S4 Group
Land Surveying
Land Development Consultants
Subdivision Specialists
Construction Surveying

124 E 7th Avenue, Anchorage, Alaska 99501 www.S4AK.com 907-306-8104

Lewis & Clark

Index of Professional Reports & Studies

Attached to this application are reports from professionals in their field, they are tabbed from A to H, the below page numbers are as per the application.

Page 35 (Tab A.) A report from the law firm of **Ashburn & Mason**, authored by attorneys Mr. Don McClintock & Ms. Rebecca Lipson, concerning HDP language on rezoning;

Page 56 (Tab B.) A report from Mr. Will Webb, PE, PTOE, of **Kinney Engineering**, LLC concerning traffic issues;

Page 59 (Tab C). A report by Mr. Steve Eng, PE, PH, of **NorthRim Engineering** concerning suitability of soils for septic systems. It should be noted that Mr. Steve Eng was the District Engineer for the Alaska Department of Environmental Conservation, Steve was in charge of subdivision review & approval in Anchorage/Western Alaska; reviewing & approving all soils/wastewater designs to meet State Regulations. During this time, he approved the first advanced wastewater treatment systems. As owner of NorthRim Engineering since 2001, Steve has designed numerous wastewater systems to meet subdivision requirements in the Anchorage area. NorthRim Engineering was hired to monitor & sample effluent from Advantex systems in Anchorage; this advanced wastewater system is used worldwide to provide superior effluent treatment. This is the system that is planned for Lewis & Clark Subdivision.

Page 98 (Tab D.) A report by Mr. Dan Young, CPG of **Terrasat, Inc** evaluating the groundwater resources for Lewis & Clark.

Page 272 (Tab E) A report by Mr. Dan Young, CPG of **Terrasat, Inc** on the evaluation of nitrates in local wells surrounding the Lewis & Clark development.

Page 296 (Tab F.) A report by Mr. David Grenier, PE, and Mr. Brandon Marcott, PE, of **Triad Engineering** on the Drainage Impact Analysis.

Page 344 (Tab G.) A report by Mr. David Grenier, PE, and Mr. Brandon Marcott, PE, of **Triad Engineering** on the Upper DeArmoun Road condition assessment.

Page 347 (Tab H.) A report by Mr. Pat Athey of **Hemlock Scientfic, LLC.** On the preliminary determination of wetlands and waters for Lewis & Clark.

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April 17, 2017

Lewis & Clark

Proposed A.O.

The Assembly finds the recommended zoning map amendment described herein satisfies the criteria of the Anchorage Municipal Code and is hereby approved with special limitations as listed below. The zoning map shall be amended by designating the following described property as R-6SL district. (This property is commonly known as Lewis & Clark.)

Legal Description:

The N ½ of the SE ¼ of Section 25, T12N, R3W, S.M., Alaska excepting the NW ¼ of the NW ¼ of the SE ¼ of Section 25, T12N, R3W, S.M. Alaska, and Lot 1 and 2 of Vergason-Jones Subdivision (Plat 98-178)

This zoning map amendment is subject to the following special limitations:

1. The maximum number of lots on the parcel is 30 single family home lots.

2. The use of a Category III Nitrogen Reducing Wastewater System is required for the development of each lot in the subdivision, except for the currently approved septic system utilized by the existing home on Lot 2, Vergason-Jones Subdivision.

This ordinance shall become effective 10 days after the Director of the Planning Department has received the written consent of at least 51 percent of the owners of the property within the area described above to any special limitations contained herein. The rezone approval herein shall automatically expire, and be null and void, if the written consent is not received within 120 days after the date on which this ordinance is passed and approved. The Director of the Planning Department shall change the zoning map accordingly.

PASSED AND APPROVED by the Anchorage Assembly this_________ day of ___________, 2017.

MUNICIPALITY OF ANCHORAGE

Planning Department
Current Planning Division

Phone: 907-343-7901
Fax: 907-343-7927

Mayor Ethan Berkowitz

April 5, 2017

S4 Group
124 E. 7th Avenue
Anchorage, AK 99501

Re: Case 2017-0072 Lewis & Clark Rezone Big Country Ent.LLC

Dear Applicant:

The Planning Department has reviewed your application in accordance with Anchorage Municipal Code and found it to be complete with exceptions.

- Ownership and beneficial interest for Big Country Enterprises LLC.
- Proposed AO for rezone

-Note: The applicant needs to demonstrate that the assumed environmental constraints of the property are either not present or can adequately be mitigated to avoid impacts on surrounding property. Further it will be the responsibility of the petitioner to clearly articulate how the rezone addresses the approval criteria identified in Title 21.

Should you have questions, please call me at 343-7941.

Sincerely,

Shawn Odell
Current Planning Division
Planning Department

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124 E 7th Avenue, Anchorage, Alaska 99501 www.S4AK.com 907-306-8104

September 1st, 2016

Mr. Hal Hart
MOA Planning Director
4700 Elmore Road
Anchorage, Ak 99507

Letter of Authorization

Lewis & Clark Rezone

Dear Mr. Hart,

The authorized signers for the below listed parcels, do hereby authorize the S4 Group to represent them before the MOA for the re-zoning of these parcels commonly known as Lewis & Clark.

The current legal description of the property includes three separate parcels of land, they are;

1. The N ½ of the SE 1/4, Section 25, T12N, R3W, S.M., Alaska, excepting the NW ¼ of the NW ¼ of the SE ¼ of Section 25, T12N, R3W, S.M., Alaska, approx. 70 acres.
2. Lot 1, Vergason-Jones Subdivision, approx. 5 acres,
3. Lot 2, Vergason-Jones Subdivision, approx. 5 acres,

Todd Brownson Elisha Brownson Susanne Gionet Paul Gionet
Parcel 1 authorized signature for: Elisha & Todd Brownson, Paul & Susanne Gionet

Evelyn Lori Vergason
Parcel 2 authorized signature for: Evelyn Lori & Bruce Vergason

Lori Gail Jones
Parcel 3 authorized signature for: Lori & Jeff Jones

Thank you,

Tom Dreyer, PLS
S4 Group
Petitioner's representative

Application for Zoning Map Amendment

Municipality of Anchorage
Planning Department
PO Box 196650
Anchorage, AK 99519-6650

PETITIONER*	PETITIONER REPRESENTATIVE (if any)
Name (last name first): Big Country Enterprises, LLC (Todd Brownson)	Name (last name first): S4 Group (Tom Dreyer)
Mailing Address: 4700 E 147TH AVE	Mailing Address: 124 E 7th Avenue
ANCHORAGE AK 99516	Anchorage, AK 99501
Contact Phone – Day: 907-406-0792 406-698-6969 Evening:	Contact Phone – Day: 907-227-1847 Evening:
Fax: N/A	Fax: N/A
E-mail: toddbrownson@hotmail.com	E-mail: Tom@S4AK.com

*Report additional petitioners or disclose other co-owners on supplemental form. Failure to divulge other beneficial interest owners may delay processing of this application.

PROPERTY INFORMATION

Property Tax # (000-000-00-000): 017-073-06-000 017-074-06-000 017-074-05-000

Site Street Address: 8600 UPPER DEARMOUN RD

Current legal description: (use additional sheet if necessary)
THE NORTH ONE-HALF OF THE SOUTHEAST ONE-QUARTER (N1/2 SE1/4) OF SECTION 25, TOWNSHIP 12 NORTH, RANGE 3 WEST, SEWARD MERIDIAN, LOCATED IN THE ANCHORAGE RECORDING DISTRICT, THIRD JUDICIAL DISTRICT, STATE OF ALASKA. EXCEPTING THEREFROM THE NORTHWEST ONE-QUARTER OF THE NORTHWEST ONE-QUARTER OF THE SOUTHEAST ONE-QUARTER (NW1/4 NW1/4 SE1/4) OF SECTION 25, TOWNSHIP 12 NORTH, RANGE 3 WEST. SEWARD MERIDIAN, LOCATED IN \HE ANCHORAGE RECORDING DISTRICT, THIRD JUDICIAL DISTRICT, STATE OF ALASKA.

LOTS 1 & 2, VERGASON-JONES SUBDIVISION (PLAT 98-178)

Existing Zoning: R-8	Acreage: 80 Acres	Grid #: SW2941
Proposed Zoning: R-6SL		
Existing use: Vacant	Proposed use (if any): Residential	

I hereby certify that (I am)(I have been authorized to act for) owner of the property described above and that I petition to rezone it in conformance with Title 21 of the Anchorage Municipal Code of Ordinances. I understand that payment of the application fee is nonrefundable and is to cover the costs associated with processing this application, and that it does not assure approval of the rezoning. I also understand that assigned hearing dates are tentative and may have to be postponed by Planning Department staff, the Planning and Zoning Commission, or the Assembly for administrative reasons.

Thomas H. Dreyer (signature) 4/3/2017
Signature ☐ Owner ☒ Representative (Representatives must provide written proof of authorization) Date

Thomas H. Dreyer
Print Name

Accepted by:	Poster & Affidavit:	Fee:	Case Number:	Requested Meeting Date:
FM	St affidavit	#22,370	2017-0072	06/12/17

COMPREHENSIVE PLAN INFORMATION

Anchorage 2020 Urban/Rural Services: ☐ Urban ☒ Rural

Anchorage 2020 Major Elements - site is within or abuts:
☐ Major employment center ☐ Redevelopment/mixed use area ☐ Town center
☐ Neighborhood commercial center ☐ Industrial reserve
☐ Transit-supportive development corridor ☐ District/area plan area: ____________________

Chugiak-Eagle River Land Use Classification:
☐ Commercial ☐ Industrial ☐ Parks/open space ☐ Public lands/institutions ☐ Town center
☐ Transportation/community facility ☐ Alpine/slope affected ☐ Special study area ☐ Development reserve
☐ Residential at _______ dwelling units per acre ☐ Environmentally sensitive area

Girdwood- Turnagain Arm Land Use Classification
☐ Commercial ☐ Industrial ☐ Parks/open space ☐ Public lands/institutions ☐ Resort
☐ Transportation/community facility ☐ Alpine/slope affected ☐ Special study area ☐ Reserve
☐ Residential at _______ dwelling units per acre ☐ Mixed use ☐ Rural homestead

ENVIRONMENTAL INFORMATION (All or portion of site affected)

Wetland Classification:	☐ None	☒ "C"	☐ "B"	☐ "A"	
Avalanche Zone:	☒ None	☐ Blue Zone	☐ Red Zone		
Floodplain:	☒ None	☐ 100 year	☐ 500 year		
Seismic Zone (Harding/Lawson):	☐ "1"	☒ "2"	☐ "3"	☐ "4"	☐ "5"

RECENT REGULATORY INFORMATION (Events that have occurred in last 5 years for all or portion of site)

☒ Rezoning - Case Number: 2014-0219
☐ Preliminary Plat ☐ Final Plat - Case Number(s):
☐ Conditional Use - Case Number(s):
☐ Zoning variance - Case Number(s):
☐ Land Use Enforcement Action for
☐ Building or Land Use Permit for
☐ Wetland permit: ☐ Army Corp of Engineers ☐ Municipality of Anchorage

SUBMITTAL REQUIREMENTS

1 copy required:
☒ Signed application (original)
☒ Ownership and beneficial interest form

35 copies required:
☒ Signed application (copies)
☒ Signatures of other petitioners (if any)
☒ Map of area to be rezoned
☒ Map of area surrounding proposed rezoning, including zoning and existing uses
☒ Narrative statement explaining:
- ⊗ need and justification for the rezoning
- ⊗ the proposed land use and development
- ⊗ the probable timeframe for development
- ⊗ an analysis of how the proposal meets the rezoning criteria on page 3 of this application

☒ Summary of community meeting(s)
☒ Proposed special limitations, if any

(Additional information may be required.)

APPLICATION CHECKLIST

1. Zoning map amendments require a minimum of 1.75 acres of land excluding right-of-way or a boundary common to the requested zoning district. (For exceptions, see AMC 21.03.160B.)
2. In the case of multiple owners, the petitioning property owners must provide documentation showing ownership of at least 51% of property to be rezoned.

ZONING MAP AMENDMENT STANDARDS (AMC 21.03.160)

A rezoning request may only be approved if it meets the approval criteria stated in AMC 21.03.160E. Please explain how the proposal meets the required criteria:

1. The rezoning shall be in the best interest of the citizens of Anchorage and shall promote the public health, safety, and general welfare.
2. The rezone complies with and conforms to the comprehensive plan, including the comprehensive plan map(s). (If the proposed rezone does not conform to the comprehensive plan, it may be considered along with a comprehensive plan amendment.)
3. The rezoning is generally consistent with the zoning district purpose in the requested zone, and the purpose of this title.
4. The rezoning is compatible with surrounding zoning and development, and protects areas designated for specific uses on the zoning map from incompatible land uses or development intensities.
5. Facilities and services (including roads and transportation, water, gas, electricity, police and fire protection, and sewage and waste disposal, as applicable) are capable of supporting the uses allowed by the zone or will be capable by the time development is complete, while maintaining adequate levels of service to existing development.
6. The rezoning is not likely to result in significant adverse impacts upon the natural environment, including air, water, noise, storm water management, wildlife, and vegetation, or such impacts shall be substantially mitigated.
7. The proposed rezoning is not likely to result in significant adverse impacts upon adjacent land uses, or such impacts shall be mitigated through stipulations.
8. The rezone does not extent or exacerbate a land use pattern that is inconsistent with the comprehensive plan.
9. The rezoning does not result in a split-zoned lot.

Supplemental Form: *OWNERSHIP AND BENEFICIAL INTEREST DISCLOSURE*

PETITIONER: CORPORATE OFFICERS OR PARTNERS

Applicants for an entitlement that will be in possession and the responsibility of more than one individual, such as a co-owner, joint venture, partnerships, corporations, company, or other similar form of ownership, are required to disclose a full and complete list of the name and address of each principal. (use additional paper if necessary)

Name	Title or Office(if any)	Address
Todd Bronson	Manager, Member	3640 E. 65th Ave, Anchorage, AK 99507
Elisha Bronson	Member	3640 E. 65th Ave, Anchorage, AK 99507
Paul Gionet	Member	4700 E. 147th Ave, Anchorage, AK 99516
Susanne Gionet	Member	4700 E. 147th Ave, Anchorage, AK 99516

PROPERTY OWNER: CORPORATE OFFICERS OR PARTNERS

The petitioner of a property owned by more than one individual that will benefit from an entitlement is required to disclose a full and complete list of the name and address of each partner, officer, or co-owner. The other owner interest to be reported is co-owner, joint venture, partnership, corporation, company, or other similar form of ownership. (use additional paper if necessary)

Name	Title or Office(if any)	Address

Attach this sheet to your application form

Accepted by:	Date	Application for	Case Number
			2017-0072

Supplemental Form: *ADDITIONAL PETITIONERS*

ADDITIONAL PETITIONERS:

Applicants for an entitlement involving more than one property description and owned by more than one individual are required to provide the name, legal description of property owned, and signature of each petitioner. Persons signatory to this application supplement are deemed to be petitioners (use additional paper if necessary)

We, the undersigned, hereby apply for: A zoning map amendment to R-6

Signature	Name (printed or typed)	Legal description of property owned within petition area
1. E Lori Vergason	Evelyn Lori Vergason	Lot-1 Vergason-Jones Subd.
2. [signature]	Bruce Vergason	" " "
3. Lori Ann Jones	Lori Jones	Lot-2 Vergason-Jones Subd
4. [signature]	Jeff Jones	" " "
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
18.		
19.		
20.		

Attach this sheet to your application form

Accepted by:	Date	Application for	Case Number

Petitioners (Rev 01/02)

S4 Group
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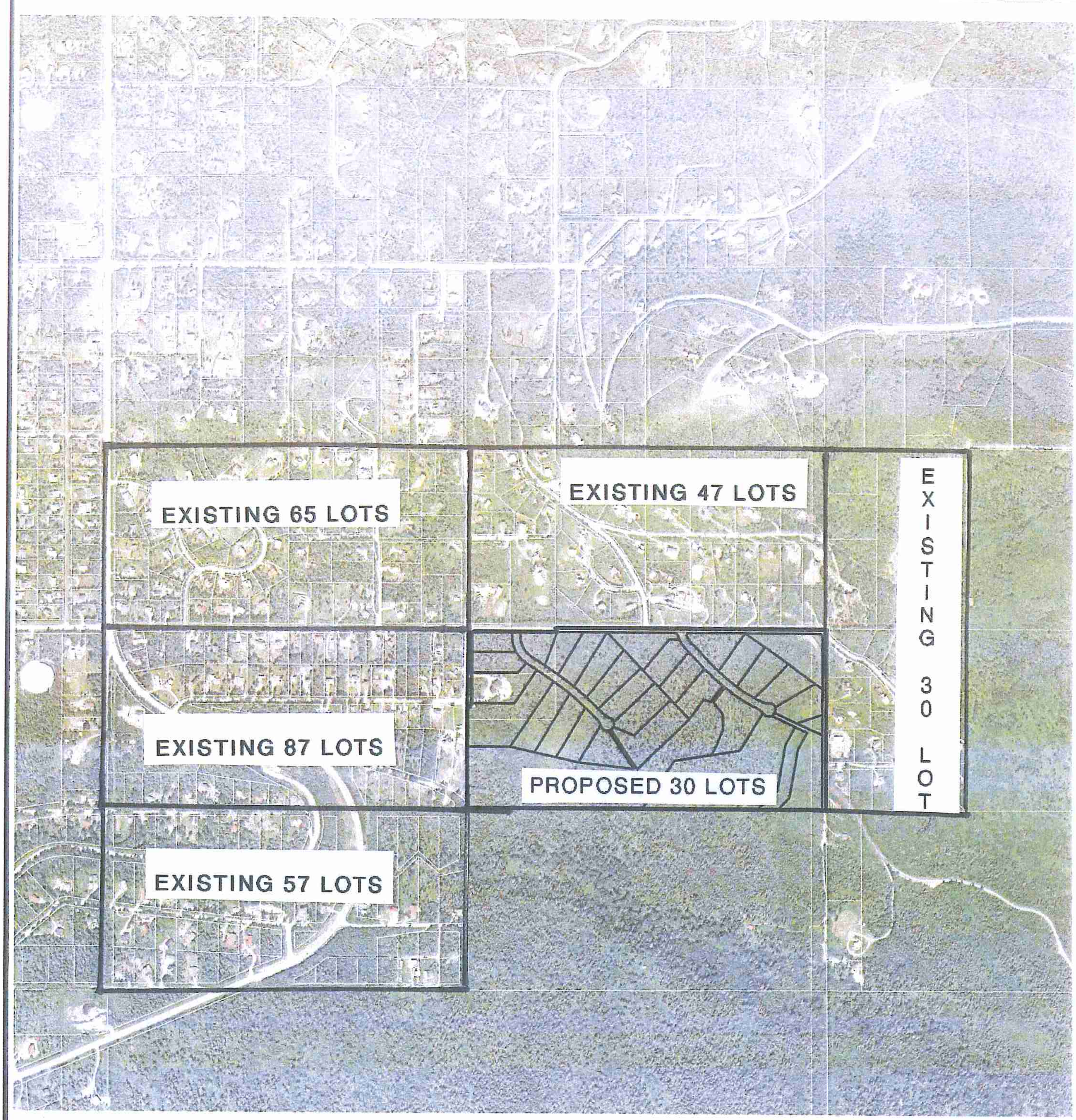
Land Development Consultants
Subdivision Specialists
Construction Surveying

Proposed
Lewis & Clark ReZone

Scale 1" = 1000'

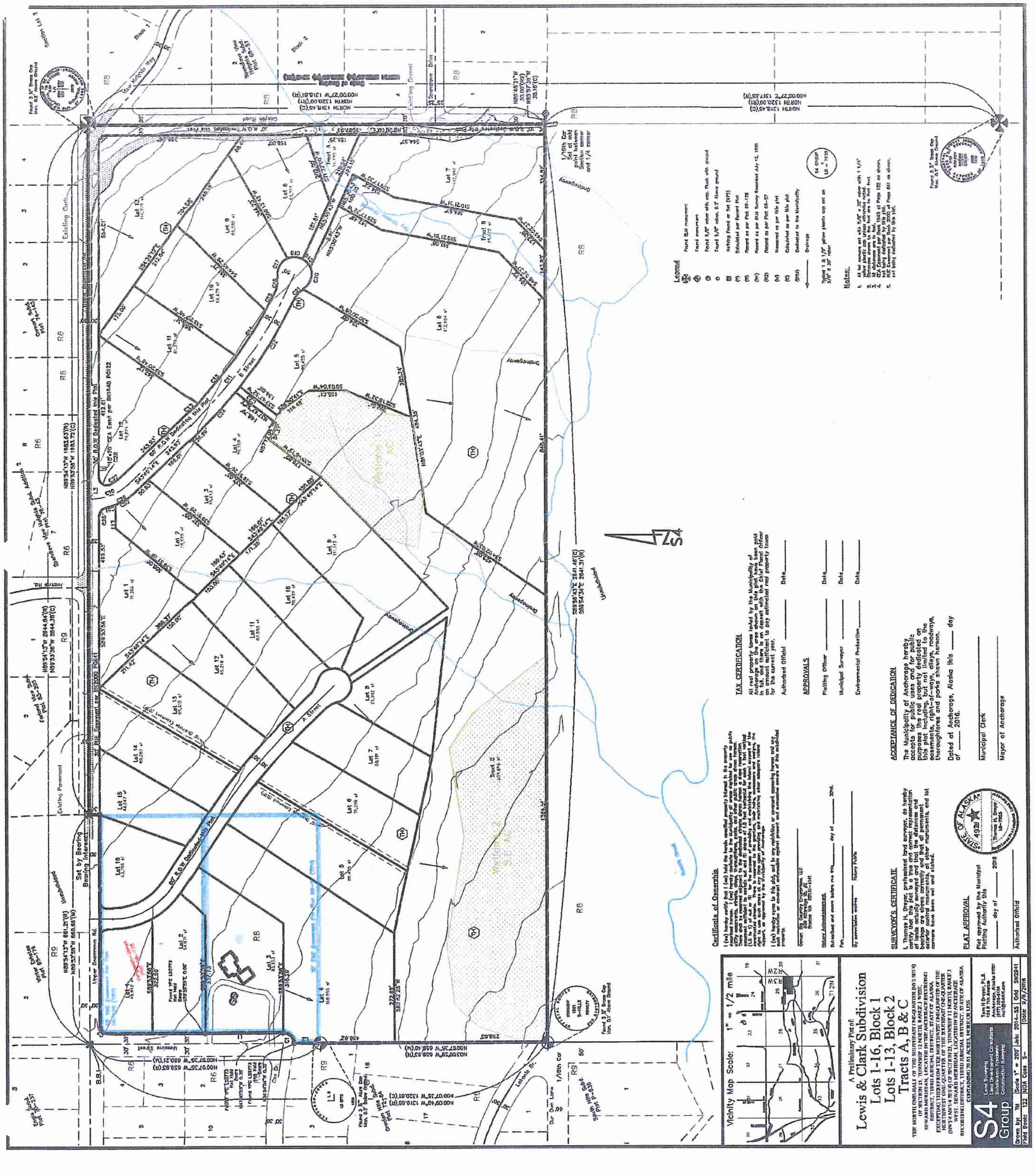


S4 Group

Land Surveying
Land Development Consultants
Subdivision Specialists
Construction Surveying

Lewis & Clark Rezone
Showing Surrounding Neighborhood Lot Counts
& The Proposed Lewis & Clark Subdivision

Scale 1" = 1000'


Vicinity Map Scale: 1" = 1/2 mile
A Preliminary Plat of:
Lewis & Clark Subdivision
Lots 1-16, Block 1
Lots 1-13, Block 2
Tracts A, B & C
CONTAINING 70.03 ACRES, MORE OR LESS
S4 Group
Certificate of Ownership
SURVEYOR'S CERTIFICATE
PLAT APPROVAL
Authorized Official
TAX CERTIFICATION
APPROVALS
ACCEPTANCE OF DEDICATION
Municipal Clerk
Mayor of Anchorage
Drawn by: TM
Field Book: 122
Scale 1" = 200'
Job: 2014-55
Grid SW2941
Date: 9/6/2016

Community Meeting!

You're Invited……

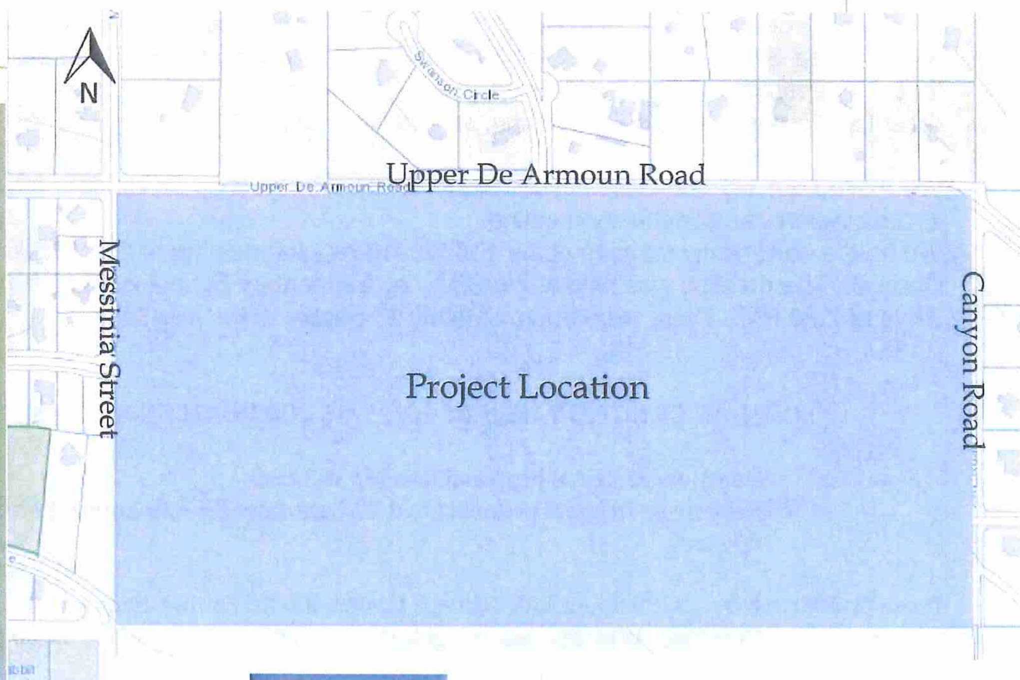
Petitioner: Big Country Enterprises, LLC

Rezoning

Community Meeting Agenda Notification

Big Country Enterprises, LLC represented by S4 Group LLC, will be at the Hillside Community Council on October 26, 2016 to present on a proposed rezoning case. The project site is located where Upper De Armoun Road turns into Canyon Road (Vergason-Jones Lots 1 & 2, T12N R3W Sec 25 S 1/2W 1/2 NW 1/4 SE 1/4 & E 1/2 NW 1/4 SE 1/4 & NE 1/4 SE 1/4) aka Lewis & Clark.

This project site is zoned low density residential (R8). The zoning map amendment is requesting a rezone to R6. Representatives will provide an overview of the rezone request, project schedule and will be available to answer questions.



Tuesday, October 25th 2016

O'Malley Elementary School Library

1100 Rockridge Drive

Anchorage, AK 99516

7:00 PM

We welcome your feedback! Interested parties may appear at the meeting and speak on the matter. You can also submit your comments or request additional information by contacting:

Tom Dreyer, PLS
4 Group, LLC
m@s4ak.com

S4 Group

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124 E 7th Avenue, Anchorage, Alaska 99501 www.S4AK.com 907-306-8104

November 1, 2016

Mr. Hal Hart, MOA Planning Division Director
4700 Elmore Road
Anchorage, Ak 99507

Re: Summary of Community Meeting

Project: "Lewis & Clark" Re-zoning

Dear Mr. Hart,

This Letter serves as the 'Summary of Community Meeting' as per Title 21.03.020.C.6. The property is commonly known as the 'Lewis & Clark' property, the legal description consists of three separate parcels;

1. The N ½ of the SE 1/4, Section 25, T12N, R3W, S.M., Alaska, excepting the NW ¼ of the NW ¼ of the SE ¼ of Section 25, T12N, R3W, S.M., Alaska, approx. 70 acres.
2. Lot 1, Vergason-Jones Subdivision, approx. 5 acres,
3. Lot 2, Vergason-Jones Subdivision, approx. 5 acres,

We mailed out 177 first class notices of the community meeting on October 4th, which was 21days before the community meeting.
We held a community meeting at the 10/25/2016 regular meeting of the Hillside Community Council. The meeting was held at the O'Malley Elementary School located at 11100 Rockridge Drive at 7:30 PM. There were approximately 25 people at the meeting.

SUMMARY OF NOTES TAKEN AT 10/25/16 COMMUNITY COUNCIL MEETING:

Question: Original proposal was for 36 Lots?
Response: Original proposal had 32 Lots, now 29 – 30 Lots with a total acreage of 80 acres.

From Gail Morrison – 8600 Spendlove Drive, 017-401-31, R6 Zoning, lives on a 1.03 acre lot.

Question: Why did you go against the Hillside District Plan? 2040 plan calls for "Large Lots".
Response: 2040 Plan calls for 1 DUA, we are at less than half the density, 0.4 dua.

Question: What is the setback for drainage ways?
Response: 25 ft either side of drainage ways, 50' either side for streams.

Question: Army Corps of Engineers Report for Wetlands was not completed.

Response: Full delineation of existing wetlands and report was completed by Pat Athey of Hemlock Scientific and provided to the MOA, but left out of package by the Planning & Zoning Department. Army Corps of Engineers JD permit submitted. We are tracting out the wetlands.

Question: If completed, why is it so difficult to produce?
Response: It is not, the report is public information, we can get you a copy.

Comment: You said 2.5 acre lots, but are showing some that are more like an acre.
Response: 2.5 acre is average density, 30 lots on 80 acres is an overall average land use of 2.5 acres per dwelling unit.

Question: Soils are clay. How can you have septic systems?
Response: 25 new test holes completed. There was not any clay encountered. Soils are silty sand with gravel and grading to more dense silt. Advanced treatment systems are not required, based on soils, but will be required by owners in development, possibly as a special limitation to the zoning.

Question: I've drilled holes in the neighborhood and always found clay.
Response: From Mr. Steve Eng, and My Dan Young: Not clay, by definition (USCS).

Question: Do you have a plan for a residence in the NE corner of property?
Response: Yes.
Question: Are you looking at cluster housing?
Response: No.

Unknown Neighbor:

a. Question: How far is southern property border from Rabbit Creek?
b. Response: It's at least 300 ft, from the southern boundary line, plus there is approximately 300 ft of "greenbelt" along the majority of the southern boundary proposed layout.

Unknown Neighbor:

Question: What are white tape descriptions on presented plan? How large are wetland areas?
Response: White Tape marks show delineated wetland areas. There is a total of approximately nine acres of wetlands. We have tracted out a total of approximately 15 acres of "greenbelt" including wetland areas.

John Oliver – 8611 Upper DeArmoun Rd, 017-401-28, R6 Zoning, lives on a 0.92 acre lot.

Question: How many roads in & out? Input & Output on Upper DeArmoun? We would like to see DeArmoun Road fixed.
Response: Two Cul-De-Sacs, input & output will be onto DeArmoun Road. We would like to see Upper DeArmoun Road fixed too.

Question: How can these lots be affordable. He has teacher/nursing loans and was fortunate to get a lot. Says traffic has gone up over last 8 years because of hikers going to Rabbit Lake.
Response: It is our goal to make the lots as affordable as possible.

From Rob Brown – 13688 Canyon Road, 021-021-07, R8 Zoning, lives on a 3.03 acre lot.

Question: Army Corps JD Permit? What year was it applied for? Under what name?
Response: Hemlock Scientific performed the Wetland Delineation and Report in 2014. The permit is under Big Country Enterprises. We are tracting out the wetlands.

Question: Would conventional systems pass? Where will advanced treatment system requirement be shown?
Response: Conventional systems would pass, but owners have elected to require advanced systems. Requirement will be a plat note, or a special limitation on the zoning.

Comment: Last application we were told all of these septic issues would be dealt with at platting. We want answers now.
Response: Advanced systems could be required in the Special Limitations of the rezone.

Comment: SE corner of property has clay. The Mills family has dealt with clay.
Question: Do you know how much acreage is occupied by Canyon Road on corner?
Response: We haven't measured that.

Question: Are you in negotiation with the city regarding right of way?
Response: Yes.

Carl Portman – 8831 Upper DeArmoun Rd, 017-41-24, R8 Zoning, lives on a 1.14 acre lot.

Question: How many lots on the upper cul-de-sac between Jeanne Road and Canyon Road. Appears that highest density of housing in that area. Concerns are views, noise, and aquifer/wells. Indicated that they bought that property thinking that lots would be 5 acres.
Response: Carl was brought up to the proposed plan. Indicated that his lot is on the north side of Upper DeArmoun Road and that he has a 1.25 acre lot. Showed him that all of the lots in his area of concern are larger than his lot and topography would not allow views to be blocked. Concerns about aquifer/wells discussed by Mr. Dan Young.

Unknown Neighbor:

Question: What about the natural springs out there?
Response: Comprehensive drainage plan is being undertaken currently, and also during the platting process. We have an obligation to manage as per strict MOA regulations.

Unknown Neighbor:

Question: This has been a dry year. Are tests accurate? Hillside rain is different than the Airport measurement.
Response: Wet June/July, 45% more precipitation than average.

Ralph Warren – 7901 Upper DeArmoun Rd, 017-014-03, R6 Zoning, lives on a 2.07 acre lot (owns 4-5 lots)

Comment: He has a property with a pond. Certain years has to pump pond. Has wells with high nitrates. Nitrate levels 10ppm.

Response: From Mr. Dan Young- Where is well? Haven't seen any readings that high. Mr. Young Has all MOA data for the last 30 years.

Mark Minor:

Question: Is there concern about egress if wildfire because of two cul-de-sacs?
Response: AFD reviewed during pre-application, meets code requirements.

Question: Will advanced septic system be individual or community?
Response: Individual.

If members of the Community Council or the MOA Planning staff need any further information or clarification, please email me at: tom@s4ak.com.

Thank you,

Tom Dreyer, PLS
S4 Group
Petitioner's representative

10/25/2016 HEC MTNG

NAME	E-MAIL OR TELE/PHONE #
LANCE Powell	Lwpowell1@ Seno[illegible]
Shirley Coté	shirlanncote@gmail.com
STEVE ENG	SteveEngPE@gmail.com
Jo Kidd	Jomommakidd@gci.net
Ralph Warren	790 Upper De Armoun 345-2010
Tom Dreyer (54 Group)	tom@54AK.COM
Scott Steele	AKQUnBEE@HOTMAIL.com
Nancy Harvey	nnharvey@gci.net
Rob Brown	robbrown1998@gmail.com
Jason Denson	2LPS4SJD@gmail.com
Gail Morrison	gmorrison@alliedgis.com
James Brady	lazyej907@gmail.com
Todd + Elisha Brownson	todd@bigcountryak.com
David Gillespie	David@GillespieForAlaska.com
Anita Bales	anita@gillespieforalaska.com
Eric + Joan Wasserman	wasserpeople@gci.net 345-[illegible]
Paul + [illegible] [illegible]	[illegible]

NAME	EMAIL OR Telephone #
KATRINA AUSTIN	907-252-4756
DAN YOUNG	344 9370
Bart Hawkins	345-~~[illegible]~~
S[illegible] Mills	smills@christianhonth.org 522-7053
Greg Kuijper	gregandkate@homeinalaska.net
Mark Miner	

	A	B	C	D	E	F
1	2101109000	ALEXANDER CHRISTOPHER & JANET LIVING TRUST	9000 SPENDLOVE DRIVE	ANCHORAGE	AK	99516
2	1740143000	ALLEN TIMOTHY J & CASSIDY ELAINE M	8450 SWANSON CIRCLE	ANCHORAGE	AK	99516-3369
3	1701348000	AMSTADTER KYLE M & JENNIFER R	8101 UPPER DEARMOUN ROAD	ANCHORAGE	AK	99516-3808
4	2102111000	ARMSTRONG BARBARA A & TUCKEY JOHN D	13551 SPENDLOVE DRIVE	ANCHORAGE	AK	99516-6915
5	1707431000	BAILEY RONALD M & JAIME L	13240 MESSINIA ST	ANCHORAGE	AK	99516-3809
6	1707372000	BELTZ THOMAS C & ABBY L	8000 COX DR	ANCHORAGE	AK	99516
7	1707306000	BIG COUNTRY ENTERPRISES LLC	4700 E 147TH AVENUE	ANCHORAGE	AK	99516
8	1740154000	BLAKESLEE-EDWARDS TERESA	PO BOX 221624	ANCHORAGE	AK	99522-1624
9	1701368000	BRADSHAW KORY W & CAROLINE	13045 PATRICK ROAD	ANCHORAGE	AK	99516-3317
10	1740126000	BRADY JAMES A & NANCY J	8731 UPPER DE ARMOUN ROAD	ANCHORAGE	AK	99516-3366
11	2102125000	BROOKS RYAN EUGENE	PO BOX 112042	ANCHORAGE	AK	99511-2042
12	2102107000	BROWN GINA M	13688 CANYON ROAD	ANCHORAGE	AK	99516-3188
13	1740153000	BRYANT WILLIAM C IV & CORINNE A (TOD)	8820 SPENDLOVE DRIVE	ANCHORAGE	AK	99516-3358
14	1707234000	BUCHHOLDT DYLAN C & ELTON CARA J	8143 RABBIT HILL DRIVE	ANCHORAGE	AK	99516-3860
15	1740147000	BURKET JOHN E & CYNTHIA G	8521 SWANSON CIRCLE	ANCHORAGE	AK	99516-3369
16	1707370000	CAMERON W B & LINDA	8040 COX DRIVE	ANCHORAGE	AK	99516-3842
17	1701309000	CASSITY GLEN KEVIN	PO BOX 90354	ANCHORAGE	AK	99509-0354
18	1740107000	CLOUD JAMES L & D LEE	PO BOX 110742	ANCHORAGE	AK	99511-0742
19	2102108000	COOK FRANK E	PO BOX 2255	VALDEZ	AK	99686-2255
20	1707429000	COVINGTON CHARLES ALBERT	7761 MCLURE CIRCLE	ANCHORAGE	AK	99507-6232
21	1707437000	DAVIS RODGER C	8000 UPPER DE ARMOUN RD	ANCHORAGE	AK	99516-3807
22	1707436000	DAVIS RODGER C & CONNIE K	8000 UPPER DE ARMOUN ROAD	ANCHORAGE	AK	99516-3807
23	1707430000	DELANEY JEANETTE N	13250 MESSINIA ST	ANCHORAGE	AK	99516-3809
24	1740135000	DELGADO ALEXIS	8601 SPENDLOVE DR	ANCHORAGE	AK	99516-3394
25	2102123000	DIRKS JEFF & ANGELA LIVING TRUST DIRKS J R & M A CO\TTES	3440 SOUTHBLUFF CIR	ANCHORAGE	AK	99515
26	1740148000	DOUGHERTY-WORBY REV TRUST	8520 SPENDLOVE DR	ANCHORAGE	AK	99516-3356
27	1707434000	DUFOUR DANIEL A & CANDANCE	5738 HERITAGE HEIGHTS DR	ANCHORAGE	AK	99516-2362
28	1740142000	FORELAND VIEW SUB ASSOC % AL HOFFIENS	BRIERWOOD DRIVE	MOBILE	AL	36606-2322
29	2102124000	HAARPER-LEWIS LOIS E	13240 VIEW HEIGHTS WAY	ANCHORAGE	AK	99516-6916
30	1701367000	HARVEY ROBERT P & NANCY	13001 PATRICK RD	ANCHORAGE	AK	99516-3317
31	1707204000	HAVARD E DANE & CATHERINE LIVING TRUST	8035 RABBIT HILL DRIVE	ANCHORAGE	AK	99516-3832
32	1707366000	HAWKINS BARTLEY C & CYNTHIA SUE ALLEN	12921 MONTEREY CIR	ANCHORAGE	AK	99516-2753
33	1740155000	HODOR MARK A LIVING TRUST & FITILIS HILARY J LIVING TRUST	8918 SPENDLOVE DRIVE	ANCHORAGE	AK	99516-3398
34	1740133000	HOLMAN AMY	8740 SPENDLOVE DR	ANCHORAGE	AK	99516-3356
35	1740122000	HUGHES KRAIG R	8931 UPPER DE ARMOUN RD	ANCHORAGE	AK	99516-3386
36	1740130000	HYATT JORGENSEN TRUST HYATT C T & JORGENSEN A L / TTES	PO BOX 112176	ANCHORAGE	AK	99511-2176
37	1707432000	JENSEN TEDDY B	13230 MESSINIA ST	ANCHORAGE	AK	99516-3809
38	1707382000	JOHNSON HAAKON K & LINDSAY A	8160 COX DR	ANCHORAGE	AK	99516-3871
39	1707405000	JONES JEFF F & LORI C	11801 MARY AVE	ANCHORAGE	AK	99515
40	1740125000	JUNE MARC W & SUSAN E	8801 UPPER DE ARMOUN ROAD	ANCHORAGE	AK	99516-3368
41	1707459000	KAUFFMAN BRYCE D	7940 UPPER DE ARMOUN RD	ANCHORAGE	AK	99516-3833
42	1740149000	KAUFMAN RAYMOND J	8521 SPENDLOVE DRIVE	ANCHORAGE	AK	99516-3357
43	2102121000	KIDD CHARLES P & JOANN K	PO BOX 111898	ANCHORAGE	AK	99511-1898

	A	B	C	D	E	F
44	1707368000	KIM CHONG MUK & CHONG MI	8130 COX DR	ANCHORAGE	AK	99516-3842
45	1740152000	KRYNYTZKY MARTA I 63% & LITTLE JERRY R 37%	8800 SPENDLOVE DRIVE	ANCHORAGE	AK	99516-3358
46	1701369000	LARSON GERALD W & SHIRLEY A	13145 PATRICK ROAD	ANCHORAGE	AK	99516-3317
47	2102130000	LEE CHONG NO & HYUN KYUNG JA	13391 CANYON ROAD	ANCHORAGE	AK	99516-6905
48	1740136000	LEE HARRY R & MARY ANN	8701 SPENDLOVE DRIVE	ANCHORAGE	AK	99516-3357
49	1740137000	LEHRMANN RAQUEL V	PO BOX 231634	ANCHORAGE	AK	99523-1634
50	2102109000	LOOMIS TODD M FLEEK ADRIENE K	13591 SPENDLOVE DRIVE	ANCHORAGE	AK	99516-6915
51	1740140000	MACDONALD STEVEN & JANET M	13130 JEANNE ROAD	ANCHORAGE	AK	99516-3346
52	2102128000	MATSUOKA STEVE & DOROFF CARLA	13564 SPENDLOVE DRIVE	ANCHORAGE	AK	99516-6915
53	1707463000	MCCASLIN ERICA R & JUSTIN E	8111 LAKONIA DRIVE	ANCHORAGE	AK	99516-3872
54	1707377000	MILLER ERICA M	13441 LARISA STREET	ANCHORAGE	AK	99516-3845
55	1707201000	MILLS WILLIAM J JR & ELAINE	1544 HIDDEN LANE	ANCHORAGE	AK	99501-4916
56	1707378000	MOBLEY PAMELA & THOMAS	8011 LAKONIA DR	ANCHORAGE	AK	99516-3838
57	1701350000	MONDAY PATRICIA C	13000 MICHAEL RD	ANCHORAGE	AK	99516-3344
58	1740131000	MORRISON MARK R & GAIL W	8600 SPENDLOVE DRIVE	ANCHORAGE	AK	99516-6971
59	1740106000	MUELLER ROYCE KENSTON REVOCABLE LIVING TRUST MUELLER D A & R K/TRUSTEES	8335 E 130TH AVENUE	ANCHORAGE	AK	99516-3336
60	1740141000	NEFEDOV SERGEY Y	8460 SWANSON CIRCLE	ANCHORAGE	AK	99516-3369
61	1740128000	OLIVER JOHN A	8611 UPPER DEARMOUN RD	ANCHORAGE	AK	99516-3316
62	2102110000	OTT BRIAN C & RUNA HALEY L	13551 SPENDLOVE DRIVE	ANCHORAGE	AK	99516-6915
63	1707423000	PEEPLES KENNETH W	7961 COX DRIVE	ANCHORAGE	AK	99516-3843
64	1740144000	PENNINGTON DAVID B JR & NIKI D	8400 SWANSON CIRCLE	ANCHORAGE	AK	99516-3369
65	2102120000	PFISTERER ROBERT B & JOANN M	13210 SPENDLOVE DR	ANCHORAGE	AK	99516-6915
66	1707376000	PHILLIPS SHERI L	13431 LARISA ST	ANCHORAGE	AK	99516-3845
67	1740146000	PIVI PAOLA	13010 JEANNE RD	ANCHORAGE	AK	99516-3392
68	1701349000	PLATT MICHAEL D & ROBIN KELLY	13160 MICHAEL RD	ANCHORAGE	AK	99516-3344
69	1707427000	POPE DAVID J	8041 COX DR	ANCHORAGE	AK	99516-3870
70	1707426000	POPE DAVID J & MICHELLE L	8041 COX DRIVE	ANCHORAGE	AK	99516-3863
71	1740124000	PORTMAN CARL RAY	8831 UPPER DEARMOUN ROAD	ANCHORAGE	AK	99516-3368
72	1740127000	PRIESTLEY JOAN CAROL 50% & DAVIS BERNARD ROBERT 50%	3705 ARCTIC BLVD #1332	ANCHORAGE	AK	99503-5774
73	1701309000	Resident	12940 MICHAEL RD	ANCHORAGE	AK	99516
74	1701348000	Resident	8101 UPPER DE ARMOUN RD	ANCHORAGE	AK	99516
75	1701349000	Resident	13160 MICHAEL RD	ANCHORAGE	AK	99516
76	1701350000	Resident	13000 MICHAEL RD	ANCHORAGE	AK	99516
77	1701367000	Resident	13001 PATRICK RD	ANCHORAGE	AK	99516
78	1701368000	Resident	13045 PATRICK RD	ANCHORAGE	AK	99516
79	1701370000	Resident	13145 PATRICK RD	ANCHORAGE	AK	99516
80	1707201000	Resident	13880 BONNIELAINE RD	ANCHORAGE	AK	99516
81	1707204000	Resident	8035 RABBIT HILL DR	ANCHORAGE	AK	99516
82	1707234000	Resident	8143 RABBIT HILL DR	ANCHORAGE	AK	99516
83	1707368000	Resident	8130 COX DR	ANCHORAGE	AK	99516
84	1707370000	Resident	8040 COX DR	ANCHORAGE	AK	99516
85	1707371000	Resident	8020 COX DR	ANCHORAGE	AK	99516
86	1707372000	Resident	8000 COX DR	ANCHORAGE	AK	99516

	A	B	C	D	E	F
87	1707373000	Resident	7960 COX DR	ANCHORAGE	AK	99516
88	1707376000	Resident	13431 LARISA ST	ANCHORAGE	AK	99516
89	1707377000	Resident	13441 LARISA ST	ANCHORAGE	AK	99516
90	1707378000	Resident	8011 LAKONIA DR	ANCHORAGE	AK	99516
91	1707382000	Resident	8160 COX DR	ANCHORAGE	AK	99516
92	1707383000	Resident	8170 COX DR	ANCHORAGE	AK	99516
93	1707384000	Resident	8120 LAKONIA DR	ANCHORAGE	AK	99516
94	1707389000	Resident	7990 LAKONIA DR	ANCHORAGE	AK	99516
95	1707406000	Resident	13301 MESSINIA ST	ANCHORAGE	AK	99516
96	1707423000	Resident	7961 COX DR	ANCHORAGE	AK	99516
97	1707424000	Resident	8001 COX DR	ANCHORAGE	AK	99516
98	1707425000	Resident	8021 COX DR	ANCHORAGE	AK	99516
99	1707426000	Resident	8041 COX DR	ANCHORAGE	AK	99516
100	1707427000	Resident	8101 COX DR	ANCHORAGE	AK	99516
101	1707428000	Resident	8141 COX DR	ANCHORAGE	AK	99516
102	1707429000	Resident	8161 COX DR	ANCHORAGE	AK	99516
103	1707430000	Resident	13250 MESSINIA ST	ANCHORAGE	AK	99516
104	1707431000	Resident	13240 MESSINIA ST	ANCHORAGE	AK	99516
105	1707432000	Resident	13230 MESSINIA ST	ANCHORAGE	AK	99516
106	1707433000	Resident	8120 UPPER DE ARMOUN RD	ANCHORAGE	AK	99516
107	1707437000	Resident	8000 UPPER DE ARMOUN RD	ANCHORAGE	AK	99516
108	1707459000	Resident	7940 UPPER DE ARMOUN RD	ANCHORAGE	AK	99516
109	1707463000	Resident	8111 LAKONIA DR	ANCHORAGE	AK	99516
110	1740104000	Resident	8324 E 130TH AVE	ANCHORAGE	AK	99516
111	1740106000	Resident	8335 E 130TH AVE	ANCHORAGE	AK	99516
112	1740107000	Resident	8301 E 130TH AVE	ANCHORAGE	AK	99516
113	1740122000	Resident	8931 UPPER DE ARMOUN RD	ANCHORAGE	AK	99516
114	1740124000	Resident	8831 UPPER DE ARMOUN RD	ANCHORAGE	AK	99516
115	1740125000	Resident	8801 UPPER DE ARMOUN RD	ANCHORAGE	AK	99516
116	1740126000	Resident	8731 UPPER DE ARMOUN RD	ANCHORAGE	AK	99516
117	1740127000	Resident	8701 UPPER DE ARMOUN RD	ANCHORAGE	AK	99516
118	1740128000	Resident	8611 UPPER DE ARMOUN RD	ANCHORAGE	AK	99516
119	1740129000	Resident	13101 JEANNE RD	ANCHORAGE	AK	99516
120	1740130000	Resident	13035 JEANNE RD	ANCHORAGE	AK	99516
121	1740131000	Resident	8600 SPENDLOVE DR	ANCHORAGE	AK	99516
122	1740132000	Resident	8700 SPENDLOVE DR	ANCHORAGE	AK	99516
123	1740133000	Resident	8740 SPENDLOVE DR	ANCHORAGE	AK	99516
124	1740135000	Resident	8601 SPENDLOVE DR	ANCHORAGE	AK	99516
125	1740136000	Resident	8701 SPENDLOVE DR	ANCHORAGE	AK	99516
126	1740137000	Resident	8801 SPENDLOVE DR	ANCHORAGE	AK	99516
127	1740138000	Resident	8901 SPENDLOVE DR	ANCHORAGE	AK	99516
128	1740140000	Resident	13130 JEANNE RD	ANCHORAGE	AK	99516
129	1740141000	Resident	8460 SWANSON CIR	ANCHORAGE	AK	99516

	A	B	C	D	E	F
130	1740143000	Resident	8450 SWANSON CIR	ANCHORAGE	AK	99516
131	1740144000	Resident	8400 SWANSON CIR	ANCHORAGE	AK	99516
132	1740146000	Resident	13010 JEANNE RD	ANCHORAGE	AK	99516
133	1740147000	Resident	8521 SWANSON CIR	ANCHORAGE	AK	99516
134	1740148000	Resident	8520 SPENDLOVE DR	ANCHORAGE	AK	99516
135	1740149000	Resident	8521 SPENDLOVE DR	ANCHORAGE	AK	99516
136	1740152000	Resident	8800 SPENDLOVE DR	ANCHORAGE	AK	99516
137	1740153000	Resident	8820 SPENDLOVE DR	ANCHORAGE	AK	99516
138	1740154000	Resident	8900 SPENDLOVE DR	ANCHORAGE	AK	99516
139	1740155000	Resident	8918 SPENDLOVE DR	ANCHORAGE	AK	99516
140	1740157000	Resident	13111 MICHAEL RD	ANCHORAGE	AK	99516
141	2101109000	Resident	9000 SPENDLOVE DR	ANCHORAGE	AK	99516
142	2102107000	Resident	13688 CANYON RD	ANCHORAGE	AK	99516
143	2102108000	Resident	13641 BONNIELAINE RD	ANCHORAGE	AK	99516
144	2102109000	Resident	13591 SPENDLOVE DR	ANCHORAGE	AK	99516
145	2102110000	Resident	13571 SPENDLOVE DR	ANCHORAGE	AK	99516
146	2102111000	Resident	13551 SPENDLOVE DR	ANCHORAGE	AK	99516
147	2102112000	Resident	13531 SPENDLOVE DR	ANCHORAGE	AK	99516
148	2102120000	Resident	13210 SPENDLOVE DR	ANCHORAGE	AK	99516
149	2102121000	Resident	13351 VIEW HEIGHTS WAY	ANCHORAGE	AK	99516
150	2102124000	Resident	13240 VIEW HEIGHTS WAY	ANCHORAGE	AK	99516
151	2102125000	Resident	13350 VIEW HEIGHTS WAY	ANCHORAGE	AK	99516
152	2102126000	Resident	13440 VIEW HEIGHTS WAY	ANCHORAGE	AK	99516
153	2102127000	Resident	13456 SPENDLOVE DR	ANCHORAGE	AK	99516
154	2102128000	Resident	13564 SPENDLOVE DR	ANCHORAGE	AK	99516
155	2102129000	Resident	13431 CANYON RD	ANCHORAGE	AK	99516
156	2102129000	Resident	13580 SPENDLOVE DR	ANCHORAGE	AK	99516
157	2102130000	Resident	13391 CANYON RD	ANCHORAGE	AK	99516
158	2102131000	Resident	13341 CANYON RD	ANCHORAGE	AK	99516
159	2102127000	REYNOLDS DEREK S & RACHELLE G	PO BOX 240053	ANCHORAGE	AK	99524-0053
160	2102104000	ROHALEY DONALD L & WASSILISSIA	7100 HUFFMAN	ANCHORAGE	AK	99516-2451
161	1740132000	ROHWER JASON A & LAUREL C	8700 SPENLOVE DR	ANCHORAGE	AK	99516
162	1707384000	ROLFS BENJAMIN & HEATHER	8051 FAIRWOOD CIR	ANCHORAGE	AK	99518
163	1707428000	SECRETARY OF HOUSING & URBAN DEVELOPMENT THE %INFO SYSTEMS & NETWORKS CORP	2401 NW 23RD ST STE 1D	OKLAHOMA CITY	OK	73107
164	2102129000	SHINE RON	13431 CANYON RD	ANCHORAGE	AK	99516-6905
165	1740104000	SMITH LAURA J & MICHAEL R	8324 E 130TH AVE	ANCHORAGE	AK	99516-3335
166	1740157000	SPENCER CURTIS D & YVONNE A	13111 MICHAEL ROAD	ANCHORAGE	AK	99516-3345
167	2102126000	STEDINGH KURT W JR & CAROL	13440 VIEW HEIGHTS WAY	ANCHORAGE	AK	99516-6916
168	2102113000	THOMAS TIMOTHY K & MICHELLE P	PO BOX 244151	ANCHORAGE	AK	99524-4151
169	1707371000	TUTTLE BETTY ANNE	8020 COX DR	ANCHORAGE	AK	99516-3842
170	1707425000	VANDUREN SHAWN & JOSCELYN	8021 COX DR	ANCHORAGE	AK	99516
171	1707406000	VERGASON BRUCE M & EVELYN LORI	13301 MESSINIA ST	ANCHORAGE	AK	99516-3810
172	2102131000	VOLPER DAVID J & KENNISON MERIDEANE	13341 CANYON ROAD	ANCHORAGE	AK	99516-6905

	A	B	C	D	E	F
173	1740156000	WASIAK LIDIA	1800 MISSION HILLS RD APT 412	NORTHBROOK	IL	60062
174	1707373000	WAYT ROBERT E	7960 COX DRIVE	ANCHORAGE	AK	99516
175	2102112000	WOCKENFUSS JEFF L & DEBORAH M	13531 SPENDLOVE DR	ANCHORAGE	AK	99516-6915
176	2101110000	WOODSON GEORGIA BURY REVOCABLE TRUST	8901 SPENDLOVE DRIVE	ANCHORAGE	AK	99516-3359
177		Hillside Community Council	4621 Golden Spring Circle	ANCHORAGE	AK	99507

Land Surveying
Land Development Consultants
Subdivision Specialists
Construction Surveying

124 E 7th Avenue, Anchorage, Alaska 99501 www.S4AK.com 907-306-8104

September 14, 2016

Mr. Francis McLaughlin
MOA Senior Planner
4700 Elmore Road
Anchorage, Ak 99507

Request for a Pre-Application Conference

Lewis & Clark Rezone

Dear Mr. McLaughlin,

On behalf of the petitioners, Big Country Enterprises, LLC, we are requesting a pre-application conference for the rezoning of the property commonly known as Lewis & Clark. The property is currently zoned R-8, and we are requesting rezoning the property to R-6. The property is approximately 80 acres in size and generally lies in the southeast quadrant of Upper DeArmoun Road and Messinia Street.

The current legal description of the property includes three separate parcels of land, they are;

1. The N ½ of the SE 1/4, Section 25, T12N, R3W, S.M., Alaska, excepting the NW ¼ of the NW ¼ of the SE ¼ of Section 25, T12N, R3W, S.M., Alaska, approx. 70 acres.
2. Lot 1, Vergason-Jones Subdivision, approx. 5 acres,
3. Lot 2, Vergason-Jones Subdivision, approx. 5 acres,

At your convenience, anytime on Tuesday, September 20th in the A.M., or anytime Wednesday, September 21th would work for us. If these dates are not available, please give me a call and we can work out another date & time for the pre-app meeting.

Thank you,

Tom Dreyer, PLS
S4 Group
Petitioner's representative

Municipality of Anchorage
Planning Division
4700 Elmore Rd.
Anchorage, AK 99507

Project Name: Lewis & Clark Rezone   Case No. ______

Meeting Type: ☐Concept ☒Pre-Application ☐Post-Application ☐Other

Meeting Requested by: Tom Dreyer, S4 Group   Date: 9-21-16
Lead MOA Planner: Francis McLaughlin   Time: 2pm

	NAME (please print)	COMPANY	PHONE	E-MAIL
1	Francis McLaughlin	Current Planning	343-8003	mclaughlinfd@muni.org
2	Terry Schoenthal	Current Planning	343-7917	schoenthaltn@muni.com
3	Ryan Yelle	Current Planning	343-7935	YelleRJ@muni.org
4	Brandon Marcott	Triad Engineering	344-3114	brandonmarcott@triadeng.com
5	DAN YOUNG	TERRASAT, INC	3449370	DAN.YOUNG@TERRASAT ENVIRONMENTAL.C
6	TOM DREYER	S4 GROUP	227-1847	tom@s4ak.com
7	DAVE GREWER	TRIAD Engineering	561-6537	daveg@triadak.com
	Jason Moncrieff	Private Development	343-8310	moncrieffjm@muni.org
9	Jody Seitz	Longrange planning, Muni	343-7940	seitzjl@muni.org
10	BRANDON TELFORD	MOA - PD	343-8443	telfordbs@muni.org
11	BROOKE BLESSING	MOA-PM&E	3438387	blessingbr@muni.org
12	Randy RIBBLE	MOA - TRAFFIC	343-8415	RIBBLERA@MUNI.ORG
13	PAUL GIONET	Big Country Ent.	345-8989	PAULANDSUSANAE@GMAIL.CO
14	TODD BROWNSON	Big Country Enterprises	698-6969	todd@grndup.com
15				
16				

Notes:

(G:\Community Development\Planning\Current\zon_plat\FORMS\Pre App or other mtg sign in sheet.doc)

Municipality of Anchorage

Public Works

Road Service Area Administration

GLEN ALPS ROAD SERVICE AREA

DATE: April 4th, 2017

Attention: Hal Hart – Planning Director @ MOA Planning Division

4700 Elmore Road, Anchorage AK 99507

Dear Mr Hal Hart,
While the Glen Alps Road Service Area Board does not endorse, support, oppose, or otherwise take any position on the Lewis and Clark Development project, developer Todd Brownson has shown a willingness to work with our road service area board to resolve issues that impact our roads and current road improvement projects. He has attended a few of our board meetings and has worked with our project manager to collaborate on strategies that could be mutually beneficial to his development and our road improvement projects. All of our interactions with Mr. Brownson to date have been professional and courteous and we are pleased to have a land owner willing to negotiate with us on road-improvement projects that directly impact their property and our service area.

Sincerely,

Joseph A. Connolly

Joe Connolly, Glen Alps Road Service Area Board Chair

Date: 4-4-17

4700 Elmore Road, 2nd floor
Anchorage, AK. 99507

S4 Group
Land Surveying
Land Development Consultants
Subdivision Specialists
Construction Surveying
124 E 7th Avenue, Anchorage, Alaska 99501 www.S4AK.com 907-306-8104

April 3, 2017

Re-zoning Application Narrative for
Lewis & Clark

Need & Justification for the rezoning: This proposal is to rezone the property to R-6SL which would allow us to subdivide the property through the platting process into individual lots for single family home construction with reduced development costs. The current zoning of R-8 requires lots with a minimum lot size of four acres and 300' in width, this equates to 20 lots that would be allowed on the 80 acre parcel. This proposal is for 30 lots on 80 acres, with lots ranging in size from 1 1/4 to 9 acres in size, the average density on the entire site is less that 0.4 dwelling units per acre. These lot sizes fit in well with the surrounding average lot sizes of about an acre and a quarter. The lots in Lewis & Clark will be highly desirable by home builders, and most of the lots will have incredible views along with a nearly flat paved interior road access.

Proposed land use and development: The proposed land use is for a development of 30 single-family homes, one per lot.

Probable timeframe for development: The probable timeframe for development of the subdivision is from 2018 to 2023.

Special Limitations: We are proposing two special limitations to the zoning. Special limitation 1 will limit the number of lots to 30, and special limitation 2 will require advanced high tech septic systems, commonly known as the Advantex system, or also known as 'Category III Nitrogen Reducing Wastewater Systems'. It should be noted that these systems are not required as per soil tests, but are over and above what is required by regulations.

Professional Reports & Studies: Attached to this application are reports from professionals in their field, they include:
A. A report from the law firm of Ashburn & Mason, authored by attorneys Mr. Don McClintock & Ms. Rebecca Lipson, concerning HDP language on rezoning;
B. A report from Mr. Will Webb, PE, PTOE, of Kinney Engineering, LLC concerning traffic issues;
C. A report by Mr. Steve Eng, PE, PH, of NorthRim Engineering concerning suitability of

soils for septic systems. It should be noted that Mr. Steve Eng was the District Engineer for the Alaska Department of Environmental Conservation, Steve was in charge of subdivision review & approval in Anchorage/Western Alaska; reviewing & approving all soils/wastewater designs to meet State Regulations. During this time, he approved the first advanced wastewater treatment systems. As owner of NorthRim Engineering since 2001, Steve has designed numerous wastewater systems to meet subdivision requirements in the Anchorage area. NorthRim Engineering was hired to monitor & sample effluent from Advantex systems in Anchorage; this advanced wastewater system is used worldwide to provide superior effluent treatment. This is the system that is planned for Lewis & Clark Subdivision.

D. A report by Mr. Dan Young, CPG of Terrasat, Inc evaluating the groundwater resources for Lewis & Clark.

E. A report by Mr. Dan Young, CPG of Terrasat, Inc on the evaluation of nitrates in local wells surrounding the Lewis & Clark development.

F. A report by Mr. David Grenier, PE, and Mr. Brandon Marcott, PE, of Triad Engineering on the Drainage Impact Analysis.

G. A report by Mr. David Grenier, PE, and Mr. Brandon Marcott, PE, of Triad Engineering on the Upper DeArmoun Road condition assessment.

H. A report by Mr. Pat Athey of Hemlock Scientfic, LLC. On the preliminary determination of wetlands and waters for Lewis & Clark.

1. The rezoning shall be in the best interest of the citizens of Anchorage and shall promote the public health, safety, and general welfare.

This rezoning to R-6SL will promote the public health & safety and general welfare of the home buying public by providing well designed lots with a safe, paved access road that is designed to all of the current code restrictions that provide safety features such as adequate turn-around for fire trucks, a safe and flat road grade in the interior streets, improved drainage systems, high tech septic systems, and large lots that are conducive to Anchorage Hillside style of living. New subdivisions on the hillside are becoming increasingly rarer as most of the land is fully developed. Lewis & Clark will provide 30 home owners the chance to be in an all-new subdivision with all-new houses, and all-new paved streets. The existing zoning of R-8 with its requirement for lot widths of 300 feet do not allow the development of lots that would be within reach financially of most home buyers. The R-6 lot minimum lot width of 150 feet reduces the cost of the roadway improvements substantially. Most of the Hillside consists of lots conforming to the R-6 dimensional standards.

2. The rezone complies with and conforms to the comprehensive plan, including the comprehensive plan maps(s). (If the proposed rezone does not conform to the comprehensive plan, it may be considered along with a comprehensive plan amendment.)

Lewis & Clark conforms to the comprehensive plan. **Policy 5** states that rezones shall be compatible in scale with adjacent uses, which this proposal strictly complies with. Adjacent to the north of this property lies R-6 zoning with developed 1 & 1/4 acre lot sizes. Adjacent to the west of this property lies R-9 zoned property and has been developed with half-acre and acre sized lots. Adjacent to the east lies R-8 zoning developed with 1 & 1/4 acre lots. Adjacent to the south lies undeveloped R-8 property that encompasses Rabbit Creek. With the addition of the special limitation of 30 homes on this property, this rezoning clearly complies with all intents and purposes of the comp plan. **Policy 13** of the comp plan states that new rural subdivisions shall be designed to maintain the rural character of the area, our proposal is for R-6 lots, which are considered rural lots. **Policy 13** states that we should link to adjacent roadway systems, which we do. **Policy 13** states that we should protect wetlands and other environmental areas. We are protecting the wetlands by creating large tracted parcels that include the wetland areas and the stream setback areas. **Policy 5** states that we should incorporate wildland fire safety design standards, which new homes are built to. **Policy 14** of the comp plan states very clearly: *"Conservation of residential lands for housing is a high community priority. New residential developments at densities less than identified in the Neighborhood or District plans* ***is discouraged.****"* This policy gives clear direction that in order for the Anchorage community to grow and prosper, properties must be developed at what they can reasonably and responsibly be constructed.

Hillside District Plan Map 2.1 "Hillside Land Use Plan'. Lewis & Clark conforms with the density levels as shown on this map. Lewis & Clark is in an area labeled as "Residential, with an allowed limited density of 0 to 1 DUA. We are proposing a density level that is in the middle of the density range. The density level in Lewis & Clark will be 0.4 dua.

Policy 1-B of the Hillside district plan states: "*This plan maintains existing residential land use designations and zoning in the southeast Hillside.*" The intent here is clear: Maintain residential where it is currently residential zoning, commercial where there is currently commercial zoning, and so on. The intent was not to limit zoning changes that would result in lots still equal or larger than that of the surrounding lots. R-6 zoning fits well within the land use designation as specified on page 2-17 of the Hillside District Plan titled "Limited Intensity Residential", which is defined as large lot, single family residences in a rural environment. Lewis & Clark fits every description and location criteria listed in the HDP. To further clarify the issue, please see the attached letter of opinion from attorneys Mr. Donald McClintock and Ms. Rebecca Lipson of the law firm of Ashburn & Mason, along with correspondence with the now retired Planning Division manager, Mr. Terry Schoenthal.

3. The rezoning is generally consistent with the zoning district purpose in the requested zone, and the purpose of this title.

This rezoning will comply with all of the R-6 zoning district purposes and specifications as in Title 21. We are proposing two special limitations; the first special limitation will limit the development to 30 dwelling units on the 80 acre parcel. The second special limitation will require each lot to be built with a Category 3 Nitrogen Reducing wastewater system, commonly called the Advantex system.

4. The rezoning is compatible with surrounding zoning and development, and protects areas designated for specific uses on the zoning map from incompatible land uses or development intensities.

Lewis & Clark will be compatible with the surrounding zoning and development. With our proposed special limitation of 30 lots on the 80 acre parcel, we will be less dense than the areas to the east, the north, and to the west of us. The area to the south is undeveloped. Please refer to the aerial map enclosed with this application that shows the number of lots in each area surrounding Lewis & Clark. In addition to being compatible as to density levels, Lewis & Clark is also compatible as to land use. The only land use allowed will be one single family house per lot.

5. Facilities and services (including roads and transportation, water, gas, electricity, police and fire protection, and sewage and waste disposal, as applicable) are capable of supporting the uses allowed by the zone or will be complete by the time development is complete, while maintaining adequate levels of service to existing development.

All facilities, utilities and services are capable of supporting the planned residential uses in Lewis & Clark. Road Access is by Upper DeArmoun Road, water services will be by individual water wells on each lot, sewer systems will be on-site systems that utilize the Advantex-style septic system, which will be required by a special limitation to this zoning. Fire protection issues will be addressed by complying with the latest fire codes, and by providing fire department approved turn-arounds at the end of each cul-de-sac within Lewis & Clark, and providing roads that are safe by width and design, and by being nearly flat in grade. For further information on water availability, please refer to the extensive report by Mr. Dan Young of Terrasat, Inc., attached to this application. For further information on the soils, please refer to the report by Mr. Steve Eng of Northrim Engineering, also attached to this application.

6. The rezoning is not likely to result in significant adverse impacts upon the natural environment, including air, water, noise, storm water management, wildlife, and vegetation, or such impacts shall be substantially mitigated.

The approval of this rezone will help reduce environmental impacts, in relation to:

Steep slopes: All lots will comply with the slope chart standards in Title 21. The Slope Chart in Title 21.80 figure 13, defines the lot area and lot width required for different slopes of land. The general slope of the Lewis & Clark parcel is within the range of 5 to 15 %. According to the slope chart, this would require a lot size of 12,000 square feet, or about a quarter acre, and a required width of 100'. Our proposed lots are from one to three acres, with a minimum width of 150'. Areas that are steeper than this have larger lots and wider widths, all within Title 21 strict standards. For example, a lot with a 20% slope would be required to have an area of 15,000 sf, and a lot width of 105', Lewis & Clark lots that are in this steeper area are 2 to 3 acres in size and 300' wide.

Wetlands/Streams/Drainageways: Pat Athey, with Hemlock Scientific, LLC has performed extensive wetland studies that have defined the wetland boundaries streams, drainage-ways, and water features of the property. Lots will be designed to these standards with the wetland areas being protected and they will be tracted out and designed utilizing Title 21 regulations. The platting process will further define and refine the details and lot lines according to the professional reports, Title 21 subdivision standards, and other reporting agencies comments. For further detail, please refer to the report prepared by Mr. Pat Athey titled, "Preliminary Determination of Wetlands & Water" attached to this application.

Hydric soils: Extensive soil and ground water studies have been conducted by the local engineering firm of Northrim Engineering, Terrasat, Inc. and the Garness Engineering Group. We have drilled extensive test holes over the entire parcel to help us define the future lot layout to insure that each lot will have adequate areas and reserve sites for septic systems. Through the platting process, all lots will meet Title 21 regulations concerning septic site standards and availability of water. Final lot line locations will take into consideration the boundaries of the areas suitable for septic sites and well-site locations. The soils are further protected by our proposed zoning special limitation of requiring each lot to have a septic system that is commonly referred to as an Advantex system. Please refer to the attached soils report by Mr. Steve Eng of NorthRim Engineering.

Traffic: DeArmoun Road, is classified as a type 1C collector according to the Anchorage Official Streets & Highways Plan. A class 1C road is required to have two lanes, a sixty foot ROW width, and a rating of 2,000 to 10,000 ADT's. DeArmoun Road is built to 1C standards, and is designed to accommodate 10,000 ADT's. This rezoning would allow 10 more lots than the existing zoning currently allows. A single family house is rated at 9.52 ADT's, which equates to an additional 95 ADT's, which equals less than 1.0% of the allowed ADT's onto DeArmoun Road as per the design standards. DeAmoun Road is a two lane paved roadway. Data Sources from the MOA and HDR shows that for Upper DeArmoun Road, a long term build out volume to capacity ratio is 0.25. This means that even after long term final build out, DeArmoun Road will be at only 25% of it's designed capacity. For further detail, please refer to the enclosed Traffic Analysis by Mr. Randy Kinney and Mr. Will Webb of Kinney Engineering, and refer to the attached report by Triad Engineering titled "Upper DeArmoun Road Condition Assessment."

7. The proposed rezoning is not likely to result in significant adverse impacts upon adjacent land uses, or such impacts shall be mitigated through stipulations.

There will be no adverse impacts to neighboring properties. For further detail, please refer to the report from Mr. David Grenier and Mr. Brandon Marcott of Triad Engineering titled 'Preliminary Drainage Impact Analysis', enclosed with this application. Their summary states: "Conclusion: As mentioned in Section 2.c., one of the primary concerns for this development will be the contributing offsite runoff from properties to the north and east of the project. Area upstream of the project generates approximately half of the total runoff that flows through the site. This runoff will be collected and routed through vegetated drainage ways and directed to Rabbit Creek, closely matching the existing drainage path on site. No grading will be done outside of the property boundary, and MOA-identified drainage ways will remain in place downstream of the project. The overall existing drainage pattern of the surrounding area will not change or be negatively affected with the development of this parcel.

Increasing the density from R-8 to R-6 zoning (limited to 30 lots) creates a minimal change in peak runoff, with an increase in the range of 3-7%. This minor increase can be safely managed by sizing drainage ways and culverts accordingly. The increase in impervious area is also minimal, increasing from 3.3% impervious under R-8 zoning to 6.1% impervious with a 30-lot R-6 development. As proposed, the project site will remain at a low density with an average lot size greater than 1&1/2 acres, with over 80% of the parcel predicted to remain as heavily vegetated brush and trees. Glaciation concerns will be addressed by keeping shallow ground water along the roadways below the ground surface. No adverse impacts to neighboring properties are anticipated under the proposed R-6 zoning designation and 30-lot limitation."

8. The rezone does not extend or exacerbate a land use pattern that is inconsistent with the comprehensive plan.

This rezone's R-6SL is consistent with the land use patterns in the area and is consistent with the comprehensive plan as stated above.

9. The rezoning does not result in a split-zoned lot.

Lewis & Clark will not create any split-zoned lots.

If you have any questions or need further clarifications, please email me at tom@s4ak.com.

Thank you,

Tom Dreyer, PLS
S4 Group

SECTION A

ASHBURN & MASON P.C.

LAWYERS

MATTHEW T. FINDLEY • EVA R. GARDNER • REBECCA E. LIPSON • DONALD W. MCCLINTOCK III
JEFFREY W. ROBINSON • JESSICA J. SPUHLER • THOMAS V. WANG
OF COUNSEL JULIAN L. MASON III • A. WILLIAM SAUPE

February 23, 2017

Re: Conformity of Proposed Rezoning to Anchorage 2020
Our File No.: 11558.001

Dear Chairperson:

We represent Big Country Enterprises, LLC. Enclosed is our correspondence to Terry Schoenthal advancing the position that the specific language of Policy 1-C (or 1-B) of the Hillside District Plan should not be read in and of itself to preclude consideration of the rezone. Electronic correspondence we received in response from Mr. Schoenthal is also enclosed for your consideration.

We look forward to working with you during this process.

Sincerely,

ASHBURN & MASON, P.C.

Rebecca Lipson

Rebecca E. Lipson

REL:haw
Encl.

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December 30, 2016

Via Electronic and US Mail

Terry Schoenthal
Municipality of Anchorage
4700 Elmore Road
Anchorage, Alaska 99507
SchoenthalTN@ci.anchorage.ak.us

Re: Conformity of Proposed Rezoning to Anchorage 2020
Our File No. 11558.001

Dear Terry:

Big Country Enterprises, LLC seeks to rezone approximately 80 acres in the Central Hillside Residential Area from a R-8 (rural residential—large lot) designation to a R-6SL (suburban residential—large lot, special limitations) designation.[1] In the past, the Planning and Zoning Commission has cited the Hillside District Plan ("HDP"), specifically Policy 1-C, as one of the grounds to deny a rezone for the subject property.

[1] The legal description is: The North One-Half of the Southeast One-Quarter (N1/2 SE 1/4) of Section 25, Township 12 North, Range 3 West, Seward Meridian, located in the Anchorage Recording District, Third Judicial District, State of Alaska. Excepting therefrom the Northwest One-Quarter of the Northwest One-Quarter of the Southeast One-Quarter (NW1/4 NW1/4 SE 1/4) of Section 25, Township 12 North, Range 3 West, Seward Meridian, located in the Anchorage Recording District, Third Judicial District, State of Alaska and Lots 1 & 2 Vergason-Jones Subdivision, according to the official plat thereof filed under Plat No. 98-178, in the records of the Anchorage Recording District, Third Judicial District, State of Alaska. Although Big Country is the lead petitioner, the owners of Lots 1 and 2 are expected to join in this request.

This letter sets forth our legal analysis of why Policy 1-C[2] does not present a legal impediment to the rezone of this property; in summary, we offer the following:

(i) Recent soils, septic and well studies have established that assumed topographic limitations that were used to establish the R-8 zoning are not present to preclude R-6SL development;
(ii) A rezone to R-6SL will allow the imposition of special limitations that will further advance other polices and goals of the comprehensive plan;
(iii) Consideration of a rezone in this area would be consistent with past precedent; and
(iv) Policy 1-C's statement to maintain current zoning should not be read as a legal impediment to rezoning, the purpose of which will meet the goals and polices of the comprehensive plan.

The factual issues discussed below are for context to our legal analysis. We are mindful that the factual issues need to be addressed in the proper proceedings. However, taking the time to address the legal effect of Policy 1-C (or as discussed below Policy 1-B) now, and obtaining the administration's legal concurrence with what we believe are clear legal principles, will avoid the confusion and the risk of wasting considerable staff and client resources in the future.

Question Presented:

Policy 1-C provides: "Maintain the same land use designations and zoning in this area as were established prior to the beginning of this plan." Does this policy preclude consideration of a rezone from R-8 to R-6 SL even if the special limitations further other polices and goals of the HDP as a component of the Anchorage 2020—Anchorage Bowl Comprehensive Plan ("Anchorage 2020") and there is no change in the land use designation?

Short Answer:

Land use planning inherently requires balancing competing and sometimes

[2] We focus our discussion on Policy 1-C as that is the analysis that staff used in the prior rezone review. However, as will be addressed subsequently, this rezone is more properly governed by Policy 1-B.

inconsistent policies and goals. Alaska case law and cases from other jurisdictions permit selection of one use over another following a balancing of relevant comprehensive plan goals and policies. The specific language of Policy 1-C (or 1-B) therefore should not be read in and of itself to preclude consideration of the rezone. Instead, the rezone request must be evaluated in light of all of the policies and goals of the HDP and Anchorage 2020 as a whole. This is particularly true in the present instance, where the development as proposed under R-6SL zoning is more in conformity and more fully furthers the goals and policies of the HDP than R-8 development.

Discussion:

1. **Historical Efforts to Rezone the Property.**

Big Country Enterprises, LLC ("Big Country") and its co-petitioners own approximately 80 acres of property located in the Central Hillside Residential Area zoned R-8 (rural residential—large lot) fronting on Upper Dearmoun Road. Past efforts to rezone the Property to R-6SL (suburban residential—large lot) have been hindered by perceptions of natural conditions, topographical challenges and nonconformity to comprehensive planning. While this last issue is the focus of this letter, a background discussion of the Property's topography and natural conditions is necessary to understand why the Property is suitable for rezoning.

The Property is located squarely among developments of large-lot residential homes.[3] Neighboring zoning designations range from R-6 to R-8, with many parcels being platted and developed prior to current zoning implementation. Efforts to maintain the same land use designation, but rezone the Property to allow for residential in-fill, have been ongoing since the 1970s. As early as 1976, the then-Acting Planning Director Daniel Wilkerson noted that the Property's zoning may have been based on an erroneous pollution level rating and suggested that the Property might be suitable for a subdivision of two and a half acre lots, while recommending against R-6 zoning.[4] Presently, with the R-8 designation, the maximum permissible number of lots ranges between sixteen to

[3] See Attachment 1.

[4] See Attachment 2. Assembly Memorandum 430-76C, dated August 24, 1976 at 2. Wilkerson reports the Property is graded as having low pollution danger, which is "the same USGS rating as other R-6 lands and that all other land zoned R-9 and R-8 have high pollution ratings."

twenty lots based upon varying Code interpretations not necessary to explore here.[5] A rezone to R-6SL could increase this number to about 30 when the wetlands and waterways are placed in separate tracts as required to meet the special limitations discussed below. None of this discussion changes the land use designation for the Property—which remains residential limited intensity with a density below 1 du per acre, the least dense designation in the comprehensive plan.[6]

Big Country brought forth the most recent rezoning effort in 2015 with AO No. 2015-102. The proposal sought to rezone the Property from R-8 to R-6SL, allowing for the development of a thirty-two (32) lot subdivision. Open questions relating to the following areas were identified as precluding a rezone at that time: (1) soil permeability for well installation, (2) on-site septic system compatibility, (3) number of permissible lots, (4) management of surface water run-off, (5) traffic volume, and (6) compatibility of rezone to the HDP, particularly Policy 1-C.

In response to the above identified issues, Big Country engaged in extensive data collection through soil sampling, hydrologic research, and traffic studies, as well as revising their subdivision design to incorporate innovative and ecologically minded development strategies, including utilization of two special limitations.[7] One such development strategy is the allocation of seventeen (17) acres of the Property into a separate tract of wetlands and water way to better protect it from development.

A conversation about the facts addressing issues (1) through (5) identified above is more appropriately left for discussion during the rezone process. However, the legal question of whether Policy 1-C (or Policy 1-B) remains a legal bar to consideration of the rezone deserves attention now.

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[5] See e.g., Table 21-06-01 at 6-6. Tom Dreyer of the S4 Group, LLC is assisting Petitioners and can explain the varying internal conflicts in the Code that affect this calculation.

[6] See HDP Land Use Map at 2-8. As noted in Policy 1-E at 2-17, this land use designation "provides for large-lot, single family residences in a rural environment, much of which is served by private wells and septic systems." This land use designation is implemented by R-6, R-8, R-9 and R-10 zones. Thus the question before us does not involved a question involving a change in the land use designation, which remains the same whether it is zoned R-6 or R-8.

[7] The two proposed Special Limitations are (1) limiting the maximum number of lots to thirty (30), and (2) requiring the use of a Category III Nitrogen Reducing wastewater system for the development of each subdivision lot.

2. Policy 1-B is the proper Policy to apply.

A map of the three Hillside Districts was not included in the final HDP. However the 2009 map that was in the draft plan shows a clear intent to have Glen Alps road as the northern line for the Southeast District. A copy is attached as Attachment 3. The final plan relies on a somewhat ambiguous narrative description; however reading the descriptors in context of the draft map, it seems clear that the Property is located in the Southeast Hillside Residential District rather than the Central Hillside Residential District. A drawing is attached as Attachment 4 showing where the subject tract is located along with a drawing of how we interpret the districts.

The Southeast Hillside Residential District is defined as the area "generally above Hillside Drive, south of Glen Alps and south of Rabbit Creek Road. This area takes in much or all of the Rabbit Creek and Potter Creek watersheds (shown on Map 1.5)."[8] To the extent there is any ambiguity, the reference to the Rabbit Creek watershed should be determinative as the Property clearly is linked to the Rabbit Creek watershed.

The first significance to this is that Policy 1-B, unlike Policy 1-C, does not textually reference maintaining existing zoning; instead it provides in relevant part: "Maintain policies for the amount of development as allowed under current land use designations." This is significant as this rezone does not change the land use designation and the development of the tract under the proposed R-6SL, like the neighboring lots, will remain well below the 1 du per acre called for by the Limited Intensity Residential designation applicable here.

We note that the discussion under Policy 1-B does provide: "This plan maintains existing residential land use designations and zoning in the southeast Hillside." There is no real clarification as to the distinction between this sentence and its absence in the Policy itself. One could infer there is less of a restriction on rezoning in the southeast district if the natural condition issues are adequately addressed. However as discussed below, the best interpretation is that Policies within the HDP do not in and of themselves prohibit rezoning, but rather any rezone application must be evaluated in the context of all of the goals and policies of the HDP.

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[8] HDP at 2-9 to 2-10.

Because this question originally came up under Policy 1-C, the remainder of this analysis continues with that language and issue. However, the discussion is equally applicable to Policy 1-B and should be read to address both Policies, especially to the extent staff and the Commission construe the discussion under Policy 1-B to carry the same weight as the language of the policy itself.

3. Policy 1-C is just one of many components influencing comprehensive planning decisions made pursuant to the HDP and Anchorage 2020.

The Municipality of Anchorage is required by state statute to adopt a comprehensive development plan and implement land use regulations in accordance with the plan.[9] The current Anchorage comprehensive plan, Anchorage 2020, is intended to set "forth the goals, objectives, strategies, and policies governing land use development of the municipality."[10] The HDP is one adopted element of the comprehensive plan.[11] To help ensure statutory compliance, the Anchorage Municipal Code ("Code") states "rezonings, conditional uses, subdivisions and other related discretionary actions under this title shall be consistent with the comprehensive plan, including the goals, objectives, policies, and strategies" of the individual plan elements.[12]

As the HDP recognizes, different planning documents use terms such as "goals, objectives, policies, standards" for different purposes and the line between terms is not always precise.[13] The HDP uses the terms goal, strategy, policy, and standard, which range from the broadest (goals) to the most specific (standards). Policy, which is not defined in the Code for comprehensive planning purposes, is defined by the HDP as "a rule for action on a specific issue" and recognizes that the "term takes in a range of measures, including land use classifications, development standards, capital improvements."[14] While the HDP identifies thirteen (13) sets of goals, with implementation *policies* for each distinct goal—including Policy 1-C—the HDP also describes its most fundamental actions as being contained in five sets of *policies*,

[9] AS 29.40.030.
[10] AMC 21.01.080(A).
[11] Id. at (B).
[12] Id. at (D)(4).
[13] HDP 1-22.
[14] Id.

suggesting those five policies are even broader than the outlined goals.[15]

The five overarching policies are (1) maintain the Hillside's existing low-density, rural residential character, (2) maintain and improve the functioning of on-site water and wastewater systems; establish a well water protection program; (3) establish new district-wide approaches to infrastructure funding and management; (4) improve roads, trails, and access to Chugach State Park, and (5) establish new approaches to development.[16] As will be discussed below, the proposed rezone will not adversely affect policies (1), (3) and (4), and will advance policies (2) and (5) by allowing a more environmentally protective development through its special limitations and segregation of sensitive lands.

As mentioned above, in addition to the five overarching polices the HDP identifies thirteen (13) sets of goals, with each goal having an area-specific implementation policy.[17] Goal 1 is "Location and Intensity of Development", which seeks to guide the amount and location of future development while maintaining the quality and diversity of the Hillside District as a place to live, ranging from low-density rural areas, to single-family suburban neighborhoods, to areas with duplexes and multifamily housing."[18] Policy 1-C is the implementing policy for Goal 1 for the Central Hillside Residential District.[19]

Policy 1-C states: "[m]aintain the same land use designations and zoning in this area as were established prior to the beginning of this plan."[20] Notably, five of the six adjacent developed subdivisions surrounding the Property have far greater densities than that proposed for the Property.[21] Big Country is not proposing a change in the applicable land use designation. Limited intensity residential is implemented by R-6, R-8, R-9, and R-10 zoning.[22] Thus, the only question is whether Policy 1-C legally precludes rezoning from R-8 to R-6SL regardless of maintaining the same land use designation.

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[15] Appendix B to the HDP, A3-12.
[16] HDP, 1-21 to 1-22.
[17] Appendix B to the HDP, A3-12.
[18] Id. at A-3.
[19] Policy 1-B is the implementing policy for Goal 1 for the Southeast Hillside Residential District.
[20] HDP on page 2-11 and page A-3.
[21] Attachment 1.
[22] HDP, 2-17.

Both R-8 and R-6 zones are considered limited intensity residential districts. Under the new Title 21 revision, the purposes of R-8 and R-6 zoning are as follows:

> *Purpose.* The R-6 district is intended primarily for single- and two-family large-lot residential areas, with gross densities of up to one dwelling unit per acre. The R-6 is designed to encourage low-density residential development. This district is intended to protect and enhance those physical and environmental features that add to the desirability of large-lot residential living. The availability of infrastructure and municipal services is varied.[23]
>
> . . .
>
> *Purpose.* The R-8 district is intended primarily for single- and two-family large-lot residential areas with gross densities less than one dwelling unit per four acres, where topographic or other natural conditions are such that higher-density development would be unfeasible. In addition to topography, some of the natural conditions which could exist to render land desirable for the densities proposed in this zone are wind hazards, marginal soils, landslide susceptibility, potential for groundwater pollution, and groundwater availability.[24]

Thus, the main distinction between R-6 verses R-8 zoning is topography and the ability of the land to handle higher-density development. Technological advances since the establishment of Hillside's zoning, such as the rise of advanced wastewater treatment systems, have gone far to address previous impediments to development. Assuming Big Country is able to demonstrate that the Property's topography or other natural conditions do not preclude higher-density development, the remaining question is whether the language of Policy 1-C alone precludes rezoning.

4. Legal Standard.

The authority tasked with reviewing a proposed land action must consider whether

[23] AMC 21.04.020(K).
[24] AMC 21.04.020(M).

the proposed action is in accordance with the applicable comprehensive plan.[25] The Code requires rezoning decisions "be consistent with the comprehensive plan, including the goals, objectives, policies, and strategies" of the HDP.[26] While the Code states that where "comprehensive plan elements conflict, the most recently adopted shall govern" the Code is silent as to how to deal with contradictions within the governing document itself.[27] In fact, the HDP contemplates that its own planning devices may contradict one another.[28] Dealing with these conflicts is presumably one of the main reasons the Code requires pre-application conference attendees discuss the "appropriateness of the development with respect to the policies set forth in the comprehensive plan and the regulations in this title."[29] The fact that different policies may support different outcomes makes it imperative that the reviewing authority utilize the comprehensive plan as a planning tool, rather than as an inflexible document.

Case law supports use of the comprehensive plan as a sounding board for evaluating the strengths and weaknesses of competing uses. The *Native Village of Eklutna v. Board of Adjustment* involved a challenge to the issuance by the Planning and Zoning Commission ("Commission") of a conditional use permit for a granite mining operation by the Native Village of Eklutna. Issuance of the permit furthered the identified goal of supporting an economic base for the community; however, the Supreme Court found that since preservation of "historic and archeological sites determined to have local and/or State significance" was also a listed comprehensive plan goal that the Commission was required to evaluate the conditional use permit in light of that goal as well.[30] To that effect the Supreme Court stated:

> The Commission should first determine the extent to which cultural resources would be adversely affected by the proposed quarry. Then, the Commission should weigh the goal of preserving historic and archeological resources against the goal of supporting an economic base for the community. If the adverse effects to archaeological and historic resources

[25] *Native Vill. of Eklutna v. Bd. of Adjustment for Municipality of Anchorage*, 995 P.2d 641, 643–44 (Alaska 2000).
[26] AMC 21.01.080(D)(3)
[27] Id. at (D)(5).
[28] HDP, 1-22 ("[N]o single goal has priority over others and there may be conflicts between individual goals.")
[29] AMC 21.03.020(4)(b)(ii).
[30] *Native Village of Eklutna v. Board of Adjustment for...*, 995 P.2d 641, 644-45 (2000).

> outweigh the economic advantage gained by the proposed conditional use, the Commission should deny the conditional use permit. If the economic gains outweigh the cultural losses, then the Board should grant the permit.[31]

This recognition that the deliberating body must weigh and balance competing interests in general land use plans is followed in other jurisdictions. In California, courts routinely acknowledge that because "policies in a general plan reflect a range of competing interests, the governmental agency must be allowed to weigh and balance the plan's policies when applying them, and it has broad discretion to construe its policies in light of the plan's purposes."[32]

The concurring opinion in *RDNT, LLC v. City of Bloomington*, a recent Minnesota Supreme Court decision, provides a helpful survey of the role of comprehensive plans in the history of land use planning across the country.[33] The survey found courts have historically "construed comprehensive plans as advisory documents that cannot guide specific land-use decisions."[34] To the extent certain modern courts deviated from this approach those courts were acting in perceived accordance with state specific statutory

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[31] *Id.* at 645.

[32] *Napa Citizens for Honest Gov't v. Napa Cty. Bd. of Supervisors*, 91 Cal. App. 4th 342, 361, 110 Cal. Rptr. 2d 579, 592 (2001), as modified (Aug. 7, 2001), as modified on denial of reh'g (Sept. 4, 2001)(citing *Save Our Peninsula Committee v. Monterey County Bd. of Supervisors* (2001) 87 Cal.App.4th 99, 142 (2001)); *Sequoyah Hills Homeowners Assn. v. City of Oakland*, 23 Cal. App. 4th 704 (1993); *Greenebaum v. City of Los Angeles* 153 Cal. App. 3d 391, 407 (1984)).

[33] 861 N.W.2d 71, 86 (Minn. 2015) (Upholding the city's denial of a conditional use permit).

[34] *Id.* at 80 (citing the following in support "*See, e.g., City of Gainesville v. Cone*, 365 So.2d 737, 739 (Fla.Dist.Ct.App.1978) ("[The comprehensive plan was] to serve merely as a guide for future decisions relating to rezoning petitions and growth and development of the City."); *Urrutia v. Blaine Cnty.*, 134 Idaho 353, 2 P.3d 738, 742–43 (2000) ("[A] comprehensive plan does not operate as legally controlling zoning law, but rather serves to guide and advise the governmental agencies responsible for making zoning decisions."); *Borsuk v. Town of St. John*, 820 N.E.2d 118, 121 (Ind.2005) ("A comprehensive plan is 'a guide to community development rather than an instrument of land-use control.'" (quoting 4 Young, *supra*, § 23.15)); *Iverson v. Zoning Bd.*, 22 Md.App. 265, 322 A.2d 569, 571 (1974) ("A master or general plan ... is but a guide or scheme recommended to the legislative branch in order to enable them to make intelligent decisions with respect to the adoption of zoning classifications." (citing *Pattey v. Bd. of Cnty. Comm'rs*, 271 Md. 352, (1974))); *Forks Twp. Bd. of Sup'rs v. George Calantoni & Sons, Inc.*, 6 Pa.Cmwlth. 521, 297 A.2d 164, 166–67 (1972) ("The comprehensive plan is a general guideline to the legislative body of the municipality for its consideration of the municipality's program of land utilization and the needs and desires of the community.").

authority.[35]

Indeed, we are aware of at least two times in the past when the Assembly has not interpreted the HDP as a strict limitation on its rezoning authority. Specific instances in which deviation was permitted include: A.O. 2012-46 (Mountain Air Estates—a rezone of 12 acres from R-9 to R-6SL); and A.O. 2011-82 (Potter Highlands—a rezone of 80 acres from R-3SL to R-6SL).[36] Presumably, these actions occurred because the rezone conformed to and furthered the goals and policies of the Anchorage 2020, and thus provide precedent for not construing Policy 1-C as a legal barrier to consideration of this rezone.

5. A rezone to R-6SL more fully furthers the goals and policies of the HDP than R-8 development.

As discussed above, the HDP establishes five sets of overarching policies. Each set of policies is explored below with respect to R-6SL verses R-8 development.[37]

(1) Maintain the hillside's existing low-density, rural residential character. The R-6SL zone will in fact further this goal. First, the actual density of a proposed R-6SL development will be comparable or less dense that the surrounding neighborhoods as shown on Attachment 1. Moreover, placing the wetlands and a delineated water course into separate tracts will provide large areas of open space, which is more compatible with the nearby public lands in appearance and feel.

(2) Maintain and improve the functioning of on-site water and wastewater systems; establish a well water protection program. Each lot will be developed with on-site water and wastewater systems. Provided R-6 SL development is permitted, Big Country agrees to a Special Limitation that all septic systems must use a Category III Nitrogen reducing wastewater system for each lot. Extensive hydrological and soil testing performed by hydrologist Dan Young of Terrasat, Inc. and soils engineers Steve Eng PE, PH, of North Rim Engineering and Jeffrey Garness, PE, MS, of Garness Engineering

[35] *Id.* at 81, *see* fn. 2.

[36] Both of these developments were covered by the Southeast Policy 1-B which provides that "This plan maintains existing residential land use designations and zoning in the southeast Hillside." (HDP at 2-9 through 2-10).

[37] HDP, 1-21 to 1-22.

Group support a finding that the proposed subdivision can meet the MOA subdivision standards. Hydrological testing included measuring water levels in 32 existing piezometers weekly to determine the highest water level in autumn 2016, evaluating water well yields from the surrounding community, drilling three exploratory water wells and conducting aquifer testing, and evaluating and modeling nitrate migration from three proposed lots.[38] The three water wells were drilled to determine adequacy and availability of groundwater. All three wells produce more than adequate water supplies, with one well producing more than 10 gallons per minute. A total of 61 test holes were used to evaluate percolation rates. The soils were found to support conventional septic systems; however, the developer remains committed to the use of advanced nitrate reducing septic systems in order to maximize stewardship of the subsurface environment. Finally, water levels were monitored throughout the autumn season and the results show that leach field designs are well above potential high water table levels.

(3) Establish new district-wide approaches to infrastructure funding and management. Although not applicable, this policy is not adversely affected by the proposed rezone.

(4) Improve roads, trails, and access to Chugach State Park. While not directly applicable given the location of the Property, responsible development of land on an important approach to Chugach State Park provides for more neighborhood stewardship of the road and advocacy for its maintenance. A report from Will Webb, PE, PTOE of Stantec Consulting Services, Inc. projected that the increased potential traffic generation associated with a lot density of thirty-two (32) lots (a number greater than currently proposed) would remain well below the maximum volumes appropriate for a neighborhood collector road. Both Upper DeArmoun Road and Canyon Road are classified as neighborhood collectors in the 2014 Official Streets and Highways Plan.

(5) Establish new approaches to development. The Lewis & Clark re-zone uses innovative design to maximize protection of wetlands, make lots self-sufficient through advanced waste water management, provides for two lengthy cul-de-sacs with minimal grading reducing the need for pedestrian activity along DeArmoun, and increases green space and trails within the development itself. The segregation of wetlands into separate

[38] Further explanation of testing is contained within correspondence from S4 to Terry Schoenthal, dated September 20, 2016 as well as a 70 page soils study report by Garness previously submitted to the Planning & Zoning Commission. Copies of both documents are available upon request.

tracts is called out by the HDP as a more protective approach to preserving sensitive lands.[39] Keeping the property as R-8 precludes tracting out separate wetlands as the 4 acre lot size limits any real subdivision flexibility. Taking out 17 acres as a wetlands tract reduces the number of lots to the extent that development is economically infeasible. A rezone to R-6SL allows the imposition of greater lot requirements such as the specification of higher technology septic units while keeping the lots commercially reasonable in price. The separate wetlands tract is significant not just visually and to improve the neighborhood feel (largely because the adjacent neighborhoods do not have these amenities as they were all subdivided much earlier), but also because these wetlands serve as an important buffer for drainage that continues down the Valley to Rabbit Creek.

Conclusion

Although we cover much of the background policy, all that is needed now is the concurrence of your legal staff that the Policy 1-C (or Policy 1-B) reference to maintain current zoning does not impair the deliberative bodies from considering a rezone to R-6SL if they determine, after weighing all of the facts in light of the goals and policies of the HDP that a rezone better serves the goals of the comprehensive plan. We look forward to your response and are available to respond to questions.

Sincerely,

ASHBURN & MASON, P.C.

Rebecca Lipson

FOR Donald W. McClintock

Rebecca Lipson

Rebecca E. Lipson

DWM:haw

[39] See generally, HDP 2-40 "Why is Open Space Important?"

{11558-001-00376014;10}

MUNICIPALITY OF ANCHORAGE

ASSEMBLY MEMORANDUM

No. AM 430-76

Meeting Date: August 24, 1976

From: Mayor

Subject: ORDINANCE NO. 132-76: REZONING FROM R-8 TO R-6, 70 ACRES ON UPPER DeARMOUN ROAD, (Case Z-1350)

The Assembly requested more information about this rezoning petition for 70 acres on Upper DeArmoun Road. In particular, Administrative staff was directed (a) to consult with the U.S. Geological Survey about its general analysis of the petition site locale and (b) to design a hypothetical subdivision for the 70 acres. The subdivision is shown in attached Memo AM 430-76B from Public Works and generally discussed below, along with a note about U.S. Geological Survey's advice.

The subdivision research by Public Works and Environmental Protection leads the Administration to now recommend that the rezoning to R-6 is not ideal and that a combination of continued R-8 for a portion of the site and R-9 for the remainder is more appropriate.

SEWAGE DISPOSAL:

It has been concluded, by cooperative study between Public Works and Environmental Protection, that the R-6 (1½ acre) zoning is not ideal because that zoning would have to be dependent on a complete on-site tertiary sewer treatment facility to satisfy Municipal Standards.

R-6 without a community treatment facility would be satisfactory if the actual platting of the 70 acres were for lot sizes of an average size closer to 2½ acres than to 1½. However, conventional on-site sewage disposal is what should be expected, and R-9 (2½ acres) is more appropriate because there would be more area on a given lot for alternative septic tank locations. Accordingly, R-9 is the more realistic zoning for public health and safety.

The southwest portion of the tract includes a silty area roughly 2,400 feet by 600 feet. This 33-acre strip could be safe at 2½-acre sizes (or 1½ with a sewer plant), but is thought by Public Works and Environmental Protection engineers to be better guided by the existing R-8 (5 acre) zoning because silt is not a good soil for on-site sewer disposal systems.

U.S. Geological Survey Maps showing the petition site and locale were debated by witnesses at the last Assembly discussion. Administrative staff have met with the USGS Officers. They advise that the summary description of the site characterizing it as predominantly "low" pollution susceptibility from septic tank systems is incorrect as reported to the Assembly on July 27th. The description has been corrected to "very low" susceptibility to septic tank pollution. The "summary description" is a factoring of water level, soils, and slope.

Attachment 2

Memo AM 430-76C
Page 2
August 24, 1976

<u>OTHER PLANNING CONSIDERATIONS:</u>

Other factors affecting the suitability of this rezoning are need, effect on other properties and housing stock, amount of similarly-zoned land, and relationship to the Comprehensive Plan.

The density at R-6 or R-9 would be in accord with the Comprehensive Plan, which designates the Hillside at the standard of "less than one dwelling per acre". There is other R-6 zoning in the general area yet to be fully-developed, but it is neither harmed by the rezoning nor should it be considered precedent for any further R-6. There is no adjacent R-9 zoning. This area has, according to USGS, data charactistics similar to other R-6 properties on the Hillside and is graded as having low pollution danger. The rezoning would be a precedent bringing a larger population with possible demands for utilities and road services, costs for which would be shared by property owners along DeArmoun Road, not simply those within the petition site. Rezoning to R-6 or R-9 would not address the public need for more affordable housing.

The original recommendation to approve R-6 provided the findings mentioned above, but was based primarily on the USGS ecological rating. Further, there was the finding that this site has the same USGS rating as other R-6 lands and that all other land zoned R-9 and R-8 have high pollution ratings. Those USGS ratings became available after the Hillside was zoned.

However, after further analysis by Environmental Protection and the hypothetical subdivision design by Public Works, it is recommended that R-6 not be approved. Except for the southwest area (2,400 feet from west to east and 600 feet south to north) which should be continued as R-8, the more appropriate zoning is R-9.

