FERC #20

# SUSITNA HYDROELECTRIC PROJECT

## SLOUGH HYDROLOGY

## INTERIM REPORT

STATE OF NEW YORK
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Susitna Hydroelectric Project
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**DECEMBER 1982**

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SUSITNA HYDROELECTRIC PROJECT

TASK 3 - HYDROLOGY
SLOUGH HYDROLOGY
INTERIM REPORT

DECEMBER 1982

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TASK 3 - HYDROLOGY
SLOUGH HYDROLOGY

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# 1 - INTRODUCTION

## 1.1 - Background and Purpose of Study

Observation of fish activity during 1981 by the Alaska Department of Fish and Game (ADF&G, 1982) indicated that the sloughs and side-channels along the mainstem Susitna River provide the most important salmon spawning habitat between Devil Canyon and Talkeetna.

The major characteristic of these sloughs which makes them suitable habitat for salmon spawning and the overwintering of salmon fry is the flow of water which continues in them throughout the year, either as surface or intergravel flow. This flow may originate from various sources, including tributaries, springs and groundwater inflow.

The sources of this flow and the manner in which it would be affected by the regulation of flow in the Susitna River are questions which must be addressed.

The purposes of this study are to:

1. describe the existing flow regimes in two selected study sloughs (8A and 9).
2. determine the origins of the groundwater component of slough discharge.
3. develop a cost-effective methodology for the determination of water sources that could be applied to other sloughs.

## 1.2 - Description of Study Area

This report concentrates only on those sloughs between Talkeetna and Devil Canyon, and specifically on sloughs designated 8A and 9 (Figure 1.1) by the Alaska Department of Fish and Game. At these two areas an intensive study was initiated to determine the year-round sources of water in the slough. Sloughs as defined by the ADF&G are the sidechannel or adjacent wetted habitats to the mainstem Susitna River which periodically receive a portion of their surface water from the mainstem Susitna River in addition to other water sources. These two sloughs are located on the east side of the Susitna river about 30 miles upstream of Talkeetna.

## 1.3 - Methods

Four methods were considered for determining the source of water in the sloughs. These were: (1) monitoring of groundwater levels and temperatures to determine direction, source, and amount of groundwater inflow (or outflow) to the sloughs; (2) environmental isotope tracking studies; (3) measurement of surface water flows into the sloughs; and (4) visual observations.

Monitoring of the changes in groundwater elevation and temperature was accomplished by a number of observation wells in the areas of Sloughs 8A and 9. These sloughs were chosen as study sites due to previous observance of groundwater input into these sloughs plus the relatively easy access into them from the Alaska Railroad.

Wells were installed the week of April 12, 1982 at 15 locations in or near Slough 9 (Figure 1.2) and at 12 locations in or near Slough 8A (Figure 1.3). The wells consist of 4-inch diameter plastic drainage pipe. They are perforated throughout their length and capped at the upper end. These wells were installed using a track mounted backhoe. A hole was dug slightly below the water table (at time of installation), the pipe inserted, and backfilled. Additional wells were also installed later in the season by hand driving a 1¼-inch diameter casing. The depth of these wells varies between 4 to 12 feet below the ground surface. The mean sea level elevation of the top of each well was surveyed in from the nearest control point.

Wells were established along the banks of the sloughs to determine whether the slough was influent (groundwater moving from the sloughs into the banks) or effluent (groundwater moving from the banks into the sloughs). Other wells were established in locations which would provide data useful in determining overall direction of groundwater flow.

Groundwater level and temperature were measured at intervals through spring, summer, and fall, and are continuing to be measured into fall and winter. Elevation of the water surface in the well is found by measuring the distance of the water surface below top of the casing, using a measuring tape coated with a water-indicating chemical which precisely shows the location of the water surface. This distance is then subtracted from the known elevation of the top of the well casing to arrive at a groundwater surface elevation. This method is accurate to within a few hundreds of a foot. Temperature is measured using a standard mercury thermometer reading to 0.1°C. The question arose as to whether the temperature of the water in the well was the same as the temperature of the local groundwater at that level. To test this, well temperatures were measured, the well pumped and allowed to refill, and the temperature re-measured. No difference in temperature was noted.

In November, 1982 four additional wells were installed in the area of Slough 9B. These wells were installed using a Nodwell mounted B-61 drill rig. By using this method of installation, as opposed to the previous method of installation by backhoe, it was possible to establish wells below the groundwater table. These were necessary for verification of a groundwater temperature model applied by Acres American. These well were instrumented in December, 1982 with Datapod recorders to measure temperatures and water surface elevation.

