.35* | **3.04** | **5.33** | **16.29** |
| **E26** | 1.80 | 0.40 | 0.45 | 0.60 | 13.8 | *2.39* | *3.38* | *6.38* | **1.72** | **2.73** | **6.88** |
| **E27** | 2.06 | 0.40 | 0.45 | 0.60 | 14.8 | *2.31* | *3.27* | *6.17* | **1.90** | **3.03** | **7.62** |
| **E28** | 0.28 | 0.66 | 0.70 | 0.82 | 5.2 | *3.40* | *4.81* | *9.09* | **0.63** | **0.93** | **2.08** |
| **E29** | 0.71 | 0.67 | 0.70 | 0.82 | 8.4 | *2.91* | *4.13* | *7.79* | **1.37** | **2.04** | **4.53** |

# APPENDIX B
# REGIONAL DETENTION POND

**Colliers Hill**
Job Number: 2527-2

## Regional Detention Pond 1113 Characteristics

### 100-Year Allowable Release Rate & Required Volume

Allowable 100-Year Release = 923 cfs *Historic Basin $Q_{10}$

$V_{100}$ = 62.8 ac-ft (From UDSWM, Element 1113)

### EURV Calculations

| Basin | Area Acres | % Imperv-iousness | Predominant Soil Type |
|---|---|---|---|
| 101 | 42.44 | 39.0 | C & D |
| 102 | 23.81 | 47.1 | B |
| 103 | 13.60 | 55.8 | C & D |
| 104 | 54.84 | 40.2 | C & D |
| 105 | 31.64 | 40.0 | C & D |
| 106 | 102.65 | 40.0 | C & D |
| 107 | 158.20 | 33.1 | C & D |
| 108 | 51.27 | 30.0 | B |
| **Total** | **478.45** | **37.4** | |

Total Hydrologic Soil Group B Area = 75.1 acres 15.69%

Total Hydrologic Soil Group C & D Area = 403.4 acres 84.31%

478.45

| | |
|---|---|
| **EURV from UDFCD Worksheet =** | **17.47 ac-ft** |
| **EURV Release Rate (72-hour Release) =** | **2.94 cfs** |

### Stage-Storage

| Pond Elevation | Depth (ft) | Total Area (s.f.) | Inc. Vol. (c.f.) | Vol. (c.f.) | Vol. (ac-ft) | Note |
|---|---|---|---|---|---|---|
| **5063.00** | 0.0 | 0 | 0 | 0 | 0.00 | ***Bottom of Pond** |
| **5064.00** | 1.0 | 123,543 | 61,772 | 61,772 | 1.42 | |
| **5065.00** | 2.0 | 130,084 | 126,814 | 188,585 | 4.33 | |
| **5066.00** | 3.0 | 137,260 | 133,672 | 322,257 | 7.40 | |
| **5067.00** | 4.0 | 174,024 | 155,642 | 477,899 | 10.97 | |
| **5068.00** | 5.0 | 207,957 | 190,991 | 668,890 | 15.36 | |
| **5068.44** | 5.4 | **213,250** | **92,103** | **760,992** | **17.47** | ***EURV W.S.E.** |
| **5069.00** | 6.0 | 220,059 | 214,008 | 882,898 | 20.27 | |
| **5070.00** | 7.0 | 238,055 | 229,057 | 1,111,955 | 25.53 | |
| **5071.00** | 8.0 | 285,724 | 261,890 | 1,373,844 | 31.54 | |
| **5072.00** | 9.0 | 342,164 | 313,944 | 1,687,788 | 38.75 | |
| **5073.00** | 10.0 | 396,007 | 369,086 | 2,056,874 | 47.22 | |
| **5074.00** | 11.0 | 431,712 | 413,860 | 2,470,733 | 56.72 | |
| **5074.60** | 11.6 | **443,970** | **264,833** | **2,735,566** | **62.80** | ***100-Year W.S.E.** |
| **5075.00** | 12.0 | 451,977 | 441,845 | 2,912,578 | 66.86 | |
| **5076.00** | 13.0 | 440,441 | 446,209 | 3,358,787 | 77.11 | |

# DETENTION VOLUME BY THE FULL SPECTRUM METHOD

**Project:** Colliers Hill - Erie, CO
**Basin ID:** Pond 1113

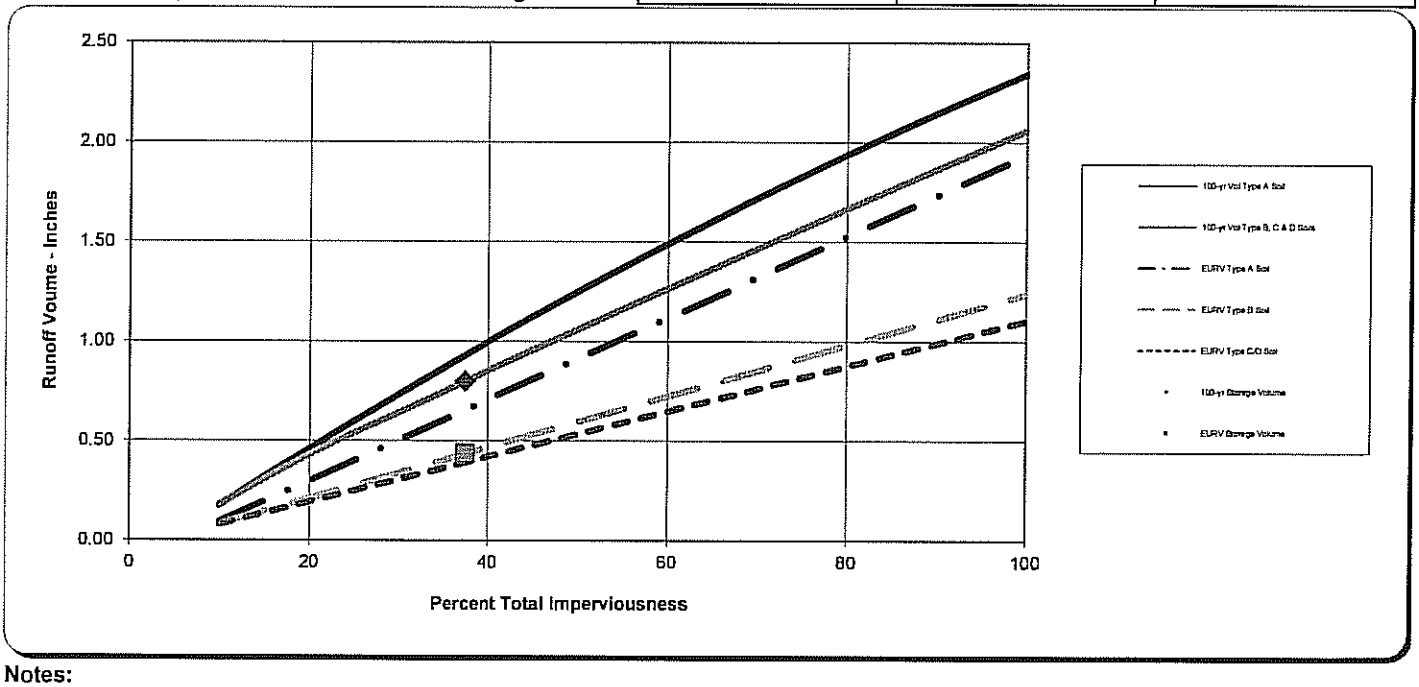
* User input data shown in blue.

| | | |
|---|---|---|
| Area of Watershed (acres) | 478.45 | |
| Subwatershed Imperviousness | 37.4% | |
| Level of Minimizing Directly Connected Impervious Area (MDCIA) | 0 | 0 |
| Effective Imperviousness[1] | 37.4% | |

| Hydrologic Soil Type | Percentage of Area | Area (acres) |
|---|---|---|
| Type A | | 0.0 |
| Type B | 15.7% | 75.1 |
| Type C or D | 84.3% | 403.4 |

| Recommended Horton's Equation Parameters for CUHP | | |
|---|---|---|
| Infiltration (inches per hour) | | Decay Coefficient--$\alpha$ |
| Initial--$f_i$ | Final--$fo$ | |
| 3.23535 | 0.5 | 0.0018 |

| | Detention Volumes[2,5] | | Maximum Allowable Release Rate, cfs[3] |
|---|---|---|---|
| | (watershed inches) | (acre-feet) | |
| Excess Urban Runoff Volume[4] | 0.44 | 17.47 | Design Oulet to Empty EURV in 72 Hours |
| ~~100-year Detention Volume Including WQCV[5]~~ | ~~0.80~~ | ~~31.85~~ | ~~407.19~~ |




**Notes:**

1) Effective imperviousness is based on Figure ND-1 of the Urban Storm Drainage Criteria Manual (USDCM).

2) Results shown reflect runoff reduction from Level 1 or 2 MDCIA and are plotted at the watershed's total imperviousness value; the impact of MDCIA is reflected by the results being below the curves.

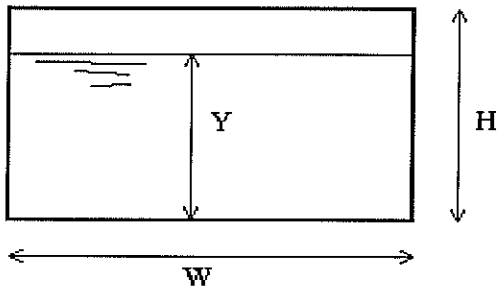
3) Maximum allowable release rates for 100-year event are based on Table SO-1. Outlet for the Excess Urban Runoff Volume (EURV) to be designed to empty out the EURV in 72 hours. Outlet design is similar to one for the WQCV outlet of an extended detention basin (i.e., perforated plate with a micro-pool) and extends to top of EURV water surface elevation.

4) EURV approximates the difference between developed and pre-developed runoff volume.

5) 100-yr detention volume includes EURV. No need to add more volume for WQCV or EURV

# BOX CONDUIT FLOW (Normal & Critical Depth Computation)

Project: Colliers Hill - Erie, CO - Job #2527-2
Box ID: Box Culvert Under Weld County Road 10




| Design Information (Input) | | | |
|---|---|---|---|
| Box conduit invert slope | So = | 0.0048 | ft/ft |
| Box Manning's n-value | n = | 0.0130 | |
| Box Width | W = | 14.00 | ft |
| Box Height | H = | 6.00 | ft |
| **Design discharge** | **Q =** | **923.00** | **cfs** |

| Full-flow capacity (Calculated) | | | |
|---|---|---|---|
| Full-flow area | Af = | 84.00 | sq ft |
| Full-flow wetted perimeter | Pf = | 40.00 | ft |
| Full-flow capacity | Qf = | 1093.84 | cfs |

| Calculations of Normal Flow Condition | | | |
|---|---|---|---|
| Normal flow depth (<H ) | Yn = | 4.31 | ft |
| Flow area | An = | 60.41 | sq ft |
| Wetted perimeter | Pn = | 22.63 | ft |
| Flow velocity | Vn = | 15.28 | fps |
| Discharge | Qn = | 923.02 | cfs |
| Percent Full | Flow = | 84.4% | of full flow |
| Normal Depth Froude Number | $Fr_n$ = | 1.30 | supercritical |

| Calculation of Critical Flow Condition | | | |
|---|---|---|---|
| Critical flow depth | Yc = | 5.13 | ft |
| Critical flow area | Ac = | 71.81 | sq ft |
| Critical flow velocity | Vc = | 12.85 | fps |
| Critical Depth Froude Number | $Fr_c$ = | 1.00 | |

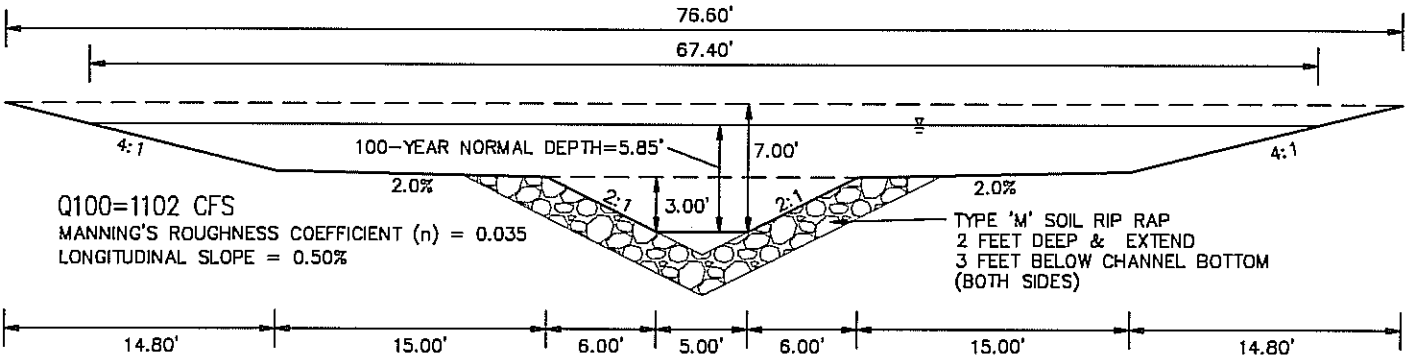
# APPENDIX C
# REGIONAL DRAINAGE CHANNEL

**Colliers Hill**
Job Number: 2527-2

## Regional Channel Analysis

$Q_{100}$ (UDSWM 530 & 730) = 1102 cfs

| **Channel Characteristics** | |
|---|---|
| $Q_{100}$ (cfs): | 1102 |
| Manning's n: | 0.035 |
| Slope of channel (S) (ft/ft): | 0.0050 |
| **Low Flow Channel** | |
| Low Flow Channel Bottom Width (ft): | 5.0 |
| Low Flow Channel Depth (ft): | 3.0 |
| Low Flow Channel Side Slope (z:1): | 2.0 |
| Low Flow Channel Area (A) ($ft^2$): | 33.00 |
| Low Flow Channel Wetted Perimeter (P) (ft): | 18.42 |
| Low Flow Channel Top Width (ft): | 17.00 |
| **Low Flow Channel Capacity (cfs) :** | **146.55** |
| Low Flow Channel Full Flow Velocity (fps): | 4.44 |
| Low Flow Channel Full Flow Froude Number: | 0.56 |
| **Full Depth Channel Analysis** | |
| Full Channel Depth (ft): | 7.00 |
| Overbank Width (ft): | 15.00 |
| Overbank Slope (ft/ft): | 0.02 |
| Slope of upper channel bank (z:1): | 4 |
| Full Channel Area ($ft^2$): | 271.26 |
| Full Channel Wetted Perimeter (ft): | 78.93 |
| Full Channel Top Width (ft): | 76.60 |
| **Full Channel Capacity (cfs):** | **1859.54** |
| **100-Year Normal Depth Analysis** | |
| **100-Year Normal Depth (ft):** | **5.85** |
| 100-Year Normal Depth Area ($ft^2$): | 188.26 |
| 100-Year Normal Depth Wetted Perimeter (ft): | 69.43 |
| 100-Year Normal Depth Top Width (ft): | 67.38 |
| 100-Year Normal Depth Capacity (cfs): | 1102.00 |
| 100-Year Normal Velocity (fps): | 5.85 |
| 100-Year Froude Number: | 0.62 |
| Minimum freeboard (ft): | 1.00 |
| Design freeboard (ft) : | 1.15 |



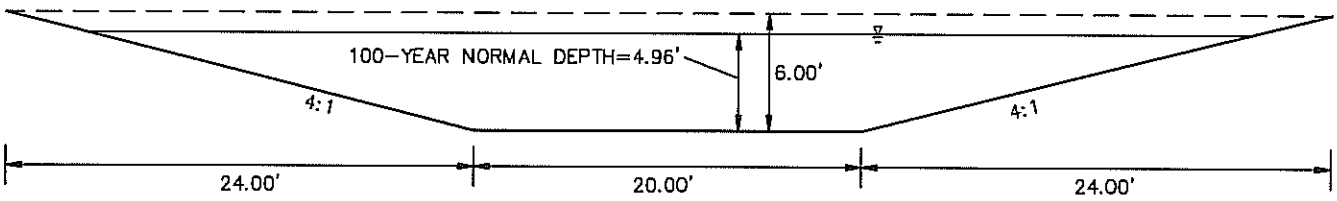

REGIONAL CHANNEL CROSS-SECTION

**Colliers Hill**
Job Number: 2527-2

## Drainage Channel North of Weld County Road 10

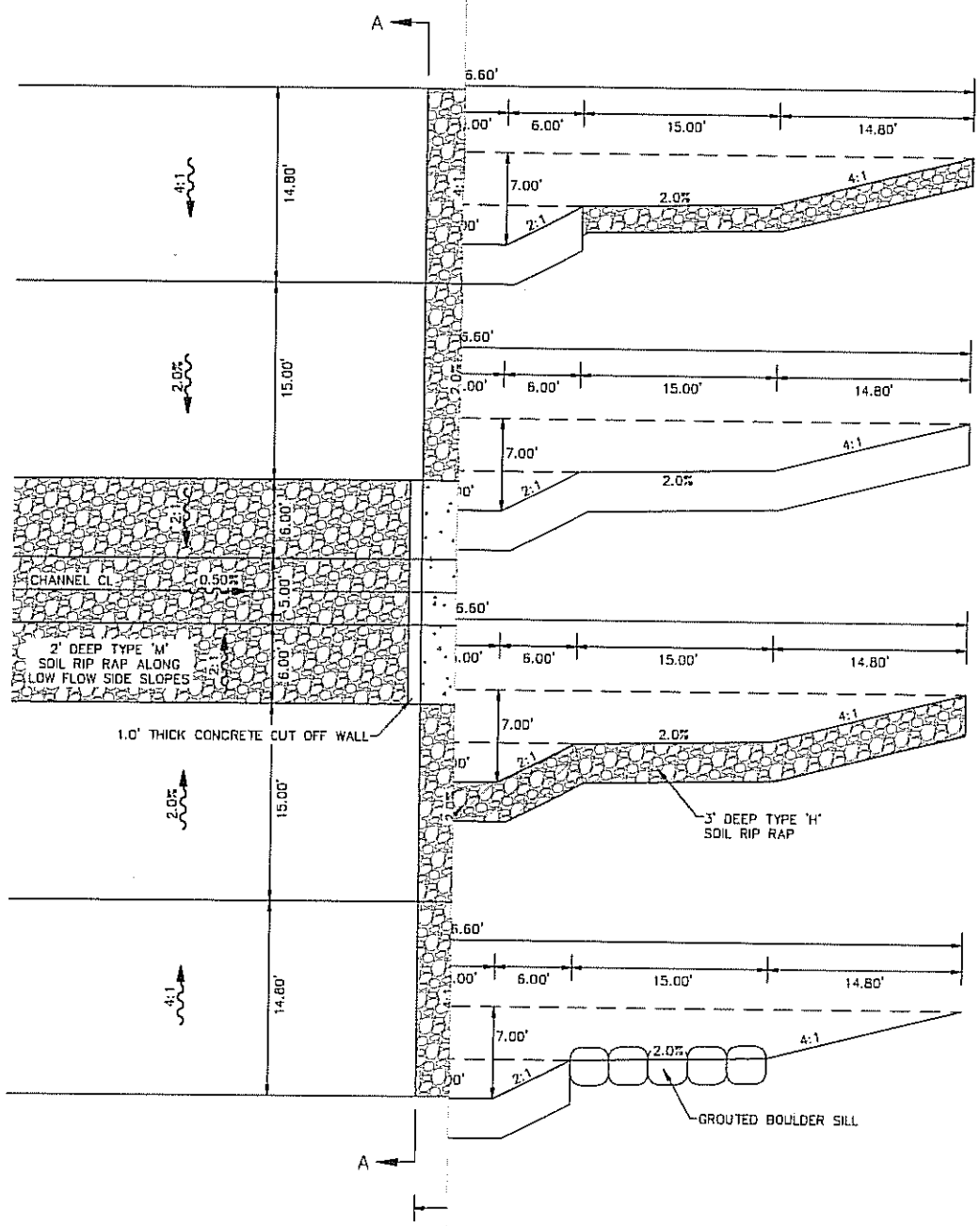
| Channel Characteristics | |
|---|---|
| **Design flow ($Q_{100}$) (cfs):** | **923.00** |
| Slope of channel bank (z:1) (entre z): | 4 |
| Base width (b) (ft) | 20 |
| **Minimum channel depth (ft):** | **6.00** |
| Slope of channel (S) (ft/ft): | 0.00330 |
| Manning's n: | 0.040 |
| **100-Year Depth Calculations** | |
| **100-Year Depth ($y_n$) (ft):** | **4.96** |
| 100-year depth area (A) ($ft^2$): | 197.41 |
| 100-year depth wetted perimeter (P) (ft): | 60.87 |
| 100-year depth top Width (ft): | 59.65 |
| **Capacity at 100-year depth (cfs):** | **923.00** |
| 100-year velocity ($v_n$) (fps): | **4.7** |
| Froude number: | 0.45 |
| **Full Depth Calculations** | |
| Full depth area (A) ($ft^2$): | 264.00 |
| Full depth wetted perimeter (P) (ft): | 69.48 |
| Full depth top width (ft) : | 68.00 |
| **Capacity at full depth (cfs) :** | **1371.91** |
| Minimum freeboard (ft): | 1.00 |
| Design freeboard (ft) : | 1.04 |

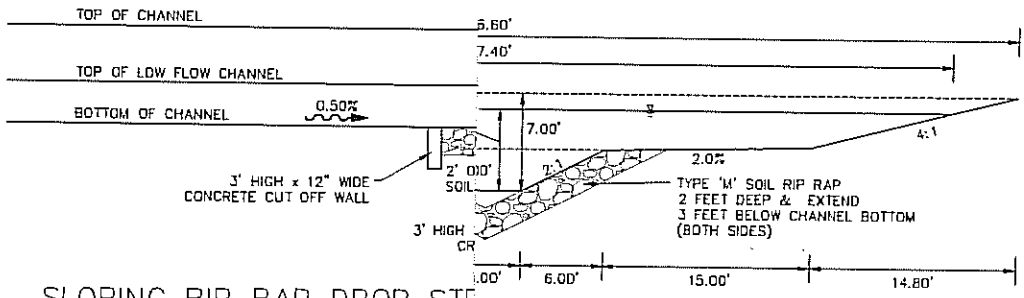
Q100=923 CFS
MANNING'S ROUGHNESS COEFFICIENT (n) = 0.040
LONGITUDINAL SLOPE = 0.50%




# DRAINAGE CHANNEL NORTH OF WCR 10

# APPENDIX D
# REGIONAL CHANNEL DROP STRUCTURE




## SLOPING RIP RAP DROP STE

LOCATION : BETWEEN ERIE PARKWAY & COLLIERS PARK
SCALE : 1" = 6'

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# APPENDIX E
# CUHP ANALYSIS

## CUHP & UDSWM Basin Inputs

| Land Use | % Imperviousness |
|---|---|
| Multi-Family - Attached Garages | 70 |
| Grass | 0 |
| Park | 7 |
| Neighborhood Recreation Center | 70 |
| School | 50 |
| Single Family Residential (1.7 lots/ac) | 30 |
| Single Family Residential (2.5 lots/ac) | 36 |
| Single Family Residential (2.7 lots/ac) | 38 |
| Single Family Residential (2.9 lots/ac) | 39 |
| Single Family Residential (3.0 lots/ac) | 40 |

*Note: The above % Imperviousnesses for SFR are from Figure RO-5 for 3,000 sq. ft. homes.*

CUHP One-Hour Rainfall Depths

| Design Storm | Rainfall Depth (in/hr) |
|---|---|
| 2-Year | 1.01 |
| 5-Year | 1.43 |
| 10-Year | 1.73 |
| 100-Year | 2.70 |

Source: Erie Standards & Specs.

## % Imperviousness Calculations

| Basin | Total Area (acres) | Total Area ($mi^2$) | SFR (1.7 lots/ac) (acres) | SFR (2.5 lots/ac) (acres) | SFR (2.7 lots/ac) (acres) | SFR (2.9 lots/ac) (acres) | SFR (3.0 lots/ac) (acres) | Multi-Family (acres) | Grass (acres) | Park (acres) | Neigh-borhood (acres) | School (acres) | % Impervi-ousness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101 | 42.44 | 0.0663 | | | | 42.44 | | | | | | | 39.0 |
| 102 | 23.81 | 0.0372 | | | | | | 16.03 | 7.77 | | | | 47.1 |
| 103 | 13.60 | 0.0212 | | | | | | 10.83 | 2.77 | | | | 55.8 |
| 104 | 54.84 | 0.0857 | | | 45.01 | | | | | | | 9.83 | 40.2 |
| 105 | 31.64 | 0.0494 | | | | | 31.64 | | | | | | 40.0 |
| 106 | 102.65 | 0.1604 | | | | | 102.65 | | | | | | 40.0 |
| 107 | 158.20 | 0.2472 | | 127.20 | | | | | | 24.00 | 7.00 | | 33.1 |
| 108 | 51.27 | 0.0801 | 51.27 | | | | | | | | | | 30.0 |

## CUHP Basin Inputs

| Basin | Total Area ($mi^2$) | % Impervi-ousness | Basin Length (mi) | Basin Slope (ft/ft) | Distance to Centroid (mi) | Depression Storage (inches) | | Infiltration (in/hr) | | Horton's Decay Rate | Predominant Soil Type |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Pervious | Impervious | Initial | Final | | |
| 101 | 0.0663 | 39.0 | 0.3892 | 0.028 | 0.2405 | 0.35 | 0.1 | 3.0 | 0.5 | 0.0018 | C & D |
| 102 | 0.0372 | 47.1 | 0.3049 | 0.023 | 0.1657 | 0.35 | 0.1 | 4.5 | 0.6 | 0.0018 | B |
| 103 | 0.0212 | 55.8 | 0.1591 | 0.033 | 0.0994 | 0.35 | 0.1 | 3.0 | 0.5 | 0.0018 | C & D |
| 104 | 0.0857 | 40.2 | 0.5170 | 0.016 | 0.1856 | 0.35 | 0.1 | 3.0 | 0.5 | 0.0018 | C & D |
| 105 | 0.0494 | 40.0 | 0.4905 | 0.020 | 0.3011 | 0.35 | 0.1 | 3.0 | 0.5 | 0.0018 | C & D |
| 106 | 0.1604 | 40.0 | 0.5237 | 0.020 | 0.2235 | 0.35 | 0.1 | 3.0 | 0.5 | 0.0018 | C & D |
| 107 | 0.2472 | 33.1 | 0.6922 | 0.020 | 0.2652 | 0.35 | 0.1 | 3.0 | 0.5 | 0.0018 | C & D |
| 108 | 0.0801 | 30.0 | 0.5653 | 0.023 | 0.1127 | 0.35 | 0.1 | 4.5 | 0.6 | 0.0018 | B |

## Time of Concentration Calculations for Basins under 90 acres

| Basin | $C_5$ | Overland Flow | | | Travel Time in Channel | | | | $T_c$ (mins) | $T_c$ Check | | Final $T_c$ (min = 5 mins) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Length (ft) | Slope (%) | $T_1$ (fig.3-1) (mins) | Length (ft) | Slope (%) | Velocity (ft/sec) (fig.3-2) | $T_t$ (mins) | | Total Length (ft) | $T_c$ = (L/180)+10 (mins) | |
| 101 | From Colliers Hill Filing 3 Storm Pipe SA-42 to SA-41 | | | | | | | | | | | 17.0 |
| 102 | 0.33 | 200 | 5.0 | 11.5 | 250 | 2.0 | 2.8 | 1.5 | 19.9 | 1300 | 17.2 | 17.2 |
| | | | | | 500 | PIPE | 5.0 | 1.7 | | | | |
| | | | | | 350 | 0.5 | 1.1 | 5.3 | | | | |
| 103 | 0.43 | 200 | 5.0 | 10.0 | 250 | 2.0 | 2.8 | 1.5 | 12.5 | 775 | 14.3 | 12.5 |
| | | | | | 325 | PIPE | 5.0 | 1.1 | | | | |
| 104 | 0.35 | 50 | 5.0 | 5.6 | 680 | 1.5 | 2.4 | 4.7 | 15.4 | 2255 | 22.5 | 15.4 |
| | | | | | 1525 | PIPE | 5.0 | 5.1 | | | | |
| 105 | 0.35 | 360 | 2.8 | 18.2 | 1050 | 1.8 | 2.7 | 6.5 | 27.3 | 2210 | 22.3 | 22.3 |
| | | | | | 800 | PIPE | 5.0 | 2.7 | | | | |
| 108 | 0.25 | 240 | 3.0 | 16.4 | 1110 | 2.5 | 3.1 | 6.0 | 32.0 | 2460 | 23.7 | 23.7 |
| | | | | | 610 | PIPE | 5.0 | 2.0 | | | | |
| | | | | | 500 | 0.5 | 1.1 | 7.6 | | | | |

## CUHP OUTPUT

| Basin | Total Area (acres) | Peak $Q_2$ (cfs) | Peak $Q_5$ (cfs) | Peak $Q_{10}$ (cfs) | Peak $Q_{100}$ (cfs) |
|---|---|---|---|---|---|
| **101** | **42.44** | 29 | 61 | 82 | 165 |
| **102** | **23.81** | 18 | 34 | 45 | 93 |
| **103** | **13.60** | 14 | 24 | 31 | 58 |
| **104** | **54.84** | 40 | 83 | 110 | 221 |
| **105** | **31.64** | 19 | 39 | 52 | 105 |
| **106** | **102.65** | 77 | 159 | 213 | 426 |
| **107** | **158.20** | 83 | 181 | 250 | 523 |
| **108** | **51.27** | 21 | 47 | 68 | 156 |

| | Time (sec.) | Time (hr.) | 100-Year Storm Hydrographs (cfs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 300 | 0.0833 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 600 | 0.1667 | 0.31 | 0.22 | 0.17 | 0.44 | 0.17 | 0.81 | 0.56 | 0.18 |
| 4 | 900 | 0.2500 | 5.21 | 3.63 | 2.79 | 7.33 | 2.86 | 13.46 | 9.49 | 2.94 |
| 5 | 1200 | 0.3333 | 14.91 | 10.01 | 7.64 | 20.67 | 8.75 | 38.9 | 33.93 | 9.6 |
| 6 | 1500 | 0.4167 | 46.7 | 25.92 | 19.55 | 63.31 | 26.69 | 118.45 | 117.23 | 32.58 |
| 7 | 1800 | 0.5000 | 129.37 | 70.54 | 46.69 | 173.43 | 74.2 | 326.2 | 352.64 | 112.47 |
| 8 | 2100 | 0.5833 | 164.61 | 93.27 | 58.13 | 221.04 | 105.38 | 425.77 | 522.7 | 155.68 |
| 9 | 2400 | 0.6667 | 146.36 | 83.3 | 51.53 | 194.22 | 101.91 | 370.02 | 508.24 | 149.4 |
| 10 | 2700 | 0.7500 | 121.79 | 69.41 | 43.03 | 158.21 | 89.47 | 293.17 | 441.18 | 131.21 |
| 11 | 3000 | 0.8333 | 100.26 | 57.04 | 35.46 | 127.59 | 77.86 | 230.44 | 375.5 | 113.25 |
| 12 | 3300 | 0.9167 | 81.05 | 45.92 | 27.69 | 101.38 | 66.83 | 179.71 | 314.22 | 95.86 |
| 13 | 3600 | 1.0000 | 67.06 | 36.89 | 19.91 | 82.95 | 57.79 | 14S.38 | 265.09 | 82.12 |
| 14 | 3900 | 1.0833 | 56.97 | 28.62 | 16.52 | 70.63 | 51.14 | 125.72 | 231.2 | 72.33 |
| 15 | 4200 | 1.1667 | 40.58 | 21.14 | 12.82 | 50.98 | 42.42 | 96.09 | 189.85 | 58.27 |
| 16 | 4500 | 1.2500 | 28.79 | 15.18 | 9.59 | 36.14 | 32.56 | 66.65 | 146.94 | 45.07 |
| 17 | 4800 | 1.3333 | 20.4 | 10.9 | 7.03 | 25.42 | 22.2 | 45.94 | 111.84 | 33.54 |
| 18 | 5100 | 1.4167 | 14.28 | 7.75 | 5.12 | 17.64 | 15.58 | 31.39 | 83.18 | 22.07 |
| 19 | 5400 | 1.5000 | 10.64 | 5.92 | 3.9 | 13.16 | 11.65 | 23.35 | 62.06 | 15.44 |
| 20 | 5700 | 1.5833 | 8.43 | 4.72 | 3.08 | 10.56 | 9.06 | 18.87 | 44.66 | 11.54 |
| 21 | 6000 | 1.6667 | 6.98 | 3.92 | 2.84 | 8.94 | 7.31 | 16.4 | 34.38 | 8.96 |
| 22 | 6300 | 1.7500 | 6.03 | 3.72 | 2.68 | 7.93 | 6.15 | 14.98 | 28.22 | 7.25 |
| 23 | 6600 | 1.8333 | 5.77 | 3.59 | 2.68 | 7.65 | 5.3 | 14.16 | 24.2 | 6.15 |
| 24 | 6900 | 1.9167 | 5.6 | 3.59 | 2.68 | 7.48 | 4.66 | 13.93 | 21.59 | 5.35 |
| 25 | 7200 | 2.0000 | 5.6 | 3.59 | 2.68 | 7.48 | 4.49 | 13.8 | 19.93 | 4.75 |
| 26 | 7500 | 2.0833 | 4.11 | 2.68 | 1.95 | 5.44 | 3.57 | 10.07 | 15.7 | 3.69 |
| 27 | 7800 | 2.1667 | 2.52 | 1.61 | 0 | 3.2 | 2.49 | 5.66 | 10.33 | 2.53 |
| 28 | 8100 | 2.2500 | 1.57 | 0 | 0 | 1.91 | 1.75 | 3.21 | 7.02 | 1.79 |
| 29 | 8400 | 2.3333 | 0 | 0 | 0 | 0 | 0 | 1.8 | 4.76 | 0 |
| 30 | 8700 | 2.4167 | 0 | 0 | 0 | 0 | 0 | 0 | 3.29 | 0 |
| 31 | 9000 | 2.5000 | 0 | 0 | 0 | 0 | 0 | 0 | 2.25 | 0 |
| 32 | 9300 | 2.5833 | 0 | 0 | 0 | 0 | 0 | 0 | 1.52 | 0 |

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 3/2015 AT TIME 21:16
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
Colliers

BASIN ID: 1 — BASIN COMMENT: 101

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.07 | 0.39 | 0.24 | 39.00 | 0.0280 | S.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.094 | 0.338 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.19 | D= 0.78 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 7.50 | 17.00 | 2593.26 | 171.93 | 3.54 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 6.75)

WIDTH AT 50 = 12. MIN. WIDTH AT 75 = 6. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 20. | 56. | 40. | 10. |
| 5. | 136. | 25. | 37. | 45. | 0. |
| 10. | 146. | 30. | 24. | 0. | 0. |
| 15. | 86. | 35. | 16. | 0. | 0. |

1 BASIN ID: 1 — BASIN COMMENT: 101
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 65. | 0.03 | 0.010 | 6. |
| 5. | 0.02 | 0.000 | 0. | 70. | 0.02 | 0.006 | 5. |
| 10. | 0.04 | 0.000 | 0. | 75. | 0.02 | 0.006 | 4. |
| 15. | 0.08 | 0.013 | 2. | 80. | 0.02 | 0.006 | 4. |
| 20. | 0.16 | 0.047 | 8. | 85. | 0.02 | 0.006 | 3. |
| 25. | 0.25 | 0.101 | 22. | 90. | 0.02 | 0.006 | 3. |
| 30. | 0.14 | 0.072 | 29. | 95. | 0.02 | 0.006 | 3. |
| 35. | 0.06 | 0.033 | 27. | 100. | 0.02 | 0.006 | 3. |
| 40. | 0.05 | 0.022 | 22. | 105. | 0.02 | 0.006 | 3. |
| 45. | 0.03 | 0.010 | 17. | 110. | 0.02 | 0.006 | 3. |
| 50. | 0.03 | 0.010 | 13. | 115. | 0.01 | 0.003 | 3. |
| 55. | 0.03 | 0.010 | 10. | 120. | 0.01 | 0.003 | 2. |
| 60. | 0.03 | 0.010 | 8. | 125. | 0.00 | 0.000 | 2. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 1.17 (1-HOUR RAIN = 1.01) EXCESS PRECIP. = 0.396 INCHES
VOLUME OF EXCESS PRECIP = 1.40 ACRE-FEET
PEAK Q = 29. CFS TIME OF PEAK = 30. MIN.

INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.34
I = 2.2 INCHES/HOUR
A = 42.4 ACRES
Q = 31. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 3/2015 AT TIME 21:16
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 2 -- BASIN COMMENT: 102

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.04 | 0.30 | 0.17 | 47.10 | 0.0230 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.090 | 0.364 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.21 | D= 0.84 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 7.73 | 17.20 | 2673.66 | 99.46 | 1.98 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER,
REPLACING THE ONE COMPUTED BY CUHPF (TP= 5.67)

WIDTH AT 50 = 11. MIN. WIDTH AT 75 = 6. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 15. | 50. | 30. | 14. |
| 5. | 73. | 20. | 33. | 35. | 10. |
| 10. | 86. | 25. | 22. | 40. | 0. |

1 BASIN ID: 2 -- BASIN COMMENT: 102
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | EXCESS PRECIP | TOTAL* STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | EXCESS PRECIP | TOTAL* STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 60. | 0.03 | 0.011 | 4. |
| 5. | 0.02 | 0.000 | 0. | 65. | 0.03 | 0.011 | 4. |
| 10. | 0.04 | 0.000 | 0. | 70. | 0.02 | 0.008 | 3. |
| 15. | 0.08 | 0.017 | 1. | 75. | 0.02 | 0.008 | 3. |
| 20. | 0.16 | 0.060 | 6. | 80. | 0.02 | 0.008 | 2. |
| 25. | 0.25 | 0.112 | 14. | 85. | 0.02 | 0.008 | 2. |
| 30. | 0.14 | 0.072 | 18. | 90. | 0.02 | 0.008 | 2. |
| 35. | 0.06 | 0.029 | 16. | 95. | 0.02 | 0.008 | 2. |
| 40. | 0.05 | 0.022 | 13. | 100. | 0.02 | 0.008 | 2. |
| 45. | 0.03 | 0.011 | 10. | 105. | 0.02 | 0.008 | 2. |
| 50. | 0.03 | 0.011 | 8. | 110. | 0.02 | 0.008 | 2. |
| 55. | 0.03 | 0.011 | 6. | 115. | 0.01 | 0.004 | 2. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 1.17 (1-HOUR RAIN = 1.01) EXCESS PRECIP. = 0.444 INCHES
VOLUME OF EXCESS PRECIP = 0.88 ACRE-FEET
PEAK Q = 18. CFS TIME OF PEAK = 30. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.38
I = 2.1 INCHES/HOUR
A = 23.8 ACRES
Q = 19. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 3/2015 AT TIME 21:16
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 3 -- BASIN COMMENT: 103

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATIDN (MIN) |
|---|---|---|---|---|---|
| 0.02 | 0.16 | 0.10 | 55.80 | 0.0330 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.086 | 0.376 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.25 | D= 0.88 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 7.50 | 12.50 | 2886.59 | 61.20 | 1.13 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER,
REPLACING THE ONE COMPUTED BY CUHPF (TP= 4.09)

WIDTH AT 50 = 10. MIN. WIDTH AT 75 = 5. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 15. | 29. | 30. | 9. |
| 5. | 45. | 20. | 20. | 35. | 0. |
| 10. | 80. | 25. | 13. | 0. | 0. |

1 BASIN ID: 3 -- BASIN COMMENT: 103
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 55. | 0.03 | 0.015 | 4. |
| 5. | 0.02 | 0.000 | 0. | 60. | 0.03 | 0.015 | 3. |
| 10. | 0.04 | 0.000 | 0. | 65. | 0.03 | 0.015 | 3. |
| 15. | 0.08 | 0.021 | 1. | 70. | 0.02 | 0.009 | 2. |
| 20. | 0.16 | 0.075 | 4. | 75. | 0.02 | 0.009 | 2. |
| 25. | 0.25 | 0.138 | 11. | 80. | 0.02 | 0.009 | 2. |
| 30. | 0.14 | 0.091 | 14. | 85. | 0.02 | 0.009 | 2. |
| 35. | 0.06 | 0.041 | 12. | 90. | 0.02 | 0.009 | 2. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 40. | 0.05 | 0.029 | 10. | 95. | 0.02 | 0.009 | 2. | |
| 45. | 0.03 | 0.015 | 8. | 100. | 0.02 | 0.009 | 2. | |
| 50. | 0.03 | 0.015 | 5. | 105. | 0.02 | 0.009 | 2. | |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 1.17 (1-HOUR RAIN = 1.01) EXCESS PRECIP. = 0.564 INCHES
VOLUME OF EXCESS PRECIP = 0.64 ACRE-FEET
PEAK Q = 14. CFS TIME OF PEAK = 30. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.48
I = 2.5 INCHES/HOUR
A = 13.6 ACRES
Q = 16. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 3/2015 AT TIME 21:16
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 4 -- BASIN COMMENT: 104

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.09 | 0.52 | 0.19 | 40.20 | 0.0160 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.093 | 0.363 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.19 | D= 0.80 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 7.50 | 15.40 | 2788.08 | 238.94 | 4.57 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER,
REPLACING THE ONE COMPUTED BY CUHPF (TP= 7.39)

WIDTH AT 50 = 11. MIN. WIDTH AT 75 = 6. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 20. | 71. | 40. | 10. |
| 5. | 180. | 25. | 44. | 45. | 0. |
| 10. | 198. | 30. | 27. | 0. | 0. |
| 15. | 114. | 35. | 17. | 0. | 0. |

1 BASIN ID: 4 -- BASIN COMMENT: 104
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 65. | 0.03 | 0.010 | 8. |
| 5. | 0.02 | 0.000 | 0. | 70. | 0.02 | 0.006 | 6. |
| 10. | 0.04 | 0.000 | 0. | 75. | 0.02 | 0.006 | 5. |
| 15. | 0.08 | 0.014 | 3. | 80. | 0.02 | 0.006 | 5. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20. | 0.16 | 0.049 | 12. | 85. | 0.02 | 0.006 | 4. | |
| 25. | 0.25 | 0.103 | 30. | 90. | 0.02 | 0.006 | 4. | |
| 30. | 0.14 | 0.074 | 40. | 95. | 0.02 | 0.006 | 4. | |
| 35. | 0.06 | 0.034 | 36. | 100. | 0.02 | 0.006 | 4. | |
| 40. | 0.05 | 0.022 | 29. | 105. | 0.02 | 0.006 | 4. | |
| 45. | 0.03 | 0.010 | 21. | 110. | 0.02 | 0.006 | 4. | |
| 50. | 0.03 | 0.010 | 16. | 115. | 0.01 | 0.003 | 4. | |
| 55. | 0.03 | 0.010 | 12. | 120. | 0.01 | 0.003 | 3. | |
| 60. | 0.03 | 0.010 | 10. | 125. | 0.00 | 0.000 | 2. | |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 1.17 (1-HOUR RAIN = 1.01) EXCESS PRECIP. = 0.409 INCHES
VOLUME OF EXCESS PRECIP = 1.87 ACRE-FEET
PEAK Q = 40. CFS TIME OF PEAK = 30. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.35
I = 2.3 INCHES/HOUR
A = 54.8 ACRES
Q = 43. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 3/2015 AT TIME 21:16
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 5 -- BASIN COMMENT: 105

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.05 | 0.49 | 0.30 | 40.00 | 0.0200 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.093 | 0.332 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIDUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.19 | D= 0.80 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 8.92 | 22.30 | 1988.89 | 98.25 | 2.63 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER,
REPLACING THE ONE COMPUTED BY CUHPF (TP= 8.21)

WIDTH AT 50 = 15. MIN. WIDTH AT 75 = 8. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIDUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDRDGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 20. | 46. | 40. | 14. |
| 5. | 70. | 25. | 34. | 45. | 10. |
| 10. | 96. | 30. | 25. | 50. | 8. |
| 15. | 66. | 35. | 19. | 55. | 0. |

1 BASIN ID: 5 -- BASIN COMMENT: 105
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 65. | 0.03 | 0.010 | 7. | |
| 5. | 0.02 | 0.000 | 0. | 70. | 0.02 | 0.006 | 6. | |
| 10. | 0.04 | 0.000 | 0. | 75. | 0.02 | 0.006 | 4. | |
| 15. | 0.08 | 0.014 | 1. | 80. | 0.02 | 0.006 | 3. | |
| 20. | 0.16 | 0.049 | 5. | 85. | 0.02 | 0.006 | 3. | |
| 25. | 0.25 | 0.103 | 13. | 90. | 0.02 | 0.006 | 3. | |
| 30. | 0.14 | 0.074 | 19. | 95. | 0.02 | 0.006 | 3. | |
| 35. | 0.06 | 0.034 | 19. | 100. | 0.02 | 0.006 | 3. | |
| 40. | 0.05 | 0.022 | 16. | 105. | 0.02 | 0.006 | 2. | |
| 45. | 0.03 | 0.010 | 13. | 110. | 0.02 | 0.006 | 2. | |
| 50. | 0.03 | 0.010 | 11. | 115. | 0.01 | 0.003 | 2. | |
| 55. | 0.03 | 0.010 | 9. | 120. | 0.01 | 0.003 | 2. | |
| 60. | 0.03 | 0.010 | 8. | 125. | 0.00 | 0.000 | 1. | |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 1.17 (1-HOUR RAIN = 1.01) EXCESS PRECIP. = 0.407 INCHES
VOLUME OF EXCESS PRECIP = 1.07 ACRE-FEET
PEAK Q = 19. CFS TIME OF PEAK = 35. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.35
I = 1.9 INCHES/HOUR
A = 31.6 ACRES
Q = 21. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 3/2015 AT TIME 21:16
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 6 -- BASIN COMMENT: 106

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.16 | 0.52 | 0.22 | 40.00 | 0.0200 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.093 | 0.397 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) R= 0.19

FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) D= 0.80

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|
| 7.61 | 2982.52 | 478.40 | 8.55 |

WIDTH AT 50 = 10. MIN. WIDTH AT 75 = 5. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 20. | 125. | 40. | 14. |
| 5. | 331. | 25. | 72. | 45. | 8. |
| 10. | 392. | 30. | 42. | 50. | 0. |
| 15. | 218. | 35. | 24. | 0. | 0. |

1 BASIN ID: 6 -- BASIN COMMENT: 106
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 65. | 0.03 | 0.010 | 15. |
| 5. | 0.02 | 0.000 | 0. | 70. | 0.02 | 0.006 | 12. |
| 10. | 0.04 | 0.000 | 0. | 75. | 0.02 | 0.006 | 10. |
| 15. | 0.08 | 0.014 | 5. | 80. | 0.02 | 0.006 | 9. |
| 20. | 0.16 | 0.049 | 22. | 85. | 0.02 | 0.006 | 8. |
| 25. | 0.25 | 0.103 | 56. | 90. | 0.02 | 0.006 | 8. |
| 30. | 0.14 | 0.074 | 77. | 95. | 0.02 | 0.006 | 8. |
| 35. | 0.06 | 0.034 | 69. | 100. | 0.02 | 0.006 | 8. |
| 40. | 0.05 | 0.022 | 54. | 105. | 0.02 | 0.006 | 8. |
| 45. | 0.03 | 0.010 | 38. | 110. | 0.02 | 0.006 | 8. |
| 50. | 0.03 | 0.010 | 27. | 115. | 0.01 | 0.003 | 7. |
| 55. | 0.03 | 0.010 | 21. | 120. | 0.01 | 0.003 | 5. |
| 60. | 0.03 | 0.010 | 17. | 125. | 0.00 | 0.000 | 4. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 1.17 (1-HOUR RAIN = 1.01) EXCESS PRECIP. = 0.407 INCHES
VOLUME OF EXCESS PRECIP = 3.48 ACRE-FEET
PEAK Q = 77. CFS TIME OF PEAK = 30. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 3/2015 AT TIME 21:16
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 7 — BASIN COMMENT: 107

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.25 | 0.69 | 0.27 | 33.10 | 0.0200 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.097 | 0.350 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.17 | D= 0.66 |

CALCULATED UNIT HYDRDGRAPH

| TIME TO PEAK (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|
| 9.10 | 2036.24 | 503.36 | 13.18 |

WIDTH AT 50 = 15. MIN. WIDTH AT 75 = 8. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 25. | 161. | 50. | 28. |
| 5. | 335. | 30. | 113. | 55. | 19. |
| 10. | 496. | 35. | 80. | 60. | 14. |
| 15. | 338. | 40. | 56. | 65. | 10. |
| 20. | 229. | 45. | 39. | 70. | 0. |

1 BASIN ID: 7 — BASIN COMMENT: 107
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

INCREMENT TOTAL* STORM** | INCREMENT TOTAL* STORM** |

| TIME (MIN.) | RAINFALL (IN) | EXCESS PRECIP | HYDROGRAPH (CFS) | TIME (MIN.) | RAINFALL (IN) | EXCESS PRECIP | HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 70. | 0.02 | 0.004 | 22. |
| 5. | 0.02 | 0.000 | 0. | 75. | 0.02 | 0.004 | 17. |
| 10. | 0.04 | 0.000 | 0. | 80. | 0.02 | 0.004 | 15. |
| 15. | 0.08 | 0.009 | 3. | 85. | 0.02 | 0.004 | 12. |
| 20. | 0.16 | 0.034 | 16. | 90. | 0.02 | 0.004 | 11. |
| 25. | 0.25 | 0.093 | 51. | 95. | 0.02 | 0.004 | 9. |
| 30. | 0.14 | 0.066 | 81. | 100. | 0.02 | 0.004 | 9. |
| 35. | 0.06 | 0.031 | 83. | 105. | 0.02 | 0.004 | 9. |
| 40. | 0.05 | 0.019 | 71. | 110. | 0.02 | 0.004 | 8. |
| 45. | 0.03 | 0.008 | 57. | 115. | 0.01 | 0.002 | 8. |
| 50. | 0.03 | 0.008 | 45. | 120. | 0.01 | 0.002 | 6. |
| 55. | 0.03 | 0.008 | 36. | 125. | 0.00 | 0.000 | 5. |
| 60. | 0.03 | 0.008 | 30. | 130. | 0.00 | 0.000 | 3. |
| 65. | 0.03 | 0.008 | 26. | 135. | 0.00 | 0.000 | 2. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 1.17 (1-HOUR RAIN = 1.01) EXCESS PRECIP. = 0.334 INCHES
VOLUME OF EXCESS PRECIP = 4.40 ACRE-FEET
PEAK Q = 83. CFS TIME OF PEAK = 35. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 3/2015 AT TIME 21:16
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: B -- BASIN COMMENT: 108

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.08 | 0.57 | 0.11 | 30.00 | 0.0230 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.099 | 0.273 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.16 | D= 0.60 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 7.85 | 23.70 | 1958.25 | 156.86 | 4.27 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 6.44)

WIDTH AT 50 = 15. MIN. WIDTH AT 75 = 8. MIN. K50 =0.31 K75 =0.42

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 25. | 52. | 50. | 11. |
| 5. | 129. | 30. | 38. | 55. | 8. |
| 10. | 146. | 35. | 28. | 60. | 0. |
| 15. | 101. | 40. | 21. | 0. | 0. |
| 20. | 71. | 45. | 15. | 0. | 0. |

1 BASIN ID: 8 — BASIN COMMENT: 108
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 60. | 0.03 | 0.006 | 8. |
| 5. | 0.02 | 0.000 | 0. | 65. | 0.03 | 0.006 | 7. |
| 10. | 0.04 | 0.000 | 0. | 70. | 0.02 | 0.003 | 6. |
| 15. | 0.08 | 0.008 | 1. | 75. | 0.02 | 0.003 | 5. |
| 20. | 0.16 | 0.028 | 5. | 80. | 0.02 | 0.003 | 3. |
| 25. | 0.25 | 0.078 | 15. | 85. | 0.02 | 0.003 | 3. |
| 30. | 0.14 | 0.048 | 21. | 90. | 0.02 | 0.003 | 3. |
| 35. | 0.06 | 0.019 | 20. | 95. | 0.02 | 0.003 | 2. |
| 40. | 0.05 | 0.014 | 17. | 100. | 0.02 | 0.003 | 2. |
| 45. | 0.03 | 0.006 | 13. | 105. | 0.02 | 0.003 | 2. |
| 50. | 0.03 | 0.006 | 11. | 110. | 0.02 | 0.003 | 2. |
| 55. | 0.03 | 0.006 | 9. | 115. | 0.01 | 0.002 | 2. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 1.17 (1-HOUR RAIN = 1.01) EXCESS PRECIP. = 0.260 INCHES
VOLUME OF EXCESS PRECIP = 1.11 ACRE-FEET
PEAK Q = 21. CFS TIME OF PEAK = 30. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.22
I = 1.8 INCHES/HOUR
A = 51.3 ACRES
Q = 21. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:54
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 1 -- BASIN COMMENT: 101

| AREA (5QMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.07 | 0.39 | 0.24 | 39.00 | 0.0280 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.094 | 0.338 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.19 | D= 0.78 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 7.50 | 17.00 | 2593.26 | 171.93 | 3.54 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 6.75)

WIDTH AT 50 = 12. MIN. WIDTH AT 75 = 6. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 20. | 56. | 40. | 10. |
| 5. | 136. | 25. | 37. | 45. | 0. |
| 10. | 146. | 30. | 24. | 0. | 0. |
| 15. | 86. | 35. | 16. | 0. | 0. |

1 BASIN ID: 1 -- BASIN COMMENT: 101
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 65. | 0.04 | 0.016 | 11. |
| 5. | 0.03 | 0.000 | 0. | 70. | 0.04 | 0.017 | 10. |
| 10. | 0.05 | 0.000 | 0. | 75. | 0.04 | 0.013 | 8. |
| 15. | 0.12 | 0.031 | 4. | 80. | 0.03 | 0.010 | 7. |
| 20. | 0.22 | 0.070 | 14. | 85. | 0.03 | 0.010 | 6. |
| 25. | 0.36 | 0.227 | 44. | 90. | 0.03 | 0.010 | 6. |
| 30. | 0.19 | 0.150 | 61. | 95. | 0.03 | 0.010 | 6. |
| 35. | 0.08 | 0.052 | 54. | 100. | 0.02 | 0.006 | 5. |
| 40. | 0.06 | 0.034 | 41. | 105. | 0.02 | 0.006 | 4. |
| 45. | 0.05 | 0.024 | 32. | 110. | 0.02 | 0.006 | 4. |
| 50. | 0.05 | 0.024 | 25. | 115. | 0.02 | 0.006 | 4. |
| 55. | 0.04 | 0.016 | 20. | 120. | 0.02 | 0.005 | 3. |
| 60. | 0.04 | 0.016 | 15. | 125. | 0.00 | 0.000 | 2. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 1.65 (1-HOUR RAIN = 1.43) EXCESS PRECIP. = 0.762 INCHES
VOLUME OF EXCESS PRECIP = 2.69 ACRE-FEET
PEAK Q = 61. CFS TIME OF PEAK = 30. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.46
I = 3.0 INCHES/HOUR
A = 42.4 ACRES
Q = 60. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:54
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 2 -- BASIN COMMENT: 102

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.04 | 0.30 | 0.17 | 47.10 | 0.0230 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.090 | 0.364 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.21 | D= 0.84 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 7.73 | 17.20 | 2673.66 | 99.46 | 1.98 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 5.67)

WIDTH AT 50 = 11. MIN. WIDTH AT 75 = 6. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 15. | 50. | 30. | 14. |
| 5. | 73. | 20. | 33. | 35. | 10. |
| 10. | 86. | 25. | 22. | 40. | 0. |

1 BASIN ID: 2 -- BASIN COMMENT: 102
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | EXCESS PRECIP | TOTAL* STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | EXCESS PRECIP | TOTAL* STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 65. | 0.04 | 0.018 | 6. |
| 5. | 0.03 | 0.000 | 0. | 70. | 0.04 | 0.018 | 6. |
| 10. | 0.05 | 0.000 | 0. | 75. | 0.04 | 0.014 | 5. |
| 15. | 0.12 | 0.040 | 3. | 80. | 0.03 | 0.012 | 5. |
| 20. | 0.22 | 0.082 | 9. | 85. | 0.03 | 0.012 | 4. |
| 25. | 0.36 | 0.208 | 24. | 90. | 0.03 | 0.012 | 4. |
| 30. | 0.19 | 0.146 | 34. | 95. | 0.03 | 0.012 | 4. |
| 35. | 0.08 | 0.049 | 30. | 100. | 0.02 | 0.008 | 3. |
| 40. | 0.06 | 0.032 | 23. | 105. | 0.02 | 0.008 | 3. |
| 45. | 0.05 | 0.023 | 18. | 110. | 0.02 | 0.008 | 3. |
| 50. | 0.05 | 0.023 | 14. | 115. | 0.02 | 0.008 | 2. |
| 55. | 0.04 | 0.018 | 11. | 120. | 0.02 | 0.007 | 2. |
| 60. | 0.04 | 0.018 | 8. | 125. | 0.00 | 0.000 | 2. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 1.65 (1-HOUR RAIN = 1.43) EXCESS PRECIP. = 0.778 INCHES
VOLUME OF EXCESS PRECIP = 1.54 ACRE-FEET
PEAK Q = 34. CFS TIME OF PEAK = 30. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.47
I = 3.0 INCHES/HOUR
A = 23.8 ACRES
Q = 34. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:54
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 3 -- BASIN COMMENT: 103

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.02 | 0.16 | 0.10 | 55.80 | 0.0330 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.086 | 0.376 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.25 | D= 0.88 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 7.50 | 12.50 | 2886.59 | 61.20 | 1.13 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 4.09)

WIDTH AT 50 = 10. MIN. WIDTH AT 75 = 5. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 15. | 29. | 30. | 9. |
| 5. | 45. | 20. | 20. | 35. | 0. |
| 10. | 50. | 25. | 13. | 0. | 0. |

1 BASIN ID: 3 -- BASIN COMMENT: 103
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | EXCESS PRECIP | TOTAL* STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | EXCESS PRECIP | TOTAL* STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 60. | 0.04 | 0.023 | 5. |
| 5. | 0.03 | 0.000 | 0. | 65. | 0.04 | 0.023 | 4. |
| 10. | 0.05 | 0.000 | 0. | 70. | 0.04 | 0.023 | 4. |
| 15. | 0.12 | 0.049 | 2. | 75. | 0.04 | 0.018 | 4. |
| 20. | 0.22 | 0.104 | 7. | 80. | 0.03 | 0.016 | 3. |
| 25. | 0.36 | 0.262 | 18. | 85. | 0.03 | 0.016 | 3. |
| 30. | 0.19 | 0.158 | 24. | 90. | 0.03 | 0.016 | 3. |
| 35. | 0.08 | 0.059 | 21. | 95. | 0.03 | 0.016 | 3. |
| 40. | 0.06 | 0.041 | 16. | 100. | 0.02 | 0.010 | 2. |
| 45. | 0.05 | 0.031 | 13. | 105. | 0.02 | 0.010 | 2. |
| 50. | 0.05 | 0.031 | 10. | 110. | 0.02 | 0.010 | 2. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 55. | 0.04 | 0.023 | 6. | 115. | 0.02 | 0.010 | 2. | |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 1.65 (1-HOUR RAIN = 1.43) EXCESS PRECIP. = 0.957 INCHES
VOLUME OF EXCESS PRECIP = 1.08 ACRE-FEET
PEAK Q = 24. CFS TIME OF PEAK = 30. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.58
I = 3.5 INCHES/HOUR
A = 13.6 ACRES
Q = 28. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:54
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 4 -- BASIN COMMENT: 104

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.09 | 0.52 | 0.19 | 40.20 | 0.0160 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TD PEAK RATE OF RUNOFF) |
|---|---|
| 0.093 | 0.363 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) R= 0.19

FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) D= 0.80

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 7.50 | 15.40 | 2788.08 | 238.94 | 4.57 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 7.39)

WIDTH AT 50 = 11. MIN. WIDTH AT 75 = 6. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 20. | 71. | 40. | 10. |
| 5. | 180. | 25. | 44. | 45. | 0. |
| 10. | 198. | 30. | 27. | 0. | 0. |
| 15. | 114. | 35. | 17. | 0. | 0. |

1 BASIN ID: 4 -- BASIN COMMENT: 104
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 65. | 0.04 | 0.017 | 15. |
| 5. | 0.03 | 0.000 | 0. | 70. | 0.04 | 0.017 | 12. |
| 10. | 0.05 | 0.000 | 0. | 75. | 0.04 | 0.013 | 11. |
| 15. | 0.12 | 0.032 | 6. | 80. | 0.03 | 0.011 | 10. |
| 20. | 0.22 | 0.072 | 19. | 85. | 0.03 | 0.011 | 9. |
| 25. | 0.36 | 0.229 | 59. | 90. | 0.03 | 0.011 | 8. |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 30. | 0.19 | 0.151 | 83. | \| | 95. | 0.03 | 0.011 | 8. | \| |
| 35. | 0.08 | 0.053 | 72. | \| | 100. | 0.02 | 0.007 | 7. | \| |
| 40. | 0.06 | 0.035 | 54. | \| | 105. | 0.02 | 0.007 | 6. | \| |
| 45. | 0.05 | 0.024 | 40. | \| | 110. | 0.02 | 0.007 | 5. | \| |
| 50. | 0.05 | 0.025 | 31. | \| | 115. | 0.02 | 0.007 | 5. | \| |
| 55. | 0.04 | 0.017 | 24. | \| | 120. | 0.02 | 0.006 | 4. | \| |
| 60. | 0.04 | 0.017 | 19. | \| | 125. | 0.00 | 0.000 | 3. | \| |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 1.65 (1-HOUR RAIN = 1.43) EXCESS PRECIP. = 0.776 INCHES
VOLUME OF EXCESS PRECIP = 3.55 ACRE-FEET
PEAK Q = 83. CFS TIME OF PEAK = 30. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.47
I = 3.2 INCHES/HOUR
A = 54.8 ACRES
Q = 82. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:54
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 5 -- BASIN COMMENT: 105

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.05 | 0.49 | 0.30 | 40.00 | 0.0200 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.093 | 0.332 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) R= 0.19
FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) D= 0.80

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | (CFS) | UNIT HYDROGRAPH PEAK VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 8.92 | 22.30 | 1988.89 | 98.25 | 2.63 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 8.21)

WIDTH AT 50 = 15. MIN. WIDTH AT 75 = 8. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 20. | 46. | 40. | 14. |
| 5. | 70. | 25. | 34. | 45. | 10. |
| 10. | 96. | 30. | 25. | 50. | 8. |
| 15. | 66. | 35. | 19. | 55. | 0. |

1 BASIN ID: 5 -- BASIN COMMENT: 105
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | \| | 65. | 0.04 | 0.017 | 13. | \| |
| 5. | 0.03 | 0.000 | 0. | \| | 70. | 0.04 | 0.017 | 11. | \| |
| 10. | 0.05 | 0.000 | 0. | \| | 75. | 0.04 | 0.013 | 8. | \| |
| 15. | 0.12 | 0.032 | 2. | \| | 80. | 0.03 | 0.011 | 6. | \| |
| 20. | 0.22 | 0.071 | 8. | \| | 85. | 0.03 | 0.011 | 6. | \| |
| 25. | 0.36 | 0.229 | 25. | \| | 90. | 0.03 | 0.011 | 5. | \| |
| 30. | 0.19 | 0.151 | 39. | \| | 95. | 0.03 | 0.011 | 5. | \| |
| 35. | 0.08 | 0.053 | 38. | \| | 100. | 0.02 | 0.007 | 4. | \| |
| 40. | 0.06 | 0.034 | 31. | \| | 105. | 0.02 | 0.007 | 4. | \| |
| 45. | 0.05 | 0.024 | 25. | \| | 110. | 0.02 | 0.007 | 3. | \| |
| 50. | 0.05 | 0.025 | 21. | \| | 115. | 0.02 | 0.007 | 3. | \| |
| 55. | 0.04 | 0.017 | 18. | \| | 120. | 0.02 | 0.006 | 3. | \| |
| 60. | 0.04 | 0.017 | 15. | \| | 125. | 0.00 | 0.000 | 2. | \| |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 1.65 (1-HOUR RAIN = 1.43) EXCESS PRECIP. = 0.774 INCHES
VOLUME OF EXCESS PRECIP = 2.04 ACRE-FEET
PEAK Q = 39. CFS TIME OF PEAK = 30. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.47
I = 2.6 INCHES/HOUR
A = 31.6 ACRES
Q = 39. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:54
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 6 -- BASIN COMMENT: 106

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.16 | 0.52 | 0.22 | 40.00 | 0.0200 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.093 | 0.397 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) R= 0.19

FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) D= 0.80

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|
| 7.61 | 2982.52 | 478.40 | 8.55 |

WIDTH AT 50 = 10. MIN. WIDTH AT 75 = 5. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYOROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 20. | 125. | 40. | 14. |
| 5. | 331. | 25. | 72. | 45. | 8. |
| 10. | 392. | 30. | 42. | 50. | 0. |
| 15. | 218. | 35. | 24. | 0. | 0. |

1 BASIN ID: 6 -- BASIN COMMENT: 106
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME | INCREMENT RAINFALL | TOTAL* EXCESS | STORM** HYDROGRAPH | TIME | INCREMENT RAINFALL | TOTAL* EXCESS | STORM** HYDROGRAPH |
|---|---|---|---|---|---|---|---|

| (MIN.) | (IN) | PRECIP | (CFS) | (MIN.) | (IN) | PRECIP | (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 70. | 0.04 | 0.017 | 24. |
| 5. | 0.03 | 0.000 | 0. | 75. | 0.04 | 0.013 | 20. |
| 10. | 0.05 | 0.000 | 0. | 80. | 0.03 | 0.011 | 18. |
| 15. | 0.12 | 0.032 | 11. | 85. | 0.03 | 0.011 | 16. |
| 20. | 0.22 | 0.071 | 36. | 90. | 0.03 | 0.011 | 15. |
| 25. | 0.36 | 0.229 | 111. | 95. | 0.03 | 0.011 | 14. |
| 30. | 0.19 | 0.151 | 159. | 100. | 0.02 | 0.007 | 12. |
| 35. | 0.08 | 0.053 | 138. | 105. | 0.02 | 0.007 | 10. |
| 40. | 0.06 | 0.034 | 100. | 110. | 0.02 | 0.007 | 9. |
| 45. | 0.05 | 0.024 | 72. | 115. | 0.02 | 0.007 | 9. |
| 50. | 0.05 | 0.025 | 54. | 120. | 0.02 | 0.006 | 8. |
| 55. | 0.04 | 0.017 | 42. | 125. | 0.00 | 0.000 | 6. |
| 60. | 0.04 | 0.017 | 33. | 130. | 0.00 | 0.000 | 3. |
| 65. | 0.04 | 0.017 | 27. | 135. | 0.00 | 0.000 | 2. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 1.65 (1-HOUR RAIN = 1.43) EXCESS PRECIP. = 0.774 INCHES
VOLUME OF EXCESS PRECIP = 6.62 ACRE-FEET
PEAK Q = 159. CFS TIME OF PEAK = 30. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:54
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 7 — BASIN COMMENT: 107

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.25 | 0.69 | 0.27 | 33.10 | 0.0200 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.097 | 0.350 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.17 | D= 0.66 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|
| 9.10 | 2036.24 | 503.36 | 13.18 |

WIDTH AT 50 = 15. MIN. WIDTH AT 75 = 8. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 25. | 161. | 50. | 28. |
| 5. | 335. | 30. | 113. | 55. | 19. |
| 10. | 496. | 35. | 80. | 60. | 14. |
| 15. | 338. | 40. | 56. | 65. | 10. |
| 20. | 229. | 45. | 39. | 70. | 0. |

1 BASIN ID: 7 — BASIN COMMENT: 107
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| INCREMENT | TOTAL* | STORM** | INCREMENT | TOTAL* | STORM** |
|---|---|---|---|---|---|

| TIME (MIN.) | RAINFALL (IN) | EXCESS PRECIP | HYDROGRAPH (CFS) | TIME (MIN.) | RAINFALL (IN) | EXCESS PRECIP | HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 75. | 0.04 | 0.011 | 38. |
| 5. | 0.03 | 0.000 | 0. | 80. | 0.03 | 0.009 | 32. |
| 10. | 0.05 | 0.000 | 0. | 85. | 0.03 | 0.009 | 27. |
| 15. | 0.12 | 0.022 | 7. | 90. | 0.03 | 0.009 | 23. |
| 20. | 0.22 | 0.061 | 31. | 95. | 0.03 | 0.009 | 20. |
| 25. | 0.36 | 0.213 | 109. | 100. | 0.02 | 0.005 | 17. |
| 30. | 0.19 | 0.148 | 181. | 105. | 0.02 | 0.005 | 14. |
| 35. | 0.08 | 0.050 | 180. | 110. | 0.02 | 0.005 | 13. |
| 40. | 0.06 | 0.032 | 146. | 115. | 0.02 | 0.005 | 11. |
| 45. | 0.05 | 0.021 | 116. | 120. | 0.02 | 0.004 | 10. |
| 50. | 0.05 | 0.022 | 94. | 125. | 0.00 | 0.000 | 8. |
| 55. | 0.04 | 0.014 | 76. | 130. | 0.00 | 0.000 | 5. |
| 60. | 0.04 | 0.014 | 61. | 135. | 0.00 | 0.000 | 4. |
| 65. | 0.04 | 0.014 | 51. | 140. | 0.00 | 0.000 | 3. |
| 70. | 0.04 | 0.014 | 44. | 145. | 0.00 | 0.000 | 2. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 1.65 (1-HOUR RAIN = 1.43) EXCESS PRECIP. = 0.692 INCHES
VOLUME OF EXCESS PRECIP = 9.12 ACRE-FEET
PEAK Q = 181. CFS TIME OF PEAK = 30. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:54
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 8 -- BASIN COMMENT: 108

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.08 | 0.57 | 0.11 | 30.00 | 0.0230 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.099 | 0.273 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.16 | D= 0.60 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 7.85 | 23.70 | 1958.25 | 156.86 | 4.27 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 6.44)

WIDTH AT 50 = 15. MIN. WIDTH AT 75 = 8. MIN. K50 =0.31 K75 =0.42

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 25. | 52. | 50. | 11. |
| 5. | 129. | 30. | 38. | 55. | 8. |
| 10. | 146. | 35. | 28. | 60. | 0. |
| 15. | 101. | 40. | 21. | 0. | 0. |
| 20. | 71. | 45. | 15. | 0. | 0. |

1 BASIN ID: B — BASIN COMMENT: 108
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 65. | 0.04 | 0.011 | 14. |
| 5. | 0.03 | 0.000 | 0. | 70. | 0.04 | 0.011 | 12. |
| 10. | 0.05 | 0.000 | 0. | 75. | 0.04 | 0.009 | 10. |
| 15. | 0.12 | 0.018 | 2. | 80. | 0.03 | 0.007 | 8. |
| 20. | 0.22 | 0.048 | 9. | 85. | 0.03 | 0.007 | 6. |
| 25. | 0.36 | 0.161 | 30. | 90. | 0.03 | 0.007 | 5. |
| 30. | 0.19 | 0.136 | 47. | 95. | 0.03 | 0.007 | 5. |
| 35. | 0.08 | 0.040 | 46. | 100. | 0.02 | 0.004 | 4. |
| 40. | 0.06 | 0.023 | 37. | 105. | 0.02 | 0.004 | 4. |
| 45. | 0.05 | 0.014 | 30. | 110. | 0.02 | 0.004 | 3. |
| 50. | 0.05 | 0.015 | 24. | 115. | 0.02 | 0.004 | 3. |
| 55. | 0.04 | 0.011 | 20. | 120. | 0.02 | 0.003 | 3. |
| 60. | 0.04 | 0.011 | 16. | 125. | 0.00 | 0.000 | 2. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 1.65 (1-HOUR RAIN = 1.43) EXCESS PRECIP. = 0.556 INCHES
VOLUME OF EXCESS PRECIP = 2.37 ACRE-FEET
PEAK Q = 47. CFS TIME OF PEAK = 30. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.34
I = 2.6 INCHES/HOUR
A = 51.3 ACRES
Q = 44. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:55
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 1 -- BASIN COMMENT: 101

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.07 | 0.39 | 0.24 | 39.00 | 0.0280 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.094 | 0.338 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.19 | D= 0.78 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 7.50 | 17.00 | 2593.26 | 171.93 | 3.54 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 6.75)

WIDTH AT 50 = 12. MIN. WIDTH AT 75 = 6. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 20. | 56. | 40. | 10. |
| 5. | 136. | 25. | 37. | 45. | 0. |
| 10. | 146. | 30. | 24. | 0. | 0. |
| 15. | 86. | 35. | 16. | 0. | 0. |

1 BASIN ID: 1 -- BASIN COMMENT: 101
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 65. | 0.06 | 0.029 | 17. |
| 5. | 0.03 | 0.000 | 0. | 70. | 0.06 | 0.029 | 16. |
| 10. | 0.06 | 0.000 | 0. | 75. | 0.06 | 0.029 | 15. |
| 15. | 0.14 | 0.041 | 6. | 80. | 0.04 | 0.017 | 13. |
| 20. | 0.26 | 0.094 | 19. | 85. | 0.03 | 0.011 | 11. |
| 25. | 0.43 | 0.329 | 62. | 90. | 0.03 | 0.011 | 9. |
| 30. | 0.21 | 0.172 | 82. | 95. | 0.03 | 0.011 | 8. |
| 35. | 0.10 | 0.066 | 69. | 100. | 0.03 | 0.011 | 7. |
| 40. | 0.07 | 0.045 | 54. | 105. | 0.03 | 0.011 | 6. |
| 45. | 0.07 | 0.038 | 42. | 110. | 0.03 | 0.011 | 6. |
| 50. | 0.06 | 0.028 | 33. | 115. | 0.03 | 0.010 | 6. |
| 55. | 0.06 | 0.028 | 27. | 120. | 0.02 | 0.006 | 5. |
| 60. | 0.06 | 0.029 | 22. | 125. | 0.00 | 0.000 | 3. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 2.00 (1-HOUR RAIN = 1.73) EXCESS PRECIP. = 1.056 INCHES
VOLUME OF EXCESS PRECIP = 3.73 ACRE-FEET
PEAK Q = 82. CFS TIME OF PEAK = 30. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR

MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.53
I = 3.7 INCHES/HOUR
A = 42.4 ACRES
Q = 83. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:55
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 2 — BASIN COMMENT: 102

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.04 | 0.30 | 0.17 | 47.10 | 0.0230 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.090 | 0.364 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.21 | D= 0.84 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 7.73 | 17.20 | 2673.66 | 99.46 | 1.98 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 5.67)

WIDTH AT 50 = 11. MIN. WIDTH AT 75 = 6. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 15. | 50. | 30. | 14. |
| 5. | 73. | 20. | 33. | 35. | 10. |
| 10. | 86. | 25. | 22. | 40. | 0. |

1 BASIN ID: 2 — BASIN COMMENT: 102
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 65. | 0.06 | 0.027 | 9. |
| 5. | 0.03 | 0.000 | 0. | 70. | 0.06 | 0.027 | 8. |
| 10. | 0.06 | 0.000 | 0. | 75. | 0.06 | 0.028 | 8. |
| 15. | 0.14 | 0.053 | 4. | 80. | 0.04 | 0.019 | 7. |
| 20. | 0.26 | 0.106 | 12. | 85. | 0.03 | 0.013 | 6. |
| 25. | 0.43 | 0.305 | 34. | 90. | 0.03 | 0.013 | 5. |
| 30. | 0.21 | 0.167 | 45. | 95. | 0.03 | 0.013 | 5. |
| 35. | 0.10 | 0.063 | 39. | 100. | 0.03 | 0.013 | 4. |
| 40. | 0.07 | 0.043 | 30. | 105. | 0.03 | 0.013 | 4. |
| 45. | 0.07 | 0.036 | 24. | 110. | 0.03 | 0.013 | 4. |
| 50. | 0.06 | 0.027 | 18. | 115. | 0.03 | 0.011 | 4. |
| 55. | 0.06 | 0.027 | 14. | 120. | 0.02 | 0.008 | 3. |
| 60. | 0.06 | 0.027 | 10. | 125. | 0.00 | 0.000 | 2. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 2.00 (1-HOUR RAIN = 1.73) EXCESS PRECIP. = 1.051 INCHES
VOLUME OF EXCESS PRECIP = 2.08 ACRE-FEET
PEAK Q = 45. CFS TIME OF PEAK = 30. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.53
I = 3.7 INCHES/HOUR
A = 23.8 ACRES
Q = 46. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:55
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 3 -- BASIN COMMENT: 103

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.02 | 0.16 | 0.10 | 55.80 | 0.0330 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.086 | 0.376 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.25 | D= 0.88 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 7.50 | 12.50 | 2886.59 | 61.20 | 1.13 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER,
REPLACING THE ONE COMPUTED BY CUHPF (TP= 4.09)

WIDTH AT 50 = 10. MIN. WIDTH AT 75 = 5. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 15. | 29. | 30. | 9. |
| 5. | 45. | 20. | 20. | 35. | 0. |
| 10. | 50. | 25. | 13. | 0. | 0. |

1 BASIN ID: 3 -- BASIN COMMENT: 103
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 65. | 0.06 | 0.035 | 6. |
| 5. | 0.03 | 0.000 | 0. | 70. | 0.06 | 0.035 | 6. |
| 10. | 0.06 | 0.000 | 0. | 75. | 0.06 | 0.035 | 6. |
| 15. | 0.14 | 0.065 | 3. | 80. | 0.04 | 0.024 | 5. |
| 20. | 0.26 | 0.134 | 9. | 85. | 0.03 | 0.016 | 4. |
| 25. | 0.43 | 0.355 | 25. | 90. | 0.03 | 0.016 | 4. |
| 30. | 0.21 | 0.179 | 31. | 95. | 0.03 | 0.016 | 3. |
| 35. | 0.10 | 0.073 | 26. | 100. | 0.03 | 0.016 | 3. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 40. | 0.07 | 0.052 | 20. | 105. | 0.03 | 0.016 | 3. | |
| 45. | 0.07 | 0.045 | 16. | 110. | 0.03 | 0.016 | 3. | |
| 50. | 0.06 | 0.035 | 12. | 115. | 0.03 | 0.014 | 3. | |
| 55. | 0.06 | 0.035 | 8. | 120. | 0.02 | 0.010 | 2. | |
| 60. | 0.06 | 0.035 | 7. | 125. | 0.00 | 0.000 | 2. | |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 2.00 (1-HOUR RAIN = 1.73) EXCESS PRECIP. = 1.261 INCHES
VOLUME OF EXCESS PRECIP = 1.43 ACRE-FEET
PEAK Q = 31. CFS TIME OF PEAK = 30. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.63
I = 4.3 INCHES/HOUR
A = 13.6 ACRES
Q = 36. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:55
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 4 -- BASIN COMMENT: 104

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.09 | 0.52 | 0.19 | 40.20 | 0.0160 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.093 | 0.363 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.19 | D= 0.80 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNDFF (AF) |
|---|---|---|---|---|
| 7.50 | 15.40 | 2788.08 | 238.94 | 4.57 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER,
REPLACING THE ONE COMPUTED BY CUHPF (TP= 7.39)

WIDTH AT 50 = 11. MIN. WIDTH AT 75 = 6. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 20. | 71. | 40. | 10. |
| 5. | 180. | 25. | 44. | 45. | 0. |
| 10. | 198. | 30. | 27. | 0. | 0. |
| 15. | 114. | 35. | 17. | 0. | 0. |

1 BASIN ID: 4 -- BASIN COMMENT: 104
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 70. | 0.06 | 0.029 | 20. |
| 5. | 0.03 | 0.000 | 0. | 75. | 0.06 | 0.029 | 20. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 10. | 0.06 | 0.000 | 0. | 80. | 0.04 | 0.017 | 17. |
| 15. | 0.14 | 0.043 | 8. | 85. | 0.03 | 0.012 | 14. |
| 20. | 0.26 | 0.096 | 26. | 90. | 0.03 | 0.012 | 11. |
| 25. | 0.43 | 0.331 | 84. | 95. | 0.03 | 0.012 | 10. |
| 30. | 0.21 | 0.172 | 110. | 100. | 0.03 | 0.012 | 9. |
| 35. | 0.10 | 0.066 | 92. | 105. | 0.03 | 0.012 | 8. |
| 40. | 0.07 | 0.046 | 70. | 110. | 0.03 | 0.012 | 8. |
| 45. | 0.07 | 0.038 | 54. | 115. | 0.03 | 0.010 | 7. |
| 50. | 0.06 | 0.029 | 41. | 120. | 0.02 | 0.007 | 6. |
| 55. | 0.06 | 0.029 | 33. | 125. | 0.00 | 0.000 | 4. |
| 60. | 0.06 | 0.029 | 27. | 130. | 0.00 | 0.000 | 3. |
| 65. | 0.06 | 0.029 | 22. | 135. | 0.00 | 0.000 | 2. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 2.00 (1-HOUR RAIN = 1.73) EXCESS PRECIP. = 1.071 INCHES
VOLUME OF EXCESS PRECIP = 4.89 ACRE-FEET
PEAK Q = 110. CFS TIME OF PEAK = 30. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.53
I = 3.9 INCHES/HOUR
A = 54.8 ACRES
Q = 114. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:55
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 5 -- BASIN COMMENT: 105

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.05 | 0.49 | 0.30 | 40.00 | 0.0200 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.093 | 0.332 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.19 | D= 0.80 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 8.92 | 22.30 | 1988.89 | 98.25 | 2.63 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER,
REPLACING THE ONE COMPUTED BY CUHPF (TP= 8.21)

WIDTH AT 50 = 15. MIN. WIDTH AT 75 = 8. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 20. | 46. | 40. | 14. |
| 5. | 70. | 25. | 34. | 45. | 10. |
| 10. | 96. | 30. | 25. | 50. | 8. |
| 15. | 66. | 35. | 19. | 55. | 0. |

1 BASIN ID: 5 -- BASIN COMMENT: 105
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 70. | 0.06 | 0.029 | 16. |
| 5. | 0.03 | 0.000 | 0. | 75. | 0.06 | 0.029 | 13. |
| 10. | 0.06 | 0.000 | 0. | 80. | 0.04 | 0.017 | 11. |
| 15. | 0.14 | 0.043 | 3. | 85. | 0.03 | 0.011 | 9. |
| 20. | 0.26 | 0.096 | 11. | 90. | 0.03 | 0.011 | 8. |
| 25. | 0.43 | 0.331 | 35. | 95. | 0.03 | 0.011 | 7. |
| 30. | 0.21 | 0.172 | 52. | 100. | 0.03 | 0.011 | 6. |
| 35. | 0.10 | 0.066 | 49. | 105. | 0.03 | 0.011 | 5. |
| 40. | 0.07 | 0.046 | 40. | 110. | 0.03 | 0.011 | 5. |
| 45. | 0.07 | 0.038 | 34. | 115. | 0.03 | 0.010 | 5. |
| 50. | 0.06 | 0.029 | 28. | 120. | 0.02 | 0.007 | 4. |
| 55. | 0.06 | 0.029 | 24. | 125. | 0.00 | 0.000 | 3. |
| 60. | 0.06 | 0.029 | 21. | 130. | 0.00 | 0.000 | 2. |
| 65. | 0.06 | 0.029 | 18. | 135. | 0.00 | 0.000 | 2. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 2.00 (1-HOUR RAIN = 1.73) EXCESS PRECIP. = 1.068 INCHES
VOLUME OF EXCESS PRECIP = 2.81 ACRE-FEET
PEAK Q = 52. CFS TIME OF PEAK = 30. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.53
I = 3.2 INCHES/HOUR
A = 31.6 ACRES
Q = 54. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:55
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 6 -- BASIN COMMENT: 106

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.16 | 0.52 | 0.22 | 40.00 | 0.0200 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.093 | 0.397 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.19 | D= 0.80 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|
| 7.61 | 2982.52 | 478.40 | 8.55 |

WIDTH AT 50 = 10. MIN. WIDTH AT 75 = 5. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 20. | 125. | 40. | 14. |
| 5. | 331. | 25. | 72. | 45. | 8. |
| 10. | 392. | 30. | 42. | 50. | 0. |
| 15. | 218. | 35. | 24. | 0. | 0. |

1 BASIN ID: 6 -- BASIN COMMENT: 106
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 70. | 0.06 | 0.029 | 38. |
| 5. | 0.03 | 0.000 | 0. | 75. | 0.06 | 0.029 | 36. |
| 10. | 0.06 | 0.000 | 0. | 80. | 0.04 | 0.017 | 32. |
| 15. | 0.14 | 0.043 | 14. | 85. | 0.03 | 0.011 | 25. |
| 20. | 0.26 | 0.096 | 49. | 90. | 0.03 | 0.011 | 20. |
| 25. | 0.43 | 0.331 | 156. | 95. | 0.03 | 0.011 | 18. |
| 30. | 0.21 | 0.172 | 213. | 100. | 0.03 | 0.011 | 16. |
| 35. | 0.10 | 0.066 | 176. | 105. | 0.03 | 0.011 | 15. |
| 40. | 0.07 | 0.046 | 129. | 110. | 0.03 | 0.011 | 15. |
| 45. | 0.07 | 0.038 | 95. | 115. | 0.03 | 0.010 | 14. |
| 50. | 0.06 | 0.029 | 72. | 120. | 0.02 | 0.007 | 12. |
| 55. | 0.06 | 0.029 | 56. | 125. | 0.00 | 0.000 | 8. |
| 60. | 0.06 | 0.029 | 47. | 130. | 0.00 | 0.000 | 5. |
| 65. | 0.06 | 0.029 | 42. | 135. | 0.00 | 0.000 | 3. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 2.00 (1-HOUR RAIN = 1.73) EXCESS PRECIP. = 1.068 INCHES
VOLUME OF EXCESS PRECIP = 9.14 ACRE-FEET
PEAK Q = 213. CFS TIME OF PEAK = 30. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:55
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 7 -- BASIN COMMENT: 107

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.25 | 0.69 | 0.27 | 33.10 | 0.0200 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.097 | 0.350 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.17 | D= 0.66 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|
| 9.10 | 2036.24 | 503.36 | 13.18 |

WIDTH AT 50 = 15. MIN. WIDTH AT 75 = 8. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 25. | 161. | 50. | 28. |
| 5. | 335. | 30. | 113. | 55. | 19. |
| 10. | 496. | 35. | 80. | 60. | 14. |
| 15. | 338. | 40. | 56. | 65. | 10. |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20. | 229. | \| | 45. | 39. | \| | 70. | 0. | \| | | | |

1 BASIN ID: 7 — BASIN COMMENT: 107
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 75. | 0.06 | 0.027 | 64. |
| 5. | 0.03 | 0.000 | 0. | 80. | 0.04 | 0.015 | 56. |
| 10. | 0.06 | 0.000 | 0. | 85. | 0.03 | 0.009 | 45. |
| 15. | 0.14 | 0.029 | 10. | 90. | 0.03 | 0.009 | 35. |
| 20. | 0.26 | 0.083 | 42. | 95. | 0.03 | 0.009 | 29. |
| 25. | 0.43 | 0.320 | 158. | 100. | 0.03 | 0.009 | 25. |
| 30. | 0.21 | 0.169 | 250. | 105. | 0.03 | 0.009 | 23. |
| 35. | 0.10 | 0.063 | 237. | 110. | 0.03 | 0.009 | 21. |
| 40. | 0.07 | 0.043 | 193. | 115. | 0.03 | 0.008 | 20. |
| 45. | 0.07 | 0.035 | 157. | 120. | 0.02 | 0.005 | 17. |
| 50. | 0.06 | 0.026 | 127. | 125. | 0.00 | 0.000 | 13. |
| 55. | 0.06 | 0.026 | 104. | 130. | 0.00 | 0.000 | 9. |
| 60. | 0.06 | 0.026 | 88. | 135. | 0.00 | 0.000 | 6. |
| 65. | 0.06 | 0.026 | 77. | 140. | 0.00 | 0.000 | 4. |
| 70. | 0.06 | 0.026 | 69. | 145. | 0.00 | 0.000 | 3. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 2.00 (1-HOUR RAIN = 1.73) EXCESS PRECIP. = 0.984 INCHES
VOLUME OF EXCESS PRECIP = 12.97 ACRE-FEET
PEAK Q = 250. CFS TIME OF PEAK = 30. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:55
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
CDLLIERS

BASIN ID: 8 — BASIN COMMENT: 108

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.08 | 0.57 | 0.11 | 30.00 | 0.0230 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.099 | 0.273 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.16 | D= 0.60 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 7.85 | 23.70 | 1958.25 | 156.86 | 4.27 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER,
REPLACING THE ONE COMPUTED BY CUHPF (TP= 6.44)

WIDTH AT 50 = 15. MIN. WIDTH AT 75 = 8. MIN. K50 =0.31 K75 =0.42

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0. | 0. | 25. | 52. | 50. | 11. | | |
| 5. | 129. | 30. | 38. | 55. | 8. | | |
| 10. | 146. | 35. | 28. | 60. | 0. | | |
| 15. | 101. | 40. | 21. | 0. | 0. | | |
| 20. | 71. | 45. | 15. | 0. | 0. | | |

1 BASIN ID: 8 -- BASIN COMMENT: 108
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 70. | 0.06 | 0.019 | 19. |
| 5. | 0.03 | 0.000 | 0. | 75. | 0.06 | 0.019 | 16. |
| 10. | 0.06 | 0.000 | 0. | 80. | 0.04 | 0.012 | 13. |
| 15. | 0.14 | 0.024 | 3. | 85. | 0.03 | 0.008 | 10. |
| 20. | 0.26 | 0.070 | 13. | 90. | 0.03 | 0.008 | 8. |
| 25. | 0.43 | 0.263 | 47. | 95. | 0.03 | 0.008 | 7. |
| 30. | 0.21 | 0.158 | 68. | 100. | 0.03 | 0.008 | 6. |
| 35. | 0.10 | 0.054 | 63. | 105. | 0.03 | 0.008 | 6. |
| 40. | 0.07 | 0.034 | 52. | 110. | 0.03 | 0.008 | 5. |
| 45. | 0.07 | 0.027 | 42. | 115. | 0.03 | 0.006 | 5. |
| 50. | 0.06 | 0.018 | 34. | 120. | 0.02 | 0.004 | 4. |
| 55. | 0.06 | 0.019 | 28. | 125. | 0.00 | 0.000 | 3. |
| 60. | 0.06 | 0.019 | 24. | 130. | 0.00 | 0.000 | 2. |
| 65. | 0.06 | 0.019 | 21. | 135. | 0.00 | 0.000 | 2. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 2.00 (1-HOUR RAIN = 1.73) EXCESS PRECIP. = 0.811 INCHES
VOLUME OF EXCESS PRECIP = 3.47 ACRE-FEET
PEAK Q = 68. CFS TIME OF PEAK = 30. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.41
I = 3.1 INCHES/HOUR
A = 51.3 ACRES
Q = 64. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:57
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 1 -- BASIN COMMENT: 101

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.07 | 0.39 | 0.24 | 39.00 | 0.0280 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.094 | 0.338 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.19 | D= 0.78 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 7.50 | 17.00 | 2593.26 | 171.93 | 3.54 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 6.75)

WIDTH AT 50 = 12. MIN. WIDTH AT 75 = 6. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 20. | 56. | 40. | 10. |
| 5. | 136. | 25. | 37. | 45. | 0. |
| 10. | 146. | 30. | 24. | 0. | 0. |
| 15. | 86. | 35. | 16. | 0. | 0. |

1 BASIN ID: 1 -- BASIN COMMENT: 101
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | EXCESS PRECIP (IN) | TOTAL* STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | EXCESS PRECIP (IN) | TOTAL* STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 70. | 0.05 | 0.027 | 41. |
| 5. | 0.03 | 0.000 | 0. | 75. | 0.05 | 0.027 | 29. |
| 10. | 0.08 | 0.002 | 0. | 80. | 0.03 | 0.011 | 20. |
| 15. | 0.12 | 0.036 | 5. | 85. | 0.03 | 0.011 | 14. |
| 20. | 0.22 | 0.070 | 15. | 90. | 0.03 | 0.011 | 11. |
| 25. | 0.38 | 0.245 | 47. | 95. | 0.03 | 0.011 | 8. |
| 30. | 0.68 | 0.630 | 129. | 100. | 0.03 | 0.011 | 7. |
| 35. | 0.38 | 0.341 | 165. | 105. | 0.03 | 0.011 | 6. |
| 40. | 0.22 | 0.184 | 146. | 110. | 0.03 | 0.011 | 6. |
| 45. | 0.17 | 0.137 | 122. | 115. | 0.03 | 0.011 | 6. |
| 50. | 0.14 | 0.106 | 100. | 120. | 0.03 | 0.011 | 6. |
| 55. | 0.11 | 0.080 | 81. | 125. | 0.00 | 0.000 | 4. |
| 60. | 0.11 | 0.080 | 67. | 130. | 0.00 | 0.000 | 3. |
| 65. | 0.11 | 0.080 | 57. | 135. | 0.00 | 0.000 | 2. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 3.12 (1-HOUR RAIN = 2.70) EXCESS PRECIP. = 2.147 INCHES
VOLUME OF EXCESS PRECIP = 7.59 ACRE-FEET
PEAK Q = 165. CFS TIME OF PEAK = 35. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.69
I = 5.8 INCHES/HOUR

A = 42.4 ACRES
Q = 168. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:57
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 2 -- BASIN COMMENT: 102

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.04 | 0.30 | 0.17 | 47.10 | 0.0230 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.090 | 0.364 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.21 | D= 0.84 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 7.73 | 17.20 | 2673.66 | 99.46 | 1.98 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 5.67)

WIDTH AT 50 = 11. MIN. WIDTH AT 75 = 6. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 15. | 50. | 30. | 14. |
| 5. | 73. | 20. | 33. | 35. | 10. |
| 10. | 86. | 25. | 22. | 40. | 0. |

1 BASIN ID: 2 -- BASIN COMMENT: 102
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 65. | 0.11 | 0.079 | 29. |
| 5. | 0.03 | 0.000 | 0. | 70. | 0.05 | 0.026 | 21. |
| 10. | 0.08 | 0.003 | 0. | 75. | 0.05 | 0.026 | 15. |
| 15. | 0.12 | 0.046 | 4. | 80. | 0.03 | 0.012 | 11. |
| 20. | 0.22 | 0.081 | 10. | 85. | 0.03 | 0.012 | 8. |
| 25. | 0.38 | 0.228 | 26. | 90. | 0.03 | 0.012 | 6. |
| 30. | 0.68 | 0.624 | 71. | 95. | 0.03 | 0.012 | 5. |
| 35. | 0.38 | 0.338 | 93. | 100. | 0.03 | 0.012 | 4. |
| 40. | 0.22 | 0.181 | 83. | 105. | 0.03 | 0.012 | 4. |
| 45. | 0.17 | 0.135 | 69. | 110. | 0.03 | 0.012 | 4. |
| 50. | 0.14 | 0.104 | 57. | 115. | 0.03 | 0.012 | 4. |
| 55. | 0.11 | 0.078 | 46. | 120. | 0.03 | 0.012 | 4. |
| 60. | 0.11 | 0.079 | 37. | 125. | 0.00 | 0.000 | 3. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 3.12 (1-HOUR RAIN = 2.70) EXCESS PRECIP. = 2.141 INCHES
VOLUME OF EXCESS PRECIP = 4.25 ACRE-FEET
PEAK Q = 93. CFS TIME OF PEAK = 35. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.69

I = 5.7 INCHES/HOUR
A = 23.8 ACRES
Q = 93. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:57
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 3 -- BASIN COMMENT: 103

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.02 | 0.16 | 0.10 | 55.80 | 0.0330 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.086 | 0.376 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.25 | D= 0.88 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 7.50 | 12.50 | 2886.59 | 61.20 | 1.13 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER,
REPLACING THE ONE COMPUTED BY CUHPF (TP= 4.09)

WIDTH AT 50 = 10. MIN. WIDTH AT 75 = 5. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 15. | 29. | 30. | 9. |
| 5. | 45. | 20. | 20. | 35. | 0. |
| 10. | 50. | 25. | 13. | 0. | 0. |

1 BASIN ID: 3 -- BASIN COMMENT: 103
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP (IN) | STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP (IN) | STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 65. | 0.11 | 0.086 | 17. |
| 5. | 0.03 | 0.000 | 0. | 70. | 0.05 | 0.034 | 13. |
| 10. | 0.08 | 0.004 | 0. | 75. | 0.05 | 0.034 | 10. |
| 15. | 0.12 | 0.058 | 3. | 80. | 0.03 | 0.016 | 7. |
| 20. | 0.22 | 0.103 | 8. | 85. | 0.03 | 0.016 | 5. |
| 25. | 0.38 | 0.281 | 20. | 90. | 0.03 | 0.016 | 4. |
| 30. | 0.68 | 0.633 | 47. | 95. | 0.03 | 0.016 | 3. |
| 35. | 0.38 | 0.346 | 58. | 100. | 0.03 | 0.016 | 3. |
| 40. | 0.22 | 0.190 | 52. | 105. | 0.03 | 0.016 | 3. |
| 45. | 0.17 | 0.143 | 43. | 110. | 0.03 | 0.016 | 3. |
| 50. | 0.14 | 0.112 | 35. | 115. | 0.03 | 0.016 | 3. |
| 55. | 0.11 | 0.086 | 28. | 120. | 0.03 | 0.016 | 3. |
| 60. | 0.11 | 0.086 | 20. | 125. | 0.00 | 0.000 | 2. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 3.12 (1-HOUR RAIN = 2.70) EXCESS PRECIP. = 2.344 INCHES
VOLUME OF EXCESS PRECIP = 2.65 ACRE-FEET
PEAK Q = 58. CFS TIME OF PEAK = 35. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.75
I = 6.6 INCHES/HOUR
A = 13.6 ACRES
Q = 68. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:57
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 4 -- BASIN COMMENT: 104

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.09 | 0.52 | 0.19 | 40.20 | 0.0160 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.093 | 0.363 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.19 | O= 0.80 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 7.50 | 15.40 | 2788.08 | 238.94 | 4.57 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 7.39)

WIDTH AT 50 = 11. MIN. WIDTH AT 75 = 6. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 20. | 71. | 40. | 10. |
| 5. | 180. | 25. | 44. | 45. | 0. |
| 10. | 198. | 30. | 27. | 0. | 0. |
| 15. | 114. | 35. | 17. | 0. | 0. |

1 BASIN ID: 4 -- BASIN COMMENT: 104
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | EXCESS PRECIP | TOTAL* STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | EXCESS PRECIP | TOTAL* STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 70. | 0.05 | 0.028 | 51. |
| 5. | 0.03 | 0.000 | 0. | 75. | 0.05 | 0.028 | 36. |
| 10. | 0.08 | 0.002 | 0. | 80. | 0.03 | 0.011 | 25. |
| 15. | 0.12 | 0.038 | 7. | 85. | 0.03 | 0.011 | 18. |
| 20. | 0.22 | 0.072 | 21. | 90. | 0.03 | 0.011 | 13. |
| 25. | 0.38 | 0.248 | 63. | 95. | 0.03 | 0.011 | 11. |
| 30. | 0.68 | 0.630 | 173. | 100. | 0.03 | 0.011 | 9. |
| 35. | 0.38 | 0.342 | 221. | 105. | 0.03 | 0.011 | 8. |
| 40. | 0.22 | 0.185 | 194. | 110. | 0.03 | 0.011 | 8. |
| 45. | 0.17 | 0.138 | 158. | 115. | 0.03 | 0.011 | 7. |
| 50. | 0.14 | 0.107 | 128. | 120. | 0.03 | 0.011 | 7. |
| 55. | 0.11 | 0.080 | 101. | 125. | 0.00 | 0.000 | 5. |
| 60. | 0.11 | 0.081 | 83. | 130. | 0.00 | 0.000 | 3. |
| 65. | 0.11 | 0.081 | 71. | 135. | 0.00 | 0.000 | 2. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 3.12 (1-HOUR RAIN = 2.70) EXCESS PRECIP. = 2.161 INCHES
VOLUME OF EXCESS PRECIP = 9.88 ACRE-FEET
PEAK Q = 221. CFS TIME OF PEAK = 35. MIN.

INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.69
I = 6.0 INCHES/HOUR
A = 54.8 ACRES
Q = 229. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:57
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 5 -- BASIN COMMENT: 105

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.05 | 0.49 | 0.30 | 40.00 | 0.0200 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.093 | 0.332 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.19 | D= 0.80 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VDLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 8.92 | 22.30 | 1988.89 | 98.25 | 2.63 |

*** NOTE : THE TIME TO PEAK IS CALCLULATED BASED ON THE TIME OF CONCENTRATION PROVIDEO BY THE USER,
REPLACING THE ONE COMPUTED BY CUHPF (TP= 8.21)

WIDTH AT 50 = 15. MIN. WIDTH AT 75 = 8. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 20. | 46. | 40. | 14. |
| 5. | 70. | 25. | 34. | 45. | 10. |
| 10. | 96. | 30. | 25. | 50. | 8. |
| 15. | 66. | 35. | 19. | 55. | 0. |

1 BASIN ID: 5 -- BASIN COMMENT: 105
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 70. | 0.05 | 0.028 | 42. |
| 5. | 0.03 | 0.000 | 0. | 75. | 0.05 | 0.028 | 33. |
| 10. | 0.08 | 0.002 | 0. | 80. | 0.03 | 0.011 | 22. |
| 15. | 0.12 | 0.038 | 3. | 85. | 0.03 | 0.011 | 16. |
| 20. | 0.22 | 0.071 | 9. | 90. | 0.03 | 0.011 | 12. |
| 25. | 0.38 | 0.248 | 27. | 95. | 0.03 | 0.011 | 9. |
| 30. | 0.68 | 0.630 | 74. | 100. | 0.03 | 0.011 | 7. |
| 35. | 0.38 | 0.342 | 105. | 105. | 0.03 | 0.011 | 6. |
| 40. | 0.22 | 0.185 | 102. | 110. | 0.03 | 0.011 | 5. |
| 45. | 0.17 | 0.138 | 89. | 115. | 0.03 | 0.011 | 5. |
| 50. | 0.14 | 0.107 | 78. | 120. | 0.03 | 0.011 | 4. |
| 55. | 0.11 | 0.080 | 67. | 125. | 0.00 | 0.000 | 4. |
| 60. | 0.11 | 0.081 | 58. | 130. | 0.00 | 0.000 | 2. |
| 65. | 0.11 | 0.081 | 51. | 135. | 0.00 | 0.000 | 2. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 3.12 (1-HOUR RAIN = 2.70) EXCESS PRECIP. = 2.158 INCHES
VOLUME OF EXCESS PRECIP = 5.69 ACRE-FEET
PEAK Q = 105. CFS TIME OF PEAK = 35. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.69
I = 5.0 INCHES/HOUR
A = 31.6 ACRES
Q = 109. CFS

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:57
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 6 -- BASIN COMMENT: 106

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.16 | 0.52 | 0.22 | 40.00 | 0.0200 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.093 | 0.397 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.19 | D= 0.80 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|
| 7.61 | 2982.52 | 478.40 | 8.55 |

WIDTH AT 50 = 10. MIN. WIDTH AT 75 = 5. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 20. | 125. | 40. | 14. |
| 5. | 331. | 25. | 72. | 45. | 8. |
| 10. | 392. | 30. | 42. | 50. | 0. |
| 15. | 218. | 35. | 24. | 0. | 0. |

1 BASIN ID: 6 -- BASIN COMMENT: 106
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS PRECIP | STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 70. | 0.05 | 0.028 | 96. |
| 5. | 0.03 | 0.000 | 0. | 75. | 0.05 | 0.028 | 67. |
| 10. | 0.08 | 0.002 | 1. | 80. | 0.03 | 0.011 | 46. |
| 15. | 0.12 | 0.038 | 13. | 85. | 0.03 | 0.011 | 31. |
| 20. | 0.22 | 0.071 | 39. | 90. | 0.03 | 0.011 | 23. |
| 25. | 0.38 | 0.248 | 118. | 95. | 0.03 | 0.011 | 19. |
| 30. | 0.68 | 0.630 | 326. | 100. | 0.03 | 0.011 | 16. |
| 35. | 0.38 | 0.342 | 426. | 105. | 0.03 | 0.011 | 15. |
| 40. | 0.22 | 0.185 | 370. | 110. | 0.03 | 0.011 | 14. |
| 45. | 0.17 | 0.138 | 293. | 115. | 0.03 | 0.011 | 14. |
| 50. | 0.14 | 0.107 | 230. | 120. | 0.03 | 0.011 | 14. |
| 55. | 0.11 | 0.080 | 180. | 125. | 0.00 | 0.000 | 10. |
| 60. | 0.11 | 0.081 | 145. | 130. | 0.00 | 0.000 | 6. |
| 65. | 0.11 | 0.081 | 126. | 135. | 0.00 | 0.000 | 3. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 3.12 (1-HOUR RAIN = 2.70) EXCESS PRECIP. = 2.158 INCHES
VOLUME OF EXCESS PRECIP = 18.46 ACRE-FEET
PEAK Q = 426. CFS TIME OF PEAK = 35. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:57
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 7 -- BASIN COMMENT: 107

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.25 | 0.69 | 0.27 | 33.10 | 0.0200 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.097 | 0.350 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.17 | D= 0.66 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|
| 9.10 | 2036.24 | 503.36 | 13.18 |

WIDTH AT 50 = 15. MIN. WIDTH AT 75 = 8. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 25. | 161. | 50. | 28. |
| 5. | 335. | 30. | 113. | 55. | 19. |
| 10. | 496. | 35. | 80. | 60. | 14. |
| 15. | 338. | 40. | 56. | 65. | 10. |
| 20. | 229. | 45. | 39. | 70. | 0. |

1 BASIN ID: 7 -- BASIN COMMENT: 107
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | EXCESS PRECIP | TOTAL* STORM** HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | EXCESS PRECIP | TOTAL* STORM** HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 80. | 0.03 | 0.009 | 112. |
| 5. | 0.03 | 0.000 | 0. | 85. | 0.03 | 0.009 | 83. |
| 10. | 0.08 | 0.002 | 1. | 90. | 0.03 | 0.009 | 62. |
| 15. | 0.12 | 0.026 | 9. | 95. | 0.03 | 0.009 | 45. |
| 20. | 0.22 | 0.061 | 34. | 100. | 0.03 | 0.009 | 34. |
| 25. | 0.38 | 0.232 | 117. | 105. | 0.03 | 0.009 | 28. |
| 30. | 0.68 | 0.629 | 353. | 110. | 0.03 | 0.009 | 24. |
| 35. | 0.38 | 0.340 | 523. | 115. | 0.03 | 0.009 | 22. |
| 40. | 0.22 | 0.182 | 508. | 120. | 0.03 | 0.009 | 20. |
| 45. | 0.17 | 0.135 | 441. | 125. | 0.00 | 0.000 | 16. |
| 50. | 0.14 | 0.104 | 376. | 130. | 0.00 | 0.000 | 10. |
| 55. | 0.11 | 0.078 | 314. | 135. | 0.00 | 0.000 | 7. |
| 60. | 0.11 | 0.078 | 265. | 140. | 0.00 | 0.000 | 5. |
| 65. | 0.11 | 0.078 | 231. | 145. | 0.00 | 0.000 | 3. |
| 70. | 0.05 | 0.025 | 190. | 150. | 0.00 | 0.000 | 2. |
| 75. | 0.05 | 0.025 | 147. | 155. | 0.00 | 0.000 | 2. |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 3.12 (1-HOUR RAIN = 2.70) EXCESS PRECIP. = 2.078 INCHES

VOLUME OF EXCESS PRECIP = 27.39 ACRE-FEET
PEAK Q = 523. CFS TIME OF PEAK = 35. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 9/ 8/2015 AT TIME 15:57
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 7
COLLIERS

BASIN ID: 8 -- BASIN COMMENT: 108

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 0.08 | 0.57 | 0.11 | 30.00 | 0.0230 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.099 | 0.273 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.16 | D= 0.60 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | TIME OF CONCENTRATION (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|---|
| 7.85 | 23.70 | 1958.25 | 156.86 | 4.27 |

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER,
REPLACING THE ONE COMPUTED BY CUHPF (TP= 6.44)

WIDTH AT 50 = 15. MIN. WIDTH AT 75 = 8. MIN. K50 =0.31 K75 =0.42

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.35 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 25. | 52. | 50. | 11. |
| 5. | 129. | 30. | 38. | 55. | 8. |
| 10. | 146. | 35. | 28. | 60. | 0. |
| 15. | 101. | 40. | 21. | 0. | 0. |
| 20. | 71. | 45. | 15. | 0. | 0. |

1 BASIN ID: 8 -- BASIN COMMENT: 108
**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

| TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS (IN) | STORM** PRECIP | HYDROGRAPH (CFS) | TIME (MIN.) | INCREMENT RAINFALL (IN) | TOTAL* EXCESS (IN) | STORM** PRECIP | HYDROGRAPH (CFS) |
|---|---|---|---|---|---|---|---|---|---|
| 0. | 0.00 | 0.000 | 0. | 0. | 70. | 0.05 | 0.018 | 58. | |
| 5. | 0.03 | 0.000 | 0. | 0. | 75. | 0.05 | 0.018 | 45. | |
| 10. | 0.08 | 0.001 | 0. | 0. | 80. | 0.03 | 0.007 | 34. | |
| 15. | 0.12 | 0.021 | 3. | 3. | 85. | 0.03 | 0.007 | 22. | |
| 20. | 0.22 | 0.049 | 10. | 10. | 90. | 0.03 | 0.007 | 15. | |
| 25. | 0.38 | 0.179 | 33. | 33. | 95. | 0.03 | 0.007 | 12. | |
| 30. | 0.68 | 0.618 | 112. | 112. | 100. | 0.03 | 0.007 | 9. | |
| 35. | 0.38 | 0.331 | 156. | 156. | 105. | 0.03 | 0.007 | 7. | |
| 40. | 0.22 | 0.174 | 149. | 149. | 110. | 0.03 | 0.007 | 6. | |
| 45. | 0.17 | 0.128 | 131. | 131. | 115. | 0.03 | 0.007 | 5. | |
| 50. | 0.14 | 0.097 | 113. | 113. | 120. | 0.03 | 0.007 | 5. | |
| 55. | 0.11 | 0.071 | 96. | 96. | 125. | 0.00 | 0.000 | 4. | |
| 60. | 0.11 | 0.071 | 82. | 82. | 130. | 0.00 | 0.000 | 3. | |
| 65. | 0.11 | 0.071 | 72. | 72. | 135. | 0.00 | 0.000 | 2. | |

* LESS ANY WATER QUALITY CAPTURE VOLUME
** INCLUDES ANY WATER QUALITY CAPTURE VOLUME RELEASE FLOW

TOTAL PRECIP. = 3.12 (1-HOUR RAIN = 2.70) EXCESS PRECIP. = 1.913 INCHES

VOLUME OF EXCESS PRECIP = 8.17 ACRE-FEET
PEAK Q = 156. CFS TIME OF PEAK = 35. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.35 IN. MAX.IMP.RET.=0.10 IN.

RATIONAL FORMULA C = 0.61
I = 4.8 INCHES/HOUR
A = 51.3 ACRES
Q = 152. CFS

# APPENDIX F
# UDSWM ANALYSIS

## UDSWM Output

| Design Point | 100-Year (cfs) |
|---|---|
| **700** | 410 |
| **705** | 599 |
| **710** | 629 |
| **715** | 635 |
| **720** | 112 |
| **730** | 978 |
| **735** | 1104 |
| **740** | 1102 |
| **750** | 923 |

| Conveyance Element | 100-Year (cfs) |
|---|---|
| **500** | 545 |
| **510** | 618 |
| **515** | 627 |
| **520** | 111 |
| **525** | 977 |
| **530** | 1102 |

| Basin | Area (acres) | % Imperv-iousness | $Q_{100}$ (cfs) |
|---|---|---|---|
| **101** | 42.44 | 39.0 | **165** |
| **102** | 23.81 | 47.1 | **94** |
| **103** | 13.60 | 55.8 | **58** |
| **104** | 54.84 | 40.2 | **222** |
| **105** | 31.64 | 40.0 | **106** |
| **106** | 102.65 | 40.0 | **427** |
| **107** | 158.20 | 33.1 | **523** |
| **108** | 51.27 | 30.0 | **156** |
| **430** | 90.4 | 65.8 | **453** |
| **431** | 143.8 | 46.8 | **556** |
| **432** | 119.9 | 56.2 | **556** |
| **433** | 110.6 | 29.0 | **240** |
| **434** | 91.1 | 2.0 | **112** |

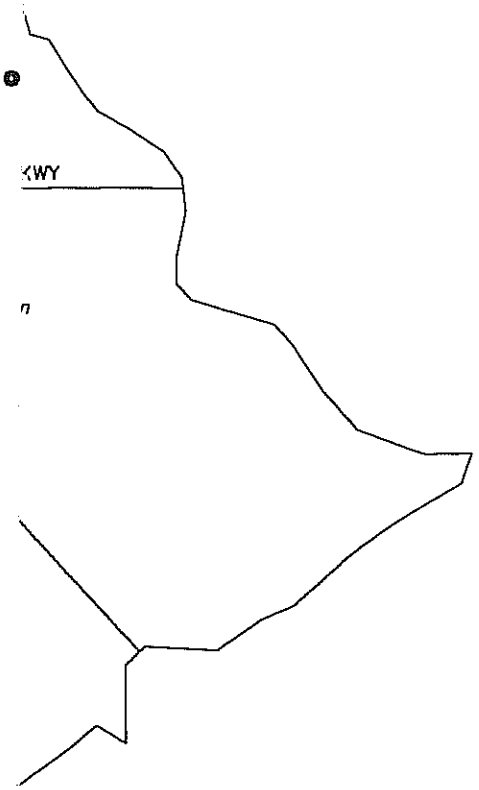
# COLLIERS HILL
# REGIONAL POND
# UDSWM DRAINAGE EXHIBIT

7

NORTH

LEGEND

| | |
|---|---|
| 500 | 1515 L.F. DRAINAGE CHANNEL @ 0.50% |
| 510 | 1015 L.F. DRAINAGE CHANNEL @ 0.50% |
| 515 | 1495 L.F. DRAINAGE CHANNEL @ 0.50% |
| 520 | 2600 L.F. STREET SECTION W/ STORM PIPE @ |
| 525 | 410 L.F. DRAINAGE CHANNEL @ 0.50% |
| 530 | 875 L.F. DRAINAGE CHANNEL @ 0.50% |
| 1113 | REGIONAL DETENTION POND |
| 1010 | HIGH SCHOOL DETENTION POND |
| 1103 | FUTURE DETENTION POND |
| 1430 | FUTURE DETENTION POND |
| 700 | DESIGN POINT (TYPICAL) |
| 111 | DRAINAGE BASIN (TYPICAL) |



```
  2  1  1  2
  3  4
WATERSHED  0
COLLIERS HILL ERIE CO
HURST & ASSOCIATES, JAN 2016
     60  0 0  5.0    1  10.                                    1
  24  5.0
 0.36 0.96 1.44 2.64 4.56 8.16 4.56 2.64 2.04 1.68
 1.32 1.32 1.32  0.6  0.6 0.36 0.36 0.36 0.36 0.36
 0.36 0.36 0.36 0.36
   1  430  4305878. 90.4 65.80.026 0.02  0.2  0.1  0.3 3.27 0.52    0.0018
   1  431  4316942.143.8 46.80.039 0.02  0.2  0.1  0.3 3.23 0.49    0.0017
   1  432  43211331119.9 56.20.032 0.02  0.2  0.1  0.3 3.85 0.55    0.0018
   1  433  4335680.110.6  29.0.022 0.02  0.2  0.1  0.3 3.32 0.52    0.0018
   1  434  4344165. 91.1   2.0.029 0.02  0.2  0.1  0.3   3.  0.5    0.0018

   0
   0
   0  430 1430   4     5.  3062.  0.026     3.     3.    0.02     3.
                   23.  3062.  0.026    20.    20.   0.044    10.
   0  431 1103   4     5.  3616.  0.039     3.     3.    0.02     3.
                   23.  3616.  0.039    20.    20.   0.044    10.
   0  432 1103   4     5.  4426.  0.032     3.     3.    0.02     3.
                   23.  4426.  0.032    20.    20.   0.044    10.
   0  433 1010   4     8.  2536.  0.022     3.     3.    0.02     0.5
                   11.  2536.  0.022    20.    20.   0.044    10.
   0  434  720   4     5.  1859.  0.029     3.     3.    0.02     3.
                   23.  1859.  0.029    20.    20.   0.044    10.
   0  700  705   3           1.
   0  705  500   3           1.
   0  710  510   3           1.
   0  715  515   3           1.
   0  730  525   3           1.
   0  740 1113   3           1.
   0  500  710   4     5.  1515.  0.005     2.     2.   0.044     3.
                   42.  1515.  0.005     4.     4.   0.044     6.
   0  510  715   4     5.  1015.  0.005     2.     2.   0.044     3.
                   42.  1015.  0.005     4.     4.   0.044     6.
   0  520  730   5     4.  2600.  0.016              0.016     4.
                    1.  2600.  0.016    20.    20.   0.02     10.
   0  515  730   4     5.  1495.  0.005     2.     2.   0.044     3.
                   42.  1495.  0.005     4.     4.   0.044     6.
   0 1010  705  6 2   0.01   0.01 0.0001                      0.01
     0.     0.     0.04     5.1     1.43     15.7     2.53     63.1
    6.24     78.2     6.25     300.     0.       0.       0.       0.
   0 1103  700  4 2   0.01   0.01 0.0001                      0.01
     0.     0.      7.8     180.     24.9     331.     24.9    10000.
   0 1430  700  6 2   0.01   0.01 0.0001                      0.01
     0.     0.     2.33     0.7      7.8     27.12    10.65     90.4
    12.5     90.4     20.     180.8     0.       0.       0.       0.
   0 1113  750  4 2   0.01   0.01 0.0001
     0.     0.    17.47     2.94     62.8     923.     90.     2000.
  -1  101  710 20 3           1.
  0.1667     0.31   0.3333    14.91   0.4167     46.7     0.5   129.37
  0.5833    164.61   0.6667   146.36     0.75   121.79   0.8333   100.26
  0.9167    81.05      1.    67.06   1.0833    56.97   1.1667    40.58
    1.25    28.79   1.3333     20.4   1.4167    14.28     1.5    10.64
  1.5833     8.43   1.6667     6.98      2.     5.6   2.3333       0.
  -1  102  710 20 3           1.
  0.1667     0.22     0.25     3.63   0.3333    10.01   0.4167    25.92
     0.5    70.54   0.5833    93.27   0.6667     83.3     0.75    69.41
  0.8333     57.04   0.9167    45.92      1.    36.89   1.0833    28.62
  1.1667     21.14     1.25    15.18   1.3333     10.9   1.4167     7.75
     1.5     5.92   1.6667     3.92   1.9167     3.59   2.1667     1.61
  -1  103  715 20 3           1.
  0.1667     0.17     0.25     2.79   0.3333     7.64   0.4167    19.55
     0.5    46.69 0.583333    58.13 0.666667    51.53     0.75    43.03
  0.8333     35.46   0.9167    27.69      1.    19.91   1.0833    16.52
  1.1667     12.82     1.25     9.59   1.3333     7.03   1.4167     5.12
     1.5      3.9   1.9167     2.68   2.0833     1.95   2.1667       0.
   0  720  520   3           1.
   0  735  530   3           1.
   0  525  735   4     5.   410.  0.005     2.     2.   0.044     3.
                   42.   410.  0.005     4.     4.   0.044     6.
   0  530  740   4     5.   875.  0.005     2.     2.   0.044     3.
```

```
              42.   875.  0.005    4.    4.  0.044    6.
-1  104  735 20 3          1.
 0.1667    0.44    0.25    7.33  0.3333   20.67  0.4167   63.31
   0.5  173.43  0.5833  221.04  0.6667  194.22    0.75  158.21
 0.8333  127.59  0.9167  101.38   82.95   70.63  1.1667   50.98
   1.25   36.14  1.3333   25.42  1.4167   17.64     1.5   13.16
 1.5833   10.56    1.75    7.93      2.    7.48    2.25    1.91
-1  105 1113 20 3          1.
 0.1667    0.17    0.25    2.86  0.3333    8.75  0.4167   26.69
   0.5    74.2  0.5833  105.38  0.6667  101.91    0.75   89.47
 0.8333   77.86  0.9167   66.83      1.   57.79  1.0833   51.14
 1.1667   42.42    1.25   32.56  1.3333    22.2  1.4167   15.58
   1.5   11.65  1.5833    9.06  1.9167    4.66    2.25    1.75
-1  106 1113 20 3          1.
 0.1667    0.81    0.25   13.46  0.3333    38.9  0.4167  118.45
   0.5   326.2  0.5833  425.77  0.6667  370.02    0.75  293.17
 0.8333  230.44  0.9167  179.71      1.  145.38  1.0833  125.72
 1.1667   96.09    1.25   66.65  1.3333   45.94  1.4167   31.39
   1.5   23.35  1.5833   18.87  2.0833   10.07  2.3333     1.8
-1  107  730 20 3          1.
 0.1667    0.56    0.25    9.49  0.3333   33.93  0.4167  117.23
   0.5  352.64  0.5833   522.7  0.6667  508.24    0.75  441.18
 0.8333   375.5  0.9167  314.22      1.  265.09  1.0833   231.2
 1.1667  189.85    1.25  146.94  1.3333  111.84  1.4167   83.18
 1.5833   44.66  1.9167   21.59  2.1667   10.33  2.5833    1.52
-1  108 1113 20 3          1.
 0.1667    0.18    0.25    2.94  0.3333     9.6  0.4167   32.58
   0.5  112.47  0.5833  155.68  0.6667   149.4    0.75  131.21
 0.8333  113.25  0.9167   95.86      1.   82.12  1.0833   72.33
 1.1667   58.27    1.25   45.07  1.3333   33.54  1.4167   22.07
   1.5   15.44  1.6667    8.96  1.9167    5.35    2.25    1.79


ENDPROGRAM
```

URBAN DRAINAGE STORM WATER MANAGEMENT MODEL - 32 BIT VERSION 1998
REVISED BY UNIVERSITY OF COLORADO AT DENVER

*** ENTRY MADE TO RUNOFF MODEL ***

COLLIERS HILL ERIE CO
HURST & ASSOCIATES, JAN 2016

0NUMBER OF TIME STEPS 60
0INTEGRATION TIME INTERVAL (MINUTES) 5.00

10.0 PERCENT OF IMPERVIOUS AREA HAS ZERO DETENTION DEPTH
0FOR 24 RAINFALL STEPS, THE TIME INTERVAL IS 5.00 MINUTES
0FOR RAINGAGE NUMBER 1 RAINFALL HISTORY IN INCHES PER HOUR

.36 .96 1.44 2.64 4.56 8.16 4.56 2.64 2.04 1.68
1.32 1.32 1.32 .60 .60 .36 .36 .36 .36 .36
.36 .36 .36 .36
1

COLLIERS HILL ERIE CO
HURST & ASSOCIATES, JAN 2016

| SUBAREA NUMBER | GUTTER OR MANHOLE | WIDTH (FT) | AREA (AC) | PERCENT IMPERV. | SLDPE (FT/FT) | RESISTANCE FACTOR IMPERV. | RESISTANCE FACTOR PERV. | SURFACE STORAGE(IN) IMPERV. | SURFACE STORAGE(IN) PERV. | INFILTRATION RATE(IN/HR) MAXIMUM | INFILTRATION RATE(IN/HR) MINIMUM | DECAY RATE | GAGE ND |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 430 | 430 | 5878. | 90.4 | 65.8 | .0260 | .020 | .200 | .100 | .300 | 3.27 | .52 | .00180 | 1 |
| 431 | 431 | 6942. | 143.8 | 46.8 | .0390 | .020 | .200 | .100 | .300 | 3.23 | .49 | .00170 | 1 |
| 432 | 432 | 11331. | 119.9 | 56.2 | .0320 | .020 | .200 | .100 | .300 | 3.85 | .55 | .00180 | 1 |
| 433 | 433 | 5680. | 110.6 | 29.0 | .0220 | .020 | .200 | .100 | .300 | 3.32 | .52 | .00180 | 1 |
| 434 | 434 | 4165. | 91.1 | 2.0 | .0290 | .020 | .200 | .100 | .300 | 3.00 | .50 | .00180 | 1 |

0TOTAL NUMBER OF SUBCATCHMENTS, 5
0TOTAL TRIBUTARY AREA (ACRES), 555.80
1

COLLIERS HILL ERIE CO
HURST & ASSOCIATES, JAN 2016

*** CONTINUITY CHECK FOR SUBCATCHMEMT ROUTING IN UDSWM386 MODEL ***

WATERSHED AREA (ACRES) 555.800

TOTAL RAINFALL (INCHES) 3.120

TOTAL INFILTRATION (INCHES) .684

TOTAL WATERSHED OUTFLOW (INCHES) 2.191

TOTAL SURFACE STORAGE AT END OF STORM (INCHES) .245

ERROR IN CONTINUITY, PERCENTAGE OF RAINFALL .003
1

COLLIERS HILL ERIE CO
HURST & ASSOCIATES, JAN 2016

| GUTTER NUMBER | GUTTER CONNECTION | NDP | NP | WIDTH OR DIAM (FT) | INVERT LENGTH (FT) | SIDE SLOPES SLOPE (FT/FT) | SIDE SLOPES HORIZ L | SIDE SLOPES TO VERT R | OVERBANK/SURCHARGE MANNING N | OVERBANK/SURCHARGE DEPTH (FT) | JK |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 430 | 1430 | 0 | 4 CHANNEL | 5.0 | 3062. | .0260 | 3.0 | 3.0 | .020 | 3.00 | 0 |
| | | | OVERFLOW | 23.0 | 3062. | .0260 | 20.0 | 20.0 | .044 | 10.00 | |
| 431 | 1103 | 0 | 4 CHANNEL | 5.0 | 3616. | .0390 | 3.0 | 3.0 | .020 | 3.00 | 0 |
| | | | OVERFLOW | 23.0 | 3616. | .0390 | 20.0 | 20.0 | .044 | 10.00 | |
| 432 | 1103 | 0 | 4 CHANNEL | 5.0 | 4426. | .0320 | 3.0 | 3.0 | .020 | 3.00 | 0 |
| | | | OVERFLOW | 23.0 | 4426. | .0320 | 20.0 | 20.0 | .044 | 10.00 | |
| 433 | 1010 | 0 | 4 CHANNEL | 8.0 | 2536. | .0220 | 3.0 | 3.0 | .020 | .50 | 0 |
| | | | OVERFLOW | 11.0 | 2536. | .0220 | 20.0 | 20.0 | .044 | 10.00 | |
| 434 | 720 | 0 | 4 CHANNEL | 5.0 | 1859. | .0290 | 3.0 | 3.0 | .020 | 3.00 | 0 |
| | | | OVERFLOW | 23.0 | 1859. | .0290 | 20.0 | 20.0 | .044 | 10.00 | |
| 700 | 705 | 0 | 3 | .0 | 1. | .0010 | .0 | .0 | .001 | 10.00 | 0 |
| 705 | 500 | 0 | 3 | .0 | 1. | .0010 | .0 | .0 | .001 | 10.00 | 0 |
| 710 | 510 | 0 | 3 | .0 | 1. | .0010 | .0 | .0 | .001 | 10.00 | 0 |
| 715 | 515 | 0 | 3 | .0 | 1. | .0010 | .0 | .0 | .001 | 10.00 | 0 |
| 730 | 525 | 0 | 3 | .0 | 1. | .0010 | .0 | .0 | .001 | 10.00 | 0 |
| 740 | 1113 | 0 | 3 | .0 | 1. | .0010 | .0 | .0 | .001 | 10.00 | 0 |

```
500    710     0     4   CHANNEL      5.0   1515.  .0050   2.0 2.0    .044    3.00     0
                       OVERFLOW    42.0   1515.  .0050   4.0 4.0    .044    6.00
510    715     0     4   CHANNEL      5.0   1015.  .0050   2.0 2.0    .044    3.00     0
                       OVERFLOW    42.0   1015.  .0050   4.0 4.0    .044    6.00
520    730     0     5   PIPE         4.0   2600.  .0160   .0  .0    .016    4.00     0
                       OVERFLOW     1.0   2600.  .0160  20.0 20.0   .020   10.00
515    730     0     4   CHANNEL      5.0   1495.  .0050   2.0 2.0    .044    3.00     0
                       OVERFLOW    42.0   1495.  .0050   4.0 4.0    .044    6.00
1010   705     6     2   PIPE         .0     0.   .0001   .0  .0    .001    .01      0
         RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW
            .0   .0    .0   5.1   1.4  15.7   2.5  63.1   6.2  78.2   6.3  300.0
1103   700     4     2   PIPE         .0     0.   .0001   .0  .0    .001    .01      0
         RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW
            .0   .0   7.8  180.0  24.9  331.0  24.9 10000.0
1430   700     6     2   PIPE         .0     0.   .0001   .0  .0    .001    .01      0
         RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW
            .0   .0   2.3   .7    7.8   27.1   10.6  90.4   12.5  90.4   20.0  180.8
1113   750     4     2   PIPE         .0     0.   .0001   .0  .0    .001    .01      0
         RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW
            .0   .0   17.5  2.9   62.8  923.0  90.0 2000.0
101    710    20     3               .0     1.   .0010   .0  .0    .001   10.00     -1
         TIME IN HRS VS INFLOW IN CFS
            .2   .3    .3  14.9    .4   46.7    .5  129.4   .6  164.6   .7  146.4
            .8  121.8   .8  100.3   .9   81.1   1.0  67.1   1.1  57.0   1.2  40.6
           1.3  28.8   1.3  20.4   1.4  14.3   1.5  10.6   1.6   8.4   1.7   7.0
           2.0   5.6   2.3   .0
102    710    20     3               .0     1.   .0010   .0  .0    .001   10.00     -1
         TIME IN HRS VS INFLOW IN CFS
            .2   .2    .3   3.6    .3   10.0    .4   25.9   .5   70.5   .6   93.3
            .7  83.3    .8  69.4    .8   57.0    .9   45.9  1.0   36.9  1.1   28.6
           1.2  21.1   1.3  15.2   1.3  10.9   1.4   7.8   1.5   5.9   1.7   3.9
           1.9   3.6   2.2   1.6
103    715    20     3               .0     1.   .0010   .0  .0    .001   10.00     -1
         TIME IN HRS VS INFLOW IN CFS
            .2   .2    .3   2.8    .3   7.6    .4   19.5   .5   46.7   .6   58.1
            .7  51.5    .8  43.0    .8   35.5    .9   27.7  1.0   19.9  1.1   16.5
           1.2  12.8   1.3   9.6   1.3   7.0   1.4   5.1   1.5   3.9   1.9   2.7
           2.1   2.0   2.2   .0
720    520     0     3               .0     1.   .0010   .0  .0    .001   10.00      0
735    530     0     3               .0     1.   .0010   .0  .0    .001   10.00      0
525    735     0     4   CHANNEL      5.0   410.  .0050   2.0 2.0    .044    3.00     0
                       OVERFLOW    42.0   410.  .0050   4.0 4.0    .044    6.00
530    740     0     4   CHANNEL      5.0   875.  .0050   2.0 2.0    .044    3.00     0
                       OVERFLOW    42.0   875.  .0050   4.0 4.0    .044    6.00
104    735    20     3               .0     1.   .0010   .0  .0    .001   10.00     -1
         TIME IN HRS VS INFLOW IN CFS
            .2   .4    .3   7.3    .3   20.7    .4   63.3   .5  173.4   .6  221.0
            .7  194.2   .8  158.2   .8  127.6    .9  101.4  82.9  70.6  1.2   51.0
           1.3  36.1   1.3  25.4   1.4  17.6   1.5  13.2   1.6  10.6   1.8   7.9
           2.0   7.5   2.3   1.9
105   1113    20     3               .0     1.   .0010   .0  .0    .001   10.00     -1
         TIME IN HRS VS INFLOW IN CFS
            .2   .2    .3   2.9    .3   8.8    .4   26.7   .5   74.2   .6  105.4
            .7  101.9   .8  89.5    .8   77.9    .9   66.8  1.0   57.8  1.1   51.1
           1.2  42.4   1.3  32.6   1.3  22.2   1.4  15.6   1.5  11.6   1.6   9.1
           1.9   4.7   2.3   1.8
106   1113    20     3               .0     1.   .0010   .0  .0    .001   10.00     -1
         TIME IN HRS VS INFLOW IN CFS
            .2   .8    .3  13.5    .3   38.9    .4  118.4   .5  326.2   .6  425.8
            .7  370.0   .8  293.2   .8  230.4    .9  179.7  1.0  145.4  1.1  125.7
           1.2  96.1   1.3  66.7   1.3  45.9   1.4  31.4   1.5  23.4   1.6  18.9
           2.1  10.1   2.3   1.8
107    730    20     3               .0     1.   .0010   .0  .0    .001   10.00     -1
         TIME IN HRS VS INFLOW IN CFS
            .2   .6    .3   9.5    .3   33.9    .4  117.2   .5  352.6   .6  522.7
            .7  508.2   .8  441.2   .8  375.5    .9  314.2  1.0  265.1  1.1  231.2
           1.2  189.9  1.3  146.9  1.3  111.8   1.4  83.2   1.6  44.7   1.9  21.6
           2.2  10.3   2.6   1.5
108   1113    20     3               .0     1.   .0010   .0  .0    .001   10.00     -1
         TIME IN HRS VS INFLOW IN CFS
            .2   .2    .3   2.9    .3   9.6    .4   32.6   .5  112.5   .6  155.7
            .7  149.4   .8  131.2   .8  113.3    .9   95.9  1.0   82.1  1.1   72.3
           1.2  58.3   1.3  45.1   1.3  33.5   1.4  22.1   1.5  15.4   1.7   9.0
           1.9   5.3   2.3   1.8
0TOTAL NUMBER OF GUTTERS/PIPES,  31
```

1

COLLIERS HILL ERIE CO
HURST & ASSOCIATES, JAN 2016

ARRANGEMENT OF SUBCATCHMENTS AND GUTTERS/PIPES

| GUTTER | TRIBUTARY GUTTER/PIPE | TRIBUTARY SUBAREA | D.A.(AC) |
|---|---|---|---|
| 101 | 0 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | .0 |
| 102 | 0 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | .0 |
| 103 | 0 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | .0 |
| 104 | 0 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | .0 |
| 105 | 0 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | .0 |
| 106 | 0 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | .0 |
| 107 | 0 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | .0 |
| 108 | 0 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | .0 |
| 430 | 0 0 0 0 0 0 0 0 0 0 | 430 0 0 0 0 0 0 0 0 0 | 90.4 |
| 431 | 0 0 0 0 0 0 0 0 0 0 | 431 0 0 0 0 0 0 0 0 0 | 143.8 |
| 432 | 0 0 0 0 0 0 0 0 0 0 | 432 0 0 0 0 0 0 0 0 0 | 119.9 |
| 433 | 0 0 0 0 0 0 0 0 0 0 | 433 0 0 0 0 0 0 0 0 0 | 110.6 |
| 434 | 0 0 0 0 0 0 0 0 0 0 | 434 0 0 0 0 0 0 0 0 0 | 91.1 |
| 500 | 705 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | 464.7 |
| 510 | 710 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | 464.7 |
| 515 | 715 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | 464.7 |
| 520 | 720 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | 91.1 |
| 525 | 730 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | 555.8 |
| 530 | 735 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | 555.8 |
| 700 | 1103 1430 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | 354.1 |
| 705 | 700 1010 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | 464.7 |
| 710 | 500 101 102 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | 464.7 |
| 715 | 510 103 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | 464.7 |
| 720 | 434 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | 91.1 |
| 730 | 520 515 107 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | 555.8 |
| 735 | 525 104 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | 555.8 |
| 740 | 530 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | 555.8 |
| 1010 | 433 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | 110.6 |
| 1103 | 431 432 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | 263.7 |
| 1113 | 740 105 106 108 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | 555.8 |
| 1430 | 430 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 | 90.4 |

1

COLLIERS HILL ERIE CO
HURST & ASSOCIATES, JAN 2016

*** PEAK FLOWS, STAGES AND STORAGES OF GUTTERS AND DETENTION DAMS ***

| CONVEYANCE ELEMENT | PEAK (CFS) | STAGE (FT) | STORAGE (AC-FT) | TIME (HR/MIN) |
|---|---|---|---|---|
| 430 | 453. | 2.4 | 0 | 35. |
| 432 | 556. | 2.5 | 0 | 35. |
| 431 | 556. | 2.4 | 0 | 35. |
| 433 | 240. | 1.3 | 0 | 35. |
| 1430 | 90. | .0 | 11.8 | 1 15. |
| 1103 | 320. | .0 | 23.6 | 1 10. |
| 1010 | 192. | .0 | 6.2 | 1 0. |
| 700 | 410. | (DIRECT FLOW) | | 1 10. |
| 705 | 599. | (DIRECT FLOW) | | 1 0. |
| 102 | 94. | (DIRECT FLOW) | | 0 35. |
| 101 | 165. | (DIRECT FLOW) | | 0 35. |
| 500 | 545. | 4.6 | 1 | 10. |
| 710 | 629. | (DIRECT FLOW) | | 1 5. |
| 103 | 58. | (DIRECT FLOW) | | 0 35. |
| 510 | 618. | 4.8 | 1 | 5. |
| 434 | 112. | 1.2 | 0 | 50. |
| 715 | 635. | (DIRECT FLOW) | | 1 5. |
| 720 | 112. | (DIRECT FLOW) | | 0 50. |
| 107 | 523. | (DIRECT FLOW) | | 0 35. |
| 515 | 627. | 4.8 | 1 | 10. |
| 520 | 111. | 2.6 | 0 | 50. |
| 730 | 978. | (DIRECT FLOW) | | 0 50. |
| 104 | 222. | (DIRECT FLOW) | | 0 35. |
| 525 | 977. | 5.5 | 0 | 50. |
| 735 | 1104. | (DIRECT FLOW) | | 0 50. |
| 530 | 1102. | 5.7 | 0 | 50. |
| 108 | 156. | (DIRECT FLOW) | | 0 35. |
| 106 | 427. | (DIRECT FLOW) | | 0 35. |
| 105 | 106. | (DIRECT FLOW) | | 0 35. |
| 740 | 1102. | (DIRECT FLOW) | | 0 50. |
| 1113 | 923. | .0 | 62.8 | 1 25. |
| 750 | 923. | (DIRECT FLOW) | | 1 25. |

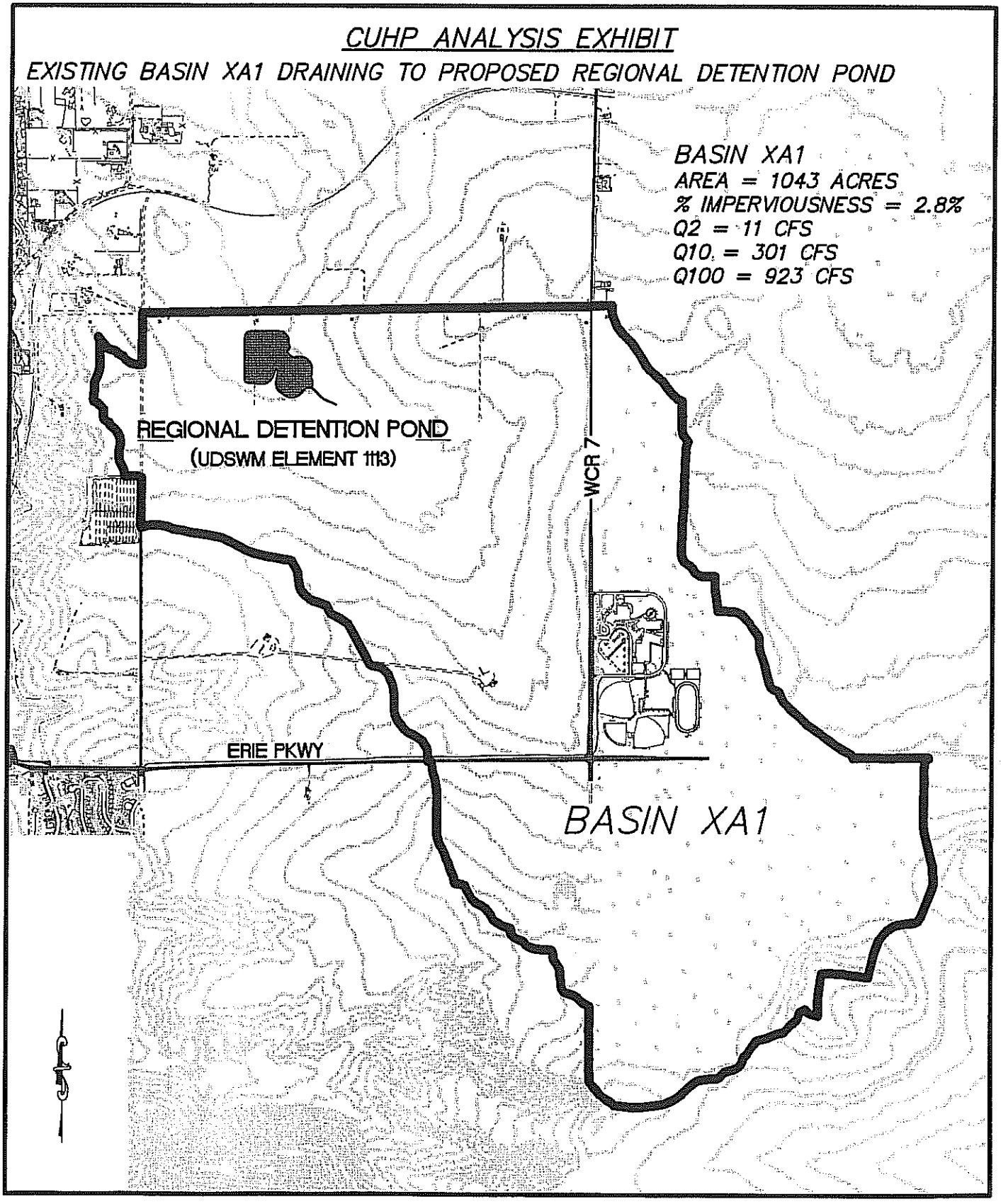
# APPENDIX G
# HISTORIC RUNOFF ANALYSIS

HURST & ASSOCIATES, INC.
CONSULTING ENGINEERS
4099 Pearl East Circle, Suite 106
Boulder, Colorado 80301 (303) 449-9105

JOB 2527-2 COLLIERS HILL
CALCULATED BY TA DATE 01/15/2016
CHECKED BY _____ DATE _____
SCALE: NTS SHEET NO. _____ OF _____

# CUHP ANALYSIS EXHIBIT

## EXISTING BASIN XA1 DRAINING TO PROPOSED REGIONAL DETENTION POND



1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 2/12/2008 AT TIME 13:56
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 3
Bridgewater - Existing

BASIN ID: 1 -- BASIN COMMENT: XA1

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 1.63 | 2.17 | 1.11 | 2.80 | 0.0192 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.153 | 0.352 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.06 | D= 0.06 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|
| 38.59 | 374.91 | 611.10 | 86.93 |