Recommended by:

Daniel L. Wilkerson
Acting Director of Planning

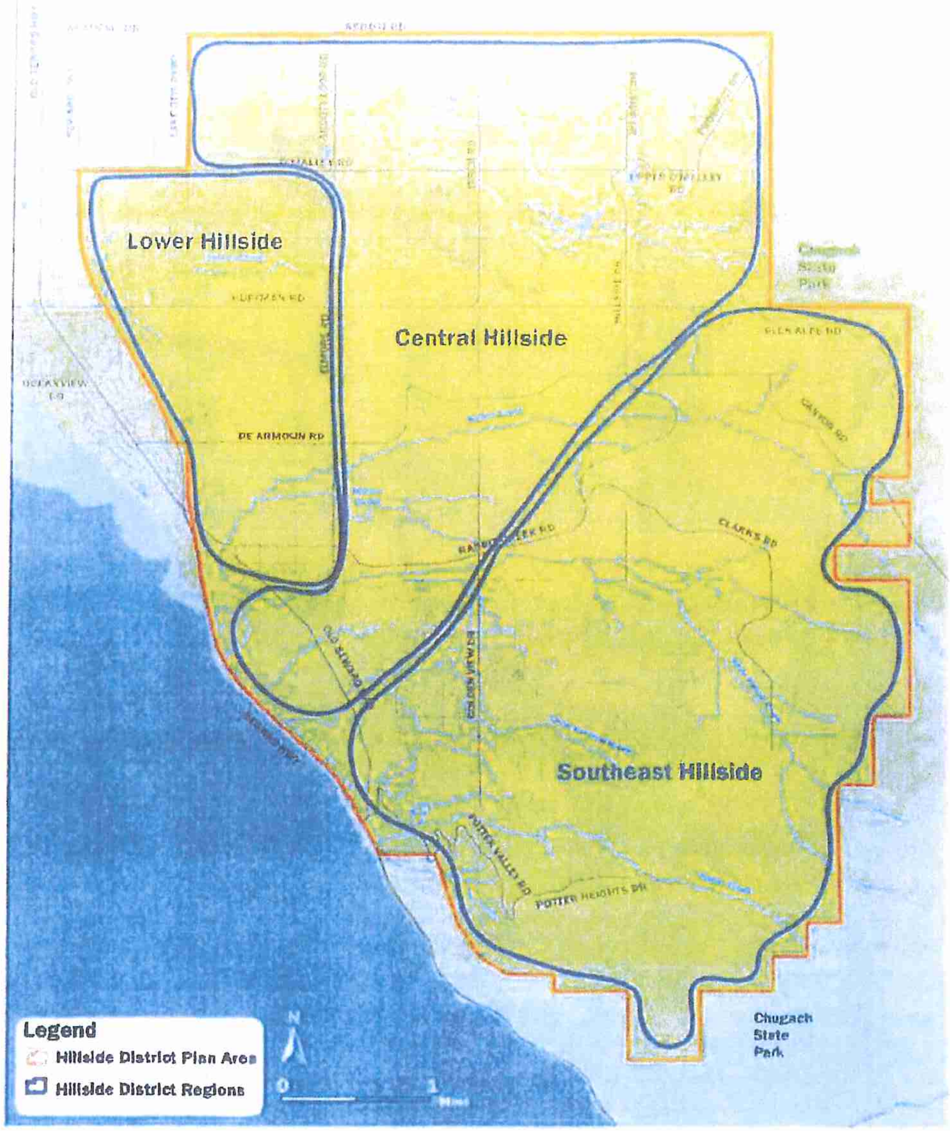
Respectfully submitted:

D. G. Weiford
for George M. Sullivan
Mayor

Attachment 2

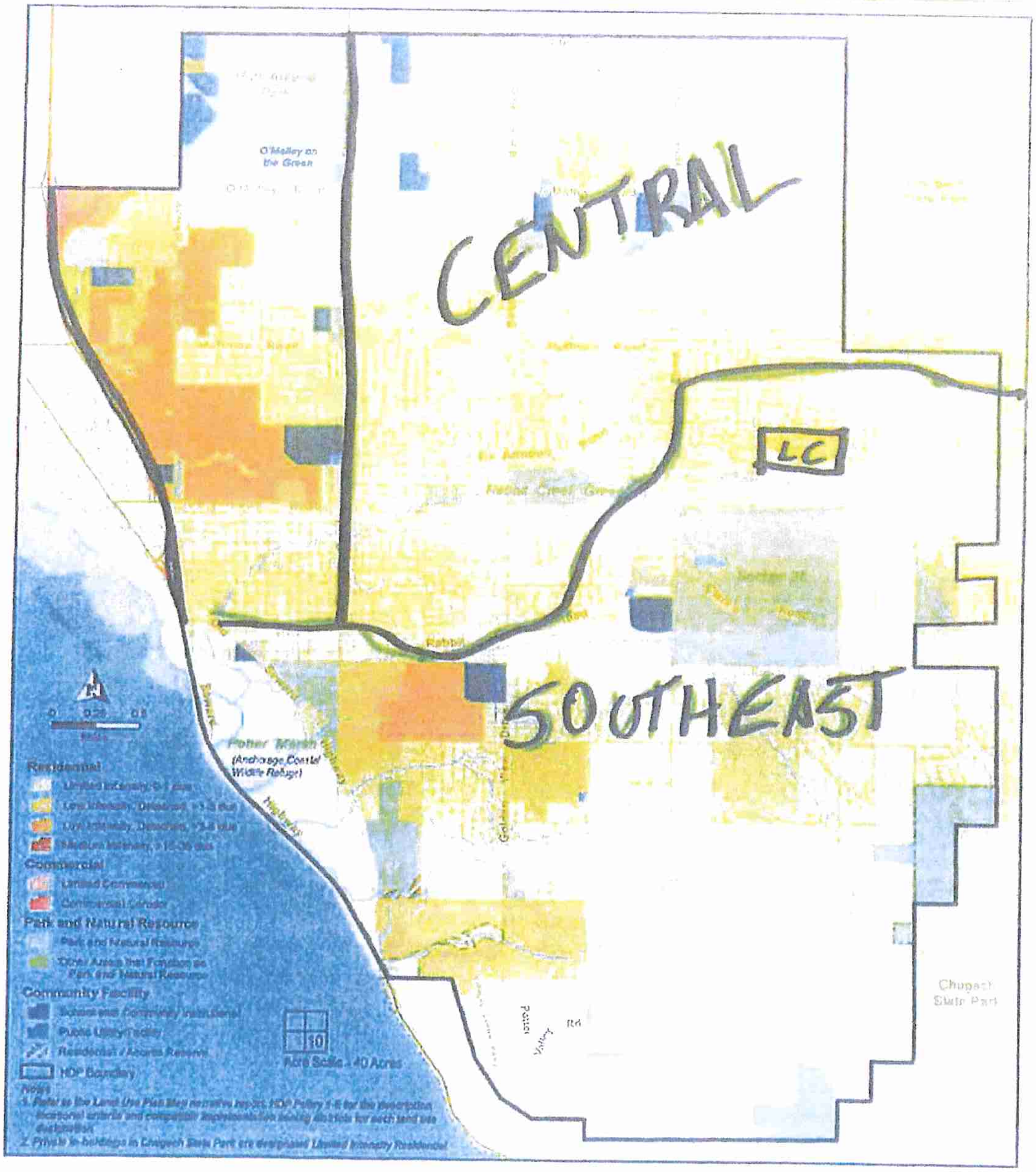
Attachment 2

Map 2.1
Hillside District Regions



The qualities Hillside residents value include open space, vegetation, quiet, dark night skies, access to trails, the presence of wildlife, privacy and other qualities associated with living in a less urban environment. While sharing these characteristics, different portions of the Hillside also have some important differences.

Map 2.1
Hillside Land Use Plan



Attachment 4

Heidi A. Wyckoff

From:	Schoenthal, Terry N. [SchoenthalTN@ci.anchorage.ak.us]
Sent:	Wednesday, January 18, 2017 11:54 AM
To:	Becky Lipson
Cc:	Wong, Carol C.; Hart, Hal H; Whitfield, David R.; Tom Dreyer (tom@s4ak.com)
Subject:	RE: Lewis & Clark: HDP Policy 1-B/1-C

Hello Becky,

Members of the Long-Range Planning Division and the Current Planning Division have reviewed the materials you supplied regarding the Lewis and Clark Subdivision and we recently met to discuss the issues you raised in your December 30 letter. In short, we concur with your premise that the owners of the property have a right to request a rezone and that if the unique characteristics of the property support such a rezone and if the rezone is consistent with the approval criteria identified in Section 21.03.160 E. of AMC Title 21, it would be supported by the Planning Department.

As you note in your letter, this property is zoned R-8 (Rural Residential – Large Lot). Title 21 further describes the R-8 zone as follows:

> The R-8 district is intended primarily for single and two-family large-lot residential areas with gross densities less than one dwelling unit per four acres, where topographic or other natural conditions are such that higher-density development would be unfeasible. In addition to topography, some of the natural conditions which could exist to render land desirable for the densities proposed in this zone are wind hazards, marginal soils, landslide susceptibility, potential for groundwater pollution, and groundwater availability.

In essence, the lower density assigned to this district is based on environmental concerns. Zoning districts in Anchorage are typically, (but not always) based on generalized data and mapping information. The Municipality cannot afford to obtain complete detailed analysis for all properties within our boundaries. In the event that detailed analysis suggests that a parcel or tract categorized as environmentally sensitive is, in fact, not so sensitive, then a suitable zoning category might be one that is more consistent with surrounding zoning and that better fits other goals identified in the Comprehensive Plan. Every parcel or tract of land in Anchorage is unique and should be judged of its own qualities as to whether proposed uses are either detrimental or supportive of community goals.

Policy 1-C of the Hillside District Plan, "Maintain the same land-use designations and zoning in this area as were established prior to the beginning of this plan" would appear to remove any consideration for any rezone in the Hillside District. It is our belief that this policy, strictly observed, is overly restrictive and should not be an acceptable policy for any neighborhood in Anchorage, because it denies any potential for change.

All of this said, the Municipal Planning Department is not prepared, at this point to support the proposed rezone. Our support will be dependent on the applicant demonstrating that the assumed environmental constraints of the property are either not present or can be adequately mitigated to avoid impacts on surrounding property. Further it will be the responsibility of the petitioner to clearly articulate how the rezone addresses the approval criteria identified in Title 21.

In short, the Municipal Planning Department will give a proposed rezone of the Lewis and Clark subdivision a fair hearing, based on the specific merits of the argument. We cannot, at this point, support a rezone, because the case for that rezone has yet to be made.

I hope this adequately explains our position and I would encourage you to contact me if you have any questions.

Sincerely,

SECTION B

KINNEY

January 20, 2017

Todd Brownson
Big Country Enterprises, LLC
4700 E 147th Avenue
Anchorage, Alaska 99516

Subject: Lewis and Clark Subdivision Rezone Traffic Letter

Dear Todd:

The Lewis & Clark Subdivision is proposed on an 80-acre parcel in Anchorage, south of Upper DeArmoun Road and east of Canyon Road. We understand you have requested a rezone from R-8 to R-6 zoning. The rezone would increase the number of residential lots on the site from a maximum of 20 to the proposed 30 lots shown on your preliminary plat.

The proposed lots (the preliminary plat from S4 is attached) access the road system by two proposed cul de sacs extending south from Upper DeArmoun. Three of the parcels also abut Canyon Road. Canyon Road and Upper DeArmoun are both classified as neighborhood collectors in the 2014 Official Streets and Highways Plan (OSHP). Neighborhood collectors are designated to carry 2,000 to 10,000 vehicles per day. Upper DeArmoun is paved with one 11-foot lane in each direction and is posted at 40 miles per hour. Canyon Road is a two-lane gravel road. Canyon Road, east of the subject parcel, is scheduled to be upgraded in 2017. Alaska Department of Transportation and Public Facilities (DOT&PF) reports the annual average daily traffic (AADT) on Upper DeArmoun as 789 vehicles per day in 2014. Similar data is not available for Canyon Road, however since Canyon Road only connects to DeArmoun, the AADT will likely be less than 789.

Traffic to and from the site is expected to use DeArmoun Road, since that is the most efficient way to get to the commercial areas of Anchorage, and to area schools.

According to the Institute of Transportation Engineers' *Trip Generation Manual* (9th Edition), single family homes typically generate 9.52 trips per day. The old Anchorage Municipal Code Title 21 recommended a trip generation rate of 8.2 trips per day, indicating a lower trip generation rate for the Anchorage area than the national *Trip Generation Manual* suggests. Increasing the housing density in the project parcel from 20 to 30 would increase expected traffic generation from 190 trips per day to 286, based 9.52 trips per day. Adding 286 trips to the existing traffic on Upper DeArmoun results in an AADT of 1,075, well below the appropriate volumes for a neighborhood collector.

There are approximately 440 undeveloped acres that will access Canyon Road in the event they are developed. Land in the area is zoned R-8, R-9, or R-10. Terrain and topography will limit the development potential of much of this land. However, assuming it all develops at a conservative density of 2 acres per unit, the area could potentially generate 2,100 additional trips. Added to the existing traffic and new traffic generated by the Lewis & Clark Subdivision, total traffic on DeArmoun would be 3,175, well within the appropriate volume of traffic to be carried by a neighborhood collector.

A concern raised by neighbors has been the poor condition of the pavement on DeArmoun Road. That is not possible to field-assess given the current snow conditions and lack of as-built information. Alaska DOT&PF does not have condition data for Upper DeArmoun Road east of Hillside Drive, but does have data on DeArmoun Road to the west, Hillside Drive, Clarks Road, and Upper Huffman. The data reveal low rutting but high roughness. This combination of observations is indicative of pavements that are old or suffering from seasonal movement and cracking, but not necessarily overloaded. Furthermore, Clarks Road, upper Huffman Road, and DeArmoun Road all feature similar cross sections as Upper DeArmoun Road, and carry more traffic than is projected for Upper DeArmoun Road. This all leads to the conclusion that, while Upper DeArmoun is in poor condition, the condition is not a result of the traffic loads on the road and would not be significantly impacted by the additional 96 residential trips per day caused by rezoning this parcel.

Sincerely,
Kinney Engineering, LLC

Will Will

Will Webb, P.E., PTOE
Senior Civil Engineer

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SECTION C

NORTHRIM
ENGINEERING

GEOTECHNICAL SOILS REPORT

FOR

LEWIS & CLARK SUBDIVISION

FOR S4 GROUP

ANCHORAGE, ALASKA

Submitted by:

NorthRim Engineering
P.O. Box 770724
Eagle River, AK 99577-0724
(907) 694-7028

Steve Eng, PE, PH
SteveEng.com

February, 2017

CIVIL ENVIRONMENTAL HYDROLOGY

NORTHRIM ENGINEERING

Lewis & Clark Subdivision, February 2017

SOILS SUMMARY

Lewis & Clark Subdivision is planned for the Upper De Armoun area. The proposed subdivision is surrounded by developed subdivisions. These surrounding subdivisions utilize on-site water wells and septic systems. Lewis and Clark Subdivision will also utilize on-site systems.

A large number of test holes have been completed the past several years within the proposed subdivision. Test holes were completed in the fall of 2016. Recent test hole logs are included in this soils report, as well as previous test holes. A location map for these test holes is included at the end of the report.

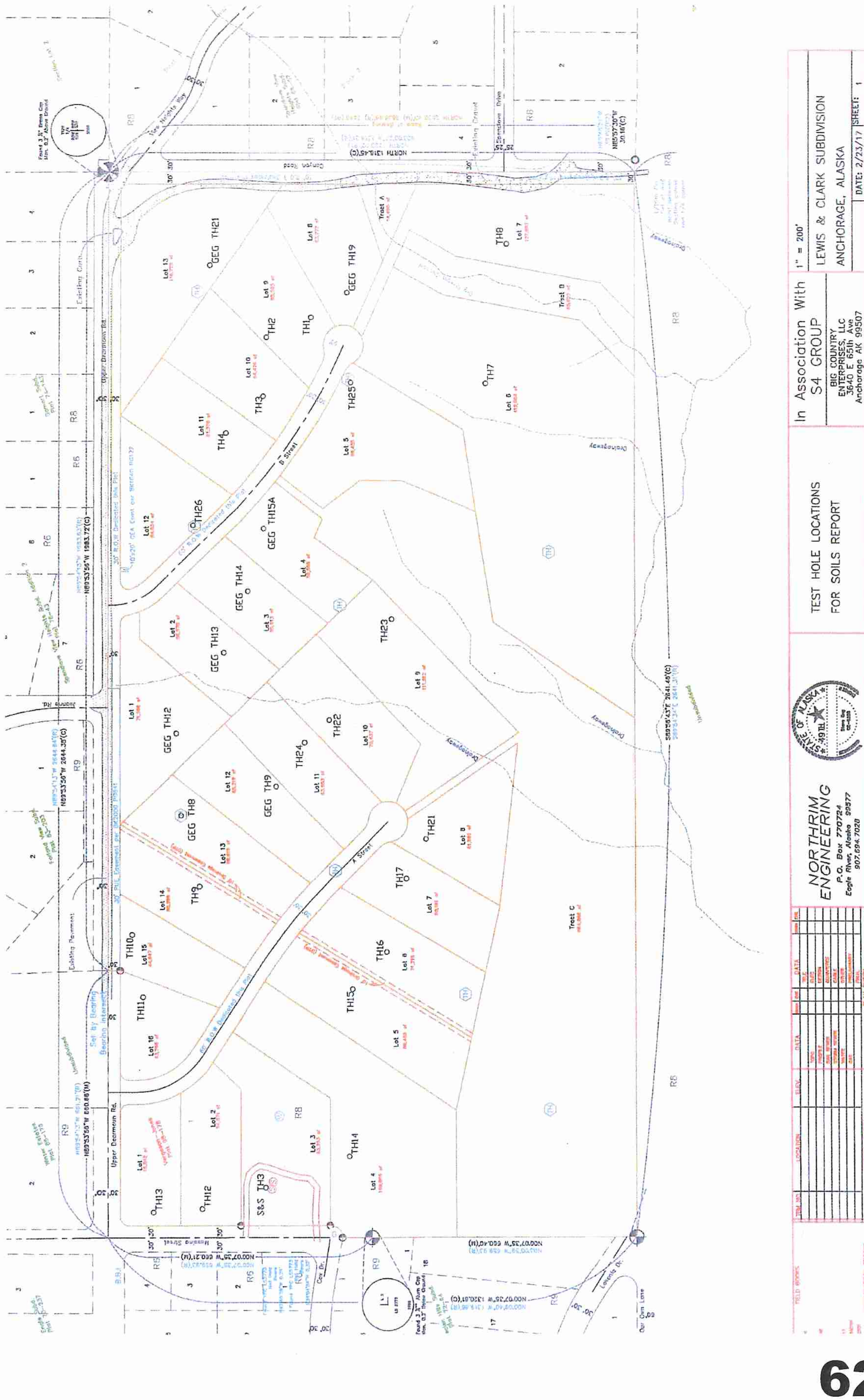
The soils in Lewis & Clark Subdivision have generally been found to be consistent with the soils in the surrounding subdivisions. The soils were placed as glacial till, and are predominately sand, silty sand, silts, and gravel. Bedrock was not encountered in the test holes. Groundwater is not an issue; all the test holes have adequate separation to groundwater. Most test holes exhibited no groundwater.

Drainages have been mapped for the subdivision. Drainages consist of small rills and seeps, associated with riparian vegetation. Several test holes required relocation after interference from these surface seeps.

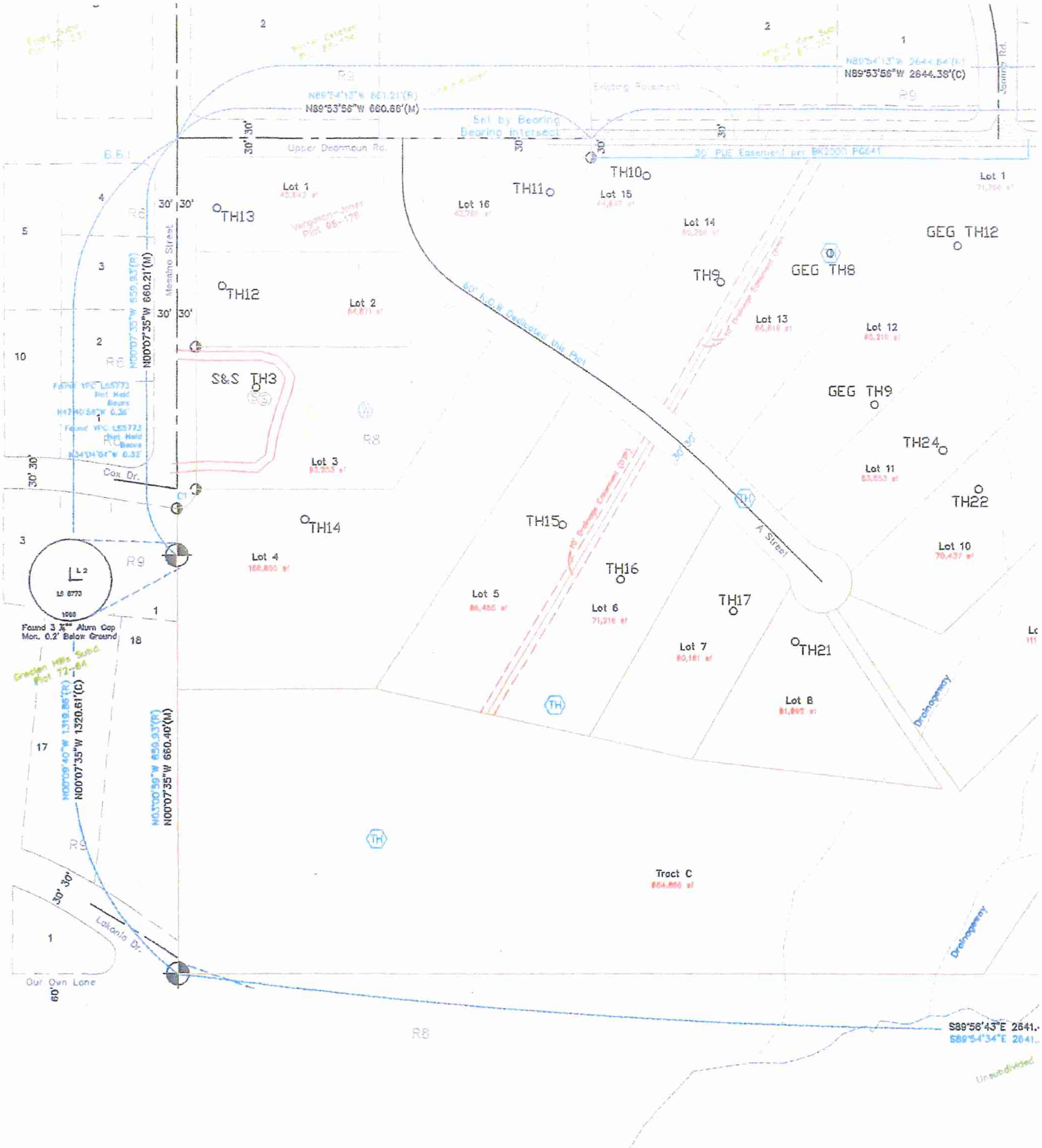
The soils logs in this report have been found to be consistent with MOA requirements for on-site systems. We are prepared to complete additional drawings demonstrating that each lot has the prescribed area for on-site systems.

STATE OF ALASKA
Steven W. Eng
PE 6256
2/23/17
REGISTERED PROFESSIONAL

AMERICAN INSTITUTE OF HYDROLOGY
Certificate Number
1017
2/23/17
STEVEN W. ENG
Professional Hydrologist



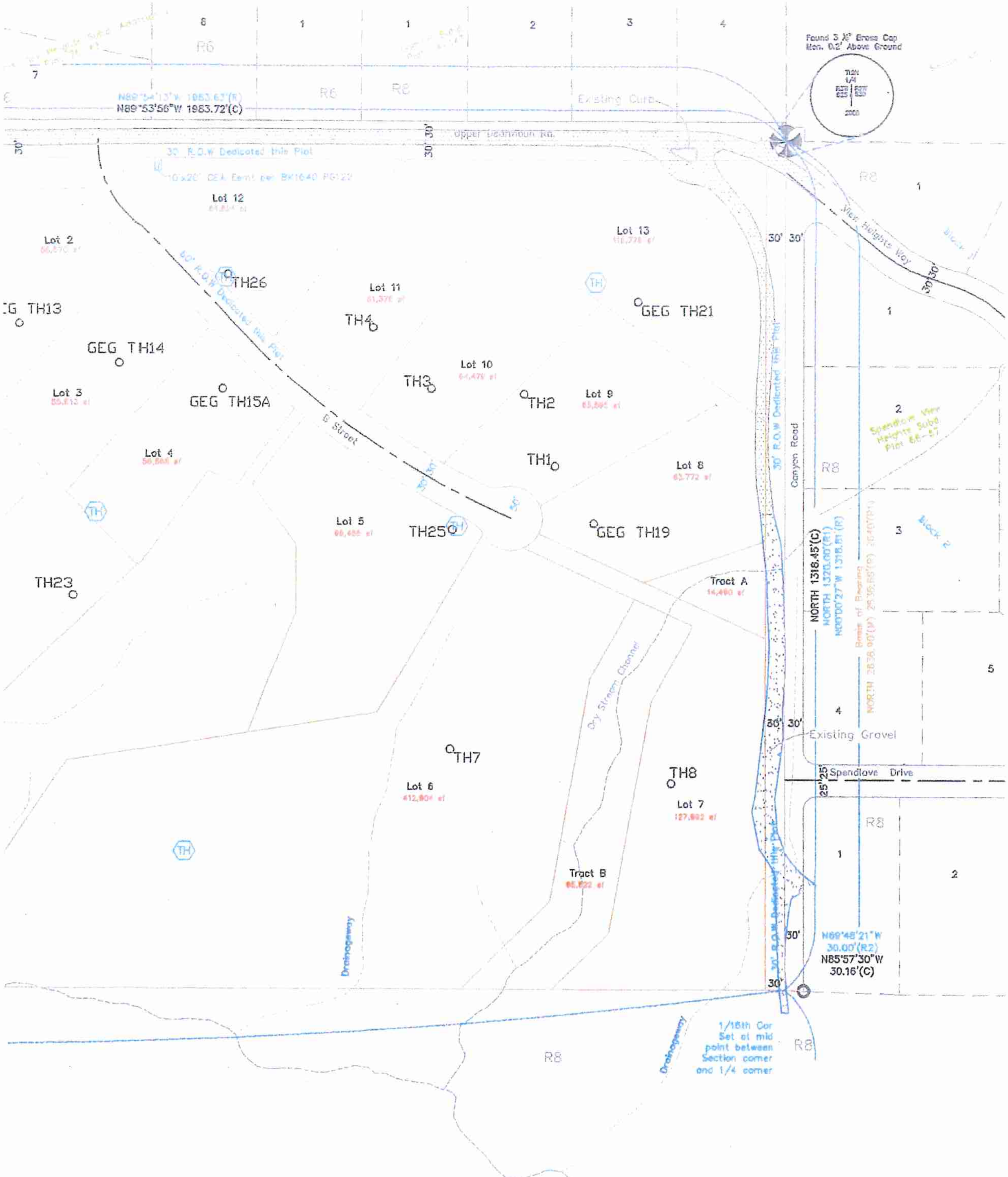
In Association With
S4 GROUP
BIG COUNTRY
ENTERPRISES, LLC
3640 E 65th Ave
Anchorage AK 99507
TEST HOLE LOCATIONS
FOR SOILS REPORT
1" = 200'
LEWIS & CLARK SUBDIVISION
ANCHORAGE, ALASKA
DATE: 2/23/17
SHEET: 1
NORTHRIM
ENGINEERING
P.O. Box 770724
Eagle River, Alaska 99577
907.694.7020
Upper Dearmoun Rd.
Canyon Road
B Street
A Street
Tract C



FIELD BOOKS | CONSTRUCTION RECORD | LOCATION | ELEV | DATA | VERTICAL DATUM | PLAN CHECK

NORTHRIM ENGINEERING
P.O. Box 770724
Eagle River, Alaska 99577
907.694.7028

STATE OF ALASKA 49TH



TEST HOLE LOCATIONS
FOR SOILS REPORT

In Association With
S4 GROUP

BIG COUNTRY
ENTERPRISES, LLC
3640 E 65th Ave
Anchorage AK 99507

1" = 200'

LEWIS & CLARK SUBDIVISION
ANCHORAGE, ALASKA

DATE: 2/23/17 SHEET: 1

SOILS LOG - PERCOLATION TEST

NORTHRIM ENGINEERING

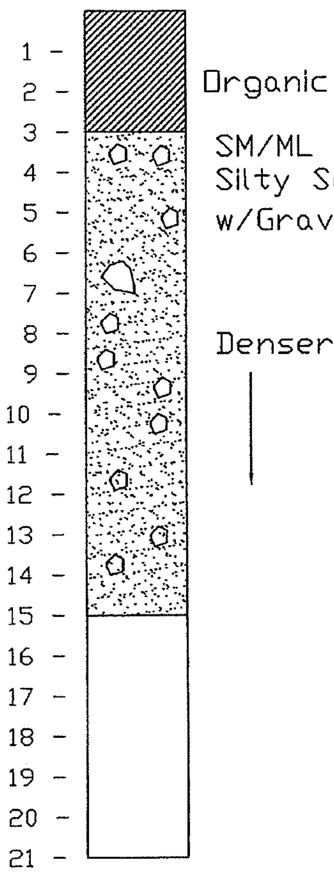
Date Performed: 9/14/16

Performed For: Todd Brownson

Legal Description: Lewis & Clark S/D, Lot 9- North Side

DEPTH (FEET)

T.H. Location: See Location Map



Groundwater? No
Depth --
Water Depth
After Monitoring. None Date: 10/14/16

#	Date	Gross Time	Net Time	Depth	Net Drop
1	9/14	0	--	2″	--
2	9/14	30	30 min.	4.5″	2.5″
3	9/14	32	--	2″	--
4	9/14	62	30 min.	4.5″	2.5″
5	9/14	65	--	2″	--
6	9/14	95	30 min.	4.5″	2.5″

Percolation Rate 12 min./inch Perc Hole Diameter 6″
Test Run Between 4′ and 5′

Comments: Presoaked.

Performed By NorthRim Eng. I ______ CERTIFY THAT THIS TEST WAS Performed in Accordance with All State/Municipal Guidelines in Effect ON THIS DATE. DATE: 10/22/16

NORTHRIM ENGINEERING
PO Box 770724
Eagle River, Alaska 99577
907.694.7028

STATE OF ALASKA 49TH Steve Eng CE-6266 REGISTERED PROFESSIONAL ENGINEER 10/22/16

TESTHOLE LOG
GEOTECHNICAL

LEWIS & CLARK S/D
LOT 9 - NORTH

TH1

Date: 10/22/10 | SHEET: 1 of 26

SOILS LOG - PERCOLATION TEST

NORTHRIM ENGINEERING

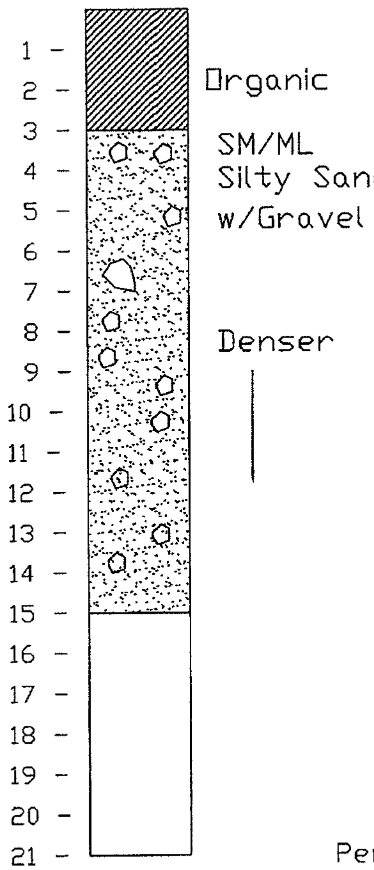
Date Performed: 9/14/16

Performed For: Todd Brownson

Legal Description: Lewis & Clark S/D, Lot 9- North Side

DEPTH (FEET)

T.H. Location: See Location Map



Groundwater? No
Depth --
Water Depth
After Monitoring. None Date: 10/14/16

#	Date	Gross Time	Net Time	Depth	Net Drop
1	9/14	0	--	2"	--
2	9/14	30	30 min.	5"	3"
3	9/14	32	--	2"	--
4	9/14	62	30 min.	5"	3"
5	9/14	65	--	2"	--
6	9/14	95	30 min.	5"	3"

Percolation Rate 10 min./inch Perc Hole Diameter 6"
Test Run Between 4' and 5'

Comments: Presoaked.

Performed By NorthRim Eng. I SE CERTIFY THAT THIS TEST WAS Performed in Accordance with All State/Municipal Guidelines in Effect ON THIS DATE. DATE: 10/22/16

NORTHRIM ENGINEERING
PO Box 770724
Eagle River, Alaska 99577
907.694.7028

STATE OF ALASKA 49TH Steve Eng CE-8256 REGISTERED ENGINEER 10/22/16

TESTHOLE LOG
GEOTECHNICAL

TH2

LEWIS & CLARK S/D
LOT 9 - NORTH

Date: 10/22/10 SHEET: 2 of 26

SOILS LOG - PERCOLATION TEST

NORTHRIM ENGINEERING

Date Performed: 9/14/16

Performed For: Todd Brownson

Legal Description: Lewis & Clark S/D, Lot 10- North Side

DEPTH (FEET)

T.H. Location: See Location Map

1 -
2 -
3 -
4 -
5 -
6 -
7 -
8 -
9 -
10 -
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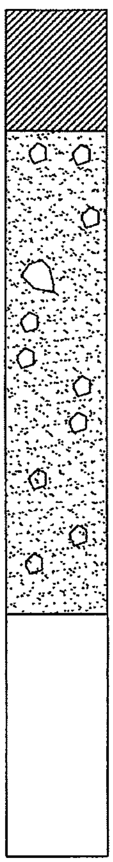
21 -



Organic

SM/ML
Silty Sand & Silt
w/Gravel

Denser

Groundwater? No
Depth --
Water Depth
After Monitoring. None Date: 10/14/16

#	Date	Gross Time	Net Time	Depth	Net Drop
1	10/14	0	--	3″	--
2	10/14	30	30 min.	4.5″	1.5″
3	10/14	32	--	3″	--
4	10/14	62	30 min.	4.5″	1.5″
5	10/14	65	--	3″	--
6	10/14	95	30 min.	4.5″	1.5″

Percolation Rate 20 min./inch Perc Hole Diameter 6″
Test Run Between 4′ and 5′

Comments: Presoaked.

Performed By NorthRim Eng. I [signature] CERTIFY THAT THIS TEST WAS Performed in Accordance with All State/Municipal Guidelines in Effect ON THIS DATE. DATE: 10/22/16

NORTHRIM ENGINEERING
PO Box 770724
Eagle River, Alaska 99577
907.694.7028

STATE OF ALASKA 49TH Steve Eng CE-6256 REGISTERED ENGINEER 10/22/16

TESTHOLE LOG GEOTECHNICAL	TH3
LEWIS & CLARK S/D LOT 10 - NORTH	Date: 10/22/10 SHEET: 3 of 26

SOILS LOG - PERCOLATION TEST

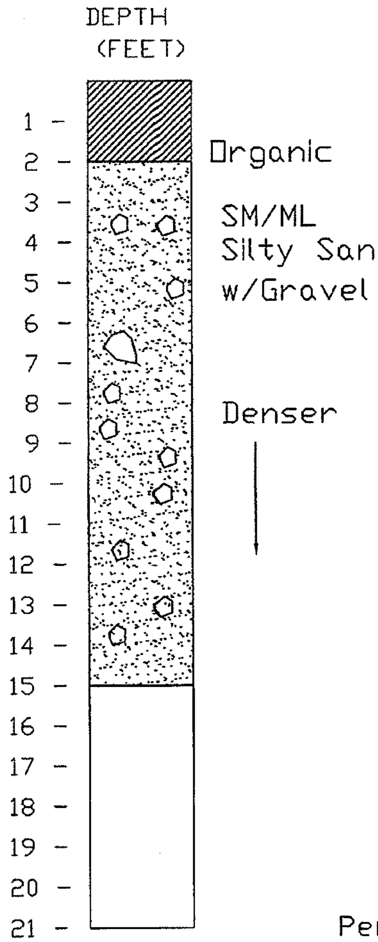
NORTHRIM ENGINEERING

Date Performed: 9/14/16

Performed For: Todd Brownson

Legal Description: Lewis & Clark S/D, Lot 11- North Side

T.H. Location: See Location Map



Groundwater? No
Depth --
Water Depth
After Monitoring None Date: 10/14/16

#	Date	Gross Time	Net Time	Depth	Net Drop
1	9/14	0	--	2.5"	--
2	9/14	30	30 min.	4.5"	2"
3	9/14	32	--	2.5"	--
4	9/14	62	30 min.	4.5"	2"
5	9/14	65	--	2.5"	--
6	9/14	95	30 min.	4.5"	2"

Percolation Rate 15 min./inch Perc Hole Diameter 6"
Test Run Between 4' and 5'

Comments: Presoaked.

Performed By NorthRim Eng. I SE CERTIFY THAT THIS TEST WAS Performed in Accordance with All State/Municipal Guidelines in Effect ON THIS DATE. DATE: 10/22/16

NORTHRIM ENGINEERING
PO Box 770724
Eagle River, Alaska 99577
907.694.7028

STATE OF ALASKA 49TH Steve Eng CE-6258 10/22/16 REGISTERED ENGINEER

TESTHOLE LOG GEOTECHNICAL	TH4
LEWIS & CLARK S/D LOT 11 - NORTH	Date: 10/22/10 SHEET: 4 of 26

NORTHRIM ENGINEERING

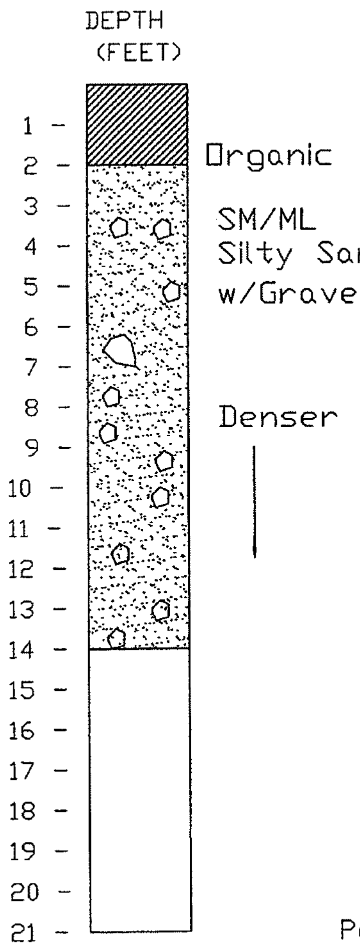
SOILS LOG - PERCOLATION TEST

Date Performed: 9/16/16

Performed For: Todd Brownson

Legal Description: Lewis & Clark S/D, Lot 6- North Side

T.H. Location: See Location Map



Groundwater? No
Depth --
Water Depth
After Monitoring. None Date: 10/14/16

#	Date	Gross Time	Net Time	Depth	Net Drop
1	9/16	0	--	2.5″	--
2	9/16	30	30 min.	8.5″	6″
3	9/16	32	--	2.5″	--
4	9/16	62	30 min.	8.5″	6″
5	9/16	65	--	2.5″	--
6	9/16	95	30 min.	8.5″	6″

Percolation Rate 5 min./inch Perc Hole Diameter 6″
Test Run Between 4′ and 5′

Comments: Presoaked.

Performed By NorthRim Eng. I [signature] CERTIFY THAT THIS TEST WAS Performed in Accordance with All State/Municipal Guidelines in Effect ON THIS DATE. DATE: 10/22/16

NORTHRIM ENGINEERING PO Box 770724 Eagle River, Alaska 99577 907.694.7028	STATE OF ALASKA 49TH Steve Eng CE-8358 REGISTERED PROFESSIONAL ENGINEER 10/22/16	TESTHOLE LOG GEOTECHNICAL LEWIS & CLARK S/D LOT 6 - NORTH	TH7 Date: 10/22/10 SHEET: 7 of 26

NORTHRIM ENGINEERING

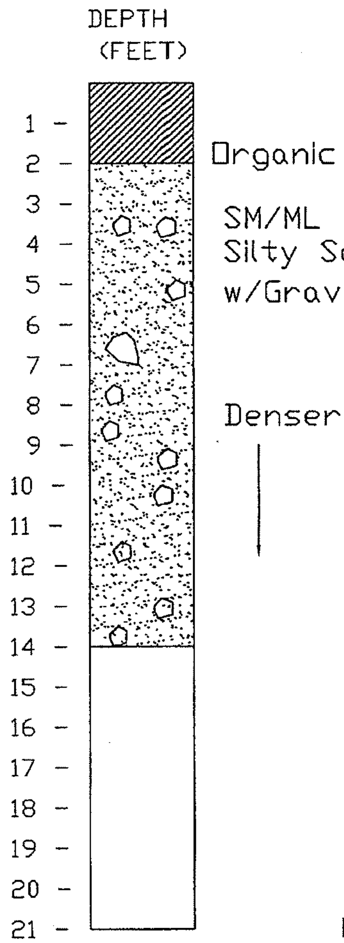
SOILS LOG - PERCOLATION TEST

Date Performed: 9/16/16

Performed For: Todd Brownson

Legal Description: Lewis & Clark S/D, Lot 7- North Side

T.H. Location: See Location Map



Groundwater? No
Depth --
Water Depth
After Monitoring: None Date: 10/14/16

#	Date	Gross Time	Net Time	Depth	Net Drop
1	9/16	0	--	2.5″	--
2	9/16	30	30 min.	6.5″	4″
3	9/16	32	--	2.5″	--
4	9/16	62	30 min.	6.5″	4″
5	9/16	65	--	2.5″	--
6	9/16	95	30 min.	6.5″	4″

Percolation Rate 7.5 min./inch Perc Hole Diameter 6″
Test Run Between 4′ and 5′

Comments: Presoaked.

Performed By NorthRim Eng. I [signature] CERTIFY THAT THIS TEST WAS Performed in Accordance with All State/Municipal Guidelines in Effect ON THIS DATE. DATE: 10/22/16

NORTHRIM ENGINEERING PO Box 770724 Eagle River, Alaska 99577 907.694.7028 STATE OF ALASKA 49TH Steve Eng CE-8255 REGISTERED 10/22/16	TESTHOLE LOG GEOTECHNICAL LEWIS & CLARK S/D LOT 7 - NORTH	TH8 Date: 10/22/10 SHEET: 8 of 26

SOILS LOG - PERCOLATION TEST

NORTHRIM ENGINEERING

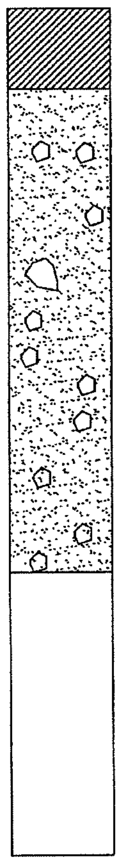
Date Performed: 9/16/16

Performed For: Todd Brownson

Legal Description: Lewis & Clark S/D, Lot 14

T.H. Location: See Location Map

DEPTH (FEET)



Groundwater? No
Depth --
Water Depth
After Monitoring. None Date: 10/14/16

#	Date	Gross Time	Net Time	Depth	Net Drop
1	9/16	0	--	3″	--
2	9/16	30	30 min.	6.5″	3.5″
3	9/16	32	--	3″	--
4	9/16	62	30 min.	6.5″	3.5″
5	9/16	65	--	3″	--
6	9/16	95	30 min.	6.5″	3.5″

Percolation Rate 8.6 min./inch Perc Hole Diameter 6″
Test Run Between 3′ and 4′

Comments: Presoaked.

Performed By NorthRim Eng. I ______ CERTIFY THAT THIS TEST WAS Performed in Accordance with All State/Municipal Guidelines in Effect ON THIS DATE. DATE: 10/22/16

NORTHRIM ENGINEERING
PO Box 770724
Eagle River, Alaska 99577
907.694.7028

STATE OF ALASKA 49TH Steve Eng CE-8256 REGISTERED PROFESSIONAL ENGINEER 10/22/16

TESTHOLE LOG GEOTECHNICAL	TH9
LEWIS & CLARK S/D LOT 14	Date: 10/22/10 SHEET: 9 of 26

SOILS LOG - PERCOLATION TEST

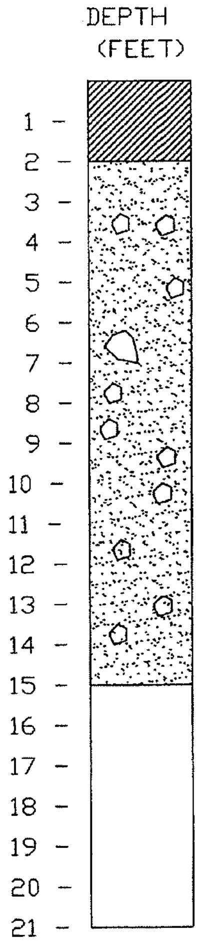
NORTHRIM ENGINEERING

Date Performed: 9/16/16

Performed For: Todd Brownson

Legal Description: Lewis & Clark S/D, Lot 15

T.H. Location: See Location Map



Organic

SM/ML
Silty Sand & Silt
w/Gravel

Denser

Groundwater? No
Depth --
Water Depth
After Monitoring. None Date: 10/14/16

#	Date	Gross Time	Net Time	Depth	Net Drop
1	9/16	0	--	2″	--
2	9/16	30	30 min.	4.5″	2.5″
3	9/16	32	--	2″	--
4	9/16	62	30 min.	4.5″	2.5″
5	9/16	65	--	2″	--
6	9/16	95	30 min.	4.5″	2.5″

Percolation Rate 12 min./inch Perc Hole Diameter 6″
Test Run Between 4′ and 5′

Comments: Presoaked.

Performed By NorthRim Eng. I ________ CERTIFY THAT THIS TEST WAS Performed in Accordance with All State/Municipal Guidelines in Effect ON THIS DATE. DATE: 10/22/16

NORTHRIM ENGINEERING
PO Box 770724
Eagle River, Alaska 99577
907.694.7028

STATE OF ALASKA 49TH Steve Eng CE-6256 10/22/16

TESTHOLE LOG GEOTECHNICAL	TH10
LEWIS & CLARK S/D LOT 15	Date: 10/22/10 SHEET: 10 of 26

NORTHRIM ENGINEERING

SOILS LOG - PERCOLATION TEST

Date Performed: 9/16/16

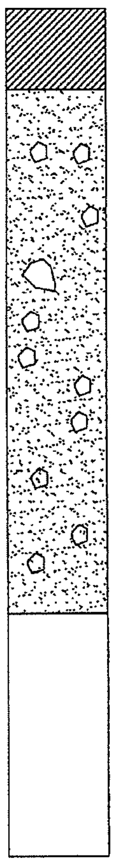
Performed For: Todd Brownson

Legal Description: Lewis & Clark S/D, Lot 16

T.H. Location: See Location Map

DEPTH (FEET)

1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10 - 11 - 12 - 13 - 14 - 15 - 16 - 17 - 18 - 19 - 20 - 21 -



Organic

SM/ML
Silty Sand & Silt
w/Gravel

Denser

Groundwater? No
Depth --
Water Depth
After Monitoring None Date: 10/14/16

#	Date	Gross Time	Net Time	Depth	Net Drop
1	9/16	0	--	2"	--
2	9/16	30	30 min.	5"	3"
3	9/16	32	--	2"	--
4	9/16	62	30 min.	5"	3"
5	9/16	65	--	2"	--
6	9/16	95	30 min.	5"	3"

Percolation Rate 10 min./inch Perc Hole Diameter 6"
Test Run Between 4' and 5'

Comments: Presoaked.

Performed By NorthRim Eng. I [signature] CERTIFY THAT THIS TEST WAS Performed in Accordance with All State/Municipal Guidelines in Effect ON THIS DATE. DATE: 10/22/16

NORTHRIM ENGINEERING PO Box 770724 Eagle River, Alaska 99577 907.694.7028	STATE OF ALASKA 49TH Steve Eng CE-6256 REGISTERED ENGINEER 10/22/16	TESTHOLE LOG GEOTECHNICAL	TH11
		LEWIS & CLARK S/D LOT 16	Date: 10/22/10 SHEET: 11 of 26

NORTHRIM ENGINEERING

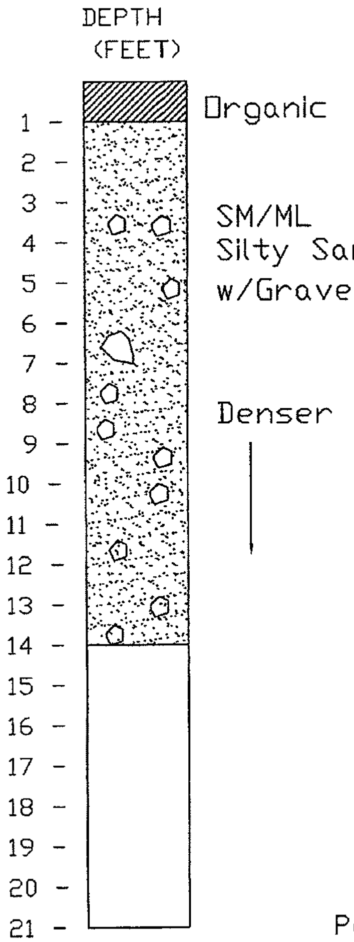
SOILS LOG - PERCOLATION TEST

Date Performed: 9/17/16

Performed For: Todd Brownson

Legal Description: Lewis & Clark S/D, Lot 2- West Side

T.H. Location: See Location Map



Groundwater? No
Depth --
Water Depth
After Monitoring. None Date: 10/14/16

#	Date	Gross Time	Net Time	Depth	Net Drop
1	9/17	0	--	2.5"	--
2	9/17	30	30 min.	5"	2.5"
3	9/17	32	--	2.5"	--
4	9/17	62	30 min.	5"	2.5"
5	9/17	65	--	2.5"	--
6	9/17	95	30 min.	5"	2.5"

Percolation Rate 12 min./inch Perc Hole Diameter 6"
Test Run Between 3' and 4'

Comments: Presoaked.

Performed By NorthRim Eng. I ______ CERTIFY THAT THIS TEST WAS Performed in Accordance with All State/Municipal Guidelines in Effect ON THIS DATE. DATE: 10/22/16

NORTHRIM ENGINEERING
PO Box 770724
Eagle River, Alaska 99577
907.694.7028

STATE OF ALASKA 49TH Steve Eng CE-8255 REGISTERED ENGINEER 10/22/16

TESTHOLE LOG
GEOTECHNICAL

LEWIS & CLARK S/D
LOT 2 - WEST

TH12

Date: 10/22/10

SHEET: 12 of 26

SOILS LOG - PERCOLATION TEST

NORTHRIM ENGINEERING

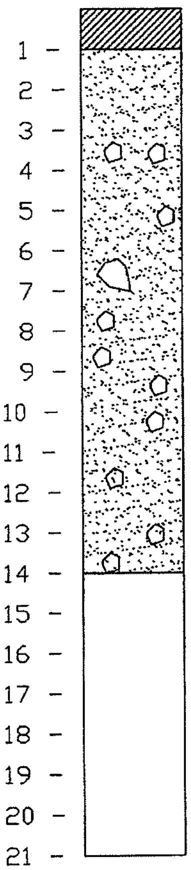
Date Performed: 9/17/16

Performed For: Todd Brownson

Legal Description: Lewis & Clark S/D, Lot 1- West Side

DEPTH (FEET)

T.H. Location: See Location Map



Organic

SM/ML
Silty Sand & Silt
w/Gravel

Denser

Groundwater? No
Depth --
Water Depth
After Monitoring None Date: 10/14/16

#	Date	Gross Time	Net Time	Depth	Net Drop
1	9/17	0	--	2.5″	--
2	9/17	30	30 min.	5″	2.5″
3	9/17	32	--	2.5″	--
4	9/17	62	30 min.	5″	2.5″
5	9/17	65	--	2.5″	--
6	9/17	95	30 min.	5″	2.5″

Percolation Rate 12 min./inch Perc Hole Diameter 6″
Test Run Between 3′ and 4′

Comments: Presoaked.

Performed By NorthRim Eng. I [signature] CERTIFY THAT THIS TEST WAS Performed in Accordance with All State/Municipal Guidelines in Effect ON THIS DATE. DATE: 10/22/16

NORTHRIM ENGINEERING
PO Box 770724
Eagle River, Alaska 99577
907.694.7028

STATE OF ALASKA 49TH Steve Eng CE-6256 REGISTERED ENGINEER 10/22/16

TESTHOLE LOG GEOTECHNICAL	TH13
LEWIS & CLARK S/D LOT 1 - WEST	Date: 10/22/10 SHEET: 13 of 26

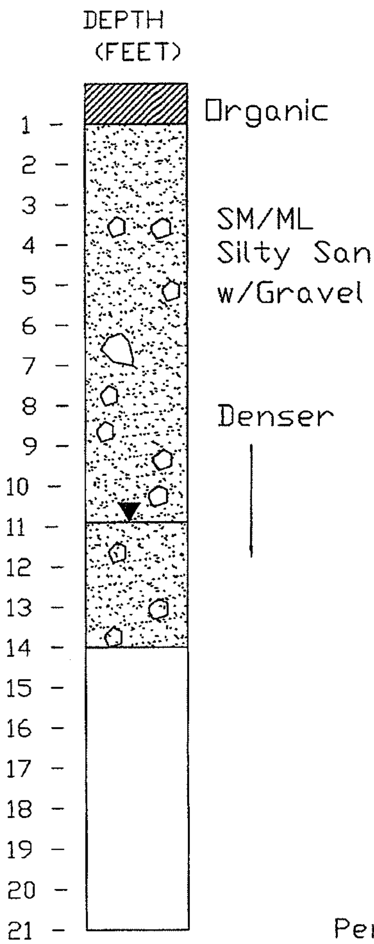
SOILS LOG - PERCOLATION TEST

NORTHRIM ENGINEERING

Date Performed: 9/17/16

Performed For: Todd Brownson

Legal Description: Lewis & Clark S/D, Lot 4- West Side



T.H. Location: See Location Map

Groundwater? No
Depth --
Water Depth
After Monitoring. 11' Date: 10/14/16

#	Date	Gross Time	Net Time	Depth	Net Drop
1	9/17	0	--	2.5"	--
2	9/17	30	30 min.	4"	1.5"
3	9/17	32	--	2.5"	--
4	9/17	62	30 min.	4"	1.5"
5	9/17	65	--	2.5"	--
6	9/17	95	30 min.	4"	1.5"

Percolation Rate 20 min./inch Perc Hole Diameter 6"
Test Run Between 4' and 5'

Comments: Presoaked.

Performed By NorthRim Eng. I [signature] CERTIFY THAT THIS TEST WAS Performed in Accordance with All State/Municipal Guidelines in Effect ON THIS DATE. DATE: 10/22/16

NORTHRIM ENGINEERING PO Box 770724 Eagle River, Alaska 99577 907.694.7028 STATE OF ALASKA 49TH REGISTERED ENGINEER Steve Eng CE-6256 10/22/16	TESTHOLE LOG GEOTECHNICAL	TH14
	LEWIS & CLARK S/D LOT 4 - WEST	Date: 10/22/10 SHEET: 14 of 26

SOILS LOG - PERCOLATION TEST

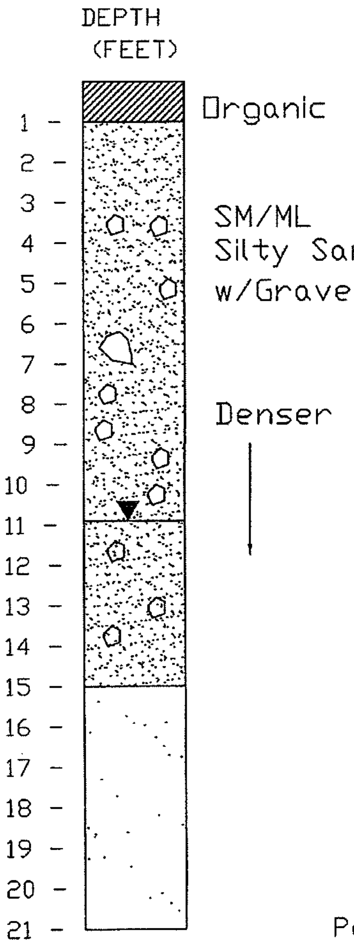
NORTHRIM ENGINEERING

Date Performed: 9/19/16

Performed For: Todd Brownson

Legal Description: Lewis & Clark S/D, Lot 5- South Side

T.H. Location: See Location Map



Groundwater? No
Depth --
Water Depth
After Monitoring. 11' Date: 10/14/16

#	Date	Gross Time	Net Time	Depth	Net Drop
1	9/19	0	--	2"	--
2	9/19	30	30 min.	4.5"	2.5"
3	9/19	32	--	2"	--
4	9/19	62	30 min.	4.5"	2.5"
5	9/19	65	--	2"	--
6	9/19	95	30 min.	4.5"	2.5"

Percolation Rate 12 min./inch Perc Hole Diameter 6"
Test Run Between 4' and 5'

Comments: Presoaked.
Performed By NorthRim Eng. I ______ CERTIFY THAT THIS TEST WAS Performed in Accordance with All State/Municipal Guidelines in Effect ON THIS DATE. DATE: 10/22/16

NORTHRIM ENGINEERING
PO Box 770724
Eagle River, Alaska 99577
907.694.7028

STATE OF ALASKA 49TH Steve Eng CE-8256 REGISTERED ENGINEER 10/22/16

TESTHOLE LOG GEOTECHNICAL	TH15
LEWIS & CLARK S/D LOT 5 - SOUTH	Date: 10/22/10 SHEET: 15 of 26

SOILS LOG - PERCOLATION TEST

NORTHRIM ENGINEERING

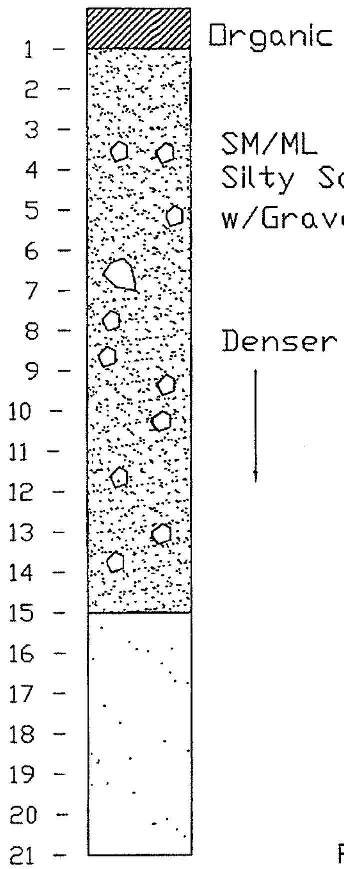
Date Performed: 9/19/16

Performed For: Todd Brownson

Legal Description: Lewis & Clark S/D, Lot 6- South Side

T.H. Location: See Location Map

DEPTH (FEET)



Groundwater? No
Depth --
Water Depth
After Monitoring. Dry Date: 10/14/16

#	Date	Gross Time	Net Time	Depth	Net Drop
1	9/19	0	--	2″	--
2	9/19	30	30 min.	8″	6″
3	9/19	32	--	2″	--
4	9/19	62	30 min.	8″	6″
5	9/19	65	--	2″	--
6	9/19	95	30 min.	8″	6″

Percolation Rate 5 min./inch Perc Hole Diameter 6″
Test Run Between 4′ and 5′

Comments: Presoaked.

Performed By NorthRim Eng. I SE CERTIFY THAT THIS TEST WAS Performed in Accordance with All State/Municipal Guidelines in Effect ON THIS DATE. DATE: 10/22/16

NORTHRIM ENGINEERING
PO Box 770724
Eagle River, Alaska 99577
907.694.7028

STATE OF ALASKA 49TH Steve Eng CE-8256 REGISTERED ENGINEER 10/22/16

TESTHOLE LOG GEOTECHNICAL

TH16

LEWIS & CLARK S/D LOT 6 - SOUTH

Date: 10/22/10 SHEET: 16 of 26

SOILS LOG - PERCOLATION TEST

NORTHRIM ENGINEERING

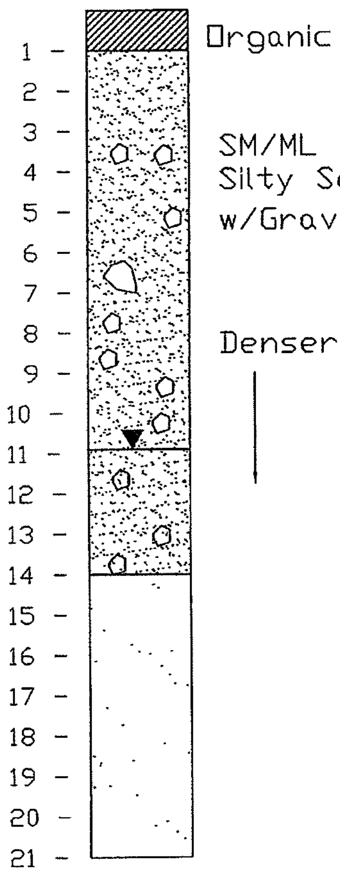
Date Performed: 9/19/16

Performed For: Todd Brownson

Legal Description: Lewis & Clark S/D, Lot 7- South Side

T.H. Location: See Location Map

DEPTH (FEET)



Groundwater? No
Depth --
Water Depth
After Monitoring. 11' Date: 10/14/16

#	Date	Gross Time	Net Time	Depth	Net Drop
1	9/19	0	--	2"	--
2	9/19	30	30 min.	5"	3"
3	9/19	32	--	2"	--
4	9/19	62	30 min.	5"	3"
5	9/19	65	--	2"	--
6	9/19	95	30 min.	5"	3"

Percolation Rate 10 min./inch Perc Hole Diameter 6"
Test Run Between 4' and 5'

Comments: Presoaked.

Performed By NorthRim Eng. I ______ CERTIFY THAT THIS TEST WAS Performed in Accordance with All State/Municipal Guidelines in Effect ON THIS DATE. DATE: 10/22/16

NORTHRIM ENGINEERING PO Box 770724 Eagle River, Alaska 99577 907.694.7028	STATE OF ALASKA 49TH REGISTERED PROFESSIONAL ENGINEER Steve Eng CE-8258 10/22/16	TESTHOLE LOG GEOTECHNICAL	TH17
		LEWIS & CLARK S/D LOT 7 - SOUTH	Date: 10/22/10 SHEET: 17 of 26

NORTHRIM ENGINEERING

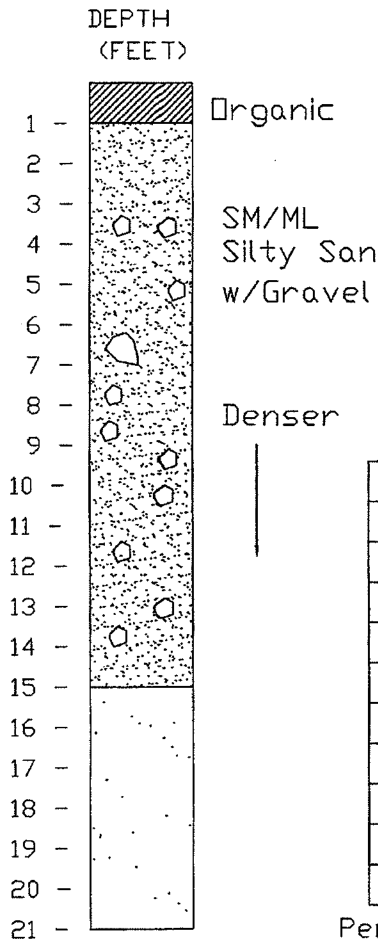
SOILS LOG - PERCOLATION TEST

Date Performed: 10/14/16

Performed For: Todd Brownson

Legal Description: Lewis & Clark S/D, Lot 8- South Side

T.H. Location: See Location Map



Groundwater? No
Depth --
Water Depth
After Monitoring. Dry Date: 10/24/16

#	Date	Gross Time	Net Time	Depth	Net Drop
1	10/19	0	--	2"	--
2	10/19	30	30 min.	4"	2"
3	10/19	32	--	2"	--
4	10/19	62	30 min.	4"	2"
5	10/19	65	--	2"	--
6	10/19	95	30 min.	4"	2"

Percolation Rate 15 min./inch Perc Hole Diameter 6"
Test Run Between 3' and 4'

Comments: Presoaked.

Performed By NorthRim Eng. I [signature] CERTIFY THAT THIS TEST WAS Performed in Accordance with All State/Municipal Guidelines in Effect ON THIS DATE. DATE: 10/22/16

NORTHRIM ENGINEERING
PO Box 770724
Eagle River, Alaska 99577
907.694.7028

STATE OF ALASKA 49TH Steve Eng CE-6256 10/22/16

TESTHOLE LOG GEOTECHNICAL

LEWIS & CLARK S/D LOT 8 - SOUTH

TH21

Date: 10/22/10

SHEET: 21 of 26

NORTHRIM ENGINEERING

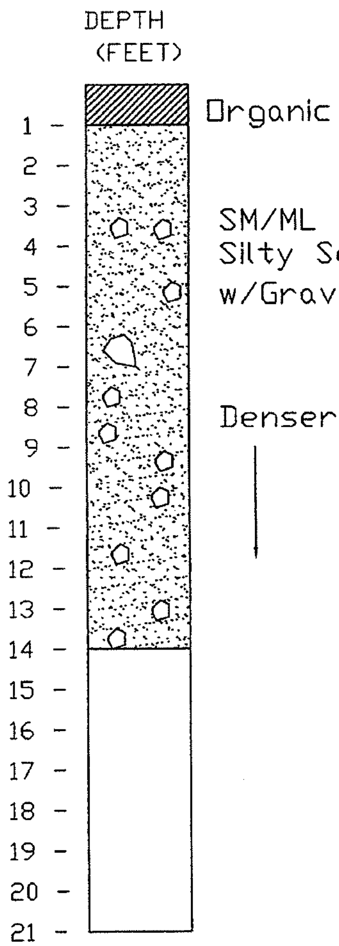
SOILS LOG - PERCOLATION TEST

Date Performed: 10/14/16

Performed For: Todd Brownson

Legal Description: Lewis & Clark S/D, Lot 10- South Side

T.H. Location: See Location Map



Groundwater? No
Depth --
Water Depth
After Monitoring. Dry Date: 10/24/16

#	Date	Gross Time	Net Time	Depth	Net Drop
1	10/19	0	--	2"	--
2	10/19	30	30 min.	5"	3"
3	10/19	32	--	2"	--
4	10/19	62	30 min.	5"	3"
5	10/19	65	--	2"	--
6	10/19	95	30 min.	5"	3"

Percolation Rate 10 min./inch Perc Hole Diameter 6"
Test Run Between 3' and 4'

Comments: Presoaked.

Performed By NorthRim Eng. I [signature] CERTIFY THAT THIS TEST WAS Performed in Accordance with All State/Municipal Guidelines in Effect ON THIS DATE. DATE: 10/22/16

NORTHRIM ENGINEERING PO Box 770724 Eagle River, Alaska 99577 907.694.7028	STATE OF ALASKA 49TH Steve Eng CE-8256 REGISTERED PROFESSIONAL ENGINEER 10/22/16	TESTHOLE LOG GEOTECHNICAL	TH22
		LEWIS & CLARK S/D LOT 10 - SOUTH	Date: 10/22/10 SHEET: 22 of 26

NORTHRIM ENGINEERING

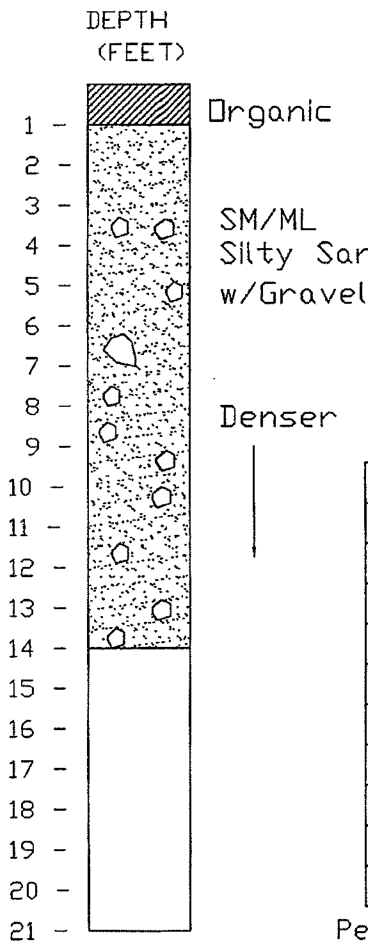
SOILS LOG - PERCOLATION TEST

Date Performed: 10/14/16

Performed For: Todd Brownson

Legal Description: Lewis & Clark S/D, Lot 9- South Side

T.H. Location: See Location Map



Groundwater? No
Depth --
Water Depth
After Monitoring. Dry Date: 10/24/16

#	Date	Gross Time	Net Time	Depth	Net Drop
1	10/19	0	--	2″	--
2	10/19	30	30 min.	4.5″	2.5″
3	10/19	32	--	2″	--
4	10/19	62	30 min.	4.5″	2.5″
5	10/19	65	--	2″	--
6	10/19	95	30 min.	4.5″	2.5″

Percolation Rate 12 min./inch Perc Hole Diameter 6″
Test Run Between 3′ and 4′

Comments: Presoaked.

Performed By NorthRim Eng. I ______ CERTIFY THAT THIS TEST WAS Performed in Accordance with All State/Municipal Guidelines in Effect ON THIS DATE. DATE: 10/22/16

NORTHRIM ENGINEERING
PO Box 770724
Eagle River, Alaska 99577
907.694.7028

STATE OF ALASKA 49TH Steve Eng CE-8258 REGISTERED PROFESSIONAL ENGINEER 10/22/16

TESTHOLE LOG
GEOTECHNICAL

LEWIS & CLARK S/D
LOT 9 - SOUTH

TH23

Date: 10/22/10

SHEET: 23 of 26

SOILS LOG - PERCOLATION TEST

NORTHRIM ENGINEERING

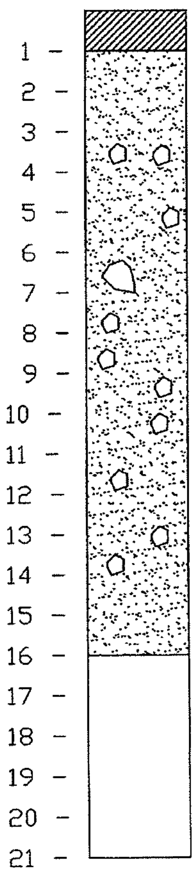
Date Performed: 10/19/16

Performed For: Todd Brownson

Legal Description: Lewis & Clark S/D, Lot 11- South Side

DEPTH (FEET)

T.H. Location: See Location Map



Organic

SM/ML
Silty Sand & Silt
w/Gravel

Denser

Groundwater? No
Depth --
Water Depth
After Monitoring. Dry Date: 10/24/16

#	Date	Gross Time	Net Time	Depth	Net Drop
1	10/19	0	--	2"	--
2	10/19	30	30 min.	8"	6"
3	10/19	32	--	2"	--
4	10/19	62	30 min.	8"	6"
5	10/19	65	--	2"	--
6	10/19	95	30 min.	8"	6"

Percolation Rate 5 min./inch Perc Hole Diameter 6"
Test Run Between 4' and 5'

Comments: Presoaked.

Performed By NorthRim Eng. I ________ CERTIFY THAT THIS TEST WAS Performed in Accordance with All State/Municipal Guidelines in Effect ON THIS DATE. DATE: 10/22/16

NORTHRIM ENGINEERING
PO Box 770724
Eagle River, Alaska 99577
907.694.7028

STATE OF ALASKA 49TH Steve Eng CE-6256 REGISTERED ENGINEER 10/22/16

TESTHOLE LOG GEOTECHNICAL

TH24

LEWIS & CLARK S/D LOT 11 - SOUTH

Date: 10/22/10 SHEET: 24 of 26

NORTHRIM ENGINEERING

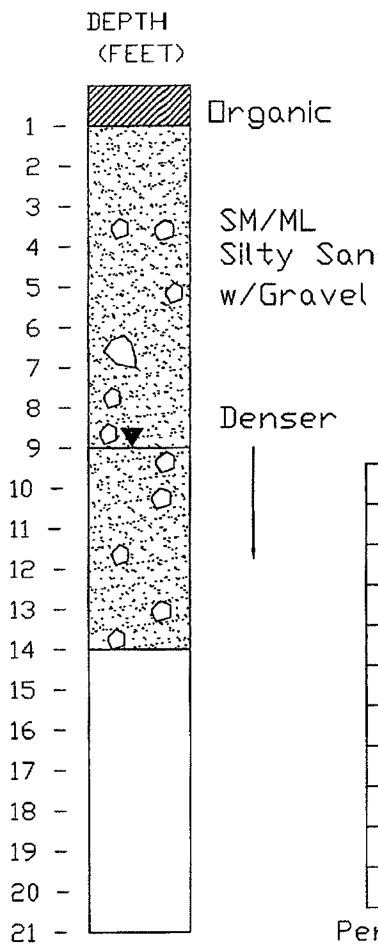
SOILS LOG - PERCOLATION TEST

Date Performed: 10/19/16

Performed For: Todd Brownson

Legal Description: Lewis & Clark S/D, Lot 5- North Side

T.H. Location: See Location Map



Groundwater? Yes
Depth 9'
Water Depth
After Monitoring. 9' Date: 10/24/16

#	Date	Gross Time	Net Time	Depth	Net Drop
1	10/19	0	--	2"	--
2	10/19	30	30 min.	4"	2"
3	10/19	32	--	2"	--
4	10/19	62	30 min.	4"	2"
5	10/19	65	--	2"	--
6	10/19	95	30 min.	4"	2"

Percolation Rate 15 min./inch Perc Hole Diameter 6"
Test Run Between 3' and 4'

Comments: Presoaked.

Performed By NorthRim Eng. I [signature] CERTIFY THAT THIS TEST WAS Performed in Accordance with All State/Municipal Guidelines in Effect ON THIS DATE. DATE: 10/22/16

NORTHRIM ENGINEERING
PO Box 770724
Eagle River, Alaska 99577
907.694.7028

STATE OF ALASKA
49TH
Steve Eng
CE-6256
REGISTERED
10/22/16

TESTHOLE LOG
GEOTECHNICAL

LEWIS & CLARK S/D
LOT 5 - NORTH

TH25

Date: 10/22/10

SHEET: 25 of 26

NORTHRIM ENGINEERING

SOILS LOG - PERCOLATION TEST

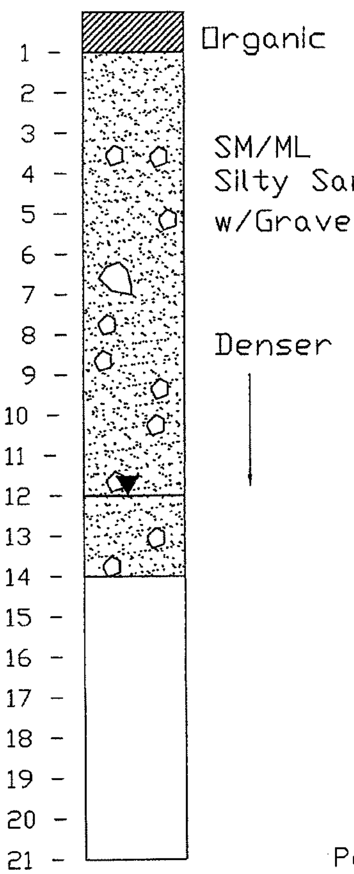
Date Performed: 10/19/16

Performed For: Todd Brownson

Legal Description: Lewis & Clark S/D, Lot 12- North East Side

T.H. Location: See Location Map

DEPTH (FEET)



Groundwater? Yes
Depth 9'
Water Depth
After Monitoring. 9' Date: 10/24/16

#	Date	Gross Time	Net Time	Depth	Net Drop
1	10/19	0	--	2"	--
2	10/19	30	30 min.	4"	2"
3	10/19	32	--	2"	--
4	10/19	62	30 min.	4"	2"
5	10/19	65	--	2"	--
6	10/19	95	30 min.	4"	2"

Percolation Rate 15 min./inch Perc Hole Diameter 6"
Test Run Between 3' and 4'

Comments: Presoaked.
Performed By NorthRim Eng. I ___ CERTIFY THAT THIS TEST WAS Performed in Accordance with All State/Municipal Guidelines in Effect ON THIS DATE. DATE: 10/22/16

NORTHRIM ENGINEERING
PO Box 770724
Eagle River, Alaska 99577
907.694.7028

STATE OF ALASKA 49TH Steve Eng CE-8256 REGISTERED PROFESSIONAL ENGINEER 10/22/16

TESTHOLE LOG GEOTECHNICAL	TH26
LEWIS & CLARK S/D LOT 12 - NORTHEAST	Date: 10/22/10 SHEET: 26 of 26

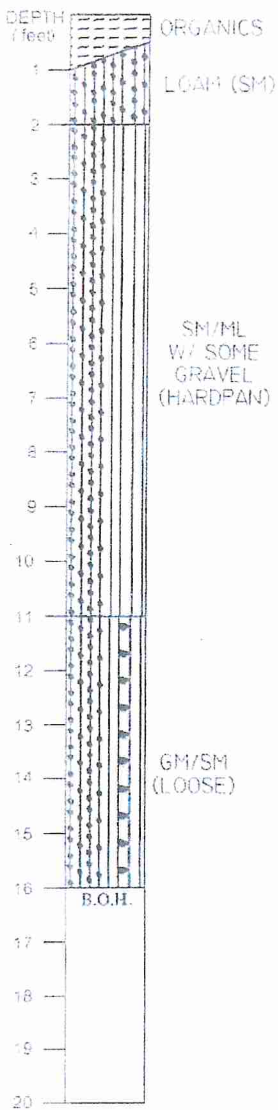
GARNESS ENGINEERING GROUP, Ltd
CIVIL & ENVIRONMENTAL ENGINEERS

SOIL LOG - PERCOLATION TEST

LEGAL DESCRIPTION: LEWIS AND CLARK S/D (PROPOSED - LOT 8)

PERFORMED FOR: BIG COUNTRY ENTERPRISES, LLC / S4 GROUP DATE: 10/16/2014

STATE OF ALASKA 49TH Jeffrey A. Garness CE-7953 4/22/15 REGISTERED PROFESSIONAL ENGINEER



TEST HOLE #8

OLD TH#1

SOIL CLASSIFICATIONS

GW, GP, GM, GC, SW, SP, SM, SC, ORG, ML, CL, OL, MH, CH, OH

DEPTH TO GROUNDWATER	DATE
DRY	10/16/2014
DRY	10/27/2014
DRY	1/15/2015
DRY	4/17/2015

SITE PLAN

DATE	READING	CLOCK TIME	NET TIME (MINUTES)	WATER LEVEL READING	NET DROP (INCHES)
10/17/2014	1	2:45	-	6"	-
	2	3:15	30	5-1/8"	1/8"
	3	3:15	-	6"	-
	4	3:45	30	5-3/8"	5/8"
	5	3:45	-	6"	-
	6	4:15	30	5-3/8"	5/8"

PERCOLATION RATE 48 (MIN./INCH) PERC. HOLE DIA. 6 (INCHES)

TEST RUN BETWEEN 4.5 FT. AND 5.5 FT.

A FOUR HOUR PRESOAK WAS PERFORMED: ■ YES ☐ NO

HOLE LOGGED BY: JODY MAUS PERCOLATION TEST PERFORMED BY: ANDREW GRAY

COMMENTS: PERCOLATION READINGS ARE WITHIN 1/16 OF INCH.

PERFORMED BY GEG, Ltd. I, JEFFREY A. GARNESS, CERTIFY THAT THIS WAS PERFORMED IN ACCORDANCE WITH ALL STATE AND MUNICIPAL GUIDELINES IN EFFECT ON THIS DATE: 4/22/15

GARNESS ENGINEERING GROUP, Ltd

CIVIL & ENVIRONMENTAL ENGINEERS

[illegible] E. TUDOR ROAD, SUITE 101 * ANCHORAGE, AK [illegible] * PHONE (907) [illegible] * FAX (907) [illegible] * WEBSITE: www.garnessengineering.com

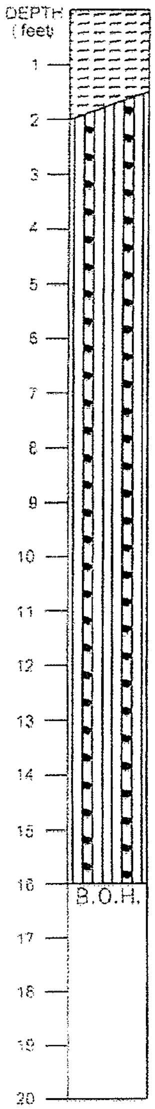
STATE OF ALASKA
49TH
Jeffrey A. Garness
CE-7953
4/22/15
REGISTERED PROFESSIONAL ENGINEER

SOIL LOG - PERCOLATION TEST

LEGAL DESCRIPTION: LEWIS AND CLARK S/D (PROPOSED - LOT 9)

PERFORMED FOR: BIG COUNTRY ENTERPRISES, LLC / S4 GROUP DATE: 1/7/2015

DEPTH (feet)



ORGANICS

GM WITH OCCASIONAL LENSES OF ML

TEST HOLE #9

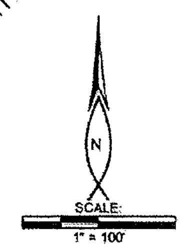
SOIL CLASSIFICATIONS

GW	ORG
GP	ML
GM	CL
GC	OL
SW	MH
SP	CH
SM	OH
SC	

DEPTH TO GROUNDWATER	DATE
DRY	1/7/2015
DRY	1/16/2015
DRY	4/17/2015

SITE PLAN

SEE ATTACHED SITE PLAN



DATE	READING	CLOCK TIME	NET TIME (MINUTES)	WATER LEVEL READING	NET DROP (INCHES)
1/8/2015	1	1:47	-	6"	-
	2	2:17	30	4-1/4"	1-3/4"
	3	2:17	-	6"	-
	4	2:47	30	4-1/2"	1-1/2"
	5	2:47	-	6"	-
	6	3:17	30	4-1/2"	1-1/2"

PERCOLATION RATE 20 (MIN./INCH) PERC. HOLE DIA. 6 (INCHES)

TEST RUN BETWEEN 4.5 FT. AND 5.5 FT.

A FOUR HOUR PRESOAK WAS PERFORMED: ■ YES ☐ NO

SOILS LOGGED BY: JODY MAUS PERCOLATION TEST PERFORMED BY: DAVID GARNESS

COMMENTS: PERCOLATION READINGS ARE WITHIN 1/16 OF INCH.

PERFORMED BY GEG, Ltd. I, JEFFREY A. GARNESS, CERTIFY THAT THIS WAS PERFORMED IN ACCORDANCE WITH ALL STATE AND MUNICIPAL GUIDELINES IN EFFECT ON THIS DATE: 4/22/15

GARNESS ENGINEERING GROUP, Ltd

CIVIL & ENVIRONMENTAL ENGINEERS

STATE OF ALASKA
49TH
Jeffrey A. Garness
CE-7953
4/22/15
REGISTERED PROFESSIONAL ENGINEER

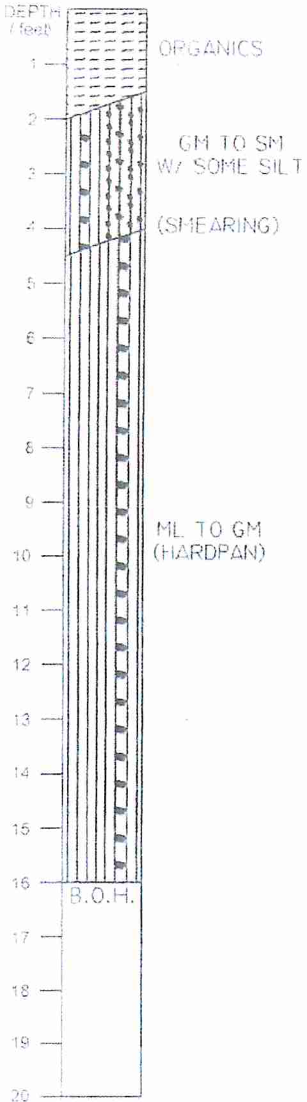
SOIL LOG - PERCOLATION TEST

LEGAL DESCRIPTION: LEWIS AND CLARK S/D (PROPOSED - LOT 12)

PERFORMED FOR: BIG COUNTRY ENTERPRISES, LLC / S4 GROUP DATE: 1/2/2015

TEST HOLE #12

PAGE 1 OF 2



SOIL CLASSIFICATIONS

GW, GP, GM, GC, SW, SP, SM, SC

ORG, ML, CL, OL, MH, CH, OH

DEPTH TO GROUNDWATER	DATE
DRY	1/2/2015
DRY	1/15/2015
DRY	4/17/2015

SITE PLAN

LOWER BENCH

DATE	READING	CLOCK TIME	NET TIME (MINUTES)	WATER LEVEL READING	NET DROP (INCHES)
1/2/2015	1/4" DROP IN 3 HOURS - DID NOT PERK (RC)				
1/5/2015	DEEPENED BENCH - RESET PERK - 1/8" DROP AFTER PRE-SOAK (DG)				

PERCOLATION RATE >120 (MIN./INCH) PERC. HOLE DIA. 6 (INCHES)

TEST RUN BETWEEN 4.5/6.5 FT. AND 5.5/7.5 FT.

A FOUR HOUR PRESOAK WAS PERFORMED: ■ YES ☐ NO

SOIL LOGGED BY: JODY MAUS PERCOLATION TEST PERFORMED BY: ROB CAMPBELL/DAVID GARNESS

COMMENTS: PERCOLATION READINGS ARE WITHIN 1/16 OF INCH.

PERFORMED BY GEG, Ltd. I, JEFFREY A. GARNESS, CERTIFY THAT THIS WAS PERFORMED IN ACCORDANCE WITH ALL STATE AND MUNICIPAL GUIDELINES IN EFFECT ON THIS DATE: 4/22/15

GARNESS ENGINEERING GROUP, Ltd
CIVIL & ENVIRONMENTAL ENGINEERS

3701 E. TUDOR ROAD, SUITE 101 * ANCHORAGE, AK 99507 * PHONE (907) 337-6119 * FAX (907) 338-3248 * WEBSITE: www.garnessengineering.com

STATE OF ALASKA
49TH
Jeffrey A. Garness
CE-7953
1/28/15
REGISTERED PROFESSIONAL ENGINEER

SOIL LOG - PERCOLATION TEST

LEGAL DESCRIPTION: LEWIS AND CLARK S/D (PROPOSED - LOT 12)

PERFORMED FOR: BIG COUNTRY LLC / S4 GROUP DATE: SEE PAGE 1 OF 2

DEPTH (feet): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

SEE PAGE 1 OF 2 FOR SOILS CLASSIFICATION

TEST HOLE #12
PAGE 2 OF 2

SOIL CLASSIFICATIONS

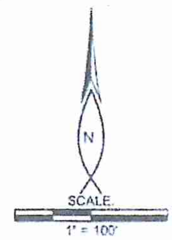
GW, GP, GM, GC, SW, SP, SM, SC

ORG, ML, CL, OL, MH, CH, OH

DEPTH TO GROUNDWATER	DATE
SEE PAGE 1 OF 2	

SITE PLAN

SEE ATTACHED SITE PLAN



UPPER BENCH

DATE	READING	CLOCK TIME	NET TIME (MINUTES)	WATER LEVEL READING	NET DROP (INCHES)
1/14/2015	1	3:00	-	6"	-
	2	3:08	8	0"	6"
	3	3:08	-	6"	-
	4	3:17	9	0"	6"
	5	3:17	-	6"	-
	6	3:36	19	0"	6"
	7	3:36	-	6"	-
	8	3:56	20	0"	6"
	9	3:56	-	6"	-
	10	4:16	20	0"	6"

PERCOLATION RATE 3.3 (MIN./INCH) PERC. HOLE DIA. 6 (INCHES)

TEST RUN BETWEEN 2 FT. AND 3 FT.

A FOUR HOUR PRESOAK WAS PERFORMED: ■ YES ☐ NO

SOILS LOGGED BY: SEE PAGE 1 OF 2 PERCOLATION TEST PERFORMED BY: ANDREW GRAY

COMMENTS: PERCOLATION READINGS ARE WITHIN 1/16 OF INCH.

PERFORMED BY GEG, Ltd. I, JEFFREY A. GARNESS, CERTIFY THAT THIS WAS PERFORMED IN ACCORDANCE WITH ALL STATE AND MUNICIPAL GUIDELINES IN EFFECT ON THIS DATE: 1/28/15

GARNESS ENGINEERING GROUP, Ltd

CIVIL & ENVIRONMENTAL ENGINEERS

TUDOR ROAD, SUITE 101 * ANCHORAGE, AK * PHONE (907) * FAX (907) * WEBSITE

STATE OF ALASKA
49TH
Jeffrey A. Garness
CE-7953
4/22/15
REGISTERED PROFESSIONAL ENGINEER

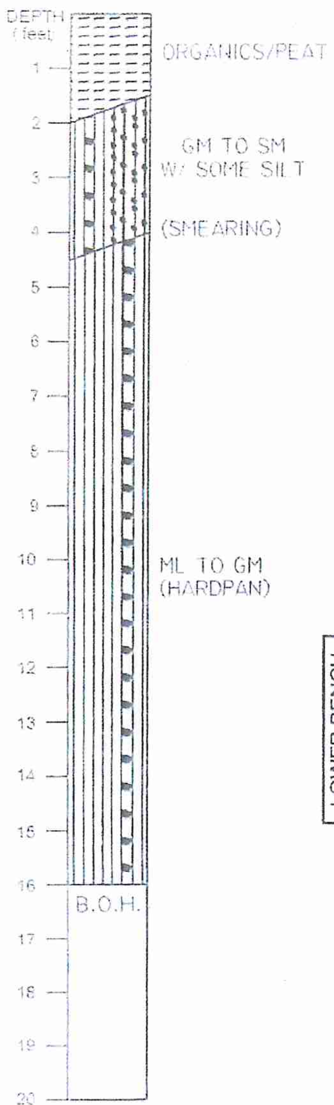
SOIL LOG - PERCOLATION TEST

LEGAL DESCRIPTION: LEWIS AND CLARK S/D (PROPOSED - LOT 13)

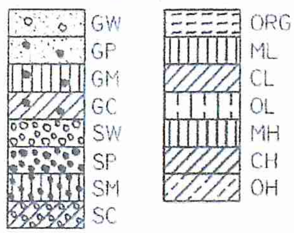
PERFORMED FOR: BIG COUNTRY ENTERPRISES, LLC / S4 GROUP DATE: 1/2/2015

TEST HOLE #13

PAGE 1 OF 2



SOIL CLASSIFICATIONS



SITE PLAN

DEPTH TO GROUNDWATER	DATE
DRY	1/2/2015
DRY	1/15/2015
DRY	4/17/2015

LOWER BENCH

DATE	READING	CLOCK TIME	NET TIME (MINUTES)	WATER LEVEL READING	NET DROP (INCHES)
1/2/2015	1/4" DROP IN 3 HOURS - DID NOT PERK (RC)				
1/5/2015	DEEPENED BENCH - RESET PERK - NO DROP DURING PRE-SOAK (DG)				

PERCOLATION RATE >120 (MIN./INCH) PERC. HOLE DIA. 6 (INCHES)

TEST RUN BETWEEN 4.5/6.5 FT. AND 5.5/7.5 FT.

A FOUR HOUR PRESOAK WAS PERFORMED: ■ YES ☐ NO

LOGGED BY: JODY MAUS PERCOLATION TEST PERFORMED BY: ROB CAMPBELL/DAVID GARNESS

COMMENTS: PERCOLATION READINGS ARE WITHIN 1/16 OF INCH.

PERFORMED BY GEG, Ltd. I, JEFFREY A. GARNESS, CERTIFY THAT THIS WAS PERFORMED IN ACCORDANCE WITH ALL STATE AND MUNICIPAL GUIDELINES IN EFFECT ON THIS DATE: 4/22/15

GARNESS ENGINEERING GROUP, Ltd

CIVIL & ENVIRONMENTAL ENGINEERS

3701 E. TUDOR ROAD, SUITE 101 * ANCHORAGE, AK 99507 * PHONE (907) 337-6179 * FAX (907) 338-3245 * WEBSITE: www.garnessengineering.com

STATE OF ALASKA
49TH
Jeffrey A. Garness
CE-7953
1/28/15
REGISTERED PROFESSIONAL ENGINEER

SOIL LOG - PERCOLATION TEST

LEGAL DESCRIPTION: LEWIS AND CLARK S/D (PROPOSED - LOT 13)

PERFORMED FOR: BIG COUNTRY LLC / S4 GROUP DATE: SEE PAGE 1 OF 2

TEST HOLE #13

PAGE 2 OF 2

DEPTH (feet): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

SEE PAGE 1 OF 2 FOR SOILS CLASSIFICATION

SOIL CLASSIFICATIONS

GW, GP, GM, GC, SW, SP, SM, SC

ORG, ML, CL, OL, MH, CH, OH

DEPTH TO GROUNDWATER	DATE
SEE PAGE 1 OF 2	

SITE PLAN

SEE ATTACHED SITE PLAN

N

SCALE: 1" = 100'

	DATE	READING	CLOCK TIME	NET TIME (MINUTES)	WATER LEVEL READING	NET DROP (INCHES)
UPPER BENCH	1/14/2015	1	3:05	-	6"	-
		2	3:35	30	1-3/4"	4-1/4"
		3	3:35	-	6"	-
		4	4:05	30	1-7/8"	4-1/8"
		5	4:05	-	6"	-
		6	4:35	30	1-7/8"	4-1/8"

PERCOLATION RATE 7.3 (MIN./INCH) PERC. HOLE DIA. 6 (INCHES)

TEST RUN BETWEEN 2 FT. AND 3 FT.

A FOUR HOUR PRESOAK WAS PERFORMED: ■ YES ☐ NO

SOILS LOGGED BY: SEE PAGE 1 OF 2 PERCOLATION TEST PERFORMED BY: ANDREW GRAY

COMMENTS: PERCOLATION READINGS ARE WITHIN 1/16 OF INCH.

PERFORMED BY GEG, Ltd. I, JEFFREY A. GARNESS, CERTIFY THAT THIS WAS PERFORMED IN ACCORDANCE WITH ALL STATE AND MUNICIPAL GUIDELINES IN EFFECT ON THIS DATE: 1/29/15

GARNESS ENGINEERING GROUP, Ltd

CIVIL & ENVIRONMENTAL ENGINEERS

STATE OF ALASKA
49TH
Jeffrey A. Garness
CE-7953
4/22/15
REGISTERED PROFESSIONAL ENGINEER

SOIL LOG - PERCOLATION TEST

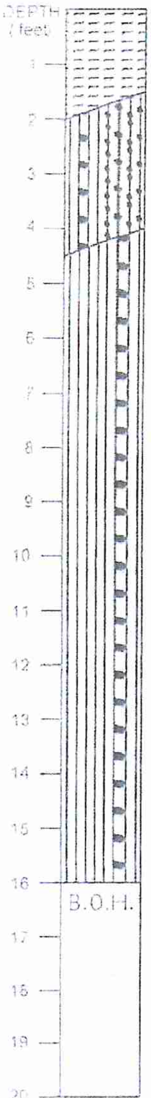
LEGAL DESCRIPTION: LEWIS AND CLARK S/D (PROPOSED - LOT 14)

PERFORMED FOR: BIG COUNTRY ENTERPRISES, LLC / S4 GROUP DATE: 1/2/2015

TEST HOLE #14

PAGE 1 OF 2

DEPTH (feet)



ORGANICS

GM TO SM W/ SOME SILT

(SMEARING)

ML TO GM (HARDPAN)

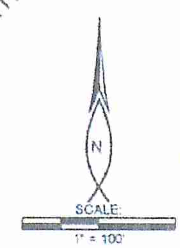
SOIL CLASSIFICATIONS

GW, GP, GM, GC, SW, SP, SM, SC

ORG, ML, CL, OL, MH, CH, OH

SITE PLAN

SEE ATTACHED SITE PLAN



DEPTH TO GROUNDWATER	DATE
DRY	1/2/2015
DRY	1/15/2015
DRY	4/17/2015

LOWER BENCH

DATE	READING	CLOCK TIME	NET TIME (MINUTES)	WATER LEVEL READING	NET DROP (INCHES)
1/2/2015	NO DROP DURING PRE-SOAK (RC)				
1/5/2015	DEEPENED BENCH - RESET PERK - NO DROP DURING PRE-SOAK (DG)				

PERCOLATION RATE >120 (MIN./INCH) PERC. HOLE DIA. 6 (INCHES)

TEST RUN BETWEEN 4.5/6.5 FT. AND 5.5/7.5 FT.

A FOUR HOUR PRESOAK WAS PERFORMED: ■ YES ☐ NO

LOGGED BY: JODY MAUS PERCOLATION TEST PERFORMED BY: ROB CAMPBELL/DAVID GARNESS

COMMENTS: PERCOLATION READINGS ARE WITHIN 1/16 OF INCH.

PERFORMED BY GEG, Ltd. I, JEFFREY A. GARNESS, CERTIFY THAT THIS WAS PERFORMED IN ACCORDANCE WITH ALL STATE AND MUNICIPAL GUIDELINES IN EFFECT ON THIS DATE: 4/22/15

GARNESS ENGINEERING GROUP, Ltd

CIVIL & ENVIRONMENTAL ENGINEERS

[illegible] TUDOR ROAD SUITE 101 * ANCHORAGE, AK [illegible] * PHONE [illegible] * FAX [illegible] * WEBSITE: [illegible]

STATE OF ALASKA
49TH
Jeffrey A. Garness
CE-7953
1/24/15
REGISTERED PROFESSIONAL ENGINEER

SOIL LOG - PERCOLATION TEST

LEGAL DESCRIPTION: LEWIS AND CLARK S/D (PROPOSED - LOT 14)

PERFORMED FOR: BIG COUNTRY ENTERPRISES, LLC / S4 GROUP DATE: SEE PAGE 1 OF 2

TEST HOLE #14

PAGE 2 OF 2

DEPTH (feet): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

SEE PAGE 1 OF 2 FOR SOILS CLASSIFICATION

SOIL CLASSIFICATIONS

GW, GP, GM, GC, SW, SP, SM, SC

ORG, ML, CL, OL, MH, CH, OH

DEPTH TO GROUNDWATER	DATE
SEE PAGE 1 OF 2	

SITE PLAN

SEE ATTACHED SITE PLAN

N

SCALE: 1" = 100'

	DATE	READING	CLOCK TIME	NET TIME (MINUTES)	WATER LEVEL READING	NET DROP (INCHES)
UPPER BENCH	1/14/2015	1	3:10	-	6"	-
		2	3:40	30	4-5/8"	1-3/8"
		3	3:40	-	6"	-
		4	4:10	30	5-1/4"	3/4"
		5	4:10	-	6"	-
		6	4:40	30	5-1/4"	3/4"

PERCOLATION RATE 40 (MIN./INCH) PERC. HOLE DIA. 6 (INCHES)

TEST RUN BETWEEN 2 FT. AND 3 FT.

A FOUR HOUR PRESOAK WAS PERFORMED: ■ YES ☐ NO

SOILS LOGGED BY: SEE PAGE 1 OF 2 PERCOLATION TEST PERFORMED BY: ANDREW GRAY

COMMENTS: PERCOLATION READINGS ARE WITHIN 1/16 OF INCH.

PERFORMED BY GEG, Ltd. I, JEFFREY A. GARNESS, CERTIFY THAT THIS WAS PERFORMED IN ACCORDANCE WITH ALL STATE AND MUNICIPAL GUIDELINES IN EFFECT ON THIS DATE: 1/28/15

GARNESS ENGINEERING GROUP, Ltd

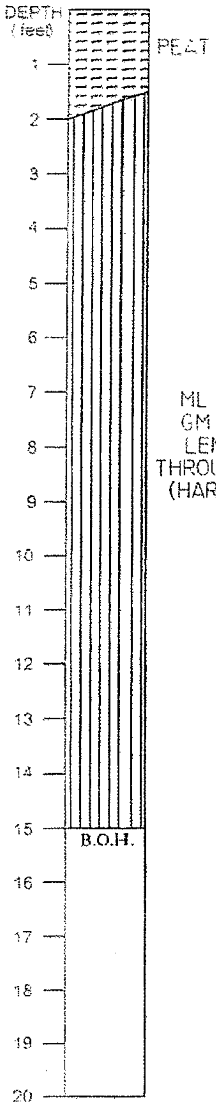
CIVIL & ENVIRONMENTAL ENGINEERS

SOIL LOG - PERCOLATION TEST

LEGAL DESCRIPTION: LEWIS AND CLARK S/D (PROPOSED - LOT 15)

PERFORMED FOR: BIG COUNTRY ENTERPRISES, LLC / S4 GROUP DATE: 10/17/2014

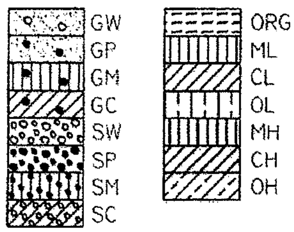
STATE OF ALASKA
49TH
Jeffrey A. Garness
CE-7953
4/22/15
REGISTERED PROFESSIONAL ENGINEER



TEST HOLE #15A

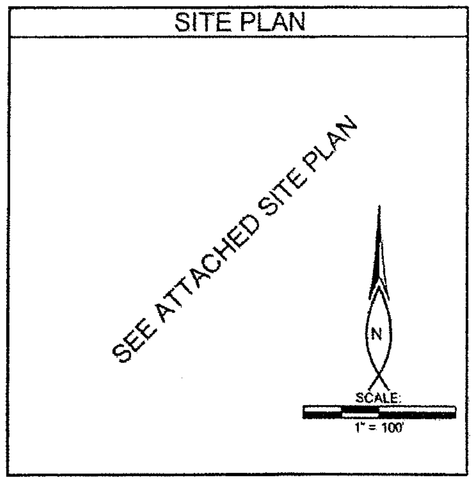
OLD TH#5

SOIL CLASSIFICATIONS



DEPTH TO GROUNDWATER	DATE
DRY	10/17/2014
DRY	10/27/2014
DRY	1/15/2015
DRY	4/17/2015

SITE PLAN



DATE	READING	CLOCK TIME	NET TIME (MINUTES)	WATER LEVEL READING	NET DROP (INCHES)
10/27/2014	1	2:49	-	6"	-
	2	3:19	30	4-3/4"	1-1/4"
	3	3:19	-	6"	-
	4	3:49	30	4-3/4"	1-1/4"
	5	3:49	-	6"	-
	6	4:19	30	4-3/4"	1-1/4"

PERCOLATION RATE 24 (MIN./INCH) PERC. HOLE DIA. 6 (INCHES)

TEST RUN BETWEEN 4.5 FT. AND 5.5 FT.

A FOUR HOUR PRESOAK WAS PERFORMED: ■ YES ☐ NO

HOLE LOGGED BY: JODY MAUS PERCOLATION TEST PERFORMED BY: PIERCE BLEWETT & DAVID GARNESS

COMMENTS: PERCOLATION READINGS ARE WITHIN 1/16 OF INCH.

PERFORMED BY GEG, Ltd. I, JEFFREY A. GARNESS, CERTIFY THAT THIS WAS PERFORMED IN ACCORDANCE WITH ALL STATE AND MUNICIPAL GUIDELINES IN EFFECT ON THIS DATE: ____________

GARNESS ENGINEERING GROUP, Ltd

CIVIL & ENVIRONMENTAL ENGINEERS

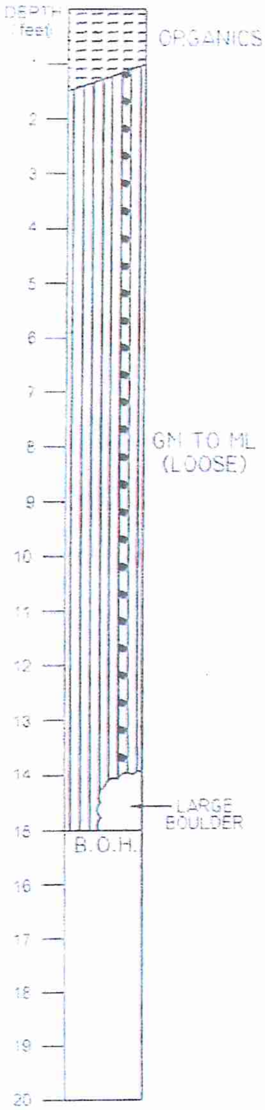
[illegible address / phone / fax / website line]

STATE OF ALASKA
49TH
Jeffrey A. Garness
CE-7953
4/22/15
REGISTERED PROFESSIONAL ENGINEER

SOIL LOG - PERCOLATION TEST

LEGAL DESCRIPTION: LEWIS AND CLARK S/D (PROPOSED - LOT 19)

PERFORMED FOR: BIG COUNTRY ENTERPRISES, LLC / S4 GROUP DATE: 1/5/2015



TEST HOLE #19

SOIL CLASSIFICATIONS

GW	ORG
GP	ML
GM	CL
GC	OL
SW	MH
SP	CH
SM	OH
SC	

DEPTH TO GROUNDWATER	DATE
DRY	1/5/2015
DRY	1/15/2015
DRY	4/17/2015

SITE PLAN

DATE	READING	CLOCK TIME	NET TIME (MINUTES)	WATER LEVEL READING	NET DROP (INCHES)
1/5/2015	1	3:50	-	6"	-
	2	4:00	10	1"	5"
	3	4:00	-	6"	-
	4	4:10	10	1"	5"
	5	4:10	-	6"	-
	6	4:20	10	1"	5"
	7	4:20	-	6"	-
	8	4:30	10	1"	5"
	9	4:30	-	6"	-
	10	4:40	10	1"	5"
	11	4:40	-	6"	-
	12	4:50	10	1"	5"

PERCOLATION RATE 2 (MIN./INCH) PERC. HOLE DIA. 6 (INCHES)

TEST RUN BETWEEN 6 FT. AND 7 FT.

