



# Department of Environmental Conservation

DIVISION OF SPILL PREVENTION AND RESPONSE Contaminated Sites Program

> 43335 Kalifornsky Beach Road, Suite 11 Soldotna, Alaska 99669 Main: 907-262-5210 Fax: 907-262-2294 www.dec.alaska.gov

> > File: 2323.38.032

July 14, 2022

Meghan Teegarden Sr. Advisor, Environmental Remediation Safety, Health and Environment Nutrien 5296 Harvest Lake Drive Loveland, Colorado 80538

Re: UNOCAL/Agrium Ammonia Urea Plant ADEC Spill # 1988230918305 Biosparge Remediation System Plan – ADEC Review

Ms. Teegarden:

On June 29, 2022, the Alaska Department of Environmental Conservation (ADEC) Contaminated Sites Program received the <u>Biosparge Remediation System Plan</u>, dated June 23, 2022 and prepared by Cook Inlet Environmental.

ADEC has reviewed the document. In future communications please include the name, address, and signature of the Qualified Environmental Professional who prepared the work plan, the name and address of the person who the report is prepared for at Nutrien, and the DEC file number and Hazard ID number on a cover letter. This allows staff unfamiliar with the project to file and respond appropriately.

Figure 4, Cross Section highlights a potential issue with the work plan. The ammonia isolines on Figure 4 are depicted crossing the unsaturated zone of soils below the semi-confining aquitard. This is not a valid method of depicting data. The iso-lines depicting liquid concentrations, cannot cross an unsaturated zone. No soils data has been presented depicting ammonia concentrations. The study *Groundwater Investigation - Interrelationship Between Aquifers and Surface Water Regimes* (Dames & Moore, 1976) highlighted some long-term trends with water table fluctuation at the site. During periods of drought, which we are in currently, the water table fluctuates, rising and falling with changes in precipitation and infiltration.

Since the contamination has moved from the surface through the unconfined to the semi-confined aquifer, we can assume that the aquitard is permeable on site and that the unsaturated soils have been impacted. Not understanding the extent of these unsaturated soils impacts leads to an incomplete conceptual site model, particularly in the source area. With a potential future rise in both the unconfined and semi-confined aquifer water table, additional urea could be mobilized. Understanding and addressing this potential issue now could be

important to the project. Please be aware that future mobilization of urea in the presently unsaturated aquifer, caused by a rise in the water table could delay site remediation.

Were unsaturated soils sampled to completely characterize source area impacts to the unsaturated zone? Was any consideration given to remediation alternatives in the unsaturated zone?

The work plan is approved. If there are any questions, please contact me at (907) 262-3412 or by e-mail at peter.campbell@alaska.gov.

Sincerely,

Peter Campbell

Peter Campbell Environmental Program Specialist

C: Electronic copies: Jene' Worley - Cook Inlet Environmental Lisa Krebs-Barsis – ADEC

Attachment: Groundwater Investigation - Interrelationship Between Aquifers and Surface Water Regimes (Dames & Moore, 1976)

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|-------------------|---|---------------------------------------|--|-------------|-----------|
| * Drilling Co     | Soldotna Driling                                    | USGS no. and                          | ADL                                    | 78077       |           |
| Driller J. S      | hellman b, of rig Cable                             | Date well Smpleted                    | 8/76                                   |             | ·         |
| Well owner Un     | ion Chemicals Division PW No. 6                     | Nearest community                     | Kenai                                  |             |           |
| Well location: (  | address & legal description 2779.7' North &         | Longitude 1512247                     | •                                      |             |           |
| 62.6' W of        | S.E. Corner of Sec. 21,T7N,R12W                     | Latitude 604102                       |  | · · · · ·   |           |
| Depth of well     | 160 ft. Casing: Depth 151                           | ft. Diameter_                         | 16                                     | 1n.         |           |
| Static watern lev | el_61.8ft. (above, below) land sur                  | face. Date                            |  | •<br>•      |           |
| Finish of well:   | (open end, screen, perforated, open hole, other) St | ainless                               |  |             |           |
| Describe screen   | intervals and size: 101-136" = 0.125 Slot           | 136-151 =0.035                        | Slot                                   |             |           |
| Well yield teste  | d by (pumping, bailing, air) at 1200                |                                       |  | gal/min.    |           |
| for 48            | hours withft. of drawdown from sta                  | tic level.                            |  | -<br>-<br>  |           |
|                   | DATILEDIS MATERIAL LOG                              |                                       |  |             |           |
| Depth below lang  | Give description of strata                          | penetrated                            | 4 1999-                                |             |           |
| surface in feet   | (size of material, color, hardness of dri           | ling, and water con                   |  |             |           |
| 0 to 23           | Dry Gravel  |                                       | 8, 9,119                               | III IIII    |           |
| 23 to 71          | Coarse Sand & Gravel-Plenty of Water                | · · · · · · · · · · · · · · · · · · · | Jun                                    |             | <b>L</b>  |
| 71 to 77          | Fine to Medium Sand                                 |                                       |  | EOT         |           |
| 77 to. 101        | Solid Blue Clay Some Large Rock                     | · · ·                                 | INN 25                                 | 1980 5      |           |
| 101 to 109        | Coarse Gravel                                       | For                                   | JAIL OLN                               | at. Res. E- |           |
| 109 to 114        | Coarse Sand & Gravel 30% Gravel                     | 6.1                                   | Kenal                                  |             |           |
| · 114 to 124      | Medium-Coarse Sand- 50% Coarse Gravel               | X                                     |  | 5035        |           |
| 124 to 128        | Coarse Sand & Small Gravel                          |                                       |  |             |           |
| 128 to 136        | Small, Medium, Coarse Gravel with Coars             | e Sand                                |  | •           | بے        |
| 136 to 139        | Very Coarse Sand with 10% Gravel                    |                                       |  |             | ار<br>ع   |
| 139to 160         | Very Coarse Sand Grading to Fine                    |                                       |  |             | S         |
| to                | 51<br>  | •                                     |  |             | loc       |
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| to                | bunch - call & request.                             |                                       | •                                      |             | ã         |
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| to                | -   |                                       | 8/16                                   | 169         | · í<br>8) |
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| to                |   |                                       |  |             | 2<br>2    |
| to                |   |                                       | •                                      |             | 8         |



# VICINITY MAP

FIGURE NO.

#54#6 WELL LAND B. UNDARIES NUK 9 10 This pt. recovered in field 5/16/79 Stan McCare JAN 2 5 1980 Dept. of Nat. Res. Kenai Pen. Area Off \_ 501.8) 1579°E (N76°E-501.80 \$ 7.6° 02' W 78058 212.01 100 70 COLLIER CARBON AND CHEMICAL CORP . \* LINE KENAL ROAD 46 89. INVESTIGATION WELL NO. 5 10' 388.5 (311.65) PRODUCTION WELL NO. 6 Top casing Elev. 92.67 - Dec.14,1976 Ground Elev. 90.5 PRODUCTION WELL Located 2, 779.7' North and NÒ. 5 . Top casing Elev. 91.22 62.6' from the SE corner of Sec. 21, Dec.14,1976 T7N, RI2W, S.M. 1/4 | Position 21 22 4 (177.81 PROP LINE (WEST 608.2) 21 22 28 27

steam system and for potable water for an ammonia and urea plant

from the public waters of the State of Alaska. The location of the water source to which the water right granted appertains is a drilled well, 160 feet deep (PW #6), within that portion of Tract Two (2) as shown on Homestead Entry Survey No. 74 (new No. U.S. Survey 1095) word 5 according to Plat K-672 which is described as follows: 磁路

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Starting at Corner No. 4 of Homestead Entry Survey No. 74 (U.S. Survey No. 1095), go North 1140 feet, the True Point of Beginning and Corner No. 1; thence West 608.2 feet to the intersection with the Kenai Boulder Point Road and Corner No. 2; thence North 23<sup>°</sup>30' West a distance of 457.4 feet to Corner No. 3; thence North 26<sup>°</sup>45' West a distance of 310.9 feet to Corner No. 4; thence South 79<sup>0</sup> East a distance of 483.6 feet to Corner No. 5; thence North 76° East a distance of 501.8 feet to Corner No. 6; thence South along the East boundary of Homestead Entry Survey No. 74, (U.S. Survey No. 1095), a distance of 710 feet to Corner No. 1, said parcel of property located within Sections 21 and 22, Township 7 North, Range 12 West, Seward Meridian.

