Too'gha Well Construction Report

October 1998

Too'gha Incorporated
Village Safe Water

MONTGOMERY WATSON

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Summary

Three test holes and one well were constructed for Too'gha Incorporated in Tanana, Alaska. The first three test holes (> 400 ft away from the river) were dry, but the final drill site adjacent to the river demonstrated sustained production of at least 50 gpm at the time of pump test. The water level in the well is closely tied to the level of the Yukon River, and the production potential of the well should be evaluated when the river is lowest. It is unlikely that the well will significantly affect adjacent wells, because of the high permeability of the water bearing formation and the high rate of recharge from the Yukon River.

Water from this well is under the influence of surface water. Initial water quality results indicate that treatment for iron, manganese, color, odor, and turbidity will be required. Benzene was also encountered in the well at concentrations well below regulatory limits. However, some benzene removal should be considered in the design of the treatment process.

Pending winter production tests of the new well, we recommend that this well be used as the sole water source for the future Too'gha water plant. We do not recommend the use of any additional wells or water sources at this time.

Introduction

Too'gha contracted Montgomery Watson to perform the support and administration of the construction of a new well to serve as a water source for the future Too'gha water plant and water distribution system. Alpine Drilling performed the work.

Test Hole Drilling

A total of four holes were drilled, the first three being dry. Montgomery Watson and the Driller were under contract to drill only two holes, but after drilling the first hole, the Too'gha Board provided a written resolution to drill two more. The driller agreed to drill the additional holes using the same unit rates in the original contract. The following table summarizes information about the test holes. Consult Appendix A for detailed soil boring logs.

	Location	Findings	Notes
TH-1	Adjacent to the future water plant building.	The soil was frozen to bedrock at 51'. No water was encountered.	8" casing was advanced to bedrock. The driller was unable to pull the casing and sealed the hole with bentonite.
TH-2	Near the southeast corner of the future water plant property.	The soil was frozen to bedrock at ~49 ft. No water was encountered.	The hole was sealed with bentonite.
TH-3	The north side of Third Avenue, southwest of the future water plant property.	The soil was frozen to ~41 ft. Bedrock was found at ~49 ft. No water was encountered.	The hole was sealed with bentonite.
Too'gha Production Well	Next to the existing city well house on Front Street.	Water was encountered at ~30 ft, and a high water producing stratum was found at 40 ft. No frozen ground was encountered. Bedrock occurred at 42 ft.	The well was constructed at this hole.

Construction of the Well

The well was constructed with 8" diameter, 0.322" thick casing extending to a depth of 39 feet. A 20 slot stainless steel screen was chosen based on a sieve analysis of a sample from the water producing formation. Three feet of the screen is exposed to the water bearing formation and the less productive formation above it.

The driller developed the well using the blast and surge method. The driller alternately sent a compressed air blast down the well, loosening sediment in the formation, and then vigorously pumped water from the well (>70 gpm). This process was repeated for two hours, when the water became and remained virtually free of visible sand particles.

Well Tests

Due to the well's proximity to the Yukon River and the high permeability of the formation, the water level in the well stabilized within one minute of any change in pumping rate. Because of the fast drawdown and recovery rates, the long term pump test and step-drawdown tests were both reduced to two hours. Results from the tests can be found in appendix B.

Additional well tests need to be conducted when the Yukon River is low, specifically during the winter. Historically, the production capacity of nearby wells has been significantly smaller during the winter months. Therefore a well test during these times is needed to assess the year-round capacity of the well and its effect on adjacent wells.

Water Quality Results

Water quality results are similar to other wells in Interior Alaska, with high iron (0.502 mg/l) and manganese (0.355 mg/l) concentrations. Also color and odor are above the recommended maximum concentration limits.

Three volatile organic compounds were encountered in the well: benzene, trichlorofluoromethane, and dichlorodifluoromethane. They are summarized below.

Trichlorofluoromethane (freon-11) (CAS 75-69-4)

Measured concentration: 1.71 µg/l

This is a highly volatile and relatively insoluble compound (10,000-50,000 mg/l at 64°F). It is more dense than water (specific gravity of 1.48). It was commonly used as an aerosol propellant and refrigerant, but its use as a propellant was banned in the US in 1978. It is very stable and can be transported long distances. It is highly volatile, and will readily evaporate when exposed to air.

The State of Alaska does not regulate this substance in drinking water. The EPA health advisory drinking water concentration for trichlorofluoromethane is 2000 µg/l for lifetime exposure[1]. It is not a recognized or suspected carcinogen.

Dichlorodifluoromethane (freon-12) (CAS 75-71-8)

Measured concentration: 0.98 µg/l

Dichlorodifluoromethane properties and uses are similar to trichlorofluoromethane.

The State of Alaska does not regulate this substance in drinking water. The EPA health advisory drinking water concentration of dichlorodifluoromethane is 1000 µg/l for lifetime exposure[1]. It is not a recognized or suspected carcinogen.

Benzene (CAS 71-43-2)

Measured concentration: 0.80 µg/l

Benzene is highly volatile, soluble, and mobile. It enters the environment from the storage and combustion of gasoline, as well as accidental spills.

Benzene is a known carcinogen. The State of Alaska (18 AAC 80) maximum contaminant level for benzene is 5 µg/l, which is six times higher than concentrations measured in the production well.

[1] *Lifetime Exposure Health Advisory* is the concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects over a lifetime of exposure, with a margin of safety. (EPA Drinking Water Regulations and Health Advisories, 1996, EPA 822-B-96-002)

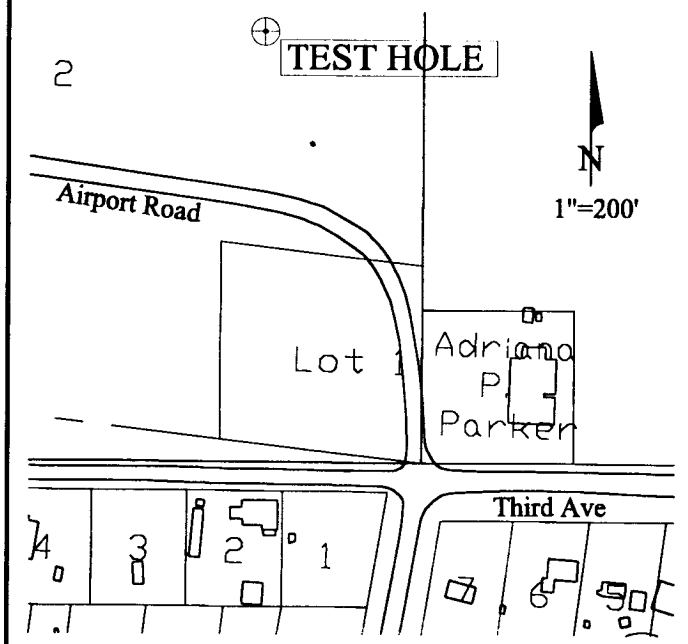
Appendix A

Well / Soil Boring Logs

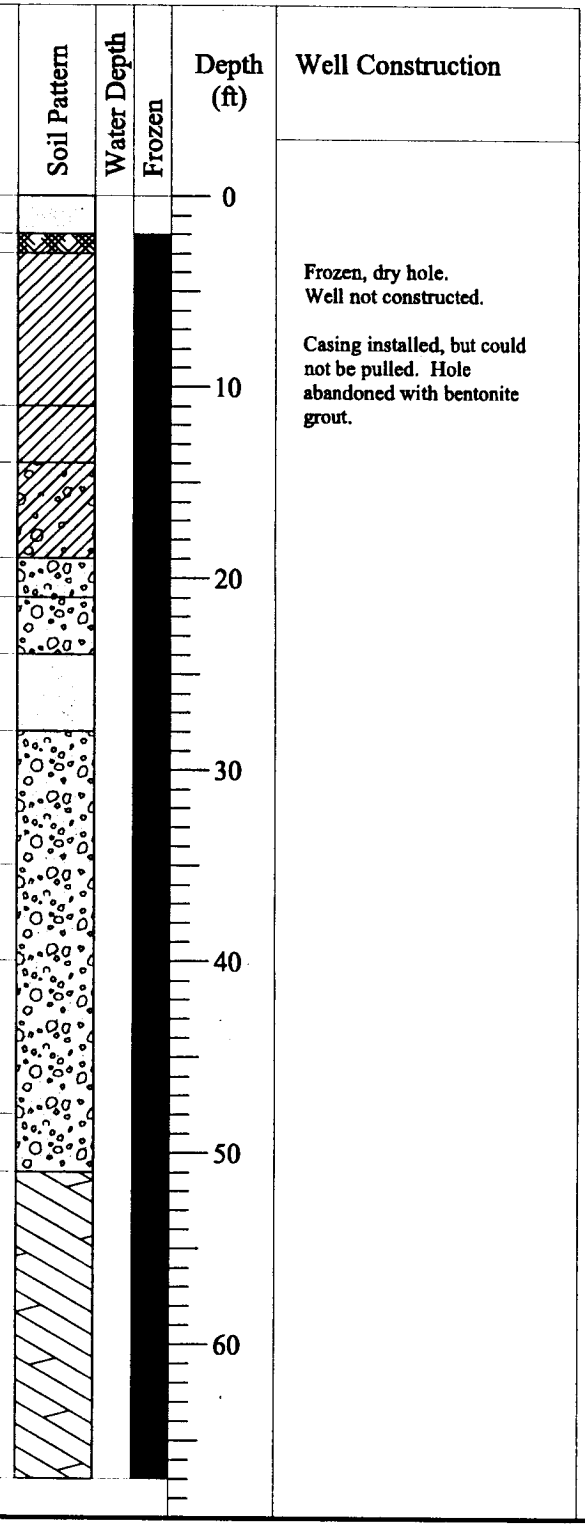
WELL LOG TH-1

Project:	Too'gha Water Source		
Location:	Tanana, Alaska		
Site:	Adjacent to proposed water plant		
Date:	25 June 1998		
Client:	Too'gha Inc.		
Engineer:	Eric Gropp PE , Montgomery Watson		
Driller:	Alpine Drilling		
Rig Type:	Air Rotary		
Boring Size:	8"	Elevation:	100 ft

Site Map



% Gravel	% Sand	% Fines	Max. Size (in)	Soil Class	Soil Description
					Sand & Gravel Fill
					Organics
5	15	80	1/2	ML	Brown Silt, some organics, ice rich, <5% sub-angular gravel
5	5	90	1/2	ML	Grey Silt, ice rich, <5% sub-angular gravel
25	15	60	3/8	ML	Gravelly Silt with sand
50	30	20	1/2	GM	Silty Gravel with sand
70	15	15	1/2	GM-GW	Well Graded Gravel with silt and sand
30	40	30	1/4	SM	Silty Sand with gravel
70	20	10	1/2	GM-GW	Well Graded Gravel with silt and sand
60	30	10	1/2	GW-GM	Well Graded Fravel with silt and sand
65	30	5	1/2	GW	Well Graded Gravel with sand and trace silt
75	20	5	1/2	GW	Well Graded Gravel with sand and trace silt
					Bedrock
					Bottom of hole No water encountered



Well Construction

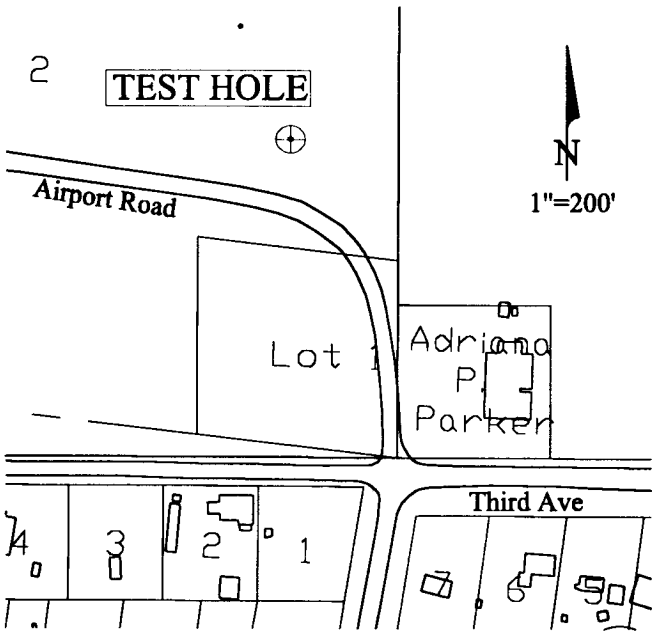
Frozen, dry hole.
Well not constructed.

Casing installed, but could not be pulled. Hole abandoned with bentonite grout.

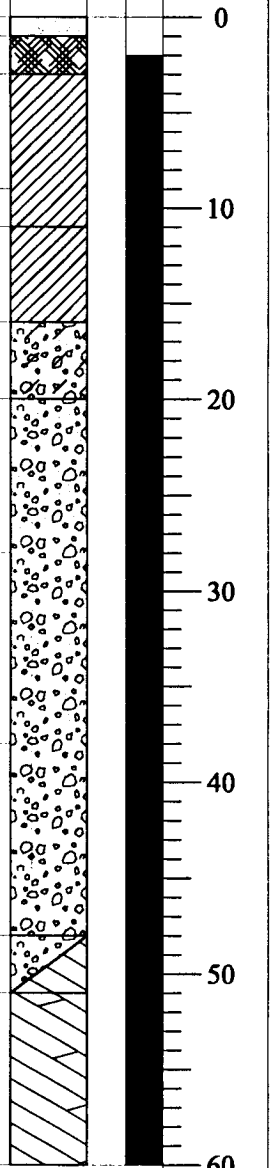
WELL LOG TH-2

Project:	Too'gha Water Source		
Location:	Tanana, Alaska		
Site:	SE Corner of Water Plant Lot		
Date:	26 June 1998		
Client:	Too'gha Inc.		
Engineer:	Eric Gropp PE , Montgomery Watson		
Driller:	Alpine Drilling		
Rig Type:	Air Rotary		
Boring Size:	6"	Elevation:	100 ft

Site Map



% Gravel	% Sand	% Fines	Max. Size (in)	Soil Class	Soil Description
					Sand & Gravel Fill
					Organics, woody
0	0	100	1/4	ML	Brown Silt, some organics, ice rich, <5% sub-angular gravel
0	0	100	1/4	ML	Grey-brown Silt, ice rich
0	0	100	1/4	ML	Grey-brown Silt
70	15	15	1/4	GM	Silty Gravel with sand
95	5	0	1/2	GW	Well Graded Gravel with few sands and trace silt
95	5	0	1/2	GW	Well Graded Gravel with few sands and trace silt
95	5	0	1/2	GW	Well Graded Gravel with few sands and trace silt
95	5	0	1/2	GW	Well Graded Gravel with few sands and trace silt
					Bedrock Bottom of hole No water encountered



Well Construction

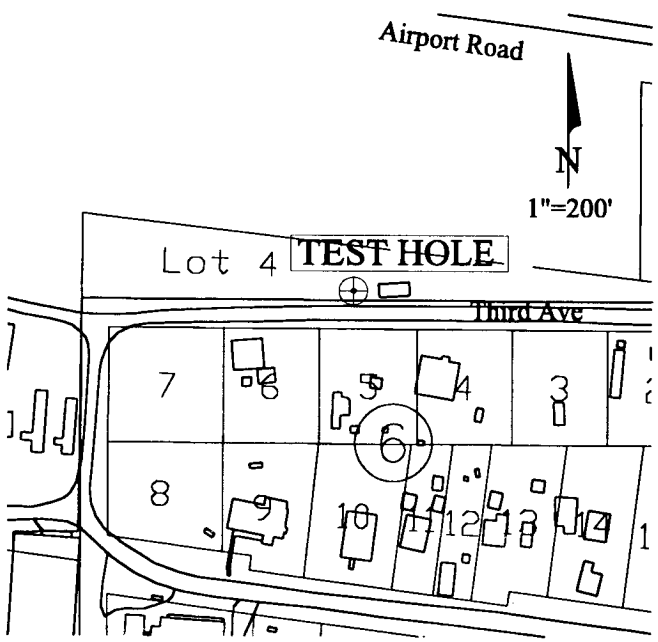
Frozen, dry hole.
Well not constructed.

Hole abandoned with bentonite grout.