WIDTH AT 50 = 80. MIN. WIDTH AT 75 = 42. MIN. K50 =0.29 K75 =0.39

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 135. | 185. | 270. | 33. |
| 5. | 55. | 140. | 174. | 275. | 31. |
| 10. | 163. | 145. | 163. | 280. | 29. |
| 15. | 294. | 150. | 153. | 285. | 28. |
| 20. | 416. | 155. | 143. | 290. | 26. |
| 25. | 510. | 160. | 135. | 295. | 24. |
| 30. | 574. | 165. | 126. | 300. | 23. |
| 35. | 605. | 170. | 119. | 305. | 21. |
| 40. | 610. | 175. | 111. | 310. | 20. |
| 45. | 595. | 180. | 104. | 315. | 19. |
| 50. | 566. | 185. | 98. | 320. | 18. |
| 55. | 528. | 190. | 92. | 325. | 17. |
| 60. | 487. | 195. | 86. | 330. | 16. |
| 65. | 453. | 200. | 81. | 335. | 15. |
| 70. | 429. | 205. | 76. | 340. | 14. |
| 75. | 404. | 210. | 71. | 345. | 13. |
| 80. | 380. | 215. | 67. | 350. | 12. |
| 85. | 356. | 220. | 63. | 355. | 11. |
| 90. | 332. | 225. | 59. | 360. | 11. |
| 95. | 308. | 230. | 55. | 365. | 10. |
| 100. | 288. | 235. | 52. | 370. | 9. |
| 105. | 271. | 240. | 49. | 375. | 9. |
| 110. | 254. | 245. | 46. | 380. | 8. |
| 115. | 238. | 250. | 43. | 385. | 8. |
| 120. | 224. | 255. | 40. | 390. | 0. |
| 125. | 210. | 260. | 38. | 0. | 0. |
| 130. | 197. | 265. | 36. | 0. | 0. |

1 BASIN ID: 1 -- BASIN COMMENT: XA1

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 2

TOTAL PRECIP. = 1.17 (1-HOUR RAIN = 1.01) EXCESS PRECIP. = 0.019 INCHES
VOLUME OF EXCESS PRECIP = 1.62 ACRE-FEET
PEAK Q = 11. CFS TIME OF PEAK = 65. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 2/12/2008 AT TIME 13:59
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 3
Bridgewater - Existing

BASIN ID: 1 -- BASIN COMMENT: XA1

| AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 1.63 | 2.17 | 1.11 | 2.80 | 0.0192 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.153 | 0.352 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS ORAINAGE ( DEFAULT ) | FRACTION OF IMPERVIOUS AREA OIRECTLY CONNECTED TO DRAINAGE SYSTEM ( DEFAULT ) |
|---|---|
| R= 0.06 | O= 0.06 |

CALCULATED UNIT HYOROGRAPH

| TIME TO PEAK (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|
| 38.59 | 374.91 | 611.10 | 86.93 |

WIDTH AT 50 = 80. MIN. WIDTH AT 75 = 42. MIN. K50 =0.29 K75 =0.39

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYOROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 135. | 185. | 270. | 33. |
| 5. | 55. | 140. | 174. | 275. | 31. |
| 10. | 163. | 145. | 163. | 280. | 29. |
| 15. | 294. | 150. | 153. | 285. | 28. |
| 20. | 416. | 155. | 143. | 290. | 26. |
| 25. | 510. | 160. | 135. | 295. | 24. |
| 30. | 574. | 165. | 126. | 300. | 23. |
| 35. | 605. | 170. | 119. | 305. | 21. |
| 40. | 610. | 175. | 111. | 310. | 20. |
| 45. | 595. | 180. | 104. | 315. | 19. |
| 50. | 566. | 185. | 98. | 320. | 18. |
| 55. | 528. | 190. | 92. | 325. | 17. |
| 60. | 487. | 195. | 86. | 330. | 16. |
| 65. | 453. | 200. | 81. | 335. | 15. |
| 70. | 429. | 205. | 76. | 340. | 14. |
| 75. | 404. | 210. | 71. | 345. | 13. |
| 80. | 380. | 215. | 67. | 350. | 12. |
| 85. | 356. | 220. | 63. | 355. | 11. |
| 90. | 332. | 225. | 59. | 360. | 11. |
| 95. | 308. | 230. | 55. | 365. | 10. |
| 100. | 288. | 235. | 52. | 370. | 9. |
| 105. | 271. | 240. | 49. | 375. | 9. |
| 110. | 254. | 245. | 46. | 380. | 8. |
| 115. | 238. | 250. | 43. | 385. | 8. |
| 120. | 224. | 255. | 40. | 390. | 0. |
| 125. | 210. | 260. | 38. | 0. | 0. |
| 130. | 197. | 265. | 36. | 0. | 0. |

1 BASIN ID: 1 -- BASIN COMMENT: XA1

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 10

TOTAL PRECIP. = 2.00 (1-HOUR RAIN = 1.73) EXCESS PRECIP. = 0.572 INCHES
VOLUME OF EXCESS PRECIP = 49.75 ACRE-FEET
PEAK Q = 301. CFS TIME OF PEAK = 70. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 2/12/2008 AT TIME 14: 2
CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998
PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 3
Bridgewater - Existing

BASIN ID: 1 -- BASIN COMMENT: XA1

| AREA (SQMI) | LENGTH OF BASIN (MI) | OIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN) |
|---|---|---|---|---|---|
| 1.63 | 2.17 | 1.11 | 2.80 | 0.0192 | 5.00 |

| COEFFICIENT (REFLECTING TIME TO PEAK) | COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF) |
|---|---|
| 0.153 | 0.352 |

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

| FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE ( OEFAULT ) | FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM ( OEFAULT ) |
|---|---|
| R= 0.06 | D= 0.06 |

CALCULATED UNIT HYDROGRAPH

| TIME TO PEAK (MIN) | PEAK RATE OF RUNOFF (CFS/SQMI) | UNIT HYDROGRAPH PEAK (CFS) | VOLUME OF RUNOFF (AF) |
|---|---|---|---|
| 38.59 | 374.91 | 611.10 | 86.93 |

WIDTH AT 50 = 80. MIN. WIDTH AT 75 = 42. MIN. K50 =0.29 K75 =0.39

RAINFALL LOSSES INPUT W/ BASIN DATA
MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 3.00 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.50 IN./HR.

| TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH | TIME | UNIT HYDROGRAPH |
|---|---|---|---|---|---|
| 0. | 0. | 135. | 185. | 270. | 33. |
| 5. | 55. | 140. | 174. | 275. | 31. |
| 10. | 163. | 145. | 163. | 280. | 29. |
| 15. | 294. | 150. | 153. | 285. | 28. |
| 20. | 416. | 155. | 143. | 290. | 26. |
| 25. | 510. | 160. | 135. | 295. | 24. |
| 30. | 574. | 165. | 126. | 300. | 23. |
| 35. | 605. | 170. | 119. | 305. | 21. |
| 40. | 610. | 175. | 111. | 310. | 20. |
| 45. | 595. | 180. | 104. | 315. | 19. |
| 50. | 566. | 185. | 98. | 320. | 18. |
| 55. | 528. | 190. | 92. | 325. | 17. |
| 60. | 487. | 195. | 86. | 330. | 16. |
| 65. | 453. | 200. | 81. | 335. | 15. |
| 70. | 429. | 205. | 76. | 340. | 14. |
| 75. | 404. | 210. | 71. | 345. | 13. |
| 80. | 380. | 215. | 67. | 350. | 12. |
| 85. | 356. | 220. | 63. | 355. | 11. |
| 90. | 332. | 225. | 59. | 360. | 11. |
| 95. | 308. | 230. | 55. | 365. | 10. |
| 100. | 288. | 235. | 52. | 370. | 9. |
| 105. | 271. | 240. | 49. | 375. | 9. |
| 110. | 254. | 245. | 46. | 380. | 8. |
| 115. | 238. | 250. | 43. | 385. | 8. |
| 120. | 224. | 255. | 40. | 390. | 0. |
| 125. | 210. | 260. | 38. | 0. | 0. |
| 130. | 197. | 265. | 36. | 0. | 0. |

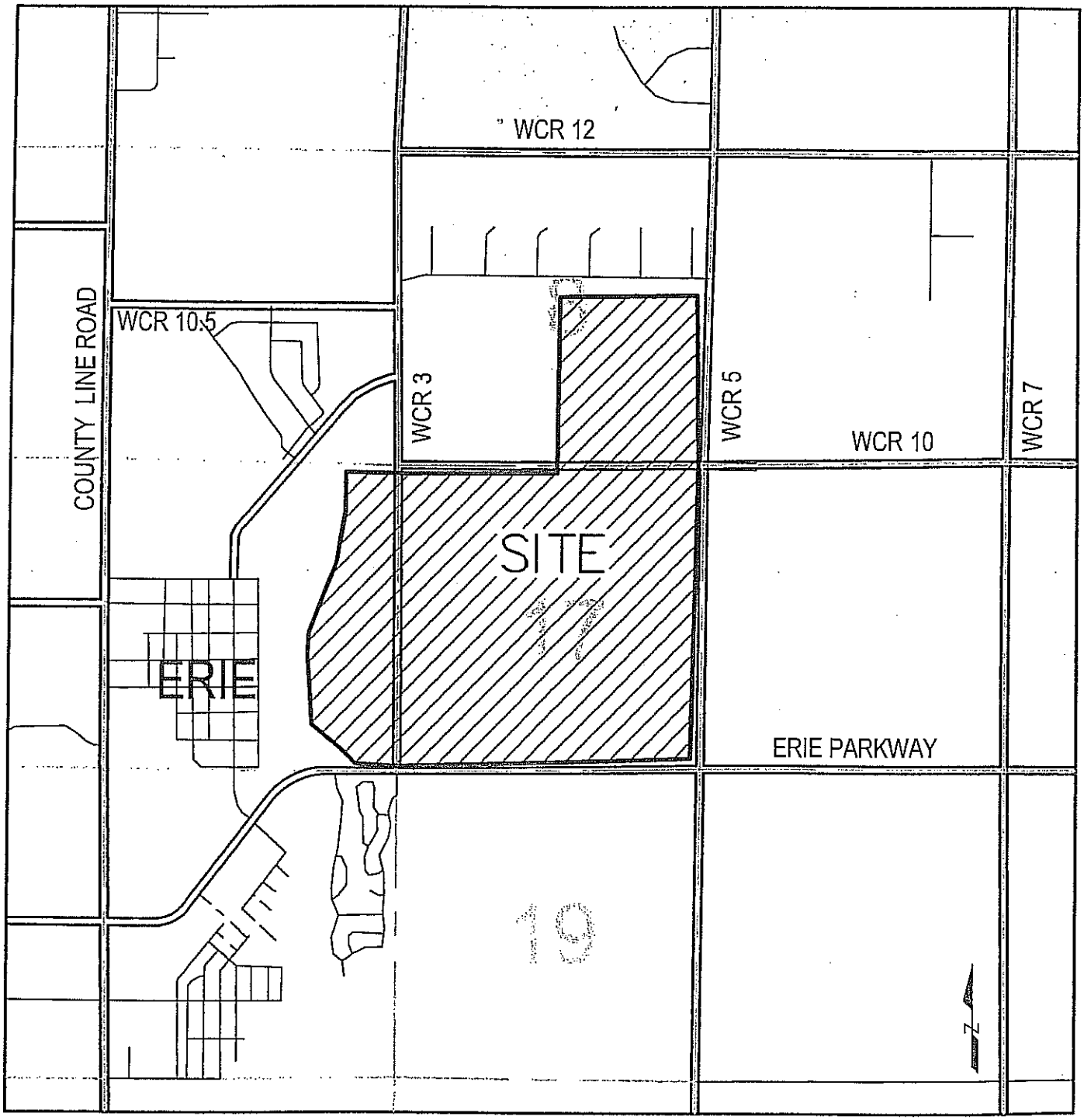
1 BASIN ID: 1 -- BASIN COMMENT: XA1

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100

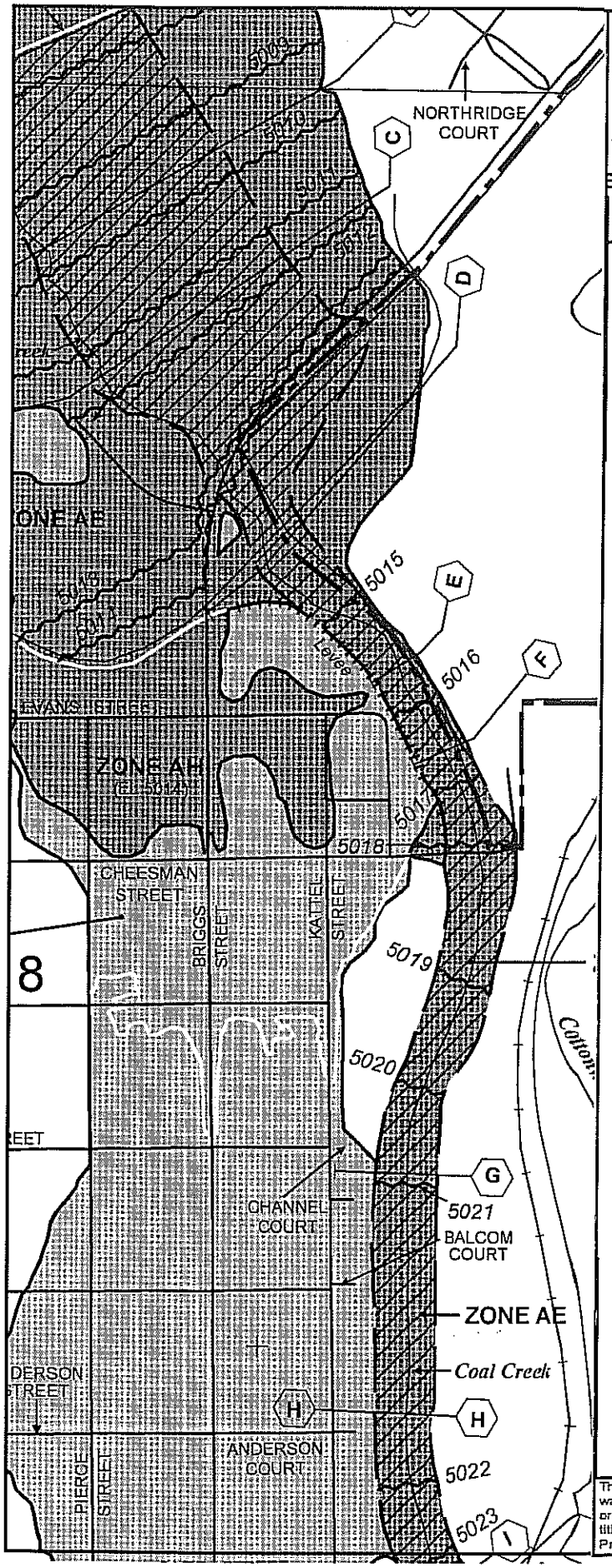
TOTAL PRECIP. = 3.12 (1-HOUR RAIN = 2.70) EXCESS PRECIP. = 1.680 INCHES
VOLUME OF EXCESS PRECIP = 146.02 ACRE-FEET
PEAK Q = 923. CFS TIME OF PEAK = 75. MIN.
INFILT.= 3.00 IN/HR DECAY =0.00180 FNINF = 0.50 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

# APPENDIX H

# MAPS




*VICINITY MAP*




MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0441J

# FIRM

## FLOOD INSURANCE RATE MAP

## BOULDER COUNTY, COLORADO

AND INCORPORATED AREAS

**PANEL 441 OF 615**

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|---|---|---|---|
| BOULDER COUNTY | 080023 | 0441 | J |
| ERIE, TOWN OF | 080181 | 0441 | J |

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

**MAP NUMBER**
**08013C0441J**

**MAP REVISED**
**DECEMBER 18, 2012**

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

G:\25272\PRELIM\DRAINAGE SET\25272-MD-OVERALL.dwg

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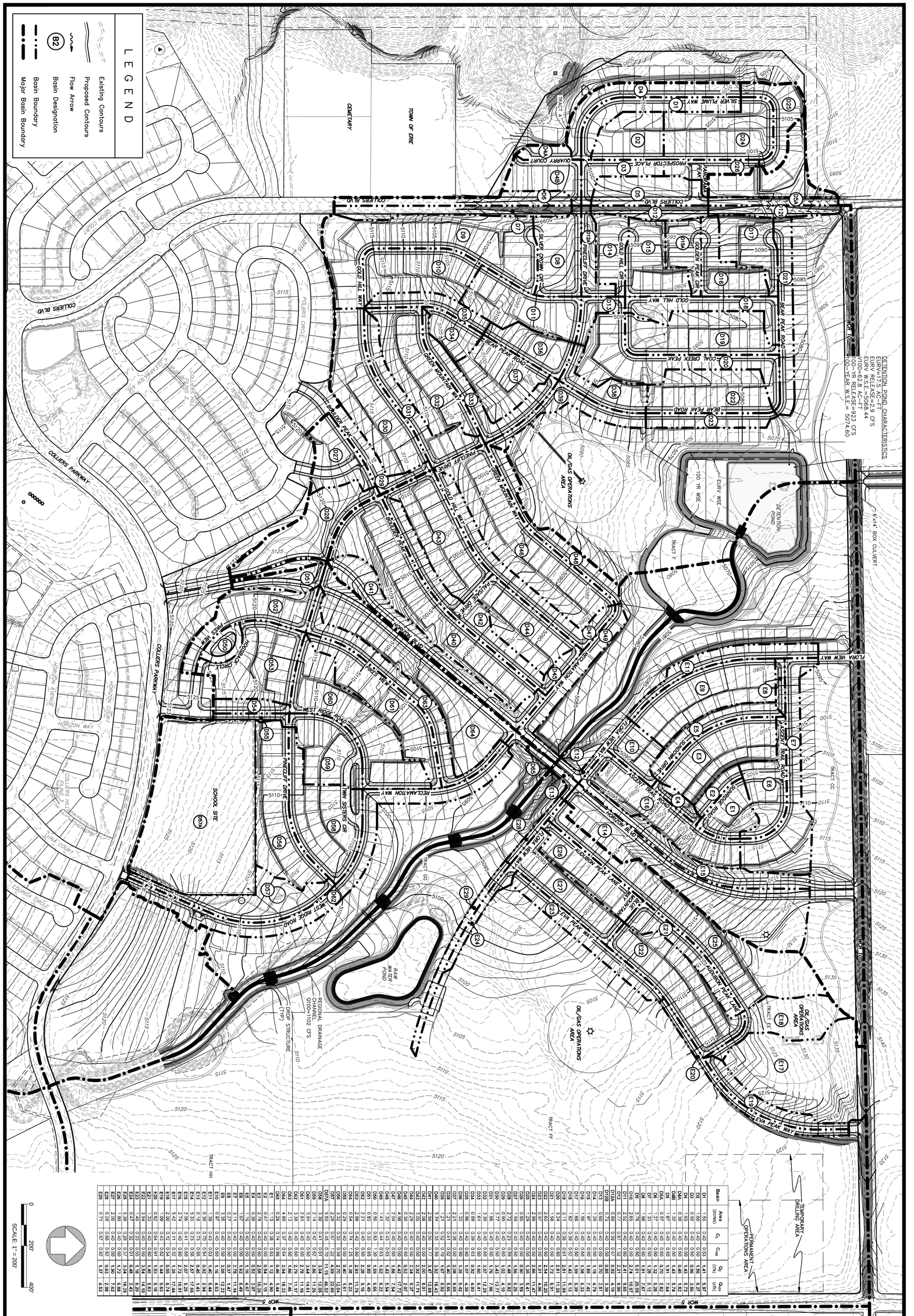
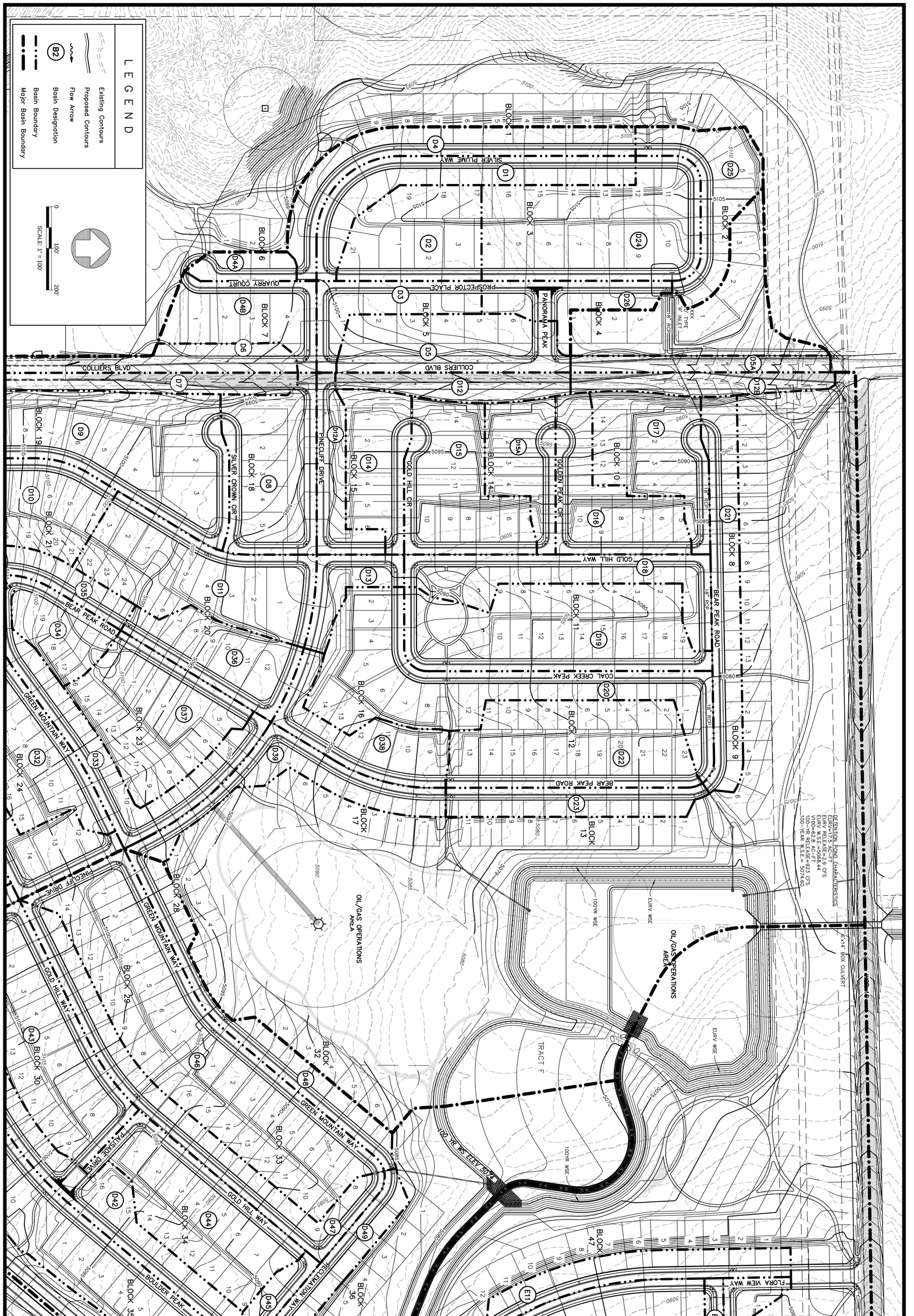

LEGEND
Existing Contours
Proposed Contours
Flow Arrow
B2
Basin Designation
Basin Boundary
Major Basin Boundary
DETENTION POND CHARACTERISTICS
EURV=17.5 AC-FT
EURV RELEASE=2.9 CFS
EURV WSE=5094.44
100=62.8 AC-FT
100-YR RELEASE=922 CFS
100-YEAR W.S.E.= 5074.60
COLLIERS BLVD
COLLIERS PARKWAY
CEMETERY
TOWN OF ERIE
SILVER PLUME WAY
PROSPECTOR PLACE
QUARRY COURT
PEAK VIEW PLACE
BEAR PEAK ROAD
COAL CREEK PEAK
GOLD HILL WAY
GOLD HILL CIR
PINECLIFF DRIVE
SILVER CROWN CT
GREEN MOUNTAIN WAY
BOULDER PEAK WAY
RED LAMATION WAY
RED LAMATION CIR
ASSENT TRAIL ROAD
SHADOW PEAK WAY
SHADOW PEAK CIR
ASSENT TRAIL CIR
ASSENT TRAIL PLACE
ASPEN PEAK WAY
ASPEN PEAK CIR
EVA PEAK WAY
EVA PEAK CIR
FLORA VIEW WAY
FLORA VIEW CIR
WEST RIDGE ROAD
WEST RIDGE CIRCLE
TWIN SISTERS DR
SOMBRERO CIRCLE
SOMBRERO WAY
SOMBRERO CIR
SOMBRERO PLACE
SOMBRERO COURT
SOMBRERO TRAIL
SOMBRERO PLACE

G:\25272\PRELIM\DRAINAGE SET\25272-MD.dwg

LAST SAVED: 2/2/2016 4:13 PM




COLLIERS HILL
PRELIMINARY PLAT NO. 2

MASTER DRAINAGE PLAN 1 OF 4

Prepared for:
DAYBREAK RECOVERY ACQUISITION, LLC

HURST
CIVIL ENGINEERING
PLANNING
SURVEYING


HURST & ASSOCIATES, INC.
2500 Broadway, Suite B
Boulder, CO 80304
303.449.9105


| SHEET NO. | SCALE: | DATE: | JOB NUMBER: |
|---|---|---|---|
| 2 | 1"=100' | 2/2/16 | 2527-2 |

| DRAWN BY: | DESIGNED BY: | DRAWING NAME: | APPROVED BY: |
|---|---|---|---|
| RD | JJ | 25272-MD | JJ |

REVISIONS

| NO. | DESCRIPTION | DATE | BY |
|---|---|---|---|
| 1 | ISSUED FOR REVIEW. | 1-9-12 | XX |

72 HOURS BEFORE YOU DIG CALL THE UTILITY NOTIFICATION CENTER OF COLORADO (U.N.C.C.)
811
GAS, ELECTRIC, TELEPHONE, CATV AND PANHANDLE EASTERN PIPELINE LOCATIONS

SCALE VERIFICATION
IF THIS BAR DOES NOT MEASURE 1" ON ORIGINAL DRAWING
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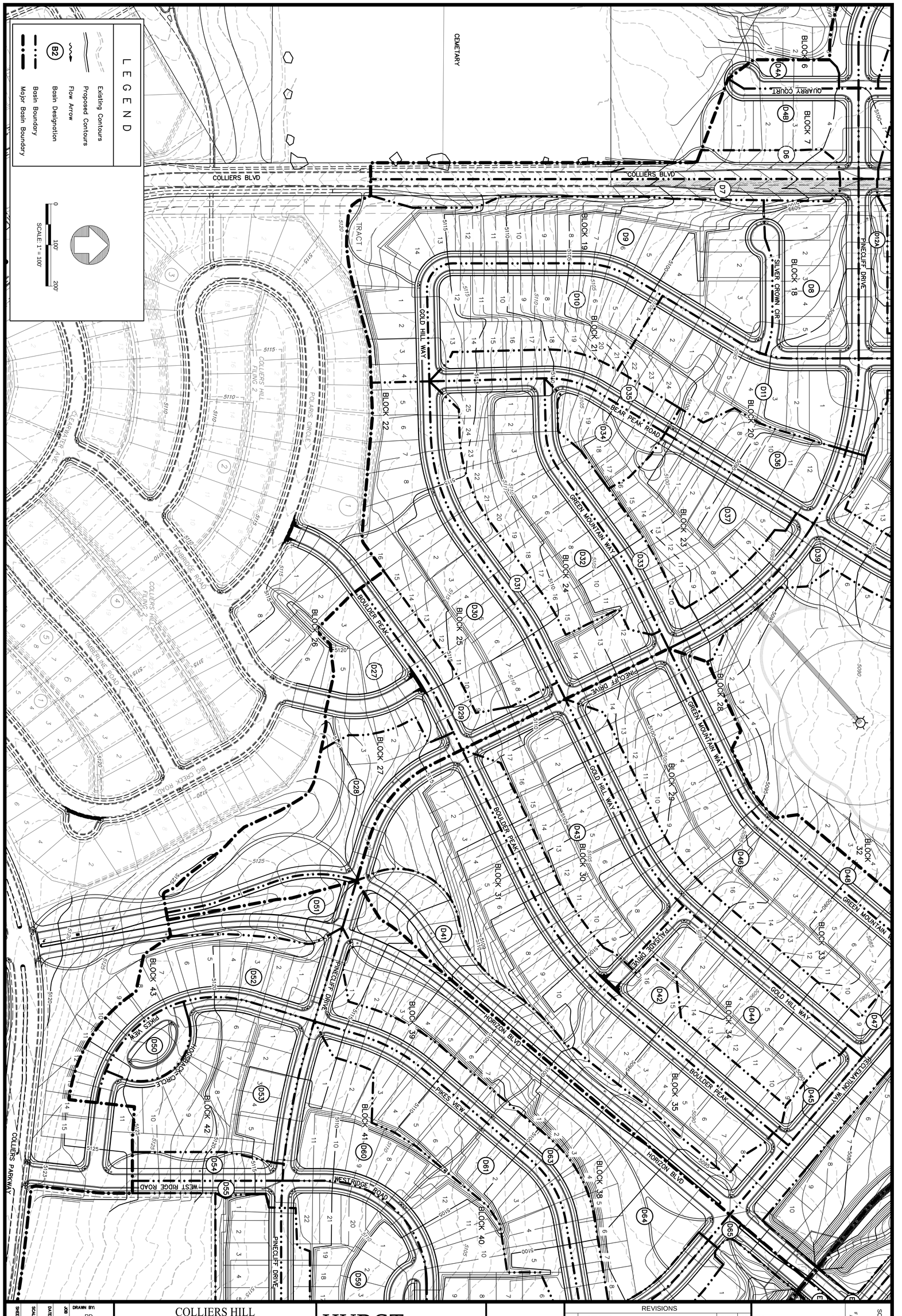


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COLLIERS HILL
PRELIMINARY PLAT NO. 2

MASTER DRAINAGE PLAN 2 OF 4

Prepared for:
DAYBREAK RECOVERY ACQUISITION, LLC

HURST
CIVIL ENGINEERING
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HURST & ASSOCIATES, INC.
2500 Broadway, Suite B
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WCR 10

WCR 5

FLORA VIEW WAY

ASCENT TRAIL ROAD

SUNRIDGE ROAD

SUNDOWN DRIVE

HORIZON BLVD

BOULDER PEAK

AUDUBON PEAK LANE

EVA PEAK WAY

BLUE MOUNTAIN WAY

CREATION WAY

BLOCK 35

BLOCK 36

BLOCK 38

BLOCK 48

BLOCK 49

BLOCK 50

BLOCK 51

BLOCK 52

BLOCK 53

BLOCK 54

BLOCK 55

BLOCK 56

BLOCK 57

BLOCK 58

BLOCK 59

BLOCK 60

TRACT EE

TRACT FF

OIL/GAS OPERATIONS AREA TO BE ABANDONED

OIL/GAS OPERATIONS AREA TO BE ABANDONED

OIL/GAS OPERATIONS AREA

PERMANENT OPERATIONS AREA

OIL & GAS PERMANENT FACILITIES AREA

TEMPORARY DRILLING AREA

E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21 E22 E23 E24 E25 E26 E27 E28 E29

D45 D64 D65

## LEGEND

- Existing Contours
- Proposed Contours
- Flow Arrow
- B2 Basin Designation
- Basin Boundary
- Major Basin Boundary

0 100' 200'

SCALE: 1" = 100'

## SCALE VERIFICATION

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HURST

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# COLLIERS HILL
# PRELIMINARY PLAT NO. 2
# MASTER DRAINAGE PLAN 3 OF 4

Prepared for:
DAYBREAK RECOVERY ACQUISITION, LLC

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BLOCK 35
BLOCK 38
BLOCK 40
BLOCK 41
BLOCK 42
BLOCK 37
BLOCK44
BLOCK 45
BLOCK 46
HORIZON BLVD
RECLAMATION WAY
WEST RIDGE ROAD
TWIN SISTERS CIR
PINECLIFF DRIVE
COLLIERS PARKWAY
HORIZON COURT
LUNA LANE
COLLIERS HILL FILING 3
RAW WATER POND
REGIONAL DRAINAGE CHANNEL Q100=1102 CFS
DROP STRUCTURE (TYP)
SCHOOL SITE
TRACT FF
TRACT HH
FUTURE NEIGHBORHOOD PARK
D65 D64 D63 D61 D60 D59 D58 D62 D56 D57 D57A D55 D54 D53
E28 E29 E24

## LEGEND

- Existing Contours
- Proposed Contours
- Flow Arrow
- B2 Basin Designation
- Basin Boundary
- Major Basin Boundary

0 100' 200'
SCALE: 1" = 100'

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RMS, ELECTRIC, TELEPHONE, CATV, AND PARKING CONTACTS, PUBLIC LOCATIONS

REVISIONS

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2500 Broadway, Suite B
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COLLIERS HILL
PRELIMINARY PLAT NO. 2

MASTER DRAINAGE PLAN 4 OF 4

Prepared for:
DAYBREAK RECOVERY ACQUISITION, LLC

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| DESIGNED BY: | JJ |
| DRAWING NAME: | 25272-MD |
| APPROVED BY: | JJ |
| JOB NUMBER: | 2527-2 |
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# COLLIERS HILL
# POTABLE WATER &WASTEWATER
# REQUIREMENTS
# ERIE, COLORADO

**Prepared For:**

Daybreak Recovery Acquisition, LLC
C/O Raintree Investments Corp.
7200 S. Alton Way
Suite C-400
Centennial, CO 80112

**Prepared By:**

Hurst & Associates, Inc.
2500 Broadway
Suite B
Boulder, CO 80304

Job No. 2527-2
September 9, 2015

## *INTRODUCTION*

The purpose of this report is to identify the potable water, non-potable water and wastewater facilities required for Colliers Hill development located in Sections 8, 17 & 18, Township 1 North, Range 68 West. Colliers Hill is annexed and within the potable water and wastewater master planning area for the Town of Erie. The following identifies infrastructure and service requirements for the proposed uses within the Colliers Hill community. This report is an update of previous reports for Colliers Bridgewater (now Colliers Hill).

## *WASTEWATER*

The Town of Erie *Water and Wastewater Master Plan, updated in 2006* was prepared by Black & Vetch Corporation in July 2003. The master plan shows general wastewater basins and proposed wastewater interceptor pipes. The proposed facilities shown on the water and wastewater master plan for Colliers Hill conform to the master plan requirements *(see map pocket).* The north water reclamation facility is operational and a 36 inch interceptor main has been installed to Old Town Erie. This interceptor will serve Colliers Hill and upstream basins. Wastewater lines will need to be extended from Colliers Hill north to the existing 36 inch interceptor main *(see map pocket).* The wastewater extension to Collier's Hill is referred to as the Bridgewater extension in The Town's master plan.

## *WASTEWATER PEAK FLOWS*

The following are the estimated wastewater peak flows for the Bridgewater extension. The peak flows were determined using the design criteria in the updated 2006 *Master Water and Wastewater Plan* by Black & Vetch. This is consistent with previous reports.

## PEAK WASTEWATER DESIGN FLOWS
## (See Map Pocket for Basins & Design Points)

**Basin A** (Coal Creek Interceptor Extension)

**WWA1** (offsite, upstream of Daybreak)

Erie High School (full buildout 2200 students)

ADF = 15,400 GPD

Residential 3840 Units (assuming 8 units per acre)

ADF = 3840 (60 Gal/Capita/Day) 2.79 Capita/Unit = 642,816 GPD

Total ADF = 658,216 GPD = .658 MGD

MDF = 1.2 (.658) = .790 MGD

$P.F. = 3.62\ (.790)^{0.167} = 3.8$

Peak Flow = 3.8 (.790) = 3.0 MGD (4.6 cfs)

**WWA2** (onsite Daybreak)

Residential

Single Family - 700 Units

ADF = 700 (60) 2.79 = 117,180 GPD

Multi-Family - 225 Units

ADF = 225 (60) 2.79 = 37,665 GPD

Park/Amenity Center ~12 Acres

ADF = 12 AC (50 Gal/AC/Day) = 600 GPD

Amenity Center - 10,000 S.F.

ADF = 10,000 (.10 GPD/S.F.) = 1,000 GPD

Total ADF = 156,445 GPD = .156 MGD

MDF = 1.2 (.156) = .187 MGD

$P.F. = 3.62(.187)^{0.167} = 4.8$

Peak Flow = 4.8 (.187) = 0.9 MGD (1.4 cfs)

**Design Point A1** (intersection of WCR 5 & Erie Parkway)

Peak Flow 4.6 cfs

**Design Point A2** (existing 18" at Coal Creek Parkway)

Total ADF = .814 MGD

MDF = 1.2 (.814) = .977 MGD

$P.F. = 3.62(.977)^{0.167} = 3.6$

Peak Flow = 3.6 (.977) = 3.5 MGD (5.4 cfs)

The existing 18 inch capacity is 8.3 cfs (minimum slope .45%)

**Basin B** (Colliers Hill Extension Upstream of Morgan Hill)

**Design Point B1**

225 Multi-Family Units

ADF = 225 (60) 2.79 = 37,665 GPD
MDF = 1.2 (37,665) = 45,198 GPD
PF = 5.0
Peak Flow = 5.0 (45,198) = 225,990 Gal/Day (.35 cfs)

**Design Point B2**

584 Residential Units

ADF = 584 (60) 2.79 = 97,762 GPD + Offsite Basin B1 51,300 = 149,062
MDF = 1.2 (149,062) = 178,874 GPD
PF = 4.8
Peak Flow = 4.8 (178,874) = 858,595 GPD (1.33 cfs)

**Design Point B3**

718 Residential Units + Offsite Basin B1

ADF = 718 (60) 2.79 + 51,308 = 171,493
MDF = 1.2 (171,493) = 205,792 GPD
PF = 4.7
Peak Flow = 4.7 (205,792) = 967,222 GPD (1.49 cfs)

**Design Point B4**

413 Residential Units, 1 Elementary School

ADF = 413 (60) 2.79 + 5,250 = 74,386 GPD
MDF = 1.2 (74,386) = 89,263 GPD
PF = 5.0
Peak Flow = 5.0 (89,263) = 446,315 GPD (.69 cfs)

**Design Point B5**

247 Residential Units

ADF = 247 (60) 2.79 = 41,348 GPD
MDF = 1.2 (41,348) = 49,618 GPD
PF = 5.0
Peak Flow = 5.0 (49,618) = 248,090 GPD (.38 cfs)

**Design Point B6**

(A4 + A5)

ADF = 74,386 + 41,348 = 115,734 GPD
MDF = 1.2 (115,734) = 138,881 GPD
PF = 5.0
Peak Flow = 5.0 (138,881) = 694,405 GPD (1.07 cfs)

**Design Point B7**

(A3 + A6)

ADF = 171,493 + 115,734 = 287,227 GPD
MDF = 1.2 (287,227) = 344,672 GPD
PF = 4.3
Peak Flow = 4.3 (344,672) = 1,482,090 GPD (2.29 cfs)

**Basin B4**

Assuming 3.0 Units/ Acre (Same density as Collier's Hill)
Residential 480 Units
ADF = 480 (60) 2.79 = 80,352 GPD (.80 MGD)
MDF = 1.2 (.080) = 0.096 MGD

**Design Point B8**

Total ADF = 419,199 GPD
MDF = 1.2 (.419) = .503 MGD

P.F. = $3.62/ (.503)^{0.167}$ = 4.1

Peak Flow = 4.1/ (.503) = 2.06 MGD (3.2 cfs)

15" @ Minimum Slope .22%

**Basin MH 1 (Morgan Hill)**

Single Family 315 Units
ADF = 315 (60) 2.79 = 52,731 GPD
Park/ Amenity Center 10 Acres
10 (50 Gal/Ac/Day) = 500 GPD
Amenity 10,000 S.F.
ADF = 10,000 S.F. (.10 GPD/S.F.) = 1,000 GPD

Total ADF = 53,871 GPD = .054 MGD
MDF = 1.2 (.054) = .065 MGD

P.F. = $3.62/ (065)^{0.167}$ = 5.7 (5.0 maximum)

Peak Flow = 5 (.065) = .325 MGD (.50 cfs)

8" Outfall to 15" adequate

**Design Point B10** (offsite north of existing high school)

Residential 250 Units (assuming 4 units per acre)

ADF = 250 (60)2.79 = 41,850 GPD

Future Middle School 1200 Students

ADF = 9,450 GPD

Total ADF = 51,300 GPD = .051 MGD

MDF = 1.2 (.051) = .061 MGD

**Design Point B11**

Residential

Single Family 300 Units

ADF = 300 (60) 2.79 = 50,220 GPD

Park Area 8 Acres Active

ADF = 8 (50)= 400 GPD

Amenity 10,000 S.F.

ADF = 10,000 S.F. (.10 GPD/S.F.) = 1,000 GPD

Total ADF = 51,620 GPD = .052 MGD

MDF = 1.2 (.052) = .062 MGD

P.F. = $3.65/ (.052)^{-0.167}$= 5.9 (5.0 maximum)

Peak Flow = 5 (.062) = .310 MGD (.48 cfs)

8" pipe is adequate

**Design Point B9**

Total ADF = 473,070 GPD

MDF = 1.2 (.473) = .568 MGD

P.F. = $3.62 (.568)^{-0.167}$ = 4.0

Peak Flow = 4.0 (.568) = 2.27 MGD (3.52 cfs)

15" Pipe @ Minimum .65% Slope (as on construction plans for Morgan Hill)

The 15 inch main extension north of Morgan Hill extends through the Andalusia proposed development. The alignment through Andalusia shown in the *map pocket* was provided by the Developers. It is assumed that Andalusia will discharge wastewater from 200 single-family residences and 8.1 acres of commercial into the 15 inch extension.

**Andalusia Contributing Flows**

Single Family ADF = 200 (60) 2.79 = 33,480 GPD (.033) MGD)
Commercial ADF = 8.1 Acres (1,000 gal/acre/day) = 8100 GPD (.008 MGD)
Total ADF = 41,580 GPD (.0416 MGD)
MDF = 1.2 (.0416) = .050 MGD

P.F. = 5.0
Peak Flow = 5(.050) = 0.250 MGD (0.39 cfs)

Total Flow Rate with Andalusia = 3.52 + 0.39 = 3.91 cfs

15' Capacity @ 0.65% = 6.15 cfs

## *WATER REQUIREMENTS*

Colliers Hill expands the existing Town of Erie water main distribution grid. The expended grid consists of 8" and 12"" water main to serve Colliers Hill and adjacent developments. All of Colliers Hill is in the zone 3 pressure zone (service elevations 5070-5210).

The potable water system will not be required to provide irrigation water for parks, open space or streetscape along arterial and major collector streets as these needs will be met by a raw water delivery system that is separate from the potable water system. Potable water system demands are based on the following factors per the Town of Erie's master plan.

**Residential Demand**

| | |
|---|---|
| Average Demand - | 140 gal per person or 420 gal per unit at an average of 2.8 people per unit |
| Peak Day Factor - | 2.85 |
| Peak Hour Factor - | 5.7 |
| Fireflow - | Residential - 1500 GPM |

**School Demand**

| | |
|---|---|
| Average Demand - | 20 gal/student |
| Peak Day Factor - | 2.85 |
| Peak Hour Factor - | 5.7 |
| Fireflow - | 2000 gpm |

Using these unit demands, the following table summarizes the Colliers Hill potable water requirements.

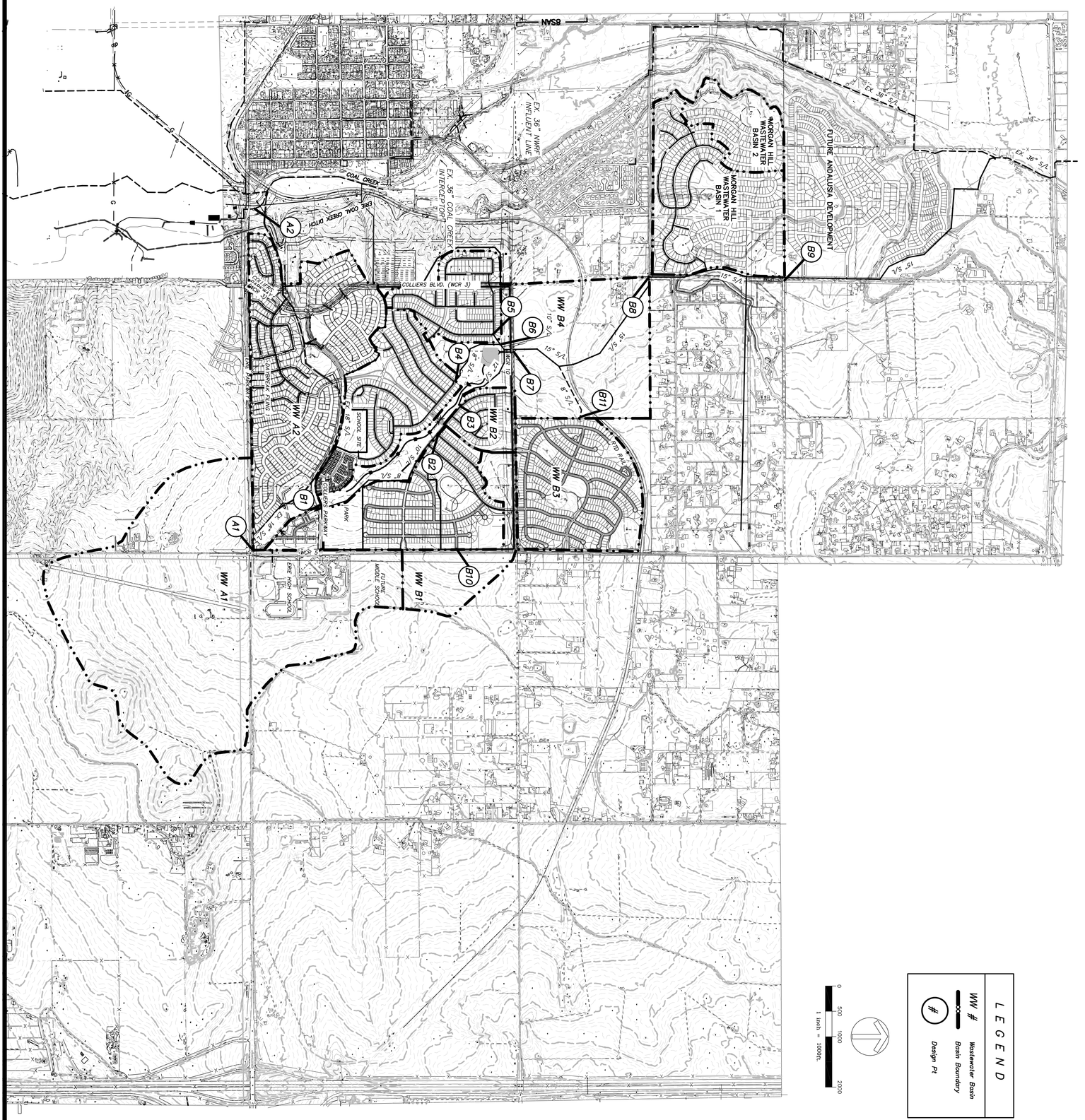
| Land Use | Avg Day Demand | Peak Day Demand | Peak Hour Demand | Peak Day + Fireflow |
|---|---|---|---|---|
| 500 Student School | 10,000 gal | 20 gpm | 40 gpm | ---- |
| 2880 Unit Residential* | 1,128,960 gal | 2334 gpm | 4469 gpm | ---- |
| Total | 1.14 mg | 2256 gpm | 4513 gpm | 4256** |

**Maximum Units by Annexation*
***Total Peak Day + School Fireflow*

The total average water demand for Colliers Hill is 1.41 million gallons per day or 1277 acre feet per year (.44 AF/Unit).

## *RAW WATER REQUIREMENTS*

Colliers Hill collector roads, parks and open spaces will be irrigated with reuse water supplied by the Town of Erie. Filings 1, 2, and 3 will be irrigated from the pump station and pond located at the northeast corner of Colliers Boulevard and Colliers Parkway. Filing 4 and future filings will be irrigated from a proposed pond within the Filing 4 open space area. A 16 inch raw water main is proposed to supply the raw water to the ponds. The Town of Erie is currently modifying the raw water master plan. Requirements for pond and pump station will be determined with final design.

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| APPROVED BY: | JJ |

COLLIERS HILL

Wastewater Exhibit 2

Prepared for:
Daybreak Recovery Acquisition, LLC


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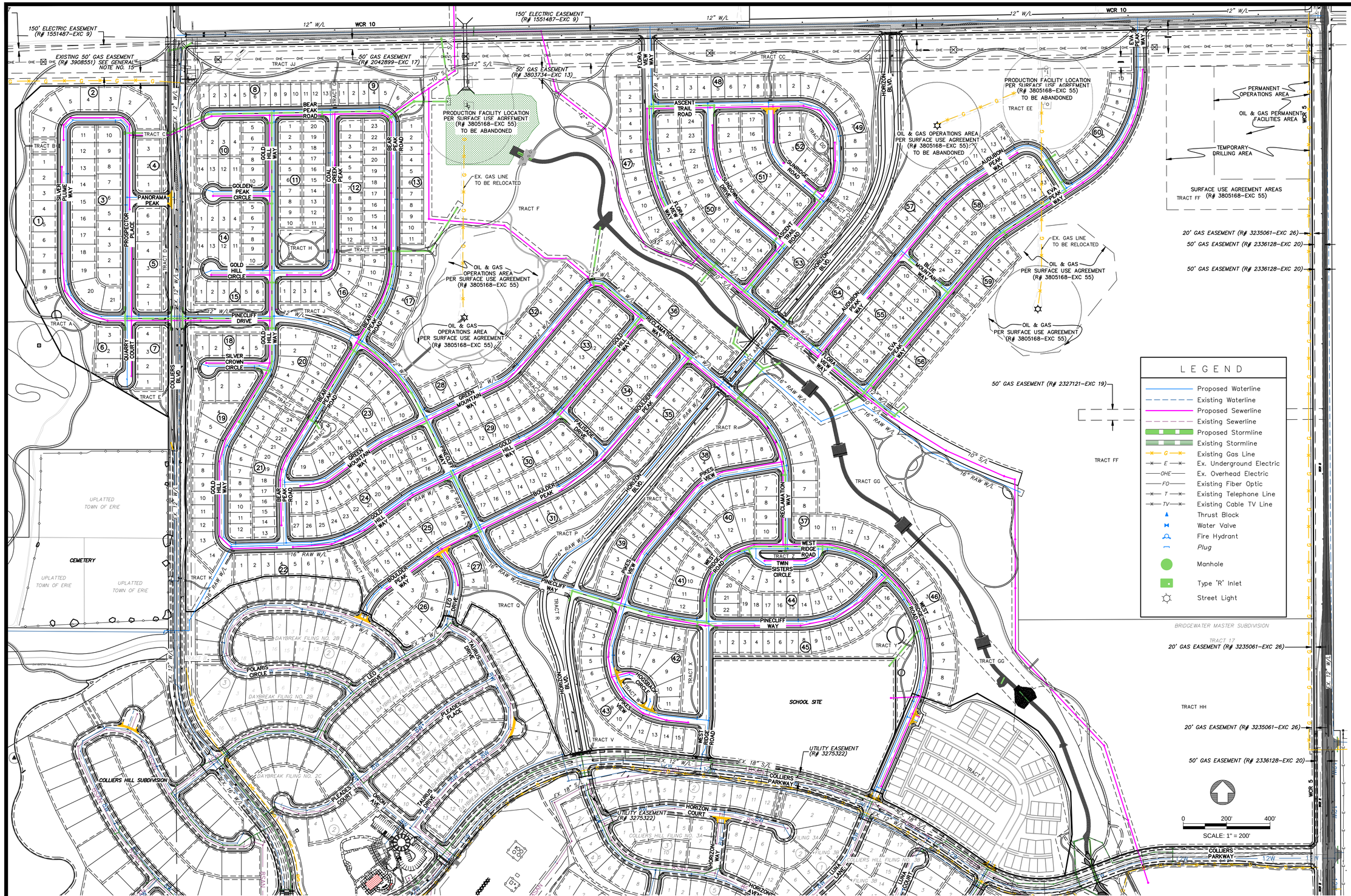


NOTE:

ALL WATER AND SANITARY LINES TO BE 8" UNLESS OTHERWISE NOTED

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303.449.9105

# COLLIER HILL
# PRELIMINARY PLAT NO. 2
# OVERALL MASTER UTILITY PLAN

Prepared for:
DAYBREAK RECOVERY ACQUISITION, LLC

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CTL | THOMPSON INCORPORATED

September 29, 2015

DAYBREAK RECOVERY ACQUISITION, LLC
c/o RainTree Investment Corporation
7200 S. Alton Way, Suite C-400
Centennial, Colorado 80112

Attention: Jerry B. Richmond III

Subject: Geologic, Preliminary Geotechnical and Mine Subsidence Studies
Colliers Hill, Phases 2 and 3
Project No. DN45212.002-115

CTL | Thompson, Inc. performed a Preliminary Geotechnical Investigation for the Colliers Hill project (formerly Tallgrass, Bridgewater and Daybreak) and presented results in a report dated June 30, 2005 (Project No. DN40,507-115). We prepared a letter dated October 6, 2010 (Project No. DN45,212-115) which included discussions of the site geology, geologic hazards and measures anticipated to mitigate geologic hazards and geotechnical concerns. Subsidence potential due to underground coal mines was also investigated, with results presented in a report dated October 14, 2010 (Project No. CT15114-130). We have reviewed the reports and letter and believe they remain appropriate for preliminary planning of Phases 2 and 3.

Additional investigations are recommended during grading design to evaluate the extent and depth of sub-excavation merited to mitigate the expansive soils and bedrock, and after site grading to provide design criteria for foundations and pavements.

Please call or email if you have questions or need further information.

Very truly yours,

CTL | Thompson, Inc.

COLORADO LICENSED RONALD M. McOMBER 20243 PROFESSIONAL ENGINEER

Ronald M. McOmber, P.E.
Chairman & CEO
rmcomber@ctlthompson.com

via email: jrichmond@raintree.us.com
emather@norris-design.com

CTL | THOMPSON INCORPORATED

October 6, 2010

Paulson & Company, Inc.
c/o Raintree Investment Corporation
110 Tiburon Boulevard, Suite 203
Mill Valley, California 94941

Attention: Mr. Michael McDonnell

Subject: Due Diligence Geotechnical Review
Portions of Bridgewater Subdivision
Northwest of Leon Wurl Parkway and
Weld County Road 5
Erie, Colorado
Project No. DN45,212-115

We understand Paulson & Company is considering the purchase of a portion of the Bridgewater Subdivision project in Erie Colorado. Bridgewater includes Section 17, the southeast quadrant of Section 8, and the east portion of Section 18, Township 1 North, Range 67 West. The proposed project includes single and multi-family parcels and associated open space; Paulson is evaluating purchase of the single-family areas.

CTL | Thompson, Inc. completed a Preliminary Geotechnical Investigation of the Bridgewater site (formerly known as Tallgrass) and presented results in a report dated June 30, 2005 (Project No. DN40,507-115). We were requested to review our records to assist in your due diligence assessment. The scope was described in our Proposal and Service Agreement DN10-0566R dated September 14, 2010. This letter contains descriptions of subsoil and ground water conditions found during our previous investigation and discussion of future residential construction as influenced by geotechnical considerations. The information contained in this letter is intended for due diligence assessment purposes only. Additional investigation will be required to develop development recommendations and design-level criteria. We are also performing environmental site assessment which will be reported under separate cover.

## Site Description and Geologic Setting

Bridgewater is located northwest of the intersection of Leon Wurl Parkway and Weld County Road 5 in Erie, Colorado, and extends north of County Road 10 and west of County Road 3 (Fig. 1). The overall site contains about 950 acres. Portions of the site have been used as farmland. Gas wells are scattered across the site. Coal Creek is located to the west; water was flowing in the Creek at the time of this investigation. There is also a ditch east of County Road 5 which was active when we visited the site. Erie Cemetery is located in the west portion of the site adjacent to Weld County Road #3. A Union Pacific Railroad right-of-way crosses the northern parcel and extends along the western property line. A

**school building is east of County Road 5. Residential development is located north and south of the site. The ground surface slopes down towards the west. Total relief across the site is about 135 feet, from elevation 5165 to 5030. Existing ground surface contours are shown on Fig. A-1.**

**Geologic mapping[1] indicates the site is underlain by wind-blown deposits of clay, silt and sand underlain by sedimentary bedrock of the Laramie formation. Our experience suggests there may be scattered alluvium (sand, gravel and cobble) below the wind-blown soils. The wind-blown soils can contain both expansive and collapsible clay and sand. The alluvium is comparatively stable, and may conduct water seepage if a source is nearby. The underlying bedrock includes claystone which is expansive.**

**The presence of expansive soils and bedrock, and collapsible (compressible) soils is considered a geologic hazard. Exhibit A contains a discussion about these geologic hazards.**

**The Laramie formation contains coal seams which were mined historically in Boulder and Weld Counties. Bridgewater is underlain by abandoned mine workings of three mines. We are evaluating mine subsidence risk under a separate project.**

**Soil and Ground Water Conditions**

**During our 2005 investigation we drilled 20 exploratory borings on the Bridgewater site; 15 of which were located within parcels which Paulson is considering. We were also provided a copy of a 1998 report prepared by Scott, Cox & Associates, Inc. and they had drilled five borings. The approximate locations of the borings are shown on Fig. 1. Appendix A contains copies of graphics from our 2005 report, Appendix B includes logs of our borings, and laboratory data is in Appendix C. Excerpts from the Scott, Cox & Associates report are in Appendix D.**

**The soils found in the 20 borings which have been drilled in the parcels under consideration included 3 to 22 feet of clay, sandy clay, clayey sand and some sand/gravel underlain by sedimentary claystone and sandstone bedrock. Some of the sand is loose. Select clay and claystone samples exhibited compression to very high swell. The sand and sandstone are generally low swelling or non-expansive. Low density, collapsing clays were identified at two test holes (TH-16 and TH-19). Samples of the bedrock exhibited compression (0.4 percent) to very high swell (14.7 percent), with about 85 percent swelling 4 percent or more when wetted under an applied pressure of 1,000 psf. Volume change of more than 4 percent implies high to very high risk for distress to ground-supported improvements unless mitigation is performed, as discussed later in this letter. Selected claystone samples swelled 4.1 to 9.6 percent after wetting under overburden pressures (1,800 to 3,600 psf). Claystone samples exhibited high plasticity,**

[1]Colton, R.B. and Anderson, L.W., "Preliminary Geologic Map of the Erie Quadrangle…", U.S.G.S., 1977

**Ground water was measured in two of our borings (TH-15 and TH-20) during the 2005 investigation at depths of 15.5 and 31.5 feet below the existing ground surface. Scott, Cox did not report any water in their borings.**

## Discussion

**The primary geotechnical issue associated with development and residential construction at Bridgewater will be the presence of highly expansive claystone bedrock. Where this material is present within about 15 to 20 feet of the proposed ground surface, it could impose risk of significant heave and associated damage to foundations, flatwork, pavements and other improvements. During our 2005 study, we judged the risk of swelling soil (or bedrock) damage to be high or very high at about half of the exploratory borings which were drilled in the parcels Paulson is evaluating (Fig. A-4). In the north portion of the site, sand and sandstone were found in six borings which represent low risk of movement. Exhibit B describes the swell risk assessment.**

**In the areas where highly expansive claystone will be present near proposed grades, we believe potential movements (heave) are high enough that construction of residences and associated improvements without mitigation will not be prudent. The common method to mitigate the potential movements is over-excavation to depths on the order of 18 to 22 feet below proposed grade in residence areas, with over-excavation of 3 to 7 feet (or more) below streets. This excavation is followed by placement of on-site materials re-worked as high moisture, compacted fill. It is normally possible to reduce potential swell to levels which allow use of footing-type foundations and slab-on-grade basement floors. Given the high plasticity of the claystone at Bridgewater, it may not be practical to achieve low swelling conditions, so use of drilled pier foundations and structurally supported basement floors may be necessary even if over-excavation is performed. For preliminary budgeting purposes, we suggest an assumption of 20 feet of over-excavation in 50 percent of the site to include the areas where preliminary data suggest high or very high swell risk. If the moderate risk areas are also included, the area would increase to about 70 to 75 percent of the site.**

**The presence of high plasticity soils will also affect the stability of subgrade soils below streets. We suggest budgets include at least 5 feet of over-excavation for 70 percent of the pavements, with chemical stabilization (fly ash or lime treatment) of subgrade in about 50 percent of the streets.**

**Control of surface and subsurface water will be critical to performance of residence foundations and other improvements. We typically advocate installation of underdrain systems below sanitary sewer mains to help control subsurface water. The alluvial soils found in a few borings may also provide a conduit for subsurface water. Interceptor drains may be necessary along portions of the perimeter of various parcels or filings.**

**We believe our 2005 soils investigation was performed using methods consistent with those used by other geotechnical engineers practicing in this area at the time. Further preliminary studies will be needed to allow better assessment**

of areas where over-excavation will be merited and other geotechnical measures for site development.

Limitations

We have reviewed previous records to provide a general characterization of subsurface conditions beneath Bridgewater for due diligence assessment. Design criteria contained in our previous report may not be valid. We believe this review was conducted in a manner consistent with that level of care and skill ordinarily used by geotechnical engineers practicing in this area at this time. No warranty, express or implied, is made.

If we can be of further service in discussing either the contents of this letter or the influence of subsurface conditions on the future construction, please call.

Very truly yours,

CTL | THOMPSON, INC.

COLORADO REGISTERED RONALD M. McOMBER 10/7 20243 PROFESSIONAL ENGINEER

Ronald M. McOmber, P.E., D.GE
Chairman & CEO

Reviewed by:

David A. Glater, P.E., C. P.G.
Principal Geological Engineer

RMM:DAG/rmm/nt/bg
(2 copies)

via email: jerrybrichmond@gmail.com

## EXHIBIT A

## GEOLOGIC HAZARDS

**Colorado is a challenging location to practice geotechnical engineering. The climate is relatively dry and the near-surface soils are typically dry and relatively stiff. These soils and related sedimentary bedrock formations tend to react to changes in moisture conditions. Some of the soils swell as they increase in moisture and are called expansive soils. Other soils can settle significantly upon wetting and are referred to as collapsing soils. Most of the land available for development east of the Front Range is underlain by expansive clay or claystone bedrock near the surface. The soils that exhibit collapse are more likely west of the continental divide; however, both types of soils occur all over the state.**

**Covering the ground with houses, streets, driveways, patios, etc., coupled with lawn irrigation and changing drainage patterns, leads to an increase in subsurface moisture conditions. As a result, some soil movement is inevitable. It is critical that all recommendations in a soils report are followed to increase the chances that foundations and slabs-on-grade will perform satisfactorily. After construction, home owners must assume responsibility for maintaining the structures and use appropriate practices regarding drainage and landscaping.**

**Expansive soils and bedrock and compressible soils are present at this site. The presence constitutes a geologic hazard. There is risk that ground heave or settlement will damage slabs-on-grade and foundations. The risks associated with swelling and compressible soils can be mitigated but not eliminated by careful design, construction and maintenance procedures. We believe the recommendations our reports will help control risk of foundation and/or slab damage; they will not eliminate that risk. The builder and home buyers should understand that slabs-on-grade and, in some instances, foundations may be affected by swelling soils. Homeowner maintenance will be required to control risk. We recommend builders provide a booklet to home buyers that describes swelling soils and includes recommendations for care and maintenance of homes constructed on expansive soils. Colorado Geological Survey Special Publication 43[2] was designed to provide this information.**

[2] **"A Guide to Swelling Soils for Colorado Homebuyers and Homeowners," Second Edition Revised and Updated by David C. Noe, Colorado Geological Survey, Department of Natural Resources, Denver, Colorado, 2007.**

## EXHIBIT B

## SWELL RISK EVALUATION

**As part of our previous evaluation of the subsoils and bedrock, samples were tested in the laboratory using a swell test. In the test procedure, a relatively undisturbed sample obtained during drilling is first loaded and then flooded with water and allowed to swell or compress. The pressure applied prior to wetting can approximate the weight of soil above the sample depth or be some standard load. This judgment has been described by the Colorado Association of Geotechnical Engineers[3] (CAGE, 1996) as it relates to basement slab-on-grade floors. It can also be used to help judge performance risk for other slabs-on-grade such as garage floors, driveways, and sidewalks. The risk evaluation is considered when we evaluate appropriate foundation systems for a given site. In general, more conservative foundation designs are used for higher risk sites to control the likelihood of excessive foundation movement.**

**As a result of the Swell Risk Evaluation, sites are categorized as low, moderate, high, or very high risk. This is a judgment of the swelling characteristics of the soils and bedrock likely to influence performance of improvements.**

### REPRESENTATIVE MEASURED SWELL AND CORRESPONDING SLAB PERFORMANCE RISK CATEGORIES

| Slab Performance Risk Category | Representative Percent Swell* (500 psf Surcharge) | Representative Percent Swell* (1000 psf Surcharge) |
|---|---|---|
| Low | 0 to <3 | 0 to <2 |
| Moderate | 3 to <5 | 2 to <4 |
| High | 5 to <8 | 4 to <6 |
| Very High | $\geq$ 8 | $\geq$ 6 |

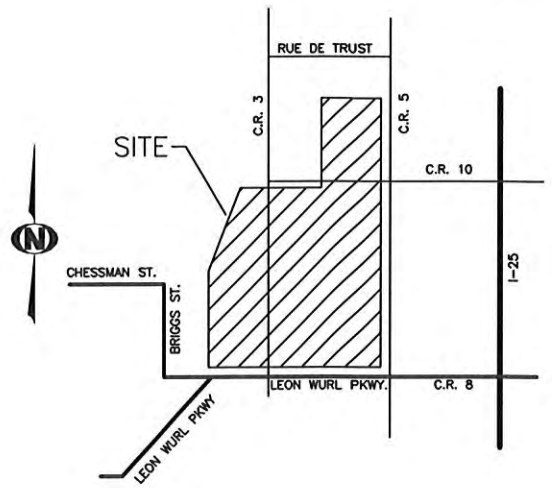
***Note:** The representative percent swell values presented are not necessarily measured values; rather, they are a judgment of the swelling characteristics of the soil and bedrock likely to influence slab performance.

**The rating of risk on a site as low or high is not absolute. Rather, this rating represents a judgment. Movement of slabs and foundations may occur with time in low, moderate, high, and very high risk areas as the soils respond to increases in moisture content. Overall, the severity and frequency of damage usually is greater in high and very high rated areas. Heave of slabs-on-grade of 3 to 5 inches is not uncommon in areas rated as high or very high risk. On low and moderate risk sites, slab heave of 1 to 2 inches is considered normal and we believe in the majority of instances, movements of this magnitude constitute reasonable slab performance; more heave can occur. Slabs can be affected on all sites.**

[3] "Guideline for Slab Performance Risk Evaluation and Residential Basement Floor System Recommendations", Colorado Association of Geotechnical Engineers, December 1996.

0 500 1000

SCALE: 1" = 1000'




**VICINITY MAP**
NOT TO SCALE

LEGEND:

TH-1 ● INDICATES APPROXIMATE LOCATION OF EXPLORATORY BORING DRILLED FOR PROJECT NO. DN40,507-115 (2005)

TH-1 ⊕ INDICATES APPROXIMATE LOCATION OF EXPLORATORY BORING DRILLED BY SCOTT, COX & ASSOCIATES, INC. (PROJECT NO. 98697; REPORT DATED NOVEMBER 1998).

**PAULSON & COMPANY, INC.**
PORTIONS OF BRIDGEWATER SUBDIVISION
**Project No. DN45,212-115**

# Locations of Exploratory Borings

Fig. 1

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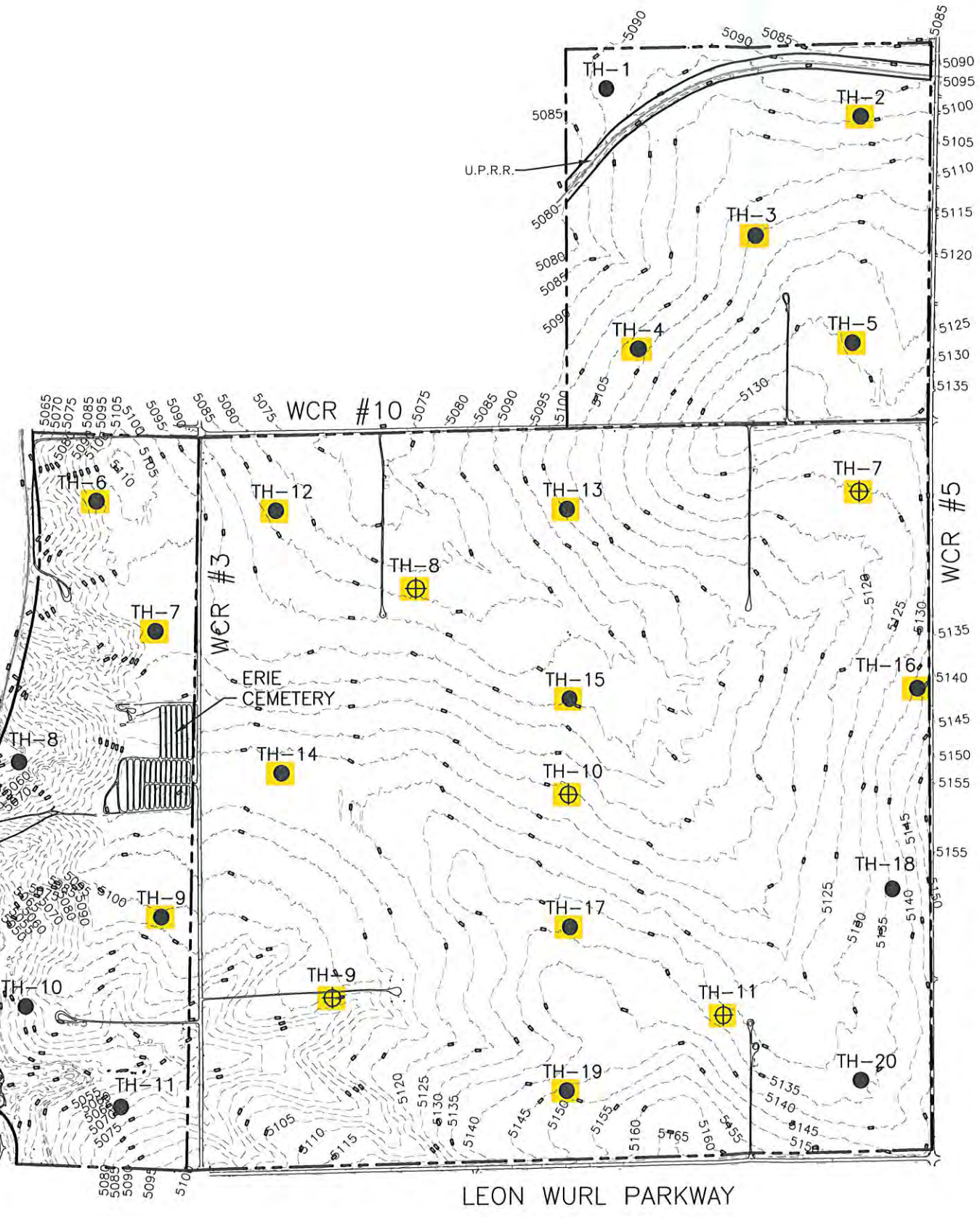
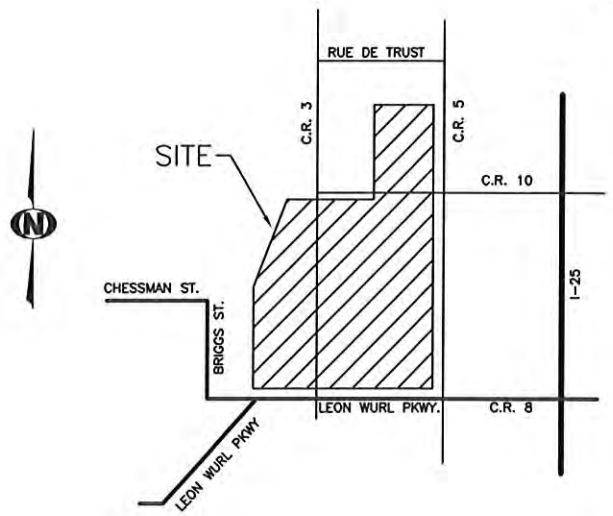
## APPENDIX A

## LOCATION OF BORINGS
## BEDROCK SURFACE EVALUATION
## PRELIMINARY SWELL RISK EVALUATION UNDERDRAIN DETAILS
**(PROJECT NO. DN40,507-115; REPORT DATED JUNE 30, 2005)**

SCALE: 1"= 1000'




VICINITY MAP
NOT TO SCALE

LEGEND:

TH-1 ● INDICATES APPROXIMATE LOCATION OF EXPLORATORY BORING

TH-1 ⊕ INDICATES APPROXIMATE LOCATION OF EXPLORATORY BORING DRILLED BY SCOTT, COX & ASSOCIATES, INC. (PROJECT NO. 98697; REPORT DATED NOVEMBER 1998).

5100 INDICATES EXISTING GROUND SURFACE ELEVATION (FEET)

BORINGS IN AREAS PAULSON IS EVALUATING

# Locations of Exploratory Borings

Project No. DN40,507-115

Fig. A - 1

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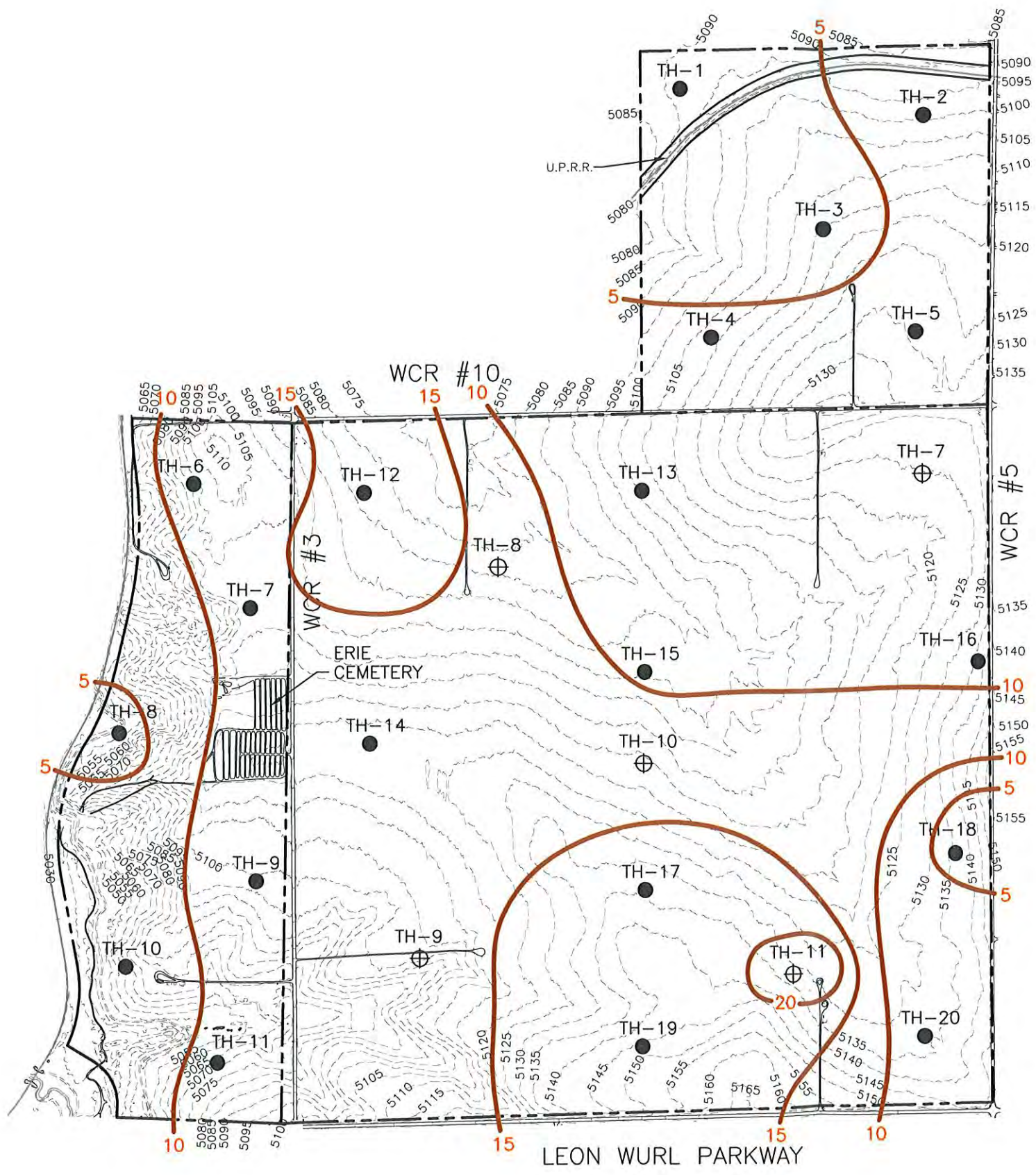
SCALE: 1"= 1000'




LEGEND:

- TH-1 ● INDICATES APPROXIMATE LOCATION OF EXPLORATORY BORING
- TH-1 ⊕ INDICATES APPROXIMATE LOCATION OF EXPLORATORY BORING DRILLED BY SCOTT, COX & ASSOCIATES, INC. (PROJECT NO. 98697; REPORT DATED NOVEMBER 1998).
- 5100 INDICATES EXISTING GROUND SURFACE ELEVATION (FEET)
- 5 INDICATES ESTIMATED DEPTH TO BEDROCK (FEET)

NOTE: THIS ESTIMATE WAS BASED UPON A SUBJECTIVE ANALYSIS OF DRILL HOLE DATA AND MAY NOT REFLECT LOCAL VARIATIONS

# Estimated Depth to Bedrock

Project No. DN40,507-115

Fig. A - 2

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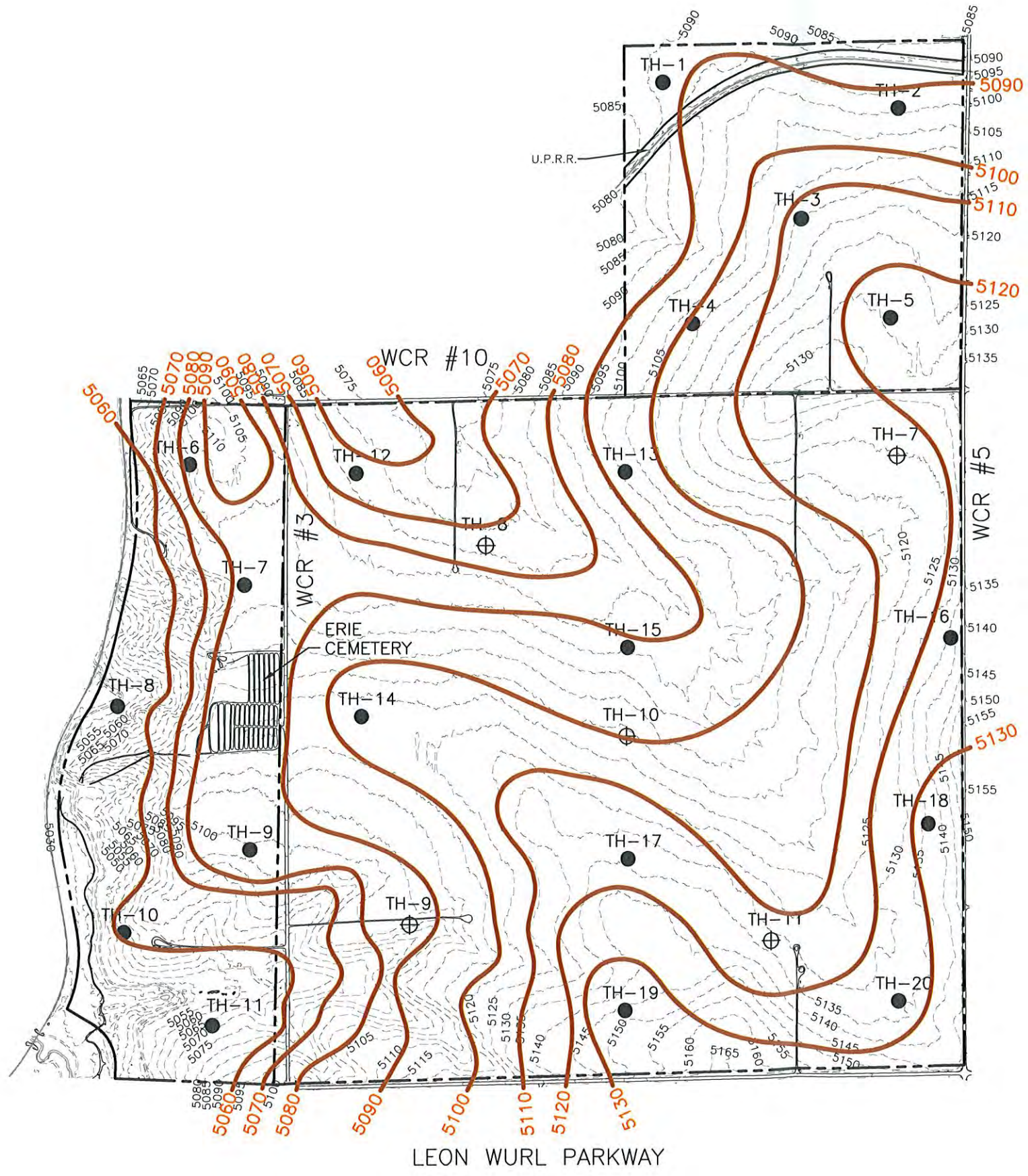
SCALE: 1"= 1000'




LEGEND:

TH–1 ● INDICATES APPROXIMATE LOCATION OF EXPLORATORY BORING

TH–1 ⊕ INDICATES APPROXIMATE LOCATION OF EXPLORATORY BORING DRILLED BY SCOTT, COX & ASSOCIATES, INC. (PROJECT NO. 98697; REPORT DATED NOVEMBER 1998).

5100 – – – INDICATES EXISTING GROUND SURFACE ELEVATION (FEET)

5060 ——— INDICATES ESTIMATED BEDROCK ELEVATION (FEET)

NOTE: THIS ESTIMATE WAS BASED UPON A SUBJECTIVE ANALYSIS OF DRILL HOLE DATA AND MAY NOT REFLECT LOCAL VARIATIONS

# Estimated Bedrock Elevation

Project No. DN40,507-115

Fig. A - 3

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LEGEND:

| | |
|---|---|
| TH-1 ● | INDICATES APPROXIMATE LOCATION OF EXPLORATORY BORING |
| TH-1 ⊕ | INDICATES APPROXIMATE LOCATION OF EXPLORATORY BORING DRILLED BY SCOTT, COX & ASSOCIATES, INC. (PROJECT NO. 98697; REPORT DATED NOVEMBER 1998). |
| L | LOW RISK |
| M | MODERATE RISK |
| H | HIGH RISK |
| VH | VERY HIGH RISK |

NOTES:

1.) RATING OF SCOTT, COX & ASSOCIATE'S BORINGS WAS BASED ON OUR EVALUATION OF THEIR TEST DATA.

2.) THIS ESTIMATE WAS BASED UPON A SUBJECTIVE ANALYSIS OF LABORATORY TEST RESULTS AND DRILL HOLE DATA. SWELL RISK WILL VARY BETWEEN BORINGS. ADDITIONAL INVESTIGATION AT CLOSER TEST HOLE SPACING IS RECOMMENDED TO BETTER DELINEATE SWELL RISK.

3.) DEEP CUT AND FILL FOR SITE GRADING WILL AFFECT SWELL RISK RATING. WE SHOULD REVIEW GRADING PLANS TO BETTER EVALUATE SWELL RISK.

BORINGS IN AREAS PAULSON IS EVALUATING

**Swell Risk Evaluation**

Project No. DN40,507-115

Fig. A - 4

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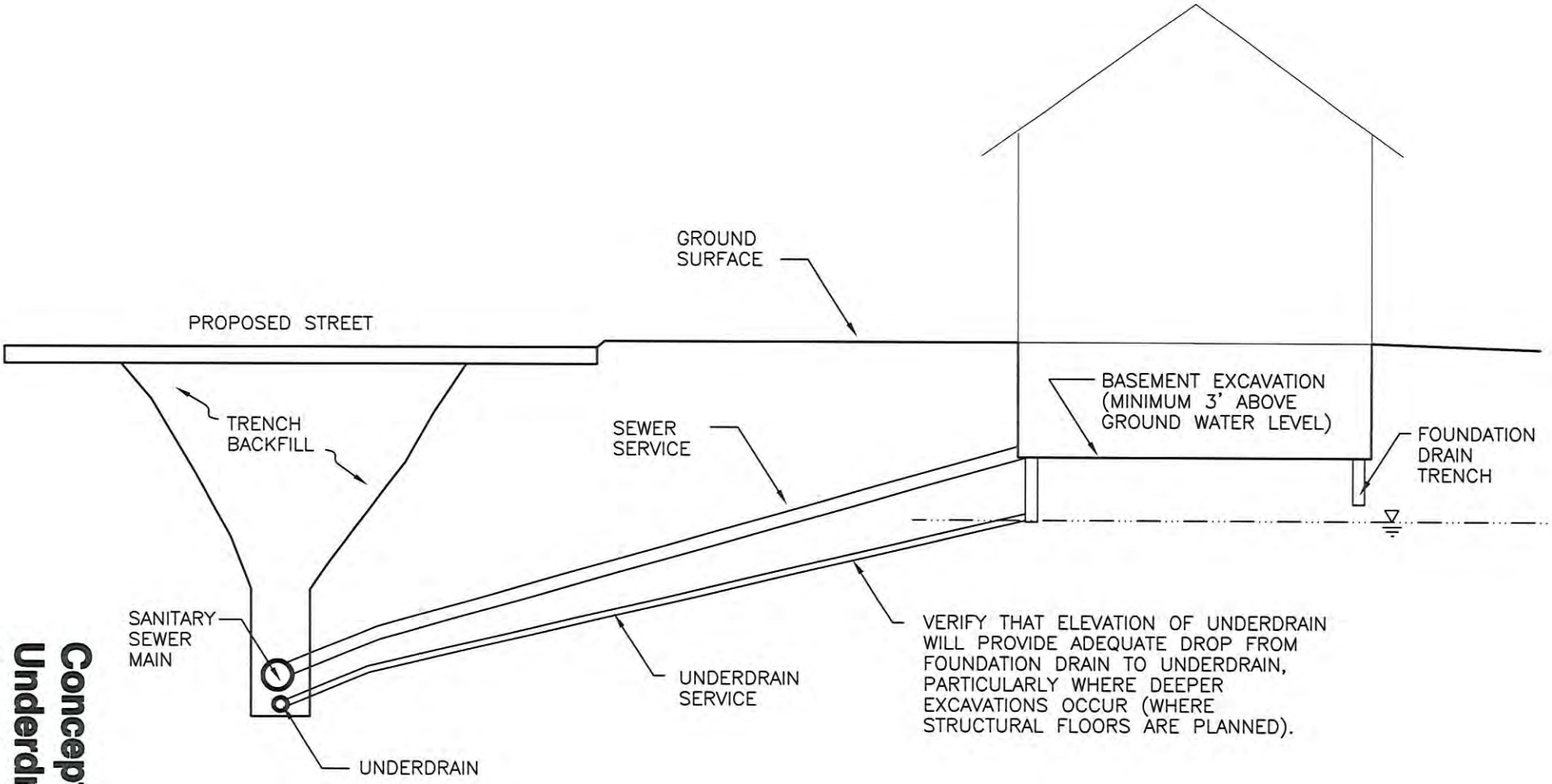
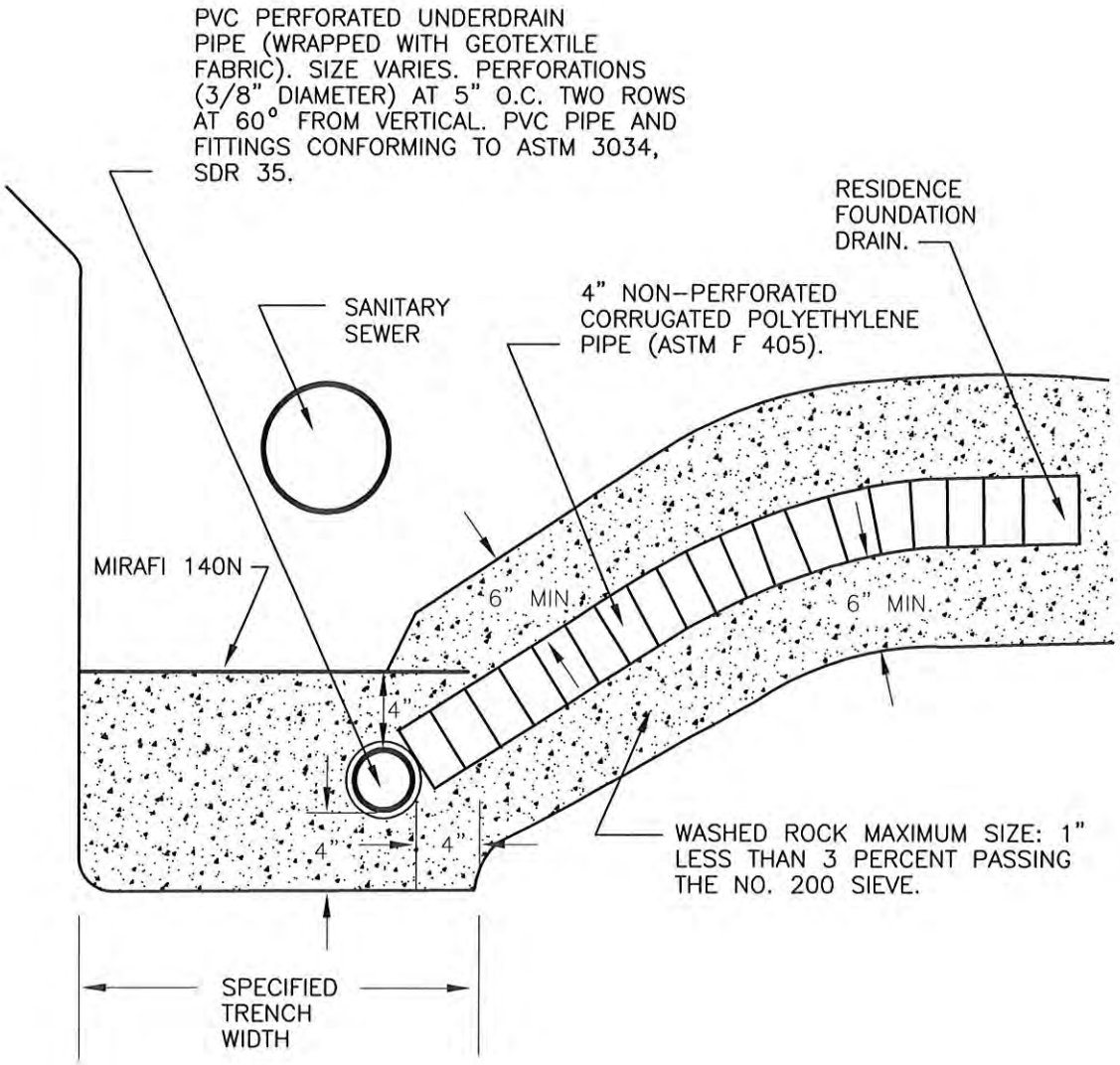
Project No. DN40,507-115

# Conceptual Underdrain Service Profile




NOT TO SCALE

Fig. A-5




NOTE: NOT TO SCALE.

# Sewer Underdrain Detail

Project No. DN40,507-115

Fig. A-6

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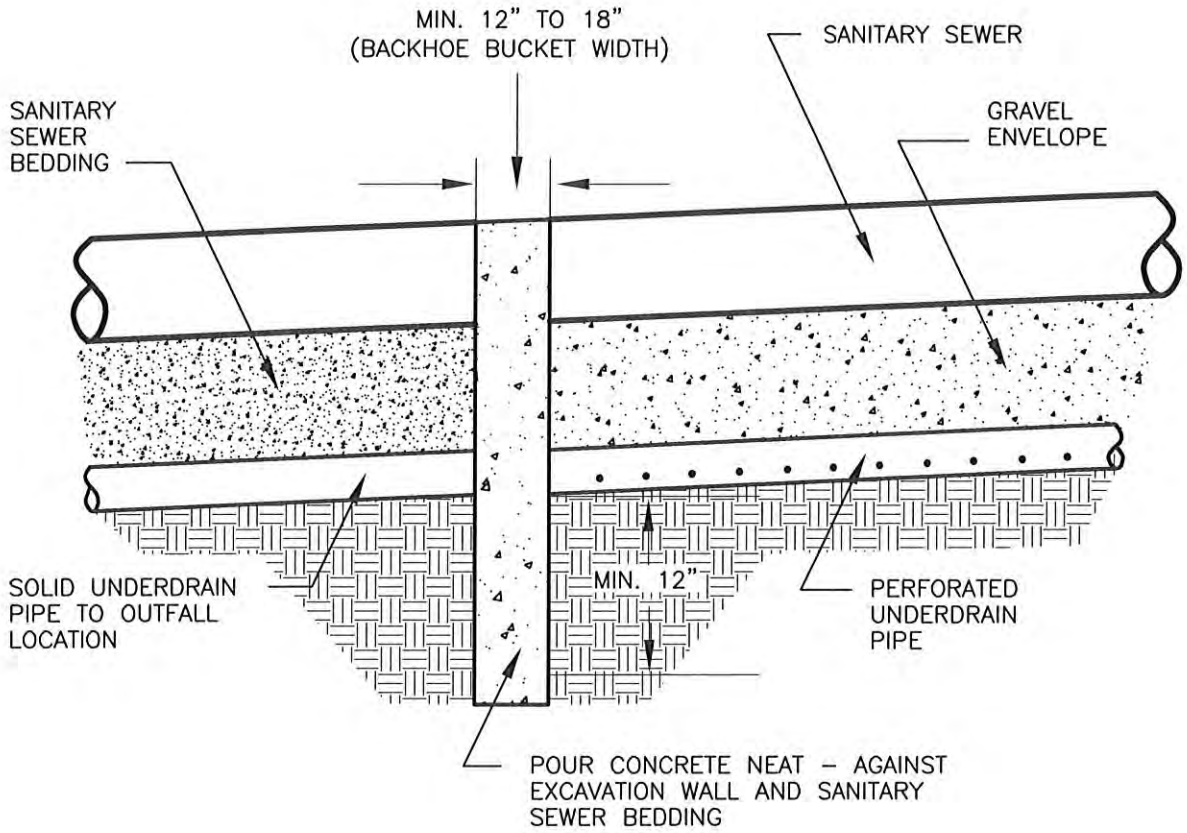
50-UNDERDRAIN_05




NOTE:
THE CONCRETE CUTOFF WALL SHOULD EXTEND INTO THE UNDISTURBED SOILS OUTSIDE THE UNDERDRAIN AND SANITARY SEWER TRENCH A MINIMUM DISTANCE OF 12 INCHES.

# Underdrain Cutoff Wall Detail

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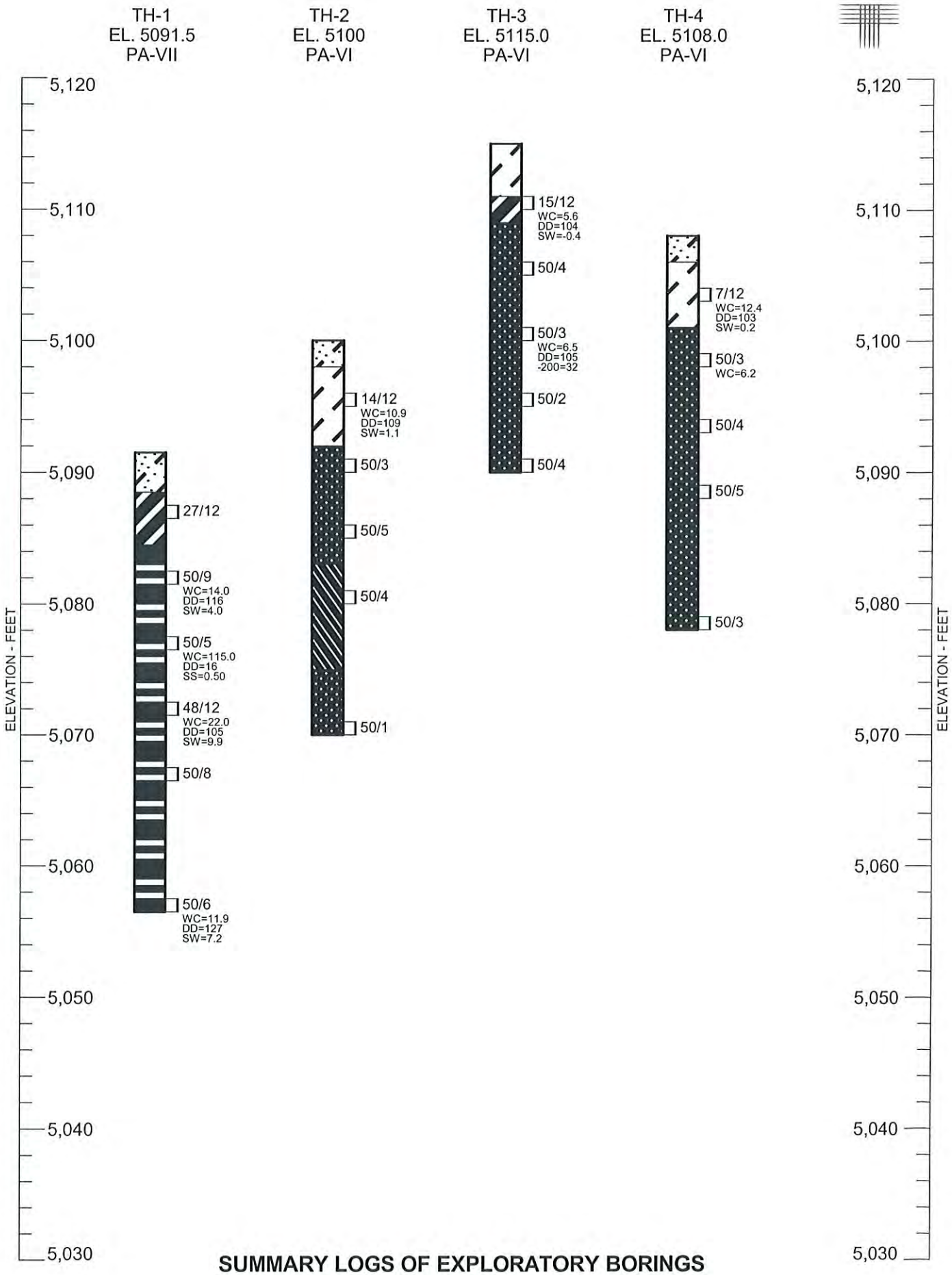
Project No. DN40,507-115

Fig. A-7

# APPENDIX B
# SUMMARY LOGS

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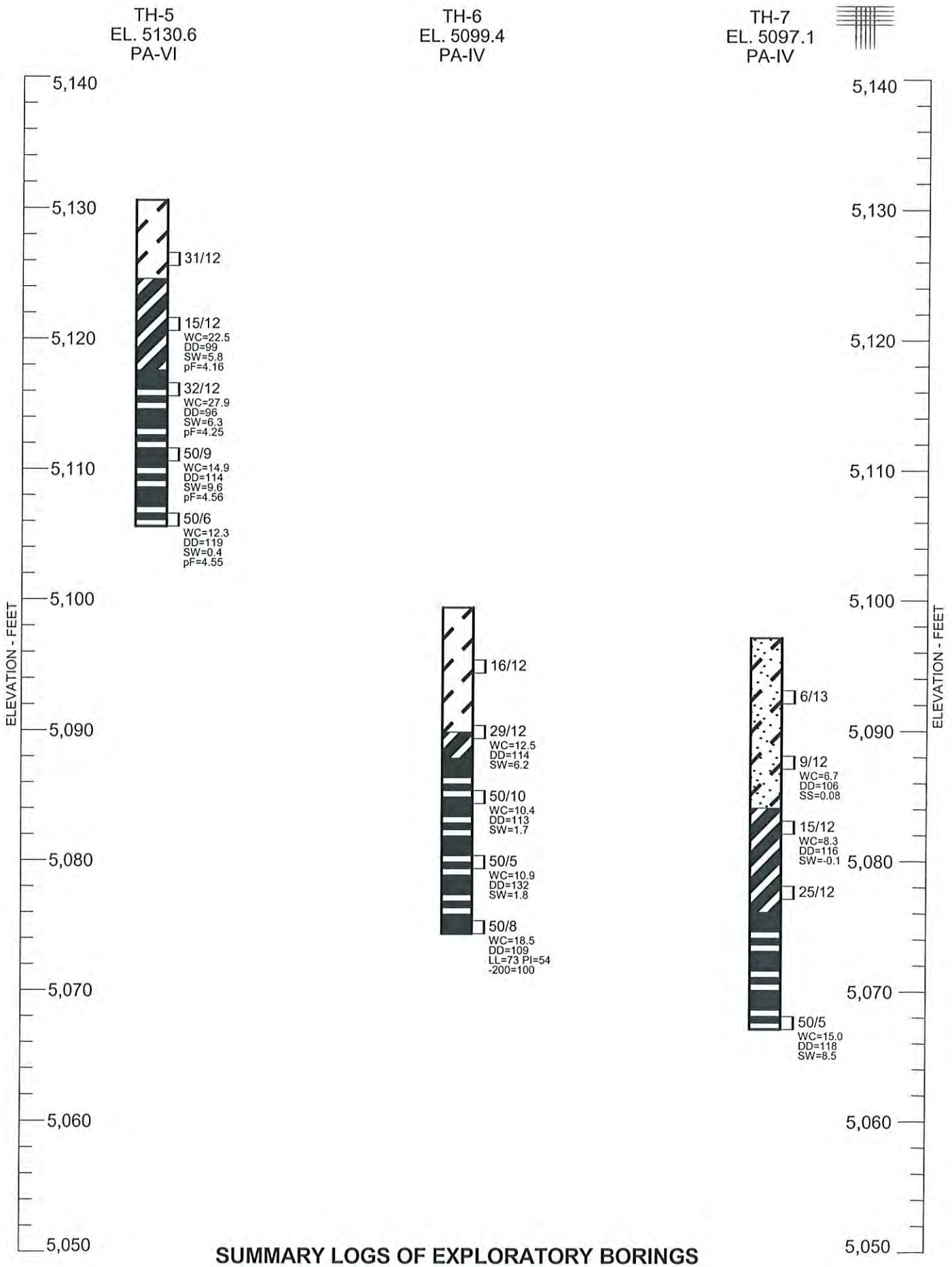
## SUMMARY LOGS OF EXPLORATORY BORINGS

PROJECT NO. DN40,507-115

FIG. B- 1

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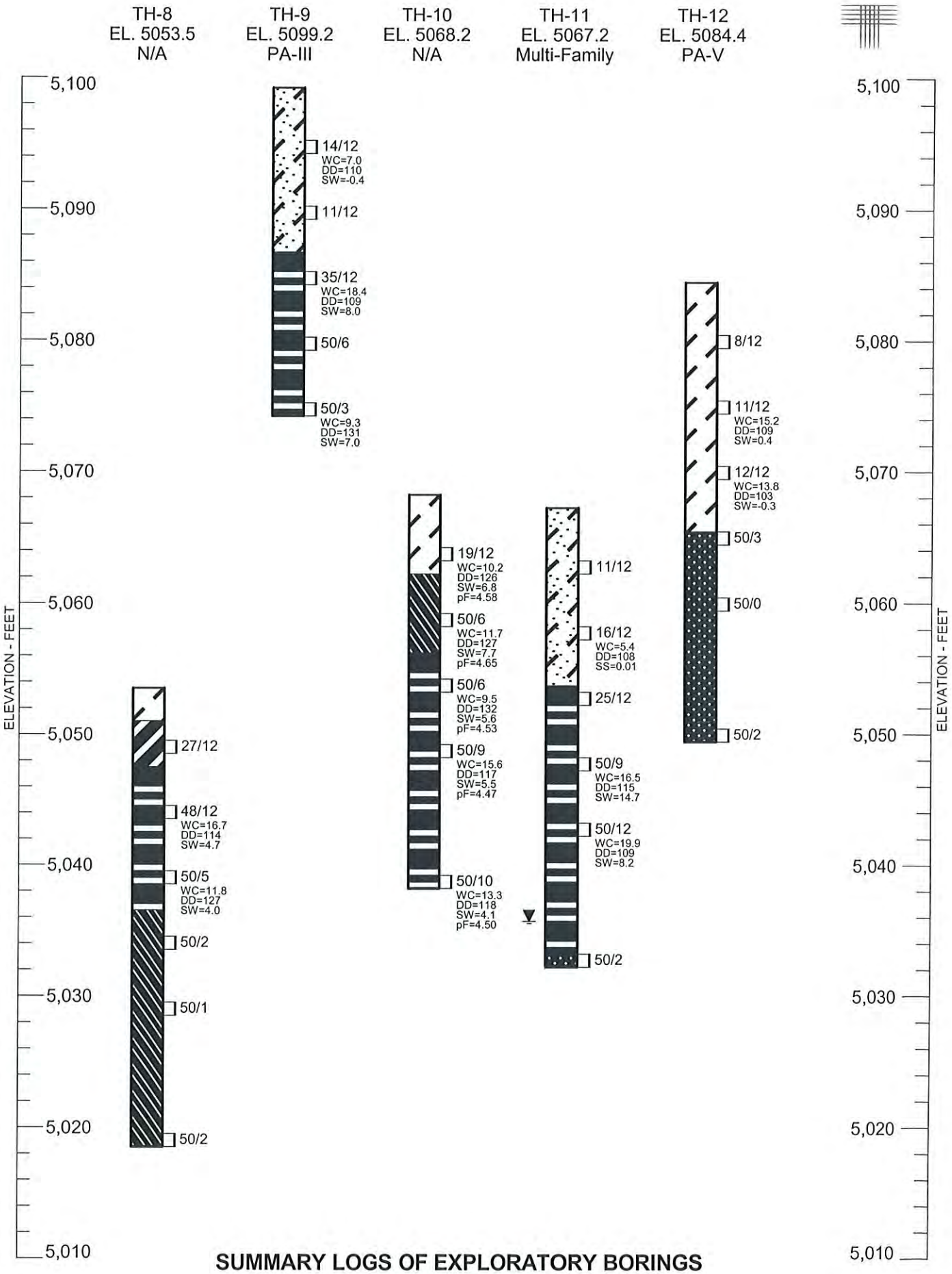
## SUMMARY LOGS OF EXPLORATORY BORINGS

PROJECT NO. DN40,507-115

FIG. B- 2

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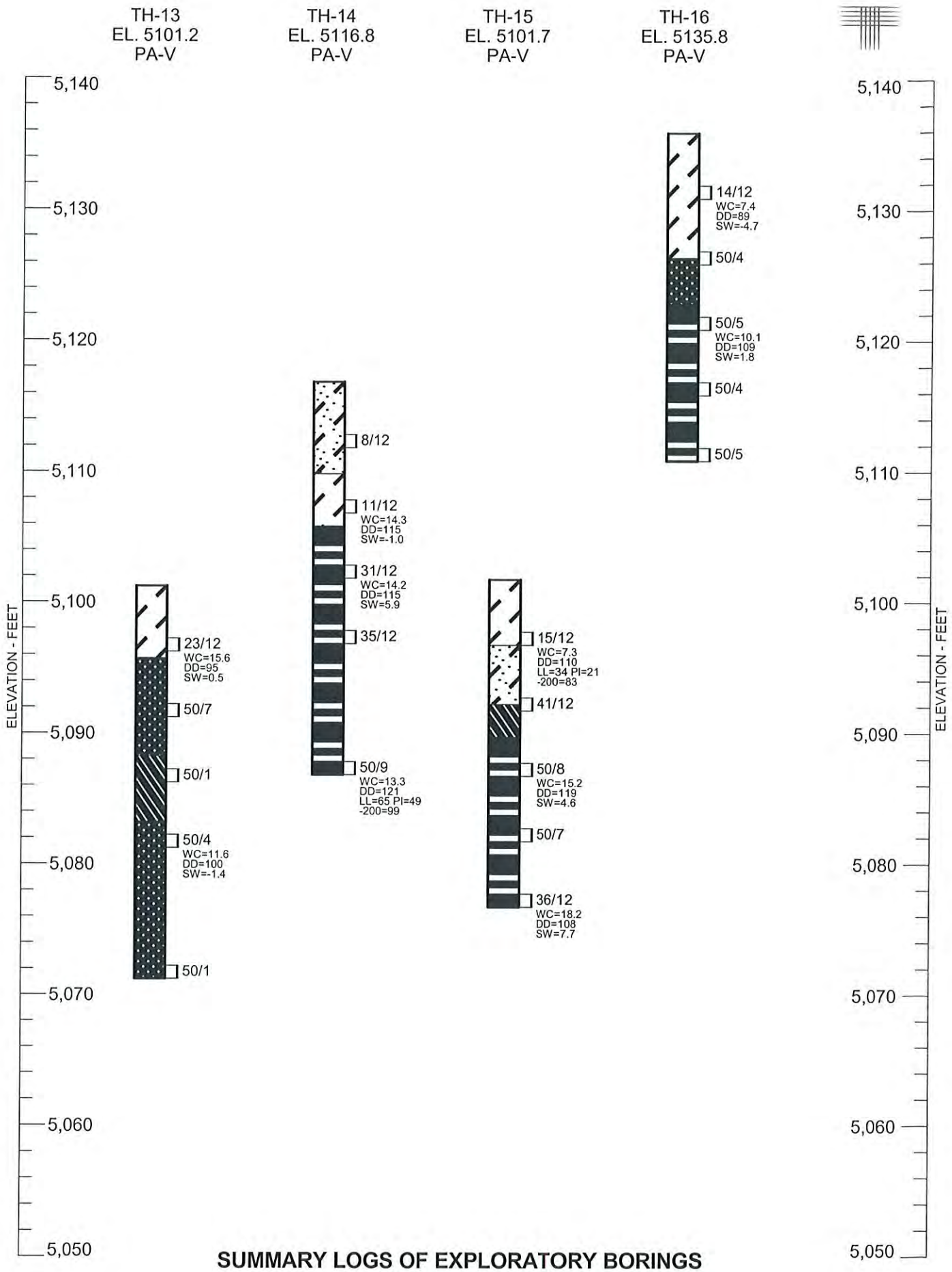
**SUMMARY LOGS OF EXPLORATORY BORINGS**

PROJECT NO. DN40,507-115

FIG. B- 3

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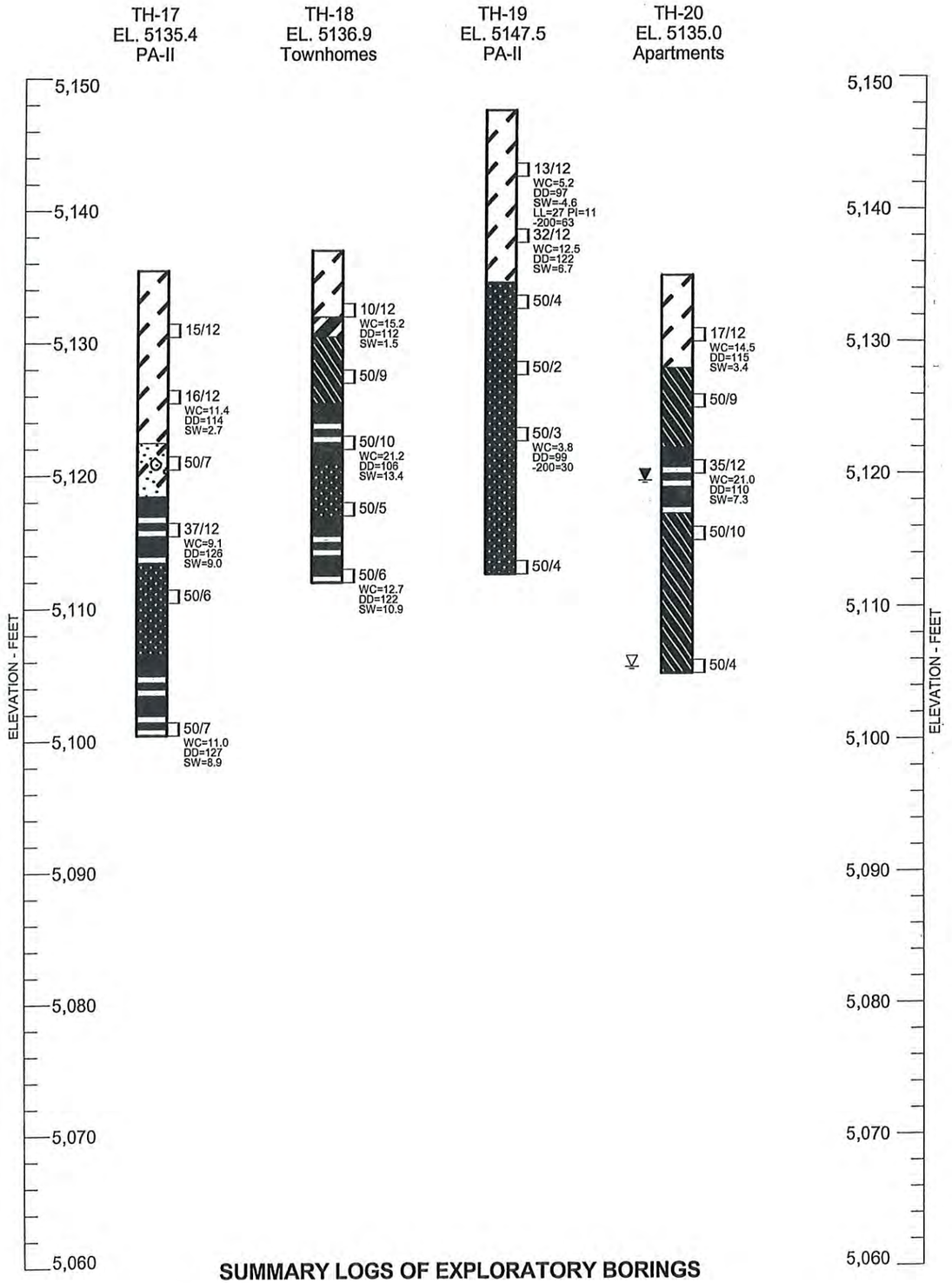
## SUMMARY LOGS OF EXPLORATORY BORINGS

PROJECT NO. DN40,507-115

FIG. B- 4

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**SUMMARY LOGS OF EXPLORATORY BORINGS**

PROJECT NO. DN40,507-115

**LEGEND:**

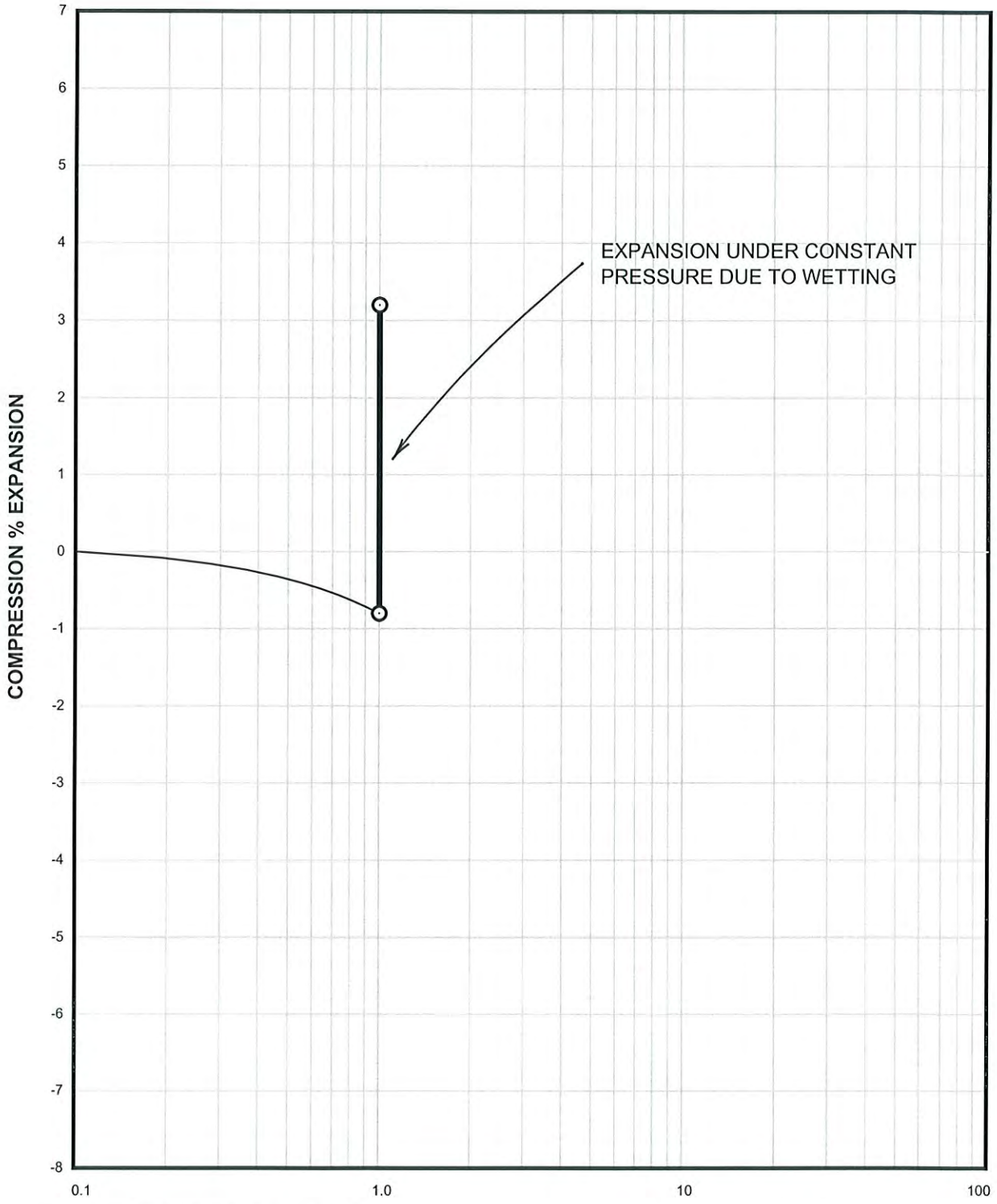
- CLAY, SANDY, MEDIUM STIFF TO VERY STIFF, SLIGHTLY MOIST, BROWN (CL).
- SAND, CLAYEY, LOOSE TO MEDIUM DENSE, SLIGHTLY MOIST, BROWN, RUST (SC).
- GRAVEL, CLAYEY, VERY DENSE, SLIGHTLY MOIST, BROWN, GRAY (GC).
- WEATHERED CLAYSTONE, MOIST, BROWN, RUST.
- BEDROCK, CLAYSTONE, MEDIUM HARD TO VERY HARD, SLIGHTLY MOIST TO MOIST, OLIVE, BROWN, GRAY.
- BEDROCK, SANDSTONE, HARD TO VERY HARD, SLIGHTLY MOIST, BROWN, TAN.
- BEDROCK, INTERBEDDED CLAYSTONE/SANDSTONE, HARD TO VERY HARD, SLIGHTLY MOIST, BROWN, GRAY.
- DRIVE SAMPLE. THE SYMBOL 27/12 INDICATES 27 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE A 2.5-INCH O.D. SAMPLER 12 INCHES.
- ▽ WATER LEVEL MEASURED AT TIME OF DRILLING.
- ▼ WATER LEVEL MEASURED SEVERAL DAYS AFTER DRILLING.

**NOTES:**

1. THE BORINGS WERE DRILLED BETWEEN MAY 6 AND 16, 2005 USING 4-INCH DIAMETER, CONTINUOUS-FLIGHT AUGER AND A TRUCK-MOUNTED DRILL RIG.
2. WC - INDICATES MOISTURE CONTENT (%).
   DD - INDICATES DRY DENSITY (pcf).
   SW - INDICATES SWELL WHEN WETTED UNDER APPLIED PRESSURE (%).
   LL - INDICATES LIQUID LIMIT (%).
   PI - INDICATES PLASTICITY INDEX (%).
   SS - INDICATES WATER-SOLUBLE SULFATE CONCENTRATION (%).
   pF - INDICATES SOIL SUCTION VALUE (pf).
   -200 - INDICATES PERCENT PASSING NO. 200 SIEVE (%).
3. BORING LOCATIONS AND ELEVATIONS ARE APPROXIMATE AND WERE SURVEYED BY AZTEC CONSULTANTS.
4. THESE LOGS ARE SUBJECT TO THE EXPLANATIONS, LIMITATIONS AND CONCLUSIONS CONTAINED IN THIS REPORT.

## APPENDIX C

## LABORATORY TEST RESULTS
## (Project No. 40,507-115, Report Dated June 30, 2005)



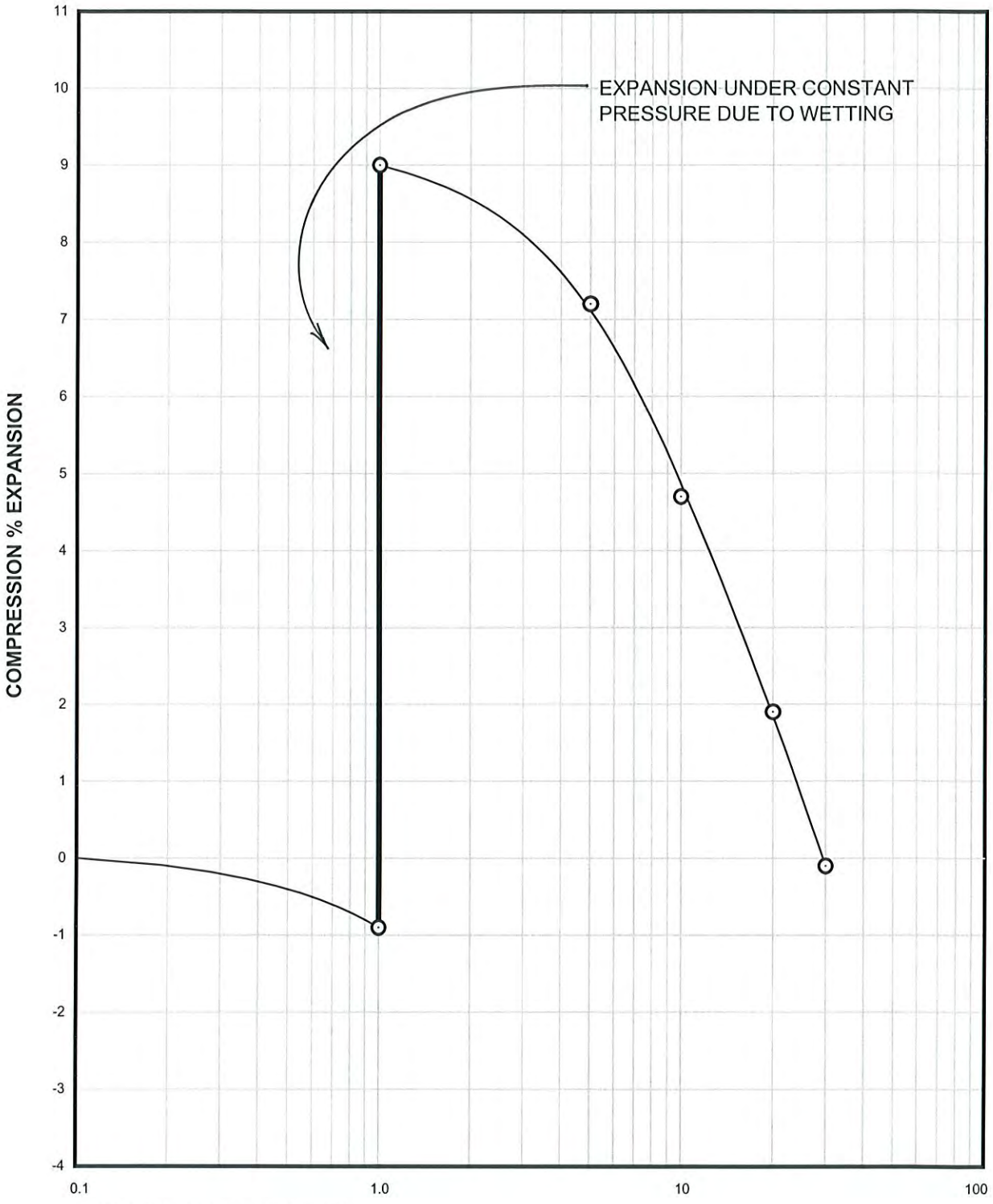

Sample of CLAYSTONE
From TH-1 AT 9 FEET

SAMPLE DRY UNIT WEIGHT= 116 PCF
SAMPLE MOISTURE CONTENT= 14.0 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-1



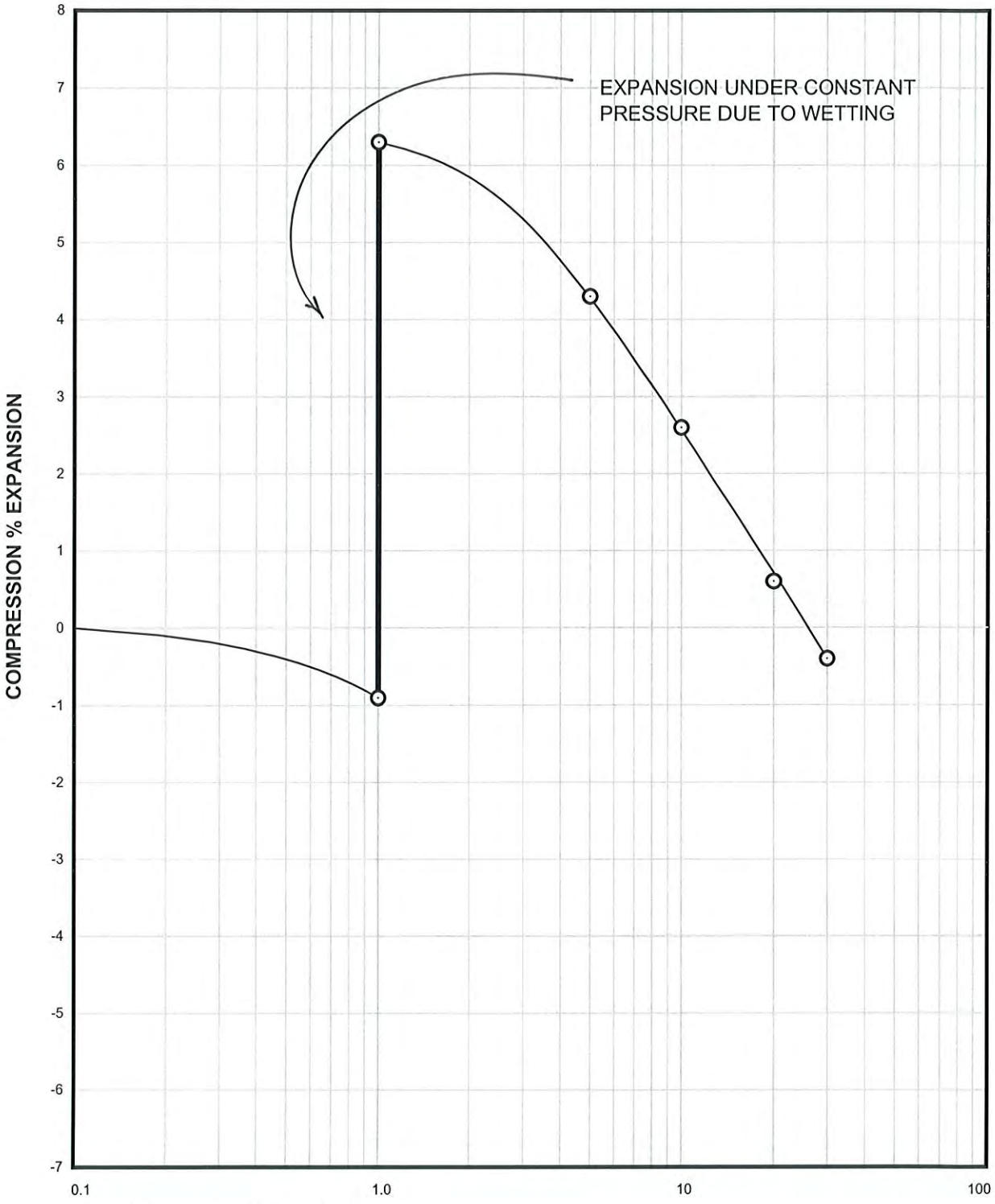

Sample of CLAYSTONE
From TH-1 AT 19 FEET

SAMPLE DRY UNIT WEIGHT= 105 PCF
SAMPLE MOISTURE CONTENT= 22.0 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-2



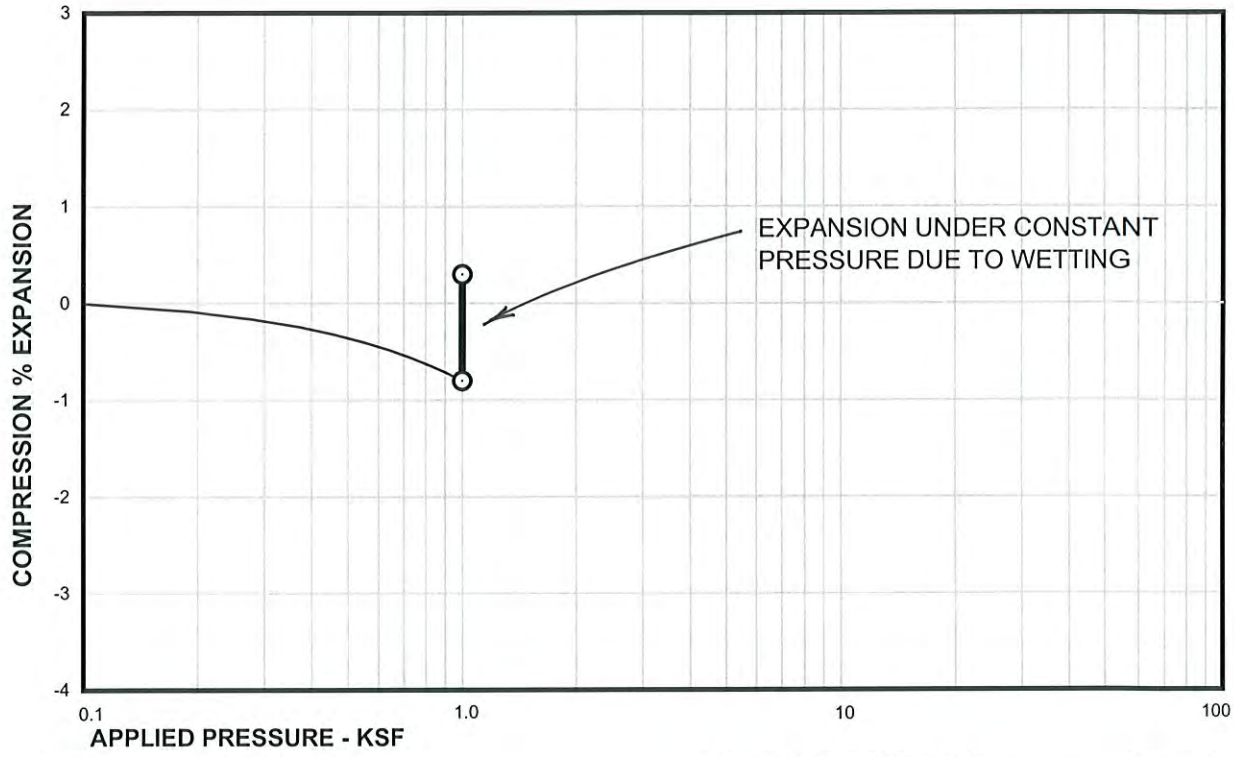

Sample of CLAYSTONE
From TH-1 AT 34 FEET

SAMPLE DRY UNIT WEIGHT= 127 PCF
SAMPLE MOISTURE CONTENT= 11.9 %

# Swell Consolidation Test Results

FIG. C-3

PROJECT NO. DN40,507-115




Sample of CLAY, SANDY (CL)
From TH-2 AT 4 FEET

SAMPLE DRY UNIT WEIGHT= 109 PCF
SAMPLE MOISTURE CONTENT= 10.9 %

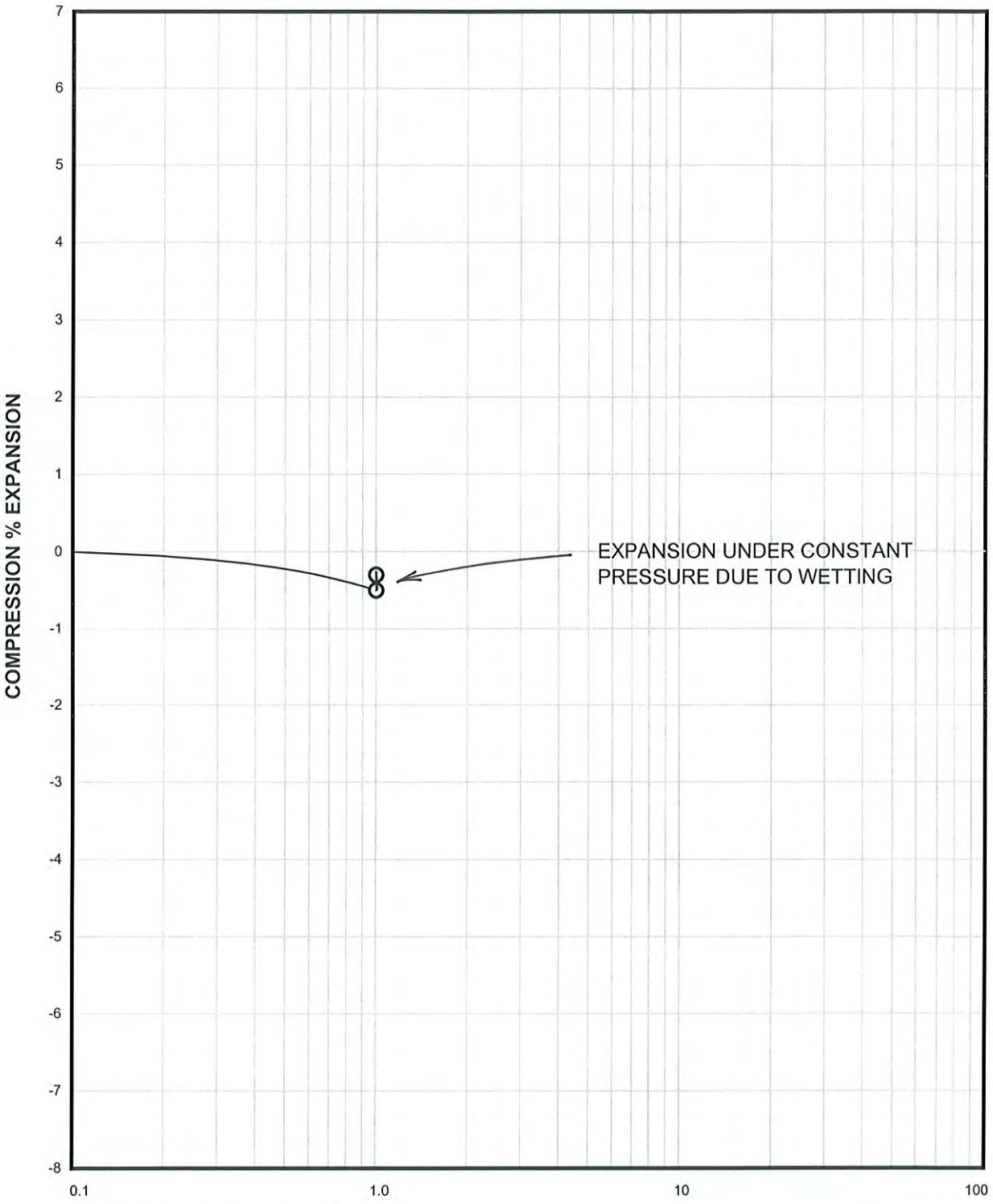
Sample of WEATHERED CLAYSTONE
From TH-3 AT 4 FEET

SAMPLE DRY UNIT WEIGHT= 104 PCF
SAMPLE MOISTURE CONTENT= 5.6 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-4



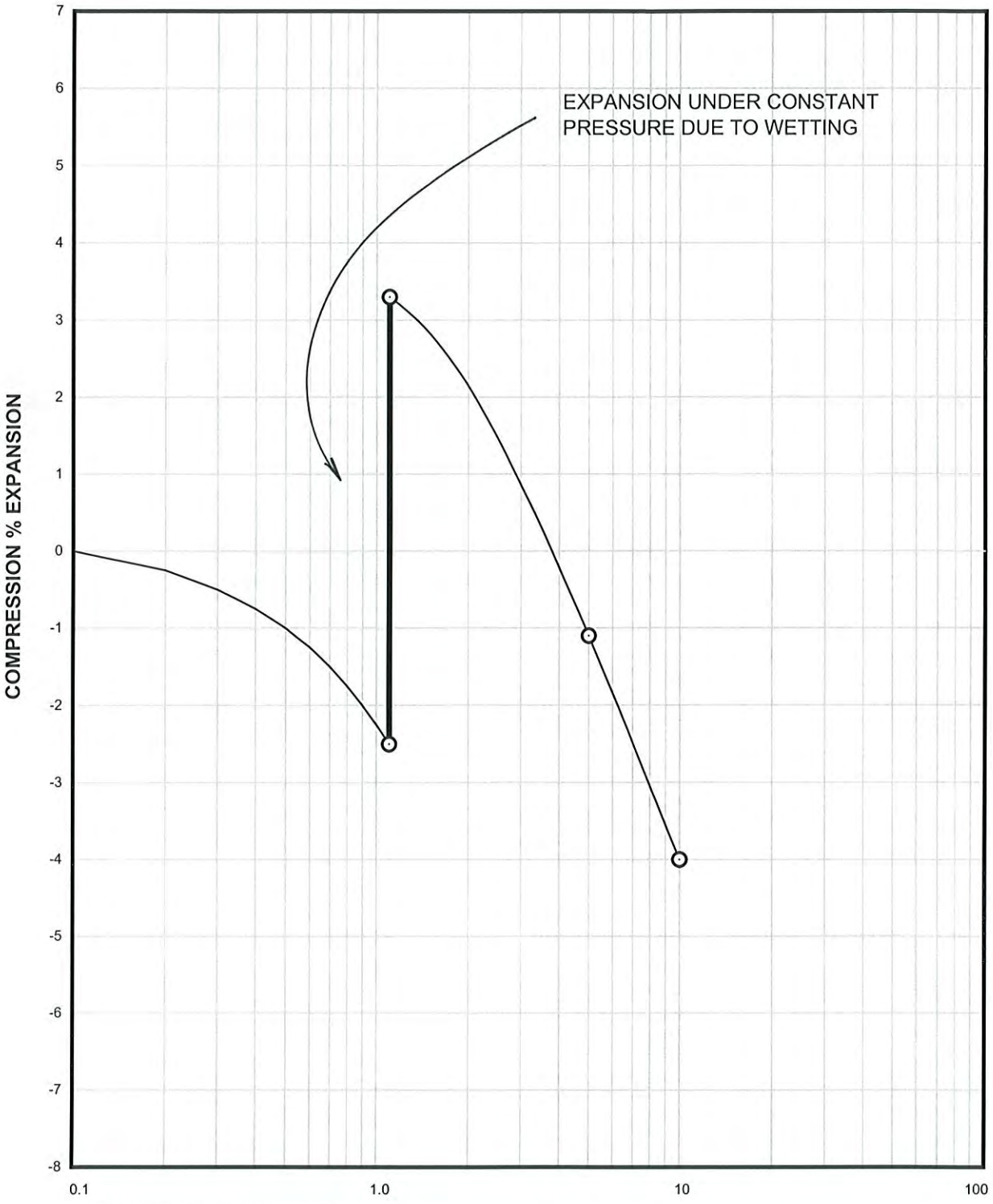

Sample of CLAY, SANDY (CL)
From TH-4 AT 4 FEET

SAMPLE DRY UNIT WEIGHT= 103 PCF
SAMPLE MOISTURE CONTENT= 12.4 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-5



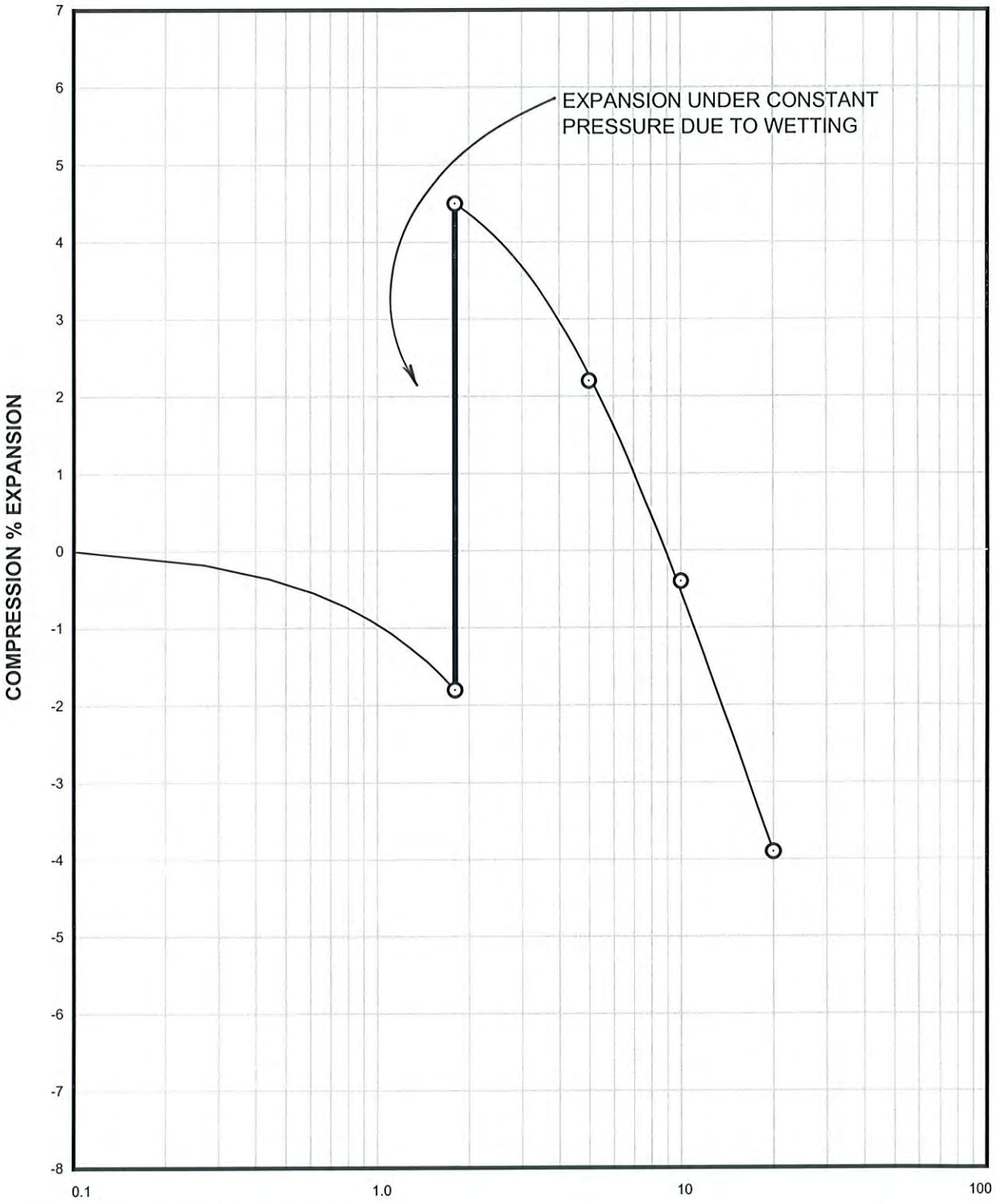

Sample of WEATHERED CLAYSTONE
From TH-5 AT 9 FEET

SAMPLE DRY UNIT WEIGHT= 99 PCF
SAMPLE MOISTURE CONTENT= 22.5 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-6



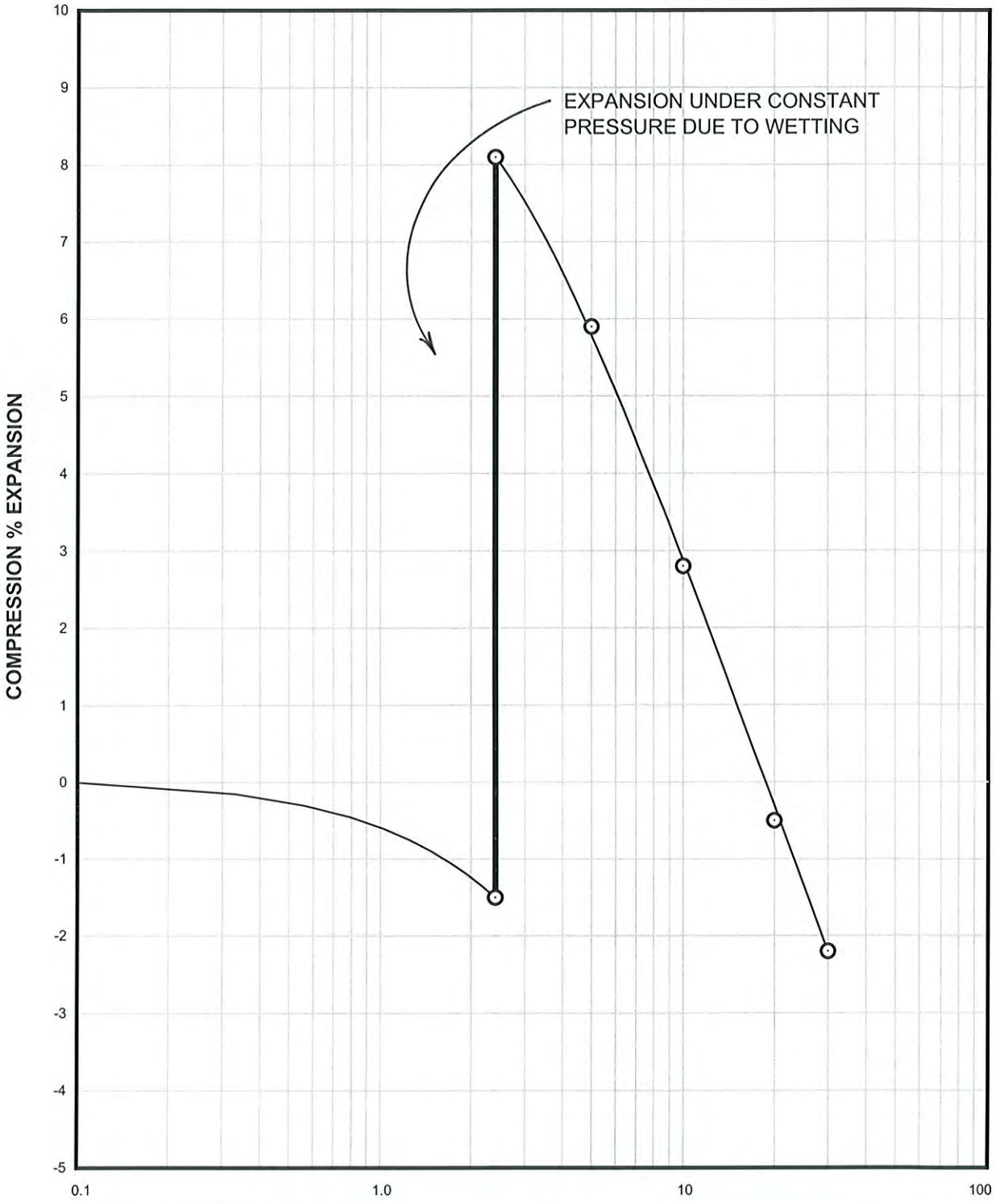

Sample of CLAYSTONE
From TH-5 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 96 PCF
SAMPLE MOISTURE CONTENT= 27.9 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-7