LS 8-28-80

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| ADDRELS KENAI ALASKA   | MO STRUCTURE .   |
|  | O FT. 10. 23 FT. DRY GRAYEL                                  |
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| COUNTY: OVINER'S MANDER, IF ANY: PROD. WELL C  | GRAYEL - PLENTY  |
| KENAI BEROUGH NEAR NOKISKI, HENSKA   | WATER  |
| 2, 779.7' NOATH & G2.6 WEST OF   | 11 . 77 . FINE - MED. SANA                                   |
| SE CORNER OF SEC. 21 TTN RIZW.   | R R  |
| SEWARD MERIDIAN.   | 17 · 101 · Solio BLUEC                                       |
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|  | 128 - 136 . SMALL MED. CS.                                   |
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| Wrilling Co                                   | Soldotna Drilling                                 | lisos no.  | System  |
| Driller J. S                                  | hellman Type of rig Cable                         | Date well completed  | 8/76  |
| Well owner                                    |   | Nearest community  | Kenai   |
| Well location: (                              | address & legal description 2779.7' North &       | Longitude 1512247  |   |
| 62.6' W of                                    | S.E. Corner of Sec. 21,T7N,R12W                   | Latitude_604102  |   |
| Depth of well                                 | 160 ft. Casing: Depth 151                         | ft. Diameter   | <u>    16                                </u>   |
| Static water lev                              | el 61.8 ft. (above, below) land                   | surface. Date  | •<br>New 2010/00/00/00/00/00/00/00/00/00/00/00/00/  |
| Finish of well:                               | (open end, screen, perforated, open hole, other)  | Stainless  | 54000000000000000000000000000000000000  |
| Describe screen                               | intervals and size: <u>101-136'' = 0.125 Slot</u> | <u>136-151 =0.035 S</u>  | lot   |
| Well yield teste                              | by (pumping, bailing, air) at <u>1200</u>         |  | gal/min.  |
| for <u>48</u>                                 | hours with <u>31.6</u> ft. of drawdown from       | static level.  | · · · · · · · · · · · · · · · · · · ·   |
|   | DRILLER'S MATERIAL LOG                            |  |   |
| Depth below lang                              | Give description of str                           | ata penetrated<br>drilling, and water conte  | nt)   |
| surface in feet                               |   | den ander en   | en e  |
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| <u>71 to 77</u>                               | Solid Blue Clay Some Large Rock                   |  | RECONSIDERED (CONTRACTOR OF CONTRACTOR OF |
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| 124 to 128                                    | Small, Medium, Coarse Gravel with Co              | parse Sand   |   |
| 126 to 130                                    | Very Coarse Sand with 10% Gravel                  |  |   |
| <u>130 to 150</u>                             | Very Coarse Sand Grading to Fine                  |  |   |
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DAMES & MOORE JOB NO. 4828-016-20 MAY 28, 1976

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REPORT GROUND WATER INVESTIGATION INTERRELATIONSHIP BETWEEN AQUIFERS AND SURFACE WATER REGIMES NORTH KENAI AREA, ALASKA FOR COLLIER CARBON AND CHEMICAL CORPORATION

#### SUMMARY

i

The adequacy of existing areal and historic hydrologic data is limited. The U.S. Geological Survey (USGS) is the primary source of data.

Numerous well logs are available but are scattered over wide areas. Many domestic well logs have not been filed with the State of Alaska or the USGS.

Lakes and swamps in the North Kenai region contain large quantities of water. A large proportion of the lakes are part of the general water table. Annual and long-term variations in precipitation are the principal causes of fluctuations in the water levels.

Surface runoff, over most of the North Kenai area, is minimal. In the North Kenai ground water basin, only Bernice Lake has a visible outlet to Cook Inlet. Sources of runoff are snowmelt and rain.

Streams draining the northeast portion of the North Kenai area are Bishop Creek and Beaver Creek. Both have sustained flow, receiving discharge from lakes and ground water.

The water-bearing deposits underlying the study area are glacial outwash deposits and drift of Quaternary age.

Ground water supplies are abundant in the North Kenai area. Two aquifer systems are present -- unconfined water table aquifers and the deeper confined artesian aquifers. The water table aquifer water is high in iron and much of the artesian water in deeper aquifers contains tanin and lignin. Water use during 1975 is estimated to be on the order of 1,100 million gallons, entirely supplied from wells. Of this amount, industry is estimated to have pumped 950 million gallons during 1975.

Precipitation and seepage from lakes are the principal sources of recharge to the water table aquifers. Precipitation is the principal source of recharge to the artesian aquifers. Precipitation at the Kenai Airport averaged 18.97 inches over the 30-year base period (1945-1975).

Evapotranspiration, pumping and f<u>low of aquifer water to Cook Inlet</u>. account for large quantities of ground water discharge.

Based on USGS measurements of high water marks in lakes, the water level has declined as much as 6 feet. This is primarily due to drought conditions and evapotranspiration.

The hydrostatic head of the artesian aquifer has been reduced approximately 6 feet since 1967 due to pumping and reduction of recharge during periods of low precipitation. Indications are that the artesian water level started to stabilize during 1975.

Chemical analyses indicate the water table aguifer to be much higher in iron than the artesian aguifer. A low iron concentration has remained constant in the artesian aguifer.

Hydraulic characteristics of aquifers of the North Kenai area are highly variable. There are high variances in transmissivity, storage characteristics and hydraulic conductivity.

17

A 5-year drought period occurred during 1946-1950 with another drought starting in 1968 and continuing through 1975. The surface water drainage basins in the North Kenai area have had an estimated net loss, related to precipitation, of 45,080 acre-feet of water for the period 1968-75.

A photogrammetric study of five lakes and evaluation of USGS data indicated that water level elevations in the North Kenai area were at very high levels in 1963. These data indicate that between 1963 and 1968 most lake levels in the area dropped about 3 to 4 feet. This water level lowering may have been due to water seeking its long-term natural level or a consequence of the 1964 earthquake. Further decreases occurred during the extreme drought period of 1968 and 1969. Since 1970, lake levels have had no large changes despite the low level of rainfall. Available information indicates that Cabin Lake dropped about 3.3 feet during the period between 1963 and late 1968 and dropped another 3 feet by late 1974. Since late 1974, the lake has raised about 1 foot.

Computer modeling results indicate that approximately 3.7 feet of water level reduction in the Cabin Lake area has occurred between late 1968 and late 1974 (correlating reasonably well with 3 feet of reduction indicated above). The primary cause of this drop may be attributed to the severe drought of 1968 and 1969 in combination with a succession of years of below normal precipitation. Other causes, including residential and industrial pumping, may be responsible for additional reductions. Because the Cabin Lake level has remained essentially constant since 1971, a period when precipitation was below normal every year, it is doubtful that pumping reduced the lake level significantly. The correlation between

iii

measured lake level reduction and the computer results are considered to be reasonable. Further attempts at exact duplication of historical data are impractical.

Results of the computer simulation indicate that about 15 percent of approximately 2.5 feet, or 0.4 feet, of lake level drawdown since Collier started pumping in late 1968 may be attributed to the pumping activities. Photogrammetric data indicate that an additional 2.5 to 3 feet of water level decline occurred prior to the start of Collier's pumping activities.

It is our opinion that water level loss due to pumping is minor when compared to the overall losses in the water resource region. It is also our opinion that water levels may continue to be reduced unless natural recharge in the area return to levels that are normal or above normal.

iv

11

#### GENERAL CONCLUSIONS

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Ground water is abundant in the North Kenai area even though drought conditions have persisted since 1968. The lowering of the water table and lake levels is principally due to lack of precipitation and, consequently, reduction of recharge to lakes and aquifers. Although contributing to these conditions, withdrawals from water wells are a less significant factor.

The seemingly stabilized water levels and apparent reversal of downward trends during 1975 may indicate that discharge is no longer exceeding recharge. However, continuation of drought conditions and increasing localized withdrawals of ground water are of concern. Pumping from water table aquifers has a direct effect on lake levels. Proper planning and management of water resources and continued monitoring of water levels and water usage can avert adverse effects on the hydrologic systems. Pumping from deeper confined aquifers will minimize any possible effects on lake levels. TABLE 1

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SUMMARY OF LAKE LEVELS IN KENAI AREA, ALASKA<sup>a</sup>

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<sup>a</sup>Source: U.S. Geological Survey, arbitrary reference point. <sup>b</sup>Revised 1975.

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TABLE 2

INDUSTRIAL GROUND WATER USAGE

(Yearly Total Gallons x 10<sup>6</sup>)

| User               | 1967              | 1968              | 1969               | 1970              | 161               | 1972              | 1973              | 1974              | 1975              |
|--------------------|-------------------|-------------------|--------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Collier Carbon     | 1                 | 92.0              | 501.0              | 549.2             | 526.0             | 599.0             | 571.0             | 599.0             | 586.0             |
| Phillips Petroleum | <b>.</b>          | 8                 | 33.4               | 156.0             | 167.0             | 193.0             | 154.0             | 163.0             | 192.0             |
| Tesoro             | 1                 | 1                 | 6.3                | 72.2              | 73.0              | 80.0              | 100.0             | 65.0              | 72.0              |
| Standard Oil       | 52.6 <sup>a</sup> | 52.6 <sup>a</sup> | .52.6 <sup>a</sup> | 53.0 <sup>b</sup> |
| Rig Tenders        | 281.0             | 242.4             | 123.4              | 70.2              | 48.0 <sup>a</sup> | 48.0              | 48.0              | 48.0 <sup>b</sup> | 30.0 <sup>b</sup> |
| Chugach Electric   | 15.8              | 15.8 <sup>a</sup> | 15.8 <sup>a</sup>  | 15.8              | 16.0 <sup>b</sup> |
|                    |                   |                   |                    |                   |                   |                   |                   |                   | ۰.                |

<sup>a</sup>Estimated by USGS. <sup>b</sup>Estimated by Dames & Moore.

