Ekwok Groundwater Investigation and Well Rehabilitation Study

Final Report

September 13, 2002

Prepared for:
The City of Ekwok and the State of Alaska Village Safe Water

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1.0 INTRODUCTION

The City of Ekwok contracted Paug-Vik Development Corporation (Paug-Vik) to conduct a Groundwater Investigation and Well Rehabilitation Study, through a Village Safe Water (VSW) grant for sanitation improvements. The community of Ekwok, situated between the Nushagak River and Klutuk Creek, is located approximately 43 miles northeast of Dillingham. It has a population of about 130 year-round residents and currently there are 34 homes in Ekwok.

Many homes in Ekwok are served by individual wells tapping a confined aquifer high in iron and manganese that is esthetically displeasing without treatment. Some home wells tap a shallower unconfined aquifer low in iron. The purpose of this study is to evaluate the feasibility and estimate the cost of providing low-iron drinking water to all residents of Ekwok, and to identify home sites that are suitable for shallow aquifer wells as primary sources of drinking water.

The 1994 *Ekwok Well Rehabilitation Plan for HUD Homes*, prepared by Bristol Environmental Services, was used as background for this study. The 1994 study characterized water quality conditions in both aquifers at Ekwok, and identified the shallow aquifer as a potentially viable source of good quality water for most homes, subject to additional on-site drilling and testing.

The present study included evaluating various water-supply options and performing a test well drilling program to test the viability of tapping the shallow aquifer for water supply throughout the community. Well sites were selected based on a drilling program work plan (Paug-Vik, March 2002). Six new test wells were successfully completed in the shallow aquifer at Ekwok during July 2002 as part of this study, and one additional unsuccessful test well was drilled and abandoned. Figure 1 shows the location of the 2002 study area and project test well locations.

The findings and recommendations presented in this report include:

- recommended well site locations;
- estimated costs for installation, testing, connection, and operation of new water wells and septic systems where needed; and
- alternative water-quality improvement options and costs for home sites where wells tapping the shallow aquifer are not feasible.

2.0 WELL REHABILITATION PLANNING

Residents are interested in wells that provide high-quality water from the shallow aquifer, as opposed to treating the deep aquifer water from their existing wells. Working with the community, we developed a recommended priority list for potential test well sites for this study based upon the following considerations:

- Available funding;
- Previous HUD-home well-site studies;
- Land use restrictions;
- Non-HUD home well-rehabilitation considerations;
- Local well characteristics and geohydrological conditions;
- Interviews with local residents; and
- A site visit to inspect potential test well sites.

2.1 EVALUATION OF 1994 WELL REHABILITATION PLAN

Bristol prepared a well rehabilitation plan for HUD homes in Ekwok in 1994, which concluded that it was feasible for some properties in the community to tap the shallow aquifer. Risks of low well yields or potential sources of contamination made other potential well sites uncertain. As part of this project, we critically reviewed the 1994 *Ekwok Well Rehabilitation Plan for HUD Homes* and reported our findings in a February 22, 2002, technical memorandum, which was provided to Ms. Lynn Marino at VSW and the City of Ekwok. A copy of this memorandum is included in Appendix F.

In our evaluation of the 1994 report, we concluded that the ranking criteria used in 1994 to identify a suitable water source in the shallow aquifer for HUD homes were reasonable based upon the factors considered in the study. The 1994 study considered only local geohydrologic conditions and potential nearby contamination sources in developing their findings and conclusions.

In our February 2002 memorandum, we identified additional factors that should be considered for future recommended well sites, and used this as a starting point for the current study. Other factors which we considered included:

- Available funding;
- Land use restrictions;
- Interviews with local residents to obtain current well and water use data; and
- A site visit to visually inspect proposed test well sites.

2.2 Land Status Research

To prepare for the drilling program, we conducted a search of land use and ownership records. Our purpose was to identify any land use restrictions that could affect proposed drilling activities, confirm ownership and legal descriptions for properties included in this study, and identify potential permit requirements for proposed drilling activities.

In the course of this search, we reviewed Alaska Division of Natural Resources land records, Bureau of Land Management land records, and legal property descriptions and titles at the Bristol Bay Borough Land Records Office in Anchorage.

As a result of our search, we did not identify any land use restrictions or permitting requirements that would impact proposed test-drilling activities in the Ekwok study area. We incorporated title records and legal descriptions for properties in this study into our Well Rehabilitation List included in Appendix A of this report.

2.3 Evaluation of Geohydrologic and Local Well Conditions

George Taylor of Ekwok conducted a door-to-door survey of local residents on March 4 and 5, 2002, to obtain additional data about individual residential wells. Based upon our review of available well logs and homeowner well surveys, we developed the following findings to characterize local geohydrologic conditions:

- Five active residential wells in the community are currently tapping the shallow aquifer.
- With no public water system serving the community, most homes rely on wells tapping the deeper confined aquifer, which typically provides highly mineralized water that most residents consider undrinkable.
- A few wells tapped the shallow aquifer in the past; however, they have mostly been abandoned in favor of newer wells tapping the deeper confined aquifer. The older wells commonly used pitcher pumps to pump water. Residents report that some of the older shallow wells had petroleum product sheens from local disposal of home heating oil residuals. Some wells exhibited inadequate yields during late winter when water levels were at seasonally low levels. Residents also are concerned about organic contamination from household wastewater disposal or dogs.
- The shallow aquifer is widely present throughout the community, and occurs at reported depths ranging from 15 feet to 48 ft below the land surface.
- Further drilling and testing of the shallow aquifer is warranted to evaluate the quantity and quality of water from the aquifer at potential well locations.

2.4 Water-Supply Option Evaluation and Selection

We considered several possible options for providing high-quality water to homes. We determined that the best solution for improving water quality at most Ekwok home sites was to install individual wells tapping the shallow aquifer as the primary water source.

Options that we considered, but found less than optimal for achieving a good solution, were:

- Perforating and testing low-iron aquifers and sealing-off high-iron zones in existing wells. However, this was determined not to be an optimal solution because of the loss of the well tapping the deeper aquifer, potential for pumping sand from the perforations, and other reasons as noted in the May workplan (Paug-Vik, 2002). We preferred leaving existing non-HUD home site wells (deep aquifer) in a serviceable condition in the event that the new wells (shallow aquifer) can only be used seasonally due to low-water conditions in the shallow aquifer.

- Hooking up multiple homes to a single well since many homes are close enough to each other to make this feasible. However, under this scenario wells providing water to multiple homes would be classified as Class C public water supply wells and would likely require treatment as a surface water source, which would increase the cost and difficulty of operating the well beyond the practical means of homeowners.

We recommended that new water-supply wells be constructed using standard 6-inch well casing with well screens, with a blind casing section below the screen to accommodate a submersible pump. This design would provide maximum protection against low water levels by allowing the available water to flow into the well and help prevent exposing the pump to air.

2.5 Test-Well Planning

We developed a preliminary priority list of proposed test well sites as part of planning a drilling program. We designed the test program to install and test wells similar to those proposed for permanent water-supply wells, to obtain geologic data throughout the community, and to test the feasibility of tapping the shallow aquifer.

Between March 6 to 8, 2002, a Paug-Vik representative visited Ekwok to:

- Assess any potential conflicts with utilities or land uses;
- Assess proximity to nearby wells;
- Identify available separation distances from septic systems or other possible contamination sources;
- Conduct homeowner interviews to obtain historical well information and identify interest in drilling new wells on each homeowner's property.

We used the information we gathered to revise the proposed well site priority list and based the final list on the following considerations:

- Drill in areas throughout the community, especially areas where geologic data are sparse or absent;
- Drill in areas where nearby wells indicate a high likelihood of developing a successful well;
- Avoid drilling in areas where groundwater may be contaminated from past waste disposal activities, and assess wells in areas where water quality may be a concern; and
- Drill wells where homeowners want new wells.

The information gathered from the site visit and local interviews was used to revise the Well Site Priority List. We provided our updated list for comment in a technical memorandum dated May 24, 2002, to the VSW and the City of Ekwok, and it was subsequently approved.

3.0 WELL DRILLING AND TESTING ACTIVITIES

Alaska Village Services, Inc. (AVSI) was selected to provide drilling services, based upon competitive pricing, qualifications, and experience of the firm. The Ekwok field team arrived on site and conducted test-well drilling for nine (9) days, from July 1 to July 9, 2002. The field team consisted of the driller, the driller's helper, and a Paug-Vik geologist who was onsite to oversee the process, sample the wells, and act as the City of Ekwok's technical representative.

All potential property owners were asked to provide written permission granting access to their property.

All final well sites were selected and approved during field drilling activities based upon the following observations and well siting conditions:

- Proximity to other active wells on the property;
- A minimum distance of 100 feet from septic systems and leach fields;
- Proximity to underground water lines;
- Proximity to other potential contaminant sources such as dog yards, grave sites, and fuel storage areas; and
- The ability to maneuver the drill rig onto position without significant damage to the property and vegetation.

Prior to drilling at each site, a utility locate was requested and completed to clear the site for potential underground utility conflicts. Property owners[1] were notified by the Paug-Vik representative of proposed well installation and asked to participate in choosing a suitable well site location on the property.

A total of seven (7) holes were drilled. Six (6) test wells were successfully installed and completed as water producing wells. One attempted well, identified as 02HURL-04 (Figure 1), had to be abandoned after the drilling reached a depth of 53 feet and no significant water was encountered. As required by ADEC, the well casing was cut off five feet below surface grade after excavating down to expose the well casing. The well was sealed by filling it with bentonite chips. A casing cap was welded over the top of the opening, and the excavation was then backfilled using local materials (gravelly sand). The site was finally graded over and leveled to the pre-existing surface grade.

[1] In one instance the property owner was out of town and could not be reached prior to drilling.

3.1 Well Installation

An air rotary rig was used to install each well; the wells were constructed of standard 6-inch well casing and five-foot well screens. In most cases wells were drilled until the underlying confining unit was encountered. The screened interval was positioned near the bottom of the aquifer and a two-foot section of blind casing was placed below the well screen to accommodate the submersible pump. This design helps to protect the pump from generating high water velocities through the screen and provides for maximum available drawdown.

3.2 Well Completion and Testing

Six of the seven test wells were successfully completed as water-producing test wells (Figure 1). We determined the location of each well using Global Positioning Satellite (GPS) measurements and recorded the total depth and water level for each well. Data for each location are provided in Table 3-1.

After it was installed each well was disinfected with a chlorine solution. The wells were developed using an air-surge method (provided by the drill rig) to draw formation water into the well until the water cleared up and water quality parameters stabilized. One well (Well Site 02HURL-01) had to be additionally developed with a portable submersible pump because of high turbidity in the water.

Water-quality parameters measured during development included pH, temperature, and conductivity, along with a visual assessment of the color and turbidity of the water. These analyses provide a general indication of water quality. Secondary drinking water standards for these parameters can be found in ADEC 18 AAC 80. The standard for pH is a range of 6.5 – 8.5. All of the wells sampled had pH readings in that range. The standard for temperature is less than 15^{o} Celsius (69.8^{o} Fahrenheit). All of the well sampled had temperatures less than 15^{o} Celsius. Conductivity was measured as total dissolved solids in ppm KCl (potassium chloride). This data was converted to microSiemens (uS) by multiplying the result by a factor of two. The secondary standard for conductivity is 1000 uS (or 500 ppm total dissolved solids). All of the wells but one (02NELS-07) had conductivity measurements that met this standard. This result is anomalous when compared to laboratory analytical results for total dissolved solids for that well, which was less than 200 mg/L (Table 4-1). Turbidity and color have standards in 18 AAC 80 as well; however, quantitative analyses were not performed for these parameters.

The time that it took for water conditions to stabilize at each well varied, although each reached stable parameters within one to three hours. The water quality field test readings taken from each well are noted in Table 3-2.

3.2.1 Well Drawdown and Recovery Testing

Following well development, each active well was tested for drawdown and recovery using a portable submersible pump. This was done to establish water production rates for each test well. All of the test wells were pumped at a known rate, for example, 5 gallons per minute (GPM). Water level readings were taken to record the amount of drawdown for each well.

After a minimum of 1 hour of pumping and generally when drawdown stabilized, pumping ceased. At this point water level recovery time was determined by recording the time it took for the water to reach the depth recorded prior to pumping. These data are shown in Table 3-3.

All of the test wells had minimal drawdown and recovered to previous water levels rapidly. One of the wells (02WALC-05) had no measurable drawdown during pumping. Two of the wells (02KAWA-02 and 02ATKI-03) had immediate water level recovery.

From this testing, we established that, at that time, all the active test wells had sufficient water production rates to meet single-family home water requirements. Static water levels and water-production rates may change due to seasonal fluctuations in the shallow aquifer.

KLUTUK CREEK

LANDFILL

02KAWA-02

02ATKI-03

E ST

D ST

AIRSTRIP

02NICK-06

6th ST

5th ST

SEWAGE LAGOON

02NELS-07

02WALC-05

H ST

G ST

SCHOOL

3rd ST

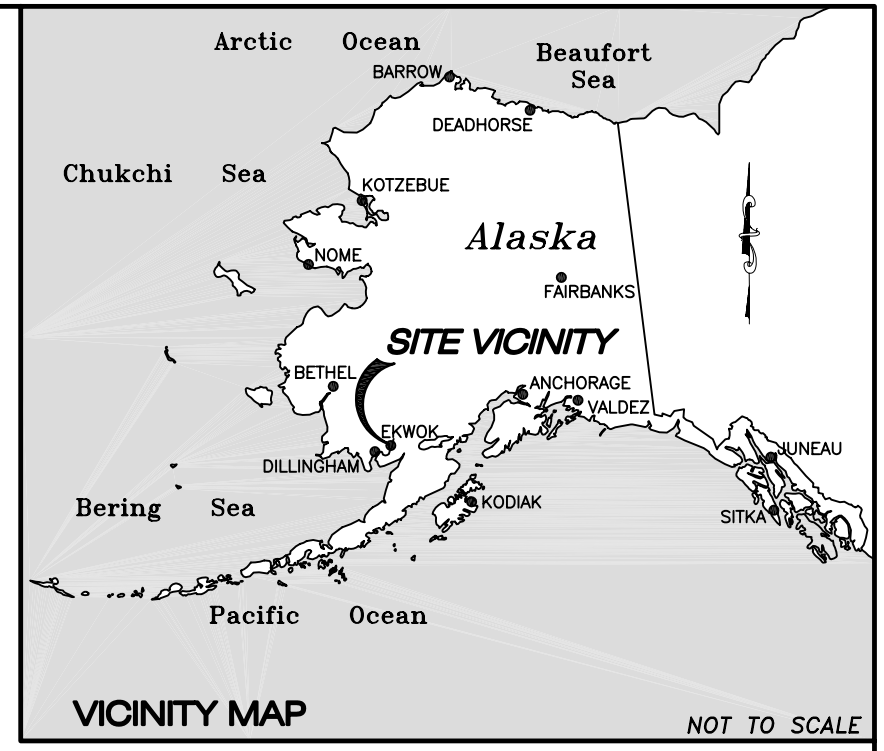
02HURL-01

FUEL STORAGE AREA

4th ST

02HURL-04

NUSHAGAK RIVER



VICINITY MAP

NOT TO SCALE

0 800' 1600' 2400'

APPROXIMATE SCALE: 1" = 800'

LEGEND

02ATKI-03	TEST WELL LOCATION WITH IDENTIFICATION NUMBER
	ROAD

NOTE:
This map was prepared from uncontrolled aerial photographs (AeroMap,U.S. 1–3, 1–5 June 16, 1996). Scale is approximate and minor distortion may exist.

FIGURE 1

TEST WELL SITES

City of Ekwok

59° 22' N 157°30' W SEC. 35, T9S R49W, Seward Meridian

GROUNDWATER INVESTIGATION AND WELL REHABILITATION STUDY

DRAWN: CDS CHKD BY: C.O./ H.G. DATE: 08/26/2002

Table 3-1: Completed Well Information

Well Site ID	Owner	Location	GPS Data (Latitude and Longitude)	Well Depth (feet)	Static Water Level (feet)
02HURL-01	Jimmy Hurley	Upriver from town site at very end of 5th St.	N 59°29.784' W 157°26.721'	45	37
02KAWA-02	Mary Kawaglia	Lot 6, Block 1, HUD homes	N 59°21.093' W 157°28.972'	25	16.5
02ATKI-03	Vera Taylor	Lot 3, Block 2, HUD homes	N 59°21.200' W 157°28.868'	25	15
02HURL-04	Mary Hurley	Lot 11, Block 11	No Data	53	NA (well abandoned)
02WALC-05	Letia Walcott	Lot 10A, Block 3	N 59°21.784' W 157°26.721'	21	4.5
02NICK-06	Wassillie Nickolai	Lot north of 6th St., between "G" and "H" St.	N 59°20.936' W 157°29.032'	25.3	17
02NELS-07	Tom Nelson	Lot near 5th St. and "D" St.	N 59°21.033' W 157°28.576'	32	24

Table 3-2: Field Water Quality Testing Results

Well Site ID ***Instrument Measurement Method***	PH *Oakton pHTestr 1 Probe*	Temperature (°F) *Oakton Temperature Probe*	Conductivity (uS) *Oakton TDSTestr1 Probe*	Color *Visual Observation*	Turbidity *Visual Observation*
02HURL-01	7.47	38.7	360	Light brown	Low
02KAWA-02	6.97	40.3	340	clear	None
02ATKI-03	6.93	37.6	460	clear	None
02WALC-05	7.1	37.0	680	clear	None
02NICK-06	7.8	37.9	240	Light brown	Low
02NELS-07	7.6	38.7	1020	Light brown	Low

Notes and Keys:

[1] Both the pH and conductivity meters were calibrated daily prior to use according to manufacturer's specifications.

° F = degrees Fahrenheit

uS = microSiemens

Table 3-3: Well Drawdown and Recovery Testing Results

Well Site ID	Test Pump Rate (GPM)	Total Drawdown At End of Test (Inches)	Duration of Test Pumping (Hours)	Time to Full Recovery (Minutes)
02HURL-01	5.0	12.0	2.5	2.5
02KAWA-02	8.0	8.0	1.0	< 1.0
02ATKI-03	10.0	8.0	1.0	< 1.0
02WALC-05	10.0	< 1.0	1.5	< 1.0
02NICK-06	5.0	12.0	1.0	2.0
02NELS-07	5.0	12.0	1.0	2.0

4.0 WATER QUALITY SAMPLING AND ANALYSES

After each well was developed and field-tested, we collected groundwater samples for chemical and biological laboratory analyses. The samples were packaged and sent to CT&E laboratory in Anchorage.

CT&E analyzed the samples for the basic drinking water parameters[2] identified in the ADEC Drinking Water standards (18 AAC 80, last amended August 23, 2000).

The lab results for each parameter tested for each well are reported in Table 4-1. ADEC prescribes a maximum contaminant level (MCL) for public water supplies for some constituents, and not for others. If available, the ADEC MCLs are included in the table for comparison with the groundwater data obtained from each well.

Two samples (02EK-HURL and 02EK-NICK) had positive results for total coliform. *Esherichia coli (E. coli)* results for both of these samples were negative. The total coliform analysis is used to indicate whether bacteria is present in the water. It is likely that the coliform bacteria that were detected were introduced into the wells by the temporary submersible pump used during test pumping. Additional disinfection of these wells should eliminate the coliform bacteria in these wells.

Three of the six samples exceeded the secondary MCL for dissolved iron, that is, 0.3 mg/L, as established by ADEC (18 AAC 80). The sample from 02EK-KAWA had an iron concentration of 0.407 mg/L; sample 02EK-ATKI had 1.01 mg/L; and sample 02EK-WALC had 3.2 mg/L. Although the concentrations in 02KAWA-02 and 02ATKI-03 exceed the ADEC criteria, they are substantially lower than the reported iron concentration (between 2.5 and 14 mg/L) in the deep aquifer. They represent a substantial improvement in water quality compared to the deep aquifer water.

All of the samples exceeded the MCL of 0.3 mg/L for total iron in the ICP-23 Element Scan. This scan likely reflects precipitated iron on particulate matter, and does not represent the dissolved iron typically responsible for adverse aesthetic qualities. If the wells were pumped for a longer period of time allowing residual particulate matter to be cleared from the well, total iron concentrations would likely decline.

[2] ADEC recommended parameters apply to Class C Public Water Systems. ADEC does not have water quality requirements for single-family domestic wells.

Table 4-1: Ekwok Test Well Samples Analytical Results

Analyte Group:		Anions				General Parameters			Bacteria	Iron	ICP-23 Element Scan							
Well	**Sample ID**	**Chloride (mg/L)**	**Nitrate (mg/L)**	**Nitrite (mg/L)**	**Sulfate (mg/L)**	**Total Dissolved Solids (mg/L)**	**Hardness (mg/L)**	**Alkalinity (mg/L)**	**Total Coliform**	**Dissolved Iron (mg/L)**	**Aluminum (ug/L)**	**Antimony (ug/L)**	**Arsenic (ug/L)**	**Barium (ug/L)**	**Beryllium (ug/L)**	**Cad-mium (ug/L)**	**Calcium (mg/L)**	**Chromium (ug/L)**
Drinking Water Standards[1]		250 [3]	10	1	250 [3]	500 [3]	NLE	NLE	Negative	0.3 [3]	NLE	6	50 [4]	2000	4	5	NLE	100
02HURL-01	02EK-HURL	1.59	1 [2]	1 [2]	1 [2]	118	12.1	10.5	**Positive**	0.25 [2]	1950	1 [2]	2 [2]	14.8	0.4 [2]	0.1 [2]	3.15	7.25
02KAWA-02	02EK-KAWA	1.99	1.05	1 [2]	1.55	70	14.4	1.05	Negative	**0.407**	21.1	1 [2]	2 [2]	3.41	0.4 [2]	0.1 [2]	3.91	4 [2]
02ATKI-03	02EK-ATKI	1.67	1	1 [2]	1.85	83.8	14	20	Negative	**1.01**	247	1 [2]	2 [2]	5.91	0.4 [2]	0.124	3.87	11.4
02WALC-05	02EK-WALC	6.65	1 [2]	1 [2]	2.54	103	22.5	27	Negative	**3.2**	20 [2]	1 [2]	5.4	7.01	0.4 [2]	0.1 [2]	5.82	4 [2]
02NICK-06	02EK-NICK	2.92	1.29	0.2 [2]	1.4	100 [2]	14.1	14.5	**Positive**	0.263	154	1 [2]	2 [2]	4.68	0.4 [2]	0.1 [2]	3.6	4 [2]
02NELS-07	02EK-NELS	4.68	0.49	0.2 [2]	1.21	200 [2]	33.6	29	Negative	0.25 [2]	8160	1 [2]	4.89	65.1	0.4 [2]	0.1 [2]	7.37	12.8

Additional Analytical Results

Analyte Group:		ICP-23 Element Scan (continued)																
Well	**Sample ID**	**Cobalt (ug/L)**	**Copper (ug/L)**	**Iron (mg/L)**	**Lead (ug/L)**	**Magnes-ium (mg/L)**	**Manganese (ug/L)**	**Molyb-denum (ug/L)**	**Nickel (ug/L)**	**Phos-phorus (ug/L)**	**Potassium (ug/L)**	**Selenium (ug/L)**	**Sodium (mg/L)**	**Zinc (ug/L)**	**Silicon (mg/L)**	**Silver (ug/L)**	**Thallium (ug/L)**	**Vanadium (ug/L)**
Drinking Water Standards[1]		NLE	1000 [3]	0.3 [3]	15	NLE	500 [3]	NLE	100	NLE	NLE	50	250 [3]	5000 [3]	NLE	100 [3]	2	NLE
02HURL-01	02EK-HURL	4 [2]	7.76	**12.1**	2.95	1.02	70.1	10 [2]	6.35	500 [2]	558	2 [2]	2.63	27	10.9	1 [2]	0.311	5 [2]
02KAWA-02	02EK-KAWA	4 [2]	4.07	**3.82**	0.4 [2]	1.14	26.9	10 [2]	5 [2]	500 [2]	500 [2]	2.51	3.58	3.86	7.84	1 [2]	1.92	5 [2]
02ATKI-03	02EK-ATKI	4 [2]	4.56	**4.36**	3.32	1.06	40.9	10 [2]	12.2	500 [2]	500 [2]	2 [2]	2.76	11.8	8.01	1 [2]	0.667	5 [2]
02WALC-05	02EK-WALC	4 [2]	1.84	**3.36**	0.4 [2]	1.94	160	10 [2]	5 [2]	500 [2]	720	2 [2]	4.81	3.93	9.6	1 [2]	0.601	5 [2]
02NICK-06	02EK-NICK	4 [2]	2.04	**1.3**	0.4 [2]	1.23	33.1	10 [2]	5 [2]	500 [2]	500 [2]	2 [2]	2.83	2 [2]	6.87	1 [2]	0.3 [2]	5 [2]
02NELS-07	02EK-NELS	5.46	24	**19.1**	5.13	3.69	260	10 [2]	14	500 [2]	1390	2 [2]	18.1	138	19.2	1 [2]	0.3 [2]	26.5

Notes

1. ADEC 18 AAC 80 Drinking Water Regulations August 23, 2000, public water supply, primary MCL (except where noted).
2. The analyte was analyzed for but not detected. The number given is the laboratory detection limit.
3. ADEC 18 AAC 80 Drinking Water Regulations August 23, 2000, class C public water supply, secondary MCL.
4. Currently the MCL for arsenic is 50 ug/L, however the new MCL for arsenic is 10 ug/L and will go into effect by the year 2006.