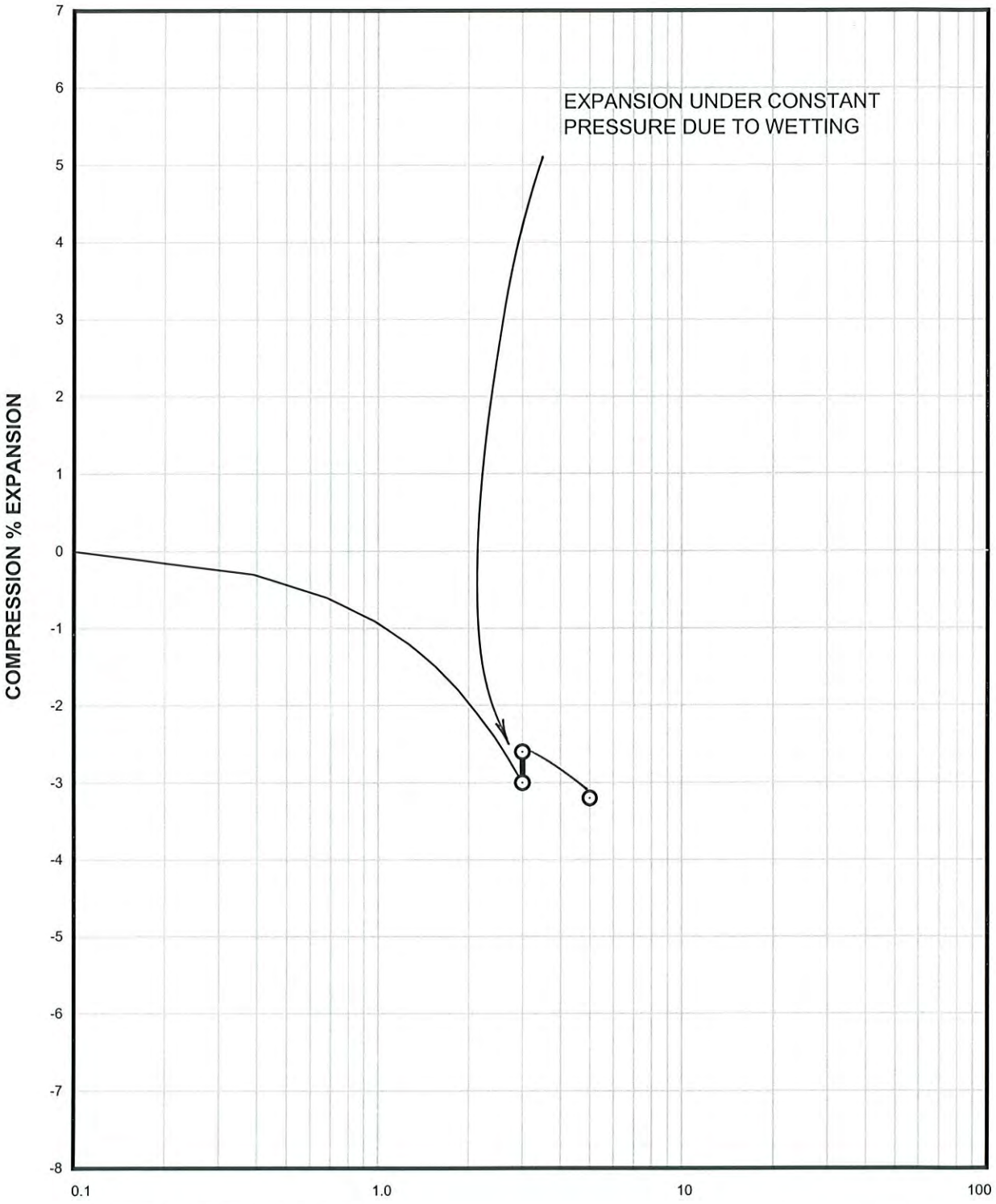

Sample of CLAYSTONE
From TH-5 AT 19 FEET

SAMPLE DRY UNIT WEIGHT= 114 PCF
SAMPLE MOISTURE CONTENT= 14.9 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-8



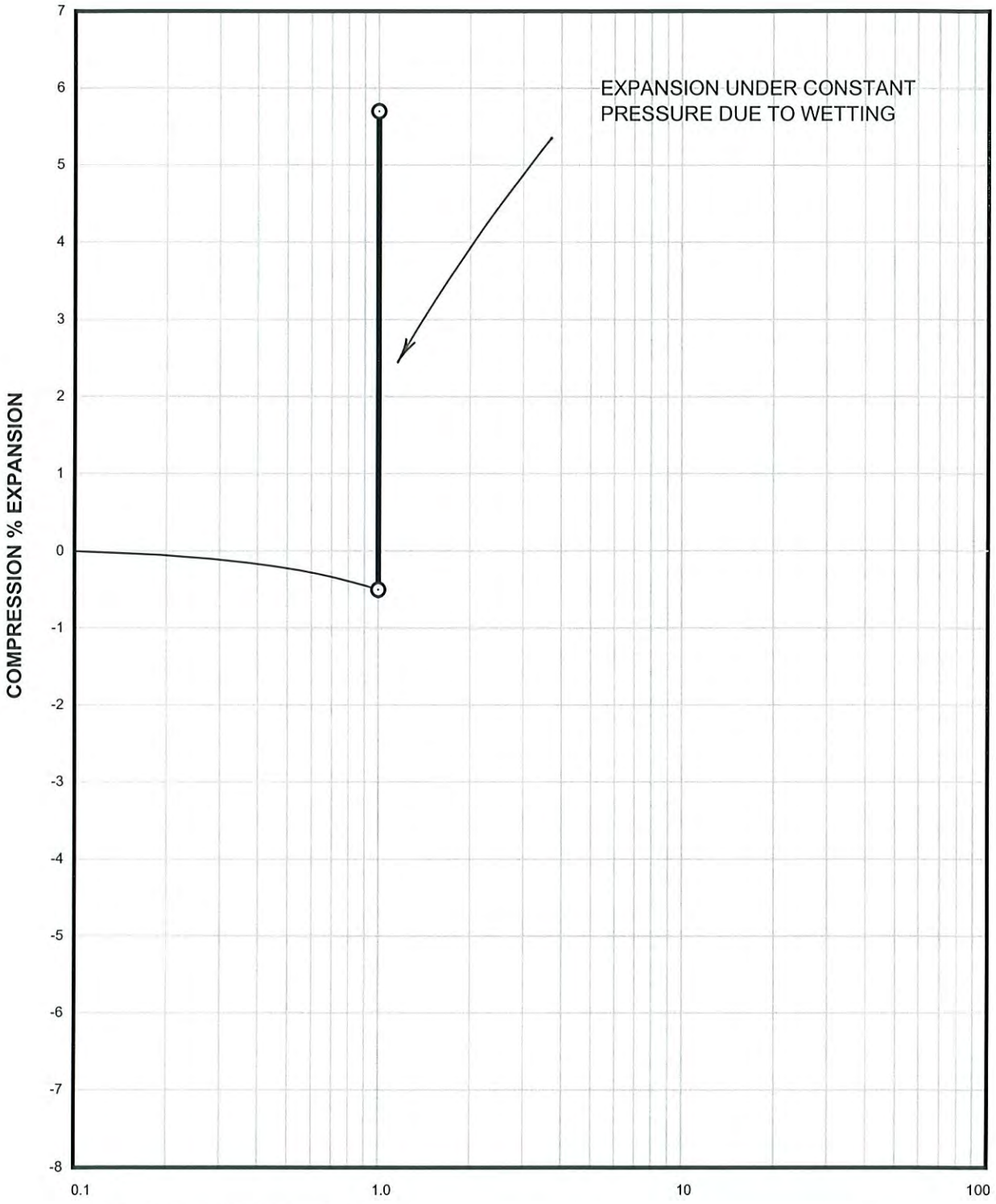

Sample of CLAYSTONE
From TH-5 AT 24 FEET

SAMPLE DRY UNIT WEIGHT= 119 PCF
SAMPLE MOISTURE CONTENT= 12.3 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-9

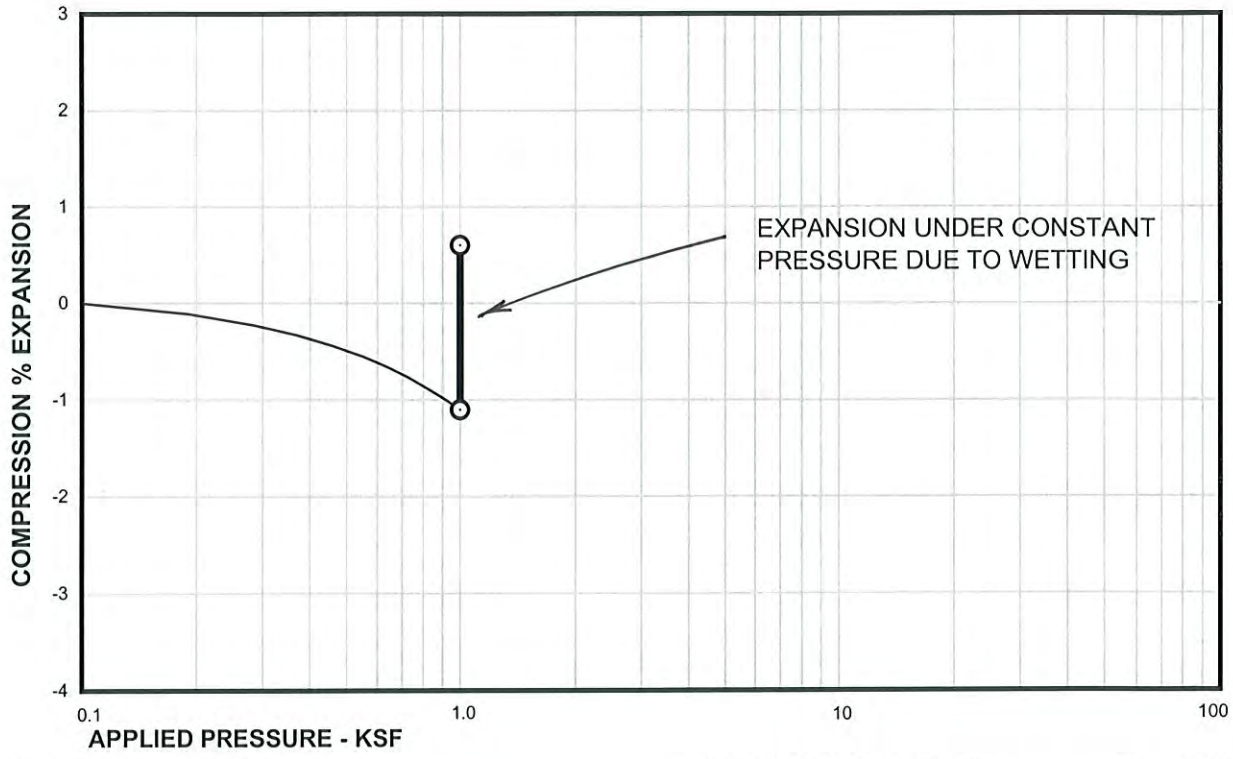



Sample of WEATHERED CLAYSTONE
From TH-6 AT 9 FEET

SAMPLE DRY UNIT WEIGHT= 114 PCF
SAMPLE MOISTURE CONTENT= 12.5 %

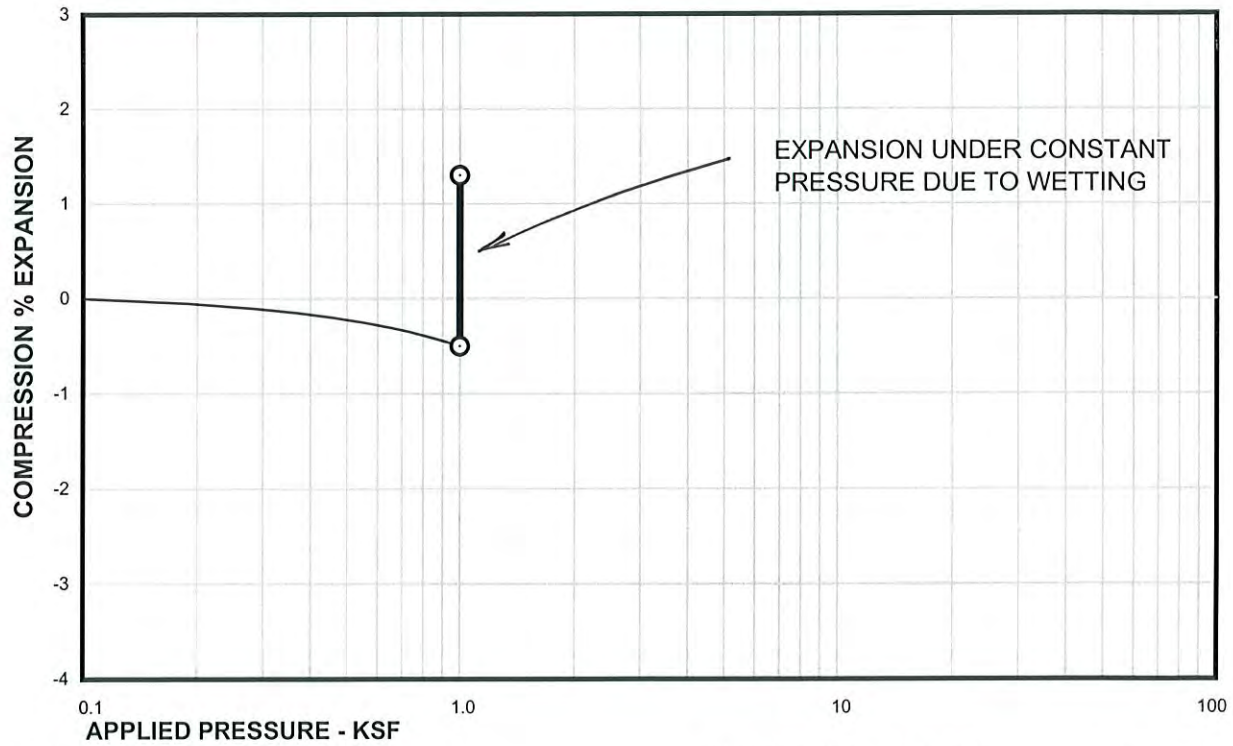
PROJECT NO. DN40,507-115

**Swell Consolidation Test Results** FIG. C-10




Sample of CLAYSTONE
From TH-6 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 113 PCF
SAMPLE MOISTURE CONTENT= 10.4 %



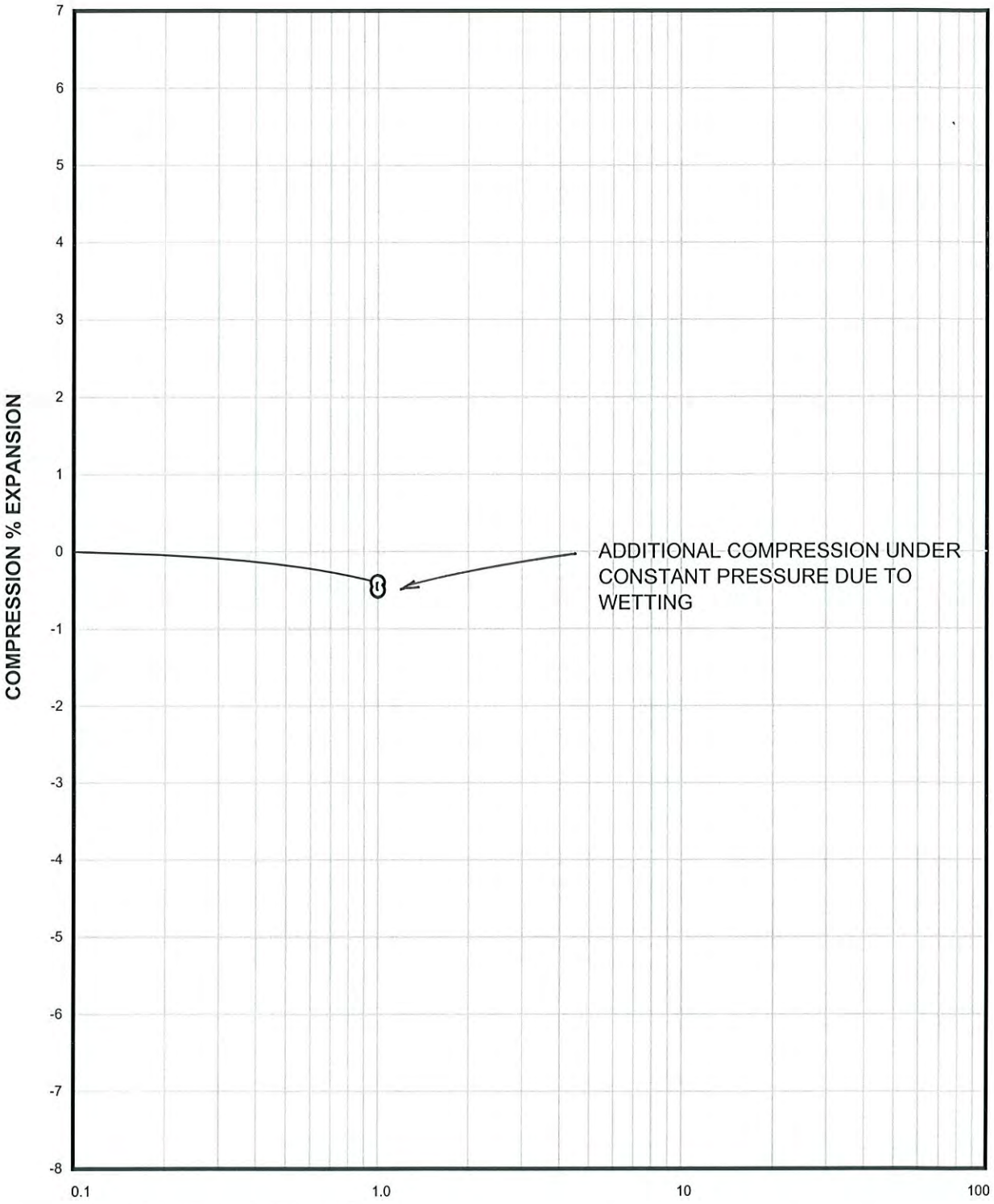

Sample of CLAYSTONE
From TH-6 AT 19 FEET

SAMPLE DRY UNIT WEIGHT= 132 PCF
SAMPLE MOISTURE CONTENT= 10.9 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-11



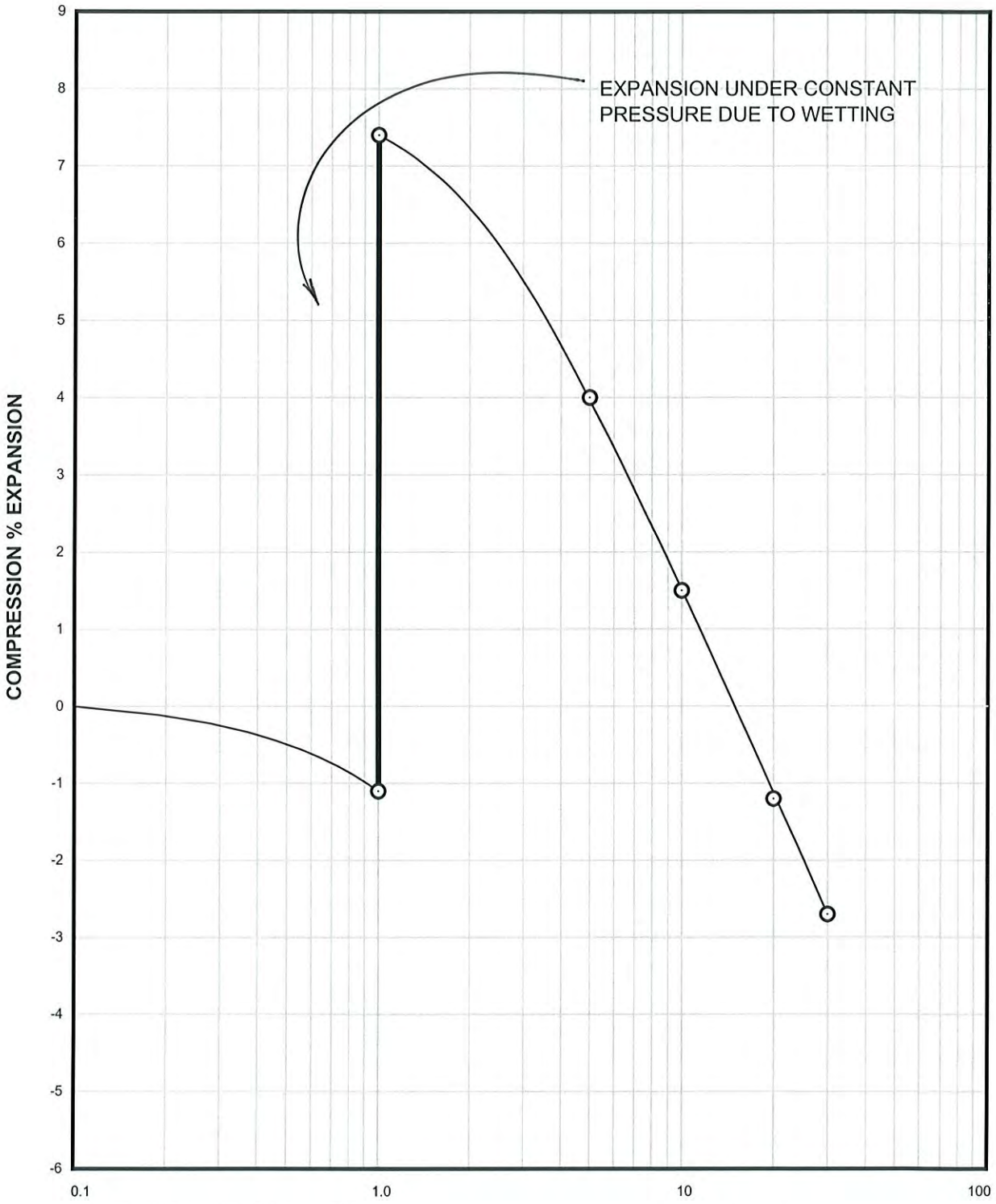

Sample of WEATHERED CLAYSTONE
From TH-7 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 116 PCF
SAMPLE MOISTURE CONTENT= 8.3 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-12



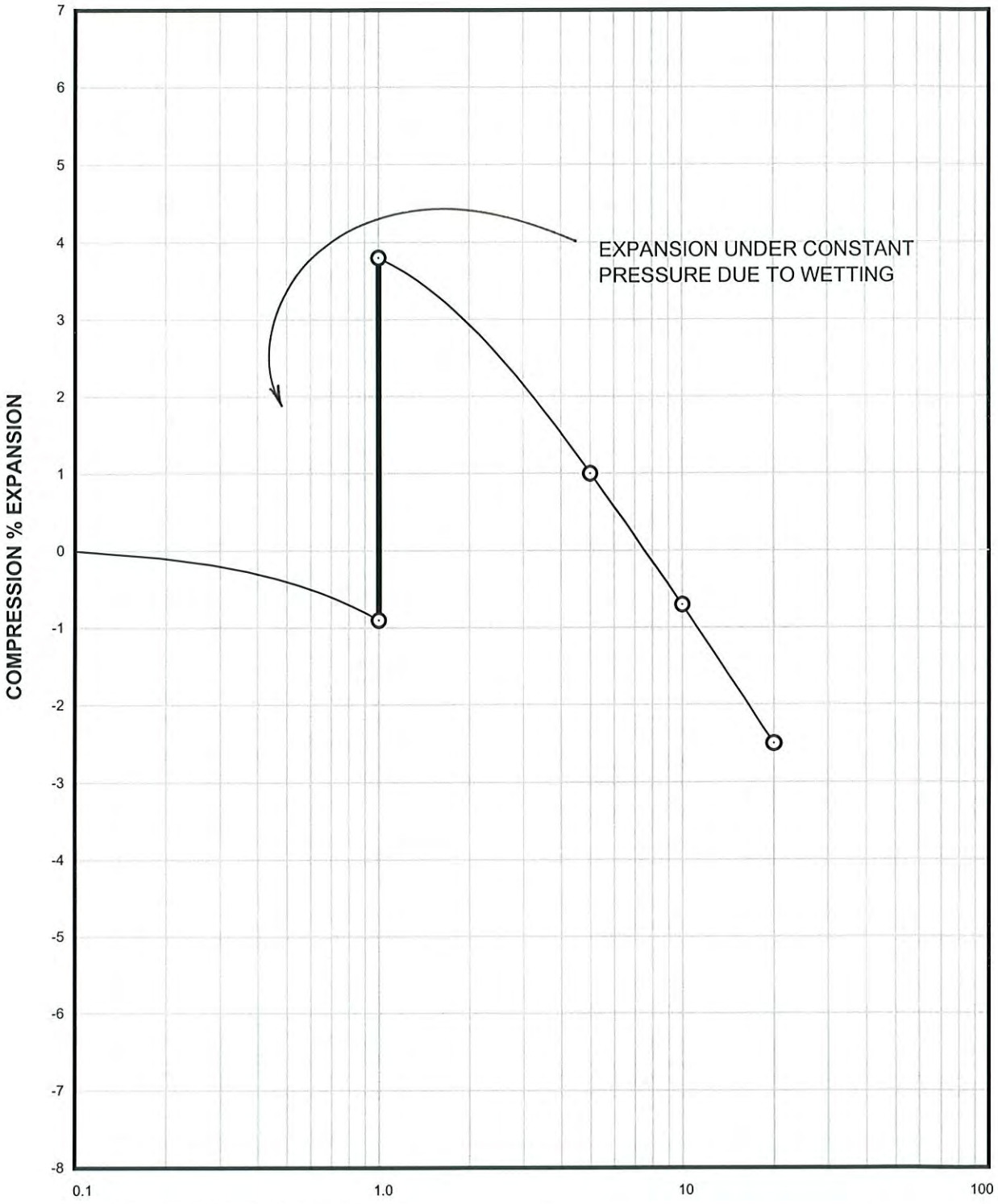

Sample of CLAYSTONE
From TH-7 AT 29 FEET

SAMPLE DRY UNIT WEIGHT= 118 PCF
SAMPLE MOISTURE CONTENT= 15.0 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-13



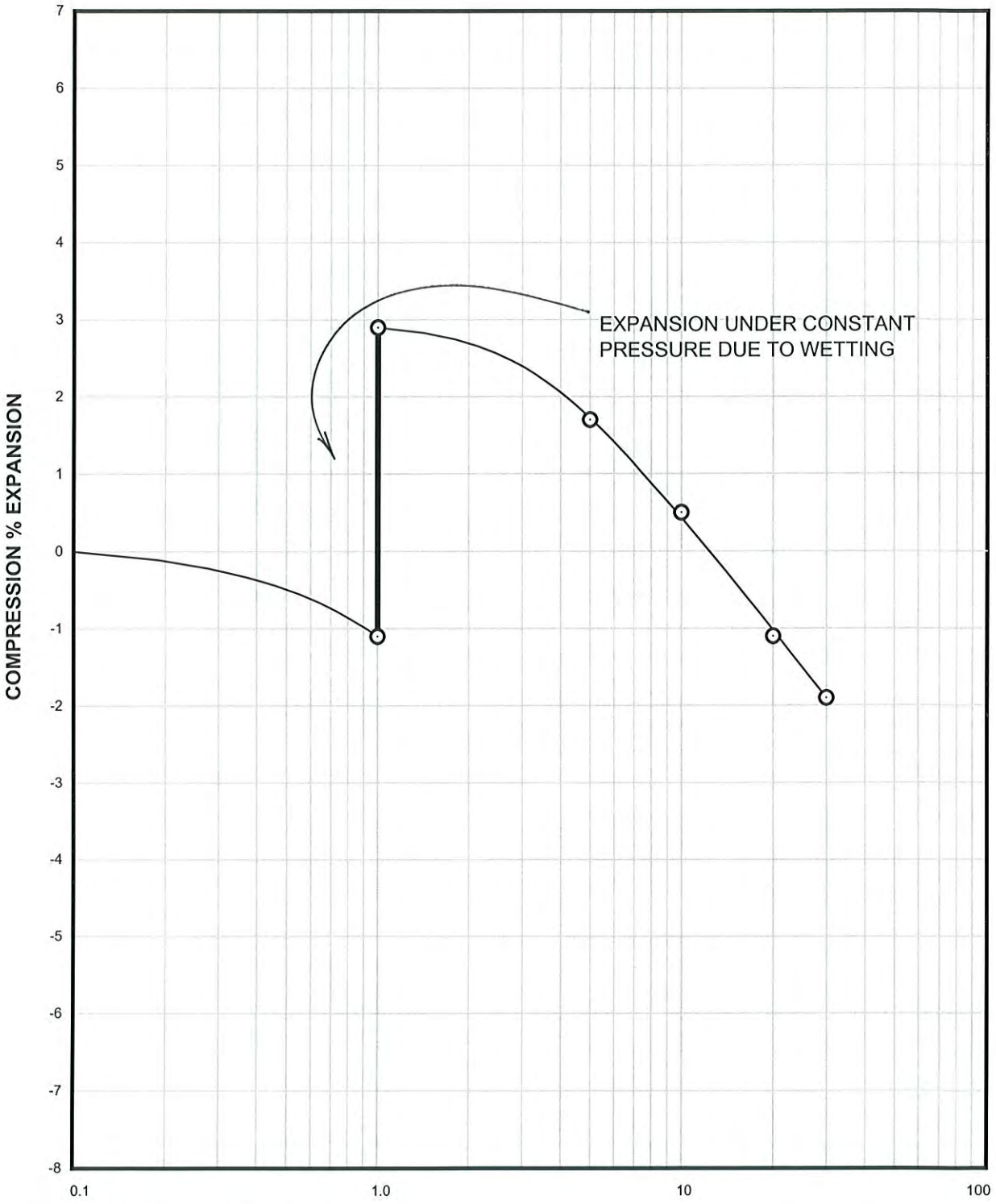

Sample of CLAYSTONE
From TH-8 AT 9 FEET

SAMPLE DRY UNIT WEIGHT= 114 PCF
SAMPLE MOISTURE CONTENT= 16.7 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-14



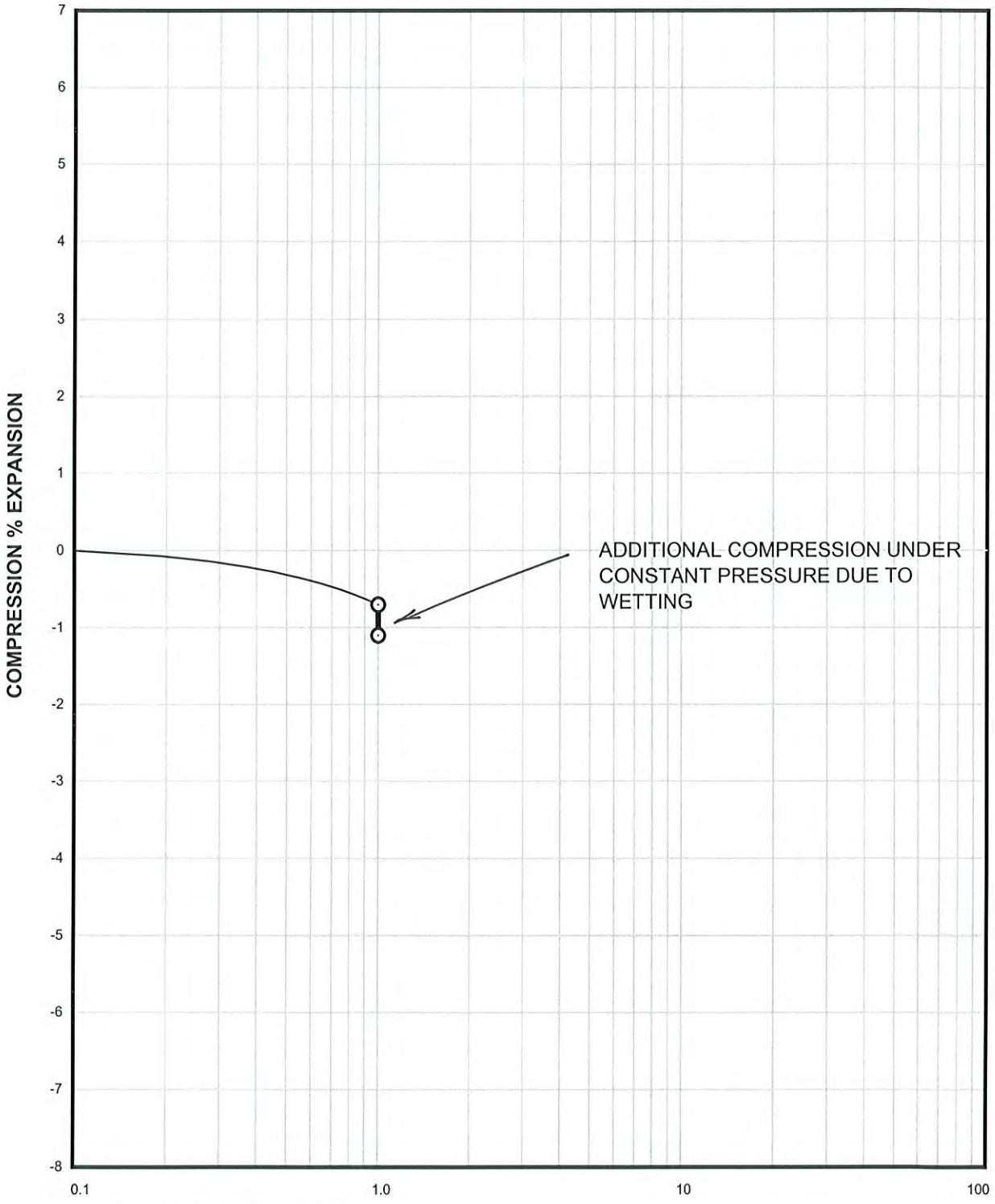

Sample of CLAYSTONE
From TH-8 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 127 PCF
SAMPLE MOISTURE CONTENT= 11.8 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-15



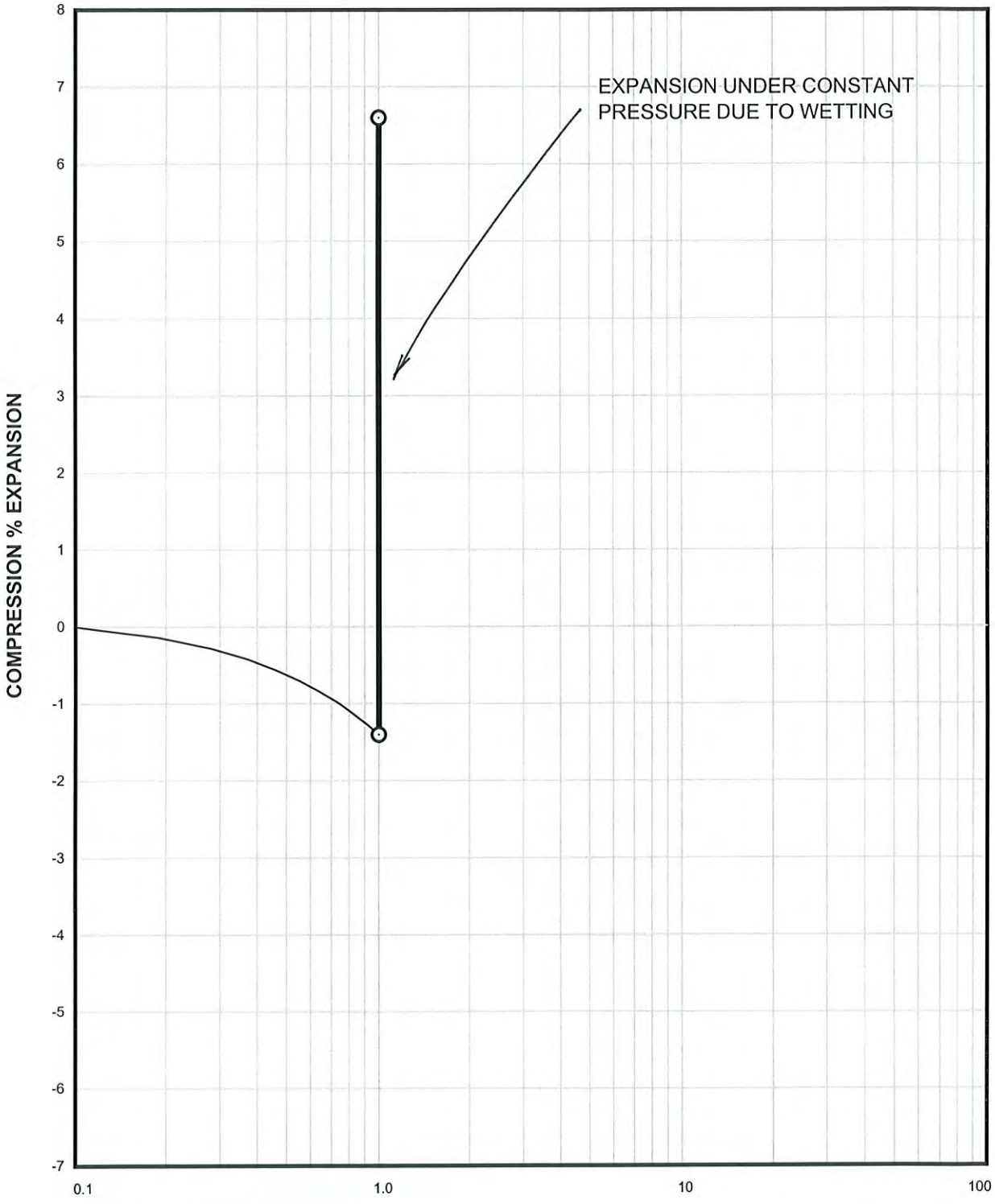

Sample of SAND, CLAYEY (SC)
From TH-9 AT 4 FEET

SAMPLE DRY UNIT WEIGHT= 110 PCF
SAMPLE MOISTURE CONTENT= 7.0 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-16



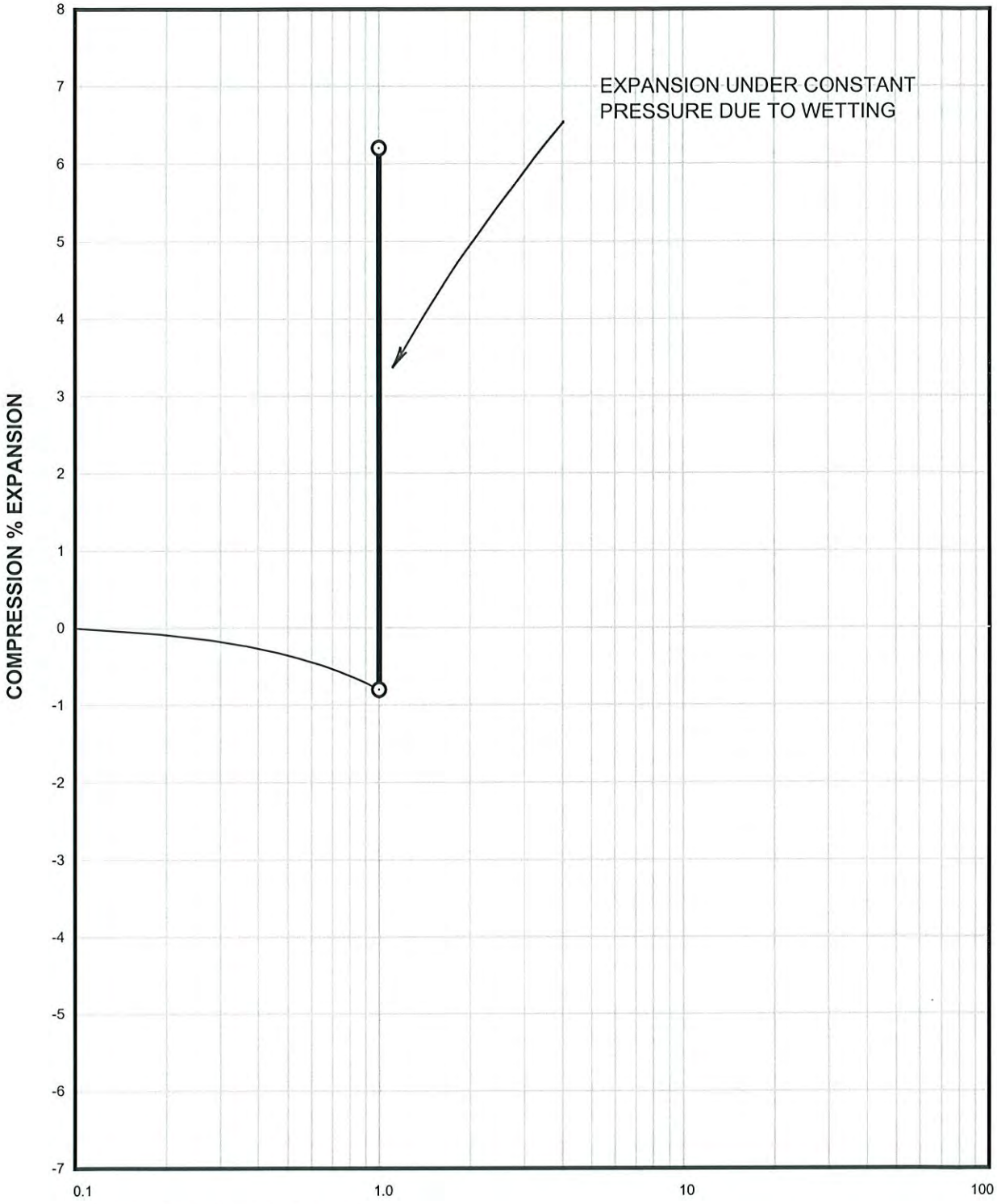

Sample of CLAYSTONE
From TH-9 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 109 PCF
SAMPLE MOISTURE CONTENT= 18.4 %

# Swell Consolidation Test Results

FIG. C-17

PROJECT NO. DN40,507-115



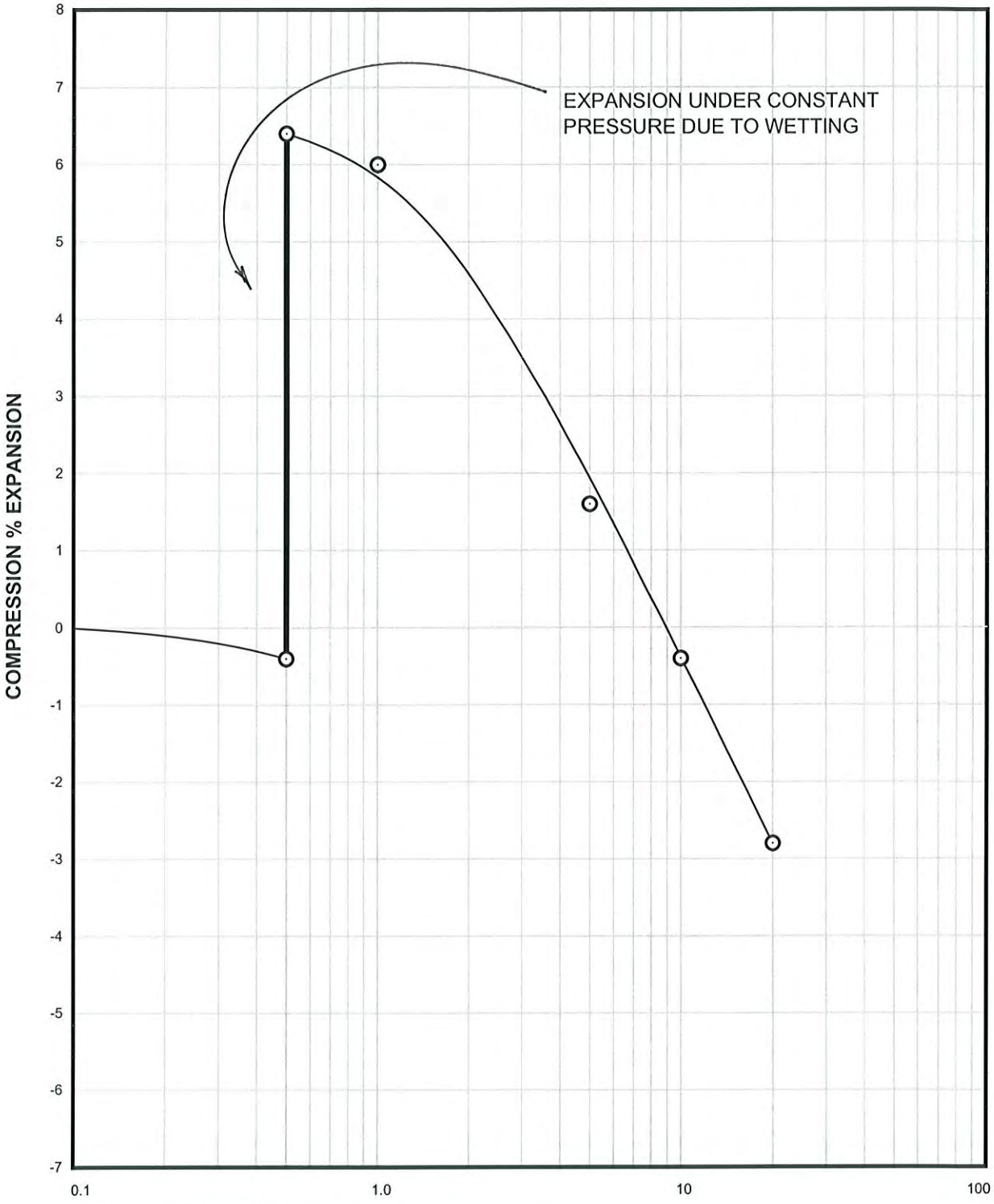

Sample of CLAYSTONE
From TH-9 AT 24 FEET

SAMPLE DRY UNIT WEIGHT= 131 PCF
SAMPLE MOISTURE CONTENT= 9.3 %

# Swell Consolidation Test Results

FIG. C-18

PROJECT NO. DN40,507-115



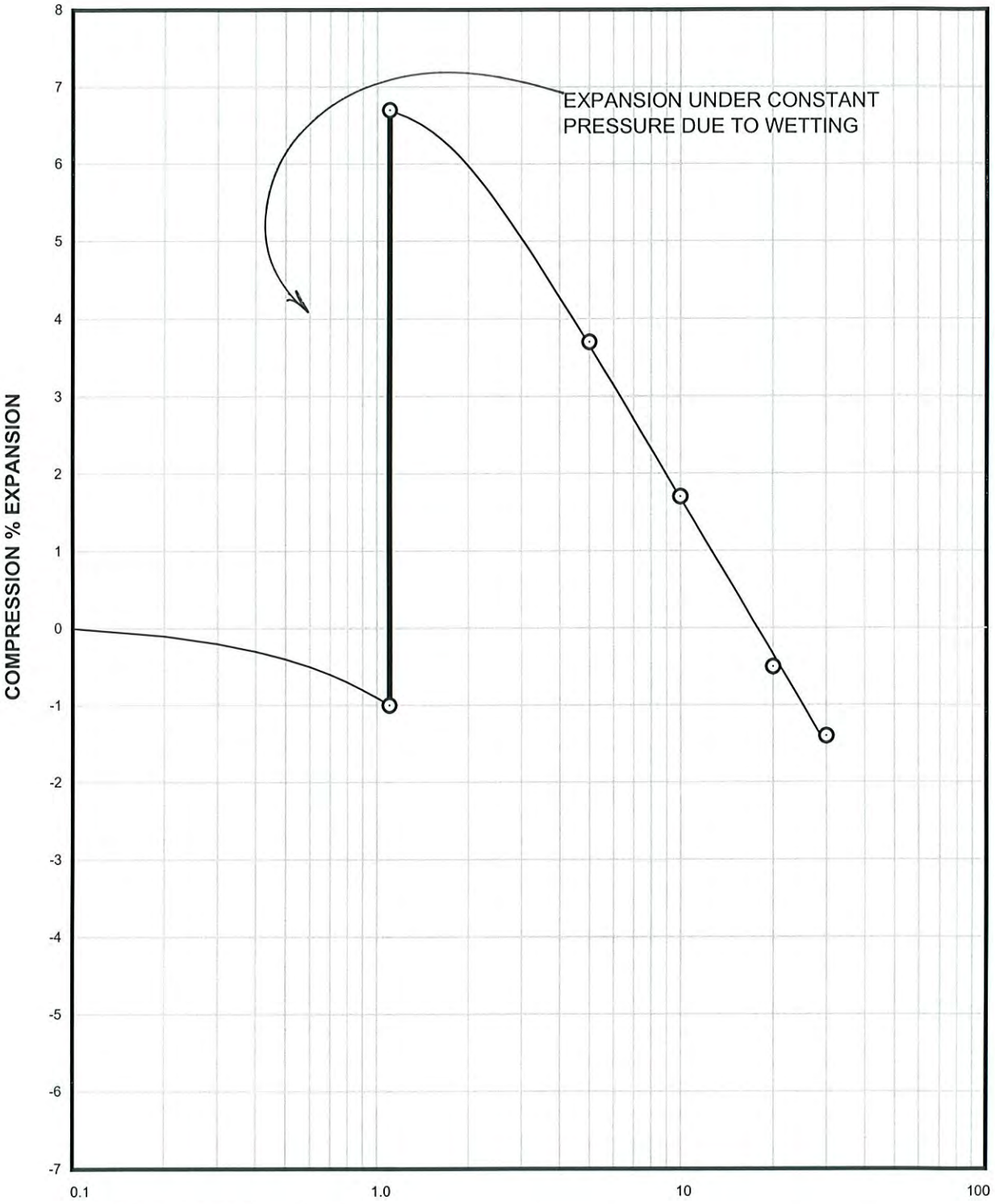

Sample of CLAY, SANDY (CL)
From TH-10 AT 4 FEET

SAMPLE DRY UNIT WEIGHT= 126 PCF
SAMPLE MOISTURE CONTENT= 10.2 %

# Swell Consolidation Test Results

FIG. C-19

PROJECT NO. DN40,507-115

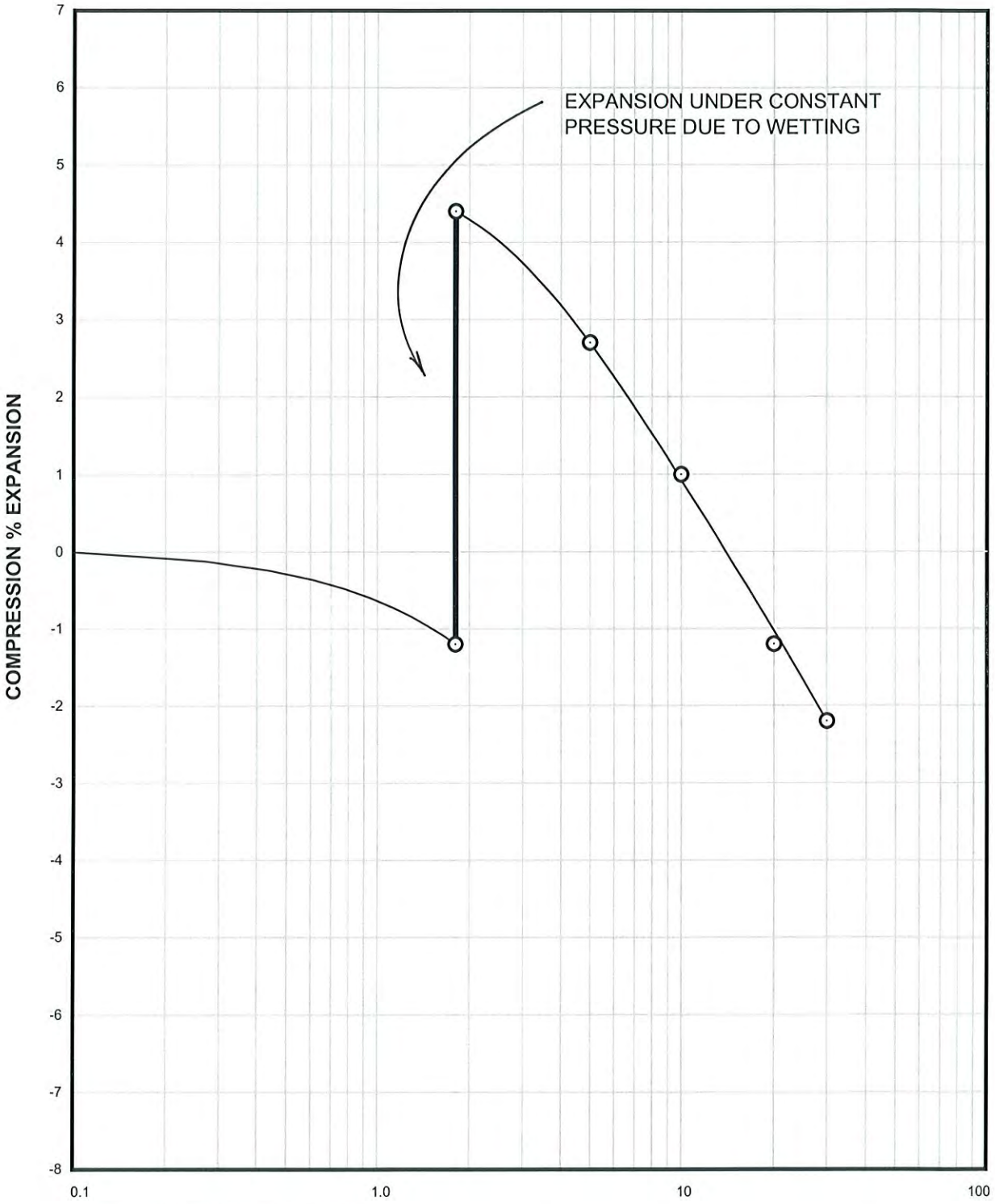



Sample of INTERBEDDED CLAYSTONE/SANDSTONE
From TH-10 AT 9 FEET

SAMPLE DRY UNIT WEIGHT= 127 PCF
SAMPLE MOISTURE CONTENT= 11.7 %

PROJECT NO. DN40,507-115

**Swell Consolidation Test Results** FIG. C-20



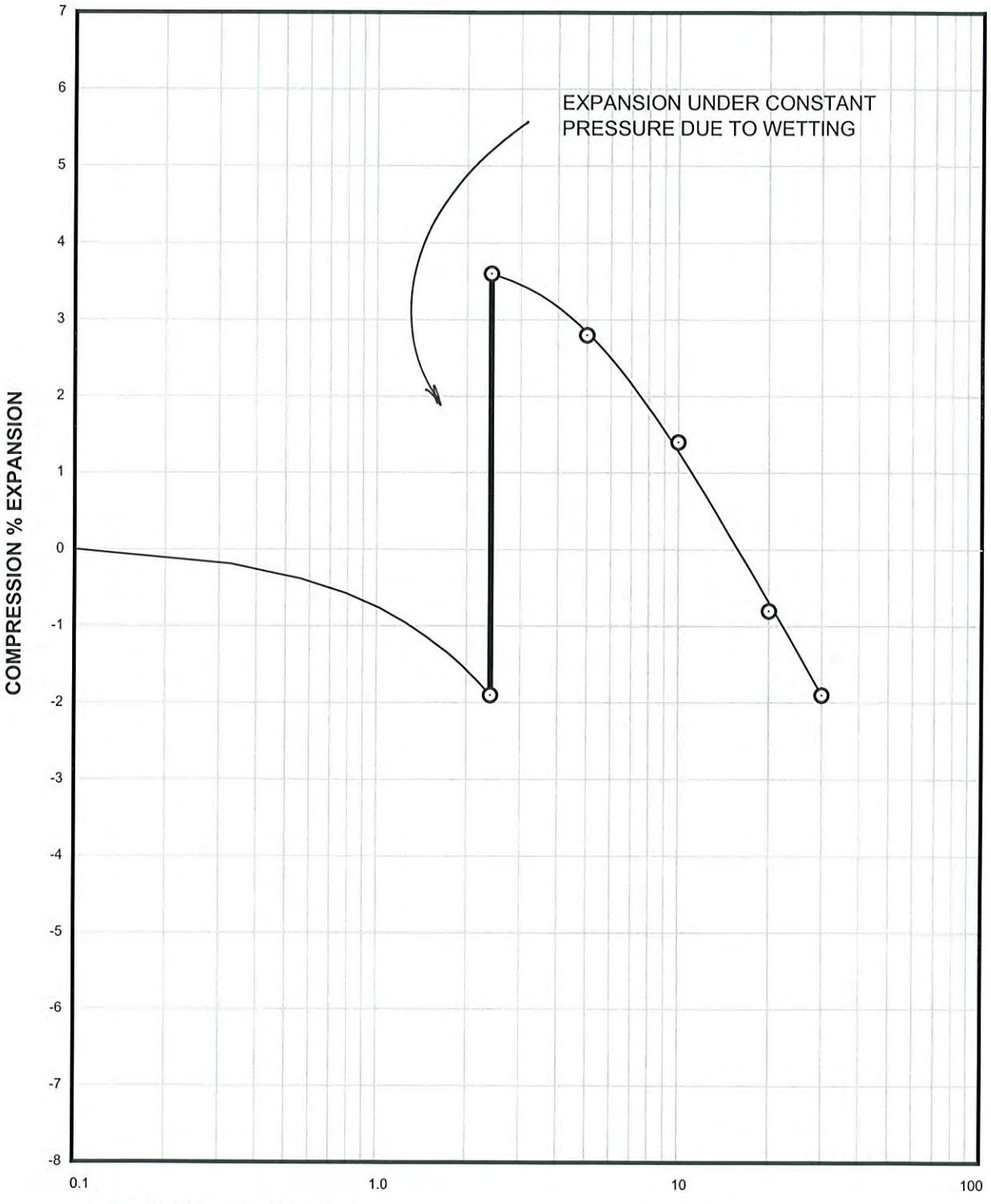

Sample of CLAYSTONE
From TH-10 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 132 PCF
SAMPLE MOISTURE CONTENT= 9.5 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-21



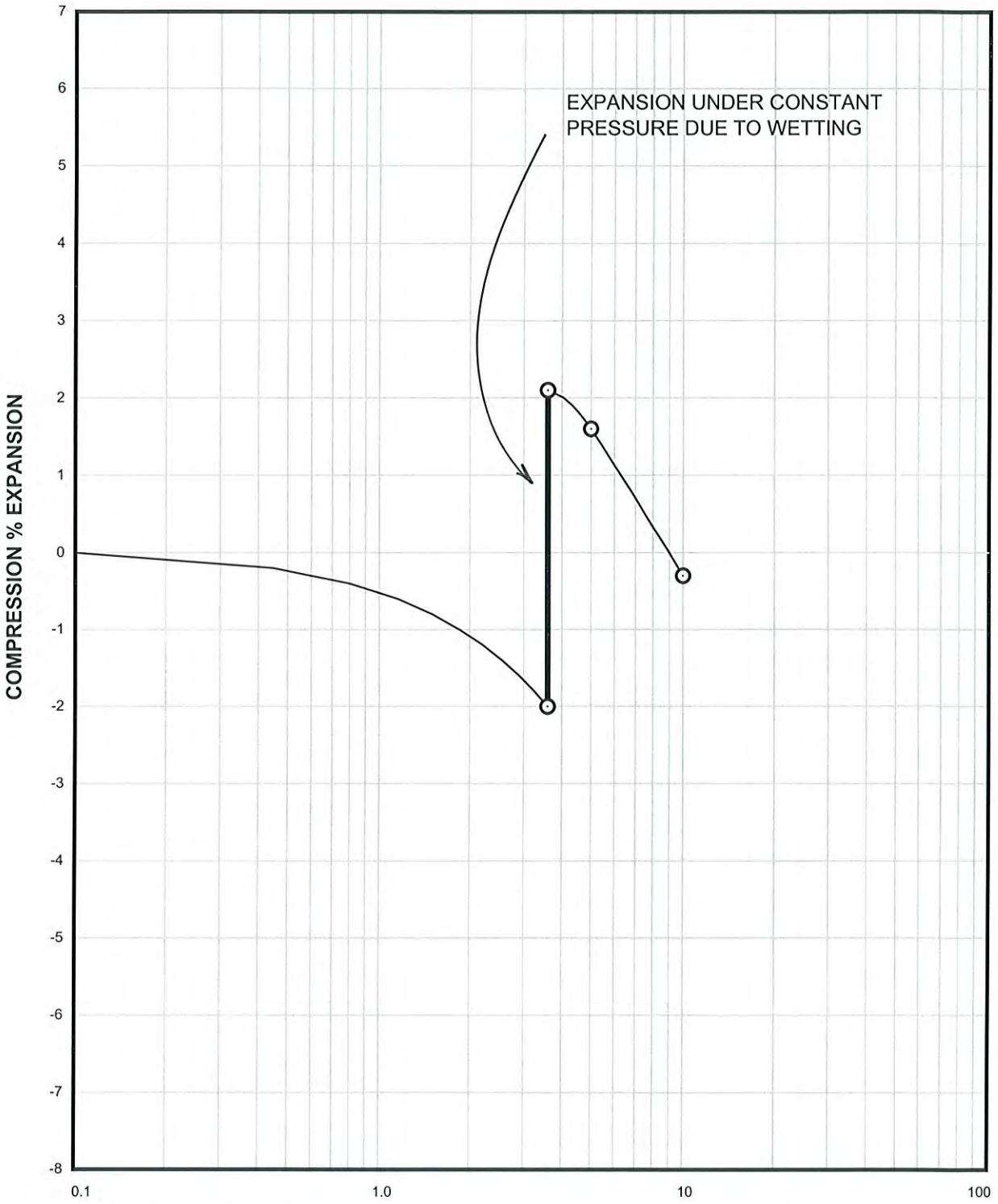

Sample of CLAYSTONE
From TH-10 AT 19 FEET

SAMPLE DRY UNIT WEIGHT= 117 PCF
SAMPLE MOISTURE CONTENT= 15.6 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-22



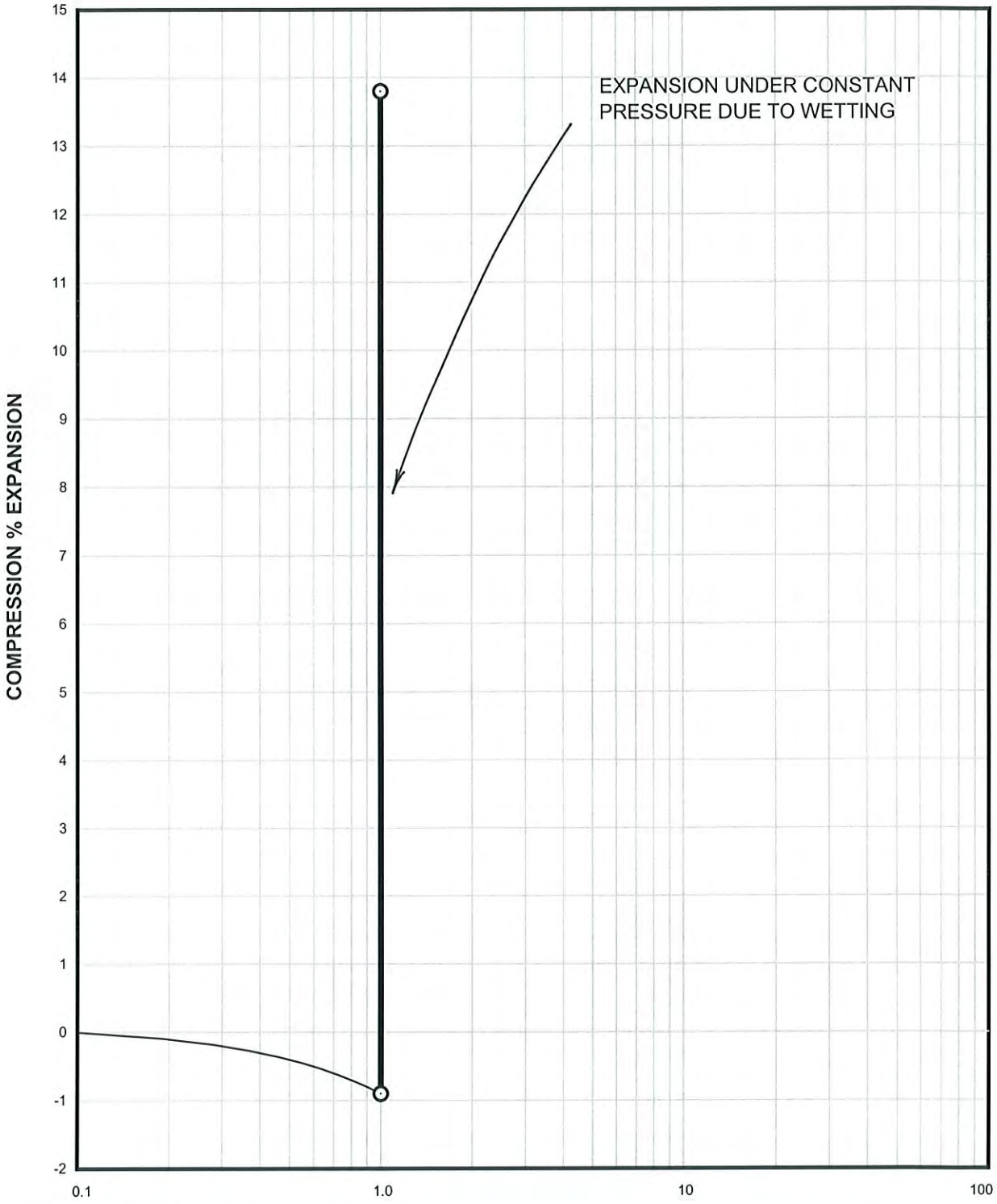

Sample of CLAYSTONE
From TH-10 AT 29 FEET

SAMPLE DRY UNIT WEIGHT= 118 PCF
SAMPLE MOISTURE CONTENT= 13.3 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-23



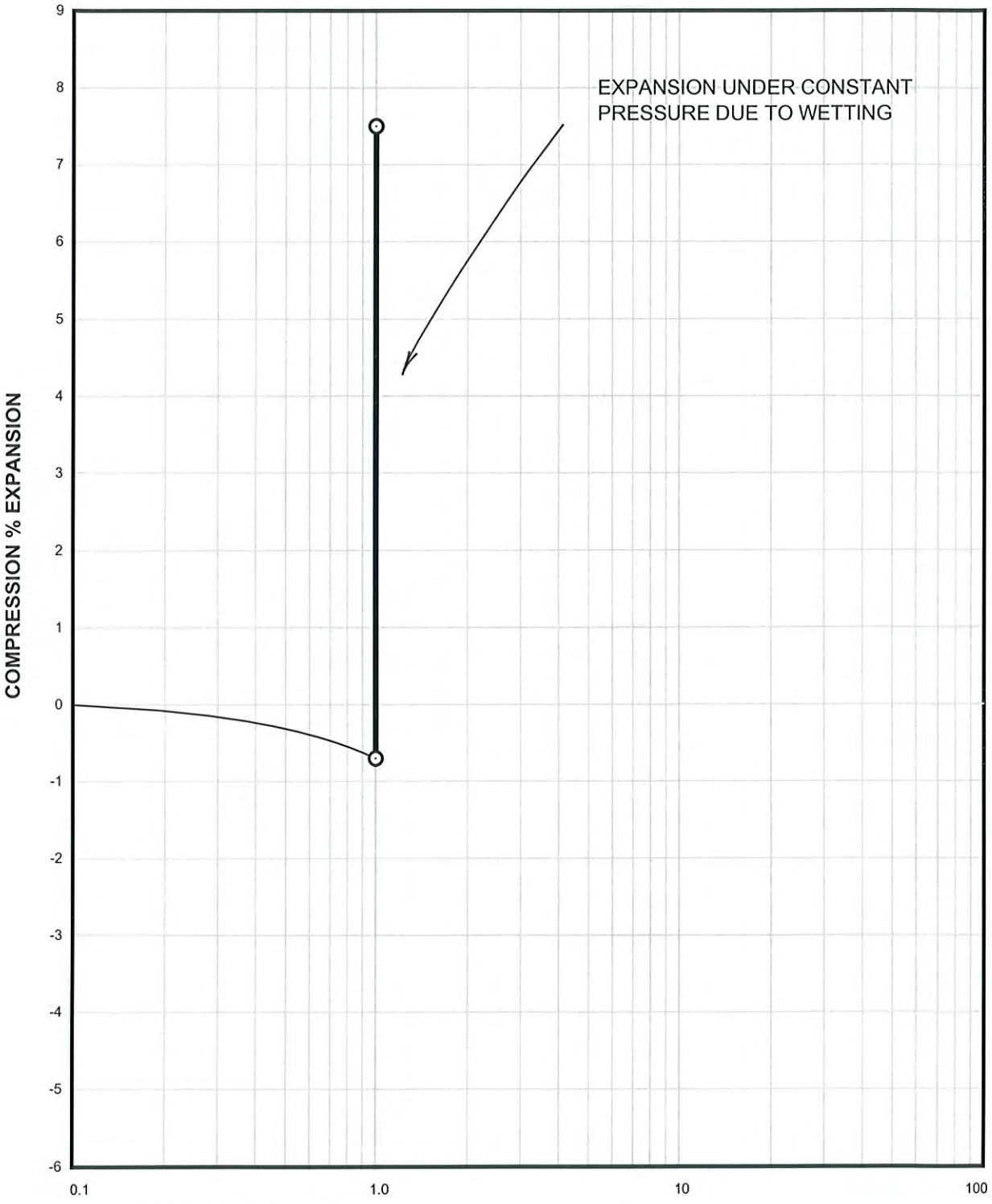

Sample of CLAYSTONE
From TH-11 AT 19 FEET

SAMPLE DRY UNIT WEIGHT= 115 PCF
SAMPLE MOISTURE CONTENT= 16.5 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-24



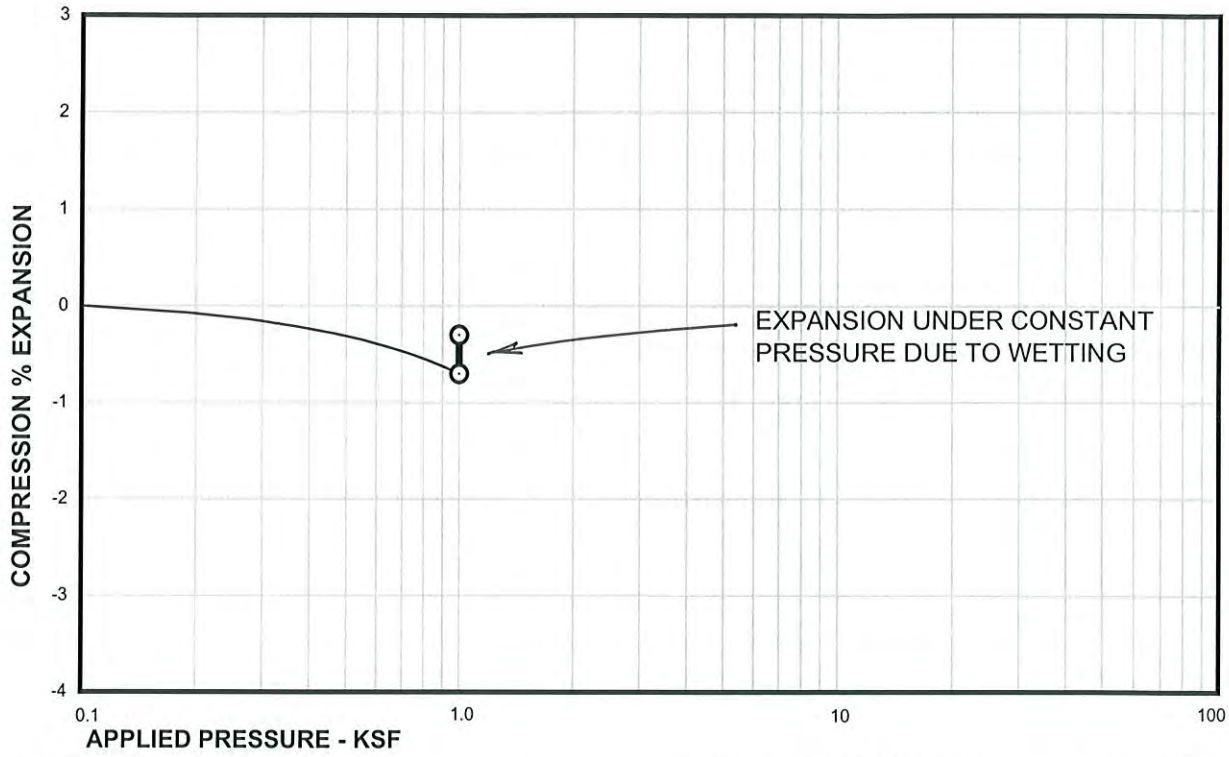

Sample of CLAYSTONE
From TH-11 AT 24 FEET

SAMPLE DRY UNIT WEIGHT= 109 PCF
SAMPLE MOISTURE CONTENT= 19.9 %

# Swell Consolidation Test Results

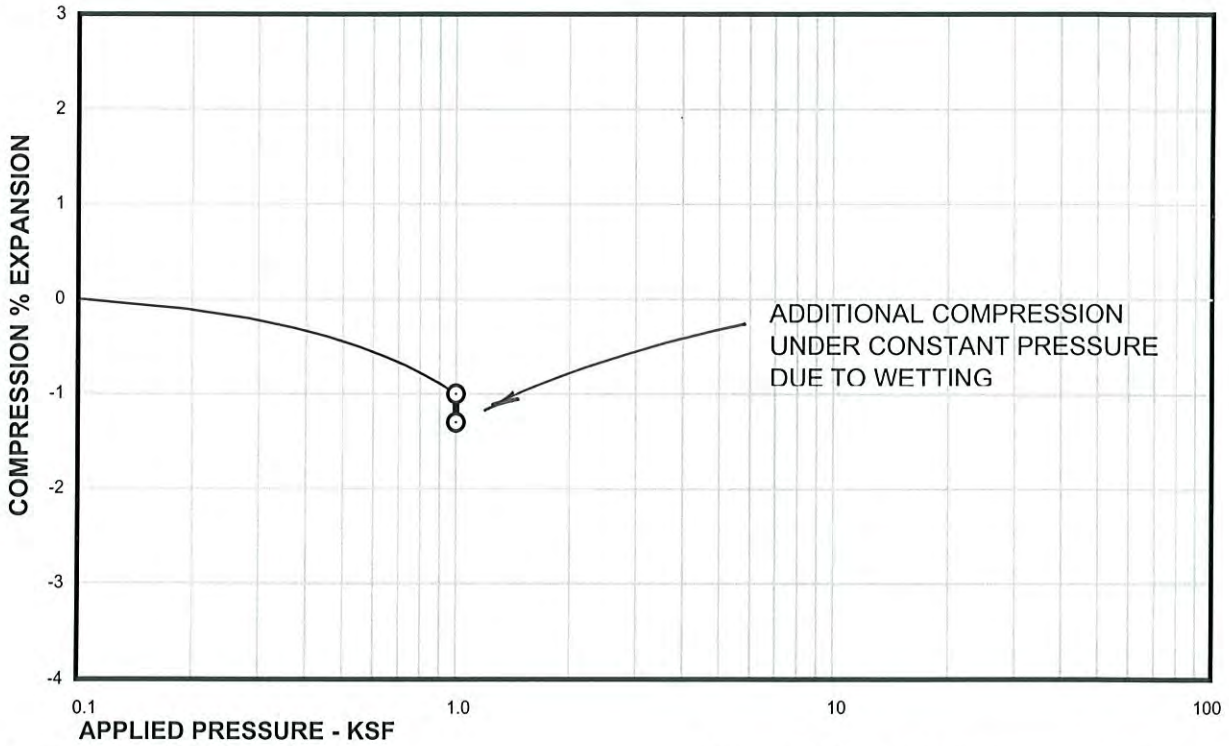
FIG. C-25

PROJECT NO. DN40,507-115




Sample of CLAY, SANDY (CL)
From TH-12 AT 9 FEET

SAMPLE DRY UNIT WEIGHT= 109 PCF
SAMPLE MOISTURE CONTENT= 15.2 %



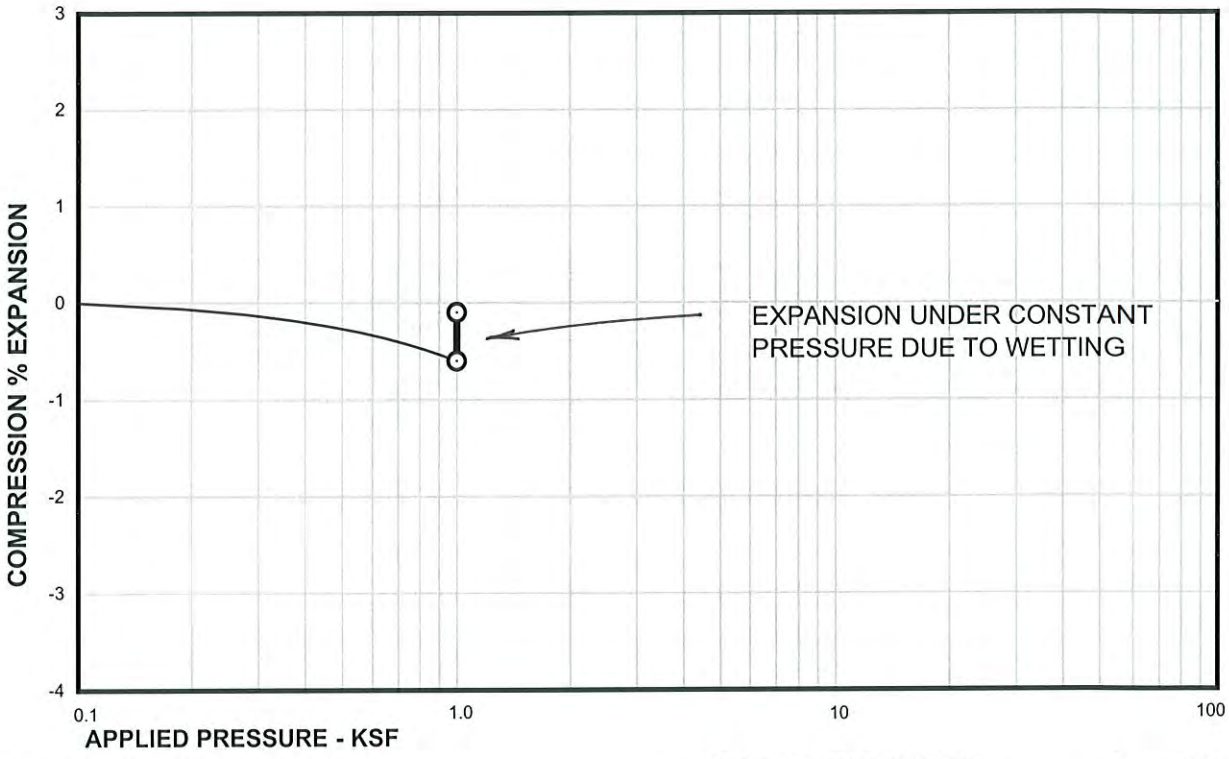

Sample of CLAY, SANDY (CL)
From TH-12 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 103 PCF
SAMPLE MOISTURE CONTENT= 13.8 %

# Swell Consolidation Test Results

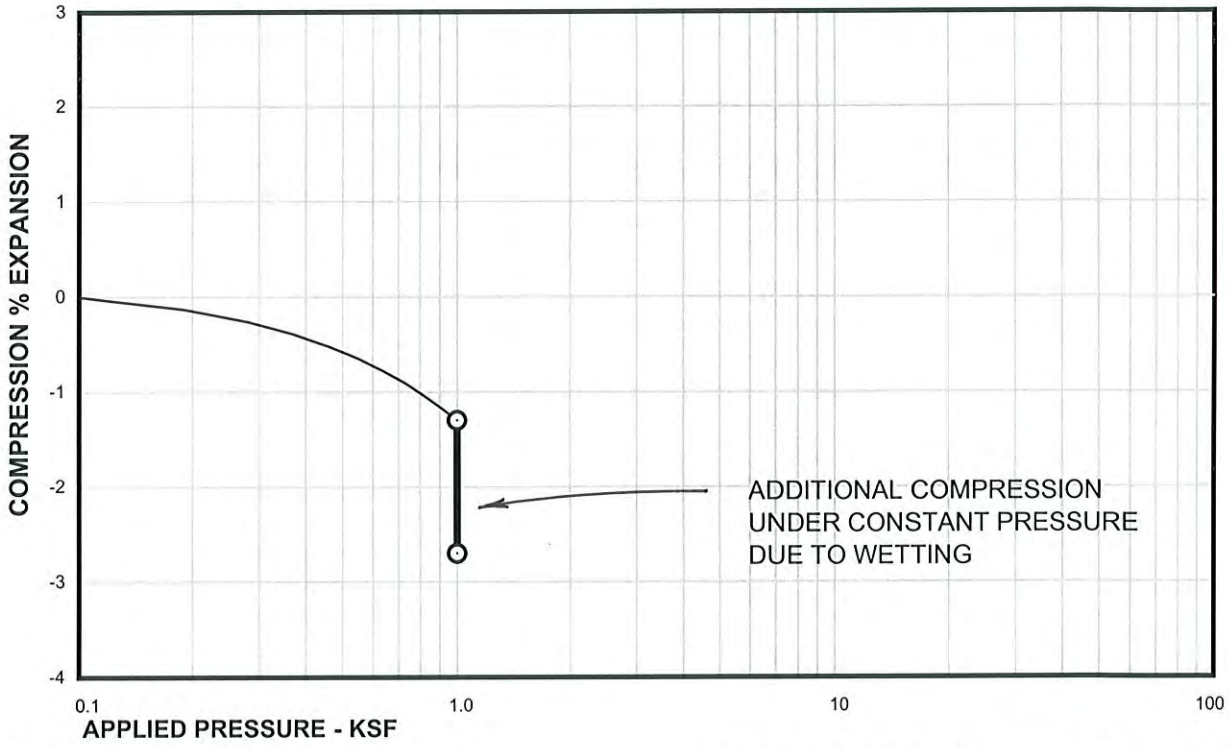
PROJECT NO. DN40,507-115

FIG. C-26




Sample of CLAY, SANDY (CL)
From TH-13 AT 4 FEET

SAMPLE DRY UNIT WEIGHT= 95 PCF
SAMPLE MOISTURE CONTENT= 15.6 %



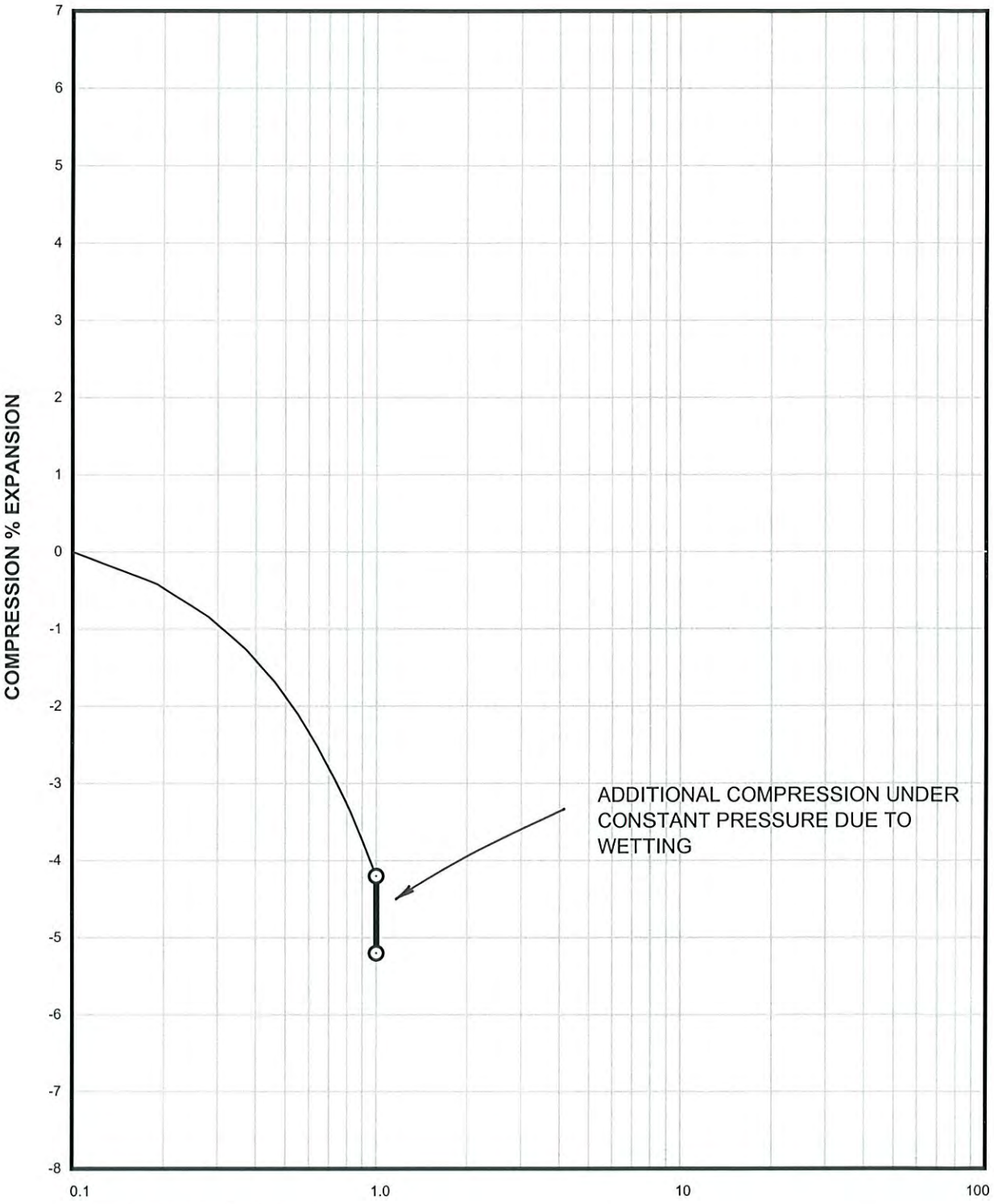

Sample of SANDSTONE
From TH-13 AT 19 FEET

SAMPLE DRY UNIT WEIGHT= 100 PCF
SAMPLE MOISTURE CONTENT= 11.6 %

**Swell Consolidation Test Results**

PROJECT NO. DN40,507-115

FIG. C-27



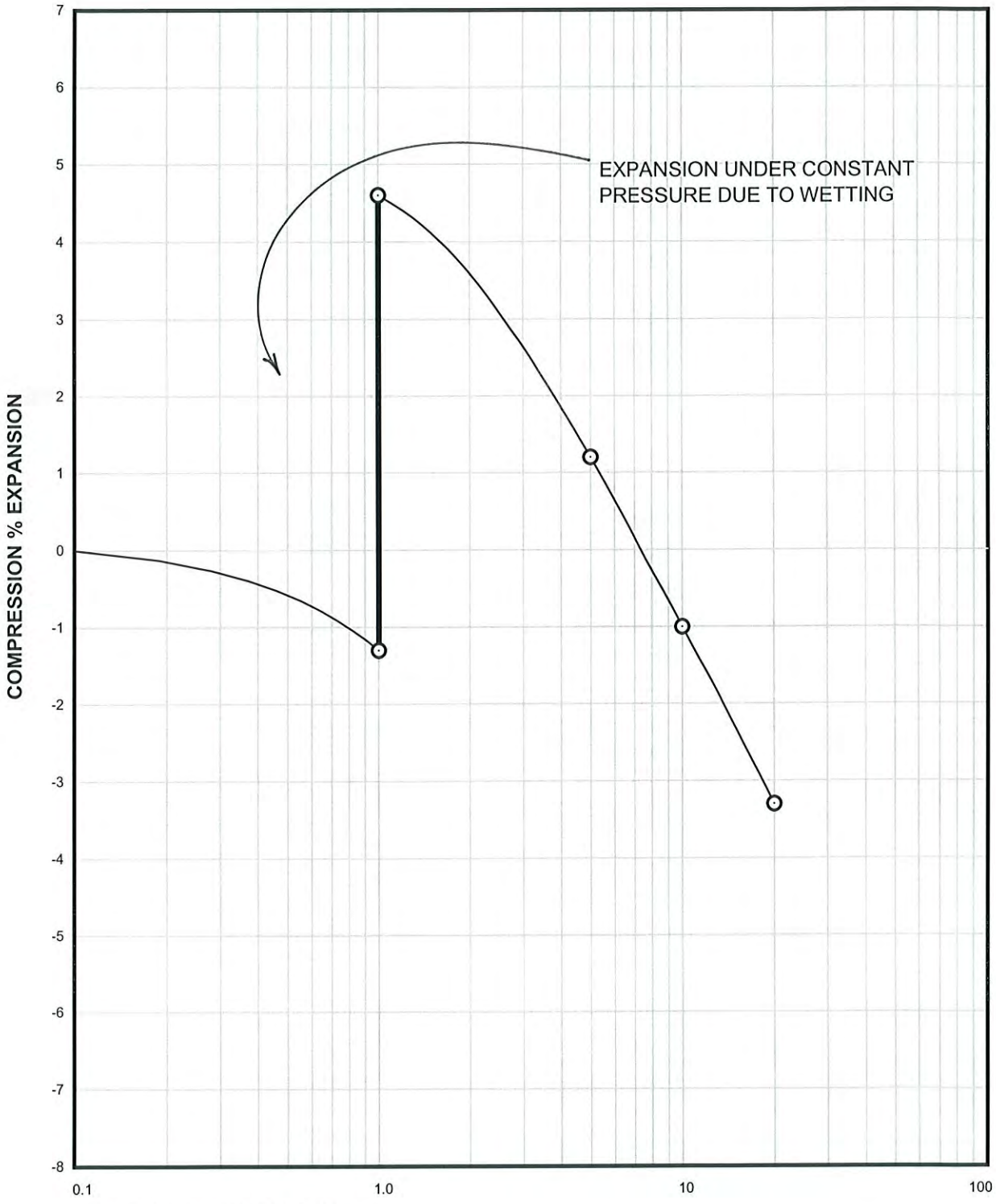

Sample of CLAY, SANDY (CL)
From TH-14 AT 9 FEET

SAMPLE DRY UNIT WEIGHT= 115 PCF
SAMPLE MOISTURE CONTENT= 14.3 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-28



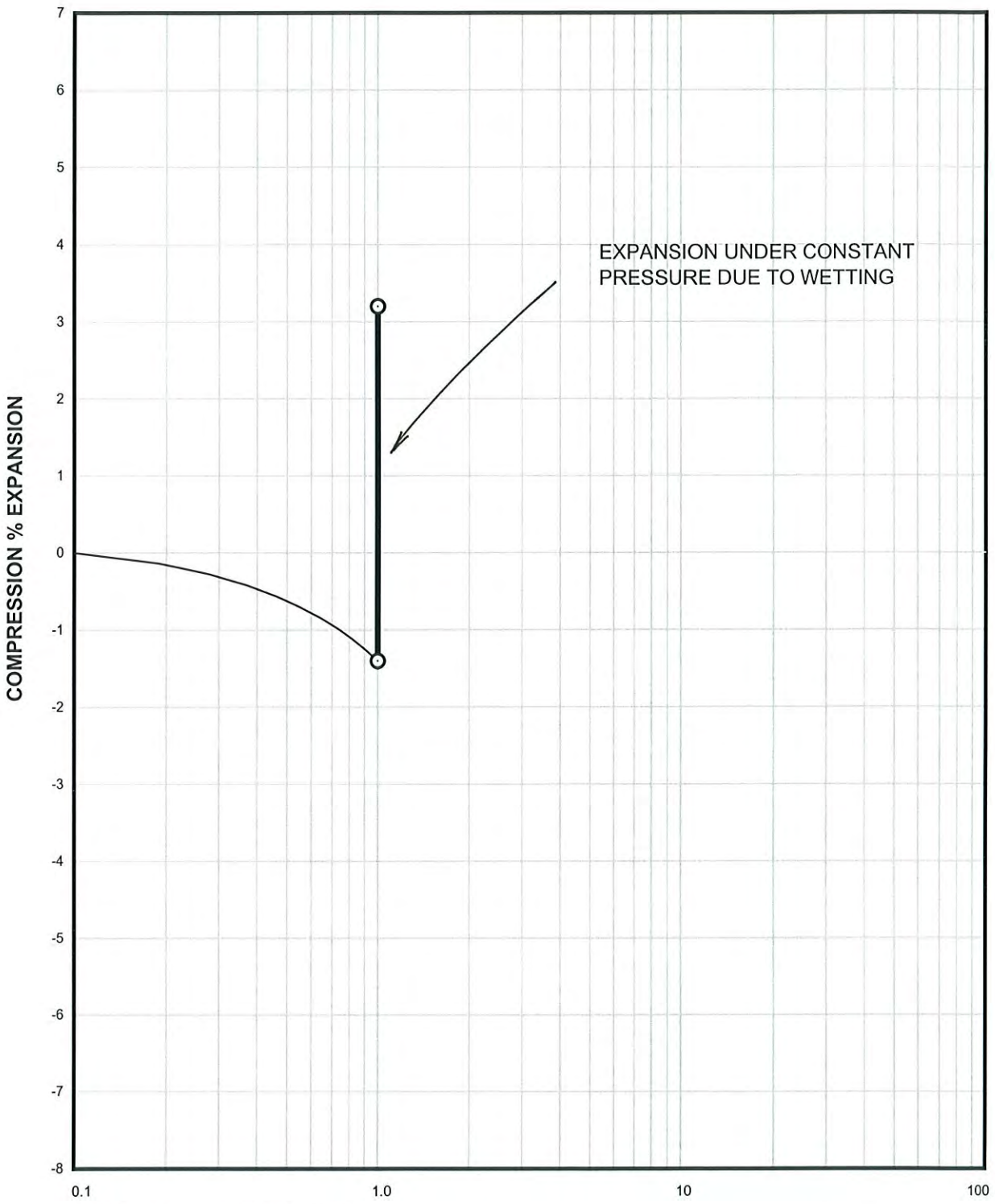

Sample of CLAYSTONE
From TH-14 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 115 PCF
SAMPLE MOISTURE CONTENT= 14.2 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-29



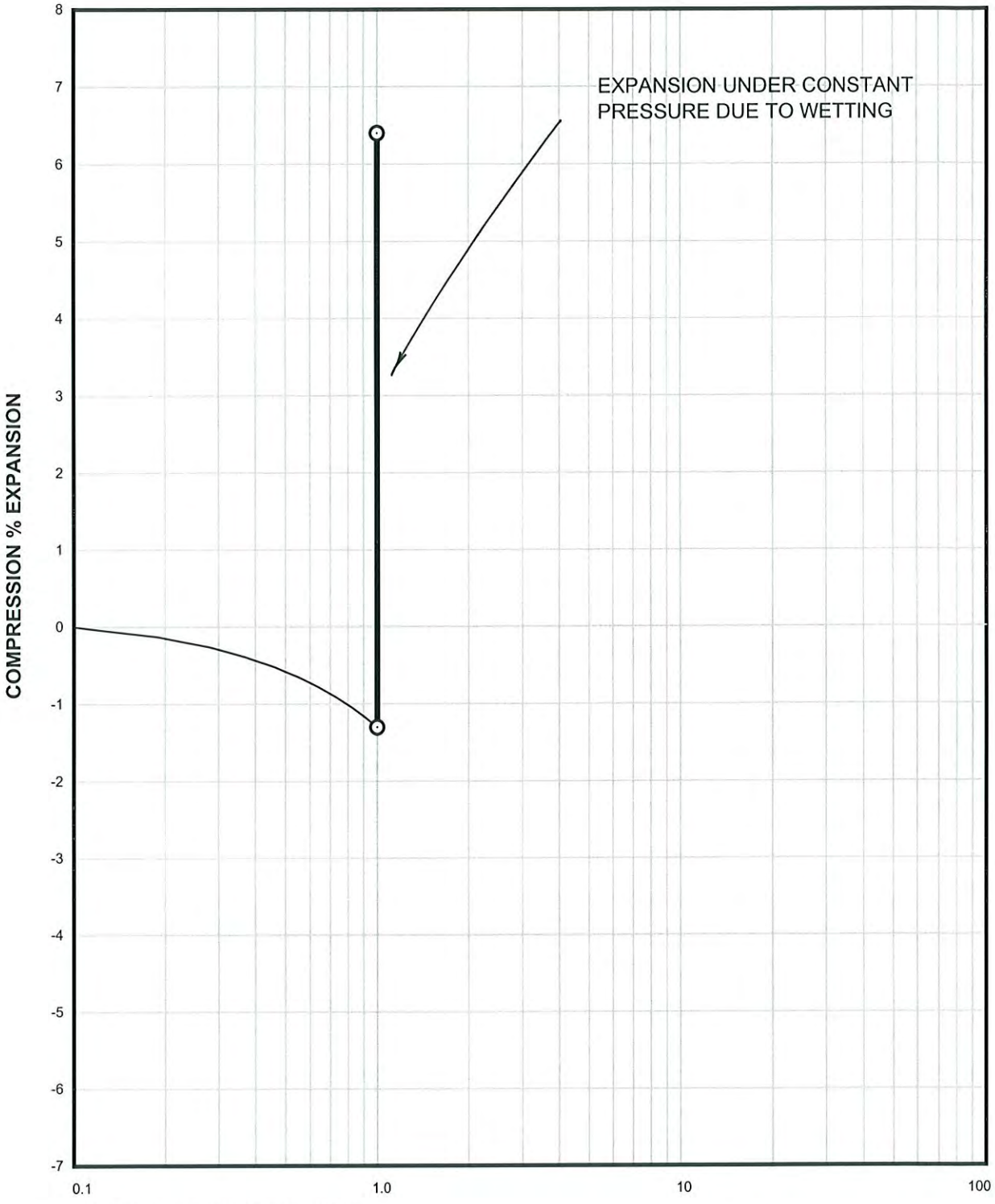

Sample of CLAYSTONE
From TH-15 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 119 PCF
SAMPLE MOISTURE CONTENT= 15.2 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-30



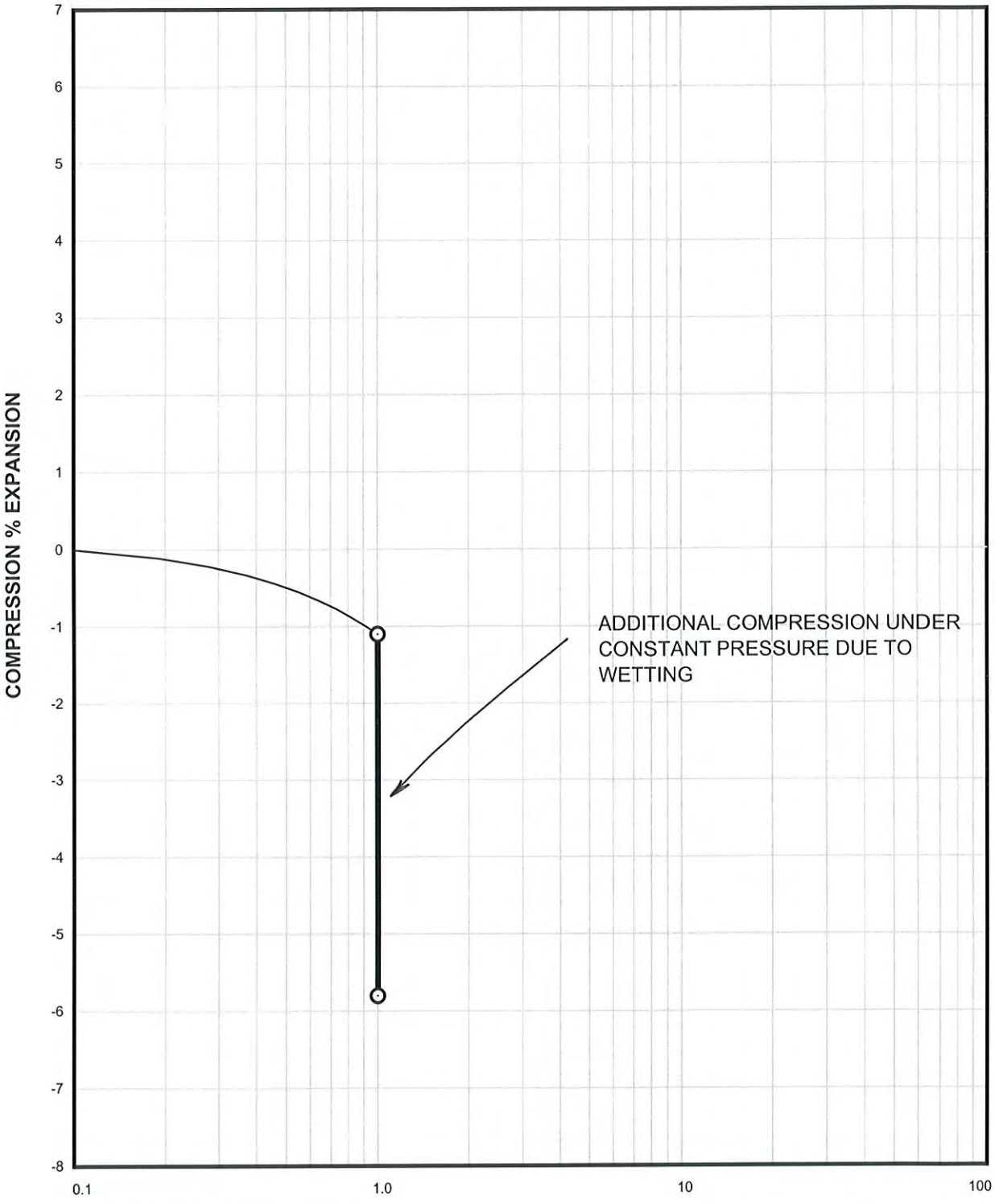

Sample of CLAYSTONE
From TH-15 AT 24 FEET

SAMPLE DRY UNIT WEIGHT= 108 PCF
SAMPLE MOISTURE CONTENT= 18.2 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-31

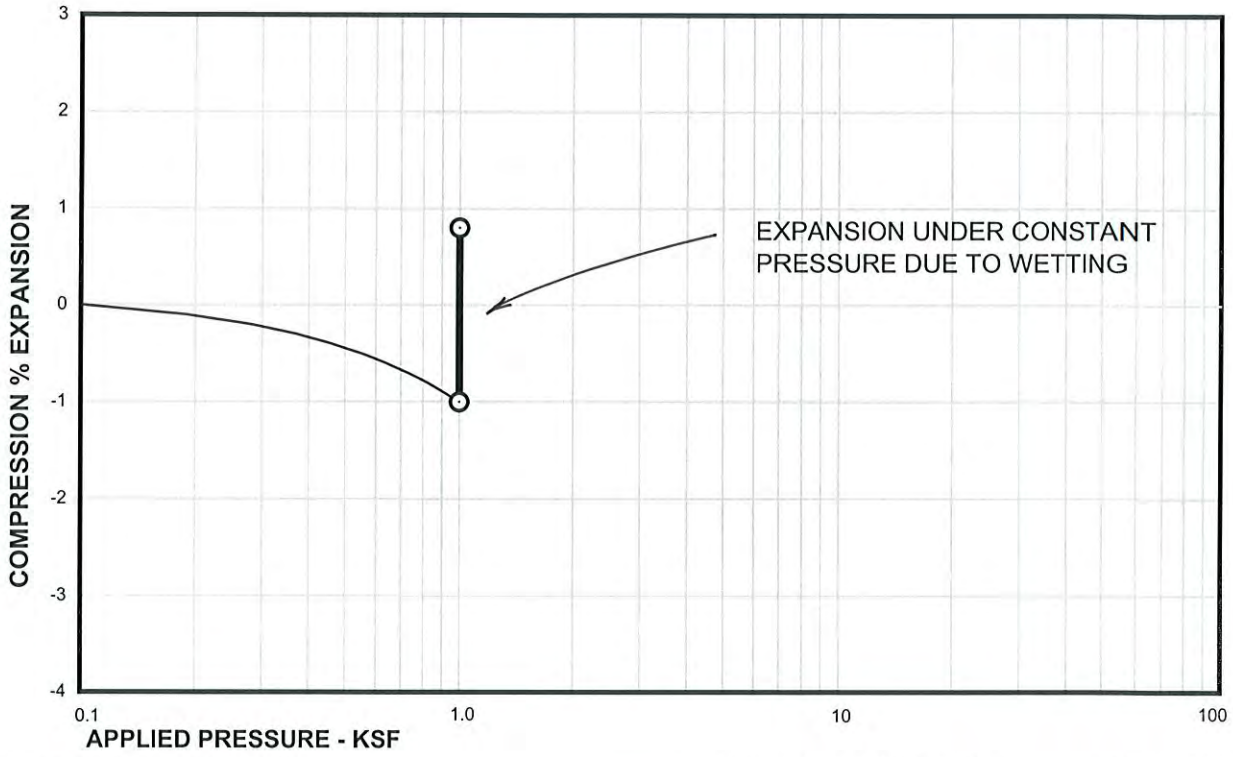



Sample of CLAY, SANDY (CL)
From TH-16 AT 4 FEET

SAMPLE DRY UNIT WEIGHT= 89 PCF
SAMPLE MOISTURE CONTENT= 7.4 %

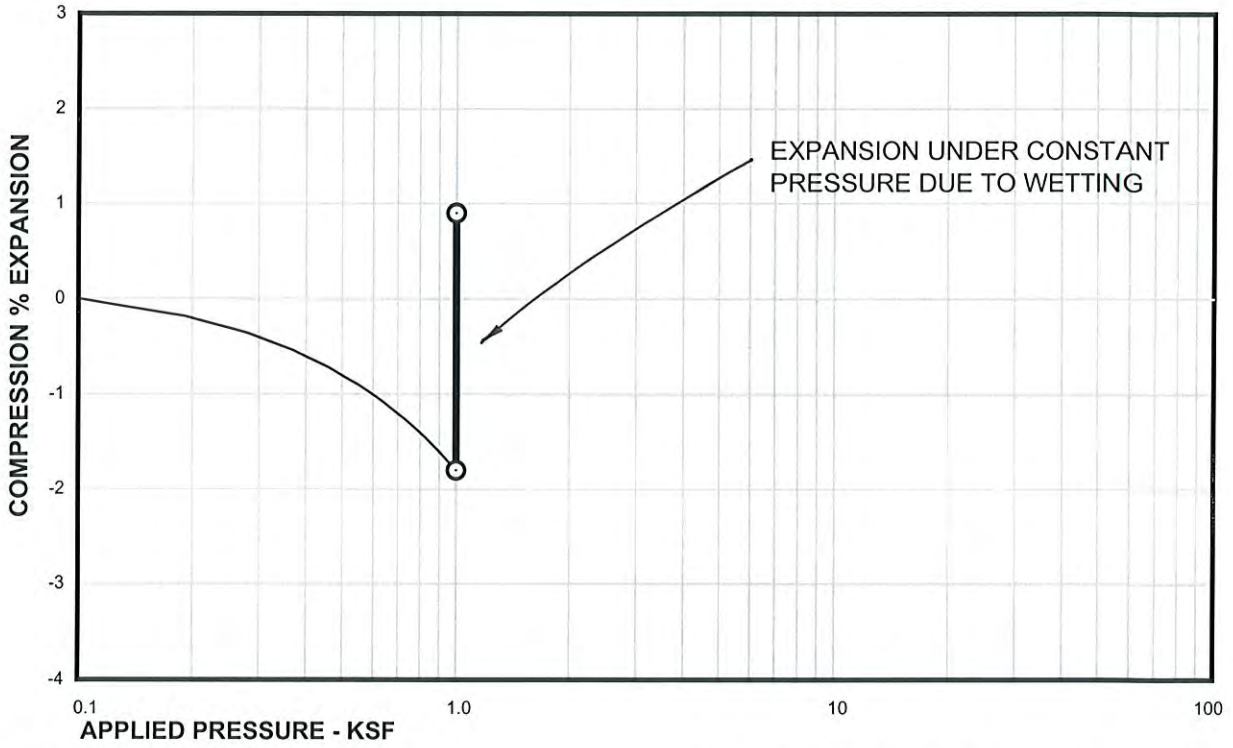
PROJECT NO. DN40,507-115

**Swell Consolidation Test Results** FIG. C-32




Sample of CLAYSTONE
From TH-16 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 109 PCF
SAMPLE MOISTURE CONTENT= 10.1 %



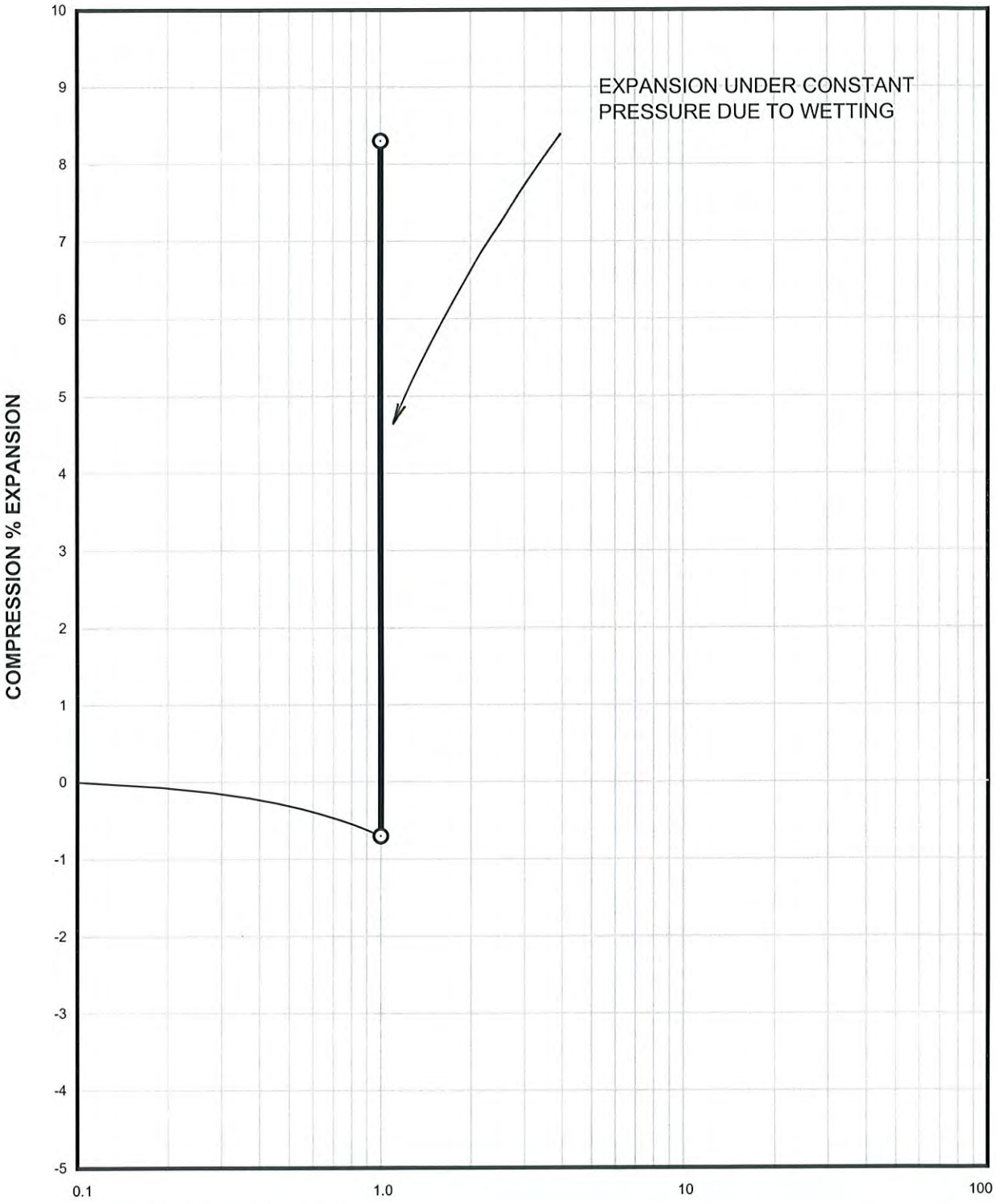

Sample of CLAY, SANDY (CL)
From TH-17 AT 9 FEET

SAMPLE DRY UNIT WEIGHT= 114 PCF
SAMPLE MOISTURE CONTENT= 11.4 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-33

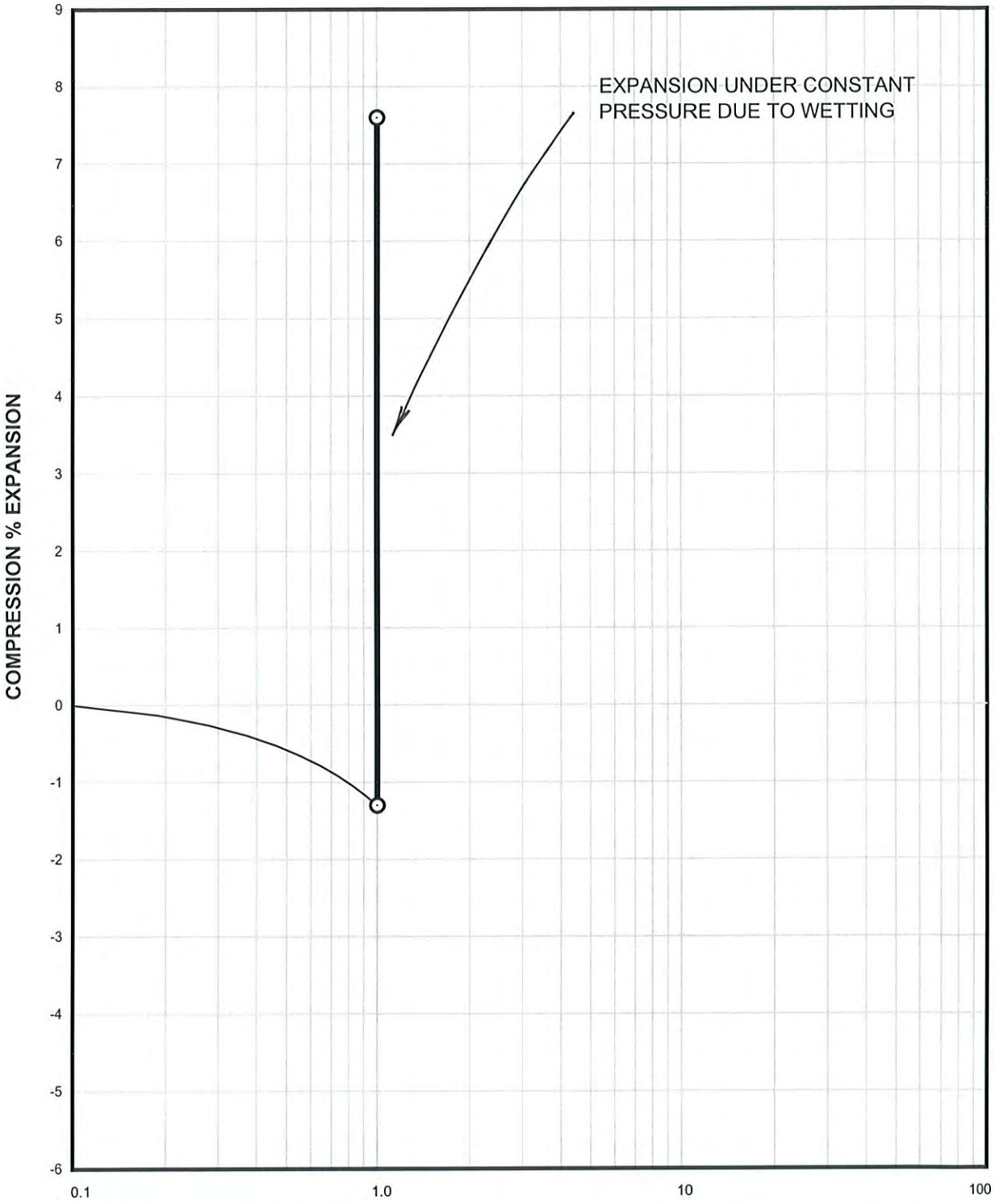



Sample of CLAYSTONE
From TH-17 AT 19 FEET

SAMPLE DRY UNIT WEIGHT= 126 PCF
SAMPLE MOISTURE CONTENT= 9.1 %

**Swell Consolidation Test Results** FIG. C-34

PROJECT NO. DN40,507-115



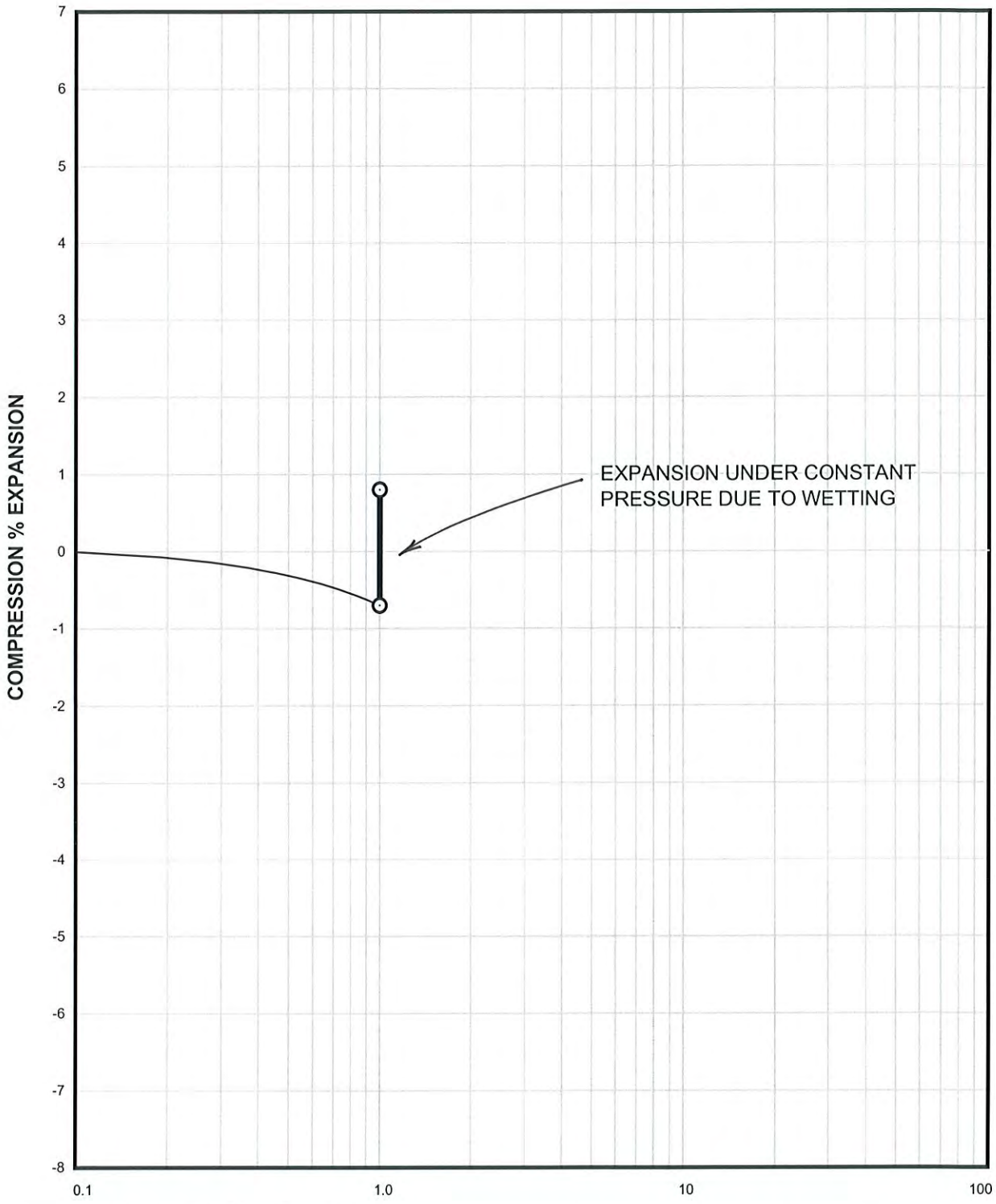

Sample of CLAYSTONE
From TH-17 AT 34 FEET

SAMPLE DRY UNIT WEIGHT= 127 PCF
SAMPLE MOISTURE CONTENT= 11.0 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-35



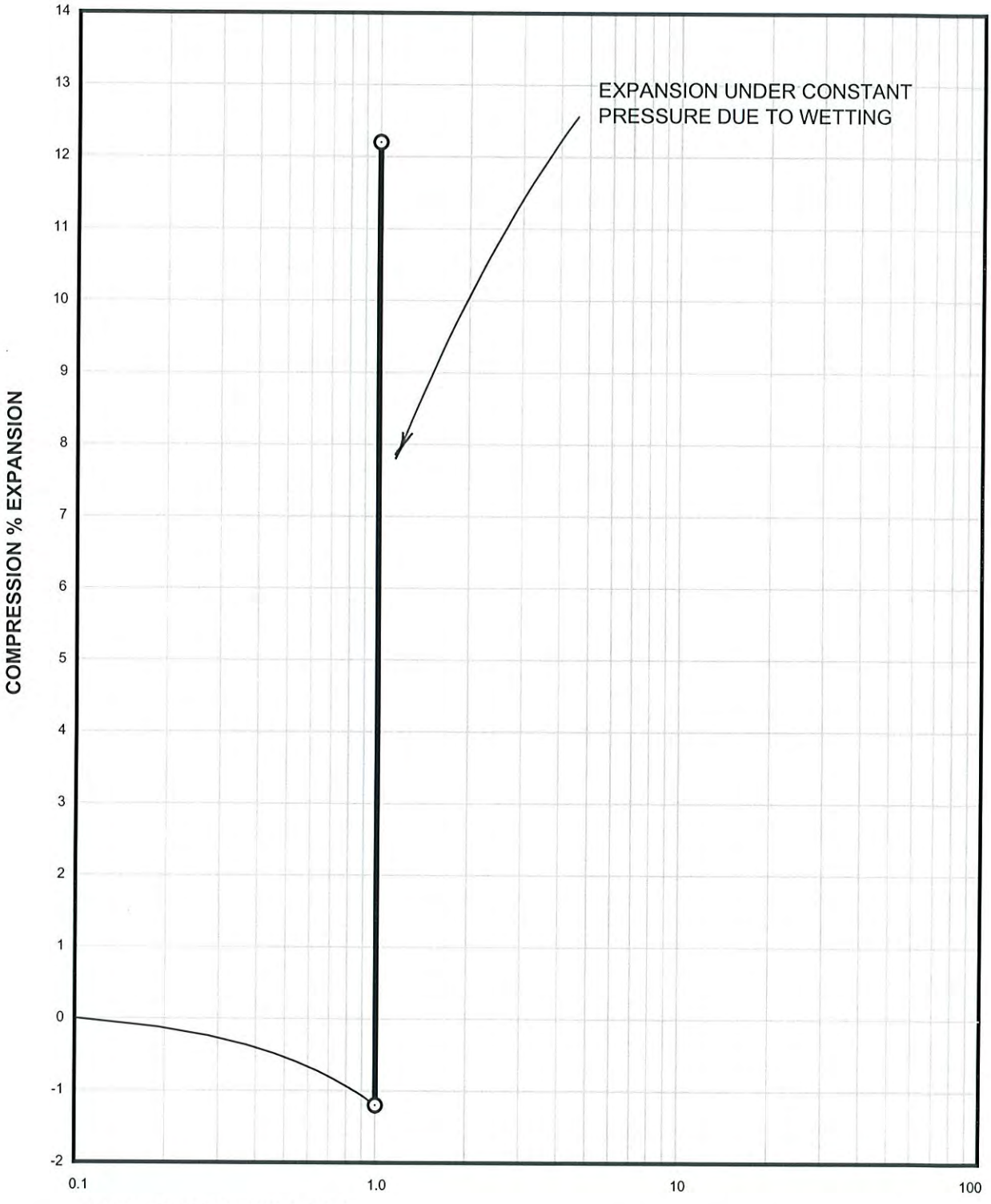

Sample of CLAY, SANDY (CL)
From TH-18 AT 4 FEET

SAMPLE DRY UNIT WEIGHT= 112 PCF
SAMPLE MOISTURE CONTENT= 15.2 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-36



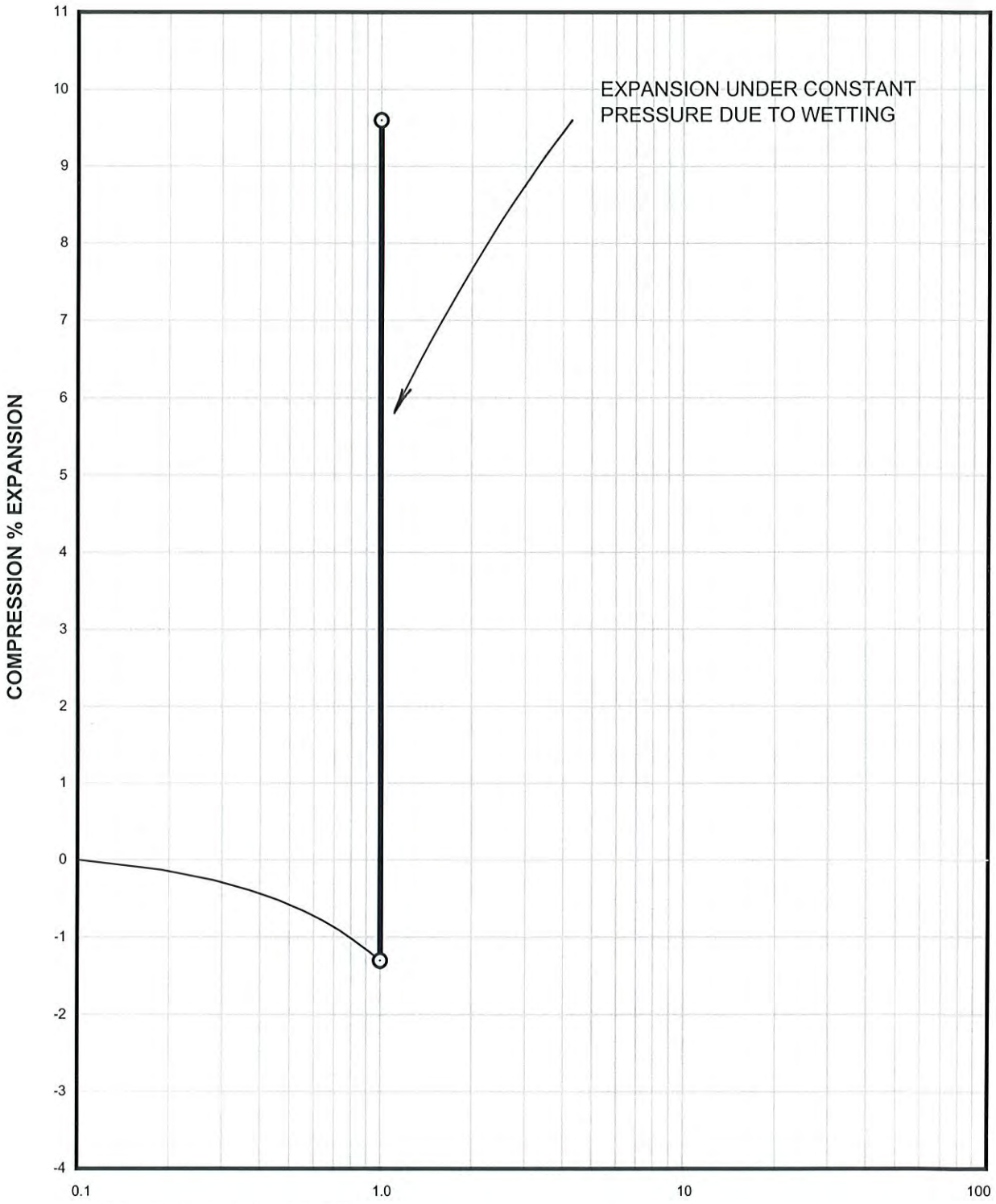

Sample of CLAYSTONE
From TH-18 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 106 PCF
SAMPLE MOISTURE CONTENT= 21.2 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-37



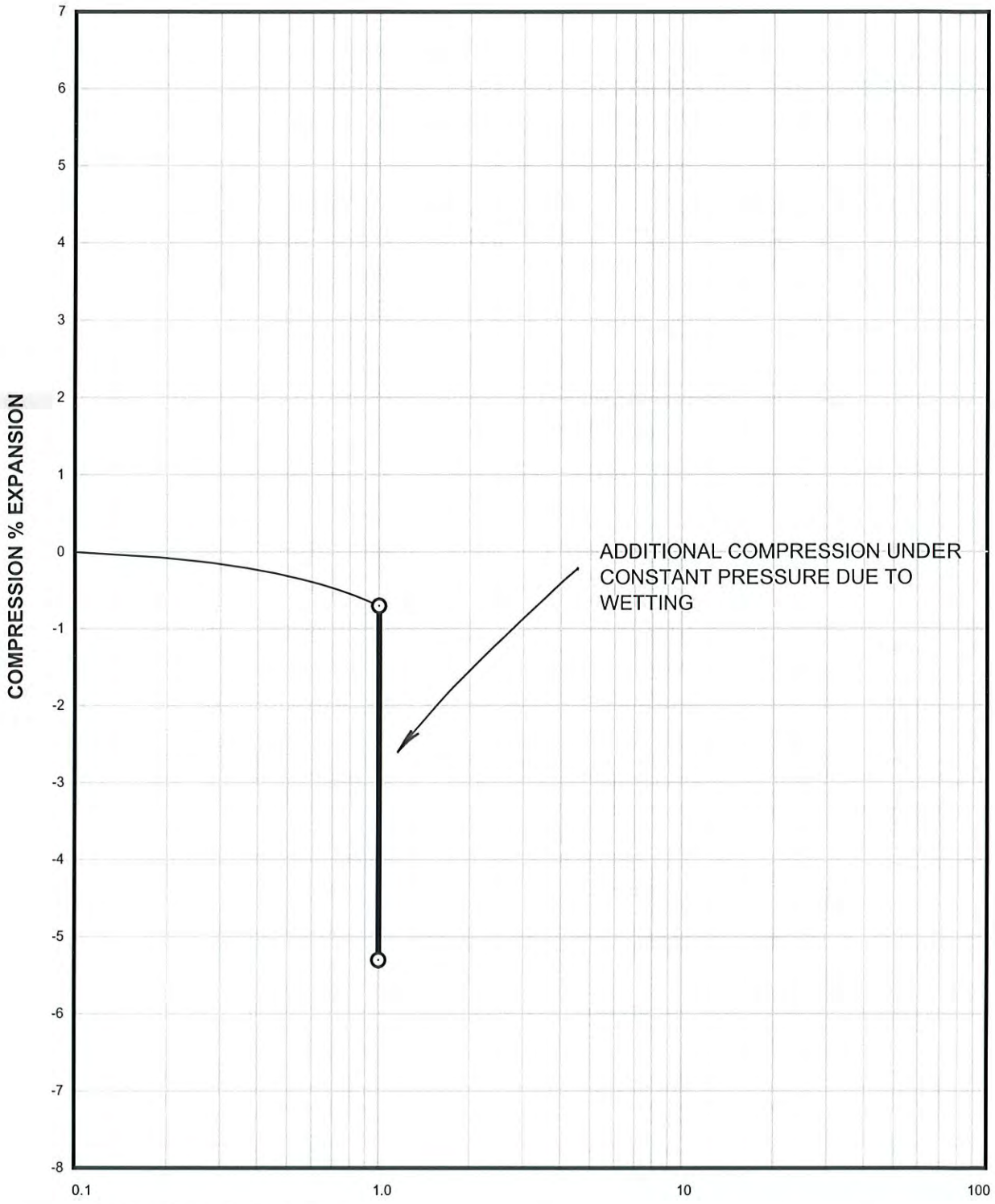

Sample of CLAYSTONE
From TH-18 AT 24 FEET

SAMPLE DRY UNIT WEIGHT= 122 PCF
SAMPLE MOISTURE CONTENT= 12.7 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-38



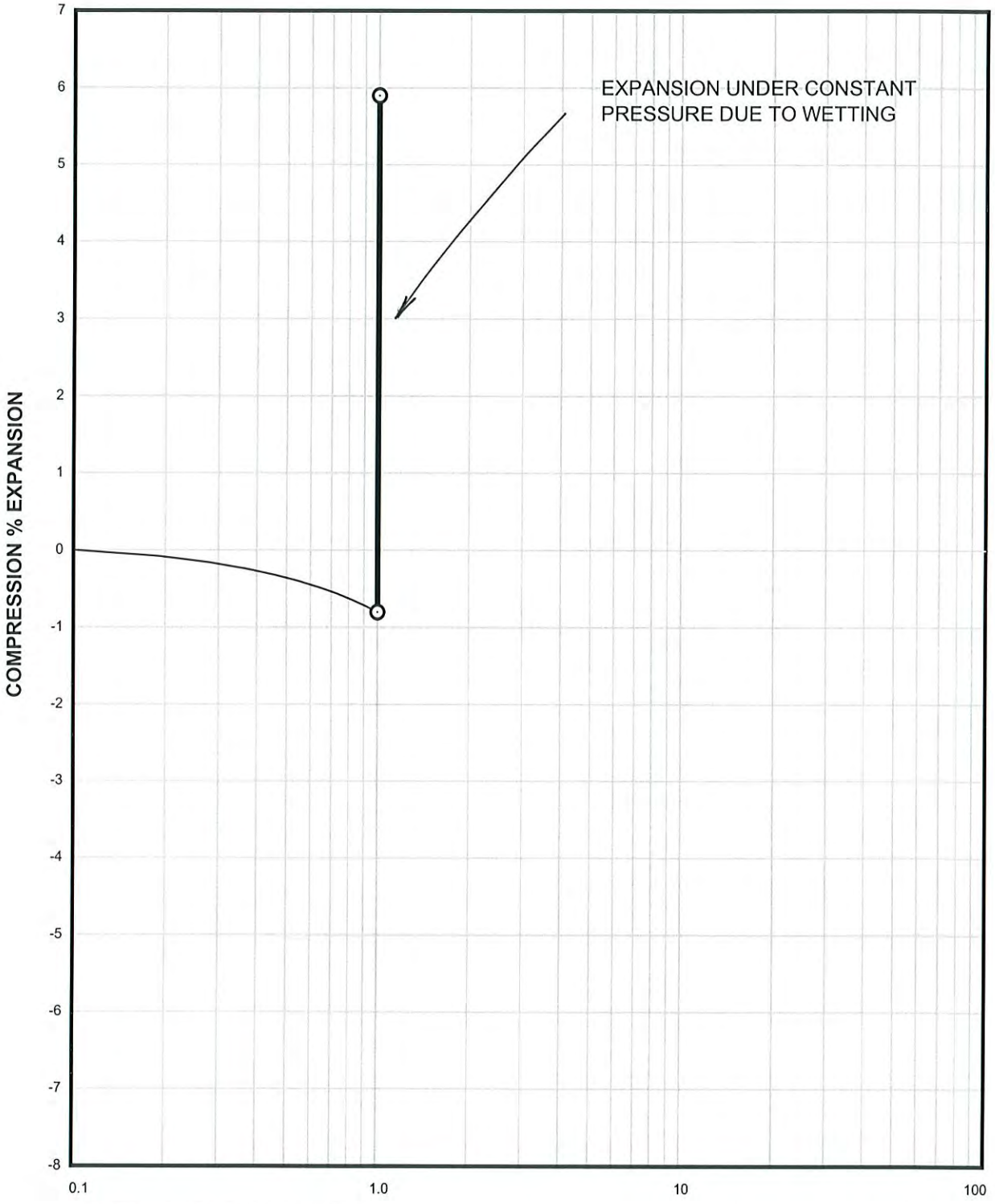

Sample of CLAY, SANDY (CL)
From TH-19 AT 4 FEET

SAMPLE DRY UNIT WEIGHT= 97 PCF
SAMPLE MOISTURE CONTENT= 5.2 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-39



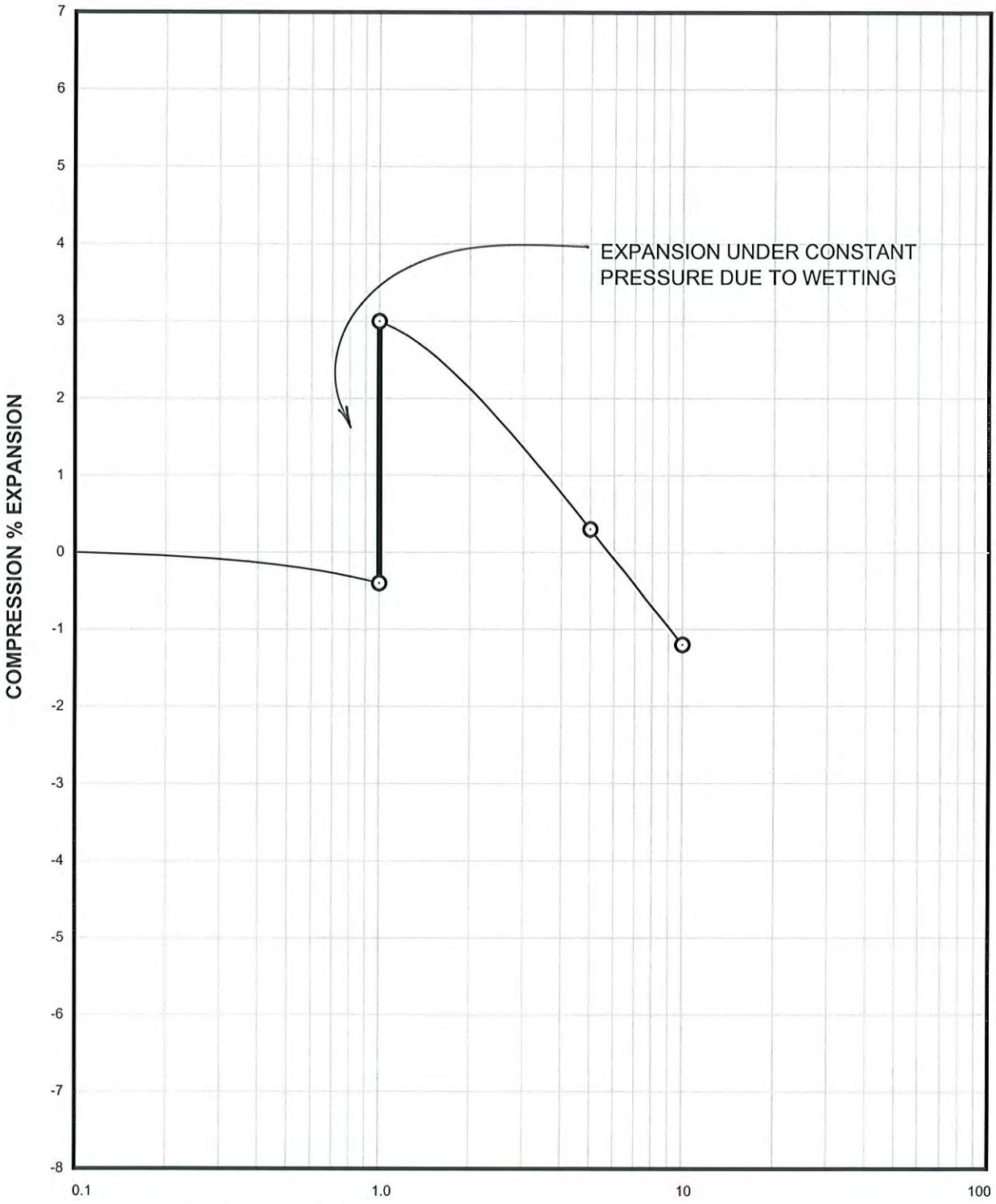

Sample of CLAY, SANDY (CL)
From TH-19 AT 9 FEET

SAMPLE DRY UNIT WEIGHT= 122 PCF
SAMPLE MOISTURE CONTENT= 12.5 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-40



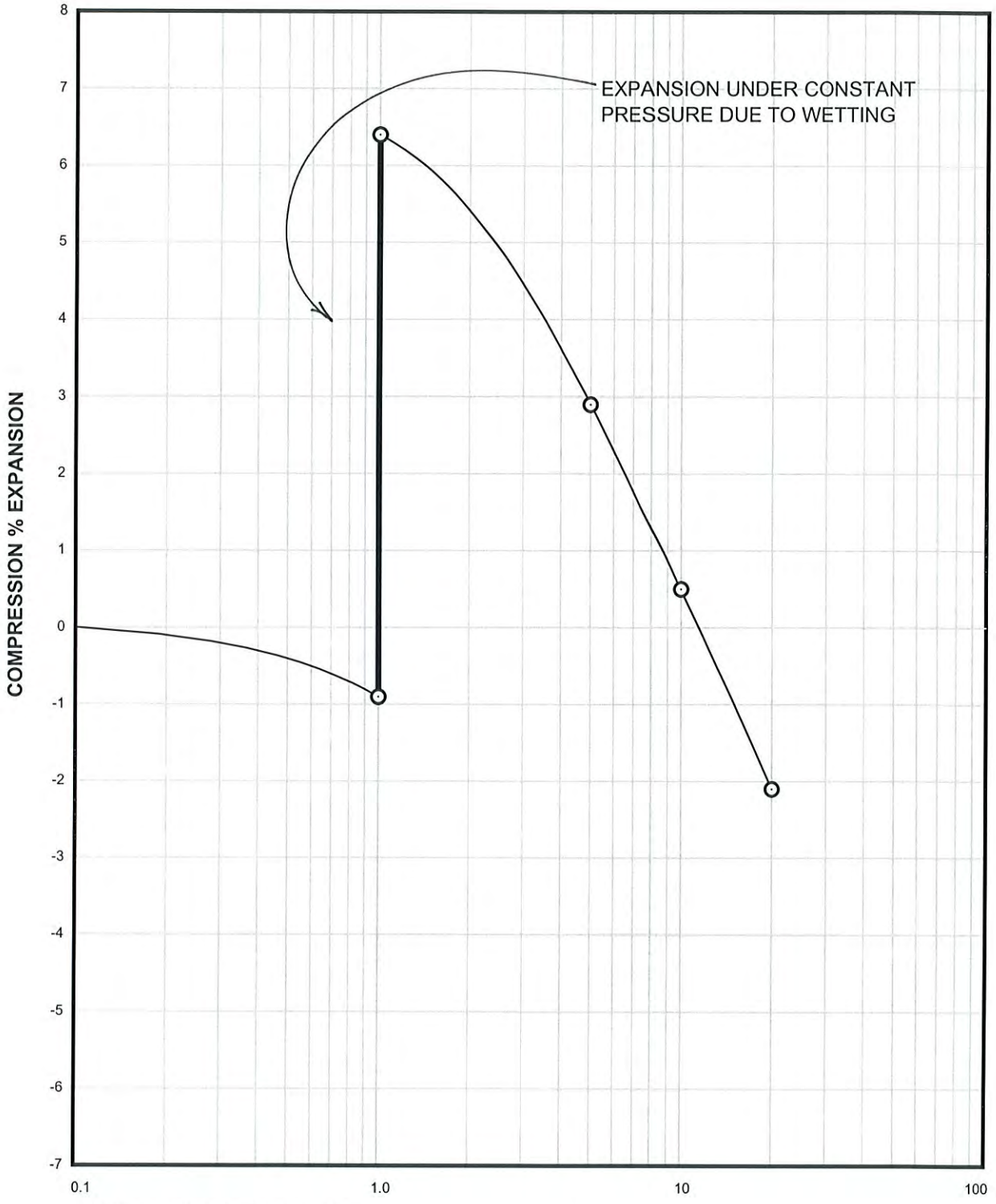

Sample of CLAY, SANDY (CL)
From TH-20 AT 4 FEET

SAMPLE DRY UNIT WEIGHT= 115 PCF
SAMPLE MOISTURE CONTENT= 14.5 %

# Swell Consolidation Test Results

FIG. C-41

PROJECT NO. DN40,507-115




Sample of CLAYSTONE
From TH-20 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 110 PCF
SAMPLE MOISTURE CONTENT= 21.0 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. C-42