A FOUR HOUR PRESOAK WAS PERFORMED: ■ YES ☐ NO

SOIL LOGGED BY: JODY MAUS PERCOLATION TEST PERFORMED BY: ROB CAMPBELL

COMMENTS: PERCOLATION READINGS ARE WITHIN 1/16 OF INCH.

PERFORMED BY GEG, Ltd. I, JEFFREY A. GARNESS, CERTIFY THAT THIS WAS PERFORMED IN ACCORDANCE WITH ALL STATE AND MUNICIPAL GUIDELINES IN EFFECT ON THIS DATE: 4/22/15

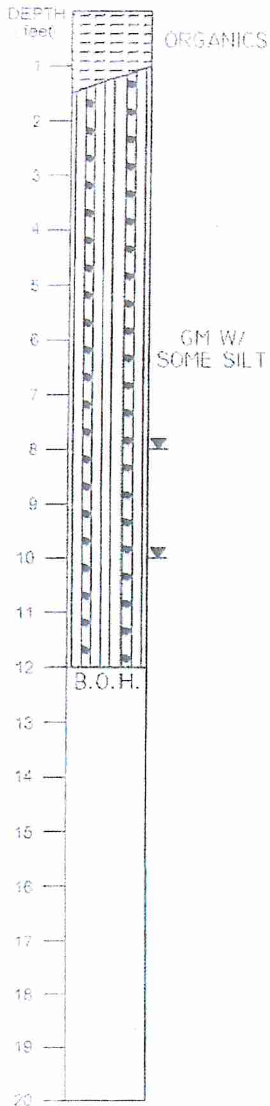
GARNESS ENGINEERING GROUP, Ltd
CIVIL & ENVIRONMENTAL ENGINEERS

STATE OF ALASKA
49TH
Jeffrey A. Garness
CE-7953
4/22/15
REGISTERED PROFESSIONAL ENGINEER

SOIL LOG - PERCOLATION TEST

LEGAL DESCRIPTION: LEWIS AND CLARK S/D (PROPOSED - LOT 21)

PERFORMED FOR: BIG COUNTRY ENTERPRISES LLC / S4 GROUP DATE: 1/5/2015



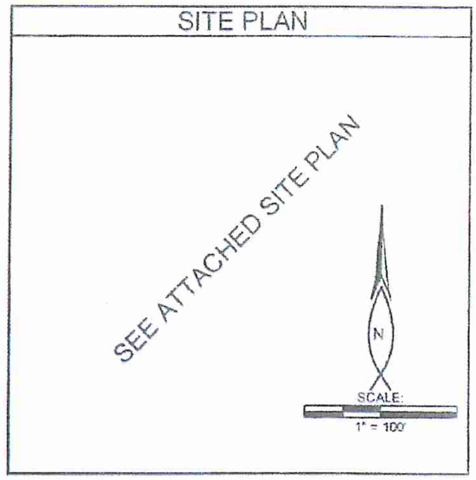
TEST HOLE #21

SOIL CLASSIFICATIONS

GW		ORG	
GP		ML	
GM		CL	
GC		OL	
SW		MH	
SP		CH	
SM		OH	
SC			

DEPTH TO GROUNDWATER	DATE
10'	1/5/2015
8'	1/16/2015
8.5'	4/17/2015

SITE PLAN



DATE	READING	CLOCK TIME	NET TIME (MINUTES)	WATER LEVEL READING	NET DROP (INCHES)
1/6/2015	1	2:38	-	6"	-
	2	3:08	30	2"	4"
	3	3:08	-	6"	-
	4	3:38	30	2"	4"
	5	3:38	-	6"	-
	6	4:08	30	2"	4"

PERCOLATION RATE 7.5 (MIN./INCH) PERC. HOLE DIA. 6 (INCHES)

TEST RUN BETWEEN 4 FT. AND 5 FT.

A FOUR HOUR PRESOAK WAS PERFORMED: ■ YES ☐ NO

HOLE LOGGED BY: JODY MAUS PERCOLATION TEST PERFORMED BY: ROB CAMPBELL

COMMENTS: PERCOLATION READINGS ARE WITHIN 1/16 OF INCH.

PERFORMED BY GEG, Ltd. I, JEFFREY A. GARNESS, CERTIFY THAT THIS WAS PERFORMED IN ACCORDANCE WITH ALL STATE AND MUNICIPAL GUIDELINES IN EFFECT ON THIS DATE: 4/22/15

Municipality of Anchorage
DEPARTMENT OF HEALTH & HUMAN SERVICES
825 "L" Street, Anchorage, Alaska 99502-0650

SOILS LOG — PERCOLATION TEST

STATE OF ALASKA
ENGINEERED SEAL
49th
ROBERT C. COWAN
CE-8801
REGISTERED PROFESSIONAL ENGINEER

PERFORMED FOR: BRUCE VERGASON

DATE PERFORMED: 12/12/95

LEGAL DESCRIPTION: NW 1/4, NW 1/4, SE 1/4 Township, Range, Section: T12N, R3W, SEC. 25

TEST HOLE # 3

DEPTH (FEET)		SLOPE	SITE PLAN
1 -	ORGANICS		N
2 -			
3 -	ML/GP LOOSE SILT W/ SOME GRAVEL		
4 -			
5 -			~400'
6 -			
7 -	▽ 5/2/97 ML DENSE SILT		→ ~130' ←
8 -			TH #3
9 -			
10 -			
11 -			
12 -	B.O.H.		

WAS GROUND WATER ENCOUNTERED? NO

IF YES, AT WHAT DEPTH? –

SLOPE

Depth to Water After Monitoring? 7' DRY Date: 5/2/97 12/21/95

DATE	GROUND WATER LEVEL
9/29/97	DRY
10/15/97	DRY
4/28/98	6 1/2'

Reading	Date	Gross Time	Net Time	Depth to Water	Net Drop
PRESOAK	12/12/95	6:04	–	3 3/4"	–
		6:19	15 MIN	6"	2 1/4"
		6:34	"	7 1/2"	1 1/2"
		6:49	"	9"	1 1/2"
		7:04	"	10 1/2"	1 1/2"

PERCOLATION RATE 10 (minutes/inch) PERC HOLE DIAMETER 6"

TEST RUN BETWEEN 2 1/2 FT AND 3 1/2 FT

COMMENTS

PERFORMED BY: S & S ENGINEERING
17034 Eagle River Loop Road No. 204
Eagle River, Alaska 99577
I [illegible] CERTIFY THAT THIS TEST WAS PERFORMED IN ACCORDANCE WITH ALL STATE AND MUNICIPAL GUIDELINES IN EFFECT ON THIS DATE. DATE: 12/21/95

(Rev. 4-85)

SECTION D

TERRASAT, INC.
4203 Iowa Drive Ave. Anchorage, AK 99517 (907) 344-9370 fax (907) 344-1490
Geological Consulting Environmental Restoration Regulatory Compliance

Ground Water Resource Evaluation for the Proposed Lewis and Clark Subdivision

Prepared for:
Big Country Enterprises, LLC.

Prepared by:
TERRASAT, Inc.
4203 Iowa Drive
Anchorage, AK 99517

February 16, 2017

Contents

Figures

Appendix

1.0 SUMMARY

(Big Country Enterprises, LLC. (Big Country) contracted TERRASAT, Inc. (TERRASAT) to conduct an investigation of hydrogeological conditions at the proposed Lewis and Clark Subdivision (see Figures 1 & 2). In addition, TERRASAT supervised the installation of three new wells and conducted aquifer testing and evaluation as part of the overall study objectives.

The proposed Lewis and Clark subdivision is comprised of approximately 80 acres of undeveloped land on the Hillside area of Anchorage, Alaska. Ten acres of the land in the northwest corner of the parcel may be not included in the final plat for the development. The parcel is bordered on the north by Upper DeArmoun Road, on the east by Canyon Road, on the west by Messinia Street on the south by undeveloped land that lies 500 to 1000 feet up gradient of a segment of Rabbit Creek. Figure 1 shows the site general location and Figure 2 shows the specific site location.

Our investigation of the area water budget concluded that sufficient sustainable ground water is available to supply the proposed Lewis and Clark subdivision land development. An evaluation of area well data suggests at least five separate aquifers exist in the local area. TERRASAT proposes that at least two aquifers will likely be used to extract groundwater for the various lots in the Lewis and Clark development.

Average yield per well for 124 residential wells in an approximate ½ mile area around Lewis and Clark subdivision that were evaluated in this study is 5.09 gallons/minute. Aquifer test results suggest that the average well in the Lewis and Clark subdivision may produce between 7 to as much as 135 gallons/minute. Hydrogeological modeling of the new wells show that the largest impact to a property 200 feet away ranges between 0.0 and 3.08 feet when a well is pumped for up to three hours at 2 gallons per minute, a typical rate. Most of the neighboring wells have more than 200 feet of available static water level in their wells. Therefore, the neighboring wells will continue to function without a significant impact.

2.0 METHODS

TERRASAT conducted a comprehensive groundwater investigation of the area in and around the proposed Lewis & Clark Subdivision using available well logs from the MOA and from the ADNR WELTS databases that were within ½ to ¾ miles from the property of interest. Figure 3 shows the locations of 124 private residential wells whose records were analyzed during the site evaluation conducted by TERRASAT for the proposed Lewis and Clark subdivision.

3.0 GEOLOGY

3.1 Background Information

Several State and Federal reports have documented the generalized geology of the area around and including the proposed Lewis and Clark subdivision. Much of the Upper Hillside area of Anchorage is part of the Chugach State Park and the boundary lies one mile east of the eastern boundary of the Lewis and Clark subdivision. A USGS map report "Generalized Geologic Map of Anchorage and Vicinity, Alaska" by Henry R. Schmoll and Ernest Dobrovolny 1972, shows the surficial geology types, not including a thin layer of organics that is found in many areas, include the following:

- Colluvium (c): Slope deposits on mountain sides and valley walls in lowlands. Consisting of diamicton and poorly sorted to well sorted gravel with some sand, silt or clay. Usually, and in this location, it is found downslope of bedrock.
- Lake and Pond Sediment (l): Near mountains it is chiefly silt and clay with some fine sand, and sand and gravel: it is accumulated in former ice-dammed lakes. In this case, from ice-dammed water flowing down the modern Rabbit Creek channel as seen in Figure 4 south of the property of interest.
- Alluvial Fan Deposits (af): Deposits in alluvial fans or alluvial cones. In this case they are likely from alluvial fan or cone deposits that came down from mountain sides in the area. Consisting dominantly of gravel and may contain some silt and clay. Often, as here, they are found next to and grade into colluvium (c).
- Morainal Deposits (m): Deposits found generally in long ridges marking the merging of former glaciers. Chiefly till.

While beneath the surface, any of the above type deposits may also be found, ultimately at some depth bedrock will be located:

- Bedrock (b): Metamorphic rock, principally McHugh Complex metamorphosed siltstone, greywacke, arkose, conglomerate sandstone, and greenstone. Chert and argillite are often associated with these deposits. This type rock is surely to be found at the Lewis and Clark site, likely at depths no greater than 250 feet bgs.

Figure 4 is a map display of the information contained in the USGS geology map of the area. Figure 5 shows the topographic location of the site and includes the location of a drainage basin divide in the area. Figure 6 below, from Hydrology For Land-Use Planning: The Hillside Area, Anchorage, Alaska, Larry L. Dearborn and William W. Barnwell, USGS Open File Report 75-105 in cooperation with the Greater Anchorage Area Borough shows likely bedrock depths of the Hillside area including the Lewis and Clark site.

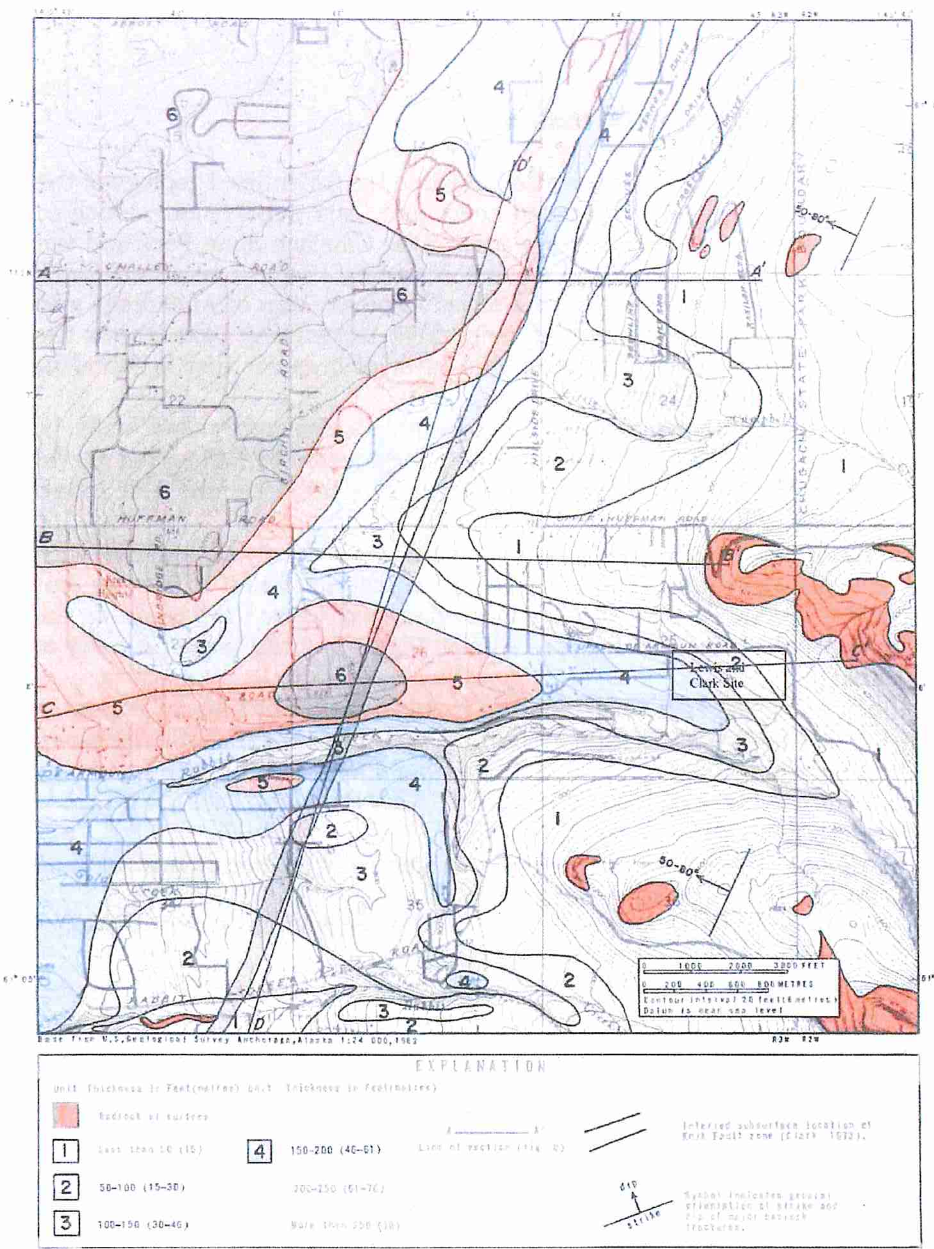


Figure 6. Hillside bedrock depths. (from Hydrology For Land-Use Planning: The Hillside Area, Anchorage, Alaska, Larry L. Dearborn and William W. Barnwell, USGS Open File Report 75-105 in Cooperation with the Greater Anchorage Area Borough)

Note in Figure 6 that bedrock depths across the Lewis and Clark site range from 50 to 200 feet (below ground surface) bgs. This compares favorably to a statistical modeling evaluation by TERRASAT, based on well log data from area wells, that showed depths to bedrock likely will range from between 0 to 158 feet bgs for the up-gradient 2/3 of the property, with greater depths downgradient in a southwestern direction. Insufficient data was available to model the lower 1/3 of the Lewis and Clark site.

Subsequent data collected from the installation of the three new wells (see following sections) in December 2016 has compared favorable to the TERRASAT and USGS bedrock modeling of that specific area of the Lewis and Clark subdivision and confirms the actual bedrock depth at those locations ranges from 43 to 92 feet below ground surface.

3.2 Subsurface Investigations

3.2.1 Pre-Drilling Evaluations

Figure 4 shows the geology of in the area of interest consists of colluvium in the south and in the north, lake and pond sediments that run in the center of the property, and alluvial fan deposits on the east of the property. Percolation test hole logs show peat in the upper 1 to 2 feet, with silty or gravelly fine sands (colluvium or lake and pond sediments) predominant for several feet beneath the upper layers.

Wells in the area are known to be in bedrock in most locations, however to the west of Lewis and Clark several private wells in the Grecian Hills Subdivision are installed in unconsolidated material as is a private well (within the project area) located on the east side of Messina Street. These wells are likely located in the alluvial fan or morainal deposits that are shown in Figure 4, indicating that either or both of those type of deposits may extend further south than the generalized USGS map indicates. This is inferred from the fact that the residential wells directly north of the Lewis and Clark subdivision, which are located in colluvium, are bedrock wells according to well logs, while wells directly west of the Lewis and Clark subdivision are located in unconsolidated material. As one moves from higher to lower elevations in the Hillside area, bedrock is generally found deeper and the percentage of wells in unconsolidated material becomes greater. This effect may become evident within the Lewis and Clark parcel because the land there grades gently downward toward the Rabbit Creek valley which lies south of it.

TERRASAT reviewed the water well data from 124 local wells and reviewed static water levels and elevations, lithology, depths to bedrock, well aquifer type, and other available information including water quality. Appendix A contains much of that information.

3.2.2 Post Well-Drilling Geological Results

Three drinking water well boreholes were drilled in December 2016 through January 2017 . Well logs (Appendix D) show that fractures in bedrock aquifers exist at several depths in the Lewis and Clark Subdivision at those specific locations. These water bearing fractures-zone aquifers are protected from surface activities by at least 100 feet of bedrock aquitard. Bedrock was initially encountered at depths of 43, 51 and 92 feet below ground surface in the three exploratory wells. Those wells were drilled to depths of 398, 256, and 236 feet below ground surface respectively. All three wells were completed in bedrock with water producing fracture zones encountered at several depth intervals. The bedrock was predominately greywacke with numerous hydrothermal veins of quartz and other minerals at various depths. Section 4.2 describes the results of aquifer testing at the three wells.

4.0 HYDROGEOLOGY

4.1 Subsurface and Previous Investigations

Several prior studies describe various aspects of the geology and hydrogeology of the area. TERRASAT used "Hydrology For Land-Use Planning: The Hillside Area, Anchorage, Alaska, Larry L. Dearborn and William W. Barnwell, USGS Open File Report 75-105" in cooperation with the Greater Anchorage Area Borough, to help define the water budget for the area. Another study that was referenced was "Emanuel and Cowing, USGS Open File Report 82-86, Hydrogeology for land-use planning; the Potter Creek Area, 1982, Anchorage, Alaska" in cooperation with the Greater Anchorage Area Borough.

Static water levels at the time of drilling from available well logs were converted to static water elevations above sea level for the area well logs used in TERRASAT's investigation. The static water elevations were then statistically evaluated to differentiate aquifers in the communities surrounding the Lewis and Clark subdivision. Five separate aquifers were delineated for the area.

The western area of the Lewis and Clark subdivision likely contains a thicker section of unconsolidated material above bedrock. At least one confined aquifer likely exists in this unconsolidated material that either does not exist further to the east, or if it exists, is too thin to produce sustainable water supplies. The one water well that currently exists in that area confirms this likelihood.

TERRASAT's investigation found that ancient channels of Rabbit Creek once crossed two locations within or very near the property of interest. Figure 7 shows the locations of these former stream channels. These ancient channels will have altered the subsurface and surface geology in those specific areas, likely creating deposits of alluvium that still exist. These will likely be encountered during development of the area and have a potential to serve as a high yield aquifer.

4.1.1 Local Aquifers and Availability of Water

According to the report; Hydrology For Land-Use Planning: The Hillside Area, Anchorage, Alaska, Larry L. Dearborn and William W. Barnwell, USGS Open File Report 75-105, the groundwater budget for the Anchorage Upper Hillside area containing the Lewis and Clark project area is approximately 10-16 Mgal/day. Figure 8, below depicts the general study area of that Hillside report which closely correlates with the 99516 area code area. Figure 9 shows the water budget in that area.

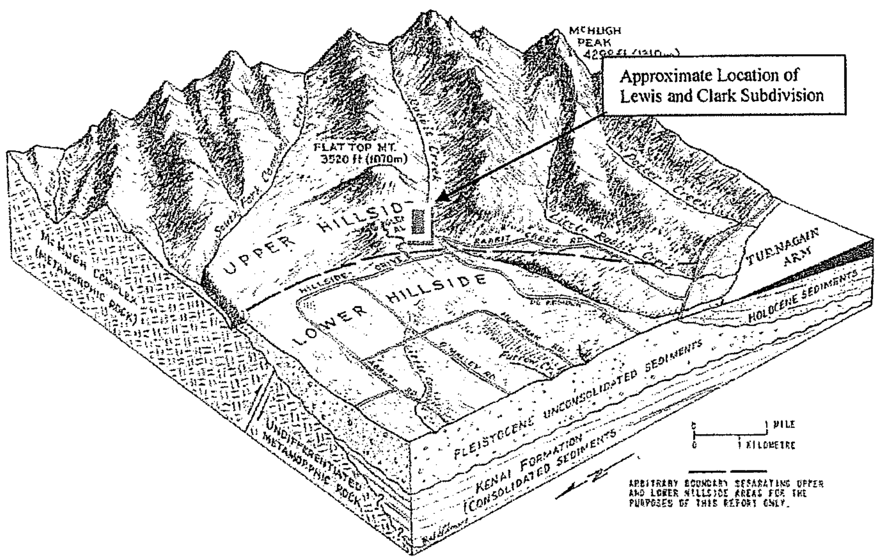


Figure 8. Upper Hillside Area (from Hydrology For Land-Use Planning: The Hillside Area, Anchorage, Alaska, Larry L. Dearborn and William W. Barnwell, USGS Open File Report 75-105 in Cooperation with the Greater Anchorage Area Borough.)

An average home in Anchorage uses approximately 450 gallons per day of water. The MOA census data from 2013 for the Upper Hillside, the area code 99516 area, lists a population of 20,781. If we are to assume that an average house contains four people, then we can assume that the area contains approximately 5195 houses. If 5195 homes use 450 gallons per day then the Upper Hillside area would use 2,337,750 gallons per days of the available 10-16 million gallons. This shows that availability of groundwater is not, at this time, an issue for the Upper Hillside area. The Lewis and Clark subdivision will have approximately 30 houses or less. The daily water consumption for 30 houses at 450 gallons per house equals 13,500 gallons per day. This is a fraction of the 10-16 million gallons per day of available groundwater shown in Figure 9. We conclude that groundwater recharge is abundant for the Lewis and Clark subdivision and surrounding subdivisions.

One-hundred seventeen wells had available data regarding aquifer type for each well. Figure 10 shows the most current static water elevations measured for each well. Some are the measurement taken at the time of drilling and some are taken at a later date, often when the property ownership was being transferred. The results show that five separate aquifers likely exist in the area.

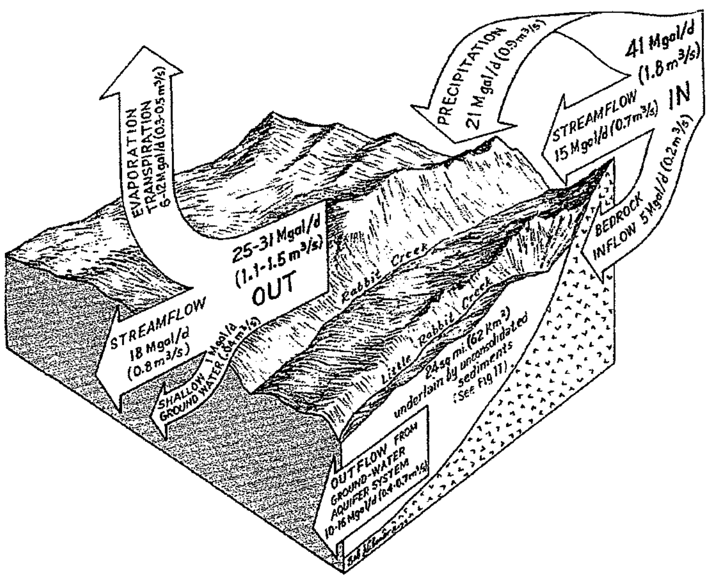


Figure 9. Water Budget of the Upper Hillside area containing the Lewis and Clark project site. (from Hydrology For Land-Use Planning: The Hillside Area, Anchorage, Alaska, Larry L. Dearborn and William W. Barnwell, USGS Open File Report 75-105)

Available well logs show 92 water wells are completed in consolidated rock (bedrock) and twenty-five are competed in unconsolidated (sand and gravel) aquifers. Figure 11 shows static water elevations at the time of drilling. These water levels differentiate aquifers.

Well yields for the 124 area wells show that 92 wells completed in bedrock have a mean yield of 2.7 gpm (see Figure 12). More than 97.5% of the consolidated rock wells produced more than 0.33 gallons per minute at the time of drilling. Figure 12 shows the well yield of all 124 wells, including the wells completed in unconsolidated material. Average yield per well for 124 residential wells in an approximate ½ mile area around Lewis and Clark subdivision that were evaluated in this study is 5.1 gallons/minute.

A four bedroom house requires about a third of a gallon per minute without the need for a holding tank. We conclude that adequate groundwater resources are available for the Lewis and Clark Subdivision with a planned density of R-6 lots.

Most homes use less than 450 gallons per day, or 0.3 gallons per minute, while most area wells produce more than 3 gallons per minute and, as Figure 12 shows, the area bedrock aquifer is capable of producing as much as 20 gallons per minute.

4.2 Well Installation and Aquifer Test Results at Lewis & Clark

Three wells were drilled on three contiguous lots in December of 2016 and January of 2017. The contiguous lots were selected so that aquifer tests could determine likely impacts to nearby wells. Well were spaced approximately 180 feet apart. These lots are typical of lots within the subdivision. Wells were drilled to depths of 393, 256, and 236 feet below ground surface. These wells were completed in bedrock. Figure 13 shows the locations of three wells installed at Lewis and Clark. Initially, step tests were performed at each well to determine the maximum rate at which each could be pumped for the 24 or 6 hour tests, without causing rapid or significant drawdown to the observations wells. These observation wells acted as proxy wells for neighboring wells.

The wells were also monitored for diurnal-antecedent water level fluctuations. Well LCW-1 is an artesian flowing well and was constantly flowing during manual observations taken several times during the January to February well drilling and aquifer testing program. Only during pump testing of LCW-2 did the water level fall temporarily below the top of the casing. Wells LCW-2 and LCW-3 were instrumented with pressure transducers for one 24 hour period. Well LCW-2 showed 0.137 ft. (1.64 inches) of water level fluctuation while well LCW-3 showed 0.8 ft. (9.6 inches) of fluctuation. From past experience, these results were not deemed great enough to affect the AqteSolv data evaluation of the aquifer pump testing, and the dataset was therefore not modified before evaluating the results.

Aquifers were tested following ASTM standards. Two wells were tested with a 24-hour continuous discharge test and one well was tested with a 6-hour continuous discharge test. Each well was allowed to recover for the same duration as the drawdown testing. Aquifer test results show that each well is capable of providing adequate water supplies and that the impact to wells on adjacent lots will be insignificant. The basic well and aquifer test results and information for each well are listed below.

LCW-1

- Total Depth (ft. top of casing) : 393
- Depth of Casing (ft. bgs) : 65
- Depth to Bedrock (ft. bgs) :43 fractured/weathered – 62 fully consolidated
- Static Water Level (ft. top of casing) : Flowing
- Static Water Level Elevation (ft AMSL) :
- Diurnal Antecedent Water Fluctuation (ft.): 0
- Casing Height Above Ground Surface (ft.) : 2.0
- Maximum Potential Yield (gpm) : 135
- Drawdown at 200 Radial Feet (@3gpm/2Hrs.) (ft.) : 0
- Recovery After 6 Hours (ft.): 100%

LCW-2

- Total Depth (ft. top of casing) : 256
- Depth of Casing (ft. bgs) : 53
- Depth to Bedrock (ft. bgs): 52
- Static Water Level (ft. top of casing): 18.5
- Static Water Level Elevation (ft. AMSL) :
- Diurnal Antecedent Water Fluctuation (ft.) : 0.137
- Casing Height Above Ground Surface (ft.) : 2.6
- Maximum Potential Yield (gpm) : 34
- Drawdown at 200 Radial Feet (@3gpm/2Hrs.) (ft.) : 5.1
- Recovery After 24 Hours (ft.): 100%

LCW-3

- Total Depth (ft. top of casing) : 236
- Depth of Casing (ft. bgs) :100
- Depth to Bedrock (ft. bgs) : 92
- Static Water Level (ft. top of casing) : 55
- Static Water Level Elevation (ft. AMSL)
- Diurnal Antecedent Water Fluctuation (ft.) : 0.8
- Casing Height Above Ground Surface (ft.) : 2.0
- Maximum Potential Yield (gpm) : 9.5
- Drawdown at 200 Radial Feet (@3gpm/2Hrs.) (ft.) : 0
- Recovery After 24 Hours (ft.) : 96%

The maximum potential yields listed above refers to the rate at which the well could be continuously pumped before 100% of the available drawdown would be reached. These test data show that abundant water is available for planned wells in the Lewis and Clark subdivision. The average Anchorage household well would need to be pumped at a rate of 0.31 gpm continuously, when equilibrating this rate to the average daily household usage of 450 gallons/day. The maximum rates listed for the wells above are therefore far above the range of expected normal rates. They indicate that much more water is available than will ever normally be used.

For the Lewis and Clark subdivision, 200 lateral feet is the approximate distance between planned wells on separate lots. That hydrogeological modeling of the new wells show that the largest drawdown impact to a property 200 feet away ranges between 0 and 3.08 feet when a well is pumped for up to three hours at 2 gallons per minute, a typical rate. The individual well data are listed below:

- Based on the aquifer test data for well LCW-1, pumping at 3 gpm for 2 hours will result in drawdown of 0.0 feet at a distance of 200 ft.
- Based on the aquifer test data for well LCW-2 pumping at 3 gpm for 2 hours will results in drawdown 3.08 ft. at a distance of 200 feet.
- Based on the aquifer test data for well LCW-3 pumping at 3 gpm for 2 hours will results in drawdown of 0.0 ft. at a distance of 200 feet.

Most wells in the Lewis and Clark Hillside area contain at least 200 feet of available drawdown. A well 200 feet away from well LCW-2 would draw down 3.08 feet, which leaves 98.46% of the available water. The drawdown is temporary and recharge begins as soon as pumping is discontinued. Pumping of the other two wells would have no drawdown effect for wells 200 feet away.

Recharge rates as listed above show that all three wells attain 96% to 100% recharge in the same amount of time or less time than they were pumped during aquifer testing. Well LCW-3 (96%) is the only well that did not achieve 100% recharge in the same time period as the pump test, and it is also the well with the highest (0.8 feet) amount of normal daily water level fluctuation.

Based on static water level elevations of the three new wells and laboratory water chemistry results (see Table 1), we conclude that at least two bedrock aquifers exist beneath the Lewis and Clark subdivision. Further, based on observations made during the aquifer testing procedures we conclude that partial connectivity exists between all three wells. Wells LCW-2 and LCW-3 exhibit a higher degree of connectivity than does LCW-1 to either of the other two wells.

5.0 ENVIRONMENTAL CONSIDERATIONS

5.1 Existing Contaminants

The proposed Lewis and Clark subdivision is an undeveloped forested parcel. Site inspections by TERRASAT have found no potential contaminants or environmental concerns that currently exist on the property. Potential contaminants and environmental considerations that are commonly associated with development are discussed below. A discussion of the potential for the Lewis and Clark development to affect adjoining or nearby properties is included for each topic of concern. The potential effect of potential contaminants on aquifers that supply drinking water is discussed in section 5.2.5.

5.1.1 Water Quality at Lewis and Clark

Water samples were collected from the three new wells drilled in January of 2017. The samples were analyzed for Calcium, Iron, Manganese, Total Dissolved Solids (TDS), and total Nitrogen by Nitrate-Nitrite. Table 1 lists the results of the water sampling. Water quality from the three wells complies with primary drinking water standards for the parameters tested. Iron and manganese exceeds the secondary drinking water standards in some wells, based on desirability of drinking water. Iron or manganese treatment could be employed to reduce these metals from the water supply.

Table 1. Results of Water Sampling in January 2017

	Sample Collection Date	Calcium (ug/L)	Iron (ug/L)	Manganese (ug/L)	TDS (mg/L)	Nitrate-Nitrite-N (mg/L)
Drinking Water Standard		NA	NA	NA	NA	10
'Secondary Drinking Water Standard		NA	300	50	500	NA
Well ID						
LCW-1	1/31/17	27000	1330	57.3	246	1.12
LCW-2	1/25/17	54900	ND (DL=78.0)	4.67	286	1.83
LCW-3	1/30/17	43300	ND (DL=78.0)	59.0	291	0.0378

NA refers to non-applicable items. ND refers to an analyte that was analyzed for but was not detected at a level above the detection limit. Calcium is not a regulated or secondary parameter of water quality in Alaska. Secondary Standards are not regulated by law but are used to suggest good or desirable water quality. DL=Detection Limit

5.2 Potential Contaminants

TERRASAT, Inc. considered potential contaminants that could be introduced to the property as a result of development. Contaminants typically associated with residential development include pesticides and herbicides, automotive wastes, de-icing chemicals, nutrients, and bacteria and viruses.

5.2.1 Pesticides and Herbicides

Pesticides and herbicides are likely to be used in small quantities in residential developments. Pesticide use in Anchorage is even less than other parts of the country because we have fewer pests and a short growing season. Both pesticides and herbicides have an affinity for carbon and, therefore, are not mobile in carbon-rich environments. This reduces their capability for overland flow and soil infiltration. This means that pesticides and herbicides will likely remain in root mass, leaf mass, or within the root zone, where they will be trapped and naturally degraded. In the Lewis and Clark development, large lawns or garden areas are not likely to be created by the new owners as the large lot concept that is planned retains most of the currently existing vegetation and trees. This will result in even lower amounts of pesticides and herbicides than an average Anchorage home that is located in the bowl area.

5.2.2 Automotive Wastes

Several types of contaminants are commonly associated with automotive waste. These include hydrocarbons (gasoline or diesel fuels, oils, grease etc.), metals (lead, copper zinc, and cadmium), and antifreeze. These contaminants are typically released to driveways and roadways and are transported in storm water. Storm water in this development will be treated using grassy swales and bio-filtering, will follow Best Management Practices, and will follow the Municipality of Anchorage Storm Water Treatment Plan Review Guidance Manual. This type of treatment is common in other Upper Hillside subdivisions, where the Municipality of Anchorage's Municipal Separate Storm Sewer System (MS4) does not reach at this time.

The treated storm water will then be discharged into Rabbit Creek and eventually to Cook Inlet as does all of Anchorage's storm water. Stormwater monitoring in other, higher-density subdivisions within the Municipality of Anchorage show that contaminants from automotive waste seldom if ever reach major conveyances. The amount of automotive waste transported in storm water is expected to be minimal and insignificant.

5.2.3 De-Icing Chemicals

The Municipality of Anchorage uses Magnesium Chloride as an anti-icing and de-icing agent on some roadways in Anchorage. Common de-icing chemicals used by residents on walkways and driveways are sodium chloride and calcium chloride. These chemicals may be applied in small quantities and would be significantly diluted by melting snow and rainwater prior to entering the storm water outflow. Low concentrations of de-icing chemicals will be removed with bio filtration.

5.2.4 Nutrients

Based on the ADEC Guidance Manual for Class A Public Water Systems and the development plan for Lewis and Clark, we determined that the most likely sources for nutrients would be leaking septic systems, lawn fertilizer, and animal waste. The nutrients that could have the greatest impact on water quality are nitrogen and phosphorus. The fate and transport of nitrogen is described in section 5.3.2 below. Phosphorus, and phosphates, complex with calcium in soil and become insoluble, thus they are less mobile than nitrates. Likewise, nutrients will be filtered by soil or used by the lawns and will be taken up by plants or immobilized within the root zone.

5.2.4.1 Septic Systems

Although there is little evidence of the water table aquifer being used to supply drinking water in the general area, one does exist throughout the area. Septic systems and leach fields within the Lewis and Clark subdivision will be installed above the shallow unconsolidated water table aquifer that exists there. The shallow water table aquifer is distinctly different from the confined unconsolidated or confined bedrock aquifers. The shallow water table aquifer is likely recharged in part from bedrock fractures. The shallow water table is not a known source of potable water for the surrounding community. Septic systems within the Lewis and Clark subdivision will use advanced treatment systems. The results are discussed in section 5.3. In summary, the shallow water table will be protected from microorganisms and nitrates.

5.2.4.2 *Lawn Fertilizer*

The Lewis and Clark development includes large lots that are likely to remain mostly forested with the original vegetation and small lawn space. Because of this, we expect that the nitrate loading to the water table aquifer due to leachate from lawn fertilizer and animal waste will be below laboratory detection limits. The process of fertilizer fate and transport in soil explains why ground water in the Upper Hillside area is not susceptible to nitrate contamination from lawn fertilizer.

The lawn fertilizer often contains a soluble form of nitrogen known urea. Urea is composed of carbon, oxygen, nitrogen and hydrogen. The urea is converted to ammonia and carbon dioxide. Some of the ammonia is lost as gas to the atmosphere. The remaining ammonia is converted to positively charged ions that attach to negatively charges soil grains. Soil bacteria then convert the ions into nitrate through a process called nitrification. The nitrogen, as nitrate, is now a in a form that is useable by plants and soil microbes. Four main processes remove nitrogen from the soil. Most nitrogen is bound in organic matter, is used by plants, or is used by bacteria and released to the atmosphere as nitrogen gas. The remaining nitrogen, as nitrate, that escapes the root and humic zones is available to leach through the soil. The amount of nitrate available to leach through the soil is reduced further as some of it is immobilized by organic sources below the root zone. Tight soils that slow or prevent the infiltrations of water also prevent the vertical migration of nitrate to the aquifer.

The minimum uptake of nitrogen by nine common grass species is 125 pounds/acre/year (Croste, 1997). The minimum uptake of nitrogen by the most popular grass seed mix sold by Alaska Mill and Feed (Fescue and bluegrass) has a minimum uptake of 158 pounds/acre/year and an average uptake rate of 211 pounds/acre/year. According to several university extension services, typical nitrate application rates for urban lawn range from 43 to 174 pounds/acre/year. Hillside Lawn and Snow, an Anchorage lawn maintenance company, reported their normal nitrate application rate to be less than 70 pounds/acre/year. Alaska Mill and Feed recommends applying nitrogen at a rate of 194 pounds/acre/year. The average uptake rate is greater than the expected application rate of nitrate in lawn fertilizer for a typical Anchorage lawn. Furthermore, some nitrate will be immobilized by organic matter and some will be denitrified. This suggests that no nitrate added during lawn fertilization will be able to reach the water table aquifer by leaching through soil in the root zone.

Several researchers have looked at nitrate leaching beneath urban lawns under various conditions. Gold *et al* (1990) looked at nitrate leaching from residential and agricultural land uses. He found that with an application rate of 218 pounds/acre/year only 4% of the applied nitrate leached in the first year of the study. The second year of the study less than 1% leached through the top 8 inches of the soil profile. Geron *et al.* (1993) looked at nitrogen leaching from seeded and sodded turf-grass under different a fertilizer programs. Using an application rate of 194.5 pounds/acre/year, he found that in the first year after establishment 26% and 28% leaches from seeded and sodded plots respectively. By the second year of the study, leaching decreased to 3.5% and 11% respectively. He concluded that "the results for the second year are more representative of a stable turf-grass environment". These studies demonstrate that even exceeding the recommended/average application rate, nitrate leaching from lawn fertilizer decreases rapidly as the sod/roots develop. A judiciously managed phased approach to fertilization during lawn establishment will greatly reduce first year nitrogen leaching.

5.2.5 Effect of Surface Contaminants on Water Supply Aquifers

The above descriptions of surface contaminant fate and transport show that most contaminants will not reach the water table. Lawns and the use of fertilizers are minimal on Anchorage R-6 zoned lots on most of the Upper Hillside. Pesticide and herbicide use on R-6 zoned lots will likely be minimal and completely insignificant. Thus, the limited use of these types of contaminants reduces the risks of water table contamination to nearly zero. Natural vegetation and soil microbes will further protect the upper water table aquifer.

Available well logs and data show that 92 water wells are completed in consolidated rock (bedrock) and twenty-five are competed in unconsolidated (sand and gravel) aquifers. Based on well static water elevations, at least five separate aquifers are being used to supply water to area wells. These do not include the water table aquifer. High static water levels in the surrounding subdivisions suggest the dominant recharge of the water table aquifer is from water migrating upward from rock fractures.

5.3 Nitrate Fate and Transport Modeling

5.3.1 ATS Systems

The Lewis and Clark development plans to use Advanced Treatment Systems (ATS) for the septic systems on all lots. These systems significantly reduce nitrate effluent using a filter media and biodegradation processes. The filter media reduces virus and bacteria outflow by 99% more than conventional systems. The likelihood of leachate migrating offsite is extremely low to non-existent. The more relevant concern is migration within the Lewis and Clark development, specifically to water well aquifers on downgradient lots.

Nitrates from septic systems, as with other compounds, have distinct migration characteristics depending on the media and physical conditions through which it passes. TERRASAT used analytical mathematical modeling techniques to determine the distances and rates at which nitrates are likely to move through the soils at the proposed sites. Of particular concern are water well distances from nitrate sources. Surface water, such as Rabbit Creek, were also considered in the modeling process.

5.3.2 Nitrate Fate and Transport

TERRASAT evaluated existing percolation test results, surface topography, water well logs, distances to property boundaries, and distances to active drainages. Sixteen water well logs from surrounding subdivisions provided the basis to determine the thickness of the shallow water table aquifer. We created two appropriate mathematical models to evaluate the fate and transport of nitrogen from the proposed advanced nitrate reducing septic systems. We modeled total nitrogen, which includes nitrates. We found that nitrogen, at the local creek, 430 feet away from the nearest lot, would be less than 0.07 mg / liter. This model assumes that no biological processes denitrify the nitrate between the source and the receptor, in this case Rabbit Creek. Denitrification does occur in aquifers, breaking down the nitrate molecule into nitrogen gas and oxygen. Denitrification by heterotrophic bacteria will occur, with published removal rates in excess of 0.01 mg per liter per day and as much as 0.44 m/l per day. Travel time from the nearest leach field to Rabbit Creek is over 112 days. That means at least I milligram/liter of nitrogen will be denitrified, converted to nitrogen gas, before it reached the creek. Therefore, we conclude that measurable nitrates will not reach Rabbit Creek from septic systems within the Lewis and Clark subdivision. Appendix B contains the worksheets and results of the nitrate fate and transport model.

TERRASAT concludes that septic nitrate migration to other properties or to Rabbit Creek is highly unlikely, based on modeling results, the use of ATS systems, and taking into consideration the topographic slopes of the Lewis and Clark property.

5.4 Bacteria and Pathogen Removal Modeling

TERRASAT considered the potential migration of five different pathogenic bacteria from a proposed leach field. The bacteria are:

- *E. Coli* bacteria
- *Enterococci* bacteria
- Fecal *streptococci* bacteria
- *Salmonella* bacteria

- *Shingella* bacteria

Bacteria and viruses are primarily removed from ground water by the process of attachment and deactivation, where attachment (think straining) is the dominant process. The Manual of Design for Slow Sand Filtration (1999) states that 97% of coliform bacteria are removed within the first meter (approximately 3 feet) of sand filtration beneath a leach field. More recent studies (Morales, et al, 2014) found removal rates of 99.99% removal of bacteria and 99.99% removal of viruses for drinking water (Predicting Attenuation of Viruses During Percolation in Soils, August, 2002)

These studies suggest that more than 99.99% pathogenic organism are removed from septic leachate before the effluent reaches groundwater. Ignoring the primary attachment process, we calculate that 99% *E. Coli* bacteria that could reach groundwater will be deactivated within 51 feet of the leach field. We conclude that the MOA separation distance of 100 feet from a leach field to a domestic water well is much more than adequate. We also conclude that pathogenic organisms will be deactivated before they can reach a lot boundary.

In conclusion, the MOA separation distance of 100 feet from a leach field to domestic water well is adequate in this subdivision and the local stream is also protected. Most lots are at least 1,000 feet from the stream and the closest lot is more than 430 feet (leach field) to the stream. Appendix B contains the deactivation models for bacteria and pathogens.

6.0 AERIAL PHOTOGRAPHIC EVALUATION OF TERRAIN

TERRASAT evaluated aerial photographs of the area to interpret site drainage and topography.

6.1 Surface Drainage

Surface drainage of the Lewis and Clark parcel is currently overland in an approximate southwestern direction as is moves downgradient toward one of the branches of Rabbit Creek. This was also verified by onsite inspections. A historic segment of Rabbit Creek was discovered that existed along the eastern border area of the parcel. Figure 7 shows this segment. This was verified by investigating older maps and documents and TERRASAT found that this segment was likely changed when Canyon Road was constructed.

6.2 Site Topography

Lewis and Clark subdivision is situated in a low point topographically compared to properties northeast and east of it. Some properties to the northwest lie cross gradient (on the approximate same elevations) as portions of Lewis and Clark. A very small portions of land to the southwest lies downgradient of the property of interest. Finally, while no land is developed in that area, the land directly south of

Lewis and Clark is downgradient of the development. Rabbit Creek prevents surface flow from moving south beyond Rabbit Creek as is accepts any runoff from up-gradient areas.
Figure 5 shows this relationship.

7.0 CONCLUSIONS

TERRASAT was concerned about the sufficiency of groundwater to support the Lewis and Clark subdivision. We were also concerned about what impact water wells would have on the new subdivision and on the surrounding neighboring water wells. We found that more than 10 million gallons per day of groundwater flows through this area of the south Anchorage hillside, far in excess of what the existing community uses. We found that groundwater recharge is from several watersheds south and east of this proposed development. TERRASAT concludes that *recharge* is expected to remain abundant and far in excess of the demands of residential use.

Available water well logs and a statistical analysis show that the community within a half mile of the Lewis and Clark subdivision exploits groundwater from at least five different aquifers. Recharge for these aquifers are up-gradient from the Lewis and Clark subdivision. Therefore, TERRASAT also concludes that, drinking water *quality* is expected to remain unaffected by the new land development.

Based on static water level elevations of the three new wells and water chemistry laboratory results we conclude that at least two bedrock aquifers exist beneath the Lewis and Clark subdivision. Further, based on observations made during the aquifer testing procedures we conclude that partial connectivity exists between the three wells. Wells LCW-2 and LCW-3 exhibit a higher degree of connectivity than does LCW-1 to either of the other two wells.

Test data shows that maximum well yield is in the range of 7.4 gpm to 135 gpm for the three water wells recently completed. Wells in this subdivision are expected to use an average of 0.31 gallons per minute. We predict that the drawdown 200 feet away will be up to 3.08 feet, an insufficient amount to impact the neighboring lots. Recharge is expected to be complete within minutes to several hours after the pumps are off, meaning the small, insignificant impact will only last for several minutes. Therefore, we conclude that impact to wells on adjacent lots will be insignificant.

TERRASAT evaluated the concern that other nearby subdivisions have a significant nitrate problem in their aquifers. Two reports about nitrates exist for this area. Both reports state that nitrate levels are low and are not concerning. TERRASAT evaluated newer data from the Municipality of Anchorage. We found low levels of nitrate exist and conclude that the newer data is consistent with the previous reports. We found that nitrate concentrations increased in some subdivisions and decreased in others. We further conclude that rates of increase are low and consistent with past information.

TERRASAT also evaluated the vulnerability of Rabbit Creek from development of the subdivision. Several community members expressed concern that nitrates from septic systems could have a negative impact to the water quality of the creek. We conducted mathematical modeling to evaluate the fate and transport of nitrates from proposed septic systems. Specifically, we modeled the septic system that would be closest to the creek. The results show that in a worst-case scenario, nitrate would reach the creek at a concentration of 0.07 milligrams per liter. However, this assumes that no denitrification occurs. Denitrification by heterotrophic bacteria will occur, with published removal rates[1] in excess of 0.01 mg per liter per day and as much as 0.44 mg/l. Travel time from the nearest leach field to Rabbit Creek is over 112 days. That means at least 1 milligram/liter of nitrogen will be denitrified, converted to nitrogen gas, before it reaches the creek. Therefore, we conclude that measurable nitrates will not reach Rabbit Creek from septic systems within the Lewis and Clark subdivision.

TERRASAT investigated the concern of several community members that nitrates from the Lewis and Clark subdivision could impact their water supply. Soils within the Lewis and Clark subdivision will, for the most part, support conventional septic systems. However, as good citizens and protectors of the environment, the developers are proposing to use advanced nitrate reducing septic treatment systems, reducing nitrate output by a factor of three from conventional systems. The ultimate fate of the nitrates after leaving the leach field is that they will ultimately reach the upper water table. In the upper water table, heterotrophic bacteria will denitrify the nitrates into nitrogen gas and nitrous oxide gas. We modeled nitrate migration to the nearest lot line in the water table. Nitrate concentrations will be less than 0.1 mg per liter at the lot boundary, minus the amount removed by denitrification, which could easily be 0.5 mg per liter. TERRASAT concludes therefore that nitrates will not likely reach an adjacent lot.

TERRASAT examined other potential impacts to the environment, such as stormwater runoff towards Rabbit Creek, pesticide use and the existence of wetlands. This low-density land development is expected to protect the natural resources and surrounding communities. We conclude that the preservation of the existing wetlands will allow the distinct existing biological communities to continue their function of treating stormwater and protecting Rabbit Creek water quality.

[1] Morales Parra, Ivan, "Modeling Onsite Wastewater Treatment System Contaminants in Current and Climate Changing Conditions" (2015). *Open Access Dissertations*. Paper 376. pg118.

Please contact us at (907) 344-9370 if you have any questions or would like further information.

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Dan Young
Principal,
CPG, #7811

Figure 1
General Location of Proposed
Lewis and Clark Subdivision

For: Big Country
Enterprises, LLC.

By: Terrasat, Inc.
Date: 4/11/16

Figure 2
Specific Site Location of Proposed Lewis and Clark Subdivision

For: Big Country Enterprises, LLC.

By: Terrasat, Inc.
Date: 4/11/16

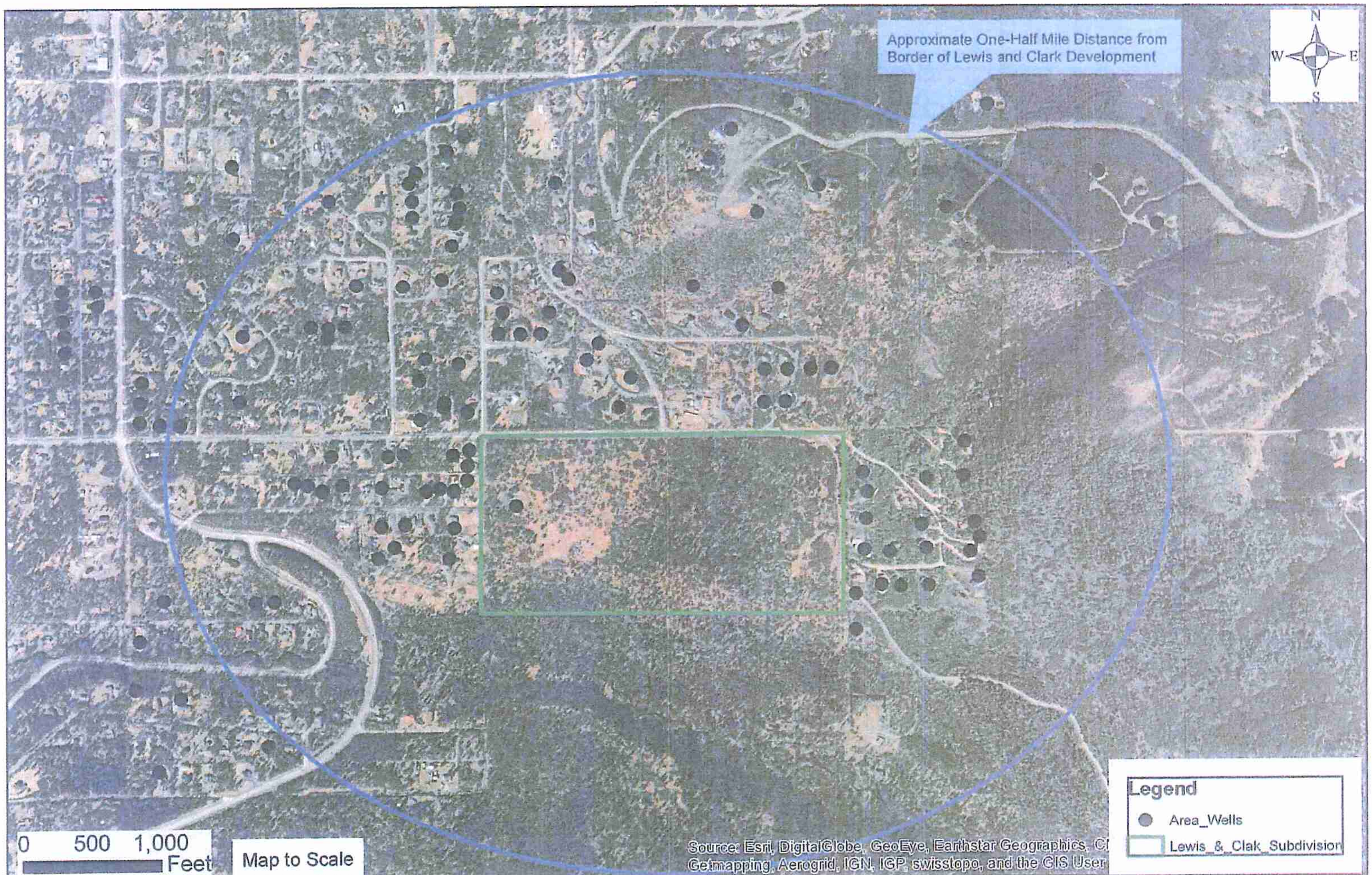
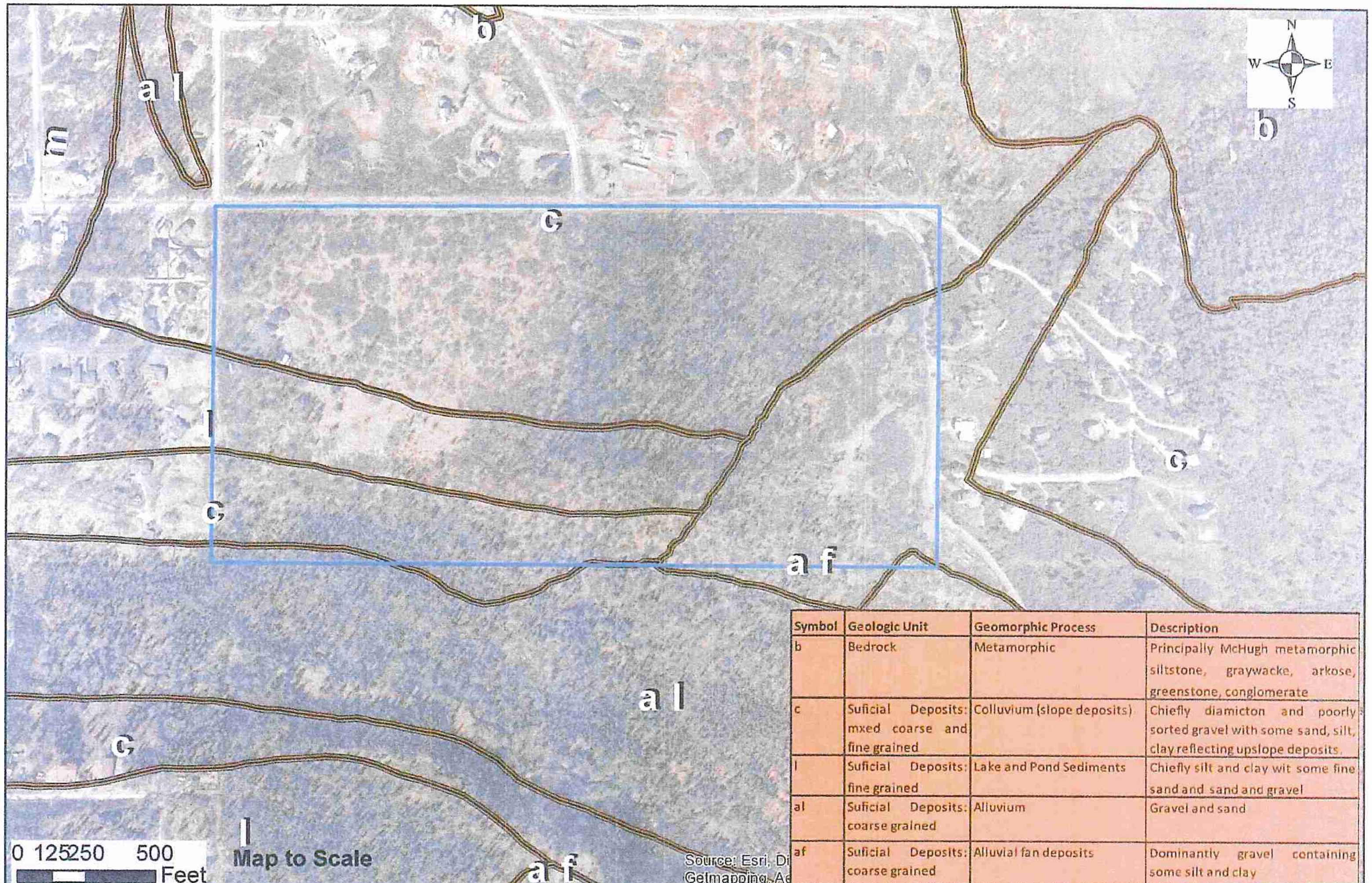


Figure 3. Locations of Area Residential Water Wells Whose Records Were Used in the Site Evaluation for Lewis and Clark	For: Big Country Enterprised, LLC.	By: Terrasat, Inc. Date:11/4/16



Symbol	Geologic Unit	Geomorphic Process	Description
b	Bedrock	Metamorphic	Principally McHugh metamorphic siltstone, graywacke, arkose, greenstone, conglomerate
c	Suficial Deposits: mxed coarse and fine grained	Colluvium (slope deposits)	Chiefly diamicton and poorly sorted gravel with some sand, silt, clay reflecting upslope deposits.
l	Suficial Deposits: fine grained	Lake and Pond Sediments	Chiefly silt and clay wit some fine sand and sand and gravel
al	Suficial Deposits: coarse grained	Alluvium	Gravel and sand
af	Suficial Deposits: coarse grained	Alluvial fan deposits	Dominantly gravel containing some silt and clay

Figure 4 Geology of Proposed Lewis and Clark Subdivision and Surrounding Area	For: Big Country Enterprises, LLC.	By: SCS Terrasat, Inc. Date: 10/11/16

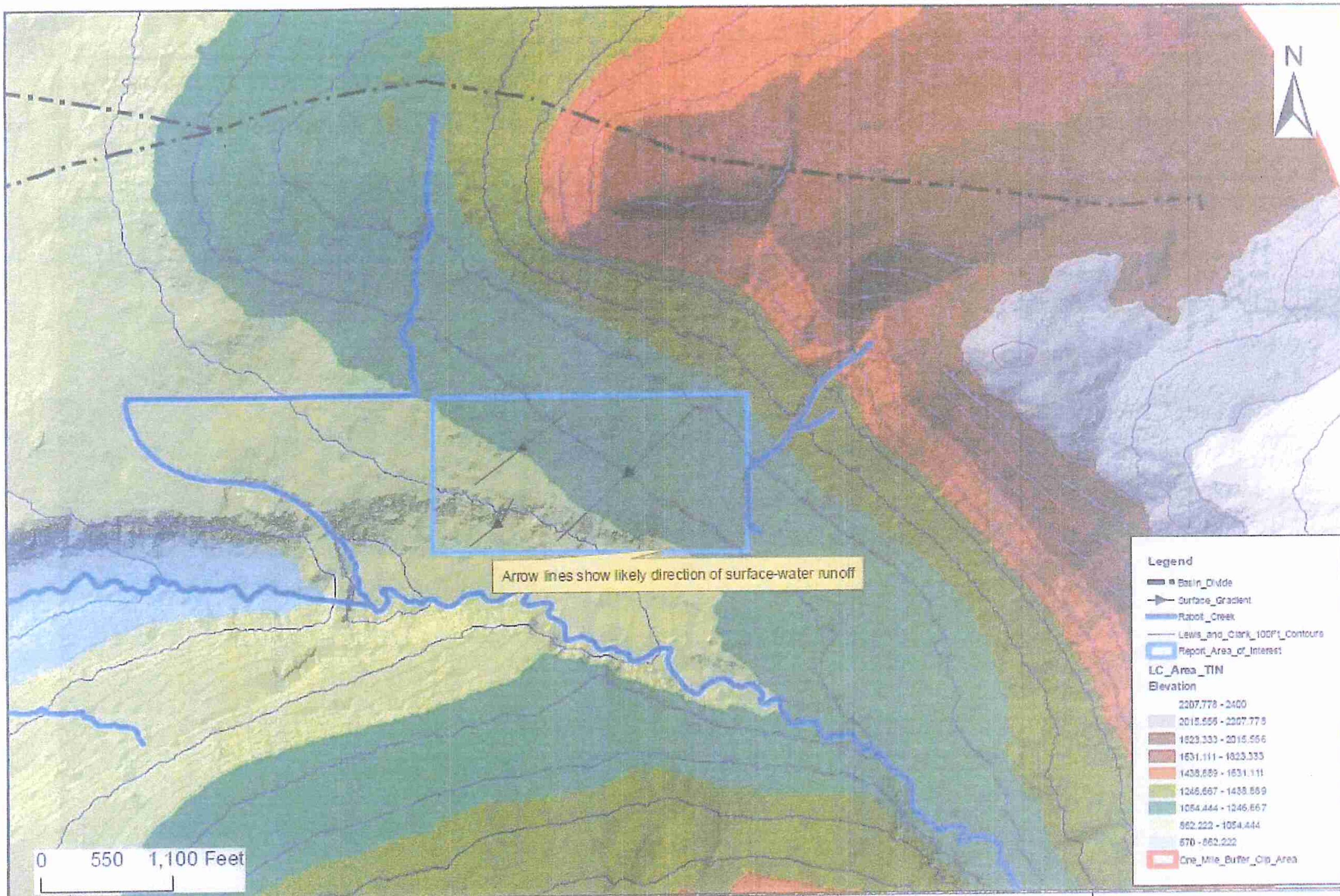


Figure 5
Shaded Relief Topographic Map Showing General Surface Gradient of the Project Area and a Nearby Water Basin Divide

For: Big Country Enterprises, LLC.

By: SCS
Terrasat, Inc.
Date:10/11/16

Figure 7 Ancient Channels of Rabbit Creek Through and Adjacent to Lewis and Clark Project Area	For: Big Country Enterprises, LLC.	By: Terrasat, Inc. Date:8/26/2016

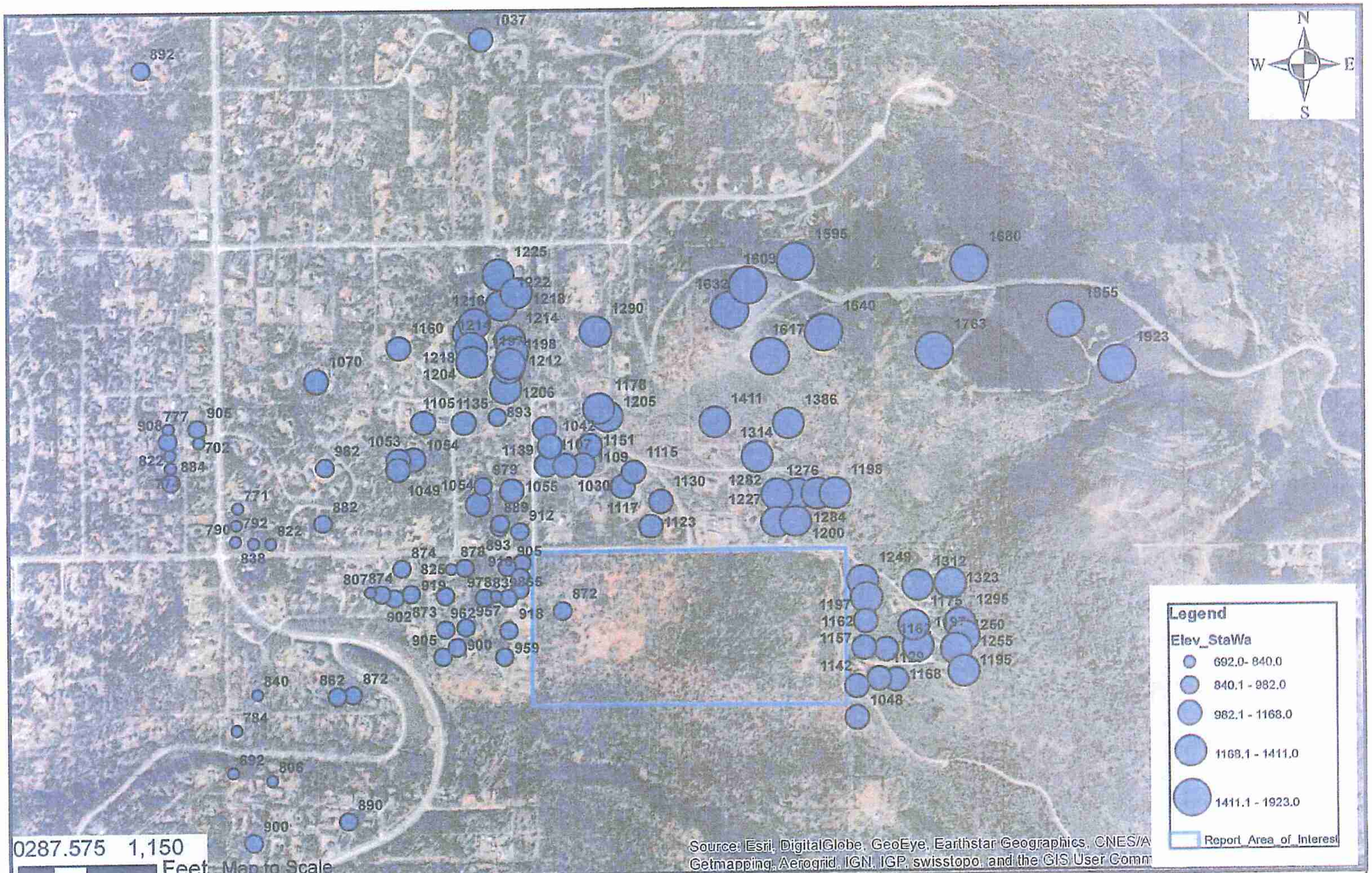


Figure 10
Static Water Elevations of Private Wells in
Study Area Showing Evidence of Multiple Aquifers

For: Big Country
Enterprises, LLC

By: SCS
Terrasat, Inc.
Date: 9/29/16

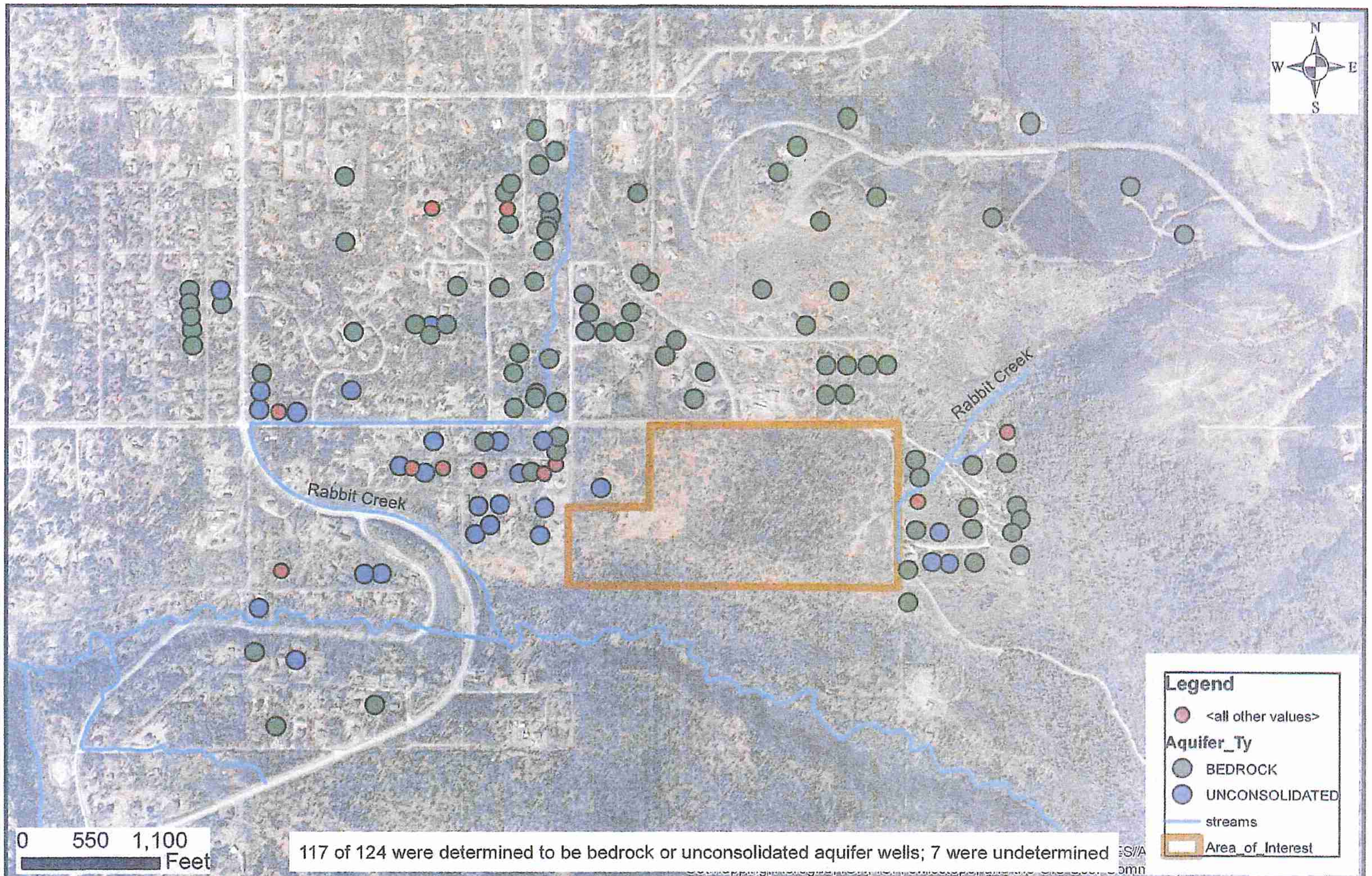


Figure 11 Aquifer Types for Water Wells in Project Area	For: Big Country Enterprises, LLC.	By: Terrasat, Inc. Date: 4/7/16

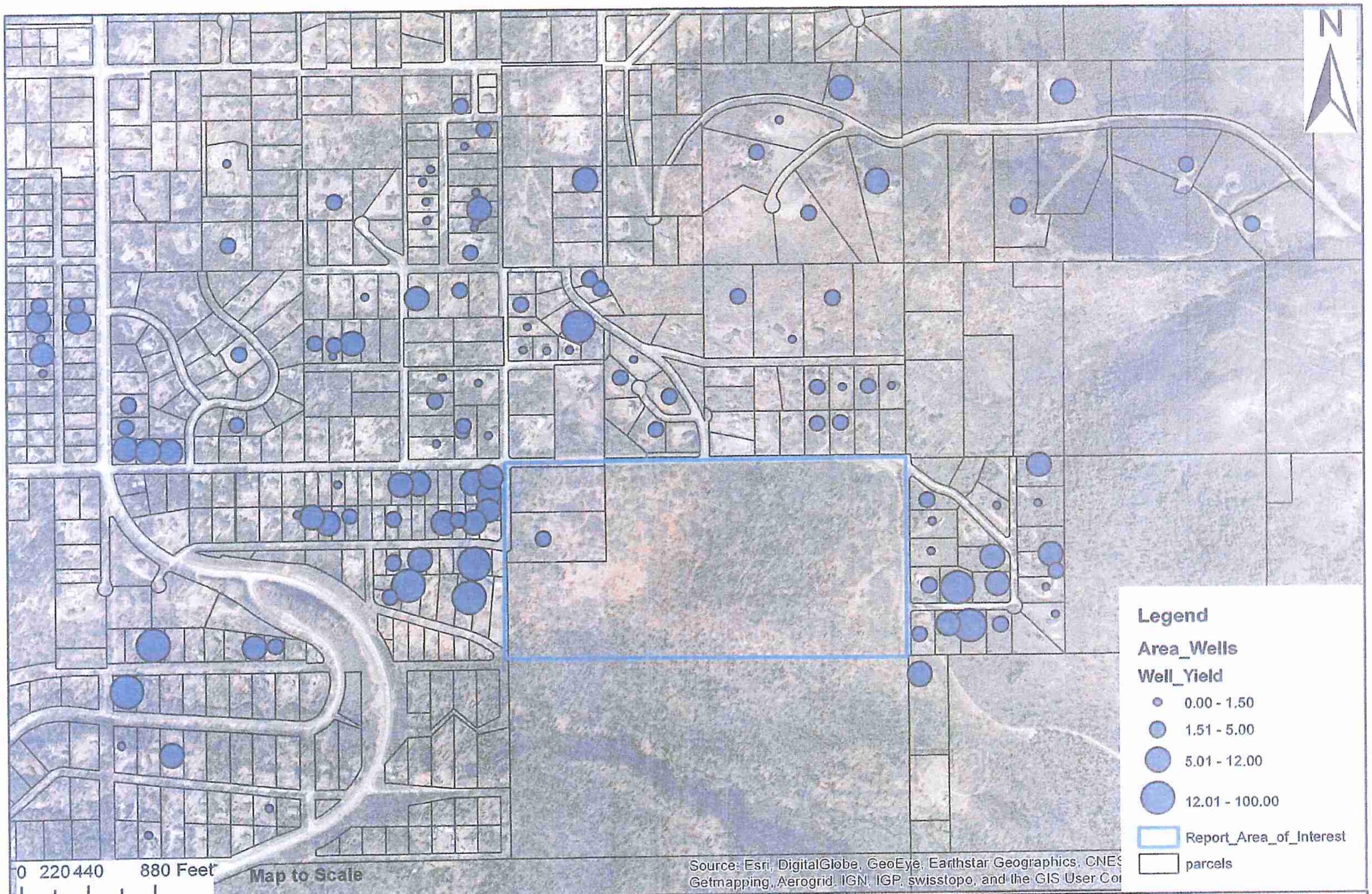


Figure 12 Well Yields as Reported By Well Driller for Residential Wells in Area of Lewis and Clark	For: Big Country Enterprises, LLC	By SCS Terrasat, Inc. Date: 9/21//2016

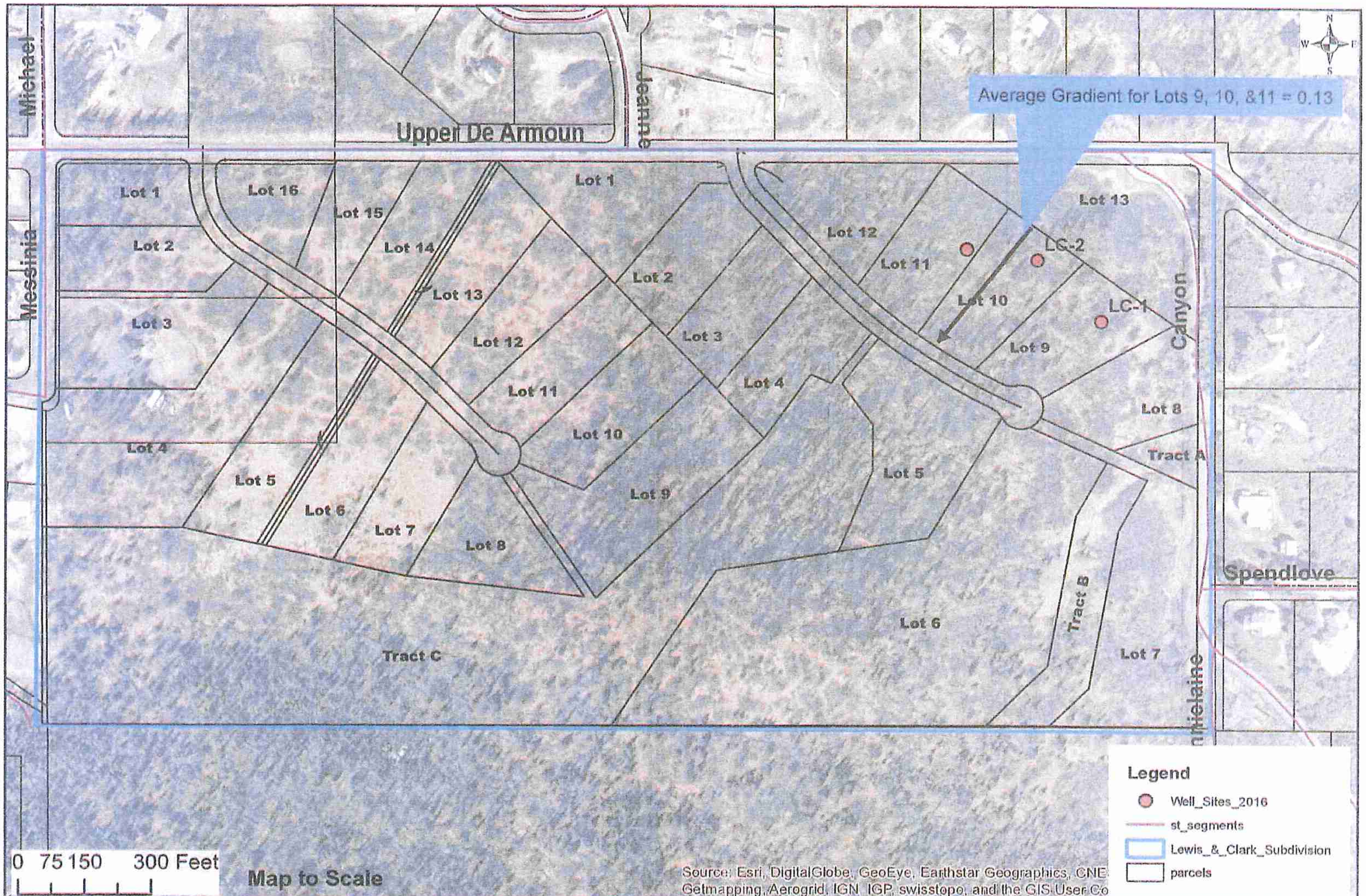


Figure 13 Proposed Locations of Three Wells and Current Site Lot Plan for Lewis and Clark	For: Big Country Enterprises, LLC.	By: SCS Terrasat, Inc. Date: 10/11/16

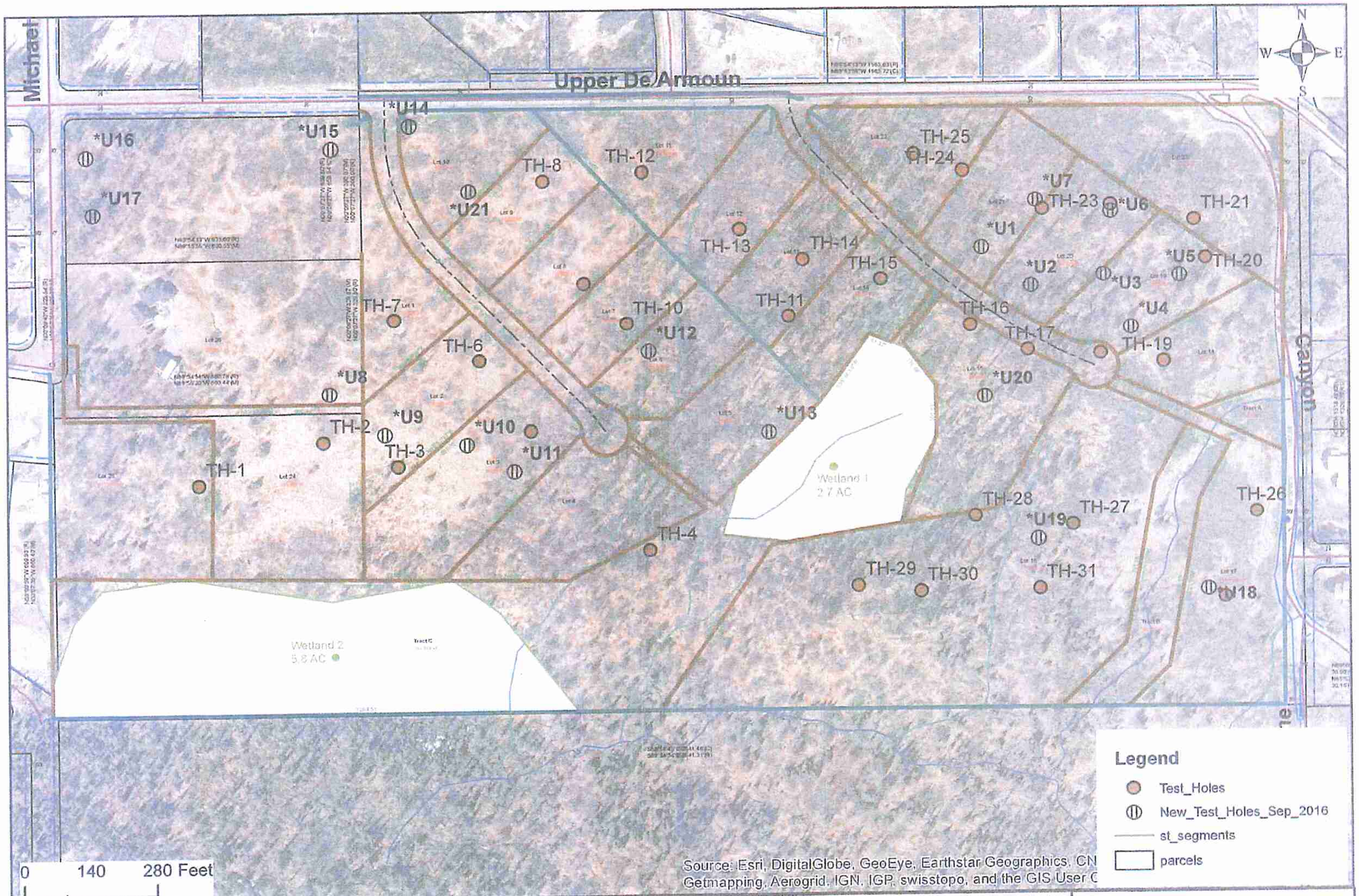


Figure 14 Locations of Percolation Test Holes Used to Determine Ground Water Levels	For: Big Country Enterprises, LLC.	By: TERRSAT, Inc. Date: 9/23/16

APPENDIX A

Residential Well Data

GIS FID	Well ID/Parcel ID	Alt ID	Total Depth (bgs)	Static Water Level (TOC)	Surface Elev	TOC Elevation	Stickup Ht	Static Water elev	Well Aquifer Type	Yield (gpm)	Subdivision - block lot	nitrate *results (mg/L)	Date of results	nitrate *results (mg/L)	Date of results	nitrate* results (mg/L)	Date of results	nitrate *results (mg/L)	Date of results	Indiv well Average	1980	1990	2000	2010	Subd. Average
107	797		130	95	1130	1132	2	1037	gravel	10	8401 Alatna	n/a									Insufficient Data				
37	31599	021-011-22	225	32	1710	1712	2	1680	bedrock	9	Alpine Acres L3	1.79	8/29/2012								Insufficient Data				
17	1012	017-013-20	195	172	960	962	2	790	and/grave	5.9	Aspen Highlands 1 B1L9	1.3	11/4/1988	1.4	8/12/1991	4.8	4/11/2003			2.50	2.3	2.6	3.4	2.0	2.6
18	2364	017-013-96	120	70	1050	1052	2	982	bedrock	5	Aspen Highlands 1 B2L6/	4.6	10/29/1987	7	1/9/1992					5.80					
109	1392	017-013-75	150	120	1000	1002	2	882	gravel	5	Aspen Highlands 1 B3L11	1	11/13/1992	1	8/3/1994	1.2	8/15/1997			1.07					
115	017-013-21		215	180	970	972	2	792	and/grave	2	Aspen Highlands B1L10	4.3	3/11/1991	2.86	10/15/1995	2.67	4/22/1999	3.86	6/28/2012	3.42					
116	017-013-22		278	201	970	972	2	771		3.4	Aspen Highlands B1L11	0.05	10/10/2012												
117	017-013-18		175	140	960	962	2	822	gravel	6	Aspen Highlands B1L7	1.4	2/4/1992												
114	017-013-19		150	124	960	962	2	838	and/grave	5.5	Aspen Highlands B1L8	1.1	12/20/1988	2.95	5/26/1999	2.7	9/26/2000	2.67	2/16/2001	2.36					
34	24994	021-011-27	245	39	1960	1962	2	1923	bedrock	4	Blue Skies 1 L3	0.597	3/22/2000												
36	24993		247	37	1890	1892	2	1855	bedrock	3.5	Blue Skies 3 L18-1	0.375	7/14/2010	0.179	8/13/2011					0.28				0.3	0.3
49	25830		507	18	1220	1222	2	1204	bedrock	0.25	Bonnie View L12	n/a										1.9	3.4	2.1	2.5
50	25831		527	18	1230	1232	2	1214	bedrock	1	Bonnie View L13	n/a													
83	017-422-10		412	24	1240	1242	2	1218	bedrock	5	Bonnie View L1	2.99	7/1/1996	1.08	12/8/2002					2.04					
89	017-422-23		142	24	1240	1242	2	1218	bedrock	0.75	Bonnie View L14	0.81	1/30/1992	5.31	4/3/2000	1.56	5/5/2000			2.56					
90	017-422-24		250	26	1240	1242	2	1216	bedrock	0.35	Bonnie View L15	1.9	2/21/1990	2	5/23/1990	0.578	1/27/2010	1.7	7/9/2013	1.54					
84	017-422-11		180	20	1240	1242	2	1222	bedrock	1	Bonnie View L2	n/a													
85	017-422-14		425	18	1230	1232	2	1214	bedrock	0.46	Bonnie View L5	2	1/0/1900	1.83	11/29/2012	2.41	1/22/2015			2.08					
3	2489	017-422-15	227	10	1220	1222	2	1212	bedrock	5.52	Bonnie View L6	5.76	7/4/2004	4.59	6/22/2011					5.18					
86	017-422-16-1		440	15	1210	1212	2	1197	bedrock	0.5	Bonnie View L7	0.36	4/12/1988												
87	017-422-16-2		177	14	1210	1212	2	1198	bedrock	0.88	Bonnie View L7	n/a													
88	017-422-39		525	6	1210	1212	2	1206	bedrock	3	Bonnie View L8A	1.4	5/23/2012												
111	14923	015-231-77	70	40	930	932	2	892	bedrock	9	Breitzman L1	n/a									Insufficient Data				
21	31649		146	64	1110	1112	2	1048	bedrock	12	Canyon Road	n/a									Insufficient Data				
91	017-013-50		140	39	1090	1093.5	3.5	1054.5	bedrock	3	Engle L1	6	4/21/1994								Insufficient Data				
92	017-013-48-1		281	173	1060	1062	2	889	bedrock	2	Engle L2	2.41	11/13/2015											3.4	3.4
93	017-013-48-2		216	169	1060	1062	2	893	bedrock	2.93	Engle L2	4.43	8/1/2012												
94	017-013-49		204	160	1070	1072	2	912	bedrock	1	Engle L3	n/a													
30	11282	017-401-41	178	19	1140	1142	2	1123	bedrock	4	Foreland View B1L2	n/a										3.5			3.5
28	6884	017-401-44	144	45	1160	1162	2	1117	bedrock	5	Foreland View B1L4	n/a													
29	7489	017-401-46	172	77	1190	1192	2	1115	bedrock	0.75	Foreland View B1L5	2.5	7/26/1994	2.46	8/5/2002	2.59	1/7/2011			2.52					
27	4286	017-401-47	110	42	1170	1172	2	1130	bedrock	5	Foreland View B1L6	4.4	9/1/1992												
32	4290	017-401-25	247	14.65	1240	1242	2	1227.35	?	3	Gombart L1	3.3	6/17/1987								Insufficient Data				
31	10937	017-401-24	240	52	1250	1252	2	1200	bedrock	2	Gombart L2	n/a													
73	017-074-28		197	137	1000	1002	2	865	bedrock	6.5	Grecian Hills B1L10	0.225	4/12/2010										0.8	1.3	1.0
67	017-073-61		197	128	1030	1032	2	904	bedrock	5.5	Grecian Hills B1L2	2.2	6/19/2000												
68	017-074-31		326	138	1030	1032	2	894	bedrock	10	Grecian Hills B1L3	n/a													
69	017-074-32		315	136	1050	1052	2	916	bedrock	10	Grecian Hills B1L4	0.05	10/16/07	0.05	1/11/2010					0.05					
70	017-073-58		180	127	1030	1032	2	905	gravel	12	Grecian Hills B1L5	0.05	11/9/2009												
71	017-074-26		62	34	1010	1012	2	978	gravel	8	Grecian Hills B1L8	0.05	1/25/2010												
72	017-073-64		225	163	1000	1002	2	839	bedrock	1.9	Grecian Hills B1L9	1.93	8/9/1996												
77	L15/16 B2		74	3	960	962	2	959	bedrock	20	Grecian Hills B2L12	n/a													
112	017-073-78		122	80	980	980		900	gravel	14	Grecian Hills B2L13	n/a													
76	L12 B2 Grecian		146	67	970	972	2	905	and/grave	3	Grecian Hills B2L15/16	n/a													
74	017-073-68		120	84	1000	1002	2	918	and/grave	20	Grecian Hills B2L3	n/a													
75	017-073-72		68	35	990	992	2	957	and/grave	9.9	Grecian Hills B2L7	4.72	7/18/2014												
58	3671		46	30	990	992	2	962	and/grave	3	Grecian Hills B2L9	n/a													
81	017-013-91		330	27	1160	1162	2	1135	bedrock	5.35	Kemp L1	1.44	6/30/2006	0.05	9/25/2006	0.194	9/9/2011			0.56		3.1	0.7		1.9
82	017-013-92		400	269.5	1160	1162	2	892.5	bedrock	1.85	Kemp L2	3.2	1/20/1994	3	3/19/1996					3.10					
14	1149	017-073-47	60	0	870	872	2	872	and/grave	4.9	Kimberley Manor 2 B3L9	0.51	9/16/1987	0.6	8/28/1992	0.919	9/11/2013			0.68		0.7			0.7
98	nb Manor B1L7		304	165	990	992	2	807	bedrock	0.4	Kimberly Manor 1 B1L7	n/a													
106	202	017-073-53	24	2	840	842	2	840	gravel	60	Kimberly Manor 2 B3L	2.1	9/26/2005												
104	84	017-073-48	61	0	860	862	2	862	gravel	6	Kimberly Manor 2 B3L	0.738	11/21/1996												
61	2.101E+09		300	49	1810	1812	2	1763	bedrock	4	Macora Hits L3	n/a													
95	017-013-67		200	113	1090	1092	2	979	bedrock	1.2	Marin L1	0.1	6/21/1993								Insufficient Data				
96	017-013-68		260	28	1080	1082	2	1054	bedrock	1.7	Marin L2	5.62	4/1/2002												
97	017-013-70		237	n/a	1050	1052	2	#VALUE!	bedrock	1.3	Marin L4	n/a													
122	017-022-18		246	178	950	952	2	774		6	Mountain Park Estates #	1.7	11/13/1987									2.4	4.4		3.4
121	017-022-03		76	67	970	972	2	905	and/grave	4.8	Mountain Park Estates #	4.45	4/21/2006	5.7	6/13/2006					5.08					
118	017-022-15		225	175	950	952	2	777		2	Mountain Park Estates #	3.21	2/823/1998	3.56	5/19/1998					3.39					
124	017-022-19		410	68	950	952	2	884		1.1	Mountain Park Estates #	0.9	10/1/1993	4.4	10/5/2002					2.65					
120	Mt Park B2L4		290	270	970	972	2	702		7	Mountain Park Estates #	n/a													
119	017-022-16		300	44	950	952	2	908		5.5	Mountain Park Estates #	3.45	1/12/1995	4.61	6/15/2000	3.93	10/2/2001			4.00					

GIS FID	Well ID/Parcel ID	Alt ID	Total Depth (bgs)	Static Water Level (TOC)	Surface Elev	TOC Elevation	Stickup Ht	Static Water elev	Well Aquifer Type	Yield (gpm)	Subdivision - block lot	nitrate *results (mg/L)	Date of results	nitrate *results (mg/L)	Date of results	nitrate* results (mg/L)	Date of results	nitrate *results (mg/L)	Date of results	Indiv well Average	1980	1990	2000	2010	Subd. Average
123	017-022-17		305	130	950	952	2	822		0.4	Mountain Park Estates #	1.08	12/27/1998	3.55	4/27/2004	4.13	3/6/2006	4.94	11/27/2013	3.43					
2	2689		304	25	1130	1132	2	1107	bedrock	1	Mountain Shadow B1L9	n/a									8.4	3.4	5.9		5.9
1	2688		268	102	1130	1132	2	1030	bedrock	1.2	Mountain Shadow B1L10	0.264	2/5/1996	0.1	10/9/2003					0.18					
0	2687		245	33	1140	1142	2	1109	bedrock	0.5	Mountain Shadow B1L12	n/a													
57	5751		165	41	1190	1192	2	1151	bedrock	15	Mountain Shadow B1L2	4.4	9/12/1992	5.39	6/16/1999					4.90					
55	3824		120	100	1140	1142	2	1042	bedrock	0.5	Mountain Shadow B1L8	9.69	7/25/2005												
56	5269		139	104	1280	1282	2	1178	bedrock	5	Mountain Shadow B2L2	5.8	6/3/2003	6.33	9/8/2003	5.79	9/16/2010			5.97					
6	530		125	87	1290	1292	2	1205	bedrock	5	Mountain Shadow B2L3	9.1	4/28/1988	7.4	5/9/1988	8.7	5/12/1988			8.40					
16	710		110	33	1170	1172	2	1139	bedrock	2.4	Mountain Shadows B1L7	6.82	11/22/2002	7.82	4/30/2009										
8	711		200	32	1320	1322	2	1290	bedrock	12	NOT LISTED	n/a									Insufficient Data				
53	14086		185	18	1070	1072	2	1054	bedrock	6	Nulukatak L3	n/a									Insufficient Data				
51	3501		67	19	1070	1072	2	1053	water table	3	Nulukatak L4	n/a													
54	14508		310	13	1060	1062	2	1049	bedrock	1	Nulukatak L4	n/a													
52	7554		475	n/a	1070	1072	2	#VALUE!	bedrock	2	Nulukatak L5	n/a													
4	1340		125	42	1110	1112	2	1070	bedrock	3	Rya Road - no subdivisio	n/a									Insufficient Data				
110	2807	017-072-18	47	8	790	792	2	784	gravel	15	Southhills B3L8	0.39	5/16/1991	0.272	5/22/1996					0.33		0.3			0.3
105	140	017-072-15	113	76	880	882	2	806	gravel	5.5	Southhills B4L6	0.43	7/12/2007												
23	2870	017-072-17	260	150	840	842	2	692	bedrock	1.5	Southhills B4L8	n/a													
22	1193	017-071-15	340	37	935	937	2	900	bedrock	1	Southhills B5L10	n/a													
15	3227	017-071-23	325	72	960	962	2	890	bedrock	1.5	Southhills B5L2	n/a													
11	27631	021-021-18	126	59	1380	1382	2	1323	bedrock	0.5	Spendlove View Hts 1 B3	1.31	6/29/2011									2.3	2.9	0.9	2.0
10	10306	021-021-16-1	362	37.5	1290	1292	2	1254.5	bedrock	3	Spendlove View Hts 1 B3	0.05	10/5/1988												
40	021-021-24		275	3	1250	1252	2	1249	bedrock	3	Spendlove View Hts 1 B2	1.09	10/26/1995												
41	021-021-33		325	35	1230	1232	2	1197	bedrock	1.5	Spendlove View Hts 1 B2	2.4	10/30/1991												
42	021-021-30		40+	40	1200	1202	2	1162	?	1.3	Spendlove View Hts 1 B2	0.5	10/12/2004												
38	31614	021-021-29	106	15	1170	1172	2	1157	bedrock	5	Spendlove View Hts 1 B2	n/a													
24	27695		67	20	1180	1182	2	1162	sand/gravel	20	Spendlove View Hts 1 B2	4.8	7/15/2003												
43	021-021-07		220	45	1240	1242	2	1197	bedrock	6	Spendlove View Hts 1 B2	2.2	2/6/1990												
44	13805		225	87	1260	1262	2	1175	bedrock	7.75	Spendlove View Hts 1 B2	n/a													
20	29996		208	0	1140	1142	2	1142	bedrock	3	Spendlove View Hts 1 B3	4.35	5/13/2008												
48	021-021-19		65+	n/a	1430	1432	2	#VALUE!	n/a	5.84	Spendlove View Hts 1 B3	1.8	9/17/2007												
46	021-021-10		45	33	1160	1162	2	1129	sand/gravel	5.9	Spendlove View Hts 1 B3	0.05	5/19/2015												
33	24164		58	4	1170	1172	2	1168	water table	30	Spendlove View Hts 1 B3	4.5	8/18/1999												
35	23414		166	n/a	1190	1192	2	#VALUE!	bedrock	4	Spendlove View Hts 1 B3	n/a													
47	23415		386	46.8	1240	1242	2	1195.2	bedrock	1.4	Spendlove View Hts 1 B3	1.4	4/8/2011												
45	021-021-15		73	22	1270	1272	2	1250	bedrock	0.8	Spendlove View Hts 1 B3	0.5	3/12/1990												
9	676	021-021-16-2	175	37	1330	1332	2	1295	bedrock	5.6	Spendlove View Hts 1 B3	n/a													
63	017-401-52		165	10	1290	1292	2	1282	bedrock	1.75	Spendlove View Hts 3 B5	0.58	8/24/1989	1.8	9/1/1995	2.4	9/1/1999	1.78	4/2/2015	1.64		1.1	0.2	0.5	0.6
64	017-401-53		160	18	1300	1302	2	1284	bedrock	1.1	Spendlove View Hts 3 B5	0.13	2/22/1991	0.12	2/8/1993					0.13					
65	017-401-54		345	36	1310	1312	2	1276	bedrock	2	Spendlove View Hts 3 B5	0.05	10/7/2010	0.108	5/11/2011					0.08					
66	017-401-55		445	134	1330	1332	2	1198	bedrock	1	Spendlove View Hts 3 B5	0.378	8/18/2006	0.05	4/2/2007	0.134	10/24/2014	0.257	5/18/2016	0.20					
39	021-021-21		40+		1310	1312	2	1312	bedrock	0.33	SpendloveView Hts 1 B1	n/a													
108	1115	017-422-30	207	42	1200	1202	2	1160	gravel	X 2 est	Stellios TrA	3.5	5/18/1990								Insufficient Data				
7	533	017-422-09	49	17	1240	1242	2	1225	bedrock	2.5	Stevehn B1L2A	2.4	5/27/1981	2.19	8/21/1993					2.30					
13	2872	017-401-35	250	11	1420	1422	2	1411	bedrock	4.5	Sunshine Acres L1	0.65	4/9/1991	0.49	3/25/1994	1.31	4/9/2008			0.82		0.6	0.7		0.6
12	1048	107-401-37	350	86	1470	1472	2	1386	bedrock	2	Sunshine Acres L3	0.88	2/20/1989	0.395	10/3/2006	0.406	4/30/2009	0.847	9/8/2014	0.63					
25	14435	017-401-38	465	38	1350	1352	2	1314	bedrock	1	Sunshine Acres L4	n/a													
5	151	017-013-88	400	37	1140	1142	2	1105	bedrock	0.3	Talisman Heights L3	1.7	5/8/1989								Insufficient Data				
60	10861	017-073-42	168	154	1030	1032	2	878	gravel	10	Terrace Hts B1L12	n/a										1.0	2.2	4.0	2.4
59	75	017-073-16	150	90	990	992	2	902	gravel	7	Terrace Hts B1L2	n/a													
99	017-073-17		141	118	990	992	2	874	bedrock	5.7	Terrace Hts B1L1	0.05	8/4/1989												
102	017-074-59		275	197	1020	1022	2	825	bedrock	6.36	Terrace Hts B1L15B	2.21	11/10/2001	4.35	12/22/2014					3.28					
103	017-074-44	7544	180	128	1000	1002	2	874	bedrock	1.2	Terrace Hts B1L18	1.9	4/16/1992	3.74	10/9/2006	5.74	8/6/2010	5.77	10/1/2014	4.29					2.4
100	017-073-14		106	73	990	992	2	919	bedrock	2.5	Terrace Hts B1L4	0.05	9/28/1992	0.1	6/18/1993	0.6	8/16/2001	0.227	1/7/2011	0.24					
101	017-073-11		155	139	1010	1012	2	873	bedrock	2.34	Terrace Hts B1L7	1.8	1/13/1994	2.31	4/21/2004					2.06					
26	30003	017-411-31	387	102	1740	1742	2	1640	bedrock	6	Tower Estates B1L6	n/a												1.1	1.1
62	017-111-33		126	17	1610	1612	2	1595	bedrock	10	Tower Estates B2L2	n/a													
78	017-411-26		205	43	1650	1652	2	1609	bedrock	1.4	Tower Estates B1L1	1.95	4/13/2016												
79	017-411-27		204	40	1670	1672	2	1632	bedrock	3.5	Tower Estates B1L2	n/a													
80	017-411-29		600	105	1720	1722	2	1617	bedrock	3.2	Tower Estates B1L4	0.15	8/10/2012												
113	017-074-060		230	160	1030	1032	2	872	sand/gravel	5	Vergason-Jones L2	1.77	12/26/2002												
19	2587	017-421-32	230	n/a	1120	1122	2	#VALUE!	bedrock	1	Zerkel 2 2A	n/a													

* for non-dect resutls (ND) a value of 0.05 is used, which is 1/2 of the PQL or LOQ for most Alaska laboratories for this test.

APPENDIX B

Nitrogen and Bacteria
Fate and Transport Models

Lewis and Clark Subdivision-- Nitrogen Migration in Water Table from a Sanitary Leach Field that is Designed to Serve a Single Family House

Three Dimentional Mass Solute Analytical Solution

Introduction

Mass solute can be modeled with 1-.2-. and 3-dimensional analytical groundwater models, as well as with a mass balance equation. Numerical models are much more complex and are used when multiple sources, multiple sinks and variable site conditions exist. Numerical models are appropriate when much more information is available, such as the horizontal and vertical distribution of hydraulic conductivities and porosity. This information is seldom known across the domain of a leach field to a down gradient receptor in Alaska.