NLE = No limits established.

mg/L = milligrams per liter
ug/L = micrograms per liter

Exceedances noted in **bold.**

5.0 SUBSURFACE STRATIGRAPHY FROM WELL LOG DATA

During bore-hole drilling at each well site, we examined and described the drill cuttings from the various depths. Well logs summarizing subsurface conditions are in Appendix C. Based on the well logs, surface topography information from aerial photographs, and site observations, we prepared cross sectional illustrations of the study area. Cross section A-A' and Appendix C also include data from a private well drilled at the R. King property following completion of work for this project.

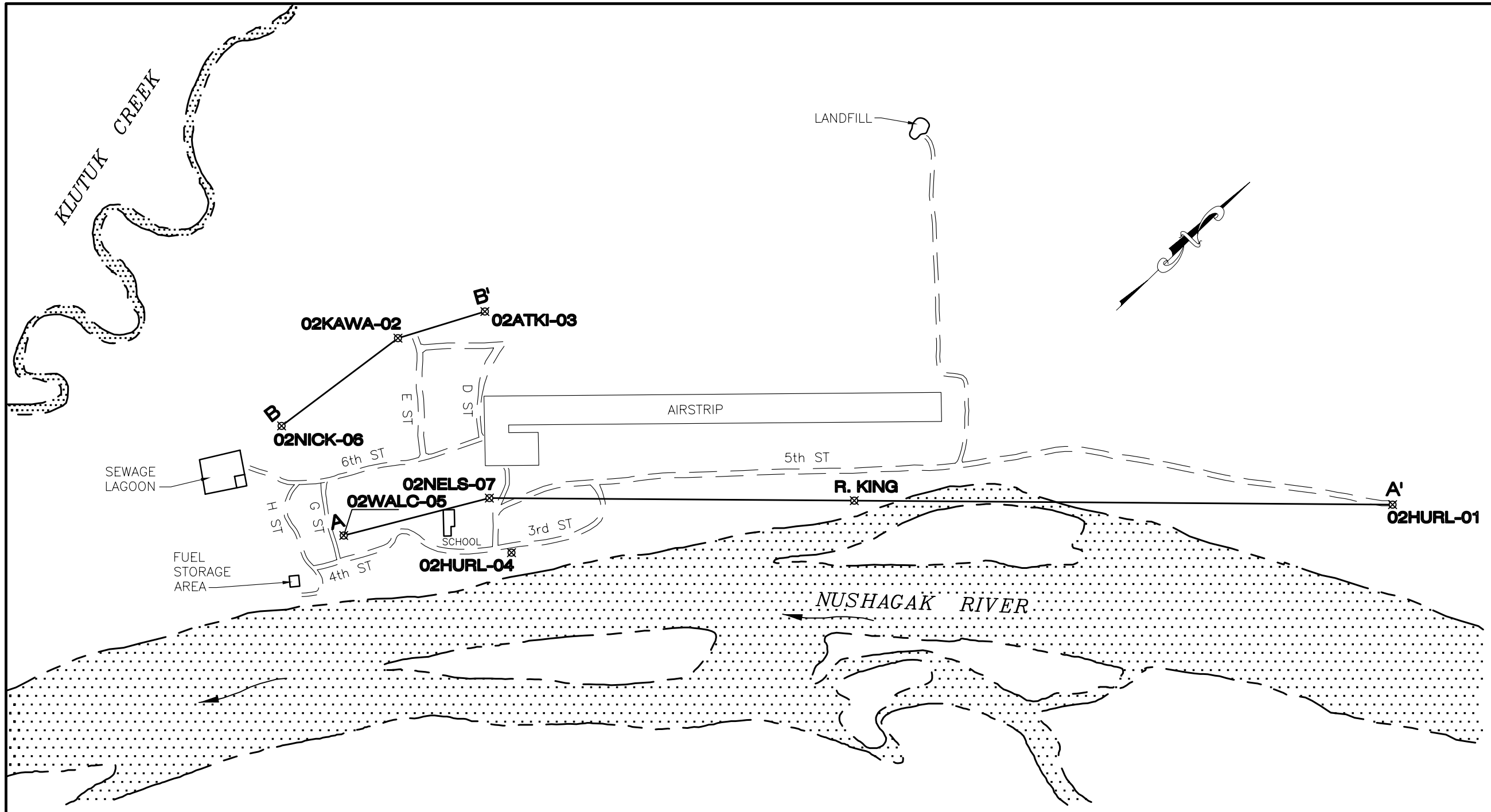
Figure 2 shows a plan view of the well locations, and identifies the locations of the two cross sections. Figure 3 shows the cross section along the A to A' line (Figure 2), and Figure 4 shows the cross section along the B to B' line (Figure 2).

In general, the subsurface soil units overlying the aquifer consist of unconsolidated glaciofluvial and alluvial material, primarily sand and gravel. The shallow aquifer, encountered at varying depths between 4.5 and 37 feet below ground surface (bgs), consisted of coarse brown sand and gravel. Permafrost was not found during the drilling.

The subsurface stratigraphy along the A to A' line (Figure 3) varied slightly in both thickness and material type, with the shallow aquifer located at 4.5 to 37 feet bgs. All well sites had a 5-foot thick surface layer of organic material. At two of the sites, 02HURL-01 and 02NELS-07, the organic layer was underlain by light brown sand, approximately 10 feet thick. The other two sites, 02WALC-05 and R. King, had a layer of brown sand and gravel of varying thickness directly below the 5 foot organic layer.

The sand layer at 02HURL-01 and 02NELS-07 appeared to grade into the brown sand and gravel unit. This variation in depositional environments was likely the result of ancient meanderings of the Nushagak River. The brown sand and gravel unit was found at varying thicknesses above the shallow aquifer at all the well sites. The confining unit, overlying the deep aquifer in the study area, is a layer of gray silt, encountered at depths of 21 to 52 feet.

The shallow aquifer is present at depths ranging from 15 feet to 17 feet deep along cross section B-B' (Figure 4). The subsurface stratigraphy at the three well sites in section B-B' was the same. A 5-foot layer of organic material at the surface was underlain by 15 feet of brown sand and gravel. An unsaturated zone in the brown sand and gravel layer was underlain by approximately eight to ten feet of saturated sand and gravel, comprising the unconfined aquifer. Dark gray silt at the bottom of the unconfined aquifer was encountered at depths of approximately 25 feet at all the well sites.



0 800' 1600' 2400'

APPROXIMATE SCALE: 1" = 800'

LEGEND

02ATKI-03	TEST WELL LOCATION WITH IDENTIFICATION NUMBER
	ROAD
A A'	CROSS SECTION LOCATION

NOTE:
This map was prepared from uncontrolled aerial photographs (AeroMap,U.S. 1–3, 1–5 June 16, 1996). Scale is approximate and minor distortion may exist.

FIGURE 2

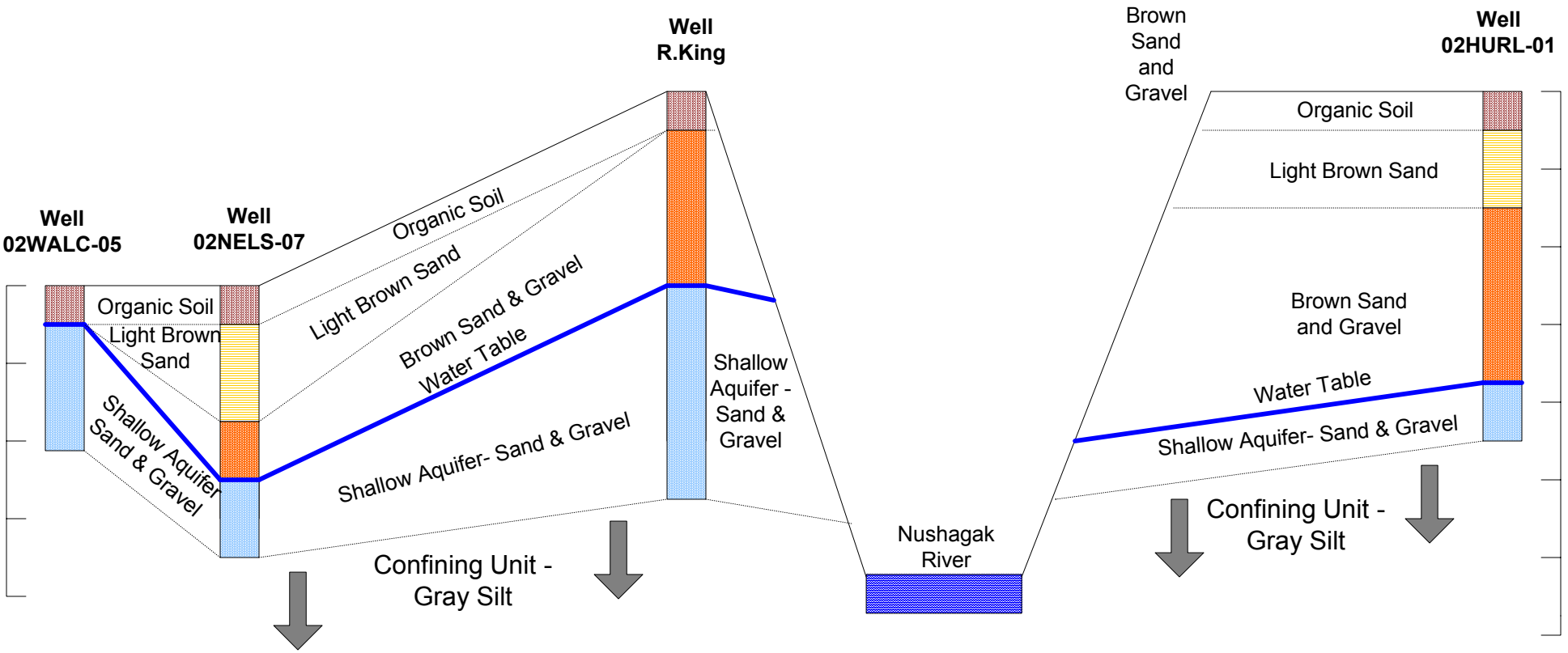
CROSS SECTION LOCATIONS

City of Ekwok

59° 22' N 157°30' W SEC. 35, T9S R49W, Seward Meridian

GROUNDWATER INVESTIGATION AND WELL REHABILITATION STUDY

DRAWN: CDS CHKD BY: C.O./ H.G. DATE: 09/03/2002



0 400' 800' 1200'

Horizontal Scale: 1" = 800'

0 10 20 30

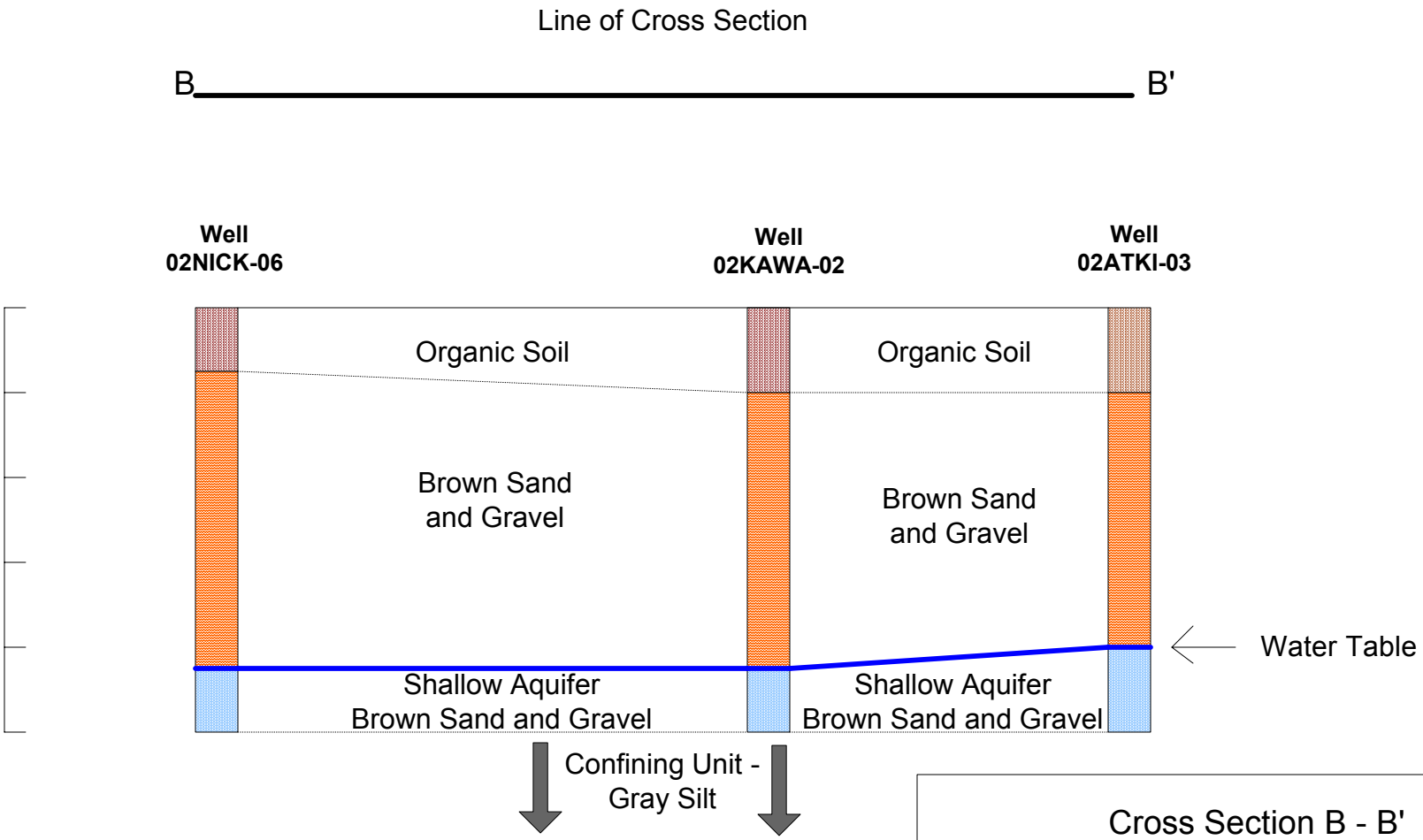
Vertical Scale: 1" = 20'

Note: Exaggerated Vertical Scale

Cross Section A - A'
(See Fig. 2 for Cross Section Location)

City of Ekwok
Ground Water Investigation and Well
Rehabilitation Study

Figure 3



0 400' 800' 1200'

HORIZONTAL SCALE: 1" = 800'

0 5 10 15

Vertical Scale: 1" = 10'

Note: Exaggerated Vertical Scale

Cross Section B - B'
(See Fig. 2 for Cross Section Location)

City of Ekwok
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Figure 4

6.0 ESTIMATED COSTS FOR WATER QUALITY IMPROVEMENT OPTIONS

This section provides general cost estimates for the various water quality improvement options considered and evaluated in this study.

The preferred option for each home site is a new well that provides residential drinking water of acceptable quality from the shallow aquifer. However, some properties may not be suitable for this option because the shallow aquifer, as a water source, is susceptible to potential impacts from nearby contamination sources, such as fuel storage areas, septic fields, dog yards, graveyards, etc. Shallow aquifer well locations must meet certain conditions to minimize the risk of potential contamination. In addition, the shallow aquifer may not be present in some areas. The cost estimate contains funds for testing all wells tapping the shallow aquifer.

We expect that there will be two to three home sites, in addition to Well Site 02HURL-04, where a shallow aquifer drinking water well will not be recommended or feasible. For these homes we recommend drilling for the unconfined aquifer in another location either on the property or on an adjacent property. If an adjacent property is used, an easement will be required prior to connecting the well to the home. If drilling in another location is unsuccessful, we recommend that the water from the existing deep aquifer well be treated to improve the water quality for drinking. In light of this, treatment options for improving local water quality were also evaluated for cost in this section.

The cost of installing new residential septic systems and leach fields is also included in this section. Total costs for well and sanitation improvements are summarized in Table 6-6. We assumed that all purchases will be made via State of Alaska Village Safe Water purchase orders to avoid contractor markup fees. Except for drilling labor and engineering services (which are included in Table 6-1), all project labor is included in Table 6-6. We assumed a 60 day field season to complete the work. With specialized skills required for much of the work, we assumed contractor crews would arrive from outside the City of Ekwok to perform the work. Table 6-6 contains a provision for a temporary camp facility to provide worker housing because of the scarcity of available rental properties during the summer. Food and lodging costs would not be materially different if rental properties became available.

6.1 Capital Costs for New Well Installation at Ekwok Properties

This section provides capital cost estimates for installation of 22 new wells at Ekwok as identified in Appendix A. Table 6-1 provides costs for mobilization, drilling, well construction materials, labor, well development, and water yield testing. The estimate also includes costs for engineering design and permitting, site supervision, and water quality sampling and analysis. This table does not include well connections to individual homes, which are estimated separately in Section 6.2.

Engineering design work includes designing wells, water lines, and connections to homes that need to be engineered for reserve use in the event of low water levels in the unconfined aquifer,

specifying water treatment systems and designing their installation, preparing bid documents, and preparing engineering drawings and reports.

The net cost for installing each well will vary based upon depth, which may slightly increase near the river bluff. An estimate of the number of drill feet needed to provide all interested residents in Ekwok with new wells is approximately nine hundred feet. Wells are not planned for public facilities such as the city office or the clinic, since these would be classified as public water systems and would likely require more extensive treatment systems. The best option for these facilities is to continue treating water from the deeper aquifer for iron removal. Cost estimates for well installation are provided in Table 6-1.

Wells proposed for water sampling include all 22 new wells, all six 2002 test wells, and all five existing residential wells tapping the unconfined aquifer.

6.2 Capital Costs for Well Connection to Individual Homes

Cost estimates for household connection of each new well and each test well drilled in 2002, to homes are provided separately in Table 6-2. Each connection is estimated at $5,420 without labor, which is estimated separately in Table 6-6.

6.3 Operation and Maintenance Cost of Operating New Wells

Annual operation and maintenance (O&M) costs for the shallow aquifer wells are estimated and tabulated in Table 6-3. Estimated annual operating costs for the new wells are $385. These costs are not included in the capital cost estimate summary.

6.4 Treating Water from Deep Aquifer Wells to Improve Water Quality

For advice on treating high iron water from the existing deep aquifer wells in Ekwok, we consulted Alaska Pure Water Products in Anchorage. They recommended the New Water Tech Industries FERROMAX MODEL I 42 Iron Removal System, which is similar to several treatment systems currently used in Ekwok by homes with wells in the deep aquifer. This system is highly effective for reducing the iron and manganese content of drinking water.

Costs to operate and maintain this system are relatively high due to Ekwok's remote location and the shipping costs for the potassium chloride salt necessary to operate the system. Cost estimates for annual operation and maintenance of the water treatment system are itemized in Table 6-4.

6.5 Costs for Residential Septic System and Leach Field Installation and Set Up

An estimated fifteen to twenty houses in Ekwok have piped sewer. Four houses lack a sewer system. The rest have septic tanks and leach fields.

The estimated costs for residential septic system and leach field installation are provided in Table 6-5 as an aid to future sanitation improvements. In addition to the four properties currently lacking septic systems or sewer hookups, we included funds for testing and maintenance for an estimated 12 existing systems, and contingency funds for four leach fields that may be in need of replacement.

Table 6-1: Cost Estimate for Drilling 22 New Wells

Item	Number of Units	Cost per Unit	Total Cost
Drilling	900 feet	$ 75	$ 67,500
Well Development	120 hours	$ 400	$ 48,000
Test Pumping/Sampling	100 hours	$ 400	$ 40,000
Well Abandonment	5 wells	$ 1,000	$ 5,000
Water Quality Analysis	33 homes	$ 1,600	$ 52,800
Engineer Design/Permitting	1	$ 150,000	$ 150,000
Surveying	1	$ 20,000	$ 20,000
Total			**$ 383,300**

Table 6-2: Costs to Connect Each Home to the New Well

Item	Number of Units	Cost Per Unit	Total Cost
Arctic Pipe Riser	1	$ 1,300	$ 1,300
Pitless Adapter	1	$ 20	$ 20
Copper Service Line	100 feet	$ .50	$ 50
Connectors, Valves, Controllers, and Supplies	1	$500	$500
Electrical Cable	100 feet	$ .50	$ 50
Excavation/Installation Equipment	12 hours	$ 125	$ 1,500
Freight, Incidentals, etc.	-	-	$ 2,000
Total			**$ 5,420**

Table 6-3: Operation and Maintenance Costs for Each New Well

Item	Life Expectancy	Replacement Cost (installed)	Annual Operating Cost
Well pump	8 years	$ 1,200	$ 150
Pressure tank	20 years	$ 800	$ 40
Electrical cost	-	-	$ 145 [a]
Water testing[b]	annual		$ 50
Total			**$385** [c]

Notes:

a. Estimate is based upon an assumed usage of 1.2 kilowatts per day for one year at a cost of $0.33 per kilowatt.
b. Annual water testing for nitrates is recommended. Cost assumes $20 for shipping.
c. O&M costs will be higher for Class C Public Water Supply wells.

Table 6-4: Cost To Treat Deep Aquifer Groundwater for Each Well

Item	Life Expectancy	Replacement Cost	Annual Operating Cost
Iron Removal System	20 years	$ 1,750	$ 90
4 - 20 Micron Filter	1 year		$ 80
36 - 40 lb. bags of salt	1 year		$ 430
Installation	-	$ 750	$ 40
Electrical Cost	-	-	$ 90 [a]
Equipment Shipping	-	$ 365	$ 20
Salt Shipping Costs	-	-	$ 2,100 [b]
Total		**$ 2,865**	**$ 2,850**

Notes:

a. Estimate is based upon an assumed usage of 0.72 kilowatts per day for one year at a cost of $ 0.33 per kilowatt.
b. Estimate is based upon shipment by air freight at an average rate of $ 0.95 per pound.

Table 6-5: Costs to Install or Replace Residential Septic System and Leach Field

Item	Number of Units	Cost Per Unit	Total Cost
1200 gal. Tank	1	$ 1,150	$ 1,150
Arctic Pipe Riser	1	$ 1,300	$ 1,300
Insulation	1	$ 300	$ 300
Pipe	250 feet	$ 1	$250
Gravel/Sand	70 yards	$ 50	$ 3,500
Design & Permitting	24 hours	$ 85	$ 2,050
Perc Test	16 hours	$ 75	$ 1,200
On-site Certification	32 hours	$ 85	$ 2,720
Freight	~ 1300 lbs.	$ 0.75	$ 1,000
Incidental Costs	NA	NA	$ 3,130
Total			**$ 16,600**

Table 6-6: Summary Cost Estimate for Well Rehabilitation in Ekwok

Item	Number of Units	Cost Per Units	Total Cost
Well Installation	22 homes	$ 17,425	$ 383,300
Well Connection to Home	28 homes	$ 5,420	$ 151,760
Connection w/Easement	4 homes	$ 8,000	$ 32,000
Water Treatment System	2 homes	$ 2,865	$ 5,730
Septic system testing/maintenance	12 homes	$1,500	$18,000
Leach Field Installation	4 homes	$ 10,000	$ 40,000
Septic System Installation	4 homes	$ 16,600	$ 66,400
Mob/Demob	1	$ 75,000	$ 75,000
Camp Costs	1	$ 75,000	$ 75,000
Labor			
Foreman	600 hours	$ 90	$ 54,000
Backhoe/Operator	240 hours	$ 200	$ 48,000
Electrician	60 hours	$ 100	$ 6,000
Installers (2)	600 hours each	$ 70	$ 84,000
Airfare	10 units	$ 500	$ 5,000
15 % Contingency	NA	NA	$ 155,810
		TOTAL	**$ 1,200,000**

7.0 CONCLUSIONS AND RECOMMENDATIONS

A study of groundwater conditions in Ekwok has confirmed that wells tapping an unconfined aquifer are a potentially viable means of supplying water to most of the homes in Ekwok. The aquifer is widely present in the community, but is not a viable water source at all locations. The quality and quantity of water available from shallow wells at most houses appears to be suitable for domestic use without treatment. Five homes currently obtain water from wells tapping the shallow aquifer, and six additional wells were drilled during this project that are suitable for conversion to sources of domestic supply. An additional 22 homes would potentially benefit from the improved quality of water available from the unconfined aquifer, compared to current water supplies that are high in iron and manganese from the deeper confined aquifer.

One test well drilled during this project failed to encounter a significant amount of water in the unconfined aquifer. This location is not suitable for well development from the unconfined aquifer, and the home should either continue relying on the deeper well or try drilling for the unconfined aquifer at another location.

Expanded development of the unconfined aquifer should be done with an understanding that the aquifer is vulnerable to contamination. The aquifer is recharged from infiltration by precipitation and snowmelt in the community, and is susceptible to potential sources of contamination including septic systems, old fuel spills, the closed landfill, shop waste, graveyards, dog lots, or other surface sources of contamination. New wells should be tested for contamination prior to use, and existing shallow wells should be tested periodically thereafter to confirm a continuing absence of contamination. Homeowners should be given information about ways to protect groundwater to guard against future contamination.

The estimated costs of providing new wells, water lines, testing, and associated facilities, including new septic systems, where needed, is $ 1,200,000.

GLOSSARY OF TERMS

Ground Water – The water found below ground surface that is located below the water table in an aquifer.

Water Table – The fluctuating surface in an aquifer delineating the zone of water saturation in the subsurface stratigraphy.

Turbidity – Sediment found in water that is commonly the result of turbulent flow.

Conductivity – A measurement of a substance's ability to conduct electricity related to the concentration of dissolved minerals in the water.

ADEC – State of Alaska Department of Environmental Conservation

EPA – Environmental Protection Agency

Drinking Water Standards – Standards concerning the level of allowable contaminants in drinking water in public water supply systems, as established in ADEC 18 AAC 80.

Aquifer – Rock or soil that is saturated with water and sufficiently permeable to allow for groundwater movement to wells and springs.

Class B Public Water Supply – Class B drinking water systems serve at least 25 individuals each day for at least 60 days of the year.