## TABLE C - I

## SUMMARY OF LABORATORY TEST RESULTS

| BORING | DEPTH (ft) | MOISTURE CONTENT (%) | DRY DENSITY (pcf) | SWELL TEST DATA | | | SOIL SUCTION VALUE (pF) | ATTERBERG LIMITS | | SOLUBLE SULFATE CONTENT (%) | PASSING NO. 200 SIEVE (%) | SOIL TYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SWELL (%) | APPLIED PRESSURE (psf) | SWELL PRESSURE (psf) | | LIQUID LIMIT (%) | PLASTICITY INDEX (%) | | | |
| TH-1 | 9 | 14.0 | 116 | 4.0 | 1,000 | | | | | | | CLAYSTONE |
| TH-1 | 14 | 16.0 | 115 | | | | | | | 0.5 | | CLAYSTONE |
| TH-1 | 19 | 22.0 | 105 | 9.9 | 1,000 | 35,000 | | | | | | CLAYSTONE |
| TH-1 | 34 | 11.9 | 127 | 7.2 | 1,000 | 40,000 | | | | | | CLAYSTONE |
| TH-2 | 4 | 10.9 | 109 | 1.1 | 1,000 | | | | | | | CLAY, SANDY (CL) |
| TH-3 | 4 | 5.6 | 104 | -0.4 | 1,000 | | | | | | | WEATHERED CLAYSTONE |
| TH-3 | 14 | 6.5 | 105 | | | | | | | | 32 | SANDSTONE |
| TH-4 | 4 | 12.4 | 103 | 0.2 | 1,000 | | | | | | | CLAY, SANDY (CL) |
| TH-4 | 9 | 6.2 | | | | | | | | | | SANDSTONE |
| TH-5 | 9 | 22.5 | 99 | 5.8 | 1,100 | 7,000 | 4.16 | | | | | WEATHERED CLAYSTONE |
| TH-5 | 14 | 27.9 | 96 | 6.3 | 1,800 | 14,000 | 4.25 | | | | | CLAYSTONE |
| TH-5 | 19 | 14.9 | 114 | 9.6 | 2,400 | 27,000 | 4.56 | | | | | CLAYSTONE |
| TH-5 | 24 | 12.3 | 119 | 0.4 | 3,000 | 4,500 | 4.55 | | | | | CLAYSTONE |
| TH-6 | 9 | 12.5 | 114 | 6.2 | 1,000 | | | | | | | WEATHERED CLAYSTONE |
| TH-6 | 14 | 10.4 | 113 | 1.7 | 1,000 | | | | | | | CLAYSTONE |
| TH-6 | 19 | 10.9 | 132 | 1.8 | 1,000 | | | | | | | CLAYSTONE |
| TH-6 | 24 | 18.5 | 109 | | | | | 73 | 54 | | 100 | CLAYSTONE |
| TH-7 | 9 | 6.7 | 106 | | | | | | | 0.08 | | SAND, CLAYEY (SC) |
| TH-7 | 14 | 8.3 | 116 | -0.1 | 1,000 | | | | | | | WEATHERED CLAYSTONE |
| TH-7 | 29 | 15.0 | 118 | 8.5 | 1,000 | 20,000 | | | | | | CLAYSTONE |
| TH-8 | 9 | 16.7 | 114 | 4.7 | 1,000 | 10,500 | | | | | | CLAYSTONE |
| TH-8 | 14 | 11.8 | 127 | 4.0 | 1,000 | 20,000 | | | | | | CLAYSTONE |
| TH-9 | 4 | 7.0 | 110 | -0.4 | 1,000 | | | | | | | SAND, CLAYEY (SC) |
| TH-9 | 14 | 18.4 | 109 | 8.0 | 1,000 | | | | | | | CLAYSTONE |
| TH-9 | 24 | 9.3 | 131 | 7.0 | 1,000 | | | | | | | CLAYSTONE |
| TH-10 | 4 | 10.2 | 126 | 6.8 | 500 | 10,000 | 4.58 | | | | | CLAY, SANDY (CL) |
| TH-10 | 9 | 11.7 | 127 | 7.7 | 1,100 | 26,000 | 4.65 | | | | | CLAYSTONE/SANDSTONE |
| TH-10 | 14 | 9.5 | 132 | 5.6 | 1,800 | 20,000 | 4.53 | | | | | CLAYSTONE |
| TH-10 | 19 | 15.6 | 117 | 5.5 | 2,400 | 30,000 | 4.47 | | | | | CLAYSTONE |
| TH-10 | 29 | 13.3 | 118 | 4.1 | 3,600 | 17,000 | 4.50 | | | | | CLAYSTONE |
| TH-11 | 9 | 5.4 | 108 | | | | | | | 0.012 | | SAND, CLAYEY (SC) |
| TH-11 | 19 | 16.5 | 115 | 14.7 | 1,000 | | | | | | | CLAYSTONE |
| TH-11 | 24 | 19.9 | 109 | 8.2 | 1,000 | | | | | | | CLAYSTONE |
| TH-12 | 9 | 15.2 | 109 | 0.4 | 1,000 | | | | | | | CLAY, SANDY (CL) |
| TH-12 | 14 | 13.8 | 103 | -0.3 | 1,000 | | | | | | | CLAY, SANDY (CL) |
| TH-13 | 4 | 15.6 | 95 | 0.5 | 1,000 | | | | | | | CLAY, SANDY (CL) |
| TH-13 | 19 | 11.6 | 100 | -1.4 | 1,000 | | | | | | | SANDSTONE |
| TH-14 | 9 | 14.3 | 115 | -1.0 | 1,000 | | | | | | | CLAY, SANDY (CL) |
| TH-14 | 14 | 14.2 | 115 | 5.9 | 1,000 | 11,000 | | | | | | CLAYSTONE |
| TH-14 | 29 | 13.3 | 121 | | | | | 65 | 49 | | 99 | CLAYSTONE |
| TH-15 | 4 | 7.3 | 110 | | | | | 34 | 21 | | 83 | CLAY, SANDY (CL) |

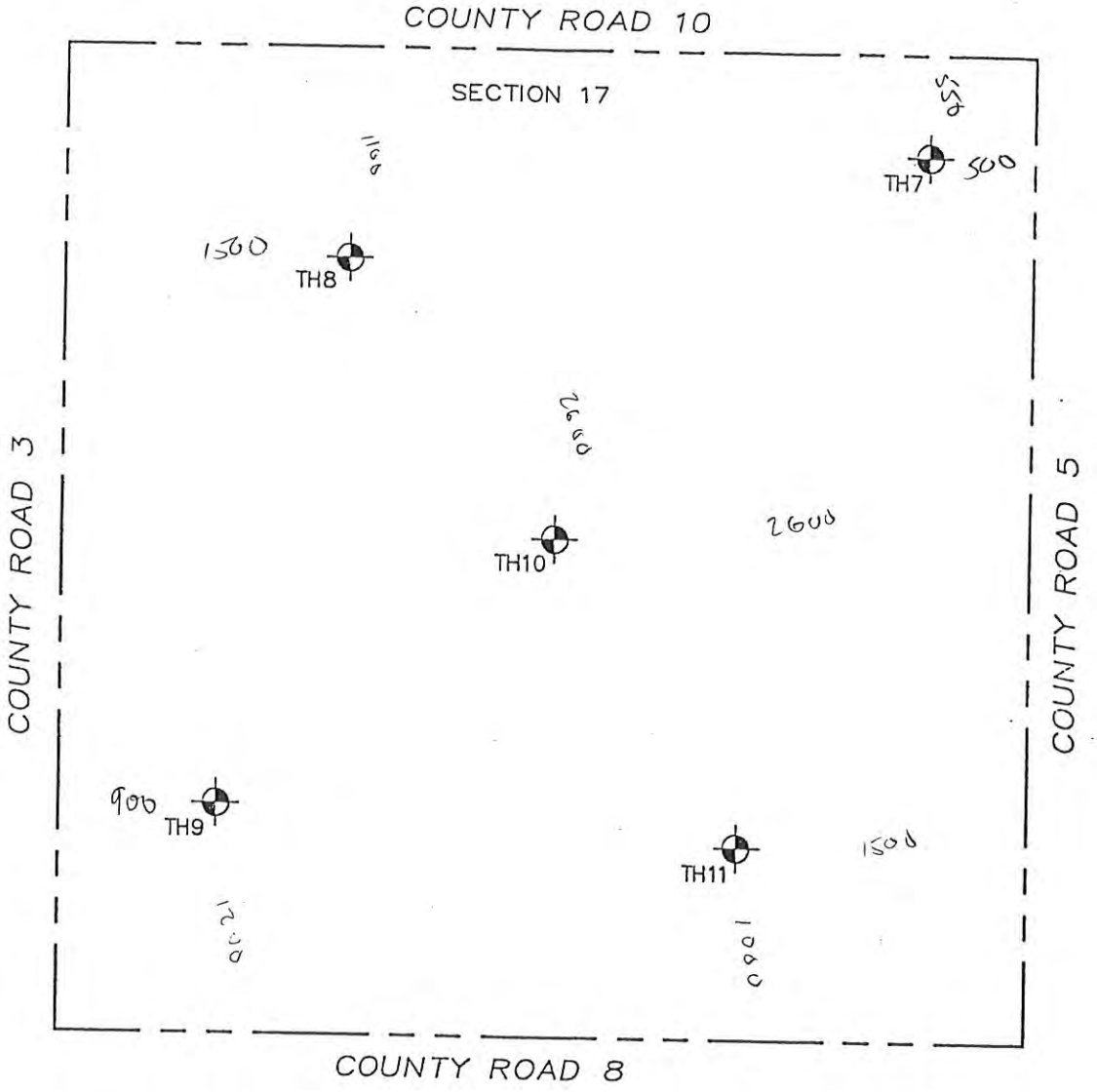
## TABLE C - I

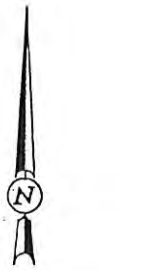
## SUMMARY OF LABORATORY TEST RESULTS

| BORING | DEPTH (ft) | MOISTURE CONTENT (%) | DRY DENSITY (pcf) | SWELL TEST DATA | | | SOIL SUCTION VALUE (pF) | ATTERBERG LIMITS | | SOLUBLE SULFATE CONTENT (%) | PASSING NO. 200 SIEVE (%) | SOIL TYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SWELL (%) | APPLIED PRESSURE (psf) | SWELL PRESSURE (psf) | | LIQUID LIMIT (%) | PLASTICITY INDEX (%) | | | |
| TH-15 | 14 | 15.2 | 119 | 4.6 | 1,000 | | | | | | | CLAYSTONE |
| TH-15 | 24 | 18.2 | 108 | 7.7 | 1,000 | | | | | | | CLAYSTONE |
| TH-16 | 4 | 7.4 | 89 | -4.7 | 1,000 | | | | | | | CLAY, SANDY (CL) |
| TH-16 | 14 | 10.1 | 109 | 1.8 | 1,000 | | | | | | | CLAYSTONE |
| TH-17 | 9 | 11.4 | 114 | 2.7 | 1,000 | | | | | | | CLAY, SANDY (CL) |
| TH-17 | 19 | 9.1 | 126 | 9.0 | 1,000 | | | | | | | CLAYSTONE |
| TH-17 | 34 | 11.0 | 127 | 8.9 | 1,000 | | | | | | | CLAYSTONE |
| TH-18 | 4 | 15.2 | 112 | 1.5 | 1,000 | | | | | | | CLAY, SANDY (CL) |
| TH-18 | 14 | 21.2 | 106 | 13.4 | 1,000 | | | | | | | CLAYSTONE |
| TH-18 | 24 | 12.7 | 122 | 10.9 | 1,000 | | | | | | | CLAYSTONE |
| TH-19 | 4 | 5.2 | 97 | -4.6 | 1,000 | | | 27 | 11 | | 63 | CLAY, SANDY (CL) |
| TH-19 | 9 | 12.5 | 122 | 6.7 | 1,000 | | | | | | | CLAY, SANDY (CL) |
| TH-19 | 24 | 3.8 | 99 | | | | | | | | 30 | SANDSTONE |
| TH-20 | 4 | 14.5 | 115 | 3.4 | 1,000 | | | | | | | CLAY, SANDY (CL) |
| TH-20 | 14 | 21.0 | 110 | 7.3 | 1,000 | 15,000 | | | | | | CLAYSTONE |

## APPENDIX D

## DATA FROM SCOTT, COX & ASSOCIATES, INC. REPORT (November 5, 1998)




Scale: 1" = 1000'

0 250 500 1000

## LEGEND

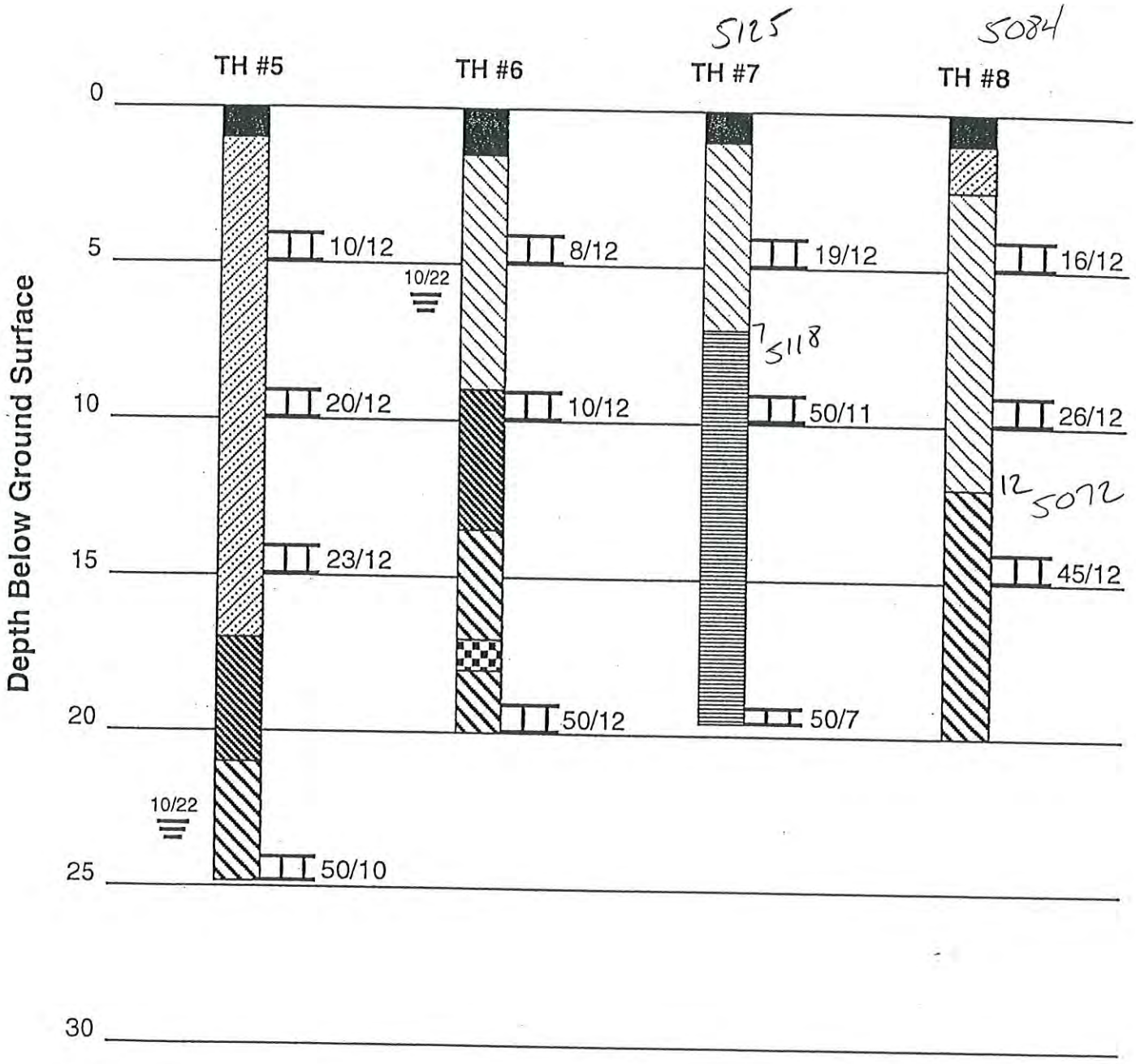
SOILS INVESTIGATION BORING LOCATION

# BORING LOCATION MAP
# FIGURE 1C

SCOTT, COX & ASSOCIATES, INC.
consulting engineers • surveyors
1530 55th Street • Boulder, Colorado 80303
(303) 444 – 3051

11/5/98 JOB NO. 98697 DRAWING NO. 98697

# Graphic Boring Logs

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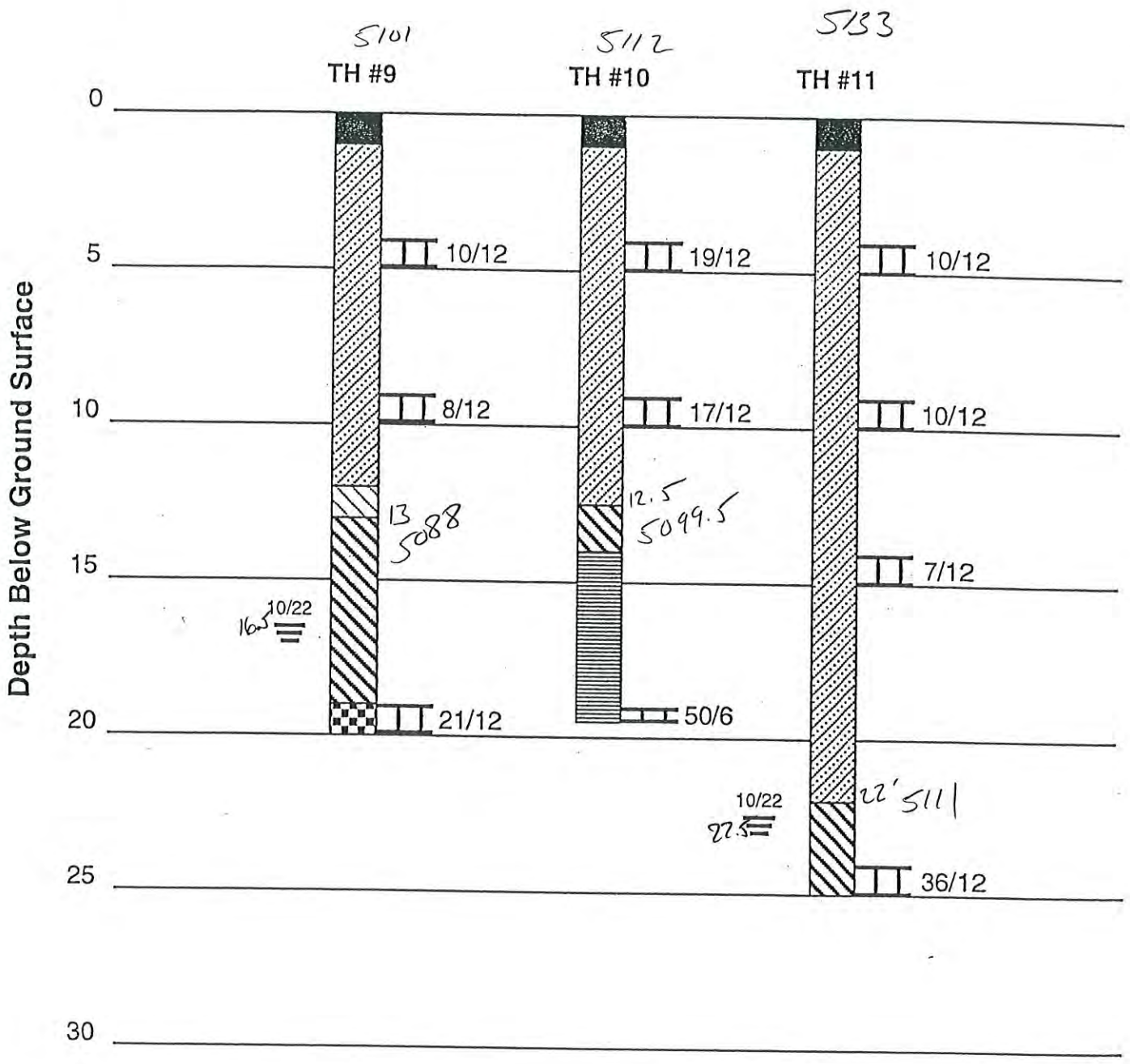
Project 98697

# Graphic Boring Logs

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# Description of Soil Types

Topsoil - Dark brown, silty, sandy to very sandy clay - Contains organics

Light brown to brown, slightly calcarious, silty, slightly sandy to sandy clay - Contains some scattered gravel

Light brown, porous, silty, very sandy clay - Contais some sand lenses

Gray to yellow brown, rust, silty, sandy, weathered claystone - Contains some sulfate crystals and lignite inclusions

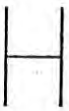
Yellow brown to gray, rust, silty to sandy claystone - Contains some thin ironstone layers and lignite inclusions

Black, carbonaceous shale or lignite

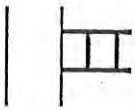
Yellow brown to gray, rust, silty, interbedded sandstone/claystone

Yellow brown, siltstone/sandstone

TH #1 Soils investigation boring number



Indicates a change in soil type - May be gradual.




12/12 indicates that 12 blows of a 140-pound hammer falling 30 inches were required to drive a 2-inch, inside diameter sampler 12 inches.

Indicates the groundwater table and the date that the measurement was taken

## Notes

1. Borings were performed October 19, 1998 with four-inch diameter, continuous flight power augers.

2. Boring logs shown in this report are subject to the limitations, explanations and conclusions of the report.



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Table 1
Summary of Soils Properties
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Project
98697

| PROPERTIES AT NATURAL MOISTURE CONTENT | | | CONSOLIDATION/SWELL | | | | DESCRIPTION |
|---|---|---|---|---|---|---|---|
| Natural Moisture (%) | Natural Dry Density (PCF) | Unconfined Compression (PSF) | Loading (PSF) | Settlement (Dry) (%) | Settlement (Saturated) (%) | Swell (%) | |
| TH # 7 @ 9 | | | | | | | |
| 9.7 | 103.1 | >9000 | 100 | 0.10 | | 0.60 | Yellow brown to gray, interbedded sandstone/claystone |
| | | | 1000 | | 0.50 | | |
| | | | 2000 | | 1.10 | | |
| *0.7 % Swell upon the addition of water* | | | | | | | |
| TH # 8 @ 9 | | | | | | | |
| 10.9 | 104.5 | 9000 | 100 | 0.20 | | 3.40 | Brown, silty, sandy clay |
| | | | 1000 | | | 1.80 | |
| | | | 2000 | | 0.70 | | |
| *3.6 % Swell upon the addition of water* | | | | | | | |
| TH # 9 @ 4 | | | | | | | |
| 6.3 | 92.3 | 4000 | 100 | 0.00 | 2.00 | | Light brown, silty, very sandy clay to clayey sand |
| | | | 1000 | | 5.10 | | |
| | | | 2000 | | 7.70 | | |
| *2.0 % Consolidation upon the addition of water* | | | | | | | |
| TH # 9 @ 19 | | | | | | | |
| 23.0 | 104.8 | >9000 | 100 | 0.70 | | 6.30 | Dark gray, claystone with lignite |
| | | | 1000 | | | 4.10 | |
| | | | 2000 | | | 2.60 | |
| | | | 8000 | | 0.30 | | |
| *7.0 % Swell upon the addition of water* | | | | | | | |
| TH # 10 @ 4 | | | | | | | |
| 9.5 | 92.7 | >9000 | 100 | 0.10 | | 2.10 | Light brown, silty, very sandy clay |
| | | | 1000 | | 2.80 | | |
| | | | 2000 | | 6.40 | | |
| *2.2 % Swell upon the addition of water* | | | | | | | |
| TH # 11 @ 9 | | | | | | | |
| 17.9 | 96.8 | 9000 | 100 | 0.20 | | 1.40 | Light brown, silty, very sandy clay |
| | | | 1000 | | | 0.60 | |
| | | | 2000 | | 0.90 | | |
| *1.6 % Swell upon the addition of water* | | | | | | | |
| TH # 11 @ 14 | | | | | | | |
| 15.6 | 109.1 | 9000 | 100 | 0.20 | | 0.60 | Light brown, silty, very sandy clay to clayey sand |
| | | | 1000 | | | 0.00 | |
| | | | 2000 | | 0.70 | | |
| *0.8 % Swell upon the addition of water* | | | | | | | |
| TH # 11 @ 24 | | | | | | | |
| 18.8 | 105.4 | >9000 | 100 | 0.50 | | 12.10 | Gray, silty claystone |
| | | | 1000 | | | 8.90 | |
| | | | 2000 | | | 5.80 | |
| | | | 8000 | | 0.30 | | |
| *12.6 % Swell upon the addition of water* | | | | | | | |

CTL | THOMPSON
INCORPORATED

# PRELIMINARY
# GEOTECHNICAL INVESTIGATION
# TALLGRASS
# LEON WURL PARKWAY AND
# WELD COUNTY ROAD #5
# ERIE, COLORADO

**Prepared For:**

**SHEA HOMES**
**9135 South Ridgeline Boulevard**
**Suite 100**
**Highlands Ranch, Colorado 80129**

**Attention: Mr. David Vasquez**

**Project No. DN40,507-115**

**June 30, 2005**

1971 West 12th Avenue | Denver, Colorado 80204 | Telephone: 303-825-0777 Fax: 303-825-4252

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APPENDIX D – GUIDELINE SUB-EXCAVATION SPECIFICATIONS

## SCOPE

This report presents the results of our Preliminary Geotechnical Investigation of Tallgrass generally located northwest of the intersection of Leon Wurl Parkway and Weld County Road #5 in Erie, Colorado (Fig. 1). The parcel consists of about 950 acres and is planned for single and multi-family residential development. Our purpose was to evaluate the subsurface conditions to assist in site acquisition assessment and preliminary planning and development of the site. The report includes descriptions of subsoil and ground water conditions found in our exploratory borings, and discussions of site development as influenced by geotechnical considerations. The scope was described in our proposal (DN 05-0381) dated April 28, 2005. Environmental and mine subsidence investigations are not within the scope of our investigation.

The report was prepared based on conditions disclosed by our exploratory borings, results of laboratory tests, engineering analysis of field and laboratory data, and our experience with similar conditions. The criteria presented in the report are intended for preliminary planning purposes. The test holes are widely spaced. Additional detailed investigations will be required for site development and to design building foundations and pavements. A summary of finding and conclusions is presented below with more complete descriptions and results of field and laboratory tests included in the report.

## SUMMARY OF FINDINGS AND CONCLUSIONS

1. The site is judged suitable for the planned development. The primary geotechnical concern for this site is the presence of expansive clays and claystone bedrock. We believe this concern can be mitigated with proper planning, engineering, design, and construction. We believe there are no geotechnical constraints at this site that would preclude the proposed construction.

2. Subsurface conditions found in the borings generally consisted of clayey sands and sandy clays underlain by weathered and comparatively unweathered bedrock. Bedrock was encountered in all of our borings at depths ranging from about 3 to 19 feet. The sand is considered low swelling or non-expansive. Some sands are loose.

Select clay and claystone samples exhibited compression to very high swell. The sands and sandstone are generally low swelling or non-expansive. Low density, collapsing clays were also identified at two test holes (TH-16 and TH-19).

3. Ground water was measured in two borings (TH-15 and TH-20) during our investigation at depths of 15.5 and 31.5 feet below the existing ground surface. Current ground water conditions are not anticipated to significantly affect site development. An underdrain system below the sanitary sewer is recommended.

4. Preliminary information indicates the proposed single or multi-family residences can be constructed on footings with minimum deadload, post-tensioned, slab-on-grade (PTS) foundations, or drilled piers bottomed in bedrock. Cuts and fills during site grading may influence the type of foundation recommended for each lot. Footings or PTS foundations can be anticipated in low swell areas. Drilled piers will be recommended if thick layers of moderate or high swelling clay and claystone bedrock are encountered near anticipated foundation levels.

   Ground modification consisting of sub-excavation can be used to reduce swell potential for areas with moderate and high swelling soils or bedrock. Sub-excavation will likely allow use of footings or pads provided the sub-excavation fill is low swelling. Some claystone exhibited high plasticity and high swell under overburden pressure. Deeper sub-excavation (more than 10 feet below basement footings) may be necessary to reduce heave. Extra effort to breakdown claystone fill should be anticipated. If the builder wishes to consider ground modification, further investigation should be performed to better delineate potential sub-excavation areas and appropriate depth of sub-excavation.

5. Based on the preliminary investigation, we judge the risk of poor slab performance will be low to very high for single-family residences with basement construction at this site (Fig. 4). The preliminary data suggest risk may be low for about 25 percent of the site, and moderate to very high for the remaining 75 percent. Site grading with deep cut or fill will likely affect the risk evaluation. For multi-family buildings without basement construction, the risk may be lower due to the possibility of a greater depth to expansive clay and claystone bedrock.

6. We recommend foundation drains be installed around the perimeter of below-grade living areas. Foundation drains with gravity discharge to an underdrain is a preferred system. Underdrain outfall should be adequately deep and above acceptable flood water level to reduce the risk of backflow which may result in basement flooding. Foundation drain also can outfall to a sump pit provided with a pump to remove water. The pump should discharge beyond the limits of the foundation backfill.

7. The near-surface sand, clay and claystone possess good to poor pavement support qualities. We anticipate about 5 to 7 inches of asphalt pavement for residential streets. Thicker pavements should be anticipated for collector streets. A subgrade investigation and pavement design should be performed after site grading is complete.

8. Overall surface drainage should be designed to provide rapid run-off away from the proposed structures. Water should not be allowed to pond near the crest of slopes, on or adjacent to pavements. Permanent slopes should be re-vegetated to reduce erosion.

## SITE CONDITIONS

Tallgrass is generally located northwest the intersection of Leon Wurl Parkway and Weld County Road #5 in Erie, Colorado (Fig. 1). The site contains about 950 acres. Portions of the site have been used as farmland. Gas wells are scattered across the site. Coal Creek is located to the west of the site. Water was flowing in the drainage at the time of this investigation. Erie Cemetery is located in west portion of the site adjacent to Weld County Road #3. The Union Pacific Railroad runs through the northern parcel and along the western property line. A school building is located east of the site. Residential development is located north and south of the site. The ground surface slopes down towards the west. Total relief across the site is about 135 feet, from elevation 5165 to 5030. The ground surface along the western property line appeared to be stable. We did not evaluate slope stability. Existing ground surface contours are shown on Fig. 1.

## PREVIOUS INVESTIGATION

A Preliminary Subsurface Investigation was performed for a portion of this site by Scott, Cox & Associates, Inc. (Project No. 98697; report dated November, 1998). Information from this previous investigation was reviewed and evaluated as part of this investigation.

## PROPOSED DEVELOPMENT

Plans are preliminary at this time. The site is proposed for development and construction of single and multi-family residences. Site grading plans are not available. We anticipate one to two-story, wood framed structures with attached garages for the single family and 3 to 8-plex, wood framed structures for the multi-family. Attached and unattached garages are anticipated for multi-family. Paved streets will be included in the development.

## SUBSURFACE CONDITIONS

Subsurface conditions were investigated by drilling 20 borings to depths of 25 to 35 feet at widely spaced locations as shown on Fig. 1. Prior to drilling, Aztec Consultants, Inc. staked and surveyed boring locations and elevations. Borings were drilled using 4-inch diameter, continuous-flight auger and a truck-mounted drill rig. The drilling operations were observed by our field representative who logged the soils and obtained samples for laboratory testing. Summary logs of the soils and bedrock found in the borings, results of field penetration resistance tests, and laboratory test results are presented in Appendix A. Samples obtained during drilling were returned to our laboratory where they were visually classified and samples were selected for testing. The results of laboratory testing are presented in Appendix B and summarized on Table B-1.

Subsurface conditions found in the borings varied but generally consisted of clayey sands and sandy clays underlain by weathered and comparatively unweathered claystone, sandstone, and interbedded claystone/sandstone bedrock. Bedrock was found in all borings at depths ranging from about 3 to 19 feet (elevation 5051 to 5134.5). Estimated depth to bedrock and bedrock elevation are presented on Figs. 2 and 3; respectively.

The sands were loose to medium dense based on field penetration resistance tests. Sands were encountered in 8 of the 20 borings at the ground surface or below the clay. A gravel layer was encountered in one boring below the clay. Thickness

ranged from 2 to 13.5 feet. One sand sample tested for swell-consolidation exhibited slight compression (0.4 percent) when wetted under an applied pressure of 1,000 psf. The sands are considered non to low expansive. Swell tests conducted after wetting under an applied pressure of about 1,000 psf are summarized in Table A.

Clays were encountered in 16 of the 20 borings either at the ground surface or below the sands. The clays were medium stiff to very stiff based on field penetration resistance tests. Samples of the clays exhibited compression (4.7 percent) to very high swell (6.7 percent). Two low density, compressible clay samples were encountered in test holes TH-16 and TH-19. Two clay samples contained 63 and 83 percent silt and clay sized particles (passing the No. 200 sieve) with liquid limits of 27 and 34 percent and plasticity indices of 11 and 21 percent.

Weathered and relatively unweathered claystone, sandstone, and interbedded claystone/sandstone bedrock was encountered in all 20 borings at depths between about 3 to 19 feet (elevation 5051 to 5134.5) below the existing ground surface. Lignite seams may be encountered within the bedrock profile. The bedrock was weathered to very hard. Samples of the bedrock exhibited compression (0.4 percent) to very high swell (14.7 percent), with about 85 percent showing high or very high swell when wetted under an applied pressure of 1,000 psf. Selected claystone samples also exhibited high swell (4.1 to 9.6 prcent) after wetting under overburden pressures (1,800 to 3,600 psf). Claystone samples exhibited high plasticity, and contained 99 and 100 percent silt and clay sized particles with liquid limits of 65 and 73 percent and plasticity indices of 49 and 54 percent.

## TABLE A
## SUMMARY OF SWELL TEST RESULTS

| Soil Type | Compression | Range of Measured Swell (%)* | | | |
|---|---|---|---|---|---|
| | | Low 0 to <2 | Moderate 2 to <4 | High 4 to <6 | Very High ≥6 |
| | Number of Samples and Percent | | | | |
| Clayey Sand | 1<br>100% | 0<br>0% | 0<br>0% | 0<br>0% | 0<br>0% |
| Sandy Clay | 4<br>33% | 5<br>42% | 2<br>17% | 0<br>0% | 1<br>8% |
| Weathered Claystone | 2<br>50% | 0<br>0% | 0<br>0% | 0<br>0% | 2<br>50% |
| Claystone Bedrock | 0<br>0% | 3<br>13% | 0<br>0% | 5<br>23% | 14<br>64% |
| Overall Number | 7 | 8 | 2 | 5 | 17 |
| Overall Percent | 18% | 20% | 5% | 13% | 44% |

*Swell measured after wetting under an applied pressure of about 1,000 psf.

Ground water was measured in two borings (TH-15 and TH-20) during our investigation at depths of 15.5 and 31.5 feet below the existing ground surface. Ground water levels are expected to vary seasonally and may rise after development as irrigation of landscaping begins. Site grading and installation of underdrains below the sanitary sewer will change ground water depth. Current ground water conditions are not anticipated to affect site development. We generally recommend excavations be limited to at least 3 feet, are preferably 5 feet, above measured ground water levels. An underdrain system below the sanitary sewer is recommended, where feasible.

## ESTIMATED SWELL POTENTIAL

Based on the subsoil profiles, swell test results, and our experience, we have prepared Fig. 4 showing preliminary estimate of swell potential or slab performance risk. Based on laboratory data, we calculated potential heave at the existing ground surface on the order of 12 inches with 15 to 20-foot depth of wetting for area where high and very high swelling soils were encountered. Potential heave of 1 to 3 inches is possible in low to moderate swell areas. Due to widely spaced borings and limited testing, variation between borings should be anticipated. Site grading with fill or cut

will affect the estimated swell potential. In addition to swelling soils, some of the sands were loose and some clays have low dry densities. These upper sand and clays may compress or settle under footings and slabs.

## SITE DEVELOPMENT

The primary geotechnical concern we believe will influence development of this site is the presence of expansive soils. We believe these impacts can be mitigated with proper planning, engineering, design, and construction.

### Overlot Grading

Grading plans are not available. We estimate about 75 percent of the site may have moderate to very high swell risk. It is possible a higher percentage of moderate or high swelling clays may be found in the detailed, design level investigation when test holes are drilled on each lot and more swell tests are performed.

Sub-excavation or moisture injection are ground modification methods commonly used to reduce the swell potential for areas with moderate/high swelling soils. We believe moisture injection may not be practical at this site due to relatively shallow bedrock. Our experience suggests sub-excavation would likely allow wider use of footing or pad foundations as well as enhance performance of slab-on-grade basement and garage floors provided the processed fill exhibit low swell. Sub-excavation is discussed in the following section of this report.

The ground surface in areas to be filled should be stripped of vegetation, scarified, and moisture conditioned and compacted to at least 95 percent of standard Proctor maximum dry density (ASTM D 698). We anticipate stripping will require cuts of 4 to 6 inches. Permanent cut and fill slopes should be no steeper than 3:1 (horizontal to vertical) and be seeded or mulched to reduce erosion.

The properties of the fill will affect the performance of foundations, slabs-on-grade, utilities, and pavements. The on-site soils can be used as site grading fill

provided deleterious, organic materials are removed. Fill should be placed in thin loose lifts, moisture conditioned and densely compacted prior to placement of the next lift. Our experience has shown clay fill moisture treated to optimum moisture content or above will likely exhibit lower swell compared to clay fill receiving the same compactive effort but moisture treated below optimum moisture content. Fill should be compacted to at least 95 percent of standard Proctor maximum dry density (ASTM D 698). Clay and claystone fill should be moistened to between 1 and 4 percent above optimum moisture content and sand fill should be moistened to within 2 percent of optimum moisture content. The placement and compaction of site grading fill should be observed and tested by a representative of our firm during construction. Guideline overlot grading specifications are presented in Appendix C.

## Sub-Excavation

Based on field and laboratory test data and our experience in the area, we estimate about 75 percent of the site contains moderate to very high swell soils at depths likely to influence foundation systems, as shown on Fig. 4. The risk may be lower for buildings without basement construction depending upon site grading. Drilled piers are normally recommended for moderate/high swell lots. Sub-excavation of the areas of expansive soils and re-working the excavated material as moisture conditioned fill to reduce the impacts of swelling on the proposed construction. If the builder wishes to consider sub-excavation, further investigation should be performed to better delineate potential sub-excavation areas and evaluate impacts of ground water on sub-excavation. Construction schedule will be affected by sub-excavation.

Typical sub-excavation involving removal of the expansive soils to depths of about 10 feet below bottom of foundations (16 to 18 feet from the ground surface) and replacement with fill at above optimum moisture contents. Some claystones have high plasticity and unusually high swells after wetting under overburden pressures. A few claystone samples had fairly high natural moisture contents (21 to 28 percent) and still possessed high swell (5.8 to 13.4 percent). Deeper sub-excavation (10 to 15 feet below basement footings) may be necessary to reduce the swell and heave. We recommend additional investigation be performed to evaluate the effectiveness and

appropriate depth of sub-excavation if sub-excavation is desired. We believe ground modification involving sub-excavation and replacement could be used on portions of this site to enhance foundation and concrete flatwork performance. Our experience suggests sub-excavation would likely allow wider use of footing or pad foundations as well as enhance performance of slab-on-grade basement and garage floors provided the processed fill possesses low swell.

Sub-excavation does not produce a non-swelling site. The degree of success in lowering swell is dependent on contractor procedures in processing and moisture conditioning the soils. The process is slower than "normal" cut/fill operations and requires an experienced contractor and full-time observation/testing.

The bottom of the sub-excavated area should extend laterally at least 5 feet and preferably 10 feet beyond building footprints at the limits of the excavation to ensure foundation elements are constructed over moisture conditioned, compacted fill. The remaining areas under driveway, curb, gutter, sidewalk and street pavement can be sub-excavated to about 3 to 5 feet or greater to improve performance. The contractor should provide a construction disc to break down fill materials and anticipate use of push-pull scraper operations and dozer assistance. Extra effort should be anticipated to break down the claystone fill and obtain uniform moisture in fill. The operation will be relatively slow. Special precautions should be taken to compact the fill at corners, edges, ends, and access ramps of the sub-excavation because it is difficult for large construction equipment to reach these areas. The contractor should use proper equipment to compact fill at these locations.

Clay fill in sub-excavation areas should be moisture conditioned to between 1 and 4 percent above optimum moisture content, with an average moisture content each day of at least 1.5 percent above optimum. Sand fill should be moisture conditioned to within 2 percent of optimum and not included within the daily average. The fill should be compacted to at least 95 percent of standard Proctor maximum dry density (ASTM D 698). Higher density requirement (100 percent) may be used for fill placed 20 feet or deeper below the finished grades to reduce potential settlement. Our representative should observe and test compaction of the fill on a full-time basis. The

swell of the moisture conditioned fill should be tested during and after fill placement to evaluate swelling characteristics of the fill and appropriate foundation systems. The sub-excavation limit and depth should be periodically surveyed by a surveyor and "as-built" sub-excavation plans should be prepared. The "as-built" sub-excavation plans should be provided to sales and construction staff for proper selection of models and siting houses inside the sub-excavation limits. Appendix D contains guideline specifications for sub-excavation.

Once fill is placed, it is important that measures be planned to reduce drying of the near-surface materials. For example, covering portions of the site planned for construction during later dates with a thin, loose lift of fill, or regular watering of the fill surface should be considered. If the fill dries excessively prior to building and pavement construction, it may be necessary to rework the drier materials just prior to paving and installing foundations.

The deep sub-excavation and fill placement with high moisture content requirement normally associated with this procedure results in higher initial costs. However, these costs may be partially recaptured or savings realized due to reduced construction cost for normal foundations and slabs-on-grade versus deep drilled piers. The process will also likely enhance performance of concrete flatwork such as driveways, sidewalks, and pavements, potentially reducing long-term maintenance. In order for the procedure to perform properly, close control of fill placement to specifications is required. The placement and compaction of fill should be observed and density tested by a representative of our firm during construction.

## Underdrain

Ground water levels will fluctuate with change in seasons and will likely rise after development. The use of underdrain systems below sanitary sewer mains and services is a common method to control ground water in response to development. We believe installation of underdrains also helps to control deep wetting, which can lead to higher frequency of heave-related foundation problems. Underdrain should be daylighted and discharged by gravity at outfalls that are below basement levels and

also above acceptable future flood water level to reduce the risk of water backflow through the underdrain and causing basement flooding. Where feasible, we recommend plans for this site include underdrains incorporated into sanitary sewer design. Underdrains should also be installed below sewer service lines to each residence planned in this area so that foundation drains can be connected to the underdrain system as a gravity outlet (Fig. 5). Recommended underdrain sizes are shown in the table below.

UNDERDRAIN SIZING

| Slope = 0.005 (0.5 percent) | | | | |
|---|---|---|---|---|
| Pipe Size (inches) | 4 | 6 | 8 | 10 |
| Maximum Number of Residences | 50 | 100 | 200 | 400 |
| **Slope = 0.01 (1.0 percent)** | | | | |
| Pipe Size (inches) | 4 | 6 | 8 | 10 |
| Maximum Number of Residences | 75 | 150 | 300 | 600 |
| **Slope = 0.02 (2.0 percent)** | | | | |
| Pipe Size (inches) | 4 | 6 | 8 | |
| Maximum Number of Residences | 100 | 300 | 600 | |

Note: Minimum slope of the underdrain will govern pipe size and maximum number of residences serviced.

The underdrain should consist of 3/4 to 1.5-inch clean, free draining gravel surrounding a perforated PVC pipe (Fig. 6). We believe use of perforated pipe below sanitary sewer mains is the most effective approach to control ground water. The pipe should be sized for anticipated flow (see table above). The line should consist of smooth, perforated or slotted rigid PVC pipe placed at a grade of at least 0.5 percent. A positive cutoff (concrete) should be constructed around the sewer pipe and underdrain pipe immediately downstream of the point where the underdrain pipe leaves the sewer trench (Fig. 7). Solid pipe should be used down gradient of this cutoff wall. The underdrains should be designed to discharge to a gravity outfall and be provided with a permanent concrete headwall and trash rack. The risk of underdrain backflow and subsequent basement flooding should be evaluated in planning and design of the underdrain. The underdrain should be provided with clean-outs and be maintained by the homeowner's association or another entity.

## Utility Construction

We believe excavations for utility installation can be performed with normal heavy-duty equipment. Utility trenches should be sloped or shored to meet local, state, and federal safety regulations. Based on our investigation, we believe the sand classifies as Type C soil, the clay classifies as Type B soil, and bedrock classifies as Type A or B soil depending upon degree of weathering and fracturing of the bedrock based on Occupational Safety and Health Administration (OSHA) standards. Excavation slopes specified by OSHA are dependent upon soil types and ground water conditions encountered. Seepage and ground water conditions in trenches may downgrade the soil type. Contractors should identify the soils encountered in the excavation and refer to OSHA standards to determine appropriate slopes. Excavations deeper than 20 feet should be designed by a professional engineer.

Water and sewer lines are usually constructed beneath paved roads. Compaction of trench backfill can have a significant effect on the life and serviceability of pavements. We believe trench backfill should be placed in thin, loose lifts, and moisture conditioned to between optimum and 3 percent above optimum moisture content for clays and within 2 percent of optimum moisture content for sands. Trench backfill should be compacted to at least 95 percent of standard Proctor maximum dry density (ASTM D 698). The placement and compaction of fill and backfill should be observed and tested by our firm during construction.

## Pavements

The soils found on-site possess good to poor pavement support qualities. We anticipate about 5 to 7 inches of asphalt pavement for residential streets. Thicker pavements should be anticipated for collector streets; we estimate 8 to 10 inches of asphalt may be required. A subgrade investigation and pavement design should be performed after overlot grading is complete.

## BUILDING CONSTRUCTION CONSIDERATIONS

The following discussions are preliminary and are not intended for design or construction. After grading is completed, design-level investigations should be performed on a lot-specific basis.

### Foundations

Preliminary information indicates single-family structures on the site can be constructed on footings or drilled pier foundations. We anticipate post-tensioned, slab-on-grade foundation systems for the multi-family structures with no basements. Cuts and fills during site grading may influence the type of foundation recommended on each lot. We estimate about 25 percent of the lots may utilize shallow foundations such as footings with minimum deadload, spread footings, or post-tensioned slab-on-grade. Footing design soil pressures may range between 1,500 and 3,000 psf considering the presence of some loose sands at the site. About 75 percent of site is estimated to contain moderate to very high swell soils that could require drilled pier foundations.

Ground modification can be used to reduce swell of swelling soils. Our experience suggests sub-excavation would likely allow use of footing or pad foundations provided the processed fill exhibits low swell. If the builder wishes to consider sub-excavation, further investigation should be performed to better delineate potential sub-excavation areas.

### Floor System and Slab-On-Grade Construction

Our preliminary investigation indicates the risk of poor slab performance will be low to very high for this site (Fig. 4). The preliminary data suggest risk may be low for about 25 percent of the site and moderate to very high for the remaining 75 percent, if normal overlot grading occurs. Sub-excavation may be considered to enhance performance of slab-on-grade floors on moderate or high risk sites.

## Surface Drainage

The performance of this development will be significantly influenced by surface drainage. When developing an overall drainage scheme, consideration should be given to drainage around each structure. Drainage should be planned so that surface runoff is directed away from foundations and is not allowed to pond adjacent to or between structures, or over pavements. Attention should be paid to compact the soils behind curb and gutter adjacent to the streets and in utility trenches. Proper compaction of backfill behind basement walls and improving surface drainage around each residence are essential to reduce the risk of wetting and potential settlements of sub-excavation fill. If surface drainage between preliminary development and construction phases is neglected, future performance of the roadways, flatwork and foundations may be poor. When considering landscaping for common areas, we recommend the use of xeriscaping that requires little watering.

## CONCRETE

Concrete in contact with soils can be subject to sulfate attack. We measured water-soluble sulfate concentrations between 0.012 and 0.5 percent in three samples from this site. One sample had a sulfate concentration greater than 0.2 percent. Water-soluble sulfate concentrations between 0.2 and 2 percent indicate Class 2 exposure to sulfate attack, according to the American Concrete Institute (ACI). For sites with Class 2 sulfate exposure, ACI recommends using a cement meeting the requirements for Type V (sulfate resistant) cement or the equivalent, with a maximum water-to-cementitious material ratio of 0.45 and air entrainment of 5 to 7 percent. As an alternative, ACI allows the use of cement that conforms to ASTM C 150 Type II requirements, if it meets the Type V performance requirements (ASTM C 452) of ACI 201, or ACI allows a blend of any type of portland cement and fly ash that meets the performance requirements (ASTM C 1012) of ACI 201. In Colorado, Type II cement with 20 percent Class F fly ash usually meets these performance requirements. The fly ash content can be reduced to 15 percent for placement in cold weather months, provided a water-to-cementitious material ratio of 0.45 or less is maintained. ACI also indicates

concrete with Class 2 sulfate exposure should have a minimum compressive strength of 4,500 psi.

Sulfate attack problems are comparatively rare in this area when quality concrete is used. Considering the range of test results, we believe risk of sulfate attack is lower than indicated by the few laboratory tests performed. The risk is also lowered to some extent by damp-proofing the surfaces of concrete walls in contact with the soil. ACI indicates sulfate resistance for Class 1 exposure can be achieved by using Type II cement, a maximum water-to-cementitious material ratio of 0.50, and a minimum compressive strength of 4,000 psi. We believe this approach should be used as a minimum at this project. The more stringent measures outlined in the previous paragraph will better control risk of sulfate attack and are more in alignment with written industry standards.

The use of sulfate resistant concrete is most appropriate for foundation elements. Surface flatwork (such as sidewalks, driveways and patios) is usually constructed with a mix that exhibits moderate resistance to sulfate attack. We have rarely seen instances of sulfate attack on surface flatwork.

The risk of poor finish quality often associated with retardation of set and plastic shrinkage cracking caused by the use of Type V cement, fly ash, and/or low water-to-cementitious material ratios is probably greater than the risk of sulfate attack. Concrete containing Type II cement and at least 564 pounds of cementitious materials per cubic yard provides better resistance to sulfate attack than the concrete that has typically been used in the past, yet results in minimal finishing problems. This approach may be considered for sites where high sulfate levels are found. A minimum compressive strength of 4,000 psi, a maximum water-to-cementitious material ratio of 0.45, and an air content of 5 to 8 percent will provide some sulfate resistance, as well as some protection against surface damage due to freeze-thaw cycles.

## RECOMMENDED FUTURE INVESTIGATIONS

Based on the results of this investigation and the proposed development, we recommend the following investigations be performed by our firm:

1. Further investigation of specific areas to evaluate the effectiveness and better delineate areas that would benefit from sub-excavation (if considered);

2. Subgrade Investigation and Pavement Design after grading;

3. Design-level Soils and Foundation Investigation for each lot after site grading; and,

4. Construction testing and observation during site development, including compaction testing of site grading fill, utility trench backfill, pavements, concrete tests, and foundation installation observations.

## LIMITATIONS

Our borings were widely spaced to provide a general characterization of subsurface conditions for preliminary assessment and planning of site development and residence construction. Conditions between borings will likely vary. We believe this investigation was conducted in a manner consistent with that level of care and skill ordinarily used by geotechnical engineers practicing in this area at this time. No warranty, express or implied, is made.

If we can be of further service in discussing either the contents of this report or the analysis of the influence of subsurface conditions on the design of the proposed development, please call.

CTL | THOMPSON, INC.

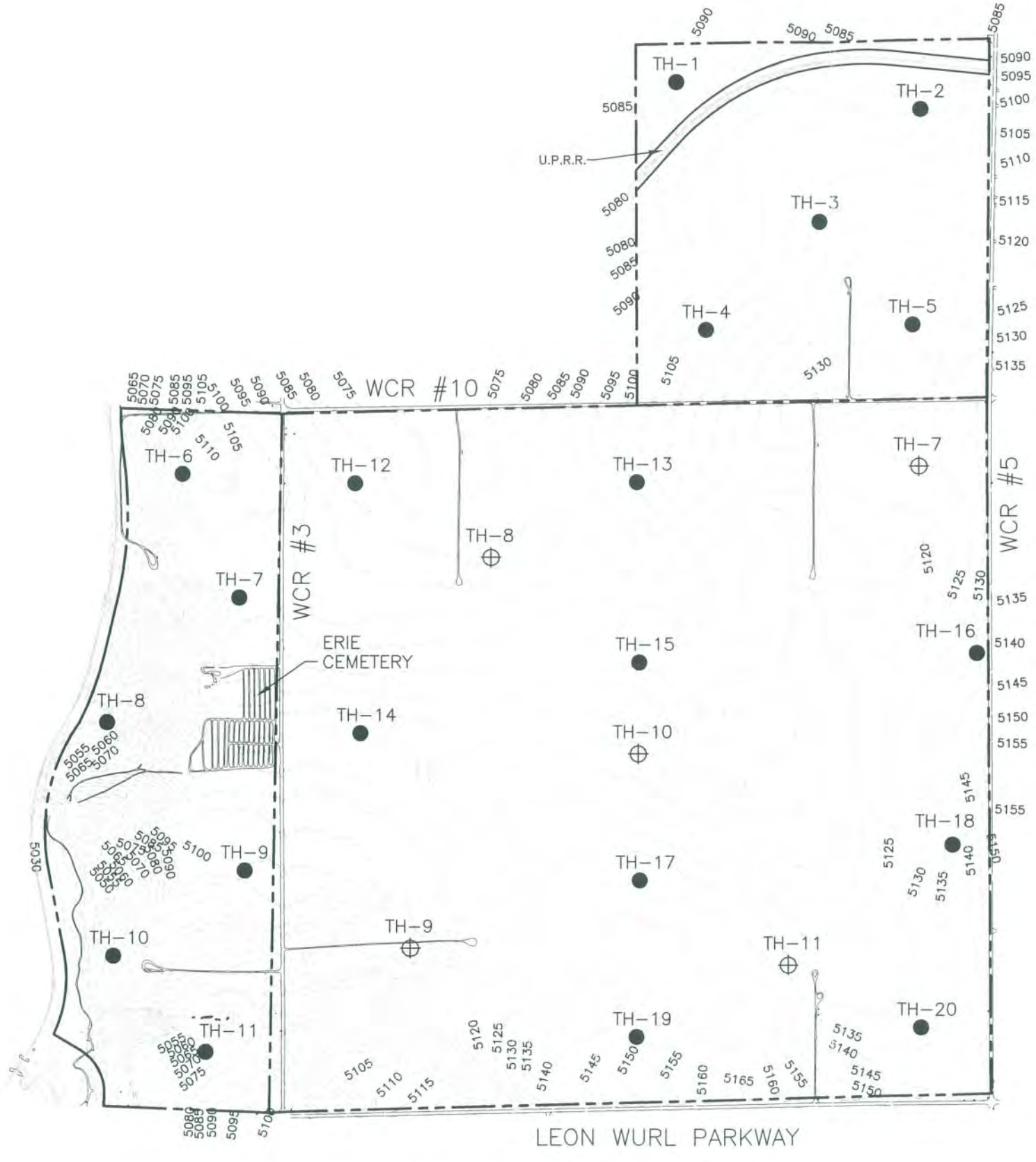
Reviewed by:

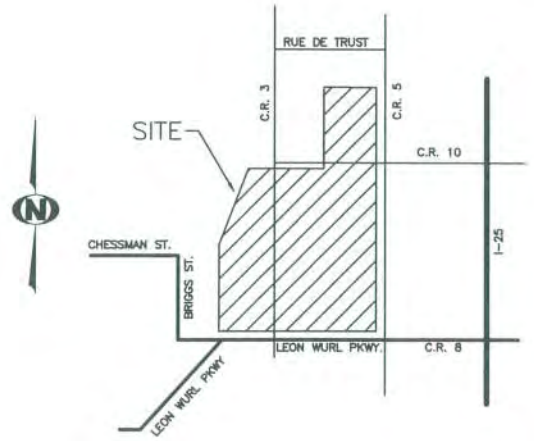
Shawn Fitzhugh, P.E.
Project Manager

Nan-Ping Hsieh, P.E.
Associate

SF:NPH/sf/bg
(5 copies)

SCALE: 1"= 1000'




VICINITY MAP
NOT TO SCALE

LEGEND:

TH-1 ● INDICATES APPROXIMATE LOCATION OF EXPLORATORY BORING

TH-1 ⊕ INDICATES APPROXIMATE LOCATION OF EXPLORATORY BORING DRILLED BY SCOTT, COX & ASSOCIATES, INC. (PROJECT NO. 98697; REPORT DATED NOVEMBER 1998).

5100 INDICATES EXISTING GROUND SURFACE ELEVATION (FEET)

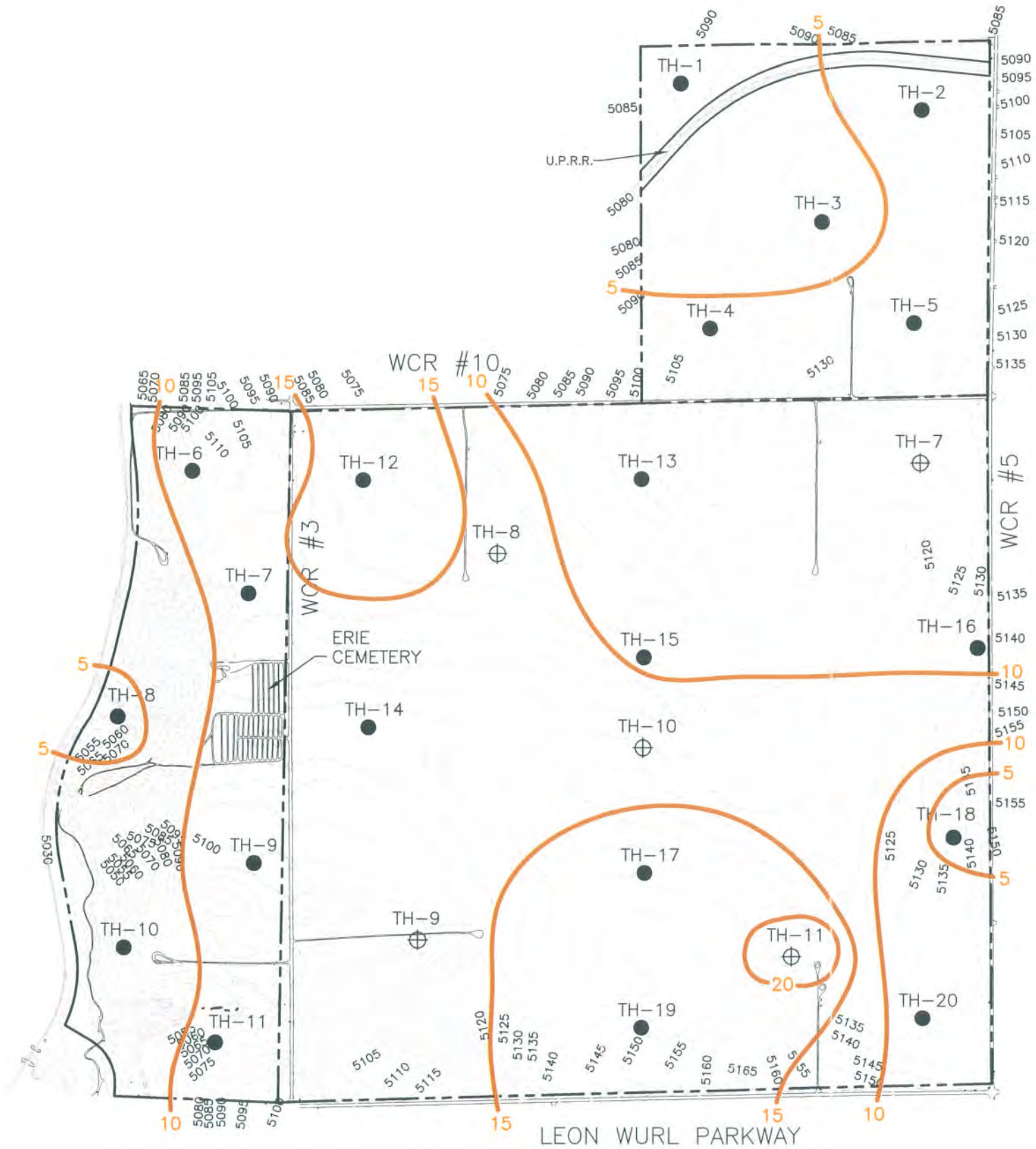
DN40507-115_F1-R1-D 6/29/05 BP/SF

Shea Homes
TALLGRASS
Project No. DN40,507-115

# Locations of Exploratory Borings

Fig. 1

SCALE: 1"= 1000'




LEGEND:

- TH-1 ● INDICATES APPROXIMATE LOCATION OF EXPLORATORY BORING
- TH-1 ⊕ INDICATES APPROXIMATE LOCATION OF EXPLORATORY BORING DRILLED BY SCOTT, COX & ASSOCIATES, INC. (PROJECT NO. 98697; REPORT DATED NOVEMBER 1998).
- 5100 INDICATES EXISTING GROUND SURFACE ELEVATION (FEET)
- 5 — INDICATES ESTIMATED DEPTH TO BEDROCK (FEET)

NOTE: THIS ESTIMATE WAS BASED UPON A SUBJECTIVE ANALYSIS OF DRILL HOLE DATA AND MAY NOT REFLECT LOCAL VARIATIONS

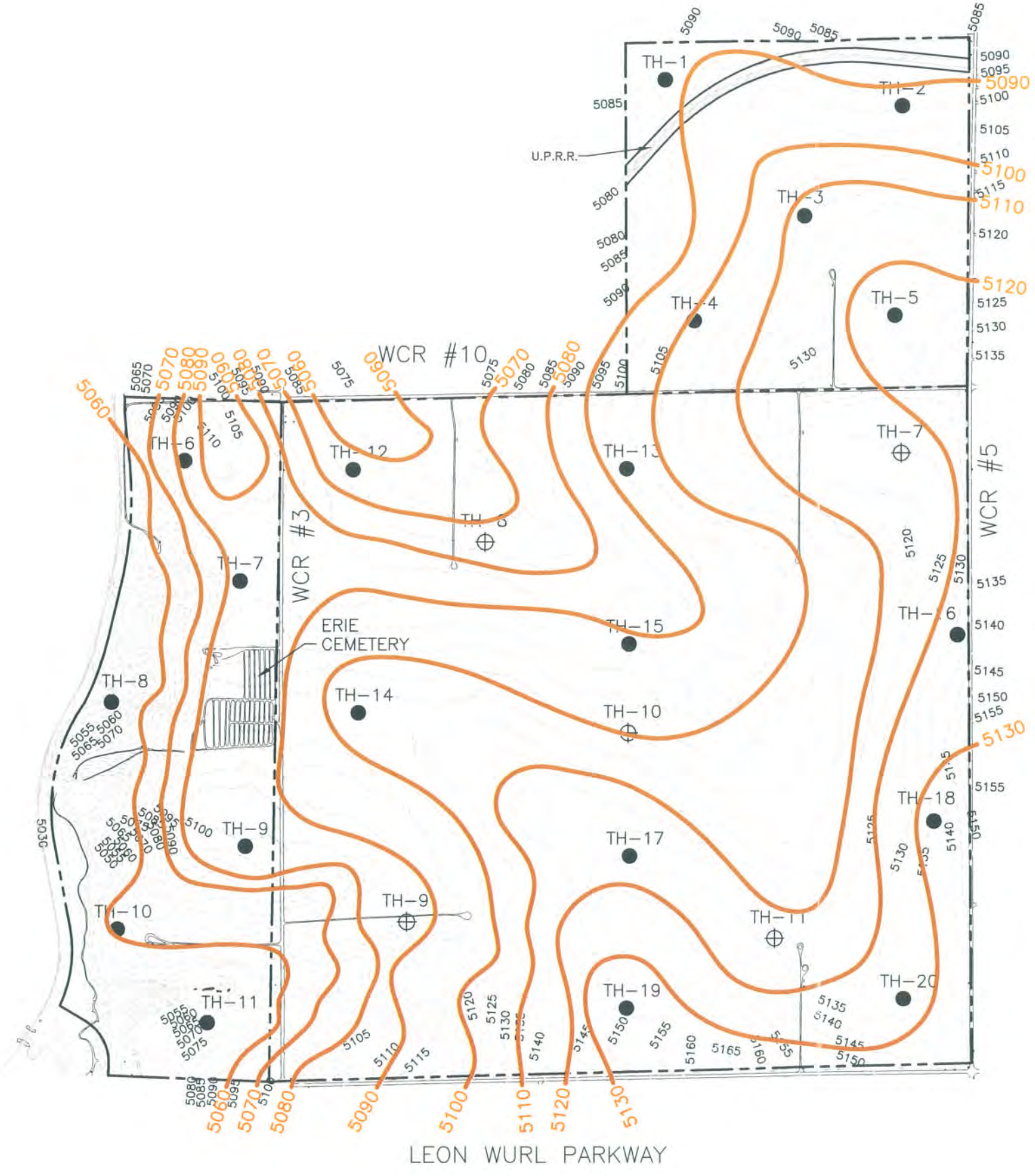
DN40507-115_F2-R1-0 6/29/05 BP/SF

Shea Homes
TALLGRASS
Project No. DN40,507-115

# Estimated Depth to Bedrock

Fig. 2

SCALE: 1"= 1000'




LEGEND:

- TH-1 ● INDICATES APPROXIMATE LOCATION OF EXPLORATORY BORING
- TH-1 ⊕ INDICATES APPROXIMATE LOCATION OF EXPLORATORY BORING DRILLED BY SCOTT, COX & ASSOCIATES, INC. (PROJECT NO. 98697; REPORT DATED NOVEMBER 1998).
- 5100 INDICATES EXISTING GROUND SURFACE ELEVATION (FEET)
- 5060 INDICATES ESTIMATED BEDROCK ELEVATION (FEET)

NOTE: THIS ESTIMATE WAS BASED UPON A SUBJECTIVE ANALYSIS OF DRILL HOLE DATA AND MAY NOT REFLECT LOCAL VARIATIONS

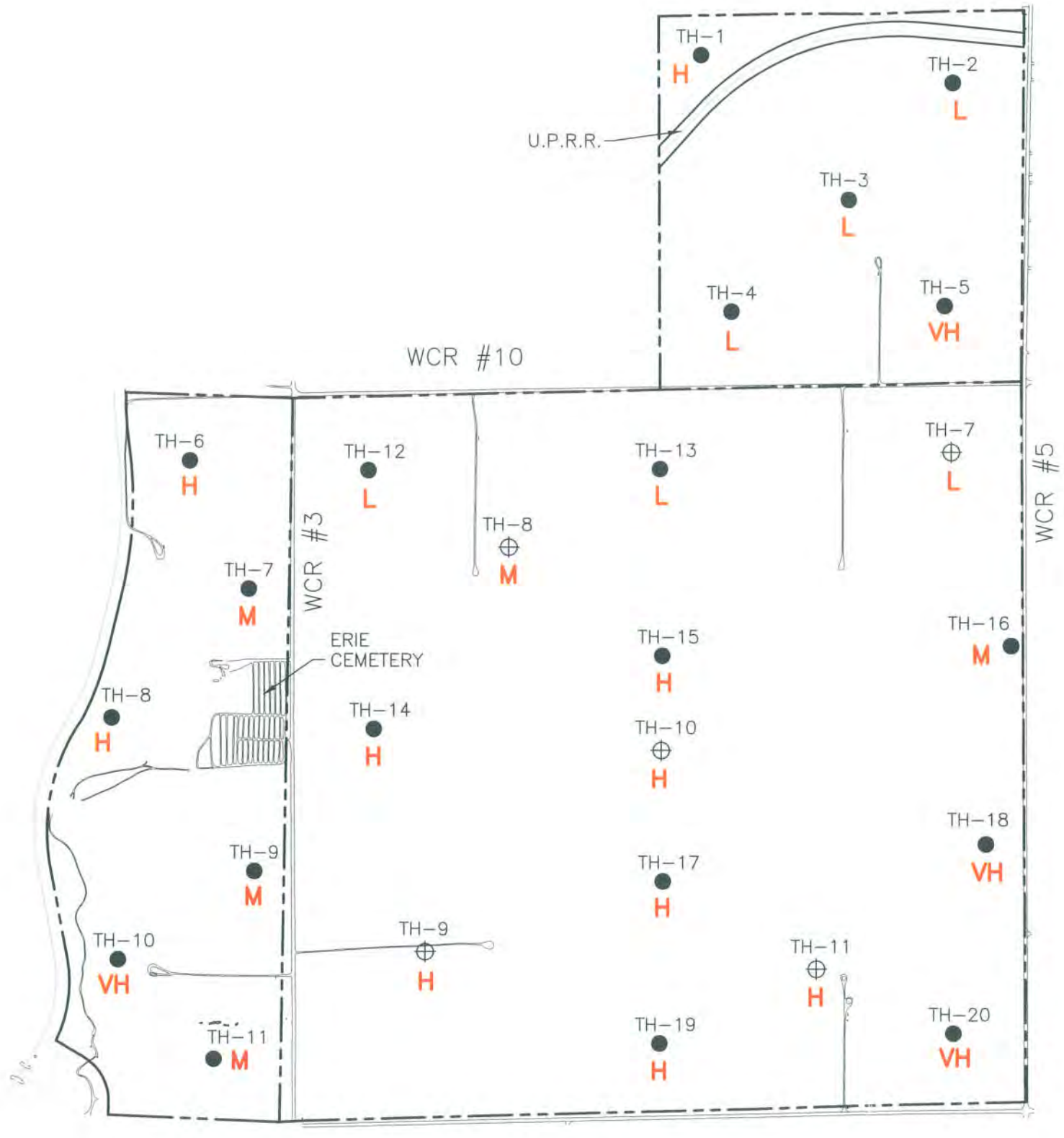
DN40507-115_F3-R1-0 6/29/05 BP/SF

Shea Homes
TALLGRASS
Project No. DN40,507-115

# Estimated Bedrock Elevation

Fig. 3

SCALE: 1"= 1000'




LEGEND:

TH-1 ● INDICATES APPROXIMATE LOCATION OF EXPLORATORY BORING

TH-1 ⊕ INDICATES APPROXIMATE LOCATION OF EXPLORATORY BORING DRILLED BY SCOTT, COX & ASSOCIATES, INC. (PROJECT NO. 98697; REPORT DATED NOVEMBER 1998).

**L** LOW RISK

**M** MODERATE RISK

**H** HIGH RISK

**VH** VERY HIGH RISK

NOTES:

1.) RATING OF SCOTT, COX & ASSOCIATE'S BORINGS WAS BASED ON OUR EVALUATION OF THEIR TEST DATA.

2.) THIS ESTIMATE WAS BASED UPON A SUBJECTIVE ANALYSIS OF LABORATORY TEST RESULTS AND DRILL HOLE DATA. SWELL RISK WILL VARY BETWEEN BORINGS. ADDITIONAL INVESTIGATION AT CLOSER TEST HOLE SPACING IS RECOMMENDED TO BETTER DELINEATE SWELL RISK.

3.) DEEP CUT AND FILL FOR SITE GRADING WILL LIKELY AFFECT SWELL RISK RATING. WE SHOULD REVIEW GRADING PLAN OR CUT AND FILL DEPTH AT TEST HOLE LOCATIONS TO BETTER EVALUATE SWELL RISK.

DN40507-115_F4-R1-0 6/29/05 BP/SF

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TALLGRASS
Project No. DN40,507-115

# Swell Risk Evaluation

Fig. 4

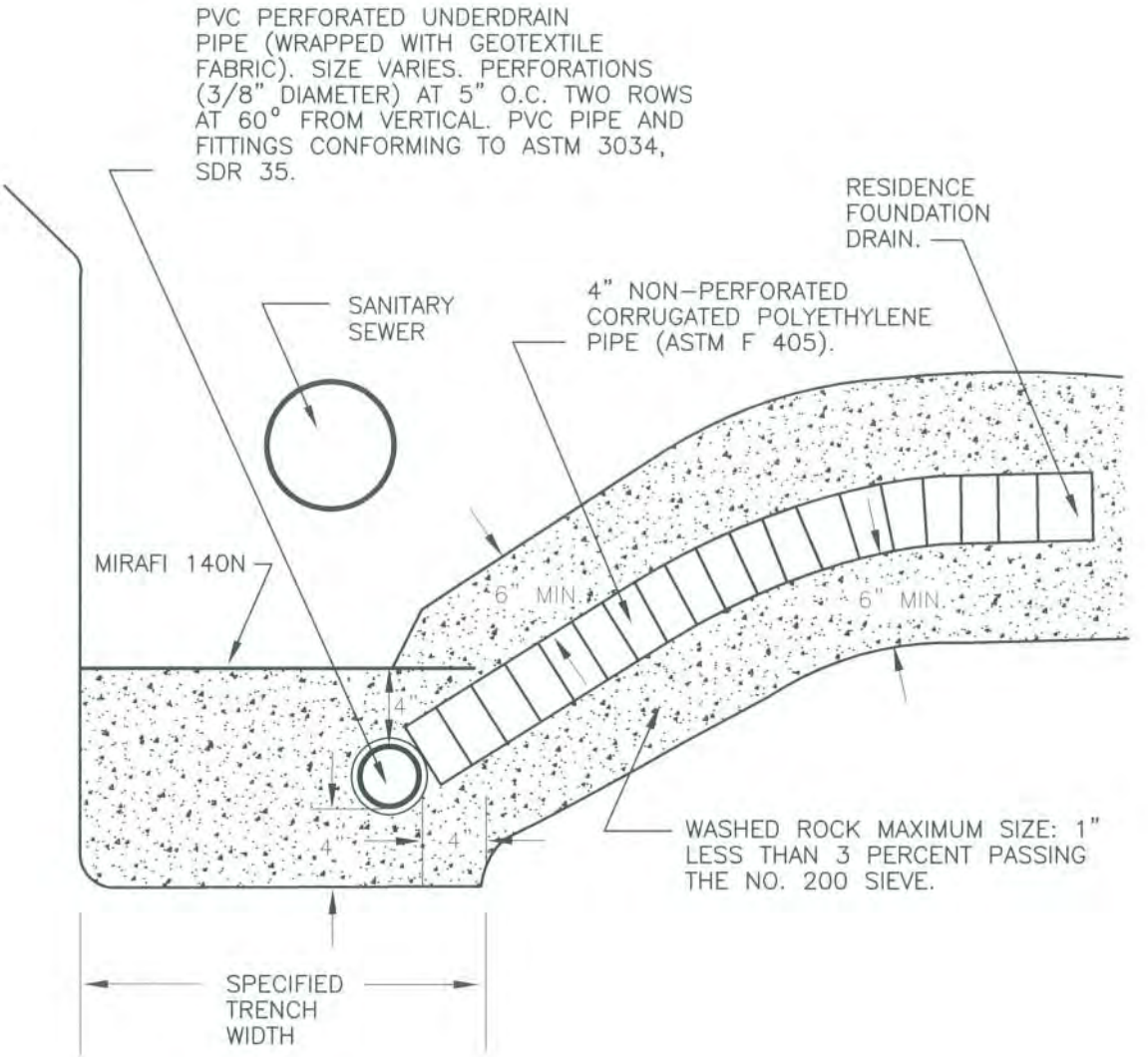
NOT TO SCALE

# Conceptual Underdrain Service Profile

Project No. DN40,507-115

Fig. 5

DN40507-115_F5-R1-D 6/29/05 BP/SF 50-UNDERDRAIN_06



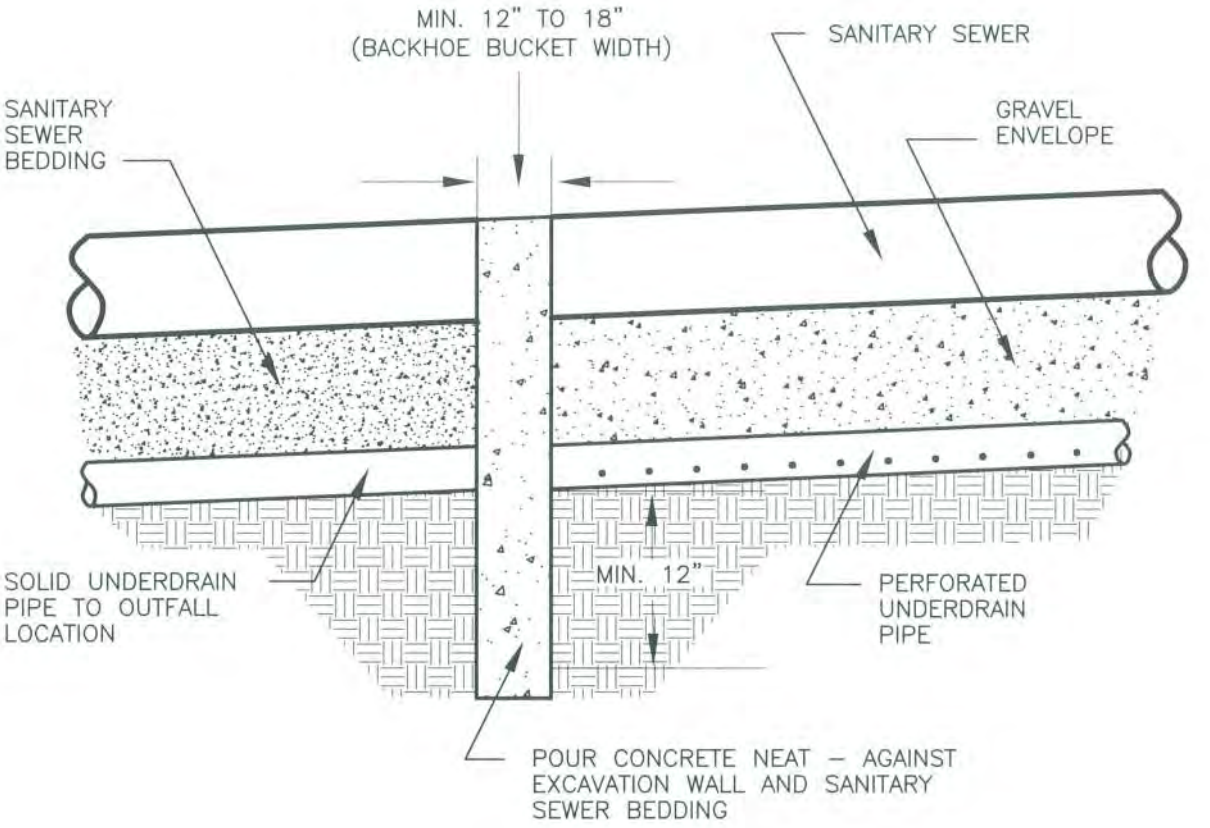

NOTE: NOT TO SCALE.

# Sewer Underdrain Detail

Project No. DN40,507-115

Fig. 6

50-UNDERDRAIN_02
DN40507-115_F6-R1-0 6/29/05 BP/SF




NOTE:
THE CONCRETE CUTOFF WALL SHOULD EXTEND INTO THE UNDISTURBED SOILS OUTSIDE THE UNDERDRAIN AND SANITARY SEWER TRENCH A MINIMUM DISTANCE OF 12 INCHES.

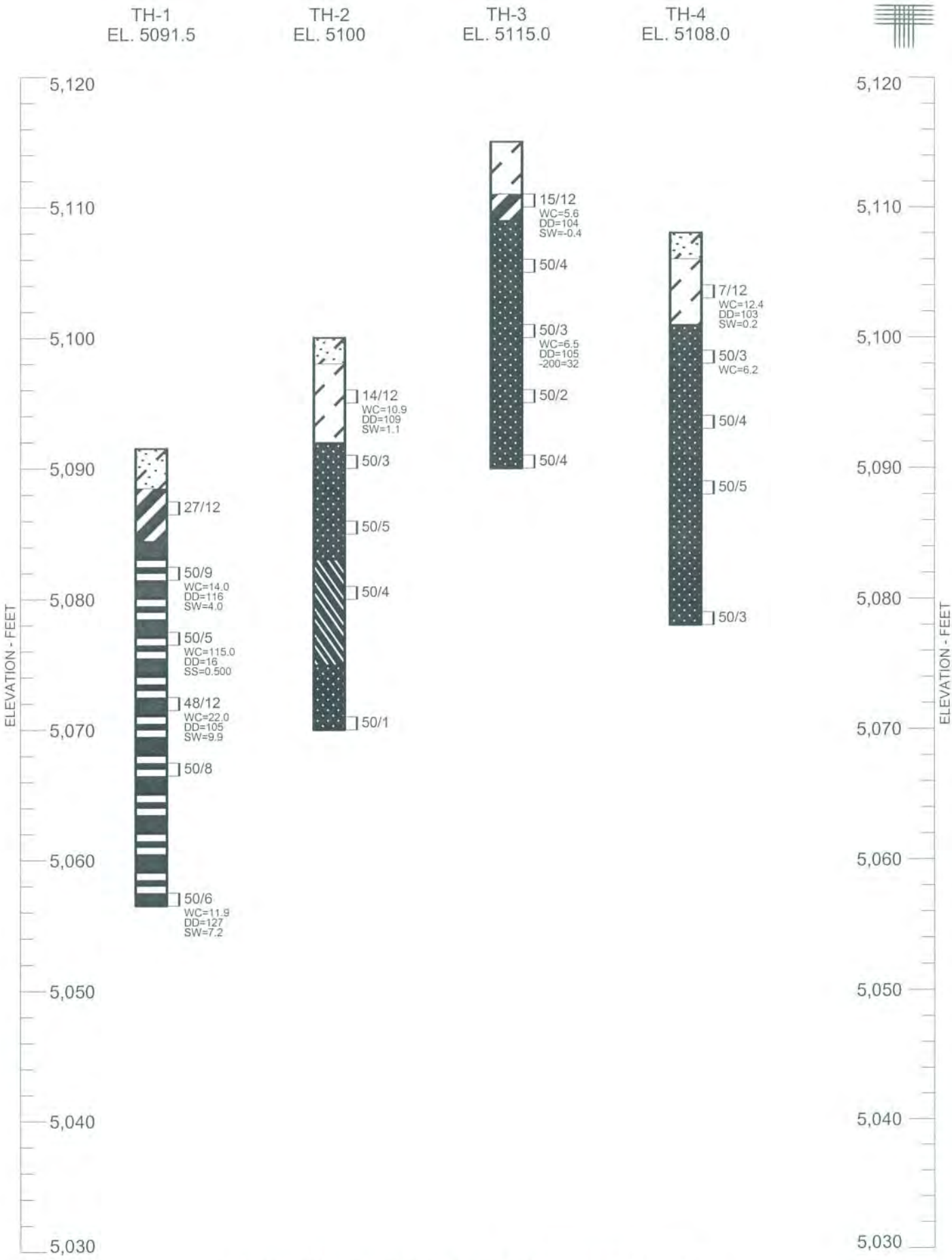
DN40507-115_F7-R1-0 6/29/05 BP/SF 50-UNDERDRAIN_05

# Underdrain Cutoff Wall Detail

Project No. DN40,507-115

Fig. 7

# APPENDIX A
# SUMMARY LOGS OF EXPLORATORY BORINGS

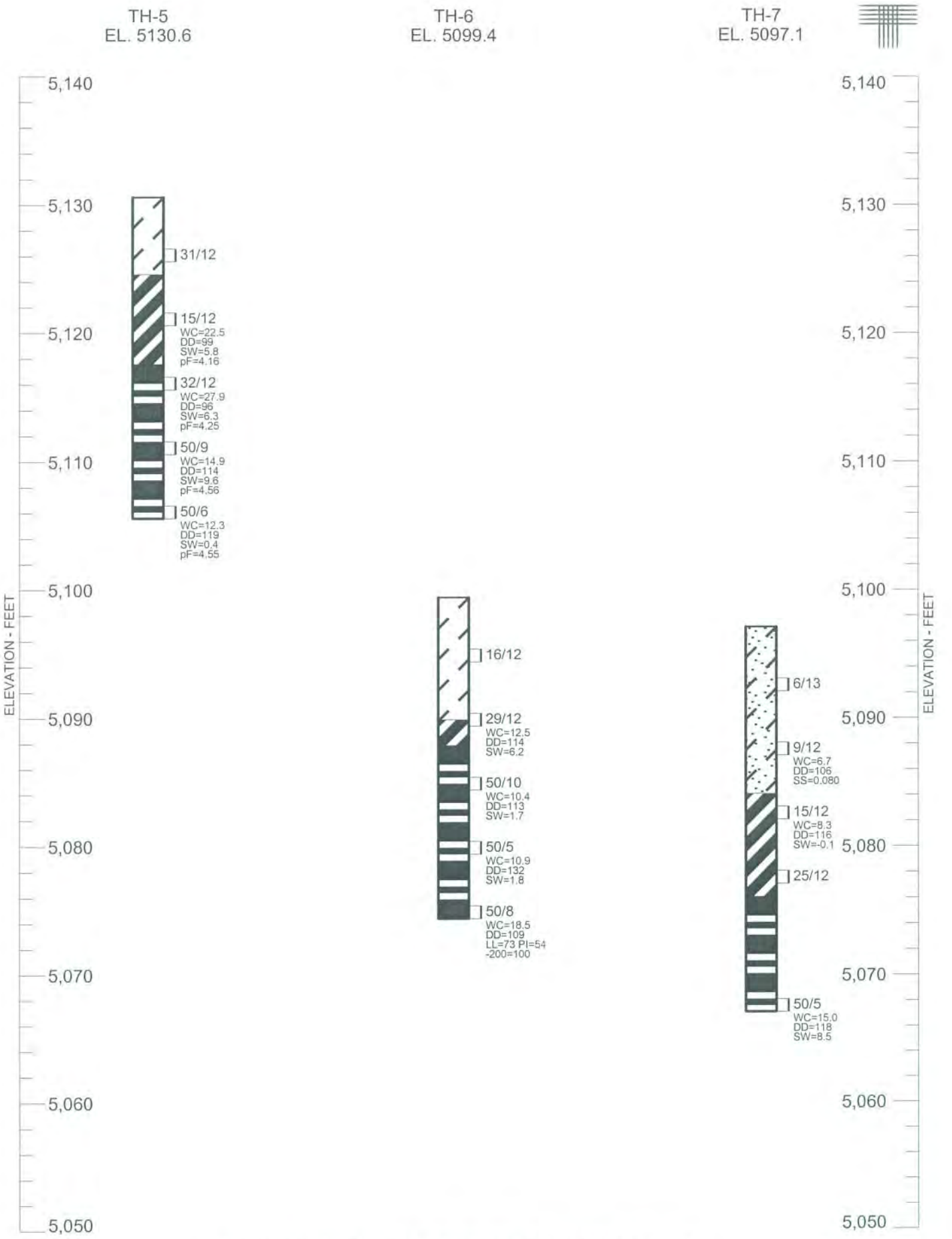



## SUMMARY LOGS OF EXPLORATORY BORINGS

FIG. A- 1

TALLGRASS
PROJECT NO. DN40,507-115

LOGS BY ELEVATION - LONG - DECIMAL DN40507-115-G1.GPJ CTLMAIN.GDT 6/29/05

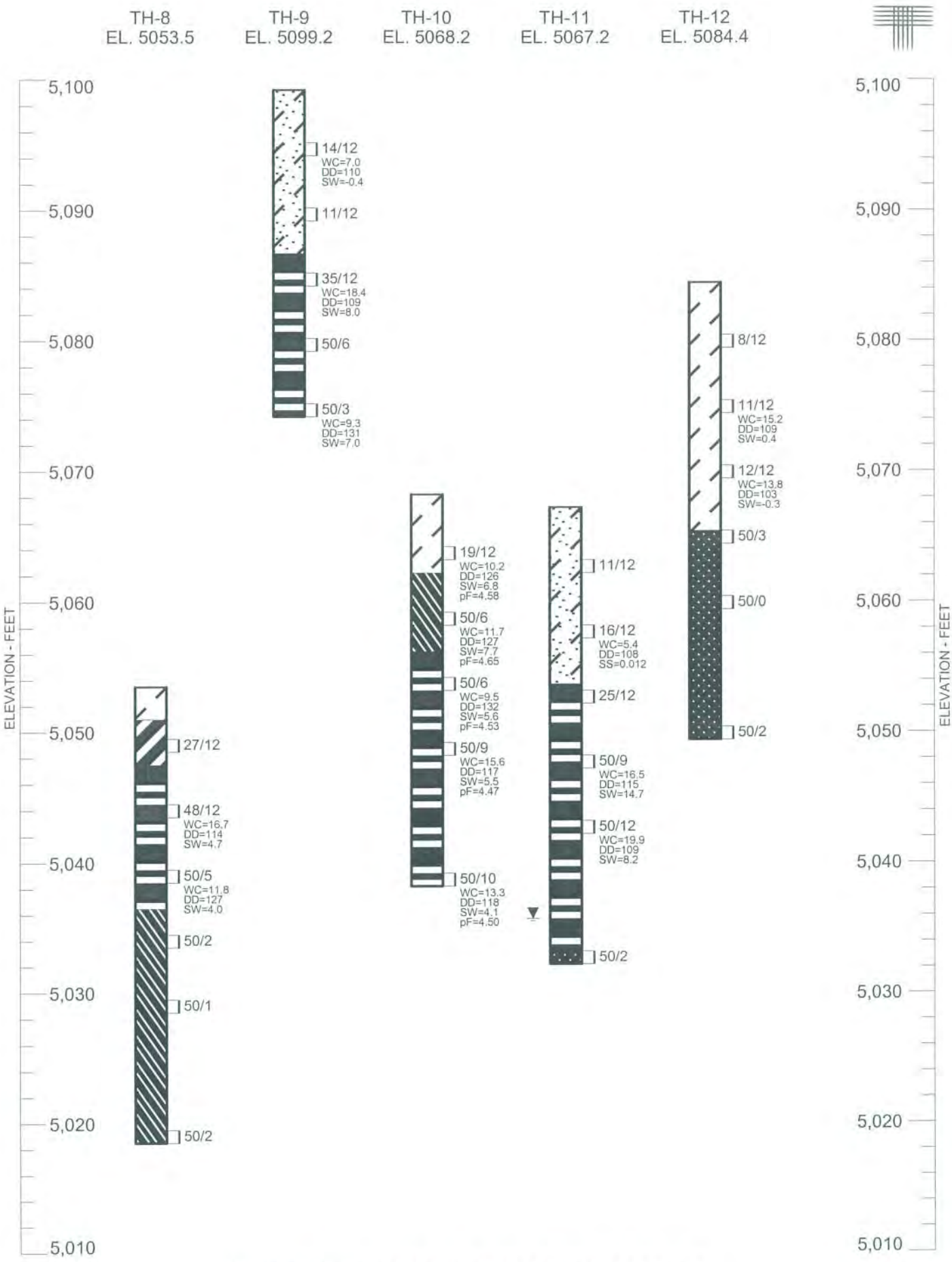



## SUMMARY LOGS OF EXPLORATORY BORINGS

FIG. A- 2

TALLGRASS
PROJECT NO. DN40,507-115

LOGS BY ELEVATION - LONG - DECIMAL DN40507-115-G1.GPJ CTLMAIN.GDT 6/24/05

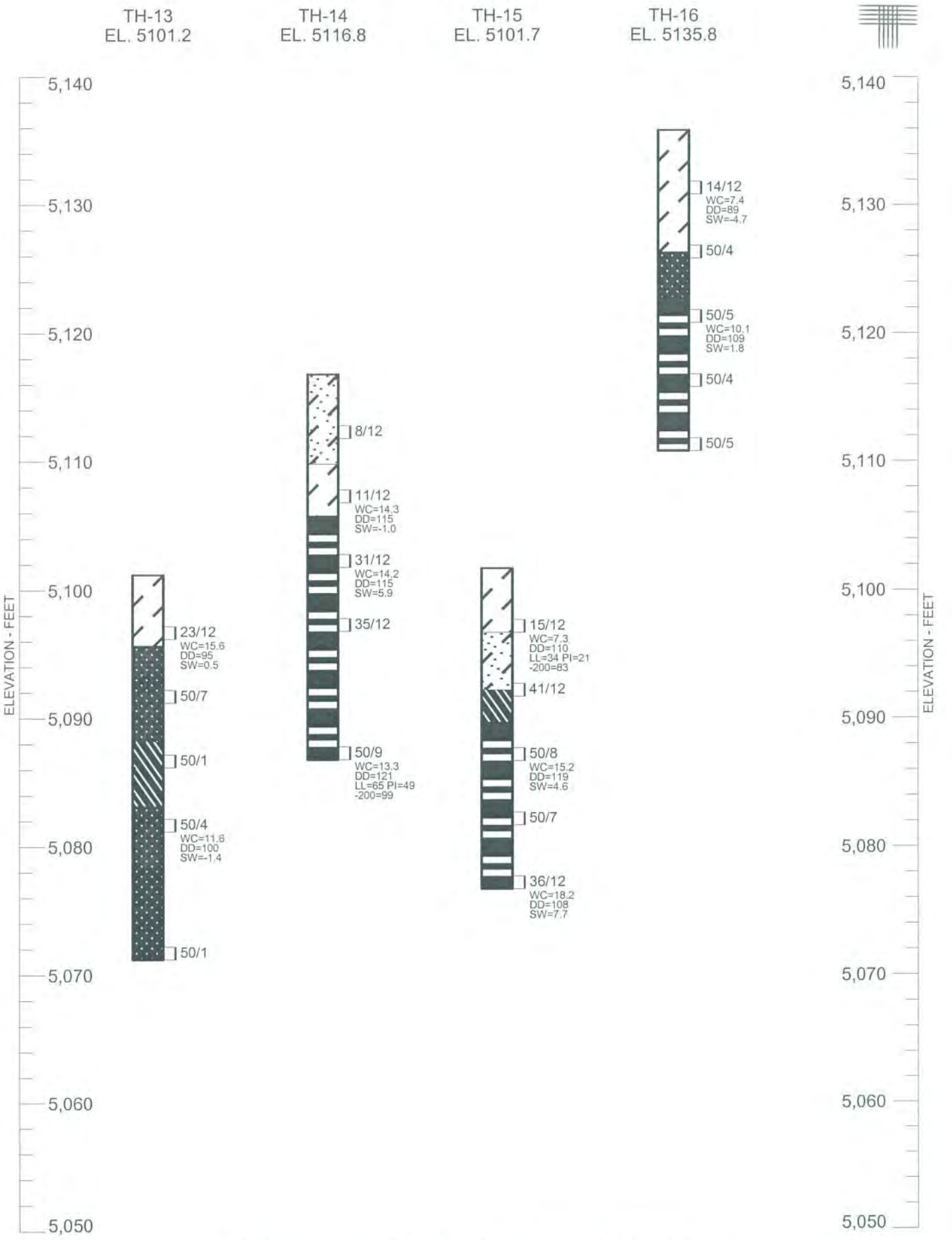



## SUMMARY LOGS OF EXPLORATORY BORINGS

FIG. A- 3

TALLGRASS
PROJECT NO. DN40,507-115

LOGS BY ELEVATION - LONG - DECIMAL DN40507-115-G1.GPJ CTLMAIN.GDT 6/24/05

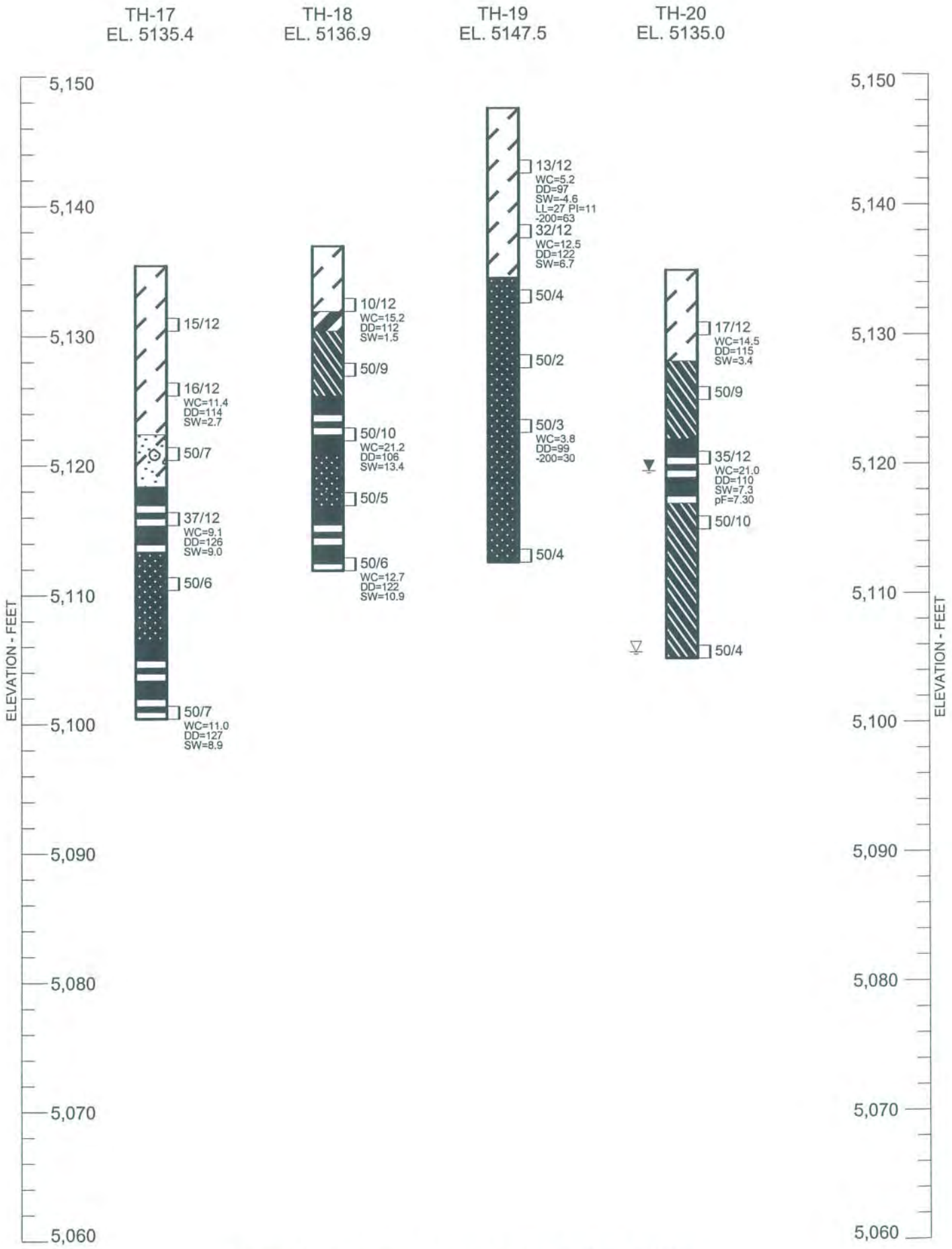



## SUMMARY LOGS OF EXPLORATORY BORINGS

FIG. A- 4

TALLGRASS
PROJECT NO. DN40,507-115

LOGS BY ELEVATION - LONG - DECIMAL DN40507-115-G1.GPJ CTLMAIN.GDT 6/29/05




## SUMMARY LOGS OF EXPLORATORY BORINGS

TALLGRASS
PROJECT NO. DN40,507-115

LOGS BY ELEVATION - LONG - DECIMAL DN40507-115-G1.GPJ CTLMAIN.GDT 6/24/05

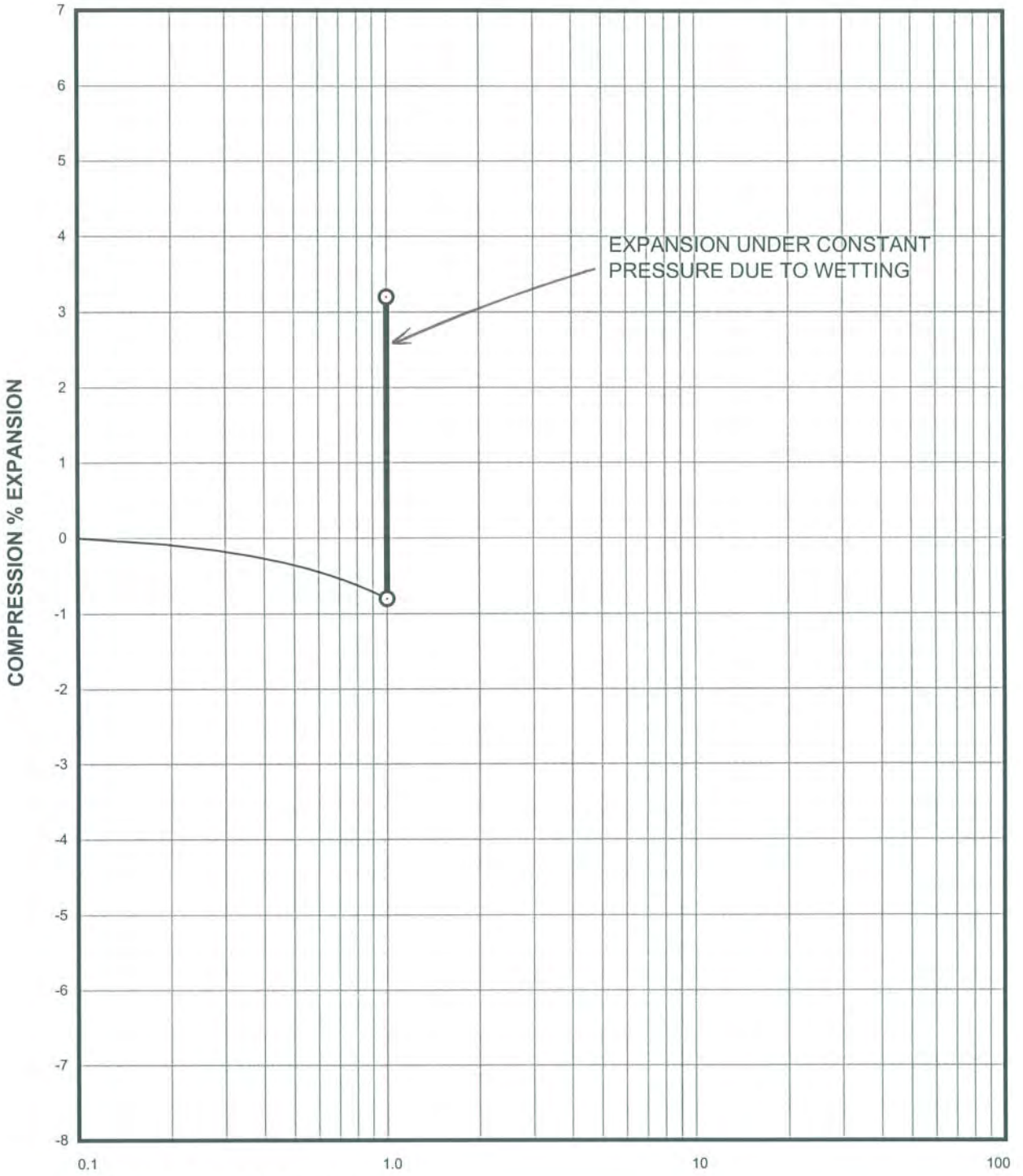
**LEGEND:**

- CLAY, SANDY, MEDIUM STIFF TO VERY STIFF, SLIGHTLY MOIST, BROWN (CL).
- SAND, CLAYEY, LOOSE TO MEDIUM DENSE, SLIGHTLY MOIST, BROWN, RUST (SC).
- GRAVEL, CLAYEY, VERY DENSE, SLIGHTLY MOIST, BROWN, GRAY (GC).
- WEATHERED CLAYSTONE, MOIST, BROWN, RUST.
- BEDROCK, CLAYSTONE, MEDIUM HARD TO VERY HARD, SLIGHTLY MOIST TO MOIST, OLIVE, BROWN, GRAY.
- BEDROCK, SANDSTONE, HARD TO VERY HARD, SLIGHTLY MOIST, BROWN, TAN.
- BEDROCK, INTERBEDDED CLAYSTONE/SANDSTONE, HARD TO VERY HARD, SLIGHTLY MOIST, BROWN, GRAY.
- DRIVE SAMPLE. THE SYMBOL 27/12 INDICATES 27 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE A 2.5-INCH O.D. SAMPLER 12 INCHES.
- ▽ WATER LEVEL MEASURED AT TIME OF DRILLING.
- ▼ WATER LEVEL MEASURED SEVERAL DAYS AFTER DRILLING.

**NOTES:**

1. THE BORINGS WERE DRILLED BETWEEN MAY 6 AND 16, 2005 USING 4-INCH DIAMETER, CONTINUOUS-FLIGHT AUGER AND A TRUCK-MOUNTED DRILL RIG.
2. WC - INDICATES MOISTURE CONTENT (%).
   DD - INDICATES DRY DENSITY (pcf).
   SW - INDICATES SWELL WHEN WETTED UNDER APPLIED PRESSURE (%).
   LL - INDICATES LIQUID LIMIT (%).
   PI - INDICATES PLASTICITY INDEX (%).
   SS - INDICATES WATER-SOLUBLE SULFATE CONCENTRATION (%).
   pF - INDICATES SOIL SUCTION VALUE (pf).
   -200 - INDICATES PERCENT PASSING NO. 200 SIEVE (%).
3. BORING LOCATIONS AND ELEVATIONS ARE APPROXIMATE AND WERE SURVEYED BY AZTEC CONSULTANTS.
4. THESE LOGS ARE SUBJECT TO THE EXPLANATIONS, LIMITATIONS AND CONCLUSIONS CONTAINED IN THIS REPORT.

# APPENDIX B
# LABORATORY TEST RESULTS



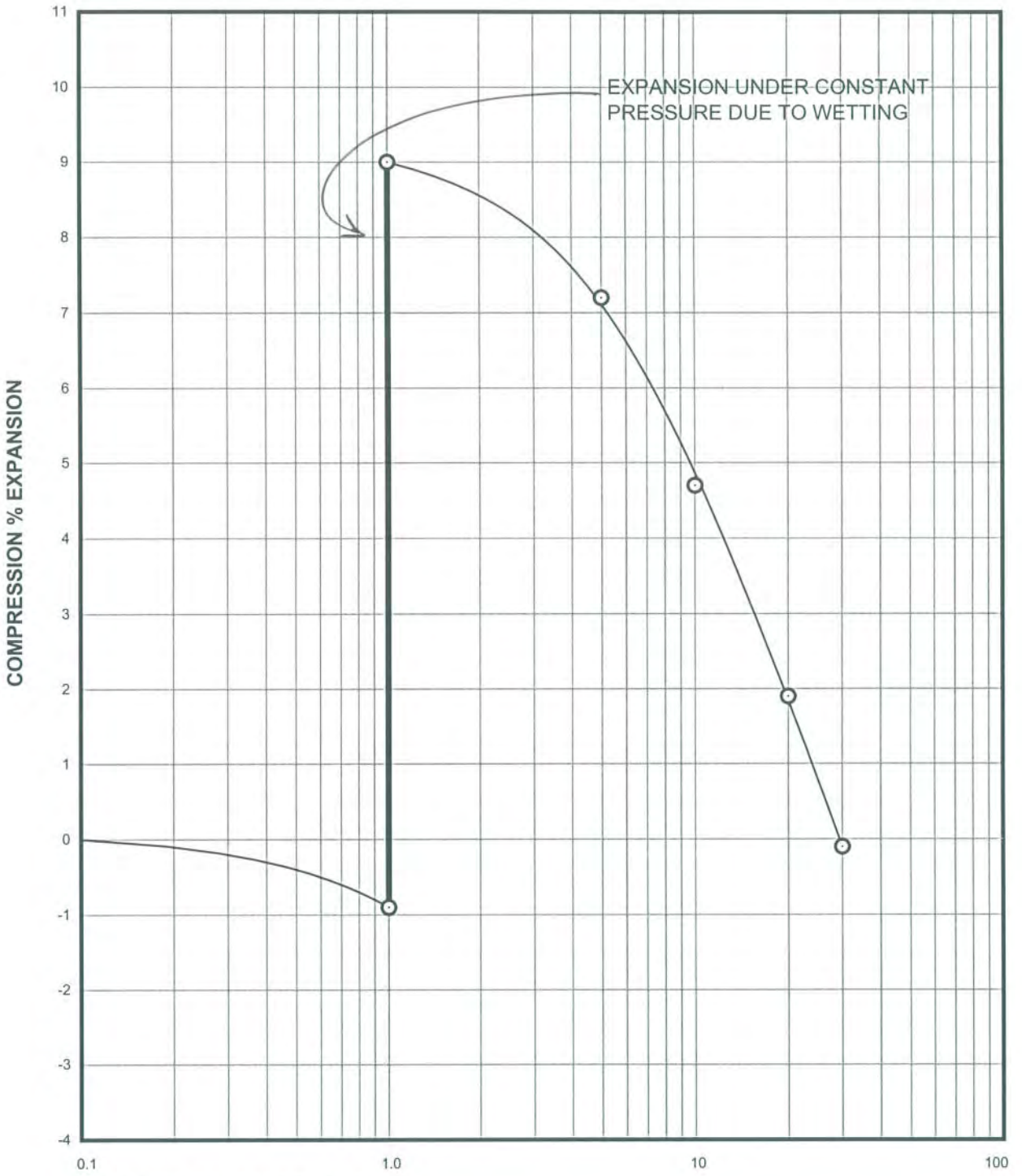

Sample of CLAYSTONE
From TH-1 AT 9 FEET

SAMPLE DRY UNIT WEIGHT= 116 PCF
SAMPLE MOISTURE CONTENT= 14.0 %

# Swell Consolidation Test Results

FIG. B-1

PROJECT NO. DN40,507-115



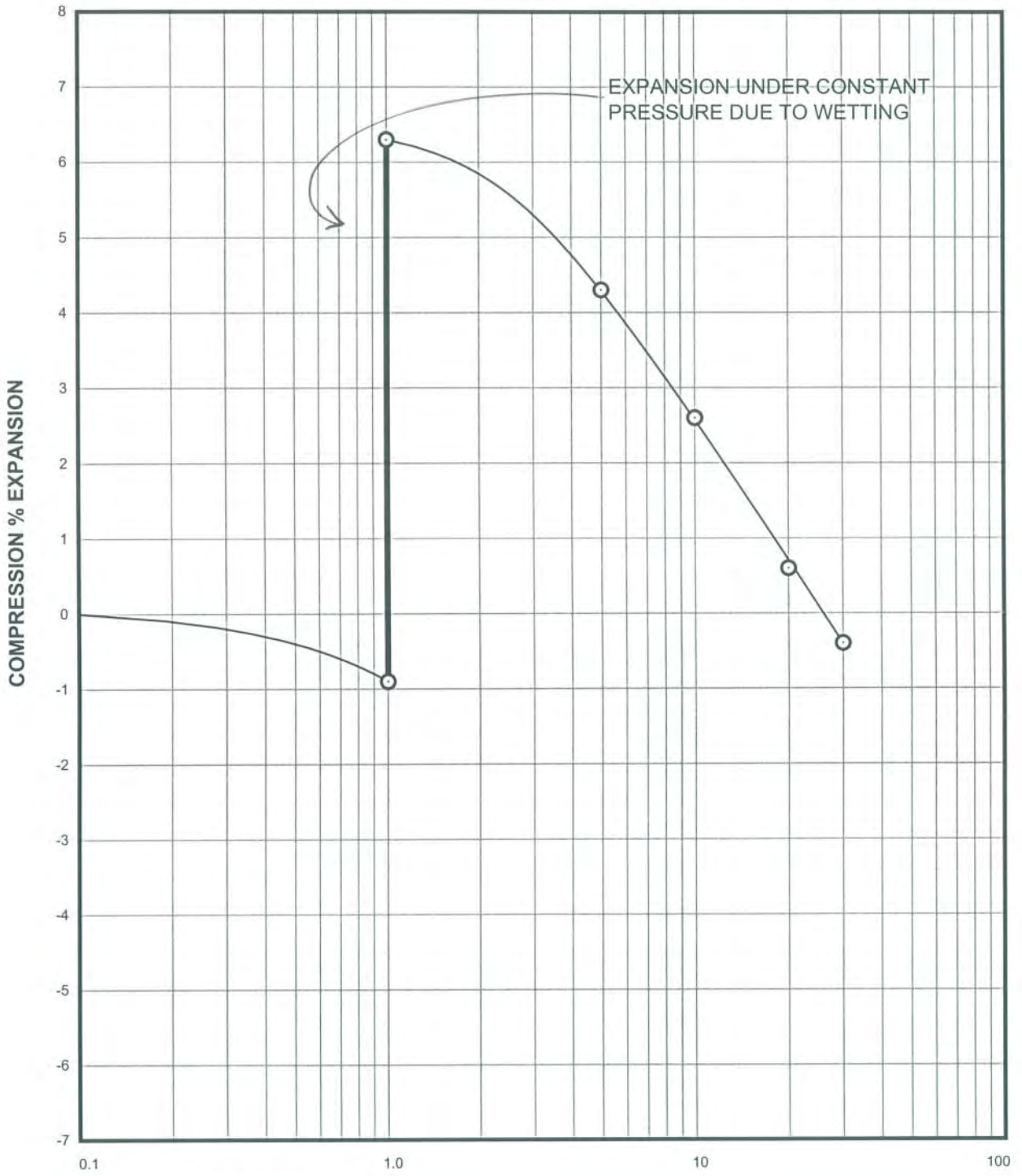

Sample of CLAYSTONE
From TH-1 AT 19 FEET

SAMPLE DRY UNIT WEIGHT= 105 PCF
SAMPLE MOISTURE CONTENT= 22.0 %

# Swell Consolidation Test Results

FIG. B-2

PROJECT NO. DN40,507-115



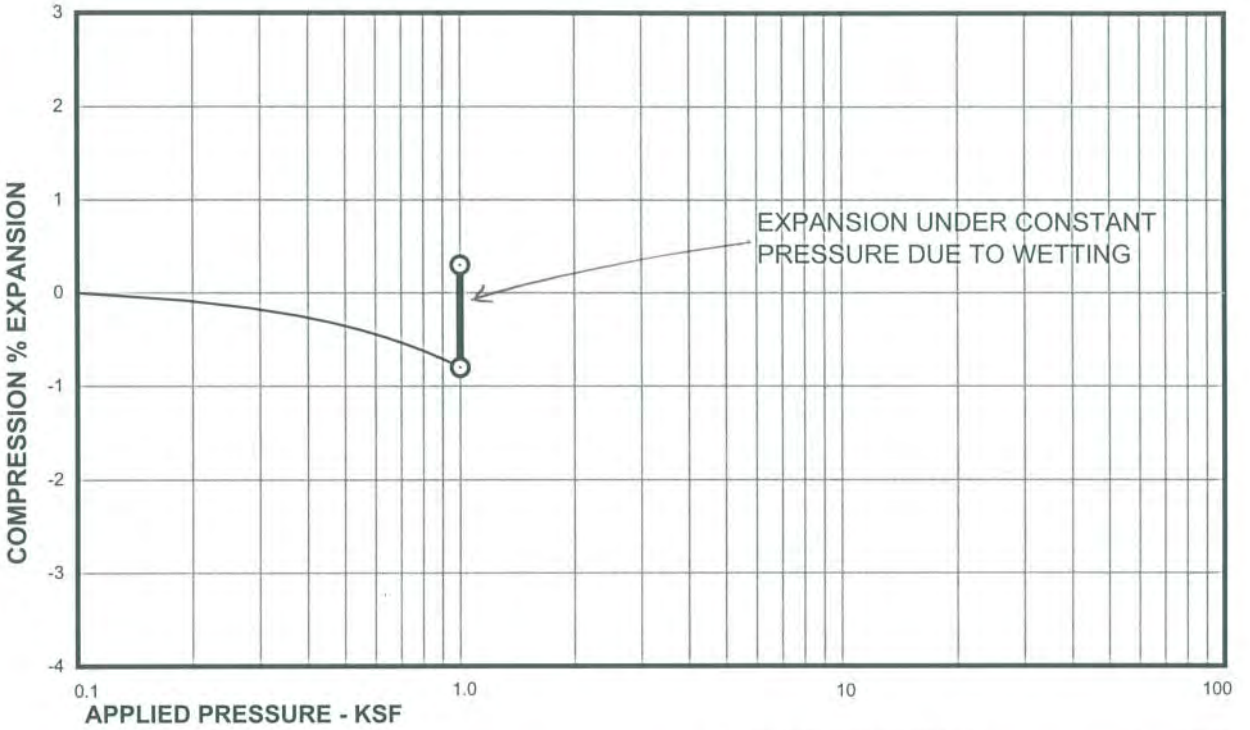

Sample of CLAYSTONE
From TH-1 AT 34 FEET

SAMPLE DRY UNIT WEIGHT= 127 PCF
SAMPLE MOISTURE CONTENT= 11.9 %

# Swell Consolidation Test Results

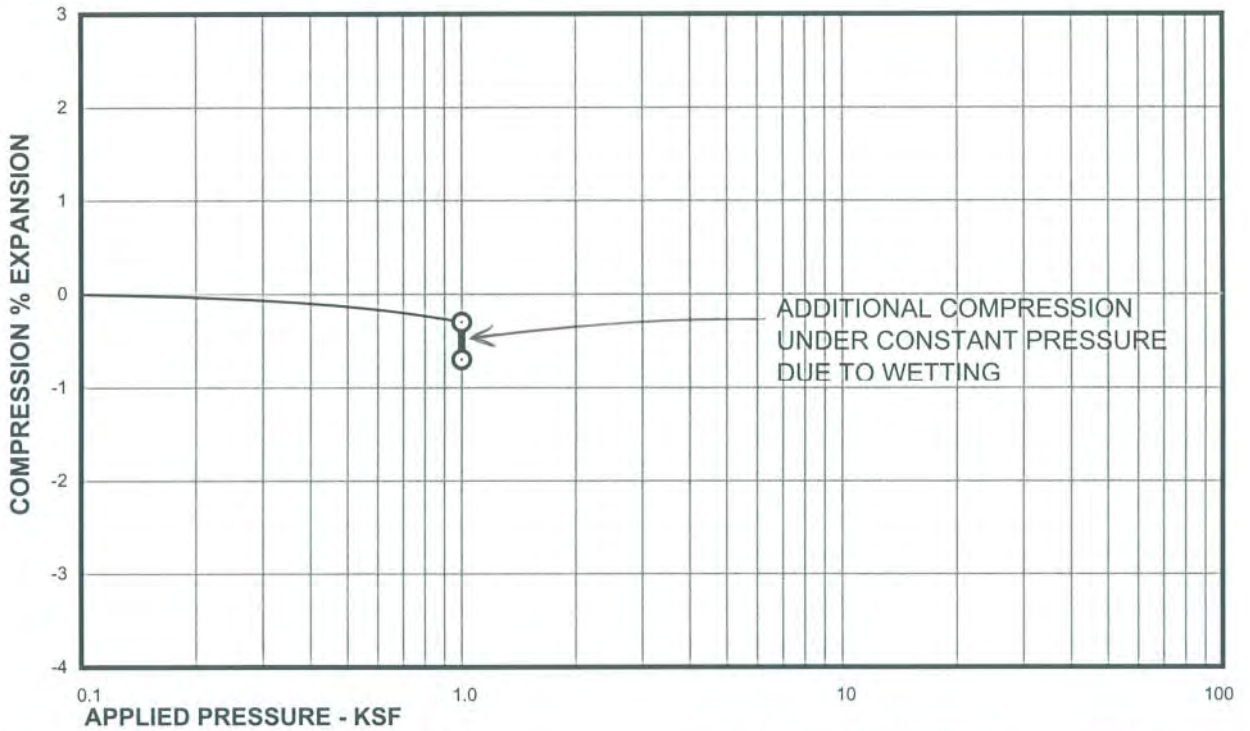
FIG. B-3

PROJECT NO. DN40,507-115




Sample of CLAY, SANDY (CL)
From TH-2 AT 4 FEET

SAMPLE DRY UNIT WEIGHT= 109 PCF
SAMPLE MOISTURE CONTENT= 10.9 %



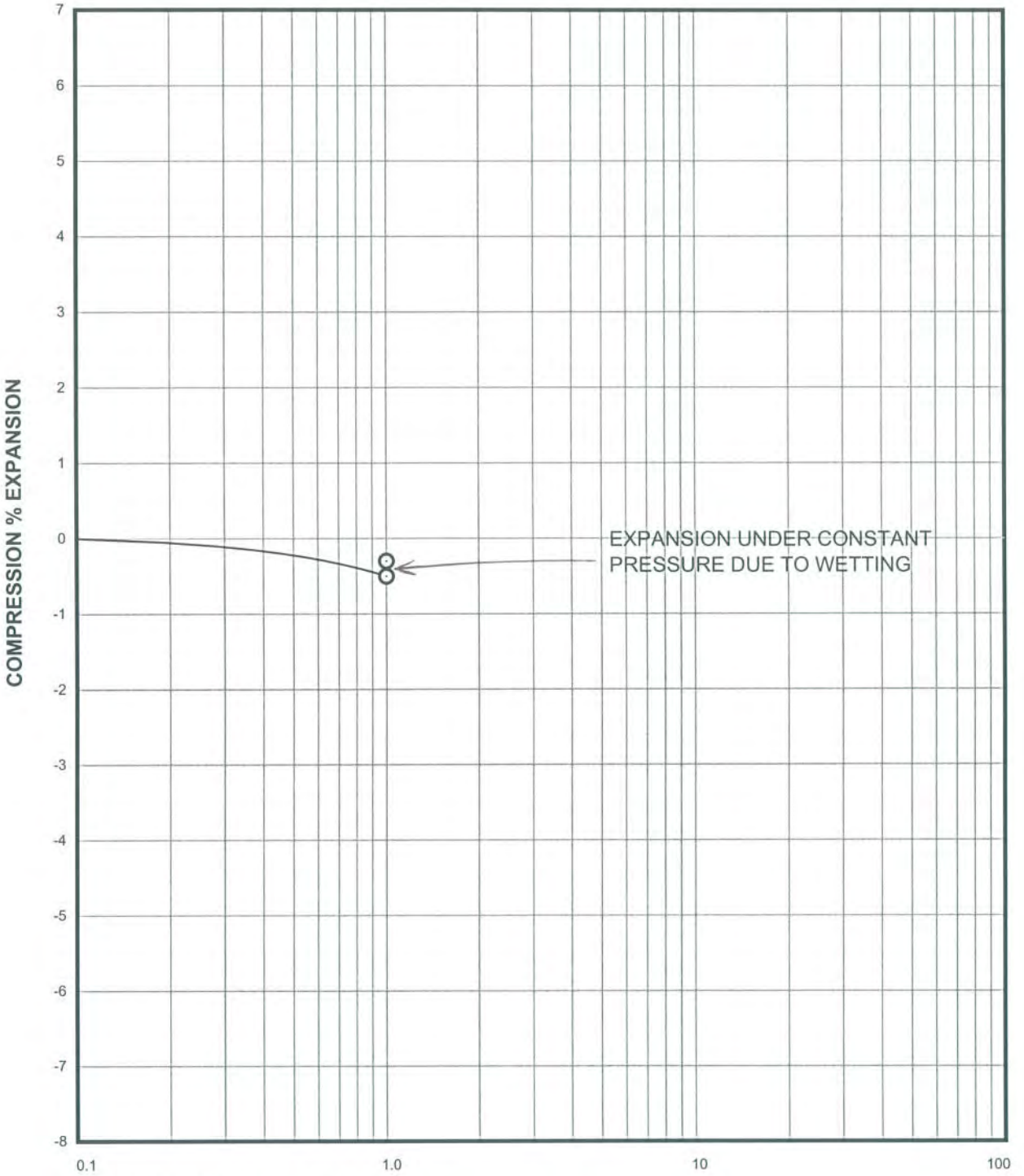

Sample of WEATHERED CLAYSTONE
From TH-3 AT 4 FEET

SAMPLE DRY UNIT WEIGHT= 104 PCF
SAMPLE MOISTURE CONTENT= 5.6 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. B-4



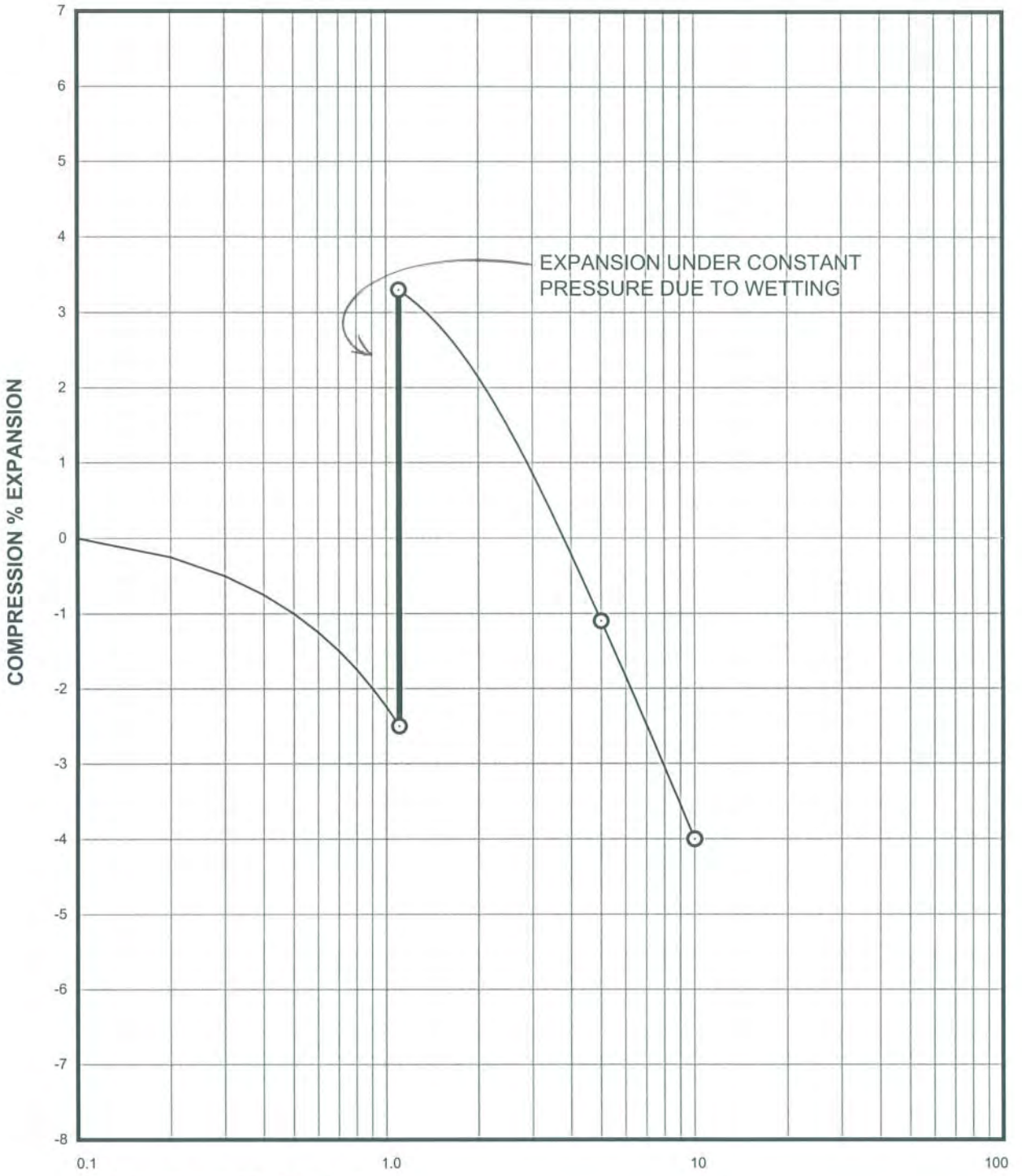

Sample of CLAY, SANDY (CL)
From TH-4 AT 4 FEET

SAMPLE DRY UNIT WEIGHT= 103 PCF
SAMPLE MOISTURE CONTENT= 12.4 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. B-5



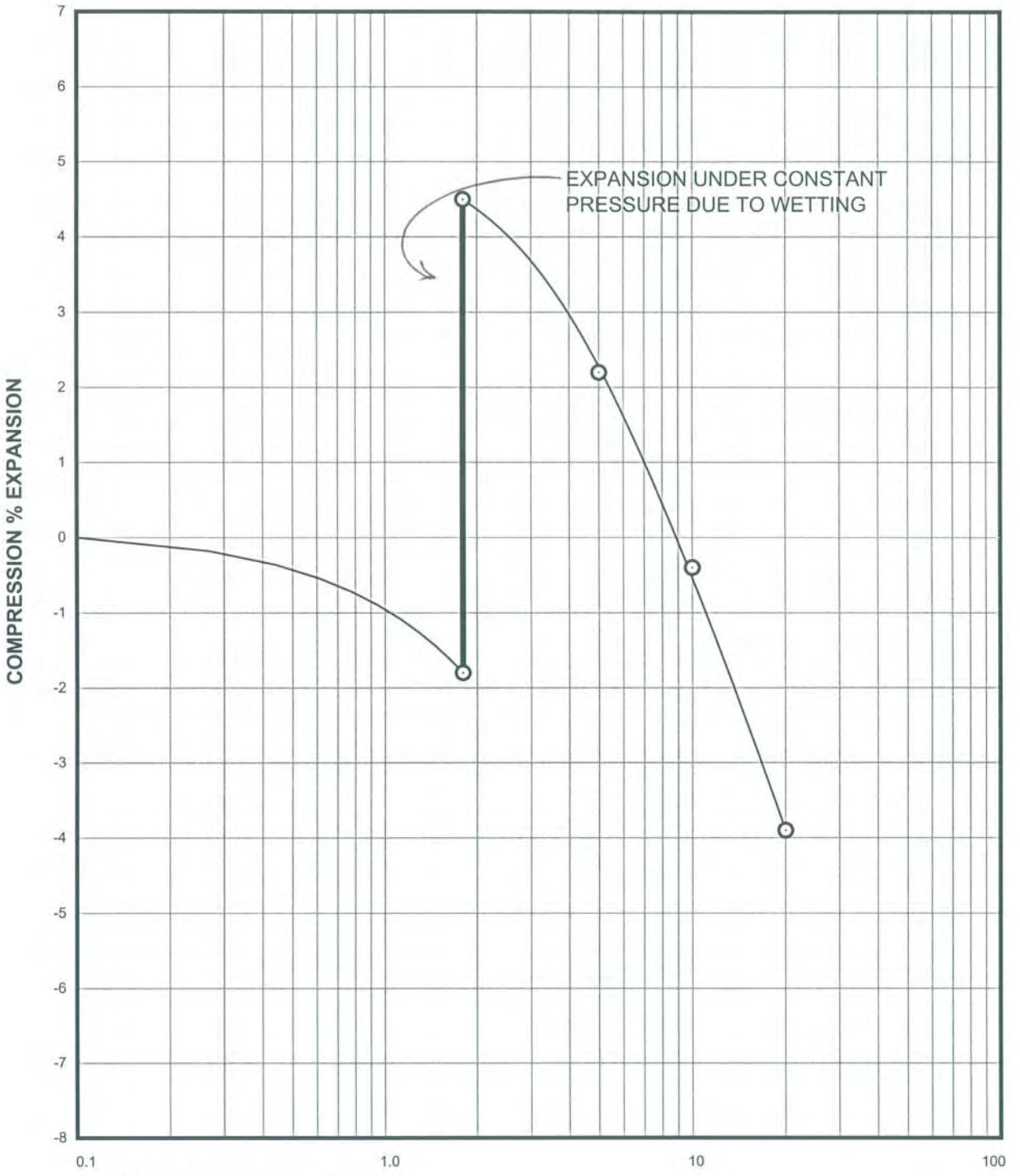

Sample of WEATHERED CLAYSTONE
From TH-5 AT 9 FEET

SAMPLE DRY UNIT WEIGHT= 99 PCF
SAMPLE MOISTURE CONTENT= 22.5 %

PROJECT NO. DN40,507-115

## Swell Consolidation Test Results

FIG. B-6



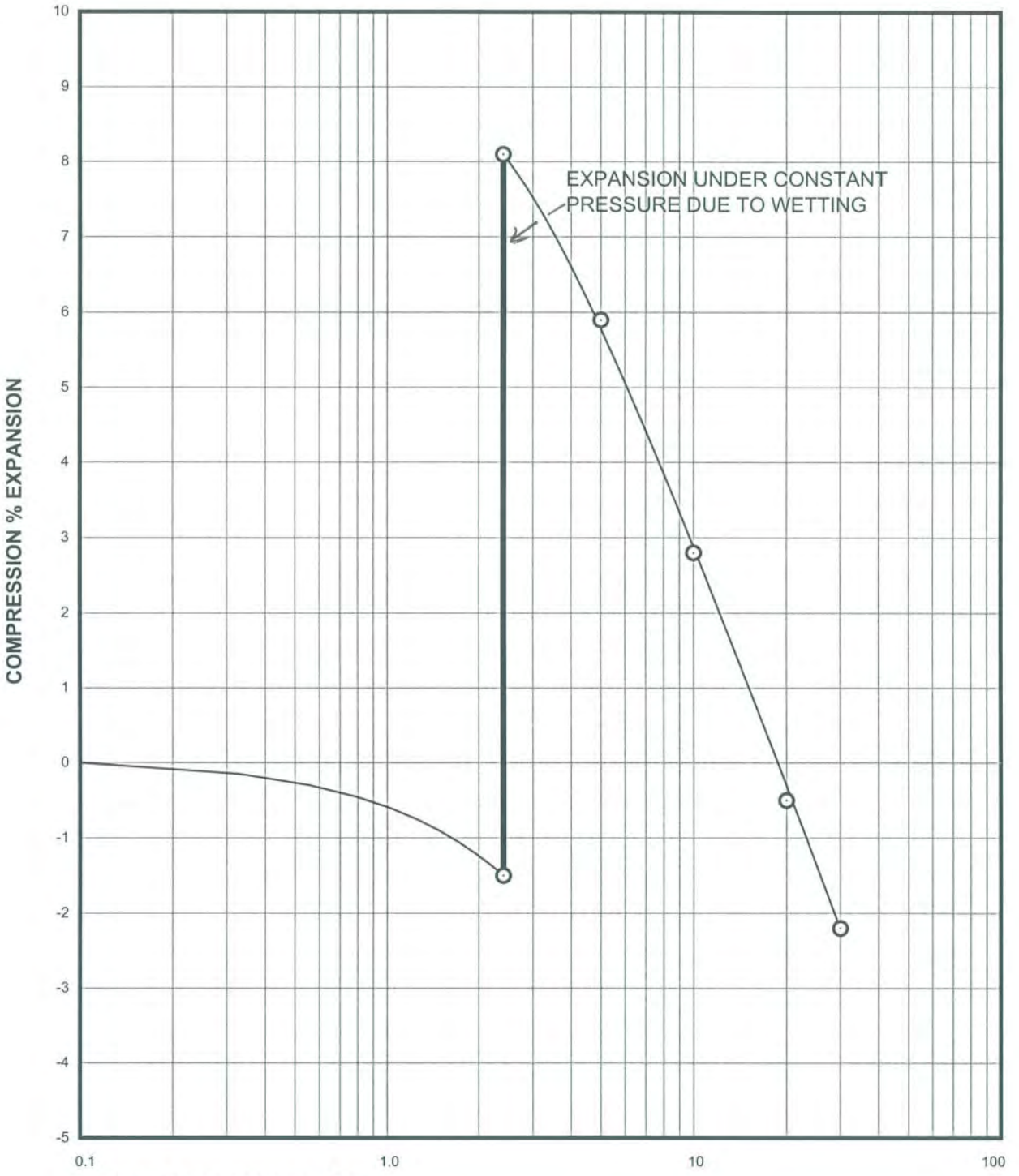

Sample of CLAYSTONE
From TH-5 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 96 PCF
SAMPLE MOISTURE CONTENT= 27.9 %