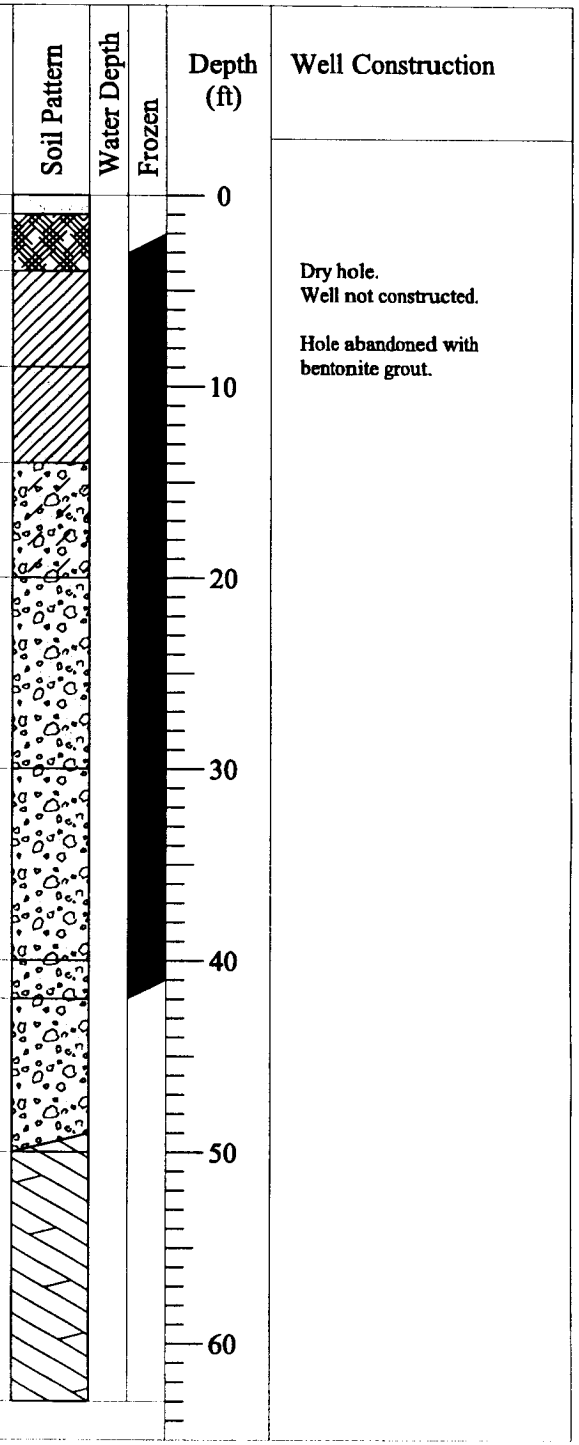
WELL LOG TH-3

Project:	Too'gha Water Source		
Location:	Tanana, Alaska		
Site:	West end of Third Avenue		
Date:	27 June 1998		
Client:	Too'gha Inc.		
Engineer:	Eric Gropp PE , Montgomery Watson		
Driller:	Alpine Drilling		
Rig Type:	Air Rotary		
Boring Size:	6"	Elevation:	96 ft

Site Map



% Gravel	% Sand	% Fines	Max. Size (in)	Soil Class	Soil Description
					Sand & Gravel Fill
					Organics
5	5	90	1/2	ML	Brown Silt, ice rich
25	25	50	1	ML	Brown Sandy Silt with Gravel
50	30	20	1/2	GM	Silty Gravel with sand
70	30	0	3/4	GW	Well Graded Gravel with sand
85	15	0	1 1/4	GW	Well Graded Gravel with sand and trace silt
100	0	0	1	GW	Gravel
100	0	0	2	GW	Gravel
					Bedrock Bottom of hole No water encountered



Well Construction

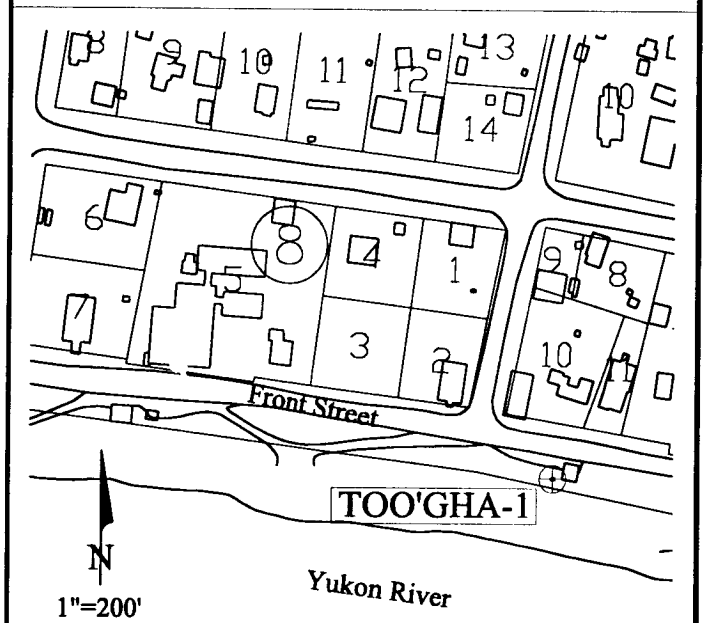
Dry hole.
Well not constructed.

Hole abandoned with bentonite grout.

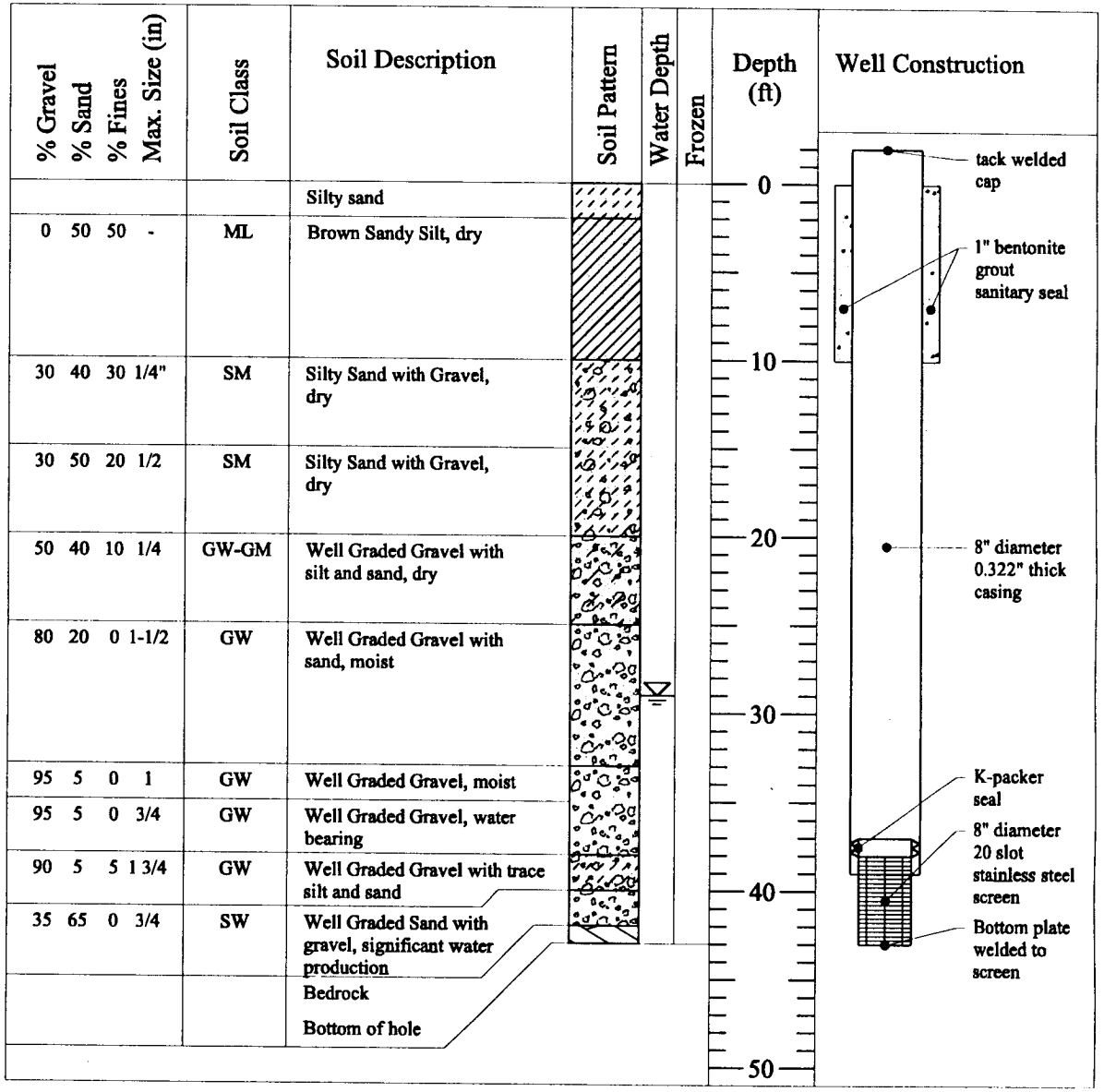
WELL LOG TOO'GHA-1

Project:	Too'gha Water Source		
Location:	Tanana, Alaska		
Site:	Adjacent to existing city well		
Date:	27/28 June 1998		
Client:	Too'gha Inc.		
Engineer:	Eric Gropp PE , Montgomery Watson		
Driller:	Alpine Drilling		
Rig Type:	Air Rotary		
Boring Size:	8"	Elevation:	96 ft

Site Map



% Gravel	% Sand	% Fines	Max. Size (in)	Soil Class	Soil Description
					Silty sand
0	50	50	-	ML	Brown Sandy Silt, dry
30	40	30	1/4"	SM	Silty Sand with Gravel, dry
30	50	20	1/2	SM	Silty Sand with Gravel, dry
50	40	10	1/4	GW-GM	Well Graded Gravel with silt and sand, dry
80	20	0	1-1/2	GW	Well Graded Gravel with sand, moist
95	5	0	1	GW	Well Graded Gravel, moist
95	5	0	3/4	GW	Well Graded Gravel, water bearing
90	5	5	1 3/4	GW	Well Graded Gravel with trace silt and sand
35	65	0	3/4	SW	Well Graded Sand with gravel, significant water production
					Bedrock
					Bottom of hole



Appendix B

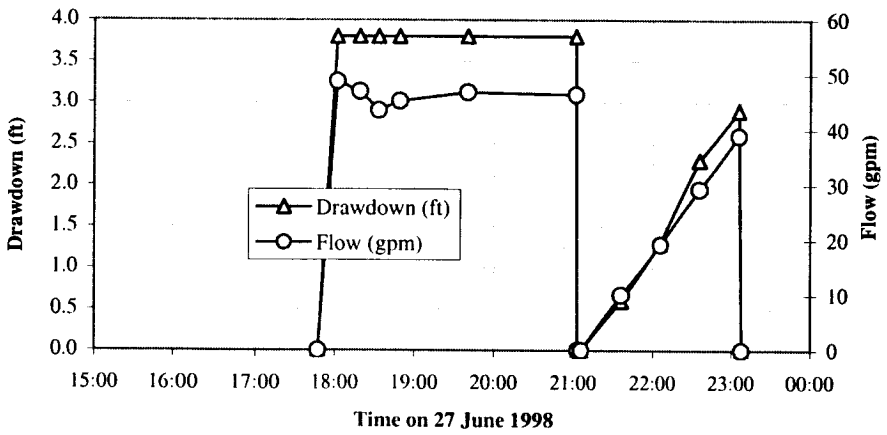
Well Test Results

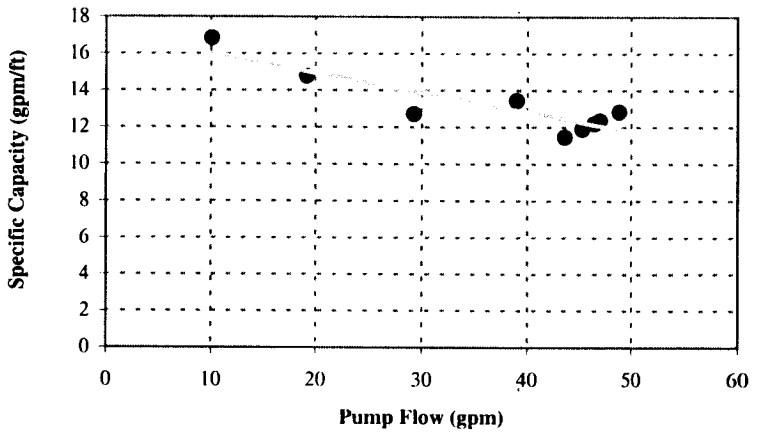
WELL TEST LOG

Project	Too'gha Water Source
Client	Too'gha Inc.
Engineer	Eric Gropp PE
Driller	Alpine Drilling

Date:	06/28/98
Location	Tanana, Alaska
Well	New community water supply, adjacent to existing city well

	Time	Meter	Water Level			Flow			
	27-Jun-98		Below Top Of Casing	Below Ground	Drawdown	Volume	Time Elapsed	Flow	Specific Capacity
		gal	(ft)	(ft)	(ft)	(gal)	(min)	(gpm)	(gpm/ft)
Long Term Drawdown Test	17:47	201975	25.3	23.3	0.0			0.00	
	18:02	202707	29.1	27.1	3.8	732	15	48.8	12.8
	18:19	203505	29.1	27.1	3.8	798	17	46.9	12.4
	18:33	204115	29.1	27.1	3.8	610	14	43.6	11.5
	18:49	204839	29.1	27.1	3.8	724	16	45.3	11.9
	19:40	207227	29.1	27.1	3.8	2388	51	46.8	12.3
	21:02	211030	29.1	27.1	3.8	3803	82	46.4	12.2
Step Drawdown Test	21:03	211030	25.3	23.3	0.0	0	1	0.0	
	21:06	211030	25.3	23.3	0.0	0	3	0.0	
	21:36	211333	25.9	23.9	0.6	303	30	10.1	16.8
	22:06	211909	26.6	24.6	1.3	576	30	19.2	14.8
	22:36	212786	27.6	25.6	2.3	877	30	29.2	12.7
	23:06	213956	28.2	26.2	2.9	1170	30	39.0	13.4
	23:08	213956	25.3	23.3	0.0	0	2	0.0	





Appendix C

Summary Water Quality Results

Water Quality Results				
Project:	**Too'gha Water Source**	Sample Date:		**31 Jul 1998 &**
Location:	**New Too'gha Well on Front Street**			**27-Aug-98 (VOC)**
Test	Parameter	Units	Result	MCL
Inorganic Contaminants				
EPA 200.9	Arsenic	mg/l	<MDL	0.05
EPA 200.9	Antimony	mg/l	<MDL	0.006
EPA 200.7	Barium	mg/l	0.123	2
EPA 200.9	Beryllium	mg/l	<MDL	0.004
EPA 200.9	Cadmium	mg/l	<MDL	0.005
EPA 200.9	Chromium	mg/l	<MDL	0.1
EPS 335.4	Cyanide	mg/l	<MDL	0.2
EPA 300.0	Fluoride	mg/l	0.287	4
EPA 245.1	Mercury by Cold Vapor	mg/l	<MDL	0.002
EPA 200.7	Nickel	mg/l	<MDL	0.1
EPA 200.9	Selenium	mg/l	<MDL	0.05
EPA 200.9	Thallium	mg/l	<MDL	0.002
Secondary Contaminants				
EPA 200.7	Aluminum	mg/l	<MDL	0.2
EPA 300.0	Chloride	mg/l	8.4	250
SM18 2120B	**Color**	**PCU**	**30**	**15**
EPA 200.7	Copper	mg/l	<MDL	1
EPA 200.0	Fluoride	mg/l	0.287	2
SM14 203	Langlier Index @ 40 °F		-0.33	
SM14 203	Langlier Index @ 140 °F		0.75	
EPA 200.7	**Iron**	**mg/l**	**0.502**	**0.3**
EPA 200.7	**Manganese**	**mg/l**	**0.355**	**0.05**
SM2150B	**Odor**	**T.O.N.**	**4**	**3**
EPA 150.1	pH		7.02	6.5-7.5
EPA 200.9	Silver	mg/l	<MDL	0.1
EPA 200.7	Sodium	mg/l	14.3	250
EPA 300.0	Sulfate	mg/l	31	250
SM 2540C	Total Dissolved Solids	mg/l	348	500
EPA 200.7	Zinc	mg/l	<MDL	5
Other Contaminants				
EPA 200.9	Lead	mg/l	<MDL	0.015
EPA 180.1	Turbidity	NTU	2.6	-
SM19 2340B	Hardness as $CaCO_3$	mg/l	330	-
SM18 9222B	Total Coliform	col/100ml	0	-
EPA 300.0	Nitrite-N	mg/l	<MRL	-
EPA 300.0	Nitrate-N	mg/l	0.35	-
SM 5440C	Foaming Agents	mg/l	<MRL	-
Volatile Organic Compounds > MRL				
EPA 524.2	Benzene	µg/l	0.80	5
EPA 524.2	Dichlorodifluoromethane	µg/l	1.71	-
EPA 524.2	Trichlorofluoromethane	µg/l	0.98	-

Appendix D

Water Quality Lab Reports

CT&E Environmental Services Inc.