Class C Public Water Supply – Class C drinking water systems generally serve no more than 24 individuals daily and have 14 or fewer service connections.

MCL – Maximum Contaminant Level

Secondary Standard – A regulation that is non-enforceable. Testing and treatment is voluntary. Chemicals or elements that exceed these standards often produce cosmetic (e.g. yellowing of teeth) or aesthetic (e.g. smell) effects.

Glaciofluvial – Soils deposited by streams that flow from glaciers.

Alluvial – Soil deposits created by rivers or streams.

Confining aquifer unit – A layer of material that is not sufficiently permeable to allow for ground water movement and found either above or below an aquifer.

Unconfined Aquifer – An aquifer that can receive ground water flow from downward seepage, lateral flow or upward seepage due to a lack of confining units either above or below them.

Cross Section – A representation of the subsurface stratigraphy drawn along a surface cross section line.

Drawdown – A lowering of the water table due to pumping groundwater from a well.

Static Water Level – The depth to the aquifer when no pumping is occurring.

Permafrost – Perennially frozen ground.

18 AAC 80 – ADEC Drinking Water regulations as amended August 23, 2000 that establishes standards for design, construction, maintenance and operation of public water systems and contaminant monitoring requirements for drinking water.

ICP-23 Element Scan – Laboratory method used to detect 23 different elements in drinking water.

mg/L – Milligrams per liter

ug/L – Micrograms per liter

uS - MicroSiemens

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Appendix A

Recommended Well Rehabilitation List

Recommended Well Rehabilitation List

Well and Property Location	Well Owner/ Renter	2002 Drilling Program Well	Legal Description and Land Status Research Comments	Well Depth – Actual or Estimated (feet)	Work To Be Completed
One of three lots upriver from town site	Jimmy Hurley/S. Kazimirowicz	Yes	Check BLM records.	**45 (Active well taps unconfined aquifer)**	Connect well to home. Water quality analysis. Install septic system and connect to home.
Lot 6, Block 1, HUD Homes	Mary Kawaglia	Yes	*Taken from Land Plat 89-3 of the HUD home subdivision (Nakelutin Subdivision) north of the airport.* Lot 6 of Block 1 and land records indicate that Mary Kawaglia is the current land owner and that the property has been temporarily conveyed to the Bristol Bay Housing Authority.	**25 (Active well taps unconfined aquifer)**	Connect well to home. Water quality analysis.
Lot 3, Block 2, HUD Homes	Vera (Atkinson) Taylor	Yes	*Taken from Land Plat 89-3 of the HUD home subdivision (Nakelutin Subdivision) north of the airport.* Lot 3 of Block 2. Property records did not show an owner listing for this property and may not be current.	**25 (Active well taps unconfined aquifer)**	Connect well to home. Water quality analysis.
NW side of Lot 11, Block 11, near 3rd St. and C St.	Mary Hurley	Yes	*Legal description from Land Plat 89-1 in the main part of the town near the River.* Block 11, Lot 11 checks out with Mary Hurley as the current property owner, and the records indicate that the property is currently in probate status (likely her husband is recently deceased – but she would still have authority over property decisions).	Assume 45 if well were drilled upriver of home site	Attempt to drill well in new location on property or drill well with easement on adjacent property or install water treatment system. If a well is installed, it will need to be connected to the home. Water quality analysis.

Well and Property Location	Well Owner/ Renter	2002 Drilling Program Well	Legal Description and Land Status Research Comments	Well Depth – Actual or Estimated (feet)	Work To Be Completed
NE side of Lot 10A, Block 3 near the corner of G St. and 4th St.	Letia Walcott	Yes	*Legal description on Land Plat 89-1 in the main part of the town near the River.* Block 3, Lot 10A has been owned by the Walcott's, but has been recently conveyed to the Bristol Bay Housing Authority temporarily for HUD home construction.	**21 (Active well taps unconfined aquifer)**	Connect well to home. Water quality analysis.
Lot north of 6th St. between G St. and H St. if they continued north	Wassilie Nickolai	Yes	*Legal description on Land Plat 89-1 in the main part of the town near the River.* The legal property description is Block 1, Lot 4 at the main town site subdivision.	**25.3 (Active well taps unconfined aquifer)**	Connect well to home. Water quality analysis.
Lot near 5th St. and D St. if D St. continued north	Tom Nelson	Yes	*Legal description on Land Plat 89-1 in the main part of the town near the River.* The legal property description is Block 8, Lot 10 at the main town site subdivision.	**34 (Active well taps unconfined aquifer)**	Connect well to home. Water quality analysis.
Lot 3D south of 5th St.	Richard/ Lorraine King	No	*Taken from Land Plat showing the 1991 Replat of the Sunshine View II Subdivision (91-10).* Block 12, Lot 3D. Land use restriction against having a septic system too close to the river bank (Nushagak River).	**52 (New 2002 well taps unconfined aquifer)**	Connect well to home. Water quality analysis.
Lot at F St. and 6th St.	Ernie Nelson	No	*Legal description on Land Plat 89-1 in the main part of the town near the River.* The legal property description is Block 1, Lot 10 at the main town site subdivision.	**30-35 (Active well taps unconfined aquifer)**	Water quality analysis.

Well and Property Location	Well Owner/ Renter	2002 Drilling Program Well	Legal Description and Land Status Research Comments	Well Depth – Actual or Estimated (feet)	Work To Be Completed
Lot at the corner of A St. and 5th St.	Paul Romie	No	*Taken from Land Plat 89-1 in the main part of the town near the River.* The legal property description is Lot 1 (no Block assigned). There is a well & water line easement on this property.	**35 (Active well taps unconfined aquifer)**	Water quality analysis.
Lot 3B south of 5th St.	Peter Walcott	No	*Taken from Land Plat showing the 1991 Replat of the Sunshine View II Subdivision (91-10).* Block 12, Lot 3B. Land use restriction against having a septic system too close to the river bank (Nushagak River).	Unknown **(Active well taps unconfined aquifer)**	Water quality analysis.
Lot 2D south of 5th St.	Julia Brandon	No	*Legal description on Land Plat 89-2 upriver on the west site of the town site.* The legal property description is Block 12, Lot 2D.	**32 (Active well taps unconfined aquifer)**	Water quality analysis.
Lot 2C south of 5th St.	Nick Nickolai	No	*Legal description on Land Plat 89-2 upriver on the west site of the town site.* The legal property description is Block 12, Lot 2C.	Unknown **(Active well taps unconfined aquifer)**	Water quality analysis.
Lot 3C south of 5th St.	Jim/Alice Karasti	No	*Taken from Land plat showing the 1991 Replat of the Sunshine View II Subdivision (91-10)* Block 12, Lot 3C. Land use restriction against having a septic system too close to the river bank (Nushagak River).	55	Drill well in unconfined aquifer. Connect well to home. Water quality analysis.
Lot 2A along 5th St.	Anecia Nelson	No	*Legal description on Land Plat 89-2 upriver on the west site of the town site.* The legal property description is Block 12, Lot 2A.	45	Drill well in unconfined aquifer. Connect well to home. Water quality analysis.

Well and Property Location	Well Owner/ Renter	2002 Drilling Program Well	Legal Description and Land Status Research Comments	Well Depth – Actual or Estimated (feet)	Work To Be Completed
Lot at the East end of 2nd St.	William Nelson	No	*Legal description on Land Plat 89-1 is* Block 11, Lot 6.	35	Drill well in unconfined aquifer. Connect well to home. Water quality analysis.
No well. Home site is South of 3rd St. at Block 12	Buck and Julia Williams	No	*Legal description on Land Plat 89-1 in the main part of the town near the River indicating that this was re-platted so the location is the same but the legal description has changed to:* Block 6, Lot 7.	40	Drill well in unconfined aquifer. Connect well to home. Water quality analysis.
Lot 2B Block 12	Sandra and Richard Stermer	No	*Legal description on Land Plat 89-2 upriver on the west site of the town site.* The legal property description is Block 12, Lot 2B.	45	Drill well in unconfined aquifer. Connect well to home. Water quality analysis.
Lot at corner of 6th St. and G St.	Billy Hurley/Ester Dunning	No	*Taken from Land Plat 89-3 of the HUD home subdivision (Nakelutin Subdivision) north of the airport.* Lot 2 of Block 2 (Elena Hurley noted as landowner on map).	25	Drill well in unconfined aquifer. Connect well to home. Water quality analysis.
Lot near intersection of E St. and 3rd St.	Alex Nelson	No	*Legal description on Land Plat 89-1 is* Block 6, Lot 4.	30	Drill well in unconfined aquifer. Connect well to home. Water quality analysis.

Well and Property Location	Well Owner/ Renter	2002 Drilling Program Well	Legal Description and Land Status Research Comments	Well Depth – Actual or Estimated (feet)	Work To Be Completed
Lot at the intersection of B St. and 5th St.	Murdo MacLeod	No	*Legal description on Land Plat 89-2 is* Block 9, Lot 1.	30	Drill well in unconfined aquifer. Connect well to home. Water quality analysis.
Lot is between H St. and G St. where 5th St. would cross if it continued west	Herman Acovak	No	*Legal description on Land Plat 89-1 is* Block 2, Lot 7 (Note: property contains a Class C drinking water well and well easement on the property).	25	Drill well in unconfined aquifer. Connect well to home. Water quality analysis.
Lot along 6th St. between G St. and F St.	Mike R. Acovik	No	*Legal description on Land Plat 89-1 is* Block 1, Lot 7.	25	Drill well in unconfined aquifer. Connect well to home. Water quality analysis.
Up river from town site	Jimmy Hurley/Pat Chiclak (renter)	No	Check BLM records.	45	Drill well in unconfined aquifer. Connect well to home. Water quality analysis. Install Septic system and connect to home.
Up river from town site	Jimmy Hurley/Rob Brown (renter)	No	Check BLM records.	45	Drill well in unconfined aquifer. Connect well to home. Water quality analysis. Install septic system and connect to home.
Lot 6 Block 2 (HUD north)	Linda Ishnook	No	*Taken from Land Plat 89-3 of the HUD home subdivision (Nakelutin Subdivision): Legal description is* Block 2, Lot 6.	25	Drill well in unconfined aquifer. Connect well to home. Water quality analysis.

Well and Property Location	Well Owner/ Renter	2002 Drilling Program Well	Legal Description and Land Status Research Comments	Well Depth – Actual or Estimated (feet)	Work To Be Completed
Lot 1 Block 1 (HUD north)	Philip Akelkok	No	*Taken from Land Plat 89-3 of the HUD home subdivision (Nakelutin Subdivision): Legal description is* Block 1, Lot 1.	25	Drill well in unconfined aquifer. Connect well to home. Water quality analysis.
Lot 5 Block 1 (HUD north)	Sophie King	No	*Taken from Land Plat 89-3 of the HUD home subdivision (Nakelutin Subdivision): Legal description is* Block 1, Lot 5.	25	Drill well in unconfined aquifer. Connect well to home. Water quality analysis.
Lot 4 Block 1 (HUD north)	Matrona Nickolai	No	*Taken from Land Plat 89-3 of the HUD home subdivision (Nakelutin Subdivision): Legal description is* Block 1, Lot 4.	25	Drill well in unconfined aquifer. Connect well to home. Water quality analysis.
Lot 2 Block 1 (HUD north)	Ramona Olson	No	*Taken from Land Plat 89-3 of the HUD home subdivision (Nakelutin Subdivision): Legal description is* Block 1, Lot 2.	25	Drill well in unconfined aquifer. Connect well to home. Water quality analysis.
Lot 5 Block 2 (HUD north)	Cindy Olson	No	*Taken from Land Plat 89-3 of the HUD home subdivision (Nakelutin Subdivision): Legal description is* Block 2, Lot 5.	25	Drill well in unconfined aquifer. Connect well to home. Water quality analysis.
Lot 2 Block 2 (HUD north)	Robert Nelson	No	*Taken from Land Plat 89-3 of the HUD home subdivision (Nakelutin Subdivision): Legal description is* Block 2, Lot 2.	25	Drill well in unconfined aquifer. Connect well to home. Water quality analysis.

Well and Property Location	Well Owner/ Renter	2002 Drilling Program Well	Legal Description and Land Status Research Comments	Well Depth – Actual or Estimated (feet)	Work To Be Completed
Lot between G St. and F St. near where 5th St. would cross	Luki Akelkok	No	*Legal description on Land Plat 89-1 is* Block 3, Lot 3.	30	Drill well in unconfined aquifer. Connect well to home. Water quality analysis.
H St., near where 5th St. would intersect if it continued west. Near sewage lagoon	*Gordon Acovik (this may not be correct)*	No	No legal description available.	25	Drill well in unconfined aquifer. Connect well to home. Water quality analysis. Install septic system and connect to home.

Note: Actual well depths indicated in bold font.

Appendix B

Site Photographs

Well Site 02KAWA-02. Drill rig prior to commencement of drilling. VSW intern Helen Trainor in background, bottom right. Confined aquifer well in bottom right.

Well Site 02NICK-06. Drill rig with AVSI employee Chris Thomas

SITE PHOTOGRAPHS 2002 WELL DRILLING PROGRAM EKWOK, ALASKA	Page 1	Date: July 2002 Project No. 0068-05

Well Site 02NELS-07. Drill rig and miscellaneous equipment set up during drilling operation.

Well Site 02NELS-07. Completed test well. Ekwok store in background.

SITE PHOTOGRAPHS 2002 WELL DRILLING PROGRAM EKWOK, ALASKA	Page 2	Date: JULY 2002 Project No. 0068-05

Appendix C

2002 Well Logs and As-Built Drawings

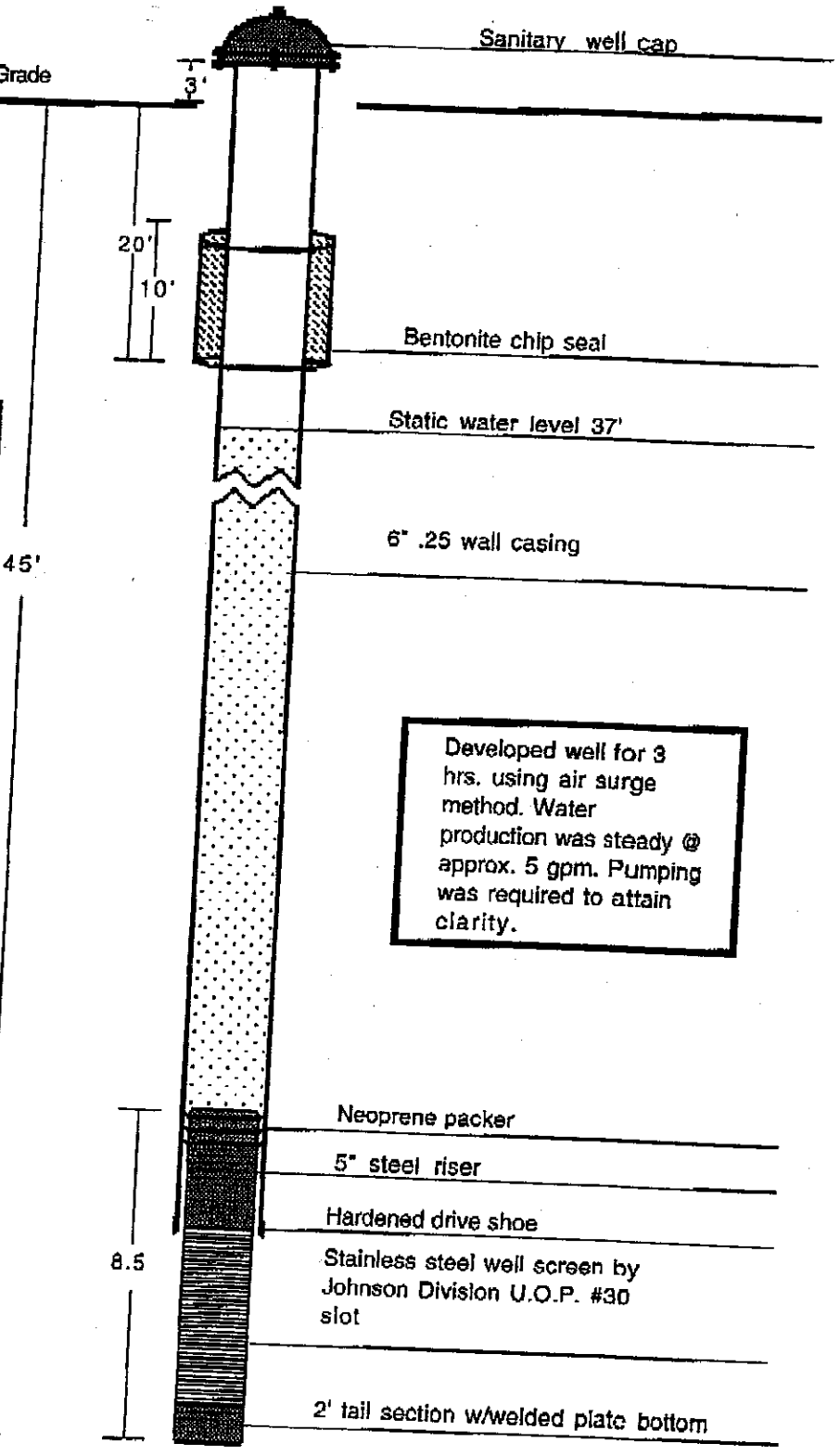
JOHNSON DRILLING CO.
KING SALMON, ALASKA
AS-BUILT DRAWING
FOR:

City Of Ekwok
Test Well Project
Ekwok, Alaska
Completed: 7/2/02
SITE 1
Jimmy Hurley
Location
N59°29.784' W157°26.721'

0-5	Organic material
5-15	Brown silt and clay
15-18	Gravel, brown sand
18-20	Coarse sand and gravel
20-40	Same becoming wet
40-45	Same with water production

Drawdown **Recovery**
Static 37.06

Test Pumped well @ 5 GPM.
Total drawdown less than 1foot
Recovery time approx. 2.5 min.



Johnson Drilling Co.

DATE munter

CREW Jim 222-5423

NAME 258-1435

PROJ. NO. 1

ADDRESS Dock 26' 3" Pipe

CITY 2 Redicrete, Well Point

PHONE

JOB LOCATION Hurley

EQUIP. #					
END					
START					

TIME	DRILL LOG	CASING
	Karen HAS Drilling	
	log TOTAL DepTH	45'
	0-5' organic	
	5-15' brown silt /clay	
	15-18' gravel, brn sand	
	18-20' coarse sand gravel	
	20-38' gravel, coarse sand	
	38' water	
	38-45' water, gravel, coarse sand	

Screen ASSY 8' 5" 30 Slott
Developed 2 Hrs needs
Add Pumping with test Pump
(Draw Down + Recovery test)

DEPTH	Pump Rate 5 GPM	
2:13	37.00	Drawdn
2:14	38.5	
2:15	38.9	
2:16	38.10	
2:17	38.10	
2:18	38.10	
2:19	38.10	
2:20	38.10	
2:21	38.10	
2:22	38.10	
2:23	38.10	
2:19.12	38.10	Recovery
2:20.10	37.10	
2:21.10	37.04	
2:22.12	37.00	

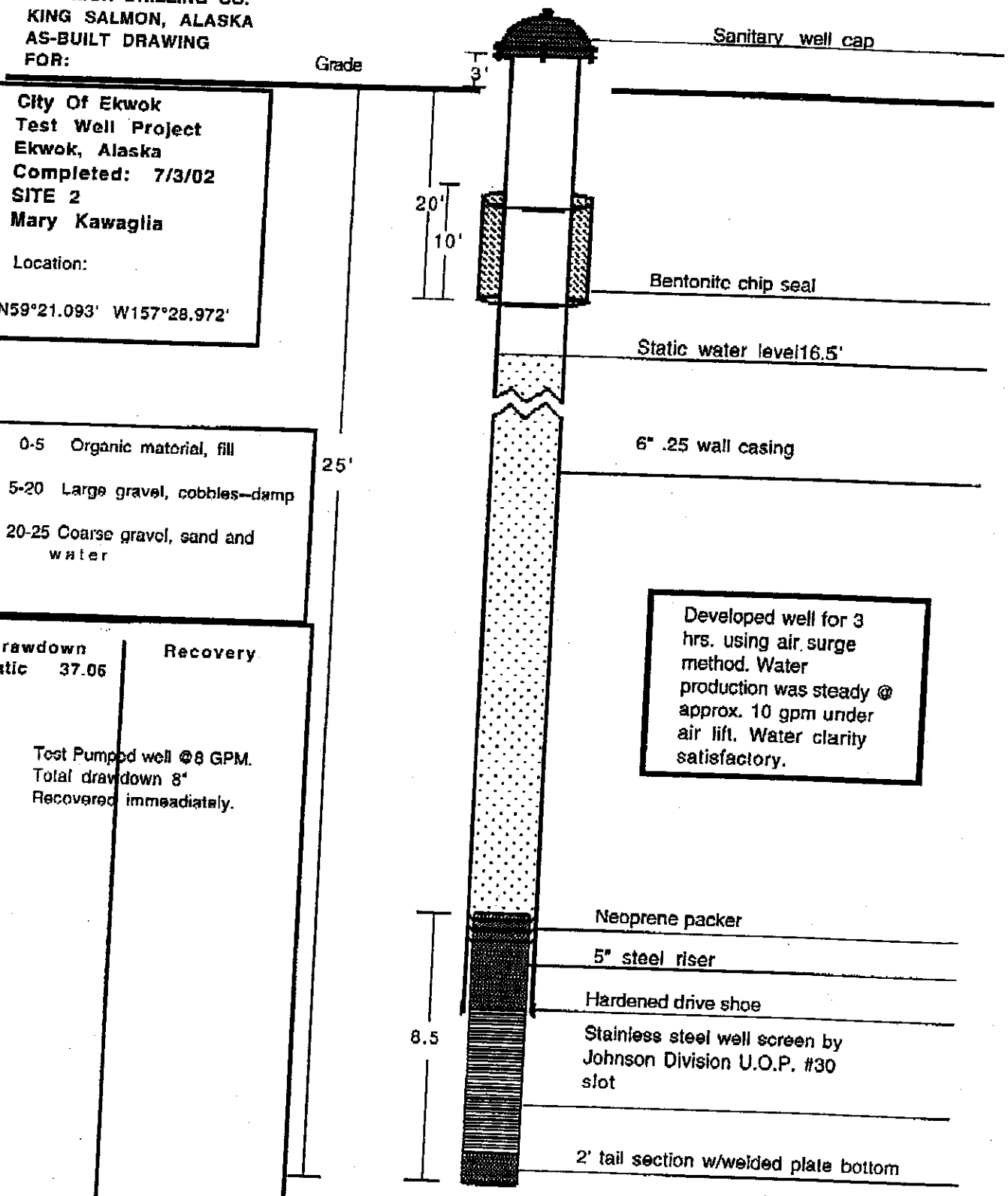
STATIC LEVEL 8'   GPM - YIELD

JOHNSON DRILLING CO.
KING SALMON, ALASKA
AS-BUILT DRAWING
FOR:

City Of Ekwok
Test Well Project
Ekwok, Alaska
Completed: 7/3/02
SITE 2
Mary Kawaglia

Location:

N59°21.093' W157°28.972'



0-5 Organic material, fill

5-20 Large gravel, cobbles--damp

20-25 Coarse gravel, sand and water

Developed well for 3 hrs. using air surge method. Water production was steady @ approx. 10 gpm under air lift. Water clarity satisfactory.

Drawdown	Recovery
Static 37.06	

Test Pumped well @8 GPM.
Total drawdown 8"
Recovered immeadiately.

Johnson Drilling Co.