We choose a 3-dimensional analytical model because it provides a good understanding of what occurs down gradient of a leach field. Analytical models have proven to be powerful tools to evaluate solute transport and are abundant in the hydrogeological literature. The 3-D model considers longitudinal dispersion, transverse dispersion and vertical dispersion, three important transport process that are only approximately accounted for in a mass balance model.

This 3-dimensional analytical model ignores molecular diffusion because diffusion is so small compared with mechanical dispersion in a flowing aquifer that diffusion becomes trivial. This 3-D model ignores precipitation entering the aquifer. Precipitation in South Central Alaska is small enough, over the model domain (<8% of recharge), that it will not significantly influence the final concentration at the compliance point.

This 3-D model considers aquifer thickness and appropriately restricts vertical dispersion to the maximum depth of the aquifer.

Nitrate is biodegradeble as it migrates down gradient from its source. Biodegradation rates are not available so the process is eliminated from this model. The results are likely biased high at the compliance point, meaning the actual results will be lower than shown.

Assumptions

The aquifer is uniform thickness. This is a limitation of the analytical model. We therefore assume that the aquifer is uniformly 12.7 feet thick, based on the average of 19 local water well logs. The aquifer could be as thick as 24 feet in places, which means significant dilution will likely occur before water reaches the compliance point. We selected 12.7 feet thick because the mean is likely the most representative value to represent site conditions, based on available water well logs from adjacent subdivisions.

We assume that the aquifer is infinite laterally and down gradient. This is likely true, within the domain of the model. Water well logs from surrounding subdivisions support this assumption.

We assume that mechanical dispersion is much greater than molecular diffusion. We assume molecular diffusion is trivial in this model and is therefore omitted. This is a safe assumption when hydraulic conductivities are moderate or higher. If molecular diffusion was significant, the final concentration at the compliance point would be decreased.

We assume that nitrogen, as it migrates, does not react with minerals or elements in the aquifer. This assumption is likely valid for nitrogen, as most models with nitrogen assume nitrogen travels at the same rate of groundwater flow.

We assume sorption does not occur for nitrogen. Nitrogen is generally known as a conservative solute, traveling at the same velocity as groundwater. If conditions exist where nitrogen does adsorb to soil particles, these models would predict higher concentrations at the compliance point than are actually likely to occur.

We assume that we have a continuous flow of both groundwater and nitrogen input from the source. Even though nitrogen is episodically discharged throughout a day, an average value is sufficient to evaluate the hydrogeologic model.

Lastly, for the Lewis and Clark Subdivision, we assume nitrates and septic effluent will likely not reach the water table, because most of the 30 plus test pits show an aquitard exists above the water table, causing effluent to remained perched.

Inputs

Source conditions

$C_0 := 15.6 \cdot \frac{mg}{L}$ Nitrogen concentration beneath septic adsorption bed, effluent. This is a weighted average from 117 advantex sites independently tested and reported in the Advantex literature.

$R := 1.$ Retardation, 1 for no retarditation

$Y := 30 \cdot ft$ Width of leach field above aquifer

$Z := 1 \cdot ft$ Depth of leachate penetration into top of aquifer, likely <1 foot

Receptor

$x := 430 \cdot ft$ Distance to receptor, lot closest to creek

$t := 1.1 \cdot yr$ Time since source began leaching into aquifer

Aquifer conditions

$i := 0.13$ hydraulic gradient (measured from MOA 10-foot contour data of land surface, the average slope of 23 lots)

$k := 0.003 \cdot \frac{cm}{s} = 8.5\ \frac{ft}{day}$ hydraulic conductivity (based on percolation tests results)

$\eta_e := 0.3$	Effective porosity (assumed, text book range for sand)
$b := 12.7 \cdot ft$	aquifer thickness (minimum, based on existing water well logs)
$v := \dfrac{k \cdot i}{\eta_e} = 3.685 \dfrac{ft}{day}$	Aquifer velocity
$\alpha_x := 0.1 \cdot x$	Longitudinal dispersivity, parallel to x-axis, Gelhar *et al.* 1992
$\alpha_y := .1 \cdot \alpha_x = 4.3\ ft$	Transverse dispersivity, perpendicular to x-axis, typically 10% of longitudinal dispersivity
$\alpha_z := .025 \cdot \alpha_x = 1.08\ ft$	Vertidal dispersivity, typically 10% of transverse dispersivity

Function Definitions

$y := 1 \cdot ft$	offset from x axis at downgradient compliance point
$z := 1 \cdot ft$	vertical offset from x axis at downgradient compliance point
$x' := \dfrac{(b-Z)^2}{\alpha_z}$	x' is used in the Z component to limit vertical dispersion to the thickness of the aquifer

$$y_{component} := \operatorname{erf}\left(\frac{y+\frac{Y}{2}}{4 \cdot \left(\alpha_y \cdot x\right)^{0.5}}\right) - \operatorname{erf}\left(\frac{y-\frac{Y}{2}}{4 \cdot \left(\alpha_y \cdot x\right)^{0.5}}\right)$$

$$Z_{component} := \operatorname{erf}\left(\frac{z+Z}{2 \cdot \left(\alpha_z \cdot x'\right)^{0.5}}\right) - \operatorname{erf}\left(\frac{z-Z}{2 \cdot \left(\alpha_z \cdot x'\right)^{0.5}}\right)$$

$t := 10 \cdot yr$	This is a guess value for time to reach steady state
$\beta := -2$	when $\beta = -2$ concentration is at steady state conditions

$$\beta = \frac{x - \frac{v \cdot t}{R}}{2 \cdot \left(\alpha_x \cdot \frac{v \cdot t}{R}\right)^{0.5}}$$

$$steady_{state\_time} := \operatorname{find}(t) = 1.05\ yr$$

Solve for time to reach steady state concentrations at distance from source $x = 430\ ft$

$$\beta := \frac{x - \frac{v \cdot t}{R}}{2 \cdot \left(\alpha_x \cdot \frac{v \cdot t}{R}\right)^{0.5}} = -2.082$$

When β <-2, aquifer is at steady state conditions at $x = 430\ ft$ from source

Analysis

$x := 430 \cdot ft$

$y = 1\ ft$

$z = 1\ ft$

$t := steady_{state\_time} = 1.05\ yr$

$$C_{xyzt} := \frac{C_0}{8} \cdot \text{erfc}\left(\frac{x - v \cdot t}{2 \cdot \left(\alpha_x \cdot v \cdot t\right)^{0.5}}\right) \cdot y_{component} \cdot Z_{component}$$

Results

$C_{xyzt} = 0.07\ \frac{mg}{l}$

Maximum nitrogen concentration in aquifer at $x = 430\ ft$ from source and aquifer has reached steaty state concentrations.

Conclusions

This three-dimensional analytical mass transport equation is an appropriate model to evaluate leachate in a septic system drainfield with essentially continuous source release. The model is widely used and accepted throughout the groundwater industry. The model assumes groundwater velocity in one direction with mechanical dispersion down gradient, transverse to the gradient, and vertical to the flow direction.

Results from these evaluations show that after the flow field reaches steady state, the highest concentration directly down gradient at $x = 430\ ft$ will be $C_{xyzt} = 0.07\ \frac{mg}{l}$.

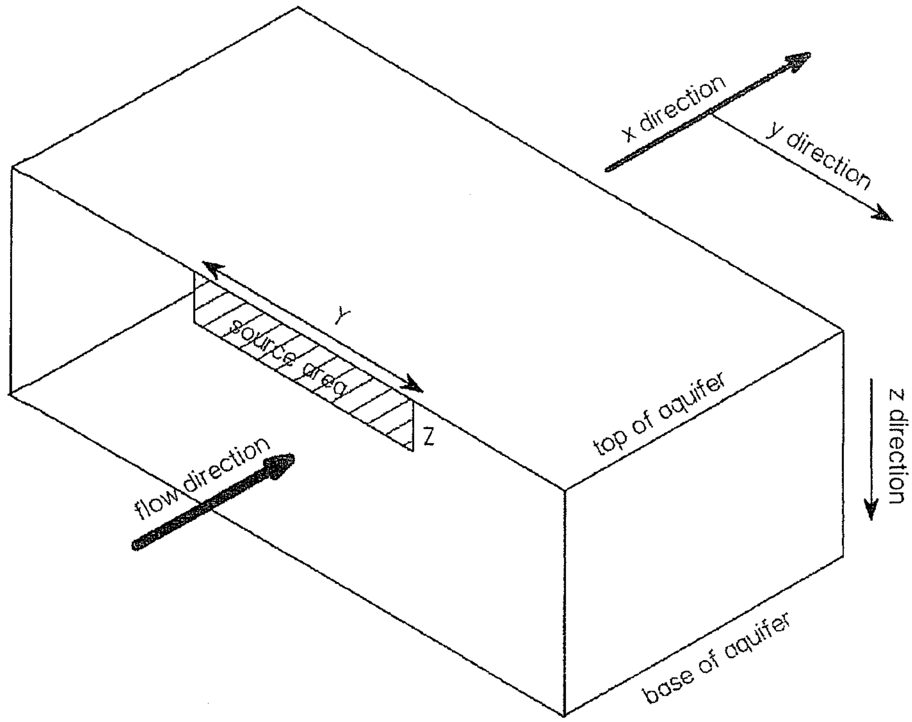
Sources:

Domenico. P., and Schwartz, F., 1990, Physical and Chemical Hydrogeology, John Wiley and Sons, Inc. 504 pps.

Domenico, P.A., and Robbins, G.A., 1985, A New Method of Contaminant Plume Analysis, Ground Water, Vol 23.

Alvarez, J.J. and Illman, W.A., 2006. Bioremediation and Natural Attenuation, John Wiley and Sons, Inc., p. 177.

Mass Transport Conceptual Model



Additional resources:

Devlin, J.F., *et. al.*, 2012, Using the Domenico Solution to Teach Contaminant Transport Modeling, Journal of Geoscience Education, vol 690, pps 123-132. "The Domenico solution is a heuristically derived equation that closely approximates rigorous solutions to the advection dispersion equation under conditions that are representative of real world plumes" (page 132 in conclusions).

Gelhar, L.W. et al., 1992, A Critical Review of Data on Field-scale Dispersion in Aquifers. Water Resources Research 28(7):1955-1974. Dispersivity values are calculated with Gelhar *et al.* methods.

Tong, W. and Rong, Y., 1999, Domenico Spreadsheet Analytical Model Manual, Underground Storage Tank Section California Regional Water Quality Control Board - Los Angeles Region, 17p.

Pennsylvania Deapartment of Environmental Protection, 2014, User's Manual for the Quick Domenico Groundwater Fate-and-Transport Model. 30 p.

Deactiviation of Pathogenic Organisms

$N_1 := 1$	Final number of colonies or viruses at specified distance from leach field
$N_2 := 10000$	Number of initial colonies or viruses
$log_{reduction} := \log\left(\frac{N_2}{N_1}\right) = 4$	log reduction in bacteria or viruses
$\tau = \frac{t}{log\left(\frac{N_2}{N_1}\right)}$	τ is the inactivation rate, t is time to deactivate with $log_{reduction} = 4$
$t = \tau \cdot log_{reduction}$	Rearrange and solve for t = time to deactivate
Average days to achieve 90% deactivation for groundwater less than 59 degrees F.	Time to achieve deactivitation for $log_{reduction} = 4$
$\tau_{Coliform\_bacteria} := 6.6 \cdot day$	$t_{coliform} := \tau_{Coliform\_bacteria} \cdot log_{reduction} = 26.4\ day$
$\tau_{Enterocci\_bacteria} := 3.5 \cdot day$	$t := \tau_{Enterocci\_bacteria} \cdot log_{reduction} = 14\ day$
$\tau_{Fecal\_streptococci} := 3.5 \cdot day$	$t := \tau_{Fecal\_streptococci} \cdot log_{reduction} = 14\ day$
$\tau_{Salmonella} := 2.0 \cdot day$	$t := \tau_{Salmonella} \cdot log_{reduction} = 8\ day$
$\tau_{Shigella} := 3.5 \cdot day$	$t := \tau_{Shigella} \cdot log_{reduction} = 14\ day$
Seepage Velocity is Vs=k*i / ϕ	k is hydraulic conductivity
$\phi := .28$	Porosity
$k := 8.3 \cdot \frac{ft}{day}$	Hydraulic conductivity
$i := 0.13$	gradient measured from source to receptor
$v_s := \frac{k \cdot i}{\phi} = 3.9\ \frac{ft}{day}$	Seepage velocity
$t_{coliform} \cdot v_s = 102\ ft$	Distance from leachfield to inactivation, assuming that bacteria travels as fast as the seepage velocity. Coliform bacteria form slime colonies and can only travel as fast as the colony can grow downgradient.

Pyne,David, 2005, Aquifer Storage Recovery, 2nd Ed., p 272, ASR Systems, LLC.

Maliva, R., and Missimer, T., 2010, Aquifer Storage and Recovery and managed Aquifer Recharge Using Wells: Planning, Hydrogeology, Design and Operation, Pg. 385. Published by Schlumberger Marketing Communications.

APPENDIX C

High Water Site
Measurements

Date	8/17/16	8/25/16	9/1/16	9/9/16	9/16/16	9/23/16	9/30/16	10/7/16	10/14/16	10/21/16	10/28/16	DEPTH
TH-1	8.9	8.16	D	8.25	8.32	8.23	8.65	8.98	9.40	9.40	9.43	9.80
TH-2	D	D	D	D	D	6.23	D	D	D	D	D	6.85
TH-3	D	D	D	D	D	D	D	D	D	D	D	4.80
TH-4	D	D	D	D	D	6.44	7.20	8.20	9.75	B	D	11.60
TH-5	D	D	D	17.74	16.92	13.40	13.45	13.05	13.42	17.19	D	17.80
TH-6	D	D	D	D	D	D	D	D	D	D	D	18.95
TH-7	D	D	D	D	D	D	D	D	D	D	D	13.55
TH-8	D	D	NA	D	D	D	D	D	D	D	D	12.30
TH-9	D	D	D	D	D	D	D	D	D	D	D	16.00
TH-10	D	D	D	D	D	D	D	D	D	D	D	18.05
TH-11	17.45	D	D	14.70	13.22	12.29	14.32	11.60	10.66	12.34	12.90	17.80
TH-12	D	D	D	D	D	D	D	D	D	D	D	16.85
TH-13	D	D	D	D	D	D	D	D	D	D	D	16.20
TH-14	13.62	12.51	14.55	12.80	13.17	10.52	9.92	11.00	12.45	14.02	15.70	17.35
TH-15	16.1	15.07	15.40	15.00	15.40	15.01	15.57	16.24	16.37	16.38	D	17.20
TH-16	D	D	NA	D	D	D	D	14.80	14.48	16.10	D	17.30
TH-17	D	D	D	D	D	D	D	18.16	16.75	17.86	18.91	19.25
TH-18	D	D	D	D	D	D	D	D	D	D	D	14.00
TH-19	D	D	D	D	15.73	14.94	15.29	15.60	15.81	16.28	D	15.20
TH-20	8.15	8.09	8.24	8.10	7.77	7.10	6.90	6.90	7.03	7.24	7.65	13.57
TH-21	9.85	10.05	9.92	10.00	9.47	9.02	8.50	8.62	8.52	9.00	9.46	13.85
TH-22	D	D	D	D	D	D	D	D	D	D	D	14.85
TH-23	D	D	D	D	D	D	D	D	D	D	D	17.60
TH-24	15.3	15.65	15.43	15.65	15.15	14.80	14.51	14.95	14.64	15.38	15.95	19.60
**TH-25	6.17	5.96	6.26	5.55	P	P	P	P	P	P	P	15.00
TH-26	D	D	D	D	D	D	D	18.57	D	D	18.25	18.70
TH-27	D	D	D	D	D	D	D	D	D	D	D	19.15
TH-28	D	D	D	D	10.30	7.82	7.91	10.00	D	D	D	15.10
TH-29	D	D	D	D	D	D	D	D	D	D	D	18.25 (*4.25)
TH-30	D	D	D	D	D	D	D	D	D	D	D	14.50
TH-31	D	D	D	D	D	10.37	10.77	11.11	D	11.50	11.78	11.75
TH-32	D	D	D	D	D	D	D	D	D	D	14.50	18.25
TH-UNK-1	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	11.70

Date	8/17/16	8/25/16	9/1/16	9/9/16	9/16/16	9/23/16	9/30/16	10/7/16	10/14/16	10/21/16	10/28/16	DEPTH
TH-UNK-2	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	18.25
TH-UNK-3	D	NA	D	D	D	D	D	D	D	D	D	17.55
TH-UNK-4	12.5	NA	12.55	12.75	12.15	11.80	11.27	11.13	11.08	11.50	D	14.80
TH-UNK-5	12.27	NA	12.15	12.15	10.80	8.30	9.28	9.70	B	B	B	15.70
U-1					NA	NA	D	D	D	D	D	16.66
U-2					NA	NA	D	D	13.40	13.30	D	14.77
U-3					D	D	D	D	D	D	D	20.10
U-4					D	D	D	D	D	D	D	20.20
U-5					NI	NI	NI	NI	NI	NI	NI	NA
U-6					NI	NI	NI	NI	NI	NI	NI	NA
U-7					NI	NI	NI	NI	NI	NI	NI	NA
U-8					NA	D	***13.63	13.36	13.15	13.14	13.30	4 (13.77 ON 9/3
U-9					NA	D	15.05	D	D	D	D	15.50
U-10					NA	D	13.16	12.42	11.95	11.70	11.93	14.90
U-11					NA	D	D	10.33	9.37	9.70	9.75	10.07
U-12					NA	5.45	6.55	8.55	D	D	D	10.20
U-13					NA	NA	P	P	P	7.30	7.34	14.70
U-14					NA	NA	D	D	D	D	D	15.00
U-15					NA	NA	D	D	D	D	D	14.87
U-16					NA	D	D	D	D	D	D	15.05
U-17					NA	D	D	D	D	D	D	15.10
U-18					D	D	D	D	D	D	D	15.10
U-19					D	NA	14.83	D	14.67	D	D	14.96
U-20					NA	D	6.05	5.75	5.71	6.00	6.17	14.70
U-21					NA	D	D	D	D	D	D	10.30
U New-1									D	D	D	10.85
U New-2									D	D	D	15.05
U New-3									D	D	D	14.00

APPENDIX D

Well Logs

TERRASAT, INC. 4203 Iowa Drive Anchorage, AK	PROJECT: **21607**	BORING ID: **LCW-1**	
	LOCATION: **Anchorage, Alaska**	WELL ID: **LCW-1**	
	DRILLING CONTRACTOR: **M-W Drilling for TERRASAT, Inc.**	NORTHING: **2594227**	EASTING: **1690709**
	DRILLING EQUIPMENT: **Acker**	GROUND SURFACE ELEV.: **1172**	TOC ELEVATION: **1174**
	DRILLING METHOD: **Air Rotary**	TOTAL DEPTH: **375**	DEPTH TO WATER: **21**
LOGGED BY: **SCS**	SAMPLING METHOD: **semi-continuous via bluey tube**	DATE STARTED: **12/16/16**	DATE COMPLETED: **1/10/17**

Depth (feet)	USCS	Graphic Log	Description	% REC	Well Construction
0	PT		Peat, organics, wood		
	SW		Gravelly sand, silty, brown - dry		
20	CL		Inorganic clay lens, grey		
	SW		Water - likely water table - thin 1-2 foot - < 1 gal/min		
	SW-GW		Higher percentage gravel		
40	GW		Gravelly sand, silty, brown; some organics		
			sitly, sandy gravel		
60			BEDROCK 43 FT BGS- Weathered - greywackee		
			BEDROCK CONSOLIDATED - greywacke		
80			CASING ENDS AT 65 FT BGS		
			BEDROCK - greywacke		
100			BEDROCK - shale		
			BEDROCK - greywacke		
120					
140					
160					
180					
200			Water - very thin fracture zone - 0.5 gal/minute water		
			BEDROCK - greywacke		
220			Water - several very thin fractures - total water production 1-1.5 gal/minute		
240			BEDROCK - greywacke with quartz and other hydrothermal mineralization		
260					
280					
300					
320					
340					
360			Water - additional 0.5 gal/minute water - total 2 gal/minute		
			BEDROCK with small fracture zones - total water 3 gal/minute		
380					
400			TD at 393 FT BGS - Producing 3 gal/minutes		

NOTES: Notes here
More notes here

TERRASAT, INC. 4203 Iowa Drive Anchorage, AK	PROJECT: 21607	BORING ID: LCW-2
	LOCATION: Anchorage, Alaska	WELL ID: LCW-2
	DRILLING CONTRACTOR: M-W Drilling for TERRASAT, Inc.	NORTHING: 2594343 / EASTING: 1690507
	DRILLING EQUIPMENT: Acker	GROUND SURFACE ELEV.: 1164 / TOC ELEVATION: 1166
	DRILLING METHOD: Air Rotary	TOTAL DEPTH: 256 / DEPTH TO WATER: 51
LOGGED BY: SCS	SAMPLING METHOD: 5-foot continuous sampler	DATE STARTED: 12/13/16 / DATE COMPLETED: 12/14/16

Depth (feet)	USCS	Graphic Log	Description	% REC	Well Construction
0	PT		Peat, organics, wood		
	SW		Gravelly sand, silty, greenish brown		
	SW-SM		very silty sand, some coarse gravel		
20	SW		Gravelly, sitly sand - well graded sand - dry		
40					
	SW-SM		Gravelly, sitly sand, more gravel		
			WATER - very thin layer < 1 gal/min		
60			BEDROCK- Not completely consolidated - greywacke matrix-		
			CASING ENDS		
			BEDROCK - Alternating between brown and grey - Consolidated - moist at 92 ft.		
80					
			BEDROCK - dry after 95 ft.		
100			BEDROCK - SHALE		
			BEDROCK - Alternating between shale and greywacke		
120			WATER - 3-5 gall/min - Fracture zone likely 3-4 ft thick		
			BEDROCK - greywacke		
140					
160			Water - additional 1-2 gal/minute - thin fracture zone		
			BEDROCK - greywacke with quartz hydrothermal veining		
180			Water - additional 1-2 gal/minute - total of 6 gal/minute		
			Additional water in several very small fractures - total 8-10 gal/minute		
200					
220					
240			BEDROCK - greywacke with green and white mineralization		
260			TD - 256 - Producing 10 gal/minute		

NOTES: Notes here
More notes here

TERRASAT, INC. 4203 Iowa Drive Anchorage, AK	PROJECT: **21607**	BORING ID: **LCW-3**	
	LOCATION: **Anchorage, Alaska**	WELL ID: **LCW-3**	
	DRILLING CONTRACTOR: **M-W Drilling for TERRASAT, Inc.**	NORTHING: **2594335**	EASTING: **1690362**
	DRILLING EQUIPMENT: **Acker**	GROUND SURFACE ELEV.: **1155.5**	TOC ELEVATION: **1166**
	DRILLING METHOD: **Air Rotary**	TOTAL DEPTH: **236**	DEPTH TO WATER: **30 to Water Table**
LOGGED BY: **SCS**	SAMPLING METHOD: **5-foot continuous sampler**	DATE STARTED: **12/6/16**	DATE COMPLETED: **12/8/16**

Depth (feet)	USCS	Graphic Log	Description	% REC	Well Construction
0	PT		Peat, organics, wood		
	SW		Gravelly sand, silty, brown - dry		
	SW-GW		Gravel content 45%, silty sand		
20	SW		Gravelly sand, silty, brown; some organics		
	CL		Inorganic clay lens, grey		
	SW		Silty sand, little gravel, fine sand		
	SM		WATER TABLE - 1 foot thick - little water		
	SC		CLAYEY sand - likely confining layer		
	SC-SM		Clayey-Silty Sand, fine gravel		
40	SC		Clayey Sand - Sand-Clay Mixture, some fine gravel		
	SW		Gravelly, sitly sands		
60	SW-SC		Clayey, gravelly, Sitly Sand		
	SW-SC		Clayey, gravelly, sitly sand - WATER, very little, either thin 1-2 ft layer or from snow in drill pipe		
	SW		Gravelly sand, fine gravel, silt		
80	SW-SM		Silty, gravelly, sand - brown		
	SM		Silty sand, little or no gravel		
			BEDROCK - Weathered/fractured ; red iron colored- mixed with silt and fine sand		
100					
			becomes more consolidated		
120			Fully Consolidated Bedrock - greywacke		
140			shale		
160			WATER - Small fracture zone < 1 gal/min		
			shale consolidated		
180					
200			WATER - Large fracture zone - 4-6 gal/min		
			BEDROCK		
220					
240			TD at 236 FT BGS - Producing 6 gal/minutes		

NOTES: Notes here
More notes here

APPENDIX E

AqteSolv Aquifer Test Results

AQTESOLV for Windows

Data Set: P:\2016 Projects\21607 - Lewis & Clark Subd Hydrogeology - Big Country Ent\REPORTS\MAIN REPORT
Date: 02/07/17
Time: 13:06:42

PROJECT INFORMATION

Company: TERRASAT
Client: Big Country EnterprisesLC
Project: 21607
Location: Anchorage, Alaska
Test Date: 1/31/17
Test Well: LCW-1

AQUIFER DATA

Saturated Thickness: 70. ft
Anisotropy Ratio (Kz/Kr): 0.93
Slab Block Thickness: 1. ft
Spherical Block Diameter: 1. ft
Fracture Length: 1. ft
Fracture Radius: 1.658 ft

PUMPING WELL DATA

No. of pumping wells: 1

Pumping Well No. 1: LCW-1

X Location: 0. ft
Y Location: 0. ft

Casing Radius: 0.25 ft
Well Radius: 0.25 ft

Fully Penetrating Well

No. of pumping periods: 4

Pumping Period Data

Time (min)	Rate (gal/min)	Time (min)	Rate (gal/min)
0.	2.	361.	0.
360.	2.	1440.	0.

OBSERVATION WELL DATA

No. of observation wells: 1

Observation Well No. 1: LCW-1

X Location: 0. ft
Y Location: 0. ft

Radial distance from LCW-1: 0. ft

Fully Penetrating Well

No. of Observations: 963

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.5	0.052	241.5	3.728
1.	0.052	242.	3.728
1.5	0.218	242.5	3.68
2.	0.29	372.	3.993
2.5	0.409	372.5	3.731
3.	0.552	373.	3.468
3.5	0.648	373.5	3.206
4.	1.006	374.	2.971
4.5	1.363	374.5	2.732
5.	1.626	375.	2.494
5.5	1.769	375.5	2.279

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
6.	1.84	376.	2.064
6.5	1.936	376.5	1.826
7.	1.983	377.	1.635
7.5	2.055	377.5	1.444
8.	2.127	378.	1.25
8.5	2.198	378.5	1.063
9.	2.222	379.	0.869
9.5	2.508	379.5	0.702
10.	2.866	380.	0.538
10.5	3.295	380.5	0.371
11.	3.629	381.	0.204
11.5	3.939	381.5	0.034
12.	4.13	382.	-0.106
12.5	4.225	382.5	-0.249
13.	4.392	383.	-0.395
13.5	4.488	383.5	-0.538
14.	4.607	384.	-0.657
14.5	4.753	384.5	-0.801
15.	4.893	385.	-0.92
15.5	4.989	385.5	-1.063
16.	5.06	386.	-1.182
16.5	5.182	386.5	-1.301
17.	5.278	387.	-1.421
17.5	5.349	387.5	-1.516
18.	5.466	388.	-1.635
18.5	5.54	388.5	-1.731
19.	5.564	389.	-1.826
19.5	5.588	389.5	-1.945
20.	5.683	390.	-2.017
20.5	5.731	390.5	-2.112
21.	5.779	391.	-2.208
21.5	5.826	391.5	-2.303
22.	5.871	392.	-2.375
22.5	5.922	392.5	-2.47
23.	5.946	393.	-2.545
23.5	5.993	393.5	-2.616
24.	6.041	394.	-2.712
24.5	6.065	394.5	-2.783
25.	6.136	395.	-2.828
25.5	6.184	395.5	-2.926
26.	6.232	396.	-2.998
26.5	6.256	396.5	-3.069
27.	6.327	397.	-3.117
27.5	6.351	397.5	-3.189
28.	6.399	398.	-3.26
28.5	6.399	398.5	-3.308
29.	6.446	399.	-3.379
29.5	6.47	399.5	-3.427
30.	6.59	400.	-3.475
30.5	6.542	400.5	-3.546
31.	6.613	401.	-3.594
31.5	6.613	401.5	-3.642
32.	6.613	402.	-3.689
32.5	6.685	402.5	-3.764
33.	6.685	403.	-3.812
33.5	6.709	403.5	-3.859
34.	6.709	404.	-3.907
34.5	6.733	404.5	-3.931
35.	6.78	405.	-3.979
35.5	6.78	405.5	-4.026
36.	6.78	406.	-4.074
36.5	6.804	406.5	-4.122
37.	6.831	407.	-4.146
37.5	6.828	407.5	-4.193
38.	6.876	408.	-4.241
38.5	6.876	408.5	-4.268
39.	6.923	409.	-4.312
39.5	6.923	409.5	-4.363
40.	6.971	410.	-4.387
40.5	6.947	410.5	-4.435

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
41.	6.995	411.	-4.459
41.5	7.019	411.5	-4.482
42.	7.022	412.	-4.53
42.5	7.022	412.5	-4.554
43.	7.09	413.	-4.578
43.5	7.093	413.5	-4.629
44.	7.141	414.	-4.649
44.5	7.141	414.5	-4.673
45.	7.117	415.	-4.7
45.5	7.165	415.5	-4.724
46.	7.189	416.	-4.772
46.5	7.165	416.5	-4.796
47.	7.213	417.	-4.796
47.5	7.237	417.5	-4.843
48.	7.237	418.	-4.867
48.5	7.284	418.5	-4.891
49.	7.284	419.	-4.915
49.5	7.284	419.5	-4.939
50.	7.308	420.	-4.962
50.5	7.332	420.5	-4.986
51.	7.383	421.	-5.01
51.5	7.359	421.5	-5.01
52.	7.359	422.	-5.058
52.5	7.407	422.5	-5.058
53.	7.43	423.	-5.106
53.5	7.43	423.5	-5.106
54.	7.454	424.	-5.129
54.5	7.454	424.5	-5.153
55.	7.454	425.	-5.177
55.5	7.454	425.5	-5.177
56.	7.478	426.	-5.201
56.5	7.502	426.5	-5.225
57.	7.502	427.	-5.249
57.5	7.526	427.5	-5.273
58.	7.502	428.	-5.296
58.5	7.526	428.5	-5.32
59.	7.55	429.	-5.32
59.5	7.55	429.5	-5.344
60.	7.573	430.	-5.344
60.5	7.597	430.5	-5.368
61.	7.597	431.	-5.392
61.5	7.624	431.5	-5.416
62.	7.597	432.	-5.416
62.5	7.645	432.5	-5.439
63.	7.645	433.	-5.463
63.5	7.648	433.5	-5.463
64.	7.672	434.	-5.487
64.5	7.696	434.5	-5.508
65.	7.693	435.	-5.511
65.5	7.696	435.5	-5.535
66.	7.72	436.	-5.535
66.5	7.72	436.5	-5.559
67.	7.72	437.	-5.559
67.5	7.696	437.5	-5.583
68.	7.624	438.	-5.583
68.5	7.624	438.5	-5.606
69.	7.672	439.	-5.606
69.5	7.648	439.5	-5.63
70.	7.696	440.	-5.654
70.5	7.743	440.5	-5.654
71.	7.746	441.	-5.678
71.5	7.72	441.5	-5.678
72.	7.743	442.	-5.702
72.5	7.743	442.5	-5.702
73.	7.746	443.	-5.702
73.5	7.743	443.5	-5.726
74.	7.77	444.	-5.726
74.5	7.77	444.5	-5.75
75.	7.746	445.	-5.75
75.5	7.77	445.5	-5.773

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
76.	7.746	446.	-5.773
76.5	7.77	446.5	-5.773
77.	7.77	447.	-5.797
77.5	7.77	447.5	-5.797
78.	7.77	448.	-5.797
78.5	7.77	448.5	-5.821
79.	7.746	449.	-5.845
79.5	7.77	449.5	-5.845
80.	7.77	450.	-5.845
80.5	7.77	450.5	-5.869
81.	7.77	451.	-5.893
81.5	7.723	451.5	-5.893
82.	7.651	452.	-5.893
82.5	7.603	452.5	-5.916
83.	7.606	453.	-5.916
83.5	7.532	453.5	-5.916
84.	7.508	454.	-5.94
84.5	7.484	454.5	-5.94
85.	7.46	455.	-5.94
85.5	7.389	455.5	-5.964
86.	7.365	456.	-5.964
86.5	7.317	456.5	-5.988
87.	7.341	457.	-5.988
87.5	7.293	457.5	-6.012
88.	7.246	458.	-6.012
88.5	7.246	458.5	-6.012
89.	7.198	459.	-6.036
89.5	7.174	459.5	-6.036
90.	7.15	460.	-6.036
90.5	7.126	460.5	-6.06
91.	7.126	461.	-6.06
91.5	7.079	461.5	-6.06
92.	7.031	462.	-6.083
92.5	6.959	462.5	-6.083
93.	6.888	463.	-6.083
93.5	6.792	463.5	-6.107
94.	6.745	464.	-6.107
94.5	6.673	464.5	-6.11
95.	6.625	465.	-6.107
95.5	6.578	465.5	-6.131
96.	6.53	466.	-6.131
96.5	6.458	466.5	-6.131
97.	6.411	467.	-6.155
97.5	6.339	467.5	-6.158
98.	6.268	468.	-6.158
98.5	6.22	468.5	-6.158
99.	6.172	469.	-6.182
99.5	6.148	469.5	-6.182
100.	6.101	470.	-6.182
100.5	6.029	470.5	-6.182
101.	5.958	471.	-6.206
101.5	5.958	471.5	-6.206
102.	5.886	472.	-6.206
102.5	5.862	472.5	-6.206
103.	5.838	473.	-6.206
103.5	5.767	473.5	-6.23
104.	5.743	474.	-6.23
104.5	5.698	474.5	-6.23
105.	5.651	475.	-6.23
105.5	5.6	475.5	-6.253
106.	5.6	476.	-6.253
106.5	5.552	476.5	-6.253
107.	5.528	477.	-6.253
107.5	5.531	477.5	-6.253
108.	5.457	478.	-6.277
108.5	5.433	478.5	-6.277
109.	5.409	479.	-6.277
109.5	5.385	479.5	-6.277
110.	5.341	480.	-6.301
110.5	5.341	480.5	-6.301

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
111.	5.341	481.	-6.301
111.5	5.293	481.5	-6.301
112.	5.242	482.	-6.301
112.5	5.242	482.5	-6.325
113.	5.221	483.	-6.325
113.5	5.197	483.5	-6.325
114.	5.197	484.	-6.325
114.5	5.197	484.5	-6.325
115.	5.15	485.	-6.349
115.5	5.126	485.5	-6.349
116.	5.102	486.	-6.349
116.5	5.102	486.5	-6.349
117.	5.031	487.	-6.349
117.5	5.031	487.5	-6.373
118.	5.031	488.	-6.349
118.5	5.031	488.5	-6.373
119.	5.007	489.	-6.373
119.5	5.007	489.5	-6.397
120.	5.007	490.	-6.397
120.5	4.983	490.5	-6.397
121.	4.935	491.	-6.397
121.5	4.959	491.5	-6.397
122.	4.959	492.	-6.397
122.5	4.959	492.5	-6.42
123.	4.959	493.	-6.42
123.5	4.959	493.5	-6.42
124.	4.959	494.	-6.42
124.5	4.959	494.5	-6.42
125.	4.983	495.	-6.444
125.5	4.983	495.5	-6.444
126.	4.959	496.	-6.444
126.5	4.959	496.5	-6.444
127.	4.935	497.	-6.444
127.5	4.959	497.5	-6.444
128.	4.935	498.	-6.444
128.5	4.935	498.5	-6.468
129.	4.911	499.	-6.468
129.5	4.887	499.5	-6.468
130.	4.911	500.	-6.468
130.5	4.911	500.5	-6.468
131.	4.911	501.	-6.492
131.5	4.911	501.5	-6.492
132.	4.887	502.	-6.492
132.5	4.887	502.5	-6.492
133.	4.887	503.	-6.492
133.5	4.887	503.5	-6.492
134.	4.864	504.	-6.495
134.5	4.864	504.5	-6.495
135.	4.84	505.	-6.516
135.5	4.84	505.5	-6.516
136.	4.84	506.	-6.516
136.5	4.84	506.5	-6.516
137.	4.816	507.	-6.516
137.5	4.816	507.5	-6.516
138.	4.816	508.	-6.54
138.5	4.792	508.5	-6.543
139.	4.792	509.	-6.543
139.5	4.816	509.5	-6.543
140.	4.816	510.	-6.543
140.5	4.792	510.5	-6.543
141.	4.768	511.	-6.543
141.5	4.768	511.5	-6.543
142.	4.771	512.	-6.567
142.5	4.747	512.5	-6.567
143.	4.792	513.	-6.567
143.5	4.744	513.5	-6.567
144.	4.72	514.	-6.567
144.5	4.771	514.5	-6.563
145.	4.747	515.	-6.567
145.5	4.744	515.5	-6.59

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
146.	4.744	516.	-6.59
146.5	4.768	516.5	-6.59
147.	4.747	517.	-6.587
147.5	4.768	517.5	-6.59
148.	4.744	518.	-6.59
148.5	4.744	518.5	-6.59
149.	4.747	519.	-6.611
149.5	4.747	519.5	-6.614
150.	4.723	520.	-6.614
150.5	4.771	520.5	-6.614
151.	4.747	521.	-6.614
151.5	4.723	521.5	-6.614
152.	4.747	522.	-6.614
152.5	4.723	522.5	-6.614
153.	4.771	523.	-6.614
153.5	4.747	523.5	-6.614
154.	4.747	524.	-6.614
154.5	4.747	524.5	-6.638
155.	4.747	525.	-6.614
155.5	4.747	525.5	-6.638
156.	4.747	526.	-6.638
156.5	4.723	526.5	-6.638
157.	4.723	527.	-6.638
157.5	4.747	527.5	-6.638
158.	4.747	528.	-6.638
158.5	4.747	528.5	-6.662
159.	4.747	529.	-6.662
159.5	4.723	529.5	-6.662
160.	4.747	530.	-6.662
160.5	4.723	530.5	-6.662
161.	4.723	531.	-6.662
161.5	4.747	531.5	-6.662
162.	4.723	532.	-6.662
162.5	4.723	532.5	-6.662
163.	4.726	533.	-6.662
163.5	4.723	533.5	-6.686
164.	4.75	534.	-6.686
164.5	4.747	534.5	-6.686
165.	4.7	535.	-6.662
165.5	4.723	535.5	-6.686
166.	4.726	536.	-6.686
166.5	4.723	536.5	-6.686
167.	4.723	537.	-6.686
167.5	4.703	537.5	-6.686
168.	4.723	538.	-6.686
168.5	4.703	538.5	-6.686
169.	4.703	539.	-6.71
169.5	4.723	539.5	-6.71
170.	4.726	540.	-6.71
170.5	4.726	540.5	-6.71
171.	4.726	541.	-6.71
171.5	4.723	541.5	-6.71
172.	4.7	542.	-6.71
172.5	4.703	542.5	-6.71
173.	4.7	543.	-6.734
173.5	4.7	543.5	-6.71
174.	4.723	544.	-6.71
174.5	4.703	544.5	-6.734
175.	4.726	545.	-6.734
175.5	4.703	545.5	-6.734
176.	4.726	546.	-6.734
176.5	4.703	546.5	-6.734
177.	4.679	547.	-6.734
177.5	4.703	547.5	-6.734
178.	4.75	548.	-6.734
178.5	4.703	548.5	-6.734
179.	4.703	549.	-6.734
179.5	4.679	549.5	-6.757
180.	4.703	550.	-6.734
180.5	4.703	550.5	-6.737

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
181.	4.703	551.	-6.757
181.5	4.726	551.5	-6.757
182.	4.679	552.	-6.757
182.5	4.679	552.5	-6.757
183.	4.679	553.	-6.757
183.5	4.679	553.5	-6.757
184.	4.679	554.	-6.757
184.5	4.679	554.5	-6.757
185.	4.679	555.	-6.757
185.5	4.679	555.5	-6.784
186.	4.726	556.	-6.757
186.5	4.726	556.5	-6.781
187.	4.703	557.	-6.781
187.5	4.703	557.5	-6.781
188.	4.726	558.	-6.781
188.5	4.703	558.5	-6.781
189.	4.679	559.	-6.781
189.5	4.703	559.5	-6.781
190.	4.726	560.	-6.781
190.5	4.703	560.5	-6.781
191.	4.703	561.	-6.805
191.5	4.679	561.5	-6.805
192.	4.679	562.	-6.805
192.5	4.679	562.5	-6.808
193.	4.679	563.	-6.805
193.5	4.703	563.5	-6.805
194.	4.679	564.	-6.805
194.5	4.726	564.5	-6.805
195.	4.703	565.	-6.805
195.5	4.703	565.5	-6.829
196.	4.679	566.	-6.805
196.5	4.655	566.5	-6.805
197.	4.703	567.	-6.805
197.5	4.703	567.5	-6.808
198.	4.703	568.	-6.805
198.5	4.726	568.5	-6.829
199.	4.706	569.	-6.829
199.5	4.706	569.5	-6.829
200.	4.703	570.	-6.829
200.5	4.703	570.5	-6.829
201.	4.703	571.	-6.829
201.5	4.703	571.5	-6.829
202.	4.729	572.	-6.829
202.5	4.75	572.5	-6.829
203.	4.703	573.	-6.829
203.5	4.726	573.5	-6.829
204.	4.726	574.	-6.829
204.5	4.703	574.5	-6.829
205.	4.729	575.	-6.853
205.5	4.703	575.5	-6.853
206.	4.753	576.	-6.829
206.5	4.679	576.5	-6.853
207.	4.682	577.	-6.853
207.5	4.726	577.5	-6.829
208.	4.703	578.	-6.853
208.5	4.703	578.5	-6.829
209.	4.706	579.	-6.853
209.5	4.703	579.5	-6.853
210.	4.729	580.	-6.853
210.5	4.726	580.5	-6.853
211.	4.706	581.	-6.856
211.5	4.703	581.5	-6.853
212.	4.726	582.	-6.856
212.5	4.726	582.5	-6.856
213.	4.706	583.	-6.856
213.5	4.706	583.5	-6.856
214.	4.729	584.	-6.853
214.5	4.729	584.5	-6.877
215.	4.729	585.	-6.877
215.5	4.706	585.5	-6.877

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
216.	4.706	586.	-6.88
216.5	4.706	586.5	-6.877
217.	4.726	587.	-6.88
217.5	4.706	587.5	-6.877
218.	4.682	588.	-6.88
218.5	4.682	588.5	-6.877
219.	4.634	589.	-6.88
219.5	4.634	589.5	-6.877
220.	4.634	590.	-6.88
220.5	4.61	590.5	-6.877
221.	4.562	591.	-6.877
221.5	4.539	591.5	-6.88
222.	4.515	592.	-6.9
222.5	4.467	592.5	-6.877
223.	4.491	593.	-6.9
223.5	4.443	593.5	-6.9
224.	4.467	594.	-6.877
224.5	4.443	594.5	-6.9
225.	4.419	595.	-6.904
225.5	4.419	595.5	-6.9
226.	4.396	596.	-6.9
226.5	4.348	596.5	-6.9
227.	4.345	597.	-6.9
227.5	4.348	597.5	-6.9
228.	4.345	598.	-6.9
228.5	4.324	598.5	-6.9
229.	4.276	599.	-6.924
229.5	4.252	599.5	-6.9
230.	4.276	600.	-6.924
230.5	4.226	600.5	-6.9
231.	4.226	601.	-6.904
231.5	4.181	601.5	-6.9
232.	4.157	602.	-6.9
232.5	4.106	602.5	-6.9
233.	4.083	603.	-6.9
233.5	4.059	603.5	-6.9
234.	4.035	604.	-6.904
234.5	4.014	604.5	-6.904
235.	3.987	605.	-6.9
235.5	3.963	605.5	-6.904
236.	3.916	606.	-6.9
236.5	3.916	606.5	-6.904
237.	3.844	607.	-6.88
237.5	3.871	607.5	-6.9
238.	3.847	608.	-6.9
238.5	3.799	608.5	-6.9
239.	3.799	609.	-6.9
239.5	3.796	609.5	-6.904
240.	3.775	610.	-6.9
240.5	3.728	610.5	-6.904
241.	3.752		

SOLUTION

Pumping Test
Aquifer Model: Fractured
Solution Method: Gringarten-Ramey w/horizontal fracture

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.009723	ft/min
Ss	0.0006773	ft^{-1}
Kz/Kr	0.93	
Rf	1.658	ft

K = 0.004939 cm/sec
T = K*b = 0.6806 ft^2/min (10.54 sq. cm/sec)

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.009723	0.05437	+/- 0.1067	0.1788	ft/min
Ss	0.0006773	0.01279	+/- 0.02509	0.05297	ft^{-1}
Kz/Kr	0.93	not estimated			
Rf	1.658	9.308	+/- 18.26	0.1781	ft

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

K = 0.004939 cm/sec
T = K*b = 0.6806 ft²/min (10.54 sq. cm/sec)

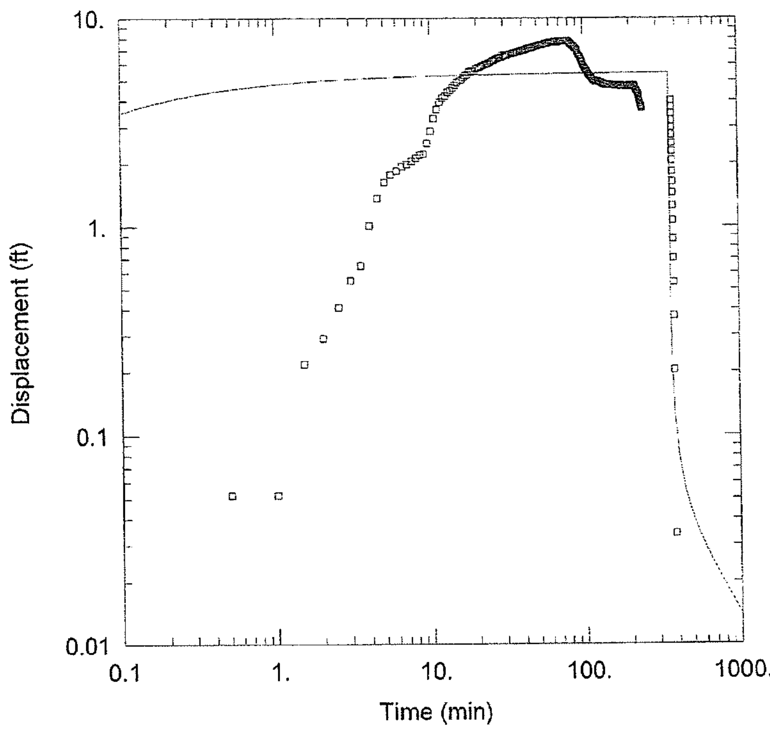
Parameter Correlations

	Kr	Ss	Rf
Kr	1.00	0.96	-1.00
Ss	0.96	1.00	-0.96
Rf	-1.00	-0.96	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . . 1.803E+4 ft^2
Variance . . . . 18.78 ft^2
Std. Deviation . . . . 4.334 ft
Mean . . . . -2.782 ft
No. of Residuals 963
No. of Estimates 3



WELL TEST ANALYSIS

Data Set: P:\...\wELL 1 oNLY 2GPMM.aqt
Date: 02/07/17 Time: 13:06:06

PROJECT INFORMATION

Company: TERRASAT
Client: Big Country EnterprisesLC
Project: 21607
Location: Anchorage, Alaska
Test Well: LCW-1
Test Date: 1/31/17

AQUIFER DATA

Saturated Thickness: 70. ft Fracture Radius: 1.658 ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
LCW-1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
▫ LCW-1	0	0

SOLUTION

Aquifer Model: Fractured Solution Method: Gringarten (Horizontal)

Kr = 0.009723 ft/min
Kz/Kr = 0.93

Ss = 0.0006773 ft^{-1}
Rf = 1.658 ft

Data Set: P:\2016 Projects\21607 - Lewis & Clark Subd Hydrogeology - Big Country Ent\REPORTS\MAIN REPORT
Date: 02/06/17
Time: 13:48:06

PROJECT INFORMATION

Company: TERRASAT
Client: Big Country EnterprisesLC
Project: 21607
Location: Anchorage, Alaska
Test Date: 1/24/17
Test Well: LCW-2

AQUIFER DATA

Saturated Thickness: 60. ft
Anisotropy Ratio (Kz/Kr): 0.93
Slab Block Thickness: 1. ft
Spherical Block Diameter: 1. ft
Fracture Length: 1. ft
Fracture Radius: 7.003 ft

PUMPING WELL DATA

No. of pumping wells: 1

Pumping Well No. 1: LCW-2

X Location: 0. ft
Y Location: 0. ft

Casing Radius: 0.25 ft
Well Radius: 0.25 ft

Fully Penetrating Well

No. of pumping periods: 4

Pumping Period Data

Time (min)	Rate (gal/min)	Time (min)	Rate (gal/min)
0.	10.	1441.	0.
1440.	10.	2880.	0.

OBSERVATION WELL DATA

No. of observation wells: 1

Observation Well No. 1: LCW-2

X Location: 0. ft
Y Location: 0. ft

Radial distance from LCW-2: 0. ft

Fully Penetrating Well

No. of Observations: 4077

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.5	1.574	1872.5	6.275
1.	5.486	1873.	6.275
1.5	5.987	1873.5	6.251
2.	6.678	1874.	6.251
2.5	7.752	1874.5	6.251
3.	9.014	1875.	6.227
3.5	10.04	1875.5	6.227
4.	10.97	1876.	6.227
4.5	11.78	1876.5	6.203
5.	12.47	1877.	6.203
5.5	13.14	1877.5	6.203

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
6.	13.69	1878.	6.179
6.5	14.19	1878.5	6.179
7.	14.67	1879.	6.179
7.5	15.07	1879.5	6.156
8.	15.5	1880.	6.156
8.5	15.89	1880.5	6.156
9.	16.24	1881.	6.156
9.5	16.58	1881.5	6.156
10.	16.89	1882.	6.156
10.5	17.17	1882.5	6.132
11.	17.46	1883.	6.132
11.5	17.75	1883.5	6.108
12.	17.98	1884.	6.108
12.5	18.22	1884.5	6.108
13.	18.46	1885.	6.108
13.5	18.65	1885.5	6.084
14.	18.86	1886.	6.084
14.5	19.06	1886.5	6.084
15.	19.25	1887.	6.06
15.5	19.46	1887.5	6.06
16.	19.65	1888.	6.036
16.5	19.84	1888.5	6.036
17.	20.01	1889.	6.034
17.5	20.18	1889.5	6.036
18.	20.37	1890.	6.034
18.5	20.54	1890.5	6.012
19.	20.73	1891.	6.012
19.5	20.89	1891.5	6.012
20.	21.08	1892.	6.012
20.5	21.23	1892.5	5.989
21.	21.39	1893.	5.989
21.5	21.56	1893.5	5.989
22.	21.73	1894.	5.965
22.5	21.9	1894.5	5.965
23.	22.04	1895.	5.965
23.5	22.2	1895.5	5.941
24.	22.35	1896.	5.941
24.5	22.49	1896.5	5.941
25.	22.64	1897.	5.941
25.5	22.78	1897.5	5.915
26.	22.95	1898.	5.917
26.5	23.09	1898.5	5.915
27.	23.21	1899.	5.893
27.5	23.35	1899.5	5.893
28.	23.47	1900.	5.893
28.5	23.61	1900.5	5.893
29.	23.73	1901.	5.867
29.5	23.85	1901.5	5.867
30.	23.97	1902.	5.869
30.5	24.07	1902.5	5.843
31.	24.18	1903.	5.845
31.5	24.3	1903.5	5.843
32.	24.4	1904.	5.82
32.5	24.54	1904.5	5.82
33.	24.66	1905.	5.82
33.5	24.78	1905.5	5.82
34.	24.88	1906.	5.822
34.5	25.	1906.5	5.798
35.	25.11	1907.	5.798
35.5	25.21	1907.5	5.798
36.	25.31	1908.	5.772
36.5	25.43	1908.5	5.774
37.	25.52	1909.	5.774
37.5	25.64	1909.5	5.772
38.	25.76	1910.	5.774
38.5	25.86	1910.5	5.75
39.	25.95	1911.	5.75
39.5	26.07	1911.5	5.75
40.	26.16	1912.	5.748
40.5	26.26	1912.5	5.726

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
41.	26.38	1913.	5.726
41.5	26.45	1913.5	5.7
42.	26.55	1914.	5.726
42.5	26.67	1914.5	5.702
43.	26.76	1915.	5.702
43.5	26.86	1915.5	5.678
44.	26.95	1916.	5.678
44.5	27.05	1916.5	5.678
45.	27.14	1917.	5.678
45.5	27.24	1917.5	5.678
46.	27.33	1918.	5.655
46.5	27.43	1918.5	5.655
47.	27.52	1919.	5.653
47.5	27.62	1919.5	5.653
48.	27.69	1920.	5.653
48.5	27.79	1920.5	5.655
49.	27.88	1921.	5.631
49.5	27.98	1921.5	5.629
50.	28.05	1922.	5.607
50.5	28.12	1922.5	5.605
51.	28.22	1923.	5.607
51.5	28.31	1923.5	5.607
52.	28.41	1924.	5.583
52.5	28.53	1924.5	5.583
53.	28.6	1925.	5.581
53.5	28.69	1925.5	5.583
54.	28.79	1926.	5.583
54.5	28.86	1926.5	5.557
55.	28.95	1927.	5.557
55.5	29.05	1927.5	5.559
56.	29.12	1928.	5.559
56.5	29.22	1928.5	5.535
57.	29.29	1929.	5.535
57.5	29.39	1929.5	5.535
58.	29.46	1930.	5.533
58.5	29.55	1930.5	5.512
59.	29.62	1931.	5.51
59.5	29.72	1931.5	5.512
60.	29.79	1932.	5.488
60.5	29.86	1932.5	5.488
61.	29.93	1933.	5.486
61.5	30.	1933.5	5.486
62.	30.1	1934.	5.488
62.5	30.17	1934.5	5.464
63.	30.24	1935.	5.464
63.5	30.32	1935.5	5.464
64.	30.39	1936.	5.44
64.5	30.48	1936.5	5.438
65.	30.55	1937.	5.44
65.5	30.6	1937.5	5.44
66.	30.7	1938.	5.438
66.5	30.74	1938.5	5.438
67.	30.82	1939.	5.416
67.5	30.86	1939.5	5.44
68.	30.93	1940.	5.416
68.5	30.98	1940.5	5.416
69.	31.05	1941.	5.416
69.5	31.1	1941.5	5.392
70.	31.17	1942.	5.392
70.5	31.22	1942.5	5.392
71.	31.29	1943.	5.368
71.5	31.34	1943.5	5.368
72.	31.41	1944.	5.366
72.5	31.46	1944.5	5.368
73.	31.53	1945.	5.345
73.5	31.58	1945.5	5.345
74.	31.63	1946.	5.345
74.5	31.7	1946.5	5.345
75.	31.77	1947.	5.343
75.5	31.82	1947.5	5.321

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
76.	31.86	1948.	5.321
76.5	31.94	1948.5	5.321
77.	31.98	1949.	5.321
77.5	32.03	1949.5	5.297
78.	32.1	1950.	5.295
78.5	32.15	1950.5	5.295
79.	32.2	1951.	5.297
79.5	32.25	1951.5	5.297
80.	32.32	1952.	5.273
80.5	32.39	1952.5	5.297
81.	32.46	1953.	5.271
81.5	32.51	1953.5	5.273
82.	32.56	1954.	5.247
82.5	32.6	1954.5	5.249
83.	32.65	1955.	5.249
83.5	32.72	1955.5	5.247
84.	32.77	1956.	5.225
84.5	32.84	1956.5	5.225
85.	32.89	1957.	5.225
85.5	32.94	1957.5	5.223
86.	32.99	1958.	5.225
86.5	33.06	1958.5	5.225
87.	33.1	1959.	5.199
87.5	33.18	1959.5	5.199
88.	33.23	1960.	5.201
88.5	33.27	1960.5	5.201
89.	33.34	1961.	5.178
89.5	33.41	1961.5	5.176
90.	33.46	1962.	5.178
90.5	33.51	1962.5	5.176
91.	33.58	1963.	5.154
91.5	33.63	1963.5	5.154
92.	33.68	1964.	5.154
92.5	33.75	1964.5	5.154
93.	33.8	1965.	5.154
93.5	33.84	1965.5	5.154
94.	33.89	1966.	5.154
94.5	33.94	1966.5	5.13
95.	34.01	1967.	5.128
95.5	34.06	1967.5	5.128
96.	34.11	1968.	5.128
96.5	34.16	1968.5	5.104
97.	34.18	1969.	5.104
97.5	34.2	1969.5	5.104
98.	34.25	1970.	5.106
98.5	34.35	1970.5	5.08
99.	34.39	1971.	5.082
99.5	34.49	1971.5	5.08
100.	34.54	1972.	5.082
100.5	34.61	1972.5	5.082
101.	34.66	1973.	5.082
101.5	34.7	1973.5	5.058
102.	34.8	1974.	5.056
102.5	34.85	1974.5	5.058
103.	34.92	1975.	5.056
103.5	34.97	1975.5	5.032
104.	35.01	1976.	5.034
104.5	35.06	1976.5	5.034
105.	35.11	1977.	5.034
105.5	35.18	1977.5	5.032
106.	35.59	1978.	5.034
106.5	35.94	1978.5	5.034
107.	36.25	1979.	5.011
107.5	36.49	1979.5	5.009
108.	36.71	1980.	5.009
108.5	36.92	1980.5	4.987
109.	37.11	1981.	4.987
109.5	37.28	1981.5	4.987
110.	37.4	1982.	4.987
110.5	37.54	1982.5	4.987

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
111.	37.64	1983.	4.961
111.5	37.73	1983.5	4.961
112.	37.85	1984.	4.963
112.5	37.92	1984.5	4.963
113.	37.99	1985.	4.963
113.5	38.04	1985.5	4.937
114.	38.14	1986.	4.961
114.5	38.19	1986.5	4.937
115.	38.28	1987.	4.937
115.5	38.33	1987.5	4.939
116.	38.4	1988.	4.939
116.5	38.47	1988.5	4.937
117.	38.52	1989.	4.915
117.5	38.57	1989.5	4.913
118.	38.59	1990.	4.913
118.5	38.64	1990.5	4.889
119.	38.66	1991.	4.891
119.5	38.71	1991.5	4.891
120.	38.76	1992.	4.889
120.5	38.78	1992.5	4.889
121.	38.85	1993.	4.891
121.5	38.9	1993.5	4.868
122.	38.95	1994.	4.889
122.5	39.	1994.5	4.866
123.	39.02	1995.	4.868
123.5	39.09	1995.5	4.868
124.	39.14	1996.	4.866
124.5	39.16	1996.5	4.844
125.	39.23	1997.	4.844
125.5	39.28	1997.5	4.82
126.	39.31	1998.	4.844
126.5	39.38	1998.5	4.82
127.	39.4	1999.	4.818
127.5	39.47	1999.5	4.82
128.	39.5	2000.	4.82
128.5	39.57	2000.5	4.818
129.	39.62	2001.	4.796
129.5	39.66	2001.5	4.794
130.	39.71	2002.	4.794
130.5	39.76	2002.5	4.794
131.	39.81	2003.	4.794
131.5	39.85	2003.5	4.796
132.	39.93	2004.	4.772
132.5	39.95	2004.5	4.77
133.	40.	2005.	4.77
133.5	40.05	2005.5	4.77
134.	40.12	2006.	4.772
134.5	40.19	2006.5	4.748
135.	40.24	2007.	4.746
135.5	40.28	2007.5	4.748
136.	40.31	2008.	4.748
136.5	40.36	2008.5	4.748
137.	40.43	2009.	4.746
137.5	40.45	2009.5	4.724
138.	40.52	2010.	4.722
138.5	40.59	2010.5	4.724
139.	40.62	2011.	4.724
139.5	40.64	2011.5	4.722
140.	40.71	2012.	4.724
140.5	40.74	2012.5	4.724
141.	40.79	2013.	4.701
141.5	40.86	2013.5	4.701
142.	40.91	2014.	4.699
142.5	40.93	2014.5	4.701
143.	40.98	2015.	4.675
143.5	41.02	2015.5	4.675
144.	41.1	2016.	4.675
144.5	41.12	2016.5	4.677
145.	41.14	2017.	4.675
145.5	41.22	2017.5	4.675

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
146.	41.24	2018.	4.675
146.5	41.29	2018.5	4.651
147.	41.33	2019.	4.653
147.5	41.38	2019.5	4.651
148.	41.43	2020.	4.651
148.5	41.48	2020.5	4.651
149.	41.5	2021.	4.653
149.5	41.55	2021.5	4.629
150.	41.57	2022.	4.627
150.5	41.64	2022.5	4.629
151.	41.67	2023.	4.627
151.5	41.72	2023.5	4.603
152.	41.74	2024.	4.603
152.5	41.79	2024.5	4.605
153.	41.84	2025.	4.605
153.5	41.88	2025.5	4.605
154.	41.91	2026.	4.605
154.5	41.95	2026.5	4.605
155.	42.	2027.	4.579
155.5	42.03	2027.5	4.581
156.	42.07	2028.	4.579
156.5	42.1	2028.5	4.579
157.	42.15	2029.	4.579
157.5	42.19	2029.5	4.579
158.	42.17	2030.	4.557
158.5	42.19	2030.5	4.557
159.	42.22	2031.	4.555
159.5	42.24	2031.5	4.555
160.	42.26	2032.	4.555
160.5	42.29	2032.5	4.532
161.	42.31	2033.	4.532
161.5	42.36	2033.5	4.534
162.	42.38	2034.	4.532
162.5	42.43	2034.5	4.534
163.	42.45	2035.	4.508
163.5	42.48	2035.5	4.51
164.	42.53	2036.	4.51
164.5	42.53	2036.5	4.508
165.	42.6	2037.	4.508
165.5	42.62	2037.5	4.508
166.	42.62	2038.	4.508
166.5	42.69	2038.5	4.51
167.	42.72	2039.	4.484
167.5	42.74	2039.5	4.484
168.	42.77	2040.	4.484
168.5	42.81	2040.5	4.484
169.	42.84	2041.	4.46
169.5	42.86	2041.5	4.46
170.	42.91	2042.	4.46
170.5	42.93	2042.5	4.46
171.	42.93	2043.	4.46
171.5	42.98	2043.5	4.438
172.	43.05	2044.	4.438
172.5	43.05	2044.5	4.438
173.	43.08	2045.	4.438
173.5	43.1	2045.5	4.46
174.	43.15	2046.	4.436
174.5	43.17	2046.5	4.436
175.	43.22	2047.	4.412
175.5	43.27	2047.5	4.412
176.	43.27	2048.	4.412
176.5	43.29	2048.5	4.414
177.	43.29	2049.	4.412
177.5	43.29	2049.5	4.414
178.	43.29	2050.	4.412
178.5	43.31	2050.5	4.414
179.	43.34	2051.	4.412
179.5	43.34	2051.5	4.389
180.	43.34	2052.	4.389
180.5	43.38	2052.5	4.389

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
181.	43.38	2053.	4.365
181.5	43.41	2053.5	4.367
182.	43.46	2054.	4.365
182.5	43.48	2054.5	4.365
183.	43.48	2055.	4.365
183.5	43.53	2055.5	4.367
184.	43.53	2056.	4.365
184.5	43.6	2056.5	4.343
185.	43.65	2057.	4.341
185.5	43.7	2057.5	4.341
186.	43.72	2058.	4.341
186.5	43.77	2058.5	4.317
187.	43.79	2059.	4.317
187.5	43.84	2059.5	4.319
188.	43.89	2060.	4.317
188.5	43.91	2060.5	4.317
189.	43.93	2061.	4.341
189.5	43.98	2061.5	4.317
190.	44.01	2062.	4.319
190.5	44.03	2062.5	4.317
191.	44.08	2063.	4.293
191.5	44.08	2063.5	4.319
192.	44.1	2064.	4.293
192.5	44.13	2064.5	4.295
193.	44.17	2065.	4.293
193.5	44.2	2065.5	4.293
194.	44.22	2066.	4.295
194.5	44.27	2066.5	4.293
195.	44.27	2067.	4.293
195.5	44.29	2067.5	4.271
196.	44.34	2068.	4.271
196.5	44.36	2068.5	4.271
197.	44.41	2069.	4.269
197.5	44.44	2069.5	4.247
198.	44.44	2070.	4.271
198.5	44.51	2070.5	4.245
199.	44.48	2071.	4.247
199.5	44.53	2071.5	4.245
200.	44.55	2072.	4.245
200.5	44.58	2072.5	4.247
201.	44.63	2073.	4.245
201.5	44.65	2073.5	4.224
202.	44.67	2074.	4.222
202.5	44.7	2074.5	4.224
203.	44.72	2075.	4.222
203.5	44.74	2075.5	4.222
204.	44.74	2076.	4.222
204.5	44.77	2076.5	4.222
205.	44.82	2077.	4.2
205.5	44.84	2077.5	4.222
206.	44.86	2078.	4.198
206.5	44.89	2078.5	4.198
207.	44.89	2079.	4.198
207.5	44.94	2079.5	4.198
208.	44.96	2080.	4.174
208.5	44.96	2080.5	4.174
209.	44.96	2081.	4.176
209.5	44.96	2081.5	4.176
210.	44.96	2082.	4.174
210.5	45.01	2082.5	4.15
211.	45.06	2083.	4.15
211.5	45.08	2083.5	4.15
212.	45.1	2084.	4.152
212.5	45.1	2084.5	4.15
213.	45.1	2085.	4.15
213.5	45.1	2085.5	4.152
214.	45.15	2086.	4.15
214.5	45.13	2086.5	4.15
215.	45.13	2087.	4.15
215.5	45.15	2087.5	4.128

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
216.	45.15	2088.	4.126
216.5	45.2	2088.5	4.126
217.	45.2	2089.	4.128
217.5	45.22	2089.5	4.126
218.	45.25	2090.	4.128
218.5	45.25	2090.5	4.102
219.	45.29	2091.	4.102
219.5	45.29	2091.5	4.102
220.	45.32	2092.	4.102
220.5	45.34	2092.5	4.104
221.	45.32	2093.	4.102
221.5	45.37	2093.5	4.102
222.	45.37	2094.	4.078
222.5	45.39	2094.5	4.078
223.	45.39	2095.	4.078
223.5	45.39	2095.5	4.078
224.	45.41	2096.	4.08
224.5	45.44	2096.5	4.078
225.	45.46	2097.	4.078
225.5	45.48	2097.5	4.078
226.	45.46	2098.	4.078
226.5	45.51	2098.5	4.055
227.	45.51	2099.	4.08
227.5	45.48	2099.5	4.055
228.	45.48	2100.	4.055
228.5	45.51	2100.5	4.055
229.	45.51	2101.	4.055
229.5	45.56	2101.5	4.055
230.	45.56	2102.	4.031
230.5	45.58	2102.5	4.031
231.	45.56	2103.	4.031
231.5	45.63	2103.5	4.031
232.	45.6	2104.	4.007
232.5	45.6	2104.5	4.031
233.	45.65	2105.	4.031
233.5	45.67	2105.5	4.007
234.	45.67	2106.	4.031
234.5	45.67	2106.5	4.007
235.	45.7	2107.	4.007
235.5	45.7	2107.5	4.007
236.	45.72	2108.	3.983
236.5	45.72	2108.5	3.983
1089.5	59.32	2109.	4.007
1090.	59.46	2109.5	3.983
1090.5	59.58	2110.	3.985
1091.	59.68	2110.5	3.983
1091.5	59.77	2111.	3.985
1092.	59.89	2111.5	3.983
1092.5	59.96	2112.	3.959
1093.	60.08	2112.5	3.983
1093.5	60.18	2113.	3.959
1094.	60.27	2113.5	3.961
1094.5	60.37	2114.	3.961
1095.	60.44	2114.5	3.959
1095.5	60.51	2115.	3.959
1096.	60.63	2115.5	3.959
1096.5	60.68	2116.	3.937
1097.	60.75	2116.5	3.961
1097.5	60.84	2117.	3.937
1098.	60.89	2117.5	3.935
1098.5	60.94	2118.	3.935
1099.	61.01	2118.5	3.935
1099.5	61.08	2119.	3.935
1100.	61.13	2119.5	3.935
1100.5	61.2	2120.	3.913
1101.	61.25	2120.5	3.911
1101.5	61.32	2121.	3.911
1102.	61.37	2121.5	3.911
1102.5	61.42	2122.	3.911
1103.	61.47	2122.5	3.911

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
1103.5	61.47	2123.	3.913
1104.	61.49	2123.5	3.911
1104.5	61.51	2124.	3.913
1105.	61.54	2124.5	3.888
1105.5	61.61	2125.	3.888
1106.	61.68	2125.5	3.888
1106.5	61.75	2126.	3.89
1107.	61.8	2126.5	3.89
1107.5	61.82	2127.	3.888
1108.	61.87	2127.5	3.866
1108.5	61.89	2128.	3.888
1109.	61.94	2128.5	3.864
1109.5	61.99	2129.	3.864
1110.	62.01	2129.5	3.864
1110.5	62.06	2130.	3.864
1111.	62.09	2130.5	3.864
1111.5	62.11	2131.	3.864
1112.	62.16	2131.5	3.842
1112.5	62.18	2132.	3.84
1113.	62.18	2132.5	3.84
1113.5	62.18	2133.	3.84
1114.	62.13	2133.5	3.864
1114.5	62.16	2134.	3.84
1115.	62.16	2134.5	3.84
1115.5	62.16	2135.	3.84
1116.	62.18	2135.5	3.84
1116.5	62.18	2136.	3.816
1117.	62.2	2136.5	3.816
1117.5	62.2	2137.	3.816
1118.	62.23	2137.5	3.818
1118.5	62.27	2138.	3.816
1119.	62.27	2138.5	3.816
1119.5	62.3	2139.	3.792
1120.	62.32	2139.5	3.816
1120.5	62.35	2140.	3.792
1121.	62.4	2140.5	3.792
1121.5	62.42	2141.	3.816
1122.	62.44	2141.5	3.792
1122.5	62.47	2142.	3.792
1123.	62.49	2142.5	3.792
1123.5	62.49	2143.	3.792
1124.	62.52	2143.5	3.792
1124.5	62.54	2144.	3.792
1125.	62.51	2144.5	3.792
1125.5	62.56	2145.	3.792
1126.	62.56	2145.5	3.768
1126.5	62.56	2146.	3.768
1127.	62.63	2146.5	3.768
1127.5	62.61	2147.	3.768
1128.	62.66	2147.5	3.77
1128.5	62.68	2148.	3.745
1129.	62.7	2148.5	3.745
1129.5	62.71	2149.	3.745
1130.	62.75	2149.5	3.745
1130.5	62.75	2150.	3.747
1131.	62.78	2150.5	3.747
1131.5	62.8	2151.	3.747
1132.	62.85	2151.5	3.745
1132.5	62.85	2152.	3.721
1133.	62.87	2152.5	3.721
1133.5	62.9	2153.	3.721
1134.	62.92	2153.5	3.721
1134.5	62.97	2154.	3.721
1135.	62.99	2154.5	3.721
1135.5	62.99	2155.	3.721
1136.	62.99	2155.5	3.721
1136.5	63.02	2156.	3.721
1137.	63.04	2156.5	3.721
1137.5	63.11	2157.	3.697
1138.	63.13	2157.5	3.721

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
1138.5	63.18	2158.	3.699
1139.	63.21	2158.5	3.697
1139.5	63.28	2159.	3.697
1140.	63.33	2159.5	3.697
1140.5	63.35	2160.	3.697
1141.	63.4	2160.5	3.697
1141.5	63.42	2161.	3.673
1142.	63.47	2161.5	3.673
1142.5	63.49	2162.	3.673
1143.	63.52	2162.5	3.673
1143.5	63.56	2163.	3.673
1144.	63.59	2163.5	3.673
1144.5	63.61	2164.	3.673
1145.	63.63	2164.5	3.673
1145.5	63.66	2165.	3.675
1146.	63.68	2165.5	3.649
1146.5	63.71	2166.	3.649
1147.	63.75	2166.5	3.649
1147.5	63.8	2167.	3.649
1148.	63.8	2167.5	3.649
1148.5	63.75	2168.	3.649
1149.	63.68	2168.5	3.649
1149.5	63.54	2169.	3.649
1150.	63.33	2169.5	3.625
1150.5	63.16	2170.	3.649
1151.	62.94	2170.5	3.625
1151.5	62.82	2171.	3.625
1152.	62.66	2171.5	3.625
1152.5	62.54	2172.	3.625
1153.	62.47	2172.5	3.625
1153.5	62.4	2173.	3.625
1154.	62.27	2173.5	3.625
1154.5	62.09	2174.	3.601
1155.	61.92	2174.5	3.601
1155.5	61.94	2175.	3.601
1156.	62.04	2175.5	3.601
1156.5	62.11	2176.	3.601
1157.	62.09	2176.5	3.603
1157.5	62.06	2177.	3.601
1158.	62.01	2177.5	3.601
1158.5	61.99	2178.	3.578
1159.	61.99	2178.5	3.578
1159.5	61.94	2179.	3.578
1160.	61.94	2179.5	3.578
1160.5	61.97	2180.	3.578
1161.	61.99	2180.5	3.578
1161.5	62.01	2181.	3.58
1162.	62.04	2181.5	3.58
1162.5	62.04	2182.	3.554
1163.	62.06	2182.5	3.554
1163.5	62.06	2183.	3.554
1164.	62.06	2183.5	3.578
1164.5	62.06	2184.	3.554
1165.	62.06	2184.5	3.556
1165.5	62.09	2185.	3.554
1166.	62.09	2185.5	3.554
1166.5	62.11	2186.	3.554
1167.	62.11	2186.5	3.554
1167.5	62.13	2187.	3.53
1168.	62.16	2187.5	3.532
1168.5	62.18	2188.	3.53
1169.	62.2	2188.5	3.53
1169.5	62.2	2189.	3.556
1170.	62.2	2189.5	3.53
1170.5	62.23	2190.	3.53
1171.	62.23	2190.5	3.53
1171.5	62.23	2191.	3.53
1172.	62.23	2191.5	3.53
1172.5	62.23	2192.	3.53
1173.	62.23	2192.5	3.53

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
1173.5	62.23	2193.	3.53
1174.	62.2	2193.5	3.53
1174.5	62.2	2194.	3.506
1175.	62.18	2194.5	3.506
1175.5	62.16	2195.	3.506
1176.	62.16	2195.5	3.506
1176.5	62.13	2196.	3.506
1177.	62.11	2196.5	3.506
1177.5	62.11	2197.	3.506
1178.	62.11	2197.5	3.506
1178.5	62.11	2198.	3.482
1179.	62.11	2198.5	3.482
1179.5	62.09	2199.	3.506
1180.	62.11	2199.5	3.482
1180.5	62.11	2200.	3.482
1181.	62.09	2200.5	3.484
1181.5	62.09	2201.	3.482
1182.	62.09	2201.5	3.482
1182.5	62.09	2202.	3.458
1183.	62.09	2202.5	3.458
1183.5	62.09	2203.	3.458
1184.	62.09	2203.5	3.458
1184.5	62.09	2204.	3.458
1185.	62.09	2204.5	3.458
1185.5	62.11	2205.	3.458
1186.	62.09	2205.5	3.458
1186.5	62.11	2206.	3.458
1187.	62.11	2206.5	3.458
1187.5	62.11	2207.	3.458
1188.	62.09	2207.5	3.434
1188.5	62.09	2208.	3.434
1189.	62.09	2208.5	3.434
1189.5	62.09	2209.	3.434
1190.	62.06	2209.5	3.434
1190.5	62.06	2210.	3.434
1191.	62.06	2210.5	3.434
1191.5	62.06	2211.	3.411
1192.	62.06	2211.5	3.411
1192.5	62.06	2212.	3.411
1193.	62.06	2212.5	3.411
1193.5	62.06	2213.	3.411
1194.	62.06	2213.5	3.411
1194.5	62.06	2214.	3.411
1195.	62.06	2214.5	3.411
1195.5	62.06	2215.	3.411
1196.	62.06	2215.5	3.411
1196.5	62.04	2216.	3.411
1197.	62.04	2216.5	3.411
1197.5	62.04	2217.	3.387
1198.	62.04	2217.5	3.387
1198.5	62.04	2218.	3.387
1199.	62.04	2218.5	3.387
1199.5	62.04	2219.	3.387
1200.	62.04	2219.5	3.387
1200.5	62.04	2220.	3.387
1201.	62.06	2220.5	3.387
1201.5	62.04	2221.	3.387
1202.	62.04	2221.5	3.387
1202.5	62.04	2222.	3.387
1203.	62.04	2222.5	3.387
1203.5	62.01	2223.	3.363
1204.	62.01	2223.5	3.363
1204.5	62.02	2224.	3.363
1205.	62.04	2224.5	3.363
1205.5	62.04	2225.	3.363
1206.	62.04	2225.5	3.363
1206.5	62.04	2226.	3.363
1207.	62.04	2226.5	3.363
1207.5	62.06	2227.	3.363
1208.	62.06	2227.5	3.363

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
1208.5	62.06	2228.	3.363
1209.	62.06	2228.5	3.341
1209.5	62.06	2229.	3.339
1210.	62.06	2229.5	3.341
1210.5	62.09	2230.	3.339
1211.	62.09	2230.5	3.339
1211.5	62.06	2231.	3.339
1212.	62.06	2231.5	3.339
1212.5	62.06	2232.	3.315
1213.	62.09	2232.5	3.315
1213.5	62.09	2233.	3.315
1214.	62.09	2233.5	3.315
1214.5	62.09	2234.	3.315
1215.	62.09	2234.5	3.315
1215.5	62.11	2235.	3.315
1216.	62.11	2235.5	3.315
1216.5	62.11	2236.	3.315
1217.	62.11	2236.5	3.315
1217.5	62.11	2237.	3.315
1218.	62.13	2237.5	3.315
1218.5	62.13	2238.	3.291
1219.	62.13	2238.5	3.315
1219.5	62.11	2239.	3.291
1220.	62.13	2239.5	3.291
1220.5	62.11	2240.	3.293
1221.	62.11	2240.5	3.291
1221.5	62.11	2241.	3.291
1222.	62.09	2241.5	3.268
1222.5	62.06	2242.	3.268
1223.	62.06	2242.5	3.268
1223.5	62.06	2243.	3.291
1224.	62.06	2243.5	3.268
1224.5	62.04	2244.	3.268
1225.	62.04	2244.5	3.268
1225.5	62.06	2245.	3.268
1226.	62.04	2245.5	3.268
1226.5	62.04	2246.	3.268
1227.	62.06	2246.5	3.268
1227.5	62.06	2247.	3.244
1228.	62.06	2247.5	3.244
1228.5	62.06	2248.	3.268
1229.	62.06	2248.5	3.244
1229.5	62.06	2249.	3.244
1230.	62.09	2249.5	3.244
1230.5	62.06	2250.	3.244
1231.	62.09	2250.5	3.244
1231.5	62.09	2251.	3.244
1232.	62.09	2251.5	3.244
1232.5	62.09	2252.	3.244
1233.	62.09	2252.5	3.22
1233.5	62.11	2253.	3.22
1234.	62.11	2253.5	3.22
1234.5	62.11	2254.	3.22
1235.	62.13	2254.5	3.22
1235.5	62.11	2255.	3.22
1236.	62.11	2255.5	3.22
1236.5	62.11	2256.	3.22
1237.	62.13	2256.5	3.22
1237.5	62.13	2257.	3.22
1238.	62.13	2257.5	3.22
1238.5	62.13	2258.	3.22
1239.	62.13	2258.5	3.22
1239.5	62.13	2259.	3.22
1240.	62.13	2259.5	3.196
1240.5	62.13	2260.	3.196
1241.	62.16	2260.5	3.196
1241.5	62.16	2261.	3.196
1242.	62.16	2261.5	3.198
1242.5	62.16	2262.	3.196
1243.	62.16	2262.5	3.196

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
1243.5	62.16	2263.	3.196
1244.	62.16	2263.5	3.172
1244.5	62.18	2264.	3.172
1245.	62.18	2264.5	3.172
1245.5	62.18	2265.	3.172
1246.	62.18	2265.5	3.172
1246.5	62.18	2266.	3.172
1247.	62.21	2266.5	3.172
1247.5	62.18	2267.	3.172
1248.	62.18	2267.5	3.172
1248.5	62.18	2268.	3.174
1249.	62.18	2268.5	3.172
1249.5	62.2	2269.	3.148
1250.	62.2	2269.5	3.15
1250.5	62.23	2270.	3.172
1251.	62.2	2270.5	3.148
1251.5	62.23	2271.	3.148
1252.	62.23	2271.5	3.148
1252.5	62.23	2272.	3.172
1253.	62.25	2272.5	3.148
1253.5	62.25	2273.	3.148
1254.	62.23	2273.5	3.148
1254.5	62.25	2274.	3.148
1255.	62.25	2274.5	3.124
1255.5	62.25	2275.	3.148
1256.	62.25	2275.5	3.124
1256.5	62.25	2276.	3.124
1257.	62.27	2276.5	3.126
1257.5	62.27	2277.	3.124
1258.	62.27	2277.5	3.124
1258.5	62.27	2278.	3.124
1259.	62.27	2278.5	3.124
1259.5	62.27	2279.	3.124
1260.	62.27	2279.5	3.124
1260.5	62.27	2280.	3.124
1261.	62.27	2280.5	3.124
1261.5	62.3	2281.	3.101
1262.	62.3	2281.5	3.124
1262.5	62.3	2282.	3.124
1263.	62.3	2282.5	3.124
1263.5	62.3	2283.	3.101
1264.	62.32	2283.5	3.101
1264.5	62.3	2284.	3.101
1265.	62.32	2284.5	3.101
1265.5	62.32	2285.	3.101
1266.	62.33	2285.5	3.101
1266.5	62.32	2286.	3.101
1267.	62.35	2286.5	3.103
1267.5	62.35	2287.	3.101
1268.	62.35	2287.5	3.077
1268.5	62.35	2288.	3.077
1269.	62.35	2288.5	3.077
1269.5	62.37	2289.	3.077
1270.	62.37	2289.5	3.077
1270.5	62.37	2290.	3.079
1271.	62.37	2290.5	3.077
1271.5	62.37	2291.	3.077
1272.	62.37	2291.5	3.079
1272.5	62.35	2292.	3.077
1273.	62.35	2292.5	3.079
1273.5	62.32	2293.	3.077
1274.	62.33	2293.5	3.077
1274.5	62.32	2294.	3.077
1275.	62.3	2294.5	3.053
1275.5	62.3	2295.	3.053
1276.	62.3	2295.5	3.077
1276.5	62.32	2296.	3.053
1277.	62.32	2296.5	3.053
1277.5	62.32	2297.	3.053
1278.	62.32	2297.5	3.053

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
1278.5	62.32	2298.	3.029
1279.	62.32	2298.5	3.053
1279.5	62.32	2299.	3.029
1280.	62.32	2299.5	3.029
1280.5	62.32	2300.	3.053
1281.	62.32	2300.5	3.029
1281.5	62.32	2301.	3.053
1282.	62.32	2301.5	3.053
1282.5	62.32	2302.	3.029
1283.	62.35	2302.5	3.029
1283.5	62.35	2303.	3.029
1284.	62.35	2303.5	3.031
1284.5	62.35	2304.	3.029
1285.	62.35	2304.5	3.029
1285.5	62.35	2305.	3.029
1286.	62.35	2305.5	3.005
1286.5	62.37	2306.	3.005
1287.	62.3	2306.5	3.005
1287.5	62.25	2307.	3.005
1288.	62.2	2307.5	3.005
1288.5	62.13	2308.	3.005
1289.	62.11	2308.5	3.029
1289.5	62.06	2309.	3.029
1290.	62.04	2309.5	3.005
1290.5	62.01	2310.	3.005
1291.	61.99	2310.5	3.005
1291.5	61.97	2311.	3.005
1292.	61.94	2311.5	3.005
1292.5	61.92	2312.	3.005
1293.	61.89	2312.5	2.981
1293.5	61.89	2313.	2.981
1294.	61.87	2313.5	2.981
1294.5	61.87	2314.	2.981
1295.	61.85	2314.5	2.981
1295.5	61.85	2315.	2.981
1296.	61.82	2315.5	2.981
1296.5	61.82	2316.	2.981
1297.	61.8	2316.5	3.005
1297.5	61.8	2317.	2.981
1298.	61.77	2317.5	2.981
1298.5	61.77	2318.	2.981
1299.	61.77	2318.5	2.957
1299.5	61.77	2319.	2.957
1300.	61.75	2319.5	2.957
1300.5	61.75	2320.	2.957
1301.	61.73	2320.5	2.957
1301.5	61.73	2321.	2.957
1302.	61.73	2321.5	2.957
1302.5	61.7	2322.	2.957
1303.	61.7	2322.5	2.957
1303.5	61.7	2323.	2.957
1304.	61.7	2323.5	2.957
1304.5	61.68	2324.	2.957
1305.	61.68	2324.5	2.957
1305.5	61.68	2325.	2.957
1306.	61.68	2325.5	2.934
1306.5	61.66	2326.	2.957
1307.	61.63	2326.5	2.957
1307.5	61.63	2327.	2.934
1308.	61.63	2327.5	2.934
1308.5	61.61	2328.	2.957
1309.	61.61	2328.5	2.957
1309.5	61.58	2329.	2.936
1310.	61.56	2329.5	2.934
1310.5	61.56	2330.	2.934
1311.	61.54	2330.5	2.91
1311.5	61.54	2331.	2.91
1312.	61.51	2331.5	2.934
1312.5	61.51	2332.	2.91
1313.	61.51	2332.5	2.91

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
1313.5	61.51	2333.	2.91
1314.	61.49	2333.5	2.91
1314.5	61.49	2334.	2.91
1315.	61.49	2334.5	2.91
1315.5	61.47	2335.	2.91
1316.	61.49	2335.5	2.91
1316.5	61.49	2336.	2.91
1317.	61.49	2336.5	2.91
1317.5	61.49	2337.	2.91
1318.	61.49	2337.5	2.91
1318.5	61.49	2338.	2.886
1319.	61.49	2338.5	2.886
1319.5	61.47	2339.	2.886
1320.	61.47	2339.5	2.886
1320.5	61.47	2340.	2.91
1321.	61.47	2340.5	2.886
1321.5	61.47	2341.	2.886
1322.	61.47	2341.5	2.886
1322.5	61.47	2342.	2.886
1323.	61.47	2342.5	2.886
1323.5	61.47	2343.	2.886
1324.	61.47	2343.5	2.886
1324.5	61.47	2344.	2.886
1325.	61.47	2344.5	2.886
1325.5	61.47	2345.	2.886
1326.	61.44	2345.5	2.886
1326.5	61.44	2346.	2.886
1327.	61.44	2346.5	2.886
1327.5	61.44	2347.	2.886
1328.	61.44	2347.5	2.862
1328.5	61.44	2348.	2.862
1329.	61.44	2348.5	2.862
1329.5	61.42	2349.	2.862
1330.	61.44	2349.5	2.862
1330.5	61.44	2350.	2.862
1331.	61.44	2350.5	2.862
1331.5	61.42	2351.	2.862
1332.	61.42	2351.5	2.838
1332.5	61.42	2352.	2.838
1333.	61.42	2352.5	2.862
1333.5	61.42	2353.	2.838
1334.	61.42	2353.5	2.862
1334.5	61.42	2354.	2.862
1335.	61.42	2354.5	2.838
1335.5	61.42	2355.	2.838
1336.	61.42	2355.5	2.838
1336.5	61.42	2356.	2.838
1337.	61.42	2356.5	2.838
1337.5	61.39	2357.	2.838
1338.	61.42	2357.5	2.838
1338.5	61.42	2358.	2.838
1339.	61.42	2358.5	2.838
1339.5	61.42	2359.	2.838
1340.	61.42	2359.5	2.838
1340.5	61.42	2360.	2.838
1341.	61.42	2360.5	2.814
1341.5	61.44	2361.	2.814
1342.	61.44	2361.5	2.814
1342.5	61.44	2362.	2.814
1343.	61.44	2362.5	2.814
1343.5	61.44	2363.	2.814
1344.	61.44	2363.5	2.814
1344.5	61.44	2364.	2.814
1345.	61.42	2364.5	2.814
1345.5	61.42	2365.	2.814
1346.	61.42	2365.5	2.814
1346.5	61.39	2366.	2.814
1347.	61.39	2366.5	2.816
1347.5	61.39	2367.	2.814
1348.	61.39	2367.5	2.79

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
1348.5	61.39	2368.	2.79
1349.	61.39	2368.5	2.79
1349.5	61.39	2369.	2.79
1350.	61.39	2369.5	2.79
1350.5	61.42	2370.	2.79
1351.	61.42	2370.5	2.79
1351.5	61.39	2371.	2.79
1352.	61.42	2371.5	2.79
1352.5	61.39	2372.	2.79
1353.	61.42	2372.5	2.79
1353.5	61.39	2373.	2.79
1354.	61.39	2373.5	2.79
1354.5	61.42	2374.	2.767
1355.	61.42	2374.5	2.767
1355.5	61.44	2375.	2.79
1356.	61.42	2375.5	2.767
1356.5	61.42	2376.	2.767
1357.	61.42	2376.5	2.767
1357.5	61.42	2377.	2.767
1358.	61.42	2377.5	2.767
1358.5	61.42	2378.	2.767
1359.	61.42	2378.5	2.767
1359.5	61.42	2379.	2.767
1360.	61.39	2379.5	2.767
1360.5	61.39	2380.	2.767
1361.	61.42	2380.5	2.767
1361.5	61.42	2381.	2.767
1362.	61.42	2381.5	2.743
1362.5	61.42	2382.	2.743
1363.	61.42	2382.5	2.743
1363.5	61.42	2383.	2.743
1364.	61.42	2383.5	2.743
1364.5	61.42	2384.	2.743
1365.	61.39	2384.5	2.743
1365.5	61.42	2385.	2.743
1366.	61.42	2385.5	2.743
1366.5	61.42	2386.	2.743
1367.	61.39	2386.5	2.743
1367.5	61.39	2387.	2.743
1368.	61.4	2387.5	2.743
1368.5	61.39	2388.	2.743
1369.	61.39	2388.5	2.743
1369.5	61.39	2389.	2.719
1370.	61.39	2389.5	2.719
1370.5	61.39	2390.	2.719
1371.	61.39	2390.5	2.719
1371.5	61.39	2391.	2.719
1372.	61.39	2391.5	2.719
1372.5	61.39	2392.	2.719
1373.	61.42	2392.5	2.719
1373.5	61.39	2393.	2.719
1374.	61.42	2393.5	2.695
1374.5	61.39	2394.	2.719
1375.	61.39	2394.5	2.719
1375.5	61.39	2395.	2.719
1376.	61.42	2395.5	2.719
1376.5	61.42	2396.	2.719
1377.	61.42	2396.5	2.695
1377.5	61.42	2397.	2.695
1378.	61.44	2397.5	2.695
1378.5	61.44	2398.	2.695
1379.	61.47	2398.5	2.695
1379.5	61.44	2399.	2.695
1380.	61.47	2399.5	2.695
1380.5	61.49	2400.	2.695
1381.	61.49	2400.5	2.695
1381.5	61.49	2401.	2.671
1382.	61.49	2401.5	2.695
1382.5	61.49	2402.	2.695
1383.	61.49	2402.5	2.695

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
1383.5	61.51	2403.	2.695
1384.	61.51	2403.5	2.695
1384.5	61.51	2404.	2.695
1385.	61.49	2404.5	2.695
1385.5	61.51	2405.	2.671
1386.	61.51	2405.5	2.671
1386.5	61.49	2406.	2.671
1387.	61.51	2406.5	2.671
1387.5	61.51	2407.	2.671
1388.	61.51	2407.5	2.671
1388.5	61.49	2408.	2.671
1389.	61.51	2408.5	2.671
1389.5	61.49	2409.	2.647
1390.	61.49	2409.5	2.671
1390.5	61.49	2410.	2.671
1391.	61.49	2410.5	2.671
1391.5	61.49	2411.	2.671
1392.	61.49	2411.5	2.647
1392.5	61.49	2412.	2.647
1393.	61.49	2412.5	2.649
1393.5	61.49	2413.	2.647
1394.	61.47	2413.5	2.647
1394.5	61.49	2414.	2.647
1395.	61.49	2414.5	2.647
1395.5	61.49	2415.	2.647
1396.	61.49	2415.5	2.647
1396.5	61.49	2416.	2.647
1397.	61.49	2416.5	2.647
1397.5	61.49	2417.	2.624
1398.	61.49	2417.5	2.647
1398.5	61.49	2418.	2.624
1399.	61.47	2418.5	2.624
1399.5	61.49	2419.	2.624
1400.	61.49	2419.5	2.624
1400.5	61.47	2420.	2.624
1401.	61.47	2420.5	2.624
1401.5	61.47	2421.	2.624
1402.	61.47	2421.5	2.624
1402.5	61.47	2422.	2.624
1403.	61.49	2422.5	2.624
1403.5	61.47	2423.	2.624
1404.	61.47	2423.5	2.624
1404.5	61.47	2424.	2.624
1405.	61.47	2424.5	2.624
1405.5	61.47	2425.	2.624
1406.	61.47	2425.5	2.624
1406.5	61.47	2426.	2.624
1407.	61.47	2426.5	2.624
1407.5	61.49	2427.	2.624
1408.	61.47	2427.5	2.624
1408.5	61.47	2428.	2.6
1409.	61.44	2428.5	2.6
1409.5	61.47	2429.	2.6
1410.	61.49	2429.5	2.6
1410.5	61.51	2430.	2.624
1411.	61.54	2430.5	2.6
1411.5	61.56	2431.	2.6
1412.	61.56	2431.5	2.6
1412.5	61.56	2432.	2.6
1413.	61.54	2432.5	2.6
1413.5	61.54	2433.	2.6
1414.	61.54	2433.5	2.576
1414.5	61.51	2434.	2.576
1415.	61.51	2434.5	2.6
1415.5	61.49	2435.	2.6
1416.	61.49	2435.5	2.576
1416.5	61.47	2436.	2.6
1417.	61.47	2436.5	2.576
1417.5	61.44	2437.	2.576
1418.	61.44	2437.5	2.576

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
1418.5	61.44	2438.	2.576
1419.	61.44	2438.5	2.576
1419.5	61.44	2439.	2.576
1420.	61.44	2439.5	2.576
1420.5	61.42	2440.	2.576
1421.	61.42	2440.5	2.576
1421.5	61.39	2441.	2.576
1422.	61.39	2441.5	2.576
1422.5	61.4	2442.	2.552
1423.	61.37	2442.5	2.576
1423.5	61.34	2443.	2.552
1424.	61.32	2443.5	2.552
1424.5	61.32	2444.	2.552
1425.	61.3	2444.5	2.552
1425.5	61.27	2445.	2.552
1426.	61.25	2445.5	2.576
1426.5	61.23	2446.	2.552
1427.	61.2	2446.5	2.552
1427.5	61.18	2447.	2.552
1428.	61.15	2447.5	2.552
1428.5	61.16	2448.	2.552
1429.	61.13	2448.5	2.552
1429.5	61.11	2449.	2.552
1430.	61.08	2449.5	2.552
1430.5	61.09	2450.	2.528
1431.	61.08	2450.5	2.528
1431.5	61.06	2451.	2.528
1432.	61.06	2451.5	2.528
1432.5	61.03	2452.	2.552
1433.	61.03	2452.5	2.528
1433.5	61.03	2453.	2.528
1434.	61.01	2453.5	2.528
1434.5	61.01	2454.	2.528
1435.	60.99	2454.5	2.528
1435.5	60.99	2455.	2.528
1436.	60.99	2455.5	2.528
1436.5	60.96	2456.	2.528
1437.	60.96	2456.5	2.528
1437.5	60.94	2457.	2.528
1438.	60.94	2457.5	2.504
1438.5	60.94	2458.	2.504
1439.	60.92	2458.5	2.528
1439.5	60.92	2459.	2.528
1440.	60.92	2459.5	2.528
1440.5	60.92	2460.	2.504
1441.	60.89	2460.5	2.504
1441.5	60.92	2461.	2.504
1442.	60.89	2461.5	2.528
1442.5	60.89	2462.	2.504
1443.	60.87	2462.5	2.504
1443.5	60.87	2463.	2.504
1444.	60.84	2463.5	2.504
1444.5	60.84	2464.	2.504
1445.	60.84	2464.5	2.504
1445.5	60.84	2465.	2.504
1446.	60.84	2465.5	2.504
1446.5	60.82	2466.	2.504
1447.	60.84	2466.5	2.504
1447.5	60.84	2467.	2.48
1448.	60.84	2467.5	2.504
1448.5	60.84	2468.	2.504
1449.	60.84	2468.5	2.504
1449.5	60.85	2469.	2.504
1450.	60.84	2469.5	2.48
1450.5	60.87	2470.	2.48
1451.	60.87	2470.5	2.48
1451.5	60.84	2471.	2.48
1452.	60.06	2471.5	2.48
1452.5	56.31	2472.	2.48
1453.	54.41	2472.5	2.48

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
1453.5	52.74	2473.	2.48
1454.	51.38	2473.5	2.48
1454.5	50.14	2474.	2.48
1455.	48.99	2474.5	2.48
1455.5	47.99	2475.	2.48
1456.	47.11	2475.5	2.48
1456.5	46.3	2476.	2.48
1457.	45.59	2476.5	2.48
1457.5	44.92	2477.	2.457
1458.	44.32	2477.5	2.457
1458.5	43.78	2478.	2.457
1459.	43.25	2478.5	2.457
1459.5	42.75	2479.	2.457
1460.	42.3	2479.5	2.48
1460.5	41.85	2480.	2.457
1461.	41.44	2480.5	2.457
1461.5	41.06	2481.	2.457
1462.	40.68	2481.5	2.457
1462.5	40.34	2482.	2.457
1463.	39.98	2482.5	2.457
1463.5	39.67	2483.	2.457
1464.	39.39	2483.5	2.457
1464.5	39.1	2484.	2.457
1465.	38.82	2484.5	2.457
1465.5	38.58	2485.	2.457
1466.	38.32	2485.5	2.457
1466.5	38.05	2486.	2.457
1467.	37.81	2486.5	2.457
1467.5	37.55	2487.	2.457
1468.	37.29	2487.5	2.433
1468.5	37.05	2488.	2.433
1469.	36.84	2488.5	2.433
1469.5	36.6	2489.	2.433
1470.	36.38	2489.5	2.433
1470.5	36.17	2490.	2.433
1471.	35.95	2490.5	2.433
1471.5	35.74	2491.	2.433
1472.	35.55	2491.5	2.433
1472.5	35.36	2492.	2.433
1473.	35.14	2492.5	2.433
1473.5	34.95	2493.	2.433
1474.	34.76	2493.5	2.433
1474.5	34.57	2494.	2.433
1475.	34.4	2494.5	2.409
1475.5	34.24	2495.	2.433
1476.	34.05	2495.5	2.433
1476.5	33.88	2496.	2.433
1477.	33.69	2496.5	2.409
1477.5	33.52	2497.	2.433
1478.	33.35	2497.5	2.409
1478.5	33.19	2498.	2.409
1479.	33.05	2498.5	2.409
1479.5	32.88	2499.	2.409
1480.	32.73	2499.5	2.409
1480.5	32.57	2500.	2.409
1481.	32.4	2500.5	2.409
1481.5	32.26	2501.	2.409
1482.	32.11	2501.5	2.409
1482.5	31.97	2502.	2.409
1483.	31.8	2502.5	2.409
1483.5	31.66	2503.	2.409
1484.	31.52	2503.5	2.385
1484.5	31.37	2504.	2.409
1485.	31.23	2504.5	2.409
1485.5	31.11	2505.	2.409
1486.	30.97	2505.5	2.385
1486.5	30.82	2506.	2.385
1487.	30.68	2506.5	2.409
1487.5	30.56	2507.	2.409
1488.	30.44	2507.5	2.385

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
1488.5	30.3	2508.	2.385
1489.	30.18	2508.5	2.385
1489.5	30.04	2509.	2.385
1490.	29.92	2509.5	2.385
1490.5	29.8	2510.	2.361
1491.	29.68	2510.5	2.385
1491.5	29.56	2511.	2.385
1492.	29.44	2511.5	2.385
1492.5	29.3	2512.	2.385
1493.	29.2	2512.5	2.385
1493.5	29.06	2513.	2.385
1494.	28.96	2513.5	2.361
1494.5	28.84	2514.	2.385
1495.	28.72	2514.5	2.361
1495.5	28.63	2515.	2.385
1496.	28.51	2515.5	2.361
1496.5	28.39	2516.	2.385
1497.	28.27	2516.5	2.361
1497.5	28.15	2517.	2.361
1498.	28.06	2517.5	2.361
1498.5	27.94	2518.	2.361
1499.	27.84	2518.5	2.385
1499.5	27.72	2519.	2.361
1500.	27.63	2519.5	2.361
1500.5	27.51	2520.	2.361
1501.	27.41	2520.5	2.361
1501.5	27.29	2521.	2.361
1502.	27.2	2521.5	2.361
1502.5	27.1	2522.	2.361
1503.	26.98	2522.5	2.361
1503.5	26.89	2523.	2.337
1504.	26.79	2523.5	2.361
1504.5	26.7	2524.	2.361
1505.	26.6	2524.5	2.361
1505.5	26.5	2525.	2.337
1506.	26.41	2525.5	2.337
1506.5	26.32	2526.	2.337
1507.	26.22	2526.5	2.361
1507.5	26.12	2527.	2.337
1508.	26.03	2527.5	2.361
1508.5	25.96	2528.	2.337
1509.	25.84	2528.5	2.337
1509.5	25.74	2529.	2.337
1510.	25.65	2529.5	2.337
1510.5	25.55	2530.	2.337
1511.	25.48	2530.5	2.337
1511.5	25.38	2531.	2.337
1512.	25.29	2531.5	2.337
1512.5	25.19	2532.	2.337
1513.	25.1	2532.5	2.337
1513.5	25.02	2533.	2.337
1514.	24.95	2533.5	2.337
1514.5	24.86	2534.	2.313
1515.	24.76	2534.5	2.313
1515.5	24.67	2535.	2.337
1516.	24.6	2535.5	2.337
1516.5	24.52	2536.	2.337
1517.	24.43	2536.5	2.337
1517.5	24.33	2537.	2.337
1518.	24.26	2537.5	2.313
1518.5	24.17	2538.	2.313
1519.	24.09	2538.5	2.313
1519.5	24.02	2539.	2.313
1520.	23.95	2539.5	2.313
1520.5	23.86	2540.	2.313
1521.	23.79	2540.5	2.313
1521.5	23.71	2541.	2.313
1522.	23.64	2541.5	2.313
1522.5	23.55	2542.	2.313
1523.	23.45	2542.5	2.313