August 06, 1998

Eric Gropp
Montgomery Watson Americas Inc
4100 Spenard Rd
Anchorage, AK 99517-2901

Dear Eric Gropp:

Thank you for your recent request for analytical services. The sample(s) below will be analyzed per your request.

These samples will be disposed 30 days after completion of analysis. Your samples are assigned to the indicated project

Client: Montgomery Watson Americas Inc - JMMENGN
Project: New Tanana Water Well - [983469]

Sample: 983469001 Client/CT&E ID: New Tanana Water Well
Matrix: 1 - Water (Surface, Eff., Ground)
Collected: 07/31/98 07:55 Received: 07/31/98 11:30 08/11/98 17:00
Receiving Codes:
OK - Sample arrived in good condition

Inorganic Contaminants
Secondary Inorganics
Turbidity
Gross Alpha
Total Coliform (MF)
LEAD/COPPER RULE

For further information or assistance concerning samples, please contact:
Eugene Larmi at (907)562-2343

CT&E Environmental Services Inc.
Laboratory Division

200 W. Potter Drive
Anchorage, AK 99518-1605
Tel: (907) 562-2343
Fax: (907) 561-5301

Montgomery Watson Americas Inc.
attention: Eric Gropp
4100 Spenard Rd.
Anchorage, AK 99517-2901

Account: Montgomery Watson Americas Inc.
Contact: Eric Gropp

Project: New Tanana Well
Received: 08/29/98 14:20

CT&E Ref#: 98.4292
Print Date: 09/15/98 15:01

Work order 98.4292 was analyzed for VOC by EPA 524
by Northern Testing Laboratories of Fairbanks AK 99701

100.522.95

NORTHERN TESTING LABORATORIES, INC.

3330 INDUSTRIAL AVENUE
8005 SCHOON STREET
POUCH 340043

FAIRBANKS, ALASKA 99701
ANCHORAGE, ALASKA 99518
PRUDHOE BAY, ALASKA 99734

(907) 456-3116 • FAX 456-3125
(907) 349-1000 • FAX 349-1016
(907) 659-2145 • FAX 659-2146

CT&E Environmental Services, Inc.
200 West Potter Drive
Anchorage, AK 99518

Attn: Heather Hall

Client ID: 98.4292-1
Client Project #:
Source:
NTL Lab#: A157959
Sample Matrix: Water
Comments: Trip Blank

Report Date: 9/9/98
Date Arrived: 9/1/98
Sample Date:
Sample Time:
Collected By:

** Legend **
MRL = Method Report Level
MCL = Max. Contaminant Level
B = Present In Method Blank
E = Estimated Value
M = Matrix Interference
H = Above MCL
D = Lost To Dilution

Method	Parameter	Units	Result	MRL	Date Prepared	Date Analyzed
EPA 524.2						
	Benzene	ug/L	<MRL	0.20		9/3/98
	Bromobenzene	ug/L	<MRL	0.20		
	Bromochloromethane	ug/L	<MRL	0.20		
	Bromodichloromethane	ug/L	<MRL	0.20		
	Bromoform	ug/L	<MRL	0.50		
	Bromomethane	ug/L	<MRL	1.00		
	n-Butylbenzene	ug/L	<MRL	0.20		
	sec-Butylbenzene	ug/L	<MRL	0.20		
	tert-Butylbenzene	ug/L	<MRL	0.20		
	Carbon Tetrachloride	ug/L	<MRL	0.20		
	Chlorobenzene	ug/L	<MRL	0.20		
	Chloroethane	ug/L	<MRL	1.00		
	Chloroform	ug/L	<MRL	0.30		
	Chloromethane	ug/L	<MRL	0.50		
	2-Chlorotoluene	ug/L	<MRL	0.20		
	4-Chlorotoluene	ug/L	<MRL	0.20		
	Dibromochloromethane	ug/L	<MRL	0.20		
	Dibromomethane	ug/L	<MRL	0.20		
	1,2-Dichlorobenzene	ug/L	<MRL	0.20		
	1,3-Dichlorobenzene	ug/L	<MRL	0.20		
	1,4-Dichlorobenzene	ug/L	<MRL	0.20		
	Dichlorodifluoromethane	ug/L	<MRL	0.50		
	1,1-Dichloroethane	ug/L	<MRL	0.20		

Reported By: Jorma K. Kuusisto
Chemistry Supervisor

NORTHERN TESTING LABORATORIES, INC.

3330 INDUSTRIAL AVENUE
8005 SCHOON STREET
POUCH 340043

FAIRBANKS, ALASKA 99701
ANCHORAGE, ALASKA 99518
PRUDHOE BAY, ALASKA 99734

(907) 456-3116 • FAX 456-3125
(907) 349-1000 • FAX 349-1016
(907) 659-2145 • FAX 659-2146

CT&E Environmental Services, Inc.
200 West Potter Drive
Anchorage, AK 99518

Attn: Heather Hall
Client ID: 98.4292-1
Client Project #:
Source:
NTL Lab#: A157959
Sample Matrix: Water
Comments: Trip Blank

Report Date: 9/9/98
Date Arrived: 9/1/98
Sample Date:
Sample Time:
Collected By:

** Legend **

MRL	=	Method Report Level
MCL	=	Max. Contaminant Level
B	=	Present In Method Blank
E	=	Estimated Value
M	=	Matrix Interference
H	=	Above MCL
D	=	Lost To Dilution

Method	Parameter	Units	Result	MRL	Date Prepared	Date Analyzed
	1,2-Dichloroethane	ug/L	<MRL	0.20		9/3/98
	1,1-Dichloroethene	ug/L	<MRL	0.20		
	cis-1,2-Dichloroethene	ug/L	<MRL	0.20		
	trans-1,2-Dichloroethene	ug/L	<MRL	0.20		
	1,2-Dichloropropane	ug/L	<MRL	0.20		
	1,3-Dichloropropane	ug/L	<MRL	0.20		
	2,2-Dichloropropane	ug/L	<MRL	0.20		
	1,1-Dichloropropene	ug/L	<MRL	0.20		
	cis-1,3-Dichloropropene	ug/L	<MRL	0.20		
	trans-1,3-Dichloropropene	ug/L	<MRL	0.20		
	Ethylbenzene	ug/L	<MRL	0.20		
	Hexachlorobutadiene	ug/L	<MRL	0.20		
	Isopropylbenzene	ug/L	<MRL	0.20		
	p-Isopropyltoluene	ug/L	<MRL	0.20		
	Methylene Chloride	ug/L	<MRL	0.50		
	Naphthalene	ug/L	<MRL	0.20		
	n-Propylbenzene	ug/L	<MRL	0.20		
	Styrene	ug/L	<MRL	0.20		
	1,1,1,2-Tetrachloroethane	ug/L	<MRL	0.20		
	1,1,2,2-Tetrachloroethane	ug/L	<MRL	0.20		
	Tetrachloroethene	ug/L	<MRL	0.20		
	Toluene	ug/L	<MRL	0.20		
	1,2,3-Trichlorobenzene	ug/L	<MRL	0.20		
	1,2,4-Trichlorobenzene	ug/L	<MRL	0.20		

Reported By: Jorma K. Kuusisto
Chemistry Supervisor

NORTHERN TESTING LABORATORIES, INC.

3330 INDUSTRIAL AVENUE, FAIRBANKS, ALASKA 99701, (907) 456-3116 • FAX 456-3125
8005 SCHOON STREET, ANCHORAGE, ALASKA 99518, (907) 349-1000 • FAX 349-1016
POUCH 340043, PRUDHOE BAY, ALASKA 99734, (907) 659-2145 • FAX 659-2146

CT&E Environmental Services, Inc.
200 West Potter Drive
Anchorage, AK 99518

Attn: Heather Hall

Client ID: 98.4292-1
Client Project #:
Source:
NTL Lab#: A157959
Sample Matrix: Water
Comments: Trip Blank

Report Date: 9/9/98
Date Arrived: 9/1/98
Sample Date:
Sample Time:
Collected By:

** Legend **
MRL = Method Report Level
MCL = Max. Contaminant Level
B = Present In Method Blank
E = Estimated Value
M = Matrix Interference
H = Above MCL
D = Lost To Dilution

Method	Parameter	Units	Result	MRL	Date Prepared	Date Analyzed
	1,1,1-Trichloroethane	ug/L	<MRL	0.20		9/3/98
	1,1,2-Trichloroethane	ug/L	<MRL	0.20		
	Trichloroethene	ug/L	<MRL	0.20		
	Trichlorofluoromethane	ug/L	<MRL	0.50		
	1,2,3-Trichloropropane	ug/L	<MRL	0.20		
	1,2,4-Trimethylbenzene	ug/L	<MRL	0.20		
	1,3,5-Trimethylbenzene	ug/L	<MRL	0.20		
	Vinyl Chloride	ug/L	<MRL	0.50		
	m,p-Xylene	ug/L	<MRL	0.20		
	o-Xylene	ug/L	<MRL	0.20		
	Total Trihalomethanes	ug/L	<MRL	0.50		
	4-Bromofluorobenzene	% Recovery	85			
	1,2-Dichlorobenzene-d4	% Recovery	82			

Reported By: Jorma K. Kuusisto
Chemistry Supervisor

NORTHERN TESTING LABORATORIES, INC.

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POUCH 340043, PRUDHOE BAY, ALASKA 99734, (907) 659-2145 • FAX 659-2146

CT&E Environmental Services, Inc.
200 West Potter Drive
Anchorage, AK 99518

Attn: Heather Hall

Client ID: 98.4292-2
Client Project #:
Source: New Tanana Well
NTL Lab#: A157960
Sample Matrix: Water
Comments:

Report Date: 9/9/98
Date Arrived: 9/1/98
Sample Date: 8/27/98
Sample Time: 10:00
Collected By:

** Legend **

MRL	=	Method Report Level
MCL	=	Max. Contaminant Level
B	=	Present In Method Blank
E	=	Estimated Value
M	=	Matrix Interference
H	=	Above MCL
D	=	Lost To Dilution

Method	Parameter	Units	Result	MRL	Date Prepared	Date Analyzed
EPA 524.2						
	Benzene	ug/L	0.80	0.20		9/3/98
	Bromobenzene	ug/L	<MRL	0.20		
	Bromochloromethane	ug/L	<MRL	0.20		
	Bromodichloromethane	ug/L	<MRL	0.20		
	Bromoform	ug/L	<MRL	0.50		
	Bromomethane	ug/L	<MRL	1.00		
	n-Butylbenzene	ug/L	<MRL	0.20		
	sec-Butylbenzene	ug/L	<MRL	0.20		
	tert-Butylbenzene	ug/L	<MRL	0.20		
	Carbon Tetrachloride	ug/L	<MRL	0.20		
	Chlorobenzene	ug/L	<MRL	0.20		
	Chloroethane	ug/L	<MRL	1.00		
	Chloroform	ug/L	<MRL	0.30		
	Chloromethane	ug/L	<MRL	0.50		
	2-Chlorotoluene	ug/L	<MRL	0.20		
	4-Chlorotoluene	ug/L	<MRL	0.20		
	Dibromochloromethane	ug/L	<MRL	0.20		
	Dibromomethane	ug/L	<MRL	0.20		
	1,2-Dichlorobenzene	ug/L	<MRL	0.20		
	1,3-Dichlorobenzene	ug/L	<MRL	0.20		
	1,4-Dichlorobenzene	ug/L	<MRL	0.20		
	Dichlorodifluoromethane	ug/L	0.98	0.50		
	1,1-Dichloroethane	ug/L	<MRL	0.20		

Reported By: Jorma K. Kuusisto
Chemistry Supervisor

NORTHERN TESTING LABORATORIES, INC.

3330 INDUSTRIAL AVENUE
8005 SCHOON STREET
POUCH 340043

FAIRBANKS, ALASKA 99701
ANCHORAGE, ALASKA 99518
PRUDHOE BAY, ALASKA 99734

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(907) 349-1000 • FAX 349-1016
(907) 659-2145 • FAX 659-2146

CT&E Environmental Services, Inc.
200 West Potter Drive
Anchorage, AK 99518

Attn: Heather Hall

Client ID: 98.4292-2
Client Project #:
Source: New Tanana Well
NTL Lab#: A157960
Sample Matrix: Water
Comments:

Report Date: 9/9/98
Date Arrived: 9/1/98
Sample Date: 8/27/98
Sample Time: 10:00
Collected By:

** Legend **

MRL = Method Report Level
MCL = Max. Contaminant Level
B = Present In Method Blank
E = Estimated Value
M = Matrix Interference
H = Above MCL
D = Lost To Dilution

Method	Parameter	Units	Result	MRL	Date Prepared	Date Analyzed
	1,2-Dichloroethane	ug/L	<MRL	0.20		9/3/98
	1,1-Dichloroethene	ug/L	<MRL	0.20		
	cis-1,2-Dichloroethene	ug/L	<MRL	0.20		
	trans-1,2-Dichloroethene	ug/L	<MRL	0.20		
	1,2-Dichloropropane	ug/L	<MRL	0.20		
	1,3-Dichloropropane	ug/L	<MRL	0.20		
	2,2-Dichloropropane	ug/L	<MRL	0.20		
	1,1-Dichloropropene	ug/L	<MRL	0.20		
	cis-1,3-Dichloropropene	ug/L	<MRL	0.20		
	trans-1,3-Dichloropropene	ug/L	<MRL	0.20		
	Ethylbenzene	ug/L	<MRL	0.20		
	Hexachlorobutadiene	ug/L	<MRL	0.20		
	Isopropylbenzene	ug/L	<MRL	0.20		
	p-Isopropyltoluene	ug/L	<MRL	0.20		
	Methylene Chloride	ug/L	<MRL	0.50		
	Naphthalene	ug/L	<MRL	0.20		
	n-Propylbenzene	ug/L	<MRL	0.20		
	Styrene	ug/L	<MRL	0.20		
	1,1,1,2-Tetrachloroethane	ug/L	<MRL	0.20		
	1,1,2,2-Tetrachloroethane	ug/L	<MRL	0.20		
	Tetrachloroethene	ug/L	<MRL	0.20		
	Toluene	ug/L	<MRL	0.20		
	1,2,3-Trichlorobenzene	ug/L	<MRL	0.20		
	1,2,4-Trichlorobenzene	ug/L	<MRL	0.20		

Reported By: Jorma K. Kuusisto
Chemistry Supervisor

NORTHERN TESTING LABORATORIES, INC.