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TABLE 3

DOMESTIC WATER USE, NORTH KENAI AREA

| Year | Estimated Population <sup>a</sup> | Ground Water Use<br>(million gallons/year) <sup>b</sup> |
|------|-----------------------------------|---|
| 1968 | 2,500                             | 91.2  |
| 1970 | 2,800                             | 102.2   |
| 1975 | 3,100                             | 113.2   |

<sup>a</sup>Population estimate from the Kenai Comprehensive Plan, Alaska State Housing Authority, 1969.

<sup>b</sup>Based upon 100 gpd/person.

17

#### HYDROLOGIC SETTING

18

#### SURFACE WATER AND DRAINAGE

The hydrology of the North Kenai region is controlled by the climatic and terrain features. Topographic relief is variable, ranging from low, swampy areas to the undulating morainal deposits. Streams are generally small and meander through extensive swamp and muskeg areas. With the exception of Bishop Creek, the streams are generally short and discontinuous. Drainage basin boundaries are difficult to define due to the low relief and isolated lakes. However, surface water basin boundaries have tentatively been delineated and divided into major and minor basins by Anderson and Jones (1972) and modified by Dames & Moore for this report (Figure 3). Drainage areas of selected basins have been calculated by planimeter and are presented in Table 5. The area measurement of Bishop Creek surface water basin, as indicated on Figure 3, was terminated at the northernmost boundary of USGS topographic map sheets Kenai C-3 and C-4. Bishop Creek is a perennial stream and drains northward to Cook Inlet. The mean annual peak discharge from streams draining the low swamps east of Nikiski average about 1 cfs per square mile. The mean annual low runoff at Nikiski averages about 0.5 cfs per square mile (Feulner, Childers, and Norman, 1971).

Lakes and swamps in the North Kenai region contain large quantities of water. Some small lakes are perched on relatively impermeable silt above the water table, while others fill topographic lows and are a part of the general water table. Annual and long-term variations in precipitation cause water levels of some lakes to fluctuate considerably. Most lakes within the study area are closed basins or seepage lakes. That is, there is no visible inlet or outlet to the lake, but ground water enters and leaves by seeping through the confines of the lake basin. Cabin, Wick, and Douglas Lakes are examples of closed basin or seepage lakes. Other lakes, such as Bernice, Salamatof, and Daniels have outlets but no visible inlet; these are semi-closed lake systems.

#### GROUND WATER

Assumed ground water basin boundaries have been developed by the USGS corresponding with either surface water drainage or known impermeable subsurface boundaries. The areas of the ground water basins are presented in Table 6. The basins are indicated on Figure 4. Confined and unconfined ground water aquifers are found over much of the North Kenai area.

Four subsurface geologic sections (Figures 5 through 8) have been compiled from existing well and boring log information. Location of the sections are indicated on Plate 2 (in pocket). The wells are too few and widely spaced in some areas to accurately map the subsurface units and the static surfaces of the water table and artesian aquifers. Broad correlations between the well locations are the basis for a description of general stratigraphy.

To depths of approximately 300 feet, four major stratigraphic units are present. The upper unit consists of outwash sand and gravel in thin alternating discontinuous layers which occur to depths of 125 feet below the surface. In this unit, ground water occurs under water table conditions. The depth to water in the water table aquifer, as indicated in the subsurface sections, varies between 5 and 70 feet below land surface.

21

Near the Cook Inlet bluffs, the surface of the static water table decreases in elevation and appears at the surface near the base of the sea cliff.

Beneath the upper sand and gravel unit is a confining stratum consisting of clay and silt which locally alternates with thin layers of silty sand and sand. The clay stratum varies in thickness from 5 to 40 feet and appears to pinch out beneath the Collier plant site near the Cook Inlet bluffs (Figure 6). The clay stratum also appears to pinch out to the north of the plant site in the vicinity of Bernice Lake (Figure 7).

Beneath the clay stratum, which acts as a confining layer to the artesian ground water, are more variable strata consisting of silty sand containing coal fragments interbedded with discontinuous strata or lenses of water bearing sand and, more rarely, gravel. The sand and gravel aquifers, being discontinuous, are difficult to locate but are differentiated in the subsurface sections where possible, as the third geologic unit. North of the plant site toward Bernice Lake, the silty sand grades to poorly graded sands and gravels with fewer fines.

In the deeper wells and borings, a second (lower) clay stratum is encountered at depths of 170 to 240 feet below the surface. The clay is interbedded with thin layers of sand and gravel containing water under artesian conditions. The lower clay unit varies in thickness from 60 to 130 feet and was encountered in borings drilled to a maximum depth of 450 feet below the ground surface.

#### Recharge

Water table aquifers of the North Kenai area are recharged primarily by precipitation and seepage from lakes. Most of the area studied lies in a

( /

soils region of good recharge potential. The region encompasses well-drained soils underlain by glacial drift. Precipitation is the principal source of recharge to the confined aquifers, although the major portion of water contribution is considered to originate east of the area of study. Data on the area to the east is extremely scarce or non-existent.

Based upon climatological, vegetated area, and soils data, net recharge from normal amounts of precipitation is estimated to range from 7 to 9 inches per year. Ground water underflow, entering the study area from the east, is also a contributing recharge factor. The flow rate is not known but is believed to be slow due to barriers of low permeabilities and gentle water table gradient.

#### Discharge

Ground water of the water table aquifer in the North Kenai area is discharged primarily by evapotranspiration, pumping, and seeps and/or springs from the coastal bluffs.

Discharge from the artesian aquifer occurs by pumpage and upward movement of the water through semi-confining beds where the artesian water level is higher than the water table aquifer. It is generally believed that artesian aquifers discharge large quantities of water into Cook Inlet.

Total evapotranspiration for the North Kenai area is estimated to be on the order of 5 to 10 inches per year, due to the high percentage of forested area and the numerous bodies of lake water. Although total ground water loss through evapotranspiration is not known, it is considered to be a significant portion of the total evapotranspiration.

29

Pumpage of ground water in the system consumes an estimated 2.9

mgd.

### Water Level Fluctuations

Fluctuation of water well levels are indicated on Figure 9 for an artesian aquifer and a water table aquifer in the North Kenai area. Water level fluctuations can be caused externally by tidal movements, changing atmospheric pressures, wind over an open well, and by earthquakes. Internally, varying amounts and rates of recharge and discharge will cause water level fluctuations.

Review of available hydrographs indicate that the water table aquifer responds to seasonal changes. The aquifer reaches its highest levels in August, September, and part of October. Once the ground freezes, there is about 6 to 7 months' lag time before winter precipitation percolates to the water table. The water levels reach their lowest point during February or March. Based on USGS hydrographs, the water level of the water table aquifer has varied as much as 5 feet (see Figure 9). This is primarily due to natural causes such as evapotranspiration and drought conditions.

Artesian aquifers generally have a greater lag time in their response to precipitation. Under drought conditions, the amount of recharge is reduced also to the artesian aquifer. Fluctuation of water levels under artesian conditions are primarily caused by changes in pressure rather than changes in storage volume. The confined aquifer serves mainly as a conduit for moving water from recharge areas to locations of natural or artificial discharge. Reduction of recharge and increased pumpage have caused the