# Swell Consolidation Test Results

FIG. B-7

PROJECT NO. DN40,507-115



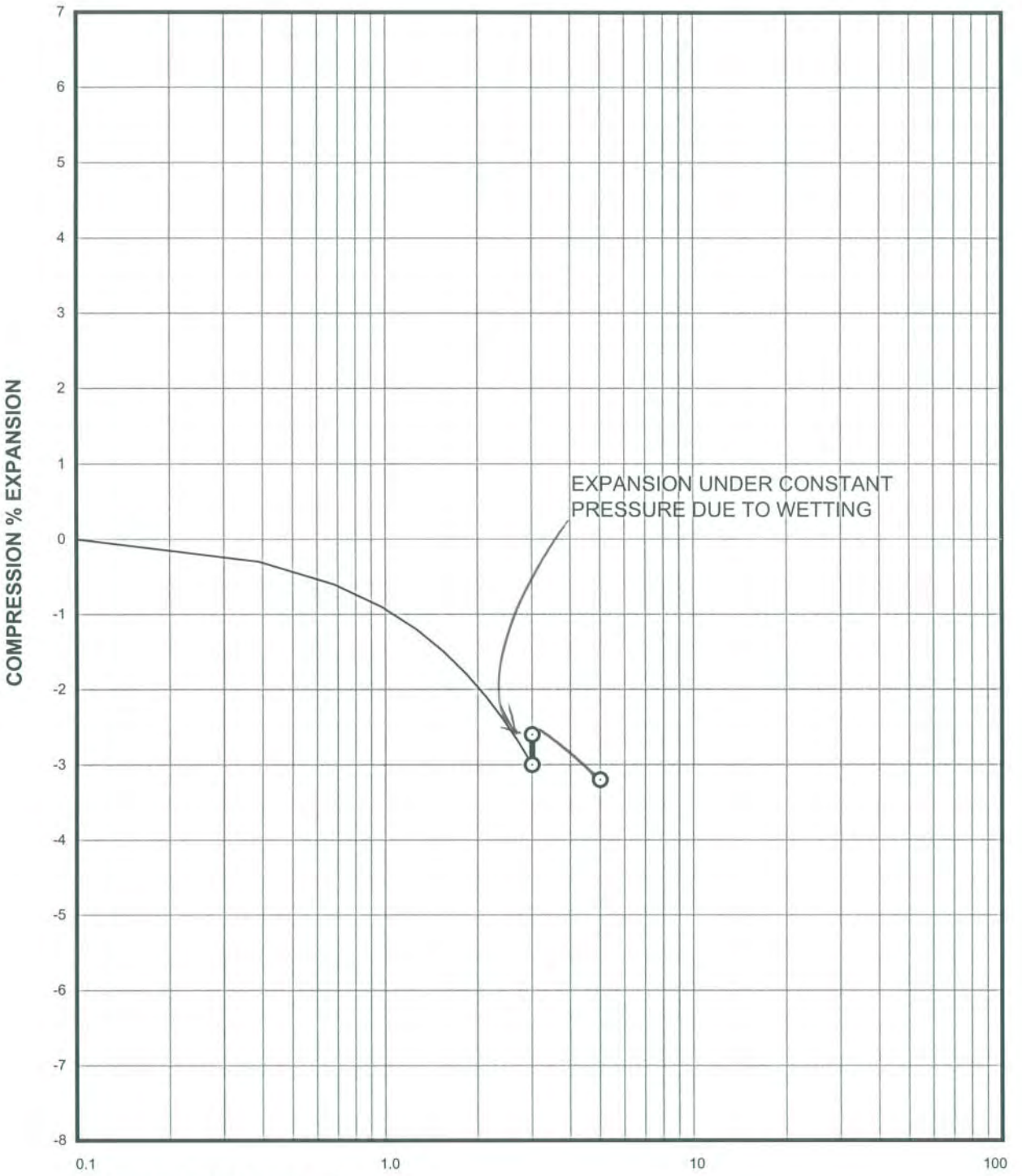

Sample of CLAYSTONE
From TH-5 AT 19 FEET

SAMPLE DRY UNIT WEIGHT= 114 PCF
SAMPLE MOISTURE CONTENT= 14.9 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. B-8



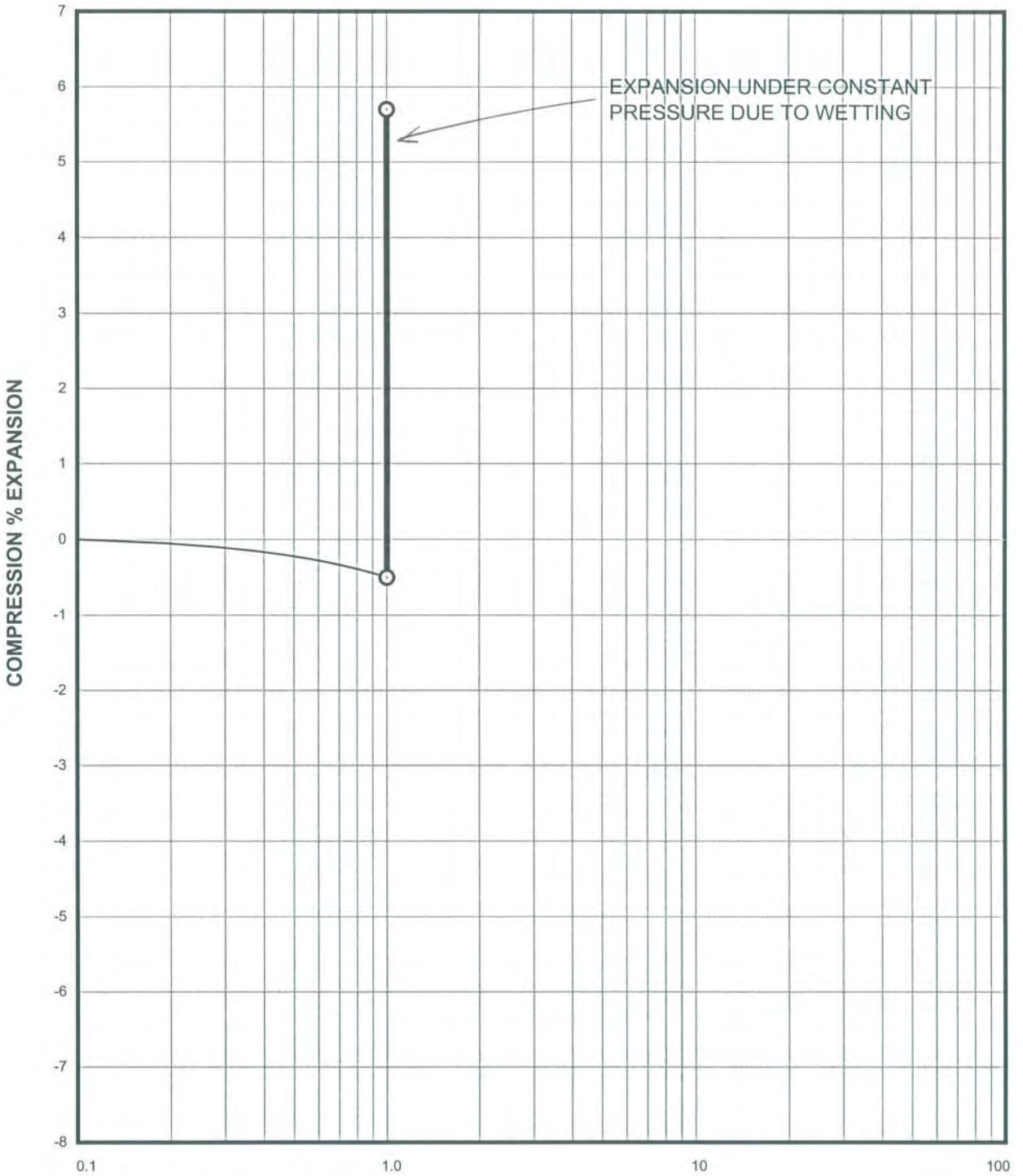

Sample of CLAYSTONE
From TH-5 AT 24 FEET

SAMPLE DRY UNIT WEIGHT= 119 PCF
SAMPLE MOISTURE CONTENT= 12.3 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. B-9



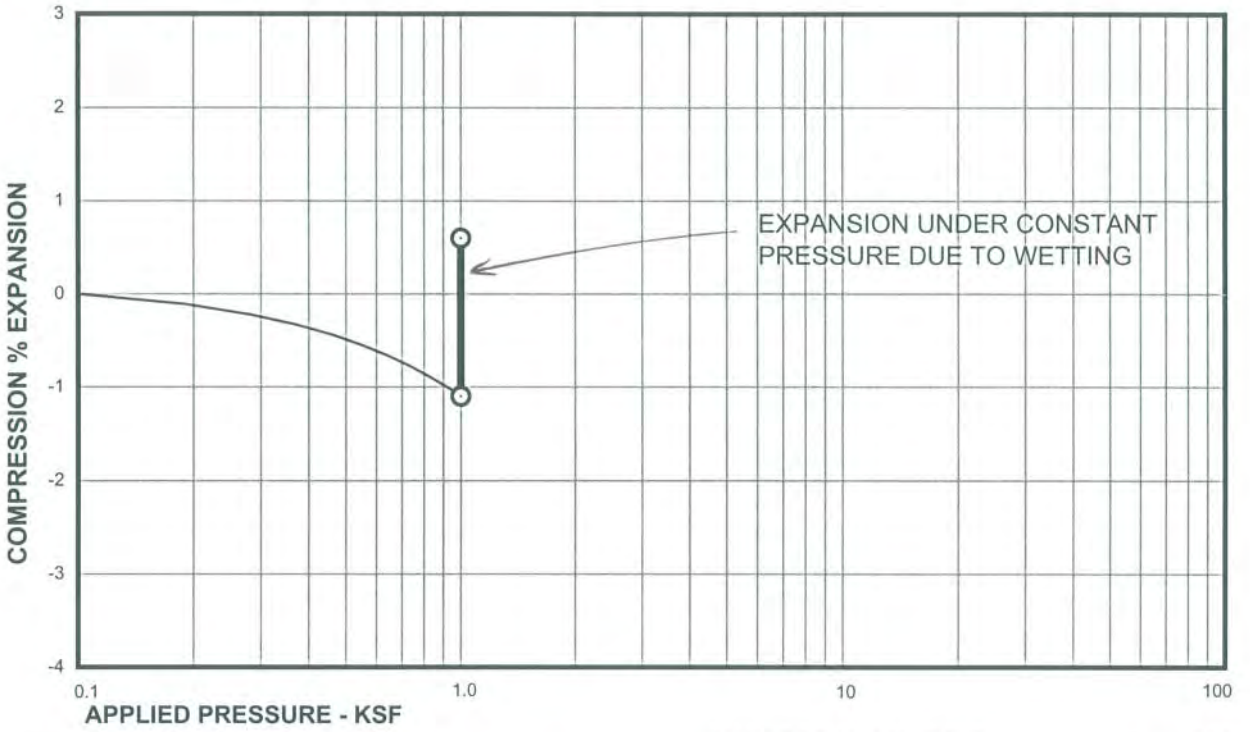

Sample of WEATHERED CLAYSTONE
From TH-6 AT 9 FEET

SAMPLE DRY UNIT WEIGHT= 114 PCF
SAMPLE MOISTURE CONTENT= 12.5 %

# Swell Consolidation Test Results

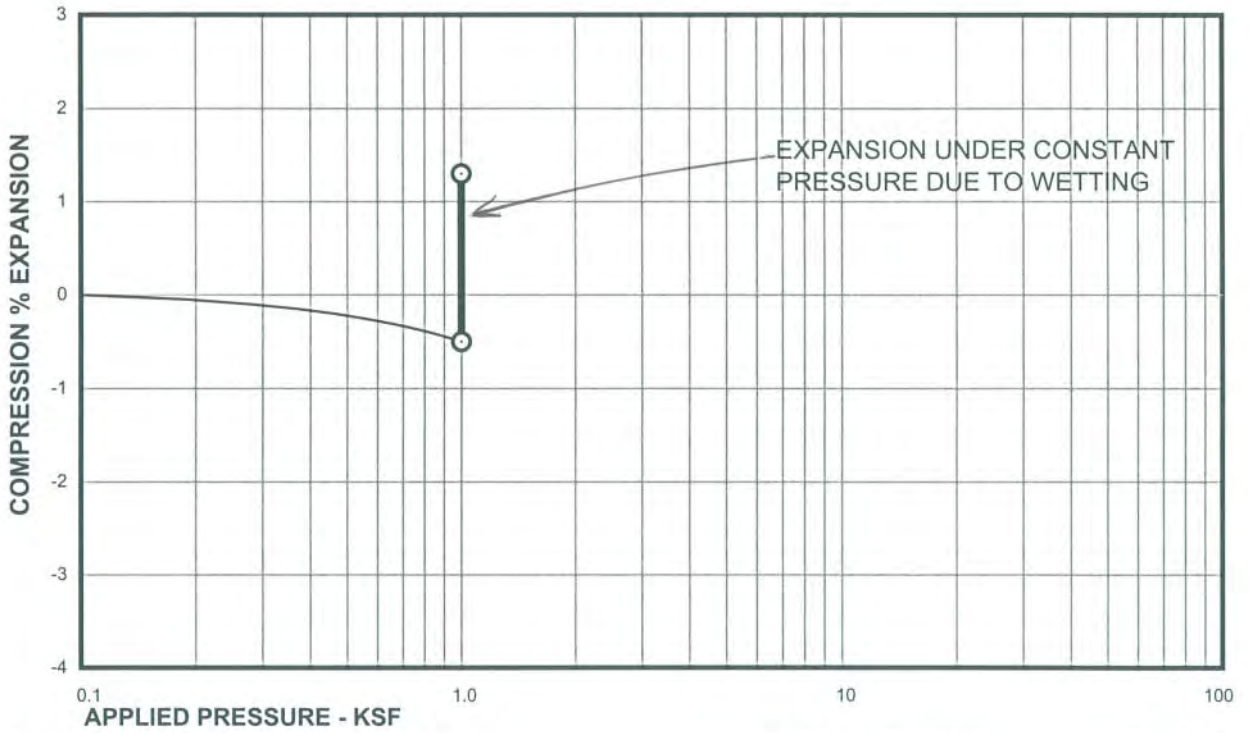
PROJECT NO. DN40,507-115

FIG. B-10




Sample of CLAYSTONE
From TH-6 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 113 PCF
SAMPLE MOISTURE CONTENT= 10.4 %



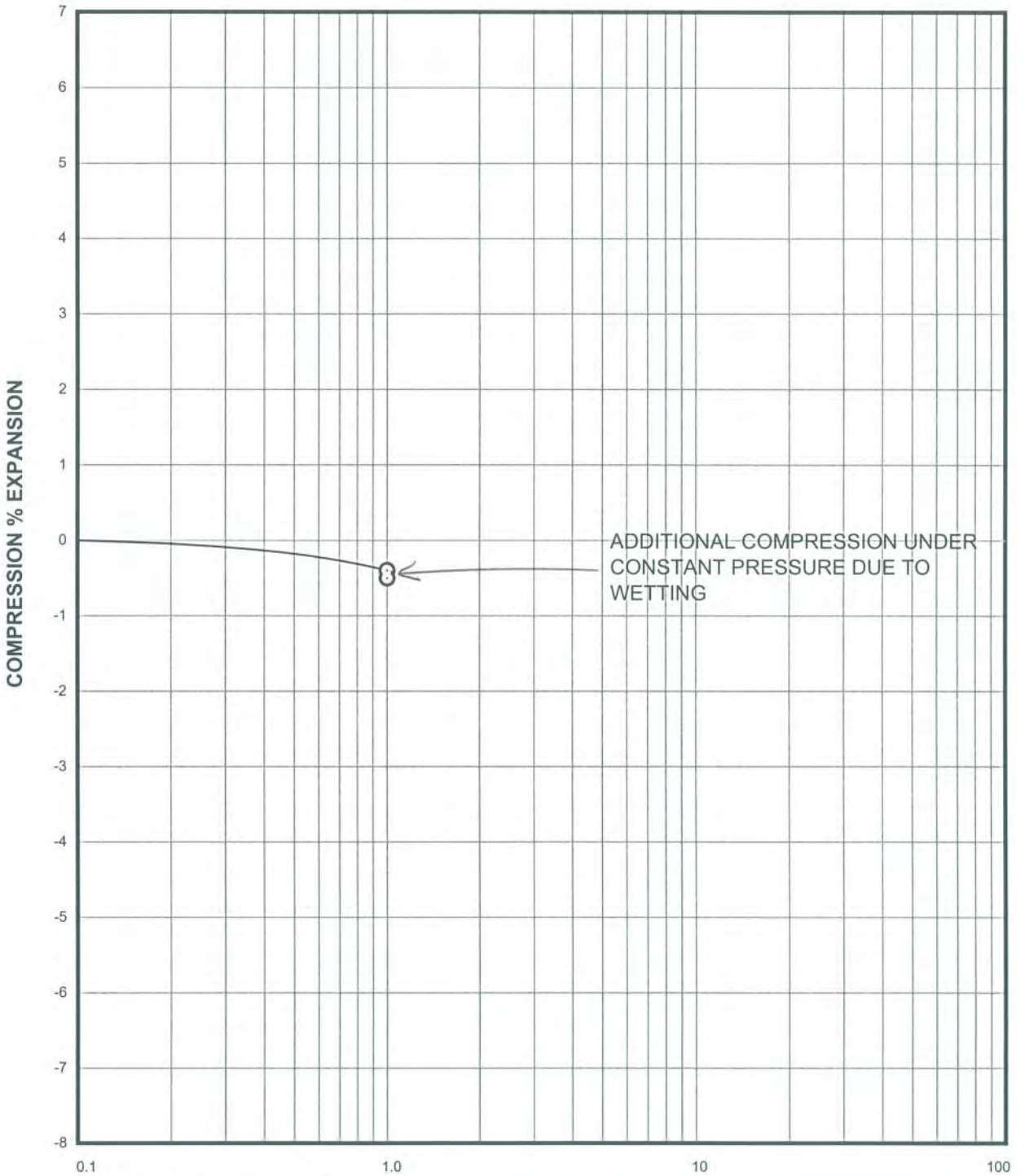

Sample of CLAYSTONE
From TH-6 AT 19 FEET

SAMPLE DRY UNIT WEIGHT= 132 PCF
SAMPLE MOISTURE CONTENT= 10.9 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. B-11



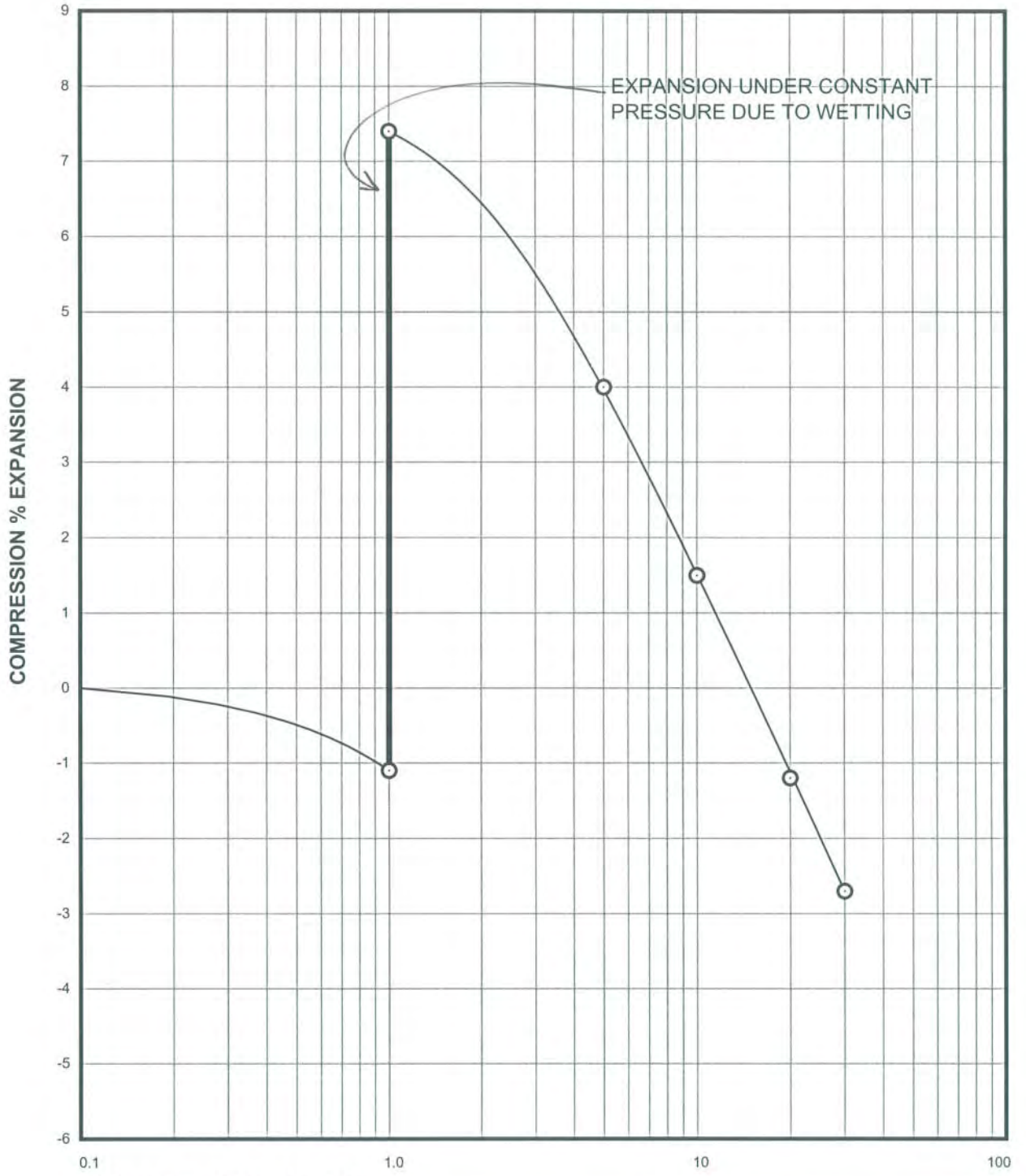

Sample of WEATHERED CLAYSTONE
From TH-7 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 116 PCF
SAMPLE MOISTURE CONTENT= 8.3 %

PROJECT NO. DN40,507-115

# Swell Consolidation Test Results

FIG. B-12



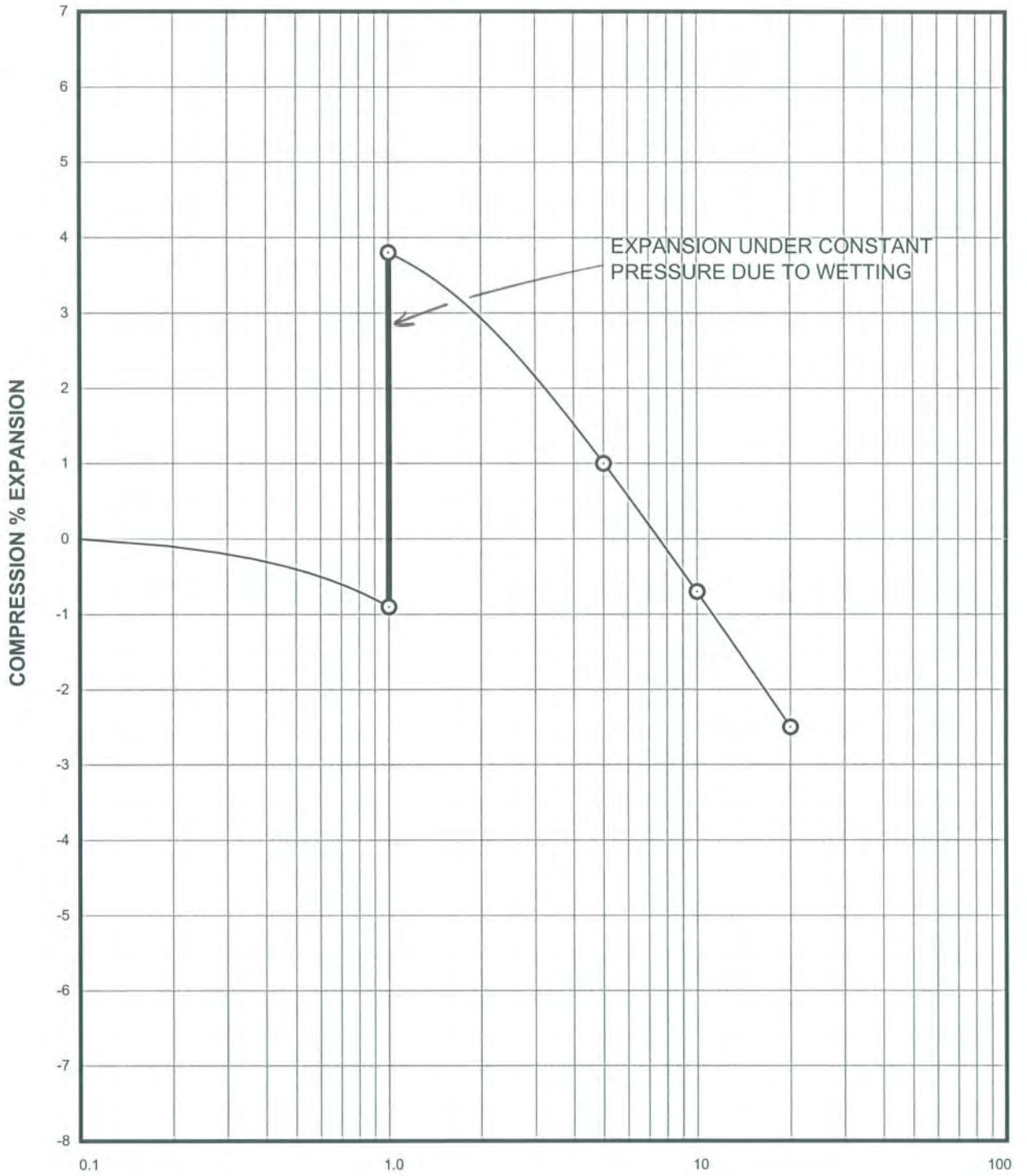

Sample of CLAYSTONE
From TH-7 AT 29 FEET

SAMPLE DRY UNIT WEIGHT= 118 PCF
SAMPLE MOISTURE CONTENT= 15.0 %

# Swell Consolidation Test Results

FIG. B-13

PROJECT NO. DN40,507-115



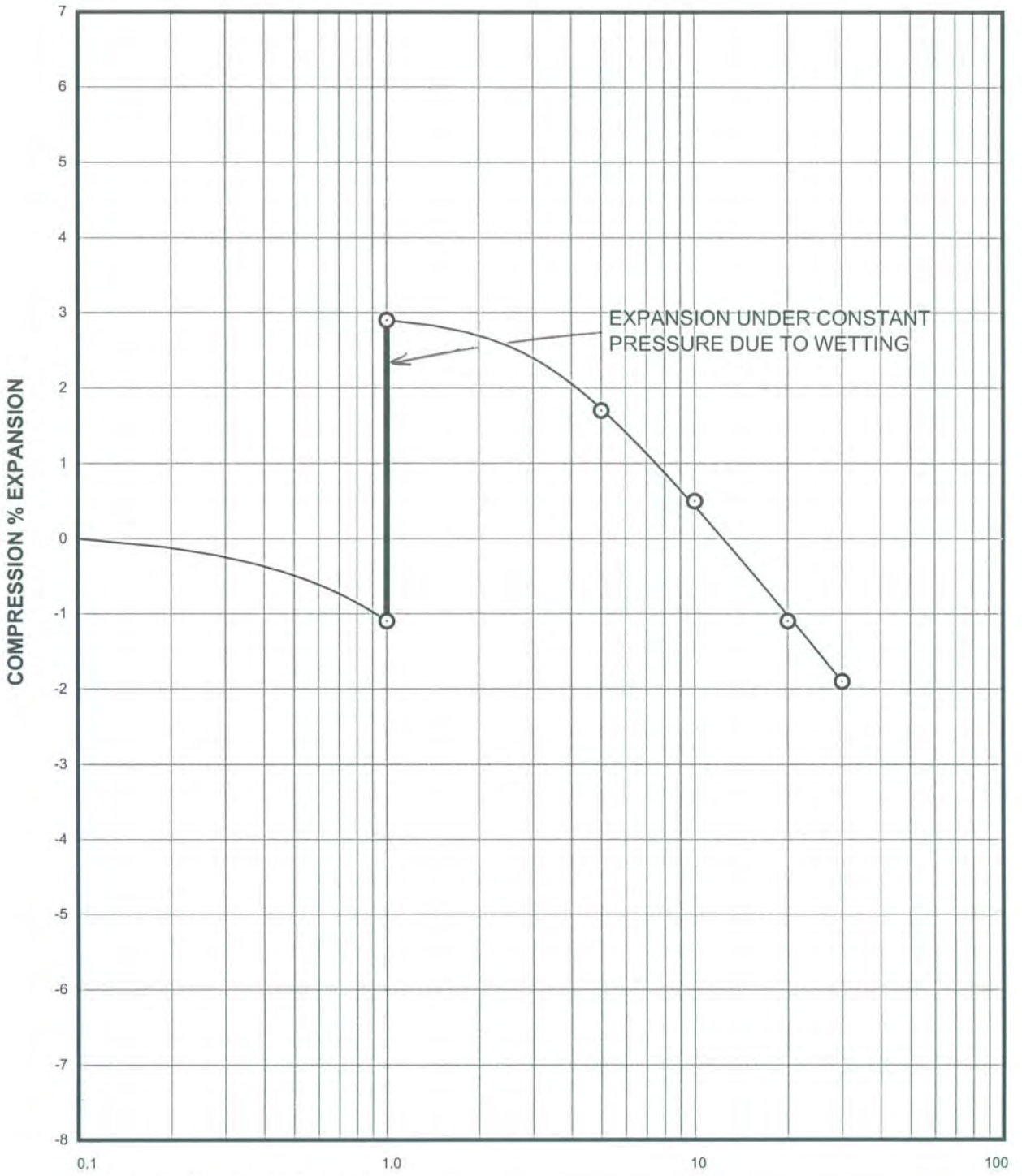

Sample of CLAYSTONE
From TH-8 AT 9 FEET

SAMPLE DRY UNIT WEIGHT= 114 PCF
SAMPLE MOISTURE CONTENT= 16.7 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. B-14



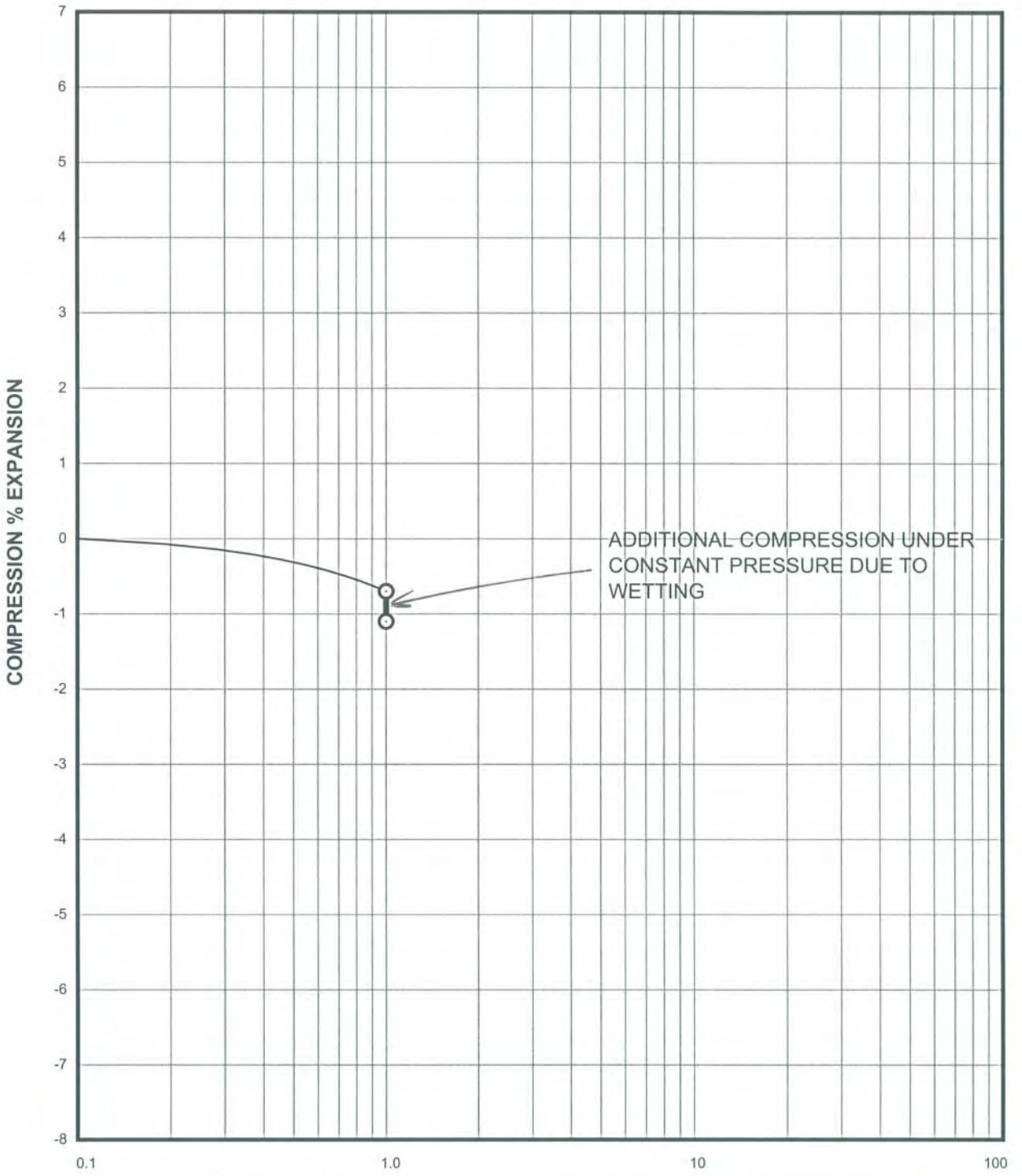

Sample of CLAYSTONE
From TH-8 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 127 PCF
SAMPLE MOISTURE CONTENT= 11.8 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. B-15



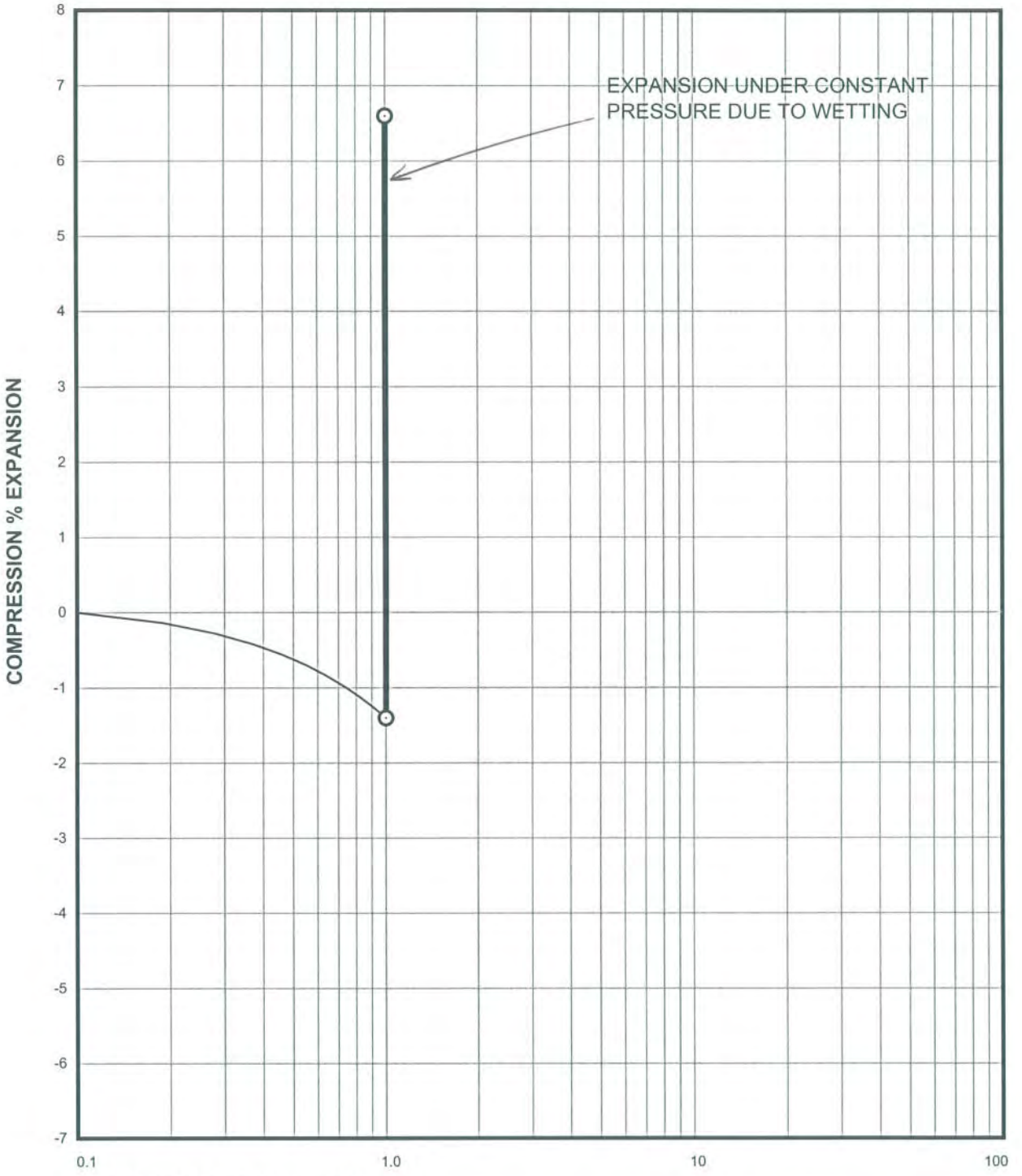

Sample of SAND, CLAYEY (SC)
From TH-9 AT 4 FEET

SAMPLE DRY UNIT WEIGHT= 110 PCF
SAMPLE MOISTURE CONTENT= 7.0 %

PROJECT NO. DN40,507-115

# Swell Consolidation Test Results

FIG. B-16

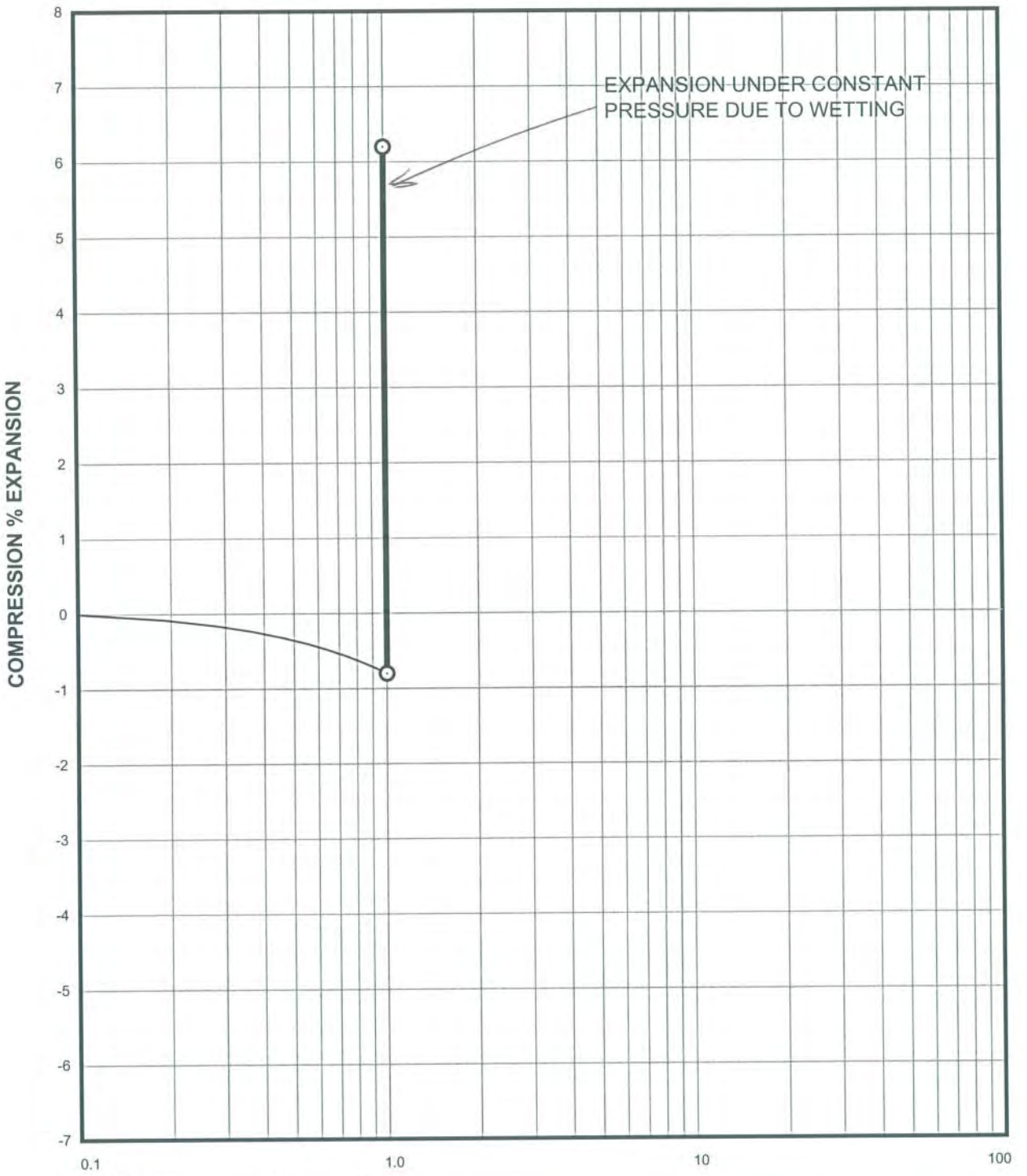



Sample of CLAYSTONE
From TH-9 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 109 PCF
SAMPLE MOISTURE CONTENT= 18.4 %

PROJECT NO. DN40,507-115

**Swell Consolidation Test Results** FIG. B-17



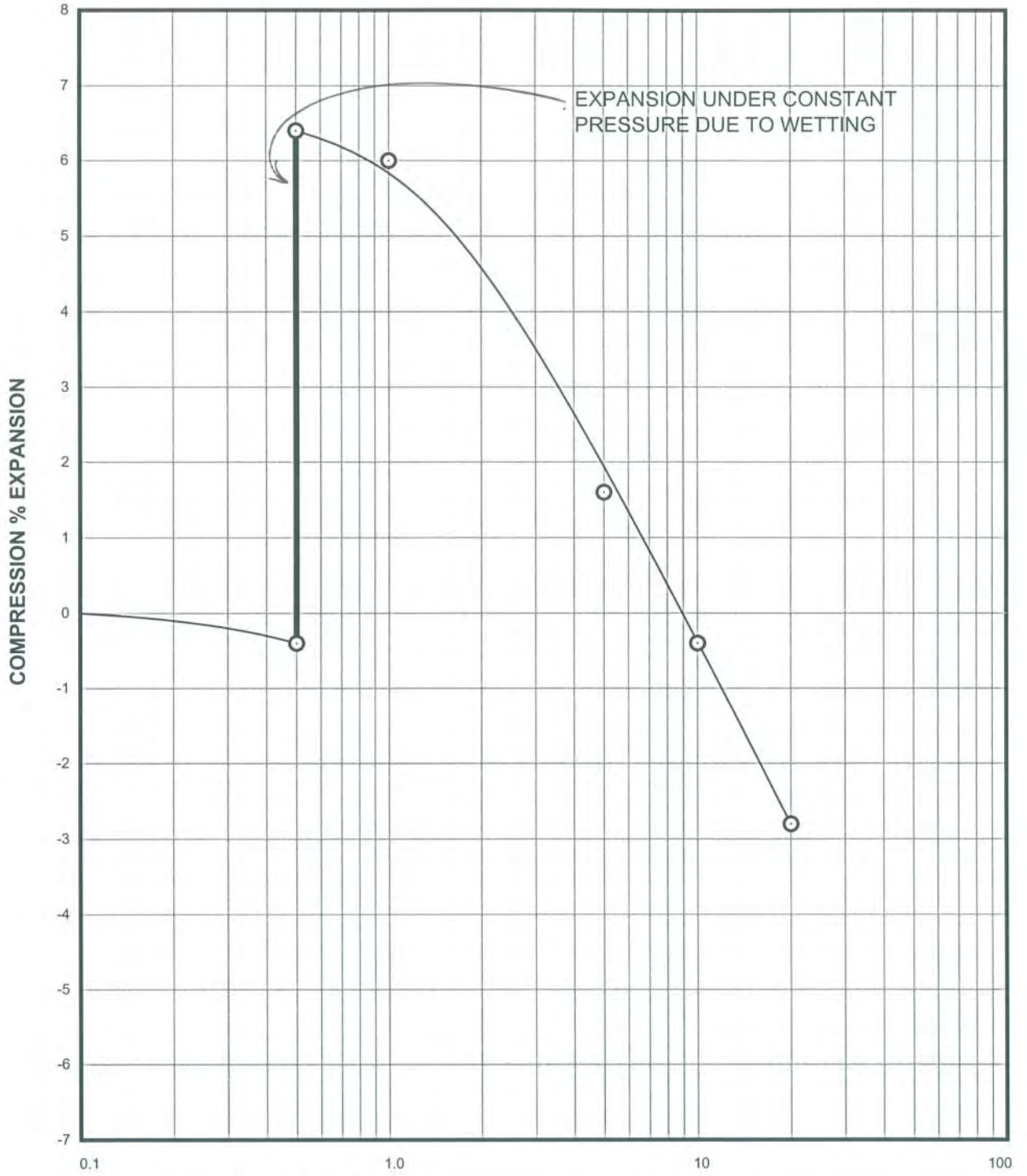

Sample of CLAYSTONE
From TH-9 AT 24 FEET

SAMPLE DRY UNIT WEIGHT= 131 PCF
SAMPLE MOISTURE CONTENT= 9.3 %

# Swell Consolidation Test Results

FIG. B-18

PROJECT NO. DN40,507-115



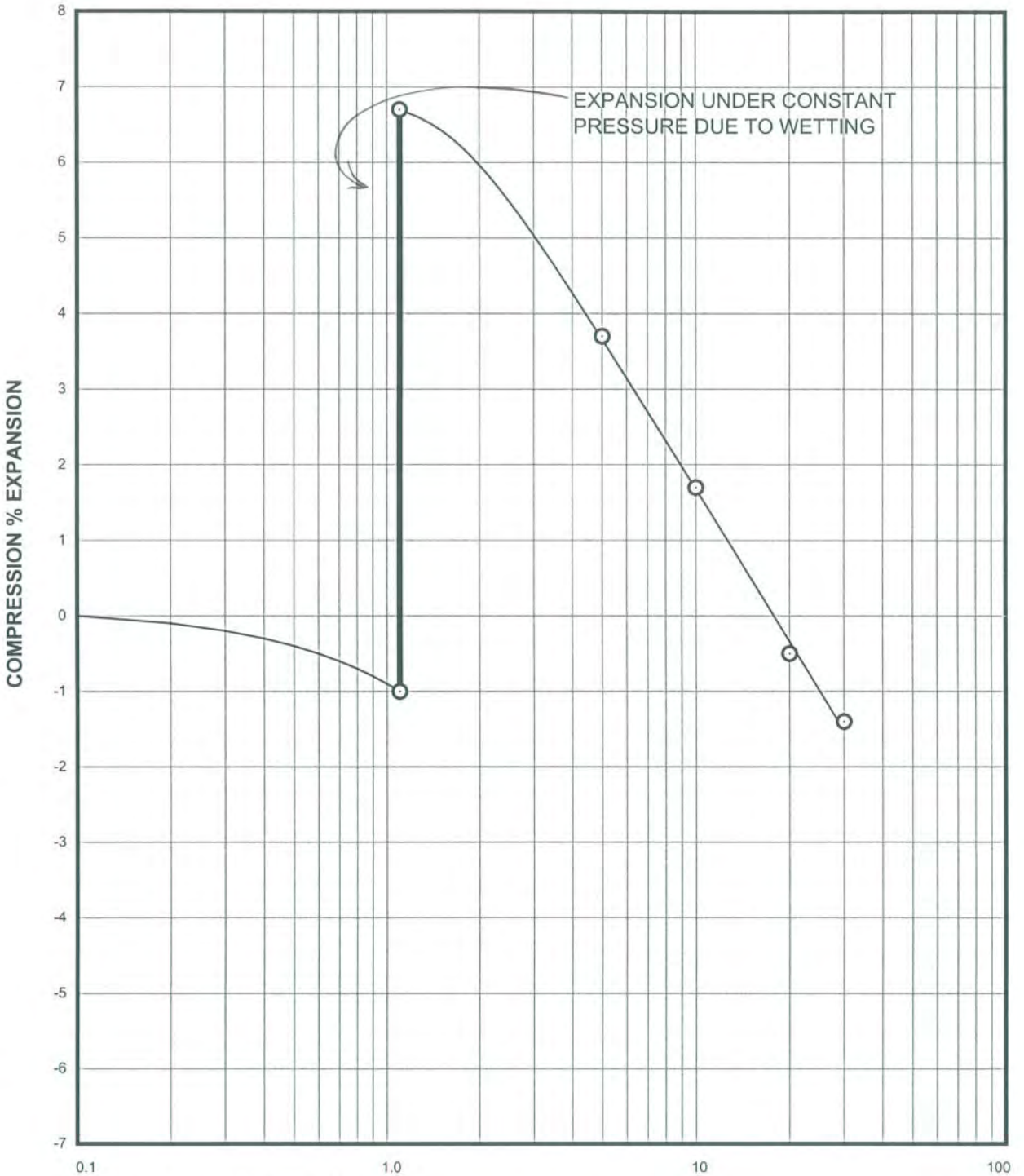

Sample of CLAY, SANDY (CL)
From TH-10 AT 4 FEET

SAMPLE DRY UNIT WEIGHT= 126 PCF
SAMPLE MOISTURE CONTENT= 10.2 %

# Swell Consolidation Test Results

FIG. B-19

PROJECT NO. DN40,507-115

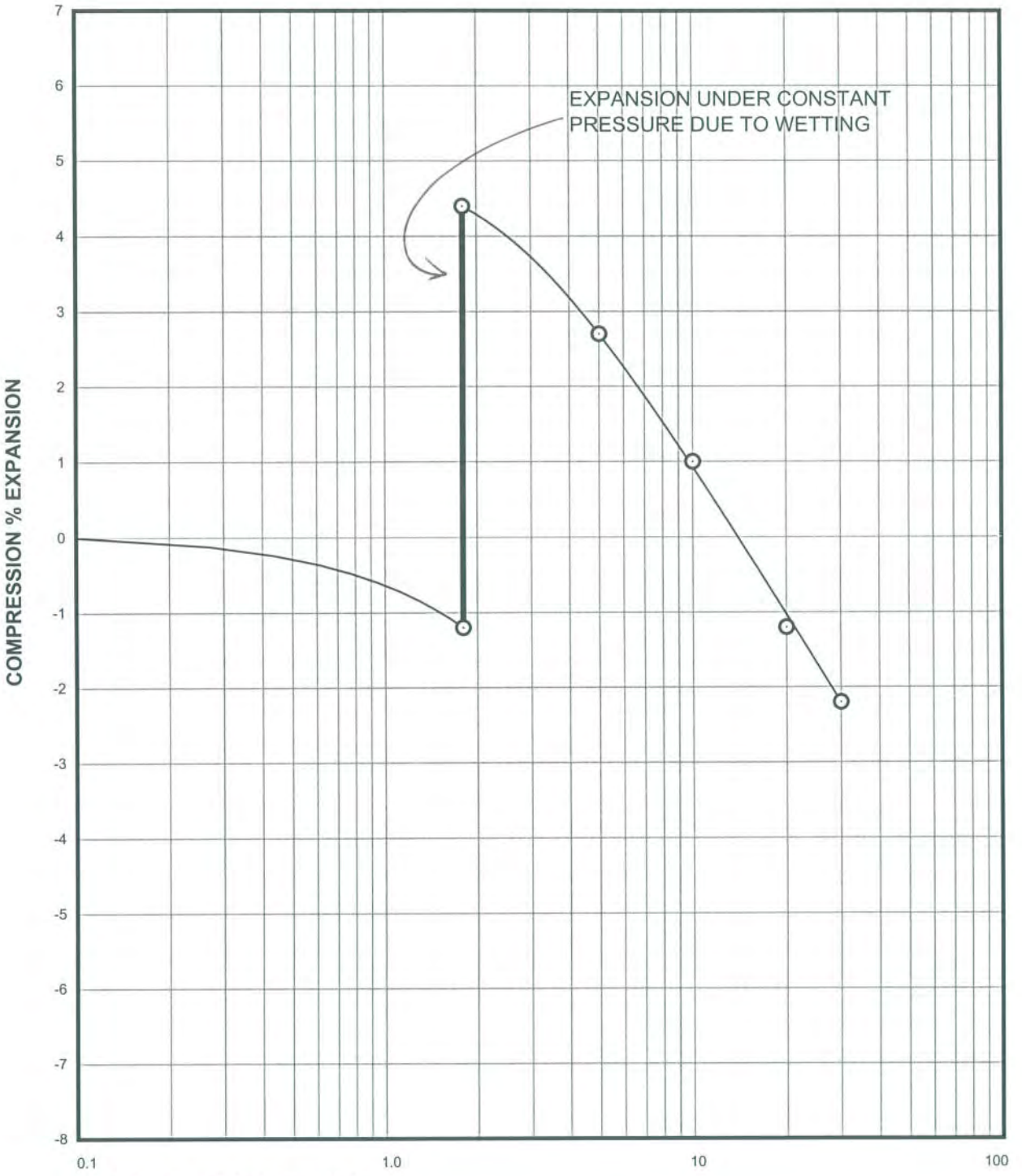



Sample of INTERBEDDED CLAYSTONE/SANDSTONE
From TH-10 AT 9 FEET

SAMPLE DRY UNIT WEIGHT= 127 PCF
SAMPLE MOISTURE CONTENT= 11.7 %

PROJECT NO. DN40,507-115

**Swell Consolidation Test Results** FIG. B-20



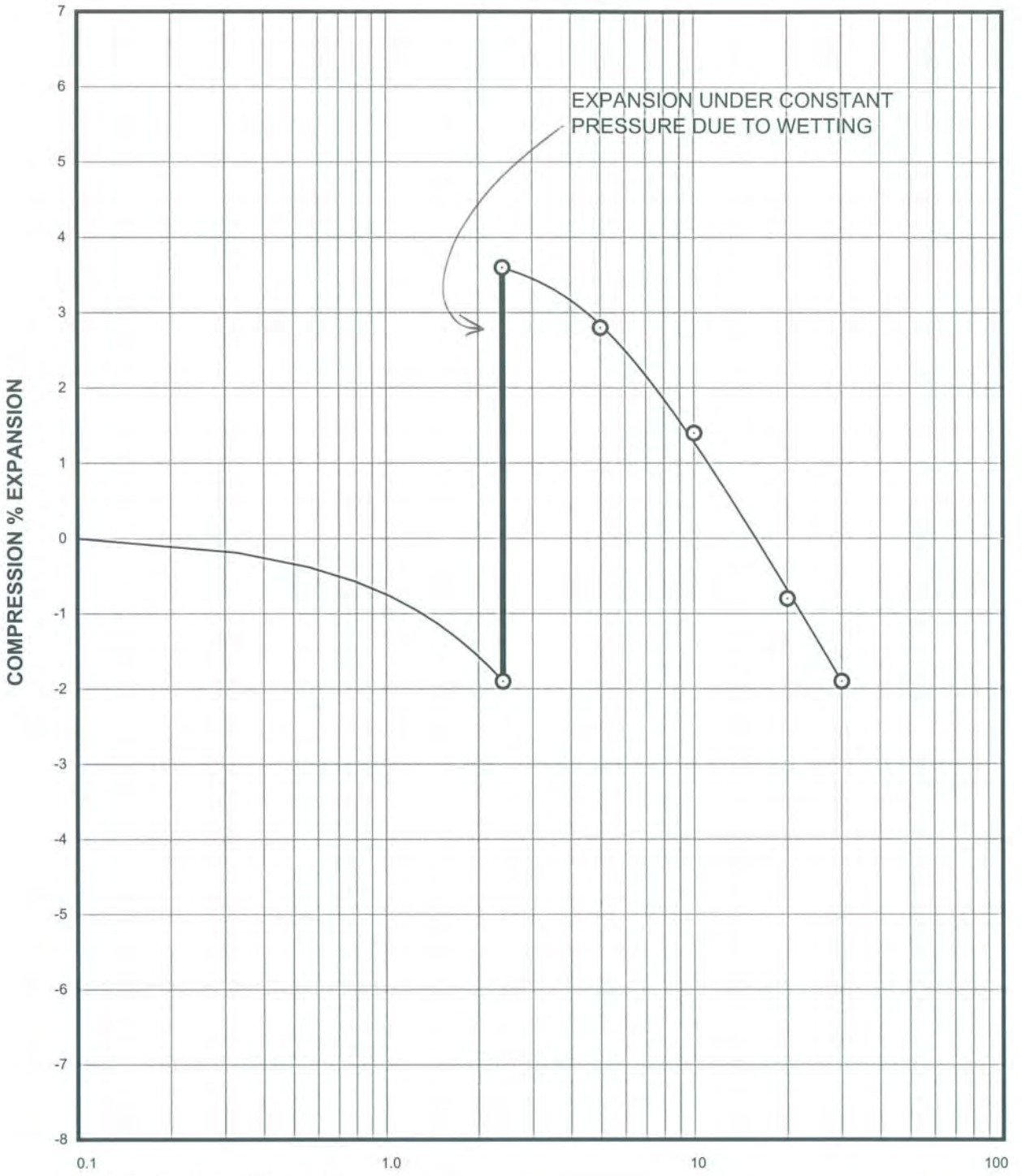

Sample of CLAYSTONE
From TH-10 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 132 PCF
SAMPLE MOISTURE CONTENT= 9.5 %

# Swell Consolidation Test Results

FIG. B-21

PROJECT NO. DN40,507-115



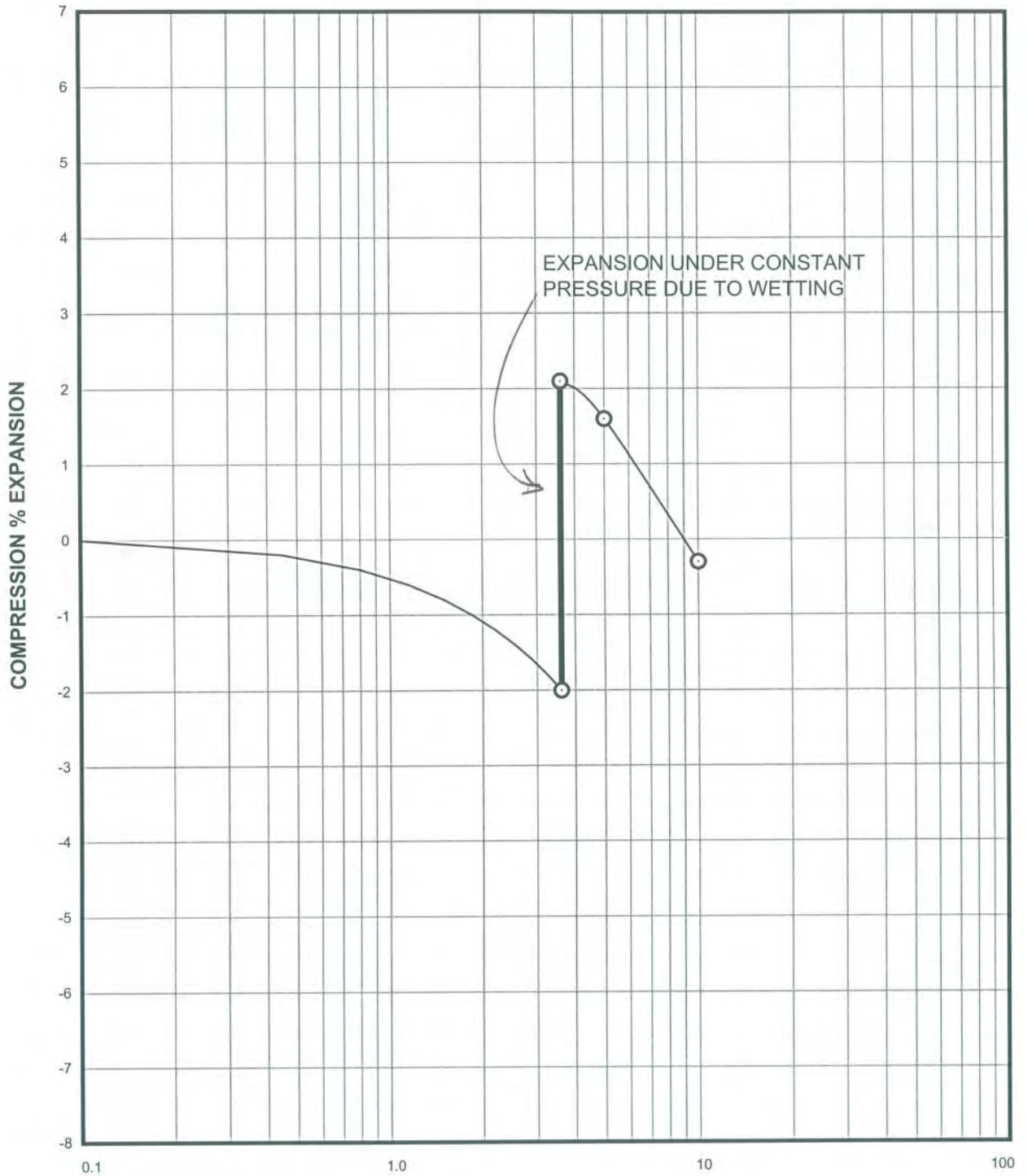

Sample of CLAYSTONE
From TH-10 AT 19 FEET

SAMPLE DRY UNIT WEIGHT= 117 PCF
SAMPLE MOISTURE CONTENT= 15.6 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. B-22



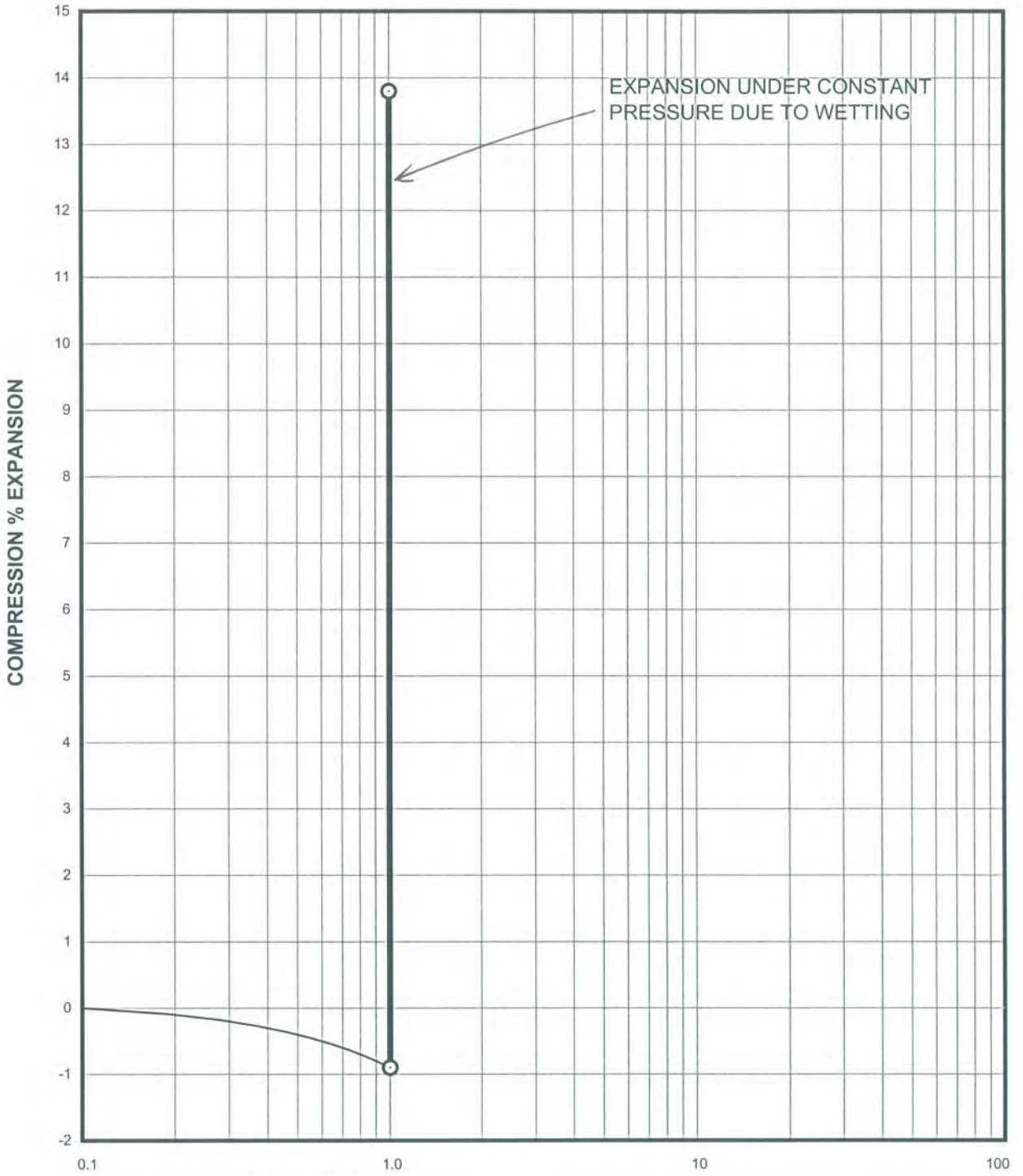

Sample of CLAYSTONE
From TH-10 AT 29 FEET

SAMPLE DRY UNIT WEIGHT= 118 PCF
SAMPLE MOISTURE CONTENT= 13.3 %

# Swell Consolidation Test Results

FIG. B-23

PROJECT NO. DN40,507-115



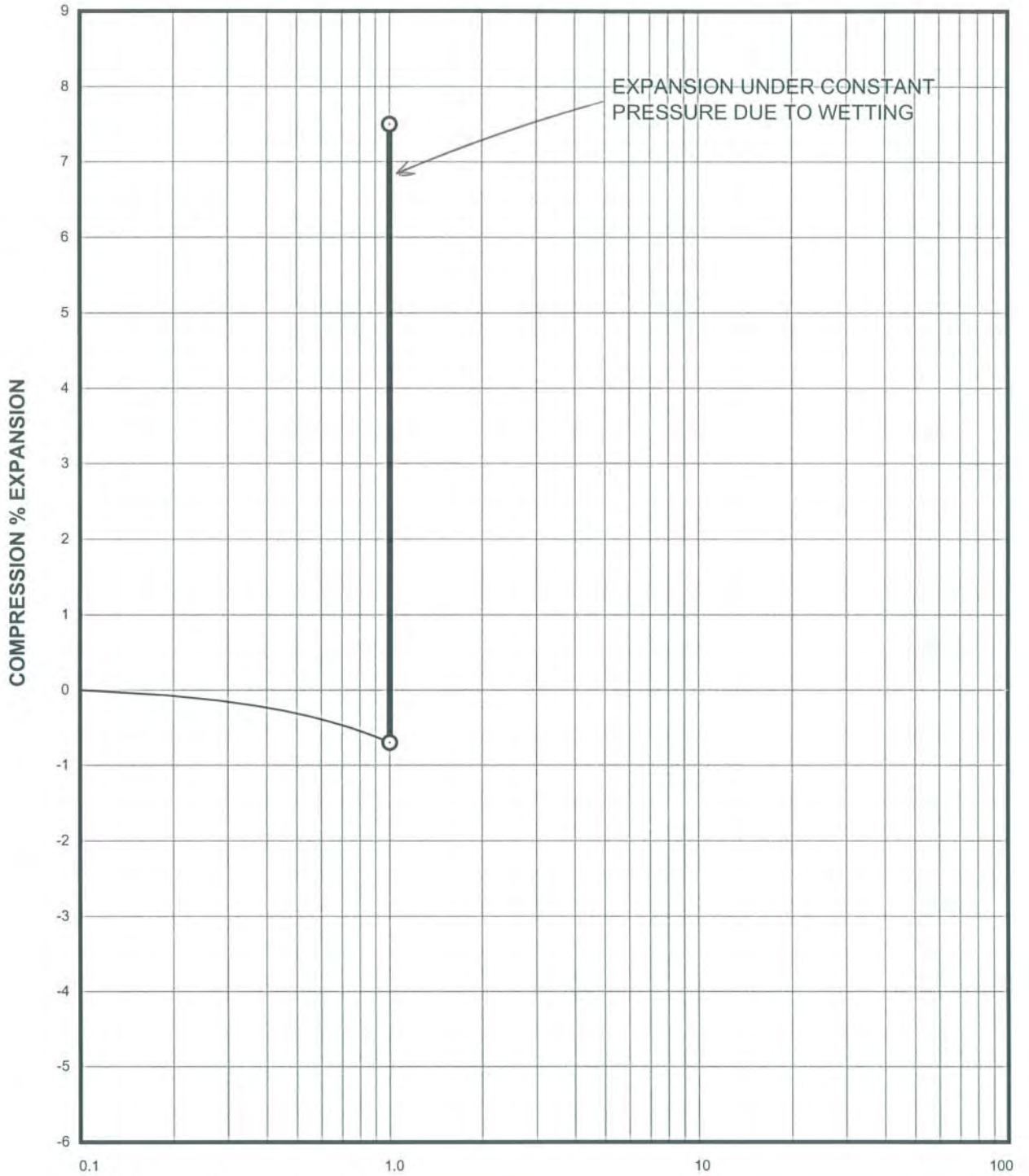

Sample of CLAYSTONE
From TH-11 AT 19 FEET

SAMPLE DRY UNIT WEIGHT= 115 PCF
SAMPLE MOISTURE CONTENT= 16.5 %

# Swell Consolidation Test Results

FIG. B-24

PROJECT NO. DN40,507-115



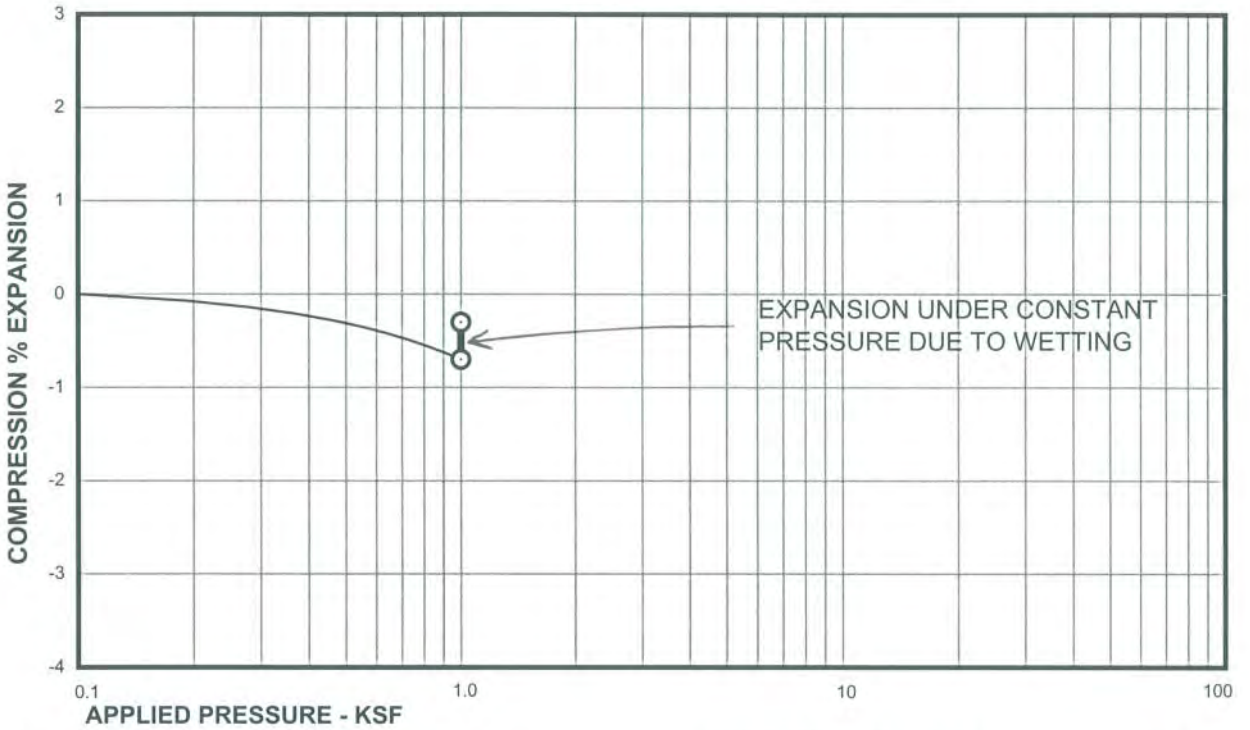

Sample of CLAYSTONE
From TH-11 AT 24 FEET

SAMPLE DRY UNIT WEIGHT= 109 PCF
SAMPLE MOISTURE CONTENT= 19.9 %

# Swell Consolidation Test Results

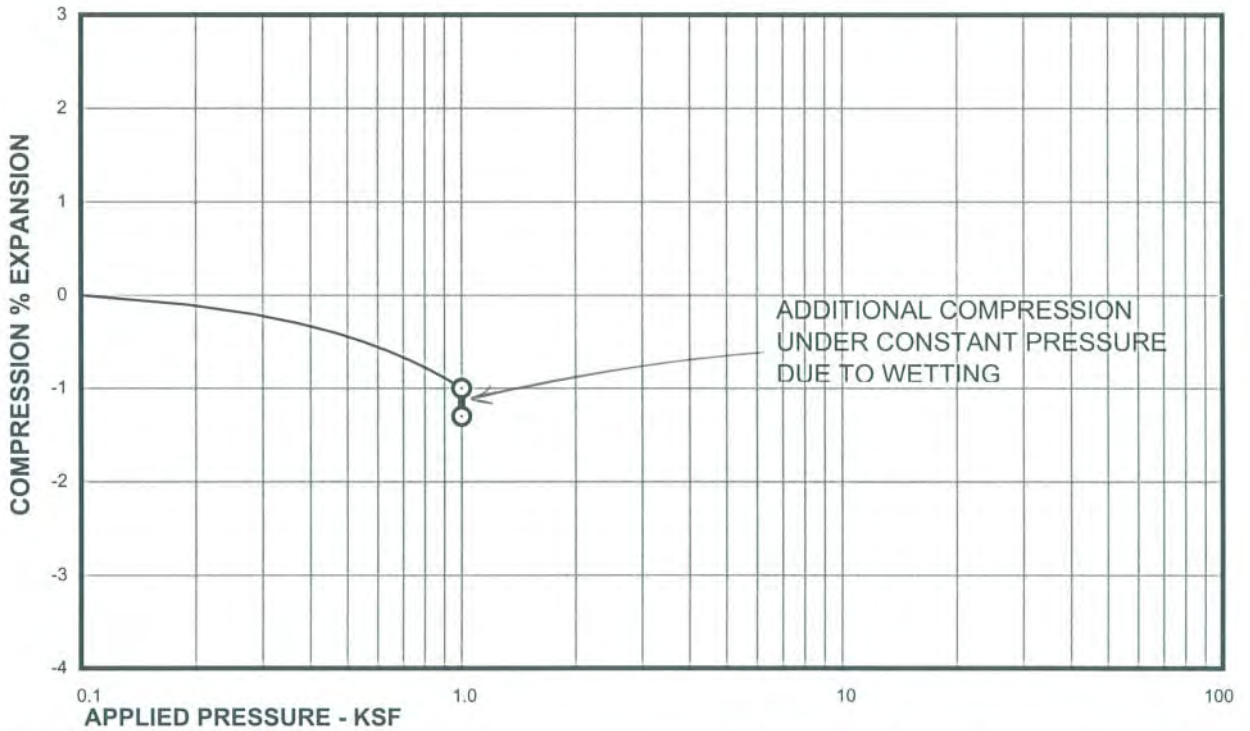
FIG. B-25

PROJECT NO. DN40,507-115




Sample of CLAY, SANDY (CL)
From TH-12 AT 9 FEET

SAMPLE DRY UNIT WEIGHT= 109 PCF
SAMPLE MOISTURE CONTENT= 15.2 %



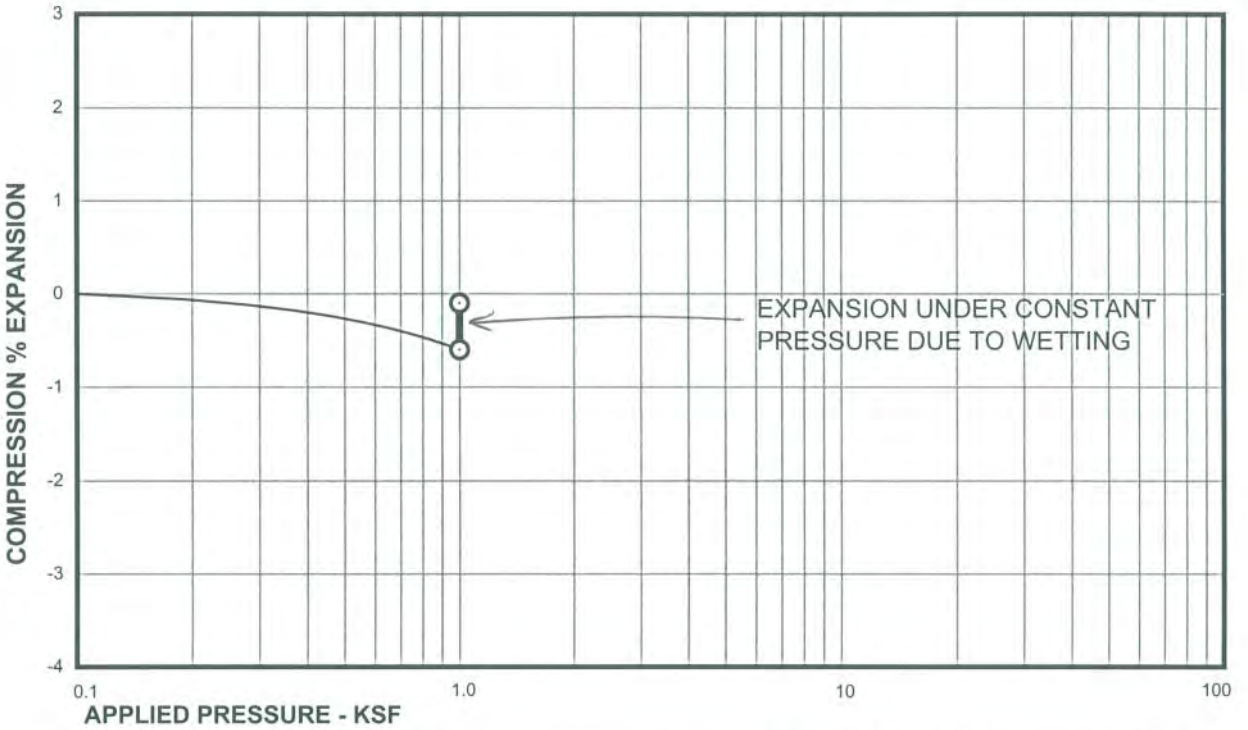

Sample of CLAY, SANDY (CL)
From TH-12 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 103 PCF
SAMPLE MOISTURE CONTENT= 13.8 %

# Swell Consolidation Test Results

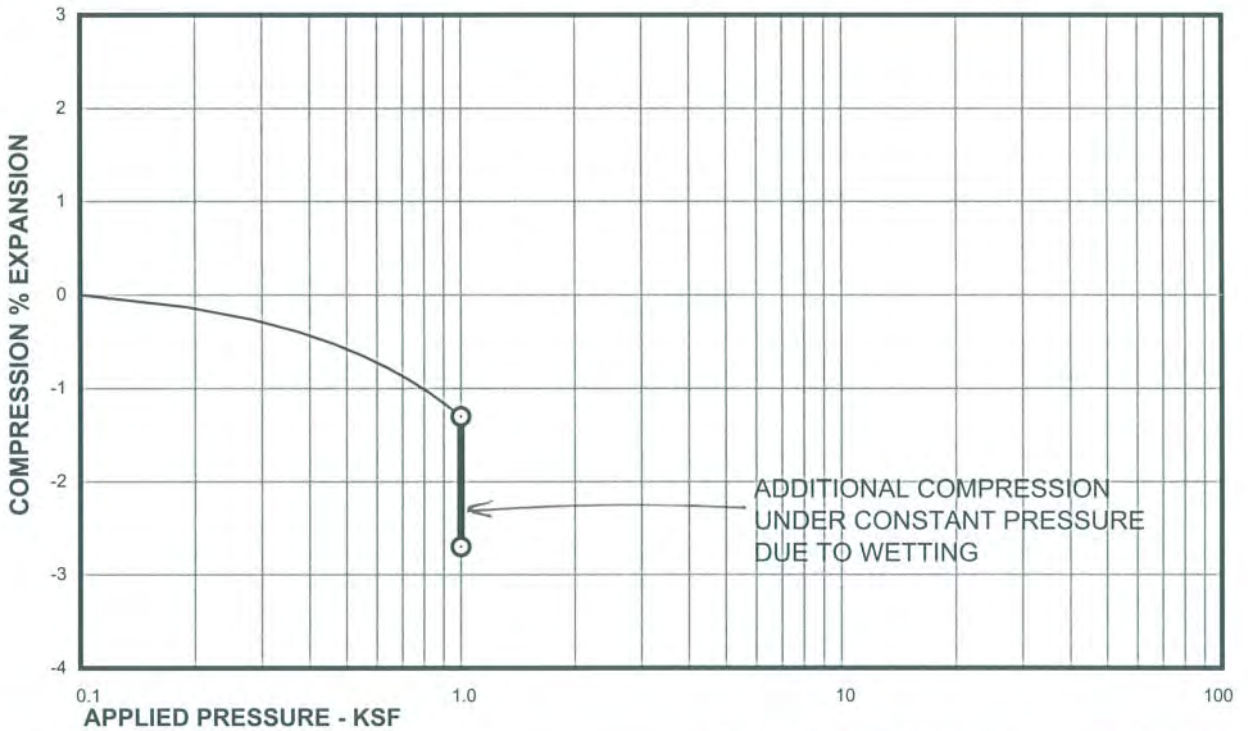
PROJECT NO. DN40,507-115

FIG. B-26




Sample of CLAY, SANDY (CL)
From TH-13 AT 4 FEET

SAMPLE DRY UNIT WEIGHT= 95 PCF
SAMPLE MOISTURE CONTENT= 15.6 %



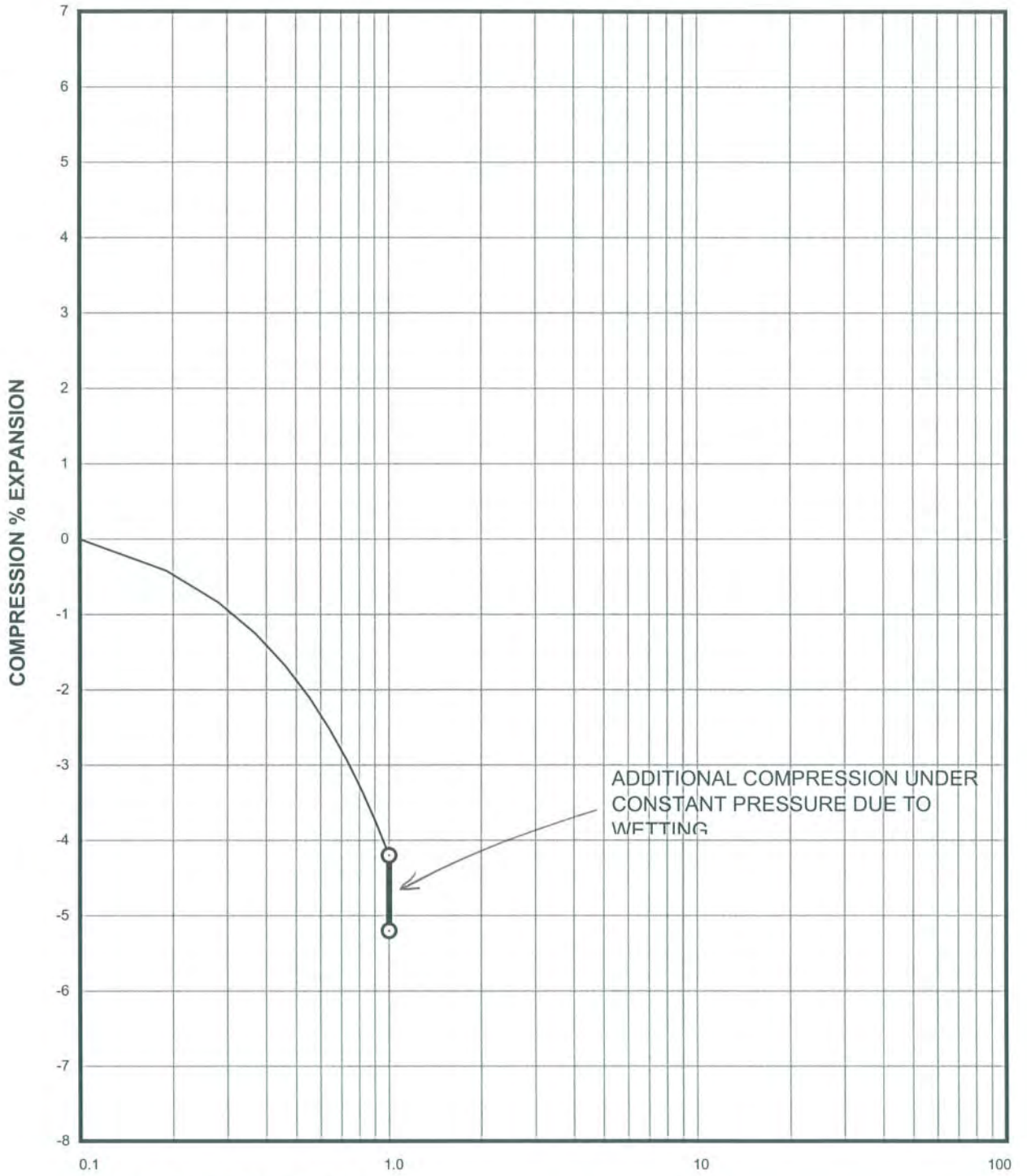

Sample of SANDSTONE
From TH-13 AT 19 FEET

SAMPLE DRY UNIT WEIGHT= 100 PCF
SAMPLE MOISTURE CONTENT= 11.6 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. B-27



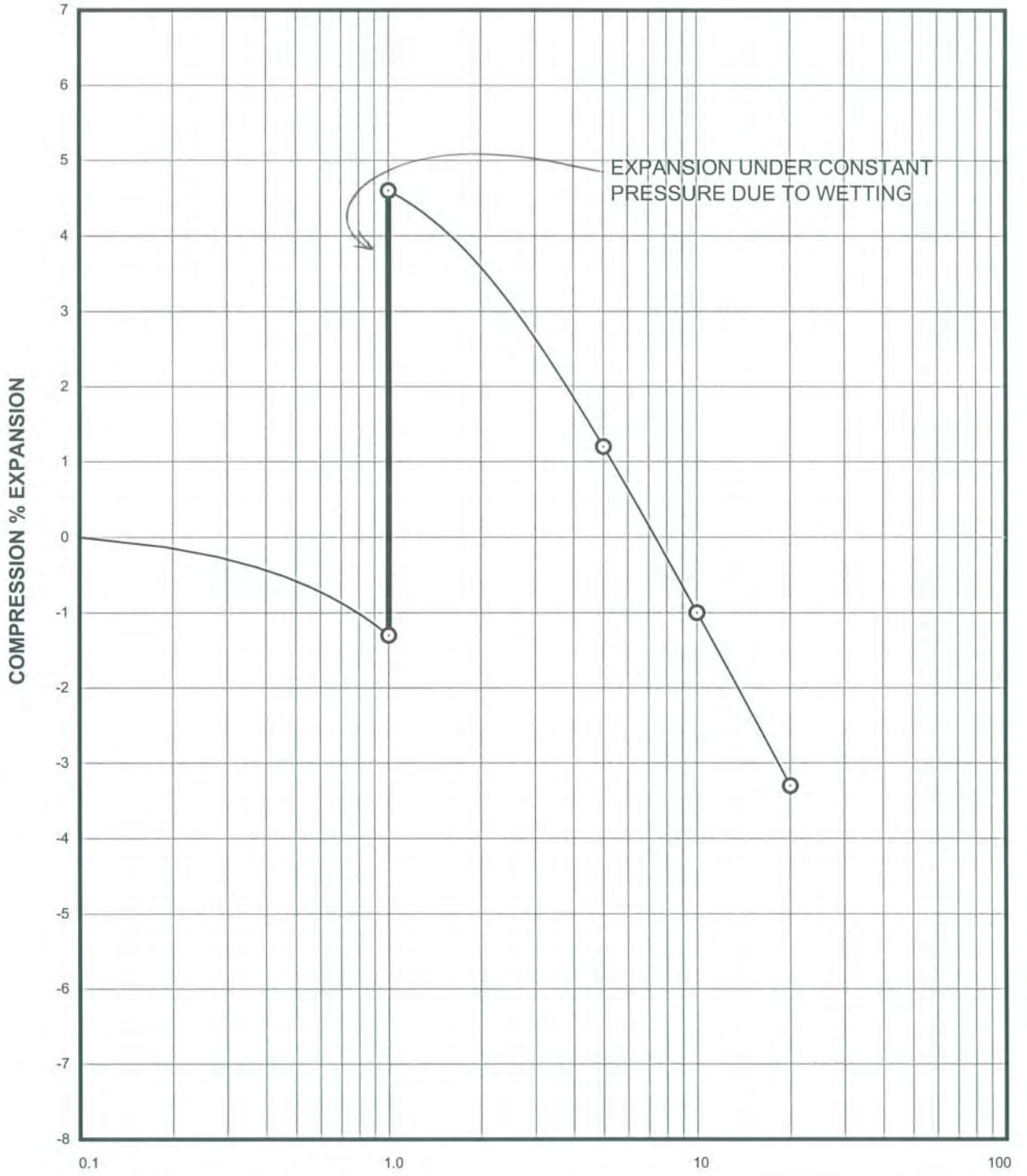

Sample of CLAY, SANDY (CL)
From TH-14 AT 9 FEET

SAMPLE DRY UNIT WEIGHT= 115 PCF
SAMPLE MOISTURE CONTENT= 14.3 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. B-28



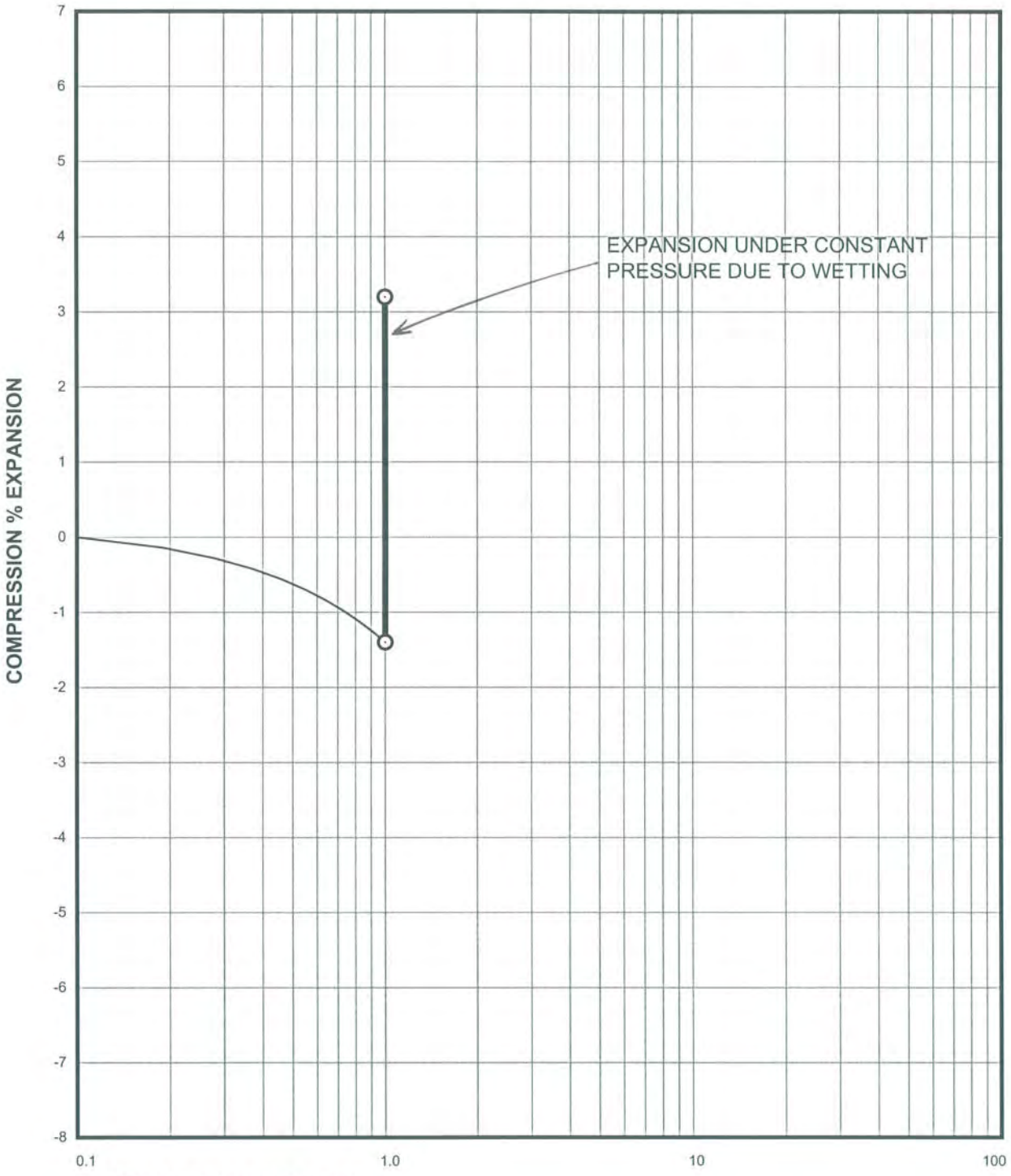

Sample of CLAYSTONE
From TH-14 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 115 PCF
SAMPLE MOISTURE CONTENT= 14.2 %

# Swell Consolidation Test Results

FIG. B-29

PROJECT NO. DN40,507-115



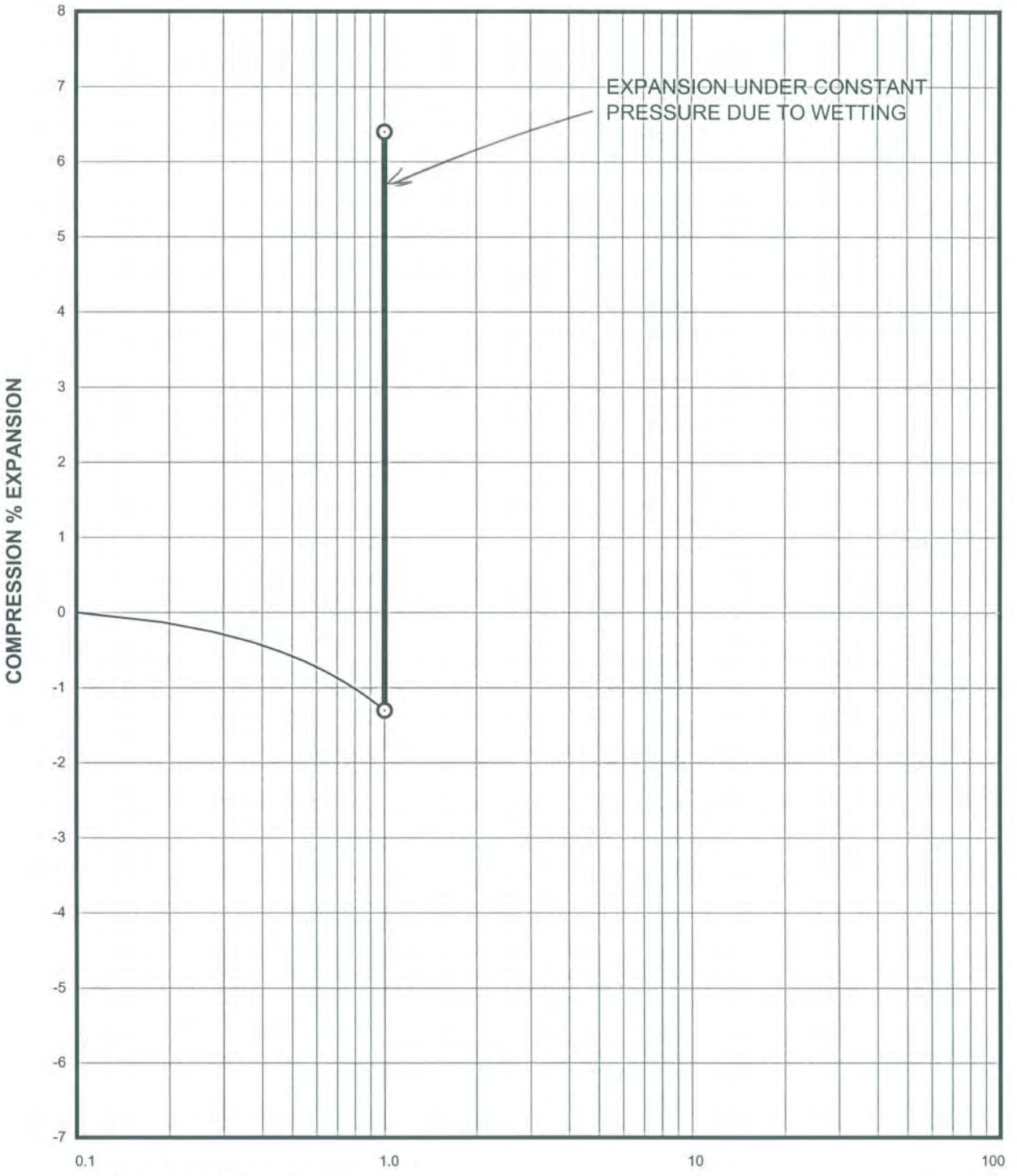

Sample of CLAYSTONE
From TH-15 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 119 PCF
SAMPLE MOISTURE CONTENT= 15.2 %

# Swell Consolidation Test Results

FIG. B-30

PROJECT NO. DN40,507-115



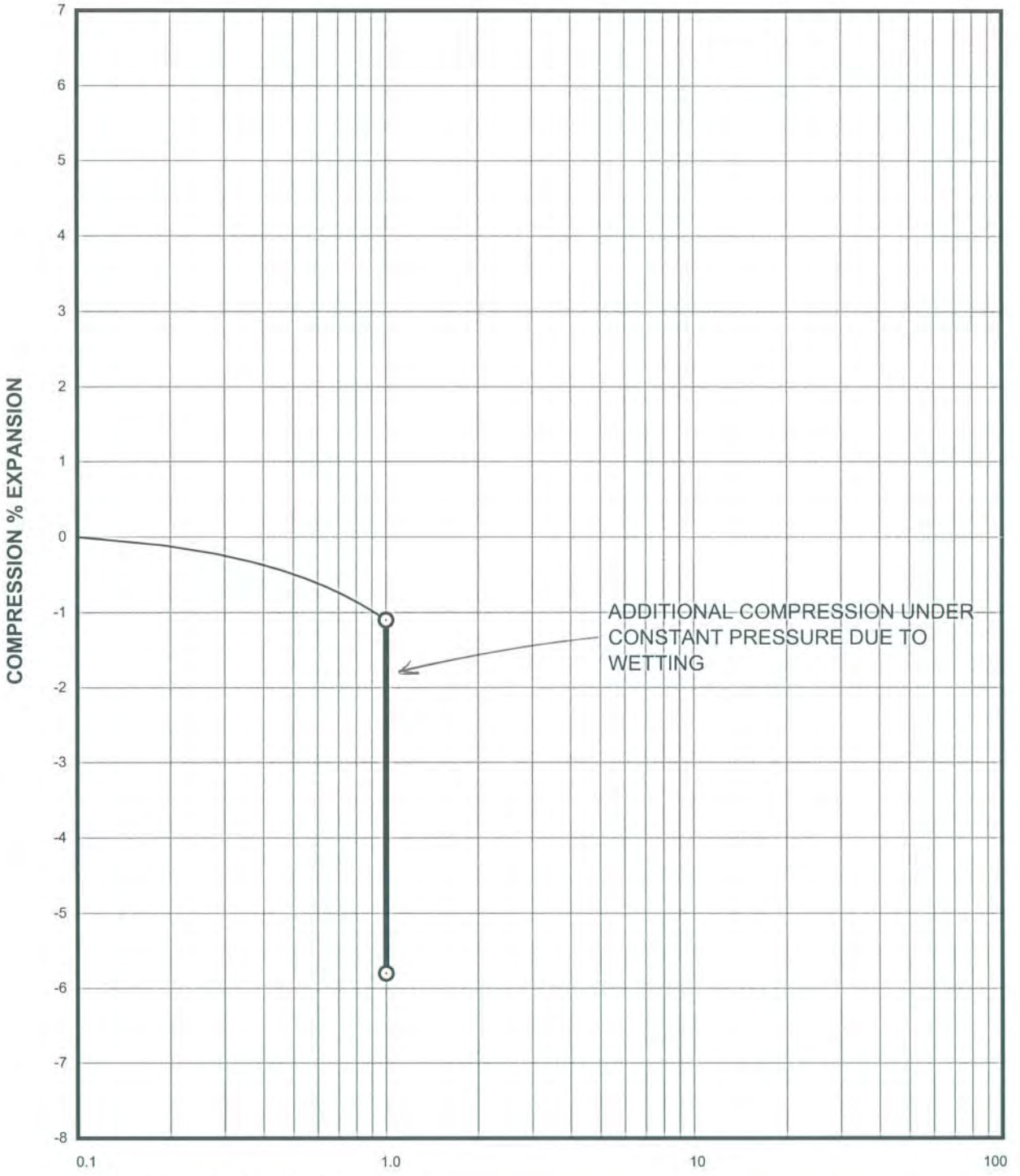

Sample of CLAYSTONE
From TH-15 AT 24 FEET

SAMPLE DRY UNIT WEIGHT= 108 PCF
SAMPLE MOISTURE CONTENT= 18.2 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. B-31



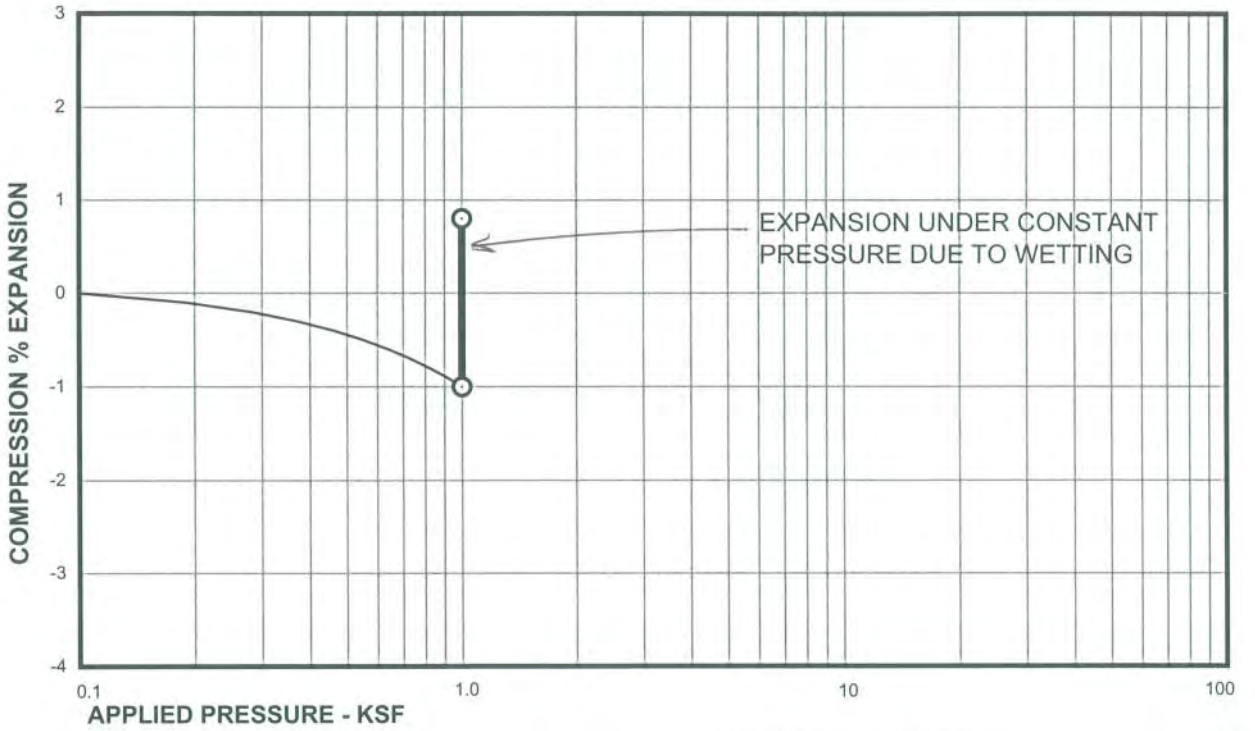

Sample of CLAY, SANDY (CL)
From TH-16 AT 4 FEET

SAMPLE DRY UNIT WEIGHT= 89 PCF
SAMPLE MOISTURE CONTENT= 7.4 %

# Swell Consolidation Test Results

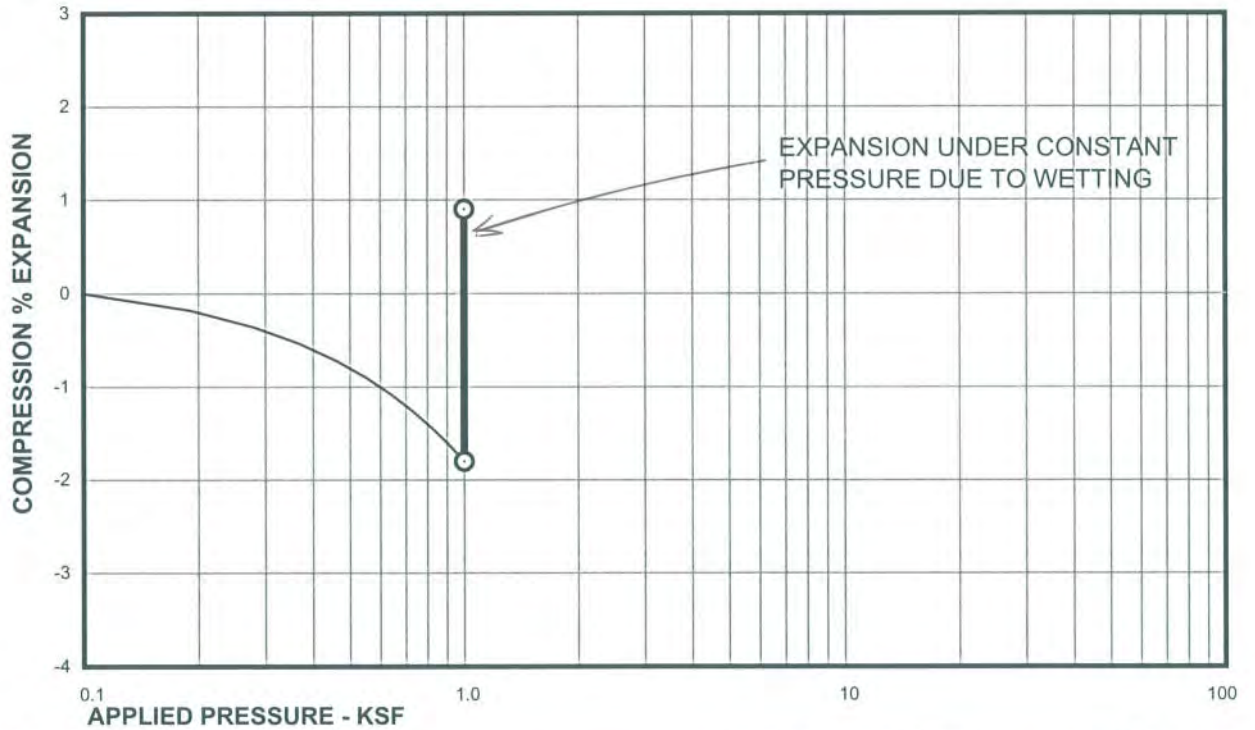
PROJECT NO. DN40,507-115

FIG. B-32




Sample of CLAYSTONE
From TH-16 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 109 PCF
SAMPLE MOISTURE CONTENT= 10.1 %



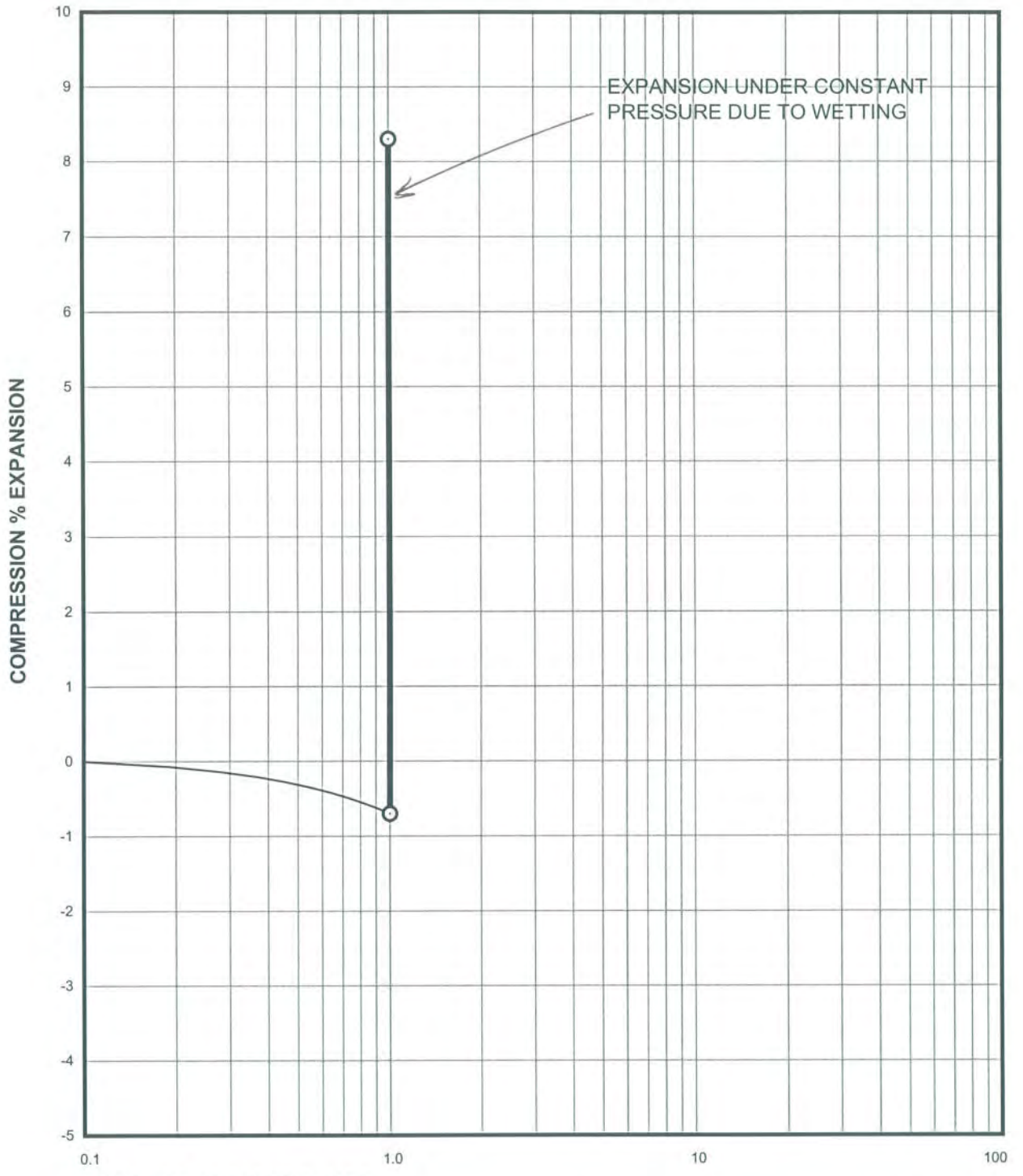

Sample of CLAY, SANDY (CL)
From TH-17 AT 9 FEET

SAMPLE DRY UNIT WEIGHT= 114 PCF
SAMPLE MOISTURE CONTENT= 11.4 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. B-33



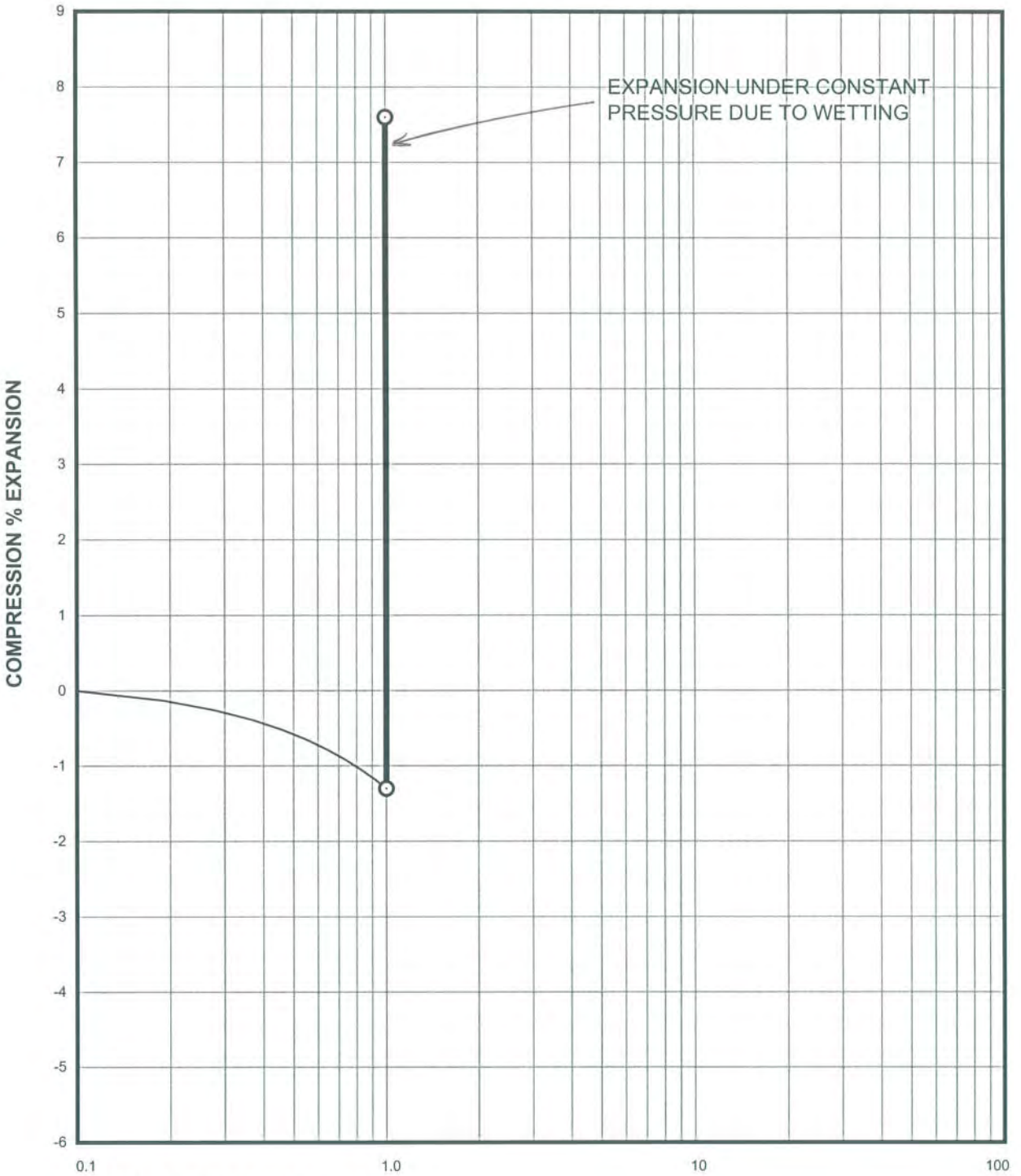

Sample of CLAYSTONE
From TH-17 AT 19 FEET

SAMPLE DRY UNIT WEIGHT= 126 PCF
SAMPLE MOISTURE CONTENT= 9.1 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. B-34



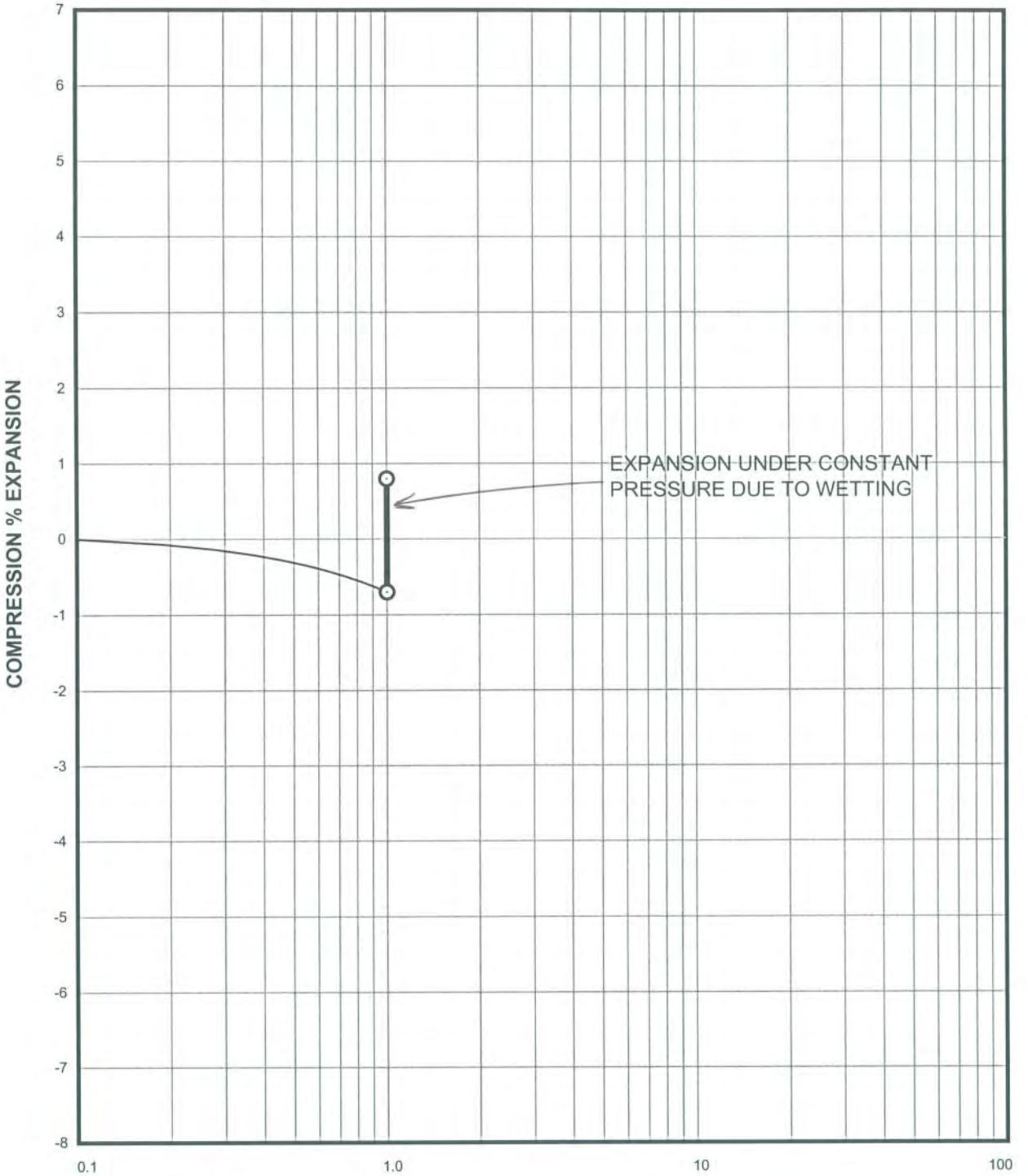

Sample of CLAYSTONE
From TH-17 AT 34 FEET

SAMPLE DRY UNIT WEIGHT= 127 PCF
SAMPLE MOISTURE CONTENT= 11.0 %

# Swell Consolidation Test Results

FIG. B-35

PROJECT NO. DN40,507-115



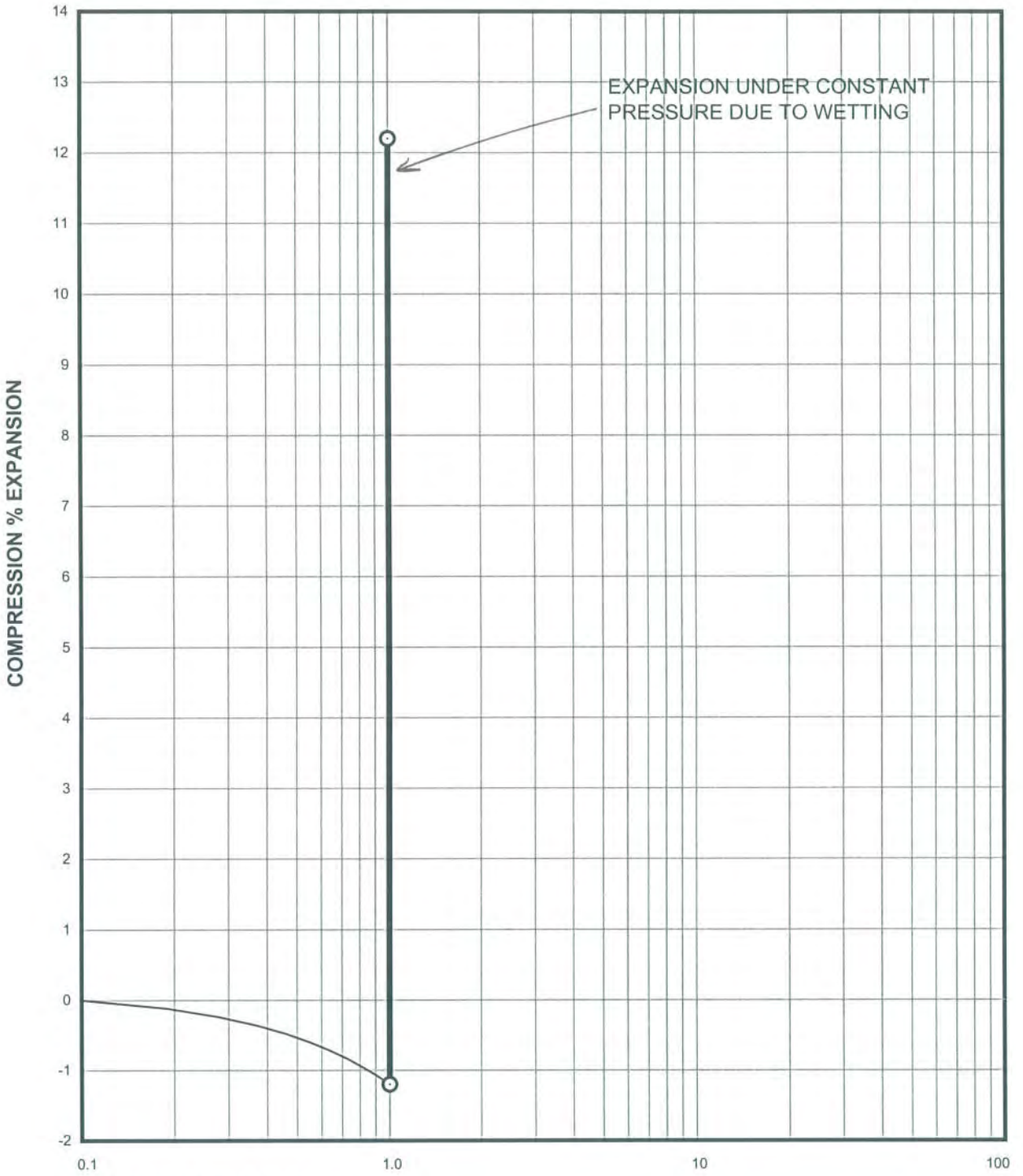

Sample of CLAY, SANDY (CL)
From TH-18 AT 4 FEET

SAMPLE DRY UNIT WEIGHT= 112 PCF
SAMPLE MOISTURE CONTENT= 15.2 %

# Swell Consolidation Test Results

FIG. B-36

PROJECT NO. DN40,507-115



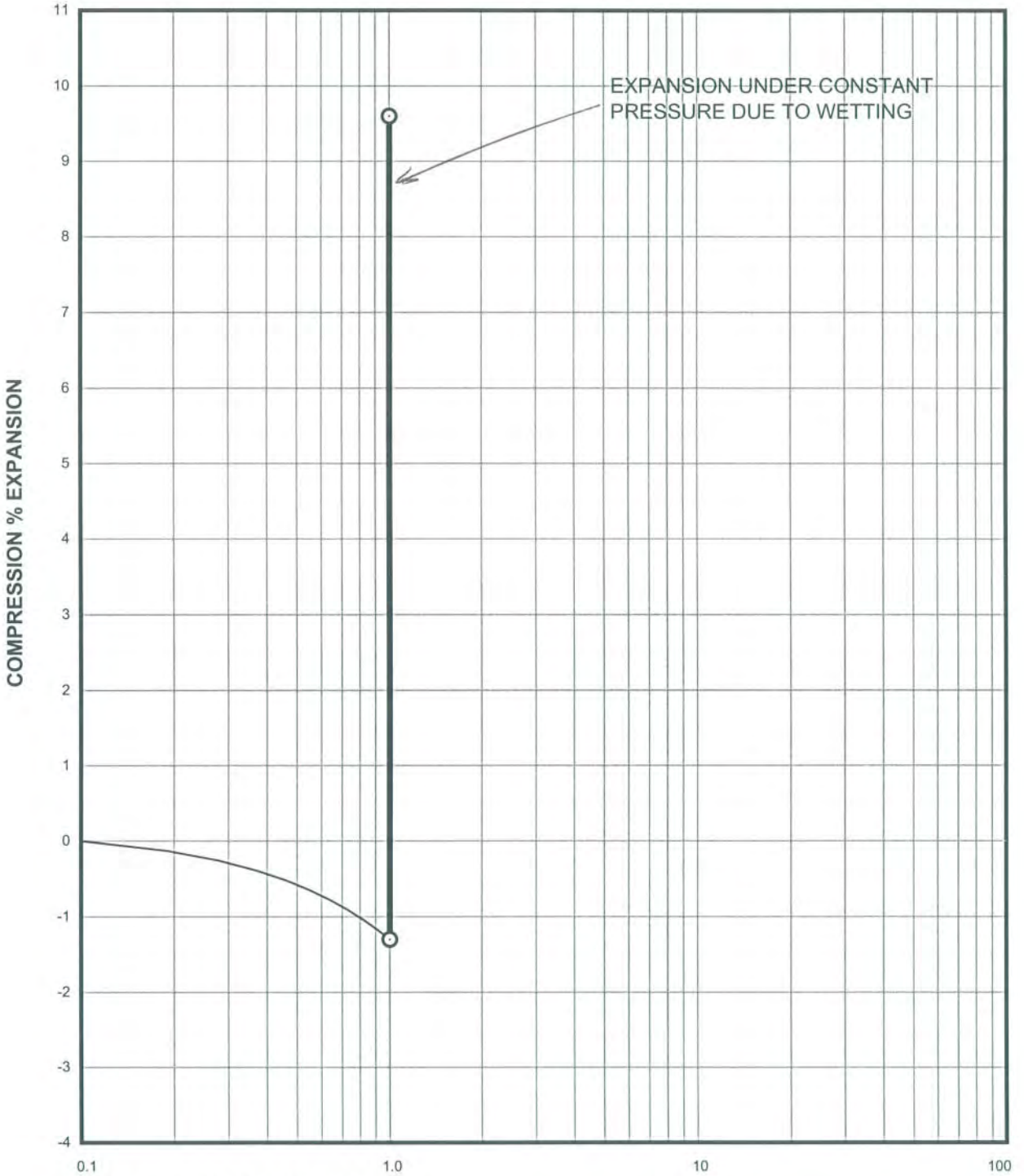

Sample of CLAYSTONE
From TH-18 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 106 PCF
SAMPLE MOISTURE CONTENT= 21.2 %

# Swell Consolidation Test Results

FIG. B-37

PROJECT NO. DN40,507-115



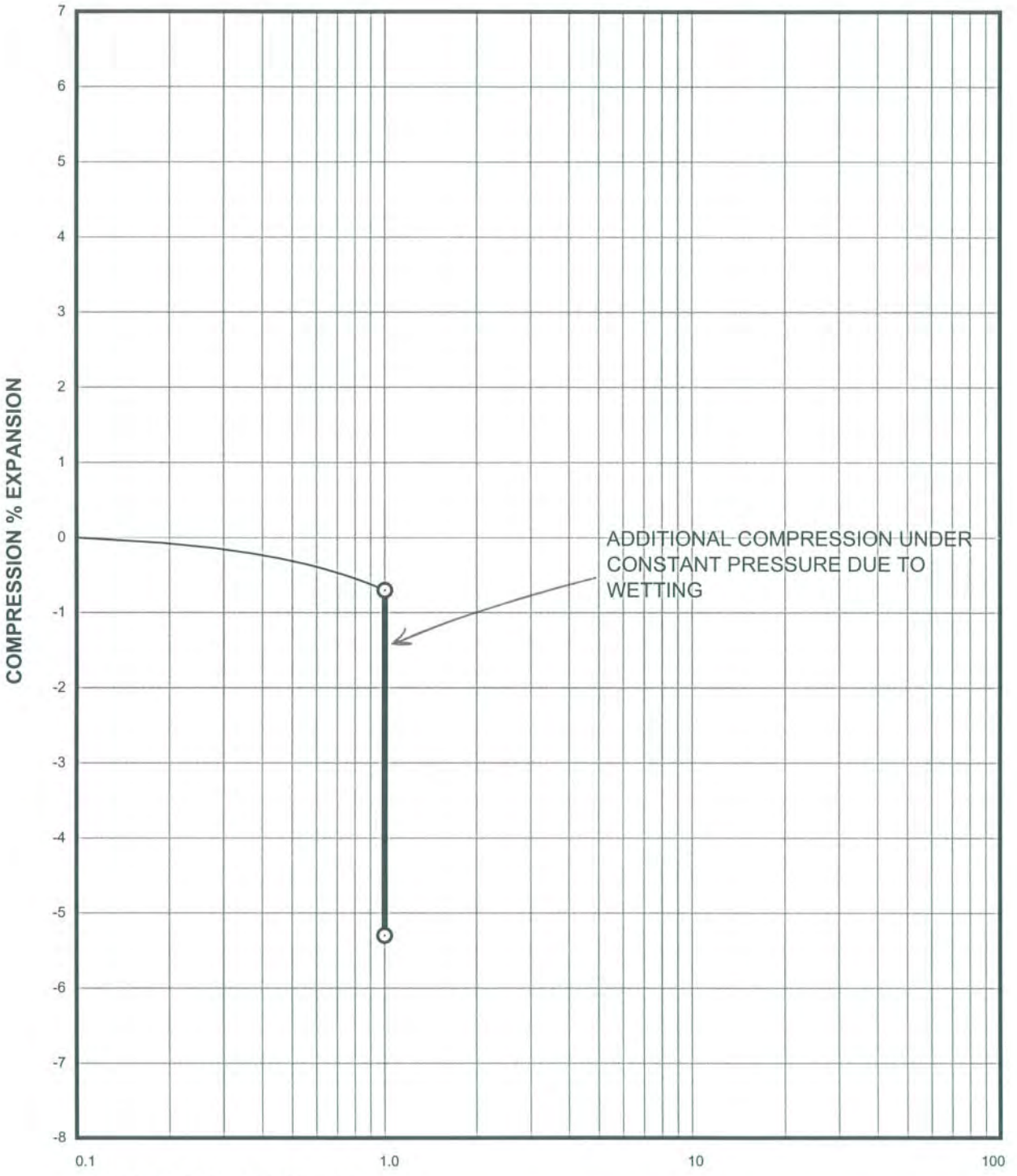

Sample of CLAYSTONE
From TH-18 AT 24 FEET

SAMPLE DRY UNIT WEIGHT= 122 PCF
SAMPLE MOISTURE CONTENT= 12.7 %

# Swell Consolidation Test Results

FIG. B-38

PROJECT NO. DN40,507-115



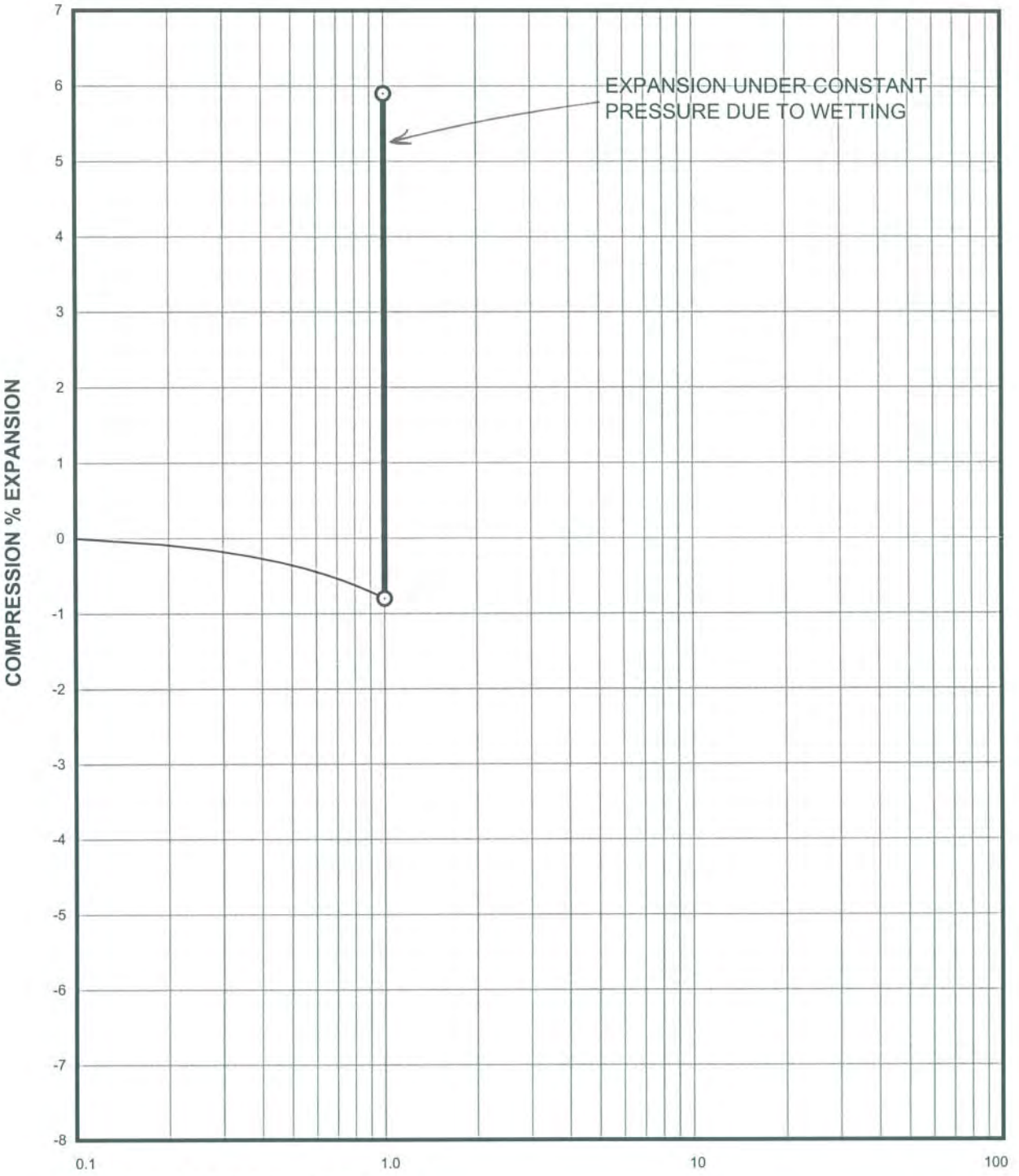

Sample of CLAY, SANDY (CL)
From TH-19 AT 4 FEET

SAMPLE DRY UNIT WEIGHT= 97 PCF
SAMPLE MOISTURE CONTENT= 5.2 %

# Swell Consolidation Test Results

PROJECT NO. DN40,507-115

FIG. B-39



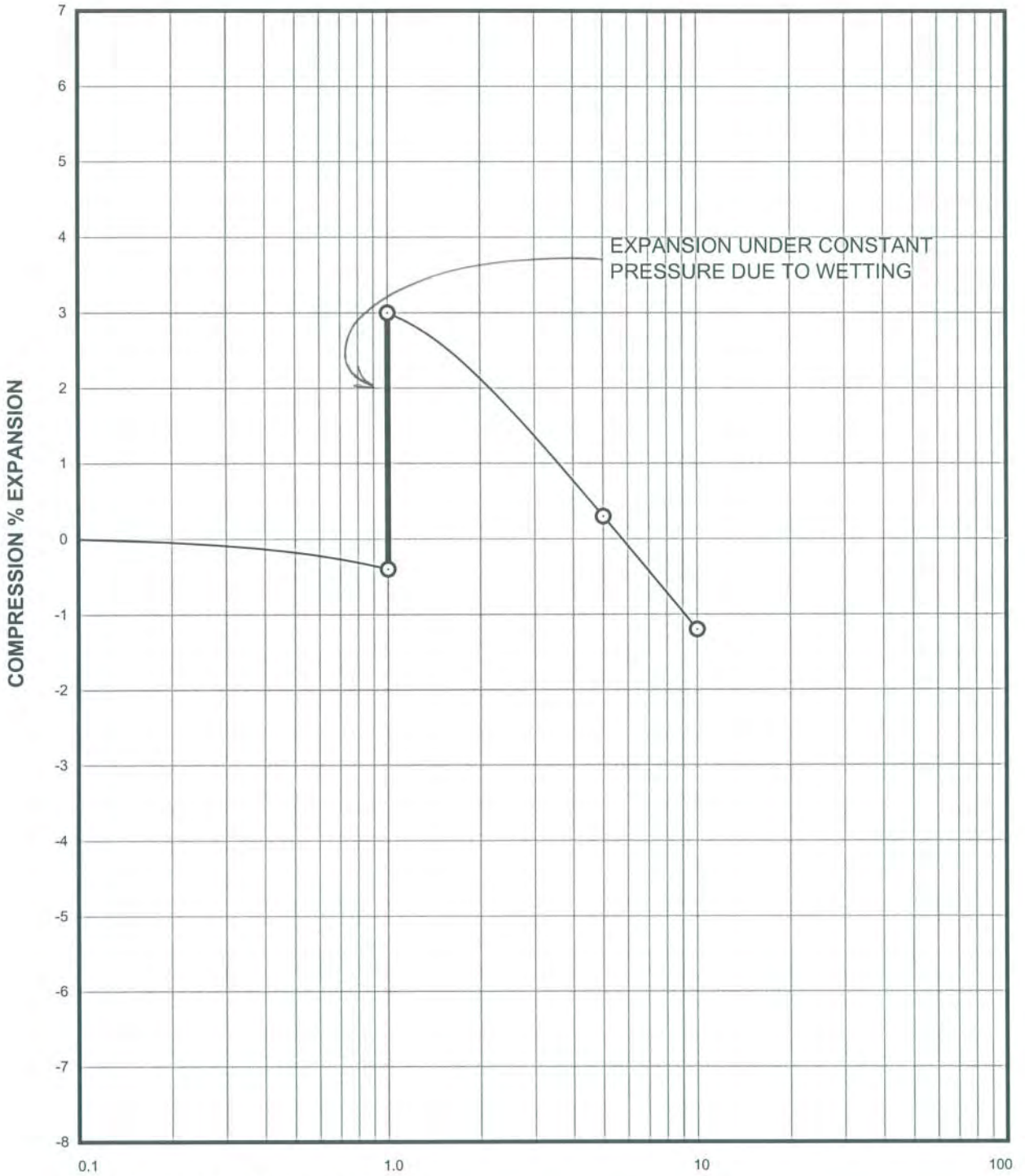

Sample of CLAY, SANDY (CL)
From TH-19 AT 9 FEET

SAMPLE DRY UNIT WEIGHT= 122 PCF
SAMPLE MOISTURE CONTENT= 12.5 %

# Swell Consolidation Test Results

FIG. B-40

PROJECT NO. DN40,507-115



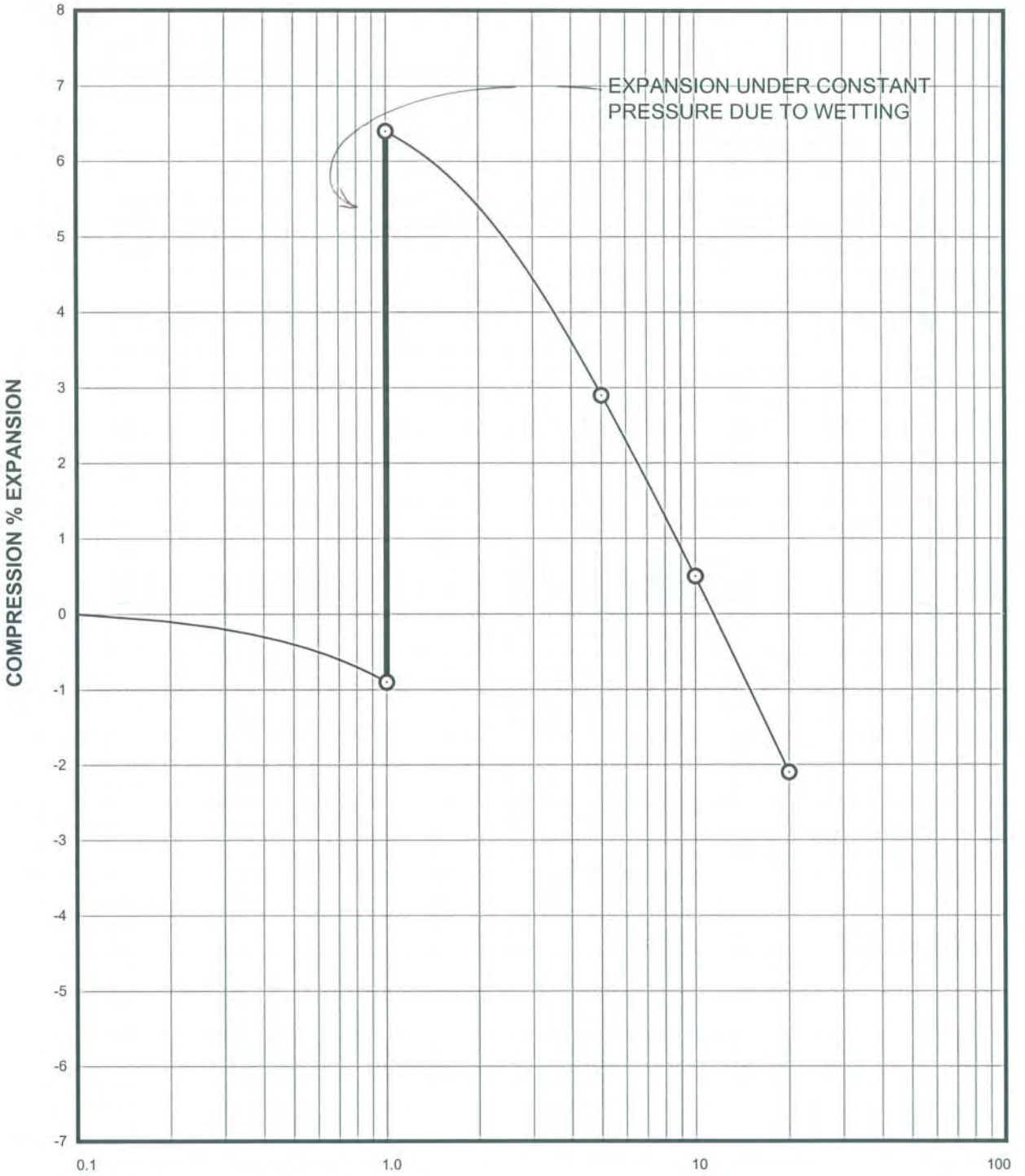

Sample of CLAY, SANDY (CL)
From TH-20 AT 4 FEET

SAMPLE DRY UNIT WEIGHT= 115 PCF
SAMPLE MOISTURE CONTENT= 14.5 %

# Swell Consolidation Test Results

FIG. B-41

PROJECT NO. DN40,507-115




Sample of CLAYSTONE
From TH-20 AT 14 FEET

SAMPLE DRY UNIT WEIGHT= 110 PCF
SAMPLE MOISTURE CONTENT= 21.0 %

# Swell Consolidation Test Results

FIG. B-42

PROJECT NO. DN40,507-115

## TABLE B - I

## SUMMARY OF LABORATORY TEST RESULTS

| BORING | DEPTH (ft) | MOISTURE CONTENT (%) | DRY DENSITY (pcf) | SWELL TEST DATA | | | SOIL SUCTION VALUE (pF) | ATTERBERG LIMITS | | SOLUBLE SULFATE CONTENT (%) | PASSING NO. 200 SIEVE (%) | SOIL TYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SWELL (%) | APPLIED PRESSURE (psf) | SWELL PRESSURE (psf) | | LIQUID LIMIT (%) | PLASTICITY INDEX (%) | | | |
| TH-1 | 9 | 14.0 | 116 | 4.0 | 1,000 | | | | | | | CLAYSTONE |
| TH-1 | 14 | 16.0 | 115 | | | | | | | 0.5 | | CLAYSTONE |
| TH-1 | 19 | 22.0 | 105 | 9.9 | 1,000 | 35,000 | | | | | | CLAYSTONE |
| TH-1 | 34 | 11.9 | 127 | 7.2 | 1,000 | 40,000 | | | | | | CLAYSTONE |
| TH-2 | 4 | 10.9 | 109 | 1.1 | 1,000 | | | | | | | CLAY, SANDY (CL) |
| TH-3 | 4 | 5.6 | 104 | -0.4 | 1,000 | | | | | | | WEATHERED CLAYSTONE |
| TH-3 | 14 | 6.5 | 105 | | | | | | | | 32 | SANDSTONE |
| TH-4 | 4 | 12.4 | 103 | 0.2 | 1,000 | | | | | | | CLAY, SANDY (CL) |
| TH-4 | 9 | 6.2 | | | | | | | | | | SANDSTONE |
| TH-5 | 9 | 22.5 | 99 | 5.8 | 1,100 | 7,000 | 4.16 | | | | | WEATHERED CLAYSTONE |
| TH-5 | 14 | 27.9 | 96 | 6.3 | 1,800 | 14,000 | 4.25 | | | | | CLAYSTONE |
| TH-5 | 19 | 14.9 | 114 | 9.6 | 2,400 | 27,000 | 4.56 | | | | | CLAYSTONE |
| TH-5 | 24 | 12.3 | 119 | 0.4 | 3,000 | 4,500 | 4.55 | | | | | CLAYSTONE |
| TH-6 | 9 | 12.5 | 114 | 6.2 | 1,000 | | | | | | | WEATHERED CLAYSTONE |
| TH-6 | 14 | 10.4 | 113 | 1.7 | 1,000 | | | | | | | CLAYSTONE |
| TH-6 | 19 | 10.9 | 132 | 1.8 | 1,000 | | | | | | | CLAYSTONE |
| TH-6 | 24 | 18.5 | 109 | | | | | 73 | 54 | | 100 | CLAYSTONE |
| TH-7 | 9 | 6.7 | 106 | | | | | | | 0.08 | | SAND, CLAYEY (SC) |
| TH-7 | 14 | 8.3 | 116 | -0.1 | 1,000 | | | | | | | WEATHERED CLAYSTONE |
| TH-7 | 29 | 15.0 | 118 | 8.5 | 1,000 | 20,000 | | | | | | CLAYSTONE |
| TH-8 | 9 | 16.7 | 114 | 4.7 | 1,000 | 10,500 | | | | | | CLAYSTONE |
| TH-8 | 14 | 11.8 | 127 | 4.0 | 1,000 | 20,000 | | | | | | CLAYSTONE |
| TH-9 | 4 | 7.0 | 110 | -0.4 | 1,000 | | | | | | | SAND, CLAYEY (SC) |
| TH-9 | 14 | 18.4 | 109 | 8.0 | 1,000 | | | | | | | CLAYSTONE |
| TH-9 | 24 | 9.3 | 131 | 7.0 | 1,000 | | | | | | | CLAYSTONE |
| TH-10 | 4 | 10.2 | 126 | 6.8 | 500 | 10,000 | 4.58 | | | | | CLAY, SANDY (CL) |
| TH-10 | 9 | 11.7 | 127 | 7.7 | 1,100 | 26,000 | 4.65 | | | | | CLAYSTONE/SANDSTONE |
| TH-10 | 14 | 9.5 | 132 | 5.6 | 1,800 | 20,000 | 4.53 | | | | | CLAYSTONE |
| TH-10 | 19 | 15.6 | 117 | 5.5 | 2,400 | 30,000 | 4.47 | | | | | CLAYSTONE |
| TH-10 | 29 | 13.3 | 118 | 4.1 | 3,600 | 17,000 | 4.50 | | | | | CLAYSTONE |
| TH-11 | 9 | 5.4 | 108 | | | | | | | 0.012 | | SAND, CLAYEY (SC) |
| TH-11 | 19 | 16.5 | 115 | 14.7 | 1,000 | | | | | | | CLAYSTONE |
| TH-11 | 24 | 19.9 | 109 | 8.2 | 1,000 | | | | | | | CLAYSTONE |
| TH-12 | 9 | 15.2 | 109 | 0.4 | 1,000 | | | | | | | CLAY, SANDY (CL) |
| TH-12 | 14 | 13.8 | 103 | -0.3 | 1,000 | | | | | | | CLAY, SANDY (CL) |
| TH-13 | 4 | 15.6 | 95 | 0.5 | 1,000 | | | | | | | CLAY, SANDY (CL) |
| TH-13 | 19 | 11.6 | 100 | -1.4 | 1,000 | | | | | | | SANDSTONE |
| TH-14 | 9 | 14.3 | 115 | -1.0 | 1,000 | | | | | | | CLAY, SANDY (CL) |
| TH-14 | 14 | 14.2 | 115 | 5.9 | 1,000 | 11,000 | | | | | | CLAYSTONE |
| TH-14 | 29 | 13.3 | 121 | | | | | 65 | 49 | | 99 | CLAYSTONE |
| TH-15 | 4 | 7.3 | 110 | | | | | 34 | 21 | | 83 | CLAY, SANDY (CL) |

## TABLE B - I

## SUMMARY OF LABORATORY TEST RESULTS

| BORING | DEPTH (ft) | MOISTURE CONTENT (%) | DRY DENSITY (pcf) | SWELL TEST DATA | | | SOIL SUCTION VALUE (pF) | ATTERBERG LIMITS | | SOLUBLE SULFATE CONTENT (%) | PASSING NO. 200 SIEVE (%) | SOIL TYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SWELL (%) | APPLIED PRESSURE (psf) | SWELL PRESSURE (psf) | | LIQUID LIMIT (%) | PLASTICITY INDEX (%) | | | |
| TH-15 | 14 | 15.2 | 119 | 4.6 | 1,000 | | | | | | | CLAYSTONE |
| TH-15 | 24 | 18.2 | 108 | 7.7 | 1,000 | | | | | | | CLAYSTONE |
| TH-16 | 4 | 7.4 | 89 | -4.7 | 1,000 | | | | | | | CLAY, SANDY (CL) |
| TH-16 | 14 | 10.1 | 109 | 1.8 | 1,000 | | | | | | | CLAYSTONE |
| TH-17 | 9 | 11.4 | 114 | 2.7 | 1,000 | | | | | | | CLAY, SANDY (CL) |
| TH-17 | 19 | 9.1 | 126 | 9.0 | 1,000 | | | | | | | CLAYSTONE |
| TH-17 | 34 | 11.0 | 127 | 8.9 | 1,000 | | | | | | | CLAYSTONE |
| TH-18 | 4 | 15.2 | 112 | 1.5 | 1,000 | | | | | | | CLAY, SANDY (CL) |
| TH-18 | 14 | 21.2 | 106 | 13.4 | 1,000 | | | | | | | CLAYSTONE |
| TH-18 | 24 | 12.7 | 122 | 10.9 | 1,000 | | | | | | | CLAYSTONE |
| TH-19 | 4 | 5.2 | 97 | -4.6 | 1,000 | | | 27 | 11 | | 63 | CLAY, SANDY (CL) |
| TH-19 | 9 | 12.5 | 122 | 6.7 | 1,000 | | | | | | | CLAY, SANDY (CL) |
| TH-19 | 24 | 3.8 | 99 | | | | | | | | 30 | SANDSTONE |
| TH-20 | 4 | 14.5 | 115 | 3.4 | 1,000 | | | | | | | CLAY, SANDY (CL) |
| TH-20 | 14 | 21.0 | 110 | 7.3 | 1,000 | 15,000 | | | | | | CLAYSTONE |

# APPENDIX C

# GUIDELINE SITE GRADING SPECIFICATIONS

## Tallgrass
## Erie, Colorado

## GUIDELINE SITE GRADING SPECIFICATIONS

**Tallgrass**
**Erie, Colorado**

### 1. DESCRIPTION

This item shall consist of the excavation, transportation, placement and compaction of materials from locations indicated on the plans, or staked by the Engineer, as necessary to achieve preliminary street and overlot elevations. These specifications shall also apply to compaction of excess cut materials that may be placed outside of the development boundaries.