3330 INDUSTRIAL AVENUE
8005 SCHOON STREET
POUCH 340043

FAIRBANKS, ALASKA 99701
ANCHORAGE, ALASKA 99518
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(907) 349-1000 • FAX 349-1016
(907) 659-2145 • FAX 659-2146

CT&E Environmental Services, Inc.
200 West Potter Drive
Anchorage, AK 99518

Attn: Heather Hall

Client ID: 98.4292-2
Client Project #:
Source: New Tanana Well
NTL Lab#: A157960
Sample Matrix: Water
Comments:

Report Date: 9/9/98
Date Arrived: 9/1/98
Sample Date: 8/27/98
Sample Time: 10:00
Collected By:

** Legend **

MRL = Method Report Level
MCL = Max. Contaminant Level
B = Present In Method Blank
E = Estimated Value
M = Matrix Interference
H = Above MCL
D = Lost To Dilution

Method	Parameter	Units	Result	MRL	Date Prepared	Date Analyzed
	1,1,1-Trichloroethane	ug/L	<MRL	0.20		9/3/98
	1,1,2-Trichloroethane	ug/L	<MRL	0.20		
	Trichloroethene	ug/L	<MRL	0.20		
	Trichlorofluoromethane	ug/L	1.71	0.50		
	1,2,3-Trichloropropane	ug/L	<MRL	0.20		
	1,2,4-Trimethylbenzene	ug/L	<MRL	0.20		
	1,3,5-Trimethylbenzene	ug/L	<MRL	0.20		
	Vinyl Chloride	ug/L	<MRL	0.50		
	m,p-Xylene	ug/L	<MRL	0.20		
	o-Xylene	ug/L	<MRL	0.20		
	Total Trihalomethanes	ug/L	<MRL	0.50		
	4-Bromofluorobenzene	% Recovery	85			
	1,2-Dichlorobenzene-d4	% Recovery	83			

Reported By: Jon a K. Kuusisto
Chemistry Supervisor

Montgomery Watson 4100 Spenard Road Anchorage AK 99517 (907)248-8883 Fax (907) 248-8884 ATTN: Eric Gropp	Too'gha	Laboratory CT&E Environmental	Volatile Organics 18AAC80.070	Trip Blank	984292
Samplers: Wilbur Jerome			40 ml Amber w/ HCL	40 ml	
Date	Time	Sample ID	Total Containers		
12-Aug-98	10:00 AM	Trip Blank ✓	2		X
27 Aug	4PM	New Tanana Well ✓	2	X	

Relinquished by: Jerome Willer	Date 8-28-98 Time 1200	Hand Delivered (Y) N	Shipped Via Hand Carried ✓	Airbill Number	Date Time
Received for Laboratory by: Rhonda Strucher	Date 8-28-98 Time 1200	Cooler Temperature Upon Arrival 2.3°C	°C	Laboratory Notified Faxed	

Relinquished By: Kelley Hatch 8/28/98 1630 Received: Sara Howell 8/29/98 1420

MONTGOMERY WATSON LABORATORIES

355 East Walnut Street
Pasadena, California 91101
818 568 6400; Fax: 818 568 6324;
1 800 566 LABS (1 800 566 5227)

Laboratory Report #47498

Commercial Testing & Engineering Co
Heather Hall
200 W. Potter Drive
Anchorage , AK 99518

Samples Received
23-sep-1998 19:21:33

Prepared	Analyzed	QC Batch#	Method	Analyte	Result	Units	MDL	Dilution
98.3469-1 TANANA (980923500)			**Sampled on 07/31/98**					
				Gross Alpha and Beta Radiation				
09/24/98	84654		(ML/EPA 900.0)	Alpha, Gross	1.3	pCi/l	1.3	1
09/24/98	84654		(ML/EPA 900.0)	Alpha, Two Sigma Error	0.7	pCi/l	0.0000	1
09/24/98	84654		(ML/EPA 900.0)	Alpha, Min Detectable Activity	1.3	pCi/l	1.3	1
09/24/98	84654		(ML/EPA 900.0)	Beta, Gross	2.4	pCi/l	1.6	1
09/24/98	84654		(ML/EPA 900.0)	Beta, Two Sigma Error	0.9	pCi/l	0.0000	1
09/24/98	84654		(ML/EPA 900.0)	Beta, Min Detectable Activity	1.6	pCi/l	1.6	1

MONTGOMERY WATSON LABORATORIES

535 East Walnut Street
Pasadena, California 91101
[illegible]; Fax: [illegible];
1 800 566 LABS (1 800 566 5227)

Laboratory QC Report #47498

Commercial Testing & Engineering Co

QC Batch #84654

Gross Alpha and Beta Radiation

QC	Analyte	Spiked	Recovered	Yield (%)	Limits (%)	RPD (%)
LCS1	Alpha, Gross	38.3	35.0	91.4	(80.00 - 120.00)	
LCS2	Alpha, Gross	38.3	37.8	98.7	(80.00 - 120.00)	7.7
MS	Alpha, Gross	76.6	68.0	88.8	(70.00 - 130.00)	
MSD	Alpha, Gross	76.6	74.6	97.4	(70.00 - 130.00)	9.3
LCS1	Beta, Gross	31.9	34.6	108.5	(80.00 - 120.00)	
LCS2	Beta, Gross	31.9	34.2	107.2	(80.00 - 120.00)	1.2
MS	Beta, Gross	63.8	58.8	92.2	(70.00 - 130.00)	
MSD	Beta, Gross	63.8	64.6	101.3	(70.00 - 130.00)	9.4

Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and DUP are advisory only and not applicable for ICR Monitoring.

CT&E Environmental Services Inc.
Laboratory Division

Laboratory Analysis Report

August 24, 1998

Eric Gropp
Montgomery Watson Americas Inc
4100 Spenard Rd
Anchorage, AK 99517-2901

Client Name	Montgomery Watson Americas Inc
Project ID	New Tanana Water Well [983469]
Printed	August 24, 1998

Enclosed are the analytical results associated with the above project.

As required by the state of Alaska and the USEPA, a formal Quality Assurance/Quality Control Program is maintained by CT&E. A copy of our Quality Control Manual that outlines this program is available at your request.

Except as specifically noted, all statements and data in this report are in conformance to the provisions set forth in our Quality Assurance Program Plan.

If you have any questions regarding this report or if we can be of any other assistance, please call your CT&E Project Manager at (907) 562-2343.

The following descriptors may be found on your report which will serve to further qualify the data.

U - Indicates the compound was analyzed for but not detected.
J - Indicates an estimated value that falls below PQL, but is greater than the MDL.
B - Indicates the analyte is found in the blank associated with the sample.
* - The analyte has exceeded allowable limits.
GT - Greater Than
D - Secondary Dilution
LT - Less Than
! - Surrogate out of range

CT&E Environmental Services Inc.

CT&E Ref.#	983469001	**Client PO#**	1189078.010103
Client Name	Montgomery Watson Americas Inc	**Printed Date/Time**	08/24/98 15:00
Project Name/#	New Tanana Water Well	**Collected Date/Time**	07/31/98 07:55
Client Sample ID	New Tanana Water Well	**Received Date/Time**	07/31/98 11:30
Matrix	Water (Surface, Eff., Ground)	**Technical Director:**	Stephen C. Ede
Ordered By		**Released By**	
PWSID			

Sample Remarks:
Nitrate/Nitrite (EPA 300) analyzed by Northern Testing Laboratories of Fairbanks, AK.
MBAS (SM 5540C) analyzed by Northern Testing Laboratories of Anchorage, AK.
Gross Alpha (EPA 900) analyzed by Montgomery Watson Laboratories of Pasadena, CA.

Parameter		Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
Inorganic Contaminants									
Arsenic		0.00500 U	0.00500	mg/L	EPA 200.9	.05 max		08/17/98	JMO
Antimony		0.00500 U	0.00500	mg/L	EPA 200.9	.006 max		08/07/98	KGF
Barium		0.123	0.0100	mg/L	EPA 200.7	2 max		08/07/98	WTA
Beryllium		0.000500 U	0.000500	mg/L	EPA 200.9	.004 max		08/06/98	KGF
Cadmium		0.000500 U	0.000500	mg/L	EPA 200.9	.005 max		08/06/98	KGF
Chromium		0.00500 U	0.00500	mg/L	EPA 200.9	.1 max		08/07/98	KGF
Cyanide		0.0100 U	0.0100	mg/L	EPA 335.4	.2 max	08/04/98	08/13/98	JMP
Fluoride		0.287	0.100	mg/L	EPA 300.0	4 max	08/06/98	08/06/98	RMV
Mercury by Cold Vapor		0.000200 U	0.000200	mg/L	EPA 245.1	.002 max	08/10/98	08/10/98	NTB
Nickel		0.0200 U	0.0200	mg/L	EPA 200.7	.1 max		08/07/98	WTA
Selenium		0.00500 U	0.00500	mg/L	EPA 200.9	.05 max		08/12/98	KGF
Thallium		0.00150 U	0.00150	mg/L	EPA 200.9	.002 max		08/07/98	KGF
Secondary Contaminants									
Aluminum		0.100 U	0.100	mg/L	EPA 200.7	.2 max		08/07/98	WTA
Chloride		8.40	0.200	mg/L	EPA 300.0	250 max		08/06/98	GCP
Color	*	30.0	5.00	PCU	SM18 2120B	15 max		08/05/98	JMP
Copper		0.0100 U	0.0100	mg/L	EPA 200.7	1 max		08/07/98	WTA
Fluoride		0.287	0.100	mg/L	EPA 300.0	2 max		08/06/98	GCP
Langlier Index @ 40 degree F		-.33			SM14 203			08/24/98	GCP
Langlier Index @ 140 degree F		0.750			SM14 203			08/24/98	GCP
Iron	*	0.502	0.0500	mg/L	EPA 200.7	.3 max		08/07/98	WTA
Manganese	*	0.355	0.0200	mg/L	EPA 200.7	.05 max		08/07/98	WTA

CT&E Environmental Services Inc.

CT&E Ref.#	983469001
Client Name	Montgomery Watson Americas Inc
Project Name/#	New Tanana Water Well
Client Sample ID	New Tanana Water Well
Matrix	Water (Surface, Eff., Ground)
Ordered By	
PWSID	

Client PO#	1189078.010103
Printed Date/Time	08/24/98 15:00
Collected Date/Time	07/31/98 07:55
Received Date/Time	07/31/98 11:30
Technical Director: Stephen C. Ede	

Parameter		Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
Odor (TON)	*	4.00	1.00	T.O.N.	SM 21508	3 max		08/10/98	JMP
pH		7.02		pH units	EPA 150.1	6.5-8.5		08/04/98	JMP
Silver		0.00200 U	0.00200	mg/L	EPA 200.9	.1 max		08/06/98	KGF
Sodium		14.3	1.00	mg/L	EPA 200.7	250 max		08/07/98	WTA
Sulfate		31.0	0.200	mg/L	EPA 300.0	250 max		08/06/98	GCP
Total Dissolved Solids		348	20.0	mg/L	SM 2540C	500 max		08/06/98	JMP
Zinc		0.0200 U	0.0200	mg/L	EPA 200.7	5 max		08/07/98	WTA
Copper/Lead Rule									
Lead		0.00500 U	0.00500	mg/L	EPA 200.9	.015 max		08/07/98	KGF
Metals by Graphite Furnace									
Turbidity		2.60	0.100	NTU	EPA 180.1			08/04/98	JMP
Hardness as CaCO3		330	5.00	mg/L	SM19 2340B			08/07/98	WTA
Waters Department Analyses									
Total Coliform		0		col/100mL	SM18 9222B			07/31/98	TMW

CT&E Environmental Services Inc

Montgomery Watson
attention: Eric Gropp
4100 Spenard Rd.
Anchorage, AK 99517

Account: Montgomery Watson
Contact: Eric Gropp

Project: New Tanana Water Well
Received: 08/03/98 8:55

CT&E Ref#: 98.3469
Print Date: 08/24/98 14:46

Work order 98.3469 was analyzed for Nitrate/Nitrite and MBAS by Northern Testing Laboratories, Inc. of Fairbanks, AK 99701

NORTHERN TESTING LABORATORIES, INC.

3330 INDUSTRIAL AVENUE, FAIRBANKS, ALASKA 99701, (907) 456-3116 • FAX 456-3125
8005 SCHOON STREET, ANCHORAGE, ALASKA 99518, (907) 349-1000 • FAX 349-1016
POUCH 340043, PRUDHOE BAY, ALASKA 99734, (907) 659-2145 • FAX 659-2146

CT&E Environmental Services Inc.
200 W. Potter Drive
Anchorage AK 99518

Attn: Heather Hall

Report Date: 08/04/98
Date Arrived: 07/31/98
Date Sampled: 07/31/98
Time Sampled: 0751
Collected By: -

MRL = Method Reporting Limit

Our Lab #: F179489
Location/Project: -
Your Sample ID: 983469001
Sample Matrix: Water
Comments:

* Flag Definitions
B = Below Regulatory Min.
H = Above Regulatory Max.

Lab#	Method	Parameter	Units	Results *	MRL	Digest Prepared	Date Analyzed
F179489	EPA 300.0	Nitrite-N	mg/L	<MRL	0.03		07/31/98
		Nitrate-N	mg/L	0.35	0.03		07/31/98

Reported By: Cindy L. Christian
Laboratory Director

NORTHERN TESTING LABORATORIES, INC.

3330 INDUSTRIAL AVENUE
8005 SCHOON STREET
POUCH 340043

FAIRBANKS, ALASKA 99701
ANCHORAGE, ALASKA 99518
PRUDHOE BAY, ALASKA 99734

(907) 456-3116 • FAX 456-3125
(907) 349-1000 • FAX 349-1016
(907) 659-2145 • FAX 659-2146

CT&E Environmental Services, Inc.
200 West Potter Drive
Anchorage, AK 99518

Attn: Heather Hall
Client ID: 98.3469-1
Client Project #:
Source:
NTL Lab#: A156879
Sample Matrix: Water
Comments: Tanana Water Well

Report Date: 8/12/98
Date Arrived: 7/31/98
Sample Date: 7/31/98
Sample Time: 7:51
Collected By:

** Legend **
MRL = Method Report Level
MCL = Max. Contaminant Level
B = Present In Method Blank
E = Estimated Value
M = Matrix Interference
H = Above MCL
D = Lost To Dilution

Method	Parameter	Units	Result	MRL	Date Prepared	Date Analyzed
SM 5540 C						
	Foaming Agents (MBAS)	mg/L	<MRL	0.10		7/31/98

Reported By: Jorma K. Kuusisto
Chemistry Supervisor

Appendix E

Daily Construction Reports

Daily Construction Report

Date: 24 Jun 98

Day	S	M	T	[W]	Th	F	S
Weather	Bright Sun —	Sunny 10%	Over-cast 50%		Rain 40%		Snow —
Temp. °F	<32	32-50	[50-70]	70-85	85-100	>100	
Wind	[Still]	Moder.	High		Report No. 1		
Humidity	Dry	[Moder.]	Humid				

PROJECT Too'gha Water Supply Well
JOB NO.
CLIENT Too'gha Inc.
CONTRACTOR Alpine Drilling & Ent.
PROJECT MANAGER Jordan Suhr

Average Field Force

Name of Contractor	Administration	Labor	Remarks
Alpine Drilling & Enterprises		2	DAVID HARPER BRIAN WILLE

Visitors

Time	Name	Representing	Remarks
4:30 PM	JEROME WILBER		ASSISTED MOVING CASINGS

Equipment at the Site

1 AIR ROTARY DRILL RIG

Unusual Items

Construction Activities

THE CONTRACTOR ARRIVED ~ 4:30 PM AND VISITED THE PRIMARY AND SUPPLEMENTARY DRILL SITES. THE CONTRACTOR MOVED THE DRILL RIG AND THREE SECTIONS OF CASING TO THE PRIMARY DRILL SITE.

Distribution:
1. Proj. Mgr.
2. Field Office
3. File
4. Client

By Eric Gropp Title Site Engineer

CM 401 (Revised 10/01/93)

Daily Construction Report

(Continuation Sheet)

Project Too'gha Water Supply Well Report No. 1

Job No. _____ Date 24 JUN 98

Construction Activities

I TOURED THE VILLAGE WITH MIKE ANDEN. WE DISCUSSED THE ORIGINAL SUPPLEMENTARY DRILL SITE AND OTHER WELLS IN TOWN. MIKE ANDEN HAD THE FOLLOWING COMMENTS;

- CITY WELL #3 (#2 IS NOT IN USE) CONSISTENTLY HAS BENZENE CONTAMINATION. (UP TO ~0.3 PPM)
- A LARGE DIESEL TANK RUPTURED AND SPILLED 20+ YEARS AGO AT THE SITE OF THE OLD POWERPLANT ~600 FT TO THE EAST OF CITY WELL #3
- FURTHER EAST, NEAR THE JUNCTION OF KOYUKUK STREET AND FIRST AVENUE WAS THE SITE OF A BUNKER C FUEL STORAGE FACILITY
- A DRAINFIELD SITS UNDER THE RIVER BANK ROUGHLY ACROSS FROM THE TANANA COMMERCIAL STORE. (I MEASURED IT AS ~300FT TO THE WEST OF CITY WELL #3)

IN VIEW OF THESE FACTS, THE SECTION OF BLUFF BETWEEN THE JUNCTIONS OF GARDEN STREET AND FIRST AVENUE AND CITY WELLS #2 AND #3 APPEARS TO BE A GOOD LOCATION FOR THE SUPPLEMENTARY WELL SITE FOR THE FOLLOWING REASONS;

- A SITE FURTHER EAST INCREASES THE LENGTH OF WATER SUPPLY PIPING AND IS UNLIKELY TO DECREASE THE RISK OF CONTAMINATION
- THIS SITE IS UPSTREAM OF THE DRAINFIELD AND GAS STATION.