# UNCONFINED AQUIFER WATER LEVEL CONTOURS & LAKE ELEVATIONS FOR JULY 1975 (FROM COMPUTER MODEL)

- 3. RECHARGE = 40% ACTUAL ANNUAL PRECIPITATION
- NOTES

I. TIME FROM START OF COMPUTER SIMULATION,

MAY 1, 1965: 3717 DAYS

2. PUMPING; LEAKY BOUNDARY

17

| -<br><sup>المر</sup> احي | in 15 B           | AL 116.                | M-W DRILLING, Inc.<br>P. O. Box 4-1224 • 1310C International Airport Road<br>(907) 274-4611<br>ANCHORAGE, ALASKA 99509 | RECEIVED   |
|--------------------------|-------------------|------------------------|--|--|
|                          |                   |                        | DRILLING LOG   | Div. C1 Coological Survey<br>Anchorage   |
| Well O                   | wner              | Union                  | Chemical   | Use of Well Explorato  |
| Lo<br>                   | bcation<br>法 mi   | (address<br>Le Nort    | of: Township, Range, Section, if known; or distance in h of Wellhouse 7m   | main road  |
| _                        | Test              | Well 1                 | 3/6  |  |
| Size of                  | casing            | 84                     | Depth of Hole <u>170</u> feet Cased to <u>160</u>  | feet   |
| Static v                 | water le          | evel50                 | ft. (above) (below) land surface. Finish of well   | (check one) open end ( $\stackrel{	imes}{\sim}$ );   |
| Sc                       | reen              | ( <b>);</b>            | Perforated ().   | 1.17. <b>1</b> 9. 10.00 (1.1.19)   |
| De                       | escribe           | screen or              | perforationN/A   | A STATE ON THE STATE S |
| Well p                   | umping<br>drawe   | g test at<br>lown from | N/A gallons per (hour) (minute) forhours   | withft.  |
| )<br>Data -f             | acam <sup>1</sup> | otion An               | ril 11. 1982   |  |
| Jate of                  | compi             | etion                  |  |  |
| Jonth ;                  | n foot d          | nom                    | WELL LOG   |  |
| ground                   | surface           | 9                      | Give details of formations penetrated, size of mater   | rial, color and hardness   |
| С                        | TO                | 2                      | Casing Stick up.   |  |
| 2                        | _TO               | 58                     | Sandy Cobble Gravel.   |  |
| 58                       | TO                | 70                     | Sandy Gravel; Water Bearing.   |  |
| 70                       | то                | 75                     | A/A:Silty.   |  |
| 75                       | <br>TO            | 99                     | Grev Clay: Slightely Gravely.  |  |
| 99                       |                   | 106                    | Gravely Clay: Sandy Medium Hand  | · ·  |
| 106                      | U                 | 110                    | Silty Sand. Gravely  | an a   |
| <u></u>                  | U                 | 112                    | Gray Clay, Sandy Coff.   | a d at   |
| 110                      |                   | <u>di di Ci</u>        | Chickey Clay Dancy, Dollar Maine   | Ellevert   |
| 112                      | TO                | 113                    | SELCKY CLAY.   | U Construct OF   |
| 115                      | TO                | 135                    | Sandy Clay: Semi, Consol   | Cortified Connacco<br>te No's. 814 & 973   |
| 135                      | TO                | 140                    | A/A, Wet & Heaving.  |  |
| 14.                      | TO                | 160                    | Fine Sand: Silty, Wet-Heaves.  |  |
| 16.)                     | _TO               | 167                    | Very Fine Sand; Brown, Silty/ Clay   | yey, Holds open hole.  |
| 1.67                     | TO                | 168                    | Sandy Grey Clay.   |  |
|                          |                   |                        |  |  |

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Sector Contractor

| LEBAL INY   | M-W DRILLING, Inc.<br>P. O. Box 4-1224 • 1310C International Airport Road<br>(907) 274-4611<br>ANCHORAGE, ALASKA 99509 | RECEIVED 34                     |
|---|--|---------------------------------|
| •<br>•  |  | Div. Of Capingled Survey        |
|   | DRILLING LOG   | Anchorage                       |
| Well Owner Union Ch                                   | emical 776-8121  | Use of WellConmercial           |
| Location (address                                     | of: Township, Range, Section, if known; or distance  | main road                       |
| 7m pump hous  | e  |                                 |
|   |  |                                 |
| Size of casing <u><b>8</b></u> <sup>''</sup> D        | Depth of Hole_153'9" feet Cased to 150'  | feet                            |
| Static water level 48'                                | ft. <del>(above</del> ) (below) land surface. Finish of well   | (check one) open end ( $X$ );   |
| Screen ( );   | Perforated ( ).  |                                 |
| Describe screen or                                    | perforation  |                                 |
| Well pumping test at                                  | gallons per (hour) (minute) forhour  | s withft.                       |
| of drawdown from                                      | static level.  |                                 |
| Date of completion $3/1$                              | 5/82   |                                 |
|   |  |                                 |
| Depth in feet from                                    | WELLLOG  |                                 |
| ground surface  | Give details of formations penetrated, size of mate  | erial, color and hardness       |
|   | Top soil   |                                 |
| 2_то 13   | Cemented gravel: some water brn lasse  | stratas $w/6''-8''$ rocks at 10 |
| 10 <b>m</b> o //                                      | Jevel.   | 1 7                             |
| <u> </u>  | Camented gravel::brown, medium, hard &   | crimples                        |
| <u>    44    TO     62                           </u> | Sand & gravel:water bearing  |                                 |
| <b>62</b> TO 78                                       | Sand & gravel: loose, caving, water bear   | ing                             |
| 78 <b>TO</b> 100                                      | Clay: blue-grey some gravel  |                                 |
|   |  | FAC.A.                          |
| <u>    100   </u> TO    103                           | Blue-grey clay   | the presence                    |
| <u>    103                                </u>        | <u>Clayey</u> gravel   | WA Certified Contra             |
| <u>105 то 113</u>                                     | Silty sand & gravel: water bearing Cert  | ificate No's. 814 & 973         |
| <u>113 то 120</u>                                     | Very silty sand & gravel: water bearing  | 3                               |
| <u>120 то 125</u>                                     | Sand & gravel: heaving, cleaner, water   | bearing                         |
| <u>125 to 131</u>                                     | Silty sand & gravel; water bearing   | ·                               |
| <u>131 TO 141</u>                                     | Silty sand & gravel: Clayey  | - c M-A                         |
| <u>141 TO 153</u>                                     | Fine silts sand  | AC CONTRACT                     |
| 15  | NWA  | VA Ceptified Contractor         |
| 10  | Grey Liny  | Breaks and St. S. D. S.         |

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v.

## M-W DRILLING, Inc. P. O. Box 4-1224 • 1310C International Airport Road (907) 274-4611 ANCHORAGE, ALASKA 99509

## DRILLING LOG

÷.

| Well Owner Union             | Chemical Us  | e of Well_COM                         |
|------------------------------|--|---------------------------------------|
| Location (address            | of: Township, Range, Section, if known; or distance main road. |                                       |
| Test Well                    | 13/7 North of 7M   |                                       |
|                              |  |                                       |
|                              |  |                                       |
| Size of casingD              | The set $Cased to 150 \times feet$                             |                                       |
| Static water level 59        | ft. (above) (below) land surface. Finish of well (check one    | ) open end ( $\times$ );              |
| Screen ();                   | Perforated (   | n a second a second a second a second |
| Describe screen or           | perforation  |                                       |
| TEST<br>Well pumping test at |  | ft.                                   |
| of drawdown from             | static level.  |                                       |
| Date of completion Max       | y 14, 1982   | •                                     |
|                              |  |                                       |
|                              | WELL LOG   | · · ·                                 |
| Depth in feet from           | Give details of formations penetrated size of material color a | nd hardnoss                           |
|                              |  | nu naruness                           |
| <u> </u>                     | Dirt, Cobbels, Gravel  |                                       |
| <b>39 TO 4</b> 0             | Sand & Gravel - Very Little H20                                |                                       |
| 40 TO 44                     | Sand & Gravel, Clay, some H20                                  |                                       |
|                              |  |                                       |
| <u>44 TO 60</u>              | Sand & Gravel - H20  |                                       |
| <u>60 TO 78</u>              | Sand & Gravel - Clean, Heaving H20                             |                                       |
| <b>70 mo</b> 02              |  | AN AL                                 |
| <u></u>                      | Crevit ray as ravel  | e Concorr                             |
| <u>83_TO_90</u>              | Grey Gravelly Clay   |                                       |
| 90 TO 92                     | Grev Gravelly Clay - Medium Hard                               | Cattified Costractor                  |
|                              | Certifi  | cate No's, 814 & ere                  |
| <u>92 TO 98</u>              | Grey Sandy Clay - Hard   |                                       |
| <u>98 TO 101</u>             | <u>Grey Clay - Soft</u>  |                                       |
| <u>101 TO 120</u>            | Grey Silty Clay - Soft   |                                       |
| <u>_120_T0_140</u>           | Formation Gradually Clay - Sandy Clay -                        | Very Silty San                        |
| <u>140 TO 150</u>            | Very Silty Sand - Some Clay                                    |                                       |
| TO                           | ·····  | ~                                     |
|                              |  |                                       |

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M-W DRILLING, Inc. 4 P. O. Box 4-1224 • 1310C International Airport Road (907) 274-4611 ANCHORAGE, ALASKA 99509

\* Log Rev. 10/25/85

## DRILLING LOG

| Well Owner Union Che                                     | emicalUse of We  | <u>llExploratory</u> |
|--|--|----------------------|
| Location (address of:<br><u>Test Well 13/4</u>           | Township, Range, Section, if known; or distance main road                      |                      |
| Size of casing8''Dept                                    | th of Hole 160 feet Cased to *121.0*feet                                       |                      |
| Static water level *66.5* f                              | ft. (\$\$\$\$\$\$) (below) land surface. Finish of well (check one) open       | end (X);             |
| Screen (X); Per  | rforated ( ). Z'Tight-   |                      |
| Describe screen or per                                   | rforation * 8", Tel. S.S. Screen 145 to 117 Top Wind, Bal. #                   | 25 slot              |
| Well pumping test at <u>*300</u><br>of drawdown from sta | 2*gallons per) (minute) for <u>*24</u> *hours with <u>*38.8</u><br>atic level. | <u>ft</u> .          |
| Date of completionJanua                                  | ary 15, 1982   |                      |
| an a                 | WELL LOG   |                      |
| Depth in feet from<br>ground surface                     | Give details of formations penetrated, size of material, color and hard        | ness                 |
| 0_то2  | Casing Stick up.   | <u> </u>             |
| 2_то23   | <u>Sandy Gravel: Semi Consol, Water @ 20'</u>                                  | <u></u>              |
| 23_то25  | Sandy Gravel: Clayey   |                      |
| 25_то41  | Sandy Gravel: Cemented, Water seaps in sand st                                 | tringers.            |
| <u>41 to 72 -</u>  | Gravely Sand: loose, slightely clayey, Wet.                                    |                      |
| 72_то81  | <u>Water Sand: Heaving, Slightely sandy.</u>                                   |                      |
| <u>81 TO 105</u>   | Grey Clay: Sticky, Slightely sandy   |                      |
| 105 то 115   | <u>Gravel &amp; Sand: Silty/Clayey, dense.</u>                                 |                      |
| 115то147   | Silty Sand & Gravel: wet(would not hold water                                  | from 127-147'        |
| <u>147 то 160</u>  | Silty Grey Clay.   |                      |
| TO   |  |                      |
| TO   | and Alexander and the second second  |                      |
| TO   | and a decipation of the second second  |                      |
| TO   | NYPTYA CORBERTINE AND<br>Provident New Action 873                              | s                    |
| TO   |  |                      |