DATE 7-31

CREW [illegible]

NAME [illegible] PROJ. NO. 2

ADDRESS [illegible]

CITY [illegible] PHONE

JOB LOCATION

EQUIP. #					
END					
START					

Screen Assy 8'5" 30 Slot

TIME	DRILL LOG	CASING
0-5	Organic + Fill	
5-20	Large Gravel + Cobble Rock At Bottom	
20-25	Gravel Coarse water Sand water	

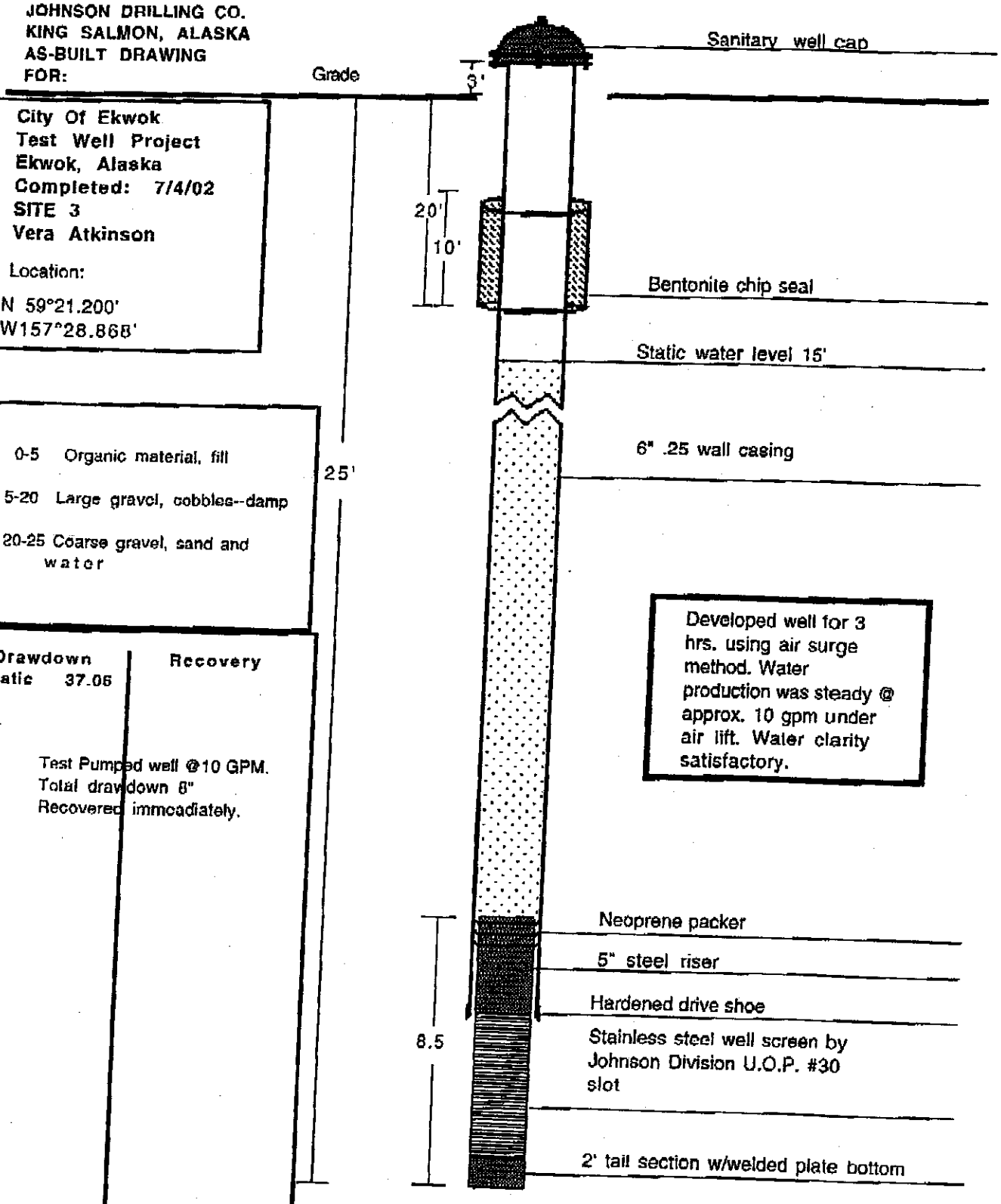
DEPTH	WELL LOG
25'	10 Hrs 45 min [redacted] 5' Grout Pipe Drill to 25' Set Screen Assy Pull Back 5' Screen Assy 8' 5" long 30 Slot Develope 2 Hrs Rig Dn Rig up test Pump Hall Sand + Gravel to no 3
	Drawdn test 86 Pm Drew Dn 8"

STATIC LEVEL 8'6" GPM - YIELD 86 PM

JOHNSON DRILLING CO.
KING SALMON, ALASKA
AS-BUILT DRAWING
FOR:

City Of Ekwok
Test Well Project
Ekwok, Alaska
Completed: 7/4/02
SITE 3
Vera Atkinson

Location:
N 59°21.200'
W157°28.868'



0-5 Organic material, fill

5-20 Large gravel, cobbles--damp

20-25 Coarse gravel, sand and water

Developed well for 3 hrs. using air surge method. Water production was steady @ approx. 10 gpm under air lift. Water clarity satisfactory.

Drawdown	Recovery
Static 37.06	

Test Pumped well @10 GPM.
Total drawdown 8"
Recovered immediately.

Johnson Drilling Co.

DATE 7-4-

CREW

NAME

ADDRESS

CITY

PROJ. NO. 3

PHONE

JOB LOCATION Atkinson

EQUIP. #					
END					
START					

Screen ASSY 8'5" 30 slot

2 Hrs Drivelope

total Hrs 8

TIME	DRILL LOG	CASING
0-5	ORGANIC	
5-20	Large GRAVAL + COBBLE DAMP AT BTM	
20-25	GRAVAL COARSE WATER SAND WATER	

DEPTH	WELL LOG
	Draw Dn test
	Pumped At 10 GPM Drew Dn. 8"

STATIC LEVEL 10 GPM - YIELD

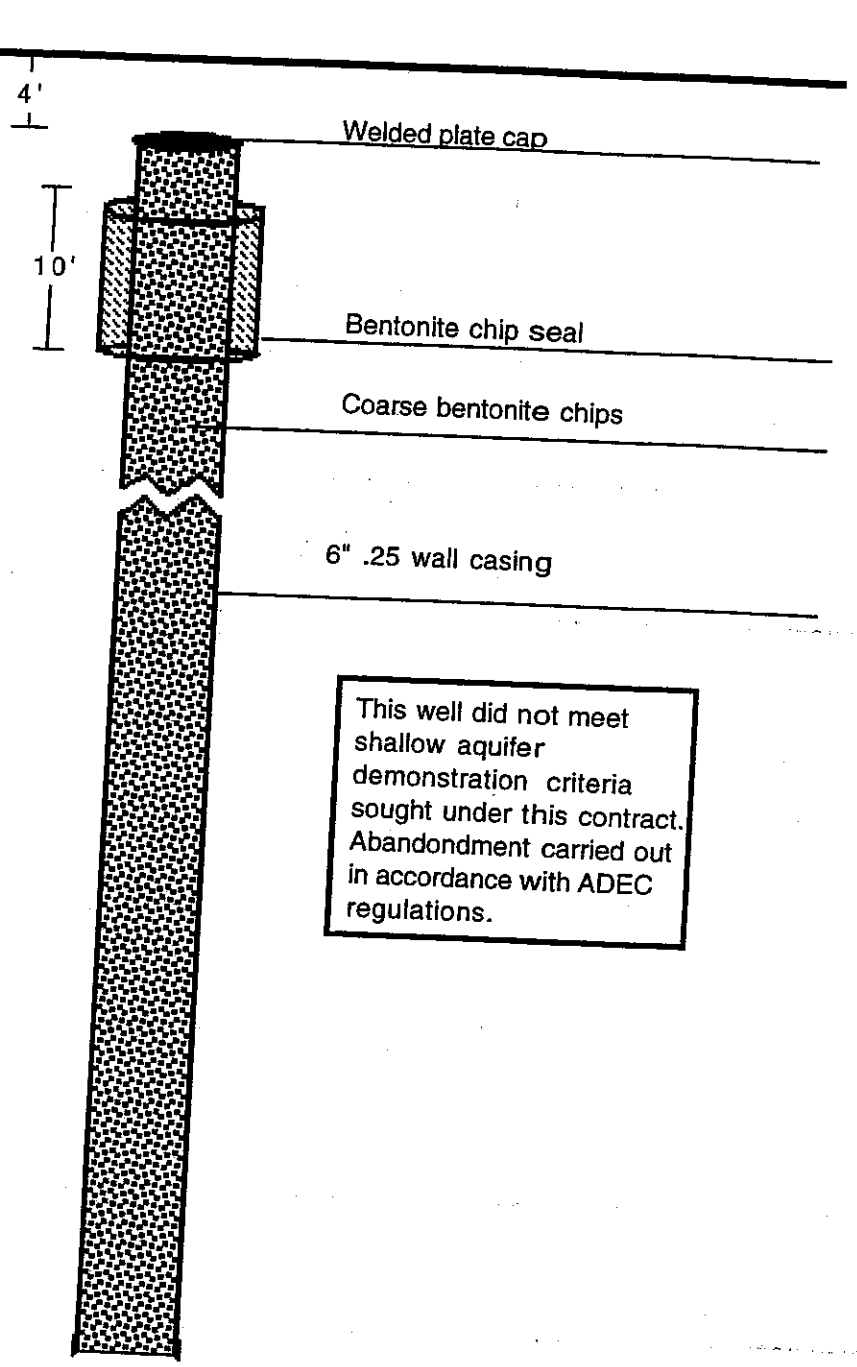
JOHNSON DRILLING CO.
KING SALMON, ALASKA
AS-BUILT DRAWING
FOR:

City Of Ekwok
Test Well Project
Ekwok, Alaska
Completed: 7/5/02
SITE 4
MARY HURLEY

0-3	Organic material
3-15	Brown sand
15-20	Gravel, brown sand
20-25	Same
25-35	Brown clay w/gravel
35-38	Gray/blue clay, sand
38-43	Fine black sand w/clay
43-53	Fine black sand-damp (heaving)

Drawdown
Static:

Recovery



This well did not meet shallow aquifer demonstration criteria sought under this contract. Abandondment carried out in accordance with ADEC regulations.

Johnson Drilling Co.

DATE 7-4-5

CREW

NAME

ADDRESS

CITY

PROJ. NO. 4

PHONE

JOB LOCATION Huxley

EQUIP. #					
END					
START					

7-4 Drill Grout Pike Runin
6" TOTAL DEPTH 23' 4HRS

Well Did not Produce A Zone
OF water THAT WAS USABLE

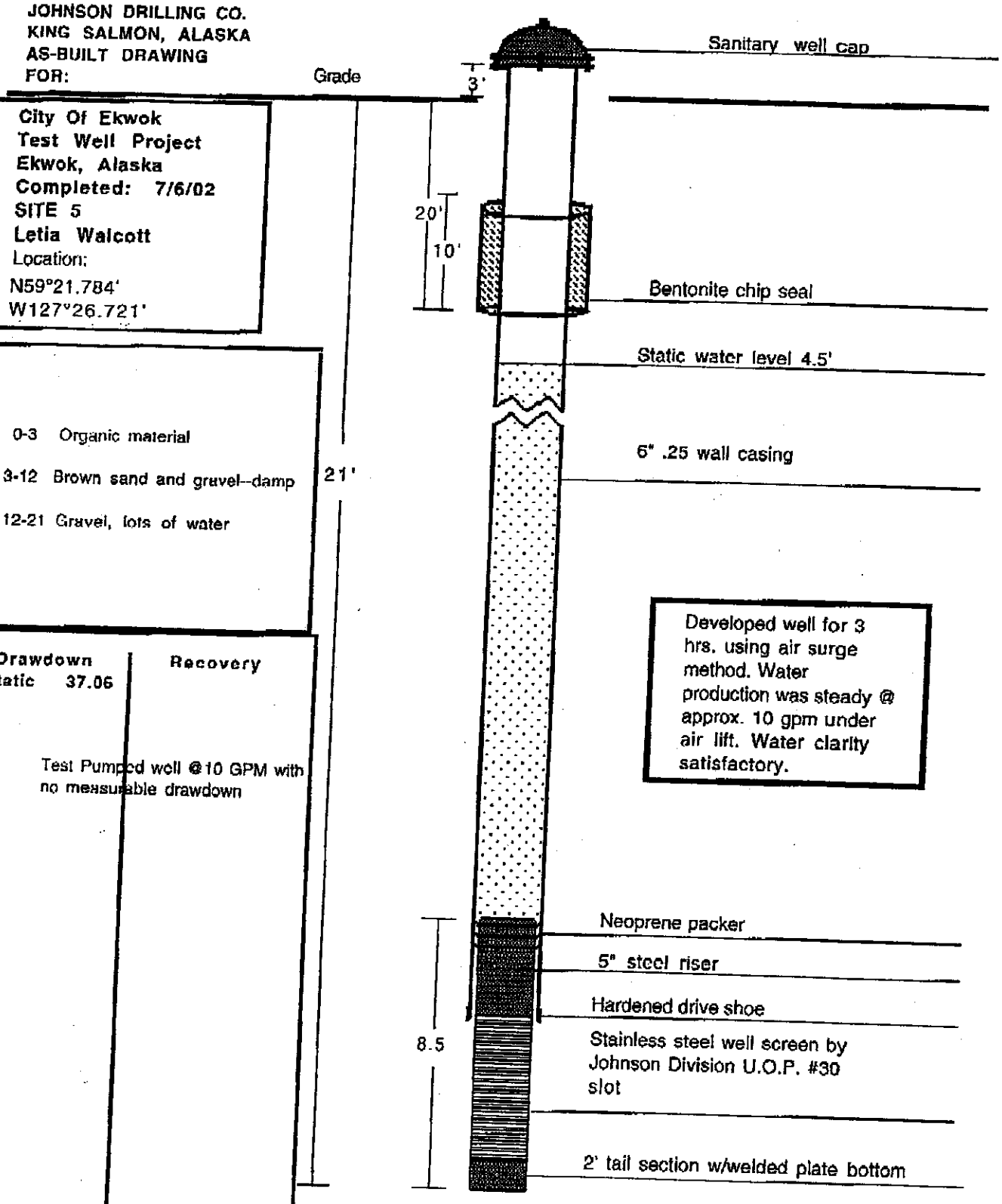
TIME	DRILL LOG	CASING
0-3	ORGANIC	
3-15	BRN SAND	
15-20	BRN SAND LARGE GRAVAL	
20-25	SAME	
25-35	BRN CLAY GRAVEL	
35-38	BLUE-GRAY CLAY + SND	
38-48	BLACK FIN-SND + CLAY	
48-53	FIN BLACK HEAVING SAND DAMP	

DEPTH	WELL LOG

STATIC LEVEL ——— GPM - YIELD

JOHNSON DRILLING CO.
KING SALMON, ALASKA
AS-BUILT DRAWING
FOR:

City Of Ekwok
Test Well Project
Ekwok, Alaska
Completed: 7/6/02
SITE 5
Letia Walcott
Location:
N59°21.784'
W127°26.721'



0-3 Organic material

3-12 Brown sand and gravel--damp

12-21 Gravel, lots of water

Developed well for 3 hrs. using air surge method. Water production was steady @ approx. 10 gpm under air lift. Water clarity satisfactory.

Drawdown	Recovery
Static 37.06	

Test Pumped well @10 GPM with no measurable drawdown

Corner of 8th N 810 N.

TIME	DRILL LOG	CASING
0-3	ORGANIC	
3-12	GRAVAL BRNSND DAMP	
12-21	GRAVAL LOTS WATER	

Johnson Drilling Co.

DATE 7-5-6

CREW

NAME	PROJ. NO. 5
ADDRESS	
CITY	PHONE

JOB LOCATION WALCOTT

EQUIP. #					
END					
START					

SCREEN ASSY 8'5" 130SLOT
PERFORATED 2 HRS
4 HRS ON WELL

DEPTH	WELL LOG
	DRAW DN + RECOVERY TEST
	TEST PUMPED AT 16 GPM
	NO DRAW DN.

STATIC LEVEL 14 GPM - YIELD

JOHNSON DRILLING CO.
KING SALMON, ALASKA
AS-BUILT DRAWING
FOR:

City Of Ekwok
Test Well Project
Ekwok, Alaska
Completed: 7/11/02
SITE 6
Wassilie Nicholai
Location:
N59°20.936'
W157°29.032

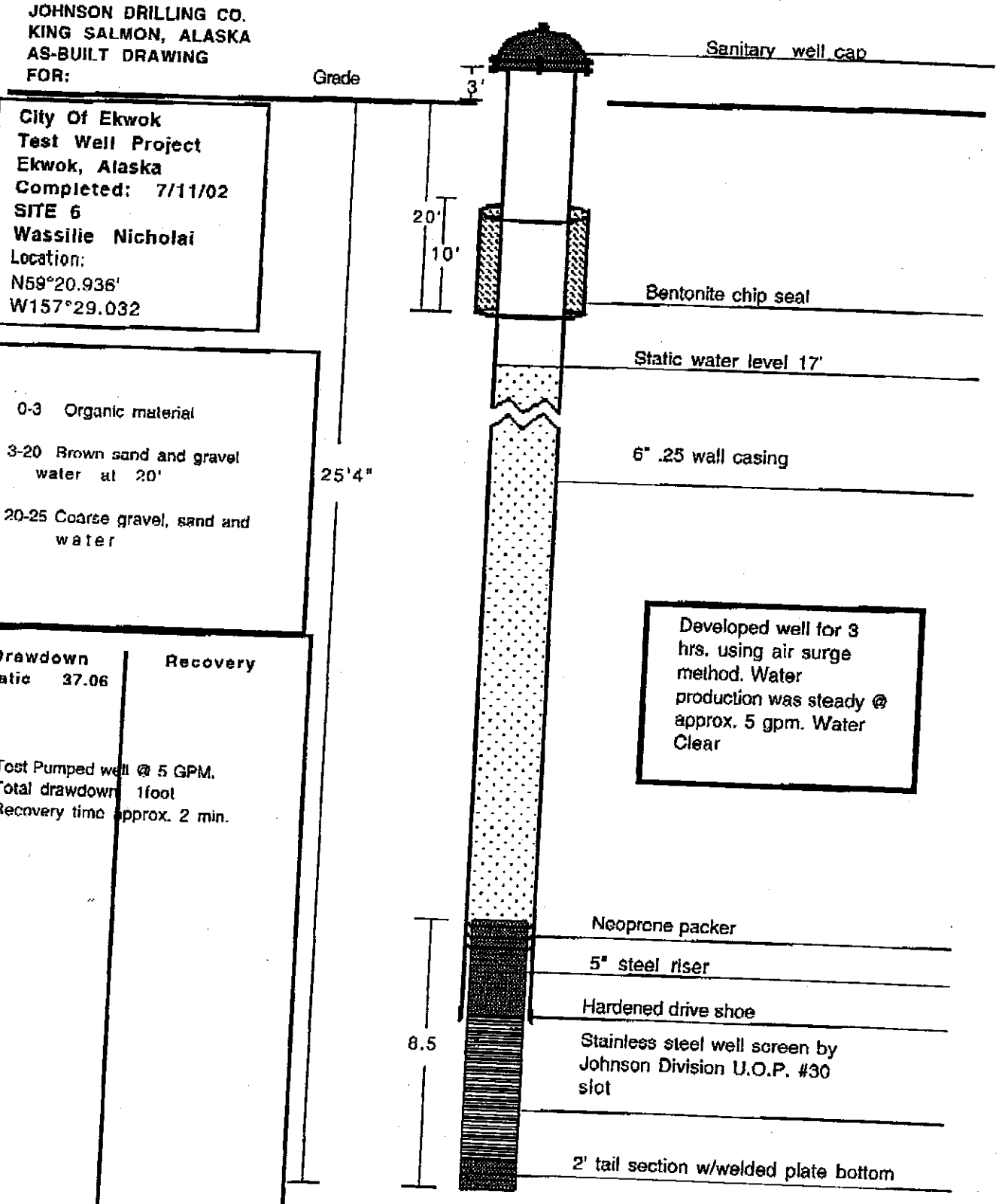
0-3 Organic material

3-20 Brown sand and gravel water at 20'

20-25 Coarse gravel, sand and water

Drawdown	Recovery
Static 37.06	

Test Pumped well @ 5 GPM.
Total drawdown 1foot
Recovery time approx. 2 min.



Developed well for 3 hrs. using air surge method. Water production was steady @ approx. 5 gpm. Water Clear

0-3	ORGANIC
3-20	BRN SND + GRAVAL WATER AT 20
20-25	GRAVAL COARSE WATER SND + WATER

Johnson Drilling Co.

DATE 7-10-11

CREW

NAME	PROJ. NO. 6
ADDRESS	
CITY	PHONE

JOB LOCATION WASALE

EQUIP. #					
END					
START					

Grout Pipe
20' Drilled
Screen ASSY 8'5" 30540

DEPTH	WELL LOG
	test Pumped And Sanitized AT 5 GPM Draw DN 1'

STATIC LEVEL 8' GPM - YIELD

OWNER REPRESENTATIVE:

JOHNSON DRILLING CO.
KING SALMON, ALASKA
AS-BUILT DRAWING
FOR:

City Of Ekwok
Test Well Project
Ekwok, Alaska
Completed: 7/11/02
SITE 7
T. Nelson
Location
N59°21.033' W157°28 576'

0-3 Organic material

3-16 Brown sand

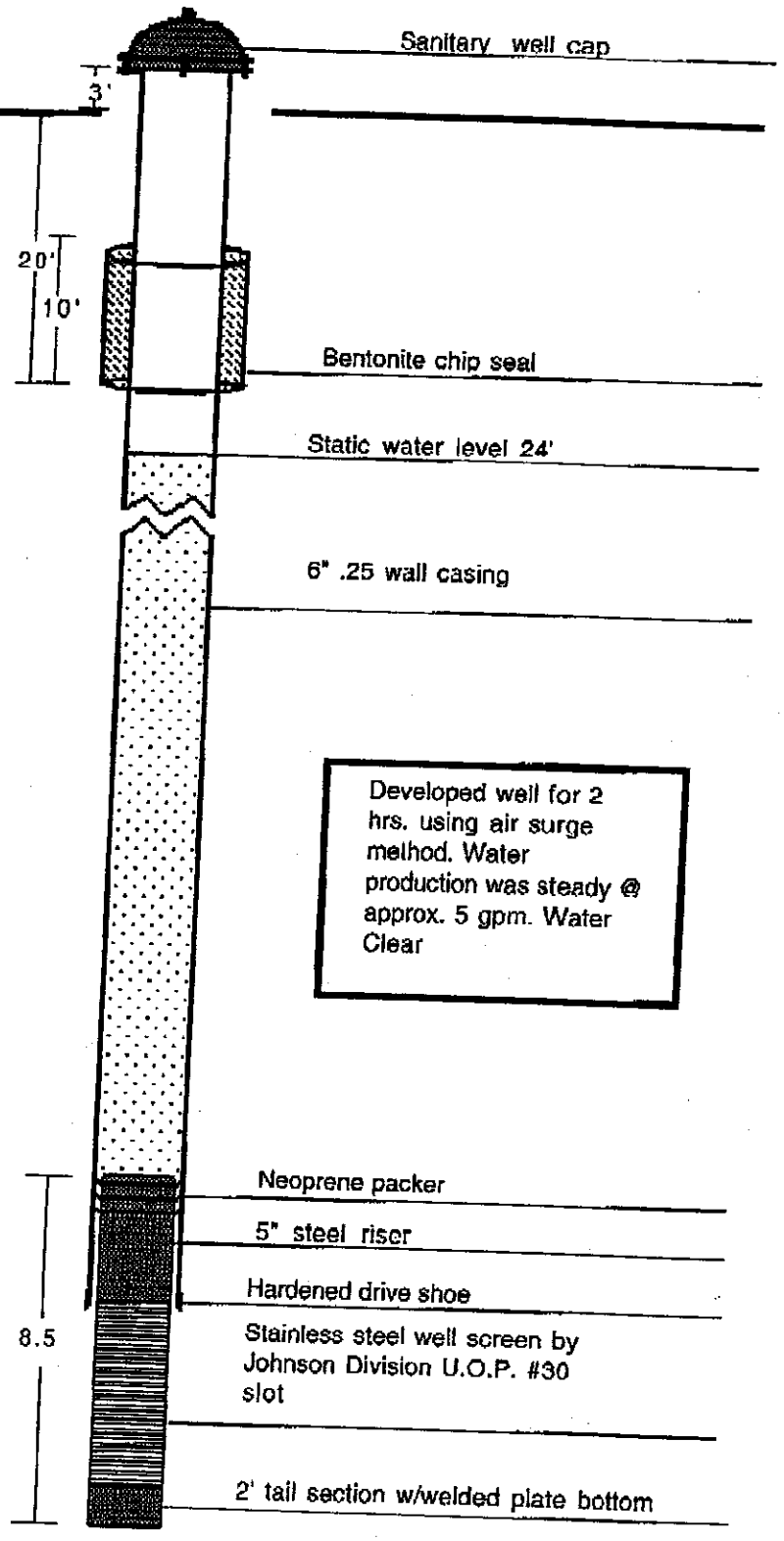
16-20 Gravel, brown sand

20-28 Same

28-32 Coarse gravel, sand, water

Drawdown	Recovery
Static 37.06	

Test Pumped well @ 5 GPM.
Total drawdown 1 foot.
Recovery time approx. 2 min.



TIME	DRILL LOG	CASING
0-3	ORGANIC	
3-16	~~[illegible]~~ LT BRN SND	
16-20	GRAVAL + BRN SND	
20 28	" " "	
28 32	GRAVAL COARSE WATER	
	SND + WATER	

Johnson Drilling Co.

DATE 7-11

CREW

NAME	PROJ. NO.
	7
ADDRESS	
CITY	PHONE

JOB LOCATION T Nelson

EQUIP. #					
END					
START					

Grout 20'

Screen ASSY 9'.5" 30Slot

DEPTH	WELL LOG
	DRAWDN TEST AT 5GPM
	1'

STATIC LEVEL 8' GPM - YIELD

OWNER REPRESENTATIVE:

TIME	DRILL LOG	CASING
0-5	Fill + ORGANIC	
5-16	Lite Brn SAND + GRAVEL	
16-35	Brn TO Redish SAND + GRAVEL	
3545	COARSE Snd + GRAVEL	
4552	COARSE Snd + GRAVEL (Wet)	
	goodwater	
52-	IS TOP OF CLAY	

Johnson Drilling Co.

DATE _____

CREW Denny, Cris, nick,

NAME	PROJ. NO.
ADDRESS	
CITY	PHONE

JOB LOCATION Rich King

EQUIP. #					
END					
START					

Screen ASSY 9's" 30 SLOT

Test Pumped 24 Hrs At 10 GPM
Draw Dn 6½ Feet Recovery
4 min.