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
1523.5	23.38	2543.	2.313
1524.	23.31	2543.5	2.313
1524.5	23.24	2544.	2.313
1525.	23.16	2544.5	2.313
1525.5	23.09	2545.	2.313
1526.	23.02	2545.5	2.313
1526.5	22.95	2546.	2.313
1527.	22.88	2546.5	2.313
1527.5	22.81	2547.	2.313
1528.	22.71	2547.5	2.29
1528.5	22.66	2548.	2.29
1529.	22.57	2548.5	2.313
1529.5	22.5	2549.	2.313
1530.	22.45	2549.5	2.29
1530.5	22.38	2550.	2.29
1531.	22.28	2550.5	2.29
1531.5	22.23	2551.	2.29
1532.	22.16	2551.5	2.29
1532.5	22.09	2552.	2.29
1533.	22.02	2552.5	2.29
1533.5	21.95	2553.	2.29
1534.	21.9	2553.5	2.29
1534.5	21.83	2554.	2.29
1535.	21.76	2554.5	2.29
1535.5	21.69	2555.	2.29
1536.	21.61	2555.5	2.29
1536.5	21.57	2556.	2.29
1537.	21.47	2556.5	2.29
1537.5	21.42	2557.	2.29
1538.	21.35	2557.5	2.266
1538.5	21.28	2558.	2.29
1539.	21.23	2558.5	2.29
1539.5	21.16	2559.	2.266
1540.	21.09	2559.5	2.29
1540.5	21.04	2560.	2.266
1541.	20.97	2560.5	2.266
1541.5	20.9	2561.	2.266
1542.	20.85	2561.5	2.266
1542.5	20.78	2562.	2.266
1543.	20.71	2562.5	2.266
1543.5	20.68	2563.	2.266
1544.	20.59	2563.5	2.266
1544.5	20.52	2564.	2.266
1545.	20.47	2564.5	2.266
1545.5	20.42	2565.	2.266
1546.	20.37	2565.5	2.266
1546.5	20.3	2566.	2.266
1547.	20.23	2566.5	2.266
1547.5	20.18	2567.	2.242
1548.	20.11	2567.5	2.242
1548.5	20.06	2568.	2.266
1549.	20.02	2568.5	2.266
1549.5	19.95	2569.	2.242
1550.	19.9	2569.5	2.266
1550.5	19.85	2570.	2.242
1551.	19.78	2570.5	2.242
1551.5	19.73	2571.	2.242
1552.	19.66	2571.5	2.242
1552.5	19.61	2572.	2.242
1553.	19.56	2572.5	2.242
1553.5	19.52	2573.	2.242
1554.	19.44	2573.5	2.242
1554.5	19.4	2574.	2.242
1555.	19.35	2574.5	2.218
1555.5	19.3	2575.	2.242
1556.	19.23	2575.5	2.242
1556.5	19.18	2576.	2.242
1557.	19.13	2576.5	2.242
1557.5	19.09	2577.	2.242
1558.	19.04	2577.5	2.242

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
1558.5	18.97	2578.	2.242
1559.	18.92	2578.5	2.242
1559.5	18.87	2579.	2.242
1560.	18.82	2579.5	2.218
1560.5	18.75	2580.	2.242
1561.	18.73	2580.5	2.242
1561.5	18.66	2581.	2.242
1562.	18.63	2581.5	2.242
1562.5	18.56	2582.	2.218
1563.	18.51	2582.5	2.242
1563.5	18.47	2583.	2.218
1564.	18.42	2583.5	2.218
1564.5	18.37	2584.	2.218
1565.	18.32	2584.5	2.218
1565.5	18.25	2585.	2.218
1566.	18.23	2585.5	2.218
1566.5	18.18	2586.	2.218
1567.	18.13	2586.5	2.218
1567.5	18.08	2587.	2.218
1568.	18.01	2587.5	2.218
1568.5	17.99	2588.	2.218
1569.	17.94	2588.5	2.218
1569.5	17.89	2589.	2.218
1570.	17.82	2589.5	2.218
1570.5	17.8	2590.	2.218
1571.	17.75	2590.5	2.218
1571.5	17.7	2591.	2.218
1572.	17.65	2591.5	2.218
1572.5	17.61	2592.	2.218
1573.	17.56	2592.5	2.194
1573.5	17.51	2593.	2.218
1574.	17.46	2593.5	2.194
1574.5	17.41	2594.	2.194
1575.	17.39	2594.5	2.194
1575.5	17.34	2595.	2.194
1576.	17.3	2595.5	2.194
1576.5	17.25	2596.	2.194
1577.	17.2	2596.5	2.194
1577.5	17.15	2597.	2.194
1578.	17.11	2597.5	2.194
1578.5	17.08	2598.	2.194
1579.	17.03	2598.5	2.194
1579.5	16.99	2599.	2.194
1580.	16.94	2599.5	2.194
1580.5	16.89	2600.	2.194
1581.	16.87	2600.5	2.194
1581.5	16.82	2601.	2.194
1582.	16.77	2601.5	2.194
1582.5	16.72	2602.	2.194
1583.	16.7	2602.5	2.194
1583.5	16.65	2603.	2.194
1584.	16.6	2603.5	2.194
1584.5	16.58	2604.	2.194
1585.	16.53	2604.5	2.194
1585.5	16.48	2605.	2.17
1586.	16.44	2605.5	2.17
1586.5	16.39	2606.	2.194
1587.	16.37	2606.5	2.194
1587.5	16.32	2607.	2.194
1588.	16.27	2607.5	2.17
1588.5	16.25	2608.	2.17
1589.	16.2	2608.5	2.194
1589.5	16.18	2609.	2.17
1590.	16.13	2609.5	2.17
1590.5	16.08	2610.	2.17
1591.	16.03	2610.5	2.17
1591.5	16.01	2611.	2.17
1592.	15.96	2611.5	2.17
1592.5	15.91	2612.	2.17
1593.	15.91	2612.5	2.17

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
1593.5	15.84	2613.	2.17
1594.	15.82	2613.5	2.17
1594.5	15.77	2614.	2.17
1595.	15.75	2614.5	2.17
1595.5	15.7	2615.	2.17
1596.	15.67	2615.5	2.17
1596.5	15.63	2616.	2.146
1597.	15.6	2616.5	2.146
1597.5	15.56	2617.	2.146
1598.	15.53	2617.5	2.17
1598.5	15.48	2618.	2.17
1599.	15.46	2618.5	2.17
1599.5	15.41	2619.	2.146
1600.	15.36	2619.5	2.17
1600.5	15.34	2620.	2.146
1601.	15.29	2620.5	2.146
1601.5	15.27	2621.	2.146
1602.	15.24	2621.5	2.146
1602.5	15.2	2622.	2.17
1603.	15.17	2622.5	2.146
1603.5	15.12	2623.	2.146
1604.	15.08	2623.5	2.146
1604.5	15.05	2624.	2.146
1605.	15.03	2624.5	2.146
1605.5	15.	2625.	2.146
1606.	14.96	2625.5	2.146
1606.5	14.93	2626.	2.146
1607.	14.89	2626.5	2.146
1607.5	14.86	2627.	2.146
1608.	14.81	2627.5	2.146
1608.5	14.79	2628.	2.146
1609.	14.74	2628.5	2.146
1609.5	14.72	2629.	2.146
1610.	14.67	2629.5	2.146
1610.5	14.65	2630.	2.146
1611.	14.62	2630.5	2.146
1611.5	14.57	2631.	2.146
1612.	14.55	2631.5	2.146
1612.5	14.53	2632.	2.146
1613.	14.48	2632.5	2.146
1613.5	14.46	2633.	2.123
1614.	14.41	2633.5	2.123
1614.5	14.38	2634.	2.123
1615.	14.36	2634.5	2.146
1615.5	14.31	2635.	2.123
1616.	14.29	2635.5	2.123
1616.5	14.27	2636.	2.123
1617.	14.24	2636.5	2.123
1617.5	14.19	2637.	2.123
1618.	14.15	2637.5	2.123
1618.5	14.15	2638.	2.123
1619.	14.1	2638.5	2.123
1619.5	14.07	2639.	2.123
1620.	14.03	2639.5	2.123
1620.5	14.	2640.	2.123
1621.	13.98	2640.5	2.123
1621.5	13.96	2641.	2.099
1622.	13.93	2641.5	2.123
1622.5	13.88	2642.	2.123
1623.	13.86	2642.5	2.123
1623.5	13.84	2643.	2.099
1624.	13.81	2643.5	2.099
1624.5	13.76	2644.	2.123
1625.	13.74	2644.5	2.099
1625.5	13.72	2645.	2.123
1626.	13.69	2645.5	2.099
1626.5	13.65	2646.	2.123
1627.	13.62	2646.5	2.123
1627.5	13.6	2647.	2.099
1628.	13.57	2647.5	2.099

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
1628.5	13.55	2648.	2.099
1629.	13.5	2648.5	2.099
1629.5	13.48	2649.	2.099
1630.	13.45	2649.5	2.099
1630.5	13.43	2650.	2.099
1631.	13.41	2650.5	2.099
1631.5	13.36	2651.	2.099
1632.	13.34	2651.5	2.099
1632.5	13.31	2652.	2.099
1633.	13.29	2652.5	2.099
1633.5	13.26	2653.	2.099
1634.	13.24	2653.5	2.099
1634.5	13.19	2654.	2.099
1635.	13.17	2654.5	2.099
1635.5	13.14	2655.	2.099
1636.	13.12	2655.5	2.075
1636.5	13.1	2656.	2.099
1637.	13.05	2656.5	2.075
1637.5	13.03	2657.	2.099
1638.	13.	2657.5	2.099
1638.5	12.98	2658.	2.099
1639.	12.95	2658.5	2.099
1639.5	12.93	2659.	2.075
1640.	12.9	2659.5	2.075
1640.5	12.88	2660.	2.075
1641.	12.86	2660.5	2.099
1641.5	12.83	2661.	2.099
1642.	12.81	2661.5	2.075
1642.5	12.79	2662.	2.075
1643.	12.76	2662.5	2.099
1643.5	12.72	2663.	2.075
1644.	12.69	2663.5	2.075
1644.5	12.67	2664.	2.075
1645.	12.64	2664.5	2.075
1645.5	12.62	2665.	2.075
1646.	12.6	2665.5	2.075
1646.5	12.57	2666.	2.075
1647.	12.55	2666.5	2.075
1647.5	12.52	2667.	2.075
1648.	12.48	2667.5	2.075
1648.5	12.48	2668.	2.075
1649.	12.43	2668.5	2.075
1649.5	12.43	2669.	2.075
1650.	12.38	2669.5	2.075
1650.5	12.36	2670.	2.075
1651.	12.33	2670.5	2.051
1651.5	12.31	2671.	2.075
1652.	12.29	2671.5	2.075
1652.5	12.26	2672.	2.051
1653.	12.26	2672.5	2.075
1653.5	12.21	2673.	2.075
1654.	12.19	2673.5	2.075
1654.5	12.17	2674.	2.051
1655.	12.14	2674.5	2.051
1655.5	12.14	2675.	2.051
1656.	12.09	2675.5	2.051
1656.5	12.07	2676.	2.051
1657.	12.05	2676.5	2.051
1657.5	12.02	2677.	2.051
1658.	12.	2677.5	2.051
1658.5	11.98	2678.	2.051
1659.	11.95	2678.5	2.051
1659.5	11.93	2679.	2.051
1660.	11.9	2679.5	2.051
1660.5	11.88	2680.	2.051
1661.	11.86	2680.5	2.051
1661.5	11.83	2681.	2.051
1662.	11.83	2681.5	2.051
1662.5	11.81	2682.	2.051
1663.	11.76	2682.5	2.051

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
1663.5	11.76	2683.	2.051
1664.	11.71	2683.5	2.051
1664.5	11.71	2684.	2.051
1665.	11.69	2684.5	2.051
1665.5	11.66	2685.	2.051
1666.	11.64	2685.5	2.027
1666.5	11.62	2686.	2.051
1667.	11.59	2686.5	2.051
1667.5	11.59	2687.	2.051
1668.	11.55	2687.5	2.027
1668.5	11.52	2688.	2.027
1669.	11.5	2688.5	2.027
1669.5	11.5	2689.	2.051
1670.	11.47	2689.5	2.027
1670.5	11.45	2690.	2.027
1671.	11.43	2690.5	2.027
1671.5	11.4	2691.	2.027
1672.	11.38	2691.5	2.027
1672.5	11.36	2692.	2.027
1673.	11.33	2692.5	2.027
1673.5	11.31	2693.	2.027
1674.	11.31	2693.5	2.027
1674.5	11.28	2694.	2.027
1675.	11.26	2694.5	2.027
1675.5	11.24	2695.	2.027
1676.	11.21	2695.5	2.027
1676.5	11.19	2696.	2.027
1677.	11.16	2696.5	2.027
1677.5	11.14	2697.	2.027
1678.	11.12	2697.5	2.027
1678.5	11.12	2698.	2.027
1679.	11.09	2698.5	2.027
1679.5	11.07	2699.	2.027
1680.	11.05	2699.5	2.027
1680.5	11.02	2700.	2.027
1681.	11.	2700.5	2.027
1681.5	10.97	2701.	2.003
1682.	10.97	2701.5	2.027
1682.5	10.95	2702.	2.027
1683.	10.93	2702.5	2.027
1683.5	10.9	2703.	2.027
1684.	10.88	2703.5	2.003
1684.5	10.85	2704.	2.027
1685.	10.85	2704.5	2.027
1685.5	10.81	2705.	2.027
1686.	10.81	2705.5	2.003
1686.5	10.78	2706.	2.003
1687.	10.78	2706.5	2.003
1687.5	10.76	2707.	2.003
1688.	10.73	2707.5	2.003
1688.5	10.71	2708.	2.003
1689.	10.69	2708.5	2.003
1689.5	10.66	2709.	2.003
1690.	10.64	2709.5	2.003
1690.5	10.64	2710.	2.003
1691.	10.62	2710.5	2.003
1691.5	10.59	2711.	2.003
1692.	10.57	2711.5	2.003
1692.5	10.57	2712.	2.003
1693.	10.54	2712.5	2.003
1693.5	10.52	2713.	2.003
1694.	10.5	2713.5	2.003
1694.5	10.5	2714.	2.003
1695.	10.47	2714.5	1.98
1695.5	10.45	2715.	2.003
1696.	10.43	2715.5	1.98
1696.5	10.4	2716.	2.003
1697.	10.38	2716.5	2.003
1697.5	10.38	2717.	2.003
1698.	10.35	2717.5	2.003

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
1698.5	10.33	2718.	2.003
1699.	10.31	2718.5	2.003
1699.5	10.31	2719.	2.003
1700.	10.28	2719.5	2.003
1700.5	10.26	2720.	2.003
1701.	10.26	2720.5	1.98
1701.5	10.23	2721.	2.003
1702.	10.21	2721.5	1.98
1702.5	10.19	2722.	1.98
1703.	10.19	2722.5	2.003
1703.5	10.16	2723.	1.98
1704.	10.14	2723.5	2.003
1704.5	10.12	2724.	1.98
1705.	10.09	2724.5	1.98
1705.5	10.09	2725.	1.98
1706.	10.07	2725.5	1.98
1706.5	10.07	2726.	1.98
1707.	10.04	2726.5	1.98
1707.5	10.02	2727.	1.98
1708.	9.996	2727.5	1.98
1708.5	9.972	2728.	1.98
1709.	9.948	2728.5	1.98
1709.5	9.948	2729.	1.98
1710.	9.924	2729.5	1.98
1710.5	9.924	2730.	1.98
1711.	9.9	2730.5	1.98
1711.5	9.876	2731.	1.98
1712.	9.852	2731.5	1.98
1712.5	9.852	2732.	1.98
1713.	9.829	2732.5	1.956
1713.5	9.805	2733.	1.98
1714.	9.805	2733.5	1.98
1714.5	9.781	2734.	1.98
1715.	9.757	2734.5	1.98
1715.5	9.757	2735.	1.98
1716.	9.733	2735.5	1.98
1716.5	9.709	2736.	1.98
1717.	9.709	2736.5	1.98
1717.5	9.685	2737.	1.956
1718.	9.662	2737.5	1.98
1718.5	9.662	2738.	1.98
1719.	9.638	2738.5	1.98
1719.5	9.614	2739.	1.98
1720.	9.614	2739.5	1.956
1720.5	9.59	2740.	1.956
1721.	9.566	2740.5	1.956
1721.5	9.566	2741.	1.956
1722.	9.519	2741.5	1.956
1722.5	9.519	2742.	1.956
1723.	9.495	2742.5	1.98
1723.5	9.495	2743.	1.956
1724.	9.471	2743.5	1.956
1724.5	9.447	2744.	1.956
1725.	9.423	2744.5	1.956
1725.5	9.423	2745.	1.956
1726.	9.423	2745.5	1.956
1726.5	9.399	2746.	1.956
1727.	9.375	2746.5	1.956
1727.5	9.375	2747.	1.956
1728.	9.352	2747.5	1.956
1728.5	9.328	2748.	1.956
1729.	9.304	2748.5	1.956
1729.5	9.304	2749.	1.956
1730.	9.28	2749.5	1.932
1730.5	9.28	2750.	1.956
1731.	9.256	2750.5	1.956
1731.5	9.232	2751.	1.956
1732.	9.232	2751.5	1.956
1732.5	9.208	2752.	1.932
1733.	9.185	2752.5	1.956

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
1733.5	9.185	2753.	1.956
1734.	9.161	2753.5	1.956
1734.5	9.161	2754.	1.956
1735.	9.137	2754.5	1.932
1735.5	9.113	2755.	1.932
1736.	9.113	2755.5	1.932
1736.5	9.089	2756.	1.956
1737.	9.065	2756.5	1.956
1737.5	9.065	2757.	1.956
1738.	9.041	2757.5	1.956
1738.5	9.041	2758.	1.956
1739.	9.018	2758.5	1.932
1739.5	9.018	2759.	1.932
1740.	8.994	2759.5	1.956
1740.5	8.994	2760.	1.932
1741.	8.97	2760.5	1.932
1741.5	8.946	2761.	1.932
1742.	8.946	2761.5	1.932
1742.5	8.922	2762.	1.932
1743.	8.922	2762.5	1.932
1743.5	8.898	2763.	1.932
1744.	8.875	2763.5	1.932
1744.5	8.875	2764.	1.932
1745.	8.875	2764.5	1.932
1745.5	8.851	2765.	1.932
1746.	8.851	2765.5	1.932
1746.5	8.827	2766.	1.908
1747.	8.827	2766.5	1.908
1747.5	8.803	2767.	1.932
1748.	8.779	2767.5	1.932
1748.5	8.755	2768.	1.908
1749.	8.755	2768.5	1.908
1749.5	8.755	2769.	1.932
1750.	8.731	2769.5	1.932
1750.5	8.708	2770.	1.932
1751.	8.708	2770.5	1.932
1751.5	8.684	2771.	1.932
1752.	8.66	2771.5	1.908
1752.5	8.66	2772.	1.908
1753.	8.636	2772.5	1.932
1753.5	8.612	2773.	1.932
1754.	8.612	2773.5	1.932
1754.5	8.612	2774.	1.908
1755.	8.588	2774.5	1.932
1755.5	8.564	2775.	1.908
1756.	8.564	2775.5	1.932
1756.5	8.541	2776.	1.908
1757.	8.541	2776.5	1.932
1757.5	8.517	2777.	1.908
1758.	8.517	2777.5	1.908
1758.5	8.493	2778.	1.908
1759.	8.493	2778.5	1.908
1759.5	8.493	2779.	1.908
1760.	8.445	2779.5	1.908
1760.5	8.445	2780.	1.908
1761.	8.445	2780.5	1.908
1761.5	8.421	2781.	1.908
1762.	8.421	2781.5	1.932
1762.5	8.398	2782.	1.908
1763.	8.374	2782.5	1.908
1763.5	8.374	2783.	1.908
1764.	8.374	2783.5	1.908
1764.5	8.35	2784.	1.908
1765.	8.326	2784.5	1.908
1765.5	8.326	2785.	1.908
1766.	8.302	2785.5	1.908
1766.5	8.278	2786.	1.908
1767.	8.278	2786.5	1.908
1767.5	8.278	2787.	1.908
1768.	8.254	2787.5	1.908

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
1768.5	8.254	2788.	1.908
1769.	8.231	2788.5	1.908
1769.5	8.231	2789.	1.908
1770.	8.207	2789.5	1.908
1770.5	8.207	2790.	1.908
1771.	8.183	2790.5	1.884
1771.5	8.159	2791.	1.884
1772.	8.159	2791.5	1.908
1772.5	8.159	2792.	1.884
1773.	8.135	2792.5	1.908
1773.5	8.135	2793.	1.908
1774.	8.135	2793.5	1.908
1774.5	8.111	2794.	1.908
1775.	8.087	2794.5	1.908
1775.5	8.087	2795.	1.908
1776.	8.064	2795.5	1.908
1776.5	8.062	2796.	1.908
1777.	8.04	2796.5	1.884
1777.5	8.04	2797.	1.884
1778.	8.04	2797.5	1.908
1778.5	8.016	2798.	1.884
1779.	8.016	2798.5	1.908
1779.5	7.992	2799.	1.884
1780.	7.968	2799.5	1.884
1780.5	7.968	2800.	1.884
1781.	7.968	2800.5	1.884
1781.5	7.944	2801.	1.884
1782.	7.92	2801.5	1.884
1782.5	7.92	2802.	1.884
1783.	7.92	2802.5	1.884
1783.5	7.897	2803.	1.884
1784.	7.897	2803.5	1.884
1784.5	7.873	2804.	1.884
1785.	7.849	2804.5	1.884
1785.5	7.873	2805.	1.884
1786.	7.849	2805.5	1.908
1786.5	7.849	2806.	1.884
1787.	7.825	2806.5	1.884
1787.5	7.801	2807.	1.884
1788.	7.801	2807.5	1.884
1788.5	7.777	2808.	1.884
1789.	7.777	2808.5	1.884
1789.5	7.777	2809.	1.884
1790.	7.754	2809.5	1.884
1790.5	7.73	2810.	1.884
1791.	7.73	2810.5	1.884
1791.5	7.706	2811.	1.884
1792.	7.706	2811.5	1.884
1792.5	7.706	2812.	1.884
1793.	7.682	2812.5	1.884
1793.5	7.682	2813.	1.884
1794.	7.658	2813.5	1.884
1794.5	7.658	2814.	1.884
1795.	7.658	2814.5	1.884
1795.5	7.634	2815.	1.884
1796.	7.634	2815.5	1.884
1796.5	7.634	2816.	1.884
1797.	7.61	2816.5	1.884
1797.5	7.61	2817.	1.884
1798.	7.587	2817.5	1.86
1798.5	7.563	2818.	1.884
1799.	7.563	2818.5	1.884
1799.5	7.539	2819.	1.884
1800.	7.539	2819.5	1.884
1800.5	7.539	2820.	1.884
1801.	7.515	2820.5	1.86
1801.5	7.515	2821.	1.884
1802.	7.491	2821.5	1.86
1802.5	7.491	2822.	1.86
1803.	7.491	2822.5	1.884

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
1803.5	7.467	2823.	1.884
1804.	7.443	2823.5	1.86
1804.5	7.443	2824.	1.884
1805.	7.443	2824.5	1.86
1805.5	7.443	2825.	1.86
1806.	7.42	2825.5	1.86
1806.5	7.396	2826.	1.884
1807.	7.396	2826.5	1.884
1807.5	7.396	2827.	1.86
1808.	7.372	2827.5	1.86
1808.5	7.372	2828.	1.86
1809.	7.372	2828.5	1.86
1809.5	7.348	2829.	1.884
1810.	7.348	2829.5	1.86
1810.5	7.348	2830.	1.86
1811.	7.324	2830.5	1.86
1811.5	7.3	2831.	1.86
1812.	7.3	2831.5	1.86
1812.5	7.3	2832.	1.86
1813.	7.277	2832.5	1.86
1813.5	7.277	2833.	1.86
1814.	7.253	2833.5	1.884
1814.5	7.253	2834.	1.86
1815.	7.253	2834.5	1.86
1815.5	7.229	2835.	1.86
1816.	7.229	2835.5	1.86
1816.5	7.205	2836.	1.86
1817.	7.205	2836.5	1.86
1817.5	7.181	2837.	1.86
1818.	7.181	2837.5	1.86
1818.5	7.181	2838.	1.86
1819.	7.157	2838.5	1.86
1819.5	7.157	2839.	1.86
1820.	7.157	2839.5	1.86
1820.5	7.133	2840.	1.86
1821.	7.133	2840.5	1.86
1821.5	7.11	2841.	1.86
1822.	7.11	2841.5	1.86
1822.5	7.11	2842.	1.86
1823.	7.11	2842.5	1.86
1823.5	7.086	2843.	1.86
1824.	7.062	2843.5	1.86
1824.5	7.062	2844.	1.86
1825.	7.062	2844.5	1.86
1825.5	7.038	2845.	1.86
1826.	7.038	2845.5	1.86
1826.5	7.014	2846.	1.86
1827.	7.038	2846.5	1.86
1827.5	7.014	2847.	1.86
1828.	6.99	2847.5	1.86
1828.5	6.99	2848.	1.836
1829.	6.99	2848.5	1.86
1829.5	6.99	2849.	1.86
1830.	6.966	2849.5	1.836
1830.5	6.966	2850.	1.86
1831.	6.943	2850.5	1.86
1831.5	6.943	2851.	1.86
1832.	6.943	2851.5	1.836
1832.5	6.919	2852.	1.836
1833.	6.919	2852.5	1.836
1833.5	6.895	2853.	1.86
1834.	6.895	2853.5	1.836
1834.5	6.893	2854.	1.836
1835.	6.871	2854.5	1.836
1835.5	6.847	2855.	1.836
1836.	6.847	2855.5	1.836
1836.5	6.847	2856.	1.836
1837.	6.847	2856.5	1.836
1837.5	6.823	2857.	1.836
1838.	6.823	2857.5	1.836

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
1838.5	6.823	2858.	1.836
1839.	6.799	2858.5	1.836
1839.5	6.799	2859.	1.86
1840.	6.799	2859.5	1.836
1840.5	6.776	2860.	1.836
1841.	6.776	2860.5	1.836
1841.5	6.776	2861.	1.86
1842.	6.752	2861.5	1.836
1842.5	6.752	2862.	1.836
1843.	6.728	2862.5	1.836
1843.5	6.726	2863.	1.836
1844.	6.728	2863.5	1.836
1844.5	6.704	2864.	1.836
1845.	6.702	2864.5	1.836
1845.5	6.704	2865.	1.836
1846.	6.68	2865.5	1.836
1846.5	6.678	2866.	1.836
1847.	6.68	2866.5	1.836
1847.5	6.654	2867.	1.836
1848.	6.656	2867.5	1.836
1848.5	6.656	2868.	1.836
1849.	6.633	2868.5	1.836
1849.5	6.633	2869.	1.836
1850.	6.609	2869.5	1.836
1850.5	6.609	2870.	1.836
1851.	6.609	2870.5	1.836
1851.5	6.607	2871.	1.836
1852.	6.585	2871.5	1.836
1852.5	6.585	2872.	1.836
1853.	6.585	2872.5	1.836
1853.5	6.561	2873.	1.813
1854.	6.561	2873.5	1.813
1854.5	6.537	2874.	1.836
1855.	6.537	2874.5	1.813
1855.5	6.535	2875.	1.813
1856.	6.511	2875.5	1.813
1856.5	6.513	2876.	1.836
1857.	6.513	2876.5	1.813
1857.5	6.489	2877.	1.836
1858.	6.489	2877.5	1.836
1858.5	6.489	2878.	1.813
1859.	6.489	2878.5	1.813
1859.5	6.466	2879.	1.813
1860.	6.466	2879.5	1.813
1860.5	6.466	2880.	1.813
1861.	6.442	2880.5	1.813
1861.5	6.442	2881.	1.813
1862.	6.442	2881.5	1.813
1862.5	6.418	2882.	1.813
1863.	6.418	2882.5	1.813
1863.5	6.394	2883.	1.813
1864.	6.394	2883.5	1.813
1864.5	6.394	2884.	1.813
1865.	6.37	2884.5	1.813
1865.5	6.394	2885.	1.813
1866.	6.37	2885.5	1.813
1866.5	6.37	2886.	1.813
1867.	6.346	2886.5	1.813
1867.5	6.346	2887.	1.813
1868.	6.346	2887.5	1.813
1868.5	6.322	2888.	1.789
1869.	6.322	2888.5	1.813
1869.5	6.299	2889.	1.813
1870.	6.299	2889.5	1.793
1870.5	6.299	2890.	1.815
1871.	6.299	2890.5	1.789
1871.5	6.275	2891.	1.813
1872.	6.275		

SOLUTION

Pumping Test
Aquifer Model: Fractured
Solution Method: Gringarten-Ramey w/horizontal fracture

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.0001819	ft/min
Ss	0.0147	ft^{-1}
Kz/Kr	0.93	
Rf	1.	ft

K = 9.242E-5 cm/sec
T = K*b = 0.01092 ft²/min (0.169 sq. cm/sec)

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
Kr	0.0009039	0.0004893	+/- 0.000959	1.847	ft/min
Ss	0.00536	0.008619	+/- 0.01689	0.6219	ft^{-1}
Kz/Kr	0.93	not estimated			
Rf	7.003	3.791	+/- 7.43	1.847	ft

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

K = 0.0004592 cm/sec
T = K*b = 0.05423 ft²/min (0.8398 sq. cm/sec)

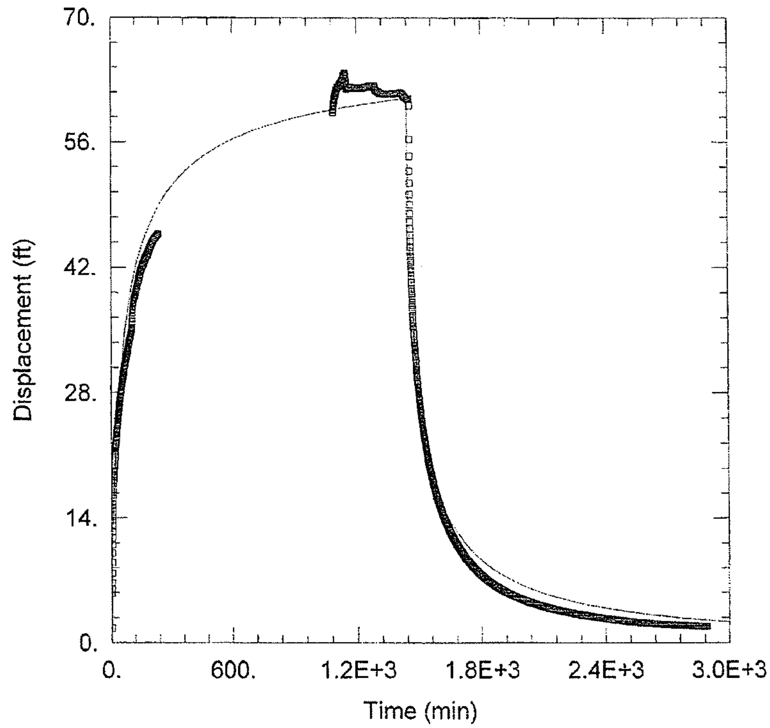
Parameter Correlations

	Kr	Ss	Rf
Kr	1.00	1.00	-1.00
Ss	1.00	1.00	-1.00
Rf	-1.00	-1.00	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . . 1.471E+4 ft^2
Variance . . . . 3.61 ft^2
Std. Deviation . . . . 1.9 ft
Mean . . . . -0.8359 ft
No. of Residuals 4077
No. of Estimates 3



WELL TEST ANALYSIS

Data Set: P:\...\Well2 Only 10gpm.aqt
Date: 02/06/17 Time: 13:46:39

PROJECT INFORMATION

Company: TERRASAT
Client: Big Country EnterprisesLC
Project: 21607
Location: Anchorage, Alaska
Test Well: LCW-2
Test Date: 1/24/17

AQUIFER DATA

Saturated Thickness: 60. ft Fracture Radius: 7.003 ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
LCW-2	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
▫ LCW-2	0	0

SOLUTION

Aquifer Model: Fractured Solution Method: Gringarten (Horizontal)

Kr = 0.0009039 ft/min Ss = 0.00536 ft^{-1}
Kz/Kr = 0.93 Rf = 7.003 ft

Data Set: P:\2016 Projects\21607 - Lewis & Clark Subd Hydrogeology - Big Country Ent\REPORTS\MAIN REPORT
Title: LCW-3 Pump & Recovery Test
Date: 02/14/17
Time: 11:02:08

PROJECT INFORMATION

Company: TERRASAT
Client: Big Country EnterprisesLC
Project: 21607
Location: Anchorage, Alaska
Test Date: 1/28/17
Test Well: LCW-3

AQUIFER DATA

Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.93
Slab Block Thickness: 1. ft
Spherical Block Diameter: 1. ft
Fracture Length: 1.743 ft
Fracture Radius: 5.775 ft

PUMPING WELL DATA

No. of pumping wells: 1

Pumping Well No. 1: LCW-3

X Location: 0. ft
Y Location: 0. ft

Casing Radius: 0.25 ft
Well Radius: 0.25 ft

Fully Penetrating Well

No. of pumping periods: 4

Pumping Period Data

Time (min)	Rate (gal/min)	Time (min)	Rate (gal/min)
0.	5.	1441.	0.
1440.	5.	2880.	0.

OBSERVATION WELL DATA

No. of observation wells: 1

Observation Well No. 1: LCW-3

X Location: 0. ft
Y Location: 0. ft

Radial distance from LCW-3: 0. ft

Fully Penetrating Well

No. of Observations: 122

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.5	2.051	1441.5	85.86
1.5	2.982	1442.	84.96
2.	3.411	1442.5	84.17
2.5	3.743	1443.	83.41
3.	4.293	1443.5	82.72
3.5	5.39	1444.	82.03
4.	6.009	1444.5	81.33
4.5	6.511	1445.	80.69
5.	7.012	1445.5	80.09
5.5	7.678	1446.	79.52

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
6.	8.275	1446.5	78.97
6.5	9.229	1447.	78.43
7.	10.35	1447.5	77.93
7.5	11.49	1448.	77.45
8.	12.74	1448.5	76.97
8.5	13.43	1449.	76.52
9.	13.86	1449.5	76.05
9.5	14.05	1450.	75.6
10.	14.31	1450.5	75.17
11.	14.74	1451.	74.81
12.	15.62	1451.5	74.48
13.	16.36	1452.5	73.86
14.	16.96	1453.5	73.22
15.	17.5	1454.5	72.5
16.	17.96	1455.5	71.65
21.	20.06	1456.5	70.79
26.	20.89	1461.5	67.14
31.	21.42	1466.5	64.04
36.	22.02	1471.5	61.2
41.	30.12	1476.5	58.78
46.	33.75	1481.5	56.28
51.	36.68	1486.5	54.06
56.	39.02	1491.5	52.05
61.	41.1	1496.5	50.17
91.	52.28	1501.5	48.42
121.	59.29	1531.5	40.07
151.	63.4	1561.5	33.99
181.	71.27	1591.5	29.53
211.	76.75	1621.5	25.97
241.	80.19	1651.5	23.21
271.	82.	1681.5	21.04
301.	83.5	1711.5	19.25
361.	85.13	1741.5	17.7
421.	84.48	1801.5	15.5
481.	84.84	1861.5	14.07
541.	85.44	1921.5	12.66
601.	86.63	1981.5	11.71
661.	87.7	2041.5	10.97
721.	88.27	2101.5	10.3
781.	87.75	2161.5	9.706
841.	86.89	2221.5	9.157
901.	86.8	2281.5	8.68
961.	86.91	2341.5	8.275
1021.	87.11	2401.5	7.869
1081.	87.3	2461.5	7.917
1141.	87.51	2521.5	7.631
1201.	87.7	2581.5	7.344
1261.	87.84	2641.5	7.368
1321.	88.01	2701.5	7.297
1381.	88.15	2761.5	7.201
1441.	88.73	2821.5	7.082

SOLUTION

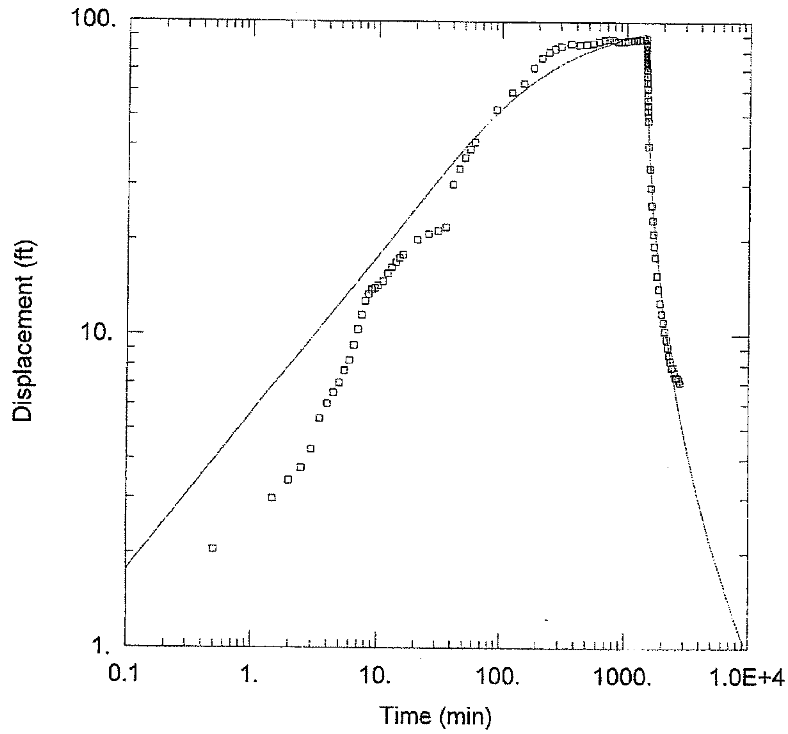
Pumping Test
Aquifer Model: Fractured
Solution Method: Gringarten-Ramey w/horizontal fracture

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
Kr	0.0003473	ft/min
Ss	0.005101	ft^{-1}
Kz/Kr	0.93	
Rf	5.775	ft

K = 0.0001764 cm/sec
T = K*b = 0.008683 ft^2/min (0.1344 sq. cm/sec)



LCW-3 PUMP & RECOVERY TEST

Data Set: P:\...\Well3 Only 5gpm.aqt
Date: 02/07/17 Time: 09:21:24

PROJECT INFORMATION

Company: TERRASAT
Client: Big Country EnterprisesLC
Project: 21607
Location: Anchorage, Alaska
Test Well: LCW-3
Test Date: 1/28/17

AQUIFER DATA

Saturated Thickness: 25. ft
Fracture Radius: 5.775 ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
LCW-3	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
▫ LCW-3	0	0

SOLUTION

Aquifer Model: Fractured
Solution Method: Gringarten (Horizontal)

Kr = 0.0003473 ft/min
Kz/Kr = 0.93

Ss = 0.005101 ft^{-1}
Rf = 5.775 ft

APPENDIX F

MOA On-Site Services
Well Permit Documents

On-Site Water System Permit

MUNICIPALITY OF ANCHORAGE
Development Services Department
On-Site Water & Wastewater Program
4700 Elmore Road, PO Box 196650
Anchorage, AK 99519-6650
Telephone: (907) 343-7904

Development Services Department

Permit Number: OSP161274
Tax Code Number: 01707306000
Work Type: Well Initial
Permit Effective Dates: September 29, 2016 to September 29, 2017

Design Engineer:
Subdivision: T12N R3W SEC 25

Site Legal Address: T12N R3W SEC 25 S2W2NW4SE4 & E2NW4SE4 & NE4SE4 G:2941
Owner/Address: BIG COUNTRY ENTERPRISES LLC Proposed Lewis & Clark L19
4700 E 147TH AVENUE ANCHORAGE AK 995160000

Site Mailing Address:
Lot Size in Sq Ft: 2954675
Total Bedrooms: 1

This permit is for the construction of:

N Disposal Field N Septic Tank N Holding Tank N Privy Y Private Well N Water Storage

All construction must be in accordance with:

1. The attached approved design.
2. All requirements specified in Anchorage Municipal code Chapters 15.55 and 15.65 and the State of Alaska Wastewater Disposal Regulations (18AAC72) and Drinking Water Regulations (18AAC80).
3. The wastewater code requires inspections during the installation. The engineer must notify the Development Services Department at least 2 hours prior to each inspection. Provide notification by calling (907) 343-7904 (24 hours).
4. From October 15 to April 15, a subsurface soil absorption system under construction during freezing weather must either:
   A. Open and Close on the same day.
   B. Covered, sealed, and heated to prevent freezing.

Special Provisions: When well testing is complete, the well driller shall place an approved sanitary seal on the well head and no pitless adapter or pump shall be installed until an approved wastewater disposal system has been constructed.

Received By: [signature] Date: 9/29/16
Issued By: Deb Workman Date: 9/29/16

On-Site Water System Permit

MUNICIPALITY OF ANCHORAGE
Development Services Department
On-Site Water & Wastewater Program
4700 Elmore Road, PO Box 196650
Anchorage, AK 99519-6650
Telephone: (907) 343-7904

Development Services Department

Permit Number: OSP161273
Tax Code Number: 01707306000
Work Type: Well Initial
Permit Effective Dates: September 29, 2016 to September 29, 2017

Design Engineer:
Subdivision: T12N R3W SEC 25

Site Legal Address: T12N R3W SEC 25 S2W2NW4SE4 & E2NW4SE4 & NE4SE4 G:2941
Proposed Lewis and Clark L2D
Owner/Address: BIG COUNTRY ENTERPRISES LLC
4700 E 147TH AVENUE ANCHORAGE AK 995160000

Site Mailing Address:

Lot Size in Sq Ft: 2954675
Total Bedrooms: 1

This permit is for the construction of:

N Disposal Field N Septic Tank N Holding Tank N Privy Y Private Well N Water Storage

All construction must be in accordance with:

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   A. Open and Close on the same day.
   B. Covered, sealed, and heated to prevent freezing.

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Received By: [signature] Date: 9/29/16

Issued By: Deb Workman Date: 9/29/16

On-Site Water System Permit

MUNICIPALITY OF ANCHORAGE
Development Services Department
On-Site Water & Wastewater Program
4700 Elmore Road, PO Box 196650
Anchorage, AK 99519-6650
Telephone: (907) 343-7904

Development Services Department

Permit Number: OSP161272
Tax Code Number: 01707306000
Work Type: Well Initial
Permit Effective Dates: September 29, 2016 to September 29, 2017

Design Engineer:
Subdivision: T12N R3W SEC 25

Site Legal Address: T12N R3W SEC 25 S2W2NW4SE4 & E2NW4SE4 & NE4SE4 G:2941

Owner/Address: BIG COUNTRY ENTERPRISES LLC Proposed Lewis & Clark L21
4700 E 147TH AVENUE ANCHORAGE AK 995160000

Site Mailing Address:

Lot Size in Sq Ft: 2954675
Total Bedrooms: 1

This permit is for the construction of:

N Disposal Field N Septic Tank N Holding Tank N Privy Y Private Well N Water Storage

All construction must be in accordance with:

1. The attached approved design.
2. All requirements specified in Anchorage Municipal code Chapters 15.55 and 15.65 and the State of Alaska Wastewater Disposal Regulations (18AAC72) and Drinking Water Regulations (18AAC80).
3. The wastewater code requires inspections during the installation. The engineer must notify the Development Services Department at least 2 hours prior to each inspection. Provide notification by calling (907) 343-7904 (24 hours).
4. From October 15 to April 15, a subsurface soil absorption system under construction during freezing weather must either.
   A. Open and Close on the same day.
   B. Covered, sealed, and heated to prevent freezing.

Special Provisions: When well testing is complete, the well driller shall place an approved sanitary seal on the well head and no pitless adapter or pump shall be installed until an approved wastewater disposal system has been constructed.

Received By: [signature] Date: 9/29/16

Issued By: [signature] Date: 9/29/16

APPENDIX G

ADNR Temporary Water-Use Permit Approval Documents

DIVISION OF MINING, LAND AND WATER
WATER RESOURCES SECTION
www.dnr.state.ak.us/mlw/water/index.htm

Alaska Department of NATURAL RESOURCES

Anchorage Office 550 West 7th Avenue, Suite 1020 Anchorage, AK 99501-3562 (907) 269-8600 Fax: (907) 269-8947	Juneau Office PO Box 111020 400 Willoughby Avenue Juneau, AK 99811-1020 (907) 465-3400 Fax: (907) 586-2954	Fairbanks Office 3700 Airport Way Fairbanks, AK 99709-4699 (907) 451-2790 Fax: (907) 451-2703	***For ADNR Use Only*** ***Date/Time Stamp***
For ADNR Use Only ***TWUP #***	***For ADNR Use Only*** ***CID #***	***For ADNR Use Only*** ***Receipt Type WR***	

APPLICATION FOR TEMPORARY USE OF WATER

INSTRUCTIONS

1. Complete one application for each project including up to five water sources (incomplete applications will not be accepted).
2. Attach legible map that includes meridian, township, range, and section lines such as a USGS topographical quadrangle or subdivision plat. Indicate water withdrawal point(s), location(s) of water use, and point(s) of return flow or discharge (if applicable).
3. Attach sketch, photos, plans of water system, or project description (if applicable).
4. Attach driller's well log for drilled wells (if available).
5. Attach copy of ADNR fish habitat permit (if applicable).
6. Submit non-refundable fee (see page 4).

APPLICANT INFORMATION

Proposed Lewis and Clark Subdivision Well Installation
Project Name

Big Country Enterprises, LLC.
Organization Name (if applicable)

TERRASAT, Inc.
Agent or Consultant Name (if applicable)

Todd Brownson
Individual Name (if applicable)

Jeremy Stariwat
Individual Co-applicant Name (if applicable)

4203 Iowa Dr.
Mailing Address

Anchorage
City

AK
State

99517
Zip Code

907-344-3970
Daytime Phone Number

Alternate Phone Number (optional)

Fax Number (if available)

jeremy@terrasatenvironmental.com
E-Mail Address (optional)

PROPERTY DESCRIPTIONS						
Location of Water Use						
Project Area (e.g. milepost range, place name, survey number)	Meridian	Township	Range	Section	Quarter Sections	
Corner of Upper De Armoun Rd. and Canyon Rd.	Seward	12N	3W	25	NW ¼	SE ¼
					¼	¼
Location of Water Source						
Geographic Name of Water Body or Well Depth	Meridian	Township	Range	Section	Quarter Sections	
Well 1 Groundwater (Well Depth Unknown)	Seward	12N	3W	25	NW ¼	SE ¼
Well 2 Groundwater (Well Depth Unknown)	Seward	12N	3W	25	NW ¼	SE ¼
Well 3 Groundwater (Well Depth Unknown)	Seward	12N	3W	25	NW ¼	SE ¼
					¼	¼
					¼	¼
Location of Water Return Flow or Discharge (if applicable)						
Geographic Name of Water Body or Well Depth	Meridian	Township	Range	Section	Quarter Sections	
South and down gradient of wells into forested area	Seward	12N	3W	25	NW ¼	SE ¼
					¼	¼

METHOD OF TAKING WATER

Pump	Pump Intake Unknown Inches Pump Output 5-15 GPM	Hours Working 24 Hours Hours/Day Length of Pipe Unknown Feet (from pump to point of use)
Gravity	Pipe Diameter ______ Inches Head ______ Feet	Length of Pipe ______ Feet (take point to point of use)
Ditch	L ____ H ____ W ____ Feet	Diversion Rate ______ ☐ GPM or ☐ CFS
Reservoir	L ____ H ____ W ____ Feet	Water Storage ______ Acre-feet
Dam	L ____ H ____ W ____ Feet	Water Storage ______ Acre-feet

AMOUNT OF WATER					
Purpose of Water Use	**Quantity of Water**			**Season of Use**	
	Maximum Withdrawal Rate	Total Daily Amount	Total Seasonal Amount	Date Work Will Start	Date Work Will be Completed
Aquifer Pump Test Well 1	15 GPM	21,600	21,600	To Be Determined	To Be Determined
Aquifer Pump Test Well 2	15 GPM	21,600	21,600	To Be Determined	To Be Determined
Aquifer Pump Test Well 3	15 GPM	21,600	21,600		
	Project Totals	64,800	64,800	Total years needed: 3 days	

PROJECT DESCRIPTION

What alternative water sources are available to your project should a portion of your requested diversion be excluded because of water shortage or public interest concerns?

N/A. Three wells, currently being drilled as of 12/14/16, will be pump tested to determine if an adequate water supply exists for lots within a proposed subdivision.

Are there any surface water bodies or water wells at or near your site(s) that could be affected by the proposed activity? If yes, list any ground water monitoring programs going on at or near the sites, any water shortages or water quality problems in the area, and any information about the water table, if known.

No. The most proximal stream is a tributary to Rabbit Creek approximately 1300 ft south of the three well locations. There are no down gradient water wells.

Briefly describe the type and size of equipment used to withdraw and transport water, including the amount of water the equipment uses or holds.

A typical water well pump, capable of pumping at least 15 GPM, will be used. This will pump water up from the well and through a discharge hose draining down gradient (south) of the three well locations.

Briefly describe what changes at the project site and surrounding area will occur or are likely to occur because of construction or operation of your project (e.g. public access, streambed alteration, trenching, grading, excavation).

Likely none. The area of discharge, south from the wells, is highly vegetated and undisturbed. No water wells are directly south and the most proximal stream is approximately 1300 ft away. Most likely the water will infiltrate into the ground as it flows south through the vegetated buffer

Briefly describe land use around the water take, use, and return flow points (e.g. national park, recreational site, residential).

The land is currently vegetated and undisturbed.

Will project be worked in phases? State reason for completion date.

The project will be in three phases. As there are three water wells, each will be pumped for 24 hours and allowed to recover for 24 hours.

Briefly describe your entire project:

The project is a proposed subdivision. Three water wells are to be installed on-site and tested to determine if there is adequate groundwater to supply residences.

(Attach extra page if needed.)

11 AAC 93.220 sets out the required information on the application and authorizes the department to consider any other information needed to process an application for a temporary use of water. This information is made a part of the state public water records and becomes public information under AS 40.25.110 and 40.25.120. Public information is open to inspection by you or any member of the public. A person who is the subject of the information may challenge its accuracy or completeness under AS 44.99.310, by giving a written description of the challenged information, the changes needed to correct it, and a name and address where the person can be reached. False statements made in an application for a benefit are punishable under AS 11.56.210.

SIGNATURE

The information presented in this application is true and correct to the best of my knowledge. I understand that no water right or priority is established per 11 AAC 93.210-220, that the water used remains subject to appropriation by others, and that a temporary water use authorization may be revoked if necessary to protect the water rights of other persons or the public interest.

Signature: Jeremy Stariwat

Date: 12/14/16

Name (please print): Jeremy Stariwat

Title (if applicable): Project Geologist

REFERENCES

Measurement Units

GPD = gallons per day
CFS = cubic feet per second
GPM = gallons per minute
AF = acre-feet
AFY = acre-feet per year (325,851 gallons/year)
AFD = acre-feet per day (325,851 gallons/day)
MGD = million gallons per day

Conversion Table

5,000 GPD=	30,000 GPD=	100,000 GPD=	500,000 GPD=	1,000,000 GPD=
0.01 CFS	0.05 CFS	0.2 CFS	0.8 CFS	1.5 CFS
3.47 GPM	20.83 GPM	69.4 GPM	347. 2 GPM	694.4 GPM
5.60 AFY	33.60 AFY	112.0 AFY	560.1 AFY	1120.1 AFY
0.2 AFD	0.09 AFD	0.3 AFD	1.5 AFD	3.1 AFD
0.01 MGD	0.03 MGD	0.1 MGD	0.5 MGD	1.0 MGD

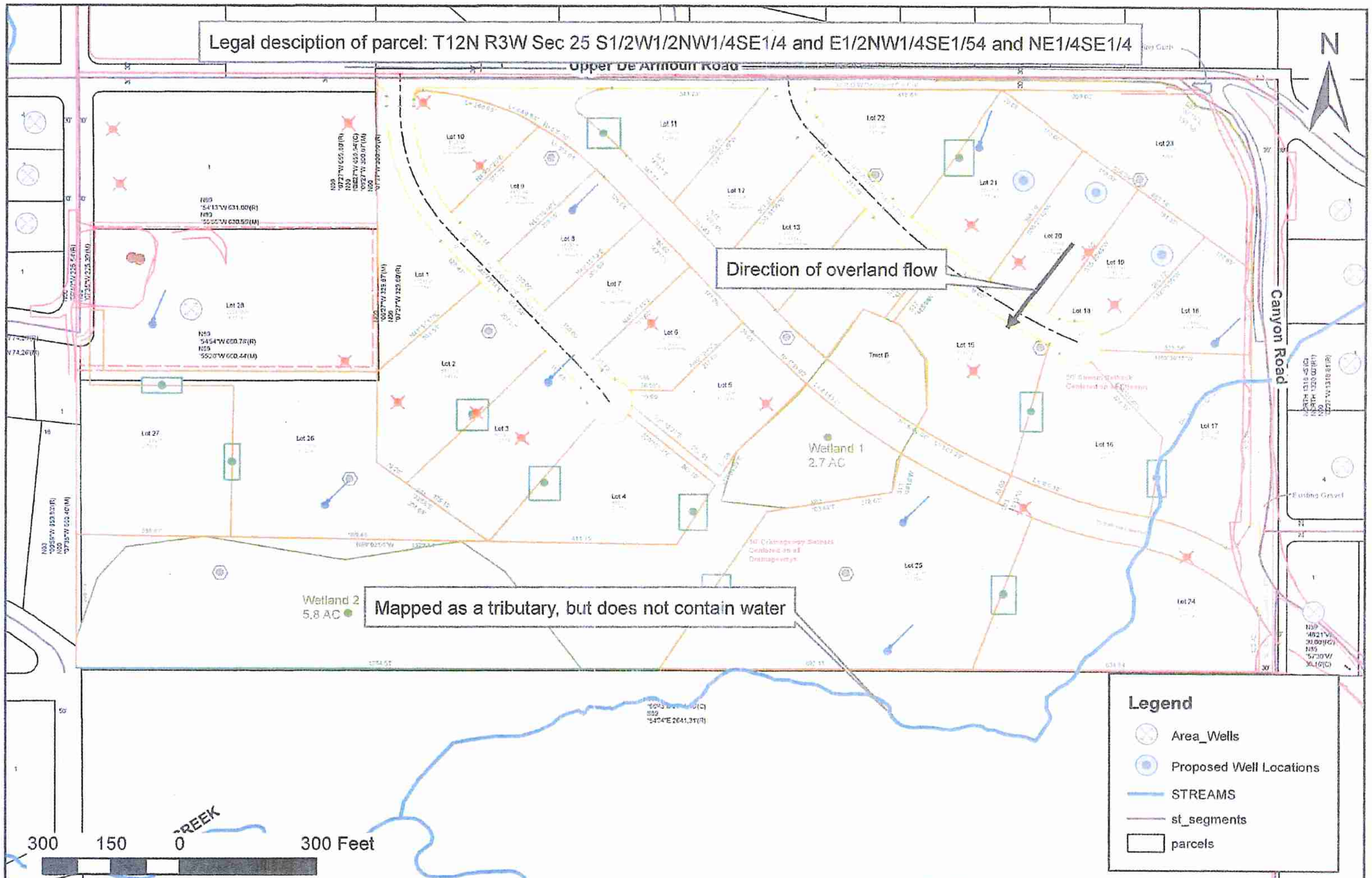
Fee required by regulation 11 AAC 05.010(a)(8)

- **$350** for all uses of water from up to five water sources

Make checks payable to "Department of Natural Resources".

Coastal Zone

If this appropriation is within the Coastal Zone, and you are planning to use more than 1,000 GPD from a surface water source or 5,000 GPD from a subsurface water source, you need to submit a completed Coastal Project Questionnaire with this application. For more information on the Coastal Zone, contact the Office of Project Management and Permitting; Anchorage 269-7470, Juneau 465-3562, www.dnr.state.ak.us/acmp/.



Proposed Lewis and Clark Subdivision Domestic Water Well Location Map

TERRASAT, Inc.	Prepared For: The Department of Natural Resources	Date: December 14, 2016

ALASKA DEPARTMENT OF NATURAL RESOURCES

Division of Mining, Land, and Water

Water Resources Section

550 West 7th Avenue, Suite 1020, Anchorage, AK 99501-3562

TEMPORARY WATER USE AUTHORIZATION
TWUA A2016-123

Pursuant to AS 46.15, as amended and the rules and regulations promulgated thereunder, permission is hereby granted to TERRASAT, INC (authorization holder), 4203 Iowa Drive, Anchorage, AK 99517, and their contractors, to withdraw up to **64,800 gallons of water per season (with a maximum limit of *21,600* gallons of water per day),** from the below described source of water. The water will be used for well tests at the planned Lewis & Clark Subdivision. The subdivision is in Anchorage, directly south/west of the corner of Upper De Armoun Road and Canyon Road. Water will be discharged onto the adjacent ground, which flows in a southwest direction.

SOURCES OF WATER

1. Well LCW-1, drilled 375 feet, located within SW¼, Section 25, Township 12 North, Range 3 West, Seward Meridian.
2. Well LCW-2, drilled 256 feet, located within SW¼, Section 25, Township 12 North, Range 3 West, Seward Meridian.
3. Well LCW-3, drilled 236 feet, located within SW¼, Section 25, Township 12 North, Range 3 West, Seward Meridian.

ADVISORY

The following prior appropriators (with addresses) are located within a ¼ mile of TWUA A2016-123:

1. ADL 42917/LAS 5793: 13351 View Heights Way, Anchorage, AK 99516
2. LAS 8862: 13440 View Heights Way, Anchorage, AK 99516
3. LAS 4314: 13391 Canyon Road, Anchorage, AK 99516
4. ADL 51668: 13215 Spendlove Dr, Anchorage, AK 99516
5. LAS 2225: 13481 Spendlove Dr, Anchorage, AK 99516
6. LAS 12531: 13641 Bonnielaine Rd, Anchorage, AK 99516
7. ADL 200347: 13341 Canyon Road, Anchorage, AK 99516
8. LAS 3922: 13035 Jeanne Rd, Anchorage, AK 99516
9. LAS 13449: 8601 Spendlove Dr, Anchorage, AK 99516
10. ADL 200565: 8701 Spendlove Dr, Anchorage, AK 99516
11. ADL 215139: 8740 Spendlove Dr, Anchorage, AK 99516
12. LAS 5725: 8901 Spendlove Dr, Anchorage, AK 99516
13. ADL 201716: 8731 Upper De Armoun Rd, Anchorage, AK 99516
14. LAS 30967: 8801 Upper De Armoun Rd, Anchorage, AK 99516
15. LAS 3587: 8831 Upper De Armoun Rd, Anchorage, AK 99516

Please see Condition 11 & Conditions 17, 18 and 19 regarding prior appropriators and the public interest.

STRUCTURES TO BE CONSTRUCTED AND USED

Pumps, pipes, and other water distribution equipment.

Changes in the natural state of water are to be made as stated herein and for the purposes indicated.

During the effective period of this authorization, the authorization holder shall comply with the following conditions:

CONDITIONS

1. This authorization does not authorize the authorization holder to enter upon any lands until proper rights-of-way, easements, or permission documents from the appropriate landowner have been obtained.

2. Follow acceptable engineering standards in exercising the privilege granted herein.

3. Comply with all applicable laws, and any rules and/or regulations issued thereunder.

4. Except for claims or losses arising from negligence of the State, defend and indemnify the State, the State's agents, and the State's employees against and hold each of them harmless from any and all claims, demands, suits, loss, liability and expense for injury to or death of persons and damages to or loss of property arising out of or connected with the exercise of the privileges covered by this authorization.

5. Notify the Water Resources Section upon change of address.

6. The authorization holder is responsible for obtaining and complying with other permits/approvals (state, federal, or local) that may be required prior to beginning water withdrawal pursuant to this authorization.

7. Failure to respond to a request for additional information during the term of the authorization may result in the termination of this authorization.

8. The authorization holder shall allow an authorized representative of the Water Resources Section to inspect, at reasonable times, any facilities, equipment, practices, or operations regulated or required under this authorization.

9. This authorization, or a copy thereof, shall be kept at the site of the authorized project described herein. The authorization holder is responsible for the actions of contractors, agents or other persons who perform work to accomplish the approved project, and shall ensure that workers are familiar with the requirements of this authorization. For any activity that significantly deviates from the approved project during its siting, construction, or operation, the authorization holder is required to contact the Water Resources Section and obtain approval before beginning the activity.

10. The Water Resources Section may modify this authorization to include different limitations, expand monitoring requirements, evaluate impacts, or require restoration at the site.

11. Pursuant to 11 AAC 93.220 (f), this authorization may be suspended by the Department of Natural Resources to protect the water rights of other persons or the public interest.

12. Any false statements or representations in any application, record, report, plan or other document filed or required to be maintained under this authorization may result in the termination of this authorization.

13. The authorization holder may not discharge water with petroleum, solvent, or any other contaminates into any surface or ground water. If contamination is encountered while exercising

this authorization, the authorization holder must notify Alaska Department of Environmental Conservation (ADEC) and Alaska Department of Natural Resources (DNR). Authorization holder shall cooperate with lawful prohibitions, restrictions, instructions or work plan requirements issued by ADEC Contaminated Sites/Response for authorization holder's projects.

14. Deviations from the project description submitted with the application which affect capacity, flow, operation or point of discharge must be approved by DNR in writing prior to implementation.

15. A well that is permanently decommissioned by the owner of the well must be in compliance with the requirements of 18 AAC 80.015(e). An abandonment report shall be submitted to this office and to the ADEC within 45 days of well decommissioning. As an alternative to permanent decommissioning, the authorization holder is encouraged to consider using the well to participate in the voluntary DNR, Alaska Hydrologic Survey, groundwater monitoring program. For further information on this program, contact melissa.hill@alaska.gov.

16. Monitoring and reporting of water withdrawal shall begin when the water withdrawal starts. Upon completion of the tests, raw data including: instrument calibration and/or manual verification checks, work plan (if available), baseline data, step test data, pumping data, recovery data, monitoring well identifications and coordinates, well lithologic logs and geophysical logs (if available) shall be submitted to the Alaska Department of Natural Resources, Water Resources Section within 45 days. Upon completion of the test, a final written report that includes the raw and processed data, including the analysis(es) shall be submitted to the Alaska Department of Natural Resources, Water Resources Section within 6 months. Reports may be submitted by mail to DNR-Water Resources Section or via email to: dnr.water.reports@alaska.gov

17. To insure that withdrawals do not unduly affect the rights of prior appropriators or the public interest, the authorization holder shall coordinate water withdrawals with all other authorized water users listed in the Advisory section, and with any additional immediate neighboring property owners.

18. A communication plan with prior appropriators and neighboring well owners will be submitted to DNR prior beginning pumping operations.

19. If any well owner notes interference during any pumping associated with TWUA A2016-123, work is to immediately cease and DNR-Water contacted. Pumping is not to resume until authorized by DNR-Water.

20. If rapid drawdown is noted in any pumping well or observation well, the test will immediately stop.

21. Record and report to this office all complaints relating to groundwater and surface discharge, including requests for information on groundwater data from local residents, should the situation occur.

22. Discharged water shall not create erosion, sedimentation or other hazards within adjacent or nearby properties, road rights-of-way, storm sewer systems or water bodies.

23. An application for a water right and/or authorization for these wells will be submitted to DNR at least 60 days prior to the wells being placed into production.

This Temporary Water Use Authorization is issued pursuant to 11 AAC 93.220. No water right or priority is established by a temporary water use authorization issued pursuant to 11 AAC 93.220. Water so used is subject to appropriation by others.

Pursuant to 11 AAC 93.210 (b), authorized temporary water use is subject to amendment, modification, or revocation by the Department of Natural Resources if the Department of Natural Resources determines that amendment, modification, or revocation is necessary to supply water to lawful appropriators of record or to protect the public interest.

This authorization shall expire on May 31, 2017.

Date issued: January 13, 2017

Approved: Henry CBrooks
Manager, South-Central Region, Water Management Unit
Water Resources Section, ADNR/DMLW

APPENDIX H

Water Sample
Laboratory Test Results

SGS

Laboratory Report of Analysis

To: Terrasat, Inc.
4203 Iowa Drive
Anchorage, AK 99517
(907)344-9370

Report Number: **1170452**

Client Project: **Lewis & Clark**

Dear Steve Smith,

Enclosed are the results of the analytical services performed under the referenced project for the received samples and associated QC as applicable. The samples are certified to meet the requirements of the National Environmental Laboratory Accreditation Conference Standards. Copies of this report and supporting data will be retained in our files for a period of ten years in the event they are required for future reference. All results are intended to be used in their entirety and SGS is not responsible for use of less than the complete report. Any samples submitted to our laboratory will be retained for a maximum of fourteen (14) days from the date of this report unless other archiving requirements were included in the quote.

If there are any questions about the report or services performed during this project, please call Victoria at (907) 562-2343. We will be happy to answer any questions or concerns which you may have.

Thank you for using SGS North America Inc. for your analytical services. We look forward to working with you again on any additional analytical needs.

Sincerely,
SGS North America Inc.

Victoria Pennick Date
Project Manager
Victoria.Pennick@sgs.com

SGS

Case Narrative

SGS Client: **Terrasat, Inc.**
SGS Project: **1170452**
Project Name/Site: **Lewis & Clark**
Project Contact: **Steve Smith**

Refer to sample receipt form for information on sample condition.

*QC comments may be associated with the field samples found in this report. When applicable, comments will be applied to associated field samples.

SGS

Laboratory Qualifiers

Enclosed are the analytical results associated with the above work order. All results are intended to be used in their entirety and SGS is not responsible for use of less than the complete report. This document is issued by the Company under its General Conditions of Service accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>. Attention is drawn to the limitation of liability, indenmification and jurisdiction issues defined therein.

Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the context or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

SGS maintains a formal Quality Assurance/Quality Control (QA/QC) program. A copy of our Quality Assurance Plan (QAP), which outlines this program, is available at your request. The laboratory certification numbers are AK00971 (DW Chemistry & Microbiology) for which SGS North America Inc. is Provisionally Certified as of 2/8/2017 & UST-005 (CS) for ADEC and 2944.01 for DOD ELAP/ISO17025 (RCRA methods: 1020B, 1311, 3010A, 3050B, 3520C, 3550C, 5030B, 5035A, 6020A, 7470A, 7471B, 8015C, 8021B, 8082A, 8260C, 8270D, 8270D-SIM, 9040C, 9045D, 9056A, 9060A, AK101 and AK102/103). Except as specifically noted, all statements and data in this report are in conformance to the provisions set forth by the SGS QAP and, when applicable, other regulatory authorities.

The following descriptors or qualifiers may be found in your report:

*	The analyte has exceeded allowable regulatory or control limits.
!	Surrogate out of control limits.
B	Indicates the analyte is found in a blank associated with the sample.
CCV/CVA/CVB	Continuing Calibration Verification
CCCV/CVC/CVCA/CVCB	Closing Continuing Calibration Verification
CL	Control Limit
DF	Dilution Factor
DL	Detection Limit (i.e., maximum method detection limit)
E	The analyte result is above the calibrated range.
GT	Greater Than
IB	Instrument Blank
ICV	Initial Calibration Verification
J	The quantitation is an estimation.
LCS(D)	Laboratory Control Spike (Duplicate)
LLQC/LLIQC	Low Level Quantitation Check
LOD	Limit of Detection (i.e., 1/2 of the LOQ)
LOQ	Limit of Quantitation (i.e., reporting or practical quantitation limit)
LT	Less Than
MB	Method Blank
MS(D)	Matrix Spike (Duplicate)
ND	Indicates the analyte is not detected.
RPD	Relative Percent Difference
U	Indicates the analyte was analyzed for but not detected.

Note: Sample summaries which include a result for "Total Solids" have already been adjusted for moisture content. All DRO/RRO analyses are integrated per SOP.

SGS

Sample Summary

Client Sample ID	Lab Sample ID	Collected	Received	Matrix
LCW-1	1170452001	01/31/2017	02/01/2017	Water (Surface, Eff., Ground)

Method	Method Description
EP200.8	Metals in Drinking Water by ICP-MS DISSO
SM21 4500NO3-F	Nitrate/Nitrite Flow injection Pres.
SM21 2540C	Total Dissolved Solids SM18 2540C

SGS

Detectable Results Summary

Client Sample ID: **LCW-1**
Lab Sample ID: 1170452001

	Parameter	Result	Units
Dissolved Metals by ICP/MS	Calcium	27000	ug/L
	Iron	1330	ug/L
	Manganese	57.3	ug/L
Waters Department	Total Dissolved Solids	246	mg/L
	Total Nitrate/Nitrite-N	1.12	mg/L

Print Date: 02/10/2017 2:13:49PM

SGS

Results of **LCW-1**

Client Sample ID: **LCW-1**	Collection Date: 01/31/17 12:35
Client Project ID: **Lewis & Clark**	Received Date: 02/01/17 16:21
Lab Sample ID: 1170452001	Matrix: Water (Surface, Eff., Ground)
Lab Project ID: 1170452	Solids (%):
	Location:

Results by **Dissolved Metals by ICP/MS**

Parameter	Result Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Calcium	27000	500	150	ug/L	1		02/10/17 10:07
Iron	1330	250	78.0	ug/L	1		02/10/17 10:07
Manganese	57.3	1.00	0.310	ug/L	1		02/10/17 10:07

Batch Information

Analytical Batch: MMS9690	Prep Batch: MXX30478
Analytical Method: EP200.8	Prep Method: E200.2
Analyst: VDL	Prep Date/Time: 02/09/17 09:52
Analytical Date/Time: 02/10/17 10:07	Prep Initial Wt./Vol.: 20 mL
Container ID: 1170452001-D	Prep Extract Vol: 50 mL

SGS

Results of LCW-1

Client Sample ID: **LCW-1**
Client Project ID: **Lewis & Clark**
Lab Sample ID: 1170452001
Lab Project ID: 1170452

Collection Date: 01/31/17 12:35
Received Date: 02/01/17 16:21
Matrix: Water (Surface, Eff., Ground)
Solids (%):
Location:

Results by Waters Department

Parameter	Result Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Total Dissolved Solids	246	10.0	3.10	mg/L	1		02/03/17 16:43

Batch Information

Analytical Batch: STS5355
Analytical Method: SM21 2540C
Analyst: AYC
Analytical Date/Time: 02/03/17 16:43
Container ID: 1170452001-B

Parameter	Result Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Total Nitrate/Nitrite-N	1.12	0.100	0.0300	mg/L	2		02/06/17 17:32

Batch Information

Analytical Batch: WFI2537
Analytical Method: SM21 4500NO3-F
Analyst: AYC
Analytical Date/Time: 02/06/17 17:32
Container ID: 1170452001-A

Print Date: 02/10/2017 2:13:50PM

J flagging is activated

SGS

Method Blank

Blank ID: MB for HBN 1753170 [MXX/30478]
Blank Lab ID: 1372557

Matrix: Water (Surface, Eff., Ground)

QC for Samples:
1170452001

Results by EP200.8

Parameter	Results	LOQ/CL	DL	Units
Calcium	250U	500	150	ug/L
Iron	125U	250	78.0	ug/L
Manganese	0.500U	1.00	0.310	ug/L

Batch Information

Analytical Batch: MMS9690
Analytical Method: EP200.8
Instrument: Perkin Elmer Nexlon P5
Analyst: VDL
Analytical Date/Time: 2/10/2017 9:49:40AM

Prep Batch: MXX30478
Prep Method: E200.2
Prep Date/Time: 2/9/2017 9:52:15AM
Prep Initial Wt./Vol.: 20 mL
Prep Extract Vol: 50 mL

SGS

Blank Spike Summary

Blank Spike ID: LCS for HBN 1170452 [MXX30478]
Blank Spike Lab ID: 1372558
Date Analyzed: 02/10/2017 09:52

Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1170452001

Results by EP200.8

	Blank Spike (ug/L)			
Parameter	Spike	Result	Rec (%)	CL
Calcium	10000	10100	101	(85-115)
Iron	5000	5320	106	(85-115)
Manganese	500	520	104	(85-115)

Batch Information

Analytical Batch: MMS9690
Analytical Method: EP200.8
Instrument: Perkin Elmer Nexlon P5
Analyst: VDL

Prep Batch: MXX30478
Prep Method: E200.2
Prep Date/Time: 02/09/2017 09:52
Spike Init Wt./Vol.: 10000 ug/L Extract Vol: 50 mL
Dupe Init Wt./Vol.: Extract Vol:

SGS

Matrix Spike Summary

Original Sample ID: 1372559
MS Sample ID: 1372560 MS
MSD Sample ID:

Analysis Date: 02/10/2017 10:07
Analysis Date: 02/10/2017 10:10
Analysis Date:
Matrix: Drinking Water

QC for Samples: 1170452001

Results by EP200.8

		Matrix Spike (ug/L)			Spike Duplicate (ug/L)					
Parameter	Sample	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Calcium	27000	10000	35700	86				70-130		
Iron	1330	5000	6530	104				70-130		
Manganese	57.3	500	583	105				70-130		

Batch Information

Analytical Batch: MMS9690
Analytical Method: EP200.8
Instrument: Perkin Elmer Nexion P5
Analyst: VDL
Analytical Date/Time: 2/10/2017 10:10:37AM

Prep Batch: MXX30478
Prep Method: DW Digest for Metals on ICP-MS
Prep Date/Time: 2/9/2017 9:52:15AM
Prep Initial Wt./Vol.: 20.00mL
Prep Extract Vol: 50.00mL

SGS

Method Blank

Blank ID: MB for HBN 1752894 [STS/5355]
Blank Lab ID: 1372459

Matrix: Water (Surface, Eff., Ground)

QC for Samples:
1170452001

Results by SM21 2540C

Parameter	Results	LOQ/CL	DL	Units
Total Dissolved Solids	5.00U	10.0	3.10	mg/L

Batch Information

Analytical Batch: STS5355
Analytical Method: SM21 2540C
Instrument:
Analyst: AYC
Analytical Date/Time: 2/3/2017 4:43:15PM

SGS

Duplicate Sample Summary

Original Sample ID: 1170417001
Duplicate Sample ID: 1372462

Analysis Date: 02/03/2017 16:43
Matrix: Water (Surface, Eff., Ground)

QC for Samples:

1170452001

Results by SM21 2540C

NAME	Original	Duplicate	Units	RPD (%)	RPD CL
Total Dissolved Solids	291	290	mg/L	0.34	(< 5)

Batch Information

Analytical Batch: STS5355
Analytical Method: SM21 2540C
Instrument:
Analyst: AYC

Print Date: 02/10/2017 2:13:56PM

SGS

Blank Spike Summary

Blank Spike ID: LCS for HBN 1170452 [STS5355]
Blank Spike Lab ID: 1372460
Date Analyzed: 02/03/2017 16:43

Spike Duplicate ID: LCSD for HBN 1170452 [STS5355]
Spike Duplicate Lab ID: 1372461
Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1170452001

Results by SM21 2540C

	Blank Spike (mg/L)			Spike Duplicate (mg/L)					
Parameter	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Total Dissolved Solids	330	319	97	330	331	100	(75-125)	3.70	(< 5)

Batch Information

Analytical Batch: STS5355
Analytical Method: SM21 2540C
Instrument:
Analyst: AYC

SGS

Method Blank

Blank ID: MB for HBN 1753171 (WFI/2537)
Blank Lab ID: 1372575

Matrix: Water (Surface, Eff., Ground)

QC for Samples:
1170452001

Results by **SM21 4500NO3-F**

Parameter	Results	LOQ/CL	DL	Units
Nitrate-N	0.0500U	0.100	0.0300	mg/L
Nitrite-N	0.0500U	0.100	0.0300	mg/L
Total Nitrate/Nitrite-N	0.0500U	0.100	0.0300	mg/L

Batch Information

Analytical Batch: WFI2537
Analytical Method: SM21 4500NO3-F
Instrument: Astoria segmented flow
Analyst: AYC
Analytical Date/Time: 2/6/2017 5:19:54PM

SGS

Blank Spike Summary

Blank Spike ID: LCS for HBN 1170452 [WFI2537]
Blank Spike Lab ID: 1372565
Date Analyzed: 02/06/2017 17:18

Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1170452001

Results by SM21 4500NO3-F

	Blank Spike (mg/L)			
Parameter	Spike	Result	Rec (%)	CL
Nitrate-N	2.5	2.60	104	(70-130)
Nitrite-N	2.5	2.50	100	(90-110)
Total Nitrate/Nitrite-N	5	5.10	102	(90-110)

Batch Information

Analytical Batch: WFI2537
Analytical Method: SM21 4500NO3-F
Instrument: Astoria segmented flow
Analyst: AYC

SGS

Matrix Spike Summary

Original Sample ID: 1170487001
MS Sample ID: 1372563 MS
MSD Sample ID: 1372564 MSD

QC for Samples: 1170452001

Analysis Date: 02/06/2017 17:37
Analysis Date: 02/06/2017 17:39
Analysis Date: 02/06/2017 17:40
Matrix: Drinking Water

Results by SM21 4500NO3-F

		Matrix Spike (mg/L)			Spike Duplicate (mg/L)					
Parameter	Sample	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Total Nitrate/Nitrite-N	3.52	5.00	8.33	96	5.00	8.36	97	90-110	0.40	(< 25)

Batch Information

Analytical Batch: WFI2537
Analytical Method: SM21 4500NO3-F
Instrument: Astoria segmented flow
Analyst: AYC
Analytical Date/Time: 2/6/2017 5:39:09PM

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CHAIN OF CUSTODY RECORD

1170452

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Instructions: Sections 1 - 5 must be filled out.
Omissions may delay the onset of analysis.

Page 1 of 1

Section 1

CLIENT: Terrasat
CONTACT: Steve Smith PHONE #: 344-9370
PROJECT NAME: Lewis & Clark Project/ PWSID/ PERMIT#:
REPORTS TO: Steve Smith E-MAIL: steve@terrasatenvironmental.com
INVOICE TO: Terrasat QUOTE #: Open P.O. #: 21607

Section 2 / Section 3

Preservative: H2SO4 | | Lab Filter/Pres

RESERVED for lab use	SAMPLE IDENTIFICATION	DATE mm/dd/yy	TIME HH:MM	MATRIX/ MATRIX CODE	# CONTAINERS	Pres: Type: Comp Grab MI (Multi-incremental)	Nitrate/Nitrite pres.	TDS	Diss Ca, Fe, Mn (200.8)							REMARKS/ LOC ID
1A	LCW-1	1/31/17	1235	W	1	G	X									60 ml-pres
1B	LCW-1	1/31/17	1235	W	1	G		X								500 ml
1C-D	LCW-1	1/31/17	1235	W	1	G			X							250 ml

Section 5

Relinquished By:	Date	Time	Received By:
(1) [signature]	2/1/17	1621	
(2)			
(3)			
(4)	2/1/17	16:21	Received For Laboratory By: [signature]

Section 4 DOD Project? Yes No

Cooler ID:

Data Deliverable Requirements: QC2/DV

Requested Turnaround Time and/or Special Instructions: "Lab filter/pres" Diss Ca, Mn, Fe

Temp Blank °C: 6.5 #D20
or Ambient [ ]
(See attached Sample Receipt Form)

Chain of Custody Seal: (Circle)
INTACT BROKEN ABSENT
(See attached Sample Receipt Form)

[ ] 200 W. Potter Drive Anchorage, AK 99518 Tel: (907) 562-2343 Fax: (907) 561-5301
[ ] 5500 Business Drive Wilmington, NC 28405 Tel: (910) 350-1903 Fax: (910) 350-1557

Hand Delivered

F083-Blank_COC_Templates_2015-03-19

1170452

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200 W. Potter Dr., Anchorage, AK 99518 (ph) 907-562-2343, (fax) 907-561-5301
3180 Peger Rd. Ste 190, Fairbanks, AK 99701 (ph) 907-474-8656, (fax) 907-474-9685

Sample Kit Request

Client Code: TERRAST
Client Name: Terrasat
Ordered By: Steve Smith — Phone #: 344-9370
Email: steve@terrasatenvironmental.com — Deliverables:
Project Name: Lewis & Clark — Project#: 21607
Quote #: Open — Profile #:
Delivery:

Does a Profile exist in LIMS? ☑ Yes ☐ No

☑ Client pickup Date: 1/18/2017 Time:
Be sure to ask if client will ship by ground (DOT) or air carrier (IATA)
☐ Deliver to client:
☐ Ship by/Air Carrier:
Airbill Number:
Date to ship by:
Notes:
Kit request taken by: VLP Date: 1/16/2017
Kit prepared by: K.W Date: 1-16-17
Kit *(including lid tightness for pres'd bottles)* checked by: EET Date: Jan. 16, 2017
Kit packed & shipped by: K.W Date: 1-16-17

No. Samples	Matrix	Analysis	Container Size & Type		Pres.	Bottle Lot #	Preservative Lot #	Hold Time	# QC Bottles	Total Bottles
3	Water	Nitrate/Nitrite pres.	1 x 60-mL	Nalgene	H2SO4					3
3	Water	TDS	1 x 500-mL	HDPE						3
3	Water	Diss Ca, Fe, Mn	1 x 250-mL	HDPE	Lab Filter/Pres					3

☐ Pack for Shipping via *ground* (DOT)
☐ Pack for Shipping via *air carrier* (IATA)
☑ Temperature Blank (*circle one:* 120-mL OR 500-mL)
☐ Soil VOA Trip Blank - Lot#:
☐ Water VOA Trip Blank - Lot#:
☐ 524 VOA Trip Blank - Lot#:
☐ Low Level Mercury Trip Blank- Lot#:
☑ Coolers
☑ Gel Ice (*circle one:* in each cooler OR in a separate cooler)
☑ Bubble Wrap
☑ Labels
☑ Custody Seals
☑ SGS COCs (**Remember: 1 COC/10 sample**) ☐ Blank COC ☐ DW COC ☑ COC initiated by PM (attached) ☐ COC provided by client
☐ Send additional instructions/documents (*Note to PM: Be sure to attach copy of requested form.*)

☐ Total # includes bottles for % Solids
☐ Track all Lot#s
☐ Foreign Soil
☐ Pack similar bottles together OR custom packing (*circle one*)

Other Notes/Reminders for Kit Prep:

Attention Client/Sampler:

1. Do not rinse container before filling and be aware of any acid preservative in container.
2. Fill container to top, but do not overfill (except volatiles which should be headspace free).
3. Label the container with your sample/site ID, as well as the date & time of collection.
4. Fill in the Chain of Custody.
5. Add frozen gel packs or ice to your cooler & pack to prevent breakage.

Charges may be invoiced for bottles which are unused or improperly used.
If you have any questions concerning this sample kit, please contact your Project Manager for assistance. *Thank you.*

SGS

e-Sample Receipt Form

SGS Workorder #: **1170452**

1 1 7 0 4 5 2

Review Criteria	Condition (Yes, No, N/A	Exceptions Noted below
Chain of Custody / Temperature Requirements	Yes	Exemption permitted if sampler hand carries/delivers.
Were Custody Seals intact? Note # & location	N/A	ABSENT
COC accompanied samples?	Yes	
	N/A	**Exemption permitted if chilled & collected <8 hours ago, or for samples where chilling is not required
Temperature blank compliant* (i.e., 0-6 °C after CF)?	[illegible]	Cooler ID: 1 @ [illegible] °C Therm. ID: D20
	n/a	Cooler ID: @ °C Therm. ID:
	N/A	Cooler ID: @ °C Therm. ID:
	N/A	Cooler ID: @ °C Therm. ID:
	N/A	Cooler ID: @ °C Therm. ID:
*If >6°C, were samples collected <8 hours ago?	[illegible]	Proceed with analyses per the client.
If <0°C, were sample containers ice free?	n/a	
If samples received without a temperature blank, the "cooler temperature" will be documented in lieu of the temperature blank & **"COOLER TEMP"** will be noted to the right. In cases where neither a temp blank nor cooler temp can be obtained, note "ambient" or "chilled".		
Note: Identify containers received at non-compliant temperature. Use form FS-0029 if more space is needed.		
Holding Time / Documentation / Sample Condition Requirements		Note: Refer to form F-083 "Sample Guide" for specific holding times.
Were samples received within holding time?	yes	
Do samples **match COC**** (i.e.,sample IDs,dates/times collected)? **Note: If times differ <1hr, record details & login per COC.	yes	
Were analyses requested unambiguous? (i.e., method is specified for analyses with >1 option for analysis)	yes	
	n/a	***Exemption permitted for metals (e.g.200.8/6020A).
Were proper containers (type/mass/volume/preservative***)used?	yes	
Volatile / LL-Hg Requirements		
Were Trip Blanks (i.e., VOAs, LL-Hg) in cooler with samples?	n/a	
Were all water VOA vials free of headspace (i.e., bubbles ≤ 6mm)?	n/a	
Were all soil VOAs field extracted with MeOH+BFB?	n/a	

Note to Client: Any "No", answer above indicates non-compliance with standard procedures and may impact data quality.

Additional notes (if applicable):

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Sample Containers and Preservatives

Container Id	Preservative	Container Condition	Container Id	Preservative	Container Condition
1170452001-A	H2SO4 to pH < 2	OK			
1170452001-B	No Preservative Required	OK			
1170452001-C	No Preservative Required	OK			
1170452001-D	HNO3 to pH < 2	PA			

Container Condition Glossary

Containers for bacteriological, low level mercury and VOA vials are not opened prior to analysis and will be assigned condition code OK unless evidence indicates than an inappropriate container was submitted.

OK - The container was received at an acceptable pH for the analysis requested.
BU - The container was received with headspace greater than 6mm.
DM- The container was received damaged.
FR- The container was received frozen and not usable for Bacteria or BOD analyses.
PA - The container was received outside of the acceptable pH for the analysis requested. Preservative was added upon receipt and the container is now at the correct pH. See the Sample Receipt Form for details on the amount and lot # of the preservative added.
PH - The container was received outside of the acceptable pH for the analysis requested. Preservative was added upon receipt, but was insufficient to bring the container to the correct pH for the analysis requested. See the Sample Receipt Form for details on the amount and lot # of the preservative added.

SGS

Laboratory Report of Analysis

To: Terrasat, Inc.
4203 Iowa Drive
Anchorage, AK 99517
(907)344-9370

Report Number: **1170368**

Client Project: **Lewis & Clark**

Dear Steve Smith,

Enclosed are the results of the analytical services performed under the referenced project for the received samples and associated QC as applicable. The samples are certified to meet the requirements of the National Environmental Laboratory Accreditation Conference Standards. Copies of this report and supporting data will be retained in our files for a period of ten years in the event they are required for future reference. All results are intended to be used in their entirety and SGS is not responsible for use of less than the complete report. Any samples submitted to our laboratory will be retained for a maximum of fourteen (14) days from the date of this report unless other archiving requirements were included in the quote.

If there are any questions about the report or services performed during this project, please call Victoria at (907) 562-2343. We will be happy to answer any questions or concerns which you may have.

Thank you for using SGS North America Inc. for your analytical services. We look forward to working with you again on any additional analytical needs.

Sincerely,
SGS North America Inc.

Victoria Pennick Date
Project Manager
Victoria.Pennick@sgs.com

Print Date: 02/09/2017 9:09:01AM

SGS

Case Narrative

SGS Client: **Terrasat, Inc.**
SGS Project: **1170368**
Project Name/Site: **Lewis & Clark**
Project Contact: **Steve Smith**

Refer to sample receipt form for information on sample condition.

1170404001MS (1372050) MS

4500NO3F - Nitrate/Nitrite - MS recovery for Total NO2/NO3 (111%) does not meet QC criteria. Refer to LCS for accuracy requirements.

1170404001MSD (1372051) MSD

4500NO3F - Nitrate/Nitrite - MSD recovery for Total NO2/NO3 (112%) does not meet QC criteria. Refer to LCS for accuracy requirements.

*QC comments may be associated with the field samples found in this report. When applicable, comments will be applied to associated field samples.

SGS

Laboratory Qualifiers

Enclosed are the analytical results associated with the above work order. All results are intended to be used in their entirety and SGS is not responsible for use of less than the complete report. This document is issued by the Company under its General Conditions of Service accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>. Attention is drawn to the limitation of liability, indenmification and jurisdiction issues defined therein.

Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the context or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

SGS maintains a formal Quality Assurance/Quality Control (QA/QC) program. A copy of our Quality Assurance Plan (QAP), which outlines this program, is available at your request. The laboratory certification numbers are AK00971 (DW Chemistry & Microbiology) & UST-005 (CS) for ADEC and 2944.01 for DOD ELAP/ISO17025 (RCRA methods: 1020B, 1311, 3010A, 3050B, 3520C, 3550C, 5030B, 5035A, 6020A, 7470A, 7471B, 8015C, 8021B, 8082A, 8260C, 8270D, 8270D-SIM, 9040C, 9045D, 9056A, 9060A, AK101 and AK102/103). Except as specifically noted, all statements and data in this report are in conformance to the provisions set forth by the SGS QAP and, when applicable, other regulatory authorities.

The following descriptors or qualifiers may be found in your report:

*	The analyte has exceeded allowable regulatory or control limits.
!	Surrogate out of control limits.
B	Indicates the analyte is found in a blank associated with the sample.
CCV/CVA/CVB	Continuing Calibration Verification
CCCV/CVC/CVCA/CVCB	Closing Continuing Calibration Verification
CL	Control Limit
DF	Dilution Factor
DL	Detection Limit (i.e., maximum method detection limit)
E	The analyte result is above the calibrated range.
GT	Greater Than
IB	Instrument Blank
ICV	Initial Calibration Verification
J	The quantitation is an estimation.
LCS(D)	Laboratory Control Spike (Duplicate)
LLQC/LLIQC	Low Level Quantitation Check
LOD	Limit of Detection (i.e., 1/2 of the LOQ)
LOQ	Limit of Quantitation (i.e., reporting or practical quantitation limit)
LT	Less Than
MB	Method Blank
MS(D)	Matrix Spike (Duplicate)
ND	Indicates the analyte is not detected.
RPD	Relative Percent Difference
U	Indicates the analyte was analyzed for but not detected.

Note: Sample summaries which include a result for "Total Solids" have already been adjusted for moisture content. All DRO/RRO analyses are integrated per SOP.

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Sample Summary

Client Sample ID	Lab Sample ID	Collected	Received	Matrix
LCW-2	1170368001	01/25/2017	01/25/2017	Water (Surface, Eff., Ground)

Method	Method Description
EP200.8	Metals in Drinking Water by ICP-MS DISSO
SM21 4500NO3-F	Nitrate/Nitrite Flow injection Pres.
SM21 2540C	Total Dissolved Solids SM18 2540C

SGS

Detectable Results Summary

Client Sample ID: **LCW-2**
Lab Sample ID: 1170368001

	Parameter	Result	Units
Dissolved Metals by ICP/MS	Calcium	54900	ug/L
	Manganese	4.67	ug/L
Waters Department	Total Dissolved Solids	286	mg/L
	Total Nitrate/Nitrite-N	1.83	mg/L

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Results of **LCW-2**

Client Sample ID: **LCW-2**
Client Project ID: **Lewis & Clark**
Lab Sample ID: 1170368001
Lab Project ID: 1170368

Collection Date: 01/25/17 11:12
Received Date: 01/25/17 16:07
Matrix: Water (Surface, Eff., Ground)
Solids (%):
Location:

Results by **Dissolved Metals by ICP/MS**

Parameter	Result Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Calcium	54900	500	150	ug/L	1		02/06/17 14:03
Iron	125 U	250	78.0	ug/L	1		02/06/17 14:03
Manganese	4.67	1.00	0.310	ug/L	1		02/06/17 14:03

Batch Information

Analytical Batch: MMS9685
Analytical Method: EP200.8
Analyst: VDL
Analytical Date/Time: 02/06/17 14:03
Container ID: 1170368001-D

Prep Batch: MXX30470
Prep Method: E200.2
Prep Date/Time: 02/01/17 12:30
Prep Initial Wt./Vol.: 20 mL
Prep Extract Vol: 50 mL

SGS

Results of **LCW-2**

Client Sample ID: **LCW-2**
Client Project ID: **Lewis & Clark**
Lab Sample ID: 1170368001
Lab Project ID: 1170368

Collection Date: 01/25/17 11:12
Received Date: 01/25/17 16:07
Matrix: Water (Surface, Eff., Ground)
Solids (%):
Location:

Results by **Waters Department**

Parameter	Result Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Total Dissolved Solids	286	10.0	3.10	mg/L	1		01/26/17 16:22

Batch Information

Analytical Batch: STS5348
Analytical Method: SM21 2540C
Analyst: AYC
Analytical Date/Time: 01/26/17 16:22
Container ID: 1170368001-B

Parameter	Result Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Total Nitrate/Nitrite-N	1.83	0.100	0.0300	mg/L	2		01/30/17 16:33

Batch Information

Analytical Batch: WFI2536
Analytical Method: SM21 4500NO3-F
Analyst: AYC
Analytical Date/Time: 01/30/17 16:33
Container ID: 1170368001-A

SGS

Method Blank

Blank ID: MB for HBN 1752745 [MXX/30470]
Blank Lab ID: 1372160

Matrix: Water (Surface, Eff., Ground)

QC for Samples:
1170368001

Results by EP200.8

Parameter	Results	LOQ/CL	DL	Units
Calcium	250U	500	150	ug/L
Iron	125U	250	78.0	ug/L
Manganese	0.500U	1.00	0.310	ug/L

Batch Information

Analytical Batch: MMS9685
Analytical Method: EP200.8
Instrument: Perkin Elmer Nexion P5
Analyst: VDL
Analytical Date/Time: 2/6/2017 1:57:16PM

Prep Batch: MXX30470
Prep Method: E200.2
Prep Date/Time: 2/1/2017 12:30:13PM
Prep Initial Wt./Vol.: 20 mL
Prep Extract Vol: 50 mL

SGS

Blank Spike Summary

Blank Spike ID: LCS for HBN 1170368 [MXX30470]
Blank Spike Lab ID: 1372161
Date Analyzed: 02/06/2017 14:00

Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1170368001

Results by EP200.8

	Blank Spike (ug/L)			
Parameter	Spike	Result	Rec (%)	CL
Calcium	10000	10400	104	(85-115)
Iron	5000	5420	108	(85-115)
Manganese	500	542	108	(85-115)

Batch Information

Analytical Batch: MMS9685
Analytical Method: EP200.8
Instrument: Perkin Elmer Nexion P5
Analyst: VDL

Prep Batch: MXX30470
Prep Method: E200.2
Prep Date/Time: 02/01/2017 12:30
Spike Init Wt./Vol.: 10000 ug/L Extract Vol: 50 mL
Dupe Init Wt./Vol.: Extract Vol:

SGS

Matrix Spike Summary

Original Sample ID: 1372201
MS Sample ID: 1372202 MS
MSD Sample ID:

QC for Samples: 1170368001

Analysis Date: 02/06/2017 14:03
Analysis Date: 02/06/2017 14:06
Analysis Date:
Matrix: Drinking Water

Results by EP200.8

		Matrix Spike (ug/L)			Spike Duplicate (ug/L)					
Parameter	Sample	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Calcium	54900	10000	65300	104				70-130		
Iron	125U	5000	5360	107				70-130		
Manganese	4.67	500	546	108				70-130		

Batch Information

Analytical Batch: MMS9685
Analytical Method: EP200.8
Instrument: Perkin Elmer Nexion P5
Analyst: VDL
Analytical Date/Time: 2/6/2017 2:06:14PM

Prep Batch: MXX30470
Prep Method: DW Digest for Metals on ICP-MS
Prep Date/Time: 2/1/2017 12:30:13PM
Prep Initial Wt./Vol.: 20.00mL
Prep Extract Vol: 50.00mL

SGS

Method Blank

Blank ID: MB for HBN 1752622 [STS/5348]
Blank Lab ID: 1371676

Matrix: Water (Surface, Eff., Ground)

QC for Samples:
1170368001

Results by **SM21 2540C**

Parameter	Results	LOQ/CL	DL	Units
Total Dissolved Solids	5.00U	10.0	3.10	mg/L

Batch Information

Analytical Batch: STS5348
Analytical Method: SM21 2540C
Instrument:
Analyst: AYC
Analytical Date/Time: 1/26/2017 4:22:23PM

SGS

Duplicate Sample Summary

Original Sample ID: 1170349001
Duplicate Sample ID: 1371679

Analysis Date: 01/26/2017 16:22
Matrix: Water (Surface, Eff., Ground)

QC for Samples:

1170368001

Results by SM21 2540C

NAME	Original	Duplicate	Units	RPD (%)	RPD CL
Total Dissolved Solids	64.0	66.0	mg/L	3.10	(< 5)

Batch Information

Analytical Batch: STS5348
Analytical Method: SM21 2540C
Instrument:
Analyst: AYC

Print Date: 02/09/2017 9:09:19AM

SGS

Blank Spike Summary

Blank Spike ID: LCS for HBN 1170368 [STS5348]
Blank Spike Lab ID: 1371677
Date Analyzed: 01/26/2017 16:22

Spike Duplicate ID: LCSD for HBN 1170368 [STS5348]
Spike Duplicate Lab ID: 1371678
Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1170368001

Results by SM21 2540C

	Blank Spike (mg/L)			Spike Duplicate (mg/L)					
Parameter	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Total Dissolved Solids	330	321	97	330	317	96	(75-125)	1.30	(< 5)

Batch Information

Analytical Batch: STS5348
Analytical Method: SM21 2540C
Instrument:
Analyst: AYC

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Method Blank

Blank ID: MB for HBN 1752717 (WFI/2536)
Blank Lab ID: 1372066

Matrix: Water (Surface, Eff., Ground)

QC for Samples:
1170368001

Results by SM21 4500NO3-F

Parameter	Results	LOQ/CL	DL	Units
Nitrate-N	0.0500U	0.100	0.0300	mg/L
Nitrite-N	0.0500U	0.100	0.0300	mg/L
Total Nitrate/Nitrite-N	0.0500U	0.100	0.0300	mg/L

Batch Information

Analytical Batch: WFI2536
Analytical Method: SM21 4500NO3-F
Instrument: Astoria segmented flow
Analyst: AYC
Analytical Date/Time: 1/30/2017 4:05:39PM

SGS

Method Blank

Blank ID: MB for HBN 1752717 (WFI/2536)
Blank Lab ID: 1372068

Matrix: Water (Surface, Eff., Ground)

QC for Samples:
1170368001

Results by **SM21 4500NO3-F**

Parameter	Results	LOQ/CL	DL	Units
Nitrate-N	0.0500U	0.100	0.0300	mg/L
Nitrite-N	0.0500U	0.100	0.0300	mg/L
Total Nitrate/Nitrite-N	0.0500U	0.100	0.0300	mg/L

Batch Information

Analytical Batch: WFI2536
Analytical Method: SM21 4500NO3-F
Instrument: Astoria segmented flow
Analyst: AYC
Analytical Date/Time: 1/30/2017 5:10:25PM

Print Date: 02/09/2017 9:09:22AM

SGS

Blank Spike Summary

Blank Spike ID: LCS for HBN 1170368 [WFI2536]
Blank Spike Lab ID: 1372053
Date Analyzed: 01/30/2017 16:03

Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1170368001

Results by SM21 4500NO3-F

	Blank Spike (mg/L)			
Parameter	Spike	Result	Rec (%)	CL
Nitrate-N	2.5	2.45	98	(70-130)
Nitrite-N	2.5	2.58	103	(90-110)
Total Nitrate/Nitrite-N	5	5.03	101	(90-110)

Batch Information

Analytical Batch: WFI2536
Analytical Method: SM21 4500NO3-F
Instrument: Astoria segmented flow
Analyst: AYC

Print Date: 02/09/2017 9:09:23AM

SGS

Blank Spike Summary

Blank Spike ID: LCS for HBN 1170368 [WFI2536]
Blank Spike Lab ID: 1372067
Date Analyzed: 01/30/2017 17:08

Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1170368001

Results by SM21 4500NO3-F

	Blank Spike (mg/L)			
Parameter	Spike	Result	Rec (%)	CL
Nitrate-N	2.5	2.55	102	(70-130)
Nitrite-N	2.5	2.62	105	(90-110)
Total Nitrate/Nitrite-N	5	5.17	103	(90-110)

Batch Information

Analytical Batch: WFI2536
Analytical Method: SM21 4500NO3-F
Instrument: Astoria segmented flow
Analyst: AYC

Print Date: 02/09/2017 9:09:23AM

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Matrix Spike Summary

Original Sample ID: 1170404001
MS Sample ID: 1372050 MS
MSD Sample ID: 1372051 MSD

Analysis Date: 01/30/2017 17:03
Analysis Date: 01/30/2017 17:05
Analysis Date: 01/30/2017 17:06
Matrix: Drinking Water

QC for Samples: 1170368001

Results by SM21 4500NO3-F

		Matrix Spike (mg/L)			Spike Duplicate (mg/L)					
Parameter	Sample	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Total Nitrate/Nitrite-N	0.100U	5.00	5.53	111 *	5.00	5.61	112 *	90-110	1.40	(< 25)

Batch Information

Analytical Batch: WFI2536
Analytical Method: SM21 4500NO3-F
Instrument: Astoria segmented flow
Analyst: AYC
Analytical Date/Time: 1/30/2017 5:05:10PM

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Instructions: Sections 1 - 5 must be filled out.
Omissions may delay the onset of analysis.

Page 1 of 1

Section 1

CLIENT: Terrasat
CONTACT: Steve Smith — PHONE #: 344-9370
PROJECT NAME: Lewis & Clark — Project/PWSID/PERMIT#:
REPORTS TO: Steve Smith — E-MAIL: steve@terrasatenvironmental.com
INVOICE TO: Terrasat — QUOTE #: Open — P.O. #: 21607

Section 3 — Preservative: H2SO4 / Lab Filter/Pres

Section 2

RESERVED for lab use	SAMPLE IDENTIFICATION	DATE mm/dd/yy	TIME HH:MM	MATRIX/ MATRIX CODE	# CONTAINERS	Pres: Type: Comp Grab MI (Multi-Incremental)	Nitrate/Nitrite pres.	TDS	Diss Ca, Fe, Mn (200.8)								REMARKS/ LOC ID
1A	LCW-2	1/25/17	1112	W	1	G	X										60 ml - pres
1B	LCW-2	1/25/17	1112	W	1	G		X									500 ml
1C-D	LCW-2	1/25/17	1112	W	1	G			X								250 ml

Section 5

Relinquished By	Date	Time	Received By
(1) Steve Smith	1/25/17	1607	
(2)			
(3)			
(4)	1/25/17	16:07	Received For Laboratory By: [illegible]

Section 4 — DOD Project? Yes No

Data Deliverable Requirements: QC2/DV

Cooler ID:

Requested Turnaround Time and/or Special Instructions: "Lab filter/pres" Diss Ca, Fe, Mn

Temp Blank °C: 4.1 #238
or Ambient [ ]
(See attached Sample Receipt Form)

Chain of Custody Seal: (Circle)
INTACT BROKEN ABSENT
(See attached Sample Receipt Form)

[ ] 200 W. Potter Drive Anchorage, AK 99518 Tel: (907) 562-2343 Fax: (907) 561-5301
[ ] 5500 Business Drive Wilmington, NC 28405 Tel: (910) 350-1903 Fax: (910) 350-1557

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F083-Blank_COC_Templates_2015-03-19

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3180 Peger Rd. Ste 190, Fairbanks, AK 99701 (ph) 907-474-8656, (fax) 907-474-9685

Sample Kit Request

Client Code: TERRAST
Does a Profile exist in LIMS? ☑ Yes ☐ No
Client Name: Terrasat
Ordered By: Steve Smith
Phone #: 344-9370
Email: steve@terrasatenvironmental.com
Deliverables:
Project Name: Lewis & Clark
Project#: 21607
Quote #: Open
Profile #:
Delivery:

☑ Client pickup Date: 1/18/2017 Time:
Be sure to ask if client will ship by ground (DOT) or air carrier (IATA)
☐ Deliver to client:
☐ Ship by/Air Carrier:
Airbill Number:
Date to ship by:
Notes:
Kit request taken by: VLP Date: 1/16/2017
Kit prepared by: K.W Date: 1-16-17
Kit (*including lid tightness for pres'd bottles*) checked by: EET Date: Jan. 16, 2017
Kit packed & shipped by: K.W Date: 1-16-17

No. Samples	Matrix	Analysis	Container Size & Type		Pres.	Bottle Lot #	Preservative Lot #	Hold Time	# QC Bottles	Total Bottles
3	Water	Nitrate/Nitrite pres.	1 x 60-mL	Nalgene	H2SO4					3
3	Water	TDS	1 x 500-mL	HDPE						3
3	Water	Diss Ca, Fe, Mn	1 x 250-mL	HDPE	Lab Filter/Pres					3

- ☐ Pack for Shipping via *ground* (DOT)
- ☐ Pack for Shipping via *air carrier* (IATA)
- ☑ Temperature Blank (*circle one:* 120-mL OR 500-mL)
- ☐ Soil VOA Trip Blank - Lot#:
- ☐ Water VOA Trip Blank - Lot#:
- ☐ 524 VOA Trip Blank - Lot#:
- ☐ Low Level Mercury Trip Blank- Lot#:
- ☑ Coolers
- ☑ Gel Ice (*circle one:* in each cooler OR in a separate cooler)
- ☑ Bubble Wrap
- ☑ Labels
- ☑ Custody Seals
- ☑ SGS COCs (**Remember: 1 COC/10 sample**) ☐ Blank COC ☐ DW COC ☑ COC initiated by PM (attached) ☐ COC provided by client
- ☐ Send additional instructions/documents (*Note to PM: Be sure to attach copy of requested form.*)

- ☐ Total # includes bottles for % Solids
- ☐ Track all Lot#s
- ☐ Foreign Soil
- ☐ Pack similar bottles together OR custom packing (*circle one*)

Other Notes/Reminders for Kit Prep:

Attention Client/Sampler:

1. Do not rinse container before filling and be aware of any acid preservative in container.
2. Fill container to top, but do not overfill (except volatiles which should be headspace free).
3. Label the container with your sample/site ID, as well as the date & time of collection.
4. Fill in the Chain of Custody.
5. Add frozen gel packs or ice to your cooler & pack to prevent breakage.