### 2. GENERAL

The Soils Engineer shall be the Owner's representative. The Soils Engineer shall approve fill materials, method of placement, moisture contents and percent compaction, and shall give written approval of the completed fill.

### 3. CLEARING JOB SITE

The Contractor shall remove vegetation and debris before excavation or fill placement is begun. The Contractor shall dispose of the cleared material to provide the Owner with a clean job site. Cleared material shall not be placed in areas to receive fill or where the material will support structures of any kind.

### 4. SCARIFYING AREA TO BE FILLED

Topsoil and vegetable matter shall be removed from the ground surface upon which fill is to be placed. The surface shall then be plowed or scarified until the surface is free from ruts, hummocks or other uneven features, which would prevent uniform compaction.

### 5. COMPACTING AREA TO BE FILLED

After the foundation for the fill has been cleared and scarified, it shall be disked or bladed until it is free from large clods, brought to the proper moisture content (0 to 3 percent above optimum moisture content for clays and within 2 percent of optimum moisture content for sands) and compacted to at least 95 percent of standard Proctor maximum dry density (ASTM D 698).

### 6. FILL MATERIALS

Fill soils shall be free from organics, debris or other deleterious substances, and shall not contain rocks or lumps having a diameter greater than six (6) inches, claystone pieces should not be greater than three (3) inches in diameter. Fill materials shall be obtained from cut areas shown on the plans or staked in the field by the Engineer.

On-site materials classifying as CL, CH, SC, SM, SW, SP, GP, GC and GM are acceptable. Concrete, asphalt, organic matter and other deleterious materials or debris shall not be used as fill.

## 7. MOISTURE CONTENT

Fill material classifying as CH and CL shall be moisture conditioned to between 1 and 4 percent above optimum moisture content. Granular soils classifying as SC, SM, SW, SP, GP, GC and GM shall be moisture conditioned to within 2 percent of optimum moisture content. Fill greater than 20 feet in depth should be moisture treated between optimum and 3 percent above optimum moisture content. Laboratory compaction tests shall be made to determine the optimum moisture content for the various soils encountered.

The Contractor may be required to add moisture to the excavation materials in the borrow area if, in the opinion of the Soils Engineer, it is not possible to obtain uniform moisture content by adding water on the fill surface. The Contractor may be required to rake or disc the fill soils to provide uniform moisture content through the soils.

The application of water to embankment materials shall be made with watering equipment, which will give the desired results. Water jets from the spreader shall not be directed at the embankment with such force that fill materials are washed out.

Should too much water be added to any part of the fill, such that the material is too wet to permit the desired compaction from being obtained, rolling and all work on that section of the fill shall be delayed until the material has been allowed to dry to the required moisture content. The Contractor will be permitted to rework wet material in an approved manner to hasten its drying.

## 8. COMPACTION OF FILL AREAS

Selected fill material shall be placed and mixed in evenly spread layers. After each fill layer has been placed, it shall be uniformly compacted to at least 95 percent of the standard Proctor maximum dry density (ASTM D 698). Fill greater than 20 feet in depth should be compacted to 100 percent of standard Proctor maximum dry density (ASTM D 698). At the option of the Soils Engineer, soils classifying as SW, GP, GC, or GM may be compacted to 95 percent of maximum density (ASTM D 1557) or 70 percent relative density for cohesionless sand soils. Fill materials shall be placed such that the thickness of loose materials does not exceed 10 inches and the compacted lift thickness does not exceed 6 inches.

Compaction as specified above, shall be obtained by means of suitable equipment. Compaction shall be accomplished while the fill material is at the specified moisture content. Compaction of each layer shall be continuous over the entire area.

9. DENSITY TESTS

Field density tests shall be made by the Soils Engineer at locations and depths of his choosing. Density tests shall be taken in compacted material below the disturbed surface. When density tests indicate that the density or moisture content of any layer of fill or portion thereof is not within specification, the particular layer or portion shall be reworked until the required density or moisture content has been achieved.

Density tests made by the Soils Engineer, shall be submitted progressively to the Owner. Dry density, moisture content, and percentage compaction shall be reported for each test taken.

10. SEASONAL LIMITS

No fill material shall be placed, spread or rolled while it is frozen, thawing, or during unfavorable weather conditions. When work is interrupted by heavy precipitation, fill operations shall not be resumed until the Soils Engineer indicates that the moisture content and density of previously placed materials are as specified.

11. NOTICE REGARDING START OF GRADING

The Contractor shall submit notification to the Soils Engineer and Owner advising them of the start of grading operations at least three (3) days in advance of the starting date. Notification shall also be submitted at least 1 day in advance of any resumption dates when grading operations have been stopped for any reason other than adverse weather conditions.

12. DECLARATION REGARDING COMPLETED FILL

The Soils Engineer shall provide a written declaration stating that the site was filled with acceptable materials, and was placed in general accordance with the specifications.

## APPENDIX D

## GUIDELINE SUB-EXCAVATION SPECIFICATIONS
## Tallgrass
## Erie, Colorado

***Note: This guideline is intended for use with sub-excavation. If sub-excavation is not selected, the guidelines in Appendix C should be followed.***

## GUIDELINE SUB-EXCAVATION SPECIFICATIONS

**Tallgrass**
**Erie, Colorado**

### 1. DESCRIPTION

This item shall consist of the excavation, transportation, placement and compaction of materials from locations indicated on the plans, or staked by the Engineer, as necessary to achieve preliminary street and overlot elevations. These specifications shall also apply to compaction of materials that may be placed outside of the development boundaries.

### 2. GENERAL

The Soils Engineer shall be the Owner's representative. The Soils Engineer shall approve fill materials, method of placement, moisture contents and percent compaction, and shall give written approval of the completed fill.

### 3. CLEARING JOB SITE

The Contractor shall remove vegetation and debris before excavation or fill placement is begun. The Contractor shall dispose of the cleared material to provide the Owner with a clean job site. Cleared material shall not be placed in areas to receive fill or where the material will support structures of any kind.

### 4. SCARIFYING AREA TO BE FILLED

Topsoil and vegetable matter shall be removed from the ground surface upon which fill is to be placed. The surface shall then be plowed or scarified until the surface is free from ruts, hummocks or other uneven features, which would prevent uniform compaction.

### 5. COMPACTING AREA TO BE FILLED

After the foundation for the fill has been cleared and scarified, it shall be disked or bladed until it is free from large clods, brought to the proper moisture content, (1 to 4 percent above optimum) and compacted to at least 95 percent of standard Proctor maximum dry density (ASTM D 698).

### 6. FILL MATERIALS

Fill soils shall be free from organics, debris or other deleterious substances, and shall not contain rocks or lumps having a diameter greater than six (6) inches, claystone pieces should not be greater than three (3) inches in diameter. Fill materials shall be obtained from cut areas shown on the plans or staked in the field by the Engineer.

On-site materials classifying as CL, CH, SC, SM, SW, SP, GP, GC and GM are acceptable. Concrete, asphalt, organic matter and other deleterious materials or debris shall not be used as fill.

## 7. MOISTURE CONTENT

Fill materials shall be moisture treated to within moisture contents specified in "Moisture Content and Density Criteria". Laboratory compaction tests shall be made to determine the optimum moisture content for the various soils encountered.

The Contractor may be required to add moisture to the excavation materials in the borrow area if, in the opinion of the Soils Engineer, it is not possible to obtain uniform moisture content by adding water on the fill surface. The Contractor will be required to rake or disc the fill to provide uniform moisture content throughout the fill.

The application of water to embankment materials shall be made with watering equipment, which will give the desired results. Water jets from the spreader shall not be directed at the embankment with such force that fill materials are washed out.

Should too much water be added to any part of the fill, such that the material is too wet to permit the desired compaction from being obtained, rolling and all work on that section of the fill shall be delayed until the material has been allowed to dry to the required moisture content. The Contractor will be permitted to rework wet material in an approved manner to hasten its drying.

## 8. COMPACTION OF FILL MATERIALS

Selected fill material shall be placed and mixed in evenly spread layers. After each fill layer has been placed, it shall be uniformly compacted to not less than the specified percentage of maximum density given in "Moisture Content and Density Criteria". Fill materials shall be placed such that the thickness of loose material does not exceed 8 inches and the compacted lift thickness does not exceed 6 inches.

Compaction, as specified above, shall be obtained by use suitable equipment. Compaction shall be accomplished while the fill material is at the specified moisture content. Compaction of each layer shall be continuous over the entire area. Compaction equipment shall make sufficient trips to ensure that the required density is obtained.

## 9. MOISTURE CONTENT AND DENSITY CRITERIA

Field density tests shall be made by the Soils Engineer at locations and depths of his choosing. Density tests shall be taken in compacted material below the disturbed surface. When density tests indicate the density or

moisture content of any layer of fill or portion thereof not within specifications, the particular layer or portion shall be reworked until the required density or moisture content has been achieved.

Density tests made by the Soils Engineer, shall be submitted progressively to the Owner. Dry density, moisture content and percentage compaction shall be reported for each test taken.

Fill material shall be substantially compacted to at least 95 percent of maximum (ASTM D 698) dry density at 1 to 4 percent above optimum moisture content. The fill density shall be increased to 100 percent for fill placed 20 feet or deeper below finished grades at optimum to 3 percent above optimum moisture content. The Contractor shall control the moisture so that moisture content of the compacted earth fill, as determined by tests performed by the Soils Engineer, shall be within the limits given. The Soils Engineer will inform the Contractor when the placement moisture is less than or exceeds the limits specified and the Contractor shall make adjustments in procedures as necessary to maintain placement moisture content within the specified limits, to satisfy the following requirements.

A. Moisture

1. The average moisture content of material tested each day shall not be less than 1.5 percent above optimum moisture content.

2. Material represented by samples tested having moisture lower than 1 percent over optimum will be rejected. Such rejected materials shall be reworked until moisture equal to or greater than 1 percent above optimum is achieved.

B. Density

1. The average dry density of material tested each day shall not be less than 95 percent of maximum ASTM D 698 dry density.

2. No more than 10 percent of the material represented by the samples tested shall be at dry densities less than 95 percent of maximum ASTM D 698 dry density.

3. Material represented by samples tested having dry density less than 93 percent of maximum ASTM D 698 dry density will be rejected. Such rejected materials shall be reworked until a dry density at least 95 percent of standard Proctor maximum dry density (ASTM D 698) is obtained.

## 10. INSPECTION AND TESTING OF FILL

Inspection by the Soils Engineer shall be sufficient during the placement of fill and compaction operations so that they can declare the fill

was placed in general conformance with specifications. All inspections necessary to test the
placement of fill and observe compaction operations will be at the expense of the Owner.

## 11. SEASONAL LIMITS

No fill material shall be placed, spread or rolled while it is frozen, thawing, or during unfavorable weather conditions. When work is interrupted by heavy precipitation, fill operations shall not be resumed until the Soils Engineer indicates the moisture content and density of previously placed materials are as specified.

CTL | THOMPSON INCORPORATED

# PHASE I ENVIRONMENTAL SITE ASSESSMENT
# COLLIERS HILL
# SELECT LOTS
# ERIE, COLORADO

**Prepared for:**

**DAYBREAK RECOVERY ACQUISITION, LLC**
**C/O RAINTREE INVESTMENT CORPORATION**
**7200 South Alton Way**
**Suite C-400**
**Denver, Colorado 80112**

**Attention: Mr. Jerry B. Richmond III**

**Project No. DN45,212.002-200**

**September 25, 2015**

1971 West 12th Avenue | Denver, Colorado 80204 | Phone: 303-825-0777 | Fax: 303-825-4252

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## EXECUTIVE SUMMARY

This report presents the results of the Phase I Environmental Site Assessment (ESA) that was performed by CTL | Thompson, Inc. for Daybreak Recovery Acquisition, LLC. The site is located generally east of the Town of Erie, Colorado south of the intersection of County Roads 3 and 10.

The Phase I ESA was conducted in general conformance with the methods and procedures described in the American Society for Testing and Materials (ASTM) E 1527-13, Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process.

The Site appears to have remained vacant or in agricultural use since at least the late 1930s. The site has generally remained as agricultural land with some local underground mining activity and oil and gas exploration and production.

We did not find evidence of a Recognized Environmental Condition (REC) for the site, but the presence of active oil and gas facilities in the area of the subject property may pose an ongoing risk to areas in or around the active oil and gas facilities, which may include portions of the subject property which cannot currently be identified.

This executive summary does not contain all the information that is found in the full report. The report should be read in its entirety to obtain a more complete understanding of the information provided and to aid in any decisions made or actions taken based on this information.

## 1.0 INTRODUCTION

This report was prepared by CTL | Thompson, Inc. (CTL) for Daybreak Recovery Acquisition, LLC and presents the results of the Phase I Environmental Site Assessment (ESA) for approximately 822 proposed residential lots of the Colliers Hill Subdivision. The Site is generally located east of the Town of Erie, Colorado, south of the intersection of County Roads 3 and 10. The Phase I ESA was conducted in general accordance with CTL Proposal Number DN 15-0426 and subsequent authorization by Mr. Jerry B. Richmond III on September 2, 2015.

### 1.1 Purpose

The purpose of the Phase I ESA was to identify Recognized Environmental Conditions (REC), to the extent feasible, pursuant to the methods and procedures described in the American Society for Testing and Materials (ASTM) Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessments, E 1527-13.

A REC is defined as the presence or likely presence of hazardous sub-stances or petroleum products on a site under conditions that indicate an existing release, a past release, or a material threat of a release of hazardous substances or petroleum products into the ground, groundwater, or surface water of the site. The term includes hazardous substances or petroleum products even under conditions in compliance with laws. The term is not intended to include de minimis conditions that generally do not present a material risk of harm to public health or the environment and that generally would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies.

ASTM Standard E1527-13 also has separate definitions for past conditions that would otherwise be considered a REC but have been addressed to the satisfaction of the applicable regulatory agencies and would either allow for generally unrestricted use

of the site (referred to as a Historic Recognized Environmental Condition, or HREC) or for use of the site with various restrictions (referred to as a Controlled Recognized Environmental Condition, or CREC).

## 1.2 Scope of Services

The scope of services for this assessment consisted of a records review, a site reconnaissance, historical research, interviews, and documentation of findings in a report.

## 1.3 Limitations

This Phase I ESA was prepared in general accordance with ASTM Standard E 1527-13. There may be additional environmental issues present at the Site that are outside the scope of this practice that include, but are not limited to, the following:

- Asbestos-containing materials;
- Radon;
- Lead-based paint;
- Lead in drinking water;
- Cultural and historic resources;
- Mold and fungi;
- Industrial hygiene;
- Indoor air quality;
- Health & safety;
- Ecological resources;
- Endangered species;
- Biological or infectious agents and pathogens;
- Wetlands;
- Jurisdictional waters of the U.S;
- Regulatory compliance;
- High voltage power lines; and,
- Mine subsidence.

CTL provided an opinion based upon the condition of the site on the day it was observed and a review of existing and reasonably ascertainable regulatory records and historical information. Our scope did not include chemical testing of soil, ground water, air, or building materials. The opinion, conclusions, and recommendations of this report are not intended to be used or relied upon by a third party to this Agreement. With the written consent of our client, CTL may be available to contract with other parties to provide an opinion or conduct additional environmental assessment services. Due to latent conditions and other contingencies which may become evident in the future, the current assessment does not result in any guarantee the subject Site is free and clear of hazardous materials. Should additional surface, subsurface or chemical data become available, the conclusions and recommendations contained in this report shall not be considered valid unless the data is reviewed and the conclusions of this report are modified or approved in writing by our firm.

We believe that this investigation was conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions in the locality of the project. No warranty, express or implied, is made.

## 2.0 SITE DESCRIPTION AND LOCATION

### 2.1 Location and Legal Description

The “Site” consists of select lots of portions of the Colliers Hill development and consists of approximately 822 planned lots on approximately 280 acres. The lots are shown on a display titled Lotting Plan – Option 5. It is considered a preliminary lot layout plan and includes tracts, road right-of-ways, a future school site and a potential location of a 2nd recreation center.

The Site is generally described as portions of the north half of Section 17 and 18, Township 1 North, Range 68 West of the 6th Principal Meridian, in Weld County, Colorado. The Site location and plan are shown on Figure 1 (Area Map) and Figure 2 (Site Plan).

### 2.2 General Description of Site and Improvements

The Site is vacant and vegetated with weeds and grasses. The Site is bounded by vacant land on the north and east. A cemetery is located southwest of the Site. Oil and gas operation facilities are included in the proposed open space tracts. A photographic record of our Site reconnaissance is presented in Appendix A.

### 2.3 General Uses of Adjoining Properties

The Site is located in a developing residential area in Erie, Colorado. The adjoining properties generally consist of transportation corridors, oil and gas facilities, vacant land and an active construction site. Additional details regarding our observations of adjacent properties are presented in Section 7.4 of this report.

## 3.0 USER PROVIDED INFORMATION

Mr. Jerry B. Richmond III of Daybreak Recovery Acquisition, LLC. (Daybreak), our client representative and property owner, responded to our environmental questionnaire via email on September 14, 2015. Mr. Richmond indicated that he is the current owner representative of the Site. The response from Daybreak, which would include client knowledge of environmental liens, activity and use limitations, and other environmental information per ASTM E1527-13 is discussed below.

## 3.1 Environmental Liens/Title Records

An environmental lien is a charge, security, or encumbrance upon title to a property to secure the payment of a cost, damage, debt, obligation, or duty arising out of response actions, cleanup, or other remediation of hazardous material or petroleum products upon a property. Daybreak was not aware of existing environmental liens on the Site.

Title records were provided by Daybreak during our investigation. We reviewed Schedule B-2 (Exceptions) of Alta Commitment Number NCS-750432-CO, prepared by First American Title Insurance Company - NCS, effective September 3, 2015, for references to environmental liens. No obvious environmental liens were indicated from the title review. Oil and gas leases are mentioned in the documents as well as land development agreements. We are not title experts and assume that the user or property buyer would conduct appropriate due diligence of the property title.

## 3.2 Activity and Use Limitations

Environmental AULs are legal or physical restrictions or limitations on the use of, or access to, a site or facility to: 1) reduce or eliminate potential exposure to hazardous substances or petroleum products in the soil or ground water on the property, or 2) prevent activities that could interfere with the effectiveness of a response action, in order to ensure maintenance of a condition of no significant risk to public health or the environment. These legal or physical restrictions may include engineering controls, institutional controls, or land use restrictions. Daybreak was not aware of recorded environmental AULs related to the Site.

## 3.3 Specialized Knowledge

Daybreak was not aware of specialized knowledge or experience related to previous environmental activities on the Site.

## 3.4 Valuation Reduction for Environmental Issues

Daybreak was not aware of valuation reduction of the site because of environmental issues.

## 3.5 Commonly Known or Reasonably Ascertainable Information

Daybreak was not aware of commonly known or reasonably ascertainable information regarding environmental issues related to the Site.

## 3.6 Previous Environmental Studies

Daybreak was aware of previous environmental studies on the Site. CTL reviewed copies of the following reports:

- *Threatened and Endangered Species and Wetlands Survey (Western Environment and Ecology, Inc., February, 2005).* This report is for 148 acres in Section 8. It does not address ground water or soil studies, but it does mention the presence of oil and gas wells. The report should be read in its entirety.

- *Bridgewater Phase I ESA (Western Environment and Ecology, Inc., February 2007).* This report is for 640 acres in Section 17. At the time of the investigation the site was cultivated fields with no structures. The report mentions seven (7) oil and gas wells on site with two listed abandoned wells. There is no mention of spills. Minor staining was observed. Production was indicated from the early 1980s. The report points out that 288 acres of the site are within the Clayton/ Old Boulder Valley Mine. There is no mention of ground water or soils studies and no recommendation of studies.

- *Bridgewater Limited Phase II ESA (Western Environment and Ecology, Inc., January 2007).* This report is a limited Phase II investigation of a 3.83 acre parcel in the southeast quarter of Section 18. The area was identified as possibly located within the unofficial Erie Landfill. Miscellaneous building debris located may also be remnants of the Northwestern Mine main shaft and air shaft, according to the report. Western drilled 5 boreholes and installed two monitoring wells. Debris was observed from the surface to a depth of 12 feet. The soils were sampled and submitted

for tests for RCRA 8 Metals and VOCs. Lab results indicated levels of metal and VOCs below State action levels. The report concluded that no significant contamination was present in that specific area.

- *Bridgewater Mine Subsidence (CTL | Thompson, DN40570-110, May, 2005)* This report identifies four parcels located in the site area, specifically the southeast corner of Section 8, Section 17 and the east half of Section 18. Four possible coal mine areas are discussed with three of them identified as a significant subsidence risk. The mines are located in the east half of Section 18 and were identified by desk review of reference material and previous reports, including one by *Western Environment and Ecology, September 1999.*

- *Phase I Environmental Site Assessment, Bridgewater, Erie, Colorado* (CTL | Thompson, DN 45,212-200, October 18, 2010). This report is a Phase I ESA for 965 acres in sections 8, 17 and 18, Township 1 North, Range 68 West in Weld County, Colorado. Our study identified eleven oil and gas wells operating within the site boundaries and four abandoned exploration sites. The report identified these well sites as a REC and recommended further investigation of the abandoned sites due to the proposed lot layout and possible conflicts.

- *Limited Phase II Environmental Site Assessment, Bridgewater, Erie, Colorado* (CTL | Thompson, DN 45,212-205, November 10, 2010). This report investigated the locations of abandoned wells and exploration sites identified in our Phase I ESA. These sites, identified through records research were not provided setbacks in the land plan presented during our research. We focused our investigation in these areas because of the possible conflict between planned housing and abandoned wells or impacted soil and groundwater. We drilled thirteen test holes to depths of twenty five feet, sampled soil, measured for groundwater, and reported on our results. No indication of impacted soils was found. We note that no groundwater was found in any of the test holes so the evaluation of groundwater was somewhat inconclusive.

- Phase I Environmental Site Assessment, Bridgewater, Erie, Colorado (CTL | Thompson, DN46,346-200, November 26, 2012, Revised January 11, 2013 and Revised February 21, 2013. This report, as well as the revisions (which were performed due to lot configuration changes) did not identify a REC for the site, however, we did consider the operating oil and gas wells as a business environmental risk or concern and acknowledged that future builders on lots near these features should consider ground water testing to determine if the lots have been impacted. Furthermore, these reports also stated that the abandoned oil and gas production features pose a potential business environmental risk due to the inexact locations plotted for these features.

- Limited Phase II Environmental Site Assessment, Bridgewater, Select Lots, Erie, Colorado (CTL | Thompson, DN46,346-205, March 11,2013.) This investigation involved the drilling of test holes and limited sampling and evaluation around one former well site and two active well sites in the south portion of Section 17, on or adjacent to where many of the proposed lots are located. Based on our findings, we did not believe that the wells had impacted the site lots.

- Phase I Environmental Site Assessment, Daybreak Filing 2A, Erie, Colorado (CTL | Thompson, DN46,346.003-200, August 13, 2014 and DN46,346.004-200, September 25, 2014. These revisions of previous assessments was performed for further lot configuration changes and did not identify a REC in connection with the site; however, we once again considered the operating oil and gas wells as a business environmental risk or concern and acknowledged that future builders on lots near these features should consider ground water testing to determine if the lots have been impacted.

### 3.7 Reason for Performing a Phase I ESA

Daybreak requested a Phase I ESA as part of their entitlement/platting process prior to development of the site.

## 4.0 RECORDS REVIEW

CTL reviewed existing sources listed in the **REFERENCES** section to assess the soils, geologic and hydrogeologic conditions of the general vicinity of the Site.

### 4.1 Physiography

Historical topographic maps indicate the Site slopes downward to the north and west. Current conditions have been modified by agricultural activity and the historic drainage in the center of the Site is less defined. The predominant surface water feature in the vicinity of the site is Coal Creek located approximately 0.25 miles west of the Site.

## 4.2 Geology and Soils

CTL conducted a Geotechnical Investigation for the Site (Project No.45212-115), for the Bridgewater Subdivision. Soils encountered in the investigation consisted of clay, sandy clay, clayey sand and some sand/gravel underlain by sedimentary claystone and sandstone bedrock. The Geotechnical Investigation should be read for further details pertaining to the soil conditions at the Site.

## 4.3 Groundwater

It is our experience that the flow direction of shallow, unconfined groundwater is generally controlled by topography. Based on topography, we estimate the general direction of groundwater flow below the Site is to the north and west. Topographic data suggests areas up-gradient of the Site are generally to the south and east. Groundwater was encountered between 18 to 28 feet in two of the twenty test holes drilled during our geotechnical investigation. The vast majority of geotechnical holes did not produce water.

## 4.4 Water Wells

Water wells are generally identified through the Colorado Division of Water Resources online water well permit database. The database did not indicate the presence of water wells on or adjacent to the Site. If wells are encountered during development, care must be taken to properly abandon the structures.

## 4.5 Oil/Gas Wells

Oil and gas wells were identified through the Colorado Oil and Gas Conservation Commission online database. The database indicated the presence of 15 active oil/gas wells and one abandoned well location within the overall development of Daybreak. Most of these locations are outside of this subject property. Three well locations are

considered within or adjacent the current Site boundaries. During our Site visit we observed evidence of wells and well equipment. These appear to be considered on the Site plan we were presented. There are open space tracts and well setbacks shown.

The proposed lot plan provides a 150 foot set back around each well site. Although this does not eliminate the environmental risk, it does remove the active wells from the "development site". The wells are listed below by section.

In Section 17, three well locations are identified near the subject lots:

- Tallgrass #31-17 (API #05-123-25610) operated by Extraction Oil and Gas LLC – 10459. It was completed on 02/09/2005. There are no records of spills or releases but there was one observation of staining during an inspection.

- East Erie #1-17 (API #05-123-14410) operated by Extraction Oil and Gas LLC – 10459. It was completed on 11/08/1993. There are no records of spills or releases.

- East Erie #2-17#1 (API #05-123-14447) operated by Extraction Oil and Gas LLC – 10459. It was completed on 11/08/1993. There are no records of spills or releases.

In Section 17, one abandoned exploration site is found near the vicinity of the subject lots;

- UPRC #13-17 (API # 05-123-19082) operated by Basin Exploration, Inc. - 6540. A permit was issued and expired on 08/23/1996. There is no completion information and the status is listed as an Abandoned Location. A field inspection from 06/05/1996 lists the well location as "No Disturbance". No well bore information is provided. It is probable that this well was never drilled. The location of this permit appears to be at least 200 feet from the nearest lot in this study and is down-gradient. We do not believe this site is a REC for the site.

As previously mentioned CTL did complete two previous Limited Phase II Environmental Site Assessments which evaluated soil and ground water conditions in two exploration areas, one of which involved this potential well Site. We found no indication

of impacted soil, but we did not find groundwater in all of our boring locations. These letters should be consulted for further details.

### 4.6 Physical Setting Analysis of Migration of Hazardous/Petroleum Substances

A hypothetic spill of a hazardous or petroleum substance on the site would be expected to migrate along the ground surface generally to the northwest. Off-Site surface spills on the adjoining parcels to the south and east appear to have the highest potential to migrate on-Site. Based on historical topography, we estimate groundwater generally flows to the north and west. Sources of contamination to groundwater beneath the Site, if present, would most likely be located to the south and east.

## 5.0 HISTORICAL USE INFORMATION

### 5.1 Historical Aerial Photographs and Topographic Maps

Historical aerial photographs of the Site and surrounding area were reviewed for 1937, 1975, 1984, 1995, 2002, and 2012; a copy of the 2012 photograph is presented in Appendix B. USGS topographic maps were reviewed for 1950, 1979 and 1950 revised 1994. An interpretation of the aerial photographs and maps is presented, as follows:

- 1937: The site appears vacant or in agricultural use. A visible drainage is seen flowing northwest on or near the east portion of the Site. The Erie Cemetery is seen as in its present location. There is ranching or other activity in the section to the east.

- 1950-1975: The Site and surrounding area appear to be in agricultural use. The agricultural fields are well defined in blocks or long wide rows. Some excavation is evident below the cemetery on the hillside above Erie. An irrigation ditch is located on the slope between Erie and the site.

- 1984-1995: The Site remains generally unchanged. Some oil and gas exploration is apparent with visible access roads and graded bare spots among the agricultural activities. A power line is visible along the north of Section 17.

- 2002-2012: The site remains generally unchanged. Oil and gas development appears to be more prevalent in the area with visible access roads. A high school is present in the section east of the Site.

## 5.2 Sanborn Fire Insurance Maps

Sanborn fire insurance maps were a tool used by the fire insurance industry to evaluate property risk. The maps often show details of historic dwellings, commercial buildings, and factories, indicate property uses and addresses, and show locations of items such as wells, cisterns, and fuel storage tanks. Sanborn Fire Insurance Map coverage was not available for the Site and surrounding area.

## 5.3 Cultural Features Map

The 1937/39 cultural features map shows the Clayton Coal Camp (150) labeled in Section 17. The existing cemetery in Section 18 is shown. Adjacent sections show settlements and camps and railroad lines as well as indications of mines. Multiple dwellings are mapped in Erie and roads are mapped south, east and north of the Site. This mapping generally conforms to that of the 1950 topographic map.

## 5.4 Historical City Directories

Due to the lack of address information, and the predominant use of the site for agricultural, historic city directories were not reviewed for the Site.

## 5.5 Assessor Records

We reviewed Weld County Assessor online files for the Site. The Site is owned by Daybreak Recovery Acquisition, LLC. There are no records of buildings.

## 5.6 Zoning/Land Use Records

The Site is currently listed as agricultural land by Weld County.

# 6.0 REGULATORY AGENCY RECORDS

Regulatory agency records were provided by GeoSearch. The report, dated September 16, 2015, is presented in Appendix C.

## 6.1 Summary of Findings

Table I presents a summary of the regulatory agency records findings provided by GeoSearch. The findings and their locations are listed by address along with a description of their distance in relation to the Site.

Table I
Regulatory Agency Findings

| Findings | Distance and Estimated Topo-graphic Location | Search Radius | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 Mile | | ½ Mile | | | | | ¼ Mile | | | | | |
| | | National Priority List (NPL) | RCRA CORRACTS | RCRA Treatment, Storage, Disposal (TSD) | CERCLIS/NFRAP | Colorado Voluntary Cleanup List (VCL) | Solid Waste | Leaking Underground Storage Tank (LUST) | Registered Tanks (UST/AST) | Institutional Controls/Engineering Controls (AUL) | Spills (ERNS) | RCRA Generator | Other HW |
| Front Range Landfill<br>AKA Erie SWDS<br>AKA Horst SWDS<br>1830 Weld County # 5<br>Erie, Colorado | Listed as 0.08 miles E | | | | | | X | | | | | | |

It should be noted that several listings which are included in our GeoSearch report are related to the known oil and gas wells regarding air emissions and do not affect our evaluation of this data for this Site. One listing is discussed below.

There are 8 unlocatable findings listed on the database. Six of the listing are for landfills or solid waste disposal areas. We believe they are associated with other solid waste findings in the area but not on the Site. The other two regard Storage Tanks and cannot be assessed because of limited information. We do not believe these unlocatable findings present an REC for the Site.

## 6.2 Detailed Discussion of Findings

This section discusses those findings listed in Table I.

### *6.2.1 Solid Waste*

This listing is identified as a Historic Solid Waste Landfill and is mapped adjacent to County Road #10 just west of County Road #5. This location would be adjacent the Site. Although we have seen many listings in the area for Solid Waste Disposal Areas, each has been mapped differently. We agree there has been waste disposal in the area and some waste has been located on adjacent sites. However, we believe this finding is mislocated or insignificant. We do not believe this listing to be an REC for this Site due to its location.

## 6.2 Local Government Records

We contacted the Weld County Health Department in regards to records of hazardous or toxic material spills on or adjacent the Site. As of the date of this report we have not received a response to our inquiry. If we receive a response that would change the findings of this report we will submit an addendum to the report.

We contacted the Mountain View Fire Protection District via email. We have not received a reply yet. However, in previous responses on October 15, 2013 and on September 24, 2014, they indicated that they did not have records or information regarding spills or hazardous materials incidents for the Colliers Hill/Daybreak property. Furthermore, they acknowledged that there are existing gas and oil wells in the area but they do not know if there has been any contamination of the soils related to the wells. They also stated that fireworks have been shot from the Erie Cemetery for several years.

## 7.0 SITE RECONNAISSANCE

The following section discusses observations made during our Site reconnaissance.

### 7.1 Methodology and Limiting Conditions

Our Mr. Grant R. Emery conducted a Site visit on September 17, 2015. The majority of the Site was accessed by walking and driving. A photographic record of the Site reconnaissance is presented in Appendix A.

### 7.2 Description of Site Structures and Roads

The Site is vacant and is vegetated with weeds and grasses. County Road 8, vacant land and an active construction area forms the southern boundary and vacant land forms the east boundary. Vacant agricultural land comprises the north boundary. Dirt access roads are present to service the developed oil and gas facilities as well as to provide access to the active earth moving operation that is present in the Filing 1 lots. A photographic record of our Site reconnaissance is presented in Appendix A.

## 7.3 Site Observations

During our reconnaissance, we specifically looked for obvious evidence of the Site features listed in Table II. Table II lists features typically observed outside of site structures. An "X" located within the table indicates that the feature was readily observable. Those features which were observed on the Site are discussed in further detail within the following subsection(s).

Table II
Exterior Site Features

| | | | |
|---|---|---|---|
| X | Aboveground Storage Tanks | | Stained Soil and/or Pavement |
| | Air Emissions Sources | X | Stockpiles of Soil or Debris |
| X | Cultivated Land/Crops | | Stressed Vegetation |
| | Drains, Sumps, Pits | | Surface Water, Streams, Ponds, Lagoons |
| | Hazardous Material Storage | | Transformers |
| | High Power Transmission Lines | | Underground Storage Tanks |
| X | Natural Gas Pipelines | | Unidentified Piping Below Grade |
| | Odors | | Unidentified Substance Containers |
| | Petroleum Pipelines | X | Vehicle Maintenance Areas |
| | Physical Irregularities | | Waste Water Discharge |
| | Placed Fill or Imported Soils | | Waste Treatment Processes |
| | Railroad Lines | | Wells (Agricultural, Water Supply) |
| | Septic Systems or Leach Fields | | Wells (Monitoring) |
| | Solid Waste or Disposal Areas | X | Wells (Oil or Natural Gas) |

### *7.3.1 Aboveground Storage Tanks*

We observed aboveground storage tanks associated with the developed oil and gas production facilities that are in the vicinity of the Site, as well as above ground storage tanks which are associated with the ongoing construction activity adjacent to the Site. There was no obvious indication of significant surficial spills or leaks. The oil and gas facilities were discussed in section 4.5.

### *7.3.2 Cultivated Land/Crops*

Although fallow ground was observed across the Site, most of the site was recently cultivated and in agricultural use. Modern-day pesticides and herbicides tend to break down readily in the environment, and assuming they are properly used, we do not consider this use to present an REC in connection with the site.

### *7.3.3 Natural Gas Pipelines*

We observed signs indicating natural gas pipelines on or in the vicinity of the Site. Natural gas is not considered a persistent contaminant when released into the soil or air. We do not believe that the existence of these pipelines represents an REC for the Site.

### *7.3.4 Oil and Gas wells*

We observed 15 oil and gas wells within 2 pad sites, adjacent the Daybreak lotting plan and three wells on Site. See section 4.5 for discussion.

### *7.3.5 Stockpiles of Soil or Debris*

We observed stockpiles of soil on or adjacent to the Site. These piles appear to be related to the earth moving activity which is occurring on the Filing 1 lots. We do not believe that these piles present an REC for the Site.

### *7.3.6 Vehicle Maintenance Areas*

We observed a fueling and maintenance area for the equipment currently active in the Filing 1 lots. This area is potentially on the southeastern portion of the Site. We did not observe obvious signs of staining or leakage associated with this area. We do not believe that this area represents evidence of an REC for the Site.

## 7.4 Review of Adjacent Properties

General observations of properties adjacent to the Site were performed in conjunction with on-Site observations made on September 17, 2015. Developed property in the vicinity of the Site consists of transportation corridors, vacant land with oil and gas wells, an active construction site and a high school. Properties immediately adjacent to the site are described below, based on outdoor observations from the site or nearby public streets.

- North: The Site is generally bounded by crop land and vacant land.
- East: The Site is generally bounded by active oil and gas wells and vacant land, with County Road 5 and Erie High School beyond.
- South: The Site is generally bounded by open land, an oil and gas easement, an active construction Site and County Road 8.
- West: The Site is bounded by vacant land, an active construction site and County Road 3.

Observation of adjacent properties did not reveal obvious visual indications of environmental concern other than the oil wells. Additional to oil and gas features, we did not observe additional evidence of landfills, lagoons, pits, or other waste treatment or disposal operations; underground storage tanks, spills, releases, or discharge of hazardous material.

# 8.0 INTERVIEWS

## 8.1 Owner, Site Manager and/or Occupants

As previously mentioned, as of the writing of this report Daybreak Recovery Acquisition, LLC. is the owner of the property. They responded to our Environmental Questionnaire as our client. They have been familiar with the site since 1998. Daybreak referred to the historic uses of the land as coal mining, oil and gas development and

agriculture. Theye also referred to compatible use agreements that are in place with oil and gas operators, but did not know of environmental restrictions or limitations on the land.

## 9.0 DEVIATIONS

### 9.1 Exceptions and Deletions

ASTM Standard E 1527-13 for Phase I Environmental Site Assessments, Section 8.3.2, states that "all obvious uses of the site shall be identified from the present, back to the site's obvious first developed use, or back to 1940, whichever is earlier." The term "developed use" includes agricultural uses (i.e., cultivated land/agricultural crops) and placement of fill. In our opinion, livestock rangeland is not a developed use.

The historical documentation for this assessment went back to 1936/1939 on the basis of an historical cultural features map. An aerial photograph from 1937 showed the property as predominantly vacant agricultural land. We were not able to ascertain the date of first agricultural use, thus the historical documentation was not fully satisfied for the ASTM standard.

It is the opinion of CTL that obtaining earlier historical information would not be sufficiently useful, reasonably ascertainable, or change the likelihood for the presence of an REC on the Site.

### 9.2 Data Gaps

We did not receive a response from the local health or fire department during our investigation, however, based on the information presented in this report, as well as our familiarity with the Site, we do not believe that this represents significant data gaps which would affect our ability to identify recognized environmental conditions associated with the Site.

## 10.0 FINDINGS AND OPINION

### 10.1 Summary of Site Historical Use

The Site is currently preliminarily planned for platted residential lots and has historically been used for agriculture, mining and oil and gas development. The Site was in agricultural use since at least the1930s. Based on our understanding of the types of crops that are typically grown in Colorado, it is our belief that significant contamination from normal pesticides and herbicide application is unlikely. Application of pesticides and herbicides is more prevalent on fruits and vegetables, and less prevalent on field crops such as alfalfa, hay, and feed corn that are common in Colorado. Normal application of pesticides and herbicides is also subject to dilution and breakdown that occurs over time, due to sunlight and aeration in the upper portion of topsoil. As such, we do not believe that previous agricultural use at the Site presents a REC.

### 10.2 Nearby Environmental Concerns

The area has a historic use of coal mining and oil and gas development and production. Although there is concern with oil and gas activities, our soil and ground water sampling data in the vicinity of the Site lots leads us to believe that this concern is relatively low.

### 10.3 Storm Water Discharges Associated With Construction Activity

Under current Federal/state regulations, construction sites that disturb one acre, or are part of a larger development in which total disturbed area is equal to or greater than one acre, are required to apply for a General Permit for Storm Water Discharges Associated With Construction Activity (General Permit) from the Colorado Department of Public Health and Environment (CDPHE). Some Municipal Separate Storm Sewer Systems (MS4s) also require additional permitting for construction sites within their jurisdiction.

The General Permit application must be submitted to the CDPHE at least 10 days prior to the start of construction activities. The General Permit requires a Storm Water Management Plan (SWMP) to be developed, implemented, and modified as needed from before commencement of construction activities until final stabilization is complete and a Notice of Termination has been submitted to the CDPHE. Furthermore, the General Permit requires that site inspections be performed at least every 14 calendar days and within 24 hours following a storm event that causes significant movement of sediment on-site. The local MS4 may require more frequent inspections. Complete and current storm water management plans should be kept on-site. CTL can assist with your storm water management and compliance needs, if desired.

## 11.0 CONCLUSIONS

We have performed a Phase I Environmental Site Assessment (ESA) in general conformance with the scope and limitations of ASTM Practice E 1527-13 of select lots within the Colliers Hill Development, the Site. Any exceptions to, or deletions from, this practice are described in Section 9.1 of this report. This assessment has revealed no evidence of recognized environmental conditions in connection with the property; however we do believe that the presence of the active oil and gas facilities in the area but outside the subject property may pose an ongoing risk for areas in or around the active oil and gas facilities, which may include portions of the subject property which cannot currently be identified.

## 12.0 QUALIFICATIONS

This Phase I ESA was supervised by, and the report reviewed by, Mr. Matthew Wardlow, a licensed Professional Engineer (P.E.) registered in the State of Colorado. Mr. Wardlow has performed or reviewed over 1,000 Phase I ESAs in the State of Colorado, and has been practicing within the local environmental consulting profession for at least fifteen (15) years. The resumes of the individuals conducting this Phase I ESA are included in Appendix E.

Mr. Wardlow declares that, to the best of his professional knowledge and belief, he meets the definition of an Environmental Professional as defined in §312.10 of 40 CFR 312. I have the specific qualifications based on education, training and experience to assess a property of the nature, history and setting of the subject site. I have developed and performed all appropriate inquiries in general conformance with the standards and practices set forth in 40 CFR Part 312.

We believe that this ESA was conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions in the locality of the project. No warranty, express or implied, is made.

If we can be of further service in discussing the contents of this report, please call.

CTL | THOMPSON, INC.

Grant R. Emery
Environmental Scientist

Reviewed by:

Matthew L. Wardlow, P.E.
Environmental Department Manager

GRE:MLW/gre/nt

Via e-mail: jrichmond@raintree.us.com

## REFERENCES


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U.S. Geological Survey Topographic Map, Erie Quadrangle, Colorado (1950, 1979 and 1950, revised 1994).

*Threatened and Endangered Species and Wetlands Survey (Western Environment and Ecology, Inc., February, 2005).*

*Bridgewater Phase I ESA (Western Environment and Ecology, Inc., February 2007*

*Bridgewater Limited Phase II ESA (Western Environment and Ecology, Inc., January 2007)*

*Bridgewater Mine Subsidence (CTL | Thompson, DN40570-110, May, 2005)*

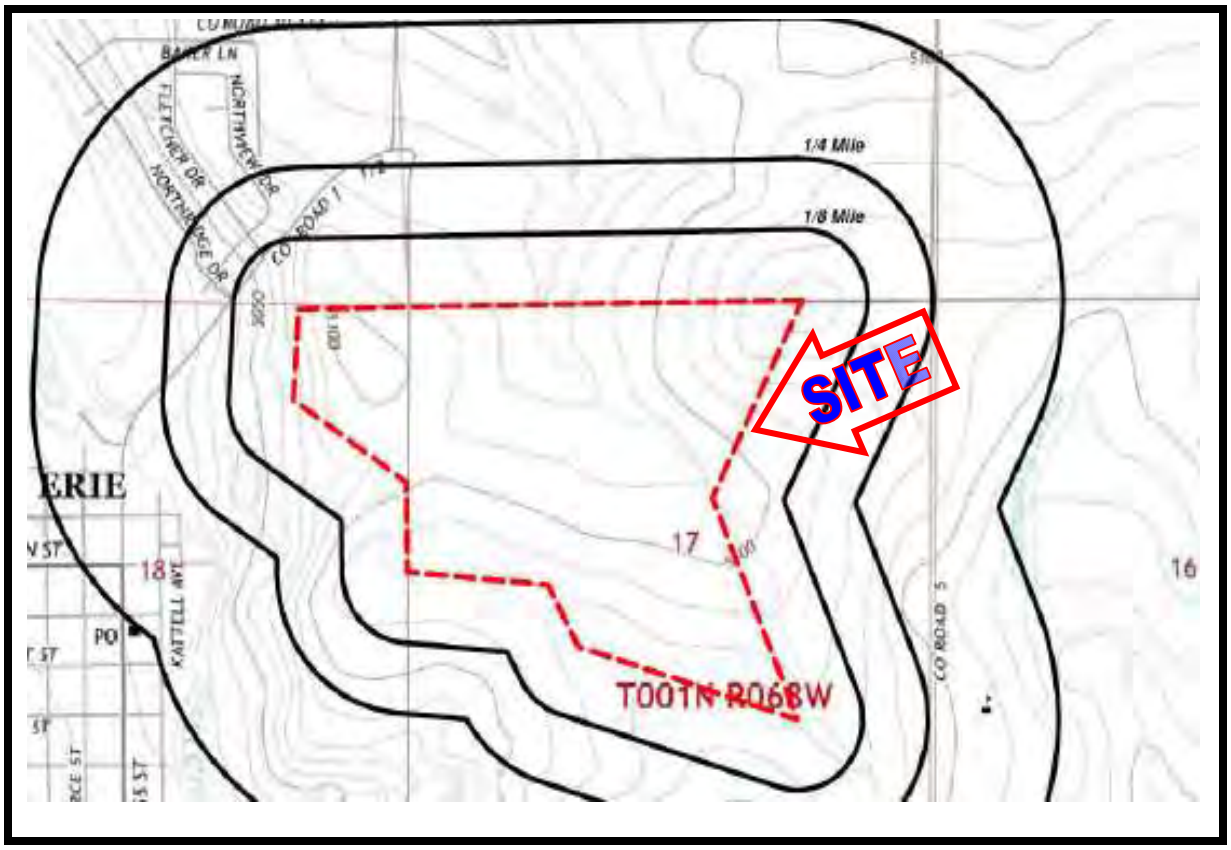
*Phase I Environmental Site Assessment, Bridgewater, Erie, Colorado* (CTL | Thompson, DN 45,212-200, October 18, 2010)

*Limited Phase II Environmental Site Assessment, Bridgewater, Erie, Colorado* (CTL | Thompson, DN 45,212-205, November 10, 2012)

Phase I Environmental Site Assessment, Bridgewater, Erie Colorado (CTL Thompson, DN46346.000-200, November 26, 2012, Revised January 11, 2013, Revised February 21, 2013 and Revised April 16, 2013)

*Limited Phase II Environmental Site Assessment, Bridgewater, Erie, Colorado* (CTL | Thompson, DN 46,346-205, March 11, 2013)

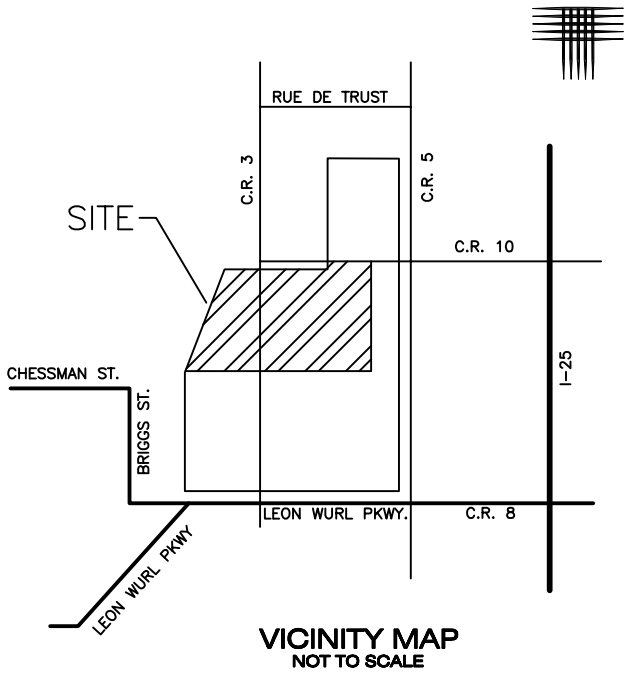
**R 68 W**




**T 1 N**

**1" ~ 2200'**

**Source:**
**U.S.G.S. Topographic Map**
**Erie Quadrangle, Colorado**
**2013**




VICINITY MAP
NOT TO SCALE

S:\PROJECTS\45200\DN45212.002\200\2. Reports\R2\DN45212.002-200-R2-D.dwg, 9/25/2015 2:46:14 PM, rstanisic

DAYBREAK RECOVERY ACQUISITION, LLC
COLLIERS HILL SUBDIVISION
Project No. DN45,212.002-200

**Site Plan** Fig. 2

# APPENDIX A
# SITE PHOTOGRAPHS

Description: General Site conditions
Direction: Southwest

Description: On-Site gas well
Direction: West

Description: Above ground Storage tank
Direction: East

Description: General Site Conditions
Direction: West

CTL | THOMPSON

# SITE PHOTOGRAPHS

**Colliers Hill**
**September 17, 2015**

CTL Project No. DN 45212.002-200

Description: On-Site Oil and Gas equipment
Direction: Northwest

Description: General Conditions Northwest portion of Site
Direction: West

Description: Stubble remains from crop production
Direction: South

Description: Southern boundary near current homebuilding
Direction: Northeast

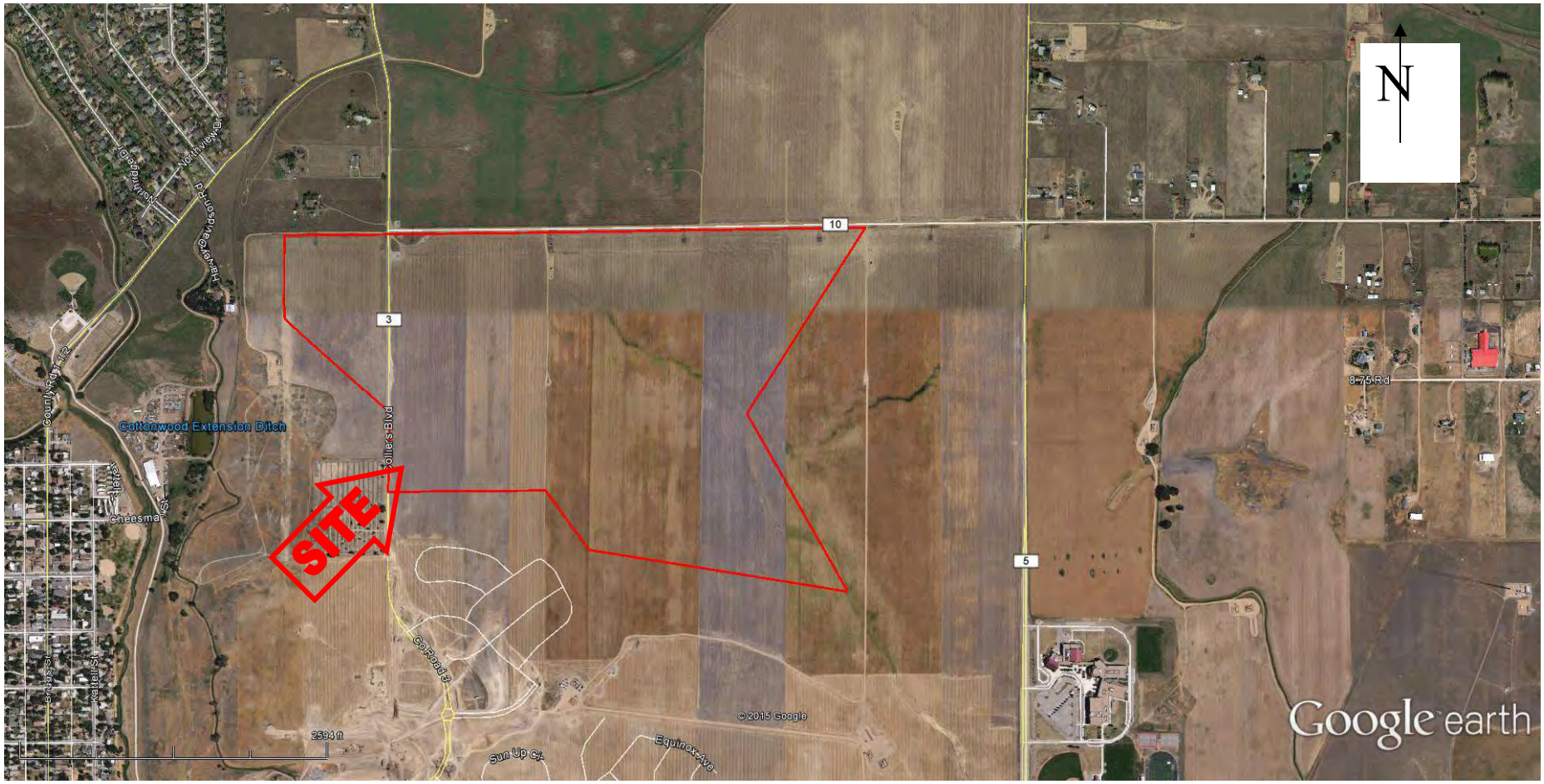
CTL | THOMPSON

# SITE PHOTOGRAPHS

**Colliers Hill**
**September 17, 2015**

CTL Project No. DN 45212.002-200

# APPENDIX B
# AERIAL PHOTOGRAPH




**CTL | T PROJECT NO. DN 45212.002-200**

**2014 AERIAL PHOTOGRAPH**
**Approximate Site Location**

# APPENDIX C
# GEOSEARCH REPORT

GeoSearch
On time. On target. In touch.™

# *Radius Report*

*Satellite view*

*Target Property:*

***Colliers Hill***
***Erie, Weld County, Colorado 80516***

*Prepared For:*

***CTL Thompson- Denver***

***Order #: 55900***
***Job #: 121177***
***Project #: DN 45212.002-200***
***Date: 09/16/2015***

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Environmental Records Definitions . . . . . 55

Unlocatable Report . . . . . See Attachment

Zip Report . . . . . See Attachment



**Disclaimer**

*This report was designed by GeoSearch to meet or exceed the records search requirements of the All Appropriate Inquires Rule (40 CFR §312.26) and the current version of the ASTM International E1527, Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process or, if applicable, the custom requirements requested by the entity that ordered this report. The records and databases of records used to compile this report were collected from various federal,state and local governmental entities. It is the goal of GeoSearch to meet or exceed the 40 CFR §312.26 and E1527 requirements for updating records by using the best available technology. GeoSearch contacts the appropriate governmental entities on a recurring basis. Depending on the frequency with which a record source or database of records is updated by the governmental entity, the data used to prepare this report may be updated monthly, quarterly, semi-annually, or annually.*

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# Target Property Summary

***Colliers Hill***
***Erie, Weld County, Colorado 80516***

*USGS Quadrangle:* ***Erie, CO***
*Target Property Geometry:* ***Area***

*Target Property Longitude(s)/Latitude(s):*
***(-105.02281, 40.058333), (-105.02607, 40.053274), (-105.02298, 40.047591), (-105.03092, 40.049464), (-105.03200, 40.051040), (-105.03710, 40.051369), (-105.03715, 40.053668), (-105.04122, 40.055771), (-105.04105, 40.058103), (-105.02281, 40.058333)***

*County/Parish Covered:*
***Weld (CO) , Boulder (CO)***

*Zipcode(s) Covered:*
***Erie CO: 80516***

*State(s) Covered:*
***CO***

****Target property is located in Radon Zone 1.***
***Zone 1 areas have a predicted average indoor radon screening level greater than 4 pCi/L (picocuries per liter).***

*This report may have unlocatable records. Please see the Unlocatables Report, attached to this file.*

# Database Findings Summary

***FEDERAL LISTING***

| Database | Acronym | Locatable | Unlocatable | Search Radius (miles) |
|---|---|---|---|---|
| EPA DOCKET DATA | DOCKETS | 0 | 0 | TP/AP |
| FEDERAL ENGINEERING INSTITUTIONAL CONTROL SITES | EC | 0 | 0 | TP/AP |
| LAND USE CONTROL INFORMATION SYSTEM | LUCIS | 0 | 0 | TP/AP |
| MATERIAL LICENSING TRACKING SYSTEM | MLTS | 0 | 0 | TP/AP |
| RCRA SITES WITH CONTROLS | RCRASC | 0 | 0 | TP/AP |
| CERCLIS LIENS | SFLIENS | 0 | 0 | TP/AP |
| TOXIC SUBSTANCE CONTROL ACT INVENTORY | TSCA | 0 | 0 | TP/AP |
| AEROMETRIC INFORMATION RETRIEVAL SYSTEM / AIR FACILITY SUBSYSTEM | AIRSAFS | 4 | 0 | 0.1250 |
| CLANDESTINE DRUG LABORATORY LOCATIONS | CDL | 0 | 0 | 0.1250 |
| EMERGENCY RESPONSE NOTIFICATION SYSTEM | ERNSCO | 0 | 0 | 0.1250 |
| HAZARDOUS MATERIALS INCIDENT REPORTING SYSTEM | HMIRSR08 | 0 | 0 | 0.1250 |
| TOXICS RELEASE INVENTORY | TRI | 0 | 0 | 0.1250 |
| BIENNIAL REPORTING SYSTEM | BRS | 0 | 0 | 0.2500 |
| HISTORICAL GAS STATIONS | HISTPST | 0 | 0 | 0.2500 |
| NO LONGER REGULATED RCRA GENERATOR FACILITIES | NLRRCRAG | 0 | 0 | 0.2500 |
| RESOURCE CONSERVATION & RECOVERY ACT - GENERATOR FACILITIES | RCRAGR08 | 0 | 0 | 0.2500 |
| RESOURCE CONSERVATION & RECOVERY ACT - NON-GENERATOR FACILITIES | RCRANGR08 | 0 | 0 | 0.2500 |
| BROWNFIELDS MANAGEMENT SYSTEM | BF | 0 | 0 | 0.5000 |
| COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION & LIABILITY INFORMATION SYSTEM | CERCLIS | 0 | 0 | 0.5000 |
| NO FURTHER REMEDIAL ACTION PLANNED SITES | NFRAP | 0 | 0 | 0.5000 |
| NO LONGER REGULATED RCRA NON-CORRACTS TSD FACILITIES | NLRRCRAT | 0 | 0 | 0.5000 |
| OPEN DUMP INVENTORY | ODI | 0 | 0 | 0.5000 |
| RESOURCE CONSERVATION & RECOVERY ACT - TREATMENT, STORAGE & DISPOSAL FACILITIES | RCRAT | 0 | 0 | 0.5000 |
| DELISTED NATIONAL PRIORITIES LIST | DNPL | 0 | 0 | 1.0000 |
| DEPARTMENT OF DEFENSE SITES | DOD | 0 | 0 | 1.0000 |
| FORMERLY USED DEFENSE SITES | FUDS | 0 | 0 | 1.0000 |
| NO LONGER REGULATED RCRA CORRECTIVE ACTION FACILITIES | NLRRCRAC | 0 | 0 | 1.0000 |
| NATIONAL PRIORITIES LIST | NPL | 0 | 0 | 1.0000 |
| PROPOSED NATIONAL PRIORITIES LIST | PNPL | 0 | 0 | 1.0000 |
| RESOURCE CONSERVATION & RECOVERY ACT - CORRECTIVE ACTION FACILITIES | RCRAC | 0 | 0 | 1.0000 |
| RESOURCE CONSERVATION & RECOVERY ACT - SUBJECT TO CORRECTIVE ACTION FACILITIES | RCRASUBC | 0 | 0 | 1.0000 |
| RECORD OF DECISION SYSTEM | RODS | 0 | 0 | 1.0000 |

# Database Findings Summary

| | | | | |
|---|---|---|---|---|
| *SUB-TOTAL* | | *4* | *0* | |

# Database Findings Summary

***STATE (CO) LISTING***

| Database | Acronym | Locatable | Unlocatable | Search Radius (miles) |
|---|---|---|---|---|
| ASBESTOS ABATEMENT AND DEMOLITION PROJECTS | ASBESTOS | 0 | 0 | TP/AP |
| ENVIRONMENTAL REAL COVENANTS LIST | COVENANTS | 0 | 0 | TP/AP |
| URANIUM MILL TAILINGS SITES | UMTS | 0 | 0 | TP/AP |
| AIR POLLUTION CONTROL DIVISION PERMITTED FACILITIES | APCDP | 5 | 0 | 0.1250 |
| CLANDESTINE DRUG LABORATORY LOCATIONS | CDL | 0 | 0 | 0.1250 |
| DRY CLEANING FACILITIES | CLEANERS | 0 | 0 | 0.1250 |
| SPILLS LISTING | SPILLS | 0 | 0 | 0.1250 |
| ABOVEGROUND STORAGE TANK FACILITIES | AST | 0 | 0 | 0.2500 |
| HAZARDOUS WASTE SITES- GENERATOR | HWSG | 0 | 0 | 0.2500 |
| UNDERGROUND STORAGE TANK FACILITIES | UST | 0 | 0 | 0.2500 |
| HISTORICAL SOLID WASTE LANDFILLS | HISTSWLF | 1 | 6 | 0.5000 |
| HAZARDOUS WASTE SITES- TREATMENT, STORAGE & DISPOSAL | HWSTSD | 0 | 0 | 0.5000 |
| LEAKING STORAGE TANK FACILITIES | LST | 2 | 0 | 0.5000 |
| LEAKING UNDERGROUND STORAGE TANKS TRUST FUND SITES | LUSTTRUST | 0 | 2 | 0.5000 |
| METHANE GAS STUDY SITES | METHANESITES | 0 | 0 | 0.5000 |
| SOLID WASTE FACILITIES | SWF | 0 | 0 | 0.5000 |
| VOLUNTARY CLEANUP AND REDEVELOPMENT PROGRAM SITES | VCRA | 0 | 0 | 0.5000 |
| HAZARDOUS WASTE SITES- CORRECTIVE ACTION | HWSCA | 0 | 0 | 1.0000 |
| SUPERFUND SITES | SF | 0 | 0 | 1.0000 |

| | | | | |
|---|---|---|---|---|
| SUB-TOTAL | | 8 | 8 | |

# Database Findings Summary

***LOCAL LISTING***

| Database | Acronym | Locatable | Unlocatable | Search Radius (miles) |
|---|---|---|---|---|
| WELD COUNTY SOLID WASTE FACILITIES | WCSWF | 0 | 0 | 0.5000 |

| | | | | |
|---|---|---|---|---|
| SUB-TOTAL | | 0 | 0 | |

# Database Findings Summary

***TRIBAL LISTING***

| Database | Acronym | Locatable | Unlocatable | Search Radius (miles) |
|---|---|---|---|---|
| UNDERGROUND STORAGE TANKS ON TRIBAL LANDS | USTR08 | 0 | 0 | 0.2500 |
| LEAKING UNDERGROUND STORAGE TANKS ON TRIBAL LANDS | LUSTR08 | 0 | 0 | 0.5000 |
| OPEN DUMP INVENTORY ON TRIBAL LANDS | ODINDIAN | 0 | 0 | 0.5000 |
| INDIAN RESERVATIONS | INDIANRES | 0 | 0 | 1.0000 |
| SUB-TOTAL | | 0 | 0 | |
| TOTAL | | 12 | 8 | |

# Locatable Database Findings

***FEDERAL LISTING***

| Acronym | Search Radius (miles) | TP/AP (0 - 0.02) | 1/8 Mile (> TP/AP) | 1/4 Mile (> 1/8) | 1/2 Mile (> 1/4) | 1 Mile (> 1/2) | > 1 Mile | Total |
|---|---|---|---|---|---|---|---|---|
| DOCKETS | 0.0200 | | NS | NS | NS | NS | NS | 0 |
| EC | 0.0200 | | NS | NS | NS | NS | NS | 0 |
| LUCIS | 0.0200 | | NS | NS | NS | NS | NS | 0 |
| MLTS | 0.0200 | | NS | NS | NS | NS | NS | 0 |
| RCRASC | 0.0200 | | NS | NS | NS | NS | NS | 0 |
| SFLIENS | 0.0200 | | NS | NS | NS | NS | NS | 0 |
| TSCA | 0.0200 | | NS | NS | NS | NS | NS | 0 |
| AIRSAFS | 0.1250 | 1 | 2 | NS | NS | NS | NS | 4 |
| CDL | 0.1250 | | 0 | NS | NS | NS | NS | 0 |
| ERNSCO | 0.1250 | | 0 | NS | NS | NS | NS | 0 |
| HMIRSR08 | 0.1250 | | 0 | NS | NS | NS | NS | 0 |
| TRI | 0.1250 | | 0 | NS | NS | NS | NS | 0 |
| BRS | 0.2500 | | 0 | 0 | NS | NS | NS | 0 |
| HISTPST | 0.2500 | | 0 | 0 | NS | NS | NS | 0 |
| NLRRCRAG | 0.2500 | | 0 | 0 | NS | NS | NS | 0 |
| RCRAGR08 | 0.2500 | | 0 | 0 | NS | NS | NS | 0 |
| RCRANGR08 | 0.2500 | | 0 | 0 | NS | NS | NS | 0 |
| BF | 0.5000 | | 0 | 0 | 0 | NS | NS | 0 |
| CERCLIS | 0.5000 | | 0 | 0 | 0 | NS | NS | 0 |
| NFRAP | 0.5000 | | 0 | 0 | 0 | NS | NS | 0 |
| NLRRCRAT | 0.5000 | | 0 | 0 | 0 | NS | NS | 0 |
| ODI | 0.5000 | | 0 | 0 | 0 | NS | NS | 0 |
| RCRAT | 0.5000 | | 0 | 0 | 0 | NS | NS | 0 |
| DNPL | 1.0000 | | 0 | 0 | 0 | 0 | NS | 0 |
| DOD | 1.0000 | | 0 | 0 | 0 | 0 | NS | 0 |
| FUDS | 1.0000 | | 0 | 0 | 0 | 0 | NS | 0 |
| NLRRCRAC | 1.0000 | | 0 | 0 | 0 | 0 | NS | 0 |
| NPL | 1.0000 | | 0 | 0 | 0 | 0 | NS | 0 |
| PNPL | 1.0000 | | 0 | 0 | 0 | 0 | NS | 0 |
| RCRAC | 1.0000 | | 0 | 0 | 0 | 0 | NS | 0 |
| RCRASUBC | 1.0000 | | 0 | 0 | 0 | 0 | NS | 0 |
| RODS | 1.0000 | | 0 | 0 | 0 | 0 | NS | 0 |
| SUB-TOTAL | | 1 | 2 | 0 | 0 | 0 | 0 | 4 |

# Locatable Database Findings

***STATE (CO) LISTING***

| Acronym | Search Radius (miles) | TP/AP (0 - 0.02) | 1/8 Mile (> TP/AP) | 1/4 Mile (> 1/8) | 1/2 Mile (> 1/4) | 1 Mile (> 1/2) | > 1 Mile | Total |
|---|---|---|---|---|---|---|---|---|
| ASBESTOS | 0.0200 | | NS | NS | NS | NS | NS | 0 |
| COVENANTS | 0.0200 | | NS | NS | NS | NS | NS | 0 |
| UMTS | 0.0200 | | NS | NS | NS | NS | NS | 0 |
| APCDP | 0.1250 | 2 | 2 | NS | NS | NS | NS | 5 |
| CDL | 0.1250 | | 0 | NS | NS | NS | NS | 0 |
| CLEANERS | 0.1250 | | 0 | NS | NS | NS | NS | 0 |
| SPILLS | 0.1250 | | 0 | NS | NS | NS | NS | 0 |
| AST | 0.2500 | | 0 | 0 | NS | NS | NS | 0 |
| HWSG | 0.2500 | | 0 | 0 | NS | NS | NS | 0 |
| UST | 0.2500 | | 0 | 0 | NS | NS | NS | 0 |
| HISTSWLF | 0.5000 | | 1 | 0 | 0 | NS | NS | 1 |
| HWSTSD | 0.5000 | | 0 | 0 | 0 | NS | NS | 0 |
| LST | 0.5000 | | 0 | 0 | 1 | NS | NS | 2 |
| LUSTTRUST | 0.5000 | | 0 | 0 | 0 | NS | NS | 0 |
| METHANESITES | 0.5000 | | 0 | 0 | 0 | NS | NS | 0 |
| SWF | 0.5000 | | 0 | 0 | 0 | NS | NS | 0 |
| VCRA | 0.5000 | | 0 | 0 | 0 | NS | NS | 0 |
| HWSCA | 1.0000 | | 0 | 0 | 0 | 0 | NS | 0 |
| SF | 1.0000 | | 0 | 0 | 0 | 0 | NS | 0 |
| SUB-TOTAL | | 2 | 3 | 0 | 1 | 0 | 0 | 8 |

# Locatable Database Findings

***LOCAL LISTING***

| Acronym | Search Radius (miles) | TP/AP (0 - 0.02) | 1/8 Mile (> TP/AP) | 1/4 Mile (> 1/8) | 1/2 Mile (> 1/4) | 1 Mile (> 1/2) | > 1 Mile | Total |
|---|---|---|---|---|---|---|---|---|
| WCSWF | 0.5000 | | 0 | 0 | 0 | NS | NS | 0 |
| SUB-TOTAL | | | 0 | 0 | 0 | 0 | 0 | 0 |

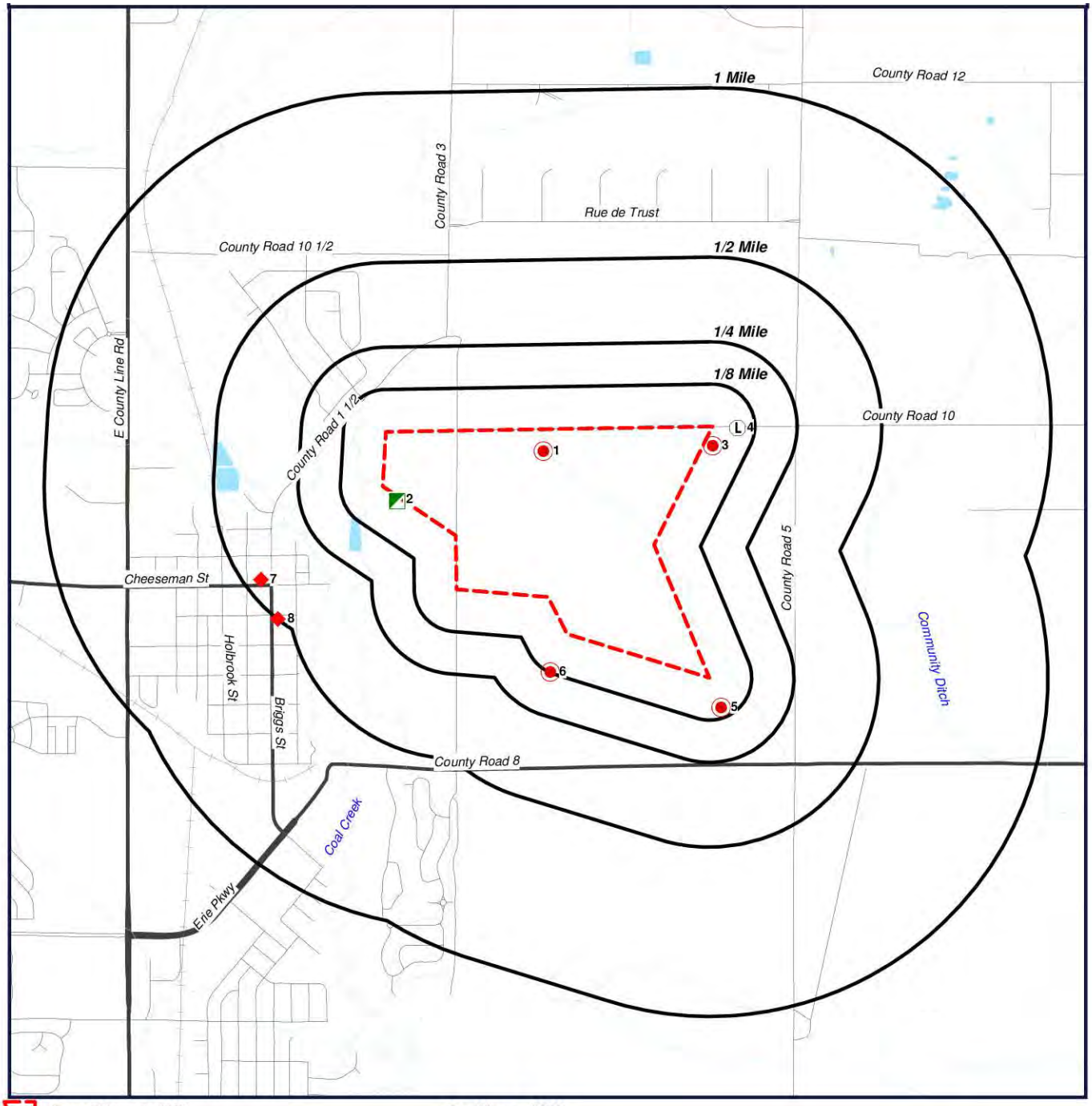
# Locatable Database Findings

***TRIBAL LISTING***

| Acronym | Search Radius (miles) | TP/AP (0 - 0.02) | 1/8 Mile (> TP/AP) | 1/4 Mile (> 1/8) | 1/2 Mile (> 1/4) | 1 Mile (> 1/2) | > 1 Mile | Total |
|---|---|---|---|---|---|---|---|---|
| USTR08 | 0.2500 | | 0 | 0 | NS | NS | NS | 0 |
| LUSTR08 | 0.5000 | | 0 | 0 | 0 | NS | NS | 0 |
| ODINDIAN | 0.5000 | | 0 | 0 | 0 | NS | NS | 0 |
| INDIANRES | 1.0000 | | 0 | 0 | 0 | 0 | NS | 0 |
| SUB-TOTAL | | | 0 | 0 | 0 | 0 | 0 | 0 |
| TOTAL | | 3 | 5 | 0 | 1 | 0 | 0 | 12 |

***NOTES:***
***NS = NOT SEARCHED***
***TP/AP = TARGET PROPERTY/ADJACENT PROPERTY***

# Radius Map 1




Target Property (TP)
AIRSAFS
APCDP
HISTSWLF
LST

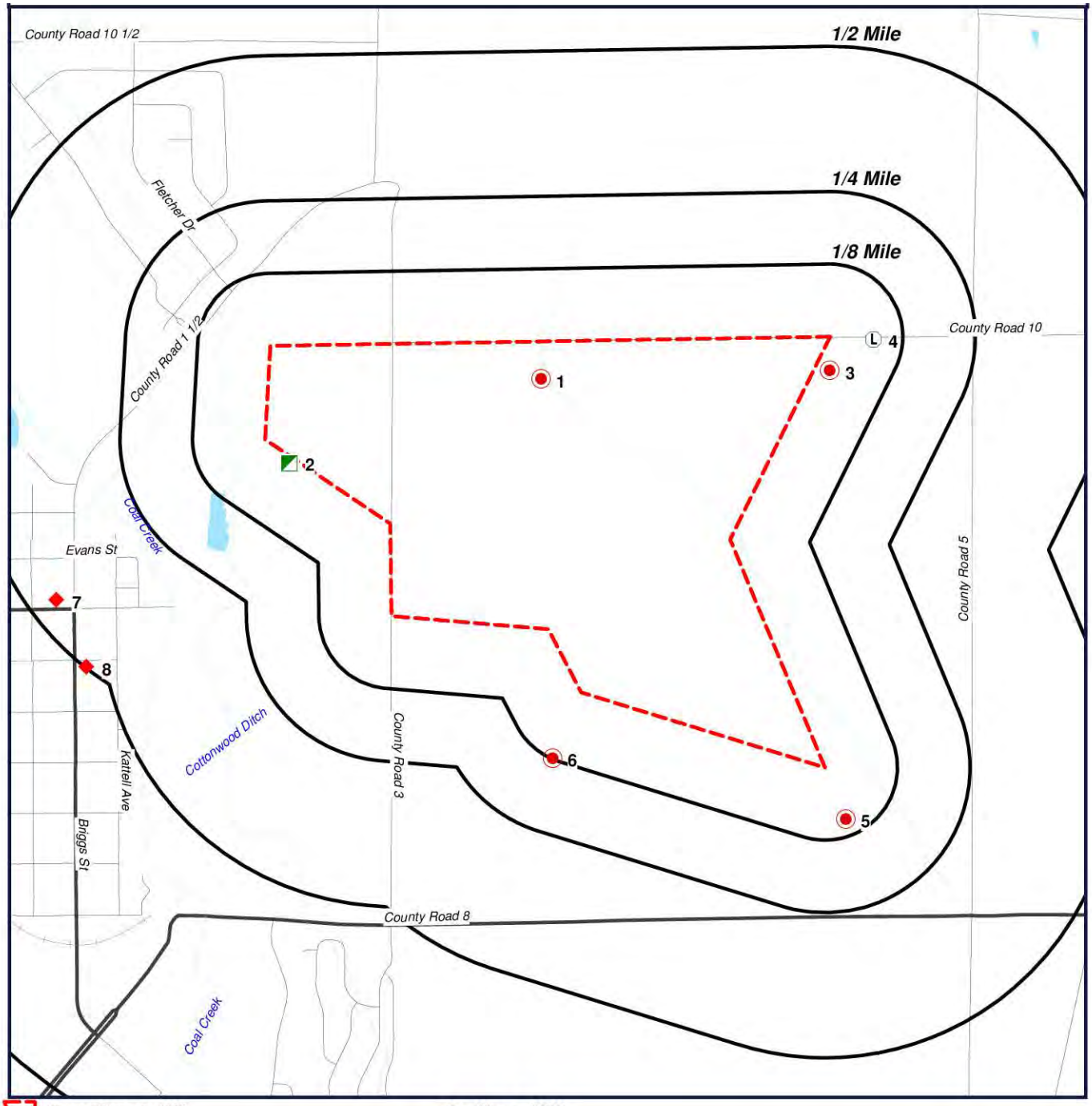
**Colliers Hill**
**Erie, Colorado**
**80516**

N
W E
S

0' 1200' 2400' 3600'
SCALE: 1" = 2400'

Click here to access Satellite view

# Radius Map 2




Target Property (TP)
AIRSAFS
APCDP
HISTSWLF
LST

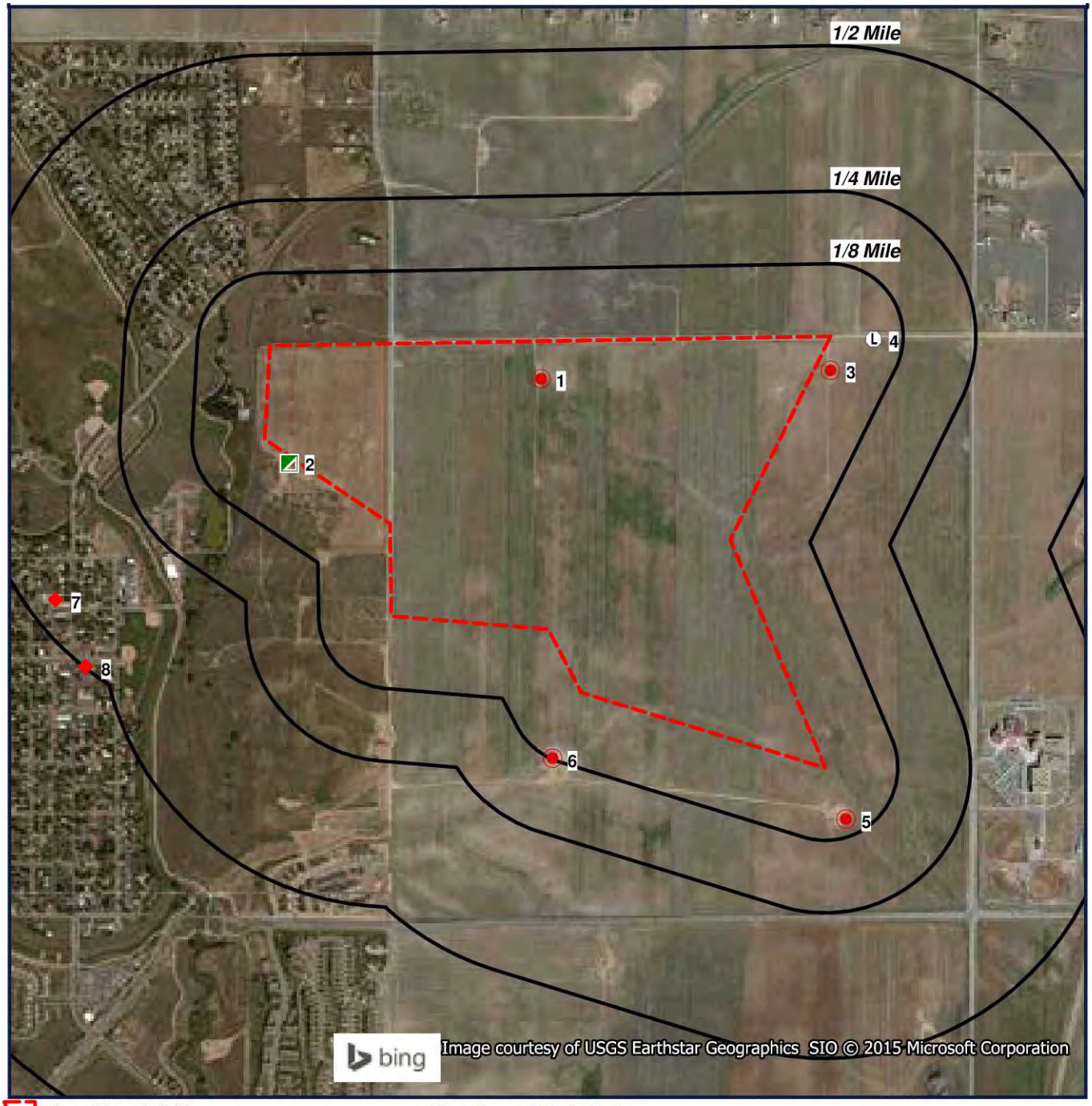
**Colliers Hill**
**Erie, Colorado**
**80516**

N
W E
S

0' 700' 1400' 2100'
SCALE: 1" = 1400'

[Click here to access Satellite view]

# Ortho Map




Target Property (TP)
AIRSAFS
APCDP
HISTSWLF
LST

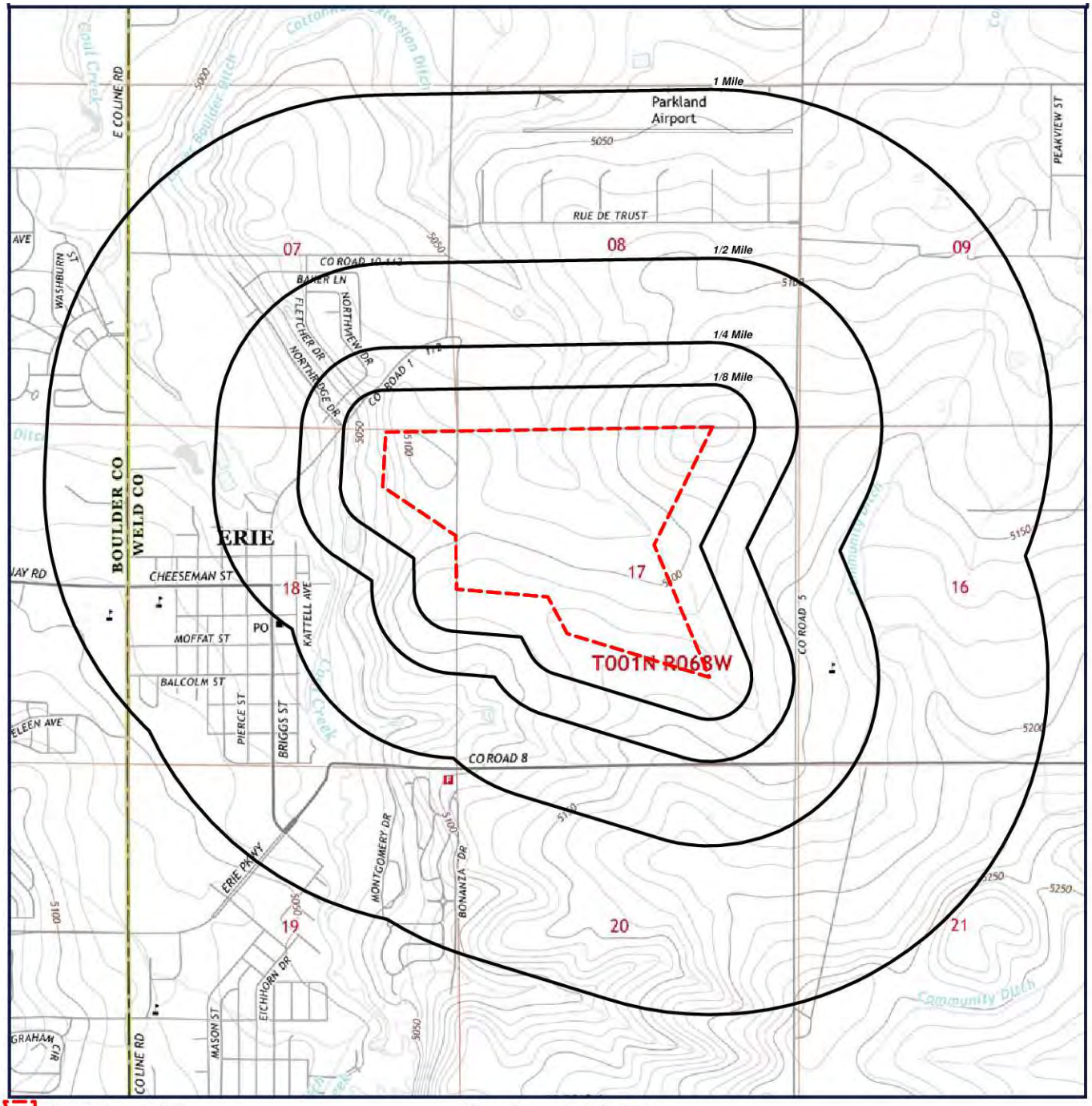
**Quadrangle(s): Erie**
**Colliers Hill**
**Erie, Colorado**
**80516**

N
W E
S

0' 700' 1400' 2100'
SCALE: 1" = 1400'

[Click here to access Satellite view]

# Topographic Map




Target Property (TP)

***Quadrangle(s): Erie***
***Source: USGS, 07/23/2013***
***Colliers Hill***
***Erie, Colorado***
***80516***

N
W E
S

0' 1200' 2400' 3600'
SCALE: 1" = 2400'

[Click here to access Satellite view]

# Report Summary of Locatable Sites

| Map ID# | Database Name | Site ID# | Distance From Site | Site Name | Address | City, Zip Code | PAGE # |
|---|---|---|---|---|---|---|---|
| 1 | AIRSAFS | 1102095 | 0.001 W | NOBLE ENERGY, INC. - BATTERY #11605600 | NENW SEC17 T1N R68W | ERIE, 80516 | 16 |
| 1 | APCDP | 123-8864 | 0.001 W | NOBLE ENERGY, INC. - BATTERY #11605600 | NENW SEC17 T1N R68W | ERIE, 80516 | 18 |
| 2 | APCDP | 123-9857 | 0.01 W | ENCANA - ERIE CHAMPLIN B UNIT 1 | NENE SEC18 T1N R68W | ERIE, 80516 | 22 |
| 3 | AIRSAFS | 1042034 | 0.03 S | NOBLE ENERGY - BATTERY #11605500 | NENE SEC 17 T1N R68W | ERIE, 80516 | 24 |
| 3 | APCDP | 123-5762 | 0.03 S | NOBLE ENERGY - BATTERY #11605500 | NENE SEC 17 T1N R68W | ERIE, 80516 | 28 |
| 4 | HISTSWLF | 00070-0000370 | 0.08 E | FRONT RANGE LANDFILL, SANIFILL | 1830 WCR 5 | ERIE, 80516 | 31 |
| 5 | AIRSAFS | 1062024 | 0.1 S | KERR-MCGEE 62084 | SESE-17-1N-68W | ERIE, 80516 | 32 |
| 5 | APCDP | 123-7802 | 0.1 S | KERR-MCGEE 62084 | SESE-17-1N-68W | ERIE, 80516 | 35 |
| 6 | AIRSAFS | 1062144 | 0.13 SW | KERR-MCGEE 35006636 | CSW-17-1N-68W | ERIE, 80516 | 42 |
| 6 | APCDP | 123-7922 | 0.13 SW | KERR-MCGEE 35006636 - CHAMPLIN 86 AMO. | CSW-17-1N-68W | ERIE, 80516 | 45 |
| 7 | LST | 3857LST | 0.46 W | ERIE CAR WASH | 235 CHEESMAN | ERIE, 80516 | 52 |
| 8 | LST | 15165LST | 0.51 SW | US POST OFFICE | 150 WELD ST | ERIE, 80516 | 53 |

**MAP ID# 1** **Distance from Property: 0.00 mi. W**

## SITE INFORMATION

UNIQUE ID: **1102095**
PLANT ID: **1102095**
NAME: **NOBLE ENERGY, INC. - BATTERY #11605600**
ADDRESS: **NENW SEC17 T1N R68W**
**ERIE, CO 80516**
CLASSIFICATION: **POTENTIAL UNCONTROLLED EMISSIONS <100 TONS/YEAR**
OPERATION STATUS: **OPERATING**
STATE COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**
FACILITY TYPE: **PRIVATELY OWNED/OPERATED**
CURRENT HIGH PRIORITY VIOLATOR: **NOT REPORTED**
SIC DESCRIPTION: **ESTABLISHMENTS PRIMARILY ENGAGED IN PRODUCING LIQUID HYDROCARBONS FROM OIL AND GAS FIELD GASES.**

## ENFORCEMENT ACTIONS

DATE ACHIEVED: **02/19/2014**
DATE RECORDED: **04/15/2014**
NATIONAL ACTION TYPE: **STATE CONDUCTED FCE/ON-SITE**
ALL AIR PROGRAM: **SIP SOURCE**
RESULTS OF STACK TEST AND TITLE V: **IN COMPLIANCE**
POLLUTANT: **NOT REPORTED**
ALL POLLUTION IN VIOLATION: **NOT REPORTED**
TYPE OF VIOLATION(S): **NOT REPORTED**
PENALTY AMOUNT: **0**

## AIR PROGRAM

AIR PROGRAM STATUS: **OPERATING**
EPA COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**
POLLUTANT COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**
POLLUTANT: **VOLATILE ORGANIC COMPOUNDS**

## HISTORICAL COMPLIANCE AIR PROGRAM LEVEL

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1401**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1402**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1304**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1403**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

Back to Report Summary

**MAP ID# 1** **Distance from Property: 0.00 mi. W**

## SITE INFORMATION

SITE ID: **123-8864**

FACILITY NAME: **NOBLE ENERGY, INC. - BATTERY #11605600**

ADDRESS: **NENW SEC17 T1N R68W**
**ERIE, CO 80516**

PERMIT NAME: **NOBLE ENERGY, INC. - BATTERY #11605600**

FACILITY CLASSIFICATION: **0**

## AIR PROGRAM

*AIR PROGRAM CLASSIFICATION: 'A'=Major, 'B'=Minor, 'SM'=Synthetic Minor, 'ND'=No Major Source Threshold Defined, 'C'=Unknown, 'BLANK'= BLANK FIELD*

AIR PROGRAM CLASS: **MINOR**

ACID PRECIPITATION: **BLANK** APEN EXEMPT: **BLANK** CFC TRACKING: **BLANK**

CONDENSATE STORAGE TANK: **B** FESOP (NON-TITLE V): **BLANK** MACT (SEC. 63 NESHAPS): **BLANK**

NESHAP: **BLANK** NON FEDERALLY REPORTABLE SOURCE: **BLANK** FEDERAL NSPS: **BLANK**

STATE NSPS: **BLANK** NSR: **BLANK** PSD: **BLANK** SIP SOURCE UNDER FEDERAL JURISDICTION: **BLANK**

SIP SOURCE: **BLANK** TITLE V PERMITS: **BLANK** NATIVE AMERICAN: **BLANK**

PLANT AIR PROGRAM: **OZONE, AREA N2081**

PROPERTY AREA: **NOT REPORTED**

COMPLIANCE MONITORING SYSTEM: **NOT REPORTED**

DATE COMPLIANCE MONITORING SYSTEM: **NOT REPORTED**

STANDARD INDUSTRIAL DESCRIPTION:

**OIL AND GAS EXTRACTION - NATURAL GAS LIQUIDS**

## SITE CONTACT INFORMATION

CONTACT NAME: **TARYN PHILLIPS**

CONTACT PHONE: **(303)228-4362**

SITE DESCRIPTION:**E&P CONDENSATE TANK BATTERY**

COMMENTS:

**NOT REPORTED**

## OWNER INFORMATION

OWNER CUSTOMER #: **7526294770**

OWNER NAME: **NOBLE ENERGY, INC.**

ADDRESS: **1625 BROADWAY**
**DENVER, 08 80202**

OWNER MAIL NAME: **BRIAN TAYLOR**

OWNER MAIL PHONE: **(720)587-2371**

SITE OWNER DESCRIPTION: **OGCC#67305 OIL & GAS EXTRACTIO**

## SITE POLLUTANT INFORMATION

EFFECTIVE YEAR OF INVENTORY: **2015**

POLLUTANT NAME: **71432 - BENZENE**

EMISSION DATA SUBMITTED YEAR: **2011**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**

POLLUTANT IS A CRITERIA POLLUTANT: **NO**

POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **YES**

POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

ESTIMATED EMISSIONS: *(TONS PER YEAR):* **0.00275**
UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* **0.02656**
EMISSIONS LIMIT: *(TONS PER YEAR):* **0.00000**
ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)* **0.00000**

EFFECTIVE YEAR OF INVENTORY: **2015**
POLLUTANT NAME: **CO - CARBON MONOXIDE**
EMISSION DATA SUBMITTED YEAR: **2011**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **YES**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**
ESTIMATED EMISSIONS: *(TONS PER YEAR):* **0.00418**
UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* **0.00418**
EMISSIONS LIMIT: *(TONS PER YEAR):* **0.00000**
ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)* **0.00000**

EFFECTIVE YEAR OF INVENTORY: **2015**
POLLUTANT NAME: **NOX - NITROGEN DIOXIDE**
EMISSION DATA SUBMITTED YEAR: **2011**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **YES**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**
ESTIMATED EMISSIONS: *(TONS PER YEAR):* **0.01906**
UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* **0.01906**
EMISSIONS LIMIT: *(TONS PER YEAR):* **0.00000**
ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)* **0.00000**

EFFECTIVE YEAR OF INVENTORY: **2015**
POLLUTANT NAME: **VOC - VOLATILE ORGANIC COMPOUNDS**
EMISSION DATA SUBMITTED YEAR: **2011**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **YES**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**
ESTIMATED EMISSIONS: *(TONS PER YEAR):* **1.57112**
UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* **15.16590**
EMISSIONS LIMIT: *(TONS PER YEAR):* **0.00000**
ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS:

*(TONS PER YEAR)*

**0.00000**

## STACK

EFFECTIVE YEAR OF INVENTORY: **2015**

EMISSION DATA SUBMITTED YEAR: **2011**

EMISSION RELEASE POINT (STACK): **FLASH EMISSIONS CONTROLLED BY FLARE**

STACK GAS FLOW RATE: *(CUBIC FEET PER MINUTE):* **5916.00000**

STACK GAS FLOW RATE (NEI COMPATIBLE): *(CUBIC FEET PER MINUTE):* **98.00000**

STACK HEIGHT: **20.00000**

STACK DIAMETER: **2.00000**

PLUME HEIGHT: **0.00000**

STACK TYPE DESCRIPTION:

**A STACK WITH AN UNOBSTRUCTED OPENING DISCHARGING IN A VERTICAL DIRECTION**

## STACK POLLUTANT

EFFECTIVE YEAR OF INVENTORY: **2015**

POLLUTANT NAME: **71432 - BENZENE**

EMISSION DATA SUBMITTED YEAR: **2011**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**

POLLUTANT IS A CRITERIA POLLUTANT: **NO**

POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **YES**

POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **0.00275** | **0.02656** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)*

**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2015**

POLLUTANT NAME: **CO - CARBON MONOXIDE**

EMISSION DATA SUBMITTED YEAR: **2011**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**

POLLUTANT IS A CRITERIA POLLUTANT: **YES**

POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**

POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **0.00418** | **0.00418** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)*

**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2015**

POLLUTANT NAME: **NO2 - NITROGEN DIOXIDE**

EMISSION DATA SUBMITTED YEAR: **2011**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**

POLLUTANT IS A CRITERIA POLLUTANT: **YES**

POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**

POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **0.01906** | **0.01906** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)*

**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2015**

POLLUTANT NAME: **VOC - VOLATILE ORGANIC COMPOUNDS**

EMISSION DATA SUBMITTED YEAR: **2011**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**

POLLUTANT IS A CRITERIA POLLUTANT: **YES**

POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**

POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **1.57112** | **15.16590** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)*

**0.00000**

**UNIT COMMENT**

**-NO COMMENTS REPORTED**

Back to Report Summary

**MAP ID# 2** **Distance from Property: 0.01 mi. W**

## SITE INFORMATION

SITE ID: **123-9857**

FACILITY NAME: **ENCANA - ERIE CHAMPLIN B UNIT 1**

ADDRESS: **NENE SEC18 T1N R68W**
**ERIE, CO 80516**

PERMIT NAME: **ENCANA - ERIE CHAMPLIN B UNIT 1**

FACILITY CLASSIFICATION: **0**

## AIR PROGRAM

*AIR PROGRAM CLASSIFICATION: 'A'=Major, 'B'=Minor, 'SM'=Synthetic Minor, 'ND'=No Major Source Threshold Defined, 'C'=Unknown, 'BLANK'= BLANK FIELD*

AIR PROGRAM CLASS: **MINOR**

ACID PRECIPITATION: **BLANK** APEN EXEMPT: **BLANK** CFC TRACKING: **BLANK**

CONDENSATE STORAGE TANK: **B** FESOP (NON-TITLE V): **BLANK** MACT (SEC. 63 NESHAPS): **BLANK**

NESHAP: **BLANK** NON FEDERALLY REPORTABLE SOURCE: **BLANK** FEDERAL NSPS: **BLANK**

STATE NSPS: **BLANK** NSR: **BLANK** PSD: **BLANK** SIP SOURCE UNDER FEDERAL JURISDICTION: **BLANK**

SIP SOURCE: **BLANK** TITLE V PERMITS: **BLANK** NATIVE AMERICAN: **BLANK**

PLANT AIR PROGRAM: **OZONE, AREA N2081**

PROPERTY AREA: **NOT REPORTED**

COMPLIANCE MONITORING SYSTEM: **NOT REPORTED**

DATE COMPLIANCE MONITORING SYSTEM: **NOT REPORTED**

STANDARD INDUSTRIAL DESCRIPTION:

**OIL AND GAS EXTRACTION - NATURAL GAS LIQUIDS**

## SITE CONTACT INFORMATION

CONTACT NAME: **CINDY ALLEN**

CONTACT PHONE: **(720)876-5474**

SITE DESCRIPTION:**E&P CONDENSATE STORAGE TANK BATTERY**

COMMENTS:

**NOT REPORTED**

## OWNER INFORMATION

OWNER CUSTOMER #: **9920105742**

OWNER NAME: **ENCANA OIL & GAS (USA) INC.**

ADDRESS: **370 17TH ST.**
**DENVER, 08 80202**

OWNER MAIL NAME: **ADAM BERIG**

OWNER MAIL PHONE: **(720)876-3884**

SITE OWNER DESCRIPTION: **OGCC#100160 OIL & GAS**

## SITE POLLUTANT INFORMATION

EFFECTIVE YEAR OF INVENTORY: **2015**

POLLUTANT NAME: **VOC - VOLATILE ORGANIC COMPOUNDS**

EMISSION DATA SUBMITTED YEAR: **2011**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**

POLLUTANT IS A CRITERIA POLLUTANT: **YES**

POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**

POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

ESTIMATED EMISSIONS: *(TONS PER YEAR):* **3.07565**
UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* **3.07565**
EMISSIONS LIMIT: *(TONS PER YEAR):* **0.00000**
ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)* **0.00000**

## STACK

EFFECTIVE YEAR OF INVENTORY: **2015**
EMISSION DATA SUBMITTED YEAR: **2011**
EMISSION RELEASE POINT (STACK): **CONDENSATE TANK FLASH EMISSIONS**
STACK GAS FLOW RATE: *(CUBIC FEET PER MINUTE):* **9747.00000**
STACK GAS FLOW RATE (NEI COMPATIBLE): *(CUBIC FEET PER MINUTE):* **162.00000**
STACK HEIGHT: **20.00000**
STACK DIAMETER: **2.84000**
PLUME HEIGHT: **0.00000**
STACK TYPE DESCRIPTION:
**A STACK WITH AN UNOBSTRUCTED OPENING DISCHARGING IN A VERTICAL DIRECTION**

## STACK POLLUTANT

EFFECTIVE YEAR OF INVENTORY: **2015**
POLLUTANT NAME: **VOC - VOLATILE ORGANIC COMPOUNDS**
EMISSION DATA SUBMITTED YEAR: **2011**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **YES**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**
ESTIMATED EMISSIONS: *(TONS PER YEAR):* **3.07565**
UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* **3.07565**
EMISSIONS LIMIT: *(TONS PER YEAR):* **0.00000**
ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)* **0.00000**

## UNIT COMMENT

**-NO COMMENTS REPORTED**

Back to Report Summary

**MAP ID# 3** **Distance from Property: 0.03 mi. S**

**SITE INFORMATION**

UNIQUE ID: **1042034**
PLANT ID: **1042034**
NAME: **NOBLE ENERGY - BATTERY #11605500**
ADDRESS: **NENE SEC 17 T1N R68W**
**ERIE, CO 80516**
CLASSIFICATION: **POTENTIAL UNCONTROLLED EMISSIONS <100 TONS/YEAR**
OPERATION STATUS: **OPERATING**
STATE COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**
FACILITY TYPE: **PRIVATELY OWNED/OPERATED**
CURRENT HIGH PRIORITY VIOLATOR: **NOT REPORTED**
SIC DESCRIPTION: **ESTABLISHMENTS PRIMARILY ENGAGED IN PRODUCING LIQUID HYDROCARBONS FROM OIL AND GAS FIELD GASES.**

**ENFORCEMENT ACTIONS** NO ENFORCEMENT ACTIONS REPORTED

**AIR PROGRAM**

AIR PROGRAM STATUS: **OPERATING**
EPA COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**
POLLUTANT COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**
POLLUTANT: **VOLATILE ORGANIC COMPOUNDS**

**HISTORICAL COMPLIANCE AIR PROGRAM LEVEL**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1401**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1003**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **0804**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **0903**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1103**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**

COMPLIANCE DATE (YYYQ): **0704**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **0901**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1203**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **0802**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1304**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **0604**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1302**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **0803**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1303**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **0902**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **0801**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **0904**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1101**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1403**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **0701**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1402**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1104**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1301**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1001**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1204**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1202**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1004**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **0702**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1102**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1002**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **0703**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1201**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

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**MAP ID# 3** **Distance from Property: 0.03 mi. S**

## SITE INFORMATION

SITE ID: **123-5762**

FACILITY NAME: **NOBLE ENERGY - BATTERY #11605500**

ADDRESS: **NENE SEC 17 T1N R68W**
**ERIE, CO 80516**

PERMIT NAME: **NOBLE ENERGY - BATTERY #11605500**

FACILITY CLASSIFICATION: **0**

## AIR PROGRAM

*AIR PROGRAM CLASSIFICATION: 'A'=Major, 'B'=Minor, 'SM'=Synthetic Minor, 'ND'=No Major Source Threshold Defined, 'C'=Unknown, 'BLANK'= BLANK FIELD*

AIR PROGRAM CLASS: **MINOR**

ACID PRECIPITATION: **BLANK** APEN EXEMPT: **BLANK** CFC TRACKING: **BLANK**

CONDENSATE STORAGE TANK: **B** FESOP (NON-TITLE V): **BLANK** MACT (SEC. 63 NESHAPS): **BLANK**

NESHAP: **BLANK** NON FEDERALLY REPORTABLE SOURCE: **BLANK** FEDERAL NSPS: **BLANK**

STATE NSPS: **BLANK** NSR: **BLANK** PSD: **BLANK** SIP SOURCE UNDER FEDERAL JURISDICTION: **BLANK**

SIP SOURCE: **BLANK** TITLE V PERMITS: **BLANK** NATIVE AMERICAN: **BLANK**

PLANT AIR PROGRAM: **OZONE, AREA N2081**

PROPERTY AREA: **NOT REPORTED**

COMPLIANCE MONITORING SYSTEM: **NOT REPORTED**

DATE COMPLIANCE MONITORING SYSTEM: **06/09/06**

STANDARD INDUSTRIAL DESCRIPTION:

**OIL AND GAS EXTRACTION - NATURAL GAS LIQUIDS**

## SITE CONTACT INFORMATION

CONTACT NAME: **ROB GARREN**

CONTACT PHONE: **(303)228-4299**

SITE DESCRIPTION:**E&P CONDENSATE STORAGE TANK BATTERY**

COMMENTS:

**NOT REPORTED**

## OWNER INFORMATION

OWNER CUSTOMER #: **7526294770**

OWNER NAME: **NOBLE ENERGY, INC.**

ADDRESS: **1625 BROADWAY**
**DENVER, 08 80202**

OWNER MAIL NAME: **BRIAN TAYLOR**

OWNER MAIL PHONE: **(720)587-2371**

SITE OWNER DESCRIPTION: **OGCC#67305 OIL & GAS EXTRACTIO**

## SITE POLLUTANT INFORMATION

EFFECTIVE YEAR OF INVENTORY: **2015**

POLLUTANT NAME: **VOC - VOLATILE ORGANIC COMPOUNDS**

EMISSION DATA SUBMITTED YEAR: **2010**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**

POLLUTANT IS A CRITERIA POLLUTANT: **YES**

POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**

POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

ESTIMATED EMISSIONS: *(TONS PER YEAR):* **3.41130**
UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* **3.41130**
EMISSIONS LIMIT: *(TONS PER YEAR):* **0.00000**
ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)* **0.00000**

EFFECTIVE YEAR OF INVENTORY: **2011**
POLLUTANT NAME: **VOC - VOLATILE ORGANIC COMPOUNDS**
EMISSION DATA SUBMITTED YEAR: **2008**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **YES**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**
ESTIMATED EMISSIONS: *(TONS PER YEAR):* **5.56905**
UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* **5.56905**
EMISSIONS LIMIT: *(TONS PER YEAR):* **0.00000**
ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)* **0.00000**

## STACK

EFFECTIVE YEAR OF INVENTORY: **2015**
EMISSION DATA SUBMITTED YEAR: **2010**
EMISSION RELEASE POINT (STACK): **CONDENSATE TANK FLASH EMISSIONS**
STACK GAS FLOW RATE: *(CUBIC FEET PER MINUTE):* **9747.00000**
STACK GAS FLOW RATE (NEI COMPATIBLE): *(CUBIC FEET PER MINUTE):* **162.00000**
STACK HEIGHT: **20.00000**
STACK DIAMETER: **2.84000**
PLUME HEIGHT: **0.00000**
STACK TYPE DESCRIPTION:
**A STACK WITH AN UNOBSTRUCTED OPENING DISCHARGING IN A VERTICAL DIRECTION**

EFFECTIVE YEAR OF INVENTORY: **2011**
EMISSION DATA SUBMITTED YEAR: **2008**
EMISSION RELEASE POINT (STACK): **CONDENSATE TANK FLASH EMISSIONS**
STACK GAS FLOW RATE: *(CUBIC FEET PER MINUTE):* **9747.00000**
STACK GAS FLOW RATE (NEI COMPATIBLE): *(CUBIC FEET PER MINUTE):* **162.00000**
STACK HEIGHT: **20.00000**
STACK DIAMETER: **2.84000**
PLUME HEIGHT: **0.00000**
STACK TYPE DESCRIPTION:
**A STACK WITH AN UNOBSTRUCTED OPENING DISCHARGING IN A VERTICAL DIRECTION**

## STACK POLLUTANT

EFFECTIVE YEAR OF INVENTORY: **2015**
POLLUTANT NAME: **VOC - VOLATILE ORGANIC COMPOUNDS**

EMISSION DATA SUBMITTED YEAR: **2010**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**

POLLUTANT IS A CRITERIA POLLUTANT: **YES**

POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**

POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **3.41130** | **3.41130** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)*

**0.00000**

**UNIT COMMENT**

**-NO COMMENTS REPORTED**

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MAP ID# 4 **Distance from Property: 0.08 mi. E**

**SITE INFORMATION**

UNIQUE ID: **00070-0000370**

NAME: **FRONT RANGE LANDFILL, SANIFILL**

ADDRESS: **1830 WCR 5**
**ERIE, CO**

DIRECTIONS: **NOT REPORTED**

COUNTY: **WELD**

**SITE DETAILS**

AGENCY SOURCE: **NOT REPORTED**

DETAIL1:

**TRS- W2T1N/R68W/S28; TYPE- LANDFILLS; REGUL'D- PERMIT #925**

DETAIL2:

**CONTACT- EDD NESTOR; C303-907-3890, 303-828-9400**

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MAP ID# 5 **Distance from Property: 0.10 mi. S**

**SITE INFORMATION**

UNIQUE ID: **1062024**
PLANT ID: **1062024**
NAME: **KERR-MCGEE 62084**
ADDRESS: **SESE-17-1N-68W**
**ERIE, CO 80516**
CLASSIFICATION: **POTENTIAL UNCONTROLLED EMISSIONS <100 TONS/YEAR**
OPERATION STATUS: **TEMPORARILY CLOSED**
STATE COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**
FACILITY TYPE: **PRIVATELY OWNED/OPERATED**
CURRENT HIGH PRIORITY VIOLATOR: **NOT REPORTED**
SIC DESCRIPTION: **ESTABLISHMENTS PRIMARILY ENGAGED IN PRODUCING LIQUID HYDROCARBONS FROM OIL AND GAS FIELD GASES.**

**ENFORCEMENT ACTIONS** NO ENFORCEMENT ACTIONS REPORTED

**AIR PROGRAM**

AIR PROGRAM STATUS: **TEMPORARILY CLOSED**
EPA COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**
POLLUTANT COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**
POLLUTANT: **VOLATILE ORGANIC COMPOUNDS**

**HISTORICAL COMPLIANCE AIR PROGRAM LEVEL**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1401**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1303**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1004**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **0904**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1101**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**

COMPLIANCE DATE (YYYQ): **1301**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1402**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1302**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1403**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1002**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **0903**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1204**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1202**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1104**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1304**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1102**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1003**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1203**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1001**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1201**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1103**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

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**MAP ID# 5** **Distance from Property: 0.10 mi. S**

## SITE INFORMATION

SITE ID: **123-7802**

FACILITY NAME: **KERR-MCGEE 62084**

ADDRESS: **SESE-17-1N-68W**

**ERIE, CO 80516**

PERMIT NAME: **KERR-MCGEE 62084**

FACILITY CLASSIFICATION: **0**

## AIR PROGRAM

*AIR PROGRAM CLASSIFICATION: 'A'=Major, 'B'=Minor, 'SM'=Synthetic Minor, 'ND'=No Major Source Threshold Defined, 'C'=Unknown, 'BLANK'= BLANK FIELD*

AIR PROGRAM CLASS: **MINOR**

ACID PRECIPITATION: **BLANK** APEN EXEMPT: **BLANK** CFC TRACKING: **BLANK**

CONDENSATE STORAGE TANK: **B** FESOP (NON-TITLE V): **BLANK** MACT (SEC. 63 NESHAPS): **BLANK**

NESHAP: **BLANK** NON FEDERALLY REPORTABLE SOURCE: **BLANK** FEDERAL NSPS: **BLANK**

STATE NSPS: **BLANK** NSR: **BLANK** PSD: **BLANK** SIP SOURCE UNDER FEDERAL JURISDICTION: **BLANK**

SIP SOURCE: **BLANK** TITLE V PERMITS: **BLANK** NATIVE AMERICAN: **BLANK**

PLANT AIR PROGRAM: **OZONE, AREA N2081**

PROPERTY AREA: **NOT REPORTED**

COMPLIANCE MONITORING SYSTEM: **NOT REPORTED**

DATE COMPLIANCE MONITORING SYSTEM: **06/25/09**

STANDARD INDUSTRIAL DESCRIPTION:

**OIL AND GAS EXTRACTION - NATURAL GAS LIQUIDS**

## SITE CONTACT INFORMATION

CONTACT NAME: **KATHERINE DOOLITTLE**

CONTACT PHONE: **(720)929-6511**

SITE DESCRIPTION:**E&P CONDENSATE STORAGE TANK BATTERY**

COMMENTS:

**NOT REPORTED**

## OWNER INFORMATION

OWNER CUSTOMER #: **9920104636**

OWNER NAME: **KERR-MCGEE OIL & GAS ONSHORE LP**

ADDRESS: **P.O. BOX 173779**

**DENVER, 08 80217-3779**

OWNER MAIL NAME: **KATHERINE DOOLITTLE**

OWNER MAIL PHONE: **(720)929-6511**

SITE OWNER DESCRIPTION: **OGCC#47120 NATURAL GAS COMPRES**

## SITE POLLUTANT INFORMATION

EFFECTIVE YEAR OF INVENTORY: **2014**

POLLUTANT NAME: **71432 - BENZENE**

EMISSION DATA SUBMITTED YEAR: **2012**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**

POLLUTANT IS A CRITERIA POLLUTANT: **NO**

POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **YES**

POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

ESTIMATED EMISSIONS: *(TONS PER YEAR):* **0.00200**
UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* **0.04000**
EMISSIONS LIMIT: *(TONS PER YEAR):* **0.00000**
ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)* **0.00000**

EFFECTIVE YEAR OF INVENTORY: **2014**
POLLUTANT NAME: **CO - CARBON MONOXIDE**
EMISSION DATA SUBMITTED YEAR: **2012**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **YES**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**
ESTIMATED EMISSIONS: *(TONS PER YEAR):* **1.28780**
UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* **1.28780**
EMISSIONS LIMIT: *(TONS PER YEAR):* **0.00000**
ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)* **0.00000**

EFFECTIVE YEAR OF INVENTORY: **2014**
POLLUTANT NAME: **NOX - NITROGEN DIOXIDE**
EMISSION DATA SUBMITTED YEAR: **2012**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **YES**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**
ESTIMATED EMISSIONS: *(TONS PER YEAR):* **0.50690**
UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* **0.50690**
EMISSIONS LIMIT: *(TONS PER YEAR):* **0.00000**
ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)* **0.00000**

EFFECTIVE YEAR OF INVENTORY: **2014**
POLLUTANT NAME: **VOC - VOLATILE ORGANIC COMPOUNDS**
EMISSION DATA SUBMITTED YEAR: **2012**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **YES**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**
ESTIMATED EMISSIONS: *(TONS PER YEAR):* **0.35650**
UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* **7.13000**
EMISSIONS LIMIT: *(TONS PER YEAR):* **0.00000**
ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS:

*(TONS PER YEAR)*

**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2011**
POLLUTANT NAME: **110543 - HEXANE,N-**
EMISSION DATA SUBMITTED YEAR: **2009**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **NO**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **YES**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **0.06257** | **1.05001** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS:
*(TONS PER YEAR)*

**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2011**
POLLUTANT NAME: **71432 - BENZENE**
EMISSION DATA SUBMITTED YEAR: **2009**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **NO**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **YES**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **0.00715** | **0.11999** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS:
*(TONS PER YEAR)*

**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2011**
POLLUTANT NAME: **VOC - VOLATILE ORGANIC COMPOUNDS**
EMISSION DATA SUBMITTED YEAR: **2009**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **YES**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **4.08226** | **68.50001** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS:
*(TONS PER YEAR)*

**0.00000**

**STACK**

EFFECTIVE YEAR OF INVENTORY: **2014**
EMISSION DATA SUBMITTED YEAR: **2012**
EMISSION RELEASE POINT (STACK): **FLASH EMISSIONS CONTROLLED BY FLARE**

| STACK GAS FLOW RATE: *(CUBIC FEET PER MINUTE):* | STACK GAS FLOW RATE (NEI COMPATIBLE): *(CUBIC FEET PER MINUTE):* |
|---|---|
| **5916.00000** | **98.00000** |

| STACK HEIGHT: | STACK DIAMETER: | PLUME HEIGHT: |
|---|---|---|
| **20.00000** | **2.00000** | **0.00000** |

STACK TYPE DESCRIPTION:
**A STACK WITH AN UNOBSTRUCTED OPENING DISCHARGING IN A VERTICAL DIRECTION**

EFFECTIVE YEAR OF INVENTORY: **2011**
EMISSION DATA SUBMITTED YEAR: **2009**
EMISSION RELEASE POINT (STACK): **FLASH EMISSIONS UNCONTROLLED**

| STACK GAS FLOW RATE: *(CUBIC FEET PER MINUTE):* | STACK GAS FLOW RATE (NEI COMPATIBLE): *(CUBIC FEET PER MINUTE):* |
|---|---|
| **9747.00000** | **162.00000** |

| STACK HEIGHT: | STACK DIAMETER: | PLUME HEIGHT: |
|---|---|---|
| **20.00000** | **2.84000** | **0.00000** |

STACK TYPE DESCRIPTION:
**A STACK WITH AN UNOBSTRUCTED OPENING DISCHARGING IN A VERTICAL DIRECTION**

EFFECTIVE YEAR OF INVENTORY: **2011**
EMISSION DATA SUBMITTED YEAR: **2009**
EMISSION RELEASE POINT (STACK): **FLASH EMISSIONS WITH FLARE**

| STACK GAS FLOW RATE: *(CUBIC FEET PER MINUTE):* | STACK GAS FLOW RATE (NEI COMPATIBLE): *(CUBIC FEET PER MINUTE):* |
|---|---|
| **5916.00000** | **98.00000** |

| STACK HEIGHT: | STACK DIAMETER: | PLUME HEIGHT: |
|---|---|---|
| **20.00000** | **2.00000** | **0.00000** |

STACK TYPE DESCRIPTION:
**A STACK WITH AN UNOBSTRUCTED OPENING DISCHARGING IN A VERTICAL DIRECTION**

## STACK POLLUTANT

EFFECTIVE YEAR OF INVENTORY: **2014**
POLLUTANT NAME: **71432 - BENZENE**
EMISSION DATA SUBMITTED YEAR: **2012**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **NO**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **YES**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **0.00200** | **0.04000** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS:
*(TONS PER YEAR)*
**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2014**
POLLUTANT NAME: **CO - CARBON MONOXIDE**
EMISSION DATA SUBMITTED YEAR: **2012**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **YES**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **1.28780** | **1.28780** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)*
**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2014**
POLLUTANT NAME: **NO2 - NITROGEN DIOXIDE**
EMISSION DATA SUBMITTED YEAR: **2012**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **YES**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **0.50690** | **0.50690** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)*
**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2014**
POLLUTANT NAME: **VOC - VOLATILE ORGANIC COMPOUNDS**
EMISSION DATA SUBMITTED YEAR: **2012**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **YES**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **0.35650** | **7.13000** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)*
**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2011**
POLLUTANT NAME: **110543 - HEXANE,N-**
EMISSION DATA SUBMITTED YEAR: **2009**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **NO**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **YES**

POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **0.01060** | **0.01060** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)*

**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2011**

POLLUTANT NAME: **110543 - HEXANE,N-**

EMISSION DATA SUBMITTED YEAR: **2009**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**

POLLUTANT IS A CRITERIA POLLUTANT: **NO**

POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **YES**

POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **0.05197** | **1.03940** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)*

**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2011**

POLLUTANT NAME: **71432 - BENZENE**

EMISSION DATA SUBMITTED YEAR: **2009**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**

POLLUTANT IS A CRITERIA POLLUTANT: **NO**

POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **YES**

POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **0.00593** | **0.11878** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)*

**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2011**

POLLUTANT NAME: **VOC - VOLATILE ORGANIC COMPOUNDS**

EMISSION DATA SUBMITTED YEAR: **2009**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**

POLLUTANT IS A CRITERIA POLLUTANT: **YES**

POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**

POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **3.39041** | **67.80816** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)*

**0.00000**

**UNIT COMMENT**

**-NO COMMENTS REPORTED**

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Back to Report Summary

MAP ID# 6 **Distance from Property: 0.13 mi. SW**

**SITE INFORMATION**

UNIQUE ID: **1062144**
PLANT ID: **1062144**
NAME: **KERR-MCGEE 35006636**
ADDRESS: **CSW-17-1N-68W**
**ERIE, CO 80516**
CLASSIFICATION: **POTENTIAL UNCONTROLLED EMISSIONS <100 TONS/YEAR**
OPERATION STATUS: **TEMPORARILY CLOSED**
STATE COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**
FACILITY TYPE: **PRIVATELY OWNED/OPERATED**
CURRENT HIGH PRIORITY VIOLATOR: **NOT REPORTED**
SIC DESCRIPTION: **ESTABLISHMENTS PRIMARILY ENGAGED IN PRODUCING LIQUID HYDROCARBONS FROM OIL AND GAS FIELD GASES.**

**ENFORCEMENT ACTIONS** NO ENFORCEMENT ACTIONS REPORTED

**AIR PROGRAM**

AIR PROGRAM STATUS: **TEMPORARILY CLOSED**
EPA COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**
POLLUTANT COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**
POLLUTANT: **VOLATILE ORGANIC COMPOUNDS**

**HISTORICAL COMPLIANCE AIR PROGRAM LEVEL**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1104**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1001**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1301**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1004**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1302**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**

COMPLIANCE DATE (YYYQ): **1201**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1303**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1204**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1403**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1102**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1103**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1304**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **0903**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1203**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1401**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1003**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1402**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1101**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **0904**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1202**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

AIR PROGRAM: **SIP SOURCE**
COMPLIANCE DATE (YYYQ): **1002**
HISTORICAL COMPLIANCE STATUS: **IN COMPLIANCE WITH PROCEDURAL REQUIREMENTS**

Back to Report Summary

**MAP ID# 6** **Distance from Property: 0.13 mi. SW**

## SITE INFORMATION

SITE ID: **123-7922**

FACILITY NAME: **KERR-MCGEE 35006636 - CHAMPLIN 86 AMO.**

ADDRESS: **CSW-17-1N-68W**

**ERIE, CO 80516**

PERMIT NAME: **KERR-MCGEE 35006636 - CHAMPLIN 86 AMO.**

FACILITY CLASSIFICATION: **0**

## AIR PROGRAM

*AIR PROGRAM CLASSIFICATION: 'A'=Major, 'B'=Minor, 'SM'=Synthetic Minor, 'ND'=No Major Source Threshold Defined, 'C'=Unknown, 'BLANK'= BLANK FIELD*

AIR PROGRAM CLASS: **MINOR**

ACID PRECIPITATION: **BLANK** APEN EXEMPT: **BLANK** CFC TRACKING: **BLANK**

CONDENSATE STORAGE TANK: **B** FESOP (NON-TITLE V): **BLANK** MACT (SEC. 63 NESHAPS): **BLANK**

NESHAP: **BLANK** NON FEDERALLY REPORTABLE SOURCE: **BLANK** FEDERAL NSPS: **BLANK**

STATE NSPS: **BLANK** NSR: **BLANK** PSD: **BLANK** SIP SOURCE UNDER FEDERAL JURISDICTION: **BLANK**

SIP SOURCE: **BLANK** TITLE V PERMITS: **BLANK** NATIVE AMERICAN: **BLANK**

PLANT AIR PROGRAM: **OZONE, AREA N2081**

PROPERTY AREA: **NOT REPORTED**

COMPLIANCE MONITORING SYSTEM: **NOT REPORTED**

DATE COMPLIANCE MONITORING SYSTEM: **06/25/09**

STANDARD INDUSTRIAL DESCRIPTION:

**OIL AND GAS EXTRACTION - NATURAL GAS LIQUIDS**

## SITE CONTACT INFORMATION

CONTACT NAME: **KATHERINE DOOLITTLE**

CONTACT PHONE: **(720)929-6511**

SITE DESCRIPTION:**E&P CONDENSATE STORAGE TANK BATTERY**

COMMENTS:

**NOT REPORTED**

## OWNER INFORMATION

OWNER CUSTOMER #: **9920104636**

OWNER NAME: **KERR-MCGEE OIL & GAS ONSHORE LP**

ADDRESS: **P.O. BOX 173779**

**DENVER, 08 80217-3779**

OWNER MAIL NAME: **KATHERINE DOOLITTLE**

OWNER MAIL PHONE: **(720)929-6511**

SITE OWNER DESCRIPTION: **OGCC#47120 NATURAL GAS COMPRES**

## SITE POLLUTANT INFORMATION

EFFECTIVE YEAR OF INVENTORY: **2014**

POLLUTANT NAME: **71432 - BENZENE**

EMISSION DATA SUBMITTED YEAR: **2012**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**

POLLUTANT IS A CRITERIA POLLUTANT: **NO**

POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **YES**

POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **0.00200** | **0.04000** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS:
*(TONS PER YEAR)*
**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2014**
POLLUTANT NAME: **CO - CARBON MONOXIDE**
EMISSION DATA SUBMITTED YEAR: **2012**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **YES**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **1.28780** | **1.28780** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS:
*(TONS PER YEAR)*
**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2014**
POLLUTANT NAME: **NOX - NITROGEN DIOXIDE**
EMISSION DATA SUBMITTED YEAR: **2012**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **YES**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **0.50690** | **0.50690** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS:
*(TONS PER YEAR)*
**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2014**
POLLUTANT NAME: **VOC - VOLATILE ORGANIC COMPOUNDS**
EMISSION DATA SUBMITTED YEAR: **2012**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **YES**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **0.25200** | **5.04000** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS:

*(TONS PER YEAR)*

**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2011**
POLLUTANT NAME: **110543 - HEXANE,N-**
EMISSION DATA SUBMITTED YEAR: **2009**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **NO**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **YES**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **0.03034** | **0.52500** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS:
*(TONS PER YEAR)*
**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2011**
POLLUTANT NAME: **71432 - BENZENE**
EMISSION DATA SUBMITTED YEAR: **2009**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **NO**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **YES**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **0.00346** | **0.05999** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS:
*(TONS PER YEAR)*
**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2011**
POLLUTANT NAME: **VOC - VOLATILE ORGANIC COMPOUNDS**
EMISSION DATA SUBMITTED YEAR: **2009**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **YES**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **1.97931** | **34.25001** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS:
*(TONS PER YEAR)*
**0.00000**

**STACK**

EFFECTIVE YEAR OF INVENTORY: **2014**
EMISSION DATA SUBMITTED YEAR: **2012**
EMISSION RELEASE POINT (STACK): **FLASH EMISSIONS CONTROLLED BY FLARE**

| STACK GAS FLOW RATE: *(CUBIC FEET PER MINUTE):* | STACK GAS FLOW RATE (NEI COMPATIBLE): *(CUBIC FEET PER MINUTE):* |
|---|---|
| **5916.00000** | **98.00000** |

| STACK HEIGHT: | STACK DIAMETER: | PLUME HEIGHT: |
|---|---|---|
| **20.00000** | **2.00000** | **0.00000** |

STACK TYPE DESCRIPTION:
**A STACK WITH AN UNOBSTRUCTED OPENING DISCHARGING IN A VERTICAL DIRECTION**

EFFECTIVE YEAR OF INVENTORY: **2011**
EMISSION DATA SUBMITTED YEAR: **2009**
EMISSION RELEASE POINT (STACK): **FLASH EMISSIONS UNCONTROLLED**

| STACK GAS FLOW RATE: *(CUBIC FEET PER MINUTE):* | STACK GAS FLOW RATE (NEI COMPATIBLE): *(CUBIC FEET PER MINUTE):* |
|---|---|
| **9747.00000** | **162.00000** |

| STACK HEIGHT: | STACK DIAMETER: | PLUME HEIGHT: |
|---|---|---|
| **20.00000** | **2.84000** | **0.00000** |

STACK TYPE DESCRIPTION:
**A STACK WITH AN UNOBSTRUCTED OPENING DISCHARGING IN A VERTICAL DIRECTION**

EFFECTIVE YEAR OF INVENTORY: **2011**
EMISSION DATA SUBMITTED YEAR: **2009**
EMISSION RELEASE POINT (STACK): **FLASH EMISSIONS WITH FLARE**

| STACK GAS FLOW RATE: *(CUBIC FEET PER MINUTE):* | STACK GAS FLOW RATE (NEI COMPATIBLE): *(CUBIC FEET PER MINUTE):* |
|---|---|
| **5916.00000** | **98.00000** |

| STACK HEIGHT: | STACK DIAMETER: | PLUME HEIGHT: |
|---|---|---|
| **20.00000** | **2.00000** | **0.00000** |

STACK TYPE DESCRIPTION:
**A STACK WITH AN UNOBSTRUCTED OPENING DISCHARGING IN A VERTICAL DIRECTION**

## STACK POLLUTANT

EFFECTIVE YEAR OF INVENTORY: **2014**
POLLUTANT NAME: **71432 - BENZENE**
EMISSION DATA SUBMITTED YEAR: **2012**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **NO**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **YES**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **0.00200** | **0.04000** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS:
*(TONS PER YEAR)*
**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2014**
POLLUTANT NAME: **CO - CARBON MONOXIDE**
EMISSION DATA SUBMITTED YEAR: **2012**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **YES**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **1.28780** | **1.28780** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)*
**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2014**
POLLUTANT NAME: **NO2 - NITROGEN DIOXIDE**
EMISSION DATA SUBMITTED YEAR: **2012**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **YES**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **0.50690** | **0.50690** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)*
**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2014**
POLLUTANT NAME: **VOC - VOLATILE ORGANIC COMPOUNDS**
EMISSION DATA SUBMITTED YEAR: **2012**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **YES**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**
POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **0.25200** | **5.04000** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)*
**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2011**
POLLUTANT NAME: **110543 - HEXANE,N-**
EMISSION DATA SUBMITTED YEAR: **2009**
POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**
POLLUTANT IS A CRITERIA POLLUTANT: **NO**
POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **YES**

POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **0.00430** | **0.00430** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)*

**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2011**

POLLUTANT NAME: **110543 - HEXANE,N-**

EMISSION DATA SUBMITTED YEAR: **2009**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**

POLLUTANT IS A CRITERIA POLLUTANT: **NO**

POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **YES**

POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **0.02603** | **0.52070** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)*

**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2011**

POLLUTANT NAME: **71432 - BENZENE**

EMISSION DATA SUBMITTED YEAR: **2009**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**

POLLUTANT IS A CRITERIA POLLUTANT: **NO**

POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **YES**

POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **0.00297** | **0.05950** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)*

**0.00000**

EFFECTIVE YEAR OF INVENTORY: **2011**

POLLUTANT NAME: **VOC - VOLATILE ORGANIC COMPOUNDS**

EMISSION DATA SUBMITTED YEAR: **2009**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT UNDER COLORADO SECTION 25-7-109.3 C.R.S: **NO**

POLLUTANT IS A CRITERIA POLLUTANT: **YES**

POLLUTANT IS REPORTABLE AS EPCRA (SARA TITLE III) COMPOUND ONLY: **NO**

POLLUTANT IS A HAZARDOUS AIR POLLUTANT LISTED UNDER THE FEDERAL CAAA SECTION 112: **NO**

POLLUTANT IS A OZONE DEPLETING COMPOUND LISTED UNDER COLORADO AQCC REGULATION 15 SECTION II.11.: **NO**

| ESTIMATED EMISSIONS: *(TONS PER YEAR):* | UNCONTROLLED ESTIMATED EMISSIONS: *(TONS PER YEAR):* | EMISSIONS LIMIT: *(TONS PER YEAR):* |
|---|---|---|
| **1.69846** | **33.96916** | **0.00000** |

ESTIMATED EMISSIONS WITH RULE EFFECTIVENESS: *(TONS PER YEAR)*

**0.00000**

**UNIT COMMENT**

**-NO COMMENTS REPORTED**

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# Leaking Storage Tank Facilities (LST)

**MAP ID# 7** **Distance from Property: 0.46 mi. W**

## FACILITY INFORMATION

UNIQUE ID: **3857LST**
FACILITY ID: **3857**
NAME: **ERIE CAR WASH**
ADDRESS: **235 CHEESMAN**
**ERIE, CO 80516**
SITE NAME: **ERIE CAR WASH**
LOCATION: **235 CHEESMAN, ERIE 80516**

## LEAKING INFORMATION

| EVENT ID: | STATUS: | RELEASE DATE: | ALTERNATE NAME: |
|---|---|---|---|
| **9167** | **CLOSED** | **3/21/2003 10:03** | **ERIE CAR WASH** |
| COSTIS LINK: http://costis.cdle.state.co.us/event.asp?h_id=9167 | | | |
| **4035** | **STATE LEAD** | **10/7/1992** | **ERIE CAR WASH** |
| COSTIS LINK: http://costis.cdle.state.co.us/event.asp?h_id=4035 | | | |

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# *Leaking Storage Tank Facilities (LST)*

**MAP ID# 8** **Distance from Property: 0.51 mi. SW**

**FACILITY INFORMATION**

UNIQUE ID: **15165LST**
FACILITY ID: **15165**
NAME: **US POST OFFICE**
ADDRESS: **150 WELD ST**
**ERIE, CO 80516**
SITE NAME: **US POST OFFICE**
LOCATION: **150 WELD ST, ERIE 80516**

**LEAKING INFORMATION**

| EVENT ID: | STATUS: | RELEASE DATE: | ALTERNATE NAME: |
|---|---|---|---|
| **8163** | **CLOSED** | **4/17/2000** | **US POST OFFICE** |

COSTIS LINK: http://costis.cdle.state.co.us/event.asp?h_id=8163

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# Unlocatable Summary

*This list contains sites that could not be mapped due to limited or incomplete address information.*

| Database Name | Site ID# | Site Name | Address | City/State/Zip/County |
|---|---|---|---|---|
| HISTSWLF | 00070-0002198 | AL CARTON DUMP | UNKNOWN | ERIE 80516 Weld |
| HISTSWLF | 00070-0000396 | COLORADO LANDFILL | NO ADDRESS REPORTED | ERIE 80516 Weld |
| HISTSWLF | 00070-0002200 | HORST/DEAMIN | UNKNOWN | ERIE 80516 Weld |
| HISTSWLF | 00070-0000397 | LANDFILL SYSTEMS, INC. | NO ADDRESS REPORTED | ERIE 80516 Weld |
| HISTSWLF | 00070-0002201 | NEWHAUSER DUMP | UNKNOWN | ERIE 80516 Weld |
| HISTSWLF | 00070-0002197 | OLD ERIE LANDFILL | UNKNOWN | ERIE 80516 Weld |
| LUSTTRUST | 00023-0000048 | ERIE | ERIE | ERIE 80000 |
| LUSTTRUST | 00023-0000265 | ERIE #1 | ERIE #1 | ERIE 80000 |

**DOCKETS** EPA Docket Data

VERSION DATE: 12/22/05

The United States Environmental Protection Agency Docket data lists Civil Case Defendants, filing dates as far back as 1971, laws broken including section, violations that occurred, pollutants involved, penalties assessed and superfund awards by facility and location. Please refer to ICIS database as source of current data.

**EC** Federal Engineering Institutional Control Sites

VERSION DATE: 01/14/15

This database includes site locations where Engineering and/or Institutional Controls have been identified as part of a selected remedy for the site as defined by United States Environmental Protection Agency official remedy decision documents. A site listing does not indicate that the institutional and engineering controls are currently in place nor will be in place once the remedy is complete; it only indicates that the decision to include either of them in the remedy is documented as of the completed date of the document. Institutional controls are actions, such as legal controls, that help minimize the potential for human exposure to contamination by ensuring appropriate land or resource use. Engineering controls include caps, barriers, or other device engineering to prevent access, exposure, or continued migration of contamination.

**LUCIS** Land Use Control Information System

VERSION DATE: 09/01/06

The LUCIS database is maintained by the U.S. Navy and contains information for former Base Realignment and Closure (BRAC) properties across the United States.

**MLTS** Material Licensing Tracking System

VERSION DATE: 04/14/14

MLTS is a list of approximately 8,100 sites which have or use radioactive materials subject to the United States Nuclear Regulatory Commission (NRC) licensing requirements.

**RCRASC** RCRA Sites with Controls

VERSION DATE: 05/19/15

This list of Resource Conservation and Recovery Act sites with institutional controls in place is provided by the U.S. Environmental Protection Agency.

**SFLIENS** CERCLIS Liens

VERSION DATE: 06/08/12

A Federal CERCLA ("Superfund") lien can exist by operation of law at any site or property at which United States

Environmental Protection Agency has spent Superfund monies. These monies are spent to investigate and address releases and threatened releases of contamination. CERCLIS provides information as to the identity of these sites and properties. This database contains those CERCLIS sites where the Lien on Property action is complete.