THIS SITE SEEMED SATISFACTORY TO MIKE ANDEN. I WILL CONFIRM THAT TOMORROW

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Sheet 2 of 3

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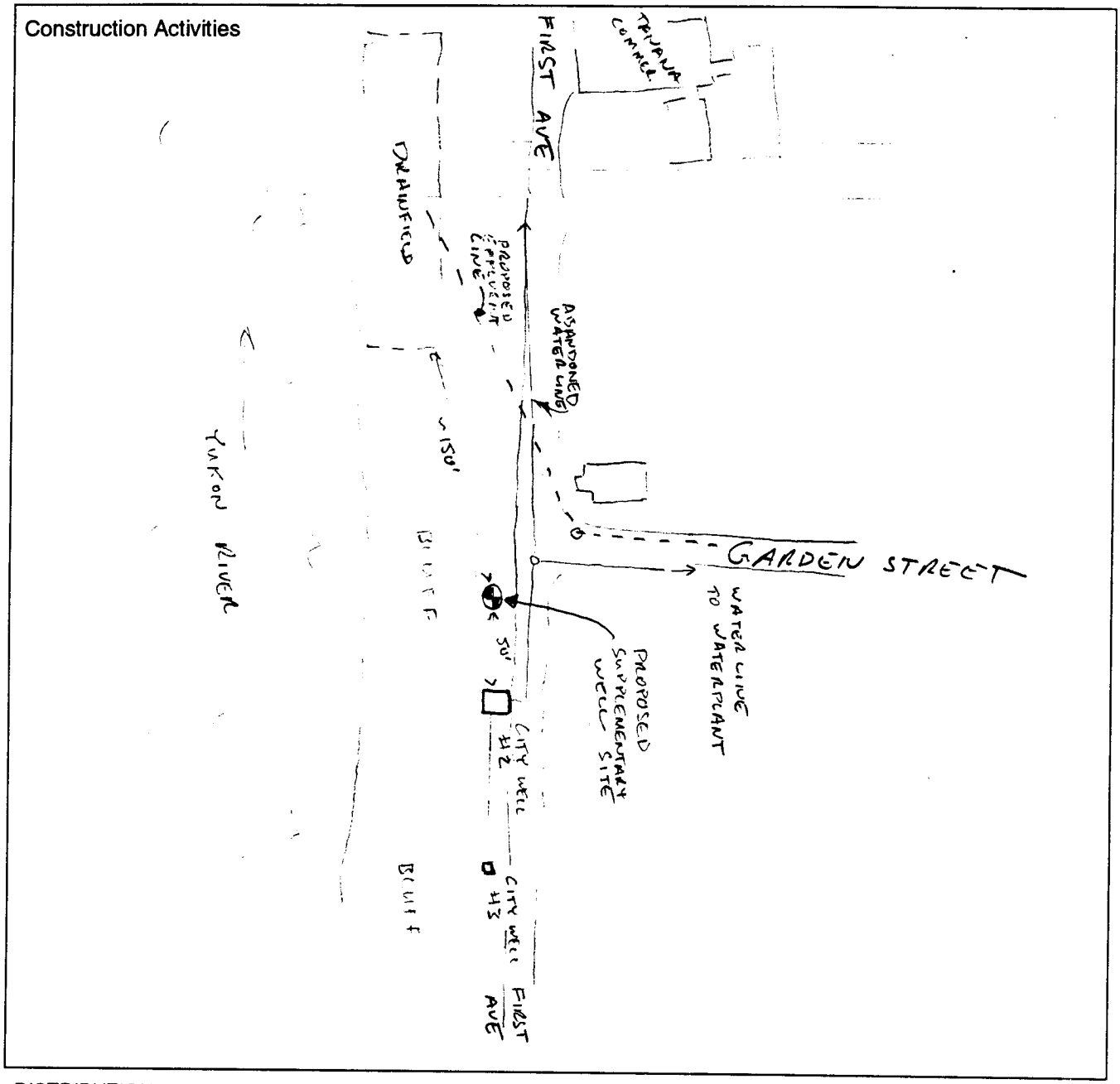
Daily Construction Report

(Continuation Sheet)

Project Too'gha Water Supply Well Report No. 1

Job No. _____ Date 24 JUN 98

Construction Activities



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CM 402 (Revised 10/01/93)

Daily Construction Report

Date 25 JUN 1998

Day	S	M	T	W	[Th]	F	S
Weather	Bright Sun —	Sunny 30%	Over-cast 40%	Rain 30%	Snow —		
Temp. °F	<32	32-50	[50-70]	70-85	85-100	>100	
Wind	Still	[Moder.]	High	Report No. 2			
Humidity	Dry	[Moder.]	Humid				

PROJECT Too'gha Water Supply Well
JOB NO.
CLIENT Too'gha Inc.
CONTRACTOR Alpine Drilling & Ent.
PROJECT MANAGER Jordan Suhr

Average Field Force

Name of Contractor	Administration	Labor	Remarks
Alpine Drilling & Enterprises		2	DAVID HARPER BRIAN WILLE

Visitors

Time	Name	Representing	Remarks
12:30 17:50 7:45	JEROME WILBER MIKE ANDON		

Equipment at the Site

1) AIR ROTARY DRILL RIG

Unusual Items

Construction Activities

WORK BEGAN ON SITE AT 8:15, AND DRILLING BEGAN AT 9:30. AN OVERSIZED BOREHOLE WAS DRILLED TO A DEPTH OF 14' WITH 10" CASING. THE DRILLER STOPPED AT 11:40 WHEN HE WAS INFORMED THAT THE 10" BOREHOLE DEPTH ONLY NEEDED TO BE TO A DEPTH OF 9'. BEDROCK WAS HIT AT A DEPTH OF 3 FEET.

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Daily Construction Report

(Continuation Sheet)

Project Too'gha Water Supply Well Report No. 2

Job No. _____ Date 25 JUN 98

Construction Activities

THERE WERE SOME PROBLEMS REMOVING THE 10" BIT. DRILLING WITH THE 8" BIT BEGAN AT 15:10. AT 16:00 TWO BAGS OF ENVIROPLUG NO. 8 SODIUM BENTONITE WERE POURED IN AROUND THE 8" CASING, AND THE REMAINING 10" CASING WAS PULLED.

AT 19:30 PROBABLE BEDROCK WAS HIT AT A DEPTH OF 49.5 FEET AND THE 8" CASING WAS DRIVEN TO A DEPTH OF 50.5 FEET. I AUTHORIZED THE DRILLER TO DRILL AN ADDITIONAL 15' WITH A 6" BIT TO CONFIRM THAT BEDROCK WAS HIT. JORDAN SUHR AND MIKE ANDON WERE INFORMED. NO WATER WAS ENCOUNTERED

AT 20:40 DRILLING BEGAN WITH THE 6" BIT. ONLY BEDROCK WAS HIT TO A DEPTH OF 65.5 FEET. DRILLING STOPPED AT 20:50. SOME WORK WAS DONE TOWARDS PULLING THE 8" CASING, BUT THERE WERE PROBLEMS WITH THE OXYACETYLENE TORCH. WORK STOPPED AT 21:15.

OTHER:

MIKE ANDON SAID THAT MEMBERS OF THE BOARD DID NOT APPROVE OF THE NEW SUPPLEMENTARY SITE MW RECOMMENDS. MIKE ANDON SUGGESTED TWO OTHER SITES: ALONG THE POSSIBLE FAULT LINE NORTH OF THIRD AVENUE TO THE WEST OF A'ILL ST. EET, AND A SITE AT THE JUNCTION OF PLATTED EAST STREET AND FIRST AVENUE. I STILL RECOMMENDED MW'S SITE, BECAUSE THE THIRD AVENUE SITE IS LIKELY TO BE DRY, AND THE SITE ON EAST STREET MAY COST AN ADDITIONAL $320,000 FOR ~3,000 FT OF WATER MAIN.

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CM 402 (Revised 10/01/93)

Daily Construction Report

Date: 26 JUNE 1998

Day	S	M	T	W	Th	[F]	S
Weather	Bright Sun	Sunny 40%	Over-cast 60%	Rain	Snow		
Temp. °F	<32	32-50	[50-70]	70-85	85-100	>100	
Wind	[Still]	Moder.	High				
Humidity	Dry	[Moder.]	Humid				

Report No. 3

PROJECT Too'gha Water Supply Well
JOB NO.
CLIENT Too'gha Inc.
CONTRACTOR Alpine Drilling & Ent.
PROJECT MANAGER Jordan Suhr

Average Field Force

Name of Contractor	Administration	Labor	Remarks
Alpine Drilling & Enterprises TOO'GHA FORCE CONTRACT CREW		2 3	INSTALLED NEW PAD FOR DRILLING

Visitors

Time	Name	Representing	Remarks
10:15	MIKE ANDON PAT MOORE	TOO'GHA —	PAT MOORE ASSISTED MIKE ANDON IN DRILL SITE SELECTION

Equipment at the Site

1 AIR ROTARY DRILL RIG

Unusual Items

1 BULL DOZER

Construction Activities

THE DRILLER STARTED WORK ON SITE AT 9:55 AND ATTEMPTED TO PULL THE CASING AT THE DRILL SITE. THE CASING MOVED A FEW INCHES, AND THE DRILLER DID NOT ATTEMPT TO MOVE IT FURTHER.

MIKE ANDON ASKED [illegible] TO DRILL A TEST WELL ON THE PROJECT SITE AND WOULD PROVIDE US WITH A RECOMMENDATION FROM THE TOO'GHA BOARD TO APPROVE. THE DRILLER PROCEEDED USING A SIX INCH BIT TO MORE QUICKLY EXPLORE THE [illegible] DRILL SITE. TWO SEVEN FOOT

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Daily Construction Report

(Continuation Sheet)

Project Too'gha Water Supply Well Report No. 3

Job No. _____ Date 26 JUN 98

Construction Activities

SEGMENTS OF SIX INCH CASING WERE BORROWED FROM RADIAN. THE LOCATION AND PAD FOR THE SECOND DRILL HOLE WAS SELECTED AND BUILT UNDER MIKE ANDON'S DIRECTION.

THE RESOLUTION FROM THE TOO'GHA BOARD TO DRILL A SECOND WELL ON THE PROJECT SITE WAS RECEIVED FROM MIKE ANDON AT 13:45. DRILLING BEGAN AT 15:10. A 10" HOLE WAS DRILLED TO 10' WITH 10" CASING. A 6" HOLE WAS DRILLED TO 60' USING 14' OF 6" CASING. BEDROCK WAS HIT AT 51'. NO WATER WAS FOUND. THE DRILLER PULLED THE 10" AND 6" CASING. WORK STOPPED AT THE DRILL SITE AT 18:55.

THE RESOLUTION ALSO APPROVED A THIRD DRILL SITE TO BE SELECTED BY THE DRILLERS AND MIKE ANDON WITH APPROVAL FROM [illegible] MARINO. MIKE ANDON HAD SELECTED A THIRD DRILL SITE ON 4 WSS 10813, NORTH OF THIRD AVENUE, AN AN ACCESS PAD WAS ALSO CONSTRUCTED THERE UNDER MIKE ANDON'S DIRECTION.

THE DRILLERS AND I VISITED THE THIRD DRILL SITE AND THE DRILL SITE NEXT TO THE CITY WELL #2 AT 19:00. THE LOCATION FOR THE THIRD SITE HAD NOT BEEN STAKED YET. THE DRILL SITE NEXT TO CITY WELL #2 SEEMED FAVORABLE TO THE DRILLERS.

THE DRILLER SAID THAT THE UNIT PRICES FROM THE ORIGINAL CONTRACT ARE ACCEPTABLE FOR THE ADDITIONAL WORK.

MIKE ANDON AGREED THAT DRILLING NEXT TO CITY WELL #2 WOULD BE A GOOD IDEA IF THE THIRD HOLE IS UNSATISFACTORY

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By Eric Gropp PE Title Site Engineer

CM 402 (Revised 10/01/93)

Daily Construction Report

Date: 27 JUNE 1998

Day	S	M	T	W	Th	F	[S]

PROJECT: Too'gha Water Supply Well
JOB NO.:
CLIENT: Too'gha Inc.
CONTRACTOR: Alpine Drilling & Ent.
PROJECT MANAGER: Jordan Suhr

Weather	Bright Sun 20	Sunny 60	Over-cast 20	Rain	Snow
Temp. °F	<32	32-50	[50-70]	[70-85]	85-100	>100
Wind	[Still]	Moder.	High	Report No. 4	
Humidity	[Dry]	Moder.	Humid		

Average Field Force

Name of Contractor	Administration	Labor	Remarks
Alpine Drilling & Enterprises		2	DAVE HARPER BRIAN WILLET

Visitors

Time	Name	Representing	Remarks

Equipment at the Site

(1) AIR ROTARY DRILL RIG

Unusual Items

Construction Activities

IN CONFERENCE WITH JORDAN SUHR I DETERMINED THE METHOD OF WELL ABANDONMENT TO CONSIST OF CUTTING THE CASING BELOW GRADE (IF NOT PULLED), FILLING THE WELL WITH NATIVE MATERIAL TO WITHIN 5' OF SURFACE, AND SEALING THE REMAINDER WITH BENTONITE.

MIKE ANDON CONFERRED WITH LYNN MARINO ABOUT DRILLING AT THE THIRD SITE ON THIRD STREET AT 8:30, THE DRILL RIG WAS MOVED TO THE 3RD SITE AT 9:00. AT 10:30. MIKE ANDON CAME TO GIVE US HIS APPROVAL AND INFORM US OF LYNN MARINO'S

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Page 1 of 3 Pages

By: Eric Gropp Title: Site Engineer

CM 401 (Revised 10/01/93)

Daily Construction Report

(Continuation Sheet)

Project Too'gha Water Supply Well Report No. 4

Job No. _____ Date 27 JUN 98

Construction Activities

APPROVAL TO DRILL AT THE THIRD DRILL SITE AT 10:30. MIKE ANDON AGREED THAT THE DRILLER SHOULD IMMEDIATELY MOVE TO THE SITE ADJACENT TO CITY WELL #2 IF THE THIRD SITE IS UNSATISFACTORY (<15 GPM). PRIOR TO DRILLING AT THE THIRD SITE, COSTS INCURRED TO DATE WERE EVALUATED WITH MIKE ANDON AND THE DRILLERS. THE DRILLERS CHOSE NOT TO CHARGE FOR WELL ABANDONMENT. THE FOLLOWING COSTS TO DATE WERE APPROVED BY THE DRILLERS AND MIKE ANDON:

	QTY	UNITS	COST	EXT COST
MOB/DEMOB	1	LS	34,000	34,000
SITE 1				
10" BOREHOLE	10	LF	550	5,500
8" BOREHOLE	53	LF	130	6,890
8" CASING	52	LF	20	1,040
SANITARY SEAL	10	LF	50	500
SITE 2				
MOVE TO SITE	1	LS	500	500
10" BOREHOLE	10	LF	550	5,500
8" BOREHOLE	50	LF	130	6,500
				60,430

WORK BEGAN AT THE THIRD SITE AT 13:00, USING 6" BIT BELOW 10' AS AUTHORIZED. (THE DRILLER AGREED THAT IN THE EVENT THAT THE WELL IS SATISFACTORY, IT WOULD BE REDRILLED WITH A 8" BIT AT NO EXTRA COST). THAWED MATERIAL WAS ENCOUNTERED AT 42' AND BEDROCK AT 49.5! DRILLING STOPPED AT 15:30 AT A DEPTH OF 63' NO WATER

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CM 402 (Revised 10/01/93)

Daily Construction Report

(Continuation Sheet)

Project Too'gha Water Supply Well Report No. 4

Job No. _____ Date 27 JUN 98

Construction Activities

WAS ENCOUNTERED. THE WELL WAS RETESTED AT 16:10, NO WATER WAS ENCOUNTERED.