Charges may be invoiced for bottles which are unused or improperly used.
If you have any questions concerning this sample kit, please contact your Project Manager for assistance. ***Thank you.***

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e-SAMPLE RECEIPT FORM

1170368	1170368

Review Criteria	Y/N (yes/no)	Exceptions Noted below
	Y	exemption permitted if sampler hand carries/delivers.
Were Custody Seals intact? Note # & location		ABSENT
COC accompanied samples?	Y	
Y		**exemption permitted if chilled & collected <8hrs ago or chilling not required (i.e., waste, oil)
	Y	Cooler ID: 1 @ 4.1 °C Therm ID: 238
		Cooler ID: @ °C Therm ID:
Temperature blank compliant* (i.e., 0-6 °C after CF)?		Cooler ID: @ °C Therm ID:
		Cooler ID: @ °C Therm ID:
		Cooler ID: @ °C Therm ID:
**If >6°C, were samples collected <8 hours ago?*		
If <0°C, were sample containers ice free?		
If samples received without a temperature blank, the "cooler temperature" will be documented in lieu of the temperature blank & "COOLER TEMP" will be noted to the right. In cases where neither a temp blank nor cooler temp can be obtained, note "ambient" or "chilled".		
Note: Identify containers received at non-compliant temperature. Use form FS-0029 if more space is needed.		
		Note: Refer to form F-083 "Sample Guide" for hold times.
Were samples received within hold time?	Y	
Do samples match COC** (i.e.,sample IDs,dates/times collected)? **Note: If times differ <1hr, record details & login per COC.	Y	The container labels were switched between the TDS and Metals containersper the client. They will be logged in and labelled correctly.
Were analyses requested unambiguous?	Y	
	Y	***Exemption permitted for metals (e.g,200.8/6020A).
Were proper containers (type/mass/volume/preservative***)used?	N	Lab filter for dissolved metals.
IF APPLICABLE		
Were Trip Blanks (i.e., VOAs, LL-Hg) in cooler with samples?		
Were all VOA vials free of headspace (i.e., bubbles ≤ 6mm)?		
Were all soil VOAs field extracted with MeOH+BFB?		

Note to Client: Any "no" answer above indicates non-compliance with standard procedures and may impact data quality.

Additional notes (if applicable):

Sample Containers and Preservatives

Container Id	Preservative	Container Condition	Container Id	Preservative	Container Condition
1170368001-A	H_2SO_4 to pH < 2	OK			
1170368001-B	No Preservative Required	OK			
1170368001-C	No Preservative Required	OK			
1170368001-D	HNO_3 to pH < 2	PA			

Container Condition Glossary

Containers for bacteriological, low level mercury and VOA vials are not opened prior to analysis and will be assigned condition code OK unless evidence indicates than an inappropriate container was submitted.

OK - The container was received at an acceptable pH for the analysis requested.
BU - The container was received with headspace greater than 6mm.
DM- The container was received damaged.
FR- The container was received frozen and not usable for Bacteria or BOD analyses.
PA - The container was received outside of the acceptable pH for the analysis requested. Preservative was added upon receipt and the container is now at the correct pH. See the Sample Receipt Form for details on the amount and lot # of the preservative added.
PH - The container was received outside of the acceptable pH for the analysis requested. Preservative was added upon receipt, but was insufficient to bring the container to the correct pH for the analysis requested. See the Sample Receipt Form for details on the amount and lot # of the preservative added.

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Laboratory Report of Analysis

To: Terrasat, Inc.
4203 Iowa Drive
Anchorage, AK 99517
(907)344-9370

Report Number: **1170417**

Client Project: **Lewis & Clark**

Dear Steve Smith,

Enclosed are the results of the analytical services performed under the referenced project for the received samples and associated QC as applicable. The samples are certified to meet the requirements of the National Environmental Laboratory Accreditation Conference Standards. Copies of this report and supporting data will be retained in our files for a period of ten years in the event they are required for future reference. All results are intended to be used in their entirety and SGS is not responsible for use of less than the complete report. Any samples submitted to our laboratory will be retained for a maximum of fourteen (14) days from the date of this report unless other archiving requirements were included in the quote.

If there are any questions about the report or services performed during this project, please call Victoria at (907) 562-2343. We will be happy to answer any questions or concerns which you may have.

Thank you for using SGS North America Inc. for your analytical services. We look forward to working with you again on any additional analytical needs.

Sincerely,
SGS North America Inc.

Victoria Pennick Date
Project Manager
Victoria.Pennick@sgs.com

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Case Narrative

SGS Client: **Terrasat, Inc.**
SGS Project: **1170417**
Project Name/Site: **Lewis & Clark**
Project Contact: **Steve Smith**

Refer to sample receipt form for information on sample condition.

*QC comments may be associated with the field samples found in this report. When applicable, comments will be applied to associated field samples.

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Laboratory Qualifiers

Enclosed are the analytical results associated with the above work order. All results are intended to be used in their entirety and SGS is not responsible for use of less than the complete report. This document is issued by the Company under its General Conditions of Service accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>. Attention is drawn to the limitation of liability, indenmification and jurisdiction issues defined therein.

Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the context or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

SGS maintains a formal Quality Assurance/Quality Control (QA/QC) program. A copy of our Quality Assurance Plan (QAP), which outlines this program, is available at your request. The laboratory certification numbers are AK00971 (DW Chemistry & Microbiology) & UST-005 (CS) for ADEC and 2944.01 for DOD ELAP/ISO17025 (RCRA methods: 1020B, 1311, 3010A, 3050B, 3520C, 3550C, 5030B, 5035A, 6020A, 7470A, 7471B, 8015C, 8021B, 8082A, 8260C, 8270D, 8270D-SIM, 9040C, 9045D, 9056A, 9060A, AK101 and AK102/103). Except as specifically noted, all statements and data in this report are in conformance to the provisions set forth by the SGS QAP and, when applicable, other regulatory authorities.

The following descriptors or qualifiers may be found in your report:

*	The analyte has exceeded allowable regulatory or control limits.
!	Surrogate out of control limits.
B	Indicates the analyte is found in a blank associated with the sample.
CCV/CVA/CVB	Continuing Calibration Verification
CCCV/CVC/CVCA/CVCB	Closing Continuing Calibration Verification
CL	Control Limit
DF	Dilution Factor
DL	Detection Limit (i.e., maximum method detection limit)
E	The analyte result is above the calibrated range.
GT	Greater Than
IB	Instrument Blank
ICV	Initial Calibration Verification
J	The quantitation is an estimation.
LCS(D)	Laboratory Control Spike (Duplicate)
LLQC/LLIQC	Low Level Quantitation Check
LOD	Limit of Detection (i.e., 1/2 of the LOQ)
LOQ	Limit of Quantitation (i.e., reporting or practical quantitation limit)
LT	Less Than
MB	Method Blank
MS(D)	Matrix Spike (Duplicate)
ND	Indicates the analyte is not detected.
RPD	Relative Percent Difference
U	Indicates the analyte was analyzed for but not detected.

Note: Sample summaries which include a result for "Total Solids" have already been adjusted for moisture content. All DRO/RRO analyses are integrated per SOP.

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Sample Summary

Client Sample ID	Lab Sample ID	Collected	Received	Matrix
LCW-3	1170417001	01/30/2017	01/30/2017	Water (Surface, Eff., Ground)

Method	Method Description
EP200.8	Metals in Drinking Water by ICP-MS DISSO
SM21 4500NO3-F	Nitrate/Nitrite Flow injection Pres.
SM21 2540C	Total Dissolved Solids SM18 2540C

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Detectable Results Summary

Client Sample ID: **LCW-3**
Lab Sample ID: 1170417001

	Parameter	Result	Units
Dissolved Metals by ICP/MS	Calcium	43300	ug/L
	Manganese	59.0	ug/L
Waters Department	Total Dissolved Solids	291	mg/L
	Total Nitrate/Nitrite-N	0.0378J	mg/L

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Results of **LCW-3**

Client Sample ID: **LCW-3**
Client Project ID: **Lewis & Clark**
Lab Sample ID: 1170417001
Lab Project ID: 1170417

Collection Date: 01/30/17 10:17
Received Date: 01/30/17 15:55
Matrix: Water (Surface, Eff., Ground)
Solids (%):
Location:

Results by **Dissolved Metals by ICP/MS**

Parameter	Result Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Calcium	43300	500	150	ug/L	1		02/06/17 14:48
Iron	125 U	250	78.0	ug/L	1		02/06/17 14:48
Manganese	59.0	1.00	0.310	ug/L	1		02/06/17 14:48

Batch Information

Analytical Batch: MMS9685
Analytical Method: EP200.8
Analyst: VDL
Analytical Date/Time: 02/06/17 14:48
Container ID: 1170417001-D

Prep Batch: MXX30473
Prep Method: E200.2
Prep Date/Time: 02/01/17 12:30
Prep Initial Wt./Vol.: 20 mL
Prep Extract Vol: 50 mL

Print Date: 02/09/2017 9:10:13AM

J flagging is activated

SGS

Results of **LCW-3**

Client Sample ID: **LCW-3**
Client Project ID: **Lewis & Clark**
Lab Sample ID: 1170417001
Lab Project ID: 1170417

Collection Date: 01/30/17 10:17
Received Date: 01/30/17 15:55
Matrix: Water (Surface, Eff., Ground)
Solids (%):
Location:

Results by **Waters Department**

Parameter	Result Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Total Dissolved Solids	291	10.0	3.10	mg/L	1		02/03/17 16:43

Batch Information

Analytical Batch: STS5355
Analytical Method: SM21 2540C
Analyst: AYC
Analytical Date/Time: 02/03/17 16:43
Container ID: 1170417001-B

Parameter	Result Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Total Nitrate/Nitrite-N	0.0378 J	0.100	0.0300	mg/L	2		02/06/17 17:26

Batch Information

Analytical Batch: WFI2537
Analytical Method: SM21 4500NO3-F
Analyst: AYC
Analytical Date/Time: 02/06/17 17:26
Container ID: 1170417001-A

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Method Blank

Blank ID: MB for HBN 1752753 [MXX/30473]
Blank Lab ID: 1372194

Matrix: Water (Surface, Eff., Ground)

QC for Samples:
1170417001

Results by EP200.8

Parameter	Results	LOQ/CL	DL	Units
Calcium	250U	500	150	ug/L
Iron	125U	250	78.0	ug/L
Manganese	0.500U	1.00	0.310	ug/L

Batch Information

Analytical Batch: MMS9685
Analytical Method: EP200.8
Instrument: Perkin Elmer Nexlon P5
Analyst: VDL
Analytical Date/Time: 2/6/2017 2:42:06PM

Prep Batch: MXX30473
Prep Method: E200.2
Prep Date/Time: 2/1/2017 12:30:38PM
Prep Initial Wt./Vol.: 20 mL
Prep Extract Vol: 50 mL

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Blank Spike Summary

Blank Spike ID: LCS for HBN 1170417 [MXX30473]
Blank Spike Lab ID: 1372195
Date Analyzed: 02/06/2017 14:45

Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1170417001

Results by EP200.8

Blank Spike (ug/L)

Parameter	Spike	Result	Rec (%)	CL
Calcium	10000	10400	104	(85-115)
Iron	5000	5290	106	(85-115)
Manganese	500	525	105	(85-115)

Batch Information

Analytical Batch: MMS9685
Analytical Method: EP200.8
Instrument: Perkin Elmer Nexion P5
Analyst: VDL

Prep Batch: MXX30473
Prep Method: E200.2
Prep Date/Time: 02/01/2017 12:30
Spike Init Wt./Vol.: 10000 ug/L Extract Vol: 50 mL
Dupe Init Wt./Vol.: Extract Vol:

SGS

Matrix Spike Summary

Original Sample ID: 1372203
MS Sample ID: 1372204 MS
MSD Sample ID:

QC for Samples: 1170417001

Analysis Date: 02/06/2017 14:48
Analysis Date: 02/06/2017 14:51
Analysis Date:
Matrix: Drinking Water

Results by EP200.8

		Matrix Spike (ug/L)			Spike Duplicate (ug/L)					
Parameter	Sample	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Calcium	43300	10000	53900	106				70-130		
Iron	125U	5000	5510	110				70-130		
Manganese	59.0	500	590	106				70-130		

Batch Information

Analytical Batch: MMS9685
Analytical Method: EP200.8
Instrument: Perkin Elmer Nexion P5
Analyst: VDL
Analytical Date/Time: 2/6/2017 2:51:03PM

Prep Batch: MXX30473
Prep Method: DW Digest for Metals on ICP-MS
Prep Date/Time: 2/1/2017 12:30:38PM
Prep Initial Wt./Vol.: 20.00mL
Prep Extract Vol: 50.00mL

Method Blank

Blank ID: MB for HBN 1752894 [STS/5355] Matrix: Water (Surface, Eff., Ground)
Blank Lab ID: 1372459

QC for Samples:
1170417001

Results by **SM21 2540C**

Parameter	Results	LOQ/CL	DL	Units
Total Dissolved Solids	5.00U	10.0	3.10	mg/L

Batch Information

Analytical Batch: STS5355
Analytical Method: SM21 2540C
Instrument:
Analyst: AYC
Analytical Date/Time: 2/3/2017 4:43:15PM

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Duplicate Sample Summary

Original Sample ID: 1170417001
Duplicate Sample ID: 1372462

Analysis Date: 02/03/2017 16:43
Matrix: Water (Surface, Eff., Ground)

QC for Samples:

1170417001

Results by SM21 2540C

NAME	Original	Duplicate	Units	RPD (%)	RPD CL
Total Dissolved Solids	291	290	mg/L	0.34	(< 5)

Batch Information

Analytical Batch: STS5355
Analytical Method: SM21 2540C
Instrument:
Analyst: AYC

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Blank Spike Summary

Blank Spike ID: LCS for HBN 1170417 [STS5355]
Blank Spike Lab ID: 1372460
Date Analyzed: 02/03/2017 16:43

Spike Duplicate ID: LCSD for HBN 1170417 [STS5355]
Spike Duplicate Lab ID: 1372461
Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1170417001

Results by SM21 2540C

	Blank Spike (mg/L)			Spike Duplicate (mg/L)					
Parameter	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Total Dissolved Solids	330	319	97	330	331	100	(75-125)	3.70	(< 5)

Batch Information

Analytical Batch: STS5355
Analytical Method: SM21 2540C
Instrument:
Analyst: AYC

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Method Blank

Blank ID: MB for HBN 1753171 (WFI/2537)
Blank Lab ID: 1372575

Matrix: Water (Surface, Eff., Ground)

QC for Samples:
1170417001

Results by SM21 4500NO3-F

Parameter	Results	LOQ/CL	DL	Units
Nitrate-N	0.0500U	0.100	0.0300	mg/L
Nitrite-N	0.0500U	0.100	0.0300	mg/L
Total Nitrate/Nitrite-N	0.0500U	0.100	0.0300	mg/L

Batch Information

Analytical Batch: WFI2537
Analytical Method: SM21 4500NO3-F
Instrument: Astoria segmented flow
Analyst: AYC
Analytical Date/Time: 2/6/2017 5:19:54PM

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Blank Spike Summary

Blank Spike ID: LCS for HBN 1170417 [WFI2537]
Blank Spike Lab ID: 1372565
Date Analyzed: 02/06/2017 17:18

Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1170417001

Results by SM21 4500NO3-F

	Blank Spike (mg/L)			
Parameter	Spike	Result	Rec (%)	CL
Nitrate-N	2.5	2.60	104	(70-130)
Nitrite-N	2.5	2.50	100	(90-110)
Total Nitrate/Nitrite-N	5	5.10	102	(90-110)

Batch Information

Analytical Batch: WFI2537
Analytical Method: SM21 4500NO3-F
Instrument: Astoria segmented flow
Analyst: AYC

Print Date: 02/09/2017 9:10:31AM

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Matrix Spike Summary

Original Sample ID: 1170487001
MS Sample ID: 1372563 MS
MSD Sample ID: 1372564 MSD

QC for Samples: 1170417001

Analysis Date: 02/06/2017 17:37
Analysis Date: 02/06/2017 17:39
Analysis Date: 02/06/2017 17:40
Matrix: Drinking Water

Results by SM21 4500NO3-F

		Matrix Spike (mg/L)			Spike Duplicate (mg/L)					
Parameter	Sample	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Total Nitrate/Nitrite-N	3.52	5.00	8.33	96	5.00	8.36	97	90-110	0.40	(< 25)

Batch Information

Analytical Batch: WFI2537
Analytical Method: SM21 4500NO3-F
Instrument: Astoria segmented flow
Analyst: AYC
Analytical Date/Time: 2/6/2017 5:39:09PM

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CHAIN OF CUSTODY RECORD

1170417

Locations Nationwide
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Instructions: Sections ... out.
Omissions may delay the onset of analysis.

Page 1 of 1

Section 1

CLIENT:	Terrasat		
CONTACT:	Steve Smith	PHONE #:	344-9370
PROJECT NAME:	Lewis & Clark	Project/ PWSID/ PERMIT#:	
REPORTS TO:	Steve Smith	E-MAIL:	steve@terrasatenvironmental.com
INVOICE TO:	Terrasat	QUOTE #:	Open
		P.O. #:	21607

Section 2 / Section 3 — Preservative

RESERVED for lab use	SAMPLE IDENTIFICATION	DATE mm/dd/yy	TIME HH:MM	MATRIX/ MATRIX CODE	# CONTAINERS	Pres: Type: Comp Grab MI (Multi-incremental)	Nitrate/Nitrite pres. (H2SO4)	TDS	Diss Ca, Fe, Mn (200.8) (Lab Filter/Pres)								REMARKS/ LOC ID
1A	LCW-3	1-30-17	1017	W	1	G	X										60 ml - pres
1B	LCW-3	1-30-17	1017	W	1	G		X									500 ml -
1C-D	LCW-3	1-30-17	1017	W	1	G			X								250 ml

Section 5

Relinquished By	Date	Time	Received By
Relinquished By: (1) [signature]	1/30/17	1555	Received By:
Relinquished By: (2)	Date	Time	Received By:
Relinquished By: (3)	Date	Time	Received By:
Relinquished By: (4)	1/30/17	15:55	Received For Laboratory By: [signature]

Section 4 DOD Project? Yes No

Cooler ID:

Data Deliverable Requirements: QC2/DV

Requested Turnaround Time and/or Special Instructions: "Lab filter/pres" Diss Ca, Fe, Mn

Temp Blank °C: 10.0 #D20
or Ambient [ ]
(See attached Sample Receipt Form)

Chain of Custody Seal: (Circle)
INTACT BROKEN ABSENT
(See attached Sample Receipt Form)

[ ] 200 W. Potter Drive Anchorage, AK 99518 Tel: (907) 562-2343 Fax: (907) 561-5301
[ ] 5500 Business Drive Wilmington, NC 28405 Tel: (910) 350-1903 Fax: (910) 350-1557

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3180 Peger Rd. Ste 190, Fairbanks, AK 99701 (ph) 907-474-8656, (fax) 907-474-9685

Sample Kit Request

Does a Profile exist in LIMS? ☑ Yes ☐ No

Client Code: TERRAST
Client Name: Terrasat
Ordered By: Steve Smith
Email: steve@terrasatenvironmental.com
Project Name: Lewis & Clark
Quote #: Open
Delivery:

Phone #: 344-9370
Deliverables:
Project#: 21607
Profile #:

☑ Client pickup Date: 1/18/2017 Time:
Be sure to ask if client will ship by ground (DOT) or air carrier (IATA)
☐ Deliver to client:
☐ Ship by/Air Carrier:
Airbill Number:
Date to ship by:
Notes:
Kit request taken by: VLP Date: 1/16/2017
Kit prepared by: K.W Date: 1-16-17
Kit (*including lid tightness for pres'd bottles*) checked by: EET Date: Jan. 16, 2017
Kit packed & shipped by: K.W Date: 1-16-17

No. Samples	Matrix	Analysis	Container Size & Type		Pres.	Bottle Lot #	Preservative Lot #	Hold Time	# QC Bottles	Total Bottles
3	Water	Nitrate/Nitrite pres.	1 x 60-mL	Nalgene	H2SO4					3
3	Water	TDS	1 x 500-mL	HDPE						3
3	Water	Diss Ca, Fe, Mn	1 x 250-mL	HDPE	Lab Filter/Pres					3

☐ Pack for Shipping via *ground* (DOT)
☐ Pack for Shipping via *air carrier* (IATA)
☑ Temperature Blank (*circle one:* 120-mL OR 500-mL)
☐ Soil VOA Trip Blank - Lot#:
☐ Water VOA Trip Blank - Lot#:
☐ 524 VOA Trip Blank - Lot#:
☐ Low Level Mercury Trip Blank- Lot#:
☑ Coolers
☑ Gel Ice (*circle one:* in each cooler OR in a separate cooler)
☑ Bubble Wrap
☑ Labels
☑ Custody Seals
☑ SGS COCs (**Remember: 1 COC/10 sample**) ☐ Blank COC ☐ DW COC ☑ COC initiated by PM (attached) ☐ COC provided by client
☐ Send additional instructions/documents (*Note to PM: Be sure to attach copy of requested form.*)

☐ Total # includes bottles for % Solids
☐ Track all Lot#s
☐ Foreign Soil
☐ Pack similar bottles together OR custom packing (*circle one*)

Other Notes/Reminders for Kit Prep:

Attention Client/Sampler:

1. Do not rinse container before filling and be aware of any acid preservative in container.
2. Fill container to top, but do not overfill (except volatiles which should be headspace free).
3. Label the container with your sample/site ID, as well as the date & time of collection.
4. Fill in the Chain of Custody.
5. Add frozen gel packs or ice to your cooler & pack to prevent breakage.

Charges may be invoiced for bottles which are unused or improperly used.
If you have any questions concerning this sample kit, please contact your Project Manager for assistance. ***Thank you.***

SGS

e-SAMPLE RECEIPT FORM

1170417	1 1 7 0 4 1 7

Review Criteria	Y/N (yes/no)	Exceptions Noted below
		Y exemption permitted if sampler hand carries/delivers.
Were Custody Seals intact? Note # & location		ABSENT
COC accompanied samples?	Y	
Y **exemption permitted if chilled & collected <8hrs ago or chilling not required (i.e., waste, oil)		

Temperature blank compliant* (i.e., 0-6 °C after CF)?	Y/N	Cooler ID	Temp	Therm ID
	N	Cooler ID: 1	@ 10.0 °C	Therm ID: D20
		Cooler ID:	@ °C	Therm ID:
		Cooler ID:	@ °C	Therm ID:
		Cooler ID:	@ °C	Therm ID:
		Cooler ID:	@ °C	Therm ID:

If >6°C, were samples collected <8 hours ago?	Y	
If <0°C, were sample containers ice free?		
If samples received without a temperature blank, the "cooler temperature" will be documented in lieu of the temperature blank & "COOLER TEMP" will be noted to the right. In cases where neither a temp blank nor cooler temp can be obtained, note "ambient" or "chilled".		
Note: Identify containers received at non-compliant temperature. Use form FS-0029 if more space is needed.		
		Note: Refer to form F-083 "Sample Guide" for hold times.
Were samples received within hold time?	Y	
Do samples match COC** (i.e.,sample IDs,dates/times collected)?	Y	
**Note: If times differ <1hr, record details & login per COC.		
Were analyses requested unambiguous?	Y	
		Y ***Exemption permitted for metals (e.g.200.8/6020A).
Were proper containers (type/mass/volume/preservative***)used?	N	Lab Filter for Dissolved Metals.
IF APPLICABLE		
Were Trip Blanks (i.e., VOAs, LL-Hg) in cooler with samples?		
Were all VOA vials free of headspace (i.e., bubbles ≤ 6mm)?		
Were all soil VOAs field extracted with MeOH+BFB?		

Note to Client: Any "no" answer above indicates non-compliance with standard procedures and may impact data quality.

Additional notes (if applicable):

SGS

Sample Containers and Preservatives

Container Id	Preservative	Container Condition	Container Id	Preservative	Container Condition
1170417001-A	H_2SO_4 to pH < 2	OK			
1170417001-B	No Preservative Required	OK			
1170417001-C	No Preservative Required	OK			
1170417001-D	HNO_3 to pH < 2	PA			

Container Condition Glossary

Containers for bacteriological, low level mercury and VOA vials are not opened prior to analysis and will be assigned condition code OK unless evidence indicates than an inappropriate container was submitted.

OK - The container was received at an acceptable pH for the analysis requested.
BU - The container was received with headspace greater than 6mm.
DM- The container was received damaged.
FR- The container was received frozen and not usable for Bacteria or BOD analyses.
PA - The container was received outside of the acceptable pH for the analysis requested. Preservative was added upon receipt and the container is now at the correct pH. See the Sample Receipt Form for details on the amount and lot # of the preservative added.
PH - The container was received outside of the acceptable pH for the analysis requested. Preservative was added upon receipt, but was insufficient to bring the container to the correct pH for the analysis requested. See the Sample Receipt Form for details on the amount and lot # of the preservative added.

SECTION E

TERRASAT, INC.
4203 Iowa Drive Ave. Anchorage, AK 99517 (907) 344-9370 fax (907) 344-1490
Geological Consulting **Environmental Restoration** **Regulatory Compliance**

Evaluation of the Distribution of Nitrates in Local Water Wells Surrounding the Lewis and Clark Subdivision

Prepared for:
Big Country Enterprises, LLC.

Prepared by:
TERRASAT, Inc.
4203 Iowa Drive
Anchorage, AK 99517

January 12, 2017

Contents

Figures

Tables

Appendix

1.0 INTRODUCTION

TERRASAT evaluated the concern that nearby subdivisions have significant nitrate problems in their aquifers. Two reports about nitrates exist for this area. Both reports state that nitrate levels are low and are not concerning. TERRASAT evaluated newer data from the Municipality of Anchorage. We found low levels of nitrate exist and that the newer data is consistent with the previous reports. We found that nitrate concentrations increased in some subdivisions and decreased in others. The rates of increase are low and consistent with past information. The proposed Lewis and Clark subdivision, Figure 1, will use nitrate reducing systems. A fate and transport evaluation was completed with the results presented in the TERRASAT report "Ground Water Resource Evaluation for the Proposed Lewis and Clark Subdivision". The results suggest nitrates will be below the detection level at the subdivision boundary.

2.0 METHODS AND DATABASES

Nitrate data was sometimes segregated into the subdivision level to create averages or trends for water quality. Figure 2 shows the approximate one-half mile distance marker outward from the Lewis and Clark site boundaries. Figure 2 shows the 124 water well locations used in the study.

TERRASAT used data from previous studies of the same area to compare nitrate trends by adding and comparing new data from the same locations to create up to date trend lines. Unfortunately, the most comprehensive study, "Status of Anchorage Hillside Well Water: Nitrates Study" (Moore *et al.*, 2011), had map locations that were different than their graphs. TERRASAT compiled MOA data to determine long-term trends. Therefore, we were able to obtain meaningful results despite the inaccurate well locations of the Moore *et al.*, 2011 report.

2.1 MOA On-Site Services (COSA)

TERRASAT compiled water quality data from the Municipality's COSA database. The data was evaluated and interpreted with geospatial techniques and statistical procedures to determine long-term trends.

2.2 Previous Studies

Two previous nitrate studies were evaluated to determine if long term trends of nitrate concentrations remained constant or were different. Specifically, the papers [1]Montgomery Watson, 2000 and Moore *et al.*, 2011 were reviewed for nitrate trends. After

[1] Local Wellhead and Aquifer Protection Study Phase II, June 2000, Montgomery Watson

review, it was found that the Moore *et al., 2011* study data was limited in its usability due to errors in mapping some of the data locations.

Nonetheless, TERRASAT used available data, up to the most current, to analyze trends and averages of nitrates for private and public wells in the study area, some of which were also included in the previous studies mentioned above.

2.3 ADEC Drinking Water Program

The ADEC Drinking Water Program include a database and maps of well locations, and through its Drinking Water Watch program it provides water quality information for public water wells in the State. TERRASAT used this web accessed database to review water quality for public wells within one-mile of the Lewis and Clark subdivision.

2.4 GIS

Elevations shapefiles, data conversions, proportional displays, and other mapping were all created in ESRI GIS mapping software. This software allowed interpretations and displays of pertinent data to be presented in a graphical display that portrays the pertinent information contained in tabulated spreadsheets. Nearly all of the major findings of this report are displayed in some form in GIS format. Microsoft Excel and SPSS software were used to interpret trends.

3.0 WATER QUALITY AND CONDITIONS IN THE LOCAL AREA

The water quality and aquifer conditions of neighboring properties were used to evaluate water quality trends (for nitrates) where possible in subbasins surrounding the Lewis and Clark Subdivision.

3.1 Results of Previous Studies

Montgomery Watson, 2000, investigated the occurrence of nitrates in an area across the Anchorage Hillside. They found that "fewer than 2% of the records in the database exceeded the State of Alaska Drinking Water Standard of 10 mg/liter nitrate-nitrogen" (Montgomery Watson, 2000, pg. ES-2). They also calculated nitrate trends for various areas of the Hillside.

Montgomery Watson 2000, pg. ES-3, selected an area of 118 acres near the intersection of DeArmoun and Hillside Drive to conduct a pilot study. They found a poor statistical correlation between levels of nitrates and:

- Well depth
- Casing depth
- Distance between well and septic field within a lot
- Well yield

- Lot bedroom count
- Soil absorption rating
- Sum of bedrooms within a 1,000 foot radius of a well
- Bedrock depth
- Static water level
- Terrain units

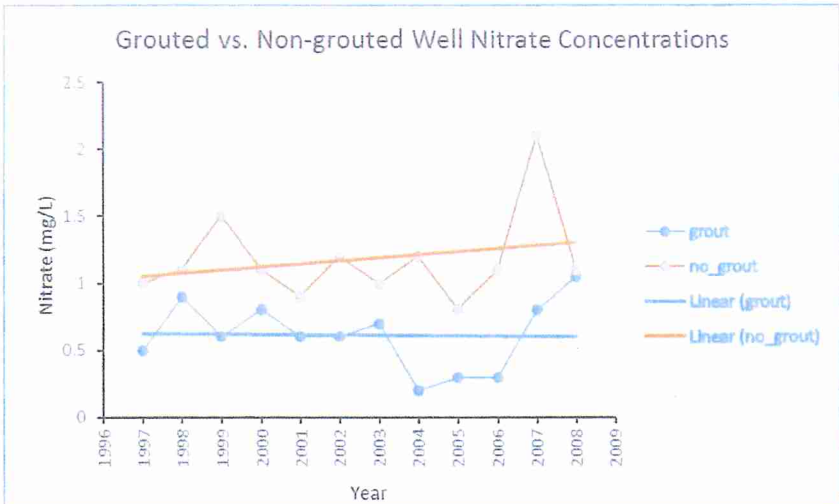
Montgomery Watson, 2000, pg. ES-3 evaluated a conceptual model of:

- Bedrock slope
- Bedrock aspect
- Water table depth
- Well depth

Their evaluation of the above criteria found no insight for the cause(s) of nitrate occurrences in the DeArmoun area.

Moore *et al.*, 2011, analyzed nitrate data "from single family and public-supply wells on the Anchorage Hillside" (pg. 1). Their report "concludes that the long-term viability of on-site wastewater systems on the Anchorage Hillside is not significantly diminished on the basis of existing nitrate trends and concentrations". They also concluded that a simple correlation does not appear to exist between septic systems usage and the occurrence of nitrates on the Anchorage Hillside.

Moore et al., 2011, pp. 23-24, compared nitrate concentrations in wells drilled before MOA grouting standards were implemented with wells constructed after grouting standards were implemented. They found the median nitrate concentration of wells pre-grouting was 1.5 mg/liter *vs.* 0.1 mg/liter for wells drilled post-grouting standard. They also plotted nitrate concentrations by year from 1997 to 2008 for wells drilled before grouting standards and wells drilled after the grouting requirements. The trend of nitrate concentrations in the wells drilled before grouting standards shows an increase since 2008. Wells constructed after grouting standards showed a neutral (flat) trend without increasing. The graph below depicts the trends of nitrate concentrations of non-grouted and grouted wells as reported in the Moore *et al.*, 2011 report.



3.2 Nitrate Trends of Private Wells

TERRASAT analyzed nitrate averages and trends for 124 private residential water wells in the area surrounding the Lewis and Clark subdivision. The data for some wells in the study area was not accessible or searchable by subdivisions or other criteria in the available web databases used in this study and therefore some wells that likely do exist within one-half mile of Lewis and Clark are not included. Thirty-eight individual wells had sufficient data to plot trends while 88 wells had at least one nitrate test result. An average was also calculated from 38 of the 88 wells, those with two or more test results. Appendix A contains spreadsheets of the data for the 124 wells used in this study.

TERRASAT found that:

- Nitrate trends showed increases for most wells that lie directly west of Lewis and Clark, while
- nitrate trends decreased or remained stable (flat) for most wells north and east of the project area.

The area directly south of Lewis and Clark is undeveloped and only a few wells southwest of Lewis and Clark were used in the study. Figure 3 shows the average or one-time nitrate test results for 88 of the 124 individual wells. Where the results were averaged, data may have been from the same decade. The average or one time only nitrate test results ranged from 0.01 mg/L (not detected above the detection limit) to 9.7 mg/L. The Alaska Department of Environmental Conservation, Drinking Water Program, considers nitrate levels of 10.0 mg/L or above to be potentially harmful to human health.

Trends or averages were more accurately calculated or plotted for subdivisions than for individual wells, as the amount of data was greater when combining all wells within a subdivision. Both nitrate trends and nitrate averages were calculated after combining the results into four decades: the 1980's, 1990's, 2000's, and 2010's, and averaging each decade if more than one test was conducted in any decade. The overall average included information from all decades where it was available. This was not possible for most of the individual wells as insufficient data were available. Trends for the ten subdivisions where the analyses were able to be conducted are shown in Figure 4, which contains ten separate graphs with trendlines.

Table 1 lists the relationship between the trend and average level of nitrates for the ten area subdivisions with data for both criteria. Of particular relevance to the Lewis and Clark development are the Grecian Hills and Terrace Hts. Subdivisions, both having an upward trend, but both with very low (1.0 mg/L – Grecian Hills) or low (2.4 mg/L Terrace Hts.) average nitrate results. Other examples are Sunshine Acres with an upward trend and a very low average of 0.6 mg/L and Mountain Shadows with a downward trend but with a relatively high nitrates average of 5.9 mg/L.

Table 1 Trend and Average Nitrate of Ten Subdivisions

Subdivision	Trend	Average (mg/L)
Aspen Highlands #1	Downward	2.6
Bonnie View	Flat	2.5
Grecian Hills	Upward	1.0
Kemp	Downward	1.9
Mountain Park Estates #2	Upward	3.4
Mountain Shadows	Downward	5.9
Spendlove View Hts. #1	Downward	2.0
Spendlove View Hts. #3	Downward	0.6
Sunshine Acres	Upward	0.6
Terrace Hts.	Upward	2.4

The Figure 4 graphs are scatter charts, with the same scale. Figure 5 shows nitrate averages for 16 of the subdivisions that had at least one decade of test results with two or more nitrate test results. As with the individual wells, not all subdivisions had sufficient data to create trends or averages.

- The average nitrate levels ranged from a low of 0.30 mg/L for the South Hills and Blue Skies #3 subdivisions to a high of 5.90 mg/L for the Mountain Shadow subdivision.

3.3 Nitrate Trends of Public Wells

TERRASAT reviewed nitrate test results of the following four public wells within one mile of Lewis and Clark: Chapel of the Cross, Greenbrook S/D, Sun Valley Hts. North, and Sun Valley Hts. South. Figure 6 shows the location of these four public wells used in this study. Figure 7 shows the plots of trend of nitrate levels with the available data that is up-to-date. Note that these results are for Nitrate only. Test for Nitrite and for Nitrate/Nitrite were also conducted at non-specific times for each of the wells, however since test methods are not the same for all three tests, only Nitrate data was used. In particular, Nitrates data for Sun Valley Hts. North and Sun Valley Hts. South was available only up to 2009, while there were some Nitrite or Nitrate/Nitrite tests done after that.

The trends for nitrates in these wells show gentle to moderate upward trends for all except Sun Valley Hts. North. Those well results were not only lower on average, but also had a slightly upward trending but nearly flat trendline. The Sun Valley Hts. North trendline was based on only seven test results, while the other three public well trendlines contained from 20 to 30 test results. Figure 8 shows the average nitrates levels for the four public wells. The average nitrate levels ranged from a low of 1.18 mg/L for the Sun Valley Heights North locations to a high of 5.17 mg/L for the Chapel of the Cross location.

4.0 SITE TOPOGRAPHY

Figure 9 shows the topography of the Lewis and Clark site area.

- Note that the average surface gradient for the entire site is 0.13
- with a downgradient general direction of southwest.

Water table gradients generally follow surface topography. As wells are completed at the site, the water table and the potentiometric surface of the static water level from confined aquifers will likely be measured.

The main conclusions that can be made after viewing Figure 9 are:

- Much of the total area of Lewis and Clark is situated down-gradient from adjoining subdivisions in the area. This means that concerns of nitrates or contaminants migrating from Lewis and Clark onto adjoining properties is extremely unlikely regarding those up gradient properties.

- There are some properties that lie in a cross-gradient attitude in relation to Lewis and Clark. Those, as seen in Figure 5, are Foreland View, Engle, Terrace Heights, and Grecian Hills. Based solely on its topographical profile relative to the other subdivisions, and the properties of surface and ground water movement, the migration of nitrate and other contaminants from Lewis and Clark to other properties is highly unlikely.

- The only adjoining subdivisions situated down-gradient of Lewis and Clark are portions of Grecian Hills and South Hills subdivisions. Because of this, it is possible that they might receive surface or groundwater migrating from Lewis and Clark.

- Fortunately, however, no contaminants of concern have the ability to move the distances required to migrate to downgradient or cross-gradient properties before they are either stopped by attaching to soil particles or their concentration levels are far below those considered harmful to human or aquatic life.

before they are either stopped by attaching to soil particles or their concentration levels are far below those considered harmful to human or aquatic life.

5.0 CONCLUSIONS

Montgomery Watson, 2000, evaluated nitrate concentrations on the Anchorage Hillside. They found nitrate concentrations decreased in some areas and had a slight increase in other areas. They were unable to find a statistical correlation with the occurrence of nitrate and features that they evaluated.

Moore *et al.* 2011, concluded that the long-term viability of septic systems is not diminished by the occurrence of nitrate in water wells on the Anchorage Hillside. They also found that increasing trends in nitrate concentration were low rates, consistent with the Montgomery Watson 2000 investigation.

Moore *et al.* 2011, page 24, found that wells constructed in bedrock after grouting standards were implemented had one tenth the concentration of wells drilled before grouting standards (0.1 mg/L). They also found that the newer wells showed no increase in concentration over time. TERRASAT concludes that properly grouted wells in the Lewis and Clark Subdivision will protect groundwater supplies both in this subdivision and the surrounding subdivisions.

TERRASAT evaluated the concern that nearby subdivisions have a significant nitrate problem in their aquifers. Two reports about nitrates exist for this area. Both reports state that nitrate levels are generally low and are generally not concerning. TERRASAT evaluated newer data from the Municipality of Anchorage. We found low levels of nitrate exist and that the newer data is consistent with the previous reports. We found that nitrate concentrations increased in some subdivisions and decreased in others. The rates of increase are low and consistent with past reported information. The proposed Lewis and Clark subdivision is unlikely to add to existing conditions because the subdivision will use nitrate reducing systems, because groundwater recharge is from areas east and south of this subdivision, and because new water wells will be grouted according to the MOA requirements.

Prepared By:	Approved By:
Steven Smith	Dan Young
Steven Smith Project Environmental Scientist	Dan Young Principal, CPG, #7811

Figure 1
Location of the Lewis and Clark Development
on the Hillside Area of Anchorage

By: Terrasat, Inc.
Date: 10/4/2016

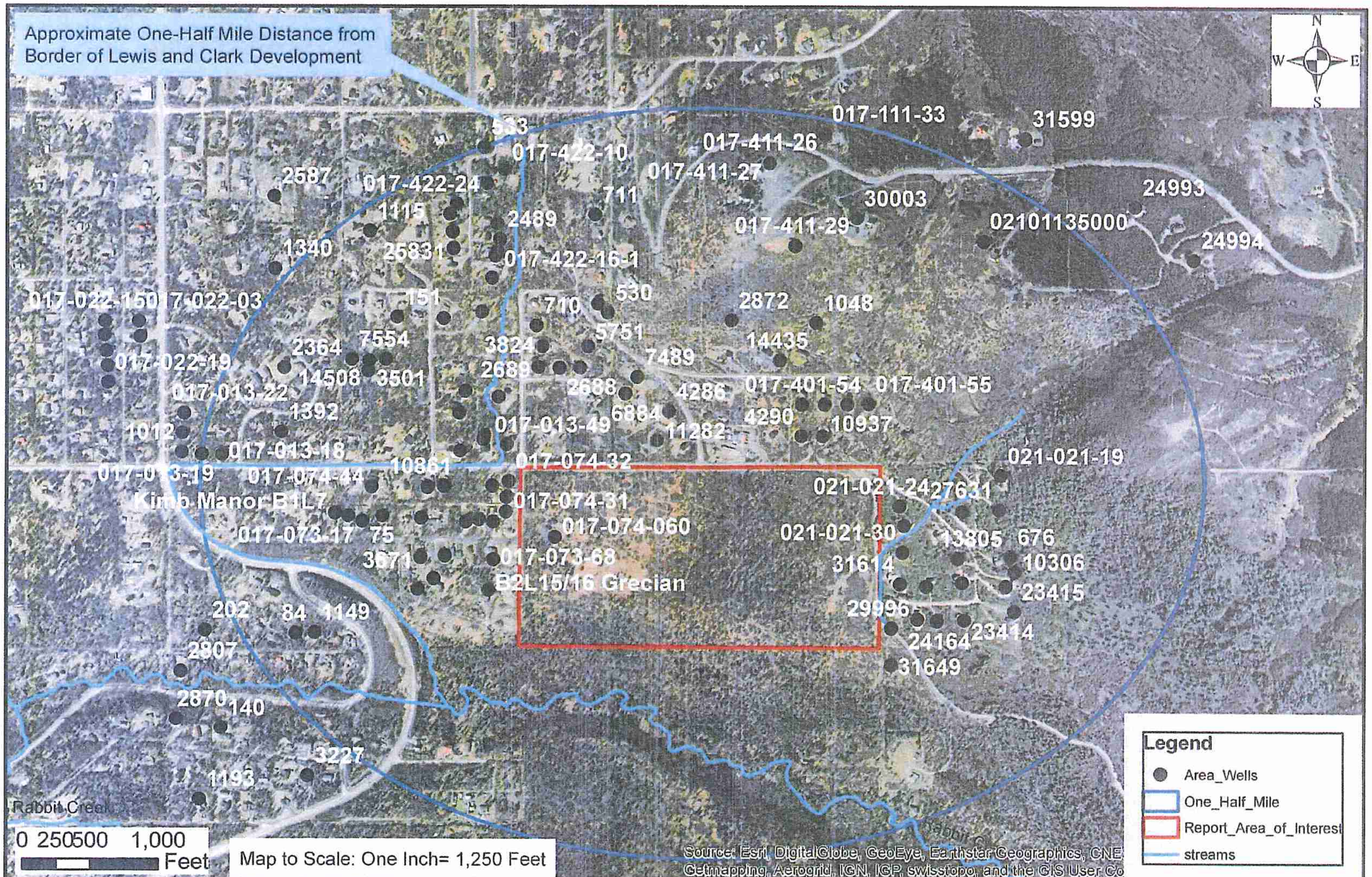


Figure 2.
Locations of Area Water Wells within One-half Mile Distance from Lewis and Clark Development

By: Terrasat, Inc.
Date:10/4/16

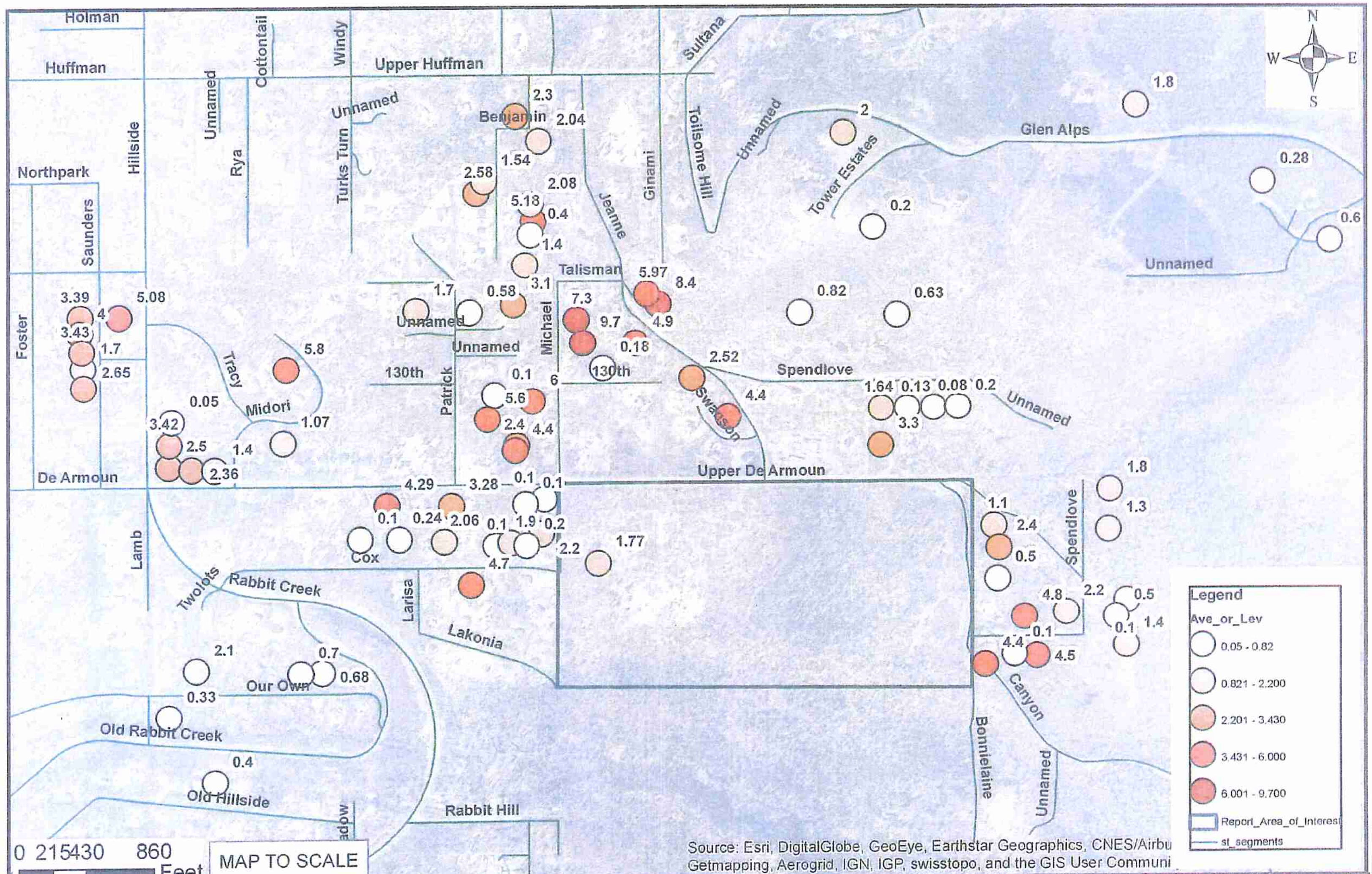
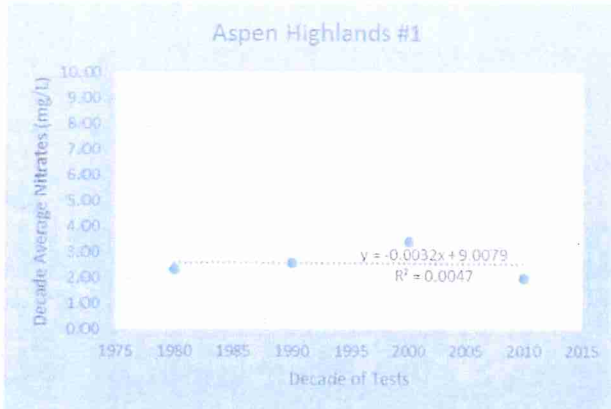


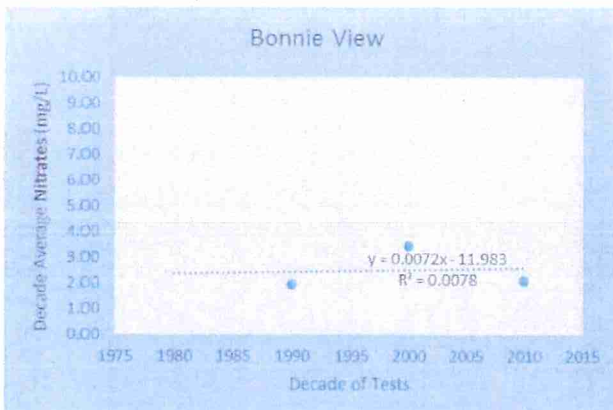
Figure 3
Nitrate Averages or Levels in 80 of 124 Individual Wells within One-half Mile of Lewis and Clark

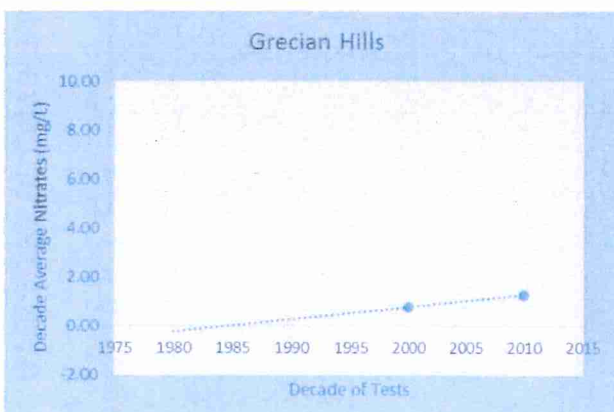
For: Big Country Enterprises LLC.

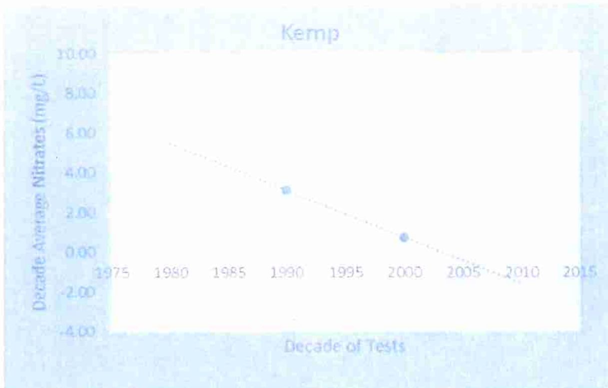
By: SCS
Terrasat, Inc.
Date: 10/4/16

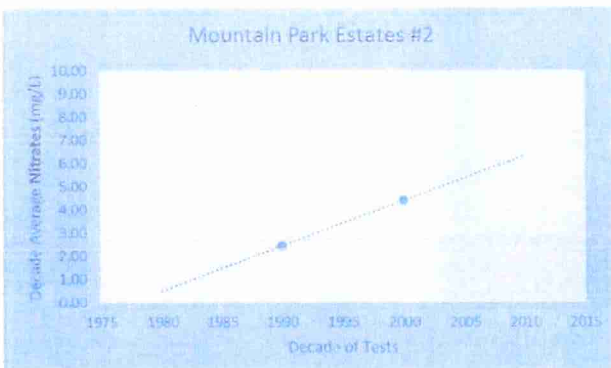
Figure 4. Nitrate Trend Plots of Area Subdivisions

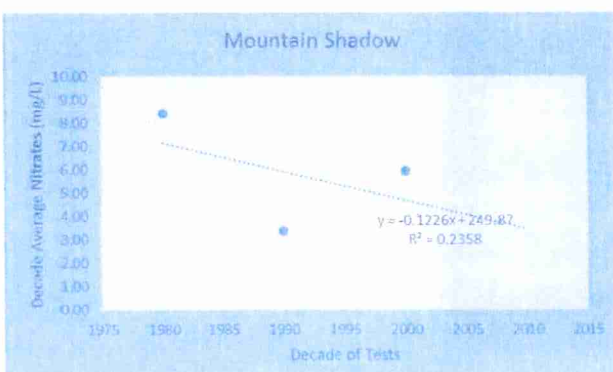




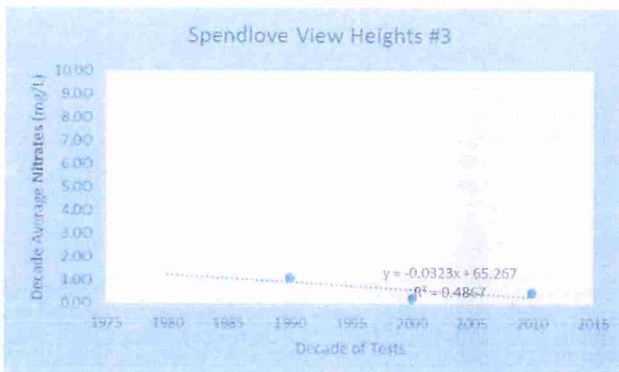


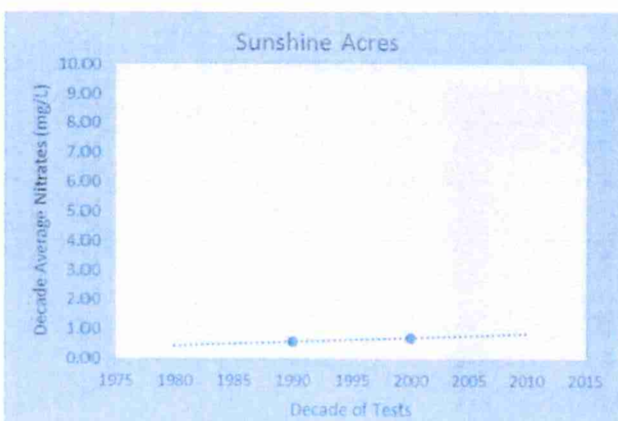

Kemp
Decade Average Nitrates (mg/L)
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
1975 1980 1985 1990 1995 2000 2005 2010 2015
Decade of Tests

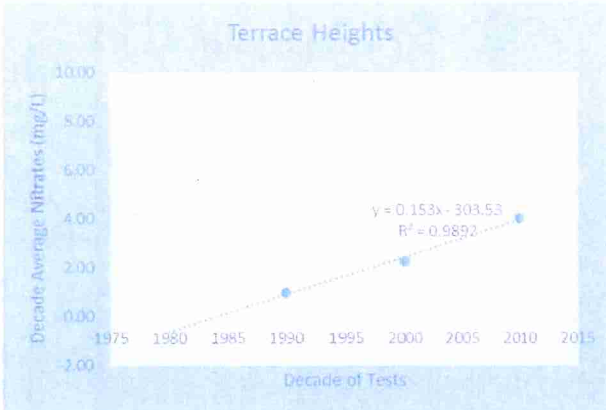

Mountain Park Estates #2
Decade Average Nitrates (mg/L)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1975 1980 1985 1990 1995 2000 2005 2010 2015
Decade of Tests


Mountain Shadow
Decade Average Nitrates (mg/L)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
y = -0.1226x + 249.87
R^2 = 0.2358
1975 1980 1985 1990 1995 2000 2005 2010 2015
Decade of Tests


Spendlove View Heights #1
Decade Average Nitrates (mg/L)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
y = -0.0699x + 141.83
R² = 0.4866
1975
1980
1985
1990
1995
2000
2005
2010
2015
Decade of Tests


Spendlove View Heights #3
Decade Average Nitrates (mg/L)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
y = -0.0323x + 65.267
R² = 0.4867
1975
1980
1985
1990
1995
2000
2005
2010
2015
Decade of Tests


Sunshine Acres
Decade Average Nitrates (mg/L)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1975
1980
1985
1990
1995
2000
2005
2010
2015
Decade of Tests


Terrace Heights
Decade Average Nitrates (mg/L)
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
1975
1980
1985
1990
1995
2000
2005
2010
2015
y = 0.153x - 303.53
R² = 0.9892
Decade of Tests

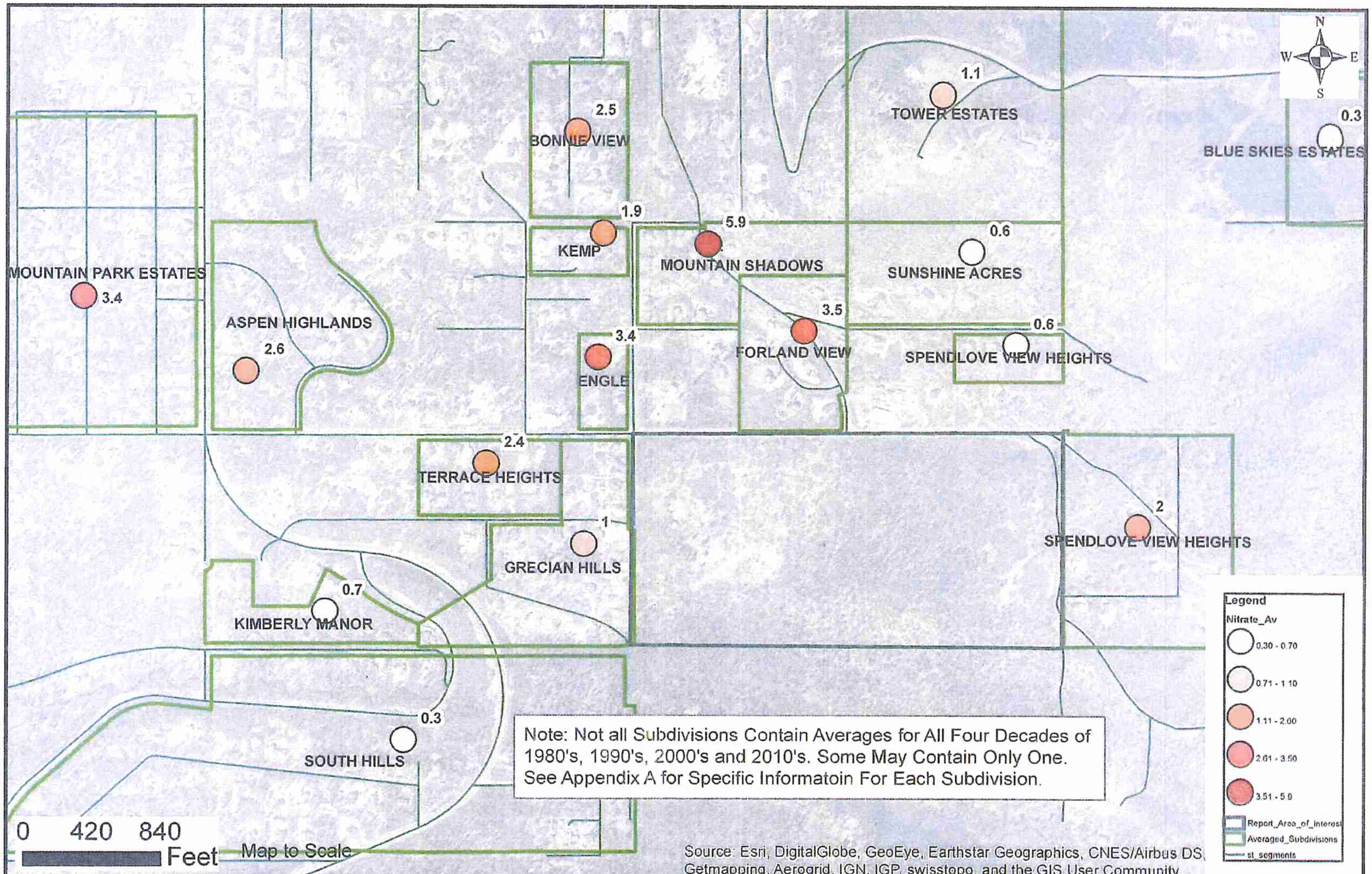


Figure 5 Nitrate Level Averages for 16 Subdivsions in the Area of Lewis and Clark.1980's to 2010's	For: Big Country Enterprises, LLC	By: Terrasat, Inc. Date: 9/19/16

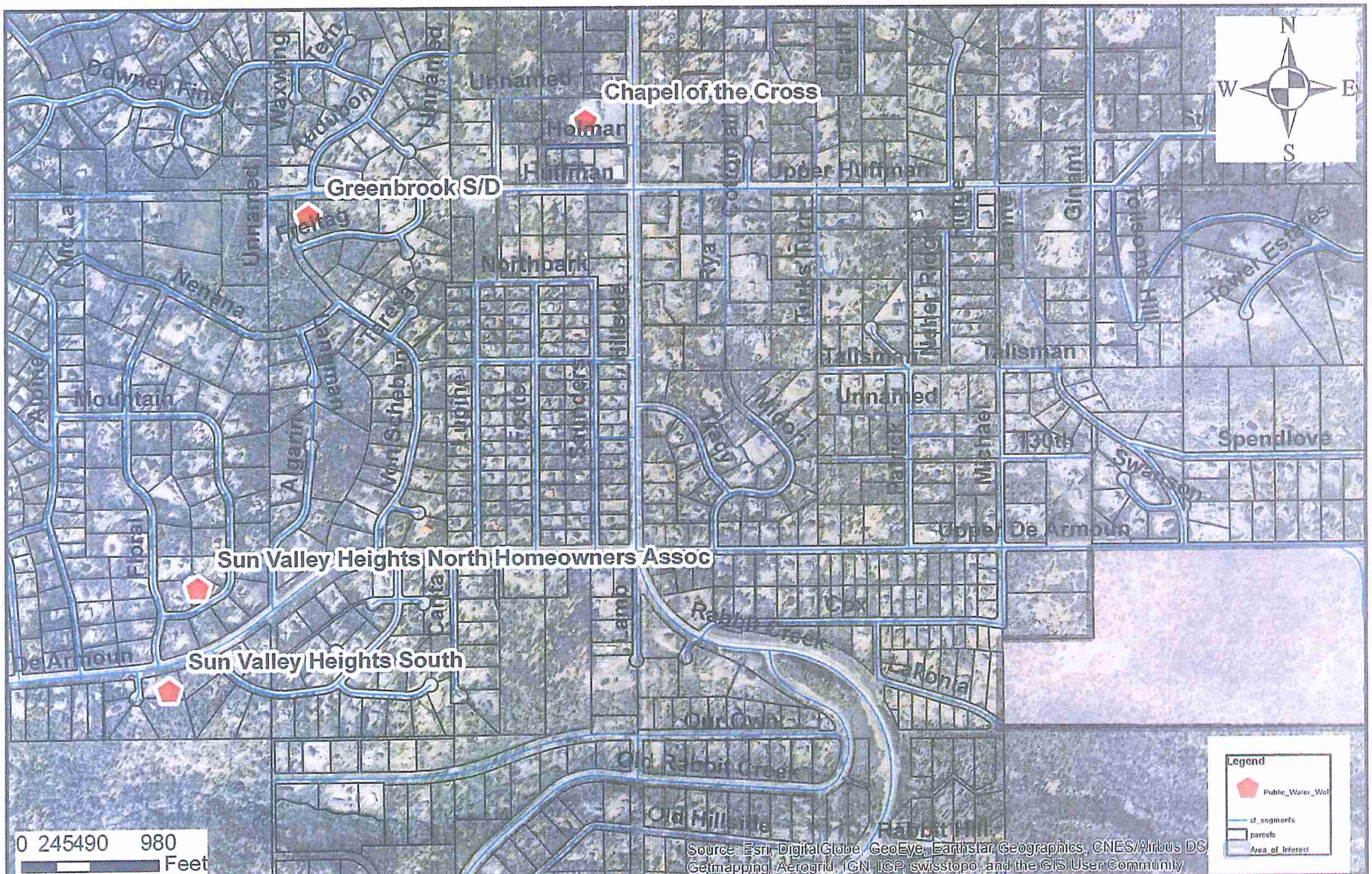
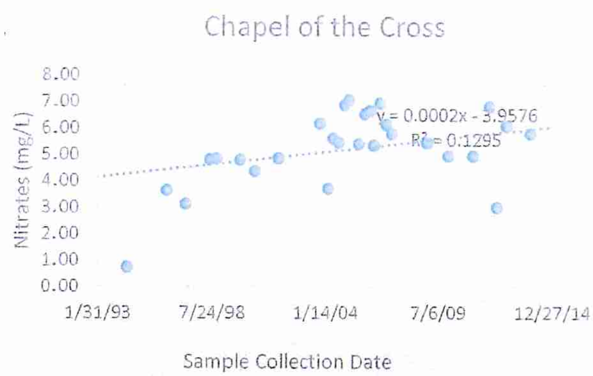
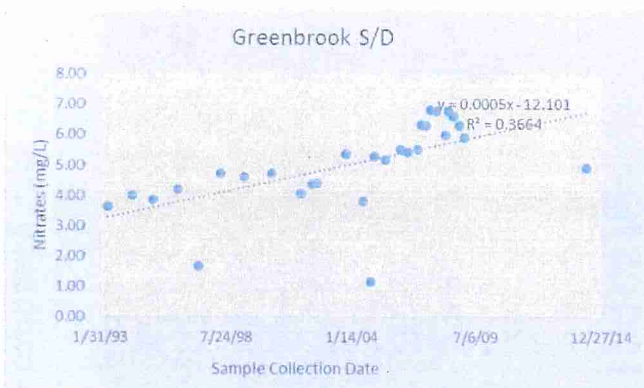
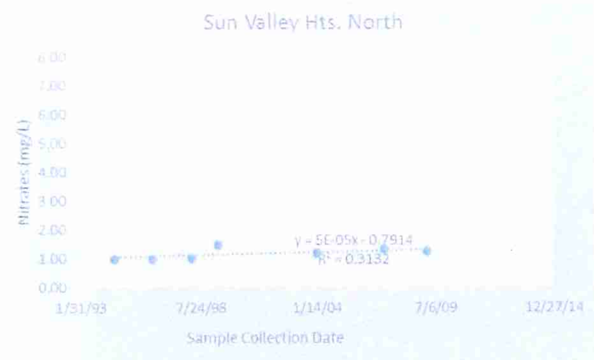


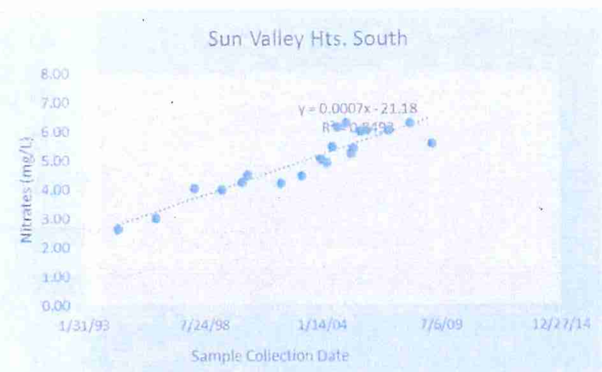
Figure 6 Public Water Systems within Approximately One Mile of the Lewis and Clark Development Area	For: Big Country Enterprises LLC.	By: SCS Terrasat, Inc. Date:9/26/16

Figure 7. Plots of Nitrate Trends for Four Public Wells






Sun Valley Hts. North
Nitrates (mg/L)
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
y = 5E-05x - 0.7914
R² = 0.3132
1/31/93
7/24/98
1/14/04
7/6/09
12/27/14
Sample Collection Date


Sun Valley Hts. South
Nitrates (mg/L)
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
y = 0.0007x - 21.18
1/31/93
7/24/98
1/14/04
7/6/09
12/27/14
Sample Collection Date

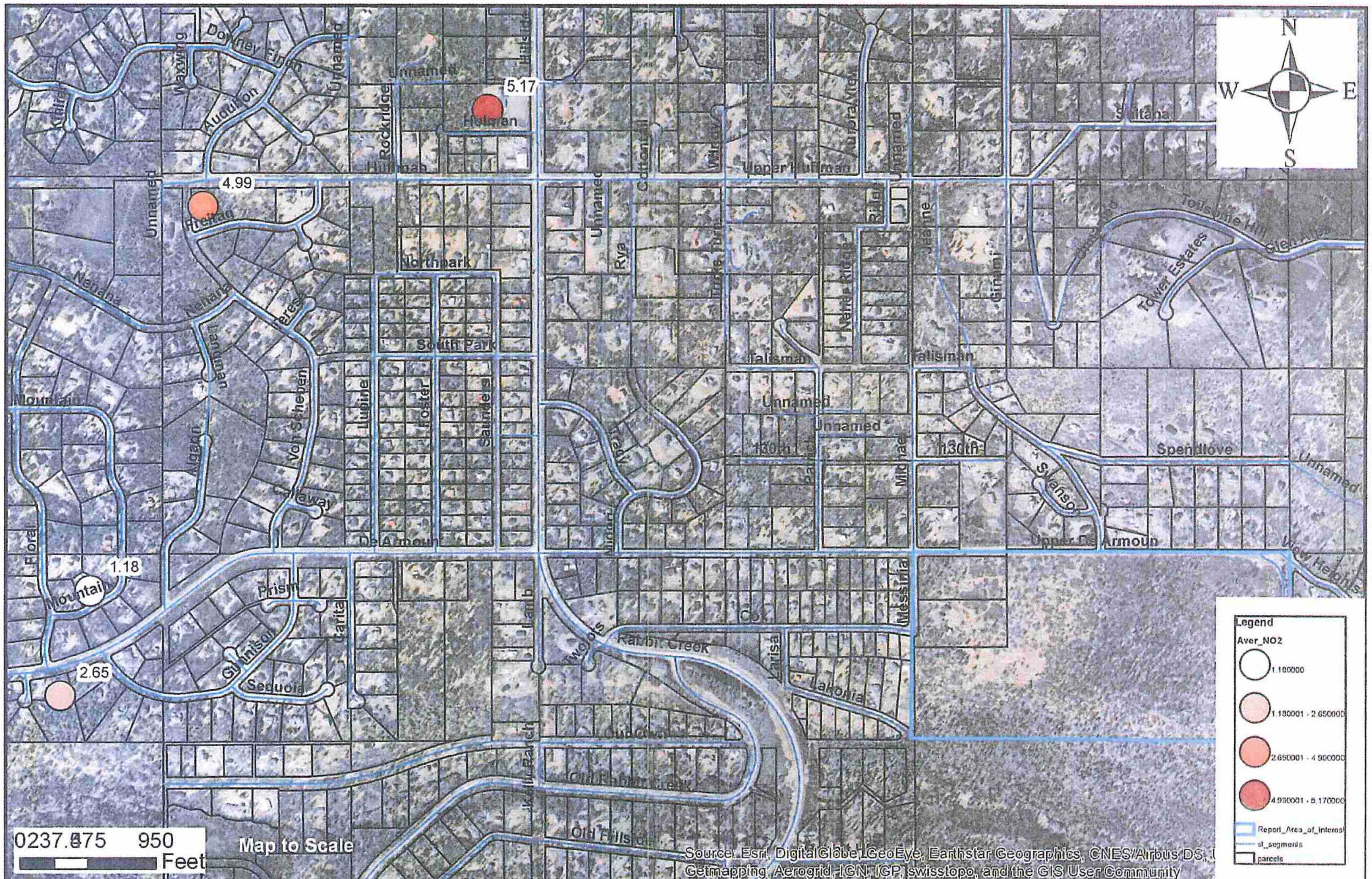


Figure 8 Average Nitrate Test Results for Four Public Wells in Study Area	For: Big Country Enterprises LLC.	By: SCS Terrasat, Inc. Date:9/26/16

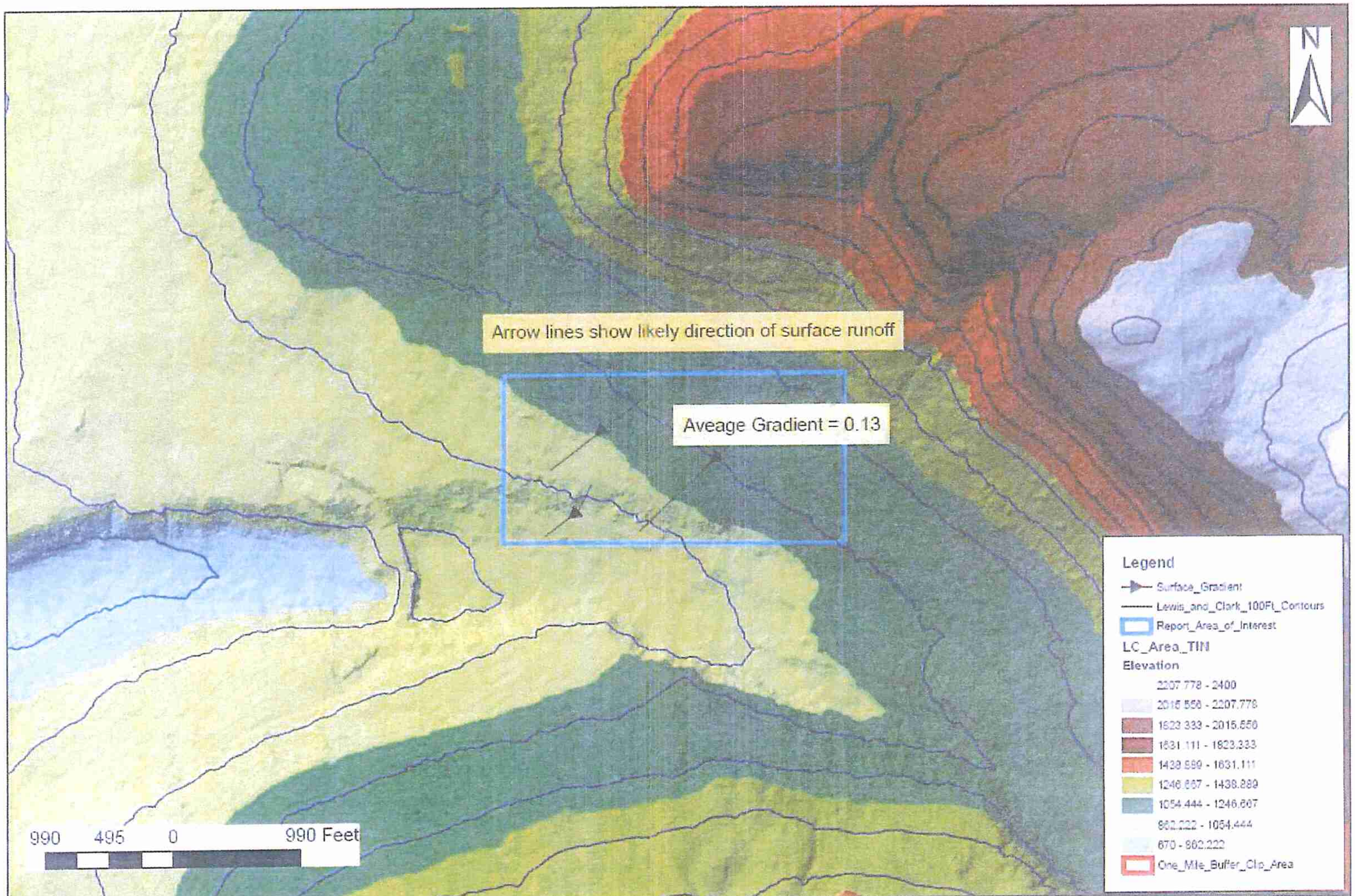


Figure 9
Shaded Relief Topographic Map that Shows the Elevational Position and Surface Gradient of the Project Area

For: Big Country Enterprises, LLC.

By: SCS
Terrasat, Inc.
Date:10/11/16

SECTION F

LEWIS & CLARK SUBDIVISION

PRELIMINARY DRAINAGE IMPACT ANALYSIS

Owner/Developer:

Big Country Enterprises, LLC

Prepared By:

TRIAD
ENGINEERING
P.O. Box 110890
Anchorage, Alaska 99511
(907) 561-6537

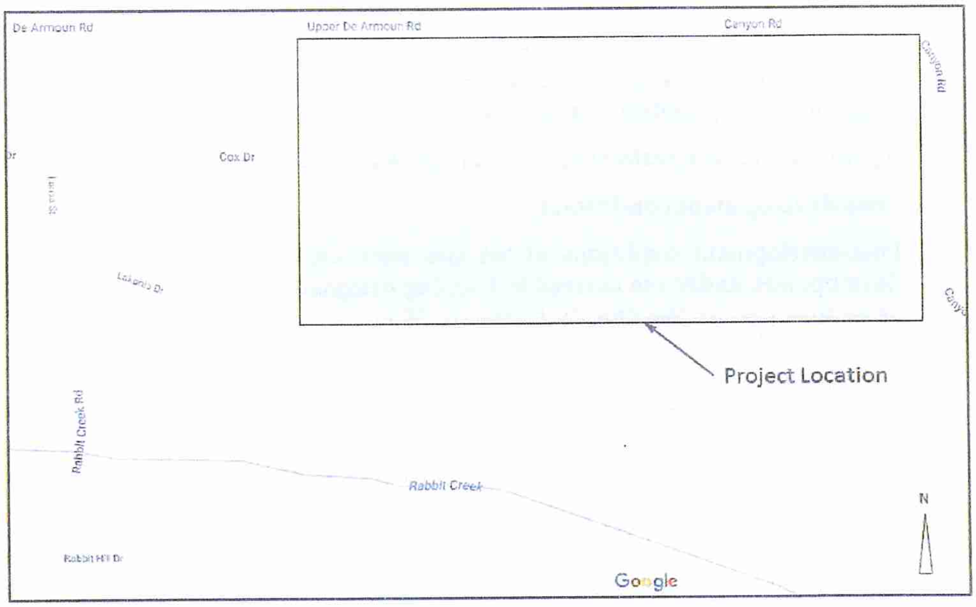
March 2017

Table of Contents

1. Project Description

a. Location

Lewis and Clark Subdivision is located south of Upper DeArmoun Road and west of Canyon Road within the upper hillside area of Anchorage, Alaska. See the location map, below. Based on the geographic location of the site, a 2.0 orographic factor was used for this analysis (map attached in the Appendix).



Lewis and Clark Location Map

b. Project Description

This project intends to rezone the existing R-8 designation to R-6 and develop the 79-acre parcel with residential, single-family housing. The pre-development conditions will be analyzed and compared to post-development conditions with a 30-lot R-6 and a 15-lot R-8 development. The project area is currently heavily vegetated with mature trees and brush. Proposed road improvements have not been finalized but would consist of strip paved roads with roadside ditches to provide vehicular access to the residential lots.

c. Analysis Description

The primary purpose of this analysis is to quantify pre and post development flow rates and determine the additional runoff generated by increasing the parcel density from R-8 to R-6. Therefore, an analysis was completed for both the 10-year and 100-year storm events. Regardless of whether the site is developed under an R-6 or R-8 zoning designation, it must be able to safely convey the 10-year storm event as well as limit flood risk and downstream impacts to neighboring properties during the 100-year event.

2. Basin Characterization

a. Pre-development conditions

The existing parcel is primarily undeveloped and heavily vegetated. There is one single family home in the northwest corner of the property. No underground storm drain facilities exist in the immediate vicinity of the project, and runoff in the area is conveyed with constructed drainage ditches and natural drainage ways.

On site drainage generally flows in a southwesterly direction via existing drainage ways that outfall to Rabbit Creek, south of the project. The slopes across the majority of the parcel are in the range of 5-20%. See Section 2.c. for the condition of the contributing offsite drainage area.

A pre-development watershed map is included in the report Appendix.

b. Post-development conditions

Post-development conditions of the site were modeled under two scenarios: 1) development under the current R-8 zoning designation and 2) if it is re-zoned and developed with an R-6 density, limited to 30 lots.

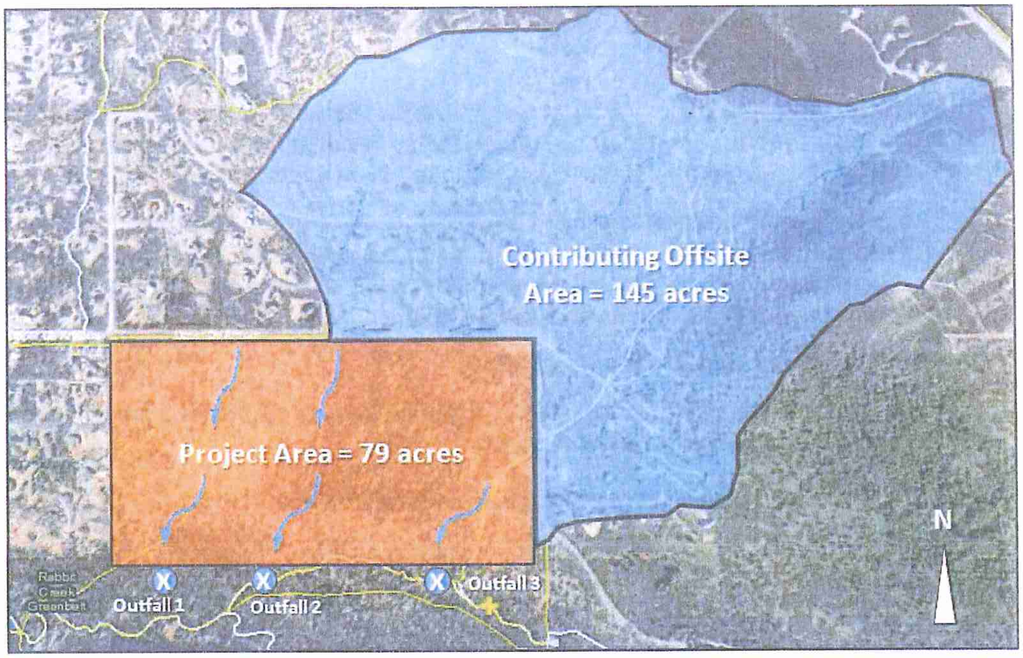
<u>R-8 Zoning</u>
If the development remains zoned as R-8, the site would be developed with access roads and approximately 15 single-family lots with an average size of approximately 5 acres per lot. This is based on the maximum density of 0.2 dwelling units/acre from Table 21.08-10 in Title 21.

<u>R-6 Zoning</u>
The maximum housing density for R-6 is 0.8 dwelling units/acre as shown in Table 21.08-10 of Title 21. This would allow for 61 lots if the project was developed with no special limitations. However, if the parcel is re-zoned to R-6, the total number of single-family lots is proposed to be limited to 30, this would result in an average lot size will in excess of 2 acres per lot. Under this development concept, the access road length is assumed to be slightly longer than for the R-8 development.

Under either scenario, drainage will continue to flow in a southwesterly direction through existing, MOA-identified drainage ways and outfall to Rabbit Creek.

c. Contributing offsite drainage

Approximately 145 acres to the northwest of the site drains into the project area. This is a significant area that contributes off-site runoff upstream of the project. The offsite area is partially developed with large-lot single-family homes and access roads. A significant portion of the offsite drainage area is undeveloped with woods and steep slopes up to 20%. Flows are captured by roadside ditches and two, 24" culverts cross DeArmoun Road and discharge this offsite runoff into the project area. These flows are conveyed through the site by natural drainage ways and outfall to Rabbit Creek. A watershed map is shown on the following page.



Lewis and Clark Contributing Drainage Map

The contributing offsite area is nearly double the size of the project area and generates significant flows that will need to be addressed in the final design of the subdivision.

d. Floodways, floodplains, and wetlands

No floodways or floodplains are known to exist within the project corridor. Approximately 8.5 acres of wetlands exist on site. See the report Appendix for wetland mapping.

e. Problem areas

Glaciation concerns are present within this site as is common within hillside developments in the Anchorage area. While generally hard to predict, glaciation tends to occur at locations of shallow subsurface water flow which can vary seasonally. This shallow flow can be drawn to the surface by cold temperatures during the winter months. As the shallow subsurface water daylights it freezes and causes glaciation. To combat this issue, known locations of shallow groundwater flow discovered during the future installation of the roadway improvements will be over excavated and the excavation lined with rock. This process further insulates the subsurface water from cold weather and keeps it in a thawed state below ground.

3. Pre-development Runoff Analysis

a. Watershed area

Six total sub-basins make up the watershed area analyzed within this report, three offsite and three on site. The three offsite basins result in a total impervious area of 9.4 acres; the remaining 135.6 acres was modeled as woods in good condition.

The project area includes approximately 70.3 acres of brush and trees modeled as woods in good condition. The single family homes, roadways, and paved driveways result in an impervious area of 0.2 acre and were modeled accordingly. The 8.5 acres of wetlands were also incorporated into the model.

b. Summary of pre-development runoff.

Totals provided in Table 1, below, are for the peak inflow, in cfs, for the summation of all contributing pre-development sub-basins.

Table 1: Pre-development Peak Runoff Rates

	10-Year [cfs]	100-Year [cfs]
Outfall 1	6.8	13.7
Outfall 2	13.5	34.4
Outfall 3	14.9	37.8

Pre development analysis calculations are located within the Appendix.

4. Post-development Runoff Analysis

a. Watershed area

Total overall watershed area does not change between pre and post development conditions and the number of sub-basins does not change. On site, the impervious area increases with the development of single family homes and access roads. Under R-8 zoning, fifteen, 5-acre lots could be developed. If re-zoned to R-6, the development would be limited to 30 lots with an average lot size exceeding 2 acres.

On a per lot basis, the impervious area was estimated at 5,000 square feet, and the grassed area was estimated at 10,000 square feet. 8.5 acres of wetlands are to be left undisturbed, and the remainder of the site was modeled as woods in good condition. See Table 1, below, for surface areas and type contributing to on site runoff.

Table 2: Post-development Drainage Surface Area

Zoning Designation	Impervious Area* [Acre]	Grassed Area [Acre]	Woods [Acre]	Wetlands [Acre]
R-8	2.6	3.3	64.6	8.5
R-6	4.8	6.9	58.8	8.5

***Includes houses, paved driveways and access roads**

For R-8 zoning, impervious area would make up 3.3% of the total 79 acres. The R-6 development would create an impervious area of approximately 6.1% of the total project area.

b. Summary of post-development runoff

Totals provided below are the summation of peak inflow, in cfs, for all post-development sub-basins.

Table 3: Post-development Peak Runoff Rates

	10-Year			100-Year		
	R-8 [cfs]	R-6 [cfs]	% Increase R-8 to R-6	R-8 [cfs]	R-6 [cfs]	% Increase R-8 to R-6
Outfall 1	12	12.9	7.0%	24.7	25.9	4.6%
Outfall 2	14.3	15.1	5.3%	33.6	34.7	3.2%
Outfall 3	12.9	13.7	5.8%	31.8	32.9	3.3%

Post development analysis calculations are included in the Appendix.

5. Conclusion

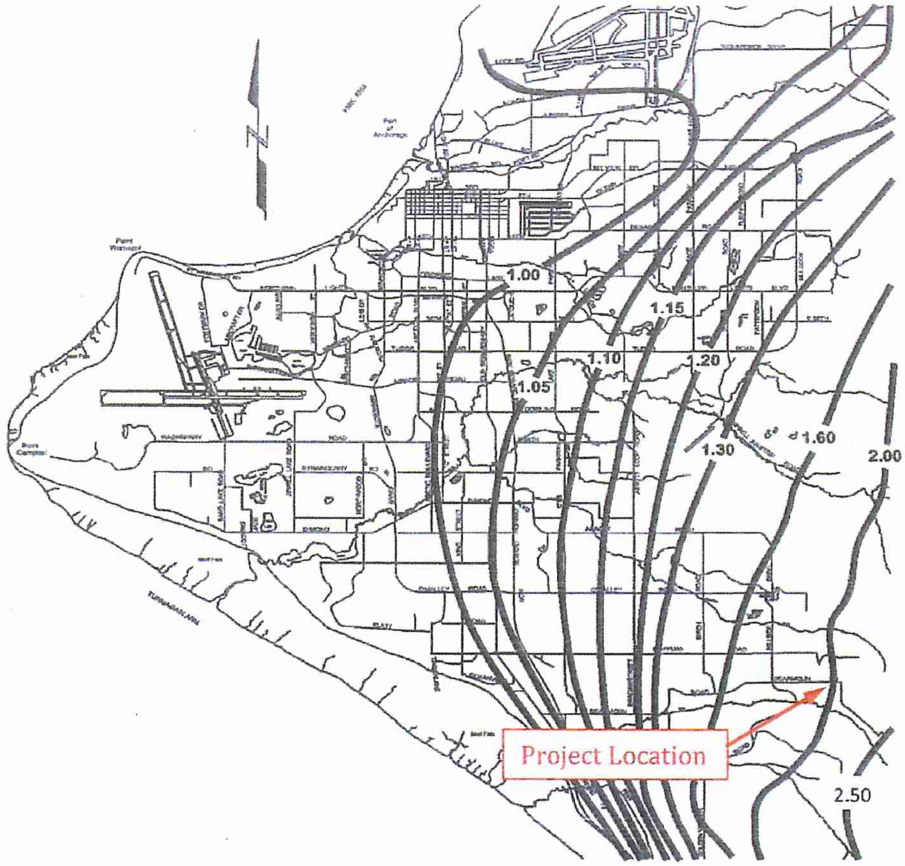
As mentioned in Section 2.c., one of the primary concerns for this development will be the contributing offsite runoff from properties to the north and east of the project. Area upstream of the project generates approximately half of the total runoff that flows through the site. This runoff will be collected and routed through vegetated drainage ways and directed to Rabbit Creek, closely matching the existing drainage path on site. No grading will be done outside of the property boundary, and MOA-identified drainage ways will remain in place downstream of the project. The overall existing drainage pattern of the surrounding area will not change or be negatively affected with the development of this parcel.

Increasing the density from R-8 to R-6 zoning (limited to 30 lots) creates a minimal change in peak runoff, with an increase in the range of 3-7%. This minor increase can be safely managed by sizing drainage ways and culverts accordingly. The increase in impervious area is also minimal, increasing from 3.3% impervious under R-8 zoning to 6.1% impervious with a 30-lot R-6 development.

As proposed, the project site will remain at a low density with an average lot size greater than 2 acres, with over 80% of the parcel predicted to remain as heavily vegetated brush and trees. Glaciation concerns will be addressed by keeping shallow ground water along the roadways below the ground surface. No adverse impacts to neighboring properties are anticipated under the proposed R-6 zoning designation and 30-lot limitation.

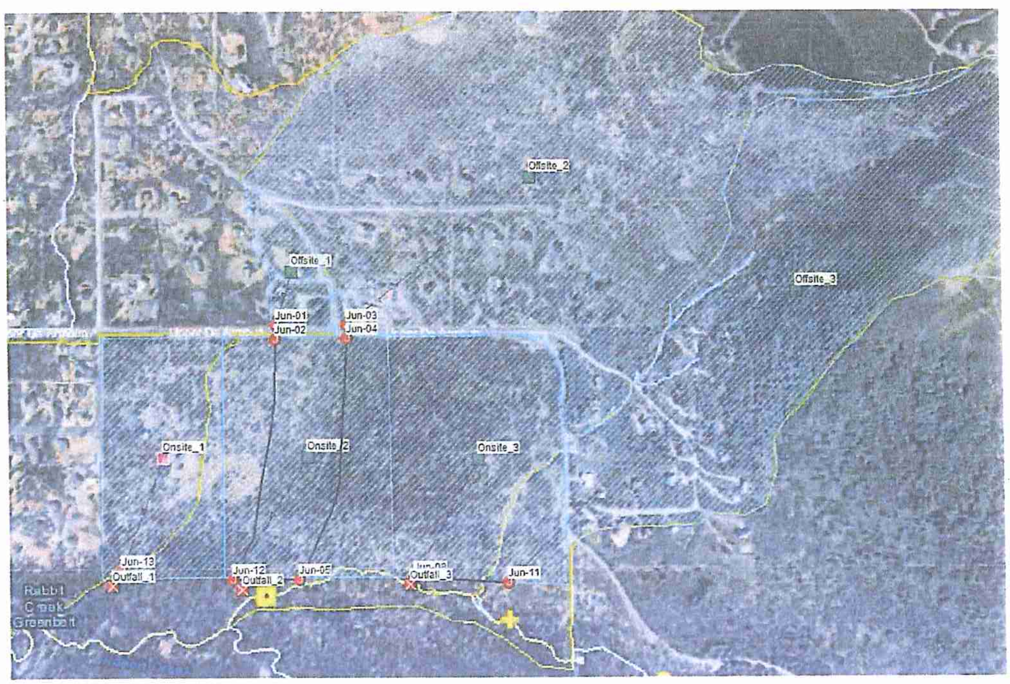
Appendix

a. Orographic Map



b. Pre-development Watershed Map

c. Post-development Watershed Map



d. Pre-development Calculations

10-Year, 24-Hour

```
******************** 
Project Description
********************
File Name ................. Lewis&Clark Predev III.SPF


****************
Analysis Options
****************
Flow Units ................ cfs
Subbasin Hydrograph Method. SCS TR-55
Time of Concentration...... SCS TR-55
Link Routing Method ....... Hydrodynamic
Storage Node Exfiltration.. Constant rate, free surface area
Starting Date ............. APR-13-2016 00:00:00
Ending Date ............... APR-14-2016 06:00:00
Report Time Step .......... 00:05:00


*************
Element Count
*************
Number of rain gages ...... 1
Number of subbasins ....... 6
Number of nodes ........... 12
Number of links ........... 9


****************
Raingage Summary
****************
Gage                Data                Data       Recording
ID                  Source              Type        Interval
                                                         min
--------------------------------------------------------------
Rain Gage           10 YR               CUMULATIVE      6.00


****************
Subbasin Summary
****************
Subbasin                 Total
                          Area
ID                       acres
------------------------------
Offsite_1                 5.20
Offsite_2               100.00
Offsite_3                40.00
Onsite_1                 15.00
Onsite_2                 28.00
Onsite_3                 36.00


************
Node Summary
************
Node                Element              Invert   Maximum    Ponded   External
ID                  Type              Elevation     Elev.      Area     Inflow
                                             ft        ft       ft²
--------------------------------------------------------------------------------
Jun-01              JUNCTION            1110.60   1113.60      0.00
Jun-02              JUNCTION            1108.94   1111.94      0.00
Jun-03              JUNCTION            1145.73   1148.73      0.00
Jun-04              JUNCTION            1143.86   1146.86      0.00
Jun-05              JUNCTION             970.00    972.00      0.00
Jun-08              JUNCTION            1022.00   1024.00      0.00
Jun-11              JUNCTION            1062.00   1064.00      0.00
Jun-12              JUNCTION             962.00    966.00      0.00
Jun-13              JUNCTION             922.00    924.00      0.00
Outfall_1           OUTFALL              920.00    922.00      0.00
Outfall_2           OUTFALL              960.00    962.00      0.00
Outfall_3           OUTFALL             1020.00   1022.00      0.00


************
Link Summary
************
Link           From Node      To Node        Element        Length     Slope    Manning's
```

ID			Type	ft	%	Roughness
Link-01	Jun-01	Jun-02	CONDUIT	39.0	4.2564	0.0130
Link-02	Jun-03	Jun-04	CONDUIT	41.5	4.5060	0.0130
Link-10	Jun-05	Jun-12	CHANNEL	60.0	10.0000	0.0320
Link-13	Jun-08	Outfall_3	CHANNEL	20.0	10.0000	0.0320
Link-17	Jun-12	Outfall_2	CHANNEL	20.0	10.0000	0.0320
Link-18	Jun-02	Jun-12	CHANNEL	1150.0	12.7774	0.0320
Link-19	Jun-04	Jun-05	CHANNEL	1350.0	12.8785	0.0320
Link-20	Jun-13	Outfall_1	CHANNEL	20.0	10.0000	0.0320
Link-23	Jun-11	Jun-08	CHANNEL	500.0	8.0000	0.0320

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
Link-01	CIRCULAR	2.00	2.00	1	3.14	0.50	46.67
Link-02	CIRCULAR	2.00	2.00	1	3.14	0.50	48.02
Link-10	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	228.55
Link-13	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	228.55
Link-17	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	228.55
Link-18	TRAPEZOIDAL	1.00	7.00	1	5.00	0.67	63.50
Link-19	TRAPEZOIDAL	1.00	7.00	1	5.00	0.67	63.75
Link-20	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	228.55
Link-23	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	204.42

Runoff Quantity Continuity	Volume acre-ft	Depth inches
Total Precipitation	66.313	3.549
Surface Runoff	1.352	0.072
Continuity Error (%)	-0.000	

Flow Routing Continuity	Volume acre-ft	Volume Mgallons
External Inflow	0.000	0.000
External Outflow	13.524	4.407
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	-0.000	

****
Composite Curve Number Computations Report
****

Subbasin Offsite_1

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Fair	3.77	B	60.00
Paved parking & roofs	1.43	B	98.00
Composite Area & Weighted CN	5.20		70.45

Subbasin Offsite_2

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Good	95.00	B	55.00
Paved parking & roofs	5.00	B	98.00
Composite Area & Weighted CN	100.00		57.15

Subbasin Offsite_3

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Good	37.00	B	55.00
Paved parking & roofs	3.00	B	98.00
Composite Area & Weighted CN	40.00		58.23

Subbasin Onsite_1

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Good	11.79	C	70.00
Paved parking & roofs	0.59	C	98.00
Wetlands	2.62	-	90.00
Composite Area & Weighted CN	15.00		74.59

Subbasin Onsite_2

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Good	24.34	C	70.00
Paved parking & roofs	0.32	C	98.00
Wetlands	3.34	-	90.00
Composite Area & Weighted CN	28.00		72.71

Subbasin Onsite_3

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Good	32.75	C	70.00
Paved parking & roofs	0.55	C	98.00
Wetlands	2.70	-	90.00
Composite Area & Weighted CN	36.00		71.93

****
SCS TR-55 Time of Concentration Computations Report
****

Sheet Flow Equation

```
Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where:

Tc = Time of Concentration (hrs)
n  = Manning's Roughness
Lf = Flow Length (ft)
P  = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)
```

Shallow Concentrated Flow Equation

```
V  = 16.1345 * (Sf^0.5) (unpaved surface)
V  = 20.3282 * (Sf^0.5) (paved surface)
V  = 15.0 * (Sf^0.5) (grassed waterway surface)
V  = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V  = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V  = 7.0 * (Sf^0.5) (short grass pasture surface)
V  = 5.0 * (Sf^0.5) (woodland surface)
V  = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
V  = Velocity (ft/sec)
Sf = Slope (ft/ft)
```

Channel Flow Equation

```
V  = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R  = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
R  = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V  = Velocity (ft/sec)
Sf = Slope (ft/ft)
n  = Manning's Roughness
```

Subbasin Offsite_1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	5.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.11	0.00	0.00
Computed Flow Time (minutes):	23.20	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	300.00	0.00	0.00
Slope (%):	8.00	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	4.24	0.00	0.00
Computed Flow Time (minutes):	1.18	0.00	0.00
Total TOC (minutes):	24.38		

Subbasin Offsite_2

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	3.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.05	0.00	0.00
Computed Flow Time (minutes):	49.55	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	2000.00	1500.00	890.00
Slope (%):	27.00	10.00	8.00
Surface Type:	Woodland	Woodland	Grassed waterway
Velocity (ft/sec):	2.60	1.58	4.24
Computed Flow Time (minutes):	12.82	15.82	3.50
Total TOC (minutes):	81.69		

Subbasin Offsite_3

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	5.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.06	0.00	0.00
Computed Flow Time (minutes):	40.39	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1500.00	500.00	0.00
Slope (%):	25.00	10.00	0.00
Surface Type:	Woodland	Unpaved	Unpaved
Velocity (ft/sec):	2.50	5.10	0.00
Computed Flow Time (minutes):	10.00	1.63	0.00
Total TOC (minutes):	52.03		

Subbasin Onsite_1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.09	0.00	0.00
Computed Flow Time (minutes):	27.56	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1200.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
Surface Type:	Woodland	Unpaved	Unpaved
Velocity (ft/sec):	1.80	0.00	0.00
Computed Flow Time (minutes):	11.11	0.00	0.00
Total TOC (minutes):	38.67		

Subbasin Onsite_2

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.09	0.00	0.00
Computed Flow Time (minutes):	27.56	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1200.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
Surface Type:	Woodland	Unpaved	Unpaved
Velocity (ft/sec):	1.80	0.00	0.00
Computed Flow Time (minutes):	11.11	0.00	0.00
Total TOC (minutes):	38.67		

Subbasin Onsite_3

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.09	0.00	0.00
Computed Flow Time (minutes):	27.56	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1100.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
Surface Type:	Woodland	Unpaved	Unpaved
Velocity (ft/sec):	1.80	0.00	0.00
Computed Flow Time (minutes):	10.19	0.00	0.00
Total TOC (minutes):	37.75		

****
Subbasin Runoff Summary
****

Subbasin ID	Total Precip in	Total Runoff in	Peak Runoff cfs	Weighted Curve Number	Time of Concentration days	hh:mm:ss
Offsite_1	3.54	1.06	2.25	70.450	0	00:24:22
Offsite_2	3.54	0.44	4.17	57.150	0	01:21:41
Offsite_3	3.54	0.48	2.31	58.230	0	00:52:01
Onsite_1	3.54	1.30	6.88	74.590	0	00:38:40

Onsite_2	3.54	1.19	11.21	72.710	0	00:38:40
Onsite_3	3.54	1.14	13.77	71.930	0	00:37:45

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
Jun-01	0.12	0.40	1111.00	0	10:15	0	0	0:00:00
Jun-02	0.04	0.15	1109.09	0	10:16	0	0	0:00:00
Jun-03	0.36	0.55	1146.28	0	11:35	0	0	0:00:00
Jun-04	0.14	0.22	1144.08	0	11:38	0	0	0:00:00
Jun-05	0.22	0.45	970.45	0	10:26	0	0	0:00:00
Jun-08	0.19	0.56	1022.56	0	10:25	0	0	0:00:00
Jun-11	0.10	0.18	1062.18	0	10:50	0	0	0:00:00
Jun-12	0.24	0.52	962.52	0	10:26	0	0	0:00:00
Jun-13	0.09	0.34	922.34	0	10:25	0	0	0:00:00
Outfall_1	0.09	0.32	920.32	0	10:25	0	0	0:00:00
Outfall_2	0.22	0.46	960.46	0	10:26	0	0	0:00:00
Outfall_3	0.18	0.49	1020.49	0	10:25	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days	hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	hh:mm
Jun-01	JUNCTION	2.24	2.24	0	10:15	0.00		
Jun-02	JUNCTION	0.00	2.24	0	10:15	0.00		
Jun-03	JUNCTION	4.17	4.17	0	11:35	0.00		
Jun-04	JUNCTION	0.00	4.17	0	11:35	0.00		
Jun-05	JUNCTION	11.19	11.82	0	10:25	0.00		
Jun-08	JUNCTION	13.67	14.94	0	10:25	0.00		
Jun-11	JUNCTION	2.31	2.31	0	10:49	0.00		
Jun-12	JUNCTION	0.00	13.48	0	10:25	0.00		
Jun-13	JUNCTION	6.84	6.84	0	10:24	0.00		
Outfall_1	OUTFALL	0.00	6.84	0	10:25	0.00		
Outfall_2	OUTFALL	0.00	13.46	0	10:26	0.00		
Outfall_3	OUTFALL	0.00	14.91	0	10:25	0.00		

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
Outfall_1	80.60	1.31	6.84
Outfall_2	86.93	5.19	13.46
Outfall_3	81.86	4.05	14.91
System	83.13	10.56	35.15

****
Link Flow Summary
****

Link ID	Element Type	Time of Peak Flow Occurrence days	hh:mm	Maximum Velocity Attained ft/sec	Length Factor	Peak Flow during Analysis cfs	Design Flow Capacity cfs	Ratio of Maximum /Design Flow	Ratio of Maximum Flow Depth	Total Time Surcharged minutes
Link-01	CONDUIT	0	10:15	8.67	2.93	2.24	46.67	0.05	0.14	0
Link-02	CONDUIT	0	11:35	9.93	2.81	4.17	48.02	0.09	0.19	0
Link-10	CHANNEL	0	10:26	6.92	1.89	11.75	228.55	0.05	0.22	0
Link-13	CHANNEL	0	10:25	7.03	5.68	14.91	228.55	0.07	0.26	0
Link-17	CHANNEL	0	10:26	6.84	5.68	13.46	228.55	0.06	0.25	0
Link-18	CHANNEL	0	10:16	2.08	1.00	2.20	63.50	0.03	0.33	0
Link-19	CHANNEL	0	11:38	4.23	1.00	4.17	63.75	0.07	0.29	0
Link-20	CHANNEL	0	10:25	5.67	5.68	6.84	228.55	0.03	0.16	0

Link-23	CHANNEL	0	10:50	2.31	1.00	2.31	204.42	0.01	0.17	0

****
Highest Flow Instability Indexes
****
All links are stable.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node Jun-12.