**TSCA** Toxic Substance Control Act Inventory

VERSION DATE: 12/31/06

The Toxic Substances Control Act (TSCA) was enacted in 1976 to ensure that chemicals manufactured, imported, processed, or distributed in commerce, or used or disposed of in the United States do not pose any unreasonable risks to human health or the environment. TSCA section 8(b) provides the United States Environmental Protection Agency authority to "compile, keep current, and publish a list of each chemical substance that is manufactured or processed in the United States." This TSCA Chemical Substance Inventory contains non-confidential information on the production amount of toxic chemicals from each manufacturer and importer site.

**AIRSAFS** Aerometric Information Retrieval System / Air Facility Subsystem

VERSION DATE: 10/20/14

The United States Environmental Protection Agency (EPA) modified the Aerometric Information Retrieval System (AIRS) to a database that exclusively tracks the compliance of stationary sources of air pollution with EPA regulations: the Air Facility Subsystem (AFS). Since this change in 2001, the management of the AIRS/AFS database was assigned to EPA's Office of Enforcement and Compliance Assurance.

**CDL** Clandestine Drug Laboratory Locations

VERSION DATE: 07/02/15

The U.S. Department of Justice ("the Department") provides this information as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments. The Department does not establish, implement, enforce, or certify compliance with clean-up or remediation standards for contaminated sites; the public should contact a state or local health department or environmental protection agency for that information.

**ERNSCO** Emergency Response Notification System

VERSION DATE: 05/10/15

This National Response Center database contains data on reported releases of oil, chemical, radiological, biological, and/or etiological discharges into the environment anywhere in the United States and its territories. The data comes from spill reports made to the U.S. Environmental Protection Agency, U.S. Coast Guard, the National Response Center and/or the U.S. Department of Transportation.

**HMIRSR08** Hazardous Materials Incident Reporting System

VERSION DATE: 06/21/15

The HMIRS database contains unintentional hazardous materials release information reported to the U.S. Department of Transportation located in EPA Region 8. This region includes the following states: Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming.

**TRI** Toxics Release Inventory

VERSION DATE: 12/31/13

The Toxics Release Inventory, provided by the United States Environmental Protection Agency, includes data on toxic chemical releases and waste management activities from certain industries as well as federal and tribal facilities. This inventory contains information about the types and amounts of toxic chemicals that are released each year to the air, water, and land as well as information on the quantities of toxic chemicals sent to other facilities for further waste management.

**BRS** Biennial Reporting System

VERSION DATE: 12/31/11

The United States Environmental Protection Agency (EPA), in cooperation with the States, biennially collects information regarding the generation, management, and final disposition of hazardous wastes regulated under the Resource Conservation and Recovery Act of 1976 (RCRA), as amended. The Biennial Report captures detailed data on the generation of hazardous waste from large quantity generators and data on waste management practices from treatment, storage and disposal facilities. Currently, the EPA states that data collected between 1991 and 1997 was originally a part of the defunct Biennial Reporting System and is now incorporated into the RCRAInfo data system.

**HISTPST** Historical Gas Stations

VERSION DATE: NR

This historic directory of service stations is provided by the Cities Service Company. The directory includes Cities Service filling stations that were located throughout the United States in 1930.

**NLRRCRAG** No Longer Regulated RCRA Generator Facilities

VERSION DATE: 06/09/15

This database includes RCRA Generator facilities that are no longer regulated by the United States Environmental Protection Agency or do not meet other RCRA reporting requirements. This listing includes facilities that formerly generated hazardous waste.
Large Quantity Generators: Generate 1,000 kg or more of hazardous waste during any calendar month; or Generate more than 1 kg of acutely hazardous waste during any calendar month; or Generate more than 100 kg of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land

or water, or acutely hazardous waste during any calendar month; or Generate 1 kg or less of acutely hazardous waste during any calendar month, and accumulate more than 1kg of acutely hazardous waste at any time; or Generate 100 kg or less of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, of acutely hazardous waste during any calendar month, and accumulated more than 100 kg of that material at any time.
Small Quantity Generators: Generate more than 100 and less than 1000 kilograms of hazardous waste during any calendar month and accumulate less than 6000 kg of hazardous waste at any time; or Generate 100 kg or less of hazardous waste during any calendar month, and accumulate more than 1000 kg of hazardous waste at any time.
Conditionally Exempt Small Quantity Generators: Generate 100 kilograms or less of hazardous waste per calendar month, and accumulate 1000 kg or less of hazardous waste at any time; or Generate one kilogram or less of acutely hazardous waste per calendar month, and accumulate at any time: 1 kg or less of acutely hazardous waste; or 100 kg or less of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, or acutely hazardous waste; or Generate 100 kg or less of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, or acutely hazardous waste during any calendar month, and accumulate at any time: 1 kg or less of acutely hazardous waste; or 100 kg or less of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, of acutely hazardous waste.

**RCRAGR08** Resource Conservation & Recovery Act - Generator Facilities

VERSION DATE: 06/09/15

This database includes sites listed as generators of hazardous waste (large, small, and exempt) in the RCRAInfo system. The United States Environmental Protection Agency defines RCRAInfo as the comprehensive information system which provides access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. RCRAInfo replaces the data recording and reporting abilities of the Resource Conservation and Recovery Information System (RCRIS) and the Biennial Reporting System (BRS). This database includes sites located in EPA Region 8. This region includes the following states: Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming.
Large Quantity Generators: Generate 1,000 kg or more of hazardous waste during any calendar month; or Generate more than 1 kg of acutely hazardous waste during any calendar month; or Generate more than 100 kg of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, or acutely hazardous waste during any calendar month; or Generate 1 kg or less of acutely hazardous waste during any calendar month, and accumulate more than 1kg of acutely hazardous waste at any time; or Generate 100 kg or less of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, of acutely hazardous waste during any calendar month, and accumulated more than 100 kg of that material at any time.
Small Quantity Generators: Generate more than 100 and less than 1000 kilograms of hazardous waste during any calendar month and accumulate less than 6000 kg of hazardous waste at any time; or Generate 100 kg or less of hazardous waste during any calendar month, and accumulate more than 1000 kg of hazardous waste at any time.
Conditionally Exempt Small Quantity Generators: Generate 100 kilograms or less of hazardous waste per calendar month, and accumulate 1000 kg or less of hazardous waste at any time; or Generate one kilogram or less of acutely hazardous waste per calendar month, and accumulate at any time: 1 kg or less of acutely hazardous waste; or 100 kg or less of any residue or contaminated soil, waste or other debris resulting from the

cleanup of a spill, into or on any land or water, or acutely hazardous waste; or Generate 100 kg or less of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, or acutely hazardous waste during any calendar month, and accumulate at any time: 1 kg or less of acutely hazardous waste; or 100 kg or less of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, of acutely hazardous waste.

**RCRANGR08** Resource Conservation & Recovery Act - Non-Generator Facilities

VERSION DATE: 06/09/15

This database identifies RCRAInfo system sites that only handle hazardous waste, such as transporters, without generating any amount hazardous waste. The United States Environmental Protection Agency defines RCRAInfo as the comprehensive information system which provides access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. RCRAInfo replaces the data recording and reporting abilities of the Resource Conservation and Recovery Information System (RCRIS) and the Biennial Reporting System (BRS). This database includes sites located in EPA Region 8. This region includes the following states: Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming.

**BF** Brownfields Management System

VERSION DATE: 07/13/15

Brownfields are real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Cleaning up and reinvesting in these properties takes development pressures off of undeveloped, open land, and both improves and protects the environment. The United States Environmental Protection Agency maintains this database to track activities in the various brown field grant programs including grantee assessment, site cleanup and site redevelopment. This database included tribal brownfield sites.

**CERCLIS** Comprehensive Environmental Response, Compensation & Liability Information System

VERSION DATE: 10/25/13

CERCLIS is the repository for site and non-site specific Superfund information in support of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). This United States Environmental Protection Agency database contains an extract of sites that have been investigated or are in the process of being investigated for potential environmental risk. In 2014, the Superfund Program implemented a new information system, the Superfund Enterprise Management System (SEMS). Efforts to migrate data to SEMS and to enhance data quality control are now in the final stages. The Program will continue to rely on the final CERCLIS data set (dated November 12, 2013, which reflects official end of Fiscal Year 2013 Program progress) for public reporting until a complete and accurate SEMS data set is available.

**NFRAP** No Further Remedial Action Planned Sites

VERSION DATE: 10/25/13

This database includes sites which have been determined by the United States Environmental Protection Agency, following preliminary assessment, to no longer pose a significant risk or require further activity under CERCLA. After initial investigation, no contamination was found, contamination was quickly removed or contamination was not serious enough to require Federal Superfund action or NPL consideration.

**NLRRCRAT** No Longer Regulated RCRA Non-CORRACTS TSD Facilities

VERSION DATE: 06/09/15

This database includes RCRA Non-Corrective Action TSD facilities that are no longer regulated by the United States Environmental Protection Agency or do not meet other RCRA reporting requirements. This listing includes facilities that formerly treated, stored or disposed of hazardous waste.

**ODI** Open Dump Inventory

VERSION DATE: 06/01/85

The open dump inventory was published by the United States Environmental Protection Agency. An “open dump” is defined as a facility or site where solid waste is disposed of which is not a sanitary landfill which meets the criteria promulgated under section 4004 of the Solid Waste Disposal Act (42 U.S.C. 6944) and which is not a facility for disposal of hazardous waste. This inventory has not been updated since June 1985.

**RCRAT** Resource Conservation & Recovery Act - Treatment, Storage & Disposal Facilities

VERSION DATE: 06/09/15

This database includes Non-Corrective Action sites listed as treatment, storage and/or disposal facilities of hazardous waste in the RCRAInfo system. The United States Environmental Protection Agency defines RCRAInfo as the comprehensive information system which provides access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. RCRAInfo replaces the data recording and reporting abilities of the Resource Conservation and Recovery Information System (RCRIS) and the Biennial Reporting System (BRS).

**DNPL** Delisted National Priorities List

VERSION DATE: 07/22/15

This database includes sites from the United States Environmental Protection Agency’s Final National Priorities List (NPL) where remedies have proven to be satisfactory or sites where the original analyses were inaccurate, and the site is no longer appropriate for inclusion on the NPL, and final publication in the Federal Register has occurred.

**DOD** Department of Defense Sites

VERSION DATE: 06/21/10

This information originates from the National Atlas of the United States Federal Lands data, which includes lands

owned or administered by the Federal government. Army DOD, Army Corps of Engineers DOD, Air Force DOD, Navy DOD and Marine DOD areas of 640 acres or more are included.

**FUDS** Formerly Used Defense Sites

VERSION DATE: 06/01/15

The 2012 Formerly Used Defense Sites (FUDS) inventory includes properties previously owned by or leased to the United States and under Secretary of Defense Jurisdiction, as well as Munitions Response Areas (MRAs). The remediation of these properties is the responsibility of the Department of Defense. This data is provided by the U.S. Army Corps of Engineers (USACE), the boundaries/polygon data are based on preliminary findings and not all properties currently have polygon data available. DISCLAIMER: This data represents the results of data collection/processing for a specific USACE activity and is in no way to be considered comprehensive or to be used in any legal or official capacity as presented on this site. While the USACE has made a reasonable effort to insure the accuracy of the maps and associated data, it should be explicitly noted that USACE makes no warranty, representation or guaranty, either expressed or implied, as to the content, sequence, accuracy, timeliness or completeness of any of the data provided herein. For additional information on Formerly Used Defense Sites please contact the USACE Public Affairs Office at (202) 528-4285.

**NLRRCRAC** No Longer Regulated RCRA Corrective Action Facilities

VERSION DATE: 06/09/15

This database includes RCRA Corrective Action facilities that are no longer regulated by the United States Environmental Protection Agency or do not meet other RCRA reporting requirements.

**NPL** National Priorities List

VERSION DATE: 07/22/15

This database includes United States Environmental Protection Agency (EPA) National Priorities List sites that fall under the EPA's Superfund program, established to fund the cleanup of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action.

**PNPL** Proposed National Priorities List

VERSION DATE: 07/22/15

This database contains sites proposed to be included on the National Priorities List (NPL) in the Federal Register. The United States Environmental Protection Agency investigates these sites to determine if they may present long-term threats to public health or the environment.

**RCRAC** Resource Conservation & Recovery Act - Corrective Action Facilities

VERSION DATE: 06/09/15

This database includes all hazardous waste sites with ongoing corrective action activity and where corrective

action is statutorily required to be address but have not had corrective action imposed in the RCRAInfo system. The Corrective Action Program requires owners or operators of RCRA facilities (or treatment, storage, and disposal facilities) to investigate and cleanup contamination in order to protect human health and the environment. The United States Environmental Protection Agency defines RCRAInfo as the comprehensive information system which provides access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. RCRAInfo replaces the data recording and reporting abilities of the Resource Conservation and Recovery Information System (RCRIS) and the Biennial Reporting System (BRS).

**RCRASUBC** Resource Conservation & Recovery Act - Subject to Corrective Action Facilities

VERSION DATE: 06/09/15

This database includes hazardous waste sites which are potentially subject to corrective action regardless of whether they have correction action underway, plus any sites showing a corrective action event of RFI or beyond in the RCRAInfo system. Sites conducting corrective action under analogous state authorities are also included. The United States Environmental Protection Agency defines RCRAInfo as the comprehensive information system which provides access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. RCRAInfo replaces the data recording and reporting abilities of the Resource Conservation and Recovery Information System (RCRIS) and the Biennial Reporting System (BRS).

**RODS** Record of Decision System

VERSION DATE: 07/01/13

These decision documents maintained by the United States Environmental Protection Agency describe the chosen remedy for NPL (Superfund) site remediation. They also include site history, site description, site characteristics, community participation, enforcement activities, past and present activities, contaminated media, the contaminants present, and scope and role of response action.

# Environmental Records Definitions - STATE (CO)

**ASBESTOS** Asbestos Abatement and Demolition Projects

VERSION DATE: 06/25/15

The Colorado Department of Public Health and Environment's Air Pollution Control Division assists schools and businesses to comply with air pollution laws regulating asbestos and asbestos containing materials. The regulation that governs asbestos in Colorado is the Colorado Air Quality Control Commission s Regulation No. 8, Part B, "Emission Standards for Asbestos." Notification is required for all demolitions of all facilities and all asbestos abatement projects that exceed the trigger levels, whatever is the lesser quantity. The notification requirements apply to both friable and non-friable asbestos materials. This database contains those related projects since January 2008.

**COVENANTS** Environmental Real Covenants List

VERSION DATE: 05/08/15

Senate Bill 01-145 gave authority to the Colorado Department of Public Health and Environment to approve requests to restrict the future use of a property using an enforceable agreement called an environmental covenant. These covenants, which are recorded with the deed and run with the land, provide a mechanism to ensure that institutional controls that are part of environmental remediation projects are properly implemented and that engineered structures are protected and maintained, so that implemented remedies continue to be protective of human health and the environment for as long as any residual contamination remains a risk.

**UMTS** Uranium Mill Tailings Sites

VERSION DATE: 08/09/02

There were nine uranium mill tailings sites in Colorado designated for cleanup under the federal Uranium Mill Tailings Radiation Control Act. These nine sites, know commonly as UMTRA sites, were remediated jointly by the State of Colorado and the U.S. Department of Energy during the late 1980's and early 1990's. Mill tailings were removed from 8 of the mill sites and relocated in engineered disposal cells. A disposal cell is designed to encapsulate the material, reduce radon emanation, and prevent the movement of water through the material. At one site, Maybell, CO, the tailings were stabilized in-place at the mill site. After remediation of the tailings was completed, the State and DOE began to investigate the residual impacts to groundwater at the mill sites. The groundwater phase of the UMTRA program is on-going. This database was provided by the Colorado Department of Public Health and Environment.

**APCDP** Air Pollution Control Division Permitted Facilities

VERSION DATE: 04/01/15

The Stationary Sources Program, located within the Air Pollution Control Division of the Colorado Department of Public Health and Environment, evaluates and develops air permits for stationary sources in Colorado. The program inspects sources to determine compliance with air regulations and permit conditions, and maintains a computerized inventory of air pollution emissions throughout the state.

**CDL** Clandestine Drug Laboratory Locations

VERSION DATE: 06/11/15

This list of Methamphetamine lab seizures is provided by multiple sources: the North Metro Task Force, FACTS (Forensic Applications Consulting Technologies, Inc) and the Colorado Springs Police Department. The North Metro Task Force list of Methamphetamine labs were seized between 2001 and 2010. The North Metro area includes the following Cities and Counties of Colorado: Adams County, Broomfield, Brighton, Commerce City, Federal Heights, Northglenn, Thornton, and Westminster. According to Section 2 of Colorado Revised Statutes: "25-18.5-103. Discovery of an illegal drug laboratory - property owner - clean-up - liability. (1) (a) Upon notification from a peace officer that chemicals, equipment, or supplies indicative of an illegal drug laboratory are located on a property, or when an illegal drug laboratory used to manufacture methamphetamine is otherwise discovered and the property owner has received notice, the owner of any contaminated property shall meet the cleanup standards for property established by the board in section 25-18.5-102". The FACTS and Colorado Springs Police Department Methamphetamine labs were seized between 2001 and 2014.

**CLEANERS** Dry Cleaning Facilities

VERSION DATE: 07/02/15

This database contains dry cleaners which have obtained an air permit through the Air Pollution Control Division at the Colorado Department of Public Health and Environment.

**SPILLS** Spills Listing

VERSION DATE: 06/15/15

The Colorado Department of Public Health and Environment's Division of Emergency Preparedness and Response maintains this listing of chemical spills and/or releases.

**AST** Aboveground Storage Tank Facilities

VERSION DATE: 07/20/15

The Oil and Public Safety Division of the Colorado Department of Labor and Employment maintains this list of aboveground storage tank (AST) facilities. This AST database also includes other types of storage tank facilities such as liquefied petroleum gas (LPG), vehicle tank meters (VTM), and compressed natural gas facilities.

**HWSG** Hazardous Waste Sites- Generator

VERSION DATE: 06/30/03

The Resource Conservation and Recovery Act (RCRA) was enacted by congress in 1976, followed by the promulgation of implementing regulations in 1980. In 1984, the State was authorized by EPA to implement the RCRA program in Colorado on their behalf. This facility listing includes RCRA sites listed as generators of hazardous waste (Small Quantity Generators and Large Quantity Generators) and was provided by the Colorado Department of Public Health and Environment.

Small Quantity Generators (SQG) generate, in any calendar month, more than 100 kg (220 lbs.) but less than 1,000 kg (2,200 lbs.) of RCRA hazardous waste; and generate, in any calendar month, or accumulate at any time, no more than 1 kg (2.2 lbs.) of acute hazardous waste and no more than 100 kg (220 lbs.) of material from the cleanup of a spill of acute hazardous waste; and accumulate on-site no more than 6000 kg (13,200 lbs) of hazardous waste at any one time; or, the site is a Small Quantity Generator if the site met all other criteria for a Conditionally Exempt Small Quantity Generator, but accumulated, at any time, more than 1,000 kg (2,200 lbs.) of RCRA hazardous waste.
Large Quantity Generators (LQG) generate, in any calendar month, 1,000 kg (2,200 lbs.) or more of RCRA hazardous waste; or generate, in any calendar month, or accumulated at any time, more than 1 kg (2.2 lbs.) of RCRA acute hazardous waste; or generate, in any calendar month, or accumulated at any time, more than 100 kg (220 lbs.) of spill cleanup material contaminated with RCRA acute hazardous waste.

**UST** Underground Storage Tank Facilities

VERSION DATE: 07/20/15

The Oil and Public Safety Division of the Colorado Department of Labor and Employment maintains this list of underground storage tank facilities.

**HISTSWLF** Historical Solid Waste Landfills

VERSION DATE: NR

This historical solid waste landfills database contains data from the Hazardous Materials Waste Management Division (HMWMD) of the Colorado Department of Public Health and other various state and local agencies. In the early 1980s, the HMWMD conducted a survey of staff members and local agencies to compile this listing of sites that were known or thought to have waste issues. This Solid Waste Historical Data is not considered complete or verifiable and has not been maintained since the late 1980s. The HMWMD is not responsible and shall not be liable to the used for damages of any kind arising out of the use of this data or information.

**HWSTSD** Hazardous Waste Sites- Treatment, Storage & Disposal

VERSION DATE: 06/30/03

The Resource Conservation and Recovery Act (RCRA) was enacted by congress in 1976, followed by the promulgation of implementing regulations in 1980. In 1984, the State was authorized by EPA to implement the RCRA program in Colorado on their behalf. TSD facilities treat, store, dispose, or recycle hazardous waste on site in units and therefore are subject to RCRA permitting requirements. Historic TSDs are facilities that have completed closure and/or post-closure of the RCRA Subtitle C Regulated Unit(s) or the Treatment/Storage/Disposal Unit is no longer regulated. This database was provided by the Colorado Department of Public Health and Environment.

**LST** Leaking Storage Tank Facilities

VERSION DATE: 07/20/15

The Oil and Public Safety Division of the Colorado Department of Labor and Employment maintains this list of

leaking aboveground and underground storage tank facilities.

**LUSTTRUST** Leaking Underground Storage Tanks Trust Fund Sites

VERSION DATE: 01/01/00

Suspected tank leaks have been discovered at the sites included in this database, but the facility responsible for the leak has not been identified. The state's investigtion and search for responsible parties is paid for out of the state's Leaking Underground Storage Tank (LUST) Trust Fund. This database was provided by the Colorado Department of Labor & Employment, Division of Oil and Public Safety, State Fund Section and is no longer updated.

**METHANESITES** Methane Gas Study Sites

VERSION DATE: 01/01/81

This Investigation of Methane Gas Hazards report was prepared by the Denver Office of Emergency Preparedness in 1981. The purpose of this study was to assess the actual and potential generation, migration, explosive and related problems associated with specified landfills, and to identify existing and potential problems, suggested strategies to prevent, abate, and control such problems and recommend investigative and monitoring functions as may be deemed necessary. The Colorado Department of Health selected eight landfills as priorities due to population density and potential hazards to population and property.

**SWF** Solid Waste Facilities

VERSION DATE: 07/01/15

The Colorado Department of Public Health and Environment maintains this database of active solid waste disposal facilities, transfer stations, recyclers, waste tire registrants, and waste grease registrants.

**VCRA** Voluntary Cleanup and Redevelopment Program Sites

VERSION DATE: 08/14/15

This site listing is provided by the Colorado Department of Public Health and Environment (CDPHE) and includes both voluntary cleanup and brownfield properties. The Voluntary Cleanup and Redevelopment program was created in 1994. The objective of the program is to facilitate the redevelopment and transfer of contaminated properties. Properties that sit untouched because of their real or perceived contamination can be rehabilitated using the CDPHE's Brownfields Program in conjunction with the Voluntary Cleanup Program. Cleanup decisions are based on existing standards and the proposed use of the property. The actual cleanup and verification is the owner's responsibility.

**HWSCA** Hazardous Waste Sites- Corrective Action

VERSION DATE: 06/30/03

The Resource Conservation and Recovery Act (RCRA) was enacted by congress in 1976, followed by the

promulgation of implementing regulations in 1980. In 1984, the Hazardous and Solid Waste Amendments (HSWA) were added to RCRA providing for corrective action at facilities subject to RCRA. That same year, the State was authorized by EPA to implement the RCRA program in Colorado on their behalf. Corrective action may be implemented as part of a RCRA Hazardous Waste Permit, an Order, or a Corrective Action Plan pursuant to the Colorado Hazardous Waste Regulations. Corrective action is the process by which regulated facilities investigate and remediate, as necessary, all contamination (soil, ground water, surface water, air) associated with their releases into the environment. Historic Corrective Action Sites are facilities that have completed the RCRA Subtitle C corrective Action process. This database was provided by the Colorado Department of Public Health and Environment.

**SF** Superfund Sites

VERSION DATE: 06/01/03

This listing contains active, deleted and proposed "Superfund" hazardous waste sites, as well as those sites identified through the Natural Resource Damages section of Superfund legislation and one Private Non-Superfund Cleanup site. A site qualifies for the National Priorities List (NPL or Superfund list) when the U.S. Environmental Protection Agency (EPA) determines there is a release or threatened release of hazardous substances that may endanger public health, welfare or the environment. In Colorado, the lead agency for Superfund remediation may be either the EPA or the Colorado Department of Public Health and Environment.

# *Environmental Records Definitions - LOCAL*

| | |
|---|---|
| **WCSWF** | Weld County Solid Waste Facilities |
| VERSION DATE: 01/01/15 | |

This listing of solid waste facilities is provided by the Weld County Public Health Department.

# *Environmental Records Definitions - TRIBAL*

**USTR08** Underground Storage Tanks On Tribal Lands

VERSION DATE: 04/01/15

This database, provided by the United States Environmental Protection Agency (EPA), contains underground storage tanks on Tribal lands located in EPA Region 8. This region includes the following states: Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming.

**LUSTR08** Leaking Underground Storage Tanks On Tribal Lands

VERSION DATE: 04/01/15

This database, provided by the United States Environmental Protection Agency (EPA), contains leaking underground storage tanks on Tribal lands located in EPA Region 8. This region includes the following states: Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming.

**ODINDIAN** Open Dump Inventory on Tribal Lands

VERSION DATE: 11/08/06

This Indian Health Service database contains information about facilities and sites on tribal lands where solid waste is disposed of, which are not sanitary landfills or hazardous waste disposal facilities, and which meet the criteria promulgated under section 4004 of the Solid Waste Disposal Act (42 U.S.C. 6944).

**INDIANRES** Indian Reservations

VERSION DATE: 01/01/00

The Department of Interior and Bureau of Indian Affairs maintains this database that includes American Indian Reservations, off-reservation trust lands, public domain allotments, Alaska Native Regional Corporations and Recognized State Reservations.

# APPENDIX D
# RESUMES

# Resume

## GRANT EMERY
## Environmental Staff Scientist

### EDUCATION

B.S. Geology
Minor in Biology
Mansfield State University of Pennsylvania, 1984

Post Graduate Studies
Various Ecology and Environmental Science courses, Colorado School of Mines and University of Colorado in Denver

### PROFESSIONAL SUMMARY

Mr. Grant Emery joined CTL|Thompson, Inc in 2008 as an Environmental Staff Scientist. Prior to joining our firm, Mr. Emery had eighteen years of Land Development, Biological Evaluations, and Erosion/Sediment Control experience.

Mr. Emery has previous experience conducting Endangered Species Surveys and Wetland Delineations as a self-employed consultant. Mr. Emery performed field surveys, plant sampling and identification, report writing and submittal to the Corps of Engineers for 404 permits.

Mr. Emery currently provides environmental consulting and assistance on different projects throughout the company, including biological evaluations, stormwater management plans and observations, and Phase I and II ESAs for various residential and commercial projects throughout the Front Range.

### PROJECT EXPERIENCE

**Community Development Project Manager, Village Homes of Colorado**
Managed all aspects of assigned development projects from due diligence through construction and local government approval/acceptance. Developed plans, permitted and insured regulatory compliance for State stormwater, endangered species, local erosion control and Federal 404 permits.

Preble's mouse and burrowing owl were evaluated at the main development project – "Idyllwilde" – later named "Community of the Year" in 2005 and 2006. Mr. Emery worked with the consultant and USFWS to demonstrate that the development was not connected to mouse habitat, and that the burrowing owl was unlikely to be found on the project. Also managed environmental compliance for Reata North, Granby Ranch, and Belle Creek projects.

**Project Manager and Erosion Control Inspector, Douglas County Public Works, Colorado**
Responsible for detail review, comment and acceptance of development proposals. Inspected and administrated contracts for routine maintenance of district drainageways.

**Urban Drainage and Flood Control District**
Researched hydrology and assisted in the design of urban drainage systems and wetlands. Evaluated maintenance needs for delineated wetlands, inspected dams and detention facilities. Evaluated, studied and certified proposed projects for presence of the Ute ladies'-tresses orchid.

**Standard Pacific Homes, various sites, Colorado**
Storm water inspection and consultation.

**Castle Keep Development, Castle Rock, Colorado**
Performed Phase I ESA on land that a nearby historic landfill has encroached upon.

# Resume

## MATTHEW L. WARDLOW, P.E.
## Environmental Division Manager

### EDUCATION

B.S. Engineering and Policy
Washington University, St. Louis, MO, 1993

### TRAINING & CERTIFICATIONS

40 Hour OSHA Training

Confined Space Training

Mold Remediation Technician Training

Principals of Forced Air Remediation

Asbestos Inspector #775 Management Planner

Air Monitoring Specialist

### PROFESSIONAL REGISTRATION

Registered Professional Engineer, Colorado No. 36223

### PROFESSIONAL SOCIETIES

American Society of Civil Engineers

American Society of Foundation Engineers

Colorado Hazardous Waste Management Society

### PROFESSIONAL SUMMARY

Mr. Wardlow joined CTL|Thompson, Inc. in 2004, having ten years of previous experience providing environmental consulting throughout Colorado. He currently serves as the Division Manager for CTL|Thompson's Denver-based Environmental Consulting Division, which includes staff supervision, project management, and business marketing. Mr. Wardlow has a variety of technical expertise in Phase I and II Environmental Site Assessments, underground storage tank removals, site characterizations, CDPHE Voluntary Cleanup applications, mold and moisture evaluations, and asbestos consulting services. Mr. Wardlow reviews and stamps Phase I and II studies that CTL|Thompson publishes, making sure that the latest regulations and standards are followed. He has developed a reputation as a consistent and reliable consultant for his clients, which include builders, lenders, attorneys, and government representatives. He encompasses a variety of project experience including transportation facilities, municipal buildings, residential developments, historical sites, medical facilities, and wastewater treatment plants.

### PROJECT EXPERIENCE

Rose Medical Center, Aurora, Colorado -

Served as Project Manager for removal of this backup generator tank. Mr. Wardlow was able to negotiate closure of the site even though residual diesel and PAH contamination remained. This was accomplished by demonstrating the lack of impact to ground water, the inapplicability and uncertainty of certain soil standards, the lack of impact on proposed use, and by submitting a materials management and health and safety plan for proposed construction.

Aurora Academy Charter School, Aurora, Colorado -

Served as Project Manager for this voluntary study arising out of a concern of a TCE plume from the nearby Lowry site. Ground water sampling and characterization followed by soil vapor sampling indicated that the impact to a proposed gymnasium addition from solvent vapors was negligible. Served as head liaison to CDPHE personnel, detailing the site activities in a face-to-face meeting. CDPHE personnel issued a No Further Action letter to the school within one week of the meeting.

Roaring Fork Transportation Authority, Aspen, Colorado -

Served as Project Engineer for Roaring Fork Transportation Authority during the Environmental Consultation phase of the project. This project involved designing a treatment process for wash down waters and other waste streams. This will enable the client to abandon the septic field properly and switch its service over to Aspen Wastewater.

Troxel Residential Property, Gardner, Colorado -

As Project Manager, Mr. Wardlow was able to coordinate a contractor and obtain an UST Closure permit on an expedited basis. Extensive soil removal was needed at this UST installation in Carbondale, Colorado. Diesel-contaminated soils were segregated and characterized properly. The client was able to obtain tank closure on a rapid turnaround basis.

3960 High Street, Denver, Colorado -

Currently serving as Project Manager for a Phase I ESA, Phase II ESA and an UST removal. Phase II ESA was performed out of concern of prolonged industrial use on site and surrounding area. CTL discovered Carbon Tetrachloride and Chloroform above ground water standards, but in keeping up with the latest regulatory revision of March 2005 and by staying in contact with regulators, CTL was able to demonstrate that the more stringent standard of Carbon Tet is inapplicable, and that Chloroform is ubiquitous in lab results. Client successfully sold this industrial property.

Governor's Mansion, Denver, Colorado -

Project Manager for removal of a 1,000-gallon gasoline tank, and a second, 500-gallon waste oil tank that was discovered. Closure was obtained.

3500 South Clarkson, Denver, Colorado -

Project Manager for a soil and ground water study. This involved concerns by Swedish Hospital of a historical gas station at the specific site. Temporary monitoring wells were installed around the site of the project and the ground water was tested. The ground water was discovered to be un-impacted and the client purchased the site successfully.

Highlands Ranch and Grant Ranch Subdivisions, Denver Area, Colorado -

Project Manager and reviewer for over 200 mold and moisture intrusion evaluations for various builders. Projects have included an initial evaluation with air sampling, a perimeter drain observation, a post-mitigation observation, and followup sampling and placement of a temperature and humidity datalogger in the crawl space. Other evaluations throughout a given house have included roof leaks, elevated humidity in the attic, foul odors from sump pits and other locations, window flashing, and drainage issues.

Hotel Building, Aspen, Colorado -

Project Engineer for mold and moisture consultation. This consultation was performed in association with contractor remodeling of the building. CTL|T assisted in evaluating moisture intrusion pathways such as roof flashing. CTL|T gathered engineering information and air sampling data into a report detailing the recommended remediation protocols. CTL|T performed a follow-up evaluation and sampling after remediation, documenting that remediation was performed to industry standards. The contractor was able to proceed with the remodel, putting previously abandoned hotel space into profitable use.

Beacon Point, Aurora, Colorado -

Project Engineer and Reviewer for storm water consultation for a residential developer. Reviewed the Storm Water Management Plan (SWMP) after development and before initial application to the state. Reviews the SWMP to reflect changing site conditions. Also provides general consultation to the client during construction, offering erosion and sediment control alternatives.

Denver Federal Center, Colorado –

Project Engineer for development of the SWMP for the general contractor. Project involves reconstruction of roads, parking lots, and utilities. This federal project is administered directly by the EPA. Mr. Wardlow provided senior review and oversight for development of the SWMP

CTL | THOMPSON INCORPORATED

# WETLAND, THREATENED AND ENDANGERED SPECIES OBSERVATION AND CULTURAL RESOURCES REVIEW
# COLLIERS HILL
# ERIE, COLORADO

**Prepared for:**

**DAYBREAK RECOVERY ACQUISITION, LLC**
**c/o RainTree Investment Corporation**
**7200 S. Alton Way, Suite C-400**
**Centennial, Colorado 80112**

**Attention: Jerry B. Richmond III**

**Project No. DN45212.002-240**

**September 25, 2015**

1971 West 12th Avenue | Denver, Colorado 80204 | Phone: 303-825-0777 | Fax: 303-825-4252

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## INTRODUCTION

Daybreak Recovery Acquisition, LLC contracted CTL | Thompson, Inc. (CTL) to perform a Wetland, Threatened and Endangered Species Observation and Cultural Resources Review of select portions of Colliers Hill,  the Site. The "Site" consists of 822 proposed lots, located northeast of the intersection of Erie Parkway and Weld County Road 3, in Erie, Colorado. The Site is generally located in the Northwest ¼ of Section 17 and the northeast ¼ of Section 18, Township 1 North, Range 68 West of the 6th Principal Meridian, in Weld County, Colorado. The Site location and plan are shown on Figure 1 (Area Map) and Appendix B (Aerial Photo).  We evaluated the Site for:

- The presence of jurisdictional wetlands;
- The presence of threatened or endangered species on the Site;
- The presence of endangered or threatened species critical habitat on the Site; and,
- The presence of registered archeological and/or historic sites on the subject Site.

On September 17, 2015 our Mr. Grant Emery conducted a Site visit. During the visit, Mr. Emery collected specific information about the Site's physical features, vegetation, hydrology, soil conditions, and surrounding environmental conditions. This information is required to evaluate the presence of threatened and/or endangered species, and to identify critical habitats.  CTL searched publicly available literature on federal, state and local websites, and contacted local historical officials regarding the Site, which are outlined in the References section of this letter report.

## PROPOSED PROJECT IMPACT AREA PREVIOUS USE

The Site is generally located northeast of the intersection of Erie Parkway and Weld County Road 3, in Erie, Weld County, Colorado.  The Site and much of the surrounding area

appears to have remained in agricultural use since at least 1937. The only known uses of the Site are for agricultural purposes, oil and gas development, and underground mining.

## EXISTING CONDITIONS

The Site is vacant and was generally accessed from an oil well access road. The Site is undeveloped land vegetated with grasses and weeds and crop remnants. There is little vegetative cover on small portions of the Site, and complete coverage on the majority of the Site.

## WATERS OF THE U.S.

The Clean Water Act was passed by the U.S. Congress in 1971 to protect the physical, biological, and chemical quality of "Waters of the U.S." The Corps Regulatory Program administers and enforces Section 404 of the Clean Water Act. Under Section 404, a Corps permit is required for the discharge of dredged or fill material into wetlands and Waters of the U.S. The Corps defines Waters of the U.S. as all navigable waters and their tributaries, all interstate waters and their tributaries, all wetlands adjacent to these waters, and all impoundments of these waters.

The Corps jurisdiction of the "Waters of the U.S." changed in 2006 as a result of the U.S. Supreme Court's Decision in Rapanos v. United States & Carabell v. United States. The June 5, 2007 Agency Guidance document indicates the Corps will continue to assert jurisdiction over all waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide. The agency will continue to assert jurisdiction over wetlands "adjacent" to traditional navigable waters.

The Corps will assert jurisdiction over non-navigable tributaries of traditional navigable waters that are relatively permanent where the tributaries typically flow year-round or have continuous flow at least seasonally (e.g. typically three months). The Corps will assert

jurisdiction over those adjacent wetlands that have continuous surface connection to such tributaries (e.g. they are not separated by uplands, a berm, dike, or similar feature).

The Corps will assert jurisdiction over non-navigable water, defined as not relatively permanent tributaries and their adjacent wetlands, as long as such tributaries and wetlands have a significant nexus to traditional navigable waters. Significant nexus includes consideration of hydraulic factors including the following:

- Volume, duration, and frequency of flow, including consideration of certain physical characteristics of the tributary;
- Proximity to the traditional navigable water;
- Size of the watershed;
- Average annual rainfall; and,
- Average annual winter snow pack.

Finally, the Corps has indicated the following geographic features generally are not jurisdictional waters:

- Swales or erosion control features (e.g. gullies, small washes characterized by low volume, infrequent, or short duration flow); and,
- Ditches (including roadside ditches) excavated wholly in and draining only uplands and that do not carry a relative permanent flow of water.

During our Site observation on September 17, 2015 we did not see features that would be considered Waters of the U.S.

## WETLAND DETERMINATION

Wetlands are defined by the U.S. Army Corps of Engineers (Corps) as those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegeta-

tion typically adapted for life in saturated soil conditions. To meet the classification, a wetland must show evidence of a minimum of one positive wetland indicator from each parameter of hydrology, soil, and vegetation. Each must be found in order to make a positive wetland determination. Wetlands that are delineated per the Corps' classifications are regulated, and proper care must be taken to protect them during development. These delineated wetlands must remain undisturbed, or a new wetland can be developed in its place, either on or off the Site. Guidelines for the mitigation of new wetlands are outlined in the U.S. Army Corps of Engineers Standard Operating Procedures for the Regulatory Program.

We found no evidence of wetlands vegetation, hydrology or soils during our Site visit.

## THREATENED, ENDANGERED AND CANDIDATE SPECIES

The project area was assessed for potential habitat for threatened, endangered, and candidate species under the Endangered Species Act (ESA). Federally threatened and endangered species are protected under the Endangered Species Act of 1973 as amended (16 U.S.C. 1531 et seq.). Significant adverse effects to a federally listed species or its habitat require consultation with the U.S. Fish and Wildlife (USFWS) under Section 7 or 10 of the Endangered Species Act (ESA). The service lists 9 threatened, endangered, proposed and candidate species with potential habitat in Weld County (USFWS 2010). Table I lists common and scientific names and the status of the species.

TABLE I
Federal Threatened, Endangered, Proposed and Candidate Species
Weld County

| Common Name | Scientific Name | Status |
|---|---|---|
| Black-footed Ferret | Mestela nigripes | Endangered |
| Mexican Spotted Owl | Strix occidentalis lucida | Threatened |
| Interior Least Tern | Sterna antillarum athalassos | Endangered |
| Piping Plover | Charadrius melodus | Threatened |
| Whooping Crane | Grus americanus | Endangered |
| Pallid Sturgeon | Scaphithynchus albus | Endangered |
| Preble's Jumping Mouse | Zapus hudsonius preblei | Threatened |
| Ute Ladies'-tresses orchid | Spiranthes diluvialis | Threatened |
| Colorado Butterfly Plant | Gaura neomexicana spp. coloraden- | Threatened |

The Black-footed Ferret is usually found on shortgrass and midgrass prairies in close association with prairie dogs. Recent data suggest that a ferret needs a prairie dog colony of at least 31.3 acres to exist for a year and at least 125 acres to raise a litter. We did not observe suitable habitat for this species on site, therefore we do not believe development of the site will adversely affect this species.

The Mexican Spotted Owl is a large bird that nests and roosts on cliff ledges or in caves in canyons with dense stands of ponderosa pine or pinyon–juniper, in forests with high canopy cover and open understory. We do not believe the site represents potential habitat for the Mexican Spotted Owl based on the lack of habitat typically considered suitable for the owl. We do not believe the development of the site will have an adverse affect on this species.

The Interior Least Tern, Piping Plover, and the Whooping Crane are species that are affected by impacts to waterways and lakes. These species of bird typically reside along sandy shorelines of creeks, lakes, and rivers. We do not believe the development of the site will adversely affect these species.

The Pallid Sturgeon is a bottom dweller, found in areas of strong current and firm sand bottom in the main channel of large turbid rivers, and is affected by water depletion from upstream sources. The Pallid Sturgeon is not present in Colorado. We do not believe the development of the site will adversely affect this species.

The Preble's Jumping Mouse is typically located in low undergrowth consisting of grasses and forbs, in open wet meadows, riparian corridors near forests, or where tall shrubs and low trees provide adequate cover. The site was assessed for potential Preble's mouse habitat. The current site conditions on the site do not present suitable habitat for the Preble's mouse, and therefore we do not believe development of the site will adversely affect this species.

Ute ladies'-tresses orchid typically occurs at elevations below 6,500 feet in moist to wet alluvial meadows, floodplains of perennial streams, and around springs and lakes. Occurrences of Ute ladies'-tresses have been documented in Colorado, Wyoming, Idaho, Nevada and Utah; currently there are only sixteen reported populations in Colorado with most populations occurring along the Front Range. The site was assessed for potential Ute ladies'-tresses habitat. It is our opinion that the site does not present habitat suitable for the Ute ladies'-tresses, and therefore we do not believe development of the site will adversely affect this species.

The Colorado butterfly plant is listed as a threatened species under the ESA. The Colorado butterfly plant is a short-lived perennial herb found within a small area of south-eastern Wyoming, western Nebraska, and Platte, Laramie and Weld Counties in Colorado. The Colorado butterfly plant is found in active floodplains along perennial streams and occurs where vegetation is relatively open. The site was assessed for potential Colorado butterfly plant habitat. It is our opinion that the site does not present habitat suitable for the Colorado butterfly plant, and therefore we do not believe development of the site will adversely affect this species.

## BALD AND GOLDEN EAGLE PROTECTION ACT OF 1940

Bald and Golden Eagles are protected by the MBTA (discussed in the next section) and the Bald and Golden Eagle Protection Act of 1940, as amended November 1978. These species nest in a variety of habitats, including on cliffs and in large trees. The Act allows further protection of eagles by prohibiting anyone, without a permit issued by the Secretary of the Interior, from "taking" eagles, including their parts, eggs or nests. Like MBTA, "take" means to pursue, hunt, wound, kill, trap, capture, collect; however it also includes "disturb," which means to agitate or bother a Bald or Golden eagle to the level that causes or is likely to cause injury, decrease in productivity, or nest abandonment. We did not observe a nest on site, and we do not believe development of the site will adversely affect these species.

## MIGRATORY BIRDS TREATY ACT

Migratory birds, as well as their eggs and nests, are protected under the Migratory Birds Treaty Act (MBTA). The MBTA does not contain any prohibition that applies to the destruction of a bird nest alone (without bird or eggs), provided that no "take" (of bird or eggs) occurs during the destruction. The regulatory definition of "take" means to pursue, hunt, shoot, kill, trap, capture or collect, or attempt to pursue, hunt, wound, kill, trap, capture, or collect. While destruction of a nest by itself is not prohibited under MBTA, nest destruction that results in the unpermitted take of migratory birds or their eggs is illegal and fully prosecutable under the MBTA. One method to avoid a violation of the MBTA is to remove vegetation and nests outside the active breeding season, which typically falls between March and August, depending on species.

The site was assessed for potential migratory bird nesting habitat. The grasses and weeds may present nesting habitat for ground-nesting migratory birds. For a greater level of assurance it is recommended that destruction of grassland vegetation be removed outside of the breeding season (March to August).

## COLORADO THREATENED, ENDANGERED, AND SPECIAL CONCERN SPECIES

The Colorado Department of Natural Resources (CDNR) has established a list of species that are found within Colorado which the CDNR has identified as potentially state threatened, endangered or state species of concern. For these identified species, the CDNR has established specific requirements pertaining to impacts to their habitat. The list of species associated with the state threatened, and endangered list includes a number of species with very limited distribution and habitat including high alpine, lakes, stream and desert locations. Do to this site location, we do not believe this project will have a direct effect or will impact their habitat. Consideration is required for two species on the list, the Burrowing Owl, which is listed as threatened and the Plains Sharp-tailed Grouse which is listed as endangered. We do not believe this site provides habitat for these species and do not believe the project will have a direct effect or will impact habitat of any state threatened or endangered species.

## HISTORIC AND ARCHEOLOGICAL FINDINGS

CTL contacted the Colorado Historical Society, Office of Archaeology and Historic Preservation, and requested a search of the Colorado Inventory of Cultural Resources. We did not receive a response to our request prior to issuing this report. We have reviewed previously issued record search responses from November of 2012, February of 2013 and from our most recent request received July 2, 2014. The reports found one survey that identified 5 sites in Section 18. The revealed sites are not eligible for inclusion in the National Register of Historic Places and do not appear to be on the Site.

## CONCLUSION AND RECOMMENDATION

Based on the direct field observations and our limited literature research, it is our professional opinion that wetlands and Waters of the U.S. are not present on the site.

We did not observe the obvious presence of federally listed endangered or threatened plant or animal species on the site. We did not observe obvious critical habitat for listed endangered or threatened plant or animal species.

We did not observe obvious evidence of ground nesting birds during our site visit, but for a greater level of assurance, it is recommended that destruction of vegetation should occur outside of the breeding season (March to August).

We did not observe obvious evidence of state listed species on the site. We did not observe obvious evidence of habitat for listed state spices.

**LIMITATIONS**

This assessment only applies to the site in its current state, in areas that were easily observed. This assessment only applies to areas of observation. We believe that CTL performed services in a professional manner, consistent with industry standards and practices in the locality of the project at the time the services were performed. No warranty, express or implied, is made.

CTL | THOMPSON, INC.

Grant R. Emery
Environmental Scientist

Reviewed by:

Matthew L. Wardlow, P.E.
Environmental Department Manager

GRE:MLW/ot

Via e-mail: jrichmond@raintree.us.com

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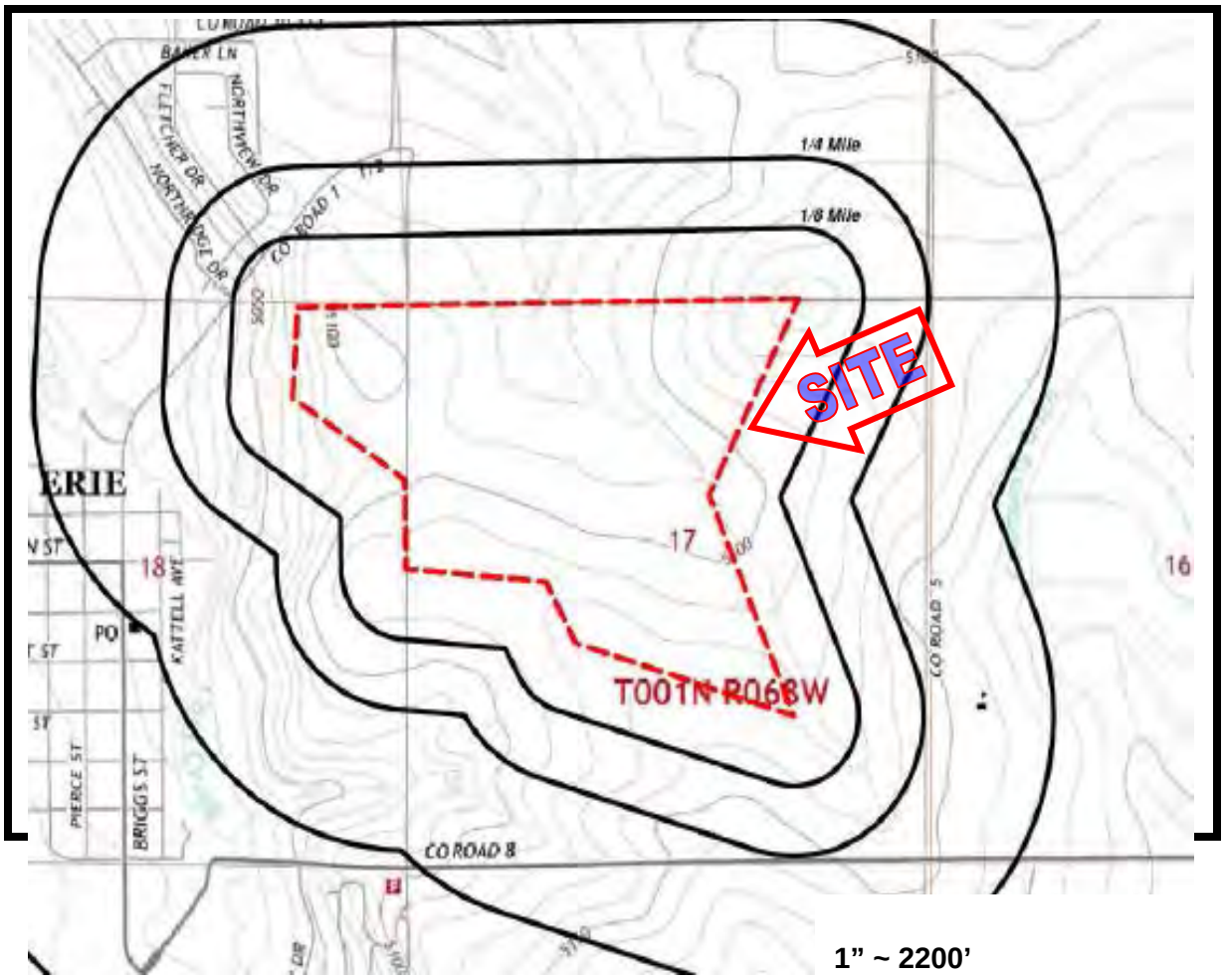
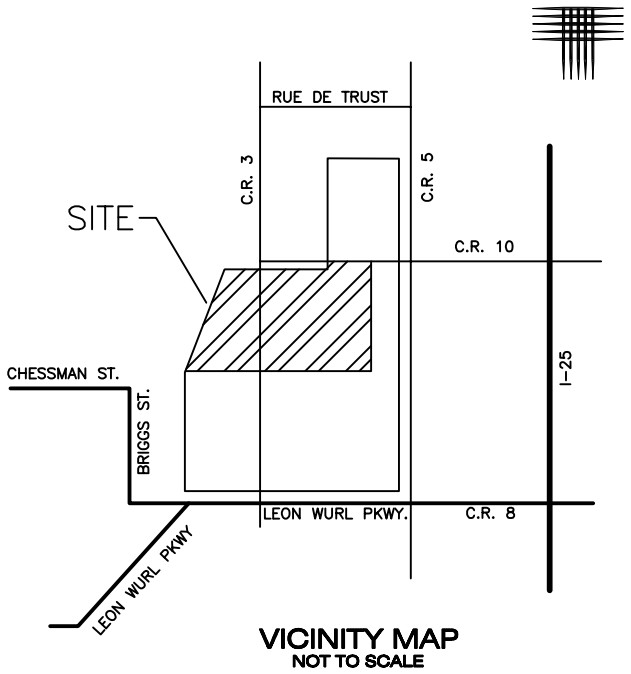



**Source:**
**U.S.G.S. Topographic Map**
**Erie Quadrangle, Colorado**
**2013**




VICINITY MAP
NOT TO SCALE

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**DAYBREAK RECOVERY ACQUISITION, LLC**
**COLLIERS HILL SUBDIVISION**
**Project No. DN45,212.002-240**

# Site Plan

Fig. 2

# APPENDIX A
# SITE PHOTOGRAPHS

**Description:** General Site conditions
**Direction:** Southwest

**Description:** On-Site gas well
**Direction:** West

**Description:** Above ground Storage tank
**Direction:** East

**Description:** General Site Conditions
**Direction:** West

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# SITE PHOTOGRAPHS

**Colliers Hill**
**September 17, 2015**

CTL Project No. DN 45212.002-240

Description: On-Site Oil and Gas equipment
Direction: Northwest

Description: General Conditions Northwest portion of Site
Direction: West

Description: Stubble remains from crop production
Direction: South

Description: Southern boundary near current homebuilding
Direction: Northeast

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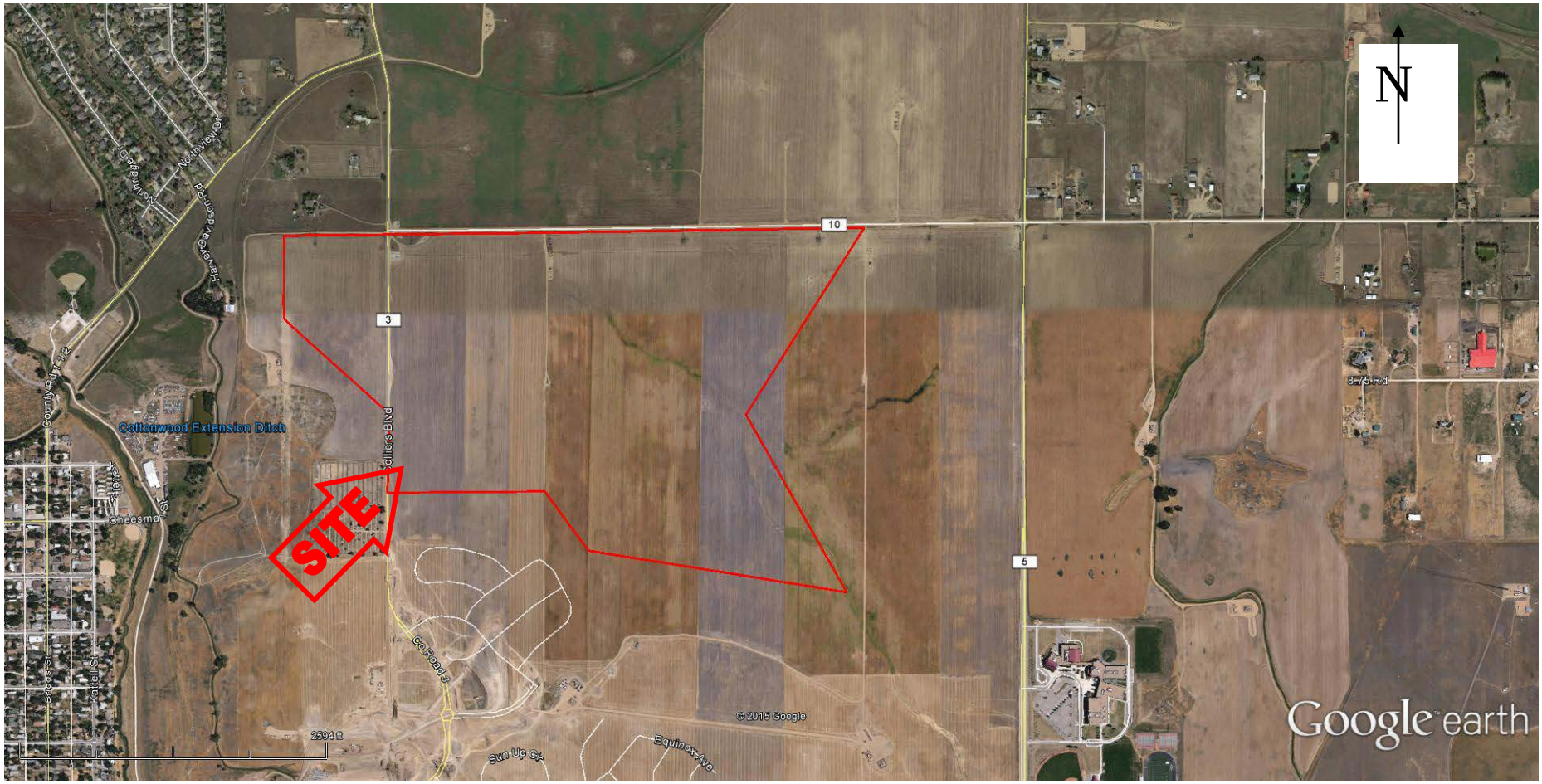
# SITE PHOTOGRAPHS

**Colliers Hill**
**September 17, 2015**

CTL Project No. DN 45212.002-240

# APPENDIX B
# AERIAL PHOTOGRAPH




**CTL | T PROJECT NO. DN 45212.002-240**

**2014 AERIAL PHOTOGRAPH**
**Approximate Site Location**

**Abstract of Surface Use Agreement**

DayBreak Community, Weld County, Colorado
N/2 of Section 17, T1N, R68W

**Effective Date:** October 10, 2011

**Recording Date/Info:** November 14, 2011, Reception No. 3805168, Weld County, Colorado

**Property:** N/2 of Section 17, T1N, R68W

**Parties:**

| | |
|---|---|
| Surface Owner: | Tallgrass Investors, LLC |
| Oil and Gas Mineral Interest Owners/Lessors: | Anadarko E&P Company LP, fka Union Pacific Resources Company, and<br>Anadarko Land Corp., fka Union Pacific Land Resources Corporation (together, the **Anadarko Entities**) |
| Pipeline/Gas Gathering Company: | Kerr-McGee Gathering LLC (or **KMGG**) |
| Oil and Gas Mineral Interest Lessee: | Noble Energy, Inc. (**Noble**) |

**SUA Supplemented by**: Letter Agreement dated October 10, 2011, among Surface Owner and Oil Companies

**Abbreviations and Notes:**

All number references in parentheses identify the sections of the Surface Use Agreement (**SUA**) under discussion. Consistent with the SUA, the abstract defines the Anadarko Entities and Noble, collectively, as the **Oil Companies**; and the Colorado Oil and Gas Conservation Commission as the **COGCC**.

**SUA Summary:**

I. **O&G Activity Areas**

The SUA identifies various areas of the Property according to the types of O&G activity allowed in the particular areas.

a. **Oil and Gas Operations Areas.**

i. O&G Companies' Permitted Uses/Restrictions.

1. O&G Wells: The Oil and Gas Operations Areas define the locations of certain Existing Wells (listed in subpart ii of this subpart I.a below) and any future O&G wells that may be developed on the Property. (1.a ; 1.b.(i); 1.f)

2. Exclusive Use: The Oil and Gas Operations Areas are designated for the exclusive use of the Oil Companies. (1.a and 1.f)

3. Permitted Uses: The location of Existing Wells and future wells and the conduct of oil and gas drilling, exploration, completion, recompletion, work-overs, fractures, refractures, plugging and abandonment activities; production and maintenance operations; the location, operation, maintenance and repair of associated oil field exploration and production equipment and facilities, including flowlines, pipelines and meters; and tanks, separators, dehydrators and compressors as necessary or convenient for the operation of (i) Existing Wells and future wells located within the Oil and Gas Operations Area and (ii) Production Facility Locations. (1.a, 1.f and 1.g)

ii. Site Locations and Sizes. The SUA describes **four** Oil and Gas Operations Areas, all shown on **Exhibit 2**, a copy of which is attached to this summary.

1. **Center of the NE/4**, which is the site of the Existing Well operated by Noble and called "East Erie #1-17," sized as shown on **Exhibit 2**. This Oil and Gas Operations Area includes (a) an "Oil and Gas Well Area," marking the site of the Existing Well and any future well, and (b) an "Oil and Gas Permanent Facilities Area," marking the location for permanent production facilities. (Recital F; 1.a; 1.b.(ii))

2. **Center of the NW/4**, which is the site of the Existing Well operated by Noble and called "East Erie 2-17 #1," sized as shown on **Exhibit 2**. (Recital F; 1.a)

3. **Center of the NW/4 NE/4**, which is the site of the Existing Well operated by Noble and called "Tallgrass 31-17" encompassing a circle with a radius of 200 feet. *Noble agreed that it will not drill new wells or locate new additional permanent production facilities within this Oil and Gas Operations Area.* In addition, at the written request of Surface Owner, the Oil Companies agree to negotiate in good faith regarding the plugging and abandonment of the Tallgrass 31-17 Well, provided that Noble determines in its sole discretion, and in consultation with the Anadarko Entities, the terms under

which it will agree to plug and abandon the Tallgrass 31-17 Well. (Recital F, 1.a, and 1.d; Supplemental Letter Agreement dated October 10, 2011)

4. **"Northeast Location," along east section line of the NE/4**, measuring 660 by 660 feet. This particular Oil and Gas Operations Area includes (a) an **Oil and Gas Permanent Facilities Area** for wells and equipment and (b) a **Temporary Drilling Area** (depicted on **Exhibit 2**) for operations related to the preparation, drilling and completion of horizontal wells and for the temporary location of production facilities for horizontal wells. (Recital F; 1.b.(ii) and (iii))

iii. Surface Owner's Restrictions and Covenants Regarding Oil and Gas Operations Areas.

1. Prohibited: Surface Owner may not plat lot lines for surface development, or construct or install any permanent or temporary building, structure or other improvement within or under the Oil and Gas Operations Areas.

2. Permitted: Surface Owner may install berms, screening, shrubs, perimeter fencing and irrigation systems adjacent to (but not within) the perimeter of the Oil and Gas Operations Areas, provided that (a) in the reasonable opinion of the Oil Company, the improvements do not impede present or future O&G operations, and (b) the Oil Companies aren't liable for damage to such installations because of the O&G operations on the Property.

3. No Public Access: Surface Owner is to cooperate with the Oil Companies to restrict public access during O&G operations in an Oil and Gas Operations Area. (1.e)

**b. Temporary Drilling Area.**

i. Location: Within the Oil and Gas Operations Area called the "Northeast Location."

ii. Use: No wells or permanent production facilities are allowed. The SUA permits only temporary uses relating to the drilling and completion of horizontal wells and the temporary location of production facilities.

iii. Expiration: The Oil Companies' right to use the Temporary Drilling Area expires on the *later* of (a) October 10, 2021, or (b) the commencement of construction on a building within a platted lot within the Northeast Location (NE/4 of Section 17). If the construction commencement milestone in clause (b) is the later date, Surface Owner must give the Oil Companies 90 days' advance written notice that construction will begin, and the Oil Companies shall move any production facilities located within the

Temporary Drilling Area within 60 days after that notice. (1.b.(iii) and 1.e(ii))

iv. Surface Owner's Use and Development: Surface Owner may plat the surface of the Temporary Drilling Area. However, until the expiration of the Oil Companies' right to use the Temporary Drilling Area (as explained in paragraph iii immediately above), Surface Owner may not construct or install permanent or temporary buildings or other improvements, or berms, screening, shrubs, perimeter fencing or irrigation systems within the Temporary Drilling Area.

c. **Production Facility Locations** (1.c and 1.g).

i. O&G Companies' Permitted Uses: For the construction, operation, location, maintenance and repair of drilling and production facilities and equipment, including tanks, separators, dehydrators, compressors, pipelines, flowlines and meters and other associated oil field equipment necessary or convenient for the operation and production of Existing Wells and future wells. (This use is also permitted in the four Oil and Gas Operations Areas described above.)

ii. Locations: The SUA describes two separate Production Facility Locations by reference to **Exhibit 2**. Each location consists of a circle with a radius of 200 feet.

iii. O&G Operator's Development of Production Facility Locations.

1. Existing Facilities: Noble may replace and maintain existing facilities in a Production Facility Location.

2. New Facilities: In developing any new wells in any location *other than* the Northeast Location, Noble may install new facilities in a Production Facility Location.

*3.* Restrictions on Noble's Development of Production Facility Locations at Requirement and Cost of Surface Owner:

*a.* New Facilities. Surface Owner may require that new production facilities be installed within an Oil and Gas Operations Area, as opposed to a Production Facility Location, *only if Surface Owner undertakes the following obligations:*

*i. Surface Owner pays Noble and/or KMGG, as the case may be, all costs associated with the installation of the facilities in the Oil and Gas Operations Area that Noble or KMGG would not*

*have incurred had the facilities been installed in a Production Facility Location (including, without limitation, costs for gathering lines, meter stations and hook-up fees); and*

ii. *Surface Owner grants KMGG a pipeline right-of-way at the location depicted* on **Exhibit 2** and in the form of **Exhibit 3** to the SUA.

b. Relocating Facilities. Surface Owner may require that facilities within a Production Facility Location be relocated to any Oil and Gas Operations Area (selected in Noble's discretion) following 60 days' advance notice to Noble and the payment by Surface Owner of all relocation costs, including (without limitation) costs of gathering lines, meter stations and hook-up fees.

iv. Surface Owner's Restrictions and Covenants Regarding Use of Production Location Facilities. The same prohibitions, permitted uses and covenants that apply to Surface Owner's use of Oil and Gas Operations Areas also apply to Production Facility Locations. (1.e)

II. **Access to Oil and Gas Operations Areas and Production Facility Locations**.

**a. Oil Companies' Access Rights.** The Oil Companies have the right to access Oil and Gas Operations Areas and Production Facility Locations as shown on **Exhibit 2**, (i) over existing routes currently in use, and (ii) over future access routes, when and if constructed. (2.a)

**b. Changes in Routes During Surface Development.** The parties may agree to different access routes on temporary or permanent bases, provided that Surface Owner pays all costs and expenses of relocating the routes. (2.a and 2.b)

**c. Other Obligations and Costs for Surface Owner.**

i. Joint Access Roads. (2.c and 2.d(1))

1. Construction. Surface Owner must construct or improve all paved or improved access roads that are jointly used by both Surface Owner or its subdivision occupants and the Oil Companies to be 30 feet or more in width, and to withstand the weight of oil field equipment (104,000 pounds, and 26,000 pounds per axle).

2. Maintenance. Surface Owner must maintain jointly used roads in good condition and repair until they are dedicated, but if an Oil Company causes damage to a road built to the specifications above, the Oil Company must pay for the repairs.

ii. Curb Cuts. Surface Owner must obtain and pay the cost of obtaining permits for curb cuts, 40 feet in width, as deemed necessary by the Oil Companies. (2.e)

d. **Oil Companies' Obligations for Oil Company Roads**. The Oil Companies must maintain any access roads reserved and used for their exclusive access, according to standards imposed by the COGCC. (2.d(2))

III. Pipelines, Flowlines and Pipeline Easements.

a. **Existing Lines.** The Oil Companies have the right to continue use, maintenance, repair and replacement of existing lines and easements, as shown on **Exhibit 2**. (3.a)

b. **Lines for Future Wells.** The oil companies have the right to use lines as shown on **Exhibit 2** that will serve future wells, and Surface Owner must grant written easements for such use on the form of **Exhibit 3** without cost to the Oil Companies. That form of Right-of-Way Grant (i) requires the grantee to lay pipe at a depth of at least 36 inches, (ii) prohibits the grantor from constructing on the easements without the grantee's consent, and (iii) obligates the grantee to indemnify the grantor for claims arising from the grantee's activities on the easement areas. (3.b)

c. **Relocation of Lines**. The Oil Companies and Surface Owner may agree to relocate lines and easements, but if Surface Owner requests the relocation, Surface Owner must pay the associated costs. (3.c)

d. **Surface Owner's Installations Underground.** Surface Owner may cross the Oil Companies' pipeline easements at approximately right angles and install and maintain access to those easements for (i) utility lines and (ii) other purposes with the applicable Oil Company's permission, not to be unreasonably withheld. The SUA includes minimum distance requirements between the Oil Company's installations and Surface Owner's installations underground. (3.e)

e. **Surface Owner's Installations on the Surface.** Surface Owner may install grasses (but not trees or shrubs) and non-permanent soft surface trails over and across pipeline easements, and paved surface trails that cross pipeline easements at generally right angles, subject to the following conditions:

i. Landscaping Along County Roads. The Town of Erie may request Surface Owner to install trees or bushes within the pipeline easements located on the Property and adjacent to Weld County Road 3 or Weld County Road 5, and Surface Owner must prepare a landscape plan for review and reasonable approval by KMGG (based on considerations such as safety issues and KMGG's ability to access the pipelines). Bushes will be preferred over trees; and trees and bushes may not be located on the surface of the pipeline easement area within 10 feet of a pipeline.

ii. Oil Companies' Liability Disclaimer. The Oil Companies will not be liable for damages to the trails, grasses, bushes or trees caused in whole or in part by their O&G operations. (3.f)

**f. Oil Companies' Safety and Continued Use Requirements.**

i. Safety/Security Priority. The Oil Companies may limit the use of pipeline easements by Surface Owner and its grantees for safety or security reasons.

ii. Surface Owner's Costs. Surface Owner must pay the Oil Companies all costs and expenses incurred to encase or lower pipelines and flowlines, as the Oil Companies determine reasonably necessary, to the extent those lines intersect and underlie any improvement permitted on the surface.

iii. No Interference with Pipeline Use. The Oil Companies' use of the flowlines and pipelines may not be prohibited at any time.

iv. Oil Companies' Liability Disclaimer. The Oil Companies shall not be liable for damage caused by O&G operations to improvements, landscaping, utilities or facilities permitted to be installed within or adjacent to pipeline easements. (3.g)

**g. Specifications**. The SUA includes specifications for pipeline and flowlines easements and installations, including installations by Surface Owner within the vicinity of the Oil Companies' lines. (3.d, 3.e and 3.h)

## IV. Surface Development Requirements and Restrictions.

**a. Notice of Public Hearings**. Surface Owner must give the Oil Companies at least 30 days' notice before each hearing in the Town of Erie or in Weld County for the approval of a plat application or other land use application. (18)

**b. Notices by Surface Owner**. Surface Owner must give the Oil Companies at least 14 days' advance notice before beginning to pave current and future streets and access routes, so that the Oil Companies may lay new lines that cross under the streets or other routes. If Surface Owner fails to give the notice, the Oil Companies may bore under the paved street or route, at the cost of Surface Owner. Surface Owner must also give advance notice to and meet with representatives of the appropriate Oil Companies to locate existing lines and coordinate surface construction activities with then current and future O&G operations. (3.i and 4)

**c. Notices by Oil Companies** An Oil Company proposing drilling activities on the Property must give Surface Owner advance notice in accordance with the rules of the COGCC. (4)

**d. Subdivision Plat Requirements**. Surface Owner must identify the Oil and Gas Operations Areas, Production Facility Locations and all present and future access routes and pipeline easements on Surface Owner's subdivision plats and

applications for development. The plats must recite certain restrictions regarding the improvements allowed around those areas, as set forth in the SUA. (6)

e. **Waiver of Setback and Other Requirements**. Acknowledging that the COGCC has rules and regulations regarding the distance between a wellhead and other installations and improvements, Surface Owner has waived all setback requirements in COGCC Rule 603 and other state or local setback requirements that are inconsistent with the SUA or the exercise of the rights of the Oil Companies under it. (8)

f. **Pipeline Depth Investigation**. If the surface development plans call for roadways to cross over existing pipelines, Surface Owner must pothole or request the Oil Companies to pothole the existing and future pipelines to check the line depth. Surface Owner must pay the Oil Companies the reasonable cost of inspecting, and if necessary, lowering the pipelines, and the reasonable cost of any sub-grade work required to meet the road construction specifications. (3.j)

g. **Kerr-McGee Guidelines.** Surface Owner is to comply with "General Guidelines for Design and Construction Activities On or Near Kerr-McGee Gathering LLC and Kerr-McGee Rocky Mountain Corporation Pipelines and Related Facilities," attached as Exhibit 4 to the SUA. (14)

h. **Shut-In Production Payments**.

   i. Notice Requirement. Surface Owner must notify the applicable Oil Company at least 20 days before beginning construction activities with heavy equipment that crosses flowlines or pipelines or in locations adjacent to an Oil and Gas Operations Area. (5.a)

   ii. Payment Requirement. If an Oil Company reasonably decides for safety reasons to shut-in a line over which heavy equipment will be operated, or if Surface Owner requests such a shut-in, Surface Owner must pay the Oil Company the following:

      1. an amount for each day of the shut-in equal to the average daily production of the affected well for the preceding six months calculated on the basis of the days the well actually produced during the six-month period;
      2. any costs to rework the well in order to place it back in production; and
      3. any costs to replace pipelines and flowlines damaged by the surface construction activities. (5.a)

i. **Electrical Equipment Change Costs.** Surface Owner must pay any costs incurred by an Oil Company to change electrical equipment for an Oil and Gas Operations Area or Production Facility Location because of the surface development. (5.b)

j. **Road / Pipeline Relocation Costs.** If Surface Owner requests an Oil Company to relocate an access road or pipeline easement as allowed under Sections 2.b and 3.c of the SUA, Surface Owner must give the Oil Company at least 30 days' notice before the relocation. The Oil Company will provide Surface Owner with an estimate of the relocation costs within 30 days after that notice, and Surface Owner must pay the estimated costs within the next 10 days. Within a reasonable time after receipt of that payment and execution of a separate relocation agreement, the Oil Company will perform the relocation work. Upon completion, the Oil Company will provide Surface Owner with an accounting of the actual relocation costs, and the parties will true-up any shortfall or excess payment within 10 days after the accounting. (9)

k. ***Impact Mitigation***.

i. **Oil Companies' Obligations**. The Oil Companies must install, maintain and repair, at their sole cost, such fences, gates and locks around wells and production facilities as required by COGCC or the Town of Erie as a condition for a special use permit to drill wells. To the extent required by law, the Oil Companies must pay for impact mitigation measures, including environmental and hazardous materials clean-up and remediation, in connection with their operations. (12.a)

ii. **Surface Owner's Obligations**. Surface Owner must pay all costs to install such noise and visual impact mitigation measures required by Surface Owner, the Town of Erie or other local jurisdictions at or around the Oil and Gas Operations Areas and Production Facility Locations, to the extent those measures exceed COGCC regulations for areas which are not high density and which are required at the time of Surface Owner's application for development approval. The operator of a well within the particular Oil and Gas Operations Area or Production Facility may veto or protest the types and locations of impact mitigation measures for safety reasons. (12.b)

V. Surface Damage.

a. **Waiver by Surface Owner Regarding O&G Areas.** Surface Owner has waived all surface damage payments and other such payments for use of the Property pursuant to any current or future COGCC or local regulation, statute, common law or prior agreement, for every well drilled and every well site constructed within an Oil and Gas Operations Area and for all production facilities within an Oil and Gas Operations Area or a Production Facilities Location, for pipeline easements and access routes as depicted on **Exhibits 2A and 2B** (or relocated), and for the use of the Temporary Oil and Gas Operations Area. (7)

b. **Limited Use and Obligations for Other Surface Use by Oil Companies.** Apart from the Oil and Gas Operations Areas, the Production Facility Locations and the access roads and easements provided in the SUA, the use of the Property is off limits to the Oil Companies except in the event of an emergency or for reasonable, incidental, temporary and non-damaging activities. The particular Oil Company shall be strictly

and solely responsible for any damages that may occur in those limited, permitted uses. (13)

VI. **Development Agreement**.

The Union Pacific entities listed with the Anadarko Entities at the beginning of this summary (as predecessors in interest to the Anadarko Entities) and Weld county Land Company, LLC, executed an Agreement for Compatible Development dated November 14, 2000, and recorded November 17, 2000 at Reception No. 280715 (the **Development Agreement**). The Development Agreement contemplated that the owner of the surface of the Property might enter into surface use agreements in the future, and this SUA has been executed pursuant to the Development Agreement. If a provision of the SUA conflicts with the Development Agreement, the SUA controls the rights and obligations of the parties. To the extent the Development Agreement is not inconsistent with the SUA, the Development Agreement still applies to the parties. (Recitals; 17)

**VII. Governmental Proceedings**.

a. **No Objection by Surface Owner.** Surface Owner (i) must not object, and waives the right to object, in any forum to the use by the Oil Companies of the surface of the Property consistent with the SUA and the Development Agreement; (ii) must provide the Oil Companies with such waivers and approvals that are requested and consistent with the SUA; (iii) has waived any rights to require or request a surface inspection for proposed wells for the purpose of requesting that conditions be attached to the permit for the well; (iv) consents to multiple wells within an Oil and Gas Operations Area; and (v) has waived its rights to object or request conditions to a well permit or to request a hearing before the COGCC or to allege potential adverse impacts with respect to the wells allowed under the SUA. (10.a)

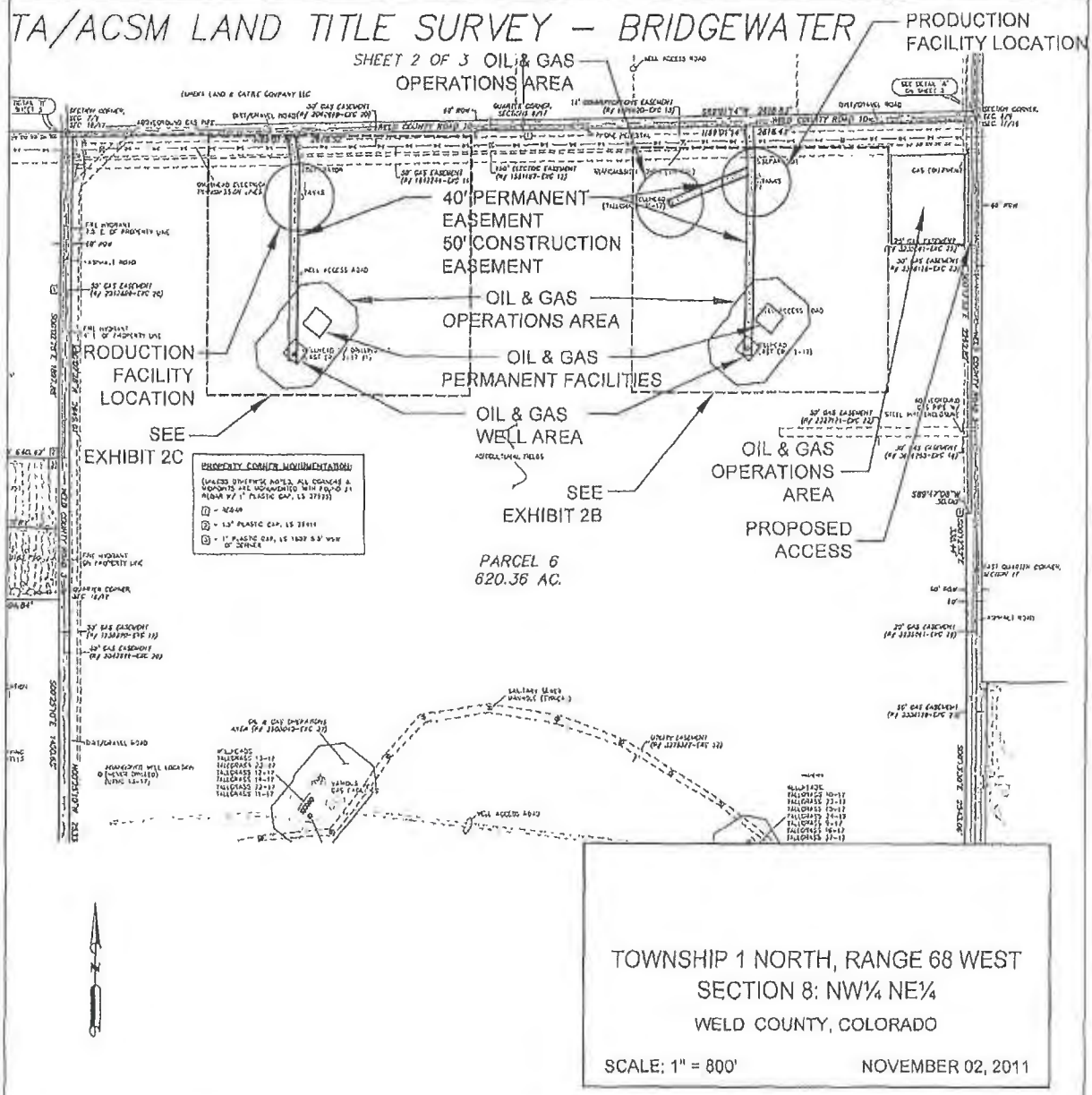
b. **No Objection by Oil Companies**. The Oil Companies have waived their right to object in any forum to a request by Surface Owner to zone or plat any of the Property, to the extent the request is consistent with the SUA. (10.b)

VIII. **Notice to Homebuilders and Home Buyers**.

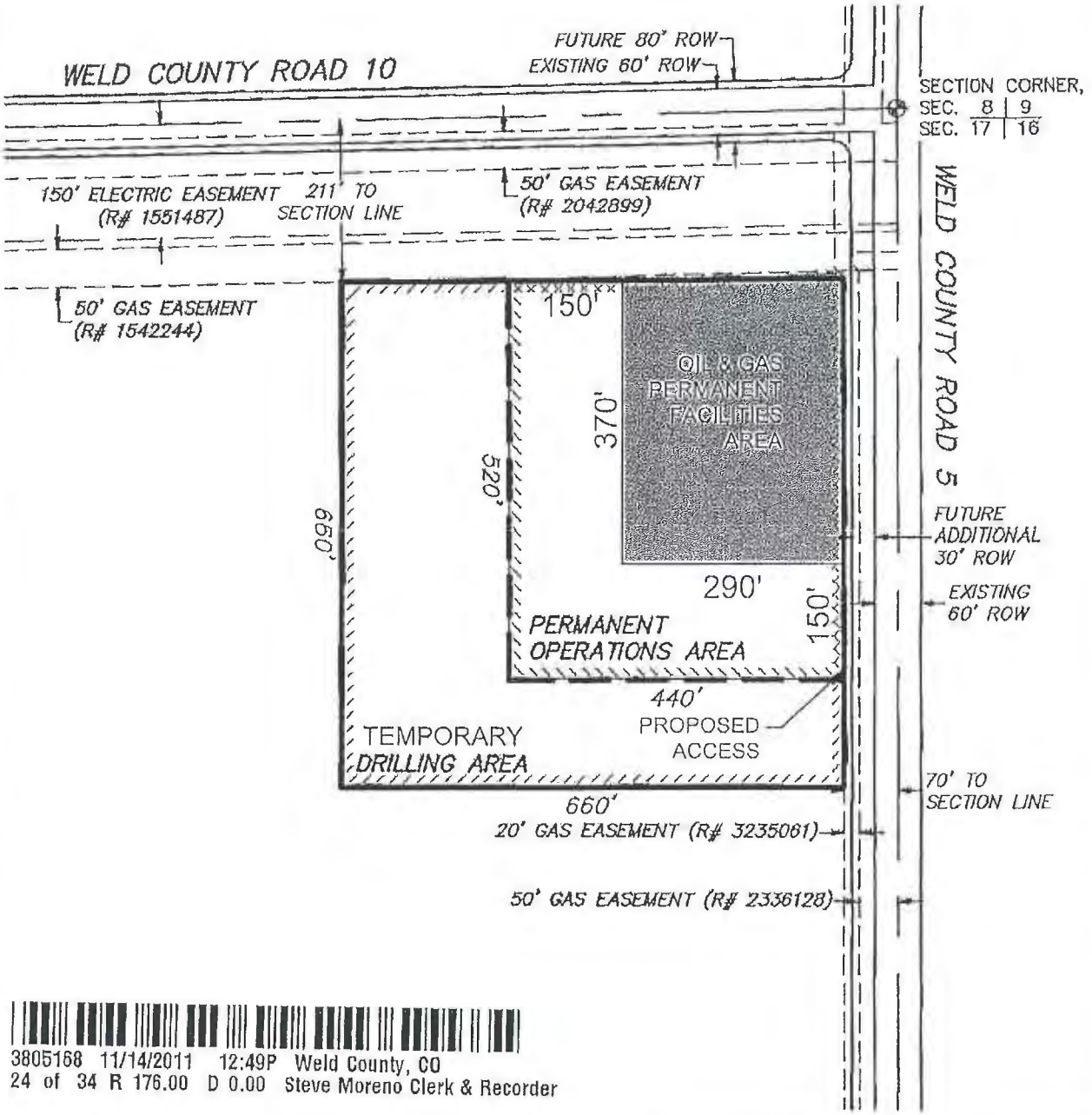
Surface Owner must furnish all purchasers of any portion of the Property with an exhibit showing the location of the Oil and Gas Operations Areas, the Production Facility Locations, existing and future pipeline easements, and existing and future access routes. In addition, Surface Owner must provide all buyers with notice regarding the O&G operations on the Property and the binding effect of certain portions of the SUA, as particularly detailed in the SUA. (11)

# EXHIBIT 2

3805168 11/14/2011 12:49P Weld County, CO
23 of 34 R 176.00 D 0.00 Steve Moreno Clerk & Recorder



# EXHIBIT 2A




3805168 11/14/2011 12:49P Weld County, CO
24 of 34 R 176.00 D 0.00 Steve Moreno Clerk & Recorder

0 100 200 400

1 inch = 200 ft.

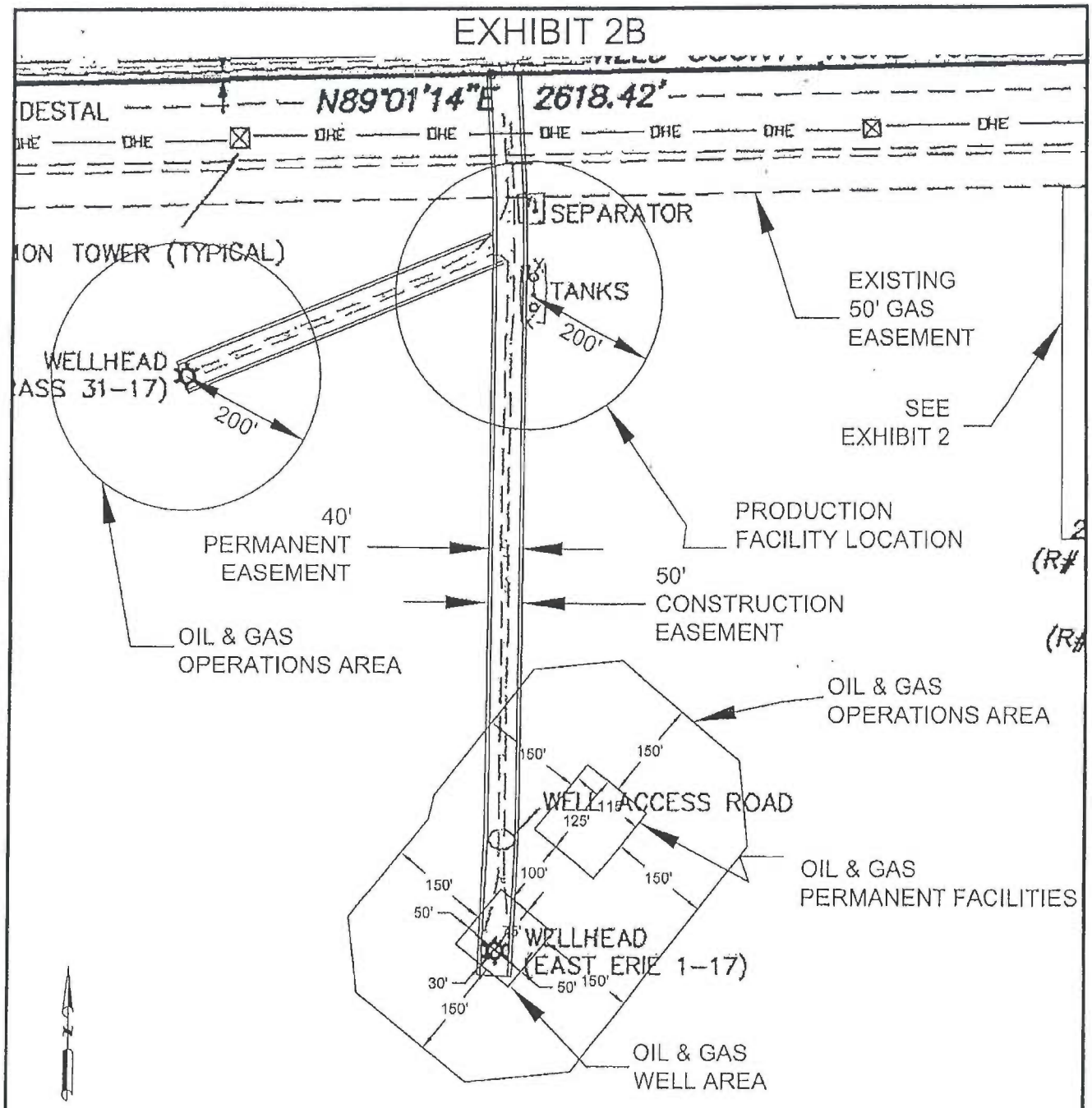
PROPOSED NOBLE
OIL & GAS OPERATIONS AREA
NE 1/4, SEC. 17, T1N, R68W
ERIE, COLORADO

HURST
ENGINEERING
PLANNING
SURVEYING
1350 Pine Street, Suite
Boulder, CO 80302
303.449.9105
www.hurst-assoc.com

| | |
|---|---|
| SCALE | HOR. 1"=200' VERT. N/A |
| DESIGN/APPR. | JJ |
| DRAWN BY | BD |
| DATE | 09/20/11 |
| SHEET | 1 OF 1 |

FILE #: \202042\

# EXHIBIT 2B

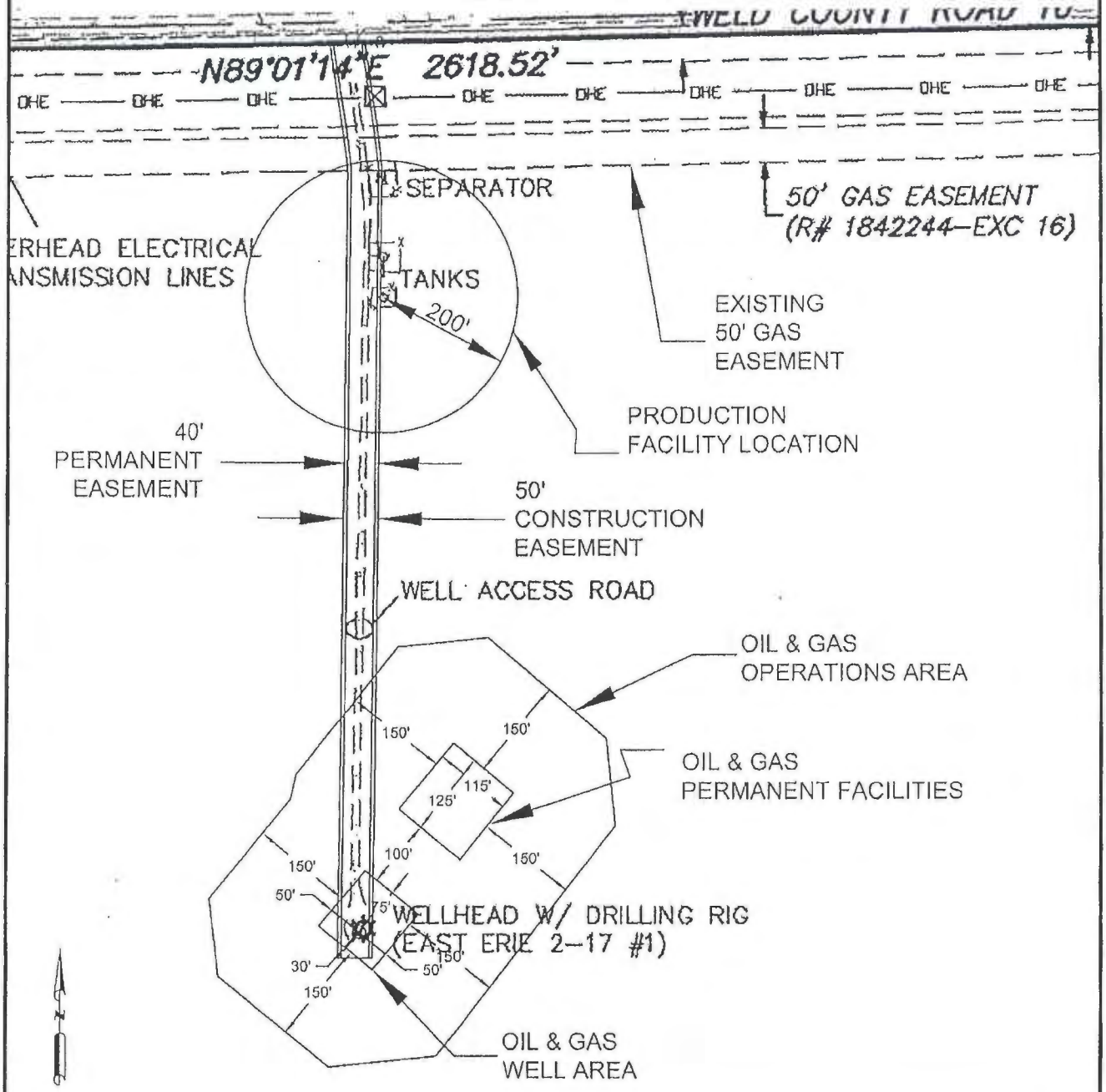



TOWNSHIP 1 NORTH, RANGE 68 WEST
SECTION 8: NE¼
WELD COUNTY, COLORADO

SCALE: 1" = 200' OCTOBER 24, 2011

3805168 11/14/2011 12:49P Weld County, CO
25 of 34 R 176.00 D 0.00 Steve Moreno Clerk & Recorder

# EXHIBIT 2C




TOWNSHIP 1 NORTH, RANGE 68 WEST
SECTION 8: NW¼
WELD COUNTY, COLORADO

SCALE: 1" = 200' OCTOBER 24, 2011

3805168 11/14/2011 12:49P Weld County, CO
26 of 34 R 176.00 D 0.00 Steve Moreno Clerk & Recorder

**Abstract of Kerr-McGee Letter Agreement Re: Pipelines**

DayBreak Community, Weld County, Colorado
Sections 8, 17 and 18, T1N, R68W

**Date:** October 11, 2011

**Recording Date/Info:** not recorded

**Property:** Portions of Sections 8, 17 and 18, T1N, R68W

**Parties:**

Surface Owner: Tallgrass Investors, LLC

Pipeline/Gas Gathering Company: Kerr-McGee Gathering LLC (**KMGG**)

**Abbreviations:**

All letter references in parentheses identify the sections of the Letter Agreement (**Agreement**) under discussion.

**Background:**

KMGG owns certain rights-of-way and easements over the Property (**Land Rights**), providing for the right to construct, operate and maintain pipelines pursuant to oil and gas leases, gas purchase agreements, surface use agreements and similar contracts. Those Land Rights allow KMGG to operate and maintain pipelines, valve sites, meter stations and other improvements above and below ground for transporting oil, gas and other hydrocarbons produced from wells on the Property and other lands.

The Agreement generally calls for the amendments to existing easements held by KMGG and the relocation and/or removal of portions of existing pipelines used by KMGG, all affecting the Property.

**Agreement Summary:**

I. **Amendments to Recorded Easements**. Surface Owner agrees to execute and deliver to KMGG the amendments to specified easements as described below.

a. **Easement 1:** Easement Deed dated October 13, 1980, and recorded November 21, 1980, Book 920, Reception No. 1842244, to be amended to provide for the following:

i. Construction of a new 24" pipeline, in addition to the 8" and 16" natural gas pipelines permitted by Easement 1;

ii. Construction of interconnections for future and existing pipelines as KMGG determines necessary or convenient within the area depicted on **Exhibit C** to the Agreement (and copied here);

iii. Amendment of the description of the easement area, to be 50 feet wide or otherwise accommodating current and future pipeline interconnections, as depicted on that **Exhibit C**;

iv. Grant to KMGG of a temporary 50-foot wide construction easement, south of the existing area, to expire 18 months after execution of the amendment to Easement 1.

**Note:** This amendment was to be executed within 14 days after execution of the Agreement (i.e., by October 25, 2011). (Paragraph C)

**b. Easement 2:** Easement Deed dated February 28, 1983, and recorded August 8, 1983, Book 1004, at Reception No. 1936290, to be amended to provide for the following:

i. Relocation, at KMGG's cost, of *Segment 2* as depicted on **Exhibit B** to Easement 2, to a location (A) adjacent to the road right-of-way for realigned County Road 3, or (B) under that road right-of-way (once required consents are obtained from the Town of Erie) if necessary to avoid impacting Surface Owner's ability to construct residences on Lots 5, Block 1; Lots 7 and 8, Block 2; and Lots 1 through 5, Block 9, all as depicted on page 3 of Bridgewater Filing No. 1 Preliminary Utility and Grading Plan, dated September 6, 2011, attached to the Agreement (and to this abstract);

ii. The change in the size of the *Segment 2* pipeline;

iii. Provision for the amended easement to measure 50 feet in width during construction, and 30 feet in width after construction;

iv. Clarification that KMGG will not be required to perform any further relocation or removal of any other segments within the Property covered by Easement 2, unless the Town or other governmental entity requires the change, in which case KMGG will be responsible for the work;

v. Requirements binding Surface Owner and KMGG in the event the pipeline is placed within an area designated as a landscape area within *Segment 2A* on **Exhibit B** to the Agreement (attached here), so that Surface Owner may install grasses (but not trees or shrubs) and soft or hard surface trails over and across pipeline easements, subject to the following conditions:

1. The local jurisdiction may request Surface Owner to install trees or bushes within the pipeline easements located on the Property, and in that case Surface Owner must prepare a landscape plan for review and reasonable approval by KMGG. Bushes will be preferred

over trees; and trees and bushes may not be located on the surface of the pipeline easement area within 5 feet of a pipeline;

2. KMGG may withhold its approval for the installation of trees and bushes for safety reasons or the convenient installation and maintenance of pipelines, but KMGG must propose reasonable alternatives when withholding consent to the landscape plan;

3. KMGG shall *not* be liable for damages to the trails, grasses, bushes or trees caused in whole or in part by their pipeline operations.

vi. Requirements binding Surface Owner and KMGG for *Segment 2B* on **Exhibit B:**

1. The existing pipeline in this *Segment 2B* will not be relocated or removed.

2. For *Segment 2B* and the portion of *Segment 2A* adjacent to realigned County Road 3:

a. Surface Owner will prepare a landscape plan for KMGG's reasonable approval;

b. KMGG may withhold its approval for the installation of trees and bushes for safety reasons or the convenient installation and maintenance of pipelines, but KMGG must propose reasonable alternatives when withholding consent to the landscape plan;

c. KMGG shall be liable for damages to the trails, grasses, bushes or trees caused in whole or in part by their pipeline operations. (Paragraph D)

**c. Easement 3:** Easement Deed dated January 16, 1988, and recorded February 13, 1986, in Book 1103 at Reception No. 02042890, to be amended to provide the following:

i. Regarding *Segment 3A* as depicted on **Exhibit B**:

1. Decommissioning or removal of *Segment 3A*, at KMGG's cost;

2. Relocation of *Segment 3A*, once new pipelines are constructed in a new easement (75 feet wide during construction, and 50 feet wide after construction) in the SW/4 of Section 17 and E/2 of Section 18, T1N, R68W, as shown on **Exhibit B**, to be documented by KMGG's right-of-way form and allowing more than one pipeline and surface appurtenances;

3. Requirements that if the pipeline is placed within an area designated as a landscape area within **Exhibit B**,

    a. Surface Owner may install grasses (but not trees or shrubs) and soft or hard surface trails over and across pipeline easements, subject to the following conditions:

    b. The local jurisdiction may request Surface Owner to install trees or bushes within the pipeline easements located on the Property, and in that case Surface Owner must prepare a landscape plan for review and reasonable approval by KMGG. Bushes will be preferred over trees; and trees and bushes may not be located on the surface of the pipeline easement area within 5 feet of a pipeline;

    c. KMGG may withhold its approval for the installation of trees and bushes for safety reasons or the convenient installation and maintenance of pipelines;

    d. KMGG shall *not* be liable for damages to the trails, grasses, bushes or trees caused in whole or in part by their pipeline operations;

    e. KMGG will be responsible for all costs of relocation and removal of *Segment 3A*. (Paragraph E)

ii. Regarding *Segment 3B* as depicted on **Exhibit B:**

    a. Surface Owner must prepare a landscape plan for review and reasonable approval by KMGG. Bushes will be preferred over trees; and trees and bushes may not be located on the surface of the pipeline easement area within 5 feet of a pipeline;

    b. KMGG may withhold its approval for the installation of trees and bushes for safety reasons or the convenient installation and maintenance of pipelines, but KMGG must propose reasonable alternatives when withholding consent to the landscape plan;

    c. KMGG shall be liable for damages to the trails, grasses, bushes or trees caused in whole or in part by their pipeline operations.

iii. Generally, confirmation that Surface Owner may not require KMGG to further relocate or remove pipelines in the Easement 3 area unless the

Town or other governmental authority requires the change, in which case KMGG will be responsible for the work. (Paragraph E)

**d.** **Easement 4:** Easement Deed dated June 2, 1993, and recorded June 8, 1993, Book 1386, Reception No. 02336128, to be amended to provide the following:

i. Surface Owner will not require KMGG to relocate or remove the pipeline within the property covered by Easement 4, but if the Town of Erie or another governmental entity requires a change in the pipeline location, KMGG will be responsible for the work.

ii. Surface Owner may install grasses (but not trees or shrubs) and soft or hard surface trails over and across the Easement 4, subject to the following conditions:

a. If the right-of-way lines are located in an area adjacent to Weld County Road 5, the local jurisdiction may request Surface Owner to install trees or bushes within the pipeline easements located on the Property, and in that case Surface Owner must prepare a landscape plan for review and reasonable approval by KMGG. Bushes will be preferred over trees; and trees and bushes may not be located on the surface of the pipeline easement area within 5 feet of a pipeline;

b. KMGG may withhold its approval for the installation of trees and bushes for safety reasons or the convenient installation and maintenance of pipelines;

c. KMGG shall *not* be liable for damages to the trails, grasses, bushes or trees caused in whole or in part by the pipeline operations. (Paragraph F)

**e.** **Easement 5:** Right-of-Way Grant dated August 20, 2007, and recorded January 1, 2009, at Reception No. 3600584, to be amended to provide for the following:

i. Extension of the easement to run the entire length of the SE/4 of Section 8 adjacent to County Road 5.

ii. The right of KMGG to construct an additional pipeline according to one of two options:

1. Option 1: KMGG could construct the new pipeline along Weld county Road 5 between the existing pipelines constructed pursuant to Easement 3 and Easement 5, as amended, provided the new pipeline des not unreasonably interfere with Surface Owner's landscape plans in that section;

a. Surface Owner must prepare a landscape plan for review and reasonable approval by KMGG;

b. KMGG may withhold its approval for the installation of trees and bushes for safety reasons or the convenient installation and maintenance of pipelines, but KMGG must propose reasonable alternatives when withholding consent to the landscape plan;

c. KMGG shall be liable for damages to the trails, grasses, bushes or trees caused in whole or in part by their pipeline operations.

2. Option 2: KMGG could change the size of the existing 4-inch pipeline constructed under Easement 5, as amended, and construct an additional pipeline to the east of the easterly most pipeline constructed under Easement 3 (and Easements 3 and 5 would be further amended to reflect the exercise of this Option 2).

Surface Owner may install grasses (but not trees or shrubs) and soft or hard surface trails over and across the Easement 4, subject to the following conditions:

a. If the right-of-way lines are located in an area adjacent to Weld County Road 5, the local jurisdiction may request Surface Owner to install trees or bushes within the pipeline easements located on the Property, and in that case Surface Owner must prepare a landscape plan for review and reasonable approval by KMGG. Bushes will be preferred over trees; and trees and bushes may not be located on the surface of the pipeline easement area within 5 feet of a pipeline;

b. KMGG may withhold its approval for the installation of trees and bushes for safety reasons or the convenient installation and maintenance of pipelines;

c. KMGG shall *not* be liable for damages to the trails, grasses, bushes or trees caused in whole or in part by the pipeline operations. (Paragraph G)

II. **KMGG's Obligation to Relocate *Segment 1* Pipeline.** In consideration for the easement amendments listed above:

**a.** KMGG agrees to relocate at its sole cost the pipeline in *Segment 1* shown on **Exhibit B** to a mutually agreeable location within 18 months after the effective date of the Agreement. The preferred location for the easement runs from the well head to the southeast, connecting to the line in County Road 5.

b. If required by the Town of Erie, KMGG will remove, at its cost, the abandoned pipeline shown as *Segment 5* on **Exhibit B** within 12 months after the effective date of the Agreement and release of record the right-of-way for *Segment 5*. (Paragraph H)

III. **Conflicts between Documents.** The Agreement is not intended to modify any existing agreement between Surface Owner and mineral interest owners except as such other agreement may expressly provide. (Paragraph I)

IV. **Assignment**. The Agreement may be assigned in whole or in part.

V. **Arbitration**. In the event of any controversy or claim arising under the Agreement, the parties must arbitrate in Denver in proceedings administered by the American Arbitration Association.

VI. **Inquiry Regarding Prescriptive Easements.** Note, the Agreement recites that KMGG is the current owner of various land rights consisting of recorded ***and prescriptive*** rights-of-way and easements,...." The purchase and sale agreement calls for the seller to disclose all title matters not of record, and particular inquiry regarding these prescriptive rights would be appropriate.

Exhibit B to Letter Agreement

Existing Layout

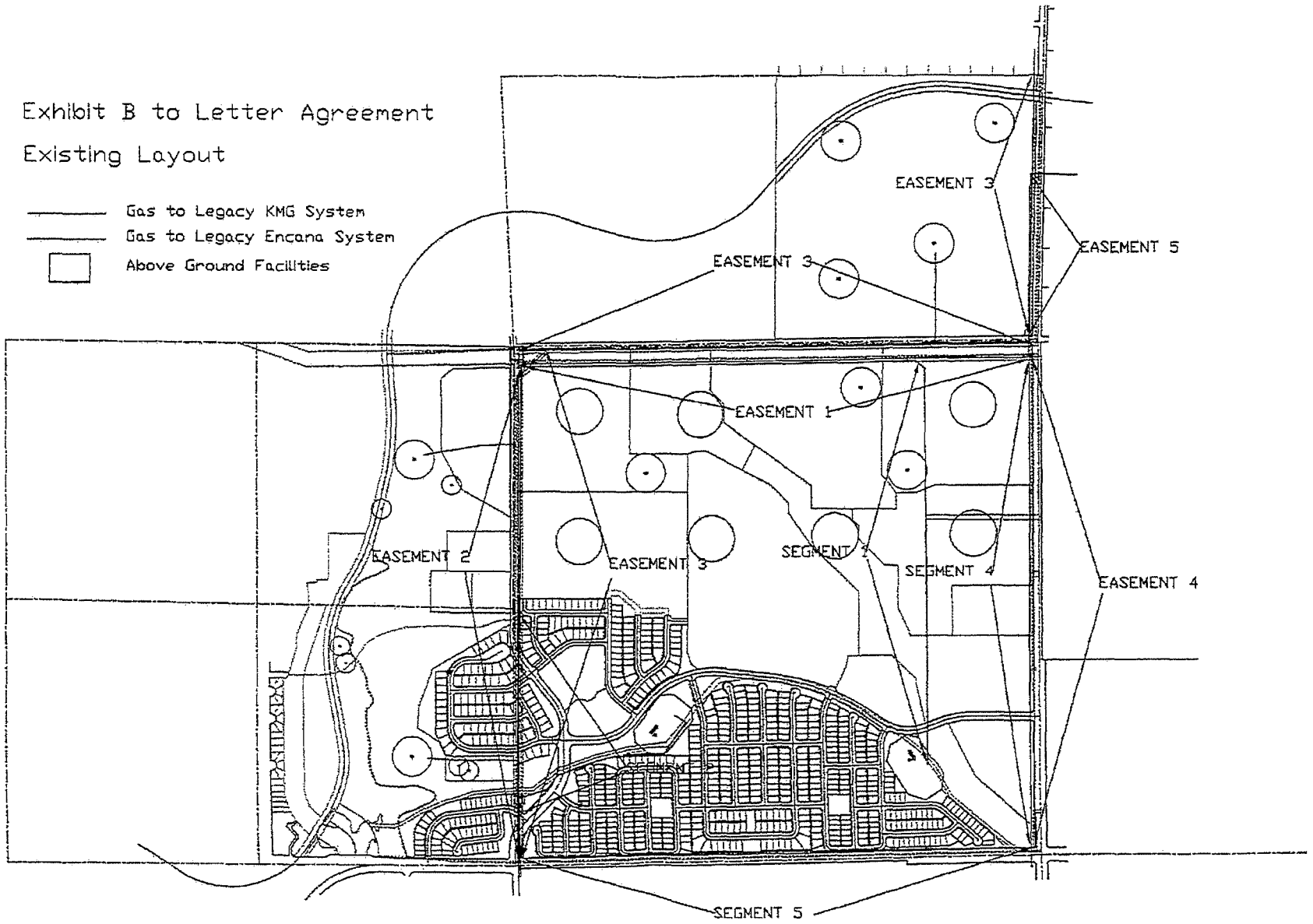


Exhibit B to Letter Agreement
Proposed Layout After Relocations

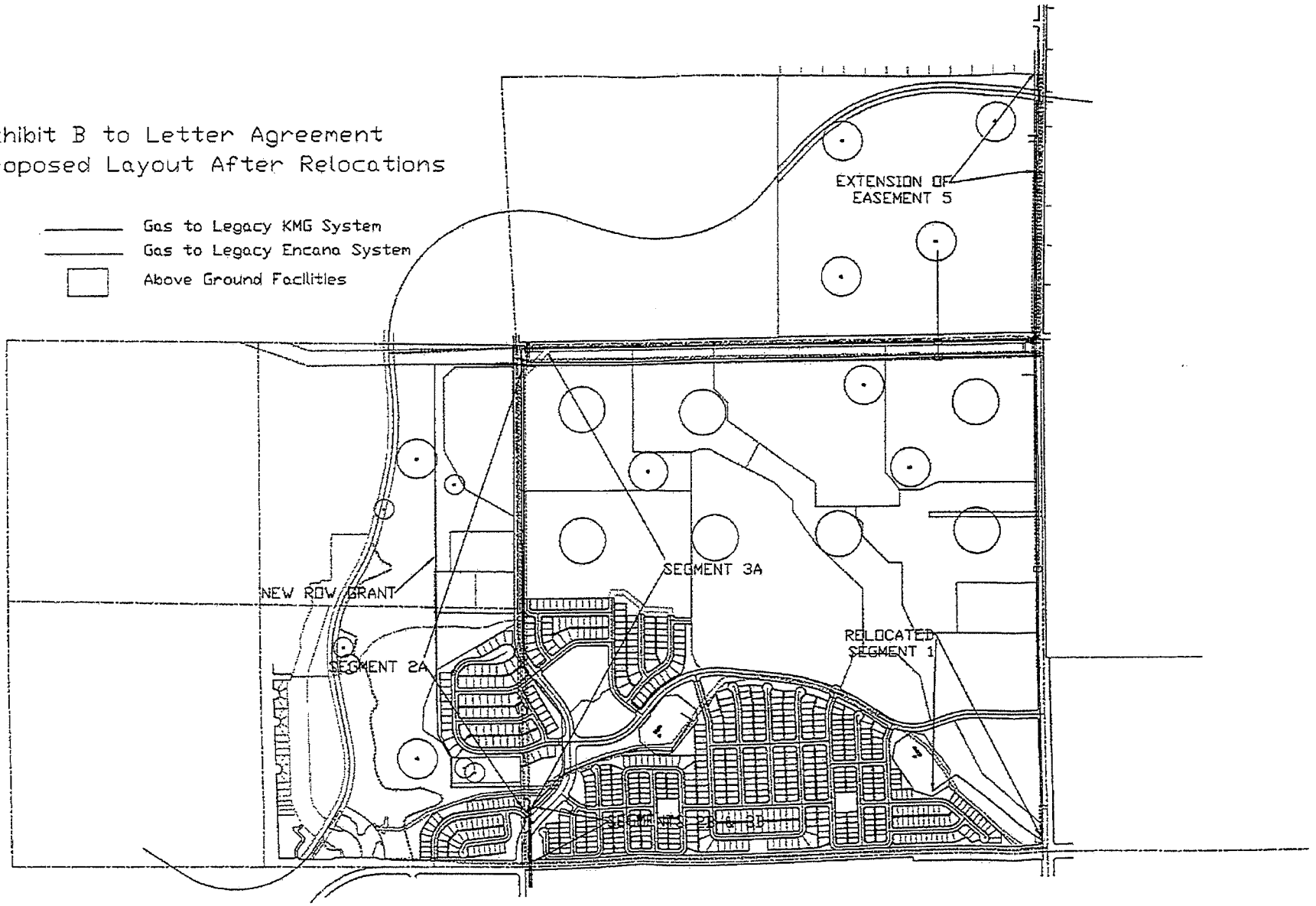
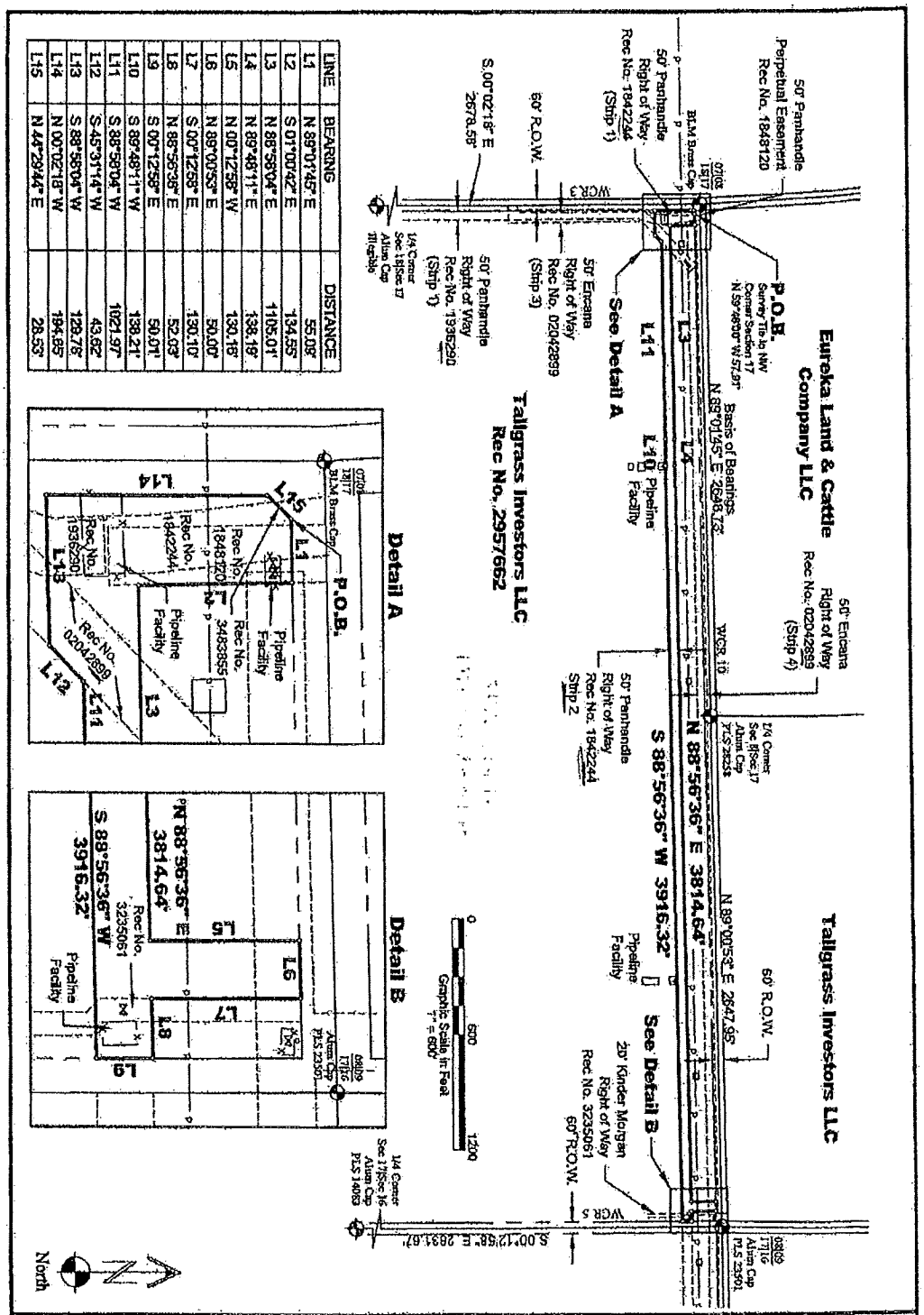


Exhibit C to Letter Agreement

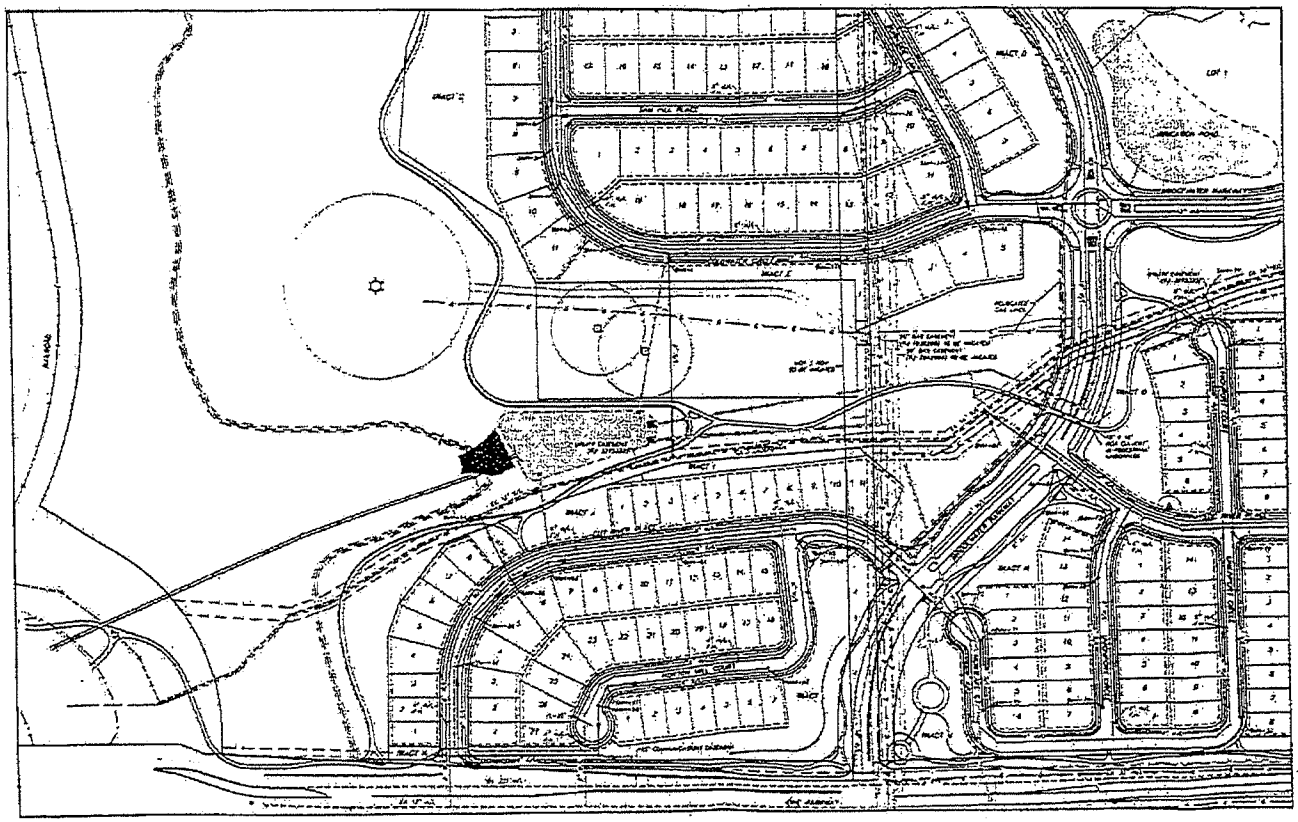


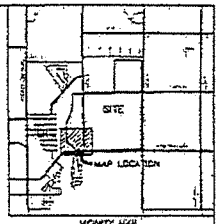

| LINE | BEARING | DISTANCE |
|---|---|---|
| L1 | N 89°01'45" E | 55.08' |
| L2 | S 01°00'42" E | 134.55' |
| L3 | N 88°58'04" E | 1105.01' |
| L4 | N 89°48'11" E | 138.19' |
| L5 | N 00°12'58" W | 130.18' |
| L6 | N 89°00'53" E | 50.00' |
| L7 | S 00°12'58" E | 130.10' |
| L8 | N 88°56'36" E | 52.03' |
| L9 | S 00°12'58" E | 50.01' |
| L10 | S 89°48'11" W | 138.21' |
| L11 | S 88°58'04" W | 1021.97' |
| L12 | S 45°31'14" W | 43.62' |
| L13 | S 88°58'04" W | 129.78' |
| L14 | N 00°02'18" W | 194.85' |
| L15 | N 44°29'44" E | 28.53' |

| | | | | |
|---|---|---|---|---|
| SHEET NO. 2 OF 2 | LAND SURVEYING AND MAPPING LAFAYETTE - WINTER PARK Ph 303 999 0579 Fx 303 999 0580 | KERR-McGEE Right of Way Survey | TOWNSHIP: 1 North<br>RANGE: 68 West 6th PM<br>COUNTY: Weld<br>STATE: Colorado | 1"=600<br>7/22/2011<br>BY: jtv | SAP AFE: 2057749<br>TRACKING:<br>REVISIONS: |

# BRIDGEWATER FILING NO. 1
# PRELIMINARY UTILITY & GRADING PLAN

SHEET 3 OF 14





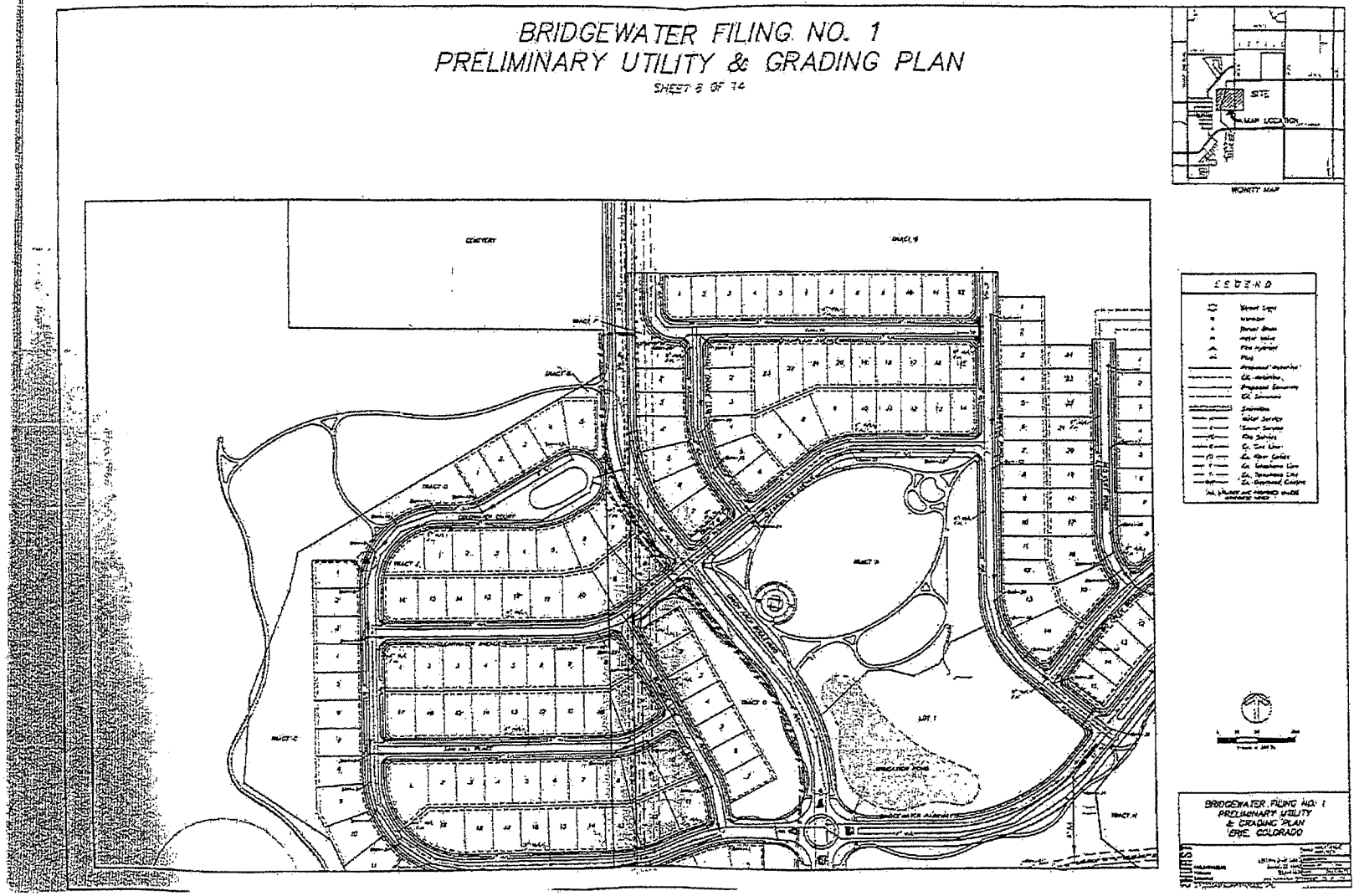

VICINITY MAP

LEGEND

BRIDGEWATER FILING NO. 1
PRELIMINARY UTILITY
& GRADING PLAN
ERIE, COLORADO

# BRIDGEWATER FILING NO. 1
# PRELIMINARY UTILITY & GRADING PLAN

SHEET 6 OF 14



568

RECORDER'S MEMORANDUM
THIS DOCUMENT WAS FOUND
TO BE INADEQUATE FOR
SCANNING PURPOSES.

3799568 10/18/2011 12:26P Weld County, CO
1 of 46 R 236.00 D 0.00 Steve Moreno Clerk & Recorder

# SURFACE USE AGREEMENT

**THIS SURFACE USE AGREEMENT** ("Agreement') is effective this 27th day of September, 2011, by and among ANADARKO E&P COMPANY LP, formerly known as Union Pacific Resources Company, and ANADARKO LAND CORP., formerly known as Union Pacific Land Resources Corporation (together the "Anadarko Entities"), both with an address of Post Office Box 1330, Houston, Texas 77251-1330; KERR-McGEE OIL & GAS ONSHORE LP ("Kerr-McGee") with an address of 1099 18th Street, Suite 1800, Denver, Colorado 80202; KERR-McGEE GATHERING LLC ("KMGG"), also with an address of 1099 18th Street, Denver, Colorado 80202; and ENCANA OIL & GAS (USA) INC. ("Encana") with an address of 370 17th Street, Suite 1700, Denver, Colorado 80202 (the Anadarko Entities, Kerr-McGee and Encana are sometimes referred to hereinafter separately as an "Oil Company" or collectively as the "Oil Companies") and TALLGRASS INVESTORS, LLC ("Surface Owner") with an address of 2500 Arapahoe Avenue, Suite 220, Boulder, Colorado 80302.

A. Surface Owner owns the surface estate for property located within the Town of Erie ("Erie") in Weld County, Colorado, described as the E/2 of Section 18, Township 1 North, Range 68 West, which is more specifically described in the attached Exhibit 1A and hereinafter referred to as the "Section 18 Property."

B. Surface Owner also owns the surface estate for property located in Erie described as the SE/4 of Section 8, Township 1 North, Range 68 West, which is more specifically described in the attached Exhibit 1B and hereinafter referred to as the "Section 8 Property."

C. The Section 18 Property and the Section 8 Property are hereinafter referred to together as the "Property."

D. The Anadarko Entities own all of the oil and gas that underlies the Property, and either the Anadarko Entities, or their predecessors, have granted oil and gas leasehold rights in the Property. Interests in such leasehold rights have been assigned to Encana and Kerr-McGee, among other parties.

E. Union Pacific Land Resources Corporation and Union Pacific Resources Company (together the "Union Pacific entities") entered into an agreement with Weld County Land Company, LLC dated November 14, 2000, entitled "Agreement for Compatible Development" ("Development Agreement") pursuant to which the parties set forth minimum standards with which Surface Owner is required to comply to protect existing oil and gas wells on the Property and for the location of future oil and gas wells on the Property, among other things.

F. The Development Agreement was recorded in the Weld County Clerk and Recorder's Office on November 17, 2000, at Reception No. 280715.

G. The Development Agreement contemplated that Surface Owner might enter into surface use agreements in the future with the parties which own oil and gas leasehold interests in the Property to which the Union Pacific entities were required to be signatory parties.

H. Encana owns certain oil and gas leasehold interests in the Section 18 Property that it derived through the Union Pacific entities and operates two oil and/or gas wells on the Section 18 Property, one identified as the Erie Champlin B Unit #1 well, generally in the center of the NE/4, and the other identified as the Erie Champlin B Unit #2 well, generally in the center of the SE/4.

I. Predecessors to Encana and Kerr-McGee entered into a joint operating agreement pursuant to which Encana, as operator, drilled and operates five oil and/or gas wells on the Section 8 Property identified as the Woolley #43-8 in the NE/4SE/4, the Woolley #33-8 in the NW/4SE/4, the Woolley #34-8 in the SW/4SE/4, and the Woolley K Unit #1 and Woolley #44-8 in the center of the SE/4.

J. The wells identified in Recitals H. and I. are hereinafter referred to alone or together as an "Existing Well" or the "Existing Wells."

K. Kerr-McGee owns certain oil and gas leasehold interests in both the Section 18 Property and the Section 8 Property that it derived through the Union Pacific entities.

L. Encana and Kerr-McGee have rights to drill additional wells on the Property.

M. KMGG is an affiliate of the Anadarko Entities and Kerr-McGee and signs this Agreement only in its capacity as a party which gathers or may gather gas produced from the Property.

N. KMGG and Surface Owner shall enter into a letter agreement that is effective the same date as this Agreement in which KMGG and Surface Owner shall agree upon certain amendments to existing pipeline easements and right-of-way grants that cover portions of the Property and property adjacent to the Property in Section 17 and within the proposed Bridgewater development and hereinafter referred to as the "Letter Agreement."

O. This Agreement provides for the compatible development of the surface estate and the oil and gas estate for the Property and, with respect to each of the Oil Companies, applies only to the oil and gas interests and/or the oil and gas leasehold interests that each owns.

NOW THEREFORE, in consideration of the covenants and mutual promises set forth in this Agreement, including in the recitals, the parties agree as follows:

1. Oil and Gas Operations Areas.

a. Existing, Proposed, and Future Wellsite Locations. With respect to the Section 18 Property, the Oil Companies agree to locate future oil and gas wells only within the two areas that are identified on Exhibit 2A as the Oil and Gas Operations Areas and located generally in the centers of the NE/4 and the SE/4 of Section 18. With respect to the Section 8 Property, the Oil Companies agree to locate future oil and gas wells only within the four areas that are identified on Exhibit 2B as the Oil and Gas Operations Areas and located generally in the centers of the SE/4, NE/4SE/4, NW/4SE/4 and SW/4SE/4. The locations identified on Exhibit 2A and Exhibit 2B are hereinafter referred to separately or together as an "Oil and Gas Operations Area"

or the "Oil and Gas Operations Areas." The Oil and Gas Operations Areas shall be made available to the Oil Companies and their designated gas gatherer by Surface Owner for their exclusive use in their present condition for their oil and gas operations and the location of wells and equipment, flowlines and pipeline easements, as specifically provided for herein.

b. The Oil and Gas Operations Areas in Section 18 and the NE/4SE/4 of Section 8. Each Oil and Gas Operations Area in Section 18 and the Oil and Gas Operations Area in the NE/4SE/4 of Section 8 includes the property specifically identified and depicted on Exhibit 2A and Exhibit 2B as the: (aa) Oil and Gas Operations Area; (bb) Oil and Gas Well Area; (cc) Facilities Location; and (dd) Temporary Easement Area adjacent to the Oil and Gas Operations Area. The Temporary Easement Area and the areas within Oil and Gas Operations Areas are for oil and gas operations and the location of wells and equipment as follows:

(i) The Oil Companies may use the Temporary Easement Area for operations related to the preparation, drilling and completion of horizontal wells to be drilled at locations within an Oil and Gas Well Area within the Oil and Gas Operations Area and for the temporary location of production facilities for horizontal wells up until and only prior to the time that construction begins on a building within a platted lot within the quarter section where the Oil and Gas Operations Area is located (NE/4 or SE/4 of Section 18 or SE/4 of Section 8, as the case may be). The Oil Companies may not locate wells or permanent production facilities within the Temporary Easement Area, but may use the Temporary Easement Area only for temporary uses relating to the drilling and completion of horizontal wells and the temporary location of production facilities. The Oil Companies shall not use the Temporary Easement Area (except as provided herein) after construction begins on a building within a platted lot within the quarter section for the particular Oil and Gas Operations Area.

(ii) The Oil and Gas Operations Areas shall be the locations for oil and gas operations, Existing Wells and future wells and production facilities and flowlines and pipeline easements.

(iii) The Oil and Gas Well Areas shall be the locations for Existing Wells and additional future wells.

(iv) The Facilities Locations shall be the locations for permanent productions facilities that service the wells described in section 1.e.

(v) For each Temporary Easement Area, Surface Owner shall give the Oil Companies ninety (90) days advance written notice that it will commence the construction of a building within the applicable quarter section for the particular Oil and Gas Operations Area. The Oil Companies shall relocate any production facilities that are located within the Temporary Easement Area within sixty (60) days from the date of the notice.

(vi) In consideration of the covenants and promises contained in this Agreement and without in any way limiting section 1.e, Surface Owner specifically agrees that wells may be drilled by the Oil Companies from the Oil and Gas Operations Area in the SE/4 of Section 18 to bottomhole locations in the SW/4 of Section 18 and production facilities to service such wells located within the Oil and Gas Operations Area in the SE/4 of Section 18.

c. The Oil and Gas Operations Areas in Section 8 Other than the NE/4SE/4 Location. Each Oil and Gas Operations Area in Section 8 other than the Oil and Gas Operations Area in the NE/4SE/4 of Section 8 shall be the size and configuration depicted on Exhibit 2B and shall be available for oil and gas operations and the location of wells and production facilities, flowlines and pipeline easements.

d. Surface Lot Line Requirements. Lot lines for surface development shall not be platted anywhere within the Oil and Gas Operations Areas, and Surface Owner shall not construct or install any permanent or temporary building, structure or other improvement within or under the Oil and Gas Operations Areas; provided, however, Surface Owner may install berms, screening, shrubs, perimeter fencing and irrigation systems adjacent to (but not within) the perimeter of the Oil and Gas Operations Areas; provided that, in the reasonable opinion of the Oil Company, such improvements do not in any way impede or interfere with present or future oil and gas operations; and, provided, further, that the Oil Companies shall not be liable for damage or injury to such berms, screening, shrubs, perimeter fencing or irrigation systems that in any way occurs because of or results from oil and gas operations on the Property. Further, upon prior notice from the Oil Company, Surface Owner shall cooperate with the applicable Oil Company to insure that improvements are restricted from public access during oil and gas operations within an Oil and Gas Operations Area that require the use of heavy equipment by the Oil Company.

e. Multiple Wells within Oil and Gas Operations Areas. The Oil Companies shall continue to have the right to operate and maintain the Existing Wells and to drill, complete, operate and maintain additional wells within the Oil and Gas Operations Areas (as described herein), including vertical, twinned, replacement, directional and horizontal wells (with bottomhole locations within and outside the Property) that produce from and drain the Property as well as lands other than the Property. The Oil Companies shall have the right to deepen, complete, recomplete, workover, fracture, refracture and plug and abandon the Existing Wells and any well that is drilled in the future; provided, however, Encana agrees to permanently plug and abandon the Existing Erie Champlin B Unit #2 Well on the Section 18 Property prior to commencing drilling operations for any future well within the Section 18 Property. The Oil and Gas Operations Areas shall be for the exclusive use of oil and gas drilling, exploration, completion, recompletion, production and maintenance operations and for the location of associated oil field exploration and production equipment and facilities (including pipelines and flowlines) necessary or convenient for the operation of a well or wells located within an Oil and Gas Operations Area. Surface Owner acknowledges and understands that: i) any wells shown on the exhibits are those existing or currently planned; ii) the Oil Companies shall not be limited or restricted to the drilling of only the depicted wells or types of wells; and (iii) the actual wells drilled, including the number and their type, may differ from those shown, as may be determined by the Oil Companies in their discretion.

f. Associated Drilling and Production Equipment. The Oil Companies shall have the right to construct, operate, locate, maintain and repair such associated drilling and production equipment, including tanks, separators, dehydrators, compressors, pipelines, flowlines and meters, and also any other associated oil field equipment necessary or convenient for the operation and production of the Existing Wells, proposed wells, and future wells within the Oil and Gas Operations Areas in the Section 8 Property and within the Facility Locations within the

Oil and Gas Operations Areas in the Section 18 Property and the NE/4SE/4 of the Section 8 Property. The Oil Companies agree to install low profile tanks for future operations; provided, however, Encana shall not be required to replace the equipment that is currently located on the Property that services the Existing Wells.

2. Access to Oil and Gas Operations Areas.

a. Access to Oil and Gas Operations Areas. Surface Owner acknowledges and understands that the Oil Companies have the right to continue to use the existing access routes that they are currently utilizing and the additional proposed access (when and if constructed) to access the Oil and Gas Operations Areas as identified on Exhibit 2A and Exhibit 2B. During surface construction by Surface Owner on pertinent portions of the Property, the parties may mutually agree upon different access routes to an Oil and Gas Operations Area and thereafter to permanent access routes; provided, however, all costs and expenses for a relocation to temporary access routes and permanent access routes shall be borne by Surface Owner; and provided, further, the Oil Companies shall at all times have access to the Oil and Gas Operations Areas and pipeline easements.

b. Relocation of Access. Access to an Oil and Gas Operations Area may be changed in the future by mutual agreement of the affected parties or their successors in interest; provided however, all costs and expenses for such relocations shall be borne by Surface Owner, if the relocation is requested by Surface Owner.

c. Maintenance and Use of Joint Access Roads. Surface Owner shall keep roads jointly used by both Surface Owner or its subdivision occupants and one or more of the Oil Companies in good condition and repair until they are dedicated to a local jurisdiction; provided, however, if an Oil Company causes damage to a road that is built to the specifications in section 2.d.(1), it agrees to promptly repair any damage that it causes that is a direct result of its use of the road. No party shall unreasonably interfere with the use by the other of an access road.

d. Construction and Width of Access Roads.

(1) Access roads that are jointly used by the Oil Companies and Surface Owner shall be thirty (30) feet or more in width, and Surface Owner shall construct or improve all paved or improved access roads so as to withstand the weight of oilfield equipment. Specifically, Surface Owner shall construct the roads so that they can be used to withstand the weight of 104,000 pounds and 26,000 pounds per axle.

(2) Access roads that are used exclusively by the Oil Companies shall be generally thirty (30) feet in width, and the Oil Companies shall install and maintain them to applicable standards of the Colorado Oil and Gas Conservation Commission ("COGCC"). The Oil Companies shall be solely responsible for the maintenance of those portions of access roads that are used exclusively by the Oil Companies.

e. Surface Owner agrees that it will obtain and pay the costs to obtain from the local jurisdiction, permits for curb cuts as deemed necessary by the Oil Companies. Said curb cuts shall be forty (40) feet in width.

3. Pipelines, Flowlines and Pipeline Easements.

a. Pipelines, Flowlines and Pipeline Easements for Existing Wells. Surface Owner acknowledges and understands that the Oil Companies and their affiliates have the right to continue to use the flowlines, pipelines and pipeline easements that they are currently utilizing to service the Existing Wells and to construct, repair, maintain and replace the flowlines and pipelines. The locations for pipelines and flowlines that service Existing Wells that are located outside Oil and Gas Operations Areas are depicted on Exhibit 2A and Exhibit 2B.

b. Relocation or Abandonment of Existing Pipelines within Section 18 Property. With respect to the Section 18 Property, KMGG agrees to abandon in place, in accordance with COGCC Rules and Regulations, the pipeline that currently gathers the gas from the Erie Champlin B Unit #1 Well ("Champlin #1 Well") in the NE/4 of Section 18 and labeled as "proposed NE/4 abandoned gathering line" on Exhibit 2A. The parties acknowledge and understand that the proposed NE/4 abandoned gathering line will not be abandoned until the pipeline is constructed and operational on the Section 18 Property in the west portion of the property and depicted on Exhibit 2A as the "Future Pipeline Easement." KMGG also agrees to abandon in place or to relocate, as provided herein, the pipeline that currently gathers gas from the Erie Champlin B Unit #2 Well ("Champlin #2 Well") in the SE/4 of Section 18 and labeled as "proposed SE/4 abandoned or relocated gathering line" on Exhibit 2A. The parties acknowledge and understand that the proposed SE/4 abandoned or relocated gathering line will not be abandoned or relocated until Encana plugs and abandons the Champlin #2 Well and the initial pipeline is constructed and in operation in the Future Pipeline Easement. The proposed abandoned gathering lines and any relocated pipeline shall be abandoned and installed by KMGG pursuant to a separate pipeline relocation agreement in the form attached hereto as Exhibit 3.

c. Pipelines, Flowlines and Pipeline Easements for Future Wells. Pipelines and pipeline easements and also flowlines (to the extent located outside Oil and Gas Operations Areas) that service future wells shall be at the locations identified on Exhibit 2A and Exhibit 2B, or as the parties may otherwise agree, and Surface Owner shall grant the Oil Companies, or KMGG, as directed by the Oil Companies, written pipeline easements for production from the Property and other lands upon the request of the Oil Companies and at no cost to them in the form of right-of-way grant attached hereto as Exhibit 4.

d. Relocation of Pipelines and Pipeline Easements. Locations of pipelines and pipeline easements may be changed by mutual agreement of Surface Owner and the appropriate Oil Company pursuant to a separate pipeline relocation agreement; provided, however, all costs and expenses of such relocations shall be borne by Surface Owner, if the relocation is requested by Surface Owner.

e. Width and Grant of Pipeline and Flowline Easements. Pipeline easements may be nonexclusive as provided in Section 3.f. For pipeline easements in Section 8, if pipelines are relocated, and for initial installation, pipeline easements shall in all cases be fifty (50) feet in width during construction activities and reduced to thirty (30) feet in width for all operations, maintenance and transportation activities. For pipeline easements in Section 18, if pipelines are relocated, and for initial installation, pipeline easements shall in all cases be seventy-five (75)

feet in width during construction activities and reduced to fifty (50) feet in width for all operations, maintenance and transportation activities.

f. Uses Within the Pipeline Easements. Pipeline easements shall be for the use of pipelines for oil and gas production and operations; provided, however, the Oil Companies may install one or more pipelines within the same easement, and provided further, Surface Owner shall be entitled to cross such easements at approximately right angles and to install and maintain access to such easements for: i) utility lines, including those for water, gas, sewer, electric, telephone, cable, television and fiber optic; and ii) other purposes with the permission of the applicable Oil Companies, which permission shall not be unreasonably withheld; provided, however, any new underground facilities which travel along or within a pipeline easement identified herein shall be located at a distance horizontally of at least ten (10) feet from parallel existing oil and gas pipelines and flowlines, and such facilities shall have at least twenty-four (24) inches of vertical clearance between the new facility and an oil and gas pipeline or flowline provided for herein, and any overhead power lines shall be at least twenty (20) feet above the ground.

g. Surface Uses Over Pipeline Easements. In all cases, Surface Owner may install grasses (no trees or shrubs) and non-permanent soft surface trails that meander over and across pipeline easements, and it may also install paved surface trails, but only that cross pipeline easements at generally right angles. In cases where pipeline easements are located on the Property and adjacent to Weld County Road 3 or Weld County Road 5 and for the pipeline easement that runs north and south to the Oil and Gas Operations Area in the center of the SE/4 of Section 8 as depicted on Exhibit 2B for the Section 8 Property, Erie may request that Surface Owner install trees or bushes within the pipeline easement. In the event of such a request, Surface Owner shall prepare a landscape plan for review and the consent of KMGG, such consent not to be unreasonably withheld; provided however: i) installation of bushes shall be preferred to trees; and ii) trees and bushes shall not be located on the surface of the pipeline easement area within ten (10) feet of a pipeline. It shall not be unreasonable for KMGG to withhold consent to the installation of trees and bushes on a case by case basis for safety reasons or for the convenient installation and maintenance by KMGG of a pipeline or a portion of the pipeline or because of the type of bush or tree proposed by Surface Owner or the practical width of the pipeline easement given the installation of other pipelines, utilities or improvements within the same easement or proposed to be installed within the same easement, among other considerations. In all cases the Oil Companies shall not be liable for damages to the trails (both hard and soft surface), grasses, bushes or trees that are caused in whole or in part by their oil and gas operations.

h. Use of Pipeline Easements. The Oil Companies shall have the right to limit or restrict use of pipeline easements by Surface Owner and its other grantees for safety or security reasons. Surface Owner shall pay the Oil Companies all costs and expenses they incur to encase or lower pipelines and flowlines, as they determine to be reasonably necessary, to the extent that such pipelines and flowlines intersect and underlie any improvement permitted under this section. Under no circumstances shall Surface Owner prohibit the Oil Companies from the use of the flowlines and pipelines at any time. In addition, the Oil Companies shall have no liability to Surface Owner or any other parties for damage to improvements, landscaping, utilities or

facilities permitted to be installed by Surface Owner or such other parties within or adjacent to pipeline easements for damage caused by the oil and gas operations of the Oil Companies.

i. Minimum Ground Cover to be Maintained. Surface Owner shall maintain a minimum ground cover of 48 inches and not more than 72 inches over pipelines and flowlines in the conduct of its operations and its construction activities on the Property.

j. Road and Pipeline Construction/Coordination. Surface Owner will provide the Oil Companies with at least fourteen (14) days advance written notice before it begins to pave current and future streets and access routes, as applicable, in order to allow the Oil Companies the opportunity to lay new flowlines or pipelines that cross underneath the streets or access routes. If Surface Owner does not give the notice required herein, the Oil Companies may bore underneath the paved streets and access routes, such costs and expenses for the boring to be paid by Surface Owner.

k. Pipeline Depth Investigation. If Surface Owner's development plans anticipate that roadways will or may in the future cross over existing pipelines, Surface Owner will pothole or request that the Oil Companies pothole the existing and future pipelines to check the depth of such pipelines. Prior to Surface Owner's installation of a new roadway, the Oil Companies will lower, as required, the affected pipelines to sufficient depth for the road elevations. Surface Owner agrees to pay the Oil Companies the reasonable cost of inspecting and lowering the pipelines, as well as the reasonable cost of any sub-grade work required to achieve the road construction specifications.