DEPTH	WELL LOG

STATIC LEVEL TOC 20' GPM · YIELD 20

OWNER REPRESENTATIVE:

Appendix D

Ground Water Sampling Data Sheets

Ekwok Well Drilling

Field Equipment Calibration Log

Date: 7/8/02			
PID #1:	Equipment Name: Equipment Model: Standard Level: Notes:	NA	Time: Calibrated (Y/N):
pH Meter	Equipment Name: Oakton Equipment Model: pHTestr1 Standard Level: 7.0 buffer Notes: 6.9 @ 7.0 buffer soln.		Time: 0930 Calibrated (Y/N):
cond Meter	Equipment Name: Oakton Equipment Model: TDSTestr1 Standard Level: 226 buffer (KCl) Notes: 230 @ 226 ppm soln		Time: 0930 Calibrated (Y/N):
ORP Meter	Equipment Name: Equipment Model: Standard Level: Notes:	NA	Time: Calibrated (Y/N):
DO Meter	Equipment Name: Equipment Model: Standard Level: Notes:	NA	Time: Calibrated (Y/N):
Date: 7/12/02			
PID #1:	Equipment Name: Equipment Model: Standard Level: Notes:	NA	Time: Calibrated (Y/N):
pH Meter	Equipment Name: Oakton Equipment Model: pHTestr1 Standard Level: 7.0 buffer Notes: 7.0 @ 7.0 buffer soln		Time: 0925 Calibrated (Y/N):
cond Meter	Equipment Name: Oakton Equipment Model: TDSTestr1 Standard Level: 226 ppm soln KCl Notes: 230 @ 226 ppm buffer soln		Time: 0925 Calibrated (Y/N):
ORP Meter	Equipment Name: Equipment Model: Standard Level: Notes:		Time: Calibrated (Y/N):
DO Meter	Equipment Name: Equipment Model: Standard Level: Notes:		Time: Calibrated (Y/N):
Date: 7/14/02			
PID #1:	Equipment Name: Equipment Model: Standard Level: Notes:		Time: 0945 (CO) Calibrated (Y/N):
pH Meter	Equipment Name: Oakton Equipment Model: pHTESTR1 Standard Level: 7.0 Notes: 6.9 @ 7.0 buffer soln.		Time: 0945 Calibrated (Y/N):
cond Meter	Equipment Name: Oakton Equipment Model: TDSTESTR1 Standard Level: 226 ppm soln. KCl Notes: 230 @ 226 ppm buffer soln.		Time: 0945 Calibrated (Y/N):
ORP Meter	Equipment Name: Equipment Model: Standard Level: Notes:		Time: Calibrated (Y/N):
DO Meter	Equipment Name: Equipment Model: Standard Level: Notes:		Time: Calibrated (Y/N):

GROUNDWATER SAMPLE DATA SHEET

Project Number: 0068
Project Name: Ekwok Groundwater Investigation
Client: City of Ekwok/State of Alaska VSW
Sampler: C. ORVIS

Sample Location (ie. MW1): Site1 - J. Hurley
Sample ID (ie. 95BIA WG003): 02EK - HURL
Date Sample Collected: 08 JULY 2002
Time sampled: 1125

Well Information

Groundwater: yes
Other:
Casing Diameter (in): 6"

a) Well Depth (ft): 45'
b) Water Depth (ft): 37'
c) Water Column (ft): 8'
d) Calc. Purge Vol. (gal): 11.76 gal

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
2	0.16
4	0.65
6	1.47

Sand Pack Diameter	Multiply c) by:
8	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS:

Time	Volume (gallons)	pH	Conductivity (pph)	Temperature (F)	Color	Turbidity	Redox	Dissolved O_2	Other
1115	15	7.5	180	38.7	brown	low	—	—	—
1120	15	7.4	180	38.7	brown	low	—	—	—
1125	15	7.5	180	38.7	brown	low	—	—	—

Total Volume Purged: 45gal
Odor: n
Free Product (y/n): n
Sheen (y/n): n

Purge Method (disposable bailer, teflon bailer, ~~submersible pump~~, etc.)

Sample Method (disposable bailer, teflon bailer, submersible pump, etc.)

Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.)
Excellent - new

Remarks (well recovery, unusual conditions/observations):
Great recovery

Duplicate Sample ID: —
Split Sample ID: —

Signed: C. A. Orvis
Date: 7/8/02

Signed/reviewer:
Date:

GROUNDWATER SAMPLE DATA SHEET

Project Number: 0068
Project Name: Ekwok Groundwater Investigation
Client: City of Ekwok/State of Alaska VSW
Sampler: C. ORVIS

Sample Location (ie. MW1): Site 2 - M. Kawaglia
Sample ID (ie. 95BIA WG003): 02EK-KAWA
Date Sample Collected: 08 JULY 2002
Time sampled: 1030

Well Information

Groundwater: YES
Casing Diameter (in): 6"
Other:

a) Well Depth (ft): 25'
b) Water Depth (ft): 16.5'
c) Water Column (ft): 8.5'
d) Calc. Purge Vol. (gal): 12.5 gal

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
2	0.16
4	0.65
6	1.47

Sand Pack Diameter	Multiply c) by:
8	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity (pph)	Temperature (F)	Color	Turbidity	Redox	Dissolved O_2	Other
1015	15	6.9	170	40.3	none	none	—	—	—
1025	15	7.0	170	40.2	none	none	—	—	—
1030	15	7.0	170	40.3	none	none	—	—	—

Total Volume Purged: 45 gal
Free Product (y/n): n
Odor: n
Sheen (y/n): n

Purge Method (disposable bailer, teflon bailer, submersible pump, etc.)

Sample Method (disposable bailer, teflon bailer, submersible pump, etc.)

Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.)
Excellent - new!

Remarks (well recovery, unusual conditions/observations):
Great recovery

Duplicate Sample ID: —
Split Sample ID: —

Signed: Cary A. Orvis
Date: 7/8/02

Signed/reviewer:
Date:

GROUNDWATER SAMPLE DATA SHEET

Project Number: 0068
Project Name: Ekwok Groundwater Investigation
Client: City of Ekwok/State of Alaska VSW
Sampler: C. ORVIS

Sample Location (ie. MW1): Site 3- V. Taylor
Sample ID (ie. 95BIA WG003): 02EK- ATK1
Date Sample Collected: 08 JULY 2002
Time sampled: 0980

Well Information

Groundwater: YES
Casing Diameter (in): 6"
Other:

a) Well Depth (ft): 25'
b) Water Depth (ft): 15'
c) Water Column (ft): 10'
d) Calc. Purge Vol. (gal): 14.7 gal

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
2	0.16
4	0.65
6	1.47

Sand Pack Diameter	Multiply c) by:
8	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity (pph)	Temperature (F)	Color	Turbidity	Redox	Dissolved O_2	Other
0920	15	6.9	230	37.6	NONE	NONE	—	—	—
0925	15	6.9	230	37.5	NONE	NONE	—	—	—
0930	15	7.0	230	37.6	NONE	NONE	—	—	—

Total Volume Purged: 45 gal
Odor: NO
Free Product (y/n): N
Sheen (y/n): N

Purge Method (disposable bailer, teflon bailer, submersible pump, etc.)

Sample Method (disposable bailer, teflon bailer, submersible pump, etc.)

Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.)
Excellent- new

Remarks (well recovery, unusual conditions/observations):
Great recovery

Duplicate Sample ID: —
Split Sample ID: —

Signed: Cary A. Orvis
Date: 7/8/02

Signed/reviewer:
Date:

GROUNDWATER SAMPLE DATA SHEET

Project Number: 0068
Project Name: Ekwok Groundwater Investigation
Client: City of Ekwok/State of Alaska VSW
Sampler: C. ORVIS

Sample Location (ie. MW1): Site 5 - Walcott
Sample ID (ie. 95BIA WG003): 02EK - WALC
Date Sample Collected: 08 JULY 2002
Time sampled: 1100

Well Information

Groundwater: yes
Casing Diameter (in): 6"
Other:

a) Well Depth (ft): 21'
b) Water Depth (ft): 4.5'
c) Water Column (ft): 16.5'
d) Calc. Purge Vol. (gal): 24.3 gal

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
2	0.16
4	0.65
6	1.47

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Sand Pack Diameter	Multiply c) by:
8	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity
Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity (pph)	Temperature (F)	Color	Turbidity	Redox	Dissolved O_2	Other
1040	25	7.1	340	37.0	none	none	—	—	—
1050	30	7.1	340	36.9	non	none	—	—	—
1100	30	7.1	340	37.0	none	non	—	—	—

Total Volume Purged: 85 gal
Odor: n
Free Product (y/n): n
Sheen (y/n): n

Purge Method (disposable bailer, teflon bailer, submersible pump) etc.)

Sample Method (disposable bailer, teflon bailer, submersible pump, etc.)

Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.)
Excellent - new

Remarks (well recovery, unusual conditions/observations):
phenomenal recovery - no drawdown

Duplicate Sample ID: —
Split Sample ID: —

Signed: Cay A. Orvis
Date: 7/8/02

Signed/reviewer:
Date:

GROUNDWATER SAMPLE DATA SHEET

Project Number:	0068	Sample Location (ie. MW1):	Site 6 - Nickolai
Project Name:	Ekwok Groundwater Investigation	Sample ID (ie. 95BIA WG003):	02EK - NICK
Client:	City of Ekwok/State of Alaska VSW	Date Sample Collected:	14 JULY 2002
Sampler:		Time sampled:	0945

Well Information

Groundwater: yes

Casing Diameter (in): 6"

Other:

a) Well Depth (ft): 25'4"
b) Water Depth (ft): 17'
c) Water Column (ft): 8.33'
d) Calc. Purge Vol. (gal): 12.25 gal

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
2	0.16
4	0.65
6	1.47

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Sand Pack Diameter	Multiply c) by:
8	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity
Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity (pph)	Temperature (F)	Color	Turbidity	Redox	Dissolved O_2	Other
0935	15	7.8	120	37.9	brn	none	low	—	—
0940	15	7.8	120	37.9	brn	none	low	—	—
0945	15	7.8	120	37.8	brown	none	low	—	—

Total Volume Purged: 45 gal
Free Product (y/n): n
Odor: n
Sheen (y/n): n

Purge Method (disposable bailer, teflon bailer, submersible pump, etc.)

Sample Method (disposable bailer, teflon bailer, submersible pump, etc.)

Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.)

Excellent - new

Remarks (well recovery, unusual conditions/observations):

great recovery

Duplicate Sample ID: —
Split Sample ID: —

Signed: Cay A. Oris
Date: 7/14/02

Signed/reviewer:
Date:

GROUNDWATER SAMPLE DATA SHEET

Project Number: 0068
Sample Location (ie. MW1): Site 7 - T. Nelson
Project Name: Ekwok Groundwater Investigation
Sample ID (ie. 95BIA WG003): 02EK-NELS
Client: City of Ekwok/State of Alaska VSW
Date Sample Collected: 12 JULY 2002
Sampler: C. ORVIS
Time sampled: 0915

Well Information

Groundwater: yes
Casing Diameter (in): 6"
Other:

a) Well Depth (ft): 32'
b) Water Depth (ft): 24'
c) Water Column (ft): 8'
d) Calc. Purge Vol. (gal): 11.74 gal

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
2	0.16
4	0.65
6	1.47

Sand Pack Diameter	Multiply c) by:
8	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity (pph)	Temperature (F)	Color	Turbidity	Redox	Dissolved O_2	Other
0905	15	7.5	510	38.7	lt. brn	low	—	—	—
0910	15	7.6	510	38.6	lt. brn	low	—	—	—
0915	15	7.6	510	38.7	lt. brn	low	—	—	—

Total Volume Purged: 45 gal
Free Product (y/n): n
Odor: n
Sheen (y/n): n

Purge Method (disposable bailer, teflon bailer, submersible pump, etc.)
submersible pump

Sample Method (disposable bailer, teflon bailer, submersible pump, etc.)
disposable bailer

Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.)
Excellent - new

Remarks (well recovery, unusual conditions/observations):
great recovery

Duplicate Sample ID: —
Split Sample ID: —

Signed: Craig A. Orvis
Date: 7/12/02

Signed/reviewer:
Date:

Appendix E

Laboratory Analytical Reports

CT&E Environmental Services Inc.

200 W. Potter Drive
Anchorage, AK 99518-1605
Tel: (907) 562-2343
Fax: (907) 561-5301
Web: http://www.cteesi.com

C Orvis
Paug-Vik Devel
810 N St Ste 201
Anchorage, AK 99501

Work Order:	1024081
	Ekwok Well Drilling
Client:	Paug-Vik Development Corp.
Report Date:	July 19, 2002

Enclosed are the analytical results associated with the above workorder.

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 analyte was analyzed for but not detected.
F	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.#	1024081004
Client Name	Paug-Vik Development Corp.
Project Name/#	Ekwok Well Drilling
Client Sample ID	02EK-HURL
Matrix	Drinking Water
Ordered By	
PWSID	0

All Dates/Times are Alaska Standard Time

Printed Date/Time	07/19/2002 10:55
Collected Date/Time	07/08/2002 11:30
Received Date/Time	07/09/2002 8:00
Technical Director	**Stephen C. Ede**

Released By Shawn Paxton

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
Phosphorus	500 U	500	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Metals Department								
Hardness as CaCO3	12.1	10.0	mg/L	SM17 2340C		07/13/02	07/16/02	KGF
Metals by ICP/MS								
Aluminum	1950	20.0	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Antimony	1.00 U	1.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Arsenic	2.00 U	2.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Barium	14.8	3.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Beryllium	0.400 U	0.400	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Cadmium	0.100 U	0.100	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Calcium	3150	500	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Chromium	7.25	4.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Cobalt	4.00 U	4.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Copper	7.76	1.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Iron	12100	250	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Lead	2.95	0.400	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Magnesium	1020	500	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Manganese	70.1	5.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Molybdenum	10.0 U	10.0	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Nickel	6.35	5.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Potassium	558	500	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Selenium	2.00 U	2.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Sodium	2630	500	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Zinc	27.0	2.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Silicon	10900	1000	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Silver	1.00 U	1.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Thallium	0.311	0.300	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Vanadium	5.00 U	5.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF

CT&E Environmental Services Inc.

CT&E Ref.#	1024081004	**All Dates/Times are Alaska Standard Time**	
Client Name	Paug-Vik Development Corp.	**Printed Date/Time**	07/19/2002 10:55
Project Name/#	Ekwok Well Drilling	**Collected Date/Time**	07/08/2002 11:30
Client Sample ID	02EK-HURL	**Received Date/Time**	07/09/2002 8:00
Matrix	Drinking Water	**Technical Director**	**Stephen C. Ede**
Ordered By			
PWSID	0		

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
Waters Department								
Nitrate-N	1.00 U	1.00	mg/L	EPA 300.0			07/09/02	JDT
Alkalinity	10.5	10.0	mg/L	SM20 2320B			07/10/02	AS
Chloride	1.59	0.200	mg/L	EPA 300.0			07/10/02	JDT
Nitrite-N	1.00 U	1.00	mg/L	EPA 300.0	(<1)		07/09/02	JDT
Sulfate	1.00 U	1.00	mg/L	EPA 300.0			07/09/02	JDT
Total Dissolved Solids	118	50.0	mg/L	SM20 2540C			07/09/02	AS
Microbiology Laboratory								
Total Coliform	TC Pos/EC Neg	0		SM18 9223B			07/09/02	SBH

CT&E Environmental Services Inc.

CT&E Ref.#	1024081002	**All Dates/Times are Alaska Standard Time**	
Client Name	Paug-Vik Development Corp.	**Printed Date/Time**	07/19/2002 10:55
Project Name/#	Ekwok Well Drilling	**Collected Date/Time**	07/08/2002 10:30
Client Sample ID	02EK-KAWA	**Received Date/Time**	07/09/2002 8:00
Matrix	Drinking Water	**Technical Director**	**Stephen C. Ede**
Ordered By			
PWSID	0	**Released By**	Shawn Paxton

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
Phosphorus	500 U	500	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Metals Department								
Hardness as CaCO3	14.4	10.0	mg/L	SM17 2340C		07/13/02	07/16/02	KGF
Metals by ICP/MS								
Aluminum	21.1	20.0	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Antimony	1.00 U	1.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Arsenic	2.00 U	2.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Barium	3.41	3.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Beryllium	0.400 U	0.400	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Cadmium	0.100 U	0.100	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Calcium	3910	500	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Chromium	4.00 U	4.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Cobalt	4.00 U	4.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Copper	4.07	1.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Iron	3820	250	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Lead	0.400 U	0.400	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Magnesium	1140	500	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Manganese	26.9	5.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Molybdenum	10.0 U	10.0	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Nickel	5.00 U	5.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Potassium	500 U	500	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Selenium	2.51	2.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Sodium	3580	500	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Zinc	3.86	2.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Silicon	7840	1000	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Silver	1.00 U	1.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Thallium	1.92	0.300	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Vanadium	5.00 U	5.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF

CT&E Environmental Services Inc.

CT&E Ref.#	1024081002
Client Name	Paug-Vik Development Corp.
Project Name/#	Ekwok Well Drilling
Client Sample ID	02EK-KAWA
Matrix	Drinking Water
Ordered By	
PWSID	0

All Dates/Times are Alaska Standard Time

Printed Date/Time	07/19/2002 10:55
Collected Date/Time	07/08/2002 10:30
Received Date/Time	07/09/2002 8:00
Technical Director	**Stephen C. Ede**

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
Waters Department								
Nitrate-N	1.05	1.00	mg/L	EPA 300.0			07/09/02	JDT
Alkalinity	15.0	10.0	mg/L	SM20 2320B			07/10/02	AS
Chloride	1.99	0.200	mg/L	EPA 300.0			07/10/02	JDT
Nitrite-N	1.00 U	1.00	mg/L	EPA 300.0	(<1)		07/09/02	JDT
Sulfate	1.55	1.00	mg/L	EPA 300.0			07/09/02	JDT
Total Dissolved Solids	70.0	50.0	mg/L	SM20 2540C			07/09/02	AS
Microbiology Laboratory								
Total Coliform	0		col/100mL	SM18 9222B	(<1)		07/09/02	SBH

CT&E Environmental Services Inc.

CT&E Ref.#	1024081001
Client Name	Paug-Vik Development Corp.
Project Name/#	Ekwok Well Drilling
Client Sample ID	02EK-ATK1
Matrix	Drinking Water
Ordered By	
PWSID	0

All Dates/Times are Alaska Standard Time

Printed Date/Time	07/19/2002 10:55
Collected Date/Time	07/08/2002 9:30
Received Date/Time	07/09/2002 8:00
Technical Director	**Stephen C. Ede**
Released By	Shawn Preston

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
Phosphorus	500 U	500	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Metals Department								
Hardness as CaCO3	14.0	10.0	mg/L	SM17 2340C		07/13/02	07/16/02	KGF
Metals by ICP/MS								
Aluminum	247	20.0	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Antimony	1.00 U	1.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Arsenic	2.00 U	2.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Barium	5.91	3.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Beryllium	0.400 U	0.400	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Cadmium	0.124	0.100	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Calcium	3870	500	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Chromium	11.4	4.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Cobalt	4.00 U	4.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Copper	4.56	1.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Iron	4360	250	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Lead	3.32	0.400	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Magnesium	1060	500	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Manganese	40.9	5.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Molybdenum	10.0 U	10.0	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Nickel	12.2	5.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Potassium	500 U	500	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Selenium	2.00 U	2.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Sodium	2760	500	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Zinc	11.8	2.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Silicon	8010	1000	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Silver	1.00 U	1.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Thallium	0.667	0.300	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Vanadium	5.00 U	5.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF

CT&E Environmental Services Inc.

CT&E Ref.#	1024081001	**All Dates/Times are Alaska Standard Time**	
Client Name	Paug-Vik Development Corp.	**Printed Date/Time**	07/19/2002 10:55
Project Name/#	Ekwok Well Drilling	**Collected Date/Time**	07/08/2002 9:30
Client Sample ID	02EK-ATK1	**Received Date/Time**	07/09/2002 8:00
Matrix	Drinking Water	**Technical Director**	**Stephen C. Ede**
Ordered By			
PWSID	0		

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
Waters Department								
Nitrate-N	1.00	1.00	mg/L	EPA 300.0			07/09/02	JDT
Alkalinity	20.0	10.0	mg/L	SM20 2320B			07/10/02	AS
Chloride	1.67	0.200	mg/L	EPA 300.0			07/10/02	JDT
Nitrite-N	1.00 U	1.00	mg/L	EPA 300.0	(<1)		07/09/02	JDT
Sulfate	1.85	1.00	mg/L	EPA 300.0			07/09/02	JDT
Total Dissolved Solids	83.8	50.0	mg/L	SM20 2540C			07/09/02	AS
Microbiology Laboratory								
Total Coliform	0		col/100mL	SM18 9222B	(<1)		07/09/02	SBH

CT&E Environmental Services Inc.

CT&E Ref.#	1024081003	**All Dates/Times are Alaska Standard Time**	
Client Name	Paug-Vik Development Corp.	**Printed Date/Time**	07/19/2002 10:55
Project Name/#	Ekwok Well Drilling	**Collected Date/Time**	07/08/2002 11:00
Client Sample ID	02EK-WALC	**Received Date/Time**	07/09/2002 8:00
Matrix	Drinking Water	**Technical Director**	**Stephen C. Ede**
Ordered By			
PWSID	0	**Released By**	Shawn Paton

Sample Remarks:

EP 300.0 - Amount of Chloride in the method blank is > 1/2 the PQL; concentration of Chloride in the sample is 10X greater.

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
Phosphorus	500 U	500	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Metals Department								
Hardness as CaCO3	22.5	10.0	mg/L	SM17 2340C		07/13/02	07/16/02	KGF
Metals by ICP/MS								
Aluminum	20.0 U	20.0	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Antimony	1.00 U	1.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Arsenic	5.40	2.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Barium	7.01	3.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Beryllium	0.400 U	0.400	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Cadmium	0.100 U	0.100	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Calcium	5820	500	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Chromium	4.00 U	4.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Cobalt	4.00 U	4.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Copper	1.84	1.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Iron	3360	250	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Lead	0.400 U	0.400	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Magnesium	1940	500	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Manganese	160	5.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Molybdenum	10.0 U	10.0	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Nickel	5.00 U	5.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Potassium	720	500	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Selenium	2.00 U	2.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Sodium	4810	500	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Zinc	3.93	2.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Silicon	9600	1000	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Silver	1.00 U	1.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Thallium	0.601	0.300	ug/L	EPA 200.8		07/13/02	07/16/02	KGF
Vanadium	5.00 U	5.00	ug/L	EPA 200.8		07/13/02	07/16/02	KGF

CT&E Environmental Services Inc.

CT&E Ref.#	1024081003	**All Dates/Times are Alaska Standard Time**	
Client Name	Paug-Vik Development Corp.	**Printed Date/Time**	07/19/2002 10:55
Project Name/#	Ekwok Well Drilling	**Collected Date/Time**	07/08/2002 11:00
Client Sample ID	02EK-WALC	**Received Date/Time**	07/09/2002 8:00
Matrix	Drinking Water	**Technical Director**	**Stephen C. Ede**
Ordered By			
PWSID	0		

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
Waters Department								
Nitrate-N	1.00 U	1.00	mg/L	EPA 300.0			07/09/02	JDT
Alkalinity	27.0	10.0	mg/L	SM20 2320B			07/10/02	AS
Chloride	6.65	1.00	mg/L	EPA 300.0			07/09/02	JDT
Nitrite-N	1.00 U	1.00	mg/L	EPA 300.0	(<1)		07/09/02	JDT
Sulfate	2.54	1.00	mg/L	EPA 300.0			07/09/02	JDT
Total Dissolved Solids	103	50.0	mg/L	SM20 2540C			07/09/02	AS
Microbiology Laboratory								
Total Coliform	0		col/100mL	SM18 9222B	(<1)		07/09/02	SBH

CT&E Environmental Services Inc.

CT&E Ref.#	1024081005
Client Name	Paug-Vik Development Corp.
Project Name/#	Ekwok Well Drilling
Client Sample ID	02EK-ATKI
Matrix	Drinking Water
Ordered By	
PWSID	0

All Dates/Times are Alaska Standard Time

Printed Date/Time	07/19/2002 10:55
Collected Date/Time	07/08/2002 9:30
Received Date/Time	07/09/2002 8:00
Technical Director	**Stephen C. Ede**
Released By	Shawn Preston

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
Metals by ICP/MS								
Iron	1010	250	ug/L	EPA 200.8 Dissolved		07/09/02	07/11/02	KGF

CT&E Environmental Services Inc.

CT&E Ref.#	1024081006
Client Name	Paug-Vik Development Corp.
Project Name/#	Ekwok Well Drilling
Client Sample ID	02EK-KAWA
Matrix	Drinking Water
Ordered By	
PWSID	0

All Dates/Times are Alaska Standard Time

Printed Date/Time	07/19/2002 10:55
Collected Date/Time	07/08/2002 10:30
Received Date/Time	07/09/2002 8:00
Technical Director	**Stephen C. Ede**
Released By	Shawn Paton

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
Metals by ICP/MS								
Iron	407	250	ug/L	EPA 200.8 Dissolved		07/09/02	07/11/02	KGF

CT&E Environmental Services Inc.

CT&E Ref.#	1024081007
Client Name	Paug-Vik Development Corp.
Project Name/#	Ekwok Well Drilling
Client Sample ID	02EK-WALC
Matrix	Drinking Water
Ordered By	
PWSID	0

All Dates/Times are Alaska Standard Time

Printed Date/Time	07/19/2002 10:55
Collected Date/Time	07/08/2002 11:00
Received Date/Time	07/09/2002 8:00
Technical Director	**Stephen C. Ede**
Released By	Shawn Preston

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
Metals by ICP/MS								
Iron	3200	250	ug/L	EPA 200.8 Dissolved		07/09/02	07/11/02	KGF

CT&E Environmental Services Inc.