Analysis began on: Mon Sep 26 12:59:00 2016
Analysis ended on: Mon Sep 26 12:59:01 2016
Total elapsed time: 00:00:01

100-Year, 24-Hour

****
Project Description
****
File Name .... Lewis&Clark Predev III.SPF

****
Analysis Options
****
Flow Units .... cfs
Subbasin Hydrograph Method. SCS TR-55
Time of Concentration...... SCS TR-55
Link Routing Method .... Hydrodynamic
Storage Node Exfiltration.. Constant rate, free surface area
Starting Date APR-13-2016 00:00:00
Ending Date APR-14-2016 06:00:00
Report Time Step 00:05:00

****
Element Count
****
Number of rain gages 1
Number of subbasins 6
Number of nodes 12
Number of links 9

****
Raingage Summary
****

Gage ID	Data Source	Data Type	Recording Interval min
Rain Gage	100 YR	CUMULATIVE	6.00

****
Subbasin Summary
****

Subbasin ID	Total Area acres
Offsite_1	5.20
Offsite_2	100.00
Offsite_3	40.00
Onsite_1	15.00
Onsite_2	28.00
Onsite_3	36.00

****
Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
Jun-01	JUNCTION	1110.60	1113.60	0.00	
Jun-02	JUNCTION	1108.94	1111.94	0.00	
Jun-03	JUNCTION	1145.73	1148.73	0.00	
Jun-04	JUNCTION	1143.86	1146.86	0.00	
Jun-05	JUNCTION	970.00	972.00	0.00	
Jun-08	JUNCTION	1022.00	1024.00	0.00	
Jun-11	JUNCTION	1062.00	1064.00	0.00	
Jun-12	JUNCTION	962.00	966.00	0.00	
Jun-13	JUNCTION	922.00	924.00	0.00	
Outfall_1	OUTFALL	920.00	922.00	0.00	

Outfall_2	OUTFALL	960.00	962.00	0.00
Outfall_3	OUTFALL	1020.00	1022.00	0.00

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
Link-01	Jun-01	Jun-02	CONDUIT	39.0	4.2564	0.0130
Link-02	Jun-03	Jun-04	CONDUIT	41.5	4.5060	0.0130
Link-10	Jun-05	Jun-12	CHANNEL	60.0	10.0000	0.0320
Link-13	Jun-08	Outfall_3	CHANNEL	20.0	10.0000	0.0320
Link-17	Jun-12	Outfall_2	CHANNEL	20.0	10.0000	0.0320
Link-18	Jun-02	Jun-12	CHANNEL	1150.0	12.7774	0.0320
Link-19	Jun-04	Jun-05	CHANNEL	1350.0	12.8785	0.0320
Link-20	Jun-13	Outfall_1	CHANNEL	20.0	10.0000	0.0320
Link-23	Jun-11	Jun-08	CHANNEL	500.0	8.0000	0.0320

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
Link-01	CIRCULAR	2.00	2.00	1	3.14	0.50	46.67
Link-02	CIRCULAR	2.00	2.00	1	3.14	0.50	48.02
Link-10	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	228.55
Link-13	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	228.55
Link-17	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	228.55
Link-18	TRAPEZOIDAL	1.00	7.00	1	5.00	0.67	63.50
Link-19	TRAPEZOIDAL	1.00	7.00	1	5.00	0.67	63.75
Link-20	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	228.55
Link-23	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	204.42

Runoff Quantity Continuity	Volume acre-ft	Depth inches
Total Precipitation	92.904	4.973
Surface Runoff	2.852	0.153
Continuity Error (%)	-0.000	

Flow Routing Continuity	Volume acre-ft	Volume Mgallons
External Inflow	0.000	0.000
External Outflow	28.521	9.294
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	-0.000	

****
Composite Curve Number Computations Report
****

Subbasin Offsite_1

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Fair	3.77	B	60.00
Paved parking & roofs	1.43	B	98.00
Composite Area & Weighted CN	5.20		70.45

Subbasin Offsite_2

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Good	95.00	B	55.00
Paved parking & roofs	5.00	B	98.00
Composite Area & Weighted CN	100.00		57.15

Subbasin Offsite_3

Soil/Surface Description	Area (acres)	Soil Group	CN

Woods, Good	37.00	B	55.00
Paved parking & roofs	3.00	B	98.00
Composite Area & Weighted CN	40.00		58.23

Subbasin Onsite_1

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Good	11.79	C	70.00
Paved parking & roofs	0.59	C	98.00
Wetlands	2.62	-	90.00
Composite Area & Weighted CN	15.00		74.59

Subbasin Onsite_2

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Good	24.34	C	70.00
Paved parking & roofs	0.32	C	98.00
Wetlands	3.34	-	90.00
Composite Area & Weighted CN	28.00		72.71

Subbasin Onsite_3

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Good	32.75	C	70.00
Paved parking & roofs	0.55	C	98.00
Wetlands	2.70	-	90.00
Composite Area & Weighted CN	36.00		71.93

SCS TR-55 Time of Concentration Computations Report

Sheet Flow Equation

```
        Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

        Where:

        Tc = Time of Concentration (hrs)
        n  = Manning's Roughness
        Lf = Flow Length (ft)
        P  = 2 yr, 24 hr Rainfall (inches)
        Sf = Slope (ft/ft)
```

Shallow Concentrated Flow Equation

```
        V  = 16.1345 * (Sf^0.5) (unpaved surface)
        V  = 20.3282 * (Sf^0.5) (paved surface)
        V  = 15.0 * (Sf^0.5) (grassed waterway surface)
        V  = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
        V  = 9.0 * (Sf^0.5) (cultivated straight rows surface)
        V  = 7.0 * (Sf^0.5) (short grass pasture surface)
        V  = 5.0 * (Sf^0.5) (woodland surface)
        V  = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
        Tc = (Lf / V) / (3600 sec/hr)

        Where:

        Tc = Time of Concentration (hrs)
        Lf = Flow Length (ft)
        V  = Velocity (ft/sec)
        Sf = Slope (ft/ft)
```

Channel Flow Equation

```
        V  = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
        R  = Aq / Wp
        Tc = (Lf / V) / (3600 sec/hr)

        Where:

        Tc = Time of Concentration (hrs)
        Lf = Flow Length (ft)
```

R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's Roughness

Subbasin Offsite_1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	5.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.11	0.00	0.00
Computed Flow Time (minutes):	23.20	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	300.00	0.00	0.00
Slope (%):	8.00	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	4.24	0.00	0.00
Computed Flow Time (minutes):	1.18	0.00	0.00
Total TOC (minutes):	24.38		

Subbasin Offsite_2

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	3.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.05	0.00	0.00
Computed Flow Time (minutes):	49.55	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	2000.00	1500.00	890.00
Slope (%):	27.00	10.00	8.00
Surface Type:	Woodland	Woodland	Grassed waterway
Velocity (ft/sec):	2.60	1.58	4.24
Computed Flow Time (minutes):	12.82	15.82	3.50
Total TOC (minutes):	81.69		

Subbasin Offsite_3

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	5.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.06	0.00	0.00
Computed Flow Time (minutes):	40.39	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1500.00	500.00	0.00
Slope (%):	25.00	10.00	0.00
Surface Type:	Woodland	Unpaved	Unpaved
Velocity (ft/sec):	2.50	5.10	0.00
Computed Flow Time (minutes):	10.00	1.63	0.00
Total TOC (minutes):	52.03		

Subbasin Onsite_1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.09	0.00	0.00
Computed Flow Time (minutes):	27.56	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1200.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
Surface Type:	Woodland	Unpaved	Unpaved
Velocity (ft/sec):	1.80	0.00	0.00
Computed Flow Time (minutes):	11.11	0.00	0.00
Total TOC (minutes):	38.67		

Subbasin Onsite_2

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.09	0.00	0.00
Computed Flow Time (minutes):	27.56	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1200.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
Surface Type:	Woodland	Unpaved	Unpaved
Velocity (ft/sec):	1.80	0.00	0.00
Computed Flow Time (minutes):	11.11	0.00	0.00
Total TOC (minutes):	38.67		

Subbasin Onsite_3

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.09	0.00	0.00
Computed Flow Time (minutes):	27.56	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1100.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
Surface Type:	Woodland	Unpaved	Unpaved
Velocity (ft/sec):	1.80	0.00	0.00
Computed Flow Time (minutes):	10.19	0.00	0.00
Total TOC (minutes):	37.75		

Subbasin Runoff Summary

Subbasin ID	Total Precip in	Total Runoff in	Peak Runoff cfs	Weighted Curve Number	Time of Concentration days	hh:mm:ss
Offsite_1	4.96	2.04	5.01	70.450	0	00:24:22
Offsite_2	4.96	1.09	18.00	57.150	0	01:21:41
Offsite_3	4.96	1.16	10.38	58.230	0	00:52:01
Onsite_1	4.96	2.38	13.81	74.590	0	00:38:40
Onsite_2	4.96	2.23	23.65	72.710	0	00:38:40
Onsite_3	4.96	2.16	29.59	71.930	0	00:37:45

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
Jun-01	0.17	0.62	1111.22	0	10:15	0	0	0:00:00
Jun-02	0.06	0.24	1109.18	0	10:15	0	0	0:00:00
Jun-03	0.64	1.40	1147.13	0	11:04	0	0	0:00:00
Jun-04	0.25	0.51	1144.37	0	11:05	0	0	0:00:00
Jun-05	0.36	0.79	970.79	0	10:31	0	0	0:00:00
Jun-08	0.31	0.98	1022.98	0	10:25	0	0	0:00:00
Jun-11	0.17	0.42	1062.42	0	10:40	0	0	0:00:00
Jun-12	0.40	0.93	962.93	0	10:30	0	0	0:00:00
Jun-13	0.14	0.53	922.53	0	10:20	0	0	0:00:00
Outfall_1	0.13	0.47	920.47	0	10:20	0	0	0:00:00
Outfall_2	0.36	0.77	960.77	0	10:30	0	0	0:00:00
Outfall_3	0.28	0.81	1020.81	0	10:25	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days	hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	hh:mm
Jun-01	JUNCTION	4.96	4.96	0	10:15	0.00		
Jun-02	JUNCTION	0.00	4.96	0	10:15	0.00		
Jun-03	JUNCTION	17.96	17.96	0	11:04	0.00		
Jun-04	JUNCTION	0.00	17.96	0	11:05	0.00		
Jun-05	JUNCTION	23.40	31.50	0	10:30	0.00		
Jun-08	JUNCTION	29.40	37.84	0	10:24	0.00		
Jun-11	JUNCTION	10.32	10.32	0	10:40	0.00		
Jun-12	JUNCTION	0.00	34.41	0	10:30	0.00		
Jun-13	JUNCTION	13.67	13.67	0	10:20	0.00		
Outfall_1	OUTFALL	0.00	13.68	0	10:20	0.00		
Outfall_2	OUTFALL	0.00	34.39	0	10:30	0.00		
Outfall_3	OUTFALL	0.00	37.79	0	10:25	0.00		

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
Outfall_1	86.79	2.26	13.68
Outfall_2	91.62	11.27	34.39
Outfall_3	87.79	7.99	37.79
System	88.73	21.52	85.22

****
Link Flow Summary
****

Link ID	Element Type	Time of Peak Flow Occurrence days hh:mm	Maximum Velocity Attained ft/sec	Length Factor	Peak Flow during Analysis cfs	Design Flow Capacity cfs	Ratio of Maximum /Design Flow	Ratio of Maximum Flow Depth	Total Time Surcharged minutes

Link-01	CONDUIT	0	10:15	9.93	2.93	4.96	46.67	0.11	0.22	0
Link-02	CONDUIT	0	11:05	12.18	2.81	17.96	48.02	0.37	0.48	0
Link-10	CHANNEL	0	10:31	9.09	1.89	31.43	228.55	0.14	0.38	0
Link-13	CHANNEL	0	10:25	8.78	5.68	37.79	228.55	0.17	0.45	0
Link-17	CHANNEL	0	10:30	8.60	5.68	34.39	228.55	0.15	0.43	0
Link-18	CHANNEL	0	10:15	2.51	1.00	4.92	63.50	0.08	0.56	0
Link-19	CHANNEL	0	11:05	6.89	1.00	17.95	63.75	0.28	0.63	0
Link-20	CHANNEL	0	10:20	6.87	5.68	13.68	228.55	0.06	0.25	0
Link-23	CHANNEL	0	10:40	3.81	1.00	10.32	204.42	0.05	0.34	0

```
*********************************
Highest Flow Instability Indexes
*********************************
All links are stable.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node Jun-12.

Analysis began on:  Mon Sep 26 13:07:07 2016
Analysis ended on:  Mon Sep 26 13:07:09 2016
Total elapsed time: 00:00:02
```

e. Post-development Calculations

<u>10-Year, 24-hour</u>

R-8 Zoning

```
*******************
Project Description
*******************
File Name ................ Lewis&Clark Postdev R-8 II.SPF

****************
Analysis Options
****************
Flow Units ............... cfs
Subbasin Hydrograph Method. SCS TR-55
Time of Concentration...... SCS TR-55
Link Routing Method ....... Hydrodynamic
Storage Node Exfiltration.. Constant rate, free surface area
Starting Date ............ APR-13-2016 00:00:00
Ending Date .............. APR-14-2016 06:00:00
Report Time Step ......... 00:05:00

*************
Element Count
*************
Number of rain gages ...... 1
Number of subbasins ....... 6
Number of nodes ........... 12
Number of links ........... 9

****************
Raingage Summary
****************
Gage           Data               Data        Recording
ID             Source             Type         Interval
                                                    min
-------------------------------------------------------
Rain Gage      10 YR              CUMULATIVE       6.00

****************
Subbasin Summary
****************
Subbasin                Total
                         Area
ID                      acres
-----------------------------
Offsite_1                5.20
Offsite_2              100.00
Offsite_3               40.00
Onsite_1                25.60
Onsite_2                25.70
Onsite_3                25.70

************
```

```
Node Summary
************
Node                 Element                  Invert   Maximum    Ponded    External
ID                   Type                  Elevation     Elev.      Area      Inflow
                                                  ft        ft       ft²
------------------------------------------------------------------------------------
Jun-01               JUNCTION                1110.60   1113.60      0.00
Jun-02               JUNCTION                1108.94   1111.94      0.00
Jun-03               JUNCTION                1145.73   1148.73      0.00
Jun-04               JUNCTION                1143.86   1146.86      0.00
Jun-05               JUNCTION                 970.00    972.00      0.00
Jun-08               JUNCTION                1022.00   1024.00      0.00
Jun-11               JUNCTION                1062.00   1064.00      0.00
Jun-12               JUNCTION                 962.00    966.00      0.00
Jun-13               JUNCTION                 922.00    924.00      0.00
Outfall_1            OUTFALL                  920.00    922.00      0.00
Outfall_2            OUTFALL                  960.00    962.00      0.00
Outfall_3            OUTFALL                 1020.00   1022.00      0.00


************
Link Summary
************
Link             From Node        To Node          Element            Length      Slope   Manning's
ID                                                 Type                   ft          %   Roughness
---------------------------------------------------------------------------------------------------
Link-01          Jun-01           Jun-02           CONDUIT              39.0     4.2564      0.0130
Link-02          Jun-03           Jun-04           CONDUIT              41.5     4.5060      0.0130
Link-10          Jun-05           Jun-12           CHANNEL              60.0    10.0000      0.0320
Link-13          Jun-08           Outfall_3        CHANNEL              20.0    10.0000      0.0320
Link-17          Jun-12           Outfall_2        CHANNEL              20.0    10.0000      0.0320
Link-18          Jun-02           Jun-12           CHANNEL            1150.0    12.7774      0.0320
Link-19          Jun-04           Jun-05           CHANNEL            1350.0    12.8785      0.0320
Link-20          Jun-13           Outfall_1        CHANNEL              20.0    10.0000      0.0320
Link-23          Jun-11           Jun-08           CHANNEL             500.0     8.0000      0.0320


*********************
Cross Section Summary
*********************
Link             Shape              Depth/        Width        No. of       Cross   Full Flow      Design
ID                                Diameter                    Barrels   Sectional   Hydraulic        Flow
                                                                             Area      Radius    Capacity
                                        ft           ft                       ft²          ft         cfs
---------------------------------------------------------------------------------------------------------
Link-01          CIRCULAR             2.00         2.00             1        3.14        0.50       46.67
Link-02          CIRCULAR             2.00         2.00             1        3.14        0.50       48.02
Link-10          TRAPEZOIDAL          2.00        11.00             1       14.00        1.17      228.55
Link-13          TRAPEZOIDAL          2.00        11.00             1       14.00        1.17      228.55
Link-17          TRAPEZOIDAL          2.00        11.00             1       14.00        1.17      228.55
Link-18          TRAPEZOIDAL          1.00         7.00             1        5.00        0.67       63.50
Link-19          TRAPEZOIDAL          1.00         7.00             1        5.00        0.67       63.75
Link-20          TRAPEZOIDAL          2.00        11.00             1       14.00        1.17      228.55
Link-23          TRAPEZOIDAL          2.00        11.00             1       14.00        1.17      204.42


**************************        Volume        Depth
Runoff Quantity Continuity       acre-ft       inches
**************************     ---------      -------
Total Precipitation ......        65.722        3.549
Surface Runoff ...........         1.356        0.073
Continuity Error (%) .....        -0.000


**************************        Volume       Volume
Flow Routing Continuity          acre-ft     Mgallons
**************************     ---------    ---------
External Inflow ..........         0.000        0.000
External Outflow .........        13.562        4.419
Initial Stored Volume ....         0.000        0.000
Final Stored Volume ......         0.000        0.000
Continuity Error (%) .....        -0.000


*******************************************
Composite Curve Number Computations Report
*******************************************

---------------------
Subbasin Offsite_1
---------------------
                                                           Area          Soil
Soil/Surface Description                                (acres)         Group          CN
-----------------------------------------------------------------------------------------
Woods, Fair                                                3.77             B       60.00
Paved parking & roofs                                      1.43             B       98.00
Composite Area & Weighted CN                               5.20                     70.45
```

Subbasin Offsite_2

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Good	95.00	B	55.00
Paved parking & roofs	5.00	B	98.00
Composite Area & Weighted CN	100.00		57.15

Subbasin Offsite_3

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Good	37.00	B	55.00
Paved parking & roofs	3.00	B	98.00
Composite Area & Weighted CN	40.00		58.23

Subbasin Onsite_1

Soil/Surface Description	Area (acres)	Soil Group	CN
> 75% grass cover, Good	1.10	C	74.00
Woods, Good	20.80	C	70.00
Wetlands	2.80	-	90.00
Paved parking & roofs	0.90	C	98.00
Composite Area & Weighted CN	25.60		73.34

Subbasin Onsite_2

Soil/Surface Description	Area (acres)	Soil Group	CN
> 75% grass cover, Good	1.10	C	74.00
Woods, Good	20.90	C	70.00
Wetlands	2.80	-	90.00
Paved parking & roofs	0.90	C	98.00
Composite Area & Weighted CN	25.70		73.33

Subbasin Onsite_3

Soil/Surface Description	Area (acres)	Soil Group	CN
> 75% grass cover, Good	1.10	C	74.00
Woods, Good	20.90	C	70.00
Wetlands	2.80	-	90.00
Paved parking & roofs	0.90	C	98.00
Composite Area & Weighted CN	25.70		73.33

SCS TR-55 Time of Concentration Computations Report

Sheet Flow Equation

```
Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where:

Tc = Time of Concentration (hrs)
n  = Manning's Roughness
Lf = Flow Length (ft)
P  = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)
```

Shallow Concentrated Flow Equation

```
V  = 16.1345 * (Sf^0.5) (unpaved surface)
V  = 20.3282 * (Sf^0.5) (paved surface)
V  = 15.0 * (Sf^0.5) (grassed waterway surface)
V  = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V  = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V  = 7.0 * (Sf^0.5) (short grass pasture surface)
V  = 5.0 * (Sf^0.5) (woodland surface)
V  = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)
```

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's Roughness

Subbasin Offsite_1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	5.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.11	0.00	0.00
Computed Flow Time (minutes):	23.20	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	300.00	0.00	0.00
Slope (%):	8.00	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	4.24	0.00	0.00
Computed Flow Time (minutes):	1.18	0.00	0.00
Total TOC (minutes):	24.38		

Subbasin Offsite_2

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	3.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.05	0.00	0.00
Computed Flow Time (minutes):	49.55	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	2000.00	1500.00	890.00
Slope (%):	27.00	10.00	8.00
Surface Type:	Woodland	Woodland	Grassed waterway
Velocity (ft/sec):	2.60	1.58	4.24
Computed Flow Time (minutes):	12.82	15.82	3.50
Total TOC (minutes):	81.69		

Subbasin Offsite_3

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C

Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	5.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.06	0.00	0.00
Computed Flow Time (minutes):	40.39	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1500.00	500.00	0.00
Slope (%):	25.00	10.00	0.00
Surface Type:	Woodland	Unpaved	Unpaved
Velocity (ft/sec):	2.50	5.10	0.00
Computed Flow Time (minutes):	10.00	1.63	0.00
Total TOC (minutes):	52.03		

Subbasin Onsite_1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.09	0.00	0.00
Computed Flow Time (minutes):	27.56	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1200.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	5.41	0.00	0.00
Computed Flow Time (minutes):	3.70	0.00	0.00
Total TOC (minutes):	31.26		

Subbasin Onsite_2

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.09	0.00	0.00
Computed Flow Time (minutes):	27.56	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1200.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	5.41	0.00	0.00
Computed Flow Time (minutes):	3.70	0.00	0.00
Total TOC (minutes):	31.26		

Subbasin Onsite_3

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.09	0.00	0.00
Computed Flow Time (minutes):	27.56	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1200.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	5.41	0.00	0.00
Computed Flow Time (minutes):	3.70	0.00	0.00
Total TOC (minutes):	31.26		

****
Subbasin Runoff Summary
****

Subbasin ID	Total Precip in	Total Runoff in	Peak Runoff cfs	Weighted Curve Number	Time of Concentration days	hh:mm:ss
Offsite_1	3.54	1.06	2.25	70.450	0	00:24:22
Offsite_2	3.54	0.44	4.17	57.150	0	01:21:41
Offsite_3	3.54	0.48	2.31	58.230	0	00:52:01
Onsite_1	3.54	1.23	12.13	73.340	0	00:31:15
Onsite_2	3.54	1.23	12.17	73.330	0	00:31:15
Onsite_3	3.54	1.23	12.17	73.330	0	00:31:15

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
Jun-01	0.12	0.40	1111.00	0	10:15	0	0	0:00:00
Jun-02	0.04	0.15	1109.09	0	10:16	0	0	0:00:00
Jun-03	0.36	0.55	1146.28	0	11:35	0	0	0:00:00
Jun-04	0.14	0.22	1144.08	0	11:38	0	0	0:00:00
Jun-05	0.16	0.24	970.24	0	11:41	0	0	0:00:00
Jun-08	0.17	0.51	1022.51	0	10:20	0	0	0:00:00
Jun-11	0.10	0.18	1062.18	0	10:50	0	0	0:00:00
Jun-12	0.23	0.54	962.54	0	10:20	0	0	0:00:00
Jun-13	0.12	0.49	922.49	0	10:19	0	0	0:00:00
Outfall_1	0.12	0.43	920.43	0	10:20	0	0	0:00:00
Outfall_2	0.22	0.48	960.48	0	10:20	0	0	0:00:00
Outfall_3	0.16	0.45	1020.45	0	10:20	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days	hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	hh:mm
Jun-01	JUNCTION	2.24	2.24	0	10:14	0.00		
Jun-02	JUNCTION	0.00	2.24	0	10:15	0.00		
Jun-03	JUNCTION	4.17	4.17	0	11:35	0.00		
Jun-04	JUNCTION	0.00	4.17	0	11:35	0.00		
Jun-05	JUNCTION	0.00	4.17	0	11:38	0.00		
Jun-08	JUNCTION	12.06	12.92	0	10:19	0.00		
Jun-11	JUNCTION	2.31	2.31	0	10:49	0.00		
Jun-12	JUNCTION	12.06	14.31	0	10:19	0.00		
Jun-13	JUNCTION	12.02	12.02	0	10:19	0.00		
Outfall_1	OUTFALL	0.00	12.02	0	10:20	0.00		
Outfall_2	OUTFALL	0.00	14.26	0	10:20	0.00		
Outfall_3	OUTFALL	0.00	12.88	0	10:20	0.00		

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency	Average Flow	Peak Inflow

	(%)	cfs	cfs
Outfall_1	80.16	2.06	12.02
Outfall_2	86.82	5.00	14.26
Outfall_3	82.14	3.31	12.88
System	83.04	10.37	39.13

****
Link Flow Summary
****

Link ID	Element Type	Time of Peak Flow Occurrence days hh:mm	Maximum Velocity Attained ft/sec	Length Factor	Peak Flow during Analysis cfs	Design Flow Capacity cfs	Ratio of Maximum /Design Flow	Ratio of Maximum Flow Depth	Total Time Surcharged minutes
Link-01	CONDUIT	0 10:15	8.67	2.93	2.24	46.67	0.05	0.14	0
Link-02	CONDUIT	0 11:35	9.93	2.81	4.17	48.02	0.09	0.19	0
Link-10	CHANNEL	0 11:41	5.00	1.89	4.17	228.55	0.02	0.12	0
Link-13	CHANNEL	0 10:20	6.77	5.68	12.88	228.55	0.06	0.24	0
Link-17	CHANNEL	0 10:20	6.95	5.68	14.26	228.55	0.06	0.26	0
Link-18	CHANNEL	0 10:16	1.77	1.00	2.20	63.50	0.03	0.34	0
Link-19	CHANNEL	0 11:38	5.21	1.00	4.17	63.75	0.07	0.23	0
Link-20	CHANNEL	0 10:20	6.64	5.68	12.02	228.55	0.05	0.23	0
Link-23	CHANNEL	0 10:50	2.53	1.00	2.31	204.42	0.01	0.16	0

****
Highest Flow Instability Indexes
****
All links are stable.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node Jun-12.

Analysis began on: Mon Sep 26 13:12:27 2016
Analysis ended on: Mon Sep 26 13:12:28 2016
Total elapsed time: 00:00:01

R-6 Zoning

****
Project Description
****
File Name .... Lewis&Clark Postdev R-6 II.SPF

****
Analysis Options
****
Flow Units .... cfs
Subbasin Hydrograph Method. SCS TR-55
Time of Concentration...... SCS TR-55
Link Routing Method .... Hydrodynamic
Storage Node Exfiltration.. Constant rate, free surface area
Starting Date APR-13-2016 00:00:00
Ending Date APR-14-2016 06:00:00
Report Time Step 00:05:00

****
Element Count
****
Number of rain gages 1
Number of subbasins 6
Number of nodes 12
Number of links 9

****
Raingage Summary
****

Gage ID	Data Source	Data Type	Recording Interval min
Rain Gage	10 YR	CUMULATIVE	6.00

****
Subbasin Summary
****

Subbasin	Total Area

ID	acres
Offsite_1	5.20
Offsite_2	100.00
Offsite_3	40.00
Onsite_1	25.60
Onsite_2	25.70
Onsite_3	25.70

****
Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
Jun-01	JUNCTION	1110.60	1113.60	0.00	
Jun-02	JUNCTION	1108.94	1111.94	0.00	
Jun-03	JUNCTION	1145.73	1148.73	0.00	
Jun-04	JUNCTION	1143.86	1146.86	0.00	
Jun-05	JUNCTION	970.00	972.00	0.00	
Jun-08	JUNCTION	1022.00	1024.00	0.00	
Jun-11	JUNCTION	1062.00	1064.00	0.00	
Jun-12	JUNCTION	962.00	966.00	0.00	
Jun-13	JUNCTION	922.00	924.00	0.00	
Outfall_1	OUTFALL	920.00	922.00	0.00	
Outfall_2	OUTFALL	960.00	962.00	0.00	
Outfall_3	OUTFALL	1020.00	1022.00	0.00	

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
Link-01	Jun-01	Jun-02	CONDUIT	39.0	4.2564	0.0130
Link-02	Jun-03	Jun-04	CONDUIT	41.5	4.5060	0.0130
Link-10	Jun-05	Jun-12	CHANNEL	60.0	10.0000	0.0320
Link-13	Jun-08	Outfall_3	CHANNEL	20.0	10.0000	0.0320
Link-17	Jun-12	Outfall_2	CHANNEL	20.0	10.0000	0.0320
Link-18	Jun-02	Jun-12	CHANNEL	1150.0	12.7774	0.0320
Link-19	Jun-04	Jun-05	CHANNEL	1350.0	12.8785	0.0320
Link-20	Jun-13	Outfall_1	CHANNEL	20.0	10.0000	0.0320
Link-23	Jun-11	Jun-08	CHANNEL	500.0	8.0000	0.0320

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
Link-01	CIRCULAR	2.00	2.00	1	3.14	0.50	46.67
Link-02	CIRCULAR	2.00	2.00	1	3.14	0.50	48.02
Link-10	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	228.55
Link-13	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	228.55
Link-17	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	228.55
Link-18	TRAPEZOIDAL	1.00	7.00	1	5.00	0.67	63.50
Link-19	TRAPEZOIDAL	1.00	7.00	1	5.00	0.67	63.75
Link-20	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	228.55
Link-23	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	204.42

Runoff Quantity Continuity	Volume acre-ft	Depth inches
Total Precipitation	65.722	3.549
Surface Runoff	1.394	0.075
Continuity Error (%)	-0.000	

Flow Routing Continuity	Volume acre-ft	Volume Mgallons
External Inflow	0.000	0.000
External Outflow	13.938	4.542
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	-0.000	

****
Composite Curve Number Computations Report

****

Subbasin Offsite_1

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Fair	3.77	B	60.00
Paved parking & roofs	1.43	B	98.00
Composite Area & Weighted CN	5.20		70.45

Subbasin Offsite_2

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Good	95.00	B	55.00
Paved parking & roofs	5.00	B	98.00
Composite Area & Weighted CN	100.00		57.15

Subbasin Offsite_3

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Good	37.00	B	55.00
Paved parking & roofs	3.00	B	98.00
Composite Area & Weighted CN	40.00		58.23

Subbasin Onsite_1

Soil/Surface Description	Area (acres)	Soil Group	CN
> 75% grass cover, Good	2.30	C	74.00
Woods, Good	18.90	C	70.00
Wetlands	2.80	-	90.00
Paved parking & roofs	1.60	C	98.00
Composite Area & Weighted CN	25.60		74.30

Subbasin Onsite_2

Soil/Surface Description	Area (acres)	Soil Group	CN
> 75% grass cover, Good	2.30	C	74.00
Woods, Good	19.00	C	70.00
Wetlands	2.80	-	90.00
Paved parking & roofs	1.60	C	98.00
Composite Area & Weighted CN	25.70		74.28

Subbasin Onsite_3

Soil/Surface Description	Area (acres)	Soil Group	CN
> 75% grass cover, Good	2.30	C	74.00
Woods, Good	19.00	C	70.00
Wetlands	2.80	-	90.00
Paved parking & roofs	1.60	C	98.00
Composite Area & Weighted CN	25.70		74.28

****
SCS TR-55 Time of Concentration Computations Report
****

Sheet Flow Equation

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where:

Tc = Time of Concentration (hrs)
n = Manning's Roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation

```
V  = 16.1345 * (Sf^0.5) (unpaved surface)
V  = 20.3282 * (Sf^0.5) (paved surface)
V  = 15.0 * (Sf^0.5) (grassed waterway surface)
V  = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V  = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V  = 7.0 * (Sf^0.5) (short grass pasture surface)
V  = 5.0 * (Sf^0.5) (woodland surface)
V  = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)
```

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation

```
V  = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R  = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)
```

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's Roughness

Subbasin Offsite_1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	5.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.11	0.00	0.00
Computed Flow Time (minutes):	23.20	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	300.00	0.00	0.00
Slope (%):	8.00	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	4.24	0.00	0.00
Computed Flow Time (minutes):	1.18	0.00	0.00
Total TOC (minutes):	24.38		

Subbasin Offsite_2

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	3.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.05	0.00	0.00
Computed Flow Time (minutes):	49.55	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	2000.00	1500.00	890.00
Slope (%):	27.00	10.00	8.00
Surface Type:	Woodland	Woodland	Grassed waterway
Velocity (ft/sec):	2.60	1.58	4.24
Computed Flow Time (minutes):	12.82	15.82	3.50

Total TOC (minutes):	81.69

Subbasin Offsite_3

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	5.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.06	0.00	0.00
Computed Flow Time (minutes):	40.39	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1500.00	500.00	0.00
Slope (%):	25.00	10.00	0.00
Surface Type:	Woodland	Unpaved	Unpaved
Velocity (ft/sec):	2.50	5.10	0.00
Computed Flow Time (minutes):	10.00	1.63	0.00
Total TOC (minutes):	52.03		

Subbasin Onsite_1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.09	0.00	0.00
Computed Flow Time (minutes):	27.56	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1200.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	5.41	0.00	0.00
Computed Flow Time (minutes):	3.70	0.00	0.00
Total TOC (minutes):	31.26		

Subbasin Onsite_2

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.09	0.00	0.00
Computed Flow Time (minutes):	27.56	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1200.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	5.41	0.00	0.00
Computed Flow Time (minutes):	3.70	0.00	0.00
Total TOC (minutes):	31.26		

Subbasin Onsite_3

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.09	0.00	0.00
Computed Flow Time (minutes):	27.56	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1200.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	5.41	0.00	0.00
Computed Flow Time (minutes):	3.70	0.00	0.00
Total TOC (minutes):	31.26		

****
Subbasin Runoff Summary
****

Subbasin ID	Total Precip in	Total Runoff in	Peak Runoff cfs	Weighted Curve Number	Time of Concentration days	hh:mm:ss
Offsite_1	3.54	1.06	2.25	70.450	0	00:24:22
Offsite_2	3.54	0.44	4.17	57.150	0	01:21:41
Offsite_3	3.54	0.48	2.31	58.230	0	00:52:01
Onsite_1	3.54	1.29	12.96	74.300	0	00:31:15
Onsite_2	3.54	1.28	13.00	74.280	0	00:31:15
Onsite_3	3.54	1.28	13.00	74.280	0	00:31:15

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
Jun-01	0.12	0.40	1111.00	0	10:15	0	0	0:00:00
Jun-02	0.04	0.15	1109.09	0	10:16	0	0	0:00:00
Jun-03	0.36	0.55	1146.28	0	11:35	0	0	0:00:00
Jun-04	0.14	0.22	1144.08	0	11:38	0	0	0:00:00
Jun-05	0.16	0.24	970.24	0	11:41	0	0	0:00:00
Jun-08	0.18	0.53	1022.53	0	10:20	0	0	0:00:00
Jun-11	0.10	0.18	1062.18	0	10:50	0	0	0:00:00
Jun-12	0.24	0.56	962.56	0	10:20	0	0	0:00:00
Jun-13	0.13	0.51	922.51	0	10:20	0	0	0:00:00
Outfall_1	0.12	0.45	920.45	0	10:20	0	0	0:00:00
Outfall_2	0.22	0.49	960.49	0	10:20	0	0	0:00:00
Outfall_3	0.17	0.47	1020.47	0	10:20	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days	hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	hh:mm
Jun-01	JUNCTION	2.24	2.24	0	10:14	0.00		
Jun-02	JUNCTION	0.00	2.24	0	10:15	0.00		
Jun-03	JUNCTION	4.17	4.17	0	11:35	0.00		
Jun-04	JUNCTION	0.00	4.17	0	11:35	0.00		
Jun-05	JUNCTION	0.00	4.17	0	11:38	0.00		
Jun-08	JUNCTION	12.89	13.74	0	10:20	0.00		
Jun-11	JUNCTION	2.31	2.31	0	10:49	0.00		
Jun-12	JUNCTION	12.89	15.13	0	10:19	0.00		
Jun-13	JUNCTION	12.85	12.85	0	10:19	0.00		
Outfall_1	OUTFALL	0.00	12.85	0	10:20	0.00		

Outfall_2	OUTFALL	0.00	15.08	0	10:20	0.00
Outfall_3	OUTFALL	0.00	13.70	0	10:20	0.00

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
Outfall_1	80.23	2.17	12.85
Outfall_2	87.15	5.09	15.08
Outfall_3	82.53	3.40	13.70
System	83.30	10.66	41.60

****
Link Flow Summary
****

Link ID	Element Type	Time of Peak Flow Occurrence days hh:mm	Maximum Velocity Attained ft/sec	Length Factor	Peak Flow during Analysis cfs	Design Flow Capacity cfs	Ratio of Maximum /Design Flow	Ratio of Maximum Flow Depth	Total Time Surcharged minutes
Link-01	CONDUIT	0 10:15	8.67	2.93	2.24	46.67	0.05	0.14	0
Link-02	CONDUIT	0 11:35	9.93	2.81	4.17	48.02	0.09	0.19	0
Link-10	CHANNEL	0 11:41	5.00	1.89	4.17	228.55	0.02	0.12	0
Link-13	CHANNEL	0 10:20	6.88	5.68	13.70	228.55	0.06	0.25	0
Link-17	CHANNEL	0 10:20	7.05	5.68	15.08	228.55	0.07	0.26	0
Link-18	CHANNEL	0 10:16	1.70	1.00	2.20	63.50	0.03	0.35	0
Link-19	CHANNEL	0 11:38	5.21	1.00	4.17	63.75	0.07	0.23	0
Link-20	CHANNEL	0 10:20	6.76	5.68	12.85	228.55	0.06	0.24	0
Link-23	CHANNEL	0 10:50	2.49	1.00	2.31	204.42	0.01	0.16	0

****
Highest Flow Instability Indexes
****
All links are stable.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node Jun-12.

Analysis began on: Mon Sep 26 13:16:36 2016
Analysis ended on: Mon Sep 26 13:16:38 2016
Total elapsed time: 00:00:02

100-Year, 24-hour

R-8 Zoning

****
Project Description
****
File Name .... Lewis&Clark Postdev R-8 II.SPF

****
Analysis Options
****
Flow Units .... cfs
Subbasin Hydrograph Method. SCS TR-55
Time of Concentration...... SCS TR-55
Link Routing Method .... Hydrodynamic
Storage Node Exfiltration.. Constant rate, free surface area
Starting Date APR-13-2016 00:00:00
Ending Date APR-14-2016 06:00:00
Report Time Step 00:05:00

****
Element Count
****
Number of rain gages 1
Number of subbasins 6
Number of nodes 12
Number of links 9

****

Raingage Summary
****

Gage ID	Data Source	Data Type	Recording Interval min
Rain Gage	100 YR	CUMULATIVE	6.00

****
Subbasin Summary
****

Subbasin ID	Total Area acres
Offsite_1	5.20
Offsite_2	100.00
Offsite_3	40.00
Onsite_1	25.60
Onsite_2	25.70
Onsite_3	25.70

****
Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
Jun-01	JUNCTION	1110.60	1113.60	0.00	
Jun-02	JUNCTION	1108.94	1111.94	0.00	
Jun-03	JUNCTION	1145.73	1148.73	0.00	
Jun-04	JUNCTION	1143.86	1146.86	0.00	
Jun-05	JUNCTION	970.00	972.00	0.00	
Jun-08	JUNCTION	1022.00	1024.00	0.00	
Jun-11	JUNCTION	1062.00	1064.00	0.00	
Jun-12	JUNCTION	962.00	966.00	0.00	
Jun-13	JUNCTION	922.00	924.00	0.00	
Outfall_1	OUTFALL	920.00	922.00	0.00	
Outfall_2	OUTFALL	960.00	962.00	0.00	
Outfall_3	OUTFALL	1020.00	1022.00	0.00	

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
Link-01	Jun-01	Jun-02	CONDUIT	39.0	4.2564	0.0130
Link-02	Jun-03	Jun-04	CONDUIT	41.5	4.5060	0.0130
Link-10	Jun-05	Jun-12	CHANNEL	60.0	10.0000	0.0320
Link-13	Jun-08	Outfall_3	CHANNEL	20.0	10.0000	0.0320
Link-17	Jun-12	Outfall_2	CHANNEL	20.0	10.0000	0.0320
Link-18	Jun-02	Jun-12	CHANNEL	1150.0	12.7774	0.0320
Link-19	Jun-04	Jun-05	CHANNEL	1350.0	12.8785	0.0320
Link-20	Jun-13	Outfall_1	CHANNEL	20.0	10.0000	0.0320
Link-23	Jun-11	Jun-08	CHANNEL	500.0	8.0000	0.0320

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
Link-01	CIRCULAR	2.00	2.00	1	3.14	0.50	46.67
Link-02	CIRCULAR	2.00	2.00	1	3.14	0.50	48.02
Link-10	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	228.55
Link-13	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	228.55
Link-17	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	228.55
Link-18	TRAPEZOIDAL	1.00	7.00	1	5.00	0.67	63.50
Link-19	TRAPEZOIDAL	1.00	7.00	1	5.00	0.67	63.75
Link-20	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	228.55
Link-23	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	204.42

************************** Runoff Quantity Continuity **************************	Volume acre-ft	Depth inches
Total Precipitation	92.076	4.973
Surface Runoff	2.847	0.154
Continuity Error (%)	-0.000	

************************** Flow Routing Continuity **************************	Volume acre-ft	Volume Mgallons
External Inflow	0.000	0.000
External Outflow	28.474	9.279
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	-0.000	

****
Composite Curve Number Computations Report
****

Subbasin Offsite_1

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Fair	3.77	B	60.00
Paved parking & roofs	1.43	B	98.00
Composite Area & Weighted CN	5.20		70.45

Subbasin Offsite_2

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Good	95.00	B	55.00
Paved parking & roofs	5.00	B	98.00
Composite Area & Weighted CN	100.00		57.15

Subbasin Offsite_3

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Good	37.00	B	55.00
Paved parking & roofs	3.00	B	98.00
Composite Area & Weighted CN	40.00		58.23

Subbasin Onsite_1

Soil/Surface Description	Area (acres)	Soil Group	CN
> 75% grass cover, Good	1.10	C	74.00
Woods, Good	20.80	C	70.00
Wetlands	2.80	-	90.00
Paved parking & roofs	0.90	C	98.00
Composite Area & Weighted CN	25.60		73.34

Subbasin Onsite_2

Soil/Surface Description	Area (acres)	Soil Group	CN
> 75% grass cover, Good	1.10	C	74.00
Woods, Good	20.90	C	70.00
Wetlands	2.80	-	90.00
Paved parking & roofs	0.90	C	98.00
Composite Area & Weighted CN	25.70		73.33

Subbasin Onsite_3

Soil/Surface Description	Area (acres)	Soil Group	CN
> 75% grass cover, Good	1.10	C	74.00
Woods, Good	20.90	C	70.00
Wetlands	2.80	-	90.00
Paved parking & roofs	0.90	C	98.00
Composite Area & Weighted CN	25.70		73.33

****
SCS TR-55 Time of Concentration Computations Report
****

Sheet Flow Equation

$$Tc = (0.007 * ((n * Lf)^{0.8})) / ((P^{0.5}) * (Sf^{0.4}))$$

Where:

Tc = Time of Concentration (hrs)
n = Manning's Roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's Roughness

Subbasin Offsite_1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	5.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.11	0.00	0.00
Computed Flow Time (minutes):	23.20	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	300.00	0.00	0.00
Slope (%):	8.00	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	4.24	0.00	0.00
Computed Flow Time (minutes):	1.18	0.00	0.00
Total TOC (minutes):	24.38		

Subbasin Offsite_2

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00

Slope (%):	3.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.05	0.00	0.00
Computed Flow Time (minutes):	49.55	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	2000.00	1500.00	890.00
Slope (%):	27.00	10.00	8.00
Surface Type:	Woodland	Woodland	Grassed waterway
Velocity (ft/sec):	2.60	1.58	4.24
Computed Flow Time (minutes):	12.82	15.82	3.50
Total TOC (minutes):	81.69		

Subbasin Offsite_3

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	5.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.06	0.00	0.00
Computed Flow Time (minutes):	40.39	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1500.00	500.00	0.00
Slope (%):	25.00	10.00	0.00
Surface Type:	Woodland	Unpaved	Unpaved
Velocity (ft/sec):	2.50	5.10	0.00
Computed Flow Time (minutes):	10.00	1.63	0.00
Total TOC (minutes):	52.03		

Subbasin Onsite_1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.09	0.00	0.00
Computed Flow Time (minutes):	27.56	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1200.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	5.41	0.00	0.00
Computed Flow Time (minutes):	3.70	0.00	0.00
Total TOC (minutes):	31.26		

Subbasin Onsite_2

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.09	0.00	0.00
Computed Flow Time (minutes):	27.56	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1200.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	5.41	0.00	0.00
Computed Flow Time (minutes):	3.70	0.00	0.00
Total TOC (minutes):	31.26		

Subbasin Onsite_3

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.09	0.00	0.00
Computed Flow Time (minutes):	27.56	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1200.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	5.41	0.00	0.00
Computed Flow Time (minutes):	3.70	0.00	0.00
Total TOC (minutes):	31.26		

****
Subbasin Runoff Summary
****

Subbasin ID	Total Precip in	Total Runoff in	Peak Runoff cfs	Weighted Curve Number	Time of Concentration days	hh:mm:ss
Offsite_1	4.96	2.04	5.01	70.450	0	00:24:22
Offsite_2	4.96	1.09	18.00	57.150	0	01:21:41
Offsite_3	4.96	1.16	10.38	58.230	0	00:52:01
Onsite_1	4.96	2.28	25.03	73.340	0	00:31:15
Onsite_2	4.96	2.28	25.11	73.330	0	00:31:15
Onsite_3	4.96	2.28	25.11	73.330	0	00:31:15

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
Jun-01	0.17	0.62	1111.22	0	10:15	0	0	0:00:00
Jun-02	0.06	0.24	1109.18	0	10:15	0	0	0:00:00
Jun-03	0.64	1.40	1147.13	0	11:05	0	0	0:00:00
Jun-04	0.25	0.51	1144.37	0	11:05	0	0	0:00:00
Jun-05	0.28	0.57	970.57	0	11:06	0	0	0:00:00
Jun-08	0.28	0.89	1022.89	0	10:20	0	0	0:00:00
Jun-11	0.17	0.42	1062.42	0	10:39	0	0	0:00:00
Jun-12	0.40	0.92	962.92	0	10:20	0	0	0:00:00
Jun-13	0.19	0.76	922.76	0	10:19	0	0	0:00:00
Outfall_1	0.17	0.65	920.65	0	10:19	0	0	0:00:00
Outfall_2	0.35	0.76	960.76	0	10:20	0	0	0:00:00
Outfall_3	0.25	0.74	1020.74	0	10:20	0	0	0:00:00

****
Node Flow Summary
****

Node	Element	Maximum	Peak	Time of	Maximum Time of Peak

ID	Type	Lateral Inflow cfs	Inflow cfs	Peak Inflow Occurrence days	hh:mm	Flooding Overflow cfs	Flooding Occurrence days	hh:mm
Jun-01	JUNCTION	4.96	4.96	0	10:15	0.00		
Jun-02	JUNCTION	0.00	4.96	0	10:15	0.00		
Jun-03	JUNCTION	17.96	17.96	0	11:05	0.00		
Jun-04	JUNCTION	0.00	17.96	0	11:05	0.00		
Jun-05	JUNCTION	0.00	17.95	0	11:05	0.00		
Jun-08	JUNCTION	24.74	31.86	0	10:20	0.00		
Jun-11	JUNCTION	10.32	10.32	0	10:39	0.00		
Jun-12	JUNCTION	24.74	33.80	0	10:19	0.00		
Jun-13	JUNCTION	24.66	24.66	0	10:19	0.00		
Outfall_1	OUTFALL	0.00	24.66	0	10:19	0.00		
Outfall_2	OUTFALL	0.00	33.64	0	10:20	0.00		
Outfall_3	OUTFALL	0.00	31.79	0	10:20	0.00		

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
Outfall_1	86.27	3.68	24.66
Outfall_2	91.60	10.96	33.64
Outfall_3	88.15	6.67	31.79
System	88.67	21.31	89.91

****
Link Flow Summary
****

Link ID	Element Type	Time of Peak Flow Occurrence days	hh:mm	Maximum Velocity Attained ft/sec	Length Factor	Peak Flow during Analysis cfs	Design Flow Capacity cfs	Ratio of Maximum /Design Flow	Ratio of Maximum Flow Depth	Total Time Surcharged minutes
Link-01	CONDUIT	0	10:15	9.93	2.93	4.96	46.67	0.11	0.22	0
Link-02	CONDUIT	0	11:05	12.18	2.81	17.96	48.02	0.37	0.48	0
Link-10	CHANNEL	0	11:06	7.81	1.89	17.94	228.55	0.08	0.28	0
Link-13	CHANNEL	0	10:20	8.45	5.68	31.79	228.55	0.14	0.41	0
Link-17	CHANNEL	0	10:20	8.56	5.68	33.64	228.55	0.15	0.42	0
Link-18	CHANNEL	0	10:15	2.21	1.00	4.92	63.50	0.08	0.57	0
Link-19	CHANNEL	0	11:05	8.16	1.00	17.95	63.75	0.28	0.54	0
Link-20	CHANNEL	0	10:19	7.96	5.68	24.66	228.55	0.11	0.35	0
Link-23	CHANNEL	0	10:39	4.30	1.00	10.32	204.42	0.05	0.32	0

****
Highest Flow Instability Indexes
****
All links are stable.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node Jun-12.

Analysis began on: Mon Sep 26 13:19:13 2016
Analysis ended on: Mon Sep 26 13:19:14 2016
Total elapsed time: 00:00:01

R-6 Zoning

****
Project Description
****
File Name .... Lewis&Clark Postdev R-6 II.SPF

****
Analysis Options
****
Flow Units .... cfs
Subbasin Hydrograph Method. SCS TR-55
Time of Concentration...... SCS TR-55
Link Routing Method .... Hydrodynamic
Storage Node Exfiltration.. Constant rate, free surface area
Starting Date APR-13-2016 00:00:00
Ending Date APR-14-2016 06:00:00
Report Time Step 00:05:00

****
Element Count
****
Number of rain gages 1
Number of subbasins 6
Number of nodes 12
Number of links 9

****
Raingage Summary
****

Gage ID	Data Source	Data Type	Recording Interval min
Rain Gage	100 YR	CUMULATIVE	6.00

****
Subbasin Summary
****

Subbasin ID	Total Area acres
Offsite_1	5.20
Offsite_2	100.00
Offsite_3	40.00
Onsite_1	25.60
Onsite_2	25.70
Onsite_3	25.70

****
Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
Jun-01	JUNCTION	1110.60	1113.60	0.00	
Jun-02	JUNCTION	1108.94	1111.94	0.00	
Jun-03	JUNCTION	1145.73	1148.73	0.00	
Jun-04	JUNCTION	1143.86	1146.86	0.00	
Jun-05	JUNCTION	970.00	972.00	0.00	
Jun-08	JUNCTION	1022.00	1024.00	0.00	
Jun-11	JUNCTION	1062.00	1064.00	0.00	
Jun-12	JUNCTION	962.00	966.00	0.00	
Jun-13	JUNCTION	922.00	924.00	0.00	
Outfall_1	OUTFALL	920.00	922.00	0.00	
Outfall_2	OUTFALL	960.00	962.00	0.00	
Outfall_3	OUTFALL	1020.00	1022.00	0.00	

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
Link-01	Jun-01	Jun-02	CONDUIT	39.0	4.2564	0.0130
Link-02	Jun-03	Jun-04	CONDUIT	41.5	4.5060	0.0130
Link-10	Jun-05	Jun-12	CHANNEL	60.0	10.0000	0.0320
Link-13	Jun-08	Outfall_3	CHANNEL	20.0	10.0000	0.0320
Link-17	Jun-12	Outfall_2	CHANNEL	20.0	10.0000	0.0320
Link-18	Jun-02	Jun-12	CHANNEL	1150.0	12.7774	0.0320
Link-19	Jun-04	Jun-05	CHANNEL	1350.0	12.8785	0.0320
Link-20	Jun-13	Outfall_1	CHANNEL	20.0	10.0000	0.0320
Link-23	Jun-11	Jun-08	CHANNEL	500.0	8.0000	0.0320

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
Link-01	CIRCULAR	2.00	2.00	1	3.14	0.50	46.67
Link-02	CIRCULAR	2.00	2.00	1	3.14	0.50	48.02
Link-10	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	228.55
Link-13	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	228.55
Link-17	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	228.55
Link-18	TRAPEZOIDAL	1.00	7.00	1	5.00	0.67	63.50

Link-19	TRAPEZOIDAL	1.00	7.00	1	5.00	0.67	63.75
Link-20	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	228.55
Link-23	TRAPEZOIDAL	2.00	11.00	1	14.00	1.17	204.42

Runoff Quantity Continuity	Volume acre-ft	Depth inches
Total Precipitation	92.076	4.973
Surface Runoff	2.898	0.157
Continuity Error (%)	-0.000	

Flow Routing Continuity	Volume acre-ft	Volume Mgallons
External Inflow	0.000	0.000
External Outflow	28.986	9.446
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	-0.000	

Composite Curve Number Computations Report

Subbasin Offsite_1

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Fair	3.77	B	60.00
Paved parking & roofs	1.43	B	98.00
Composite Area & Weighted CN	5.20		70.45

Subbasin Offsite_2

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Good	95.00	B	55.00
Paved parking & roofs	5.00	B	98.00
Composite Area & Weighted CN	100.00		57.15

Subbasin Offsite_3

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Good	37.00	B	55.00
Paved parking & roofs	3.00	B	98.00
Composite Area & Weighted CN	40.00		58.23

Subbasin Onsite_1

Soil/Surface Description	Area (acres)	Soil Group	CN
> 75% grass cover, Good	2.30	C	74.00
Woods, Good	18.90	C	70.00
Wetlands	2.80	-	90.00
Paved parking & roofs	1.60	C	98.00
Composite Area & Weighted CN	25.60		74.30

Subbasin Onsite_2

Soil/Surface Description	Area (acres)	Soil Group	CN
> 75% grass cover, Good	2.30	C	74.00
Woods, Good	19.00	C	70.00
Wetlands	2.80	-	90.00
Paved parking & roofs	1.60	C	98.00
Composite Area & Weighted CN	25.70		74.28

Subbasin Onsite_3

Soil/Surface Description	Area (acres)	Soil Group	CN

> 75% grass cover, Good	2.30	C	74.00
Woods, Good	19.00	C	70.00
Wetlands	2.80	-	90.00
Paved parking & roofs	1.60	C	98.00
Composite Area & Weighted CN	25.70		74.28

```
***************************************************
SCS TR-55 Time of Concentration Computations Report
***************************************************

Sheet Flow Equation
-------------------

        Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

        Where:

        Tc = Time of Concentration (hrs)
        n  = Manning's Roughness
        Lf = Flow Length (ft)
        P  = 2 yr, 24 hr Rainfall (inches)
        Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation
----------------------------------

        V  = 16.1345 * (Sf^0.5) (unpaved surface)
        V  = 20.3282 * (Sf^0.5) (paved surface)
        V  = 15.0 * (Sf^0.5) (grassed waterway surface)
        V  = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
        V  = 9.0 * (Sf^0.5) (cultivated straight rows surface)
        V  = 7.0 * (Sf^0.5) (short grass pasture surface)
        V  = 5.0 * (Sf^0.5) (woodland surface)
        V  = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
        Tc = (Lf / V) / (3600 sec/hr)

        Where:

        Tc = Time of Concentration (hrs)
        Lf = Flow Length (ft)
        V  = Velocity (ft/sec)
        Sf = Slope (ft/ft)

Channel Flow Equation
---------------------

        V  = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
        R  = Aq / Wp
        Tc = (Lf / V) / (3600 sec/hr)

        Where:

        Tc = Time of Concentration (hrs)
        Lf = Flow Length (ft)
        R  = Hydraulic Radius (ft)
        Aq = Flow Area (ft²)
        Wp = Wetted Perimeter (ft)
        V  = Velocity (ft/sec)
        Sf = Slope (ft/ft)
        n  = Manning's Roughness

---------------------
Subbasin Offsite_1
---------------------
```

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	5.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.11	0.00	0.00
Computed Flow Time (minutes):	23.20	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	300.00	0.00	0.00
Slope (%):	8.00	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	4.24	0.00	0.00
Computed Flow Time (minutes):	1.18	0.00	0.00
Total TOC (minutes):	24.38		

Subbasin Offsite_2

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	3.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.05	0.00	0.00
Computed Flow Time (minutes):	49.55	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	2000.00	1500.00	890.00
Slope (%):	27.00	10.00	8.00
Surface Type:	Woodland	Woodland	Grassed waterway
Velocity (ft/sec):	2.60	1.58	4.24
Computed Flow Time (minutes):	12.82	15.82	3.50
Total TOC (minutes):	81.69		

Subbasin Offsite_3

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	5.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.06	0.00	0.00
Computed Flow Time (minutes):	40.39	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1500.00	500.00	0.00
Slope (%):	25.00	10.00	0.00
Surface Type:	Woodland	Unpaved	Unpaved
Velocity (ft/sec):	2.50	5.10	0.00
Computed Flow Time (minutes):	10.00	1.63	0.00
Total TOC (minutes):	52.03		

Subbasin Onsite_1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.09	0.00	0.00
Computed Flow Time (minutes):	27.56	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1200.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	5.41	0.00	0.00
Computed Flow Time (minutes):	3.70	0.00	0.00
Total TOC (minutes):	31.26		

Subbasin Onsite_2

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.09	0.00	0.00
Computed Flow Time (minutes):	27.56	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1200.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	5.41	0.00	0.00
Computed Flow Time (minutes):	3.70	0.00	0.00
Total TOC (minutes):	31.26		

Subbasin Onsite_3

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.80	0.00	0.00
Flow Length (ft):	150.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.52	0.00	0.00
Velocity (ft/sec):	0.09	0.00	0.00
Computed Flow Time (minutes):	27.56	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	1200.00	0.00	0.00
Slope (%):	13.00	0.00	0.00
Surface Type:	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec):	5.41	0.00	0.00
Computed Flow Time (minutes):	3.70	0.00	0.00
Total TOC (minutes):	31.26		

****
Subbasin Runoff Summary
****

Subbasin ID	Total Precip in	Total Runoff in	Peak Runoff cfs	Weighted Curve Number	Time of Concentration days	hh:mm:ss
Offsite_1	4.96	2.04	5.01	70.450	0	00:24:22
Offsite_2	4.96	1.09	18.00	57.150	0	01:21:41
Offsite_3	4.96	1.16	10.38	58.230	0	00:52:01
Onsite_1	4.96	2.36	26.23	74.300	0	00:31:15
Onsite_2	4.96	2.36	26.30	74.280	0	00:31:15
Onsite_3	4.96	2.36	26.30	74.280	0	00:31:15

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
Jun-01	0.17	0.62	1111.22	0	10:14	0	0	0:00:00
Jun-02	0.06	0.24	1109.18	0	10:15	0	0	0:00:00
Jun-03	0.64	1.40	1147.13	0	11:04	0	0	0:00:00
Jun-04	0.25	0.51	1144.37	0	11:05	0	0	0:00:00
Jun-05	0.28	0.57	970.57	0	11:06	0	0	0:00:00
Jun-08	0.28	0.90	1022.90	0	10:20	0	0	0:00:00
Jun-11	0.17	0.42	1062.42	0	10:39	0	0	0:00:00
Jun-12	0.40	0.93	962.93	0	10:20	0	0	0:00:00
Jun-13	0.19	0.78	922.78	0	10:15	0	0	0:00:00

Outfall_1	0.18	0.66	920.66	0	10:15	0	0	0:00:00
Outfall_2	0.35	0.78	960.78	0	10:20	0	0	0:00:00
Outfall_3	0.26	0.75	1020.75	0	10:20	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days	hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	hh:mm
Jun-01	JUNCTION	4.96	4.96	0	10:14	0.00		
Jun-02	JUNCTION	0.00	4.96	0	10:15	0.00		
Jun-03	JUNCTION	17.96	17.96	0	11:04	0.00		
Jun-04	JUNCTION	0.00	17.96	0	11:05	0.00		
Jun-05	JUNCTION	0.00	17.95	0	11:05	0.00		
Jun-08	JUNCTION	25.87	32.94	0	10:20	0.00		
Jun-11	JUNCTION	10.32	10.32	0	10:39	0.00		
Jun-12	JUNCTION	25.87	34.89	0	10:20	0.00		
Jun-13	JUNCTION	25.83	25.83	0	10:15	0.00		
Outfall_1	OUTFALL	0.00	25.85	0	10:15	0.00		
Outfall_2	OUTFALL	0.00	34.73	0	10:20	0.00		
Outfall_3	OUTFALL	0.00	32.87	0	10:20	0.00		

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
Outfall_1	86.49	3.78	25.85
Outfall_2	91.86	11.04	34.73
Outfall_3	88.38	6.77	32.87
System	88.91	21.59	93.18

****
Link Flow Summary
****

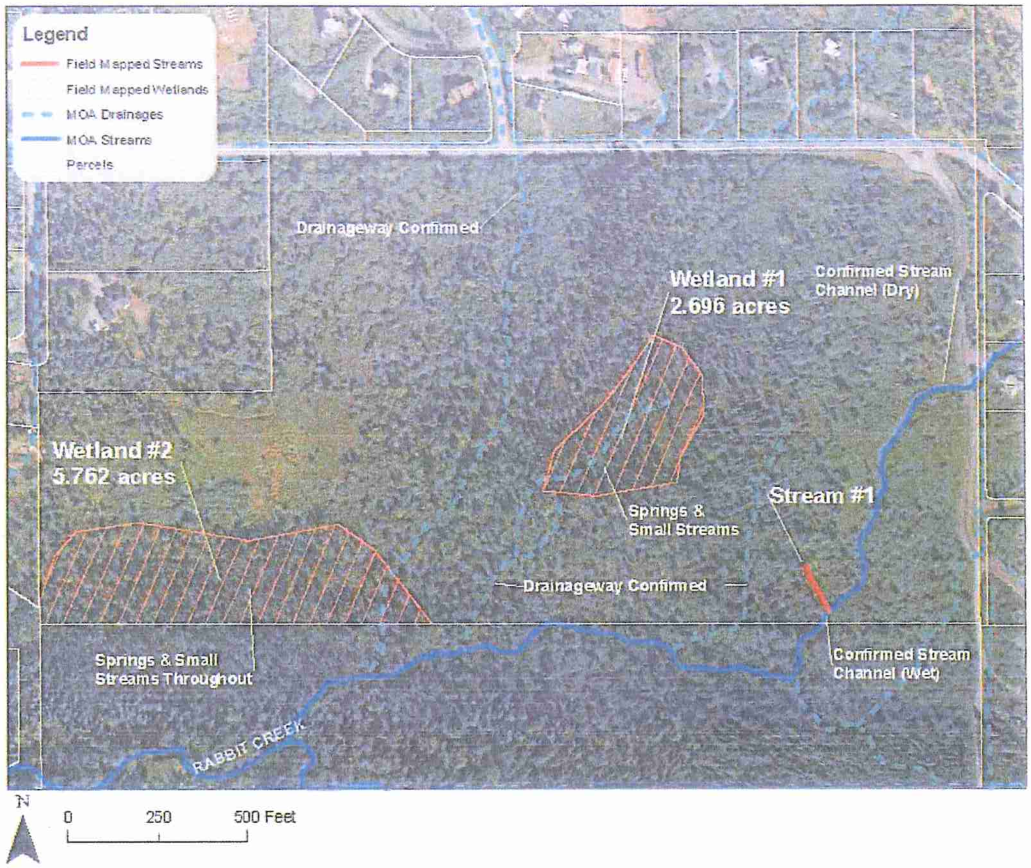
Link ID	Element Type	Time of Peak Flow Occurrence days	hh:mm	Maximum Velocity Attained ft/sec	Length Factor	Peak Flow during Analysis cfs	Design Flow Capacity cfs	Ratio of Maximum /Design Flow	Ratio of Maximum Flow Depth	Total Time Surcharged minutes
Link-01	CONDUIT	0	10:15	9.93	2.93	4.96	46.67	0.11	0.22	0
Link-02	CONDUIT	0	11:05	12.18	2.81	17.96	48.02	0.37	0.48	0
Link-10	CHANNEL	0	11:06	7.81	1.89	17.94	228.55	0.08	0.28	0
Link-13	CHANNEL	0	10:20	8.51	5.68	32.87	228.55	0.14	0.41	0
Link-17	CHANNEL	0	10:20	8.62	5.68	34.73	228.55	0.15	0.43	0
Link-18	CHANNEL	0	10:15	2.16	1.00	4.92	63.50	0.08	0.58	0
Link-19	CHANNEL	0	11:05	8.16	1.00	17.95	63.75	0.28	0.54	0
Link-20	CHANNEL	0	10:15	8.05	5.68	25.85	228.55	0.11	0.36	0
Link-23	CHANNEL	0	10:39	4.26	1.00	10.32	204.42	0.05	0.32	0

****
Highest Flow Instability Indexes
****
All links are stable.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node Jun-12.

Analysis began on: Mon Sep 26 13:21:32 2016
Analysis ended on: Mon Sep 26 13:21:33 2016
Total elapsed time: 00:00:01

f. Wetland Mapping



SECTION G

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LEWIS & CLARK SUBDIVISION
UPPER DEARMOUN ROAD CONDITION ASSESSMENT
3-24-17

The following assessment of Upper DeArmoun Road is intended to provide a planning level review of the current road condition and the impact, if any, that the Lewis and Clark Subdivision will have due to increased traffic loading. Lewis and Clark Subdivision is a proposed 80 acre development in Anchorage, Alaska. The project intends to rezone from the current R-8 zoning to R-6 with a Special Limitation to limit the total number of lots to 30. Access to the development would be provided via two secondary roads that would connect onto Upper DeArmoun generally between Michael Road and Jeanne Road.

Triad Engineering has reviewed the traffic letter dated January 20th, 2017 provided by Kinney Engineering, LLC and notes the following:

- Upper DeArmoun Road is classified as a neighborhood collector (IC) which is designated to carry 2,000 to 10,000 vehicles per day.
- ADOT traffic counts for 2014 show an annual average daily traffic (AADT) for Upper DeArmoun Road as 789 vehicles per day.
- Traffic from the Lewis and Clark Subdivision development, based on 30 lots, would increase traffic loading on Upper DeArmoun Road by 286 trips per day.
- The resulting AADT on Upper DeArmoun Road of 1,075 trips per day is *"well below the appropriate volumes for a neighborhood collector*[1]*."*

Kinney Engineering further provides a brief evaluation of the current condition of Upper DeArmoun Road and finds, based on the data available, that the poor pavement condition is likely due to pavement age and the result of seasonal movement and cracking, not indicative of overloading or structural failure.

Triad Engineering has reviewed aerial photography of Upper DeArmoun Road as well as performed site visits in the summer of 2016 to assess the current road condition. Evidence between Michael and Jeanne Roads shows the majority of surface flaws to be longitudinal and transverse cracking of the pavement surface. Alligator cracking, potholes, rutting or frost heaves, which are typical signs of subbase failure, were not visually evident.

In general, longitudinal and transverse cracking can be attributed to pavement fatigue (age), reflective cracking, poor pavement joint construction and seasonal temperature cycles. Structural failure of the road, due to overloading for instance, would typically lead to alligator cracking, potholes and rutting.

[1] Webb, W. (2017, January 20). Lewis and Clark Subdivision Rezone Traffic Letter [Letter to Todd Brownson].

The cracks within Upper DeArmoun Road have been sealed with an asphalt sealant to prevent moisture from entering the subgrade. This is standard practice from a maintenance standpoint. Due to the extensive sealing performed along this portion of Upper DeArmoun Road, an overlay (or milling and repaving), as part of the ongoing maintenance of the road, would appear prudent.

In summary, based on the above information, Triad Engineering concurs with the evaluation provided by Kinney Engineering that the current road condition of Upper DeArmoun Road is likely due to pavement age and the seasonal movement that occurs with that age. Pavement replacement due to old age, whether by overlay or milling and repaving, is a maintenance obligation and falls under the responsibility of the Glen Alps Road Service Area, not a future developer. Furthermore, the addition of 286 trips per day from the proposed Lewis and Clark development would not significantly impact the current condition of the road.

Submitted By:
Brandon Marcott, P.E.

SECTION H

Preliminary Determination of Wetlands & Waters

MOA Parcel 1707306000;
SEC 25, T12N, R3W, SM;
SW corner of Upper DeArmoun Rd and Canyon Rd.

Municipality of Anchorage, Alaska

22 December 2014

Prepared by

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Introduction

This report summarizes a delineation of wetlands and waters performed by Patrick Athey of Hemlock Scientific, LLC at MOA Parcel 1707306000, located at the southwest corner of Upper Dearmoun Rd and Canyon Rd., within the Hillside district of Anchorage, Alaska. The location of the parcel is illustrated in Map 1.

Methods

Wetland determinations and boundary mapping was performed at the property during August and September of 2011. Field adjustment of wetland boundaries and mapping of additional wetlands were made in August 2012. Determination of wetlands and the boundaries of wetlands with non-wetlands were made according to the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Alaska Region (Version 2.0) dated September 2007 and the 1987 Corps of Engineers Wetland Delineation Manual.

The primary tasks for the work included: 1) a review of existing maps and ecological data, 2) collection of field data at observation points to determine the presence or absence of wetlands, and 3) field delineation of the boundaries separating wetlands and uplands.

Existing data that was reviewed as part of this work included, USGS Topographic Series Maps, Municipality of Anchorage Wetland Atlas, Soil Survey of the Anchorage Area, Alaska published by the Natural Resources Conservation Service, and National Wetlands Inventory (NWI) Maps.

The methodology used for delineating wetlands is known as the triple parameter approach as described in the Alaska Regional Supplement. The premise of this approach is that the three essential characteristics of wetlands (hydrophytic vegetation, hydric soils, and wetland hydrology) must all be present to have a positive wetland determination. These methods were used to achieve accurate characterization of the wetland community at specific observation points and to correlate the findings with existing data (aerial photography, soils mapping, and other maps where these were available). The determination points were numbered sequentially (e.g., "DP-1") for tracking on wetland determination data forms published in the Alaska Regional Supplement. Completed Wetland Data Forms are included as Attachment 2. Photos of wetland features and site conditions encountered in the field investigation are provided in Attachment 3.

Soils were evaluated for hydric indicators by digging test pits and comparing the soil to the listed indicators provided in the Regional Guidance document. Soil colors were evaluated with a Munsell Soil Color Chart (Kollmogren, 1990). Observations were correlated with the soil type descriptions in the soil surveys were used to identify mapped soil types. Field conditions were compared to the published soil series mapping for the area, the *Soil Survey of Anchorage Area, Alaska* (NRCS, 2001). The NRCS soils are displayed in Map 3 along with the National Wetland Inventory (NWI) designations. Additionally, the location of field Determination Points (DPs) are provided on Map 3. The NRCS-mapped soil units on the property are summarized in Table 1.

Table 1. NRCS Soil Map Units

Symbol	Soil Unit Name[1]
412	Deception-Estelle-Kichatna complex, 20 to 45 percent slopes
414	Deception-Estelle-Kichatna complex, undulating and hilly
417	Doroshin peat, 0 to 7 percent slopes (listed hydric soil)
426	Jacobsen-Disappear-Doroshin complex, 3 to 7 percent slopes
427	Jacobsen-Disappear-Doroshin complex, 7 to 12 percent slopes
438	Moose River-Niklason complex, occasionally flooded, 0 to 3 percent slopes (listed hydric)

[1]From NRCS (2001).

Water must be present in order for wetlands to exist; however, it does not need to be present throughout the entire year. Wetland hydrology is considered to be present when there is permanent or periodic inundation or soil saturation for a significant period of time during the growing season, which is specified as two weeks or more by Alaska Regional Guidance. Indicators of wetland hydrology include areas of ponding or soil saturation, evidence of previous water inundation such as dry algae on bare soil, watermarks on soils or leaves, and drainage patterns among others. Where positive indicators are observed, it is assumed that wetland hydrology occurs for a significant period of the growing season. Test pits were inspected to confirm the presence of indicators below ground surface (e.g., saturation, high water table).

Dominant plant species were characterized in a 30-foot diameter circle centered at the soil pit. Within this circle, the cover of each plant species was estimated to obtain representative data of the vegetation components. The vegetation cover of each species and its assigned wetland indicator status were used to calculate indices of hydrophytic vegetation. Plant species were identified using regional plant guides, including Collet (2002), Dickenson (1999), Hulten (1968), Johnson, et al. (1995), Pratt (1989), Tande and Lipkin (2003), Viereck and Little (1972), among others. Plant species names used on data forms followed the nomenclature of Reed (1988) which also provides the wetland indicator status of the plants.

The geographic coordinates of wetland Determination Points (DPs), wetland boundaries, streams, and other features were recorded in the field with a handheld GPS unit.

The potential presence of wetlands was evaluated also by inspection of the Anchorage Wetland Management Plan mapping, which is presented in Map 4 along with the location of the DPs.

Findings

Potential jurisdictional wetlands were found within the property as determined by a detailed evaluation of vegetation, soils, and hydrology at established determination points and supported with observations throughout the area. The boundaries of wetlands with adjacent uplands were flagged in the field and the positions recorded with a hand-held GPS unit.

The results of the field delineation are presented in Maps 5 through 8 (Attachment 1). Table 2 provides a summary of the wetlands and other aquatic features. A total of eight (8) wetland polygons were identified and mapped on the subject property. Additionally, there are surface water features on the property including two ponds formed by beaver dams on Fire Creek and four other small streams.

Inspection of the property occurred during the normal growing season in southcentral Alaska during late August through early September 2014. The local precipitation patterns were consulted to determine if hydrology indicators observed at the site were representative of normal conditions. In this case, the climate records for Anchorage (National Weather Service at Anchorage) indicate above-average precipitation in the months from June through September 2014. During the time prior to the investigation, there was an excess more than 3.25 inches above normal for the cumulative precipitation annually and seasonally (Table 3).

These data are used to estimate general weather patterns that may exist at the investigation site, though it is important to note that precipitation patterns within the Anchorage area may vary somewhat depending upon altitude and geography. The inspections were done in August and early September, described as the wet season in southcentral Alaska by the Alaska Regional Manual (Corps, 2007). The observed conditions at the time of inspection are considered to represent the height of soil moisture accumulation near the end of wetter-than-normal growing season. Overall, the data support the observation that hydrology and soil moisture conditions observed during the field work are representative of normal environmental conditions for the area and the lack of saturation or high water tables was not due to abnormally low precipitation occurring prior to the inspection.

Table 2. Summary of Wetlands and Other Aquatic Sites in Tract 40-A

Habitat	Cowardin	Acres	Lineal Ft
Wetland			
Wetland #1	PFO4/EM1B	2.696	.
Wetland #2	PFO4/EM1C	5.762	.
Stream			
Rabbit Creek	R3US5	.	920
Stream 1	R3US5	.	144
Total		**8.458**	**1,064**

Table 3. Cumulative Precipitation (Anchorage) for Field Inspection Dates

Precipitation (In)	Observed	Normal	Departure
August 26, 2014			
Since Jun 1	8.29	5.71	3.21
Since Jan 1	12.15	8.95	3.2
September 3, 2014			
Since Jun 1	9.08	6.37	3.40
Since Jan 1	13.53	10.22	3.31
September 9, 2014			
Since Jun 1	10.30	6.90	3.40
Since Jan 1	13.53	10.22	3.31

The wetland hydrology indicators were evaluated carefully to consider the potential for false positive results, which could influence the accurate determination of wetland hydrology and wetlands. In particular, the lack of saturation was considered a very strong indicator of negative wetland hydrology. Conversely, the presence of saturation in the upper 12-inches of soil without an associated high water table was not considered a particularly strong indicator of wetland hydrology and was evaluated carefully with evidence of hydric soils and hydrophytic vegetation occurring at a particular location.

Wetland #1 is located in the central part of the property and includes 2.696 acres of herbaceous and graminoid wetlands, springs, and small streams. The general habitat is open black spruce (*Picea mariana*; FACW) forest with open meadows. The soils are predominantly saturated organic histosol. Tree density in this wetland is sparse and numerous shrubs, herbs, and hydrophytic graminoid groundcover species occur. The wetland-associated moss *Sphagnum* spp. is prevalent in the wetland areas. The lack of *Sphagnum* was found to be a general indicator of non-hydric soil and non-wetland conditions on the parcel.

Soils in this wetland were found to consist of histosols and histic epipedons with a depleted underlying mineral substrate. The soils in this area are mapped by NRCS as Unit No. 427—Jacobsen-Disappear-Doroshin complex, 7 to 12 percent slopes, which is a listed hydric soil. The soil conditions observed in the field generally match the descriptions for these soil types. The boundary of Wetland #1 with adjacent uplands was determined through soil probing for soil saturation and changes in groundcover vegetation, including the presence of *Sphagnum* moss.

Table 4. Summary of Determination Point Data

Location ID	Vegetation	Hydrology	Soil	Wetland
DP-1	-	-	-	-
DP-2	X	-	-	-
DP-3	X	-	-	-
DP-4	X	-	-	-
DP-5	X	X	X	X
DP-6	X	X	X	X
DP-7	X	X	X	X
DP-8	X	-	-	-
DP-9	-	-	-	-
DP-10	X	-	-	-
DP-11	-	-	-	-
DP-12	-	-	-	-
DP-13	-	-	-	-
DP-15	-	-	-	-
DP-16	-	-	-	-
DP-17	X	-	-	-
DP-18	X	-	-	-
DP-19	-	-	-	-
DP-20	X	-	-	-
DP-21	X	X	X	X
DP-22	X	-	-	-
DP-23	X	X	X	X
DP-24	X	X	X	X
DP-25	-	-	-	-
DP-26	-	-	-	-

X – Positive Determination Result

The observations made in Wetland #1 are documented in data sheets for DP-5, -6, and -7; surrounding uplands are documented in data sheets for DP-8, DP-13, and DP-4. This wetland can be characterized as *Palustrine, Needle-Leaved Forested / Emergent Persistent, Saturated* (PFO4/EM1B) by the Cowardin system.

Wetland #1 is separated from Rabbit Creek and the Upper Pond by several hundred feet of non-wetlands on relatively steep gradient. Subsurface flow through the loam soils in downslope uplands likely provides a hydrological connection with Rabbit Creek.

Wetland #1.

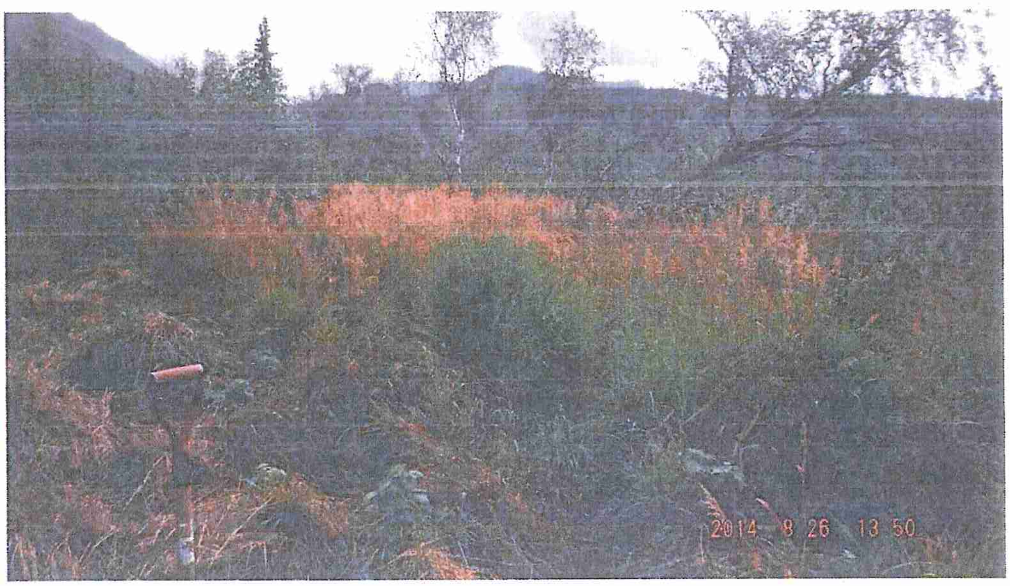
Wetland #2 is located in the south part of the property and includes 5.762 acres of seasonally flooded black spruce forest and emergent marsh on a sloping terrace that drains south to Rabbit Creek. Several springs emerge from the base of the slope separating the uplands to the north and flow as small streams to the south. Much of the area is densely wooded with black spruce, birch, and alder; some of the large spruce trees succumbed to beetle kill and litter the area, making foot access difficult. The emergent vegetation is characterized by bluejoint reed grass *Calamagrostis canadensis* (FAC) and sedges *Carex* spp.(most species are FAC, FACW, or OBL).

Soils in this wetland are histosols and histic epipedons with a depleted underlying mineral substrate. The area is mapped by NRCS as Unit No. 438—Moose River-Niklason complex, occasionally flooded, 0 to 3 percent, which is a listed hydric soil. The soil conditions observed in the field generally match the descriptions for these soil types.

This wetland can be characterized as *Palustrine, Needle-Leaved Forested / Emergent Persistent, Seasonally Flooded (*PFO4/EM1C) by the Cowardin system.

Streams are present on the property including the MOA-mapped Rabbit Creek tributary channel, which enters the parcel on the east side via a culvert beneath Canyon Rd. and extends south following the steep grade in the southeast corner of the parcel. A tributary of the creek was located near the south property line, identified as Stream #1 and was flowing with a small amount of discharge, estimated at less than 1 gallon per minute. Above the confluence with this tributary, the channel Rabbit Creek on the property was dry during the inspection.

Wetland #2.



Upland Bluejoint Reed Grass Vegetation at DP-9.

Upland Open Forest Vegetation at DP-20.

Stream #1

Rabbit Creek Tributary Channel (obscured in alder brush).

Bibliography

Collet, D.M. 2002. Willows of Southcentral Alaska. Kenai Watershed Forum.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, D.C., pp. 103.

Dickenson, R. 1999. Weeds of the Northern U.S. and Canada. Univ. of Alberta Press.

Gallant et al., 1995. Ecoregions of Alaska. U.S. Geological Survey Professional Paper 1567. Prepared in cooperation with Colorado State University and the Environmental Protection Agency.

Hulten, E. 1968. Flora of Alaska and Neighboring Territories: A Manual of the Vascular Plant. Stanford University Press, Stanford, CA.

Johnson, D., L. Kershaw, A. MacKinnon, and J. Pojar. 1995. Plants of the Western Boreal Forest and Aspen Parkland. Lone Pine Publishing.

Kollmogren Instrument Division, 1990. Munsell Soil Color Chart Baltimore, Maryland.

Municipality of Anchorage, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and Alaska District Corps of Engineers. 2000. Anchorage Debit Credit Method: A Method for Determining Development Debits and Compensatory Mitigation Credits for Aquatic Areas in Anchorage, Alaska. December 12.

Pratt, V.E. 1989. Field Guide to Alaskan Wildflowers.

Reed, Jr. Porter B. 1988. National List of Plant Species that Occurs in Wetlands: National Summary. U.S. Fish and Wildlife Service. Biological Report 88(24), pp. 244.

Tande, G. and R. Lipkin. 2003. Wetland Sedges of Alaska. Alaska Natural Heritage Program.

U.S. Army Corps of Engineers (Corps). 1987. Wetland Delineation Manual, 1987. Department of the Army. U.S. Army Corps of Engineers. Technical Report Y-87-1. Waterways Experiment Station, Vicksburg, Mississippi, pp. 117.

U.S. Army Corps of Engineers (Corps). 2007. Clean Water Act Jurisdiction Following the U.S. Supreme Court's Decision in Rapanos v. United States & Carabell v. United States (June 5, 2007)

U.S. Army Corps of Engineers (Corps). 2007. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Alaska Region (Version 2.0). Department of the Army. U.S. Army Corps of Engineers. U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi, pp. 117.

U.S. Army Corps of Engineers (Corps). 2007. U.S. Army Corps of Engineers Jurisdictional Determination Form Instructional Guidebook and Approved Jurisdictional Determination Form (May 30, 2007).

U.S. Army Corps of Engineers (Corps). 2009. Alaska District Regulatory Guidance Letter 09-01.

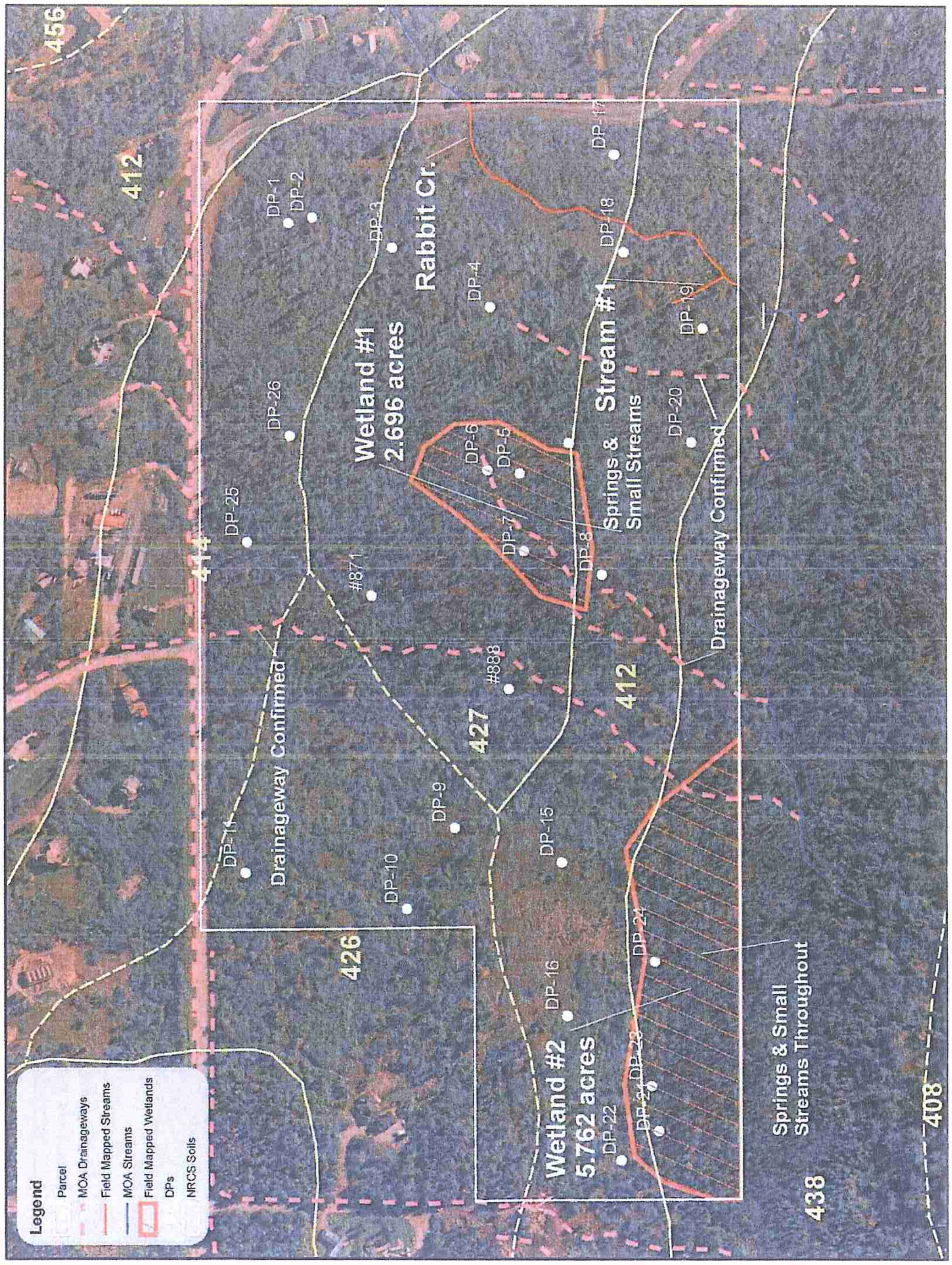
U.S. Department of Agriculture, Natural Resource Conservation Service (NRCS). 2001. Soil Survey of Anchorage Area, Alaska.

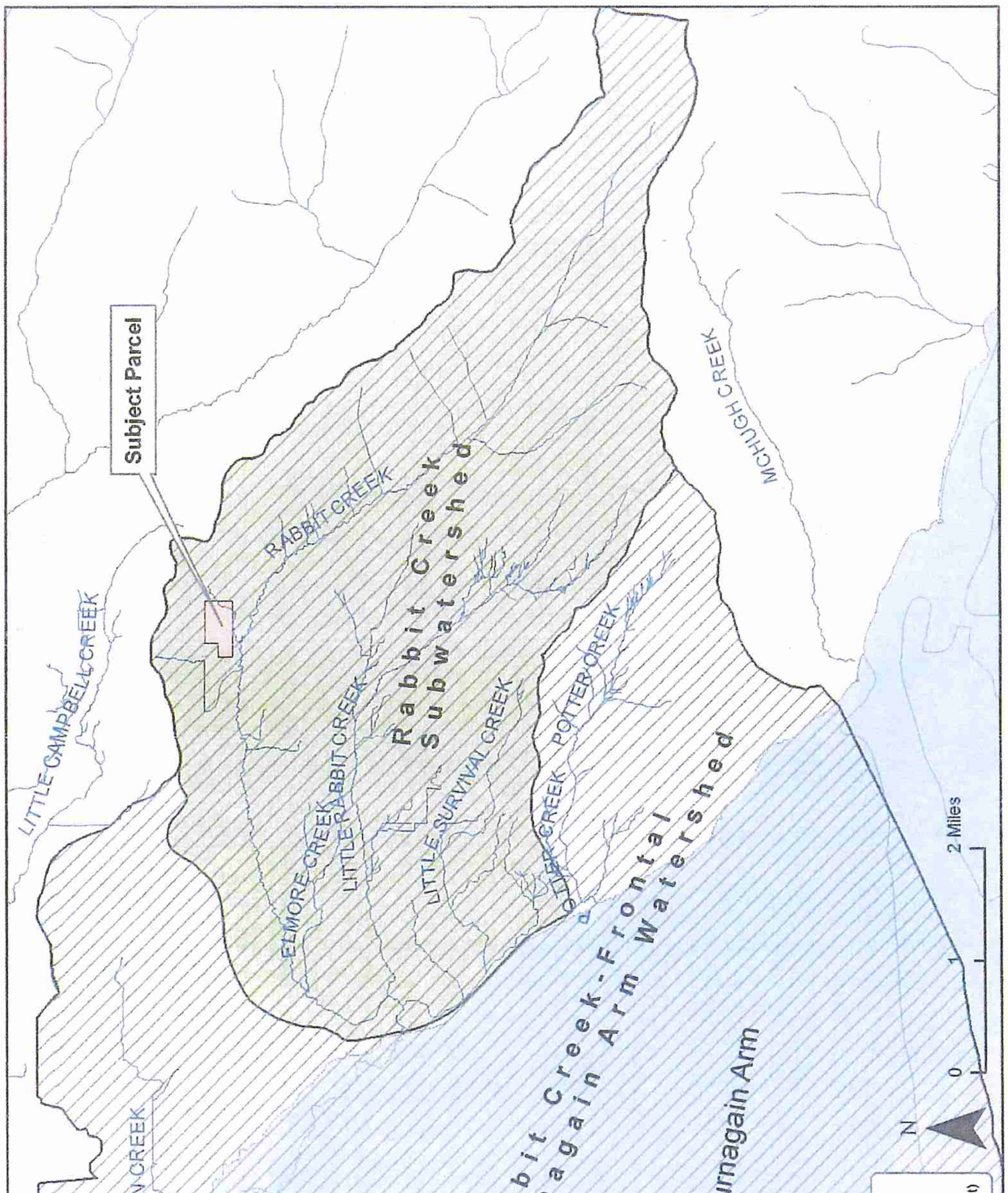
Viereck, L.A. and E.L. Little, Jr. 1972. Alaska Trees and Shrubs. Agricultural Handbook 410. U.S. Department of Agriculture, Forest Service, Washington D.C.

Viereck, L.A.; Dyrness, C.T.; Batten, A.R.; Wenzlick, K.J. 1992. The Alaska vegetation classification. Gen. Tech. Rep. PNW-GTR-286. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 278 p.

Attachment 1
Maps

MOA Parcel 1707306000


Legend
Parcel
MOA Drainageways
Field Mapped Streams
MOA Streams
Field Mapped Wetlands
DPs
NRCS Soils
Wetland #1
2.696 acres
Wetland #2
5.762 acres
Stream #1
Rabbit Cr.
Springs &
Small Streams
Springs & Small
Streams Throughout
Drainageway Confirmed
Drainageway Confirmed
DP-1
DP-2
DP-3
DP-4
DP-5
DP-6
DP-7
DP-8
DP-9
DP-10
DP-11
DP-15
DP-16
DP-17
DP-18
DP-19
DP-20
DP-21
DP-22
DP-23
DP-24
DP-25
DP-26
#871
#888
456
412
414
412
427
426
438
408
0
250
500 Feet
N



Subject Parcel
LITTLE CAMPBELL CREEK
RABBIT CREEK
MCHUGH CREEK
Rabbit Creek Subwatershed
ELMORE CREEK
LITTLE RABBIT CREEK
LITTLE SURVIVAL CREEK
POTTER CREEK
OTTER CREEK
FURROW CREEK
Rabbit Creek-Frontal Turnagain Arm Watershed
Turnagain Arm
N
0
1
2 Miles
Legend
Subject Parcel
Watershed (10-digit)
Subwatershed (12-digit)

Attachment 2
Data Forms

MOA Parcel 1707306000

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd Borough/City: Anchorage Sampling Date: 8/26/2014

Applicant/Owner: ______ Sampling Point: DP-1

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Concave Slope (%): ______

Subregion: Southcentral Lat: N 61.1007 Long: W 149.7162 Datum: NAD83

Soil Map Unit Name: 414—Deception-Estelle-Kichatna complex, undulating and hilly NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes	No X	Is the Sampled Area within a Wetland? Yes ____ No X
Hydric Soil Present?	Yes	No X	
Wetland Hydrology Present?	Yes	No X	

Remarks: Site is located on a south-facing mountain slope in open spruce-birch forest and dense alder shrub growth. Much of the spruce has been beetle-killed and blown down, opening up the canopy for shrubs to thrive.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Betula papyrifera (Southcentral)*	25	Yes	FAC
2.			
3.			
4.			
Total Cover:	25		
50% of total cover: 12.5		20% of total cover: 5	
Sapling/Shrub Stratum			
1. *Alnus viridis*	75	Yes	FAC
2. *Oplopanax horridus*	25	Yes	FACU
3. *Rubus idaeus*	10		FACU
4. *Viburnum edule*	10		FACU
5. *Actaea rubra*	5		FAC
6.			
Total Cover:	125		
50% of total cover: 62.5		20% of total cover: 25	
Herb Stratum			
1. *Calamagrostis canadensis*	50	Yes	FAC
2. *Gymnocarpium dryopteris*	25	Yes	FACU
3. *Urtica dioica*	25	Yes	FACU
4. *Athyrium filix-femina*	10		FAC
5. *Galium boreale*	10		FACU
6. *Poa pratensis*	5		FACU
7.			
8.			
9.			
10.			
Total Cover:	125		
50% of total cover: 62.		20% of total cover: 25	

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ______

% Cover of Wetland Bryophytes 0 Total Cover of Bryophytes 25
(Where applicable)

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species		x 2 = 0
FAC species	165	x 3 = 495
FACU species	110	x 4 = 440
UPL species		x 5 = 0
Column Totals:	275 (A)	935 (B)

Prevalence Index = B/A = 3.39

Hydrophytic Vegetation Indicators:

No Dominance Test is >50%

No Prevalence Index is ≤3.0

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ____ No X

Remarks:

SOIL

Sampling Point: DP-1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
+2-0	v dk gray brn 10YR3/2	50					slightly decomposed plant material	
	black 10YR2/1	50						
0-4	v dk gray 10YR3/1	100					silt loam, many fine roots, dry	
4-14	v dk gray 10YR3/1	100					silt loam & organics, dry, slightly greasy upon wetting	
14-26	grey brn 10YR5/2	100					silt loam, few med roots, dry, nonfriable	
26-30	brown 10YR5/3	100					silt loam w/ gravel & cobbles, dry; massive; firm	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol or Histel (A1)
___ Histic Epipedon (A2)
___ Hydrogen Sulfide (A4)
___ Thick Dark Surface (A12)
___ Alaska Gleyed (A13)
___ Alaska Redox (A14)
___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

___ Alaska Color Change (TA4)[4]
___ Alaska Alpine Swales (TA5)
___ Alaska Redox With 2.5Y Hue
___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):
Type: None
Depth (inches): ___

Hydric Soil Present? Yes ___ No X

Remarks: Surface soil layer is very dark hue but does not exhibit hydric characteristics. The absence of redox indicators and lack of soil moisture during this wet season supports the finding of nonhydric soil.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Surface Soil Cracks (B6)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Marl Deposits (B15)
___ Hydrogen Sulfide Odor (C1)
___ Dry-Season Water Table (C2)
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

___ Water-stained Leaves (B9)
___ Drainage Patterns (B10)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Salt Deposits (C5)
___ Stunted or Stressed Plants (D1)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ Microtopographic Relief (D4)
___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___
Water Table Present? Yes ___ No X Depth (inches): ___
Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site lacks characteristics of wetland hydrology despite the seasonally high cumulative precipitation in the region. Cumulative total precipitation on August 26, 2014 was above normal with 8.29 inches since June 1st, compared to the normal of 5.71 inches, resulting in an excess of 3.21 inches. Since January 1st, the total was 12.15 inches, compared to the normal of 8.95 inches, resulting in an excess of 3.2 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd. Borough/City: Anchorage Sampling Date: 8/26/2014

Applicant/Owner: ______ Sampling Point: DP-2

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Concave Slope (%): ______

Subregion: Southcentral Lat: N 61.1006 Long: W 149.7162 Datum: NAD83

Soil Map Unit Name: 414—Deception-Estelle-Kichatna complex, undulating and hilly NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ______ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	Is the Sampled Area within a Wetland? Yes ______ No X
Hydric Soil Present?	Yes	No X	
Wetland Hydrology Present?	Yes	No X	

Remarks: Site is located on a south-facing mountain slope at the edge of open spruce-birch forest and bluejoint-herb meadow downslope to the south. The vegetation mat is thick and despite the slopes there are no signs of erosion.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Picea mariana*	5	Yes	FACW
2.			
3.			
4.			
Total Cover:	5		
50% of total cover: 2.5	20% of total cover: 1		
Sapling/Shrub Stratum			
1. *Alnus viridis*	50	Yes	FAC
2. *Oplopanax horridus*	25	Yes	FACU
3. *Ribes triste*	10		FAC
4. *Cornus canadensis*	10		FACU
5. *Rubus idaeus*	5		FACU
6.			
Total Cover:	100		
50% of total cover: 50	20% of total cover: 20		
Herb Stratum			
1. *Calamagrostis canadensis*	75	Yes	FAC
2. *Heracleum maximum*	10		FACU
3. *Plantago lanceolata*	5		FACU
4. *Athyrium filix-femina*	5		FAC
5.			
6.			
7.			
8.			
9.			
10.			
Total Cover:	95		
50% of total cover: 47.	20% of total cover: 19		

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ______

% Cover of Wetland Bryophytes 0 Total Cover of Bryophytes 10
(Where applicable)

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species	5	x 2 = 10
FAC species	140	x 3 = 420
FACU species	55	x 4 = 220
UPL species		x 5 = 0
Column Totals:	200 (A)	650 (B)

Prevalence Index = B/A = 3.25

Hydrophytic Vegetation Indicators:

Yes Dominance Test is >50%

No Prevalence Index is ≤3.0

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ______

Remarks:

SOIL

Sampling Point: DP-2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-4	black 10YR2/1	100					silt loam, no roots, moist, greasy, friable	
4-15	v dk gray 10YR3/1	100					silt loam & organics, dry, slightly greasy upon wetting	
15-23	grey brn 10YR5/2	100					silt loam, few med roots, dry, nonfriable	
23-30	brn 10YR5/3	100					silt loam w/ gravel & cobbles, dry; massive; firm, slightly sticky and slightly plastic	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol or Histel (A1)
- ___ Histic Epipedon (A2)
- ___ Hydrogen Sulfide (A4)
- ___ Thick Dark Surface (A12)
- ___ Alaska Gleyed (A13)
- ___ Alaska Redox (A14)
- ___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

- ___ Alaska Color Change (TA4)[4]
- ___ Alaska Alpine Swales (TA5)
- ___ Alaska Redox With 2.5Y Hue
- ___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
- ___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):
Type: None
Depth (inches): ______

Hydric Soil Present? Yes ___ No X

Remarks: The lower portion of the profile correlates wtih the mapped unit for this location, Deception-Estelle-Kichatna complex. The absence of redox indicators and lack of soil moisture during this wet season supports the finding of nonhydric soil. The surface accumulation of dark silt loam is likely due to the deposition of leaf matter with its accumulated dust in this high-productivity plant community

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-stained Leaves (B9)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ______
Water Table Present? Yes ___ No X Depth (inches): ______
Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ______

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site lacks characteristics of wetland hydrology despite the seasonally high cumulative precipitation in the region. Cumulative total precipitation on August 26, 2014 was above normal with 8.29 inches since June 1st, compared to the normal of 5.71 inches, resulting in an excess of 3.21 inches. Since January 1st, the total was 12.15 inches, compared to the normal of 8.95 inches, resulting in an excess of 3.2 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM, SW corner of Upper DeArmoun Rd and Canyon Rd. Borough/City: Anchorage Sampling Date: 8/26/2014

Applicant/Owner: ______ Sampling Point: DP-3

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Flat Slope (%): ______

Subregion: Southcentral Lat: N 61.1000 Long: W 149.7166 Datum: NAD83

Soil Map Unit Name: 427—Jacobsen-Disappear-Doroshin complex, 7 to 12 percent slopes NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	Is the Sampled Area within a Wetland? Yes ____ No X
Hydric Soil Present?	Yes	No X	
Wetland Hydrology Present?	Yes	No X	

Remarks: Site is located on a south-facing mountain slope at the edge of open spruce-birch forest and bluejoint-herb meadow downslope to the south. The vegetation mat is thick and despite the slopes there are no signs of erosion.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Picea mariana*	5	Yes	FACW
2.			
3.			
4.			
Total Cover:	5		
50% of total cover: 2.5	20% of total cover: 1		
Sapling/Shrub Stratum			
1. *Alnus viridis*	50	Yes	FAC
2. *Rubus idaeus*	25	Yes	FACU
3. *Rosa acicularis*	10		FACU
4. *Cornus canadensis*	10		FACU
5.			
6.			
Total Cover:	95		
50% of total cover: 47.5	20% of total cover: 19		
Herb Stratum			
1. *Calamagrostis canadensis*	50	Yes	FAC
2. *Equisetum arvense*	25	Yes	FAC
3. *Poa pratensis*	10		FACU
4. *Carex laeviculmis*	10		FACW
5. *Carex echinata*	10		OBL
6. *Geocaulon lividum*	5		FACU
7. *Geranium erianthum*	5		FACU
8. *Sanguisorba canadensis*	1		FACW
9.			
10.			
Total Cover:	116		
50% of total cover: 58	20% of total cover: 23.2		

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ______

% Cover of Wetland Bryophytes 0 Total Cover of Bryophytes 0
(Where applicable)

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 80 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	10	x 1 = 10
FACW species	11	x 2 = 22
FAC species	135	x 3 = 405
FACU species	60	x 4 = 240
UPL species		x 5 = 0
Column Totals:	216 (A)	677 (B)

Prevalence Index = B/A = 3.13

Hydrophytic Vegetation Indicators:

Yes Dominance Test is >50%

No Prevalence Index is ≤3.0

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ____

Remarks:

SOIL

Sampling Point: DP-3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
+7-0	black 10YR2/1	50					wood debris and decomposed plant material	
	dk red brn 5YR3/4	50						
0-12	v dk gray 10YR3/1	100					silt loam, many fine roots, dry	
12 -15	v dk gray 10YR3/1	100					silt loam, few med roots, dry, nonfriable	
15-29	brn 10YR5/3	50					silt loam w/ gravel & cobbles, dry; massive	
	v dk gray 10YR3/1	50						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol or Histel (A1)
- ___ Histic Epipedon (A2)
- ___ Hydrogen Sulfide (A4)
- ___ Thick Dark Surface (A12)
- ___ Alaska Gleyed (A13)
- ___ Alaska Redox (A14)
- ___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

- ___ Alaska Color Change (TA4)[4]
- ___ Alaska Alpine Swales (TA5)
- ___ Alaska Redox With 2.5Y Hue
- ___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
- ___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):

Type: None

Depth (inches): ____

Hydric Soil Present? Yes ____ No X

Remarks: The lower portion of the profile correlates wtih the mapped unit for this location, Deception-Estelle-Kichatna complex. The absence of redox indicators and lack of soil moisture during this wet season supports the finding of nonhydric soil. The surface accumulation of dark silt loam is likely due to the deposition of leaf matter with its accumulated dust in this high-productivity plant community

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-stained Leaves (B9)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ____ No X Depth (inches): ____

Water Table Present? Yes ____ No X Depth (inches): ____

Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): ____

Wetland Hydrology Present? Yes ____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site lacks characteristics of wetland hydrology despite the seasonally high cumulative precipitation in the region. Cumulative total precipitation on August 26, 2014 was above normal with 8.29 inches since June 1st, compared to the normal of 5.71 inches, resulting in an excess of 3.21 inches. Since January 1st, the total was 12.15 inches, compared to the normal of 8.95 inches, resulting in an excess of 3.2 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd. Borough/City: Anchorage Sampling Date: 8/26/2014

Applicant/Owner: ______ Sampling Point: DP-4

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Flat Slope (%): ______

Subregion: Southcentral Lat: N 61.0994 Long: W 149.7174 Datum: NAD83

Soil Map Unit Name: 427—Jacobsen-Disappear-Doroshin complex, 7 to 12 percent slopes NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	Is the Sampled Area within a Wetland?	Yes ____	No X
Hydric Soil Present?	Yes	No X			
Wetland Hydrology Present?	Yes	No X			

Remarks: Site is located on a south-facing mountain slope in open spruce-birch forest and dense alder shrub growth. Much of the spruce has been beetle-killed and blown down, opening up the canopy for shrubs and herbs to colonize the area.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Betula papyrifera (Southcentral)*	5	Yes	FAC
2.			
3.			
4.			
Total Cover:	5		
50% of total cover: 2.5 20% of total cover: 1			
Sapling/Shrub Stratum			
1. *Alnus viridis*	50	Yes	FAC
2. *Rubus idaeus*	25	Yes	FACU
3. *Rosa acicularis*	10		FACU
4. *Cornus canadensis*	10		FACU
5.			
6.			
Total Cover:	95		
50% of total cover: 47.5 20% of total cover: 19			
Herb Stratum			
1. *Calamagrostis canadensis*	75	Yes	FAC
2. *Heracleum maximum*	25	Yes	FACU
3. *Equisetum arvense*	25		FAC
4. *Taraxacum officinale*	10		FACU
5. *Carex laeviculmis*	10		FACW
6. *Carex echinata*	10		OBL
7. *Geocaulon lividum*	5		FACU
8. *Geranium erianthum*	5		FACU
9. *Sanguisorba canadensis*	1		FACW
10.			
Total Cover:	166		
50% of total cover: 83 20% of total cover: 33.2			

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ____

% Cover of Wetland Bryophytes 0 (Where applicable) Total Cover of Bryophytes 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 60 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	10	x 1 = 10
FACW species	11	x 2 = 22
FAC species	155	x 3 = 465
FACU species	90	x 4 = 360
UPL species		x 5 = 0
Column Totals:	266 (A)	857 (B)

Prevalence Index = B/A = 3.22

Hydrophytic Vegetation Indicators:

Yes Dominance Test is >50%

No Prevalence Index is ≤3.0

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ____

Remarks:

SOIL

Sampling Point: DP-4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
+3-0	black 10YR2/1	100					decomposed plant material, roots, silt	
0-10	black 10YR2/1 v dk gray 10YR3/1	50 50					silt loam, many fine roots, dry	
12-15	v dk gray 10YR3/1	100					silt loam, few med roots, dry, nonfriable	
15-27	brn 10YR5/3	100					silt loam w/ gravel & cobbles, dry; massive	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol or Histel (A1)
- ___ Histic Epipedon (A2)
- ___ Hydrogen Sulfide (A4)
- ___ Thick Dark Surface (A12)
- ___ Alaska Gleyed (A13)
- ___ Alaska Redox (A14)
- ___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

- ___ Alaska Color Change (TA4)[4]
- ___ Alaska Alpine Swales (TA5)
- ___ Alaska Redox With 2.5Y Hue
- ___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
- ___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):
Type: None
Depth (inches): ___

Hydric Soil Present? Yes ___ No X

Remarks: The lower portion of the profile correlates wtih the mapped unit for this location, Deception-Estelle-Kichatna complex. The absence of redox indicators and lack of soil moisture during this wet season supports the finding of nonhydric soil. The surface accumulation of dark silt loam is likely due to the deposition of leaf matter with its accumulated dust in this high-productivity plant community

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-stained Leaves (B9)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___
Water Table Present? Yes ___ No X Depth (inches): ___
Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site lacks characteristics of wetland hydrology despite the seasonally high cumulative precipitation in the region. Cumulative total precipitation on August 26, 2014 was above normal with 8.29 inches since June 1st, compared to the normal of 5.71 inches, resulting in an excess of 3.21 inches. Since January 1st, the total was 12.15 inches, compared to the normal of 8.95 inches, resulting in an excess of 3.2 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd   Borough/City: Anchorage   Sampling Date: 8/26/2014

Applicant/Owner: ______   Sampling Point: DP-5

Investigator(s): Pat Athey   Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Concave   Slope (%): ______

Subregion: Southcentral   Lat: N 61.0992   Long: W 149.7196   Datum: NAD83

Soil Map Unit Name: 427—Jacobsen-Disappear-Doroshin complex, 7 to 12 percent slopes   NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed?   Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic?   (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	Is the Sampled Area within a Wetland?	Yes X No ____
Hydric Soil Present?	Yes X	No		
Wetland Hydrology Present?	Yes X	No		

Remarks: Site is located on a south-facing mountain slope in open black spruce forest interspersed with sedge-grass meadows and small sreams that emerge from the slopes, flow a short distance before re-entering the ground. Much of the spruce has been beetle-killed and blown down, opening up the canopy for shrubs and herbs to colonize the area.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Picea mariana*	25	Yes	FACW
2.			
3.			
4.			
Total Cover:	25		
50% of total cover: 12.5	20% of total cover: 5		
Sapling/Shrub Stratum			
1. *Alnus viridis*	10	Yes	FAC
2. *Picea mariana*	10	Yes	FACW
3. *Dasiphora fruticosa*	10	Yes	FAC
4. *Vaccinium uliginosum*	5		FAC
5.			
6.			
Total Cover:	35		
50% of total cover: 17.5	20% of total cover: 7		
Herb Stratum			
1. *Calamagrostis canadensis*	25	Yes	FAC
2. *Sanguisorba canadensis*	10	Yes	FACW
3. *Deschampsia caespitosa*	10		FAC
4. *Equisetum fluviatile*	10		OBL
5. *Carex laeviculmis*	5		FACW
6. *Carex echinata*	1		OBL
7. *Parnassia palustris*	1		FACW
8.			
9.			
10.			
Total Cover:	62		
50% of total cover: 31	20% of total cover: 12.4		

Plot size (radius, or length x width) 30-ft diameter   % Bare Ground ______

% Cover of Wetland Bryophytes 10   Total Cover of Bryophytes 10
(Where applicable)

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 6 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	11	x 1 = 11
FACW species	51	x 2 = 102
FAC species	60	x 3 = 180
FACU species		x 4 = 0
UPL species		x 5 = 0
Column Totals:	122 (A)	293 (B)

Prevalence Index = B/A = 2.40

Hydrophytic Vegetation Indicators:

Yes Dominance Test is >50%

Yes Prevalence Index is ≤3.0

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ____

Remarks:

SOIL

Sampling Point: DP-5

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-30	v dk gray brn 10YR3/2	50						muck and plant debris, roots; saturated; greasy;
	black 10YR2/1	50						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- X Histosol or Histel (A1)
- ___ Histic Epipedon (A2)
- ___ Hydrogen Sulfide (A4)
- ___ Thick Dark Surface (A12)
- ___ Alaska Gleyed (A13)
- ___ Alaska Redox (A14)
- ___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

- ___ Alaska Color Change (TA4)[4]
- ___ Alaska Alpine Swales (TA5)
- ___ Alaska Redox With 2.5Y Hue
- ___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
- ___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.