MIKE ANDON APPROVED DRILLING AT THE SITE NEXT TO CITY WELL #2. DRILLING BEGAN AT 18:35 UNDER MY DIRECTION 10 FEET FROM THE WELLHOUSE. SHORTLY AFTER STARTING, HEAT TRACE CABLES WERE NOTICED ENTERING THE GROUND ON THE SOUTH FACE OF THE WELL HOUSE. DRILLING WAS STOPPED AND MIKE ANDON WAS CALLED AND CAME TO THE SITE. NO AS-BUILTS WERE AVAILABLE. I ESTIMATED THAT IT WAS UNLIKELY THAT THE CABLES WERE CLOSE TO THE DRILL HOLE SITE. DRILLING RESUMED AT 19:20. NO PERMAFROST WAS ENCOUNTERED: WATER BEARING SOIL WAS ENCOUNTERED AT 33', HIGHLY PERMEABLE SAND WITH GRAVEL AT 40', AND BEDROCK AT 42'. THE DRILLER INSTALLED A 10' DEEP 10" BOREHOLE, 34' OF 8" BOREHOLE, 42' OF 8" CASING, AND A 10' SANITARY SEAL. WORK STOPPED ON SITE AT 21:30

I RETRIEVED TWO SIEVE ANALYSES ON THE FORMATION AT 42'. THE RESULTS WERE

	% PASSING	
	SAMPLE 1	SAMPLE 2
NO. 10	67%	65%
NO. 20	60%	57%
NO. 40	41%	37%

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CM 402 (Revised 10/01/93)

Daily Construction Report

(Continuation Sheet)

Project Too'gha Water Supply Well Report No. _____

Job No. _____ Date _____

Construction Activities

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Sheet _____ of _____

By Eric Gropp PE Title Site Engineer

CM 402 (Revised 10/01/93)

Daily Construction Report

Date 28 JUNE 1996

Day	[S]	M	T	W	Th	F	S
Weather	Bright Sun 75%	Sunny 50%		Over-cast 20%	Rain 5%		Snow
Temp. °F	<32	32-50	[50-70]	[70-85]	85-100		>100
Wind	Still	[Moder.]		High	Report No. 5		
Humidity	Dry	[Moder.]		Humid			

PROJECT Too'gha Water Supply Well
JOB NO.
CLIENT Too'gha Inc.
CONTRACTOR Alpine Drilling & Ent.
PROJECT MANAGER Jordan Suhr

Average Field Force

Name of Contractor	Administration	Labor	Remarks
Alpine Drilling & Enterprises		2	DAVE HARPER BRIAN WILLE

Visitors

Time	Name	Representing	Remarks

Equipment at the Site

1 AIR ROTARY DRILL RIG

Unusual Items

40 GPM SERIES 3HP 230V GRUNDFOS PUMP.

Construction Activities

BASED ON THE SIEVE ANALYSIS AND CONFERENCE WITH JORDAN SUHR AND THE DRILLERS A 30 SLOT SCREEN WAS CHOSEN FOR THE WELL. WORK BEGAN ON SITE AT 10:00 (STATIC WATER LEVEL 24'). DRILLING FOR THE SCREEN BEGAN AT 10:35. BEDROCK WAS ENCOUNTERED AT 42 FEET, AND DRILLING STOPPED AT 10:50 AT 43'. A TOTAL OF THREE FEET WAS DRILLED FOR THE SCREEN.

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CM 401 (Revised 10/01/93)

Daily Construction Report

(Continuation Sheet)

Project Too'gha Water Supply Well Report No. 5

Job No. _____ Date 28 JUNE 98

Construction Activities

THE 5" SCREEN WITH PACKER ASSEMBLY AND END CAP (TOTAL LENGTH 5'-11") WAS INSTALLED AT 12:40 AND THE BOTTOM OF THE CASING WAS PULLED UP TO 39' AT 12:55.

WELL DEVELOPMENT BEGAN AT 13:15 BY REPEATED BLASTING OF THE FORMATION WITH HIGH PRESSURE AIR AND CONTINUOUS PUMPING AT ~100 GPM. DEVELOPMENT STOPPED AT 15:30.

AT 17:45 THE LONG TERM PUMP TEST BEGAN AT A FLOW RATE OF 46.8 GPM. MIKE ANDON ALLOWED THE DRILLERS USE POWER FROM THE WELLHOUSE. DURING THE PUMP TEST, THE OTHER WELL SITES WERE ABANDONED. THE LONG TERM PUMP TEST STOPPED AT 21:00. NO CHANGE IN THE DRAW DOWN OCCURRED AFTER THE FIRST 10 MINUTES OF THE TEST. DRAWDOWN DURING THE TEST WAS 3.1 FEET; RECOVERY TOOK 30 SECONDS. TWO OUT OF THREE 1.5 LITER WATER SAMPLES HAD NO VISIBLE SAND, ONE HAD TWO VISIBLE FLECKS (<0.5mm) SAND PRODUCTION FROM THE WELL IS MINIMAL.
THE STEP DRAWDOWN TEST RAN FROM 21:06 TO 23:06 USING 30 MINUTE INTERVALS. THE RESULTS WERE:

FLOW	DRAWDOWN
10 GPM	0.7 FT
20 GPM	1.3 FT
30 GPM	2.3 FT
40 GPM	2.9 FT

THE SITE WAS CLEANED UP AND WORK STOPPED AT 23:30.

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Sheet 2 of 2

By Eric Gropp PE Title Site Engineer

CM 402 (Revised 10/01/93)

Daily Construction Report

Date **29 June 1998**

PROJECT Too'gha Water Supply Well
JOB NO.
CLIENT Too'gha Inc.
CONTRACTOR Alpine Drilling
PROJECT MANAGER Jordan Suhr

Day	S	**M**	T	W	Th	F	S
Weather	Bright Sun 40%	Sunny 80%	Overcast 10%	Rain	Snow		
Temp. °F	<32	32-50	**50-70**	**70-85**	85-100	>100	
Wind	Still	**Moder.**	High	Report No. 6			
Humidity	Dry	**Moder.**	Humid				

Average Field Force

Name of Contractor	Administration	Labor	Remarks
Alpine Drilling		2	Dave Harper Brian Wille

Visitors

Time	Name	Representing	Remarks

Equipment at the Site

1 Air Rotary Drill Rig

Unusual Items

Construction Activities

At 9:15 drillers disinfected the new well and tack welded a steel cap to the top of the casing. Work stopped on site at 10:15. The drill crew and I left Tanana at 12:40.

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Appendix F

Final Water Source Evaluation
Memorandum

M E M O R A N D U M

MONTGOMERY WATSON

To:	Lynn Marino, P.E.	**Date:**	November 5, 1997
	ADEC: VSW	**Reference:**	1189078.010103
From:	MWA Team		
Subject:	Phase I Water/Sewer Design - Final Water Source Evaluation[1]		

INTRODUCTION

Supplemental to our Phase I Water/Sewer Design for Too'gha, Inc., Tanana, Alaska, Montgomery Watson performed a focused water source evaluation. A reliable water source is necessary to operate the proposed, new Water Treatment Plant (WTP)/ Laundry Facility in Tanana. An optimal water source for the facility would be capable of providing a minimum of 30 gallons per minute (gpm), based on a design population of 670. Per our discussion October 3, 1997, Montgomery Watson evaluated the potential groundwater production capability and feasibility of four alternatives for a water source:

Alternative #1: Drill One New Well at the Proposed WTP/Laundry Facility (Onsite)
Alternative #2: Rehabilitate Existing City Wells and Layout Associated Piping
Alternative #3: Rehabilitate Existing Native Council Well and Layout Associated Piping
Alternative #4: Drill One New Well Offsite and Layout Associated Piping

The purpose of this evaluation was to review all available data and determine the best alternative, or combination of alternatives. A site vicinity map is shown in Figure 1.

DATA REVIEW

Montgomery Watson reviewed the following documents to evaluate the hydrogeologic conditions at the proposed WTP/Laundry Facility and vicinity:

- CH2M Hill, (1997). *City of Tanana Water Source Investigation Report.* Prepared for Too'gha, Inc., Tanana, Alaska and Village Safe Water, Alaska Department of Environmental Conservation.
- CH2M Hill, (1997). *City of Tanana Water and Sewer Feasibility Study.* Prepared for Too'gha, Inc., Tanana, Alaska and Village Safe Water, Alaska Department of Environmental Conservation.
- Chapman, Robert M., et. al., (1982). *Reconnaissance Geologic Map of the Tanana Quadrangle, Alaska.* U.S. Geological Survey Open-File Report 82-734.

[1] This memorandum updates the previous Water Source Evaluation Memo, dated October 13, 1997.

- Duane Miller & Associates, (1997). *Geotechnical Investigation, Water and Sewer Improvements, Tanana, Alaska.* Prepared for Too'gha, Inc. C/O State of Alaska Village Safe Water. (draft review copy)
- Ecology and Environment, Inc., (1995). *Site Investigation Report, Alaska Area Native Health Service Hospital, Tanana, Alaska.* Prepared for U.S. Public Health Service.
- Ecology and Environment, Inc., (1997). *Site Investigation Report Phase II, Alaska Area Native Health Service Hospital, Tanana, Alaska.* Prepared for Indian Health Service Engineering Services-Seattle.
- Nakanishi, Allan S., and Dorava, Joseph M., (1994). *Overview of Environmental and Hydrogeologic Conditions at Tanana, Alaska.* U.S. Geological Survey Open-File Report 94-527. Prepared in cooperation with the Federal Aviation Administration.
- Terrasat, Inc., (1996). *Groundwater Investigation for Tanana, Alaska.* Prepared for Too'gha, Inc., C/O P.O. Box 249, Tanana, Alaska. (with amendments)
- Wheaton, Scott, (1980). *Shallow Groundwater Resources at Tanana, Alaska.* Prepared for U.S. Public Health Service, Environmental Health Branch.

Montgomery Watson reviewed additional boring logs by the N.C. Company, 1975, furnished by the U.S. Public Health Service (PHS). In addition to reviewing available hydrogeologic data, Montgomery Watson spoke with representatives from three drilling companies to gain further insight about the water source alternatives:

- Wayne Wesberg, MW Drilling, Inc., Anchorage, AK
- Rocky MacDonald, Aurora Drilling, Inc., Fairbanks, AK
- Lee Ice, Ice Water Well, Inc., Fairbanks, AK

METHOD OF EVALUATION

Montgomery Watson studied all available boring logs to evaluate the hydrogeologic condition at the proposed WTP/Laundry Facility site and vicinity. The logs provided information about subsurface soil type, permafrost, bedrock, groundwater, well construction and yield. A cross section was chosen to depict available hydrogeologic data extending from the proposed WTP/Laundry Facility site to the Yukon River. Figure 2 illustrates the cross section A-A'. Subsurface details from several well logs and geotechnical logs were projected onto the cross section. In many places, the subsurface condition had to be inferred, due to incomplete boring log documentation, insufficient boring depth, or lack of boring coverage.

The Native Council Well, City Well #2, and the New City Well #3 are shown in Figure 1. These wells currently supply water for two water systems in Tanana. These wells were considered for rehabilitation and their potential to yield higher volumes. Available yield data, water quality data, and well locations were considered in evaluating these wells.

FINDINGS

Based on our review of available information in the vicinity of the proposed site (and along cross section A-A'), the following findings are noted:

- A predictable sequence generally describes the soils from 0 to approximately 50 feet below grade. The sequence begins with organic material at or near the surface, which is found to be overlying a silt layer. This silt is found to be overlying sand and gravel. The sand and gravel layer is variable in grain size and grading, typical of braided stream deposits. This sand and gravel generally overlies bedrock. The soil/bedrock interface is not a flat surface, nor is it easily identified in the boring logs due to weathering of the uppermost bedrock. The predominant bedrock types encountered are sandstone, claystone, and schist.

- In the vicinity of Tanana, thawed permafrost appears to be related to two factors: (1) the thawing influence of the Yukon River creating a thaw bulb, and (2) thawing caused by land development (Duane Miller & Associates, 1997). At the proposed WTP/Laundry Facility site, permafrost extends beyond 30 feet below grade and may reach bedrock as evidenced in wells at the Power Plant and in Block 5.

- The top of continuous permafrost is located generally between 1 and 8 feet below grade and it appears to be discontinuous near the Yukon River. A thaw bulb is apparent beneath the Yukon River. A boring drilled in Block 7, approximately 300 feet from the river, appears to have penetrated the thaw bulb at 50 feet below grade.

- Productive wells located near the Yukon River are mostly screened or open within the thaw bulb and may be under the influence of surface water. Other productive wells set back from the river are mostly screened or open in stratigraphic or structural "water bearing" zones. Terrasat, Inc., suggests a fault may control some productive wells that are located in Block 6. The Power Plant Well, approximately 1,000 feet southeast of the site, penetrated water bearing schist beyond 200 feet below grade; however, production from this well is believed to be low, and is not well documented.

- City Well #2 and New City Well #3 produced 6 and 15 gpm when originally constructed in 1967 and 1991, respectively. The Native Council Well produced 50 gpm when originally installed in 1976. These wells all have the potential to be encrusted with iron and manganese, which is known to exist at high levels in the groundwater. The two City Wells and the Native Council Well are roughly the same distance, 1,800 feet, from the proposed WTP/Laundry Facility site.

- In the vicinity of the PHS compound, Ecology and Environment (1997) detected petroleum hydrocarbons in the groundwater. The areas of known groundwater contamination are shown in Figure 1. Gasoline and Diesel Range Organics were detected in groundwater samples at concentrations up to 37.8 and 402.0 mg/l, respectively. Benzene was detected at concentrations up to 0.296 mg/l.

EVALUATION OF ALTERNATIVES

The findings described above were used to develop a rationale for estimating the probability of success of each water source alternative. Construction costs were estimated to aid in the decision process. The costs are considered Rough Order of Magnitude (ROM) estimates, but adequate for decision-making purposes. Table 1 summarizes the cost and probability of success of each

alternative. "Success" is defined as the ability to produce 30 gpm from the source alternative. Following is a discussion regarding our evaluation.

Alternative #1 - Drill One New Well at the Proposed WTP/Laundry Facility (Onsite)

The subsurface hydrogeologic data at the site is limited to geotechnical borings that do not extend beyond 30 feet below grade. Each of these borings are terminated in permanently frozen sand and gravels, and the deeper stratigraphy at the site must be inferred. Available data furnished by Terrasat, Inc. is inconclusive regarding the likelihood of locating groundwater at this site. A well drilled at the site may encounter a thin, thawed zone in the unconsolidated deposits, or it may encounter groundwater from deeper bedrock. However, the probability of producing 30 gpm from these zones is considered relatively low. **Therefore, we would recommend this alternative only with another alternative as a back-up.**

Alternative #2 - Rehabilitate Existing City Wells and Layout Associated Piping

City Well #2 and New City Well #3 produced 6 and 15 gpm when originally constructed. Their productivity is likely to be less now due to iron and manganese encrustation. Rehabilitating these wells might increase their present production, but could not provide a sufficient volume of water necessary for the proposed WTP/Laundry Facility, since they only produced a combined 21 gpm when new. Moreover, these wells are reported to have low yield in late winter. For these reasons, we recommend eliminating Alternative #2 from further consideration.

Alternative #3 - Rehabilitate Existing Native Council Well and Layout Associated Piping

Upon reviewing the investigation by Ecology and Environment (E&E, 1997), this well is considered to be within 100 feet and east of shallow groundwater contamination, as shown in Figure 1. The E&E report indicates that the groundwater flow direction is to the south, from the PHS compound to the Yukon River. However, since the Native Council Well is screened in a shallow aquifer (39 to 49 feet below grade), increased pumping could draw contaminated groundwater to the well. For this reason, Montgomery Watson recommends eliminating Alternative #3 from further consideration. We also recommend regular groundwater analysis for fuel-related hydrocarbons at the Native Council Well as long as it is continued to be used as a drinking water source.