CT&E Ref.#	1024081008	**All Dates/Times are Alaska Standard Time**	
Client Name	Paug-Vik Development Corp.	**Printed Date/Time**	07/19/2002 10:55
Project Name/#	Ekwok Well Drilling	**Collected Date/Time**	07/08/2002 11:30
Client Sample ID	02EK-HURL	**Received Date/Time**	07/09/2002 8:00
Matrix	Drinking Water	**Technical Director**	**Stephen C. Ede**
Ordered By			
PWSID	0	**Released By**	Shawn Preston

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
Metals by ICP/MS								
Iron	250 U	250	ug/L	EPA 200.8 Dissolved		07/09/02	07/11/02	KGF

CT&E Environmental Services Inc.
Laboratory Division

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

Drinking Water Analysis Report for Total Coliform Bacteria

READ INSTRUCTIONS ON REVERSE SIDE BEFORE COLLECTING SAMPLE

MUST BE COMPLETED BY WATER SUPPLIER

- ☐ PUBLIC WATER SYSTEM I.D. # ☐☐☐☐☐☐
- ☑ PRIVATE WATER SYSTEM

☑ *Send Results* ☑ *Send Invoice*

Water System Name/Company Name: Para-Vik Development Co. Contact name: Caryn Orvis
Phone Number: (907) 258-1345 Fax Number: (907) 222-5423
Mailing Address: 810 N St. Ste 201
City: Anchorage State: AK Zip Code: 99501

☐ *Send Results* ☐ *Send Invoice*

Company Name: Contact name:
Mailing Address:
City: State: Zip Code:

TO BE COMPLETED BY LABORATORY

Analysis shows this Water SAMPLE to be:

- ☒ Satisfactory
- ☐ Unsatisfactory
- ☐ Sample over 30 hours old, results may be unreliable
- ☐ Sample too long in transit; sample should not be over 30 hours old at examination to indicate reliable results. Please send new sample via special delivery mail.

Date Received: 7/9/02
Time Received: 0800
Analysis Began: 1520 ~~0800~~ MK

Analytical Method: ☒ Membrane Filter ☐ MMO-MUG

* Number of colonies/100 ml.

SAMPLE DATE: Month 07 Day 08 Year 02

1024081

Result* 0 Analyst SH

SAMPLE TYPE:

- ☑ Routine
- ☐ Repeat Sample (for routine sample with lab ref. no. _____)
- ☐ Special Purpose
- ☐ Treated Water
- ☑ Untreated Water

SAMPLE LOCATION	Time Collected	Collected By
Vera Atkinson	0935	Caryn Orvis (Please Print)

Anch Fbks Jun ☐ Faxed

Date: _____ Time: _____

Client notified of unsatisfactory results:

☐ Phoned _____ Spoke with ☐ Faxed

Date: _____ Time: _____

BACTERIOLOGICAL WATER ANALYSIS RECORD

MMO-MUG Result: Total Coliform _____ *E. Coli* _____

Membrane Filter: Direct Count 0 Colonies/100 ml

Verification: LTB _____ BGB _____ COLIFIRM _____

Fecal Coliform Confirmation _____

Final Membrane Filter Results 0 Coliform/100 ml

Reported By SHaddeN Date 7/11/02 Time 950 hrs

TNTC = Too Numerous To Count

OB = Other Bacteria

Comments:

100/522/95

CT&E Environmental Services Inc.
Laboratory Division

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

Drinking Water Analysis Report for Total Coliform Bacteria

READ INSTRUCTIONS ON REVERSE SIDE BEFORE COLLECTING SAMPLE

MUST BE COMPLETED BY WATER SUPPLIER

- ☐ PUBLIC WATER SYSTEM I.D. # ☐☐☐☐☐☐☐
- ☑ PRIVATE WATER SYSTEM

☑ *Send Results* ☑ *Send Invoice*

Water System Name/Company Name: Paug-Vik Development Co. Contact name: Canyn Orvis
Phone Number: (907) 258-1345 Fax Number: (907) 222-5423
Mailing Address: 810 N St. Ste 201
City: Anchorage State: AK Zip Code: 99501

☐ *Send Results* ☐ *Send Invoice*

Company Name: _____ Contact name: _____
Mailing Address: _____
City: _____ State: _____ Zip Code: _____

TO BE COMPLETED BY LABORATORY

Analysis shows this Water SAMPLE to be:

- ☑ Satisfactory
- ☐ Unsatisfactory
- ☐ Sample over 30 hours old, results may be unreliable
- ☐ Sample too long in transit; sample should not be over 30 hours old at examination to indicate reliable results. Please send new sample via special delivery mail.

Date Received 7/9/02
Time Received 0800
Analysis Began 1555

Analytical Method: ☑ Membrane Filter ☐ MMO-MUG

* Number of colonies/100 ml.

SAMPLE DATE: 07 (Month) 08 (Day) 02 (Year)

1024081
-2A

Result* [0] **Analyst** SH

SAMPLE TYPE:

- ☑ Routine
- ☐ Repeat Sample (for routine sample with lab ref. no. _____)
- ☐ Special Purpose
- ☐ Treated Water
- ☐ Untreated Water

.nch Fbks Jun ☐ Faxed

Date: _____ Time: _____

Client notified of unsatisfactory results:

☐ Phoned _____ Spoke with ☐ Faxed

Date: _____ Time: _____

SAMPLE LOCATION	Time Collected	Collected By
Ekwok - Mary Kawaglia	1040	Canyn Orvis (Please Print)

BACTERIOLOGICAL WATER ANALYSIS RECORD

MMO-MUG Result: Total Coliform _____ *E. Coli* _____

Membrane Filter: Direct Count 0 Colonies/100 ml

Verification: LTB _____ BGB _____ COLIFIRM _____

Fecal Coliform Confirmation _____

Final Membrane Filter Results 0 Coliform/100 ml

Reported By SBHadden Date 7/11/02 Time 950 hrs

TNTC = Too Numerous To Count

OB = Other Bacteria

Comments: _____

100/522/95

CT&E Environmental Services Inc.
Laboratory Division

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

Drinking Water Analysis Report for Total Coliform Bacteria

READ INSTRUCTIONS ON REVERSE SIDE BEFORE COLLECTING SAMPLE

MUST BE COMPLETED BY WATER SUPPLIER

- ☐ PUBLIC WATER SYSTEM I.D. # ☐☐☐☐☐☐
- ☑ PRIVATE WATER SYSTEM

☑ *Send Results* ☑ *Send Invoice*

Water System Name/Company Name: Pavg-Vik Devel. Contact name: Canyn Orvis

Phone Number: (907) 258-1345 Fax Number: (907) 222-5423

Mailing Address: 810 N St. Ste 201

City: Anchorage State: AK Zip Code: 99501

☐ *Send Results* ☐ *Send Invoice*

Company Name _____ Contact name _____

Mailing Address _____

City _____ State _____ Zip Code _____

SAMPLE DATE: 07 (Month) 08 (Day) 02 (Year)

SAMPLE TYPE:

- ☑ Routine
- ☐ Repeat Sample (for routine sample with lab ref. no. _____)
- ☐ Special Purpose
- ☐ Treated Water
- ☐ Untreated Water

SAMPLE LOCATION	Time Collected	Collected By
Eknok - Walcott	1100	Canyn Orvis (Please Print)

TO BE COMPLETED BY LABORATORY

Analysis shows this Water SAMPLE to be:

- ☒ *Satisfactory*
- ☐ Unsatisfactory
- ☐ Sample over 30 hours old, results may be unreliable
- ☐ Sample too long in transit; sample should not be over 30 hours old at examination to indicate reliable results. Please send new sample via special delivery mail.

Date Received 7/9/02

Time Received 0800

Analysis Began 1555

Analytical Method: ☒ Membrane Filter ☐ MMO-MUG

* Number of colonies/100 ml.

Lab Ref. No.	Result*	Analyst
1024081 -3A	0	SH

Sent to A.D.E.C. Anch Fbks Jun ☐ Faxed

Date: _____ Time: _____

Client notified of unsatisfactory results:

☐ Phoned _____ Spoke with ☐ Faxed

Date: _____ Time: _____

BACTERIOLOGICAL WATER ANALYSIS RECORD

MMO-MUG Result: Total Coliform _____ *E. Coli* _____

Membrane Filter: Direct Count 0 Colonies/100 ml

Verification: LTB _____ BGB _____ COLIFIRM _____

Fecal Coliform Confirmation _____

Final Membrane Filter Results 0 Coliform/100 ml

Reported By SBadden Date 7/4/02 Time 950 hrs

TNTC = Too Numerous To Count

OB = Other Bacteria

Comments: _____

100/522/95

CT&E Environmental Services Inc.
Laboratory Division

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

Drinking Water Analysis Report for Total Coliform Bacteria

READ INSTRUCTIONS ON REVERSE SIDE BEFORE COLLECTING SAMPLE

MUST BE COMPLETED BY WATER SUPPLIER

☐ PUBLIC WATER SYSTEM I.D. # ☐☐☐☐☐☐

☑ PRIVATE WATER SYSTEM

☑ *Send Results* ☑ *Send Invoice*

Water System Name/Company Name: Pavg-Vik Development — Contact name: Caryn Orvis

Phone Number: (907) 258-1345 — Fax Number: (907) 222-5423

Mailing Address: 810 N St. Ste 201

City: Anchorage — State: AK — Zip Code: 99501

☐ *Send Results* ☐ *Send Invoice*

Company Name — Contact name

Mailing Address

City — State — Zip Code

SAMPLE DATE: 07 (Month) 08 (Day) 02 (Year)

SAMPLE TYPE:

☑ Routine
☐ Repeat Sample (for routine sample with lab ref. no. _____)
☐ Special Purpose
☐ Treated Water
☐ Untreated Water

SAMPLE LOCATION	Time Collected	Collected By
EKwok - Jimmy Hurley	1130	Caryn Orvis (Please Print)

TO BE COMPLETED BY LABORATORY

Analysis shows this Water SAMPLE to be:

☐ Satisfactory
☒ Unsatisfactory
☐ Sample over 30 hours old, results may be unreliable
☐ Sample too long in transit; sample should not be over 30 hours old at examination to indicate reliable results. Please send new sample via special delivery mail.

Date Received 7/9/02

Time Received 0800

Analysis Began 1430

Analytical Method: ☐ Membrane Filter ☒ MMO-MUG

* Number of colonies/100 ml.

Lab Ref. No.	Result*	Analyst
1024081-4A	TC pos EC neg	SH

Sent to A.D.E.C. Anch Fbks Jun ☐ Faxed

Date: _____ Time: _____

Client notified of unsatisfactory results:

☐ Phoned _____ Spoke with ☒ Faxed

Date: 7/11/02 Time: 1337

BACTERIOLOGICAL WATER ANALYSIS RECORD

MMO-MUG Result: Total Coliform SH 7/11/02 positive *E. Coli* negative

Membrane Filter: Direct Count _____ Colonies/100 ml

Verification: LTB _____ BGB _____ COLIFIRM _____

Fecal Coliform Confirmation _____

Final Membrane Filter Results _____ Coliform/100 ml

Reported By SBHadden Date 7/11/02 Time 1330 hrs

TNTC = Too Numerous To Count

OB = Other Bacteria

Comments:

100/522/95

CT&E Environmental Services Inc.

CT&E Ref.#	439013 Method Blank	**Printed Date/Time**	07/19/2002 10:56
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Matrix	Water (Surface, Eff., Ground)	**Date**	

QC results affect the following production samples:

1024081001, 1024081002, 1024081003, 1024081004

Sample Remarks:

Parameter	Results	Reporting Limit	Units	Analysis Date	Init
Waters Department					
Alkalinity	5.00 U	5.00	mg/L	07/10/02	AS
Batch WTI 1976 **Method** SM20 2320B **Instrument**					

CT&E Environmental Services Inc.

CT&E Ref.#	439014 Lab Control Sample	**Printed Date/Time**	07/19/2002 10:56
		Prep Batch	
Client Name	Paug-Vik Development Corp.	**Method**	
Project Name/#	Ekwok Well Drilling	**Date**	
Matrix	Water (Surface, Eff., Ground)		

QC results affect the following production samples:
1024081001, 1024081002, 1024081003, 1024081004

Sample Remarks:
LCS

Parameter		QC Results	Pct Recov	LCS/LCSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date	Init
Waters Department									
Alkalinity		LCS 258	103	(90-110)			250 mg/L	07/10/02	AS
Batch	WTI 1976								
Method	SM20 2320B								
Instrument									

CT&E Environmental Services Inc.

CT&E Ref.#	439015 Duplicate	**Printed Date/Time**	07/19/2002 10:56
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Original	1024056001	**Date**	
Matrix	Water (Surface, Eff., Ground)		

QC results affect the following production samples:

1024081001, 1024081002, 1024081003, 1024081004

Sample Remarks:

Parameter	Original Result	QC Result	RPD	RPD Limits	Analysis Date	Init
Waters Department						
Alkalinity	103	103	0	(< 20)	07/10/02	AS
Batch WTI 1976						
Method SM20 2320B						
Instrument						

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CT&E Environmental Services Inc.

CT&E Ref.#	438818 Method Blank	**Printed Date/Time**	07/19/2002 10:56
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Matrix	Water (Surface, Eff., Ground)	**Date**	

QC results affect the following production samples:

1024081001, 1024081002, 1024081003, 1024081004

Sample Remarks:

Parameter	Results	Reporting Limit	Units	Analysis Date	Init
Waters Department					
Bromide	0.100 U	0.100	mg/L	07/09/02	JDT
Chloride	0.122	0.100	mg/L	07/09/02	JDT
Fluoride	0.100 U	0.100	mg/L	07/09/02	JDT
Nitrate-N	0.100 U	0.100	mg/L	07/09/02	JDT
Nitrite-N	0.100 U	0.100	mg/L	07/09/02	JDT
Sulfate	0.100 U	0.100	mg/L	07/09/02	JDT

Batch WIC 2710
Method EPA 300.0
Instrument Dionex DX-300 HPLC

CT&E Environmental Services Inc.

CT&E Ref.#	438819 Lab Control Sample	**Printed Date/Time**	07/19/2002 10:56
		Prep Batch	
Client Name	Paug-Vik Development Corp.	**Method**	
Project Name/#	Ekwok Well Drilling	**Date**	
Matrix	Water (Surface, Eff., Ground)		

QC results affect the following production samples:
1024081001, 1024081002, 1024081003, 1024081004

Sample Remarks:
LCS

Parameter		QC Results	Pct Recov	LCS/LCSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date	Init
Waters Department									
Bromide	LCS	5.34	107	(90-110)			5 mg/L	07/09/02	JDT
Chloride	LCS	5.45	109	(90-110)			5 mg/L	07/09/02	JDT
Fluoride	LCS	4.93	99	(90-110)			5 mg/L	07/09/02	JDT
Nitrate-N	LCS	4.99	100	(90-110)			5 mg/L	07/09/02	JDT
Nitrite-N	LCS	5.24	105	(90-110)			5 mg/L	07/09/02	JDT
Sulfate	LCS	5.39	108	(90-110)			5 mg/L	07/09/02	JDT

Batch WIC 2710
Method EPA 300.0
Instrument Dionex DX-300 HPLC

CT&E Environmental Services Inc.

CT&E Ref.#	438810 Undigested Duplicate	**Printed Date/Time**	07/19/2002 10:56
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Original		**Date**	
Matrix	Drinking Water		

QC results affect the following production samples:

1024081001, 1024081002, 1024081003, 1024081004

Sample Remarks:

Parameter	Original Result	QC Result	RPD	RPD Limits	Analysis Date	Init
Waters Department						
Nitrate-N	3.72	3.73	0	(< 20)	07/09/02	JDT
Batch WIC 2710						
Method EPA 300.0						
Instrument Dionex DX-300 HPLC						

CT&E Environmental Services Inc.

CT&E Ref.#	438811	Matrix Spike	**Printed Date/Time**	07/19/2002 10:56
			Prep Batch	
			Method	
			Date	
Original	1024080001			
Matrix	Drinking Water			

QC results affect the following production samples:
1024081001, 1024081002, 1024081003, 1024081004

Sample Remarks:
MS

Parameter		Original Result	QC Result	Pct Recov	MS/MSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date	Init
Waters Department										
Nitrate-N	MS	3.72	13.6	99	(80-120)			10 mg/L	07/09/02	JDT

Batch WIC 2710
Method EPA 300.0
Instrument Dionex DX-300 HPLC

CT&E Environmental Services Inc.

CT&E Ref.#	439120 Method Blank	**Printed Date/Time**	07/19/2002 10:56
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Matrix	Water (Surface, Eff., Ground)	**Date**	

QC results affect the following production samples:

1024081001, 1024081002, 1024081004

Sample Remarks:

Parameter	Results	Reporting Limit	Units	Analysis Date	Init
Waters Department					
Bromide	0.100 U	0.100	mg/L	07/10/02	JDT
Chloride	0.100 U	0.100	mg/L	07/10/02	JDT
Fluoride	0.100 U	0.100	mg/L	07/10/02	JDT
Nitrate-N	0.100 U	0.100	mg/L	07/10/02	JDT
Nitrite-N	0.100 U	0.100	mg/L	07/10/02	JDT
Sulfate	0.100 U	0.100	mg/L	07/10/02	JDT

Batch WIC 2711
Method EPA 300.0
Instrument Dionex DX-300 HPLC

CT&E Environmental Services Inc.

CT&E Ref.# 439121 Lab Control Sample

Printed Date/Time 07/19/2002 10:56

Prep Batch
Method
Date

Client Name Paug-Vik Development Corp.
Project Name/# Ekwok Well Drilling
Matrix Water (Surface, Eff., Ground)

QC results affect the following production samples:
1024081001, 1024081002, 1024081004

Sample Remarks:
LCS

Parameter		QC Results	Pct Recov		LCS/LCSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date	Init
Waters Department										
Bromide	LCS	5.37	107		(90-110)			5 mg/L	07/10/02	JDT
Chloride	LCS	5.49	110		(90-110)			5 mg/L	07/10/02	JDT
Fluoride	LCS	5.23	105		(90-110)			5 mg/L	07/10/02	JDT
Nitrate-N	LCS	5.03	101		(90-110)			5 mg/L	07/10/02	JDT
Nitrite-N	LCS	4.69	94		(90-110)			5 mg/L	07/10/02	JDT
Sulfate	LCS	5.55	111	*	(90-110)			5 mg/L	07/10/02	JDT

Batch WIC 2711
Method EPA 300.0
Instrument Dionex DX-300 HPLC

CT&E Environmental Services Inc.

CT&E Ref.#	439103 Undigested Duplicate	**Printed Date/Time**	07/19/2002 10:56
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Original		**Date**	
Matrix	Drinking Water		

QC results affect the following production samples:

1024081001, 1024081002, 1024081004

Sample Remarks:

Parameter	Original Result	QC Result	RPD	RPD Limits	Analysis Date	Init
Waters Department						
Nitrate-N	0.200 U	0.200 U	0	(< 20)	07/10/02	JDT
Batch WIC 2711						
Method EPA 300.0						
Instrument Dionex DX-300 HPLC						

CT&E Environmental Services Inc.

CT&E Ref.#	439104	Matrix Spike	**Printed Date/Time**	07/19/2002 10:56
			Prep Batch	
			Method	
			Date	
Original	1024140001			
Matrix	Drinking Water			

QC results affect the following production samples:
1024081001, 1024081002, 1024081004

Sample Remarks:

Parameter		Original Result	QC Result	Pct Recov	MS/MSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date	Init
Waters Department										
Nitrate-N	MS	0.200 U	10.5	105	(80-120)			10 mg/L	07/10/02	JDT
Batch	WIC 2711									
Method	EPA 300.0									
Instrument	Dionex DX-300 HPLC									

CT&E Environmental Services Inc.

CT&E Ref.#	439009 Method Blank	**Printed Date/Time**	07/19/2002 10:56
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Matrix	Water (Surface, Eff., Ground)	**Date**	

QC results affect the following production samples:

1024081001, 1024081002, 1024081003, 1024081004

Sample Remarks:

Parameter	Results	Reporting Limit	Units	Analysis Date	Init
Waters Department					
Total Dissolved Solids	20.0F	25.0	mg/L	07/09/02	AS

Batch WAT 3610
Method SM20 2540C
Instrument

CT&E Environmental Services Inc.

CT&E Ref.#	439010 Lab Control Sample	**Printed Date/Time**	07/19/2002 10:56
		Prep Batch	
Client Name	Paug-Vik Development Corp.	**Method**	
Project Name/#	Ekwok Well Drilling	**Date**	
Matrix	Water (Surface, Eff., Ground)		

QC results affect the following production samples:
1024081001, 1024081002, 1024081003, 1024081004

Sample Remarks:
LCS

Parameter		QC Results	Pct Recov	LCS/LCSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date	Init
Waters Department									
Total Dissolved Solids	LCS	228	106	(75-125)			214 mg/L	07/09/02	AS
Batch WAT 3610									
Method SM20 2540C									
Instrument									

CT&E Environmental Services Inc.

CT&E Ref.#	439011 Duplicate	**Printed Date/Time**	07/19/2002 10:56
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Original	1023476001	**Date**	
Matrix	Drinking Water		

QC results affect the following production samples:

1024081001

Sample Remarks:

Parameter	Original Result	QC Result	RPD	RPD Limits	Analysis Date	Init
Waters Department						
Total Dissolved Solids	264	271	3	(< 25)	07/09/02	AS
Batch WAT 3610						
Method SM20 2540C						
Instrument						

F-701

CT&E Environmental Services Inc.

CT&E Ref.#	439012 Duplicate	**Printed Date/Time**	07/19/2002 10:56
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Original	1024081001	**Date**	
Matrix	Drinking Water		

QC results affect the following production samples:

1024081001, 1024081002, 1024081003, 1024081004

Sample Remarks:

Parameter	Original Result	QC Result	RPD	RPD Limits	Analysis Date	Init
Waters Department						
Total Dissolved Solids	83.8	83.8	0	(< 25)	07/09/02	AS
Batch WAT 3610						
Method SM20 2540C						
Instrument						

F-701

CT&E Environmental Services Inc.

CT&E Ref.#	438894 Method Blank	**Printed Date/Time**	07/19/2002 10:56
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Matrix	Water (Surface, Eff., Ground)	**Date**	

QC results affect the following production samples:

1024081001, 1024081002, 1024081003

Sample Remarks:

Parameter	Results	Reporting Limit	Units	Analysis Date	Init
Microbiology Laboratory					
Total Coliform	0		col/100mL	07/09/02	SBH
Batch BTF 4840					
Method SM18 9222B					
Instrument					

CT&E Environmental Services Inc.

CT&E Ref.#	438897 Method Blank	**Printed Date/Time**	07/19/2002 10:56
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Matrix	Water (Surface, Eff., Ground)	**Date**	

QC results affect the following production samples:

1024081001, 1024081002, 1024081003

Sample Remarks:

Parameter	Results	Reporting Limit	Units	Analysis Date	Init
Microbiology Laboratory					
Total Coliform	0		col/100mL	07/09/02	SBH
Batch BTF 4840					
Method SM18 9222B					
Instrument					

CT&E Environmental Services Inc.

CT&E Ref.#	439056 Method Blank	**Printed Date/Time**	07/19/2002 10:56
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Matrix	Water (Surface, Eff., Ground)	**Date**	

QC results affect the following production samples:

1024081004

Sample Remarks:

Parameter	Results	Reporting Limit	Units	Analysis Date	Init
Microbiology Laboratory					
Total Coliform	TC Neg/EC Neg	0		07/09/02	SBH
Batch BTF 4842					
Method SM18 9223B					
Instrument					

CT&E Environmental Services Inc.

CT&E Ref.#	439124 Undigested Duplicate	**Printed Date/Time**	07/19/2002 10:56
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Original		**Date**	
Matrix	Water (Surface, Eff., Ground)		

QC results affect the following production samples:

1024081005, 1024081006, 1024081007, 1024081008

Sample Remarks:

Parameter	Original Result	QC Result	RPD	RPD Limits	Analysis Date	Init
Nickel	5.00 U	2.21F	15	(< 20)	07/11/02	KGF
Potassium	647	663	3	(< 20)	07/11/02	KGF
Silver	1.00 U	1.00 U *	-20	(< 20)	07/11/02	KGF
Sodium	3000	3100	3	(< 20)	07/11/02	KGF
Manganese	5.00 U	5.00 U	3	(< 20)	07/11/02	KGF
Zinc	12.1	12.2	1	(< 20)	07/11/02	KGF
Magnesium	8960	9150	2	(< 20)	07/11/02	KGF
Calcium	54200	55400	2	(< 20)	07/11/02	KGF
Cadmium	0.100 U	0.100 U *	-28	(< 20)	07/11/02	KGF
Aluminum	20.0 U	20.0 U *	-9	(< 20)	07/11/02	KGF
Chromium	4.00 U	4.00 U	7	(< 20)	07/11/02	KGF
Copper	1.00 U	1.00 U	17	(< 20)	07/11/02	KGF
Lead	0.400 U	0.400 U *	909	(< 20)	07/11/02	KGF

Batch MMS 2088
Method EPA 200.8
Instrument Perkin Elmer Sciex ICP-MS P3

CT&E Environmental Services Inc.

CT&E Ref.#	439125	Bench Spike Liquid	**Printed Date/Time**	07/19/2002 10:56
			Prep Batch	
			Method	
			Date	
Original	1024056001			
Matrix	Water (Surface, Eff., Ground)			

QC results affect the following production samples:
1024081005, 1024081006, 1024081007, 1024081008

Sample Remarks:
BN1

Parameter		Original Result	QC Result	Pct Recov	MS/MSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date	Init
Sodium	BN1	3000	28600	102	(70-130)			25000 ug/L	07/11/02	KGF
Manganese	BN1	5.00 U	5130	103	(70-130)			5000 ug/L	07/11/02	KGF
Nickel	BN1	5.00 U	4730	95	(70-130)			5000 ug/L	07/11/02	KGF
Potassium	BN1	647	27400	107	(70-130)			25000 ug/L	07/11/02	KGF
Silver	BN1	1.00 U	1220	97	(70-130)			1250 ug/L	07/11/02	KGF
Zinc	BN1	12.1	4820	96	(70-130)			5000 ug/L	07/11/02	KGF
Magnesium	BN1	8960	34800	103	(70-130)			25000 ug/L	07/11/02	KGF
Lead	BN1	0.400 U	4800	96	(70-130)			5000 ug/L	07/11/02	KGF
Cadmium	BN1	0.100 U	4780	96	(70-130)			5000 ug/L	07/11/02	KGF
Calcium	BN1	54200	79800	102	(70-130)			25000 ug/L	07/11/02	KGF
Chromium	BN1	4.00 U	4920	98	(70-130)			5000 ug/L	07/11/02	KGF
Copper	BN1	1.00 U	4500	90	(70-130)			5000 ug/L	07/11/02	KGF
Aluminum	BN1	20.0 U	4900	99	(70-130)			5000 ug/L	07/11/02	KGF

Batch MMS 2088
Method EPA 200.8
Instrument Perkin Elmer Sciex ICP-MS P3

CT&E Environmental Services Inc.