M-W DRILLING, Inc. P. O. Box 4-1224 • 1310C International Airport Road (907) 274-4611 ANCHORAGE, ALASKA 99509 20050 したし DRILLING LOG Well Owner Union Chemical Use of Well Commercial 6 Location (address of: Township, Range, Section, if known; or distance main road\_ 77 N 23 F 11W Test Well 13/8 5 F.N/MU) of 7 p North of 7m 150-200 4 6 149 • Size of casing <u>6''</u> Depth of Hole\_ feet Cased to\_\_\_\_ feet ٩ Static water level 24-18 Q (above) (below) land surface. Finish of well (check one) open end ( x ); ft. 50. 12 of see 23 night on the by see, line half may down へ Perforated ( ).  $\square$ Screen ( ); LL. 0 Describe screen or perforation Mona Z Well pumping test at <u>a</u>gallons per (hour) (minute) for <u>b</u>hours with Ð. ft. UCAL of drawdown from static level. S Date of completion June 23, 1982 WELL LOG Depth in feet from Give details of formations penetrated, size of material, color and hardness ground surface 20 Casing Stick-up 0 <del>39</del> 37 Sandy Cobble Gravel \_TO 62 60 37 Sandy & Gravel (damp) \_TO 60 89-78 2 NWWA Certified Contructor Sand & Gravel TO Certifinate No's. 814 & 973 -37 79 -37 <u>\_</u>78 TO Gray Clay 79 89-87 Grav Gravelly Clay - Soft 37 \_TO 87 84 Gray Soudy Clay - Medium Hard -TO 89 101 Variations of Gray Clay - Very Silty Sandy TO\_TO 17 10- 103 101 Silty Sand & Gravel (Formation Sample # 1) LOJ. . TO 103 109 Silty Sand & Gravel (Formation Sample # 2) 195 TO 109 Silty Sand & Gravel (Formation Sample # 3) 110 TO 113 Silty Sand & Gravel (Formation Sample # 4) 777 112 \_TO 138 Silty Sand & Gravel (Pormation Sample # 5-9) 142 .TO 138 149 Gray Clay, Dry, Open Hole Drilling Possible. 1-7-TO TO.

Dave Rice

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|  |  | 2599       |
|--|--|------------|
| 5B7-12-23 CD<br>712 26 BA                | IVI-VV DRILLING, Inc.<br>D C 3 - 4 P.O. Box 10-378 ● 10300 Old Seward Highway<br>(907) 349-8535  |            |
| ROD GILGE                                | ANCHOHAGE, ALASKA 99511  |            |
|  | DRILLING LOG 1.2 MI OT N KEWAI RA N KEWAI RA   |            |
| Well Owner Union Che                     | unical 7/6-8/2 Use of Well Commerci  | al         |
| Location (address of:<br>400' north of 7 | Township, Range, Section, if known; or distance main road  |            |
|  | i parameter and the second sec |            |
| Size of casing <u>10"</u> Dep            | 134 (38 109.8)<br>oth of Hole $\frac{136}{140}$ feet Cased to $\frac{111.81}{111.81}$ feet BF  | HAR        |
| Static water level 65                    | ft (above) (below) land surface. Finish of well (check one) open end (   | <u>ر</u>   |
| Screen ( $^{XX}$ ); Pe                   | erforated (  | <b>J 3</b> |
| Describe screen or pe                    | rforation <sup>2</sup> 24' of 10" telescope Johnson 304 Stainless Steel screen w/2   | ) <b>f</b> |
| Well pumping test at 520                 | gallons per (hour) (minute) for 20.75 hours with 35.5  | ,e<br>ft.  |
| of drawdown from sta                     | atic level.  |            |
| Date of completion                       |  |            |
|  | WELL LOG   |            |
| ground surface                           | Give details of formations penetrated, size of material, color and hardness  | SO         |
| -2- TO 20                                | Casing stickup   | -GS        |
|  | Brown cemented gravel  | ×          |
| - + 12<br>TO + 12                        | Gray silty gravel  | m.º        |
| 12<br>TO                                 | Gravelly with gray clay  | 6          |
| 38<br>TO 48 46                           | Gravel with gray clay, not so cemented   | 00         |
| 46<br>48 TO 57 52                        | Clean gravel   | A -        |
| 52 82<br>54 TO 282                       | Sand & graval: heaving somethat  | Q W        |
| 82<br>96                                 | Gray clay with some sand and wood chips  |            |
| 96<br>TO 195/03                          | Gray clay with wood chips  | 5/0        |
| 103<br>103<br>110/08                     | Clay with sand and small gravel, waterheaving  |            |
| 108<br>135 133                           | Sand and movel: waterhooring   |            |
| 133<br>134                               | Sand and maral with fine silts may al  | -0 W       |
| 134<br>134<br>138                        | Sand gilt and lar  | -4 V       |
|  | onnu, Slit and Clay  |            |
| TO                                       |  | ,<br>      |
| TO                                       |  | $\neg$     |