Alternative #4 - Drill One New Well Offsite and Layout Associated Piping

The probability of success and cost suggest this alternative to be most favorable. Several wells with adequate yield are already known to exist in locations near the Yukon River. In accordance with recommendations made by CH2M Hill (1997), we suggest an offsite well location along First Avenue, east or west of Mill Street, as shown in Figure 1. More than one exploratory boring may be necessary to find a well location with adequate yield, and this may increase cost. In addition, this offsite well is likely to be considered under the influence of surface water, requiring additional filtration equipment to protect against *giardia lamblia* and viruses.

Attachments:

Table 1 - Water Source Alternatives
Figure 1 - Site Vicinity Map
Figure 2 - Cross Section A-A'
Selected Boring Logs

Table 1
Water Source Alternatives
Phase I Water/Sewer Design - Water Source Evaluation
Too'gha, Inc., Tanana, Alaska

No.	Alternative	Cost*		Estimated Probability of Success**	Piping	Rationale for Probability Estimate	Comments
1	Drill One New Well Onsite	$ 50,000 $ 50,000 $ 100,000	Mobilization Well Construction **Total**	15%	N/A	Low/No production from wells north of Third Avenue. Boring logs suggest frozen soils and bedrock.	Anticipate deep well, into bedrock/fractures. Probability of well providing 1-10 gpm might be 40%.
2	Rehabilitate City Well #2 and New City Well #3	$ 50,000 $ 25,000 $ 50,000 $ 198,000 $ 323,000	Mobilization Rehabilitation SWTR*** Piping **Total**	5%	1800' Piping @ $110/ft	Low production (6 and 15 gpm) when wells were newly installed. Reports of low/no yield in late winter.	City Well #2 rehabilitated in 1978 with unknown results. Located in well house. New City Well #3 has stainless steel screen, installed in 1991 near well house.
3	Rehabilitate Native Council (PHS) Well	$ 50,000 $ 15,000 $ 50,000 $ 198,000 $ 313,000	Mobilization Rehabilitation SWTR Piping **Total**	5%	1800' Piping @ $110/ft	Good production (50 gpm) when newly installed. Located too close to known groundwater contamination.	Provides community with water in late winter. May be difficult to coordinate. Uncertain future water quality.
4	Drill One New Well Offsite (near Yukon River)	$ 50,000 $ 50,000 $ 50,000 $ 154,000 $ 304,000	Mobilization Well Construction SWTR Piping **Total**	70%	1400' Piping @ $110/ft	Good prospect for finding groundwater, production difficult to predict.	Piping cost estimated by location of prospective well along First Avenue within 200 feet east or west of Mill Street. Expect increased cost if multiple exploratory borings are required.

* Costs are Rough Order of Magnitude (+/- 30%) based on personal communication with drilling companies.
** Estimated probability of success based on achieving production capacity of 30 gpm, without impact by groundwater contamination.
*** Surface Water Treatment Rule (SWTR) requires additional filtration equipment for wells under influence of surface water.

QCD
10/1/65
SoA
DOT&PF
Plat 92-1RS

Lot 3

PROPOSED SITE

POSSIBLE FAULT, INTERPRETED BY TERRASAT, INC. (1996)

EIN100 C4
60' road
elec. & Tel.

EIN102 C4
60' road
elec. & Tel.

USS 5958

P.H.S.

Lot 11

Lot 12

USS 10815

Lot 2

Lot 1

Lot 4

Adriana P. Parker

B-2

B-3

B-4

B-7

B-8

B-10

B-16

JUDY SOMMERS WELL (1981, 20 GPM)

WALTER NICHOLIA WELL (1967, 30 GPM)

6-14

5-9

5-10

7-1

7-2

990

NATIVE COUNCIL WELL (1976, 50 GPM)

CITY WELL #2 (1967, 6 GPM)

NEW CITY WELL #3 (1991, 15 GPM)

PROSPECTIVE OFFSITE WELL LOCATION AREA ALTERNATIVE #4

USS 397

Water Plant and Sewage Lagoon

POWER PLANT SITE

City Shop

Ice Rink

Eller Subd.

Plats 81-3 81-4 83-2

Sixth Ave

Fifth Ave

Fourth Ave

Third Ave

Second Ave

First Ave

Eamole Street

Yukon Street

Koyukuk Street

Mill Street

Garden Street

A

A'

YUKON RIVER

USS 2754 A&B

NORTH

SCALE IN FEET

0 300

LEGEND

- EXISTING WELLS
- ESTIMATED EXTENT OF GROUNDWATER CONTAMINATION EXCEEDING REGULATORY GUIDANCE LEVELS, BY E&E (1997)
- LOCAL GROUNDWATER FLOW DIRECTION MEASURED IN OCTOBER 1996 BY E&E (1997)

BORINGS AND WELLS PROJECTED ONTO CROSS SECTION A-A':

- BY DUANE MILLER & ASSOCIATES (1997)
- BY A&L DRILLING (1967)
- BY N.C. COMPANY (1975)

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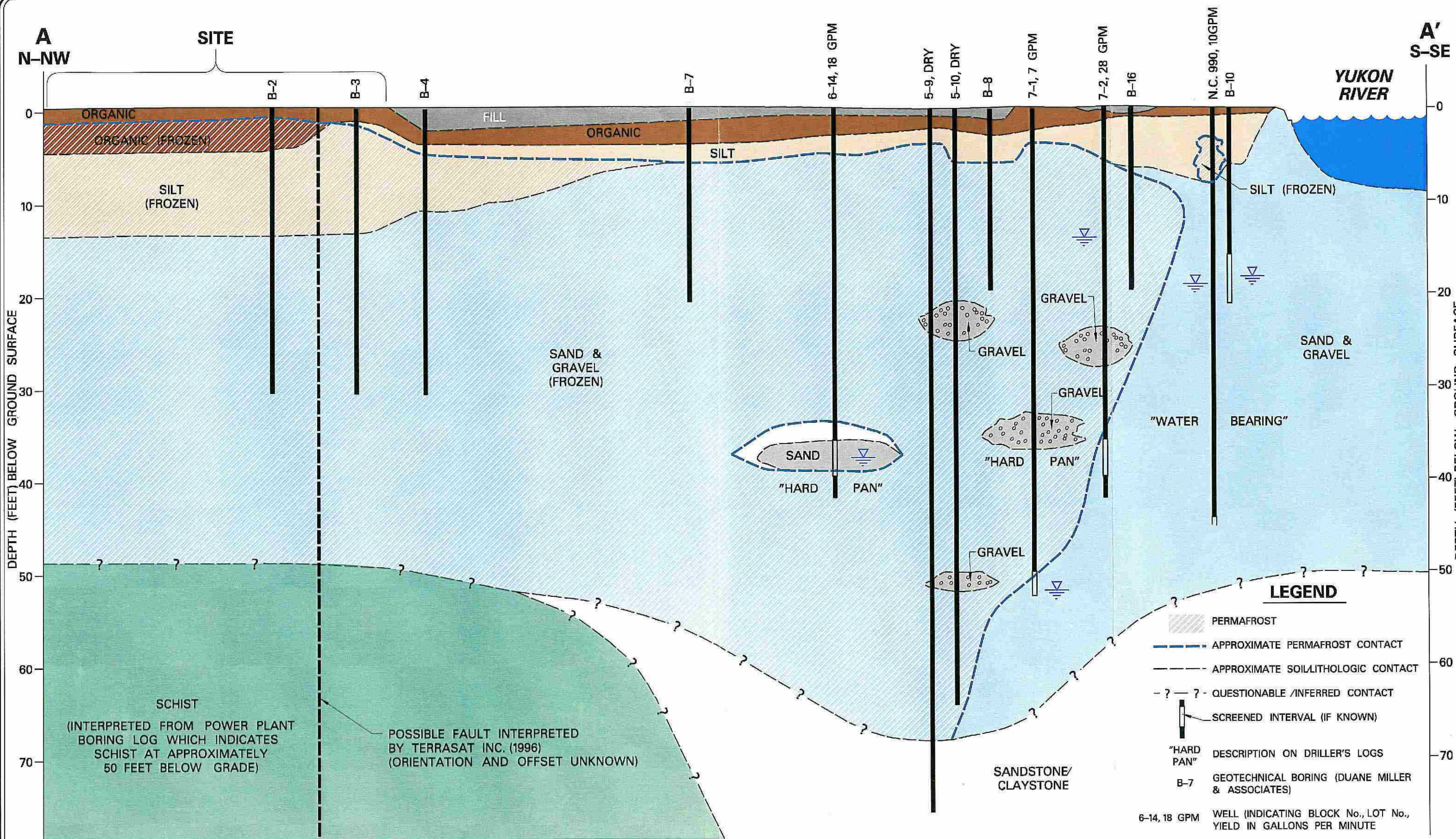
JOB No. 189076.01003 TIME: 07-OCT-1998 11:08

MONTGOMERY WATSON
Anchorage, Alaska

FIGURE 1
TOO'GHA WATER SUPPLY WELL

SITE VICINITY MAP



A
N–NW
SITE
A'
S–SE
YUKON RIVER
B–2
B–3
B–4
B–7
6–14, 18 GPM
5–9, DRY
5–10, DRY
B–8
7–1, 7 GPM
7–2, 28 GPM
B–16
N.C. 990, 10GPM
B–10
ORGANIC
ORGANIC (FROZEN)
FILL
ORGANIC
SILT
SILT (FROZEN)
SILT (FROZEN)
SAND & GRAVEL (FROZEN)
SAND & GRAVEL
"WATER BEARING"
GRAVEL
GRAVEL
GRAVEL
GRAVEL
SAND
"HARD PAN"
"HARD PAN"
SCHIST (INTERPRETED FROM POWER PLANT BORING LOG WHICH INDICATES SCHIST AT APPROXIMATELY 50 FEET BELOW GRADE)
POSSIBLE FAULT INTERPRETED BY TERRASAT INC. (1996) (ORIENTATION AND OFFSET UNKNOWN)
SANDSTONE/ CLAYSTONE
DEPTH (FEET) BELOW GROUND SURFACE
0
10
20
30
40
50
60
70
LEGEND
PERMAFROST
APPROXIMATE PERMAFROST CONTACT
APPROXIMATE SOIL/LITHOLOGIC CONTACT
? — ? QUESTIONABLE /INFERRED CONTACT
SCREENED INTERVAL (IF KNOWN)
"HARD PAN" DESCRIPTION ON DRILLER'S LOGS
B–7 GEOTECHNICAL BORING (DUANE MILLER & ASSOCIATES)
6–14, 18 GPM WELL (INDICATING BLOCK No., LOT No., YIELD IN GALLONS PER MINUTE

MONTGOMERY WATSON

Anchorage, Alaska

HORIZONTAL SCALE: 1" = 100'
VERTICAL SCALE: 1" = 10'

FIGURE 2

TOO'GHA WATER SUPPLY WELL

CROSS SECTION A–A'

SELECTED BORING LOGS

Summary of Tanana Borings

Boring Number	Location of hole	Setting	Date	Boring Depth (Bottom PF)	PVC Pipe	Water Depth	Top of Frozen Soil	Fill Thickness	Organic Thickness	Top of Silt	Top of Sand/ Gravel
1	W. P. S./~30 ft. N of Airport Rd	Woodland	8/26/97	30.5 ft	30.0 ft	-	1.5 ft	-	1.0 ft	1.0 ft	12.5 ft
2	W. P. S./~120 ft. N of Airport Rd	Woodland	8/26/97	30.5 ft	30.0 ft	-	1.0 ft	-	4.5 ft	4.5 ft	13.5 ft
3	W. P. S./~140 ft. N of Airport Rd	Woodland	8/27/97	30.5 ft	30.0 ft	-	2.0 ft	-	1.5 ft	1.5 ft	13.5 ft
4	W. P. S./N shoulder of Airport Rd	Road shoulder	8/27/97	31.0 ft	31.0 ft	-	5.5 ft	2.5 ft	1.5 ft	4.0 ft	11.0 ft
5	W. P. S./~130 ft S of Airport Rd	Woodland	8/27/97	30.7 ft	30.0 ft	-	1.0 ft	-	1.0 ft	1.0 ft	14.5 ft
6	W. P. S./~50 ft S of Airport Rd	Woodland	8/28/97	20.5 ft	-	-	1.0 ft	-	1.5 ft	1.5 ft	12.0 ft
7	3rd & Mills, SW cor	Road shoulder	8/28/97	20.5 ft	*20.0 ft	-	4.0?/8.5	2.5 ft	1.5 ft	4.0 ft	6.0 ft
8	2nd & Mills, NW cor	Road shoulder	8/28/97	20.0 ft	*20.0 ft	-	6.0?/8.5	1.5 ft	1.5 ft	3.0 ft	6.0 ft
9	1st & Garden, 30 ft S	Gravel/Grass	8/28/97	21.5 ft	-	-	-	1.0 ft	-	1.0 ft	6.5 ft
10	1st & Mills, ~30 ft S	Park Grassland	8/28/97	21.0 ft	*21.0 ft**	18.0 ft	-	-	1.0 ft	1.0 ft	6.0 ft
11	1st @ school, S edge	Road shoulder	8/28/97	21.5 ft	21.0 ft**	20.5 ft	8.0-14.0	0.3 ft	1.7 ft	2.0 ft	7.0 ft
12	3rd @ ice rink, S edge	Road shoulder	8/29/97	21.0 ft	*21.0 ft	-	7.0 ft	2.2 ft	1.3 ft	3.5 ft	16.5 ft
13	3rd between City & Utility shops, S	Road shoulder	8/29/97	20.5 ft	*20.0 ft	-	8.0 ft	1.5 ft	1.0 ft	2.5 ft	11.0 ft
14	School St between 2nd & 3rd, 14 ft W	Grass	8/29/97	20.0 ft	20.0 ft**	-	6.5-9.0	-	1.5 ft	1.5 ft	11.5 ft
15	3rd between School & Mills, S edge	Road shoulder	8/29/97	20.5 ft	*20.0 ft	-	6.5 ft	1.0 ft	1.5 ft	2.5 ft	8.0 ft
16	Ist & Mills, NW cor	Road shoulder	8/29/97	20.5 ft	*20.0 ft	-	8.0 ft	0.5 ft	0.5 ft	1.0 ft	6.5 ft
17	Park & Garden, SE cor	Road shoulder	8/29/97	20.5 ft	*20.0 ft	-	5.0?/6.0	0.5 ft	0.5 ft	1.0 ft	7.0 ft
18	3rd & Garden, N edge	Road shoulder	8/29/97	15.0 ft	-	-	13.5 ft	2.5 ft	1.0 ft	3.5 ft	13.5 ft

ne = not encountered. *Top of PVC set below grade, covered with steel can. **Bottom 5 ft of pipe is slotted.

Duane Miller & Associates
Job No. 4135.02
September 1997

1397 986

WELL LOG

6/27/75 CLIFF ELLER

POWER PLANT WELL TANANA, ALASKA

0' - 1' Tundra
1' - 12' ~~Frozen Silt~~
12' - 50' Frozen Gravel
50' - 73' Hard White Schist & Quartz
73' - 97' White & Gray Schist
97' - 170' " " "
170' - 175' Damp Schist
175' - 215' White & Gray Schist
215' - 218' Broken Schist & Water
218' - 223' Gray Shhist + Water

Well cased to 52' Static water level 155'
No Pump

Tom WOLF

~~Well cased to~~ Dry Hole

Well 1400.

1401 990

WELL LOG

6/25/75 N.C. Company
Well Location-Tanana, Alaska

0' - 3' Silt & Wood
3' - 8' Silt Frozen
8' - 34' Gravel, Silt & Sand
34' - 45' Water Bearing Gravel & Sand

Well cased to 45' Johnson Screen #50 slot
6" 10'long
~~Water static level 19' 10GPM no drawdown~~

LOG OF DRILLING by A & L DRILLING COMPANY

10

OWNER OF LAND: Ekada

ADDRESS: 10--6

WELL—SITE: Tanana, Alaska

DATE—STARTED: July 14, 1967

DATE—ENDED: July 14, 1967

DEPTH OF WELL: 51 feet

STATIC LEVEL OF WATER FT.: 19

DRAW DOWN FT.: 8

GALS. PER HR.: 420

KIND OF CASING: 6 5/8" O.D.