CT&E Ref.#	439603 Method Blank	**Printed Date/Time**	07/19/2002 10:56
Client Name	Paug-Vik Development Corp.	**Prep Batch**	MXX 10282
Project Name/#	Ekwok Well Drilling	**Method**	E200.2
Matrix	Water (Surface, Eff., Ground)	**Date**	07/13/2002

QC results affect the following production samples:

1024081001, 1024081002, 1024081003, 1024081004

Sample Remarks:

Parameter	Results	Reporting Limit	Units	Analysis Date	Init
Phosphorus	500 U	500	ug/L	07/16/02	KGF

Batch MMS 2095
Method EPA 200.8
Instrument Perkin Elmer Sciex ICP-MS P3

Metals by ICP/MS

Aluminum	20.0 U	20.0	ug/L	07/16/02	KGF
Antimony	1.00 U	1.00	ug/L	07/16/02	KGF
Arsenic	2.00 U	2.00	ug/L	07/16/02	KGF
Barium	3.00 U	3.00	ug/L	07/16/02	KGF
Beryllium	0.400 U	0.400	ug/L	07/16/02	KGF
Cadmium	0.100 U	0.100	ug/L	07/16/02	KGF
Calcium	500 U	500	ug/L	07/16/02	KGF
Chromium	3.15F	4.00	ug/L	07/16/02	KGF
Cobalt	4.00 U	4.00	ug/L	07/16/02	KGF
Copper	1.00 U	1.00	ug/L	07/16/02	KGF
Iron	250 U	250	ug/L	07/16/02	KGF
Lead	0.400 U	0.400	ug/L	07/16/02	KGF
Magnesium	500 U	500	ug/L	07/16/02	KGF
Manganese	5.00 U	5.00	ug/L	07/16/02	KGF
Molybdenum	10.0 U	10.0	ug/L	07/16/02	KGF
Nickel	1.02F	5.00	ug/L	07/16/02	KGF
Potassium	500 U	500	ug/L	07/16/02	KGF
Selenium	2.00 U	2.00	ug/L	07/16/02	KGF
Sodium	500 U	500	ug/L	07/16/02	KGF
Zinc	2.00 U	2.00	ug/L	07/16/02	KGF
Silver	1.00 U	1.00	ug/L	07/16/02	KGF
Thallium	0.300 U	0.300	ug/L	07/16/02	KGF
Vanadium	5.00 U	5.00	ug/L	07/16/02	KGF

Batch MMS 2095
Method EPA 200.8
Instrument Perkin Elmer Sciex ICP-MS P3

CT&E Ref.#	439604 Lab Control Sample	**Printed Date/Time**	07/19/2002 10:56
		Prep Batch	MXX 10282
Client Name	Paug-Vik Development Corp.	**Method**	E200.2
Project Name/#	Ekwok Well Drilling	**Date**	07/13/2002
Matrix	Water (Surface, Eff., Ground)		

QC results affect the following production samples:

1024081001, 1024081002, 1024081003, 1024081004

Sample Remarks:

Parameter		QC Results	Pct Recov	LCS/LCSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date	Init
Batch	MMS 2095								
Method	EPA 200.8								
Instrument	Perkin Elmer Sciex ICP-MS P3								
Metals by ICP/MS									
Aluminum		LCS	912	91	(85-115)		1000 ug/L	07/16/02	KGF
Antimony		LCS	959	96	(85-115)		1000 ug/L	07/16/02	KGF
Arsenic		LCS	938	94	(85-115)		1000 ug/L	07/16/02	KGF
Barium		LCS	956	96	(85-115)		1000 ug/L	07/16/02	KGF
Beryllium		LCS	372	93	(85-115)		400 ug/L	07/16/02	KGF
Cadmium		LCS	484	97	(85-115)		500 ug/L	07/16/02	KGF
Calcium		LCS	10000	100	(85-115)		10000 ug/L	07/16/02	KGF
Chromium		LCS	896	90	(85-115)		1000 ug/L	07/16/02	KGF
Cobalt		LCS	940	94	(85-115)		1000 ug/L	07/16/02	KGF
Copper		LCS	930	93	(85-115)		1000 ug/L	07/16/02	KGF
Iron		LCS	971	97	(85-115)		1000 ug/L	07/16/02	KGF
Lead		LCS	927	93	(85-115)		1000 ug/L	07/16/02	KGF
Magnesium		LCS	9840	98	(85-115)		10000 ug/L	07/16/02	KGF
Manganese		LCS	930	93	(85-115)		1000 ug/L	07/16/02	KGF
Molybdenum		LCS	943	94	(85-115)		1000 ug/L	07/16/02	KGF
Nickel		LCS	926	93	(85-115)		1000 ug/L	07/16/02	KGF
Potassium		LCS	9770	98	(85-115)		10000 ug/L	07/16/02	KGF
Selenium		LCS	947	95	(85-115)		1000 ug/L	07/16/02	KGF
Sodium		LCS	9630	96	(85-115)		10000 ug/L	07/16/02	KGF
Zinc		LCS	947	95	(85-115)		1000 ug/L	07/16/02	KGF
Silver		LCS	189	95	(85-115)		200 ug/L	07/16/02	KGF
Thallium		LCS	960	96	(85-115)		1000 ug/L	07/16/02	KGF
Vanadium		LCS	937	94	(85-115)		1000 ug/L	07/16/02	KGF
Batch	MMS 2095								
Method	EPA 200.8								
Instrument	Perkin Elmer Sciex ICP-MS P3								

CHAIN OF CUSTODY RECORD 1024081

CT&E Environmental Services Inc.
Laboratory Division

(1)

CLIENT: Paug-Vik Development Co.
CONTACT: Caryn Orvis PHONE NO: (907) 258-1345
PROJECT: Ekwok Well Drilling PWSID#: ~~5833~~
REPORTS TO: C. Orvis
FAX NO: (907) 222-5423
INVOICE TO: Paug-Vik QUOTE# 5833
P.O. NUMBER: 0068 - 05

CT&E Reference:

PAGE 1 OF 1

(2)

LAB NO.	SAMPLE IDENTIFICATION	DATE	TIME	MATRIX	No. CONTAINERS	SAMPLE TYPE C=COMP G=GRAB	Preservatives Used	HNO_3	HNO_3	4°C	4°C	$Na_2S_2O_3$/ZnAc					REMARKS
							Analysis Required (3)	Metals/Hardness	Dissolved Fe	300.0 NO_3/NO_2/Style	TDS/Alkalinity	Total Coliform					
(1) A-D, G	02EK-ATKI	07-08-02	0930	water	5	G		1	A 1 (2)	1	1	1					
(2) A-D, G	02EK-KAWA	7-8-02	1030	water	5	G		1	A 1 (6)	1	1	1					
(3) A-D, G	02EK-WALC	7-8-02	1100	water	5	G		1	A 1 (7)	1	1	1					
(4) A-D, G	02EK-HURL	7-8-02	1130	water	5	G		1	A 1 (8)	1	1	1					
		~~7-8-02~~ (CO)		~~water~~ (CO)													

(5)

Collected/Relinquished By: (1)	Date	Time	Received By:
Caryn A. Orvis	7/8/02	1245	
Relinquished By: (2)	Date	Time	Received By:
Relinquished By: (3)	Date	Time	Received By:
Relinquished By: (4)	Date 7/9/02	Time 0800	Received For Laboratory By:

(4)

Shipping Carrier: Penn Air
Shipping Ticket No:
Temperature C:
Data Deliverables:
Level I Level II Level III EDD Type:
Chain of Custody Seal: (Circle)
INTACT BROKEN ABSENT
Requested Turnaround Time and Special Instructions:

200 W. Potter Drive **Anchorage, AK 99518** Tel: (907) 562-2343 Fax: (907) 561-5301
3180 Peger Road **Fairbanks, AK 99701** Tel: (907) 474-8656 Fax: (907) 474-9685

CT&E Environmental Services Inc.

200 W. Potter Drive
Anchorage, AK 99518-1605
Tel: (907) 562-2343
Fax: (907) 561-5301
Web: http://www.cteesi.com

C Orvis
Paug-Vik Devel
810 N St Ste 201
Anchorage, AK 99501

Work Order:	1024328
	Ekwok Well Drilling
Client:	Paug-Vik Development Corp.
Report Date:	July 24, 2002

Enclosed are the analytical results associated with the above workorder.

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 analyte was analyzed for but not detected.
F	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.#	1024328002	**All Dates/Times are Alaska Standard Time**	
Client Name	Paug-Vik Development Corp.	**Printed Date/Time**	07/24/2002 19:22
Project Name/#	Ekwok Well Drilling	**Collected Date/Time**	07/14/2002 9:45
Client Sample ID	02EK-NICK	**Received Date/Time**	07/15/2002 8:45
Matrix	Drinking Water	**Technical Director**	**Stephen C. Ede**
Ordered By			
PWSID	0	**Released By**	Shawn Paxton

Sample Remarks:

EP 300.0 - Amount of Sulfate in the method blank is > 1/2 the PQL; concentration of Sulfate in the sample is 10X greater.

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
Phosphorus	500 U	500	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Metals Department								
Hardness as CaCO3	14.1	10.0	mg/L	SM17 2340C		07/16/02	07/22/02	KGF
Metals by ICP/MS								
Aluminum	154	20.0	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Antimony	1.00 U	1.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Arsenic	2.00 U	2.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Barium	4.68	3.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Beryllium	0.400 U	0.400	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Cadmium	0.100 U	0.100	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Calcium	3600	500	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Chromium	4.00 U	4.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Cobalt	4.00 U	4.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Copper	2.04	1.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Iron	1300	250	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Lead	0.400 U	0.400	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Magnesium	1230	500	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Manganese	33.1	5.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Molybdenum	10.0 U	10.0	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Nickel	5.00 U	5.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Potassium	500 U	500	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Selenium	2.00 U	2.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Sodium	2830	500	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Zinc	2.00 U	2.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Silicon	6870	1000	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Silver	1.00 U	1.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Thallium	0.300 U	0.300	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Vanadium	5.00 U	5.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF

CT&E Environmental Services Inc.

CT&E Ref.#	1024328002	**All Dates/Times are Alaska Standard Time**	
Client Name	Paug-Vik Development Corp.	**Printed Date/Time**	07/24/2002 19:22
Project Name/#	Ekwok Well Drilling	**Collected Date/Time**	07/14/2002 9:45
Client Sample ID	02EK-NICK	**Received Date/Time**	07/15/2002 8:45
Matrix	Drinking Water	**Technical Director**	**Stephen C. Ede**
Ordered By			
PWSID	0		

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
Waters Department								
Nitrate-N	1.29	0.200	mg/L	EPA 300.0			07/15/02	JDT
Alkalinity	14.5	5.00	mg/L	SM20 2320B			07/18/02	NCS
Chloride	2.92	0.200	mg/L	EPA 300.0			07/15/02	JDT
Nitrite-N	0.200 U	0.200	mg/L	EPA 300.0	(<1)		07/15/02	JDT
Sulfate	1.40	0.200	mg/L	EPA 300.0			07/15/02	JDT
Total Dissolved Solids	100 U	100	mg/L	SM20 2540C			07/15/02	AS
Microbiology Laboratory								
Total Coliform	1 OB, W/Coli-No FC		col/100mL	SM18 9222B	(<1)		07/15/02	KAP

CT&E Environmental Services Inc.

CT&E Ref.#	1024328001	**All Dates/Times are Alaska Standard Time**	
Client Name	Paug-Vik Development Corp.	**Printed Date/Time**	07/24/2002 19:22
Project Name/#	Ekwok Well Drilling	**Collected Date/Time**	07/12/2002 9:30
Client Sample ID	02EK-NELS	**Received Date/Time**	07/15/2002 8:45
Matrix	Drinking Water	**Technical Director**	**Stephen C. Ede**
Ordered By		**Released By**	Shawn Peterson

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
Phosphorus	500 U	500	ug/L	EPA 200.8	no regs?	07/16/02	07/22/02	KGF
Metals Department								
Hardness as CaCO3	33.6	10.0	mg/L	SM17 2340C		07/16/02	07/22/02	KGF
Metals by ICP/MS								
Aluminum	8160	20.0	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Antimony	1.00 U	1.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Arsenic	4.89	2.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Barium	65.1	3.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Beryllium	0.400 U	0.400	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Cadmium	0.100 U	0.100	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Calcium	7370	500	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Chromium	12.8	4.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Cobalt	5.46	4.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Copper	24.0	1.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Iron	19100	250	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Lead	5.13	0.400	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Magnesium	3690	500	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Manganese	260	5.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Molybdenum	10.0 U	10.0	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Nickel	14.0	5.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Potassium	1390	500	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Selenium	2.00 U	2.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Sodium	18100	500	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Zinc	138	2.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Silicon	19200	1000	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Silver	1.00 U	1.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Thallium	0.300 U	0.300	ug/L	EPA 200.8		07/16/02	07/22/02	KGF
Vanadium	26.5	5.00	ug/L	EPA 200.8		07/16/02	07/22/02	KGF

CT&E Environmental Services Inc.

CT&E Ref.#	1024328003
Client Name	Paug-Vik Development Corp.
Project Name/#	Ekwok Well Drilling
Client Sample ID	02EK-NELS1
Matrix	Drinking Water
Ordered By	
PWSID	0

All Dates/Times are Alaska Standard Time

Printed Date/Time	07/24/2002 19:22
Collected Date/Time	07/14/2002 10:00
Received Date/Time	07/15/2002 8:45
Technical Director	**Stephen C. Ede**

Released By Shawn Paxton

Sample Remarks:

EP 300.0 - Amount of Sulfate in the method blank is > 1/2 the PQL; concentration of Sulfate in the sample is 10X greater.

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
E. Coli	Negative	0	100mL	SM18 9223B			07/15/02	KAP
Total Coliform	Negative	0	100mL	SM18 9223B			07/15/02	KAP
Waters Department								
Nitrate-N	0.489	0.200	mg/L	EPA 300.0			07/15/02	JDT
Chloride	4.68	0.200	mg/L	EPA 300.0			07/15/02	JDT
Nitrite-N	0.200 U	0.200	mg/L	EPA 300.0	(<1)		07/15/02	JDT
Sulfate	1.21	0.200	mg/L	EPA 300.0			07/15/02	JDT

CT&E Environmental Services Inc.

CT&E Ref.#	1024328001	**All Dates/Times are Alaska Standard Time**	
Client Name	Paug-Vik Development Corp.	**Printed Date/Time**	07/24/2002 19:22
Project Name/#	Ekwok Well Drilling	**Collected Date/Time**	07/12/2002 9:30
Client Sample ID	02EK-NELS	**Received Date/Time**	07/15/2002 8:45
Matrix	Drinking Water	**Technical Director**	**Stephen C. Ede**
Ordered By			

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
Waters Department								
Alkalinity	29.0	10.0	mg/L	SM20 2320B			07/18/02	NCS
Total Dissolved Solids	200 U	200	mg/L	SM20 2540C			07/15/02	AS

CT&E Environmental Services Inc.

CT&E Ref.#	1024328004	**All Dates/Times are Alaska Standard Time**	
Client Name	Paug-Vik Development Corp.	**Printed Date/Time**	07/24/2002 19:22
Project Name/#	Ekwok Well Drilling	**Collected Date/Time**	07/12/2002 9:30
Client Sample ID	02EK-NELS	**Received Date/Time**	07/15/2002 8:45
Matrix	Drinking Water	**Technical Director**	**Stephen C. Ede**
Ordered By			
PWSID	0	**Released By**	Shawn Preston

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
Metals by ICP/MS								
Iron	250 U	250	ug/L	EPA 200.8 Dissolved		07/15/02	07/18/02	KGF

F-701

CT&E Environmental Services Inc.

CT&E Ref.#	1024328005
Client Name	Paug-Vik Development Corp.
Project Name/#	Ekwok Well Drilling
Client Sample ID	02EK-NICK
Matrix	Drinking Water
Ordered By	
PWSID	0

All Dates/Times are Alaska Standard Time

Printed Date/Time	07/24/2002 19:22
Collected Date/Time	07/12/2002 9:30
Received Date/Time	07/15/2002 8:45
Technical Director	**Stephen C. Ede**
Released By	Shawn Preston

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
Metals by ICP/MS								
Iron	263	250	ug/L	EPA 200.8 Dissolved		07/15/02	07/18/02	KGF

F-701

CT&E Environmental Services Inc.

CT&E Ref.#	440729 Method Blank	**Printed Date/Time**	07/24/2002 19:22
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Matrix	Water (Surface, Eff., Ground)	**Date**	

QC results affect the following production samples:

1024328001, 1024328002

Sample Remarks:

Parameter	Results	Reporting Limit	Units	Analysis Date	Init
Waters Department					
Alkalinity	5.00 U	5.00	mg/L	07/18/02	NCS
Batch WTI 1981					
Method SM20 2320B					
Instrument					

CT&E Environmental Services Inc.

CT&E Ref.#	440730 Lab Control Sample	**Printed Date/Time**	07/24/2002 19:23
		Prep Batch	
Client Name	Paug-Vik Development Corp.	**Method**	
Project Name/#	Ekwok Well Drilling	**Date**	
Matrix	Water (Surface, Eff., Ground)		

QC results affect the following production samples:
1024328001, 1024328002

Sample Remarks:
LCS

Parameter		QC Results	Pct Recov	LCS/LCSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date	Init
Waters Department									
Alkalinity		LCS 252	101	(90-110)			250 mg/L	07/18/02	NCS
Batch	WTI 1981								
Method	SM20 2320B								
Instrument									

F-701

CT&E Environmental Services Inc.

CT&E Ref.#	440731 Duplicate	**Printed Date/Time**	07/24/2002 19:22
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Original	1023497001	**Date**	
Matrix	Water (Surface, Eff., Ground)		

QC results affect the following production samples:

1024328001, 1024328002

Sample Remarks:

Parameter	Original Result	QC Result	RPD	RPD Limits	Analysis Date	Init
Waters Department						
Alkalinity	137	137	0	(< 20)	07/18/02	NCS
Batch WTI 1981						
Method SM20 2320B						
Instrument						

F-701

CT&E Environmental Services Inc.

CT&E Ref.#	440208 Method Blank	**Printed Date/Time**	07/24/2002 19:22
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Matrix	Water (Surface, Eff., Ground)	**Date**	

QC results affect the following production samples:

1024328002, 1024328003

Sample Remarks:

Parameter	Results	Reporting Limit	Units	Analysis Date	Init
Waters Department					
Bromide	0.100 U	0.100	mg/L	07/15/02	JDT
Chloride	0.100 U	0.100	mg/L	07/15/02	JDT
Fluoride	0.100 U	0.100	mg/L	07/15/02	JDT
Nitrate-N	0.100 U	0.100	mg/L	07/15/02	JDT
Nitrite-N	0.100 U	0.100	mg/L	07/15/02	JDT
Sulfate	0.116	0.100	mg/L	07/15/02	JDT

Batch WIC 2714
Method EPA 300.0
Instrument Dionex DX-300 HPLC

CT&E Environmental Services Inc.

CT&E Ref.#	440209 Lab Control Sample	**Printed Date/Time**	07/24/2002 19:23
		Prep Batch	
Client Name	Paug-Vik Development Corp.	**Method**	
Project Name/#	Ekwok Well Drilling	**Date**	
Matrix	Water (Surface, Eff., Ground)		

QC results affect the following production samples:
1024328002, 1024328003

Sample Remarks:
LCS

Parameter		QC Results	Pct Recov	LCS/LCSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date	Init
Waters Department									
Bromide	LCS	4.85	97	(90-110)			5 mg/L	07/15/02	JDT
Chloride	LCS	4.93	99	(90-110)			5 mg/L	07/15/02	JDT
Fluoride	LCS	4.52	90	(90-110)			5 mg/L	07/15/02	JDT
Nitrate-N	LCS	4.56	91	(90-110)			5 mg/L	07/15/02	JDT
Nitrite-N	LCS	4.74	95	(90-110)			5 mg/L	07/15/02	JDT
Sulfate	LCS	4.81	96	(90-110)			5 mg/L	07/15/02	JDT

Batch WIC 2714
Method EPA 300.0
Instrument Dionex DX-300 HPLC

CT&E Environmental Services Inc.

CT&E Ref.#	440203 Undigested Duplicate	**Printed Date/Time**	07/24/2002 19:22
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Original		**Date**	
Matrix	Drinking Water		

QC results affect the following production samples:

1024328002, 1024328003

Sample Remarks:

Parameter	Original Result	QC Result	RPD	RPD Limits	Analysis Date	Init
Waters Department						
Nitrate-N	3.72	3.80	2	(< 20)	07/15/02	JDT

Batch WIC 2714
Method EPA 300.0
Instrument Dionex DX-300 HPLC

CT&E Environmental Services Inc.

CT&E Ref.#	440205 Undigested Duplicate	**Printed Date/Time**	07/24/2002 19:22
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Original		**Date**	
Matrix	Drinking Water		

QC results affect the following production samples:

1024328002, 1024328003

Sample Remarks:

Parameter	Original Result	QC Result	RPD	RPD Limits	Analysis Date	Init
Waters Department						
Nitrate-N	0.200	0.200	0	(< 20)	07/15/02	JDT
Batch WIC 2714						
Method EPA 300.0						
Instrument Dionex DX-300 HPLC						

CT&E Environmental Services Inc.

CT&E Ref.#	440261 Method Blank	**Printed Date/Time**	07/24/2002 19:22
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Matrix	Water (Surface, Eff., Ground)	**Date**	

QC results affect the following production samples:

1024328001, 1024328002

Sample Remarks:

Parameter	Results	Reporting Limit	Units	Analysis Date	Init
Waters Department					
Total Dissolved Solids	23.8F	25.0	mg/L	07/15/02	AS
Batch WAT 3625					
Method SM20 2540C					
Instrument					

CT&E Environmental Services Inc.

CT&E Ref.#	440262 Lab Control Sample	**Printed Date/Time**	07/24/2002 19:23
		Prep Batch	
Client Name	Paug-Vik Development Corp.	**Method**	
Project Name/#	Ekwok Well Drilling	**Date**	
Matrix	Water (Surface, Eff., Ground)		

QC results affect the following production samples:
1024328001, 1024328002

Sample Remarks:
LCS

Parameter		QC Results	Pct Recov	LCS/LCSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date	Init
Waters Department									
Total Dissolved Solids	LCS	263	122	(75-125)			214 mg/L	07/15/02	AS
Batch	WAT 3625								
Method	SM20 2540C								
Instrument									

CT&E Environmental Services Inc.

CT&E Ref.#	440118 Method Blank	**Printed Date/Time**	07/24/2002 19:22
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Matrix	Water (Surface, Eff., Ground)	**Date**	

QC results affect the following production samples:

1024328002

Sample Remarks:

Parameter	Results	Reporting Limit	Units	Analysis Date	Init
Microbiology Laboratory					
Total Coliform	0		col/100mL	07/15/02	KAP
Batch BTF 4851					
Method SM18 9222B					
Instrument					

CT&E Environmental Services Inc.

CT&E Ref.#	440602 Method Blank	**Printed Date/Time**	07/24/2002 19:22
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Matrix	Water (Surface, Eff., Ground)	**Date**	

QC results affect the following production samples:

1024328003

Sample Remarks:

Parameter	Results	Reporting Limit	Units	Analysis Date	Init
E. Coli	Negative	0	100mL	07/15/02	KAP
Total Coliform	Negative	0	100mL	07/15/02	KAP

Batch BTF 4853
Method SM18 9223B
Instrument

CT&E Environmental Services Inc.

CT&E Ref.#	440600 Undigested Duplicate	**Printed Date/Time**	07/24/2002 19:22
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Original	1024328004	**Date**	
Matrix	Drinking Water		

QC results affect the following production samples:

1024328004, 1024328005

Sample Remarks:

Parameter	Original Result	QC Result	RPD	RPD Limits	Analysis Date	Init
Iron	250 U	250 U	127		07/18/02	KGF

Batch MMS 2101
Method EPA 200.8
Instrument Perkin Elmer Sciex ICP-MS P3

CT&E Environmental Services Inc.