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ADL#40059\*

Be Her Concrete Producto

USGS SITE 1D 604016 151212401 BORING AND WELL DATALOCAL

|                                       |                                |                             | · · .                                 |  |  |  | BOT  | CING                                    |                                 | .raD                 | W Eiliz                        | DHI                              | LOCA   | L NC  | 580   | 0701227 ACAA1-9   |
|---------------------------------------|--------------------------------|-----------------------------|---------------------------------------|--|--|--|--|---|---------------------------------|----------------------|--------------------------------|----------------------------------|--|---|---|---|
| Owner/<br>Boring or<br>Well<br>Number | Bor<br>or<br>Wel<br>Dis<br>(10 | tog<br>1<br>meter<br>sches) | Maximum<br>Depth<br>Drilled<br>(feet) | Original<br>Surface<br>Elevation<br>MTLW<br>(feet) | Static<br>Water<br>Table<br><u>Elevation</u><br>(feet) | Appro<br>Eleva<br>Scree<br>Water<br><u>So</u><br>(feet | timate<br>tion of<br>mable<br>Bearing<br>is<br><u>bottom</u><br>(feet) | Test<br>Screen<br><u>Pis</u> .<br>(in.) | Well<br>Size<br>Lergth<br>(ft.) | <u>Slot</u><br>(in.) | Maximum<br>Production<br>(Spm) | Test<br>Well<br>Drawdown<br>(fz) | Specific<br><u>Caracity</u><br>(gpm/ft<br>of draudown) | Radial<br>Influence<br>of<br><u>Wel1</u><br>(ft.) | Coef. of<br>Perm.<br>(gale/day<br>per sq.ft.) | Remarke   |
| Observation<br>#1                     |                                | 6                           | 140                                   | 132.5  | +36.5  | +18.5  | - 6.5  | 5-5/8                                   | 5                               | .018                 |                                | 2.2                              |  |   |   | Located 80 feet from TW 4   |
| Observation<br>#2                     |                                | 6                           | 175                                   | 128.0  | +38.0  |  |  |   |                                 |                      | '                              |                                  | <b></b> ,  |   |   |   |
| Observation<br>#3                     |                                | 6                           | 143                                   | 128.0  | +36.5  | + 7  | -12  | 5-5/8                                   | 5                               | .020                 |                                | 13.0                             |  |   | ·-  | Located 30 feet from TW 4   |
| Observation<br>#4                     |                                | 6                           | 164                                   | 128.0  | +33.5  | - 2  | - 8  |   |                                 |                      |                                |                                  |  |   | <b></b>                                       |   |
| Observation<br>#5                     |                                | 6                           | 151                                   | 128.0  | +40.5  | +17  | + 3  | 5-5/8                                   | 5                               | .050                 |                                | 1.6                              |  |   |   | Located 30 feet from TW 3   |
| Observation<br>#6                     |                                | 6                           | 148                                   | 130.0  | +39.0  | +10  |  | <del></del>                             |                                 |                      |                                |                                  |  |   |   |   |
| Observation<br>#7                     |                                | 6                           | 137                                   | 134.0  | +38.0  | +19  | + 4  | 5-5/8                                   | 5                               | .018 -               | ·                              | 1.0                              |  |   |   | Located 50 feet from TW 2   |
| Observation #8                        |                                | 6                           | 120                                   | 130.0  | +39.0  | +15  |  | 5-5/8                                   | 5                               | .018                 |                                | 1.3                              | ,  |   |   | Located 30 feet from TW 2   |
| Test Well 1                           |                                | 10                          | 135                                   | 128.0  | +38.0  |  | ·  |   | ••                              |                      | NG (not tes                    | ted)                             |  |   | <b></b> .                                     |   |
| Test Well 2                           |                                | 10                          | 130                                   | 133.0  | +35.0  | +19  | + 6  | 9-5/8                                   | 3<br>10                         | .050                 | 94                             | 27.5                             | .3.4   | 100-150   | 214   | Radius of influence extrapolated  |
| Test Well 3                           |                                | 10                          | 122                                   | 129.0  | +39.0  | +25  | +11  | 9-5/8                                   | 5<br>6<br>3                     | .050<br>.030<br>.020 | 104<br>104<br>104              | 28.5                             | 3.6  | 100-150   | 218   | Radius of influence extrapolated  |
| Test Well 4                           |                                | 10                          | 146                                   | 129.5  | +35.5  | + 5.5  | -14.5  | 9-5/8                                   | 20                              | .018                 |                                | 47.0                             | 3.9  | 100   | 194   | Radius of influence extrapolated  |
|                                       | 5                              |                             |                                       |  |  | ·VI  | CINI   | TY                                      | BOF                             | RING                 | S ANI                          | D WE                             | LLS  |   | -   |   |
| Standard Uij                          | (2)<br>(3)                     | 6                           | 171                                   | 150 <u>+</u>                                       | +26  | + 2  | -21  | 5-5/8                                   | 10<br>10                        | .010<br>.014         | 100                            | 10                               | 10.0   |   |   | Wells 1 and 3 reportedly same<br>as 2. Water has high iron                      |
| Chugach                               | (1)                            | 10                          | 173                                   | 150 <u>+</u>                                       | +28  | -13  |  | 9-5/8                                   | 10                              | .010                 | 60                             | 14                               | 4.3  |   | <b></b>                                       | Reportedly started pumping  |
| Electric                              | (2)                            | 10<br>10                    | 173                                   | 150 <u>+</u><br>150 <u>+</u>                       | +28<br>+28   | -13<br>-12   |  | 9-5/8<br>9-5/8                          | 10<br>10                        | .010<br>.010         | 60<br>150                      | 16<br>                           |  |   |   | This well was acidized in<br>1965 when acreen became<br>clogged. Water has high |
| Rig Tenders                           | œ                              | 6                           | 200                                   | 30   | +19  | -25  | -40.   | 5-5/8                                   | 5                               | .014                 | 135                            | 22                               | 6.1  |   |   | iron content.<br>Water high in iron.  |
|                                       | (2)                            | 10                          | 60                                    | 30   | +10  | -10  | -18  | 9-5/8                                   | 8                               | .012                 | 200                            | 38                               | 5.3  |   |   | Same as above.  |
|                                       | (3)                            | 10                          | 70                                    | 30   | +15  | - 3  | -16  | 9-5/8                                   | 13                              | .012                 | 100                            | 28                               | 3.6  | ·   |   | Same as above.  |
|                                       | (4)                            | 10                          | 80                                    | 30   | +12  | ٥  | -26  | 9-5/ <u>8</u>                           | 26                              | .016                 |                                |                                  |  |   |   | Pump test not completed to date.  |
| Phillips<br>Petroleum                 | (1)                            | 6                           | 245                                   | 115±   | +72<br>+70   | +72  | +38<br>-100  |   | <u></u>                         |                      | 800-1000<br>(est.)             |                                  |  |   |   | No pump test to date. Water<br>high in iron. Not tested.                        |
| •                                     | (2)                            | 6                           | 287                                   | :132 <u>+</u>                                      |  | +38  | +31  |   |                                 |                      | N.G.                           |                                  |  |   |   | Not tested.   |
|                                       | (3)                            | 6                           | 245                                   |  |  |  |  |   |                                 |                      | N.G.<br>600-800                |                                  |  |   |   | Not tested.   |
| Kensi<br>Pipeline                     |                                | 6                           | 79                                    | 135 <u>+</u>                                       | +96  | ,+67   | +56  | 5-5/8                                   | 10                              | .020                 | (est.)<br>70                   | 7                                | 10.0   |   | ••  | Red bress acreen used.  |
| Cement Plant                          |                                |                             | 69                                    | 1185 MSL.  | +80  | +75  | +65  | 7-5/8                                   | 10                              | .030                 | 150                            |                                  |  |   |   | Water high in iron.   |
| Tee Pee                               |                                | 6                           |                                       | 130 <u>+</u>                                       |  | -80  | -81  | Perfor                                  | ated C                          | asing                | 4                              |                                  |  |   | ••  | Took two weeks of pumping to clear water.                                       |

uell is still functioning. \* case clussed Nowever

NOTES:

no log

- THE FIGURE NEXT TO THE WELL LOCATION INDICATES THE WELL YIELD 2.
- NG INDICATES THAT THE CONDITIONS ENCOUNTERED IN THE BORING ARE NOT SUITABLE FOR WELL DEVELOPMENT ON-SITE WELL DATA HAS BEEN ESTABLISHED BY RECORDS TAKEN UNDER DAMES & MCORE SUPERVISION. VICINITY WELL DATA WAS OBTAINED FROM VARIOUS SOURES, VERBALLY AND IN WRITING. THIS INFORMATION MAY 3.

4.

NOT REFLECT A HIGH DEGREE OF ACCURACY BUT SHOULD INDICATE GENERAL CONDITIONS. ESTIMATES OF POTENTIAL YIELD OF BORINGS ARE BASED ON INTERPRETATION OF BORING INFORMATION. ACTUAL 5.

YIELDS MAY VARY CONSIDERABLY FROM THE ESTIMATES. 6. REFER TO THE WELL INVESTIGATION PLAN, PLATE 2, FOR ADDITIONAL LOCATION INFORMATION OF OBSERVATION AND TEST WELLS.

7. REFER TO THE APPENDIX FOR STAGE PUMP TEST DATA FOR ON-SITE WELLS.

350

SUMMARY DATA

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700

WELLS AND EXPLORATIONS AT THE SITE AND IN THE VICINITY OF THE SITE

FEET

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following page



"SGS SITE ID CC LOCAL NO. SB 7-12-1.4 A ADR

got ADL # brom John in Cenai DNR in Cenai DNR

LOCAL # 4-12-14-AACC 1-) SITE 10 60420715/193101 an agu

rost Office Box 158 Kensi, Floska 99611 June 7, 1977

Doiglos Ulson Fost office Dox 58 Tonsi, Altoks 99611

Desr.r. Olson:

BLOCK 1

672

The following in a log of the well day on your Island Lake property, Lake Dhore Estates, Lot 13, Ep. 18 NW, NE2 Section 74 Township 7N hange 12% Deward Acridian. Awrong

| $\smile$     | •      |                 |  |
|--------------|--------|-----------------|--|
| 5/27/77      | C-31'  | 0-12'<br>12-14' | Gravel<br>Gravel & shall amount of clay                                    |
|              |        | 15-31           | Gravel<br>water  |
| 5/28/77<br>• | 31-35' | 31-56'<br>36'   | aster with gravel<br>Finished here in order to have a<br>5' head of water. |
|              |        |                 |  |

ramped over an hour at 15 jallons a minute and the well never went dry.

Thank you very such for the opportunity to be of service.

Yours very truly,

DIRC Enterprises

Rex D. Bennett

LUL/03b

CUSTOMER'S COPY

5月1日月1日月1日日日 11188 -WELL CONSTRUCTION LOG nothan Drilling Co. \_ USGS no. Celle-3E Driller 100201 7-13-77 Type of rig Date well completed Well owner Nearest community\_ Well location: (address & legal description Location sketch or remarks Lot 6, Block 1, Lakeshore Estates Subd, well w/in swt set nEt nEt Sec. 14, 60. lo. Depth of well 59 TTN, RIZW, SM. .ft. diam. It. Casing: depth in. Static water level 4-18 (above. delow) land surface. Date 2-13-7 N63-0604206.7 Finish of well: fopen-end, screen, perforated, open-hole, other)\_\_\_\_\_ W07-1511917.0 goo. Sottom Bescribe intervals and size:\_\_\_\_ Well yield tested by (pumping (bailing, Air) at. 12 gal/min. hours for ft. of drawdown from static level. DRILLER'S MATERIAL LOG Depth below land Give description of strata penetrated surface in feet (size of material, color, hardness of drilling, and water content) Rec Ton So. 1  $\hat{\sigma} = \hat{\sigma}$ Sam t٥  $\sim R$ CANGAN incre In. 1. - Sterie GAGA \_\_\_\_\_to \_\_\_ 1. 18 1. - 经通 t a -12 (A 🖉 R. to t o - 2013 10 The second to ÷. to a. . to t e · . . · 702.2 to. 159 to\_