[4]Give details of color change in Remarks.

Restrictive Layer (if present):

Type: Saturation

Depth (inches): 0

Hydric Soil Present? Yes X No ___

Remarks: An area of groundwater discharge, small springs emerge from the slope and formstreams that flow a short distance then seep back into the ground.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- X Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-stained Leaves (B9)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes X No ___ Depth (inches): 4

Water Table Present? Yes ___ No X Depth (inches): 0

Saturation Present? (includes capillary fringe) Yes X No ___ Depth (inches): 0

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: There has been an seasonally high cumulative precipitation in the region over the past growing season that likley contributes to the observed wetland hydrology. Cumulative total precipitation on August 26, 2014 was above normal with 8.29 inches since June 1st, compared to the normal of 5.71 inches, resulting in an excess of 3.21 inches. Since January 1st, the total was 12.15 inches, compared to the normal of 8.95 inches, resulting in an excess of 3.2 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd Borough/City: Anchorage Sampling Date: 8/26/2014

Applicant/Owner: ______ Sampling Point: DP-6

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Concave Slope (%): ______

Subregion: Southcentral Lat: N 61.0994 Long: W 149.7196 Datum: NAD83

Soil Map Unit Name: 427—Jacobsen-Disappear-Doroshin complex, 7 to 12 percent slopes NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ______ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	Is the Sampled Area within a Wetland?	Yes X No ______
Hydric Soil Present?	Yes X	No		
Wetland Hydrology Present?	Yes X	No		

Remarks: Site is located on a south-facing mountain slope in open black spruce forest interspersed with sedge-grass meadows and small sreams that emerge from the slopes, flow a short distance before re-entering the ground. Much of the spruce has been beetle-killed and blown down, opening up the canopy for shrubs and herbs to colonize the area.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Picea mariana*	10	Yes	FACW
2.			
3.			
4.			
Total Cover:	10		
50% of total cover: 5		20% of total cover: 2	
Sapling/Shrub Stratum			
1. *Dasiphora fruticosa*	25	Yes	FAC
2. *Alnus viridis*	10	Yes	FAC
3. *Betula nana*	10		FAC
4. *Vaccinium uliginosum*	5		FAC
5. *Ledum groenlandicum*	5		FAC
6. *Empetrum nigrum*	5		FAC
Total Cover:	60		
50% of total cover: 30		20% of total cover: 12	
Herb Stratum			
1. *Calamagrostis canadensis*	25	Yes	FAC
2. *Arctagrostis latifolia*	25	Yes	FACW
3. *Sanguisorba canadensis*	10		FACW
4. *Equisetum fluviatile*	10		OBL
5. *Carex laeviculmis*	5		FACW
6. *Carex echinata*	5		OBL
7. *Geocaulon lividum*	1		FACU
8. *Mertensia paniculata*	1		FACU
9.			
10.			
Total Cover:	82		
50% of total cover: 41		20% of total cover: 16.4	

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ______

% Cover of Wetland Bryophytes 10 Total Cover of Bryophytes 10
(Where applicable)

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	15	x 1 = 15
FACW species	35	x 2 = 70
FAC species	102	x 3 = 306
FACU species		x 4 = 0
UPL species		x 5 = 0
Column Totals:	152 (A)	391 (B)

Prevalence Index = B/A = 2.57

Hydrophytic Vegetation Indicators:

Yes Dominance Test is >50%

Yes Prevalence Index is ≤3.0

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ______

Remarks:

SOIL

Sampling Point: DP-6

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-30	v dk gray brn 10YR3/2	50					muck and plant debris, roots; saturated; greasy;	
	black 10YR2/1	50						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- X Histosol or Histel (A1)
- ___ Histic Epipedon (A2)
- ___ Hydrogen Sulfide (A4)
- ___ Thick Dark Surface (A12)
- ___ Alaska Gleyed (A13)
- ___ Alaska Redox (A14)
- ___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

- ___ Alaska Color Change (TA4)[4]
- ___ Alaska Alpine Swales (TA5)
- ___ Alaska Redox With 2.5Y Hue
- ___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
- ___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):
Type: Saturation
Depth (inches): 0

Hydric Soil Present? Yes X No ___

Remarks: An area of groundwater discharge, small springs emerge from the slope and formstreams that flow a short distance then seep back into the ground.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- X Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-stained Leaves (B9)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes X No ___ Depth (inches): 4
Water Table Present? Yes ___ No X Depth (inches): 0
Saturation Present? (includes capillary fringe) Yes X No ___ Depth (inches): 0

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: There has been an seasonally high cumulative precipitation in the region over the past growing season that likley contributes to the observed wetland hydrology. Cumulative total precipitation on August 26, 2014 was above normal with 8.29 inches since June 1st, compared to the normal of 5.71 inches, resulting in an excess of 3.21 inches. Since January 1st, the total was 12.15 inches, compared to the normal of 8.95 inches, resulting in an excess of 3.2 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd   Borough/City: Anchorage   Sampling Date: 8/26/2014

Applicant/Owner: ______   Sampling Point: DP-7

Investigator(s): Pat Athey   Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Concave   Slope (%): ______

Subregion: Southcentral   Lat: N 61.0992   Long: W 149.7207   Datum: NAD83

Soil Map Unit Name: 427—Jacobsen-Disappear-Doroshin complex, 7 to 12 percent slopes   NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed?   Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic?   (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	Is the Sampled Area within a Wetland? Yes X No ____
Hydric Soil Present?	Yes X	No	
Wetland Hydrology Present?	Yes X	No	

Remarks: Site is located on a south-facing mountain slope in open black spruce forest interspersed with sedge-grass meadows and small sreams that emerge from the slopes, flow a short distance before re-entering the ground. Much of the spruce has been beetle-killed and blown down, opening up the canopy for shrubs and herbs to colonize the area.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Picea mariana*	10	Yes	FACW
2.			
3.			
4.			
Total Cover: 10			
50% of total cover: 5 / 20% of total cover: 2			
Sapling/Shrub Stratum			
1. *Alnus viridis*	25	Yes	FAC
2. *Picea mariana*	10	Yes	FACW
3. *Dasiphora fruticosa*	10		FAC
4. *Betula nana*	10		FAC
5. *Vaccinium uliginosum*	5		FAC
6. *Ledum groenlandicum*	5		FAC
Total Cover: 65			
50% of total cover: 32.5 / 20% of total cover: 13			
Herb Stratum			
1. *Calamagrostis canadensis*	25	Yes	FAC
2. *Deschampsia caespitosa*	25	Yes	FAC
3. *Sanguisorba canadensis*	10		FACW
4. *Equisetum fluviatile*	10		OBL
5. *Carex laeviculmis*	5		FACW
6. *Carex echinata*	5		OBL
7. *Geocaulon lividum*	1		FACU
8. *Mertensia paniculata*	1		FACU
9.			
10.			
Total Cover: 82			
50% of total cover: 41 / 20% of total cover: 16.4			

Plot size (radius, or length x width) 30-ft diameter   % Bare Ground ______

% Cover of Wetland Bryophytes 10 (Where applicable)   Total Cover of Bryophytes 10

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	15	x 1 = 15
FACW species	35	x 2 = 70
FAC species	105	x 3 = 315
FACU species	2	x 4 = 8
UPL species		x 5 = 0
Column Totals:	157 (A)	408 (B)

Prevalence Index = B/A = 2.59

Hydrophytic Vegetation Indicators:

Yes Dominance Test is >50%

Yes Prevalence Index is ≤3.0

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ______

Remarks:

SOIL

Sampling Point: DP-7

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-30	v dk gray brn 10YR3/2	50					muck and plant debris, roots; saturated; greasy;	
	black 10YR2/1	50						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- X Histosol or Histel (A1)
- ___ Histic Epipedon (A2)
- ___ Hydrogen Sulfide (A4)
- ___ Thick Dark Surface (A12)
- ___ Alaska Gleyed (A13)
- ___ Alaska Redox (A14)
- ___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

- ___ Alaska Color Change (TA4)[4]
- ___ Alaska Alpine Swales (TA5)
- ___ Alaska Redox With 2.5Y Hue
- ___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
- ___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):
Type: Saturation
Depth (inches): 0

Hydric Soil Present? Yes X No ___

Remarks: An area of groundwater discharge, small springs emerge from the slope and formstreams that flow a short distance then seep back into the ground.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- X Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-stained Leaves (B9)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes X No ___ Depth (inches): 4
Water Table Present? Yes ___ No X Depth (inches): 0
Saturation Present? (includes capillary fringe) Yes X No ___ Depth (inches): 0

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: There has been an seasonally high cumulative precipitation in the region over the past growing season that likley contributes to the observed wetland hydrology. Cumulative total precipitation on August 26, 2014 was above normal with 8.29 inches since June 1st, compared to the normal of 5.71 inches, resulting in an excess of 3.21 inches. Since January 1st, the total was 12.15 inches, compared to the normal of 8.95 inches, resulting in an excess of 3.2 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd. Borough/City: Anchorage Sampling Date: 8/26/2014

Applicant/Owner: ______ Sampling Point: DP-8

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Convex Slope (%): ______

Subregion: Southcentral Lat: N 61.0987 Long: W 149.7210 Datum: NAD83

Soil Map Unit Name: 412—Deception-Estelle-Kichatna complex, 20 to 45 percent slopes NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	Is the Sampled Area within a Wetland? Yes ____ No X
Hydric Soil Present?	Yes	No X	
Wetland Hydrology Present?	Yes	No X	

Remarks: Site is located on a small knob along a south-facing mountain slope within open spruce-birch forest and bluejoint-herb meadow downslope. The location is slightly upslope of a major topographic break that runs east-west along the property, with the area further downslope to the south becoming dense black spruce forest and wet.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Betula papyrifera (Southcentral)*	25	Yes	FAC
2. *Picea glauca*	1		FACU
3.			
4.			
Total Cover:	26		
50% of total cover: 13 / 20% of total cover: 5.2			
Sapling/Shrub Stratum			
1. *Cornus canadensis*	75	Yes	FACU
2. *Alnus viridis*	10		FAC
3. *Vaccinium vitis-idaea*	10		FAC
4. *Oplopanax horridus*	5		FACU
5.			
6.			
Total Cover:	100		
50% of total cover: 50 / 20% of total cover: 20			
Herb Stratum			
1. *Sanguisorba canadensis*	25	Yes	FACW
2. *Geocaulon lividum*	10	Yes	FACU
3. *Calamagrostis canadensis*	10	Yes	FAC
4. *Rhinanthus minor*	5		FACU
5. *Equisetum arvense*	5		FAC
6. *Phleum pratense*	5		FACU
7. *Heracleum maximum*	1		FACU
8. *Mertensia paniculata*	1		FACU
9. *Carex mertensii*	1		FACW
10.			
Total Cover:	63		
50% of total cover: 31. / 20% of total cover: 12.6			

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ____

% Cover of Wetland Bryophytes 0 Total Cover of Bryophytes 5
(Where applicable)

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 60 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species	26	x 2 = 52
FAC species	60	x 3 = 180
FACU species	103	x 4 = 412
UPL species		x 5 = 0
Column Totals:	189 (A)	644 (B)

Prevalence Index = B/A = 3.40

Hydrophytic Vegetation Indicators:

Yes Dominance Test is >50%

No Prevalence Index is ≤3.0

____ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

____ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ____

Remarks:

SOIL

Sampling Point: DP-8

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
+5-0	black 10YR2/1	50					silt, roots, wood debris and decomposed plant matter	
	dk red brn 5YR3/4	50						
0-5	black 10YR2/1	50					silt loam w/ gravel; many fine roots; dry	
	v dk gray 10YR3/1	50						
5-23	v pale brn 10YR7/3	50					silt loam w/ gravel & cobbles, dry; massive; firm	
	brown 10YR5/3	50						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol or Histel (A1)
- ___ Histic Epipedon (A2)
- ___ Hydrogen Sulfide (A4)
- ___ Thick Dark Surface (A12)
- ___ Alaska Gleyed (A13)
- ___ Alaska Redox (A14)
- ___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

- ___ Alaska Color Change (TA4)[4]
- ___ Alaska Alpine Swales (TA5)
- ___ Alaska Redox With 2.5Y Hue
- ___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
- ___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):
Type: None
Depth (inches): ____

Hydric Soil Present? Yes ____ No X

Remarks: The lower portion of the profile correlates wtih the mapped unit for this location, Deception-Estelle-Kichatna complex.The washed-out coloration of the lower profile is likley from remnant ash layers that leached down thorugh underlying brown silt loam soil. The absence of redox indicators and lack of soil moisture during this wet season supports the finding of nonhydric soil.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-stained Leaves (B9)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ____ No X Depth (inches): ____
Water Table Present? Yes ____ No X Depth (inches): ____
Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): ____

Wetland Hydrology Present? Yes ____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site lacks characteristics of wetland hydrology despite the seasonally high cumulative precipitation in the region. Cumulative total precipitation on August 26, 2014 was above normal with 8.29 inches since June 1st, compared to the normal of 5.71 inches, resulting in an excess of 3.21 inches. Since January 1st, the total was 12.15 inches, compared to the normal of 8.95 inches, resulting in an excess of 3.2 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd. Borough/City: Anchorage Sampling Date: 8/26/2014

Applicant/Owner: ______ Sampling Point: DP-9

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Convex Slope (%): ______

Subregion: Southcentral Lat: N 61.0996 Long: W 149.7245 Datum: NAD83

Soil Map Unit Name: 426—Jacobsen-Disappear-Doroshin complex, 3 to 7 percent slopes NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ______ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes	No X	Is the Sampled Area within a Wetland? Yes ______ No X
Hydric Soil Present?	Yes	No X	
Wetland Hydrology Present?	Yes	No X	

Remarks: Site is located on a south-facing mountain slope in open bluejoint reed grass-herb meadow. The site is exposed with trees and high shrubs absent

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	0		
50% of total cover: 0		20% of total cover: 0	
Sapling/Shrub Stratum			
1. *Rubus idaeus*	25	Yes	FACU
2.			
3.			
4.			
5.			
6.			
Total Cover:	25		
50% of total cover: 12.5		20% of total cover: 5	
Herb Stratum			
1. *Calamagrostis canadensis*	100	Yes	FAC
2. *Equisetum sylvaticum*	5		FAC
3. *Heracleum maximum*	5		FACU
4. *Gymnocarpium dryopteris*	1		FACU
5.			
6.			
7.			
8.			
9.			
10.			
Total Cover:	111		
50% of total cover: 55.		20% of total cover: 22.2	

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ______

% Cover of Wetland Bryophytes 0 Total Cover of Bryophytes 0
(Where applicable)

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species		x 2 = 0
FAC species	105	x 3 = 315
FACU species	31	x 4 = 124
UPL species		x 5 = 0
Column Totals:	136 (A)	439 (B)

Prevalence Index = B/A = 3.22

Hydrophytic Vegetation Indicators:

No Dominance Test is >50%

No Prevalence Index is ≤3.0

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ______ No X

Remarks:

SOIL

Sampling Point: DP-9

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
+1-0	dk gray brn 10YR4/2	100					silt, roots, wood debris and decomposed plant matter	
0-7	black 10YR2/1	50					silt loam w/ cobbles; few med roots;; dry	
	v dk gray 10YR3/1	50						
7-31	pale brn 10YR6/3	10					silt loam w/ gravel & cobbles, dry; massive; firm	
	yel brown 10YR6/3	90						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol or Histel (A1)
___ Histic Epipedon (A2)
___ Hydrogen Sulfide (A4)
___ Thick Dark Surface (A12)
___ Alaska Gleyed (A13)
___ Alaska Redox (A14)
___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

___ Alaska Color Change (TA4)[4]
___ Alaska Alpine Swales (TA5)
___ Alaska Redox With 2.5Y Hue
___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):
Type: None
Depth (inches): ______

Hydric Soil Present? Yes ___ No X

Remarks: The lower portion of the profile correlates wtih the mapped unit for this location, Deception-Estelle-Kichatna complex.The washed-out coloration of the lower profile is likley from remnant ash layers that leached down thorugh underlying brown silt loam soil. The absence of redox indicators and lack of soil moisture during this wet season supports the finding of nonhydric soil.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Surface Soil Cracks (B6)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Marl Deposits (B15)
___ Hydrogen Sulfide Odor (C1)
___ Dry-Season Water Table (C2)
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

___ Water-stained Leaves (B9)
___ Drainage Patterns (B10)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Salt Deposits (C5)
___ Stunted or Stressed Plants (D1)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ Microtopographic Relief (D4)
___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ______
Water Table Present? Yes ___ No X Depth (inches): ______
Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ______

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site lacks characteristics of wetland hydrology despite the seasonally high cumulative precipitation in the region. Cumulative total precipitation on August 26, 2014 was above normal with 8.29 inches since June 1st, compared to the normal of 5.71 inches, resulting in an excess of 3.21 inches. Since January 1st, the total was 12.15 inches, compared to the normal of 8.95 inches, resulting in an excess of 3.2 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd Borough/City: Anchorage Sampling Date: 8/26/2014

Applicant/Owner: ______ Sampling Point: DP-10

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Convex Slope (%): ______

Subregion: Southcentral Lat: N 61.1000 Long: W 149.7256 Datum: NAD83

Soil Map Unit Name: 426—Jacobsen-Disappear-Doroshin complex, 3 to 7 percent slopes NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	Is the Sampled Area within a Wetland?	Yes ____ No X
Hydric Soil Present?	Yes	No X		
Wetland Hydrology Present?	Yes	No X		

Remarks: Site is located on a south-facing mountain slope in open bluejoint reed grass-herb meadow. The site is partially exposed with trees and high shrubs occurring at the edge of the plot.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	0		
50% of total cover: 0 / 20% of total cover: 0			
Sapling/Shrub Stratum			
1. *Rubus idaeus*	25	Yes	FACU
2. *Alnus viridis*	10	Yes	FAC
3.			
4.			
5.			
6.			
Total Cover:	35		
50% of total cover: 17.5 / 20% of total cover: 7			
Herb Stratum			
1. *Calamagrostis canadensis*	100	Yes	FAC
2. *Equisetum sylvaticum*	5		FAC
3. *Heracleum maximum*	5		FACU
4. *Gymnocarpium dryopteris*	1		FACU
5.			
6.			
7.			
8.			
9.			
10.			
Total Cover:	111		
50% of total cover: 55. / 20% of total cover: 22.2			

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ______

% Cover of Wetland Bryophytes 0 (Where applicable) Total Cover of Bryophytes 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 66.6 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species		x 2 = 0
FAC species	115	x 3 = 345
FACU species	31	x 4 = 124
UPL species		x 5 = 0
Column Totals:	146 (A)	469 (B)

Prevalence Index = B/A = 3.21

Hydrophytic Vegetation Indicators:

Yes Dominance Test is >50%

No Prevalence Index is ≤3.0

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ____

Remarks:

SOIL

Sampling Point: DP-10

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
+2-0	dk gray brn 10YR4/2	100					silt, roots, wood debris and decomposed plant matter	
0-10	v pale brn 10YR7/2	20					ash and silt loam; many fine, med roots; dry	
	yel brown 10YR6/3	80						
7-31	pale brn 10YR6/3	10					silt loam w/ gravel & cobbles, dry; massive; firm	
	yel brown 10YR6/3	90						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol or Histel (A1)
- ___ Histic Epipedon (A2)
- ___ Hydrogen Sulfide (A4)
- ___ Thick Dark Surface (A12)
- ___ Alaska Gleyed (A13)
- ___ Alaska Redox (A14)
- ___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

- ___ Alaska Color Change (TA4)[4]
- ___ Alaska Alpine Swales (TA5)
- ___ Alaska Redox With 2.5Y Hue
- ___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
- ___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):
Type: None
Depth (inches): ____

Hydric Soil Present? Yes ___ No X

Remarks: The profile correlates wtih the mapped unit for this location, Deception-Estelle-Kichatna complex.The absence of redox indicators and lack of soil moisture during this wet season supports the finding of nonhydric soil.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-stained Leaves (B9)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ____
Water Table Present? Yes ___ No X Depth (inches): ____
Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ____

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site lacks characteristics of wetland hydrology despite the seasonally high cumulative precipitation in the region. Cumulative total precipitation on August 26, 2014 was above normal with 8.29 inches since June 1st, compared to the normal of 5.71 inches, resulting in an excess of 3.21 inches. Since January 1st, the total was 12.15 inches, compared to the normal of 8.95 inches, resulting in an excess of 3.2 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd. Borough/City: Anchorage Sampling Date: 8/26/2014

Applicant/Owner: ______ Sampling Point: DP-11

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Convex Slope (%): ______

Subregion: South central Lat: N 61.1010 Long: W 149.7251 Datum: NAD83

Soil Map Unit Name: 426—Jacobsen-Disappear-Doroshin complex, 3 to 7 percent slopes NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes	No X	**Is the Sampled Area within a Wetland?**	Yes ____ No X
Hydric Soil Present?	Yes	No X		
Wetland Hydrology Present?	Yes	No X		

Remarks: Site is located on a south-facing mountain slope in open bluejoint reed grass-herb meadow. The site is partially exposed with trees and high shrubs occurring at the edge of the plot.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	0		
50% of total cover: 0 20% of total cover: 0			
Sapling/Shrub Stratum			
1. *Rubus idaeus*	25	Yes	FACU
2. *Alnus viridis*	10	Yes	FAC
3. *Sorbus scopulina*	10	Yes	FACU
4.			
5.			
6.			
Total Cover:	45		
50% of total cover: 23 20% of total cover: 9			
Herb Stratum			
1. *Calamagrostis canadensis*	100	Yes	FAC
2. *Equisetum sylvaticum*	5		FAC
3. *Heracleum maximum*	5		FACU
4. *Gymnocarpium dryopteris*	1		FACU
5.			
6.			
7.			
8.			
9.			
10.			
Total Cover:	111		
50% of total cover: 56 20% of total cover: 22			

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ______

% Cover of Wetland Bryophytes 0 Total Cover of Bryophytes 0
(Where applicable)

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species		x 2 = 0
FAC species	115	x 3 = 345
FACU species	41	x 4 = 164
UPL species		x 5 = 0
Column Totals:	156 (A)	509 (B)

Prevalence Index = B/A = 3.26

Hydrophytic Vegetation Indicators:

No Dominance Test is >50%

No Prevalence Index is ≤3.0

____ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

____ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ____ No X

Remarks:

SOIL

Sampling Point: DP-11

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
+2-0	black 10YR2/1	50					wood debris and decomposed plant material	
	dk red brn 5YR3/4	50						
0-8	black 10YR2/1	50					charcol, ash, and silt loam; many fine, med roots; dry	
	white 10YR 81	20						
	v pale brn 10YR7/2	20						
8-25	pale brn 10YR6/3	10					silt loam w/ gravel & cobbles, dry; massive; firm	
	yel brown 10YR6/3	90						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol or Histel (A1)
- ___ Histic Epipedon (A2)
- ___ Hydrogen Sulfide (A4)
- ___ Thick Dark Surface (A12)
- ___ Alaska Gleyed (A13)
- ___ Alaska Redox (A14)
- ___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

- ___ Alaska Color Change (TA4)[4]
- ___ Alaska Alpine Swales (TA5)
- ___ Alaska Redox With 2.5Y Hue
- ___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
- ___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):
Type: None
Depth (inches): ______

Hydric Soil Present? Yes ___ No X

Remarks: The absence of redox indicators and lack of soil moisture during this wet season supports the finding of nonhydric soil.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-stained Leaves (B9)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___
Water Table Present? Yes ___ No X Depth (inches): ___
Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site lacks characteristics of wetland hydrology despite the seasonally high cumulative precipitation in the region. Cumulative total precipitation on August 26, 2014 was above normal with 8.29 inches since June 1st, compared to the normal of 5.71 inches, resulting in an excess of 3.21 inches. Since January 1st, the total was 12.15 inches, compared to the normal of 8.95 inches, resulting in an excess of 3.2 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd Borough/City: Anchorage Sampling Date: 9/3/2014

Applicant/Owner: ____ Sampling Point: DP-12

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Concave Slope (%): ____

Subregion: Southcentral Lat: N 61.1002 Long: W 149.7213 Datum: NAD83

Soil Map Unit Name: 427—Jacobsen-Disappear-Doroshin complex, 7 to 12 percent slopes NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes	No X
Hydric Soil Present?	Yes	No X
Wetland Hydrology Present?	Yes	No X

Is the Sampled Area within a Wetland? Yes ____ No X

Remarks: Site is located on a south-facing mountain slope in closed shrub-scrub of alder and red elder.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Alnus viridis*	10	Yes	FAC
2.			
3.			
4.			
Total Cover:	10		
50% of total cover: 5		20% of total cover: 2	

Sapling/Shrub Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Alnus viridis*	75	Yes	FAC
2. *Sorbus scopulina*	25	Yes	FACU
3. *Ribes triste*	5		FAC
4.			
5.			
6.			
Total Cover:	105		
50% of total cover: 53		20% of total cover: 21	

Herb Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Calamagrostis canadensis*	50	Yes	FAC
2. *Mertensia paniculata*	25	Yes	FACU
3. *Mertensia paniculata*	10	Yes	FACU
4. *Chamerion angustifolium*	10		FACU
5. *Urtica dioica*	10		FACU
6. *Gymnocarpium dryopteris*	1		FACU
7.			
8.			
9.			
10.			
Total Cover:	106		
50% of total cover: 53		20% of total cover: 21	

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ____

% Cover of Wetland Bryophytes 0 (Where applicable) Total Cover of Bryophytes 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species		x 2 = 0
FAC species	140	x 3 = 420
FACU species	81	x 4 = 324
UPL species		x 5 = 0
Column Totals:	221 (A)	744 (B)

Prevalence Index = B/A = 3.36

Hydrophytic Vegetation Indicators:

No Dominance Test is >50%

No Prevalence Index is ≤3.0

____ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

____ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ____ No X

Remarks:

SOIL

Sampling Point: DP-12

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
+10- +4	dk gray brn 10YR4/2	100					silt, roots, wood debris and decomposed plant matter	
+4-0	black 10YR2/1	50					silt loam, many fine roots, dry	
	v dk gray 10YR3/1	50						
0-11	dk gray brn 10YR4/2	100					gravelly silt loam; few med roots; dry	
11-17	v pale brn 10YR7/3	50					silt loam w/ gravel & cobbles, dry; loose	
	brown 10YR5/3	50						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol or Histel (A1)
- ___ Histic Epipedon (A2)
- ___ Hydrogen Sulfide (A4)
- ___ Thick Dark Surface (A12)
- ___ Alaska Gleyed (A13)
- ___ Alaska Redox (A14)
- ___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

- ___ Alaska Color Change (TA4)[4]
- ___ Alaska Alpine Swales (TA5)
- ___ Alaska Redox With 2.5Y Hue
- ___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
- ___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.

[4]Give details of color change in Remarks.

Restrictive Layer (if present):

Type: None

Depth (inches): ________

Hydric Soil Present? Yes ____ No X

Remarks: The absence of redox indicators and lack of soil moisture during this wet season supports the finding of nonhydric soil.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-stained Leaves (B9)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ____ No X Depth (inches): ____

Water Table Present? Yes ____ No X Depth (inches): ____

Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): ____

Wetland Hydrology Present? Yes ____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site lacks characteristics of wetland hydrology despite the seasonally high cumulative precipitation in the region. Cumulative total precipitation on September 3, 2014 was above normal with 9.08 inches since June 1st, compared to the normal of 6.37 inches, resulting in an excess of 2.71 inches. Since January 1st, the total was 12.31 inches, compared to the normal of 9.61 inches, resulting in an excess of 2.7 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd. Borough/City: Anchorage Sampling Date: 9/3/2014

Applicant/Owner: ______ Sampling Point: DP-13

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Convex Slope (%): ______

Subregion: Southcentral Lat: N 61.0989 Long: W 149.7192 Datum: NAD83

Soil Map Unit Name: 427—Jacobsen-Disappear-Doroshin complex, 7 to 12 percent slopes NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ______ (If no, explain in Remarks.)

Are Vegetation ______, Soil ______, or Hydrology ______ significantly disturbed? Are "Normal Circumstances" present? Yes X No ______

Are Vegetation ______, Soil ______, or Hydrology ______ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes	No X	Is the Sampled Area within a Wetland? Yes ______ No X
Hydric Soil Present?	Yes	No X	
Wetland Hydrology Present?	Yes	No X	

Remarks: Site is located on a south-facing mountain slope in open spruce forest and dense alder shrub growth. Much of the spruce has been beetle-killed and blown down, opening up the canopy for shrubs and herbs to colonize the area.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Picea mariana*	25	Yes	FACW
2. *Alnus viridis*	10	Yes	FAC
3.			
4.			
Total Cover:	35		
50% of total cover: 18	20% of total cover: 7		
Sapling/Shrub Stratum			
1. *Alnus viridis*	25	Yes	FAC
2. *Rosa acicularis*	25	Yes	FACU
3. *Rubus idaeus*	10	Yes	FACU
4. *Oplopanax horridus*	5		FACU
5. *Cornus canadensis*	5		FACU
6.			
Total Cover:	70		
50% of total cover: 35	20% of total cover: 14		
Herb Stratum			
1. *Calamagrostis canadensis*	50	Yes	FAC
2. *Mertensia paniculata*	25	Yes	FACU
3. *Heracleum maximum*	10	Yes	FACU
4. *Chamerion angustifolium*	10		FACU
5. *Urtica dioica*	10		FACU
6. *Gymnocarpium dryopteris*	1		FACU
7. *Mertensia paniculata*	1		FACU
8. *Geranium erianthum*	1		FACU
9. *Chamerion angustifolium*	1		FACU
10.			
Total Cover:	109		
50% of total cover: 55	20% of total cover: 22		

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ______

% Cover of Wetland Bryophytes 0 Total Cover of Bryophytes 0
(Where applicable)

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 8 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species	75	x 2 = 150
FAC species	35	x 3 = 105
FACU species	104	x 4 = 416
UPL species		x 5 = 0
Column Totals:	214 (A)	671 (B)

Prevalence Index = B/A = 3.13

Hydrophytic Vegetation Indicators:

No Dominance Test is >50%

No Prevalence Index is ≤3.0

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ______ No X

Remarks:

SOIL

Sampling Point: DP-13

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
+8 -0	black 10YR2/1	50					silt, roots, wood debris and decomposed plant matter	
	dk red brn 5YR3/4	50						
+4-0	black 10YR2/1	50					silt loam, many fine roots, dry	
	v dk gray 10YR3/1	50						
0-11	black 10YR2/1	100					silt loam; few med roots; dry; greasy when wetted	
11-14	black 10YR2/1	80					silt loam and ash; dry	
	white 10YR 8/1	20						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol or Histel (A1)
- ___ Histic Epipedon (A2)
- ___ Hydrogen Sulfide (A4)
- ___ Thick Dark Surface (A12)
- ___ Alaska Gleyed (A13)
- ___ Alaska Redox (A14)
- ___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

- ___ Alaska Color Change (TA4)[4]
- ___ Alaska Alpine Swales (TA5)
- ___ Alaska Redox With 2.5Y Hue
- ___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
- ___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):
Type: None
Depth (inches): ____

Hydric Soil Present? Yes ___ No X

Remarks: The absence of redox indicators and lack of soil moisture during this wet season supports the finding of nonhydric soil.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-stained Leaves (B9)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No X	Depth (inches): ___
Water Table Present?	Yes ___	No X	Depth (inches): ___
Saturation Present? (includes capillary fringe)	Yes ___	No X	Depth (inches): ___

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site lacks characteristics of wetland hydrology despite the seasonally high cumulative precipitation in the region. Cumulative total precipitation on September 3, 2014 was above normal with 9.08 inches since June 1st, compared to the normal of 6.37 inches, resulting in an excess of 2.71 inches. Since January 1st, the total was 12.31 inches, compared to the normal of 9.61 inches, resulting in an excess of 2.7 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd. Borough/City: Anchorage Sampling Date: 9/3/2014

Applicant/Owner: ______ Sampling Point: DP-15

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Convex Slope (%): ______

Subregion: Southcentral Lat: N 61.0989 Long: W 149.7249 Datum: NAD83

Soil Map Unit Name: 412—Deception-Estelle-Kichatna complex, 20 to 45 percent slopes NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ______ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes	No X	Is the Sampled Area within a Wetland?	Yes ____ No X
Hydric Soil Present?	Yes	No X		
Wetland Hydrology Present?	Yes	No X		

Remarks: Site is located on a south-facing mountain slope in open bluejoint reed grass-herb meadow. The site is exposed with trees and high shrubs absent.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	0		
50% of total cover: 0 20% of total cover: 0			
Sapling/Shrub Stratum			
1. *Rubus idaeus*	25	Yes	FACU
2. *Sorbus scopulina*	10	Yes	FACU
3. *Rubus idaeus*	10	Yes	FACU
4.			
5.			
6.			
Total Cover:	45		
50% of total cover: 23 20% of total cover: 9			
Herb Stratum			
1. *Calamagrostis canadensis*	100	Yes	FAC
2. *Equisetum sylvaticum*	5		FAC
3. *Heracleum maximum*	5		FACU
4. *Gymnocarpium dryopteris*	1		FACU
5.			
6.			
7.			
8.			
9.			
10.			
Total Cover:	111		
50% of total cover: 56 20% of total cover: 22			

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ______

% Cover of Wetland Bryophytes 0 Total Cover of Bryophytes 0
(Where applicable)

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 25 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species		x 2 = 0
FAC species	105	x 3 = 315
FACU species	51	x 4 = 204
UPL species		x 5 = 0
Column Totals:	156 (A)	519 (B)

Prevalence Index = B/A = 3.32

Hydrophytic Vegetation Indicators:

No Dominance Test is >50%

No Prevalence Index is ≤3.0

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ____ No X

Remarks:

SOIL

Sampling Point: DP-15

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
+2-0	dk gray brn 10YR4/2	100					silt, roots, and decomposed plant matter	
0-8	black 10YR2/1	50					silt loam, many fine roots, dry	
	v dk gray 10YR3/1	50						
8-29	brown 10YR5/3	50					silt loam w/ gravel & cobbles, dry; massive; loose	
	yel brown 10YR5/6	50						
>29							cobbles and gravel, compacted, dry	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol or Histel (A1)
- ___ Histic Epipedon (A2)
- ___ Hydrogen Sulfide (A4)
- ___ Thick Dark Surface (A12)
- ___ Alaska Gleyed (A13)
- ___ Alaska Redox (A14)
- ___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

- ___ Alaska Color Change (TA4)[4]
- ___ Alaska Alpine Swales (TA5)
- ___ Alaska Redox With 2.5Y Hue
- ___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
- ___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):
Type: None
Depth (inches): ________

Hydric Soil Present? Yes _____ No X

Remarks: The profile correlates wtih the mapped unit for this location, Deception-Estelle-Kichatna complex. The absence of redox indicators and lack of soil moisture during this wet season supports the finding of nonhydric soil.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-stained Leaves (B9)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No X Depth (inches): ________
Water Table Present? Yes _____ No X Depth (inches): ________
Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): ________

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site lacks characteristics of wetland hydrology despite the seasonally high cumulative precipitation in the region. Cumulative total precipitation on September 3, 2014 was above normal with 9.08 inches since June 1st, compared to the normal of 6.37 inches, resulting in an excess of 2.71 inches. Since January 1st, the total was 12.31 inches, compared to the normal of 9.61 inches, resulting in an excess of 2.7 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd. Borough/City: Anchorage Sampling Date: 9/3/2014

Applicant/Owner: ______ Sampling Point: DP-16

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Concave Slope (%): ______

Subregion: Southcentral Lat: N 61.0989 Long: W 149.7270 Datum: NAD83

Soil Map Unit Name: 412—Deception-Estelle-Kichatna complex, 20 to 45 percent slopes NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ______ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes	No X	Is the Sampled Area within a Wetland? Yes ______ No X
Hydric Soil Present?	Yes	No X	
Wetland Hydrology Present?	Yes	No X	

Remarks: Site is located on a south-facing mountain slope in open bluejoint reed grass-herb meadow. The site is exposed with trees and high shrubs absent.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	0		
50% of total cover: 0	20% of total cover: 0		
Sapling/Shrub Stratum			
1. *Rubus idaeus*	25	Yes	FACU
2. *Sorbus scopulina*	10	Yes	FACU
3. *Rubus idaeus*	10	Yes	FACU
4.			
5.			
6.			
Total Cover:	45		
50% of total cover: 23	20% of total cover: 9		
Herb Stratum			
1. *Calamagrostis canadensis*	100	Yes	FAC
2. *Athyrium filix-femina*	25		FAC
3. *Heracleum maximum*	10		FACU
4. *Gymnocarpium dryopteris*	1		FACU
5. *Mertensia paniculata*	1		FACU
6. *Chamerion angustifolium*	1		FACU
7. *Equisetum sylvaticum*	1		FAC
8.			
9.			
10.			
Total Cover:	139		
50% of total cover: 70	20% of total cover: 28		

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ______

% Cover of Wetland Bryophytes 0 Total Cover of Bryophytes 0
(Where applicable)

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 25 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species		x 2 = 0
FAC species	125	x 3 = 375
FACU species	59	x 4 = 236
UPL species		x 5 = 0
Column Totals:	184 (A)	611 (B)

Prevalence Index = B/A = 3.32

Hydrophytic Vegetation Indicators:

No Dominance Test is >50%

No Prevalence Index is ≤3.0

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ______ No X

Remarks:

SOIL

Sampling Point: DP-16

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
+1-0	dk gray brn 10YR4/2	100					silt, roots, and decomposed plant matter	
0-12	gray brn 10YR5/2 v dk gray 10YR3/1	50 50					silty gravel, many fine/med roots, dry	
12-19	gray brn 10YR5/2 gray 10YR6/1	80 20					gravel and small cobble, few med roots, moist (not saturated)	
19-29	gray 10YR6/1 lt gray 10YR7/1	20 80					cobbles and gravel, compacted, saturated	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol or Histel (A1)
- ___ Histic Epipedon (A2)
- ___ Hydrogen Sulfide (A4)
- ___ Thick Dark Surface (A12)
- ___ Alaska Gleyed (A13)
- ___ Alaska Redox (A14)
- ___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

- ___ Alaska Color Change (TA4)[4]
- ___ Alaska Alpine Swales (TA5)
- ___ Alaska Redox With 2.5Y Hue
- ___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
- ___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):
Type: None
Depth (inches): ____

Hydric Soil Present? Yes ___ No X

Remarks: The presence of depleted (lt gray) soil is indicative of hydric conditions below 12-in. depth, which is too deep to qualify the soil profile as hydric. The absence of redox indicators and lack of soil moisturein the upper 12-in. during this wet season supports the finding of nonhydric soil.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-stained Leaves (B9)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ____
Water Table Present? Yes ___ No X Depth (inches): ____
Saturation Present? (includes capillary fringe) Yes X No ___ Depth (inches): 19

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Saturation at 19-in. depth is below the threshold for wetland hydrology, especially supporte by the abundance of accumulated precipitation at the time of the investigation. Cumulative total precipitation on September 3, 2014 was above normal with 9.08 inches since June 1st, compared to the normal of 6.37 inches, resulting in an excess of 2.71 inches. Since January 1st, the total was 12.31 inches, compared to the normal of 9.61 inches, resulting in an excess of 2.7 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd. Borough/City: Anchorage Sampling Date: 9/4/2014

Applicant/Owner: ______ Sampling Point: DP-17

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Concave Slope (%): ______

Subregion: Southcentral Lat: N 61.0986 Long: W 149.7153 Datum: NAD83

Soil Map Unit Name: 427—Jacobsen-Disappear-Doroshin complex, 7 to 12 percent slopes NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	Is the Sampled Area within a Wetland? Yes ____ No X
Hydric Soil Present?	Yes	No X	
Wetland Hydrology Present?	Yes	No X	

Remarks: Site is located on a south-facing mountain slope in closed shrub-scrub of red elder and alder.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Alnus viridis*	10	Yes	FAC
2.			
3.			
4.			
Total Cover:	10		
50% of total cover: 5	20% of total cover: 2		
Sapling/Shrub Stratum			
1. *Sorbus scopulina*	75	Yes	FACU
2. *Alnus viridis*	25	Yes	FAC
3.			
4.			
5.			
6.			
Total Cover:	100		
50% of total cover: 50	20% of total cover: 20		
Herb Stratum			
1. *Urtica dioica*	50	Yes	FACU
2. *Calamagrostis canadensis*	25	Yes	FAC
3. *Chamerion angustifolium*	10		FACU
4. *Mertensia paniculata*	1		FACU
5. *Streptopus amplexifolius*	1		FACU
6.			
7.			
8.			
9.			
10.			
Total Cover:	87		
50% of total cover: 44	20% of total cover: 17		

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ______

% Cover of Wetland Bryophytes 0 Total Cover of Bryophytes 0
(Where applicable)

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 60 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species		x 2 = 0
FAC species	60	x 3 = 180
FACU species	137	x 4 = 548
UPL species		x 5 = 0
Column Totals:	197 (A)	728 (B)

Prevalence Index = B/A = 3.69

Hydrophytic Vegetation Indicators:

Yes Dominance Test is >50%

No Prevalence Index is ≤3.0

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ____

Remarks:

SOIL

Sampling Point: DP-17

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
+10 -0	black 10YR2/1	50					silt, roots, wood debris and decomposed plant matter	
	dk gray brn 10YR4/2	50						
0-23	gray brn 10YR5/2	50					silt loam and decomposed plant material; few med roots; dry	
	yel brown 10YR6/3	50						
23-34	yel brown 10YR6/3	80					silt loam; few med roots; dry	
	dk gray brn 10YR4/2	20						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol or Histel (A1)
- ___ Histic Epipedon (A2)
- ___ Hydrogen Sulfide (A4)
- ___ Thick Dark Surface (A12)
- ___ Alaska Gleyed (A13)
- ___ Alaska Redox (A14)
- ___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

- ___ Alaska Color Change (TA4)[4]
- ___ Alaska Alpine Swales (TA5)
- ___ Alaska Redox With 2.5Y Hue
- ___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
- ___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):

Type: None

Depth (inches): ______

Hydric Soil Present? Yes ___ No X

Remarks: The lower portion of the profile correlates wtih the mapped unit for adjacent areas, Deception-Estelle-Kichatna complex. The absence of redox indicators and lack of soil moisture during this wet season supports the finding of nonhydric soil.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-stained Leaves (B9)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ______

Water Table Present? Yes ___ No X Depth (inches): ______

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ______

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site lacks characteristics of wetland hydrology despite the seasonally high cumulative precipitation in the region. Cumulative total precipitation on September 4, 2014 was above normal with 9.63 inches since June 1st, compared to the normal of 6.47 inches, resulting in an excess of 3.16 inches. Since January 1st, the total was 12.86 inches, compared to the normal of 9.71 inches, resulting in an excess of 3.15 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd. Borough/City: Anchorage Sampling Date: 9/4/2014

Applicant/Owner: ______ Sampling Point: DP-18

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Convex Slope (%): ______

Subregion: Southcentral Lat: N 61.0985 Long: W 149.7166 Datum: NAD83

Soil Map Unit Name: 412—Deception-Estelle-Kichatna complex, 20 to 45 percent slopes NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	Is the Sampled Area within a Wetland? Yes ____ No X
Hydric Soil Present?	Yes	No X	
Wetland Hydrology Present?	Yes	No X	

Remarks: Site is located on a south-facing mountain slope in open bluejoint reed grass-herb meadow. The site is exposed with trees and high shrubs absent.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	0		
50% of total cover: 0	20% of total cover: 0		

Sapling/Shrub Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
Total Cover:	0		
50% of total cover: 0	20% of total cover: 0		

Herb Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Calamagrostis canadensis*	100	Yes	FAC
2. *Athyrium filix-femina*	25		FAC
3. *Heracleum maximum*	10		FACU
4. *Gymnocarpium dryopteris*	1		FACU
5. *Mertensia paniculata*	1		FACU
6. *Chamerion angustifolium*	1		FACU
7. *Equisetum sylvaticum*	1		FAC
8.			
9.			
10.			
Total Cover:	139		
50% of total cover: 70	20% of total cover: 28		

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ______

% Cover of Wetland Bryophytes 0 Total Cover of Bryophytes 0
(Where applicable)

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species		x 2 = 0
FAC species	126	x 3 = 378
FACU species	13	x 4 = 52
UPL species		x 5 = 0
Column Totals:	139 (A)	430 (B)

Prevalence Index = B/A = 3.09

Hydrophytic Vegetation Indicators:

Yes Dominance Test is >50%

No Prevalence Index is ≤3.0

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ____

Remarks:

SOIL

Sampling Point: DP-18

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
+2 -0	dk gray brn 10YR4/2	100					silt loam; many fine/med roots; wood debris and decomposed plant matter	
0-10	dk yel brn 10YR4/4	50					silt loam; many fine/med roots; dry	
	dk gray brn 10YR4/2	50						
10-23	yel brown 10YR6/3	60					sandy silt loam; dry	
	gray brn 10YR5/2	20						
	dk gray brn 10YR4/2	20						
23-35	brown 10YR5/3	50					sandy silt loam; dry; massive; loose	
	yel brown 10YR5/6	50						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol or Histel (A1)
___ Histic Epipedon (A2)
___ Hydrogen Sulfide (A4)
___ Thick Dark Surface (A12)
___ Alaska Gleyed (A13)
___ Alaska Redox (A14)
___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

___ Alaska Color Change (TA4)[4]
___ Alaska Alpine Swales (TA5)
___ Alaska Redox With 2.5Y Hue
___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):
Type: None
Depth (inches): ______

Hydric Soil Present? Yes ____ No X

Remarks: The profile correlates wtih the mapped unit for this location, Deception-Estelle-Kichatna complex. The absence of redox indicators and lack of soil moisture during this wet season supports the finding of nonhydric soil.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Surface Soil Cracks (B6)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Marl Deposits (B15)
___ Hydrogen Sulfide Odor (C1)
___ Dry-Season Water Table (C2)
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

___ Water-stained Leaves (B9)
___ Drainage Patterns (B10)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Salt Deposits (C5)
___ Stunted or Stressed Plants (D1)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ Microtopographic Relief (D4)
___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ____ No X Depth (inches): ______
Water Table Present? Yes ____ No X Depth (inches): ______
Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): ______

Wetland Hydrology Present? Yes ____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site lacks characteristics of wetland hydrology despite the seasonally high cumulative precipitation in the region. Cumulative total precipitation on September 4, 2014 was above normal with 9.63 inches since June 1st, compared to the normal of 6.47 inches, resulting in an excess of 3.16 inches. Since January 1st, the total was 12.86 inches, compared to the normal of 9.71 inches, resulting in an excess of 3.15 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd. Borough/City: Anchorage Sampling Date: 9/4/2014

Applicant/Owner: ______ Sampling Point: DP-19

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Concave Slope (%): ______

Subregion: Southcentral Lat: N 61.0980 Long: W 149.7177 Datum: NAD83

Soil Map Unit Name: 412—Deception-Estelle-Kichatna complex, 20 to 45 percent slopes NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?		X
Hydric Soil Present?		X
Wetland Hydrology Present?		X

Is the Sampled Area within a Wetland? Yes ____ No X

Remarks: Site is located on a south-facing mountain slope in open bluejoint reed grass-herb meadow. The site is partially exposed with trees and high shrubs occurring at the edge of the plot.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Betula papyrifera (Southcentral)*	25	Yes	FAC
2. *Picea glauca*	10	Yes	FACU
3.			
4.			
Total Cover:	35		
50% of total cover: 18 20% of total cover: 7			

Sapling/Shrub Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Alnus viridis*	25	Yes	FAC
2. *Rosa acicularis*	25	Yes	FACU
3. *Cornus canadensis*	25	Yes	FACU
4. *Oplopanax horridus*	5		FACU
5.			
6.			
Total Cover:	80		
50% of total cover: 40 20% of total cover: 16			

Herb Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Calamagrostis canadensis*	25	Yes	FAC
2. *Dryopteris expansa*	10		FACU
3. *Heracleum maximum*	10		FACU
4. *Sanguisorba canadensis*	10		FACW
5. *Mertensia paniculata*	1		FACU
6. *Chamerion angustifolium*	1		FACU
7.			
8.			
9.			
10.			
Total Cover:	57		
50% of total cover: 29 20% of total cover: 11			

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ______

% Cover of Wetland Bryophytes 0 Total Cover of Bryophytes 0
(Where applicable)

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species	10	x 2 = 20
FAC species	75	x 3 = 225
FACU species	87	x 4 = 348
UPL species		x 5 = 0
Column Totals:	172 (A)	593 (B)

Prevalence Index = B/A = 3.44

Hydrophytic Vegetation Indicators:

No Dominance Test is >50%

No Prevalence Index is ≤3.0

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ____ No X

Remarks:

SOIL

Sampling Point: DP-19

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
+7 -0	black 10YR2/1	100					organic soil (silt, roots, wood debris and decomposed plant matter); not saturated; many fine/med roots; greasy when wetted	
0-14	black 10YR2/1	50					silt loam w/fine sand; dry	
	dk gray brn 10YR4/2	50						
14-23	lt brn gray 10YR6/2	80					silt loam w/fine sand; dry	
	gray brn 10YR5/2	20						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:
- ___ Histosol or Histel (A1)
- ___ Histic Epipedon (A2)
- ___ Hydrogen Sulfide (A4)
- ___ Thick Dark Surface (A12)
- ___ Alaska Gleyed (A13)
- ___ Alaska Redox (A14)
- ___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:
- ___ Alaska Color Change (TA4)[4]
- ___ Alaska Alpine Swales (TA5)
- ___ Alaska Redox With 2.5Y Hue
- ___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
- ___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):
Type: None
Depth (inches): ______

Hydric Soil Present? Yes ____ No X

Remarks: The surfical organic, black soil indicates potential hydric conditions but does not extend to depth and is not saturated. The absence of redox indicators and lack of soil moisture during this wet season supports the finding of nonhydric soil.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)
- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)
- ___ Water-stained Leaves (B9)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:
Surface Water Present? Yes ____ No X Depth (inches): ______
Water Table Present? Yes ____ No X Depth (inches): ______
Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): ______

Wetland Hydrology Present? Yes ____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site lacks characteristics of wetland hydrology despite the seasonally high cumulative precipitation in the region. Cumulative total precipitation on September 4, 2014 was above normal with 9.63 inches since June 1st, compared to the normal of 6.47 inches, resulting in an excess of 3.16 inches. Since January 1st, the total was 12.86 inches, compared to the normal of 9.71 inches, resulting in an excess of 3.15 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd. Borough/City: Anchorage Sampling Date: 9/4/2014

Applicant/Owner: ____ Sampling Point: DP-20

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Concave Slope (%): ____

Subregion: Southcentral Lat: N 61.0981 Long: W 149.7192 Datum: NAD83

Soil Map Unit Name: 412—Deception-Estelle-Kichatna complex, 20 to 45 percent slopes NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	Is the Sampled Area within a Wetland? Yes ____ No X
Hydric Soil Present?	Yes	No X	
Wetland Hydrology Present?	Yes	No X	

Remarks: Site is located on a south-facing mountain slope in open bluejoint reed grass-herb meadow. The site is partially exposed with trees and high shrubs occurring at the edge of the plot.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Betula papyrifera (Southcentral)*	25	Yes	FAC
2. *Picea mariana*	10	Yes	FACW
3.			
4.			
Total Cover:	35		
50% of total cover: 18 20% of total cover: 7			

Sapling/Shrub Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Alnus viridis*	25	Yes	FAC
2. *Rosa acicularis*	25	Yes	FACU
3. *Cornus canadensis*	25	Yes	FACU
4. *Oplopanax horridus*	5		FACU
5.			
6.			
Total Cover:	80		
50% of total cover: 40 20% of total cover: 16			

Herb Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Calamagrostis canadensis*	25	Yes	FAC
2. *Dryopteris expansa*	10		FACU
3. *Heracleum maximum*	10		FACU
4. *Sanguisorba canadensis*	10		FACW
5. *Mertensia paniculata*	1		FACU
6. *Chamerion angustifolium*	1		FACU
7.			
8.			
9.			
10.			
Total Cover:	57		
50% of total cover: 29 20% of total cover: 11			

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ____

% Cover of Wetland Bryophytes 0 Total Cover of Bryophytes 0 (Where applicable)

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 67 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species	20	x 2 = 40
FAC species	75	x 3 = 225
FACU species	77	x 4 = 308
UPL species		x 5 = 0
Column Totals:	172 (A)	573 (B)

Prevalence Index = B/A = 3.33

Hydrophytic Vegetation Indicators:

Yes Dominance Test is >50%

No Prevalence Index is ≤3.0

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ____

Remarks:

SOIL

Sampling Point: DP-20

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
+2-0	dk yel brn 10YR4/6	50					silt, roots, and decomposed plant matter	
	dk red brn 5YR3/4	50						
0-6	dk yel brn 10YR4/4	50					silt loam; many fine/med roots; dry	
	dk gray brn 10YR4/2	50						
6-18	gray brn 10YR5/2	50					gravel and small cobble; few med roots; dry	
	gray 10YR6/1	50						
18-30	brown 10YR5/3	50					gravelly silt loam; dry; massive; loose	
	yel brown 10YR5/6	50						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol or Histel (A1)
- ___ Histic Epipedon (A2)
- ___ Hydrogen Sulfide (A4)
- ___ Thick Dark Surface (A12)
- ___ Alaska Gleyed (A13)
- ___ Alaska Redox (A14)
- ___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

- ___ Alaska Color Change (TA4)[4]
- ___ Alaska Alpine Swales (TA5)
- ___ Alaska Redox With 2.5Y Hue
- ___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
- ___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):
Type: None
Depth (inches): ______

Hydric Soil Present? Yes ___ No X

Remarks: The lower portion of the profile correlates wtih the mapped unit for this location, Deception-Estelle-Kichatna complex. The absence of redox indicators and lack of soil moisture during this wet season supports the finding of nonhydric soil.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-stained Leaves (B9)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ______
Water Table Present? Yes ___ No X Depth (inches): ______
Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ______

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site lacks characteristics of wetland hydrology despite the seasonally high cumulative precipitation in the region. Cumulative total precipitation on September 4, 2014 was above normal with 9.63 inches since June 1st, compared to the normal of 6.47 inches, resulting in an excess of 3.16 inches. Since January 1st, the total was 12.86 inches, compared to the normal of 9.71 inches, resulting in an excess of 3.15 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd. Borough/City: Anchorage Sampling Date: 9/8/2014

Applicant/Owner: ______ Sampling Point: DP-21

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Concave Slope (%): ______

Subregion: Southcentral Lat: N 61.0983 Long: W 149.7286 Datum: NAD83

Soil Map Unit Name: 438—Moose River-Niklason complex, occasionally flooded, 0 to 3 percent NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ______ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	Is the Sampled Area within a Wetland? Yes X No ______
Hydric Soil Present?	Yes X	No	
Wetland Hydrology Present?	Yes X	No	

Remarks: Site is located at the base of a south-facing mountain slope in closed black spruce trees and alder scrub. Springs emerge from the slope to the north and form small streams that flow only a short distance before re-entering the ground.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Picea mariana*	25	Yes	FACW
2. *Alnus viridis*	25	Yes	FAC
3.			
4.			
Total Cover:	50		
50% of total cover: 25	20% of total cover: 10		
Sapling/Shrub Stratum			
1. *Alnus viridis*	50	Yes	FAC
2.			
3.			
4.			
5.			
6.			
Total Cover:	50		
50% of total cover: 25	20% of total cover: 10		
Herb Stratum			
1. *Calamagrostis canadensis*	75	Yes	FAC
2. *Equisetum fluviatile*	25	Yes	OBL
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
Total Cover:	100		
50% of total cover: 50	20% of total cover: 20		

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ______

% Cover of Wetland Bryophytes 0 Total Cover of Bryophytes 0
(Where applicable)

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	25	x 1 = 25
FACW species	25	x 2 = 50
FAC species	150	x 3 = 450
FACU species		x 4 = 0
UPL species		x 5 = 0
Column Totals:	200 (A)	525 (B)

Prevalence Index = B/A = 2.62

Hydrophytic Vegetation Indicators:

Yes Dominance Test is >50%

Yes Prevalence Index is ≤3.0

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ______

Remarks:

SOIL

Sampling Point: DP-21

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
+16-0	black 10YR2/1	50					muck and plant debris, roots; saturated; greasy;	
	dk yel brn 10YR4/4	50						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

X Histosol or Histel (A1)
___ Histic Epipedon (A2)
___ Hydrogen Sulfide (A4)
___ Thick Dark Surface (A12)
___ Alaska Gleyed (A13)
___ Alaska Redox (A14)
___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

___ Alaska Color Change (TA4)[4]
___ Alaska Alpine Swales (TA5)
___ Alaska Redox With 2.5Y Hue
___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):
Type: Saturation
Depth (inches): 0

Hydric Soil Present? Yes X No ___

Remarks: The soil profile generally correlates with the mapped soil unit for the location, Moose River-Niklason complex. This is an area of groundwater discharge, small springs emerge from the slope and form streams that flow a short distance then seep back into the ground, providing a permanent source of soil moisture resulting in the observed hydric soil.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

X Surface Water (A1)
X High Water Table (A2)
X Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Surface Soil Cracks (B6)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Marl Deposits (B15)
___ Hydrogen Sulfide Odor (C1)
___ Dry-Season Water Table (C2)
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

___ Water-stained Leaves (B9)
___ Drainage Patterns (B10)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Salt Deposits (C5)
___ Stunted or Stressed Plants (D1)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ Microtopographic Relief (D4)
___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes X No ___ Depth (inches): 0
Water Table Present? Yes ___ No X Depth (inches): 0
Saturation Present? (includes capillary fringe) Yes X No ___ Depth (inches): 0

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: There has been an seasonally high cumulative precipitation in the region over the past growing season that likley contributes to the observed wetland hydrology. Cumulative total precipitation on August 26, 2014 was above normal with 8.29 inches since June 1st, compared to the normal of 5.71 inches, resulting in an excess of 3.21 inches. Since January 1st, the total was 12.15 inches, compared to the normal of 8.95 inches, resulting in an excess of 3.2 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd Borough/City: Anchorage Sampling Date: 9/8/2014

Applicant/Owner: ______ Sampling Point: DP-22

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Concave Slope (%): ______

Subregion: Southcentral Lat: N 61.0986 Long: W 149.7290 Datum: NAD83

Soil Map Unit Name: 412—Deception-Estelle-Kichatna complex, 20 to 45 percent slopes NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	Is the Sampled Area within a Wetland? Yes ____ No X
Hydric Soil Present?	Yes	No X	
Wetland Hydrology Present?	Yes	No X	

Remarks: Site is located at the base of a south-facing mountain slope in open bluejoint reed grass-herb meadow. The site is exposed with a few high shrubs prseent.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	0		
50% of total cover: 0	20% of total cover: 0		
Sapling/Shrub Stratum			
1. *Sorbus scopulina*	10	Yes	FACU
2. *Alnus viridis*	10	Yes	FAC
3.			
4.			
5.			
6.			
Total Cover:	20		
50% of total cover: 10	20% of total cover: 4		
Herb Stratum			
1. *Calamagrostis canadensis*	100	Yes	FAC
2. *Athyrium filix-femina*	25		FAC
3. *Heracleum maximum*	10		FACU
4. *Gymnocarpium dryopteris*	1		FACU
5. *Mertensia paniculata*	1		FACU
6. *Chamerion angustifolium*	1		FACU
7. *Equisetum sylvaticum*	1		FAC
8.			
9.			
10.			
Total Cover:	139		
50% of total cover: 70	20% of total cover: 28		

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ______

% Cover of Wetland Bryophytes 0 (Where applicable) Total Cover of Bryophytes 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 67 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species		x 2 = 0
FAC species	136	x 3 = 408
FACU species	23	x 4 = 92
UPL species		x 5 = 0
Column Totals:	159 (A)	500 (B)

Prevalence Index = B/A = 3.14

Hydrophytic Vegetation Indicators:

Yes Dominance Test is >50%

No Prevalence Index is ≤3.0

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ______

Remarks:

SOIL

Sampling Point: DP-22

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
+7- +5	dk yel brn 10YR4/6	50					silt, roots, and decomposed plant matter	
	dk red brn 5YR3/4	50						
+5 -0	black 10YR2/1	100					organic soil (silt, roots, wood debris and decomposed plant matter); not saturated; many fine/med roots; greasy when wetted	
0-19	lt brn gray 10YR6/2	80					silt loam w/fine sand; dry	
	gray brn 10YR5/2	20						
19-23	dk gray brn 10YR4/2	80					gravelly silt loam; moist; massive; loose	
	gray brn 10YR5/2	20						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

__ Histosol or Histel (A1)
__ Histic Epipedon (A2)
__ Hydrogen Sulfide (A4)
__ Thick Dark Surface (A12)
__ Alaska Gleyed (A13)
__ Alaska Redox (A14)
__ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

__ Alaska Color Change (TA4)[4]
__ Alaska Alpine Swales (TA5)
__ Alaska Redox With 2.5Y Hue
__ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
__ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):
Type: None
Depth (inches): ____

Hydric Soil Present? Yes ____ No X

Remarks: The surfical organic, black soil indicates potential hydric conditions but does not extend to depth and is not saturated. The absence of redox indicators and lack of soil moisture during this wet season supports the finding of nonhydric soil.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

__ Surface Water (A1)
__ High Water Table (A2)
__ Saturation (A3)
__ Water Marks (B1)
__ Sediment Deposits (B2)
__ Drift Deposits (B3)
__ Algal Mat or Crust (B4)
__ Iron Deposits (B5)
__ Surface Soil Cracks (B6)
__ Inundation Visible on Aerial Imagery (B7)
__ Sparsely Vegetated Concave Surface (B8)
__ Marl Deposits (B15)
__ Hydrogen Sulfide Odor (C1)
__ Dry-Season Water Table (C2)
__ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

__ Water-stained Leaves (B9)
__ Drainage Patterns (B10)
__ Oxidized Rhizospheres along Living Roots (C3)
__ Presence of Reduced Iron (C4)
__ Salt Deposits (C5)
__ Stunted or Stressed Plants (D1)
__ Geomorphic Position (D2)
__ Shallow Aquitard (D3)
__ Microtopographic Relief (D4)
__ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ____ No X Depth (inches): ____
Water Table Present? Yes ____ No X Depth (inches): ____
Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): ____

Wetland Hydrology Present? Yes ____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site lacks characteristics of wetland hydrology despite the seasonally high cumulative precipitation in the region. Cumulative total precipitation on September 8, 2014 was above normal with 10.06 inches since June 1st, compared to the normal of 6.88 inches, resulting in an excess of 3.18 inches. Since January 1st, the total was 13.29 inches, compared to the normal of 10.12 inches, resulting in an excess of 3.17 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd Borough/City: Anchorage Sampling Date: 9/8/2014

Applicant/Owner: ______ Sampling Point: DP-23

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Concave Slope (%): ______

Subregion: Southcentral Lat: N 61.0983 Long: W 149.7280 Datum: NAD83

Soil Map Unit Name: 438—Moose River-Niklason complex, occasionally flooded, 0 to 3 percent NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	Is the Sampled Area within a Wetland? Yes X No ____
Hydric Soil Present?	Yes X	No	
Wetland Hydrology Present?	Yes X	No	

Remarks: Site is located at the base of a south-facing mountain slope in closed black spruce trees and alder scrub. Springs emerge from the slope to the north and form small streams that flow only a short distance before re-entering the ground.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Alnus viridis*	10	Yes	FAC
2.			
3.			
4.			
Total Cover:	10		
50% of total cover: 5	20% of total cover: 2		
Sapling/Shrub Stratum			
1. *Alnus viridis*	50	Yes	FAC
2.			
3.			
4.			
5.			
6.			
Total Cover:	50		
50% of total cover: 25	20% of total cover: 10		
Herb Stratum			
1. *Calamagrostis canadensis*	75	Yes	FAC
2. *Equisetum fluviatile*	25	Yes	OBL
3. *Heracleum maximum*	1		FACU
4.			
5.			
6.			
7.			
8.			
9.			
10.			
Total Cover:	101		
50% of total cover: 51	20% of total cover: 20		

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ______

% Cover of Wetland Bryophytes 10 Total Cover of Bryophytes 10
(Where applicable)

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	25	x 1 = 25
FACW species		x 2 = 0
FAC species	135	x 3 = 405
FACU species	1	x 4 = 4
UPL species		x 5 = 0
Column Totals:	161 (A)	434 (B)

Prevalence Index = B/A = 2.69

Hydrophytic Vegetation Indicators:

Yes Dominance Test is >50%

Yes Prevalence Index is ≤3.0

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ______

Remarks:

SOIL Sampling Point: DP-23

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
+16-0	black 10YR2/1	50					muck and plant debris, roots; saturated; greasy;	
	dk yel brn 10YR4/4	50						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:
- X Histosol or Histel (A1)
- ___ Histic Epipedon (A2)
- ___ Hydrogen Sulfide (A4)
- ___ Thick Dark Surface (A12)
- ___ Alaska Gleyed (A13)
- ___ Alaska Redox (A14)
- ___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:
- ___ Alaska Color Change (TA4)[4]
- ___ Alaska Alpine Swales (TA5)
- ___ Alaska Redox With 2.5Y Hue
- ___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
- ___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):
Type: Saturation
Depth (inches): 0

Hydric Soil Present? Yes X No ___

Remarks: The soil profile generally correlates with the mapped soil unit for the location, Moose River-Niklason complex. This is an area of groundwater discharge, small springs emerge from the slope and form streams that flow a short distance then seep back into the ground, providing a permanent source of soil moisture resulting in the observed hydric soil.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)
- X Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)
- ___ Water-stained Leaves (B9)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:
- Surface Water Present? Yes X No ___ Depth (inches): 0
- Water Table Present? Yes ___ No X Depth (inches): 0
- Saturation Present? (includes capillary fringe) Yes X No ___ Depth (inches): 0

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: There has been an seasonally high cumulative precipitation in the region over the past growing season that likley contributes to the observed wetland hydrology. Cumulative total precipitation on August 26, 2014 was above normal with 8.29 inches since June 1st, compared to the normal of 5.71 inches, resulting in an excess of 3.21 inches. Since January 1st, the total was 12.15 inches, compared to the normal of 8.95 inches, resulting in an excess of 3.2 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd. Borough/City: Anchorage Sampling Date: 9/8/2014

Applicant/Owner: ______ Sampling Point: DP-24

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Concave Slope (%): ______

Subregion: Southcentral Lat: N 61.0983 Long: W 149.7263 Datum: NAD83

Soil Map Unit Name: 438—Moose River-Niklason complex, occasionally flooded, 0 to 3 percent NWI classification: PSS1/4B

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	Is the Sampled Area within a Wetland? Yes X No ____
Hydric Soil Present?	Yes X	No	
Wetland Hydrology Present?	Yes X	No	

Remarks: Site is located at the base of a south-facing mountain slope in closed black spruce trees and alder scrub. Springs emerge from the slope to the north and form small streams that flow only a short distance before re-entering the ground.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Alnus viridis*	25	Yes	FAC
2. *Betula papyrifera (Southcentral)*	10	Yes	FAC
3. *Picea mariana*	10	Yes	FACW
4.			
Total Cover:	45		
50% of total cover: 23	20% of total cover: 9		
Sapling/Shrub Stratum			
1. *Alnus viridis*	25	Yes	FAC
2.			
3.			
4.			
5.			
6.			
Total Cover:	25		
50% of total cover: 13	20% of total cover: 5		
Herb Stratum			
1. *Calamagrostis canadensis*	75	Yes	FAC
2. *Athyrium filix-femina*	10		FAC
3. *Heracleum maximum*	10		FACU
4.			
5.			
6.			
7.			
8.			
9.			
10.			
Total Cover:	95		
50% of total cover: 48	20% of total cover: 19		

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ______

% Cover of Wetland Bryophytes 5 Total Cover of Bryophytes 5
(Where applicable)

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species	10	x 2 = 20
FAC species	145	x 3 = 435
FACU species	10	x 4 = 40
UPL species		x 5 = 0
Column Totals:	165 (A)	495 (B)

Prevalence Index = B/A = 3

Hydrophytic Vegetation Indicators:

Yes Dominance Test is >50%

No Prevalence Index is ≤3.0

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ______

Remarks:

SOIL

Sampling Point: DP-24

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
+8-0	black 10YR2/1	50					muck and plant debris, roots; saturated; greasy;	
	dk yel brn 10YR4/4	50						
0-3	dk yel brn 10YR4/4	50					silt loam;several med roots; saturated	
	dk gray brn 10YR4/2	50						
3-25	lt gray N7/1	50					silty clay loam w/fine sand; plastic; massive; oxidized root channels; moist (saturated at 22-in. depth)	
	lt brn gray 10YR6/2	50						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol or Histel (A1)
- ___ Histic Epipedon (A2)
- ___ Hydrogen Sulfide (A4)
- ___ Thick Dark Surface (A12)
- X Alaska Gleyed (A13)
- ___ Alaska Redox (A14)
- ___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

- ___ Alaska Color Change (TA4)[4]
- ___ Alaska Alpine Swales (TA5)
- ___ Alaska Redox With 2.5Y Hue
- ___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
- ___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):
Type: Compacted soil
Depth (inches): 12

Hydric Soil Present? Yes X No ___

Remarks: The soil profile generally correlates with the mapped soil unit for the location, Moose River-Niklason complex. The presenece of gleyed soil with oxidized root channels qaulifies as Alaska Gleyed hydric soil. This is an area of groundwater discharge, small springs emerge from the slope and form streams that flow a short distance then seep back into the ground, providing a permanent source of soil moisture resulting in the observed hydric soil.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-stained Leaves (B9)
- X Drainage Patterns (B10)
- X Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___
Water Table Present? Yes ___ No X Depth (inches): ___
Saturation Present? (includes capillary fringe) Yes X No ___ Depth (inches): 22

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: No saturation w/in 12-inches but the presence of depleted soil along with the secondary indicators of oxidized root channels, and the obvious drainage patterns in the area support a wetland hydrology finding. Cumulative total precipitation on August 26, 2014 was above normal with 8.29 inches since June 1st, compared to the normal of 5.71 inches, resulting in an excess of 3.21 inches. Since January 1st, the total was 12.15 inches, compared to the normal of 8.95 inches, resulting in an excess of 3.2 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd. Borough/City: Anchorage Sampling Date: 9/9/2014

Applicant/Owner: ______ Sampling Point: DP-25

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Flat Slope (%): ______

Subregion: Southcentral Lat: N 61.1011 Long: W 149.7206 Datum: NAD83

Soil Map Unit Name: 414—Deception-Estelle-Kichatna complex, undulating and hilly NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes	No X	Is the Sampled Area within a Wetland? Yes ____ No X
Hydric Soil Present?	Yes	No X	
Wetland Hydrology Present?	Yes	No X	

Remarks: Site is located on a south-facing mountain slope in open spruce-birch forest and dense alder shrub growth. Much of the spruce has been beetle-killed and blown down, resulting in an open canopy.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Picea mariana*	25	Yes	FACW
2. *Betula papyrifera (Southcentral)*	5		FAC
3.			
4.			
Total Cover:	30		
50% of total cover: 15 20% of total cover: 6			
Sapling/Shrub Stratum			
1. *Sorbus scopulina*	25	Yes	FACU
2. *Rosa acicularis*	25	Yes	FACU
3. *Cornus canadensis*	25	Yes	FACU
4. *Viburnum edule*	10		FACU
5. *Alnus viridis*	10		FAC
6.			
Total Cover:	95		
50% of total cover: 48 20% of total cover: 19			
Herb Stratum			
1. *Calamagrostis canadensis*	25	Yes	FAC
2. *Gymnocarpium dryopteris*	25	Yes	FACU
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
Total Cover:	50		
50% of total cover: 25 20% of total cover: 10			

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ______

% Cover of Wetland Bryophytes 0 Total Cover of Bryophytes 0
(Where applicable)

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species	25	x 2 = 50
FAC species	40	x 3 = 120
FACU species	110	x 4 = 440
UPL species		x 5 = 0
Column Totals:	175 (A)	610 (B)

Prevalence Index = B/A = 3.48

Hydrophytic Vegetation Indicators:

No Dominance Test is >50%

No Prevalence Index is ≤3.0

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ____ No X

Remarks:

SOIL

Sampling Point: DP-25

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
+9- +5	v dk gray brn 10YR3/2	50					silt, roots, wood debris and decomposed plant matter	
	black 10YR2/1	50						
+5-0	black 10YR2/1	50					organic soil; many fine roots; greasy when wetted; dry	
	v dk gray 10YR3/1	50						
0-10	dk gray brn 10YR4/2	100					silt loam and charcol; dry	
10-17	v pale brn 10YR7/3	50						
	brown 10YR5/3	50						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol or Histel (A1)
- ___ Histic Epipedon (A2)
- ___ Hydrogen Sulfide (A4)
- ___ Thick Dark Surface (A12)
- ___ Alaska Gleyed (A13)
- ___ Alaska Redox (A14)
- ___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

- ___ Alaska Color Change (TA4)[4]
- ___ Alaska Alpine Swales (TA5)
- ___ Alaska Redox With 2.5Y Hue
- ___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
- ___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.

[4]Give details of color change in Remarks.

Restrictive Layer (if present):

Type: None

Depth (inches): ________

Hydric Soil Present? Yes _____ No X

Remarks: The surfical organic, black soil indicates potential hydric conditions but does not extend to depth and is not saturated. The absence of redox indicators and lack of soil moisture during this wet season supports the finding of nonhydric soil.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-stained Leaves (B9)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No X Depth (inches): ________

Water Table Present? Yes _____ No X Depth (inches): ________

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): ________

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site lacks characteristics of wetland hydrology despite the seasonally high cumulative precipitation in the region. Cumulative total precipitation on September 9, 2014 was above normal with 10.30 inches since June 1st, compared to the normal of 6.90 inches, resulting in an excess of 3.40 inches. Since January 1st, the total was 13.53 inches, compared to the normal of 10.22 inches, resulting in an excess of 3.31 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: MOA Parcel 1707306000; SEC 25, T12N, R3W, SM; SW corner of Upper DeArmoun Rd and Canyon Rd Borough/City: Anchorage Sampling Date: 9/9/2014

Applicant/Owner: ______ Sampling Point: DP-26

Investigator(s): Pat Athey Landform (hillside, terrace, hummocks, etc.): Mountain slope

Local relief (concave, convex, none): Flat Slope (%): ______

Subregion: Southcentral Lat: N 61.1008 Long: W 149.7192 Datum: NAD83

Soil Map Unit Name: 414—Deception-Estelle-Kichatna complex, undulating and hilly NWI classification: None Indicated

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes	No X	Is the Sampled Area within a Wetland? Yes ____ No X
Hydric Soil Present?	Yes	No X	
Wetland Hydrology Present?	Yes	No X	

Remarks: Site is located on a south-facing mountain slope in open spruce-birch forest and dense alder shrub growth. Much of the spruce has been beetle-killed and blown down, resulting in an open canopy.

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. *Picea mariana*	25	Yes	FACW
2. *Picea glauca*	25	Yes	FACU
3. *Betula papyrifera (Southcentral)*	10	Yes	FAC
4.			
Total Cover:	60		
50% of total cover: 30	20% of total cover: 12		
Sapling/Shrub Stratum			
1. *Cornus canadensis*	50	Yes	FACU
2. *Rosa acicularis*	10	Yes	FACU
3. *Rubus idaeus*	10	Yes	FACU
4. *Viburnum edule*	10		FACU
5. *Alnus viridis*	10		FAC
6.			
Total Cover:	90		
50% of total cover: 45	20% of total cover: 18		
Herb Stratum			
1. *Calamagrostis canadensis*	25	Yes	FAC
2. *Gymnocarpium dryopteris*	10	Yes	FACU
3. *Equisetum arvense*	10	Yes	FAC
4. *Sanguisorba canadensis*	5		FACW
5. *Mertensia paniculata*	1		FACU
6. *Chamerion angustifolium*	1		FACU
7.			
8.			
9.			
10.			
Total Cover:	52		
50% of total cover: 26	20% of total cover: 10		

Plot size (radius, or length x width) 30-ft diameter % Bare Ground ______

% Cover of Wetland Bryophytes 0 Total Cover of Bryophytes 0
(Where applicable)

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 9 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 44 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species	30	x 2 = 60
FAC species	55	x 3 = 165
FACU species	117	x 4 = 468
UPL species		x 5 = 0
Column Totals:	202 (A)	693 (B)

Prevalence Index = B/A = 3.43

Hydrophytic Vegetation Indicators:

No Dominance Test is >50%

No Prevalence Index is ≤3.0

____ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

____ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ____ No X

Remarks:

SOIL

Sampling Point: DP-26

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
+10- +4	dk gray brn 10YR4/2	100					organic matter,fine roots, wood debris and decomposed plants	
+4-0	black 10YR2/1	50					organic soil; many fine roots; greasy when wetted; dry	
	v dk gray 10YR3/1	50						
0-11	black 10YR2/1	100					silt loam and charcol; dry	
11-19	v pale brn 10YR7/3	50					silt loam w/ gravel & cobbles, dry; loose	
	brown 10YR5/3	50						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol or Histel (A1)
- ___ Histic Epipedon (A2)
- ___ Hydrogen Sulfide (A4)
- ___ Thick Dark Surface (A12)
- ___ Alaska Gleyed (A13)
- ___ Alaska Redox (A14)
- ___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

- ___ Alaska Color Change (TA4)[4]
- ___ Alaska Alpine Swales (TA5)
- ___ Alaska Redox With 2.5Y Hue
- ___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
- ___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):
Type: None
Depth (inches): ______

Hydric Soil Present? Yes ____ No X

Remarks: The surfical organic, black soil indicates potential hydric conditions but does not extend to depth and is not saturated. The absence of redox indicators and lack of soil moisture during this wet season supports the finding of nonhydric soil.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-stained Leaves (B9)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ____ No X Depth (inches): ______
Water Table Present? Yes ____ No X Depth (inches): ______
Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): ______

Wetland Hydrology Present? Yes ____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site lacks characteristics of wetland hydrology despite the seasonally high cumulative precipitation in the region. Cumulative total precipitation on September 9, 2014 was above normal with 10.30 inches since June 1st, compared to the normal of 6.90 inches, resulting in an excess of 3.40 inches. Since January 1st, the total was 13.53 inches, compared to the normal of 10.22 inches, resulting in an excess of 3.31 inches. The site is within the Rabbit Creek-Frontal Turnagain Arm Watershed (HUC 1902040107); Rabbit Creek Subwatershed (HUC 190204010701).

Attachment 3
Photos

MOA Parcel 1707306000

DP-1

DP-1

DP-1

DP-2

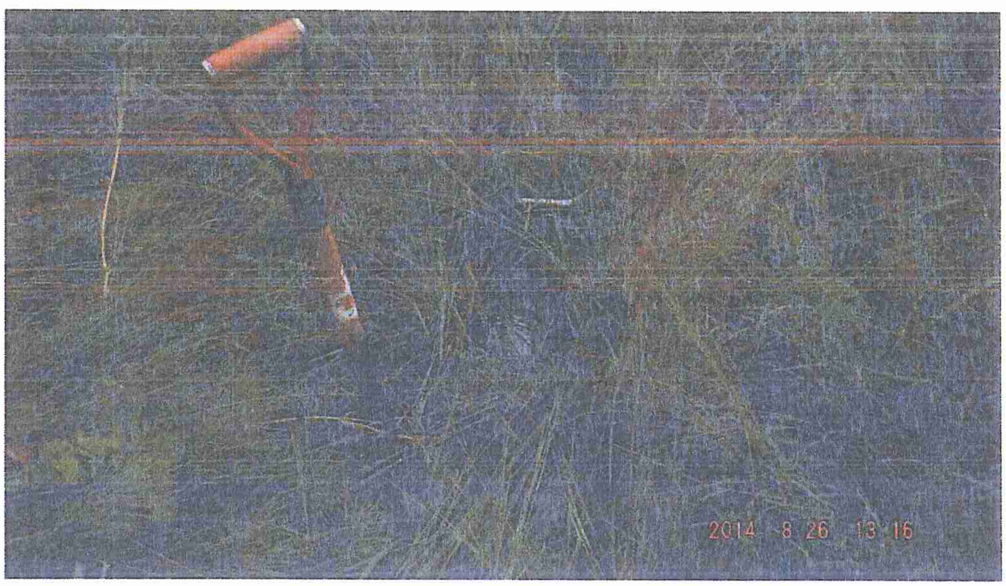
DP-3

DP-3

DP-4

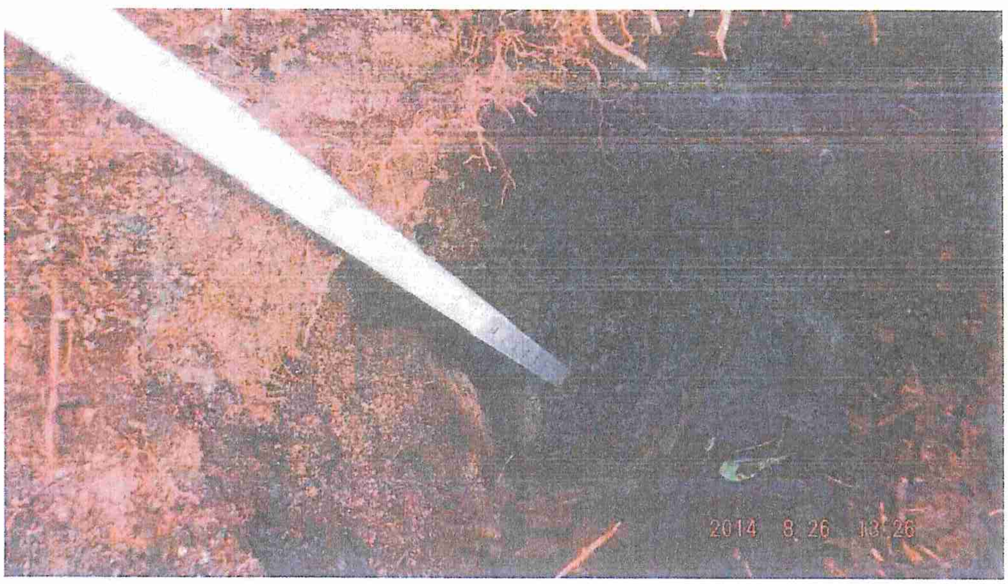
DP-4

DP-5



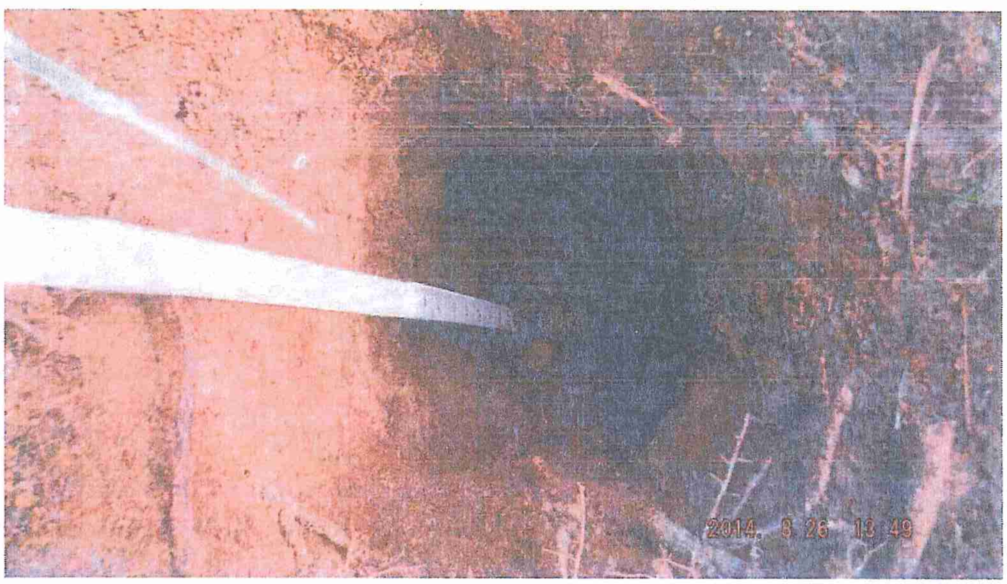
DP-6

DP-7



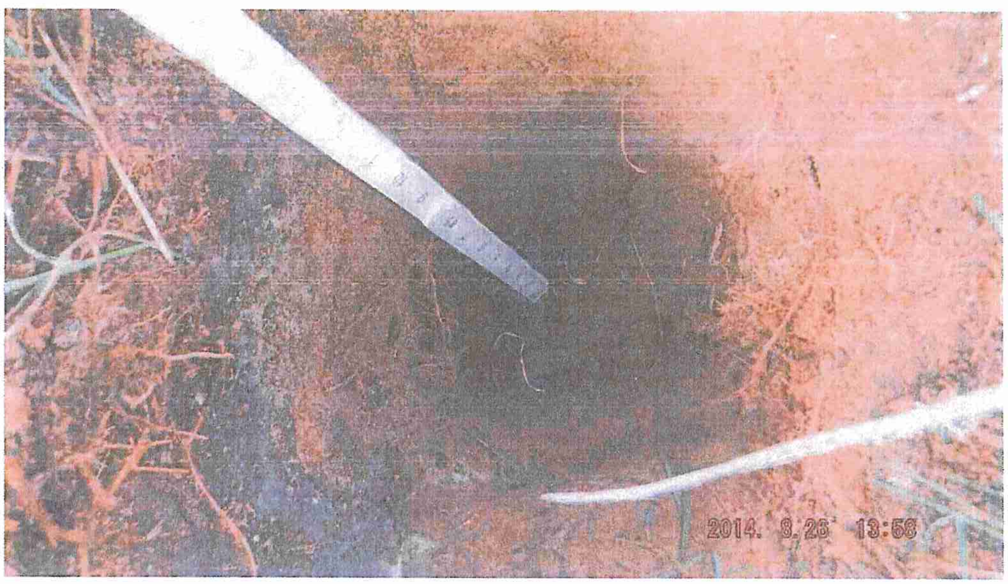
DP-8

DP-9



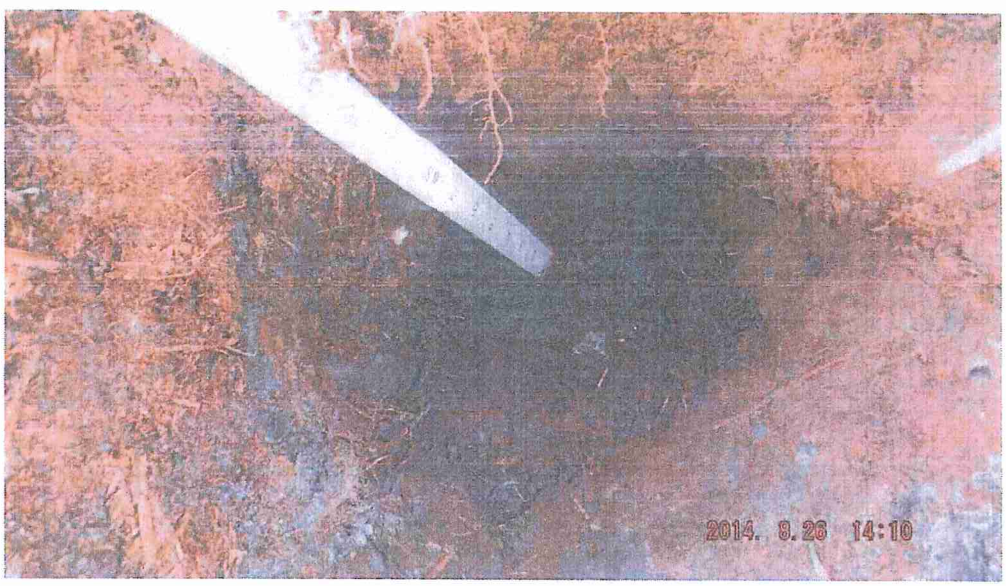
DP-9

DP-10



DP-10

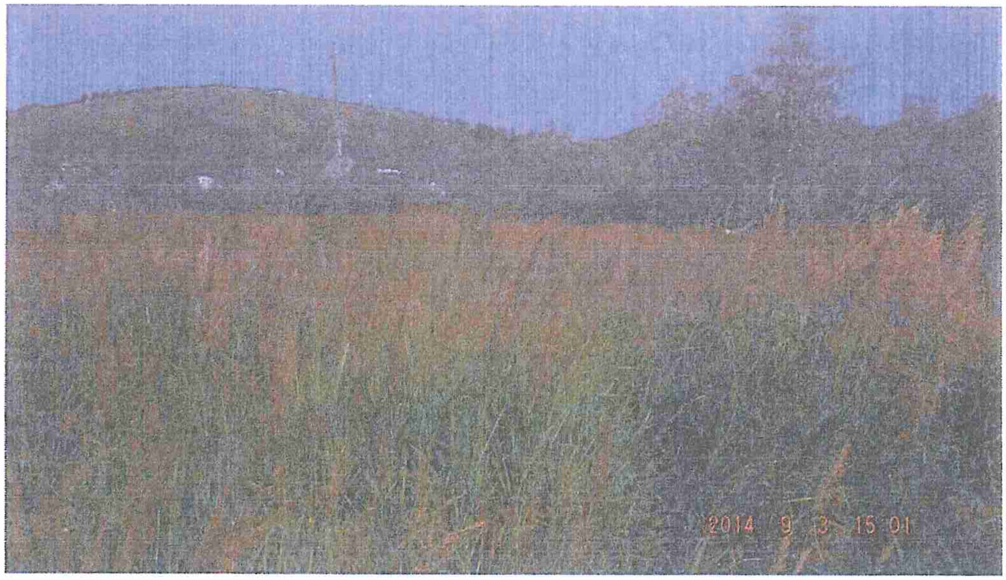
DP-11



DP-11

DP-13

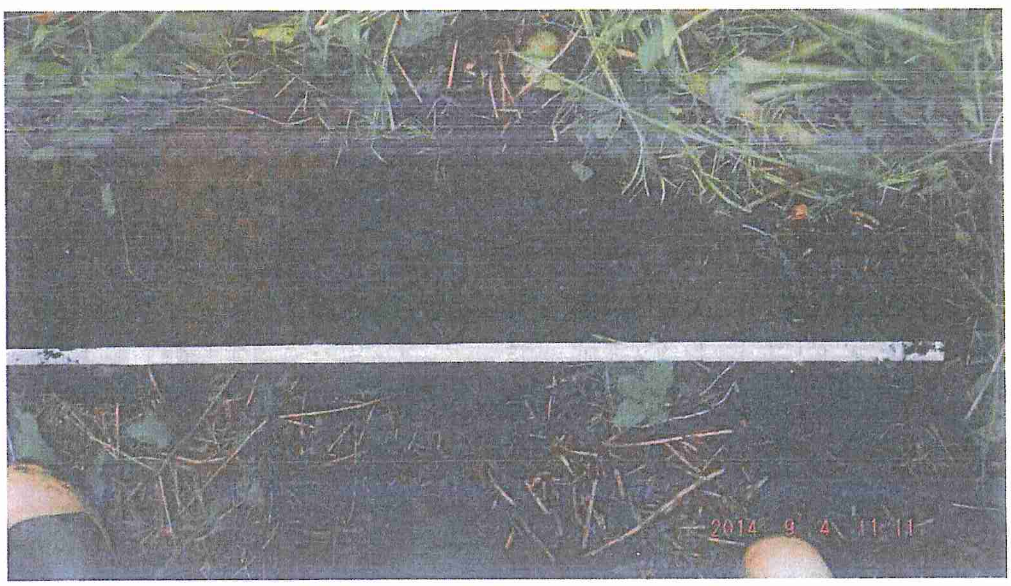
DP-15



DP-15

DP-16

DP-16



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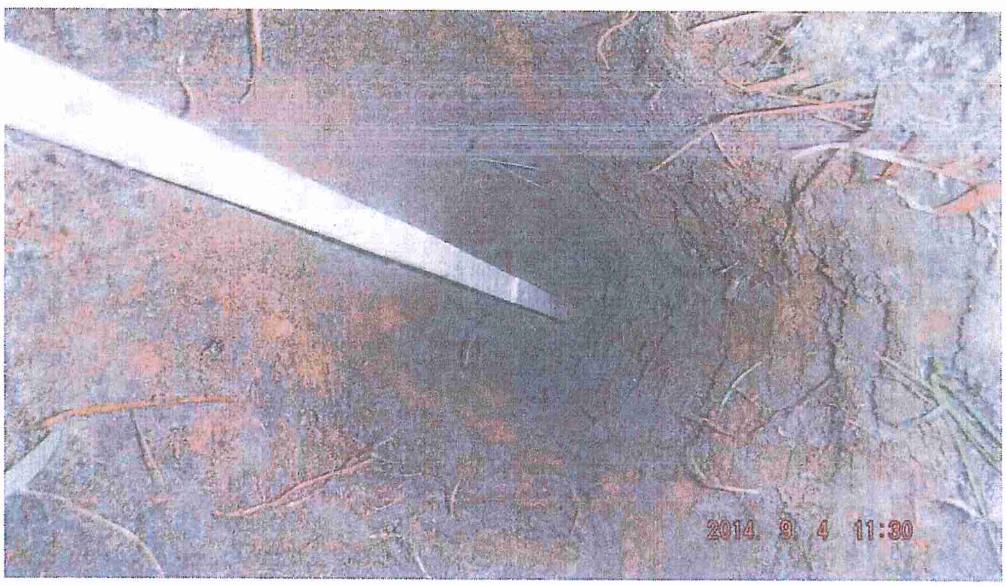

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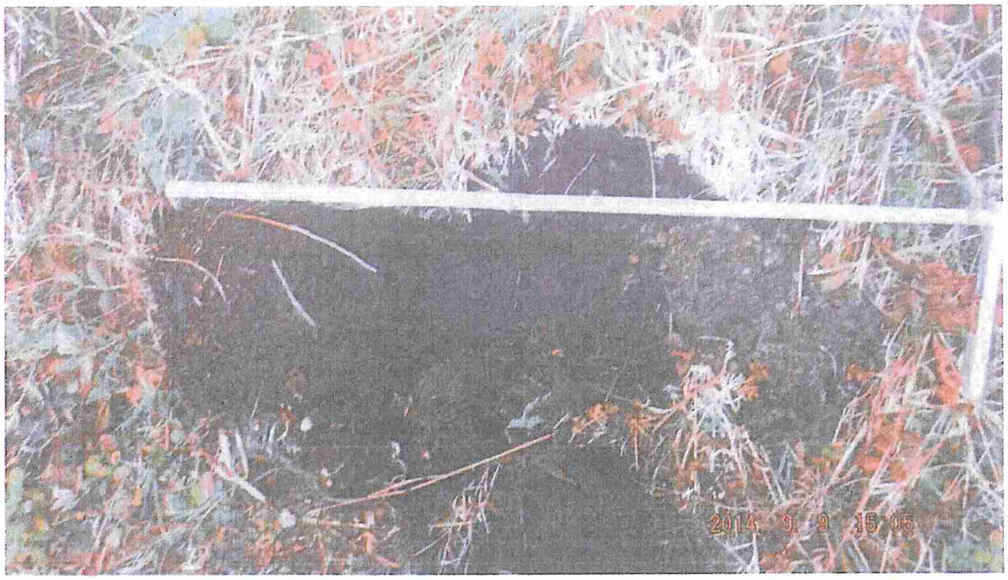

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