KIND OF FORMATION:

FROM	FT. TO	FT.
0	4	Over Burden
4	33	Perma Frost
33	37	Gravel, Frozen
37	51	Hard Pan, Frozen, Water
51		Sand, Gravel, Water, 7 gpm

MISCL. INFORMATION:

Cased to 42'8"; not cased to full depth of well--water temperature--32 degrees. Air developed 7 hours. Well flushed to 10 feet.

PROJECT ENGINEER ______________________

DRILLER'S NAME ______________________

Block 7, Lot 1

LOG OF DRILLING by A & L DRILLING COMPANY

17

OWNER OF LAND Edgar Joseph

ADDRESS 17--24

WELL—SITE Tanana, Alaska

DATE—STARTED July 21, 1967

DATE—ENDED July 21, 1967

DEPTH OF WELL 65 feet

STATIC LEVEL OF WATER FT. dry

DRAW DOWN FT. dry

GALS. PER HR. dry

KIND OF CASING ------

KIND OF FORMATION:

FROM	0	FT. TO	1	FT.	Over Burden	FROM ..... FT. TO ..... FT.	
FROM	1	FT. TO	6	FT.	Clay	FROM ..... FT. TO ..... FT.	
FROM	6	FT. TO	21	FT.	Sand & Gravel	FROM ..... FT. TO ..... FT.	
FROM	21	FT. TO	25	FT.	Gravel	FROM ..... FT. TO ..... FT.	
FROM	25	FT. TO	50	FT.	Sand & Gravel	FROM ..... FT. TO ..... FT.	
FROM	50	FT. TO	52	FT.	Gravel	FROM ..... FT. TO ..... FT.	
FROM	52	FT. TO	65	FT.		FROM ..... FT. TO ..... FT.	
FROM ..... FT. TO ..... FT.						FROM ..... FT. TO ..... FT.	
FROM ..... FT. TO ..... FT.						FROM ..... FT. TO ..... FT.	
FROM ..... FT. TO ..... FT.						FROM ..... FT. TO ..... FT.	
FROM ..... FT. TO ..... FT.						FROM ..... FT. TO ..... FT.	
FROM ..... FT. TO ..... FT.						FROM ..... FT. TO ..... FT.	

MISCL. INFORMATION:

PROJECT ENGINEER _____ DRILLER'S NAME .....

Block 5, Lot 10

LOG OF DRILLING by A & L DRILLING COMPANY 8

OWNER OF LAND Pete Nicholia

ADDRESS 3' 8--23

WELL—SITE Tanana, Alaska

DATE—STARTED July 13, 1967

DATE—ENDED July 13, 1967

DEPTH OF WELL 75

STATIC LEVEL OF WATER FT. ---

DRAW DOWN FT. ----

GALS. PER HR. ----

KIND OF CASING ----

KIND OF FORMATION:

FROM	FT. TO	FT.	FROM	FT. TO	FT.
0	4	Over Burden			
4	75	Perma Frost--dry			

MISCL. INFORMATION: Sand GRAVEL 44-68 ft

DRY HOLE

Sand Stone 68-75

PROJECT ENGINEER

DRILLER'S NAME

Block 5, Lot 9

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND Hudson Hicholia
ADDRESS 1 42--17
WELL—SITE Tanana, Alaska
DATE—STARTED August 20, 1967
DATE—ENDED August 20, 1967

DEPTH OF WELL 42 feet
STATIC LEVEL OF WATER FT. 8
DRAW DOWN FT. 15
GALS. PER HR. 1080
KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM	0	FT. TO	1	FT.	Over Burden		
FROM	1	FT. TO	5	FT.	Sand		
FROM	5	FT. TO	15	FT.	Sand, Gravel		
FROM	15	FT. TO	18	FT.	Sand, Gravel		
FROM	18	FT. TO	26	FT.	Sand, Gravel		
FROM	26	FT. TO	35	FT.	Coarse Sand, Small Gravel		
FROM		FT. TO		FT.			
FROM	35	FT. TO	36	FT.	Sand & Gravel		
FROM	36	FT. TO	39	FT.	Black Water, sand		
FROM	39	FT. TO	42	FT.	Hard Pan		
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			

FROM ..... FT. TO ..... FT.
FROM ..... FT. TO ..... FT.
FROM ..... FT. TO ..... FT.
FROM ..... FT. TO ..... FT.
FROM ..... FT. TO ..... FT.
FROM ..... FT. TO ..... FT.
FROM ..... FT. TO ..... FT.
FROM ..... FT. TO ..... FT.
FROM ..... FT. TO ..... FT.
FROM ..... FT. TO ..... FT.

MISCL. INFORMATION:

Well caved to 41'9". Casing perforated from 35'9" to 33'9".
Well grouted to 10 feet.

PROJECT ENGINEER _____ DRILLER'S NAME .....

Block G, Lot 14

Hospital 2 - in use

WELL LOG

Hospital 2

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION PHS Hospital-Tanana, Alaska DATE STARTED August 18, 1976

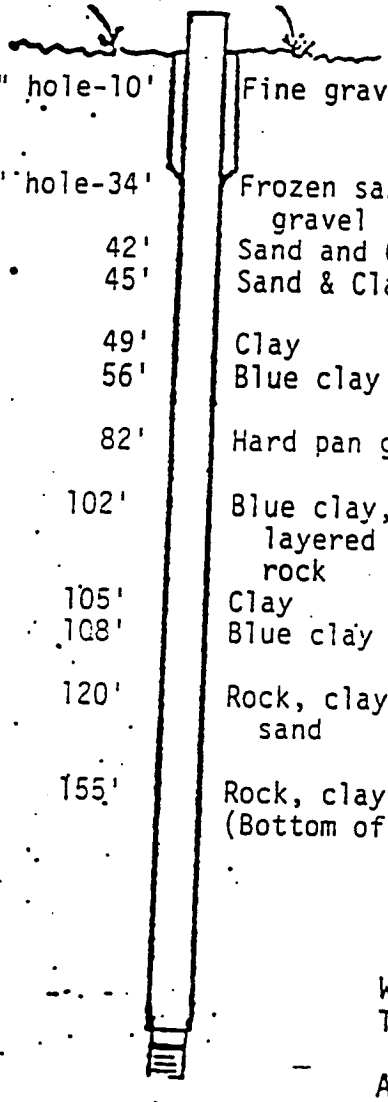
DATE COMPLETED August 28, 1976 CREW Bordner & Horner

TOTAL DEPTH OF WELL 155 FT. CASING INSTALLED 97' DIAMETER 8" & 6"

GROUT Bentonite SCREEN SIZE #40 MFG. Johnson 39' - 99' bgs LENGTH 10'

STATIC WATER LEVEL 25'-6" HRS. PUMPED 20 @ 50 GPM DRAWDOWN ____ FT.

DEVELOPMENT PROCEDURES Run surge blocks 8 hrs



DATE	DEPTH FROM - TO	FORMATION
	0-10'	Fine gravel
	10-34'	Frozen sand & gravel
	34-42'	Sand & gravel
	42-45'	Sand & gray clay
	45-49'	Gray clay
	49-56'	Blue clay silt
	56-82'	Hard pan gravel
	82-102'	Blue clay, layered rotten rock
	102-105'	Clay (purplish color)
	105-108'	Blue clay
	108-120'	Rock, clay (gray) & sand
	120-155'	Rock, clay (bottom of hole)

WATER DATA FIELD TEST

TASTE Good APPEARANCE FRESH Good

AFTER 24 HOURS ____ IRON ____ CHLORIDES ____

TDS ____ ALKALINITY ____ pH ____

SPECIAL NOTES:

See attached drawing.

Native Council Well

In 1974, well rehabilitated. In well house, east of Garden St. Can be used. Well # 2 (actually #1)

LOG OF DRILLING by A & L DRILLING COMPANY

OWNER OF LAND Community Hall
ADDRESS Front Street
WELL—SITE Tanana, Alaska
DATE—STARTED August 28, 1967
DATE—ENDED August 28, 1967

DEPTH OF WELL 49 feet
STATIC LEVEL OF WATER FT. 22
DRAW DOWN FT. 18
GALS. PER HR. 360
KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM	0	FT. TO	1	FT.	Over Burden	FROM ... FT. TO ... FT.	
FROM	1	FT. TO	8	FT.	Sand	FROM ... FT. TO ... FT.	
FROM	8	FT. TO	18	FT.	Sand & Gravel	FROM ... FT. TO ... FT.	
FROM	18	FT. TO	22	FT.	Coarse Sand & Gravel	FROM ... FT. TO ... FT.	
FROM		FT. TO		FT.		FROM ... FT. TO ... FT.	
FROM	22	FT. TO	23	FT.	Large Gravel, Sand	FROM ... FT. TO ... FT.	
FROM	23	FT. TO	31	FT.	Coarse Sand & Gravel	FROM ... FT. TO ... FT.	
FROM		FT. TO		FT.		FROM ... FT. TO ... FT.	
FROM	31	FT. TO	36	FT.	Water Sand & Gravel	FROM ... FT. TO ... FT.	
FROM		FT. TO		FT.		FROM ... FT. TO ... FT.	
FROM	36	FT. TO	42	FT.	Water Sand, Fine	FROM ... FT. TO ... FT.	
FROM	42	FT. TO	49	FT.	Rock	FROM ... FT. TO ... FT.	

MISCL. INFORMATION:

Well cased to 42 feet 6 inches. Casing perforated from 34'6" to 39'6". Well grouted to 10 feet.

PROJECT ENGINEER _____ DRILLER'S NAME _____

City Well #2

1 of a

CITY WELL #3 (NEW)
In use. ~200' from well house.

Project # NOD-2-91 JOB # AN-70030

ICE WATER WELL, INC.
P.O. Box 10529
FAIRBANKS, ALASKA 99710
(907) 457-6444

(1991)

P.H.S.

WELL LOG

Well Owner City of Tanana Date Started 9-6-91 Date Finished 9-11-91
Well Location Tanana AK Driller Ice Water Well Inc.
Mailing Address P.H.S. Anch. AK Tac Time N/A To N/A
Size of Casing 6" Steel Depth of Hole 50 Cased To 38'
Static Water Level 27' 11" Drawdown to 33' 6" Finish of Well Screen
Well Pump Test at 15 fifteen Gallons per minute for Ten Hours

Formations Encountered:

0	to 10	Silt
10	to 25	Silty Gravel
25	to 36	Sandy Gravel
36	to 46	Large Water Bearing Gravel
46	to 50	Bed Rock
	to	
	to	Well Screened 38 to 50
	to	# 40 Slot Stainless Steel
	to	Well Capped w/Steel Plate 9-11-91

Pump Installation:
Date Installed *Test Pump* Type Gouldes 18EM Size 1½ HP
Material Used: *Removed after test pumping was complete*
6" pipe
6" Shoe
10' #40 Slot Screen + 2' Blank 5' Stinger
K Packer Neo Prem
Bentonite Seal

New City Well #3

WELL LOG LOCATED BLOC · 6 LOT 10

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION TANANA ALASKA / JUDY SOMMERS DATE STARTED 3/22/81

DATE COMPLETED 3/24/81 DRILLER PETE ARCHIBALD / GLENN FOWLER

TOTAL DEPTH OF WELL 52 FT. CASING INSTALLED 52 DIAMETER 6"

GROUT CEMENT BENTONITE SCREEN SIZE 20 SLOT MFG. JOHNSON LENGTH 5'

STATIC WATER LEVEL 31 HRS. PUMPED 12 @ 20 GPM DRAWDOWN 72" FT.

HOLE DIAMETER
CASING DIAMETER

DEPTH	FORMATION
0 - 2'	FROZEN SILT
2' - 20'	SAND
20' - 50'	GRAVELS
50' - 52'	BLUE CLAY

SOIL DATA TO 15 FT.
FEET THAWED _____
BOTTOM OF FROST & MATERIAL 2'
SEASONAL OR PERMA FROST SEASONAL

WATER DATA FIELD TEST
TASTE NO IRON TASTE
APPEARANCE FRESH GOOD
AFTER 24 HOURS NO VISUAL TRACE OF IRON
IRON _____
CHLORIDES _____
TDS _____

PUMP TEST 31' - STATIC LEVEL
PUMPING LEVEL 49' @ 20 GPM
AFTER _____ HRS.

HIGHEST RECOMMENDED PUMP RATE
WILL STATIC LEVEL CHANGE WITH
TIDES _____ OR FROST _____

Judy Sommers Well

DEVELOP PROCEDURE SURGE BLOCK

ESTIMATED MAN HOURS FOR DRILLING 40 HRS HOURS FOR TOTAL JOB 40 HRS

CREW PETE ARCHIBALD / GLENN FOWLER

LOG OF DRILLIN by A & L DRILLING COMPANY

OWNER OF LAND Walter Nicholia

ADDRESS 36--15

WELL—SITE Tanana, Alaska

DATE—STARTED August 9, 1967

DATE—ENDED August 9, 1967

DEPTH OF WELL 50 feet

STATIC LEVEL OF WATER FT. 18

DRAW DOWN FT. 17

GALS. PER HR. 1800

KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM	0	FT. TO	2	FT.	Over Burden
FROM	2	FT. TO	10	FT.	Sand
FROM	10	FT. TO	15	FT.	Small Gravel, Sand
FROM	15	FT. TO	20	FT.	Large Gravel, Sand
FROM	20	FT. TO	41	FT.	Small Gravel, Sand
FROM		FT. TO		FT.	
FROM	41	FT. TO	47	FT.	Water, Sand
FROM	47	FT. TO	50	FT.	Sand Stone
FROM		FT. TO		FT.	
FROM		FT. TO		FT.	
FROM		FT. TO		FT.	
FROM		FT. TO		FT.	

FROM ..... FT. TO ..... FT.

FROM ..... FT. TO ..... FT.

FROM ..... FT. TO ..... FT.

FROM ..... FT. TO ..... FT.

FROM ..... FT. TO ..... FT.

FROM ..... FT. TO ..... FT.

FROM ..... FT. TO ..... FT.

FROM ..... FT. TO ..... FT.

FROM ..... FT. TO ..... FT.

FROM ..... FT. TO ..... FT.

MISCL. INFORMATION:

Well cased to 49'9". Casing perforated from 42'9" to 46'9".
Well grouted to 10 feet.

PROJECT ENGINEER _____ DRILLER'S NAME .....

17

5C

Block 6, Lot 11

Block 7, Lot 2

LOG OF DRILLING by A & L DRILLING COMPANY

45

OWNER OF LAND Episcopal Residence

ADDRESS Episcopal Residence

WELL—SITE Tanana, Alaska

DATE—STARTED August 23, 1967

DATE—ENDED August 23, 1967

DEPTH OF WELL 43 feet

STATIC LEVEL OF WATER FT. 14

DRAW DOWN FT. 10

GALS. PER HR. 1600

KIND OF CASING 6 5/8" O.D.

KIND OF FORMATION:

FROM	0	FT. TO	2	FT.	Over Burden		
FROM	2	FT. TO	15	FT.	Sand		
FROM	15	FT. TO	18	FT.	Sand & Gravel		
FROM	18	FT. TO	25	FT.	Coarse Sand, Small Gravel		
FROM		FT. TO		FT.			
FROM	25	FT. TO	28	FT.	Large Gravel, Sand		
FROM		FT. TO		FT.			
FROM	28	FT. TO	34	FT.	Sand & Gravel		
FROM	34	FT. TO	42	FT.	Water Sand		
FROM	42	FT. TO	43	FT.	Clay		
FROM		FT. TO		FT.			
FROM		FT. TO		FT.			

FROM	FT. TO	FT.	
FROM	FT. TO	FT.	
FROM	FT. TO	FT.	
FROM	FT. TO	FT.	
FROM	FT. TO	FT.	
FROM	FT. TO	FT.	
FROM	FT. TO	FT.	
FROM	FT. TO	FT.	
FROM	FT. TO	FT.	
FROM	FT. TO	FT.	
FROM	FT. TO	FT.	

MISCL. INFORMATION:

Well cased to 42 feet 10 inches. Casing perforated from 36'10" to 39'10". No Grout.

PROJECT ENGINEER

DRILLER'S NAME

Block 7, Lot 2