CCI DGGS 5/85

45-2955

|           | $\sum_{i=1}^{3} \frac{1}{2} $ |
|-----------|---|
| ALL ENTER | WATER SYSTEMS & SEDULOR   |
| فرمن بع   | Rt. 1, Box 1517 Kengi, Alaska 99611   |
|           |   |
|           | Dated this $3916$ day of $1016$ , $1983$  |
|           | Vial Construction Owners: John + Debra Ganak<br>Box ESOG MRB<br>Kenning HT 994.11   |
|           | Dear Sir:   |
|           | The following is a well log located on Lot <u>I</u> Flock <u>i</u><br><u>BELUGA GHORES NO 2</u><br>in the Kenai Recording District. The owner at the time<br>water well was requested <u>TIU UFHL</u> .   |
|           | l'to 3 feet depsell<br>3 to 33 feet glavel no water<br>33 to 43 feet dand and gravel water forwater<br>to feet  |
|           | Submersible pump was wasn't installed as requested<br>Screen was wasn't installed as requested and/or necessary<br>Well yield was wasn't tested by pumping, bailing at <u>20</u> gpm  |
|           | We have been pleased to serve your water needs and if you<br>have any further questions, problems, or comments please<br>don't hesitate to call or write.   |
|           | Sincerely,<br>Munif U. U. 7   |
|           | KEINETH D. DYER<br>Owner  |
|           | kd/dd   |
|           |   |
|           |   |
|           |   |
|           | The NCCS 11/86  |

C۵ 10665 SB 07 - 12 - 26 DBAA

WELL- BERNICE LAKE CAMPGROUN SW4 of SE4 of Sec. 15, TTN, R 12 W, S.M.

1788

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-4

6"059 EL.88 Gravelly silty sandy topsoil contains rocts and org. matte OL.  $\varphi$ 6P-GM Sandy Gravel, probably silty -contains cabiles, branish 0 Static W.L. 12 May 72 16 Gravelly Sand, possibly silty -cemented, grayish. SP SP-SM 27 27 5P Grazelly Sand- water Gravely Sand, possibly sitty -cemented, gragish. SP SP-SM 37 58-51-1 Silly pebbly Soud - contains pea 43 gravel, no rightwant vistor. Gravelly Sand - some what commented possibly city, limited amount of which SP-SM Gravelly Sond - Lecening coorser, gray, obtoidant water. 5715-SP-

Well drilled 10-12 May 1972 by Alaskan Enterprises (Floyd Howell, driller). Open end casing. Well developed by cleaning out with a sand pump, then bailing until bettern stabilized at lower and of casing. Well was pumped at 20 gpm for an hear - water diadaged clean, with only a few scattered gand grains. Bail-tosted at 38 gpm, 5 ft. drawdown.





7 M-W DRILLING, Inc. P. O. Box 4-1224 • 1310C International Airport Road (907) 274-4611 ANCHORAGE, ALASKA 99509

\* 15

## DRILLING LOG

Div. Of Geolog ad s

Use of Well Conmercy i al

## Well Owner Union Chemical

BAL

IN FOR MAT

Location (address of: Township, Range, Section, if known; or distance main road\_\_\_\_\_

.

## Well # 13/2-8

| h of Hole_ <u>153</u> feet Cased to_ <u>153</u> feet                        |
|---|
| t. (above) (below) land surface. Finish of well (check one) open end ( X ); |
| rforated (  |
| foration  |
| _gallons per (hour) (minute) forhours withft.<br>tic level.                 |
| er 14, 1981. Well abandoned for insufficient yield                          |
| WELL LOG  |
| Give details of formations penetrated, size of material, color and hardness |
| Casing stickup  |
| Tan silty gravel  |
| Brown silty gravel (damp) Mr. Con   |
| Sand and gravel (damp)  |
| Gray clay and gravel  |
| Sand and gravel (damp)  |
| Gray clay with traces of gravel   |
| Gray clay sand and gravel (damp)  |
| Sand, clay and gravel (damp) 776-8197                                       |
| Sand and gravel (damp)  |
| Silty sand clay, waterbearing   |
| Wet silty sand  |
| Silty sand, some gravel, waterbearing                                       |
| Wet sand and gravel   |
| Wet sand and gravel   |
|   |

IN SUFFICIENT LEGAL INFORMA M-W DRILLING, Inc. P. O. Box 4-1224 • 1310C International Airport Road (907) 274-4611 ANCHORAGE, ALASKA 99509 DRILLING LOG Union Chemical (page 22 Well Owner\_\_\_\_ Use of Well Commercial i. Location (address of: Township, Range, Section, if known; or distance main road. Size of casing\_\_\_\_\_Depth of Hole\_\_\_\_\_feet Cased to\_\_\_\_ CONTINUATION Static water level\_\_\_\_\_ft. (above) (below) land surface. Finish ); Screen ( ); Perforated ( ). Describe screen or perforation Well pumping test at \_\_\_\_\_gallons per (hour) (minute) for\_\_\_\_ ft. of drawdown from static level. Date of completion\_\_\_\_ WELL LOG Depth in feet from ground surface Give details of formations penetrated, size of material, color and hardness 115117 Wet gravel TO 117 127 Gray silty sand, waterbearing TO 127 136 Gray silty clay, some gratel, waterbearing то 138 140 Gray silty sand w/traces of gravel, waterbearing TO 151 140153 Gray silty sand and gravel, waterbearing TO TO \_\_\_\_TO\_\_ TO\_ \_TO\_\_ TO\_ Mayne E Mesters \_TO\_\_\_\_ TO\_\_\_ NWWA Certified Contractor Certificate No's. 814 & 973 \_TO\_\_\_\_\_ .TO\_\_\_\_ TO\_

2 – STATE

SOLDOTNA DRILLING CO. WATER WELL CONTRACTORS

#### P. D. Box 351 BOLDOTNA, ALASKA 99669

#### OCT 3 1974 DJV:

12 74

DATE October 3

Collier Carbon & Chemical Corporation

Well Logs for Test Bores

|  |   | Test B     | ore # 8   |          |          | a anna a thaith anns in  | utionpringerings<br> <br> |
|--|---|------------|---|----------|----------|--|---------------------------|
|  | 1 0!                                    | 121        | Silty Sand & Gravel                                   |          |          |  |                           |
|  | 12'                                     |            | Gravely Sand  |          |          |  |                           |
|  |   | 581        | Sandy Gravel Slightly Cemented                        |          |          |  |                           |
| Signal Springerstration of the surgerst statement of the surgerst stat |   | 66!        | Silty Fine Sand                                       |          |          | *  |                           |
|  | 66!                                     |            | Fine_Sand_w/Lignite_chunkswater                       | 19<br>   |          |  |                           |
|  | n de des faits cites aux arranges.      | Test_B     | ore #9  |          |          |  |                           |
|  |   |            | Gravely Sand  |          |          | ورور ورور ورور مرد مرد الم   |                           |
| -  |   | _561       | _ Sandy Gravelcemented                                |          |          |  |                           |
|  | 56!                                     | 64!        | Sand w/Lignite bits                                   |          | <u> </u> |  |                           |
|  |   | _70!_      | Fine Sandwater  |          |          | ·····  | -                         |
|  | 1997 1996 - C. Handler, or Barlin, 1997 | Test_B     | ore_#10   |          |          | anna - annanananan   |                           |
|  | 0!                                      | 10!        | Gravely Silty Sand                                    | -        | <u> </u> |  |                           |
| aanaan oo ah   | 10'                                     | 301        | Gravely Sand  |          |          | and a second publication of the second s | _                         |
| 22120200000000000000000000000000000000   |   | 62!        | Sandy Gravel Cemented                                 |          | <u></u>  |  |                           |
|  | 621                                     | 70'        | Fine Silty Sand w/Lignitewater                        | 1 1<br>  |          | a de marine act  |                           |
|  | Test Bore #11                           |            |   |          |          |  |                           |
|  |   | <u>4</u>   | Top Soil  |          |          |  |                           |
|  |   |            | Gravely Sand  | <u> </u> |          |  |                           |
| ·····  |   | 691        | Sandy Gravel  | <u> </u> | ļi       |  |                           |
|  |   |            | Fine Silty Sandwater                                  | ````     | ·        |  | +                         |
|  |   | Test Ba    | pro_#12   |          |          |  | - <del> </del>            |
|  |   |            | Top Soil  |          | 1        | terran califications   |                           |
|  |   |            | Gravely Sand  |          | <u> </u> |  |                           |
|  |   | 61.        | Sandy Gravel  |          |          | ,.   |                           |
| <b>spente - N</b> atice  |   | 701<br>751 | , <i>m.</i><br>MedCoarse Sand<br>Fine Silty Sandwater |          |          |  |                           |

75'

:

Fine Silty Sand--water

WATER WELL CONTRACTORS P. D. BOX 351 SOLDOTNA, ALASKA 99669

A DATINA DRILLING

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OATE- All Gld Bater Radomers 1 2 - 74

Well Logs for Test Borings

an san han Malanal Cast L. Barrella considerer anne and an and 1.0. 31 K Greately Seed \* 31 \* 48' Sanay Gravel-partially comented a ex for a second with iron oxide--reddish brown 66' Silty Sand 61 1 en anticipation faithe station is any second 66' 73' Fine Sand--water bearing 731 6" Clay-Blue Gray 1 Provide the second s Second seco a star and a #2 Test Bore 27 55 Sendy Gravel -- Cemented-Red-Brown 55 63 Sand W/lignite Particale a di secondari e constructore constructore e constructore constructore e constructore e construc 63 71 Med. to course sand-water manual and a Test Bore Bore and a second and a 0 36 L - GBOVOLF SOND 36 57! Sandy Gravel -- Cemented -- Red t the strategy and the 57. 64 Sand & Lignite 64 70 Mater Bearing find Sand Beland Sold By Test //4 Bone 0 <u>61</u> Over hurden Soil 34 46 Sandy Gravely-Partly cemented 16 Grey Send-Small gravels & Lignite bits 1 Clay Blue Grey 

22-44 - Wallman Prays, Inc., North Chicago, III.