4. Notice of Commencement of Surface Construction and Drilling Activities.

a. Surface Owner Notice. Surface Owner shall give advance notice to and meet at the site with representatives of the appropriate Oil Companies to locate existing pipelines and flowlines and to coordinate proposed surface construction activities with current and prospective oil and gas operations.

b. Oil Company Notice. The applicable Oil Company shall give notice to Surface Owner of proposed drilling activities on the Property in accordance with the rules and regulations of the COGCC, but in no event less than ten (10) days advance notice.

5. Surface Construction Activities.

a. Shut-In Production Payments. Surface Owner shall notify the applicable Oil Company at least twenty (20) days before Surface Owner intends to commence construction activities where it will utilize heavy equipment or other equipment that crosses flowlines or pipelines or that will occur adjacent to an Oil and Gas Operations Area. An Oil Company may, in its reasonable discretion, for safety purposes, shut in any pipeline or flowline over which Surface Owner's heavy earth moving equipment is to be run. Further, Surface Owner may request, or an Oil Company may elect, in its reasonable discretion, to shut in one or more of its wells during Surface Owner's construction activity on the surface of the Property. During the period of shut-in of any well, pipeline or flowline (either at the request of Surface Owner or at the discretion of the Oil Company as herein provided), Surface Owner shall pay the applicable

Oil Company an amount for each day of the shut-in equal to the average daily production of the affected well for the preceding six months calculated on the basis of the days that the well actually produced during the six month period.

Surface Owner shall also pay the Oil Company any costs to rework the well in order to place the well in production status after the shut-in and costs to replace pipelines and flowlines that are damaged by the surface construction activities of Surface Owner.

b. Electrical Equipment. Surface Owner shall pay the applicable Oil Company all costs that the Oil Company incurs to change electrical equipment for an Oil and Gas Operations Area where the Oil Company is required to make the change because of actual surface development of the Property.

6. Subdivision Plat and Local Regulations. Surface Owner shall identify the Temporary Easement Areas and the Oil and Gas Operations Areas and all present and future access routes and pipeline easements on its subdivision plats and in all applications for development that it files with a local jurisdiction. Plats shall include restrictions that no property line, permanent or temporary building, structure or other improvement, landscaping or sprinkler systems shall be located, constructed or installed within the Oil and Gas Operations Areas and pipeline easements, except as otherwise expressly permitted in sections 1.d. and 3.g. Except as expressly permitted under this Agreement, Surface Owner shall not locate temporary or permanent buildings, structures, improvements or landscaping or sprinkler systems within the Oil and Gas Operations Areas or upon or within the pipeline easements, and it shall not locate structures, improvements and equipment under the surface of the Oil and Gas Operations Areas, including but not limited to, sewer lines, gas pipelines or water lines.

7. Waiver of Surface Damage Payments. Surface Owner hereby waives all surface damage payments or other such payments for the use of the Property or portions thereof pursuant to any current or future COGCC or local regulation, state statute, common law or prior agreement for each and every well and related wellsite that is drilled and constructed within an Oil and Gas Operations Area and for all production facilities and for the pipeline easements and access routes as depicted on Exhibit 2A and Exhibit 2B (or relocated area) and for the use of the Temporary Easement Area as provided for herein. The Oil Companies may provide a copy of this Agreement to the COGCC or to any local jurisdiction, person or entity or any court of law as evidence of this waiver. The term "surface damages" shall be given the meaning commonly used in the oil and gas industry, but is not intended to be a waiver of damages caused by the negligence of the Oil Companies or their unreasonable use of the surface.

8. Waiver of Setback and Other Requirements. Surface Owner understands and acknowledges that the COGCC has rules and regulations that apply to the distance between a wellhead and public roads, production facilities, building units and surface property lines, among other things. Surface Owner hereby waives all setback requirements in COGCC Rule 603 (including the high density setback rules), or any successor rule or amendment to the COGCC setback rules, and to any other state or local setback requirements that are or become inconsistent with this Agreement or that would prohibit or interfere with the rights of the Oil Companies to explore for and produce the oil and gas in accordance with this Agreement. Surface Owner understands (and shall notify parties who purchase all or portions of the Property from Surface

Owner) that the Oil Companies may cite the waiver in this section 8 in order to obtain a location requirement exception or variance under COGCC rules or from a local jurisdiction; provided, any such request for an exception location or variance is consistent with the terms of this Agreement.

9. Payment of Relocation Costs. Surface Owner shall give advance written notice to the applicable Oil Company at least thirty (30) days prior to the time that Surface Owner requests that an Oil Company relocate an access road or pipeline pursuant to sections 2.b. or 3.d. The applicable Oil Company shall thereafter provide Surface Owner with an estimate of the costs for the relocation within thirty (30) days after receipt of the notice. Surface Owner shall pay the full amount of the estimate of relocation costs to the Oil Company within ten (10) days from the date it receives the estimate. Upon receipt of the estimate of costs by Surface Owner and the execution of a separate relocation agreement, the Oil Company will within a reasonable time commence the relocation of the applicable access road or pipeline, install the same in a good and workmanlike manner, and diligently pursue such relocation work to completion within a reasonable time. Upon completion of the relocation, the Oil Company shall give Surface Owner an accounting of the costs and expenses of the relocation. If the amount of such costs exceeds the amount of the estimate, Surface Owner shall pay the Oil Company the amount of the shortfall within ten (10) days from the receipt of the accounting. If the amount of such costs is less than the amount of the estimate, the Oil Company shall reimburse the difference to Surface Owner at the time it provides the accounting to Surface Owner.

10. Governmental Proceedings.

a. Surface Owner Will Not Object. Surface Owner agrees that: i) it will not object in any forum to the use by the Oil Companies of the surface of the Property consistent with this Agreement and the Development Agreement, to the extent not inconsistent with this Agreement, and hereby waives any such right to object or to request a hearing; ii) it will provide such other written approvals and waivers which are requested and consistent with this Agreement, including, but not limited to, all approvals and waivers to drill a well or to conduct oil and gas operations on the Property because of any law or regulation, including any local ordinance and regulations of the COGCC, and including, for example, waivers to state and local setback requirements and to any setback requirement from a surface property line or for an exception location; iii) it waives any rights it has to require or request a surface inspection for wells proposed to be drilled on the Property for the purpose of requesting that conditions be attached to a permit to drill a well and waives its right to request such conditions; iv) it consents to the location of multiple wells within an Oil and Gas Operations Area (as provided herein) that are greater or less than fifty feet apart so long as all such wells are located within the Oil and Gas Operations Area (as provided herein); and v) it waives its rights to object, request a hearing before the COGCC or that conditions be attached to a COGCC permit to drill, and to allege noncompliance with COGCC rules or applicable statutes, or to allege potential adverse impacts to public health, safety, and welfare, including the environment and wildlife resources, that are within the jurisdiction of the COGCC with respect to COGCC Applications for Permit to Drill ("Form 2") and COGCC Oil and Gas Location Assessments ("Form 2A").

b. Oil Companies Will Not Object. Except as provided in section 28.c. with respect to the Anadarko Entities, the Oil Companies agree that they will not object in any forum to a

request by Surface Owner to zone, rezone, plat or replat all or any portion of the Property to the extent such request is consistent with this Agreement and the Development Agreement, to the extent not inconsistent with this Agreement.

11. Notice to Home Builders and Homeowners. Surface Owner shall furnish all persons or entities that have a contract to purchase or that purchase all or any portion of the Property from Surface Owner with an exhibit that shows the locations of all Oil and Gas Operations Areas, existing and future pipeline easements and existing and proposed access routes. In addition, Surface Owner shall provide written notice to all such purchasers that includes as follows:

i. such buyers are not purchasing and will not own any interest in the oil and gas mineral estate;

ii. there may be ongoing oil and gas operations and production on the surface of the Property within the Oil and Gas Operations Areas, pipeline easements and access routes;

iii. additional oil and gas wells are likely to be drilled and oil and gas operations and production will likely take place on the Property, including the construction of oil and gas facilities, pipelines and flowlines, which will affect the surface of the Property within the Oil and Gas Operations Areas, pipeline easement(s) and access road(s);

iv. heavy equipment will be used by the oil and gas interest owners from time to time for oil and gas drilling and production operations, and such operations may be conducted on a 24 hour basis;

v. future purchasers of all or a portion of the Property, as successors in interest, will be bound by the covenants and provisions in this Agreement and subject to the waivers and covenants (i) included in sections 1.d., 2.a., 3.c., 7, 8, 10 and 21, among others; (ii) prohibiting the location of any building, structure, or other improvement by the purchaser within the Oil and Gas Operations Areas and pipeline easement areas; (iii) waiving objections to the drilling of wells, the construction of facilities, and the conduct of oil and gas operations on the Property consistent with this Agreement; and iii) waiving objections to the setback requirements under the rules of the COGCC or any local jurisdiction.

12. Impact Mitigation.

a. Oil Company Mitigation. The Oil Companies agree that they shall install and maintain and repair at their sole cost and expense such fences, gates and locks around the wells and production facilities as are required by the COGCC or Erie or Weld County as a condition for a special use permit to drill wells. To the extent required by law or regulation, the Oil Companies shall bear the costs of impact mitigation measures, including environmental or hazardous materials cleanup, remediation or mitigation for their individual operations on the Property.

b. Surface Owner Mitigation. Except as provided in section 12.a., Surface Owner shall bear all costs and expenses to install such noise and visual impact mitigation measures it desires or Erie or Weld County or other applicable local jurisdiction requires at or around the Oil

shall be construed as if drafted jointly by the parties and no presumption or burden of proof shall arise favoring or disfavoring any party by virtue of authorship of any of the provisions of this Agreement. Any reference to any federal, state, local or foreign statute or law shall be deemed also to refer to all rules and regulations promulgated thereunder, unless the context requires otherwise. The word "including" shall mean including, without limitation.

23. Successors and Assigns. This Agreement and all of the covenants in it shall be binding upon the personal representatives, heirs, successors and assigns of all of the parties, and the benefits of this Agreement shall inure to their personal representatives, heirs, successors and assigns. This Agreement and all of the covenants in it shall be covenants running with the land.

24. Recording. The Oil Companies shall record this Agreement with the Clerk and Recorder of Weld County promptly after it is executed by all of the parties and provide evidence to the other parties of the recording.

25. Governing Law. The validity, interpretation and performance of this Agreement shall be governed and construed in accordance with the laws of the State of Colorado without reference to its conflicts of laws provisions.

26. Severability. If any part of this Agreement is found to be in conflict with applicable laws, such part shall be inoperative, null and void insofar as it conflicts with such laws; however, the remainder of this Agreement shall be in full force and effect. In the event that any part of this Agreement would otherwise be unenforceable or in conflict with applicable laws due to the term or period for which such part is in effect, the term or period for which such part of this Agreement shall be in effect shall be limited to the longest period allowable which does not cause such part to be unenforceable or in conflict with applicable laws.

27. Incorporation by Reference. Exhibits 1A, 1B, 2A, 2B, 3, 4 and 5 are incorporated into this Agreement by reference.

28. Entire Agreement and Conflicts in Agreements.

a. Entire Agreement. With respect to the matters included in them, this Agreement, the Development Agreement and the Letter Agreement set forth the entire understanding among the parties or the particular parties to the specific agreement and supersede any previous communications, representations or agreements, whether oral or written. No change of any of the terms or conditions herein shall be valid or binding on any party unless in writing and signed by an authorized representative of each party.

b. Conflicts Between Particular Agreements. In the event of a conflict between this Agreement and the Development Agreement for a matter specifically covered in this Agreement, this Agreement shall control. In the event of a conflict between this Agreement and the Letter Agreement for a matter specifically covered in the Letter Agreement, the Letter Agreement shall control.

c. Anadarko Entities Agreement Conditional. The agreement herein of the Anadarko Entities is conditioned upon the execution by Surface Owner of: i) the Letter

and Gas Operations Areas which are in excess of or in addition to those measures which are required by COGCC regulations for areas which are not high density and which are required at the time Surface Owner applies for surface development approvals; provided, however, the operator of the well within the particular Oil and Gas Operations Area shall have reasonable discretion to veto or protest the types and locations of impact mitigation measures in order to allow for safe oil and gas operations.

13. Limited Surface Use By Oil Companies. Except for the Oil and Gas Operations Areas and the access roads and easements associated with flowlines, gathering lines and pipelines as provided for in this Agreement, and the use of the Temporary Easement Areas as provided herein, the Oil Companies shall not occupy the surface of the Property except in the event of an emergency or for reasonable incidental, temporary and non-damaging activities, for which the particular Oil Company shall be strictly and solely responsible for any damages that may occur.

14. Compliance with Kerr-McGee's General Guidelines. Surface Owner acknowledges that it has received a copy of a document from Kerr-McGee titled "General Guidelines for Design and Construction Activities On or Near Kerr-McGee Gathering LLC and Kerr-McGee Rocky Mountain Corporation Pipelines and Related Facilities" (Revision 1/2010) with which Surface Owner agrees to comply and which is attached as Exhibit 5.

15. Individual Liability of Oil Companies. Nothing in this Agreement is intended to create a cause of action by any Oil Company against any other Oil Company or to enlarge or diminish any right or interest created by any agreement or lease or assignment of lease between or among the Oil Companies. The liability of the Oil Companies to perform any obligation or to comply with any agreement hereunder or to comply with any state or local rule or regulation is individual and several and not joint or collective. No Oil Company shall be liable or responsible for the acts, omissions, performance, obligations or duties of the other Oil Companies under this Agreement. Surface Owner shall look solely to the applicable Oil Company for the performance by such Oil Company of its obligations under this Agreement and compliance with applicable laws and regulations with respect to its respective oil and gas operations on the Property. The agreements herein of a particular Oil Company apply only to the extent of the oil and gas interests in the Property that are now owned or that may be owned in the future by that Oil Company. This Agreement does not create a joint venture or partnership between or among any of the Oil Companies or the Anadarko Entities. The Anadarko Entities shall in no event be liable for the acts or omissions of their lessees, assignees of such lessees or farmoutees or the contractors and subcontractors of any of them.

16. No Waiver of Rights. The Oil Companies do not waive the rights they have pursuant to each of their respective oil and gas interests to explore for, drill and produce the oil and gas for the Property or for ingress and egress to any Oil and Gas Operations Area, except as specifically provided in this Agreement.

17. Conflict in Agreements. In the event of a conflict between this Agreement and the Development Agreement, this Agreement shall control; provided, however, the terms of the Development Agreement shall continue to apply to the extent that they are not inconsistent with this Agreement.

18. Notice of Hearings. Surface Owner shall provide the Oil Companies with written notice not less than thirty (30) days before each hearing for approval of a plat application or other land use application for the Property that is to be held before Erie or Weld County.

19 Notices. Any notice or other communication required or permitted under this Agreement shall be given in writing by any of: i) personal delivery; ii) expedited delivery service with proof of delivery; iii) United States mail, postage prepaid, and registered or certified mail with return receipt requested; or iv) prepaid telecopy or fax, the receipt of which shall be acknowledged, addressed as follows:

| | |
|---|---|
| Surface Owner: | Tallgrass Investors, LLC<br>2500 Arapahoe Avenue, Suite 220<br>Boulder, Colorado 80302<br>Attention: Jon Lee<br>Fax: (303) 442-1241 |
| Anadarko Entities<br>Kerr-McGee<br>and KMGG: | Anadarko Petroleum Corporation<br>1099 18th Street, Suite 1800<br>Denver, Colorado 80202 |
| Encana: | Encana Oil & Gas (USA) Inc.<br>370 17th Street, Suite 1700<br>Denver, Colorado 80202<br>Attn: DJ Land Team Lead |

Any party may, by written notice as provided in this section, change the address of the individual to whom delivery of notices shall be made thereafter.

20. Acknowledgment of Title to Oil and Gas. Surface Owner specifically acknowledges the title of Anadarko E&P and Anadarko Land to the oil and gas reserved for the Property and relinquishes all rights and claims thereto, and it also acknowledges the oil and gas leasehold rights that Kerr-McGee and Encana own for the Property and relinquishes all rights and claims thereto.

21. Compliance with Common Law and Statutory and Regulatory Requirements. Surface Owner expressly acknowledges that this Agreement satisfies the obligations and requirements of the Oil Companies pursuant to COGCC rules and regulations and Colorado statutes to consult in good faith with Surface Owner regarding existing and proposed oil and gas operations on the Property, including pursuant to COGCC Rules 305 and 306, as amended. Surface Owner further expressly acknowledges that this Agreement shall be deemed to be specifically applicable to, and to fully satisfy, the obligations of the Oil Companies to accommodate the use of the surface of the Property by Surface Owner, existing and future, and Surface Owner waives any statutory and common law claims to the contrary, including, but not limited to, any claims pursuant to C.R.S. 34-60-127.

22. Construction. The parties have participated jointly in the negotiating and drafting of this Agreement. In the event ambiguity or question of intent or interpretation arises, this Agreement

Agreement; and ii) a separate letter agreement among the Anadarko Entities, Noble Energy, Inc. and Surface Owner for property included in the Bridgewater development described as the N/2 of Section 17, Township 1 North, Range 68 West.

29. Counterpart Executions. This Agreement may be executed in counterparts, each of which shall be deemed an original, and all of which together shall constitute one and the same instrument.

IN WITNESS WHEREOF, the undersigned parties have caused this Agreement to be executed by duly authorized representatives on the dates set forth in the acknowledgements, but to be effective on the date first above written.

ANADARKO E&P COMPANY LP

By: _____
Name: David Bell
Its: Agent and Attorney-In-Fact

ENCANA OIL & GAS (USA) INC.

By: _____
Name: _____
Its: _____

ANADARKO LAND CORP.

By: _____
Name: David Bell
Its: Agent and Attorney-In-Fact

TALLGRASS INVESTORS, LLC

By: _____
Name: _____
Its: _____

KERR-McGEE OIL & GAS ONSHORE LP

By: _____
Name: David Bell
Its: Agent and Attorney-In-Fact

Kerr-McGee Gathering LLC signs this Agreement as the entity which gathers and may in the future gather gas from wells drilled on the Property or on lands near the Property and in no other capacity. KMGG is not otherwise bound by the obligations in this Agreement, but shall have the right to enforce the provisions in section 3.

KERR-McGEE GATHERING LLC

By: _____
Name: Ronald H. Olsen
Title: Agent + Attorney-in-Fact

Agreement; and ii) a separate letter agreement among the Anadarko Entities, Noble Energy, Inc. and Surface Owner for property included in the Bridgewater development described as the N/2 of Section 17, Township 1 North, Range 68 West.

29. Counterpart Executions. This Agreement may be executed in counterparts, each of which shall be deemed an original, and all of which together shall constitute one and the same instrument.

IN WITNESS WHEREOF, the undersigned parties have caused this Agreement to be executed by duly authorized representatives on the dates set forth in the acknowledgements, but to be effective on the date first above written.

ANADARKO E&P COMPANY LP

By: _____
Name: _____
Its: _____

ENCANA OIL & GAS (USA) INC.

By: _____
Name: Ricardo D. Gallegos
Its: Attorney In Fact

ANADARKO LAND CORP.

By: _____
Name: _____
Its: _____

TALLGRASS INVESTORS, LLC

By: _____
Name: _____
Its: _____

KERR-McGEE OIL & GAS ONSHORE LP

By: _____
Name: _____
Its: _____

Kerr-McGee Gathering LLC signs this Agreement as the entity which gathers and may in the future gather gas from wells drilled on the Property or on lands near the Property and in no other capacity. KMGG is not otherwise bound by the obligations in this Agreement, but shall have the right to enforce the provisions in section 3.

KERR-McGEE GATHERING LLC

By: _____
Name: _____
Title: _____

Agreement; and ii) a separate letter agreement among the Anadarko Entities, Noble Energy, Inc. and Surface Owner for property included in the Bridgewater development described as the N/2 of Section 17, Township 1 North, Range 68 West.

29. Counterpart Executions. This Agreement may be executed in counterparts, each of which shall be deemed an original, and all of which together shall constitute one and the same instrument.

IN WITNESS WHEREOF, the undersigned parties have caused this Agreement to be executed by duly authorized representatives on the dates set forth in the acknowledgements, but to be effective on the date first above written.

ANADARKO E&P COMPANY LP

By: _____
Name: _____
Its: _____

ENCANA OIL & GAS (USA) INC.

By: _____
Name: _____
Its: _____

ANADARKO LAND CORP.

By: _____
Name: _____
Its: _____

TALLGRASS INVESTORS, LLC

By: _____
Name: Jon RLEE
Its: AUTHORIZED REPRESENTATIVE

KERR-McGEE OIL & GAS ONSHORE LP

By: _____
Name: _____
Its: _____

Kerr-McGee Gathering LLC signs this Agreement as the entity which gathers and may in the future gather gas from wells drilled on the Property or on lands near the Property and in no other capacity. KMGG is not otherwise bound by the obligations in this Agreement, but shall have the right to enforce the provisions in section 3.

KERR-McGEE GATHERING LLC

By: _____
Name: _____
Title: _____

3799568 10/18/2011 12:26P Weld County, CO
18 of 46 R 236.00 D 0.00 Steve Moreno Clerk & Recorder

## ACKNOWLEDGMENTS

STATE OF Colorado )
) ss.
COUNTY OF Adams )

The foregoing instrument was acknowledged before me this 10th day of October, 2011, by David Bell, as Agent and Attorney-In-Fact for ANADARKO E&P COMPANY LP.

My Commission expires: 9/27/2015:

*Witness my hand and official seal.*

Notary Public

M. HENCMANN NOTARY PUBLIC STATE OF COLORADO
My Commission Expires 9-27-2015

STATE OF Colorado )
) ss.
COUNTY OF Adams )

The foregoing instrument was acknowledged before me this 10th day of October, 2011, by David Bell, as Agent and Attorney-In-Fact for ANADARKO LAND CORP.

My Commission expires: 9/27/2015:

*Witness my hand and official seal.*

Notary Public

M. HENCMANN NOTARY PUBLIC STATE OF COLORADO
My Commission Expires 9-27-2015

STATE OF Colorado )
) ss.
COUNTY OF Adams )

The foregoing instrument was acknowledged before me this 10th day of October, 2011, by David Bell, as Agent and Attorney-In-Fact for KERR-McGEE OIL & GAS ONSHORE LP.

My Commission expires: 9/27/2015:

*Witness my hand and official seal.*

Notary Public

M. HENCMANN NOTARY PUBLIC STATE OF COLORADO
My Commission Expires 9-27-2015

3799568 10/18/2011 12:26P Weld County, CO
19 of 46 R 236.00 D 0.00 Steve Moreno Clerk & Recorder

STATE OF Colorado )
Denver ) ss.
COUNTY OF ~~Adams~~ )

The foregoing instrument was acknowledged before me this 11th day of October, 2011, by Ronald H. Olsen, as Agent and Attorney-In-Fact for KERR-McGEE GATHERING LLC.

My Commission expires: 9/27/2015:

*Witness my hand and official seal.*

Notary Public

M. HENGMANN NOTARY PUBLIC STATE OF COLORADO
My Commission Expires 9-27-2015

STATE OF COLORADO )
) ss.
City and County of Denver )

The foregoing instrument was acknowledged before me this _____ day of _____, 2011, by _____, as _____ for ENCANA OIL & GAS (USA) INC.

My Commission expires:_____:

*Witness my hand and official seal.*

_____
Notary Public

STATE OF COLORADO )
) ss.
COUNTY OF _____ )

The foregoing instrument was acknowledged before me this _____ day of _____, 2011, by _____, as _____ for TALLGRASS INVESTORS, LLC

My Commission expires:_____:

*Witness my hand and official seal.*

_____
Notary Public

3799568 10/18/2011 12:26P Weld County, CO
20 of 46 R 236.00 D 0.00 Steve Moreno Clerk & Recorder

STATE OF _____ )
) ss.
COUNTY OF _____ )

The foregoing instrument was acknowledged before me this _____ day of _____, 2011, by _____, as _____ for KERR-McGEE GATHERING LLC.

My Commission expires:_____:

*Witness my hand and official seal.*

_____
Notary Public

STATE OF COLORADO )
) ss.
City and County of Denver )

The foregoing instrument was acknowledged before me this 28th day of September 2011, by Rick Gallegar, as Attorney-in-Fact for ENCANA OIL & GAS (USA) INC.

My Commission expires: 11/30/2011:

*Witness my hand and official seal.*

Notary Public

EMILY CONRAD NOTARY PUBLIC STATE OF COLORADO
My Commission Expires 11/30/2011

STATE OF COLORADO )
) ss.
COUNTY OF _____ )

The foregoing instrument was acknowledged before me this _____ day of _____, 2011, by _____, as _____ for TALLGRASS INVESTORS, LLC

My Commission expires:_____:

*Witness my hand and official seal.*

_____
Notary Public

3799568 10/18/2011 12:26P Weld County, CO
21 of 46 R 236.00 D 0.00 Steve Moreno Clerk & Recorder

STATE OF _____ )
) ss.
COUNTY OF _____ )

The foregoing instrument was acknowledged before me this _____ day of _____, 2011, by _____, as _____ for KERR-McGEE GATHERING LLC.

My Commission expires:_____:

*Witness my hand and official seal.*

_____
Notary Public

STATE OF COLORADO )
) ss.
City and County of Denver )

The foregoing instrument was acknowledged before me this _____ day of _____, 2011, by _____, as _____ for ENCANA OIL & GAS (USA) INC.

My Commission expires:_____:

*Witness my hand and official seal.*

_____
Notary Public

STATE OF COLORADO )
) ss.
COUNTY OF DENVER )

The foregoing instrument was acknowledged before me this 14th day of October, 2011, by Jon R. Lee, as Authorized Representative for TALLGRASS INVESTORS, LLC

My Commission expires: 4/27/2013:

LORRI L. SIMPSON NOTARY PUBLIC STATE OF COLORADO My Commission Expires 4/27/13

*Witness my hand and official seal.*

Lorri L. Simpson
Notary Public

3799568 10/18/2011 12:26P Weld County, CO
22 of 46 R 236.00 D 0.00 Steve Moreno Clerk & Recorder

**Exhibit 1A**
to
**Surface Use Agreement effective September 27, 2011 by and among Anadarko Land Corp., Anadarko E&P Company LP, Kerr-McGee Oil & Gas Onshore LP, Kerr-McGee Gathering LLC (for the limited purposes described herein), Encana Oil & Gas (USA) Inc. and Tallgrass Investors, LLC**

**Legal Description of the Section 18 Property**

**Township 1 North, Range 68 West**
**Section 18: metes and bounds description**
**Weld County, Colorado**

**See attached legal description consisting of two (2) pages.**

3799568 10/18/2011 12:26P Weld County, CO
25 of 46 R 236.00 D 0.00 Steve Moreno Clerk & Recorder

**Exhibit 1B**
**to**
**Surface Use Agreement effective September 27, 2011**
**by and among Anadarko Land Corp., Anadarko E&P Company LP, Kerr-McGee Oil & Gas Onshore LP, Kerr-McGee Gathering LLC (for the limited purposes described herein), Encana Oil & Gas (USA) Inc. and Tallgrass Investors, LLC**

**Legal Description of the Section 8 Property**

**Township 1 North, Range 68 West**
**Section 8: metes and bounds description**
**Weld County, Colorado**

**See attached legal description consisting of two (2) pages.**

3799568 10/18/2011 12:26P Weld County, CO
23 of 46 R 236.00 D 0.00 Steve Moreno Clerk & Recorder

# Section 18 Property

A parcel of land situate in the E1/2 of Section 18, Township 1 North, Range 68 West of th 6th P.M., Weld County, more particularly described as follows:

PARCEL D

Commencing at the Northeast corner of Section 18, Township 1 North, Range 68 West, 6th P.M., from whence the East 1/4 corner of said section lies S00°02'28" E, 2678.62 feet;
Thence N89°14'48" W, 30.07 feet to the point of beginning;
Thence S00°02'28" E, 1897.89 feet parallel with and 30.00 feet distant West of the East line of the NE1/4 of Section 18 to a point on the North line of the Erie Cemetery, partially described in a deed recorded on May 23, 1968, as Reception No. 1516751;
Thence N89°59'20" W, 640.42 feet to the Northwest corner of said cemetery;
Thence S00°03'40" W, 404.65 feet to the North line of a parcel recorded in Book 30, Page 483;
Thence N89°34'58" W, 163.67 feet to the Northwest corner of said parcel;
Thence S00°04'57" E, 417.42 feet to the Southwest corner of said parcel;
Thence S89°34'58" E, 804.84 feet to a point 30.00 feet westerly of the East line of the SE1/4 of Section 18;
Thence S00°25'10" E, 1450.65 feet parallel with and 30.00 feet distant westerly of the East line of said SE1/4 to a point on the North line of a parcel recorded as Reception No 1516751;

Thence along boundary of said parcel the following three courses:
1) S89°40'50" W, 658.56 feet,
2) S00°19'10" E, 253.00 feet,
3) N89°40'50" E, 659.00 feet to a point 30.00 feet westerly of the East line of the SE1, of Section 18;

Thence S00°25'10" E, 825.08 feet to a point 30.00 feet northerly of the South line of sai SE1/4 of Section 18, said point also being the northerly right-of-way line of Weld County Road 8;
Thence N89°31'17" W, 258.53 feet, along said northerly right of way, parallel with and 30.00 feet North of the South line of said SE1/4;
Thence N86°54'04" W, 1098.49 feet along the northerly line of Weld County Road 8, as described in Book 15551, Pages 39-43, Reception Nos. 2495437-41 to a point on the easterl line of property described in Book 754 at Reception No. 1676471;

Thence along said property the following three courses:
1) N00°29'16" E, 49.80 feet;
2) 453.09 feet along the arc of a tangent curve to the left, said arc subtended by a radius of 440.00 feet, a central angle of 59°00'00", and a chord bearing N29°00'44" W 433.33 feet;
3) N58°30'44" W, 204.67 feet to a point 50.00 feet distant southeasterly, measured at right angles, from the centerline of the main track of the Boulder branch of the Unic

(continued)

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Pacific Railroad Company as presently constructed and operated, said right of way conveyed to the Union Pacific Railroad by deed recorded in Book 359 at Page 418;
Thence northerly along a line drawn parallel and/or radially with said centerline of ma. track the following nine courses:

1) 629.21 feet along the arc of a non-tangent curve to the left, said arc subtended by radius of 1007.50 feet, a central angle of 35°46'57", and a chord bearing N07°31'37 E, 619.03 feet;
2) Thence N10°21'52" W, 694.70 feet;
3) 894.20 feet along the arc of a tangent curve to the right, said arc subtended by a radius of 1287.50 feet, a central angle of 39°47'36", and a chord bearing N09°31'57 E, 876.34 feet;
4) N29°25'45" E, 224.87 feet;
5) 463.85 feet along the arc of a tangent curve to the left, said arc subtended by a radius of 1673.50 feet, a central angle of 15°52'51", and a chord bearing N21°29'19 E, 462.36 feet;
6) N13°32'54" E, 421.72 feet;
7) 966.21 feet along the arc of a tangent curve to the left, said arc subtended by a radius of 2957.50 feet, a central angle of 18°43'06", and a chord bearing N04°11'21 E, 961.91 feet;
8) N05°10'12" W, 351.67 feet;
9) 165.08 feet along the arc of a tangent curve to the right, said arc subtended by a radius of 1575.00 feet, a central angle of 06°00'20", and a chord bearing N02°10'02 W, 165.01 feet to a point on the North line of the NE1/4 of Section 18;

Thence along said North line S89°14'48" E, 1206.77 feet to the point of beginning,
EXCEPTING THEREFROM a "road right of way 8 feet in width leading to said cemetery from Erie", so described in Book 30 at Page 483.

3799568 10/18/2011 12:26P Weld County, CO
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# Section 8 Property

Two parcels of land situate in the S21/4 of Section 8, Township 1 North, Range 68 West o the 6th P.M., Weld County, more particularly described as follows:

PARCEL B

Commencing at the Southeast corner of Section 8, Township 1 North, Range 68 West, 6th P.M., from whence the East 1/4 corner of said section lies N00°49'09" E, 2674.68 feet; Thence N45°04'48" W, 41.78 feet to the point of beginning, 30.00 feet North of the South line of said section;
Thence S89°01'14" W, 2618.83 feet parallel with and 30.00 feet North of the South line o said section to a point on the North-South centerline of Section 8;
Thence N00°01'31" E, 1579.23 feet along said North-South centerline to a point on the South right of way line of the Union Pacific Railroad, said right-of-way conveyed to the Union Pacific Railroad by a deed recorded June 13, 1912, in Book 359 at Page 418, said right-of-way line being 50.00 feet distant southerly as measured at right angles or radially from the existing main track centerline;
Thence along said right of way the following three courses:

1) N42°43'40" E, 467.34 feet,
2) 1735.43 feet along the arc of a tangent curve to the right, said arc subtended by a radius of 1858.50 feet, a central angle of 53°30'06", and a chord bearing N69°28'43" E, 1673.07 feet,
3) S83°46'14" E, 772.36 feet to a point 30.00 feet West of the East line of the S1/2 of the section;

Thence S00°49'09" W, 2380.71 feet parallel with and 30.00 feet West of the East line of the S1/2 to the point of beginning.

(continued)

3799568 10/18/2011 12:26P Weld County, CO
27 of 46 R 236.00 D 0.00 Steve Moreno Clerk & Recorder

PARCEL B-1

Commencing at the East 1/4 corner of Section 8, Township 1 North, Range 68 West, 6th P.M. from whence the Southeast corner of said section lies S00°49'09" W, 2674.68 feet;
Thence along the East-West centerline S89°35'35" W, 30.00 feet to the point of beginning;
Thence S00°49'09" W, 163.81 feet parallel with and 30.00 feet West of the East line of th S1/2 of Section 8 to a point on the northerly right-of-way line of the Union Pacific Railroad, said right of way conveyed to the Union Pacific Railroad by a deed recorded Jur 13, 1912, in Book 359 at Page 418, said right-of-way line being 50.00 feet distant northerly as measured at right angles or radially from the existing main track centerline;
Thence following said northerly right of way the following three courses:

1) N83°46'14" W, 762.89 feet,
2) 1828.81 feet along the arc of a tangent curve to the left, said arc subtended by a radius of 1958.50 feet, a central angle of 53°30'06", and a chord bearing S69°28'43" W, 1763.09 feet;
3) S42°43'40" W, 358.98 feet to a point on the North-South centerline of Section 8;

Thence N00°01'31" E, 943.91 feet along said North-South centerline to a point on the East-West centerline of said Section 8;
Thence N89°35'35" E, 2655.15 feet along the East-West centerline to the point of beginning.

(continued)

3799568 10/18/2011 12:26P Weld County, CO
28 of 46 R 236.00 D 0.00 Steve Moreno Clerk & Recorder

**Exhibit 2A**

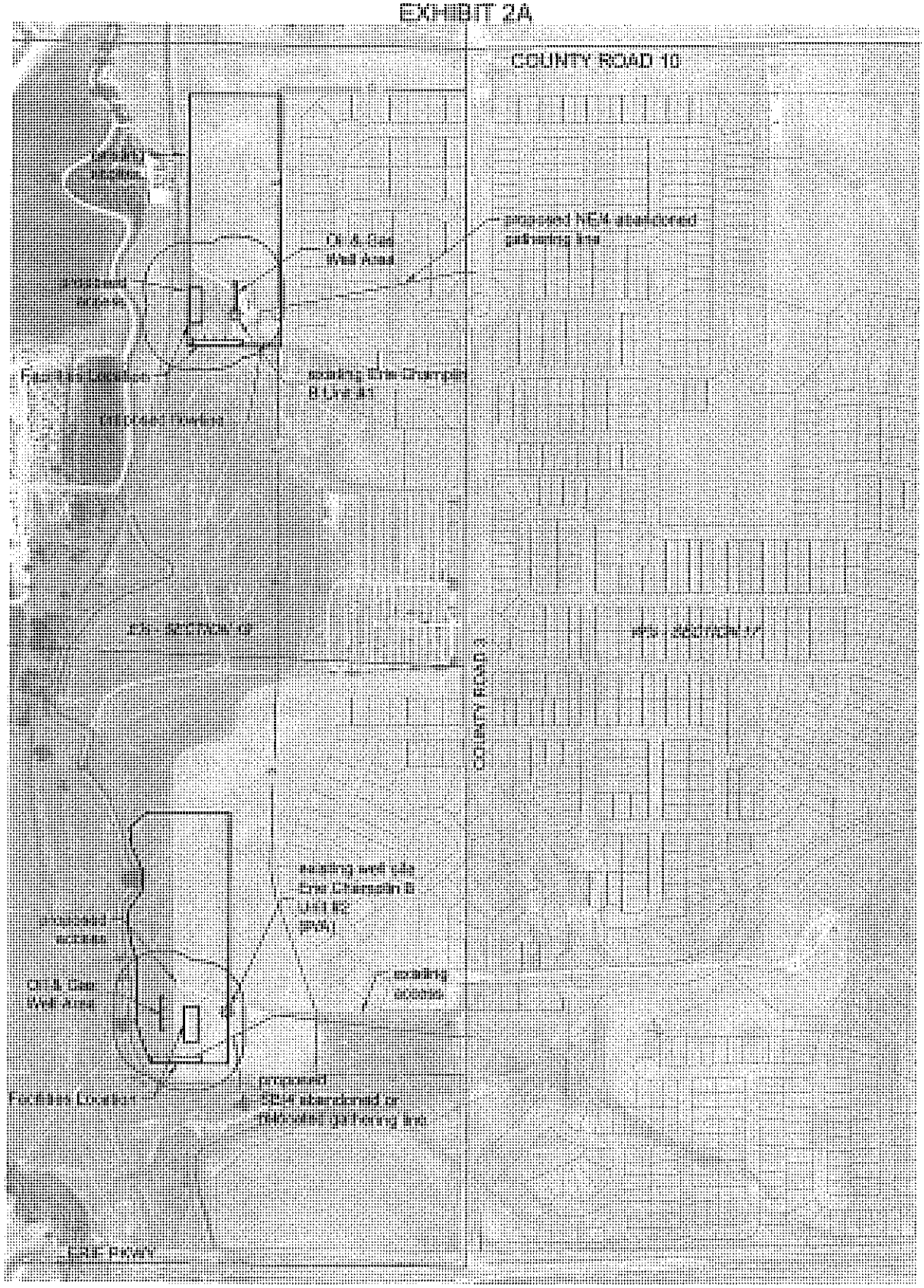
to

**Surface Use Agreement effective September 27, 2011 by and among Anadarko Land Corp., Anadarko E&P Company LP, Kerr-McGee Oil & Gas Onshore LP, Kerr-McGee Gathering LLC (for the limited purposes described herein), Encana Oil & Gas (USA) Inc. and Tallgrass Investors, LLC**

**See attached Plats consisting of three (3) pages for the Section 18 Property.**

3799568 10/18/2011 12:26P Weld County, CO
29 of 46 R 236.00 D 0.00 Steve Moreno Clerk & Recorder

EXHIBIT 2A




PROPOSED ACCESS

TEMPORARY EASEMENT AREA

FUTURE PIPELINE EASEMENT (75' TEMPORARY & 50' PERMANENT)

OIL & GAS OPERATIONS AREA

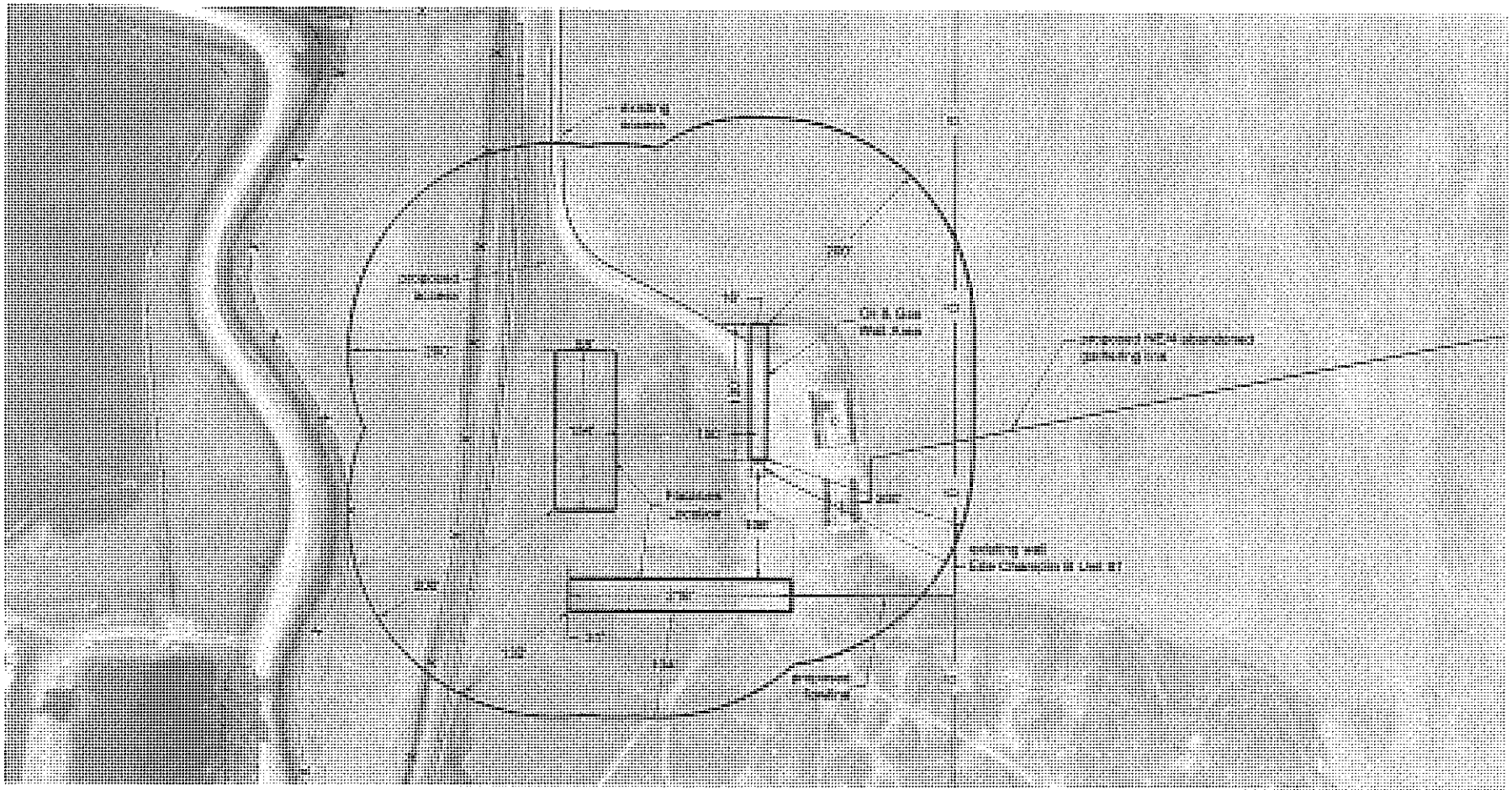
encana

TOWNSHIP 1 NORTH, RANGE 68 WEST
A PORTION OF SECTIONS 17 & 18
WELD COUNTY, COLORADO

SCALE: 1" = 400' SEPTEMBER 26, 2011

# EXHIBIT 2A.1

3799568 10/18/2011 12:26P Weld County, CO
30 of 46 R 236.00 D 0.00 Steve Moreno Clerk & Recorder



OIL & GAS OPERATIONS AREA

PROPOSED ACCESS

g FUTURE PIPELINE EASEMENT
(75' TEMPORARY & 50' PERMANENT)

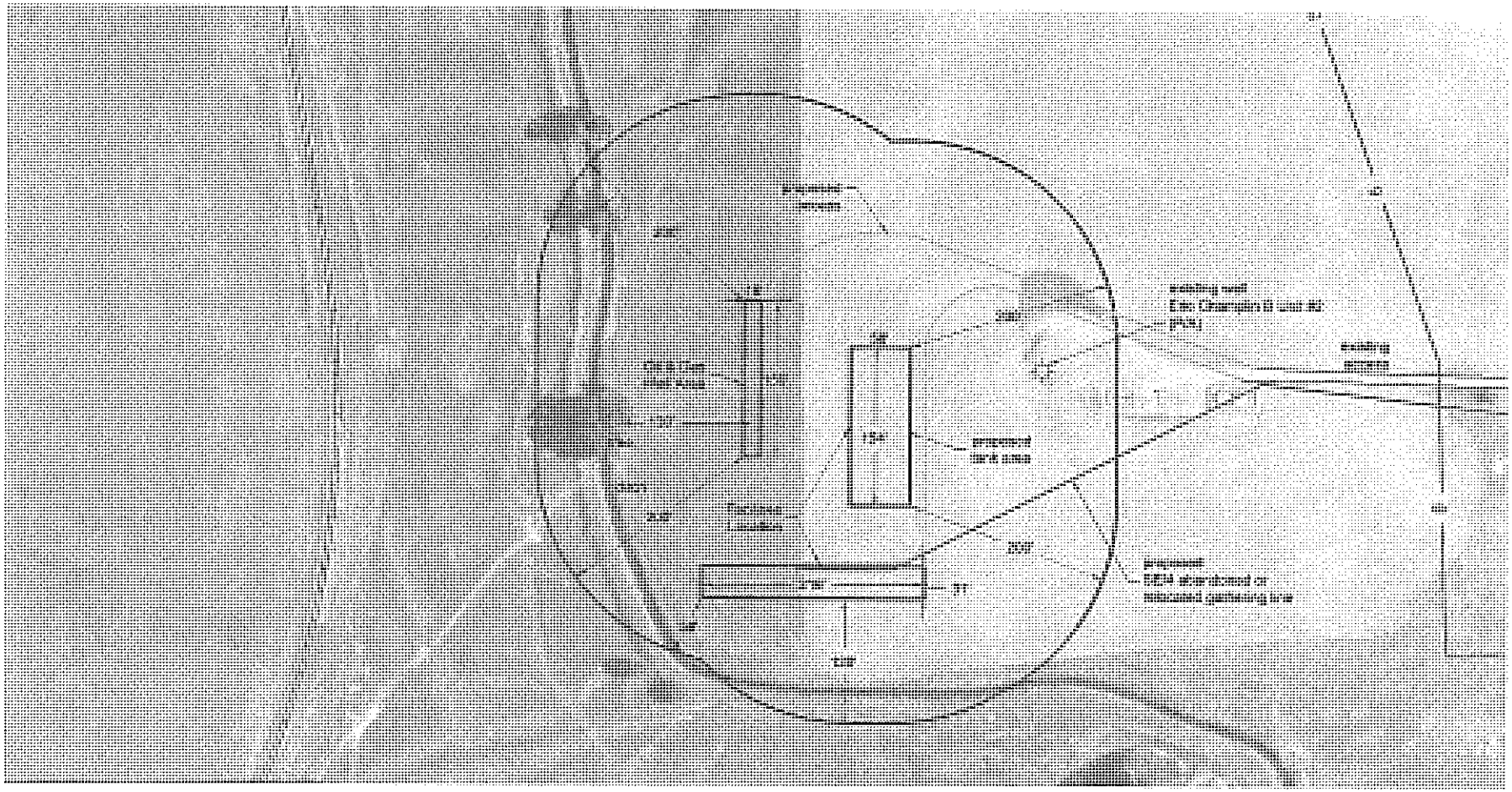
encana

TOWNSHIP 1 NORTH, RANGE 68 WEST
SECTION 18: NE¼
WELD COUNTY, COLORADO

SCALE: 1" = 150' SEPTEMBER 26, 2011

# EXHIBIT 2A.2

3799568 10/18/2011 12:26P Weld County, CO
31 of 46 R 236.00 D 0.00 Steve Moreno Clerk & Recorder



OIL & GAS OPERATIONS AREA

PROPOSED ACCESS

g

FUTURE PIPELINE EASEMENT
(75' TEMPORARY & 50' PERMANENT)

encana

TOWNSHIP 1 NORTH, RANGE 68 WEST
SECTION 18: SE¼
WELD COUNTY, COLORADO

SCALE: 1" = 150'

SEPTEMBER 26, 2011

3799568 10/18/2011 12:26P Weld County, CO
32 of 46 R 236.00 D 0.00 Steve Moreno Clerk & Recorder

**Exhibit 2B**

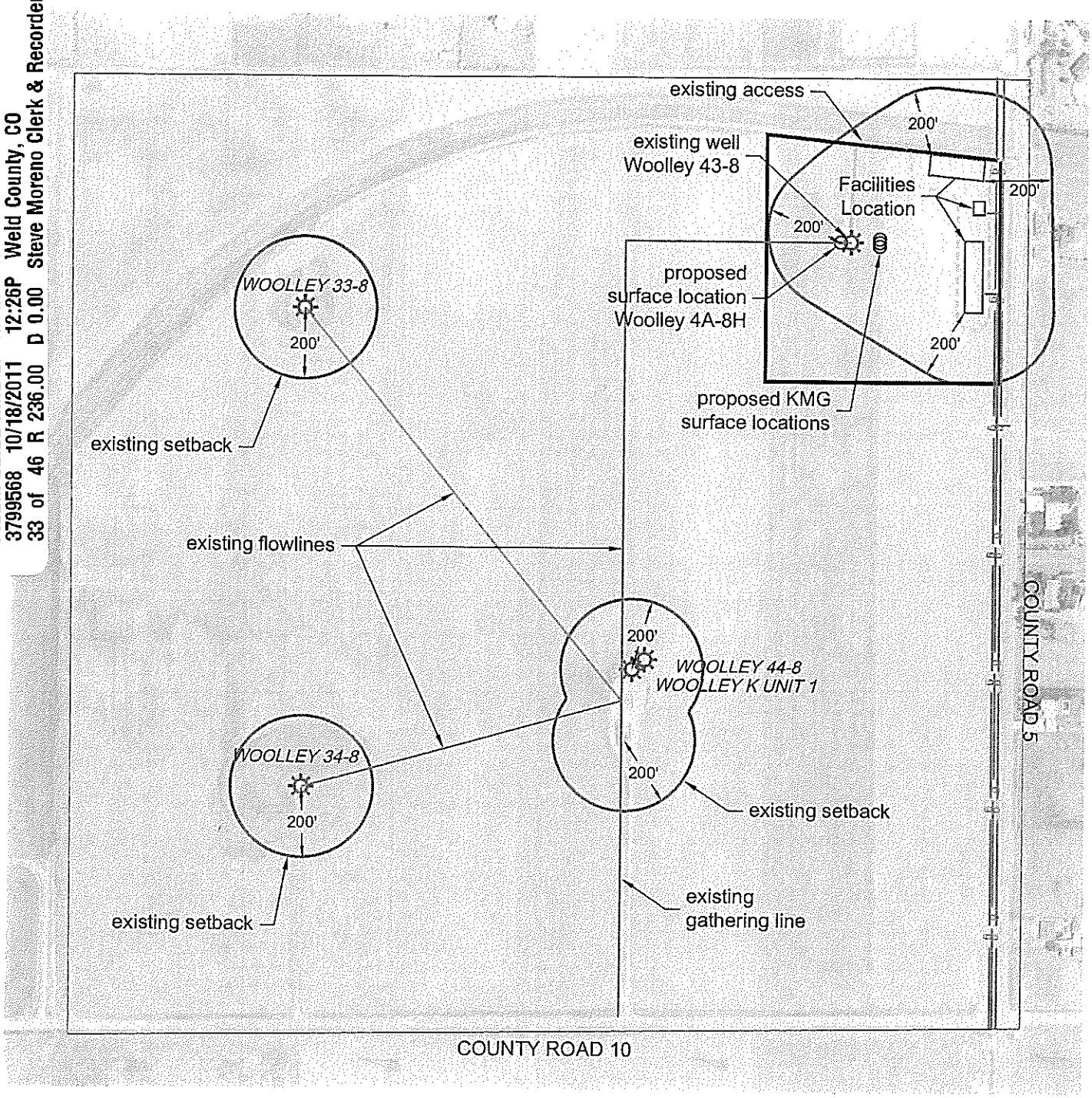
to

**Surface Use Agreement effective September 27, 2011 by and among Anadarko Land Corp., Anadarko E&P Company LP, Kerr-McGee Oil & Gas Onshore LP, Kerr-McGee Gathering LLC (for the limited purposes described herein), Encana Oil & Gas (USA) Inc. and Tallgrass Investors, LLC**

**See attached Plats consisting of two (2) pages for the Section 8 Property.**

# EXHIBIT 2B

3799568 10/18/2011 12:26P Weld County, CO
33 of 46 R 236.00 D 0.00 Steve Moreno Clerk & Recorder




TEMPORARY EASEMENT AREA

OIL & GAS OPERATIONS AREA

PROPOSED FUTURE PIPELINE EASEMENT
(50' TEMPORARY & 30' PERMANENT)

PROPOSED ACCESS

encana

TOWNSHIP 1 NORTH, RANGE 68 WEST
SECTION 8: SE¼

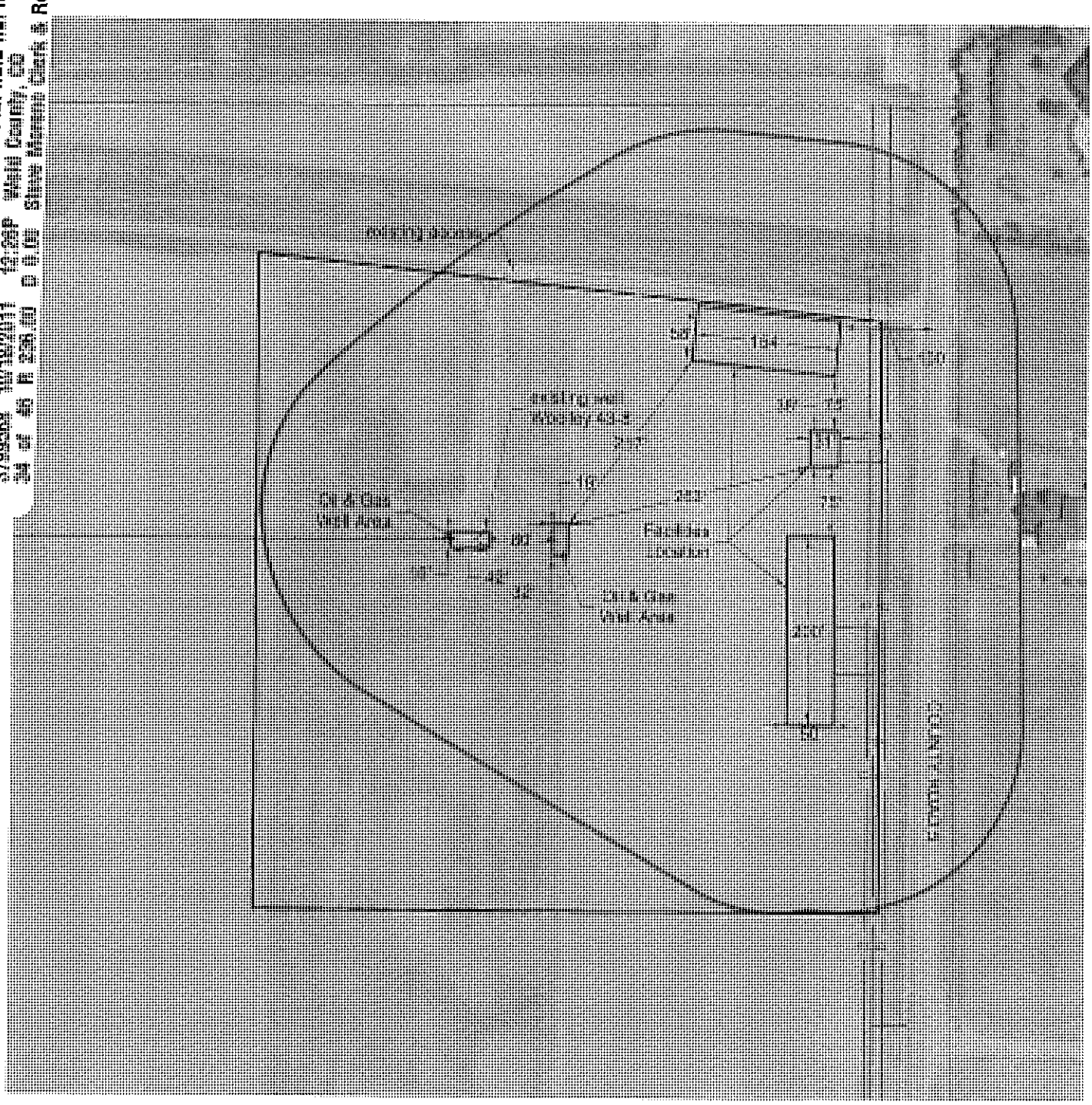
WELD COUNTY, COLORADO

SCALE: 1" = 400'

OCTOBER 12, 2011

3799569 10/19/2011 12:28P Weld County, CO
34 of 46 R 236.00 D 0.00 Steve Moreno Clerk & Recorder

# EXHIBIT 2B.1



TEMPORARY EASEMENT AREA

OIL & GAS OPERATIONS AREA

g PROPOSED FUTURE PIPELINE EASEMENT (50' TEMPORARY & 30' PERMANENT)

PROPOSED ACCESS

encana natural gas

TOWNSHIP 1 NORTH, RANGE 68 WEST
SECTION 8: NE¼SE¼
WELD COUNTY, COLORADO

SCALE: 1" = 150' OCTOBER 10, 2011

3799568 10/18/2011 12:26P Weld County, CO
35 of 46 R 236.00 D 0.00 Steve Moreno Clerk & Recorder

**Exhibit 3**
**to**
**Surface Use Agreement effective September 27, 2011**
**by and among Anadarko Land Corp., Anadarko E&P Company LP, Kerr-McGee Oil & Gas Onshore LP, Kerr-McGee Gathering LLC (for the limited purposes described herein), Encana Oil & Gas (USA) Inc. and Tallgrass Investors, LLC**

## AGREEMENT FOR RELOCATION OF PIPELINE AND RIGHT-OF-WAY

**THIS AGREEMENT** ("Agreement") is entered into this ____ day of _____, 20__, by and between **Tallgrass Investors, LLC** ("Tallgrass"), whose address is 2500 Arapahoe Avenue, Suite 220, Boulder, Colorado 80302 and **Kerr-McGee Gathering LLC** ("KMGG"), a Colorado limited liability company, whose address is 1099 18th Street, Denver, Colorado 80202.

RECITALS

A. KMGG is the successor in interest to a Right-of-Way Grant ("Easement") across a portion of the ____ of Section ____, Township 1 North, Range 68 West of the 6th P.M. in Weld County, Colorado. The Easement was originally conveyed to _____ for natural gas pipeline purposes by instrument recorded_____, reception #_____, of the records of the Weld County Clerk and Recorder.

B. Tallgrass is the current owner of a portion of the ___ of Section ___, Township 1 North, Range 68 West, 6th P.M., Weld County, Colorado (the "Property").

C. Tallgrass plans to develop the surface of the Property as a part of a residential development known as Bridgewater.

D. In order to accommodate the proposed development of the Property by Tallgrass, KMGG agrees to release a portion of the Easement lying within and across the Property and in consideration therefore, Tallgrass agrees to provide a Right-of-Way so that KMGG's pipeline(s) can be physically relocated and operated.

**NOW, THEREFORE**, in consideration of the covenants contained herein and the mutual benefits to be derived, KMGG and Tallgrass agree as follows:

1. Partial Release. KMGG shall execute and deliver a Partial Release of Easement (Exhibit "D") relinquishing and quitclaiming unto Tallgrass, the Easement, insofar, and only insofar, as it crosses or lies within the Property. Said Partial Release of Easement will be provided after delivery of the new Right-of-Way, as provided below, and after the physical relocation of the pipeline(s) and the tie-in of the relocated pipeline(s).

2. Amendment of Right-of-Way. Upon removal and rerouting of the existing pipelines from their current locations, KMGG shall execute and deliver an Amendment of Right-of-Way on the form attached hereto as Exhibit "A" and incorporated herein by this reference, amending permanently KMGG's pipeline Right-of-Way to the route(s) set forth and described in Exhibit "B" attached hereto which shall be attached to the Amendment as Exhibit "A". The Amendment will be provided after the physical relocation of the pipeline(s) and the tie-in of the relocated pipeline(s).

3. Conveyance of Right-of-Way. Tallgrass hereby agrees to provide and deliver to KMGG, prior to the actual placement and operation of new pipeline, an executed and recordable new Right-of-Way conveying unto KMGG, its successors and assigns, a perpetual right-of-way and easement for pipeline purposes on the form attached hereto as Exhibit "C". The new Right-of-Way shall be for the purposes of, and convey rights to survey, construct, install, maintain, inspect, operate, repair, replace, modify, change the size of, reconstruct, mark, monitor, abandon or remove, at KMGG's election, pipelines and all appurtenances, above or below ground, reasonably necessary or convenient for the transportation or transmission of oil, gas, petroleum products, water, hydrocarbons, and any other substances, whether fluid or gaseous, and any products, derivatives, combinations or mixtures of any of the foregoing. The width of the New Right-of-Way shall be _____ feet (___') during construction of the relocated portion of the pipeline(s) and any maintenance thereto, and subsequent to construction shall be _____ feet (___').

4. Title and Authority. Tallgrass represents and warrants to KMGG that Tallgrass is the sole owner in fee simple of the lands described in Exhibit "B" and Exhibit "C", being the route(s) of the Amended Right-of-Way and new Right-of-Way, respectively, and that Tallgrass has full power, right and authority to execute and deliver the Amendment of the Right-of-Way and new Rights-of-Way.

5. Senior Rights. KMGG acknowledges that all routes are non-exclusive and agrees that it will not object to the concurrent use of the routes by Tallgrass, utilities providers and other operators as Tallgrass may grant from time to time; provided, however, that such concurrent use does not in any way interfere with the use of the routes by KMGG. All pipes shall be placed with a minimum horizontal clearance of ten (10) feet from all other pipelines and utilities; and a minimum vertical clearance of eighteen (18) inches from all other pipelines and utilities. KMGG's "General Guidelines for Design and Construction Activities On or Near Kerr- McGee Gathering LLC and Kerr- McGee Oil & Gas Onshore LP Pipelines and Related Facilities" shall be strictly adhered to at all times. Said General Guidelines are attached hereto as Exhibit "F". Tallgrass further represents and warrants that it has full power, right and authority to enter into this Agreement and to make the covenants set forth herein.

6. Title Insurance. Tallgrass must deliver to KMGG a title commitment from an insurer acceptable to KMGG with any request for the relocation of any pipeline. If any of the exceptions contained in Schedule B-2 of said title commitment are (i) senior liens or encumbrances on the land upon which the right(s)-of-way to be granted to KMGG pursuant to this Agreement are to be located; or (ii) deemed by KMGG to infringe on its right of free use and enjoyment of new right(s)-of-way granted under this Agreement, the liens or encumbrances must be released or subordinated and any infringements must be cured by Tallgrass prior to the relocation of any pipelines. Prior to commencing any relocation activities, Tallgrass must furnish KMGG with a policy of title insurance insuring KMGG's title to its right(s)-of-way against any senior lien or encumbrance and against any interest that may interfere with KMGG's quiet enjoyment of the right(s)-of-way to be granted pursuant to this Agreement. KMGG will not be required to relocate any pipeline unless and until it has been furnished with a policy of title insurance that is satisfactory to it.

7. Pipeline Relocation Expense. KMGG has prepared a good faith estimate of the costs and expenses to be incurred in the pipeline relocation project and a summary of those costs and expenses is set forth on Exhibit "E" hereto. Costs include KMGG's corporate overhead of fifteen percent (15%) for the legal, engineering, and other administrative costs necessary to process and complete the relocation. Upon execution of this Agreement, Tallgrass will pay

KMGG the total estimated cost of pipeline relocation, which is $_____. It is understood that this amount is only an estimate and that Tallgrass shall be obligated to pay or reimburse KMGG for all actual costs and expenses related to the pipeline relocation. Upon conclusion of the relocation, the parties shall reconcile the costs incurred and payments made, with appropriate adjustments and reimbursements to Tallgrass or supplemental payments to KMGG being made within one-hundred twenty (120) days after the pipeline relocation is completed.

8. Amendments. This Agreement cannot be modified, except by a written agreement signed by both parties hereto.

9. Binding Effect. The rights granted herein may be assigned in whole or in part, and the terms, conditions, and provisions of this Agreement shall be a covenant running with the Property and shall extend to and be binding upon the heirs, executors, administrators, personal representatives, successors, and assigns of Tallgrass and KMGG.

**IN WITNESS WHEREOF**, the parties have executed this Agreement as of the date first above written.

**TALLGRASS INVESTORS, LLC**

By: _____

Title: _____

**KERR-MCGEE GATHERING LLC**
a Colorado limited liability company

By: _____
_____, Agent and Attorney-in-Fact

STATE OF COLORADO )
) ss.
COUNTY OF )

The foregoing instrument was acknowledged before me this _____ day of _____, 201_, by _____, as _____, on behalf of _____ .

Witness my hand and official Seal.

My Commission Expires:_____

_____
Notary Public

(SEAL)

STATE OF )
)ss.
COUNTY OF )

The foregoing instrument was acknowledged before me this _____ day of _____, 201_, by _____ as Agent and Attorney-in-Fact for Kerr-McGee Oil & Gas Onshore LP, a Delaware Limited Partnership, in its capacity as Manager of Kerr-McGee Gathering LLC, a Colorado limited liability company, on behalf of such company.

Witness my hand and official Seal.

My Commission Expires: _____

_____
Notary Public

(SEAL)

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**Exhibit 4**
**to**
**Surface Use Agreement effective September 27, 2011**
**by and among Anadarko Land Corp., Anadarko E&P Company LP, Kerr-McGee Oil & Gas Onshore LP, Kerr-McGee Gathering LLC (for the limited purposes described herein), Encana Oil & Gas (USA) Inc. and Tallgrass Investors, LLC**

# RIGHT-OF-WAY GRANT

**THIS RIGHT-OF-WAY GRANT** ("Grant) is made this ____ day of _____, 20__, from TALLGRASS INVESTORS, LLC with an address of 2500 Arapahoe Avenue, Suite 220, Boulder, Colorado 80302 ("Grantor") to _____, with an address of _____ ("Grantee"). The parties agree as follows:

For and in consideration of Ten Dollars ($10.00) and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Grantor hereby grants, conveys and warrants unto Grantee, its successors and assigns, a perpetual right-of-way(s) and easement(s) to survey, construct, maintain, inspect, operate, repair, replace, modify, change the size of, reconstruct, mark, monitor, abandon or remove, at Grantee's election, pipelines and all appurtenances, below and/or above ground, including but not limited to, launchers and receivers, convenient for the transportation or transmission of oil, gas, petroleum products, water, hydrocarbons and any other substances, whether fluid, solid or gaseous, and any products, derivatives, combinations or mixtures of any of the foregoing, in, on, over, under, or through the lands situated in Weld County, State of Colorado, being generally described as follows and more specifically described on Exhibit "A" attached hereto and made a part hereof:

**TOWNSHIP 1 NORTH, RANGE 68 WEST, 6TH PM**
**Section ___: ____**

The specific route and course of the right-of-way(s) and easement(s) conveyed hereby ("Right-of-Way Lands") is more particularly described on Exhibit "B" attached hereto and made a part hereof. The width of the Right-of-Way Lands during construction shall be _____ feet (___') and subsequent to construction shall be _____ feet (___').*

Grantor represents and warrants to Grantee that Grantor is the sole owner in fee simple of the Right-of-Way Lands and has full right, power and authority to make this Grant.

Grantee shall lay all pipe at a depth of not less than 36 inches. Grantee shall repair and/or restore any fence on or adjacent to the Right-of-Way Lands removed or severed by Grantee in the course of the operations provided for in this Grant. If necessary to prevent the escape of Grantor's livestock, Grantee shall construct temporary gates or fences.

**Fifty (50) feet construction/thirty (30) feet permanent for Section 8 and Seventy-Five (75) feet construction/fifty (50) feet permanent for Section 18.*

Grantee shall have all rights, privileges and benefits necessary or convenient for the full use and enjoyment of this Grant, including but not limited to, the right of ingress and egress over and across Grantor's lands lying adjacent to the Right-of-Way Lands for any and all purposes necessary and incidental to exercising Grantee's rights hereunder. Grantor agrees not to build, create, construct or permit to be built, created or constructed, any obstruction, building, fence, landscaping, reservoir, engineering works or other structures or improvements over, under, on or across the Right-of-Way Lands without prior written consent of Grantee.

Grantee shall be obligated to pay for, repair, replace or otherwise compensate Grantor for any damages resulting from Grantee's activities and operations on the Right-of-Way Lands, and Grantor shall pay for, reimburse, indemnify and hold Grantee harmless from any and all claims or damages resulting from Grantor's activities on the Right-of-Way Lands. Grantor shall have the right to use and enjoy the Right-of Way Lands, subject to the rights herein granted.

This Grant cannot be modified, except in writing signed by Grantor and Grantee.

The rights granted herein may be assigned in whole or in part, and the terms, conditions, and provisions of this Grant are a covenant running with the land and shall extend to and be binding upon the successors and assigns of Grantor and Grantee.

Grantee agrees to level and restore any lands that may have excessive settling and sufficiently compact the soil within a reasonable period of time after completion of construction.

This Grant may be executed in counterparts each of which shall be considered one and the same agreement.

IN WITNESS WHEREOF, the parties have executed this Grant as of the date first above written.

Grantor:
Tallgrass Investors, LLC

By: _____
Name: _____
Its: _____

Grantee:
_____

By: _____
Name: _____
Agent & Attorney-in-Fact

STATE OF COLORADO )
) ss.
COUNTY OF _____ )

The foregoing instrument was acknowledged before me this _____ day of _____, 201__, by _____ as _____ of Tallgrass Investors, LLC.

Witness my hand and official Seal.

My Commission Expires:_____

_____

Notary Public

STATE OF _____ )
) ss.
COUNTY OF _____ )

The foregoing instrument was acknowledged before me this _____ day of_____, 201_, by _____, as Agent and Attorney-in-Fact of _____, on behalf of such company.

Witness my hand and official Seal.

My Commission Expires:_____

_____

Notary Public

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**Exhibit 5**

**to**

**Surface Use Agreement effective September 27, 2011 by and among Anadarko Land Corp., Anadarko E&P Company LP, Kerr-McGee Oil & Gas Onshore LP, Kerr-McGee Gathering LLC (for the limited purposes described herein), Encana Oil & Gas (USA) Inc. and Tallgrass Investors, LLC**

**See attached Guidelines consisting of four (4) pages.**

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# General Guidelines for Design and Construction Activities On or Near Kerr- McGee Gathering LLC Pipelines and Related Facilities

This list of design, construction and contractor requirements, including but not limited to the following, is for the design and installation of foreign utilities or improvements on Kerr McGee Gathering LLC (KMGG) right-of-way (ROW). These are not intended to, nor do they waive or modify any rights KMGG may have under existing easements or ROW agreements. For information regarding KMGG's rights and requirements as they pertain to the existing easements, please reference existing easements and amendments documents. This list of requirements is applicable for KMGG facilities on easements and in road rights of ways only. Encroachments on fee property should be referred to the Land & ROW Department. Any reference to KMGG in the below requirements is meant to include and apply to any Kerr McGee entity.

## Design

- KMGG shall be provided sufficient prior notice of planned activities involving excavation, blasting, or any type of construction on KMGG's ROW or near its facilities. This is to determine and resolve any location, grade or encroachment problems and allow for the protection of KMGG's facilities and the general public. This prior notification is to be made before the actual work is to take place.

- The encroaching entity shall provide KMGG with a set of drawings for review and a set of final construction drawings showing all aspects of the proposed facilities in the vicinity of KMGG's ROW. The encroaching entity shall also provide a set of "as-built drawings" and submit to KMGG, showing the facilities in the vicinity of KMGG's ROW upon completion of the work.

- Only facilities shown on drawings reviewed by KMGG will be approved for installation on KMGG's ROW. All drawing revisions that affect facilities proposed to be placed on KMGG's ROW must be approved by KMGG in writing.

- KMGG shall approve the design of all permanent road crossings.

- Any repair to surface facilities following future pipeline maintenance or repair work by KMGG on its "prior rights" ROW will be at the expense of the developer or landowner. In addition, any repair to surface facilities following future pipeline maintenance or repair work by KMGG on replacement ROW granted to relocate KMGG facilities will also be done at the expense of the developer or landowner unless expressly addressed in surface use agreements and approved in writing by KMGG.

- The depth of cover over the KMGG pipelines shall not be increased or reduced nor surface modified for drainage without KMGG's written approval.

- Construction of any permanent structure within KMGG pipeline easement is **not** permitted without written approval by KMGG.

- Planting of shrubs and trees is not permitted on KMGG pipeline easement without written approval by KMGG.

- Irrigation equipment i.e. backflow prevent devices, meters, valves, valve boxes, etc. shall not be located on KMGG easement without written approval by KMGG.

- Foreign utility installations, i.e., distribution gas, oil and gas gathering, water, electric, telephone, cable and sewer lines, etc., may cross perpendicular to KMGG's pipeline within the ROW, provided that a minimum of eighteen inches (18") of vertical clearance is maintained between KMGG pipeline(s) and the foreign utility. Any installation by a foreign utility with less than 18" of vertical separation is not allowed without written approval by KMGG. In no case will vertical separation be less than 12". Constant line elevations must be maintained across KMGG's entire ROW width, gravity drain lines are the only exception and must be approved in writing. Foreign line crossings below the KMGG pipeline must be evaluated by KMGG to ensure that a significant length of the KMGG line is not exposed and unsupported during construction. Foreign line crossings above the KMGG pipeline with less than 18" of clearance must be evaluated by KMGG to ensure that additional support is not necessary to prevent settling on top of the KMGG natural gas pipeline. A KMGG representative must be on site during any crossing activities to verify clearance depths and to assure the integrity and support of the KMGG facility. All installations of foreign crossings done by boring and or jacking require the KMGG facility to be exposed to verify clearances.

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# General Guidelines for Design and Construction Activities On or Near Kerr- McGee Gathering LLC Pipelines and Related Facilities

- Foreign utilities shall not run parallel to KMGG pipelines within the KMGG easement without written permission by KMGG. A minimum of 10 feet of horizontal separation must be maintained in parallel installations whether the foreign utility is placed within the KMGG easement or adjacent to the KMGG easement. Any deviation from the 10' horizontal requirement must be approved in writing by KMGG and an "as built survey" provided to KMGG after installation. In the instance that high voltage electric lines, greater than 20kV, are installed parallel to a KMGG pipeline a minimum horizontal distance of 15' must be maintained.

- The foreign utility should be advised that KMGG maintains cathodic protection on its pipelines and facilities. The foreign utility must coordinate their cathodic protection system with KMGG's. At the request of KMGG, foreign utilities shall install (or allow to be installed) cathodic protection test leads at all crossings for the purposes of monitoring cathodic protection interference. The KMGG CP technician and the foreign utility CP technician shall perform post construction CP interference testing. Interference issues shall be resolved by mutual agreement between foreign utility and KMGG. All costs associated with the correction of cathodic protection interference issues on KMGG pipelines as a result of the foreign utility crossing shall be borne by the foreign utility for a period of one year from date the foreign utility is put in service.

- The developer shall understand that KMGG, whether specifically required per federal law or by company standard, will mark the routing of its underground facilities with aboveground pipeline markers and test leads and maintain those markers and test leads. Markers will be installed at every point the pipeline route changes direction and adequate markers will be installed on straight sections of pipeline to insure, in the sole opinion of KMGG, the safety of the public, contractor, KMGG personnel and KMGG facilities.

- On all foreign utility crossings and / or encroachments, metallic foreign lines shall be coated with a suitable pipe coating for a distance of at least 10 feet on either side of the crossing.

- AC Electrical lines must be installed in conduit and properly insulated.

- On all foreign pipelines, DOT approved pipeline markers shall be installed so as to indicate the route of the foreign pipeline across the KMGG ROW.

- No power poles, light standards, etc. shall be installed in the KMGG easement without written approval by KMGG.

- KMGG installs above ground appurtenances at various locations that are used in the operation of its facilities. Kerr McGee will install protective enclosures at the above ground appurtenances to protect them from outside damage. The design and placement of these above ground appurtenances and protective enclosures is done at KMGG's sole discretion, and may exceed any regulatory requirements.

## Construction

- If KMGG will be relocating KMGG facilities for any entity, grading in the new KMGG ROW shall be +/- 6 inches before KMGG will mobilize to complete the relocation. Final cover after the completion of the project will not be manipulated by the requesting entity to be less than 48" nor more than 72". All cover that exceeds 72" or less than 48" will be approved in writing by KMGG. This does not preclude KMGG from installing the pipeline at a minimum cover of 36" as provided for in CFR 49 Part 192. Cover during all construction activities will NEVER be less than 36" unless approved in writing and a KMGG representative is on site during the time cover is reduced.

- The entity requesting relocation shall survey top of pipe after installation but before backfill to determine proper final elevation of KMGG facilities. The entity requesting relocation is solely responsible for the final depth of cover over the relocated KMGG facility. Any deviation from cover requirements as outlined above will be corrected at the sole expense of the entity requesting relocation.

- Contractors shall be advised of KMGG's requirements and be contractually obligated to comply.

- The continued integrity of KMGG's pipelines and the safety of all individuals in the area of proposed work near KMGG's facilities are of the utmost importance. Therefore, contractor must meet with KMGG representatives prior to construction to provide and receive notification listings for appropriate area operations and emergency personnel. **KMGG's on-site representative will require discontinuation of any work that, in his or her opinion, endangers the operations or safety of personnel, pipelines or facilities.**

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# General Guidelines for Design and Construction Activities On or Near Kerr- McGee Gathering LLC Pipelines and Related Facilities

- The Contractor must expose all KMGG pipelines prior to crossing to determine the exact alignment and depth of the lines. A KMGG representative must be present.
- The use of probing rods for pipeline locating shall be performed by KMGG representatives only, to prevent unnecessary damage to the pipeline coating. A KMGG representative shall do all line locating.
- Notification shall be given to KMGG at least 72 hours before start of construction. A schedule of activities for the duration of the project must be made available at that time to facilitate the scheduling of KMGG's work site representative. Any Contractor schedule changes shall be provided to KMGG immediately.
- Heavy equipment will not be allowed to operate directly over KMGG pipelines or in KMGG ROW unless written approval is obtained from KMGG. Heavy equipment shall only be allowed to cross KMGG pipelines at locations designated by KMGG. Haul roads will be constructed at all crossings. The haul roads will be constructed using lightweight equipment. The existing depth of cover over the pipeline must be verified. Cover will be added such that a total of 8' of fill exists over the pipeline and extends a minimum of 10' on each side of the pipeline. Depth of cover will then taper as required for equipment access. Steel plates may be used for load dissipation only if approved in writing by KMGG.
- Contractor shall comply with all precautionary measures required by KMGG, at its sole discretion to protect its pipelines. When inclement weather exists, provisions must be made to compensate for soil displacement due to subsidence of tires.
- Excavating or grading which might result in erosion or which could render the KMGG ROW inaccessible shall not be permitted unless the contractor agrees to restore the area to its original condition and provide protection to KMGG's facility. At no time will cover be reduced to less than 36" without written approval by KMGG and a KMGG representative on site.
- A KMGG representative shall be notified prior to construction activities within twenty-five (25) feet of a KMGG pipeline or above ground appurtenance. The contractor shall not be allowed to work within twenty-five (25) feet of KMGG facilities without approval from the KMGG representative. The KMGG representative may or may not remain on site during the entire construction activity. Contractor shall use extreme caution and take appropriate measures to protect KMGG facilities. The contractor shall call the KMGG representative prior to backfilling around the KMGG facility to allow for a final inspection of the KMGG facility.
- Ripping is only allowed when the position of the pipe is known and not within ten (10) feet of KMGG facility. KMGG personnel must be present.
- Temporary support of any exposed KMGG pipeline by Contractor may be necessary if required by KMGG's on-site representative. Backfill below the exposed lines and 12" above the lines shall be replaced with sand or other selected material as approved by KMGG's on-site representative and thoroughly compacted in 12" lifts to 95% of standard proctor dry density minimum or as approved by KMGG.'s on-site representative. This is to adequately protect against stresses that may be caused by the settling of the pipeline.
- No blasting shall be allowed within 1000 feet of KMGG's facilities unless blasting notification is given to KMGG Including complete Blasting Plan Data. A pre-blast meeting shall be conducted by the organization responsible for blasting.
- KMGG shall be indemnified and held harmless from any loss, cost of liability for personal injuries received, death caused or property damage suffered or sustained by any person resulting from any blasting operations undertaken within 500 feet of its facilities. The organization responsible for blasting shall be liable for any and all damages caused to KMGG's facilities as a result of their activities whether or not KMGG representatives are present. KMGG shall have a signed and executed Blasting Indemnification Agreement before authorized permission to blast can be given.
- No blasting shall be allowed within 200 feet of KMGG's facilities unless blasting notification is given to KMGG a minimum of one week before blasting. The organization responsible for blasting must complete Blasting Plan Data. KMGG shall review and analyze the blasting methods. A written blasting plan shall be provided by the organization responsible for blasting and agreed to in writing by KMGG. A written emergency plan shall be provided by the organization responsible for blasting.
- KMGG shall have a signed and executed Blasting Indemnification Agreement before authorized permission to blast can be given. A pre-blast meeting shall be conducted by the organization responsible for blasting.

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# General Guidelines for Design and Construction Activities On or Near Kerr- McGee Gathering LLC Pipelines and Related Facilities

- Any contact with any KMGG facility, pipeline, valve set, etc. shall be reported immediately to KMGG. If repairs to the pipe are necessary, they will be made and inspected before the section is re-coated and the line is back-filled.
- KMGG personnel shall install all test leads on KMGG facilities.

## Local Kerr-McGee Gathering LLC Representation:

| | | |
|---|---|---|
| Operations Manager | Kevin Osif, P.E. | Phone: (303) 655-4307 |
| Staff Engineer: | Joseph E. Sanchez, P.E. | Phone: (303) 655-4319 |
| Pipeline Foreman: | James Phillips | Phone: (303) 655-4343 |
| Construction Foreman: | Jim McQuiston | Phone: (303) 655-4326 |
| Construction Supervisor | Darrel Gentry | Phone: (303) 655-4326 |

## Emergency Contacts:

| | |
|---|---|
| On call supervisor | Phone: (303) 559-4001 |
| Kerr McGee 24 hour emergency number | Phone: (303) 659-5922 |
| One Call Emergency | Phone: 811 |

**AMENDMENT OF RIGHT-OF-WAY GRANT** **PARAGRAPH G**

**THIS AMENDMENT OF RIGHT-OF-WAY GRANT** ("Amendment") is entered into this 17th day of April, 2014, by and between **Daybreak Metropolitan District No. 3, a quasi-municipal corporation and political subdivision of the State of Colorado**, with an address of c/o White, Bear & Ankele, 2154 E. Commons Avenue, Suite 2000, Centennial, Colorado 80122 and **Daybreak Recovery Acquisition LLC, a Delaware limited liability company**, with an address of 1251 Avenue of the Americas, 50th Floor, New York, New York 10020 (together the "Grantors") and **Kerr-McGee Gathering LLC, a Colorado limited liability company** ("KMGG"), with an address of 1099 18th Street, Denver, Colorado 80202. Grantors and KMGG are sometimes referred to hereinafter alone or together as a "Party" or the "Parties."

**RECITALS**

A. Tallgrass Investors, LLC, a Colorado limited liability company granted, conveyed and warranted a Right-of-Way Grant to KMGG dated August 20, 2007 and recorded in the Office of the Clerk and Recorder of Weld County on September 20, 2007 at Reception No. 3505741 and re-recorded on January 21, 2009 at Reception No. 3600584 ("Easement") granting and conveying a perpetual right-of-way and easement for purposes of surveying, constructing, operating, replacing and maintaining (among other purposes) one (1) four inch (4") pipeline and appurtenances in, over and across a portion of the SE/4 of Section 8, Township 1 North, Range 68 West of the 6th P.M., Weld County, Colorado ("Property"), all as specifically described in the Easement, copies of the recorded duplicate Easements being attached hereto as Exhibit 1.

B. Grantors are successors in interest to Tallgrass Investors, LLC.

C. KMGG has constructed a pipeline within the Easement, and KMGG now desires, among other things, to construct, operate and maintain an additional pipeline (the "Additional Pipeline") within the Easement.

D. Purposes of this Amendment are: i) to provide for and allow the Additional Pipeline within the Right-of-Way Lands; ii) to amend the property description of the Right-of-Way Lands to extend the Easement to run the full length north to south along the east boundary of the SE/4 of Section 8; iii) to provide for a temporary easement on the Property as described herein; iv) to include certain agreed upon landscaping provisions in the Easement; and v) to allow KMGG to change the size of the existing four-inch pipeline.

**NOW, THEREFORE**, in consideration of Ten Dollars ($10) and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Grantors and KMGG hereby agree to amend the Easement as follows:

1. Each of Grantors, for itself, represents and warrants to KMGG that (i) it is the sole owner in fee simple of that portion of the Right-of-Way Lands to which it holds title, subject to the burden of current taxes, the Easement and any prior recorded easements, public dedications and other matters of record, and (ii) it has full right, power and authority to enter into this Amendment.

2. The description of the Right-of-Way Lands as described on Exhibit A to the Easement is hereby amended to be the description on Exhibit 2 to this Amendment. Exhibit 2 to this Amendment replaces Exhibit A to the Easement. A reference herein and in the Easement to the "Right-of-Way Lands" shall be a reference to the property described in the attached Exhibit 2.

3. Paragraph 2 of the Easement is amended to allow for one (1) four-inch (4") pipeline and one additional pipeline not to exceed sixteen inches (16").

4. KMGG may elect to change the size of the existing four-inch (4") pipeline to any size up to twelve inches (12").

5. Prior to any landscaping activities on the Right-of-Way Lands, Grantors shall prepare and submit a landscape plan to KMGG for the review and consent of KMGG, such consent not be unreasonably withheld; provided, however, it shall not be unreasonable for KMGG to withhold consent to the installation of trees, bushes or other landscape improvements on a case by case basis for safety reasons related to a pipeline or a portion of a pipeline or because of the

type of bush, tree or other landscape improvement proposed by Grantors. If KMGG withholds its consent, KMGG shall propose reasonable solutions to Grantors. KMGG shall be liable for damages to landscaping within the Right-of-Way Lands to the extent caused by the construction or operation of pipelines constructed within the Right-of-Way Lands, but only for landscaping that is installed pursuant to a landscape plan approved by KMGG as provided herein.

6. Grantors hereby grant and convey unto KMGG a temporary construction easement for a term of eighteen (18) months from the date of this Amendment for purposes of surveying, accessing, staging and storing materials and equipment necessary or convenient for the construction of the Additional Pipeline. The temporary construction easement shall be shall be adjacent to and west of the Right-of-Way Lands, as depicted on the attached Exhibit 3 as "Temporary Work Space".

7. KMGG shall not bring onto or permit to be brought onto the Right-of Way Lands or Temporary Work Space, any hazardous or toxic substance or material (including petroleum) regulated by the State of Colorado, the United States government, or any other government authority with applicable jurisdiction ("Hazardous Materials"), without the express written permission of Grantor. Grantor does acknowledge that the Easement as hereby amended, is granted to KMGG for the installation and operation of pipelines for the transportation or transmission of oil, gas, petroleum products, water, hydrocarbons or mixtures of any of the forgoing and Grantor does hereby grant to KMGG express written permission to transport said products across the Right-of-Way Lands.

8. The Easement, as amended by this Amendment ("Amended Easement"), cannot be modified except by a written agreement signed by the Parties.

9. Except as modified herein, and except to the extent necessary to conform to and incorporate the provisions of this Amendment, all other terms, covenants and obligations of the Easement shall remain in full force and effect and are hereby affirmed by the Parties. In the event of a conflict between this Amendment and the Easement for a matter specifically covered herein, this Amendment shall control.

10. Exhibits 1, 2 and 3 are incorporated into this Amendment by reference.

11. The rights granted herein may be assigned in whole or in part, and the terms, conditions and provisions of the Amended Easement shall extend to and be binding upon the heirs, executors, administrators, personal representatives, successors and assigns of Grantors and KMGG.

**IN WITNESS WHEREOF**, the Parties have executed this Amendment as of the date first above written.

**Daybreak Metropolitan District No. 3, a quasi-municipal corporation and political subdivision of the State of Colorado**

By: _____
Name: JERRY B. RICHMOND III
Title: BOARD PRESIDENT

**Daybreak Recovery Acquisition LLC, a Delaware limited liability company**

By: _____
Name: Jonathan Shymoker
Title: Authorized Signatory

**KERR-MCGEE GATHERING LLC, a Colorado limited liability company**

By: _____
**, Agent and Attorney-in-Fact**

STATE OF Colorado )
)ss.
COUNTY OF Arapahoe)

The foregoing instrument was acknowledged before me this 22nd day of April, 2014, by Jerry R. Richmond, as Board President of Daybreak Metropolitan District No. 3, a quasi-municipal corporation and political subdivision of the State of Colorado.

Witness my hand and official Seal.

My Commission Expires: 2/17/16

Notary Public

WENDY J CRAVEN NOTARY PUBLIC STATE OF COLORADO COMM. EXP. 02-17-16

(SEAL)

STATE OF New York )
)ss.
COUNTY OF New York)

The foregoing instrument was acknowledged before me this 17th day of April, 2014, by Jonathan Shumaker, as Authorized Signatory of Daybreak Recovery Acquisition LLC, a Delaware limited liability.

Witness my hand and official Seal.

My Commission Expires:

STEPHANIE SCHULMAN
Notary Public, State of New York
No. 02SC6258887
Qualified in Westchester County
Commission Expires April 9, 2016

Notary Public

(SEAL)

STATE OF COLORADO )
)ss.
COUNTY OF DENVER )

The foregoing instrument was acknowledged before me this _____ day of_____, 20__, by_____, as Agent and Attorney-in-Fact for Kerr-McGee Gathering LLC, a Colorado limited liability company, on behalf of such company.

WITNESS my hand and official seal.

My commission expires: _____

Notary Public

Notary Public

(SEAL

Exhibits

Exhibit 1--duplicate original recorded Easements

Exhibit 2---description of right-of way lands

Exhibit 3---depiction of temporary construction easement

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# AGREEMENT FOR COMPATIBLE DEVELOPMENT

THIS AGREEMENT FOR COMPATIBLE DEVELOPMENT is made and entered into this 14th day of November, 2000, among UNION PACIFIC RESOURCES COMPANY, a Delaware corporation ("UPRC"), and UNION PACIFIC LAND RESOURCES CORPORATION, a Nebraska corporation ("UPLRC"), both with an address for business of P.O. Box 1330, Houston, Texas 77251-1330 and referred to hereinafter alone or together, as appropriate, as the "UP Entities" and WELD COUNTY LAND COMPANY, LLC, a Colorado limited liability company, with an address for business of 2500 Arapahoe, Suite 220, Boulder, Colorado 80302 ("Developer").

## RECITALS

A. Community Development Group of Erie, LLC ("CDG") and UPLRC have entered into an Offer to Purchase and Agreement of Sale ("Sales Agreement") that covers the sale by UPLRC to CDG of portions of the surface estate and certain mineral interests in Weld County, Colorado, for the property that is described in Exhibit "A" hereto (the "Property").

B. CDG has assigned all of its interests in the Sales Agreement to Developer.

C. Developer intends to purchase the Property in order to develop the surface in the future.

D. The UP Entities, or either of them, own and will reserve to themselves the oil and gas estate for the Property in any deed or deeds issued pursuant to the Sales Agreement.

E. The UP Entities, as owners of the oil and gas estate, or other companies or entities pursuant to oil and gas leases or other agreements or assignments, have the right to explore for and develop the oil and gas under the Property.

F. Oil and gas well sites and production sites and access roads and pipelines currently are located on the Property.

G. Current Colorado Oil and Gas Conservation Commission ("COGCC") rules and regulations would allow the owners and/or lessees of the oil and gas for the Property to locate drillsites, one each in approximately the center of each quarter section and one in the center of each quarter quarter section.

H. The parties enter into this Agreement for Compatible Development ("Agreement") to provide for the coexistence and joint development of the surface estate and the oil and gas estate and to delineate the process with which the parties shall comply with respect to the development of the two estates.

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NOW, THEREFORE, in consideration of the covenants and the mutual promises set forth in the Sales Agreement and in this Agreement, including the representations set forth in the recitals, the parties agree as follows:

1. THIS AGREEMENT SUPERCEDES EARLIER AGREEMENT.

This Agreement supercedes and replaces in its entirety the Agreement for Compatible Development dated September 18, 1998 among UPLRC, UPRC, and CDG.

2. DEFINITIONS.

(a) Application for Development includes a proposed subdivision plat, a planned unit development, a special use permit application, an application for a preliminary or final plat or plan, or any other designation for a surface development application used by a local jurisdiction, and any annexation request and any application for zoning or rezoning.

(b) Oil and Gas Interest Owners include the UP Entities and the lessees identified in oil and gas leases which have been recorded in the land records of Weld County, Colorado, or the assignees of recorded oil and gas leases where a notice of the assignment has been recorded in the land records of Weld County, Colorado and any other person or entity which a UP Entity identifies in writing to Developer as having an interest in the Property.

(c) Oil and Gas Well Operator means any individual or entity which operates an oil and gas well or other oil and gas facility on a Production Site or Well Site and whose identity, address, and phone number is displayed on a sign situated at the Well Site or Production Site.

(d) Applicable Oil and Gas Interest Owners refers to those Oil and Gas Interest Owners who have an interest in the parcel of property that is the subject of an Application for Development.

(e) Oil and Gas includes all oil, gas and associated liquid hydrocarbons, coal gas, coalbed methane, nitrogen, carbon dioxide, helium and all other natural gases.

(f) Production Site means that area surrounding proposed or existing production pits or other accessory equipment required in oil and gas production, at which may also be located tanks and tank batteries, exclusive of transmission and gathering pipelines.

(g) Proposed Production Site or Well Site means a site that is set aside as a future location pursuant to Section 4.

(h) Surface Use Agreement means a surface use agreement referred to herein to be entered into between Developer and the applicable Oil and Gas Interest Owners.

(i) Well Site means that area surrounding a proposed or existing well or wells and accessory structures and equipment necessary for drilling, completion, recompletion, workover, development and production activities.

3. EXISTING WELL SITE AND PRODUCTION SITE LOCATIONS. The following terms shall apply to all Well Sites and Production Sites that are in existence at the time Developer files an Application for Development:

(a) Lot lines for surface development shall be platted no closer than 200 feet from wellheads and from oil and gas facilities, including tank batteries, meter stations and separators, or any greater distance as is required by local regulations.

(b) Oil and Gas Interest Owners may continue to use their historic access to existing Well Sites and Production Sites and other oil and gas facilities and their historic easements for pipelines; provided, however, Developer and the operator of a Well Site or Production Site or pipeline may mutually agree upon alternate access routes and pipeline easements, all costs and expenses of relocations to be borne by Developer.

(c) Developer shall give advance notice to and meet at the site with representatives of the Oil and Gas Well Operator or the affected Oil and Gas Interest Owners to locate existing pipelines and to coordinate proposed surface construction activities with current and prospective oil and gas operations.

4. PROPOSED WELL SITE AND PRODUCTION SITE LOCATIONS. The following terms shall apply to proposed Production Sites and Well Sites:

(a) Prior to the approval of an Application for Development, other than for annexation and rezoning requests, Developer shall use its best efforts to meet with the applicable Oil and Gas Interest Owners to agree upon the number and location of future Well Site and Production Site locations to be installed on the Property. In the event an agreement is reached, the parties shall enter into a Surface Use Agreement specific to the parcel to be developed. In the event Developer and the applicable Oil and Gas Interest Owners cannot reach an agreement upon the number and location of future Well Sites and Production Sites or on the terms of a Surface Use Agreement, Developer shall, in connection with its Application for Development, include proposed Production Sites and Well Sites in the center of each quarter section and in the center of each quarter quarter section that conform to the locations identified in COGCC Rule 318A.a (1) and (2), a copy of which is attached to this Agreement as Exhibit B; provided, however, the size of the Well Sites and Production Sites shall conform to the description in Subsection 4.(b)(i).

(b) In locating Well Sites and Production Sites, access and pipeline easements, the parties shall include in the Surface Use Agreement, or if no Surface Use Agreement is entered

into, Developer shall, in providing for such proposed Production Sites and Well Sites, provide at a minimum, as follows:

(i) Each location shall include at least enough acreage to equal either approximately a square of four acres or a circle with a diameter of 467 feet, which acreage shall be reserved exclusively for oil and gas operations, so that surface property lines may abut, but may not be included within such acreage.

(ii) More than one well with attendant facilities may be located at both existing and proposed Well Sites and Production Sites subject to COGCC rules and regulations.

(iii) Routes to access each Well Site And Production Site and the location of pipeline easements shall be identified.

(iv) Subject to clause 4(b)(i), sufficient setbacks between buildings, building units and lot lines and Well Sites and Production Sites or wellheads and production facilities shall be provided to allow the Oil and Gas Interest Owners to comply with local setback regulations to drill a well and to conduct subsequent oil and gas operations.

5. IMPACT MITIGATION. Developer shall bear all costs to install such noise and visual impact mitigation measures it desires or the local jurisdiction or Weld County requires at or around existing and proposed Well Sites and Production Sites which are in excess of or in addition to those measures which are required by COGCC regulations for areas which are not high density; provided, however, the operator of the Well Site or Production Site shall have reasonable discretion to veto or protest the types and location of impact mitigation measures in order to allow for safe oil and gas operations. To the extent required by law or regulation, the UP Entities shall bear the cost of other impact mitigation measures, including environmental or hazardous materials cleanup, remediation or mitigation for any of its operations on the Property.

6. ACCESS AND PIPELINE EASEMENTS. All existing and future access roads and pipeline easements shall comply, at a minimum, as follow:

(a) Roads used for access shall be at least thirty (30) feet in width .

(b) Developer shall keep access that is jointly used by both surface occupants and the public and the Oil and Gas Interest Owners in good condition and repair once Developer has commenced development of the applicable parcel and until they are dedicated to a local jurisdiction. With respect to any roads that are jointly used by both the surface owner and the UP entities which are damaged as a result of actions or use by the UP entities or Developer, the cost of such repair of such damage shall be paid by the party causing the damage.

(c) Neither the UP Entities nor Developer shall unreasonably interfere with the use by the other of access roads.

(d) All pipeline easements shall be fifty (50) feet in width during construction, and thirty (30) feet in width during operations, transportation and maintenance activities. Developer shall grant the pipeline easements (for production from the property and other lands) to the Oil and Gas Interest Owners at the time they request them. It is the intention of the parties that pipeline easements be located in the most reasonably direct routes and, to the extent practicable, within dedicated rights-of-way and open space areas.

(e) Oil and Gas Interest Owners may install one or more pipelines within the easements.

7. PLAT AND LOCAL APPLICATIONS. Developer shall identify on plats and in Applications for Development (other than for annexation and rezoning requests) the locations and size of all existing and proposed Well Sites and Production Sites and other oil and gas facilities and existing and future access roads and pipeline easements, as well as the setbacks between existing and proposed Well Sites and Production Sites and planned and existing lot lines. Developer shall record a plat or other Application for Development which reflects the foregoing in the office of the Clerk and Recorder of Weld County after it is approved by the local jurisdiction.

8. NOTICE OF HEARINGS. Developer shall provide to each applicable Oil and Gas Interest Owner and Oil and Gas Well Operators written notice fifteen (15) days before each hearing on an Application for Development which affects such Oil and Gas Interest Owner's property.

9. WAIVER OF CERTAIN REQUIREMENTS AND OBJECTIONS. Developer hereby waives state and local setback regulations and other requirements that are inconsistent with this Agreement or a Surface Use Agreement and also agrees to not object in any forum to the use by Oil and Gas Interest Owners of the surface of the Property consistent with this Agreement or a Surface Use Agreement. At the request of an Oil and Gas Interest Owner, Developer shall provide such other written approvals and waivers which are reasonably requested and consistent with this Agreement or an applicable Surface Use Agreement, including, but not limited to, all approvals and waivers to drill a well or to conduct oil and gas operations on the Property because of any law or regulation, including any local ordinance and regulations of the COGCC and including, for example, waivers to the setback requirements in the current COGCC Rule 603, if applicable, or any successor state or local setback regulation and to any state setback requirement from a surface property line or for an exception location request.

10. COMPLIANCE WITH RULES AND REGULATIONS. Except as may be otherwise provided in Section 9, Developer and the UP Entities agree to comply with all valid and applicable federal, state and local regulations that pertain to the development of the surface estate and the exploration and development of Oil and Gas on the Property. The UP Entities shall make reasonable efforts to persuade Oil and Gas Interest Owners to enter into Surface Use Agreements with Developer.

11. NO OBJECTION TO DEVELOPMENT. The UP Entities agree that they will not object to a request by Developer to annex, rezone, plat or replat all or any portion of the Property to the extent such request is consistent with the use by the Oil and Gas Interest Owners of the surface of the Property in the manner identified in this Agreement and any applicable Surface Use Agreement; provided, however, neither of the UP Entities shall be required to incur any expenses in connection with such request.

12. UPRC OR UPLRC A PARTY TO SURFACE USE AGREEMENTS. UPRC or UPLRC shall be a party to each Surface Use Agreement that is entered into between Developer and other applicable Oil and Gas Interest Owners.

13. OIL AND GAS INTEREST OWNERS WHICH ARE KNOWN TO THE UP ENTITIES. Attached as Exhibit C is a list of those entities which the UP Entities believe own a leasehold or other Oil and Gas interest in the Property as of the date of this Agreement. The Developer may not rely on this list, and is required to perform an independent investigation as provided in Section 2(b) and provide notice to the applicable Oil and Gas Interest Owners and Oil and Gas Well Operators.

14. WAIVER OF SURFACE DAMAGE PAYMENTS. In the event that Developer and the applicable Oil and Gas Interest Owners do not enter into a Surface Use Agreement and Developer is required under Section 4(a) to preserve drillsite locations at the locations identified in COGCC Rules 318A ("Legal Locations"), Developer hereby agrees to waive all surface damage payments for each and every well that is drilled at a Legal Location. Oil and Gas Interest Owners may provide a copy of this Agreement to the COGCC as evidence of this waiver. The term "surface damage payments" as used herein shall be given the meaning commonly used in the oil and gas industry.

15. ACKNOWLEDGMENT OF TITLE TO THE OIL AND GAS. As between the parties, Developer specifically acknowledges the title of the UP Entities to the Oil and Gas reserved and relinquishes all rights and claims thereto.

16. SURFACE OWNER CONSENT. Developer, for itself and its successors and assigns, agrees that it will not withhold its consent as surface owner of the Property (if the UP Entities, in their sole discretion, require such consent) to the exercise by the Oil and Gas Interest

Owners of their rights to explore for and develop the Oil and Gas under the Property in accordance with this Agreement or any applicable Surface Use Agreement and all applicable laws and regulations.

17. CONFLICT IN AGREEMENTS. In the event of a conflict between this Agreement and a Surface Use Agreement, the terms of the Surface Use Agreement shall control. The provisions in a Surface Use Agreement shall supersede any inconsistent provisions in this Agreement.

18. OIL AND GAS INTEREST OWNERS ARE BENEFICIARIES. The benefits of the terms of this Agreement shall extend to the Oil and Gas Interest Owners, and any of them may bring an action directly against Developer for damages or injuries sustained resulting from a breach of this Agreement by Developer; however, nothing in this Agreement is intended to create a cause of action by any Oil and Gas Interest Owner against either of the UP Entities or to enlarge any right or interest created by any agreement or lease between a UP Entity and an Oil and Gas Interest Owner.

19. RIGHTS OF OIL AND GAS LESSEES AND THEIR ASSIGNEES. Developer understands and acknowledges that the UP Entities, or either of them, have entered into leases and agreements with various entities for portions of the Property and that the UP Entities have granted their lessees the exclusive right to explore for and develop the Oil and Gas that underlies the property that is the subject of a lease. Developer further recognizes that the UP Entities enter into this Agreement in their capacity as the owners of the Oil and Gas and to protect their reversionary interest to explore for and develop the Oil and Gas at such time as a lease terminates. In this regard, Developer is aware that the applicable Oil and Gas lessees or their assignees have rights to explore for and develop the Oil and Gas that are not affected by this Agreement.

20. NO LIMITATION ON RIGHTS. Except as provided herein with respect to the Oil and Gas Interests of the UP Entities only, nothing in this Agreement is intended to limit the rights of the Oil and Gas Interest Owners under the terms of their oil and gas leases and pursuant to state law.

21. SUCCESSORS AND ASSIGNS. This Agreement and all of the covenants in it shall be binding upon the personal representatives, heirs, successors and assigns of all of the parties, and the benefits of this Agreement shall inure to their personal representatives, heirs, successors and assigns; provided, however, this Agreement is not intended to bind Oil and Gas Interest Owners other than the UP Entities and reference herein to the obligations of one or both of the UP entities is strictly limited to such entities. This Agreement and all of the covenants in it shall be covenants running with the land.

22. RECORDING. This Agreement shall be recorded with the Clerk and Recorder of Weld County at any time after Developer closes on the sale of all or any portion of the Property.

23. APPLICABILITY TO PROPERTY PURCHASED BY DEVELOPER. This Agreement shall apply only to that portion of the Property that Developer purchases.

24. GOVERNING LAW. The validity, interpretation and performance of this Agreement shall be governed and construed in accordance with the laws of the State of Colorado.

25. SEVERABILITY. If any part of this Agreement is found to be in conflict with applicable laws, such part shall be inoperative, null and void insofar as it conflicts with such laws; however, the remainder of this Agreement shall be in full force and effect. In the event that any part of this Agreement would otherwise be unenforceable or in conflict with applicable laws due to the term or period for which such part is in effect, the term or period for which such part of this Agreement shall be in effect shall be limited to the longest period allowable which does not cause such part to be unenforceable or in conflict with applicable laws.

26. NOTICES. Any notice or communication required or permitted by this Agreement shall be given in writing either by (a) personal delivery; (b) expedited delivery service with proof of delivery; (c) United States mail, postage prepaid, and registered or certified mail with return receipt requested; or (d) prepaid telecopy or fax, the receipt of which shall be acknowledged, addressed as follows:

UP Entities: Union Pacific Resources Company
c/o Anadarko Petroleum Corporation
Attention: Manager Western U.S. Land
P.O. Box 1330
17001 North Chase Drive
Houston, Texas 77251-1330

Developer: Weld County Land Company, LLC
2500 Arapahoe, Suite 220
Boulder, Colorado 80302
Attention: Jon Lee

with a copy to: Alan Lottner, Esq.
Lottner Rubin Fishman Brown & Saul, P.C.
633 17th Street, Suite 2700
Denver, Colorado 80202-3635

27. INCORPORATION BY REFERENCE. Exhibits A and B, and C are incorporated herein by this reference.

28. COUNTERPART EXECUTIONS. This Agreement may be executed in counterparts, each of which shall be deemed an original.

29. ENTIRE AGREEMENT. This Agreement sets forth the entire understanding among the parties and supersedes any previous communications, representations or agreements, whether oral or written. No change of any of the terms or conditions herein shall be valid or binding on any party unless in writing and signed by an authorized representative of each party.

IN WITNESS WHEREOF, the undersigned parties have caused this Agreement to be executed by a duly authorized representative on the date and year first above written.

**UP ENTITIES:**

UNION PACIFIC RESOURCES COMPANY,
a Delaware corporation

By: _____ mdj
Its: Attorney-In-Fact

UNION PACIFIC LAND RESOURCES CORPORATION, a Nebraska corporation

By: _____ mdj
Its: Attorney-in-Fact

**DEVELOPER:**

WELD COUNTY LAND COMPANY, LLC,
a Colorado limited liability company

By: _____
Its: MANAGER

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STATE OF COLORADO )
CITY AND ) ss.
COUNTY OF DENVER )

The foregoing instrument was acknowledged before me this 14th day of November, 2000, by G. E. Peters, as Attorney-in-Fact of Union Pacific Land Resources Corporation, a Nebraska corporation.

WITNESS my hand and official seal.

My Commission expires: 8/29/01

Melissa A. Morman
Notary Public

STATE OF COLORADO )
CITY AND ) ss.
COUNTY of DENVER )

The foregoing instrument was acknowledged before me this 14th day of November, 2000, by James L. Newcomb, as Attorney-in-Fact of Union Pacific Resources Company, a Delaware corporation.

WITNESS my hand and official seal.

My Commission expires: 8/29/01

Melissa A. Morman
Notary Public

STATE OF COLORADO )
CITY AND ) ss.
COUNTY of DENVER )

The foregoing instrument was acknowledged before me this 14th day of November, 2000, by Charles R. Bullock, as Manager of Weld County Land Company, LLC, a Colorado limited liability company.

WITNESS my hand and official seal.

My Commission expires: 8/29/01

Melissa A. Morman
Notary Public

# EXHIBIT A

Attached to and made part of Agreement for Compatible Development
dated November 14, 2000, by and among
UNION PACIFIC LAND RESOURCES CORPORATION,
UNION PACIFIC RESOURCES COMPANY, and
WELD COUNTY LAND COMPANY, LLC

A parcel of land situate in Section 4, Township 1 North, Range 68 West of the 6th P.M., Weld County, more particularly described as follows:

PARCEL A

Commencing at the Southwest corner of Section 4, Township 1 North, Range 68 West, 6th P.M., from whence the West 1/4 corner of said Section lies N00°02'03" E, 2682.02 feet;
Thence N44°47'52" E, 42.60 feet to the point of beginning, 30.00 feet easterly of the We line of the SW1/4 of Section 4;
Thence N00°02'03" E, 2651.78 feet parallel with and 30.00 feet East of West line of the SW1/4 of Section 4;
Thence N00°01'00" E, 2418.32 feet parallel with and 30.00 feet East of the West line of the NW1/4 of Section 4 to a point on the South right-of-way line of State Highway 52 recorded in Book 491, Reception No. 1413164 and along said right of way the following two courses:
1. N55°55'30" E, 60.40 feet;
2. N88°34'43" E, 5153.37 feet, to a point 30.00 feet westerly of the East line of the NE1/4 of Section 4;

Thence S00°05'46" E, 2568.01 feet parallel with and 30.00 feet West of the East line of the NE1/4 of Section 4;
Thence S00°08'21" E, 2632.37 feet parallel with and 30.00 feet West of the East line of the SE1/4 of Section 4 to a point 30.00 feet northerly of the South line of the SE1/4 of Section 4;
Thence S89°44'56" W, 2608.67 feet parallel with and 30.00 feet North of the South line of the SE1/4 of Section 4;
Thence S89°33'41" W, 2606.23 feet parallel with and 30.00 feet North of the South line of the SW1/4 of Section 4 to the point of beginning.

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Two parcels of land situate in the SE1/4 of Section 8, Township 1 North, Range 68 West o the 6th P.M., Weld County, more particularly described as follows:

PARCEL B

Commencing at the Southeast corner of Section 8, Township 1 North, Range 68 West, 6th P.M., from whence the East 1/4 corner of said section lies N00°49'09" E, 2674.68 feet; Thence N45°04'48" W, 41.78 feet to the point of beginning, 30.00 feet North of the South line of said section;
Thence S89°01'14" W, 2618.83 feet parallel with and 30.00 feet North of the South line o said section to a point on the North-South centerline of Section 8;
Thence N00°01'31" E, 1579.23 feet along said North-South centerline to a point on the South right of way line of the Union Pacific Railroad, said right-of-way conveyed to the Union Pacific Railroad by a deed recorded June 13, 1912, in Book 359 at Page 418, said right-of-way line being 50.00 feet distant southerly as measured at right angles or radially from the existing main track centerline;
Thence along said right of way the following three courses:

1) N42°43'40" E, 467.34 feet,
2) 1735.43 feet along the arc of a tangent curve to the right, said arc subtended by a radius of 1858.50 feet, a central angle of 53°30'06", and a chord bearing N69°28'43" E, 1673.07 feet,
3) S83°46'14" E, 772.36 feet to a point 30.00 feet West of the East line of the S1/2 of the section;

Thence S00°49'09" W, 2380.71 feet parallel with and 30.00 feet West of the East line of the S1/2 to the point of beginning.

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PARCEL B-1

Commencing at the East 1/4 corner of Section 8, Township 1 North, Range 68 West, 6th P.M. from whence the Southeast corner of said section lies S00°49'09" W, 2674.68 feet;
Thence along the East-West centerline S89°35'35" W, 30.00 feet to the point of beginning;
Thence S00°49'09" W, 163.81 feet parallel with and 30.00 feet West of the East line of th S1/2 of Section 8 to a point on the northerly right-of-way line of the Union Pacific Railroad, said right of way conveyed to the Union Pacific Railroad by a deed recorded Jun 13, 1912, in Book 359 at Page 418, said right-of-way line being 50.00 feet distant northerly as measured at right angles or radially from the existing main track centerline;
Thence following said northerly right of way the following three courses:

1) N83°46'14" W, 762.89 feet,
2) 1828.81 feet along the arc of a tangent curve to the left, said arc subtended by a radius of 1958.50 feet, a central angle of 53°30'06", and a chord bearing S69°28'43" W, 1763.09 feet;
3) S42°43'40" W, 358.98 feet to a point on the North-South centerline of Section 8;

Thence N00°01'31" E, 943.91 feet along said North-South centerline to a point on the East-West centerline of said Section 8;
Thence N89°35'35" E, 2655.15 feet along the East-West centerline to the point of beginning.

(continued)

Three parcels of land situate in Section 10, Township 1 North, Range 68 West of the 6th P.M., Weld County, more particularly described as follows:

PARCEL C

Commencing at the Northwest corner of Section 10, Township 1 North, Range 68 West, 6th P.M., from whence the West 1/4 corner of said section lies S00°24'43" W, 2669.01 feet;
Thence N89°45'35" E, 30.00 feet;
Thence S00°08'14" E, 30.00 feet to the point of beginning;
Thence parallel with and 30.00 feet South of the North line of the NW1/4 of Section 10 N89°45'35" E, 2627.62 feet to a point on the West line of said NE1/4;
Thence parallel with and 30.00 feet South of the North line of the NE1/4 of Section 10 N89°45'48" E, 2408.00 feet to a point on the West right-of-way line of Interstate Highway 25, as recorded in Book 1513 at Page 241;
Thence along said West right-of-way line the following two courses:
1) S00°23'52" E, 2628.85 feet;
2) S00°22'56" E, 2628.28 feet to a point 30.00 feet northerly of the South line of the SE1/4 of Section 10;
Thence parallel with and 30.00 feet North of said South line S89°37'55" W, 2446.01 feet to a point on the West line of SE1/4 of Section 10;
Thence parallel with and 30.00 feet North of the South line of the SW1/4 of Section 10 S89°43'33" W, 844.10 feet to a point on the northeasterly line of a parcel recorded in Book 359 at Page 418, being 50.00 feet northeasterly, as measured radially, from the centerline of the main track of the Boulder branch of the Union Pacific Railroad as now constructed and operated;

Thence along said line the following two courses:
1) 969.32 feet along the arc of a non-tangent curve to the left, said arc subtended by a radius of 2857.50 feet, a central angle of 19°26'45", and a chord bearing N57°09'36" W, 965.16 feet;
2) N66°52'58" W, 372.83 feet to a point on the southerly line of a parcel recorded in Book 847 at Page 316 and described as "60 feet in width and eight tenths (0.8) of an acre";
Thence along said line the following twelve courses:
1) 239.36 feet along the arc of a tangent curve to the left, said arc subtended by a radius of 974.72 feet, a central angle of 14°04'55", and a chord bearing N81°58'35" E 238.96 feet;
2) N74°56'08" E, 244.90 feet (14.1' beyond the beginning of a 43.5' wide strip, 2.5 acre in area described in Book 847 at Page 316);
3) 80.62 feet along the arc of a tangent curve to the right, said arc subtended by a radius of 727.80 feet, a central angle of 06°20'49", and a chord bearing N78°06'32" E 80.58 feet;
4) N81°16'57" E, 7.90 feet;

(continued)

5) 22.90 feet along the arc of a tangent curve to the right, said arc subtended by a radius of 727.80 feet, a central angle of 01°48'10", and a chord bearing N82°11'02" 22.90 feet;
6) N83°05'07" E, 599.90 feet;
7) 217.92 feet along the arc of a tangent curve to the right, said arc subtended by a radius of 727.80 feet, a central angle of 17°09'20", and a chord bearing S88°20'13" 217.11 feet;
8) S79°45'33" E, 394.90 feet;
9) 125.19 feet along the arc of a tangent curve to the left, said arc subtended by a radius of 797.80 feet, a central angle of 08°59'27", and a chord bearing S84°15'17" 125.06 feet;
10) S88°45'00" E, 447.00 feet;
11) 113.58 feet along the arc of a tangent curve to the left, said arc subtended by a radius of 797.80 feet, a central angle of 08°09'26", and a chord bearing N87°10'17" E, 113.49 feet;
12) N83°05'34" E, 469.60 feet to the southwesterly corner of a parcel of land recorded Book 1003 at Page 464;

Thence along boundary of said parcel the following three courses:
1) N83°05'34" E, 200.00 feet;
2) N06°54'26" W, 108.50 feet;
3) S83°05'34" W, 200.00 feet to the northeasterly corner of the previous parcel recorde in Book 847 at Page 316;

Thence along northerly line of said parcel the following five courses:
1) S83°05'34" W, 336.10 feet;
2) S06°54'26" E, 23.50 feet;
3) S83°05'34" W, 133.50 feet;
4) 101.48 feet along the arc of a tangent curve to the right, said arc subtended by a radius of 712.80 feet, a central angle of 08°09'26", and a chord bearing S87°10'17" 101.40 feet;
5) N88°45'00" W, 293.50 feet to the easterly corner of a parcel recorded in Book 934 at Page 209;

Thence along northerly line of said parcel the following two courses:
1) N79°31'35" W, 554.21 feet;
2) S88°19'28" W, 364.79 feet to a point on the northerly line of the previous parcel recorded in Book 847 at Page 316;

Thence along northerly line of said parcel the following eight courses:
1) S83°05'07" W, 585.80 feet;
2) 26.47 feet along the arc of a tangent curve to the left, said arc subtended by a radius of 812.80 feet, a central angle of 01°51'58", and a chord bearing S82°09'07" 26.47;

(continued)

3) 6.10 feet along the arc of a compound curve to the left, said arc subtended by a radius of 2755.00 feet, a central angle of 00°07'37", and a chord bearing S81°16'57" W, 6.10 feet;
4) 90.94 feet along the arc of a compound curve to the left, said arc subtended by a radius of 812.80 feet, a central angle of 06°24'37", and a chord bearing S78°08'26" W, 90.89 feet;
5) S74°56'08" W, 14.10 feet;
6) S15°03'52" E, 25.00 feet;
7) S74°56'08" W, 230.80 feet;
8) 395.38 feet along the arc of a tangent curve to the right, said arc subtended by a radius of 914.72 feet, a central angle of 24°45'57", and a chord bearing S87°19'06" W, 392.31 feet to a point on the northeasterly line of the parcel recorded at Book 512 at Page 418, being 50.00 feet northeasterly, as measured radially from the main track of the Boulder branch of the Union Pacific Railroad as now constructed and operated;

Thence along said Northeasterly line of parcel N66°52'58" W, 485.14 feet;
Thence N00°08'27" W, 1683.89 feet to a point on the South line of the NW1/4 of Section 12;
Thence N00°08'14" W, 2638.73 feet to the point of beginning.

**Except portions conveyed to the Department of Transportation, State of Colorado by Rule and Order recorded June 23, 2000 at Reception No. 2776783**

(continued)

PARCEL C-1

Commencing at the Southwest corner of Section 10, Township 1 North, Range 68 West, 6th P.M., from whence the West 1/4 corner of said Section lies N00°31'01" E, 2635.71 feet;
Thence N89°43'33" E, 86.08 feet;
Thence N00°08'27" W, 30.00 feet to the point of beginning
Thence continuing N00°08'27" W, 684.18 feet to a point on the southerly line of a parcel recorded in Book 512 at Page 337;
Thence along said Southerly line of parcel 408.40 feet along the arc of a non-tangent curve to the right, said arc subtended by a radius of 968.02 feet, a central angle of 24°10'22", and a chord bearing S85°43'12" E, 405.38 feet to the northeasterly corner of a parcel recorded in Book 833 at Page 482;

Thence around said parcel the following three courses:
1) S23°07'02" W, 44.34 feet;
2) S66°52'58" E, 545.00 feet;
3) N23°07'02" E, 50.00 feet; to a point on the southwesterly line of a parcel recorded in Book 359 at Page 418, being 50.00 feet southwesterly of the centerline of the main track of the Boulder branch of the Union Pacific Railroad as now constructed and operated;

Thence along line of said parcel the following two courses:
1) S66°52'58" E, 13.41 feet;
2) 825.61 feet along the arc of a tangent curve to the right, said arc subtended by a radius of 2757.50 feet, a central angle of 17°09'17", and a chord bearing S58°18'19" E, 822.53 feet to a point 30.00 feet northerly of the South line of the SW1/4 of Section 10;
Thence parallel with and 30.00 feet North of said South line S89°43'33" W, 1618.24 feet to the point of beginning.

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PARCEL C-2

Commencing at the Southwest corner of Section 10, Township 1 North, Range 68 West, 6th P.M., from whence the West 1/4 corner of said section lies N00°31'01" E, 2655.71 feet;
Thence N89°43'33" E, 86.08 feet;
Thence N00°08'27" W, 815.00 feet to the point of beginning;
Thence continuing N00°08'27" W, 47.81 feet to a point on the southwesterly line of a parcel recorded in Book 359 at Page 418, being 50.00 feet southwesterly, as measured perpendicularly, from the centerline of the main track of the Boulder branch of the Union Pacific Railroad as now constructed and operated;
Thence along said southwesterly line S66°52'58" E, 102.68 feet to a point on the northerl line of a parcel recorded in Book 512 at Page 337;
Thence along said northerly line 94.64 feet along the arc of a non-tangent curve to the left, said arc subtended by a radius of 1063.02 feet, a central angle of 05°04'38", and a chord bearing S85°27'14" W, 94.61 feet to the point of beginning.

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A parcel of land situate in the E1/2 of Section 18, Township 1 North, Range 68 West of th 6th P.M., Weld County, more particularly described as follows:

PARCEL D

Commencing at the Northeast corner of Section 18, Township 1 North, Range 68 West, 6th P.M., from whence the East 1/4 corner of said section lies S00°02'28" E, 2678.62 feet;
Thence N89°14'48" W, 30.07 feet to the point of beginning;
Thence S00°02'28" E, 1897.89 feet parallel with and 30.00 feet distant West of the East line of the NE1/4 of Section 18 to a point on the North line of the Erie Cemetery, partially described in a deed recorded on May 23, 1968, as Reception No. 1516751;
Thence N89°59'20" W, 640.42 feet to the Northwest corner of said cemetery;
Thence S00°03'40" W, 404.65 feet to the North line of a parcel recorded in Book 30, Page 483;
Thence N89°34'58" W, 163.67 feet to the Northwest corner of said parcel;
Thence S00°04'57" E, 417.42 feet to the Southwest corner of said parcel;
Thence S89°34'58" E, 804.84 feet to a point 30.00 feet westerly of the East line of the SE1/4 of Section 18;
Thence S00°25'10" E, 1450.65 feet parallel with and 30.00 feet distant westerly of the East line of said SE1/4 to a point on the North line of a parcel recorded as Reception No 1516751;

Thence along boundary of said parcel the following three courses:
1) S89°40'50" W, 658.56 feet,
2) S00°19'10" E, 253.00 feet,
3) N89°40'50" E, 659.00 feet to a point 30.00 feet westerly of the East line of the SE1, of Section 18;

Thence S00°25'10" E, 825.08 feet to a point 30.00 feet northerly of the South line of sai SE1/4 of Section 18, said point also being the northerly right-of-way line of Weld County Road 8;
Thence N89°31'17" W, 258.53 feet, along said northerly right of way, parallel with and 30.00 feet North of the South line of said SE1/4;
Thence N86°54'04" W, 1098.49 feet along the northerly line of Weld County Road 8, as described in Book 15551, Pages 39-43, Reception Nos. 2495437-41 to a point on the easterl line of property described in Book 754 at Reception No. 1676471;

Thence along said property the following three courses:
1) N00°29'16" E, 49.80 feet;
2) 453.09 feet along the arc of a tangent curve to the left, said arc subtended by a radius of 440.00 feet, a central angle of 59°00'00", and a chord bearing N29°00'44" W 433.33 feet;
3) N58°30'44" W, 204.67 feet to a point 50.00 feet distant southeasterly, measured at right angles, from the centerline of the main track of the Boulder branch of the Unio

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Pacific Railroad Company as presently constructed and operated, said right of way conveyed to the Union Pacific Railroad by deed recorded in Book 359 at Page 418;
Thence northerly along a line drawn parallel and/or radially with said centerline of main track the following nine courses:

1) 629.21 feet along the arc of a non-tangent curve to the left, said arc subtended by a radius of 1007.50 feet, a central angle of 35°46'57", and a chord bearing N07°31'37" E, 619.03 feet;
2) Thence N10°21'52" W, 694.70 feet;
3) 894.20 feet along the arc of a tangent curve to the right, said arc subtended by a radius of 1287.50 feet, a central angle of 39°47'36", and a chord bearing N09°31'57" E, 876.34 feet;
4) N29°25'45" E, 224.87 feet;
5) 463.85 feet along the arc of a tangent curve to the left, said arc subtended by a radius of 1673.50 feet, a central angle of 15°52'51", and a chord bearing N21°29'19" E, 462.36 feet;
6) N13°32'54" E, 421.72 feet;
7) 966.21 feet along the arc of a tangent curve to the left, said arc subtended by a radius of 2957.50 feet, a central angle of 18°43'06", and a chord bearing N04°11'21" E, 961.91 feet;
8) N05°10'12" W, 351.67 feet;
9) 165.08 feet along the arc of a tangent curve to the right, said arc subtended by a radius of 1575.00 feet, a central angle of 06°00'20", and a chord bearing N02°10'02" W, 165.01 feet to a point on the North line of the NE1/4 of Section 18;

Thence along said North line S89°14'48" E, 1206.77 feet to the point of beginning,
EXCEPTING THEREFROM a "road right of way 8 feet in width leading to said cemetery from Erie", so described in Book 30 at Page 483.

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A parcel of land situate in Section 17, Township 1 North, Range 68 West of the 6th P.M., Weld County, more particularly described as follows:

PARCEL E

Commencing at the Northeast corner of Section 17, Township 1 North, Range 68 West, 6th P.M., from whence the East 1/4 corner of said Section lies S00°12'52" E, 2631.66 feet;
Thence S44°24'11" W, 42.71 feet to the point of beginning, 30.00 feet westerly of the East line of the N1/2 of Section 17;
Thence S00°12'52" E, 2601.26 feet parallel with and 30.00 feet West of the East line of the N1/2 of Section 17;
Thence S00°13'30" E, 2602.21 feet parallel with and 30.00 feet West of the East line of the SE1/4 of Section 17 to a point 30.00 feet northerly of the South line of the SE1/4 of Section 17;
Thence S88°48'09" W, 2618.87 feet parallel with and 30.00 feet North of the South line of the SE1/4 of Section 17;
Thence S88°48'45" W, 2617.65 feet parallel with and 30.00 feet North of the South line of the SW1/4 of Section 17 to a point 30.00 feet easterly of the West line of the SW1/4 of Section 17;
Thence N00°29'10" W, 2573.96 feet parallel with and 30.00 feet East of the West line of the SW1/4 of Section 17;
Thence N00°02'28" W, 2649.01 feet parallel with and 30.00 feet East of the West line of the NW1/4 of Section 17 to a point 30.00 feet southerly of the North line of Section 17;
Thence N89°01'14" E, 5236.94 feet parallel with and 30.00 feet South of the North line of Section 17 to the point of beginning.

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A parcel of land situate in the E1/2 of Section 33, Township 2 North, Range 68 West of th 6th P.M., Weld County, more particularly described as follows:

PARCEL F

Commencing at the Northeast corner of said Section 33 from whence the East 1/4 corner li S00°02'01" E, 2661.98 feet;
Thence along the East line of the NE1/4 of said Section 33 S00°02'01" E, 30.00 feet;
Thence along a line parallel with and 30.00 feet southerly, measured at right angles, fr the North line of the NE1/4 of said Section 33, S89°08'30" W, 150.02 feet to the point o beginning;
Thence continuing along said line parallel with and 30.00 feet distant southerly from th North line of the NE1/4 of Section 33, S89°08'30" W, 2491.97 feet to a point on the West line of the NE1/4 of said Section 33;
Thence S00°02'38" E, 2594.11 feet along West line to the SW1/4 corner of the NE1/4 of Section 33;
Thence S00°02'52" E, 2648.52 feet along the West line of the SE1/4 of said Section 33 to point that is 30.00 feet distant northerly from the South 1/4 corner of said Section 33;
Thence N89°37'29" E, 487.95 feet along a line parallel with and 30.00 feet distant northerly from the South line of the SE1/4 of said Section 33 to a point on the East lin of a parcel recorded in Book 1506, Reception No. 2451280;
Thence along East line of said parcel N03°40'23" E, 2651.19 feet to a point on the South line of the NE1/4 of said Section 33;
Thence N89°57'46" E, 1951.25 feet along the South line of the NE1/4 of Section 33 to a point that is 30.00 feet distant westerly from the East 1/4 corner of said Section 33;
Thence N00°02'01" W, 722.66 feet along a line parallel with and 30.00 feet distant westerly from the East line of the NE1/4 of Section 33 to the Southeast corner of the parcel recorded May 13, 1998, at Reception No. 2612563;

Thence along said parcel the following three courses:
1. S89°57'59" W, 363.76 feet;
2. N00°02'01" W, 240.00 feet;
3. N89°57'59" E, 363.76 feet;

Thence N00°02'01" W, 449.60 feet along a line parallel with and 30.00 feet distant westerly from the East line of the NE1/4 of Section 33 to a point on the South line of th parcel recorded at Reception No. 2288334;
Thence along the South line of said parcel S89°57'59" W, 250.00 feet to the Southwest corner of parcel;
Thence along the West line of said parcel N00°02'01" W, 120.00 feet to a point on the South line of that parcel owned by Nick Harkales in the year 1948;
Thence along South line of said parcel S89°57'59" W, 10.00 feet to the Southwest corner o the parcel;
Thence along West line of said parcel N00°02'01" W, 110.00 feet to a point on the South

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line of a parcel recorded January 29, 1993, in Book 1368 at Reception No. 2319926;

Thence along said parcel the following three courses:
1. S89°57'59" W, 3.30 feet;
2. N00°02'01" W, 56.21 feet;
3. N89°57'59" E, 263.30 feet;
Thence N00°02'01" W, 353.51 feet along a line parallel with and 30.00 feet distant westerly from the East line of the NE1/4 of Section 33 to the Southeast corner of a parcel recorded April 12, 1945, in Book 1153, Page 15;
Thence along the South line of said parcel S89°57'59" W, 150.00 feet;
Thence N00°02'01" W, 150.00 feet to the Northwest corner of a parcel recorded April 24, 1926, in Book 788, Page 400;
Thence along North line of said parcel N89°57'59" E, 150.00 feet;
Thence N00°02'01" W, 304.55 feet along a line parallel with and 30.00 feet distant westerly from the East line of the NE1/4 of Section 33;
Thence S89°08'30" W, 120.01 feet;
Thence N00°02'01" W, 125.01 feet to the point of beginning.

(continued)

Three parcels of land situate in Section 19, Township 1 North, Range 68 West of the 6th P.M., Weld County, More particularly described as follows:

PARCEL G

Commencing at the Northeast corner of the NW1/4 of the NE1/4 of Section 19, Township 1 North, Range 68 West, 6th P.M., from whence the Northeast corner of Section 19 lies S89°31'17" E, 1298.14 feet;
Thence S00°24'57" E, 24.66 feet along the East line of the W1/2 of the NE1/4 of Section 19 to the point of beginning;
Thence continuing along line S00°24'57" E, 2609.86 feet to a point on the South line of NE1/4 of Section 19;
Thence along East line of the W1/2 of the SE1/4 of Section 19 S00°25'02" E, 2604.36 feet to a point 30.00 feet northerly of the South line of the SE1/4 of Section 19;
Thence S89°56'56" W, 1292.51 feet parallel with and 30.00 feet North of the South line of the SE1/4 of Section 19;
Thence S89°57'02" W, 1267.09 feet parallel with and 30.00 feet North of the South line of the SW1/4 of Section 19;
Thence N00°33'50" W, 2616.47 feet along the West line of the E1/2 of the SW1/4 to the South line of the NW1/4 of Section 19;
Thence along the South line of said NW1/4 S89°46'26" E, 1.97 feet to a point on the easterly line of a parcel of land recorded at Reception No. 2633609;

Thence along the easterly line of said parcel the following five courses:

1) 94.67 feet along the arc of a non-tangent curve to the left, said arc subtended by a radius of 340.00 feet, a central angle of 15°57'12", and a chord bearing N22°39'50" W, 94.36 feet,
2) 29.56 feet along the arc of a reverse curve to the right, said arc subtended by a radius of 20.00 feet, a central angle of 84°40'19", and a chord bearing N11°41'44" E, 26.94 feet,
3) 236.41 feet along the arc of a reverse curve to the left, said arc subtended by a radius of 950.00 feet, a central angle of 14°15'29", and a chord bearing N46°54'09" E, 235.80 feet,
4) N39°46'24" E, 2542.95 feet,
5) 888.62 feet along the arc of a tangent curve to the right, said arc subtended by a radius of 1030.00 feet, a central angle of 49°25'52", and a chord bearing N64°29'20" E, 861.31 feet, to the point of beginning.

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PARCEL G-1

Commencing at the N 1/4 corner of Section 19, Township 1 North, Range 68 W, 6th P.M., from whence the Northwest corner of said section lies N89°30'18" W, 2543.60 feet;
Thence along the North line of the NW1/4 of Section 19 N89°30'18" W, 1108.21 feet to the point of beginning;
Thence S56°52'34" E, 304.45 feet parallel with and 100.00 feet distant, southwesterly, from the centerline of the Boulder branch of the main track of the Union Pacific Railroad Company, as presently constructed and operated;
Thence continuing parallel with and 100.00 feet distant, measured radially, from the centerline of said railroad track, 1393.34 feet along the arc of a tangent curve to the left, said arc subtended by a radius of 1050.98 feet, a central angle of 75°57'37", and a chord bearing N85°08'37" E, 1293.52 feet, bounded northerly, in part, by a parcel of land recorded in Book 1453, Reception No. 2400985, to a point on the boundary of a parcel of land recorded at Reception No. 2633609;

Thence along westerly boundary of said parcel the following four courses:
1) S00°17'05" E, 242.48 feet,
2) 36.04 feet along the arc of a non-tangent curve to the left, said arc subtended by a radius of 1170.00 feet, a central angle of 01°45'54", and a chord bearing S40°39'21" W, 36.04 feet,
3) S39°46'24" W, 2542.95 feet,
4) 492.51 feet along the arc of a tangent curve to the right, said arc subtended by a radius of 810.00 feet, a central angle of 34°50'17", and a chord bearing S57°11'33" W 484.96 feet, to a point on the East line of a parcel of land recorded in Book 1623, Reception No. 2566192;

Thence along said easterly line the following three courses:
1) N01°09'00" E, 63.08 feet,
2) 242.86 feet along the arc of a tangent curve to the right, said arc subtended by a radius of 5679.65 feet, a central angle of 02°27'00", and a chord bearing N02°12'02" E, 242.84 feet,
3) N03°35'48" E, 2245.72 feet to the northerly line of the NW1/4 of Section 10;
Thence S89°30'18" E, 361.43 feet along said northerly line to the point of beginning.

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PARCEL G-2

Commencing at the Northwest corner of Section 19, Township 1 North, Range 68 W, 6th P.M. from whence the W1/4 corner of said section lies S00°30'22" E, 2652.75 feet;
Thence along the North line of the NW1/4 of Section 19 S89°30'18" E, 30.00 feet to the point of beginning;
Thence continuing along said North line, S89°30'18" E, 943.81 feet to a point on the West line of a parcel of land described in Book 1623, Reception No. 2566192,

Thence along said West line the following three courses:
1) S03°35'48" W, 2240.30 feet,
2) 247.14 feet along the arc of a tangent curve to the left, said arc subtended by a radius of 5779.65 feet, a central angle of 02°27'00", and a chord bearing S02°12'31" W, 247.11 feet,
3) S01°08'50" W, 86.00 feet, to a point on the North line of a parcel of land recorded as Reception No. 2633609;

Thence along North line of said parcel the following two courses:
1) 118.06 feet along the arc of a non-tangent curve to the right, said arc subtended by radius of 810.00 feet, a central angle of 08°21'05", and a chord bearing S86°03'02" W, 117.96 feet,
2) N89°46'26" W, 651.49 feet to a point 30.00 feet easterly of the West line of the NW1/4 of Section 19;
Thence N00°30'22" W, 2582.61 feet parallel with and 30.00 feet East of West line of the NW1/4 of Section 19 to the point of beginning.

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EXHIBIT B

Attached to and made a part of Agreement for Compatible Development
dated November 14, 2000, by and among
UNION PACIFIC LAND RESOURCES CORPORATION,
UNION PACIFIC RESOURCES COMPANY, and
WELD COUNTY LAND COMPANY, LLC

**318A. Greater Wattenberg Area Special well location rule.**

a. The Greater Wattenberg Area ("GWA") is defined to include those lands from and including Townships 2 South to 7 North and Ranges 61 West to 68 West, 6th P.M. In GWA, operators may utilize the following described drilling locations to drill or twin a well, deepen a well, or recomplete a well and to commingle any or all of the Cretaceous Age formations from the base of the Dakota to the surface ("GWA wells"):

(1) a square with sides four hundred (400) feet in length, the center of which is the center of any quarter/quarter section; and,

(2) a square with sides eight hundred (800) feet in length, the center of which is the center of any quarter section.

b. Any GWA well in existance prior to the effective date of this rule, which is not located as described above, may also be utilized for deepening to or recompletion in any Cretaceous Age formation, and for the commingling of production therefrom.

c. Where an existing well cannot be utilized for deepening or recompletion, for reasons including, but not limited to, differing ownership or wellbore limitations, any new, twinned well shall be located as close to such existing well as is practicable, consistent with sound engineering practice.

d. This rule does not alter the size or configuration of drilling units for GWA wells in existance prior to its effective date. Where deemed necessary an operator for purposes of allocating production, such operator may allocate production to an expanded drilling unit with respect to a particular Cretaceous Age formation consistent with the provisions of this rule.

e. This rule shall not serve to bar the granting of relief to owners who file an application alleging abuse of their correlative rights to the extent that such owners can demonstrate that their opportunity to produce the Cretaceous Age formations from the drilling locations herein authorized does not provide an equal opportunity to obtain their just and equitable share of oil and gas from such formations.

f. Subject to Paragraph d. above, this rule supersedes all prior Commission drilling and spacing orders affecting the GWA wells. Well location exceptions to this rule shall be subject to the provisions of Rule 318.c.

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**EXHIBIT C**

Attached to and made a part of Agreement for Compatible Development
dated November 14, 2000, by and among
UNION PACIFIC LAND RESOURCES CORPORATION,
UNION PACIFIC RESOURCES COMPANY, and
WELD COUNTY LAND COMPANY, LLC

Probable Owners of Oil and Gas Leasehold Interests:

HS Resources, Inc.
1999 Broadway, Suite 3600
Denver, Colorado 80202

United States Exploration, Inc.
1560 Broadway, Suite 1900
Denver, Colorado 80202

Patina Oil & Gas Corporation ("Patina")
1625 Broadway, Suite 2000
Denver, Colorado 80202

North American Resources Company ("NARCO")
1700 Broadway, Suite 508
Denver, Colorado 80290

2. Probable Oil and Gas Interests as Follows:

| | |
|---|---|
| Township 2 North, Range 68 West | |
| Section 33: NE4 and part of W2SE4 | UXP, HS and Patina |
| Township 1 North, Range 68 West | |
| Section 4: All | HS and UXP |
| Section 8: SE4 | HS and UXP |
| Section 10: All | HS and UXP |
| Section 17: All | HS and UXP |
| Section 18: E2 east of RR r/w | NARCO, HS, Thomas S. Morton and James G. Norton |
| Section 19: W2E2, E2SW4 and NW4 | NARCO and HS |