CT&E Ref.#	440097 Method Blank	**Printed Date/Time**	07/24/2002 19:22
Client Name	Paug-Vik Development Corp.	**Prep Batch**	MXX 10296
Project Name/#	Ekwok Well Drilling	**Method**	E200.2
Matrix	Water (Surface, Eff., Ground)	**Date**	07/16/2002

QC results affect the following production samples:

1024328001, 1024328002

Sample Remarks:

Parameter	Results	Reporting Limit	Units	Analysis Date	Init
Phosphorus	500 U	500	ug/L	07/18/02	KGF

Batch MMS 2101
Method EPA 200.8
Instrument Perkin Elmer Sciex ICP-MS P3

Metals by ICP/MS

Aluminum	20.0 U	20.0	ug/L	07/18/02	KGF
Antimony	1.00 U	1.00	ug/L	07/18/02	KGF
Arsenic	1.63F	2.00	ug/L	07/18/02	KGF
Barium	3.00 U	3.00	ug/L	07/18/02	KGF
Beryllium	0.400 U	0.400	ug/L	07/18/02	KGF
Cadmium	0.100 U	0.100	ug/L	07/18/02	KGF
Calcium	500 U	500	ug/L	07/18/02	KGF
Chromium	4.00 U	4.00	ug/L	07/18/02	KGF
Cobalt	4.00 U	4.00	ug/L	07/18/02	KGF
Copper	1.00 U	1.00	ug/L	07/18/02	KGF
Iron	250 U	250	ug/L	07/18/02	KGF
Lead	0.400 U	0.400	ug/L	07/18/02	KGF
Magnesium	500 U	500	ug/L	07/18/02	KGF
Manganese	5.00 U	5.00	ug/L	07/18/02	KGF
Molybdenum	10.0 U	10.0	ug/L	07/18/02	KGF
Nickel	5.00 U	5.00	ug/L	07/18/02	KGF
Potassium	500 U	500	ug/L	07/18/02	KGF
Selenium	2.00 U	2.00	ug/L	07/18/02	KGF
Sodium	500 U	500	ug/L	07/18/02	KGF
Zinc	2.00 U	2.00	ug/L	07/18/02	KGF
Silver	1.00 U	1.00	ug/L	07/18/02	KGF
Thallium	0.300 U	0.300	ug/L	07/18/02	KGF
Vanadium	5.00 U	5.00	ug/L	07/18/02	KGF

Batch MMS 2101
Method EPA 200.8
Instrument Perkin Elmer Sciex ICP-MS P3

CT&E Environmental Services Inc.

CT&E Ref.#	440098 Lab Control Sample	**Printed Date/Time**	07/24/2002 19:23
		Prep Batch	MXX 10296
Client Name	Paug-Vik Development Corp.	**Method**	E200.2
Project Name/#	Ekwok Well Drilling	**Date**	07/16/2002
Matrix	Water (Surface, Eff., Ground)		

QC results affect the following production samples:
1024328001, 1024328002

Sample Remarks:

Parameter		QC Results	Pct Recov	LCS/LCSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date	Init
Batch	MMS 2101								
Method	EPA 200.8								
Instrument	Perkin Elmer Sciex ICP-MS P3								
Metals by ICP/MS									
Aluminum		LCS	920	92	(85-115)		1000 ug/L	07/18/02	KGF
Antimony		LCS	953	95	(85-115)		1000 ug/L	07/18/02	KGF
Arsenic		LCS	976	98	(85-115)		1000 ug/L	07/18/02	KGF
Barium		LCS	970	97	(85-115)		1000 ug/L	07/18/02	KGF
Beryllium		LCS	397	99	(85-115)		400 ug/L	07/18/02	KGF
Cadmium		LCS	488	98	(85-115)		500 ug/L	07/18/02	KGF
Calcium		LCS	10400	104	(85-115)		10000 ug/L	07/18/02	KGF
Chromium		LCS	917	92	(85-115)		1000 ug/L	07/18/02	KGF
Cobalt		LCS	961	96	(85-115)		1000 ug/L	07/18/02	KGF
Copper		LCS	961	96	(85-115)		1000 ug/L	07/18/02	KGF
Iron		LCS	947	95	(85-115)		1000 ug/L	07/18/02	KGF
Lead		LCS	954	95	(85-115)		1000 ug/L	07/18/02	KGF
Magnesium		LCS	9750	98	(85-115)		10000 ug/L	07/18/02	KGF
Manganese		LCS	945	95	(85-115)		1000 ug/L	07/18/02	KGF
Molybdenum		LCS	930	93	(85-115)		1000 ug/L	07/18/02	KGF
Nickel		LCS	974	97	(85-115)		1000 ug/L	07/18/02	KGF
Potassium		LCS	9640	96	(85-115)		10000 ug/L	07/18/02	KGF
Selenium		LCS	1010	101	(85-115)		1000 ug/L	07/18/02	KGF
Sodium		LCS	9700	97	(85-115)		10000 ug/L	07/18/02	KGF
Zinc		LCS	961	96	(85-115)		1000 ug/L	07/18/02	KGF
Silver		LCS	188	94	(85-115)		200 ug/L	07/18/02	KGF
Thallium		LCS	939	94	(85-115)		1000 ug/L	07/18/02	KGF
Vanadium		LCS	951	95	(85-115)		1000 ug/L	07/18/02	KGF
Batch	MMS 2101								
Method	EPA 200.8								
Instrument	Perkin Elmer Sciex ICP-MS P3								

CT&E Environmental Services Inc.

CT&E Ref.#	441437 Undigested Duplicate	**Printed Date/Time**	07/24/2002 19:22
Client Name	Paug-Vik Development Corp.	**Prep Batch**	
Project Name/#	Ekwok Well Drilling	**Method**	
Original	1024309001	**Date**	
Matrix	Drinking Water		

QC results affect the following production samples:

1024328001, 1024328002

Sample Remarks:

Parameter	Original Result	QC Result	RPD	RPD Limits	Analysis Date	Init
Thallium	0.300 U	0.300 U	0		07/22/02	KGF
Selenium	2.00 U	2.00 U	13		07/22/02	KGF
Nickel	11.8	23.8	68		07/22/02	KGF
Chromium	4.00 U	4.27	15		07/22/02	KGF
Cadmium	0.100 U	0.100 U	0		07/22/02	KGF
Beryllium	0.400 U	0.400 U	600		07/22/02	KGF
Barium	41.0	40.8	0		07/22/02	KGF
Arsenic	18.7	17.7	6		07/22/02	KGF
Antimony	1.00 U	1.00 U	93		07/22/02	KGF

Batch MMS 2104
Method EPA 200.8
Instrument Perkin Elmer Sciex ICP-MS P3

CT&E Environmental Services Inc.

CT&E Ref.#	440102	Matrix Spike	**Printed Date/Time**	07/24/2002 19:23
			Prep Batch	MXX 10296
			Method	DW Digest for Metals on I
			Date	07/16/2002
Original	1024337001			
Matrix	Water (Surface, Eff., Ground)			

QC results affect the following production samples:
1024328001, 1024328002

Sample Remarks:

Parameter		Original Result	QC Result	Pct Recov	MS/MSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date	Init
Batch	MMS 2104									
Method	EPA 200.8									
Instrument	Perkin Elmer Sciex ICP-MS P3									
Metals by ICP/MS										
Potassium	MS	9950	9900	98	(70-130)			10000 ug/L	07/22/02	KGF
	MSD		9950	98		0	(< 20)	10000 ug/L	07/22/02	KGF
Aluminum	MS	1240	1260	111	(70-130)			1000 ug/L	07/22/02	KGF
	MSD		1240	109		2	(< 20)	1000 ug/L	07/22/02	KGF
Zinc	MS	1010	998	99	(70-130)			1000 ug/L	07/22/02	KGF
	MSD		1010	100		2	(< 20)	1000 ug/L	07/22/02	KGF
Sodium	MS	10300	10500	100	(70-130)			10000 ug/L	07/22/02	KGF
	MSD		10300	98		2	(< 20)	10000 ug/L	07/22/02	KGF
Nickel	MS	978	987	99	(70-130)			1000 ug/L	07/22/02	KGF
	MSD		978	98		1	(< 20)	1000 ug/L	07/22/02	KGF
Manganese	MS	1000	1000	99	(70-130)			1000 ug/L	07/22/02	KGF
	MSD		1000	100		0	(< 20)	1000 ug/L	07/22/02	KGF
Magnesium	MS	11500	11600	99	(70-130)			10000 ug/L	07/22/02	KGF
	MSD		11500	99		0	(< 20)	10000 ug/L	07/22/02	KGF
Lead	MS	988	987	99	(70-130)			1000 ug/L	07/22/02	KGF
	MSD		988	99		0	(< 20)	1000 ug/L	07/22/02	KGF
Cadmium	MS	502	501	100	(70-130)			500 ug/L	07/22/02	KGF
	MSD		502	100		0	(< 20)	500 ug/L	07/22/02	KGF
Calcium	MS	14700	14500	99	(70-130)			10000 ug/L	07/22/02	KGF
	MSD		14700	101		1	(< 20)	10000 ug/L	07/22/02	KGF
Copper	MS	967	958	96	(70-130)			1000 ug/L	07/22/02	KGF
	MSD		967	97		1	(< 20)	1000 ug/L	07/22/02	KGF
Batch	MMS 2104									
Method	EPA 200.8									
Instrument	Perkin Elmer Sciex ICP-MS P3									

CHAIN OF CUSTODY RECORD

1024328

CT&E Environmental Services Inc.
Laboratory Division

(1)

CLIENT: Paug-Vik Development Co.
CONTACT: Caryn Orvis PHONE NO: (907) 258-1345
PROJECT: Ekwok Well Drilling PWSID#:
REPORTS TO: Caryn Orvis FAX NO: (907) 222-5423
INVOICE TO: Paug-Vik Devel. QUOTE# 5833
P.O. NUMBER: 0068-5

CT&E Reference:

PAGE 1 OF 1

(2)

LAB NO.	SAMPLE IDENTIFICATION	DATE	TIME	MATRIX	No. CONTAINERS	SAMPLE TYPE C=COMP G=GRAB	Preservatives Used	HNO3	HNO3	4°C	4°C	Nones 9/40					REMARKS
							Analysis Required (3)	Metals/Hardness	Dissolved Fe	300.0 NO3/NO2/SO4/Cl	TDS/Alkalinity	Total Coliform					
(1) A~~-C~~ FAT 7/15/02	OZEK-NELS	7-12-02 ~~7-14-02~~	0930 ~~1000~~	Water	~~5~~ 3	G		1	1	~~CO~~	1	~~CO~~					
(2) A-B	OZEK-NICK	7-14-02	0945	Water	5	G		1	1	1	1	1					
(3) A-B	OZEK-NELS 2	7-14-02	1000	Water	2	G			1			1					
								(6) A	(5) A								

(5)

Collected/Relinquished By: (1)	Date	Time	Received By:
Caryn A. Orvis	7/14/02	1035	
Relinquished By: (2)	Date	Time	Received By:
~~Relinquished By: (3)~~	Date	Time	Received By:
Relinquished By: (4)	Date	Time	Received For Laboratory By:
Caryn A. Orvis	7/15/02	0845	Heather Hansen

(4)

Shipping Carrier:
Shipping Ticket No:
Temperature C: Cooler = 3.4 TB = 3.9
Data Deliverables:
Level I Level II Level III EDD Type:
Chain of Custody Seal: (Circle)
INTACT BROKEN ABSENT
Requested Turnaround Time and Special Instructions:

200 W. Potter Drive **Anchorage, AK 99518** Tel: (907) 562-2343 Fax: (907) 561-5301
3180 Peger Road **Fairbanks, AK 99701** Tel: (907) 474-8656 Fax: (907) 474-9685

White - Retained by Lab (Project File) Yellow - Returned with Report Pink - Retained by Sampler

Table 3-2 Test Well Samples: Analytical Detections and Data Exceeding Criteria

Analyte Group	Analyte or Parameter	Units	Sample Location	Sample ID	Result	Criteria Exceeded (Y/N)	Primary Criteria	Note
Chloride	Chloride	mg/L	J. Hurley	02 EK-HURL	1.59		250 mg/L	
		mg/L	M. Kawaglia	02EK-KAWA	1.99		250 mgL	
		mg/L	V. Taylor	02EK-ATKI	1.67		250 mgL	
		mg/L	L. Walcott	02EK-WALC	6.65		250 mgL	
		mg/L	W. Nickolai	02EK-NICK	2.92		250 mgL	
		mg/L	T. Nelson	02EK-NELS	4.68		250 mgL	
Nitrogen	Nitrate	mg/L	J. Hurley	02 EK-HURL	1		10.0 mg/L	
		mg/L	M. Kawaglia	02EK-KAWA	1.05		10.0 mg/L	
		mg/L	V. Taylor	02EK-ATKI	1		10.0 mg/L	
		mg/L	L. Walcott	02EK-WALC	1		10.0 mg/L	
		mg/L	W. Nickolai	02EK-NICK	1.29		10.0 mg/L	
		mg/L	T. Nelson	02EK-NELS	0.489		10.0 mg/L	
	Nitrite	mg/L	J. Hurley	02 EK-HURL	1		1.0 mg/L	
		mg/L	M. Kawaglia	02EK-KAWA	1		1.0 mg/L	
		mg/L	V. Taylor	02EK-ATKI	1		1.0 mg/L	
		mg/L	L. Walcott	02EK-WALC	1		1.0 mg/L	
		mg/L	W. Nickolai	02EK-NICK	0.2		1.0 mg/L	
		mg/L	T. Nelson	02EK-NELS	0.2		1.0 mg/L	
Sulfate	Sulfate	mg/L	J. Hurley	02 EK-HURL	1		250 mg/L	
		mg/L	M. Kawaglia	02EK-KAWA	1.55		250 mg/L	
		mg/L	V. Taylor	02EK-ATKI	1.85		250 mg/L	
		mg/L	L. Walcott	02EK-WALC	2.54		250 mg/L	
		mg/L	W. Nickolai	02EK-NICK	1.4		250 mg/L	
		mg/L	T. Nelson	02EK-NELS	1.21		250 mg/L	
Total Dissolved Solids	Total Dissolved Solids	mg/L	J. Hurley	02 EK-HURL	118		500 mg/L	
		mg/L	M. Kawaglia	02EK-KAWA	70		500 mg/L	
		mg/L	V. Taylor	02EK-ATKI	83.8		500 mg/L	
		mg/L	L. Walcott	02EK-WALC	103		500 mg/L	
		mg/L	W. Nickolai	02EK-NICK	100		500 mg/L	
		mg/L	T. Nelson	02EK-NELS	200		500 mg/L	
Hardness As $CaCO_3$	Hardness as $CaCO_3$	mg/L	J. Hurley	02 EK-HURL	12.1			
		mg/L	M. Kawaglia	02EK-KAWA	14.4			
		mg/L	V. Taylor	02EK-ATKI	14			
		mg/L	L. Walcott	02EK-WALC	22.5			
		mg/L	W. Nickolai	02EK-NICK	14.1			
		mg/L	T. Nelson	02EK-NELS	33.6			
Alkalinity	Alkalinity	mg/L	J. Hurley	02 EK-HURL	10.5		20000 ug/L	
		mg/L	M. Kawaglia	02EK-KAWA	1.05		20000 ug/L	
		mg/L	V. Taylor	02EK-ATKI	20		20000 ug/L	
		mg/L	L. Walcott	02EK-WALC	27		20000 ug/L	
		mg/L	W. Nickolai	02EK-NICK	14.5		20000 ug/L	
		mg/L	T. Nelson	02EK-NELS	29		20000 ug/L	
Total Dissolved Iron	Total Dissolved Iron	ug/L	J. Hurley	02 EK-HURL	250			
		ug/L	M. Kawaglia	02EK-KAWA	407			
		ug/L	V. Taylor	02EK-ATKI	1010			
		ug/L	L. Walcott	02EK-WALC	3200			
		ug/L	W. Nickolai	02EK-NICK	263			
		ug/L	T. Nelson	02EK-NELS	250			
Total Coliform	Total Coliform	mg/L	J. Hurley	02 EK-HURL	**Positive**			
		mg/L	M. Kawaglia	02EK-KAWA	Negative			
		mg/L	V. Taylor	02EK-ATKI	Negative			
		mg/L	L. Walcott	02EK-WALC	Negative			
		mg/L	W. Nickolai	02EK-NICK	**Postive**			
		mg/L	T. Nelson	02EK-NELS	Negative			

Table 4-1: Ekwok Test Well Samples Analytical Results

Analyte Group:		Anions				General Parameters			Bacteria	Iron	ICP-23 Element Scan						
Well	**Sample ID**	**Chloride (mg/L)**	**Nitrate (mg/L)**	**Nitrite (mg/L)**	**Sulfate (mg/L)**	**Total Dissolved Solids (mg/L)**	**Hardness (mg/L)**	**Alkalinity (mg/L)**	**Total Coliform**	**Dissolved Iron (mg/L)**	**Aluminum (ug/L)**	**Antimony (ug/L)**	**Arsenic (ug/L)**	**Barium (ug/L)**	**Beryllium (ug/L)**	**Cad-mium (ug/L)**	**Calcium (mg/L)**
Drinking Water Standards[1]		250 [3]	10	1	250 [3]	500 [3]	NLE	NLE	Negative	0.3 [3]	NLE	6	50 [4]	2000	4	5	NLE
02HURL-01	02EK-HURL	1.59	1 [2]	1 [2]	1 [2]	118	12.1	10.5	**Positive**	0.25 [2]	1950	1 [2]	2 [2]	14.8	0.4 [2]	0.1 [2]	3.15
02KAWA-02	02EK-KAWA	1.99	1.05	1 [2]	1.55	70	14.4	1.05	Negative	**0.407**	21.1	1 [2]	2 [2]	3.41	0.4 [2]	0.1 [2]	3.91
02ATKI-03	02EK-ATKI	1.67	1	1 [2]	1.85	83.8	14	20	Negative	**1.01**	247	1 [2]	2 [2]	5.91	0.4 [2]	0.124	3.87
02WALC-05	02EK-WALC	6.65	1 [2]	1 [2]	2.54	103	22.5	27	Negative	**3.2**	20 [2]	1 [2]	5.4	7.01	0.4 [2]	0.1 [2]	5.82
02NICK-06	02EK-NICK	2.92	1.29	0.2 [2]	1.4	100 [2]	14.1	14.5	**Positive**	0.263	154	1 [2]	2 [2]	4.68	0.4 [2]	0.1 [2]	3.6
02NELS-07	02EK-NELS	4.68	0.49	0.2 [2]	1.21	200 [2]	33.6	29	Negative	0.25 [2]	8160	1 [2]	4.89	65.1	0.4 [2]	0.1 [2]	7.37

Additional Analytical Results

Analyte Group:		ICP-23 Element Scan (continued)															
Well	**Sample ID**	**Cobalt (ug/L)**	**Copper (ug/L)**	**Iron (mg/L)**	**Lead (ug/L)**	**Magnes-ium (mg/L)**	**Manganese (ug/L)**	**Molyb-denum (ug/L)**	**Nickel (ug/L)**	**Phos-phorus (ug/L)**	**Potassium (ug/L)**	**Selenium (ug/L)**	**Sodium (mg/L)**	**Zinc (ug/L)**	**Silicon (mg/L)**	**Silver (ug/L)**	**Thallium (ug/L)**
Drinking Water Standards[1]		NLE	1000 [3]	0.3 [3]	15	NLE	500 [3]	NLE	100	NLE	NLE	50	250 [3]	5000 [3]	NLE	100 [3]	2
02HURL-01	02EK-HURL	4 [2]	7.76	**12.1**	2.95	1.02	70.1	10 [2]	6.35	500 [2]	558	2 [2]	2.63	27	10.9	1 [2]	0.311
02KAWA-02	02EK-KAWA	4 [2]	4.07	**3.82**	0.4 [2]	1.14	26.9	10 [2]	5 [2]	500 [2]	500 [2]	2.51	3.58	3.86	7.84	1 [2]	1.92
02ATKI-03	02EK-ATKI	4 [2]	4.56	**4.36**	3.32	1.06	40.9	10 [2]	12.2	500 [2]	500 [2]	2 [2]	2.76	11.8	8.01	1 [2]	0.667
02WALC-05	02EK-WALC	4 [2]	1.84	**3.36**	0.4 [2]	1.94	160	10 [2]	5 [2]	500 [2]	720	2 [2]	4.81	3.93	9.6	1 [2]	0.601
02NICK-06	02EK-NICK	4 [2]	2.04	**1.3**	0.4 [2]	1.23	33.1	10 [2]	5 [2]	500 [2]	500 [2]	2 [2]	2.83	2 [2]	6.87	1 [2]	0.3 [2]
02NELS-07	02EK-NELS	5.46	24	**19.1**	5.13	3.69	260	10 [2]	14	500 [2]	1390	2 [2]	18.1	138	19.2	1 [2]	0.3 [2]

Notes

1. ADEC 18 AAC 80 Drinking Water Regulations August 23, 2000, public water supply, primary MCL (except where noted).
2. The analyte was analyzed for but not detected. The number given is the laboratory detection limit.
3. ADEC 18 AAC 80 Drinking Water Regulations August 23, 2000, class C public water supply, secondary MCL.
4. Currently the MCL for arsenic is 50 ug/L, however the new MCL for arsenic is 10 ug/L and will go into effect by the year 2006.

NLE = No limits established.

mg/L = milligrams per liter
ug/L = micrograms per liter

Exceedances noted in **bold.**

Table 4-1: Ekwok Test Well Samples Analytical Results

Chromium (ug/L)
100
7.25
4 [2]
11.4
4 [2]
4 [2]
12.8

Vanadium (ug/L)
NLE
5 [2]
5 [2]
5 [2]
5 [2]
5 [2]
26.5

Appendix F

Paug-Vik's February 22, 2002, Review Memorandum of

1994 *Well Rehabilitation Plan* prepared by

Bristol Environmental

file

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pdc_environmental@pvil.com

February 22, 2002

Ms. Lynn Marino P.E.
State of Alaska Village Safe Water
555 Cordova Street
Anchorage, Alaska 99501

Subject: **Review of *Ekwok Well Rehabilitation Plan* Prepared by Bristol Environmental for Well Rehabilitation Study at Ekwok, Alaska.**

Dear Ms. Marino:

Paug-Vik Development Corporation (PDC) is pleased to provide our review of the *Ekwok Well Rehabilitation Plan* dated December 1994 that was prepared by Bristol Environmental for the above referenced project. This letter constitutes a review of this document and a summary of the author's professional opinion regarding the report's conclusions.

The *Ekwok Well Rehabilitation Plan* considers each of the 20 HUD houses that are located in Ekwok. The report does not cover the 12 non-HUD houses located in Ekwok, nor does this letter review consider any of these non-HUD homes. A review and overall priority ranking that includes these non-HUD homes will be provided in the Draft Work Plan that is due on March 22, 2002.

According to the Ekwok Well Rehabilitation Plan, two aquifers underlie Ekwok. A deeper confined aquifer at depths of 65 to 80 feet that yields water high in iron (2.5-14 mg/L) and manganese (0.14-2.2 mg/L). A second unconfined aquifer is found at depths of a few feet to 50 feet and yields good quality water for which the majority of testing has not exceeded the ADEC's drinking water quality criteria (18 AAC 70). The majority of wells in Ekwok tap into the deeper aquifer and residents complain about the water quality and the expense and labor required using water-softening equipment to remove the iron and manganese.

The *Ekwok Well Rehabilitation Plan*, in general, recommends drilling of a well to tap the shallow aquifer for each of the homes in Ekwok. The report identifies two primary risks from the tapping of the shallow aquifer as a household water supply source. First there is the risk resulting from the greater potential for contamination of shallow wells resulting from human activities. The potential sources of contamination identified for Ekwok included the following items:

- Septic system sources;
- A former dump site that is located less than 200 ft east of Lot2 Block2;
- Fuel spills or leaks; and
- Graveyards

The second potential source risk identified is that wells that tap the shallow aquifer may not yield sufficient water to meet household needs. Obviously, this risk will be greatest where the shallow aquifer is the thinnest and will also be affected by seasonal variations in the shallow aquifer groundwater elevation.

Two other factors were considered in the development of a priority-ranking scheme for determining the selection of well drilling sites. They included 1) relative problems caused by the exiting well (such as iron concentrations) and 2) relative cost of drilling the shallow well (based on length of water line needed to connect well).

I agree that these are the primary risks associated with the tapping of the shallow aquifer and that it would be my recommendation to use these risk criteria as a basis for priority ranking of the well drilling activities. However, I would suggest that the following factors also be included in the criteria. First, it is not evident what information was used to account for the relative likelihood of adequate aquifer yield. Providing geological information, such as estimated aquifer thickness, would better clarify how the ranking was achieved. Second, the depth of drilling for the shallow well should be added to the relative cost factor. In many instances, the well drilling costs constitute the majority of the water supply cost. It may also be advisable to develop a numerical ranking system for each of the criteria to more clearly indicate how the overall priority ranking was achieved.

Overall the suggested priority ranking for Ekwok properties appears to be reasonable for the factors that were considered. It is not yet known how the priority ranking may be revised, if at all, considering the addition of the recommendations listed above or the addition of the non-HUD homes.

I hope this letter addresses any concerns regarding the recommendations of the *Ekwok Well Rehabilitation Plan.* If you have any questions please contact me at (907) 258-4880.

Sincerely,

Tim McDougall, PE
Paug-Vik Development Corporation

Cc: Rob Brown City of Ekwok

Appendix G

Ekwok City Council Resolution 03-07 to Accept

The Findings of the 2002 Well Drilling Program

CITY OF EKWOK

RESOLUTION # 03-07

A resolution supporting the recommendations of the Ekwok Groundwater Investigation and Well Rehabilitation Study, prepared by Paug-Vik Development Corporation, September 2002.

WHEREAS: The Ekwok City Council is the governing body of Ekwok, Alaska, and

WHEREAS: The Council desires to improve sanitation in Ekwok, and

WHEREAS: The City of Ekwok hired Paug-Vik Development Corporation (PVDC) to study groundwater in Ekwok, and

WHEREAS: PVDC has completed the study and confirms that wells tapping a shallow, unconfined aquifer in the community are a potentially viable means of supplying water to most of the homes in Ekwok, and

WHEREAS: PVDC further recommends that additional wells be drilled into the shallow aquifer and that houses be hooked up to these wells, when the city can afford to do so,

NOW THEREFORE BE IT RESOLVED, that the City of Ekwok supports the recommendations of the Ekwok Groundwater Investigation and Well Rehabilitation Study.

I, the undersigned, hereby certify that the Council is composed of 6 members of who 4, constituting a quorum, were present and that the foregoing resolution was PASSES AND APPRROVED by the Ekwok City Council, this 12 day of September, 2002.

Vote: 4 Yeas ____ Nays Signed _____
Mayor

Attest: City Clerk Council Member