WATER WELL CONTRACTORS P. G. Box 351

JINA DRILLING

17

## BOLDOTNA, ALÁSKA 99669

DATE August 28 74

Well Logs for Test Bore

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| international and the second   | 1000 - 2010 - 2010 - 2010 - 2010 - 2010 - 2010 - 2010 - 2010 - 2010 - 2010 - 2010 - 2010 - 2010 - 2010 - 2010  | 1. O. 33! GRAVELY Sand   |   |  |  | ur jantsansställije  |
| <b>Hallin Brenzen</b> (del 1999)   | 4<br>***   | 33 48 Sandy Gravel Cemented with Iron  |   | en forstenen genoem genoem genoem ge   |  | en sentrenernerie  |
| utita dainatsing selangkara  | fer  | .48 62 Gravely Sand  |   | a (  | n filmen og en som e<br>Som en som en<br>Som en som en<br>Som en som en<br>Som en som en<br>Som en som en<br>Som en som en<br>Som en som en<br>Som en som en<br>Som en som en<br>Som en som en<br>Som en som en<br>Som en som en so | <ul> <li>Contraction of the second of th</li></ul> |
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| AMERICAN AMERICAN AND A MARKAN AMERICAN AMERICAN AMERICAN AMERICAN AMERICAN AMERICAN AMERICAN AMERICAN AMERICAN  | د<br>به د دیر آیمو   | 69 Clay Blue-Grey  | n – volga stanosti v to por ne nego nakogo nakogo   |  | Antonio a construir contra este managenerate<br>}<br>}   | ia lanare are sayaligi   |
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WATER WELL CONTRACTORS

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## BOLDOTNA, ALÁSKA 99669

OCT 3 1974 DJW

DATE October 3 19 74

# Collier Carbon & Chemical Corporation

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Well Logs for Test Bores

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| Contraction and provide an provide the large $r$ , $r_{\rm eff}$ , $r_{\rm e$ |   | 121   | <u>Silty Send</u>  | 1 & Gravel   |  |  |   | 104070% iento richtspäisteria-para  |                           |
| ANTERENDER DE Franker - Antonio - Antonio   | 121   | 341   | Gravely Se   |  | Media (2) a Alakevi State Providsky ( ) - projektova State State ( ) - projektova State State State State State  |  |   |   |                           |
| approximitational control of the second s   | 341   | 581   | Sandy Gray   | velSlightly Cement   | ed   |  |   |   |                           |
|   | 581   | 66.1  | Silty Fine   | 2. Sand  | inenida harindako udalar - ken birregelaguidgan  |  |   |   |                           |
| an Shank a Charlenna dh' an Shara a ta an sa  | 661   | 791   | Fine_Sand  | w/Lignite chunksw  | later  |  |   |   |                           |
| dialogram and a survey of the   | e ( e e como e como   | North Construction and a second                 | neer – Brisseliser moneerska de aktivitationerska sjonare i sjon o   | க்கள் பிரப்படுத்துகள் தேரான அரச்சப்படும் பிரப்பும் பிரப்பட்ட பரிப்பத்து.<br>கிகையிரப்படுத்துகள் தேரான அரச்சப்படுத்து பிரப்பட்ட பரப்பட்ட பரப்படுத்து கிலை திலை பிரப்பு இரச்சு<br>இது இது பிரப்படுத்துகள் தேரான அரச்சப்படுத்து பிரப்படுத்து கிலை விரப்பு பிரப்பு பிரப்பு   | ,<br>Natura e e e e e e e e e e e e e e e e e e e  | " n d' n De Staten, d'a primara  | Roll of the second s |   |                           |
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| galor and the contract of the   | 31 !  | 561   | Sandy Grav   | relcemented  | n in the states with a state of the state of | where a strain of the strain o | n a Garage  | · ( - 4.000 - 1.000 - 1.000 - 1.000   |                           |
| AND MADE IN THE PROPERTY OF A STREET OF A   | . 56!   |   | Sand_w/Lig   | snite bits   | and the second s | **************************************   |   |   | }                         |
| angan nanasan na n   | 64!   | 7.0.1   | Fine Sand-   | • •••• WARDER DE PROVINSIONE   | i<br>i<br>Mara Douto i a subgar comen  | A Stractic states and a strategy of  |   | <ul> <li>Settema menutica</li> </ul>  | Ing Print downland        |
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| gyenteknet, telto - elk telefitte dura a s  | ·· ·  | Test_B  | ore #10  | nanwests (2008) with the construction of the const | n na sana na sana sa sa Mara   | 40 °   | e statute<br>El compete   | - vitter of a transit trading cover   | *                         |
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| <b>mod -</b> Nulicial 2   | <sup>9</sup> 1000, Inc., 11<br><b>61 1</b>  | ionth Chicago,<br>701                           | . <i>m.</i><br>Med Coare   | e Sand   |  | <ul> <li></li></ul>  |   | and the international states of   | 2000000000000000000000    |
|   | 701   | 751   | Fine Silty   | Sandwater  |  |  |   |   |                           |

SOLDOTNA DRILLING CO. WATER WELL CONTRACTORS P. D. BOX 351 BOLDOTNA, ALASKA 99669

DATE August 28

19.74

Well Logs for Test Borings

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| CERCENT COLOR  | and a an analogophysically including provide a special statement of the second statement of the |   |                | <br>   |
|--|---|---|----------------|--|
| -  | #1_Test_Bore  | 1   | <u> </u>       |  |
|  | 0 31 Gravely Sand   |   |                | <br>-  |
|  | 31: 48: Sandy Gravel-partially cemented   | 4<br>   | به<br>الله الم | <br>-  |
|  |   | 18<br>-<br>   | _              | <br>-  |
| Supervision and the second   | 181 611 Gray sand & Lignite Particle  | ;<br>; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;                                |                | <br>   |
| Contractory and  | 61: 66' Silty Sand  | -   |                |  |
|  | 661731Fine_Sand==water_bearing  |   |                | <br>ine diates                               |
|  | 731. 6"Clay-Blue_Gray   |   |                | <br>na na n |
| -  |   | na – Nacional Manager Nacional States                                     |                | <br>taniauskapist                            |
|  | #2_Test_Bore  |   |                | <br>   |
| -  | 0271- Gravely_Sand  |   | !              | <br>   |
| and the second s | 27 55 Sandy_Gravel -= Cemented-Red-Brown  |   | i              |  |
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|  | •<br>2<br>2 ** • * * • • • • • • • • • • • • • • •  |   |                | <br>nonutes                                  |
|  | # 3. Test_Bore  |   |                | <br>202-mong                                 |
| en la companya de la  |   |   |                | <br>   |
|  | 36Sandy_GravelCementedRed   |   |                | `  |
| antitution and a   | 5764Sand & Lignite  | ·:<br>  |                | <br>-  |
| 00884000000000000000000000000000000000   | 6470Water Bearing find Sand   | 1   | 1              | <br>antication of the                        |
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|  | 0. 6! Over burden Soil  |   |                | <br>   |
|  | -6Gravely_Sand  | <u>I</u> <u> </u>   | ļļ             | <br>-  |
| - ####################################   | 3446Sandy Gravely-Partly cemonted   | 1   |                | <br>   |
|  | 46 Groy_Sand-Small_gravels_& Lignite  | bits  |                | <br>   |
|  | 61 Find_Sand-greyish_Water  | 1   |                | <br>ikonatiti)                               |
|  | 173 Clay Blue Grey  | 1   |                | -  |

## SOLDOTNA DRILLING CO. WATER WELL CONTRACTORS P. O. BOX 351

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BOLDOTNA, ALASKA 99669

DATE August 28

12 74

Well Logs for Test Bore

# 5 Tost Bore 33' Gravely Sand 0 ĥ. 33 -\_\_\_48\_\_\_Sandy\_Gravel== Comented with Iron 62 Gravely Sand 68 Fine Silty sand--water 62 69 \_\_\_\_ Clay\_ Blue-Gray. Ľ h ٠, 15 Į. 1 i.

BRADE - No. 1 and Process Inches North Chicagos ille