Environmental isotope tracking studies are described in Section 3.7. Water originating from different sources may have differing "signatures" based on their isotope contents. Groundwater samples for this study were obtained up-gradient from the sloughs, and surface water samples obtained from the mainstem Susitna and side sloughs. The isotope ratios for these samples are to be determined, and this ratio used to identify the source of water found in the sloughs.

All sources of surface flow into the sloughs were documented and measured using standard discharge measurement equipment. Continuous stage recorders were also located in both sloughs and rating curves developed to relate the stage to discharge.

Visual observations focused on locating areas of upwelling groundwater and seepage of groundwater from the banks into the sloughs.

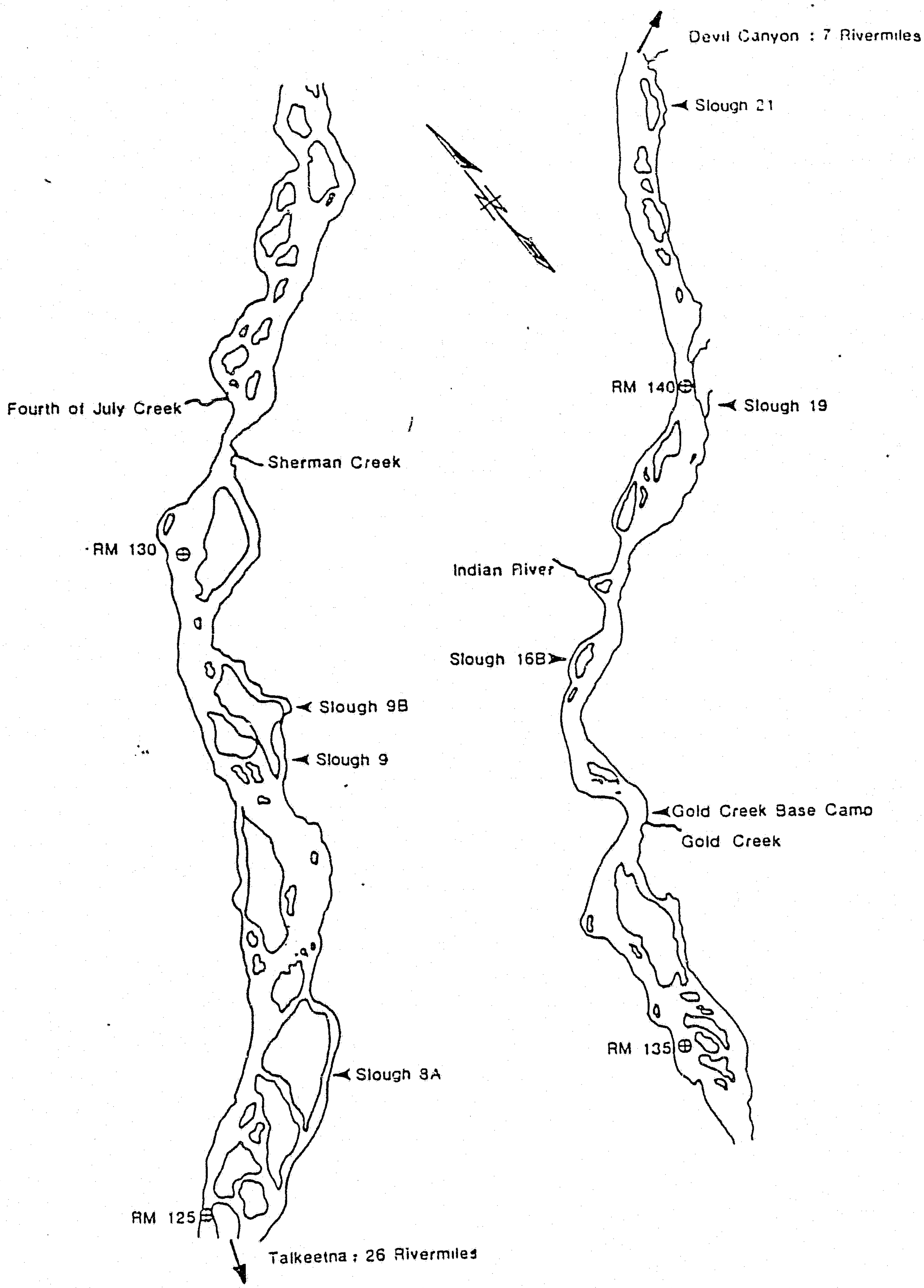


**FIG. 1.1** Location of selected habitat slough sites along the Susitna River between Talkeenta and Portage Creek (adapted from ADF&G 1981a)

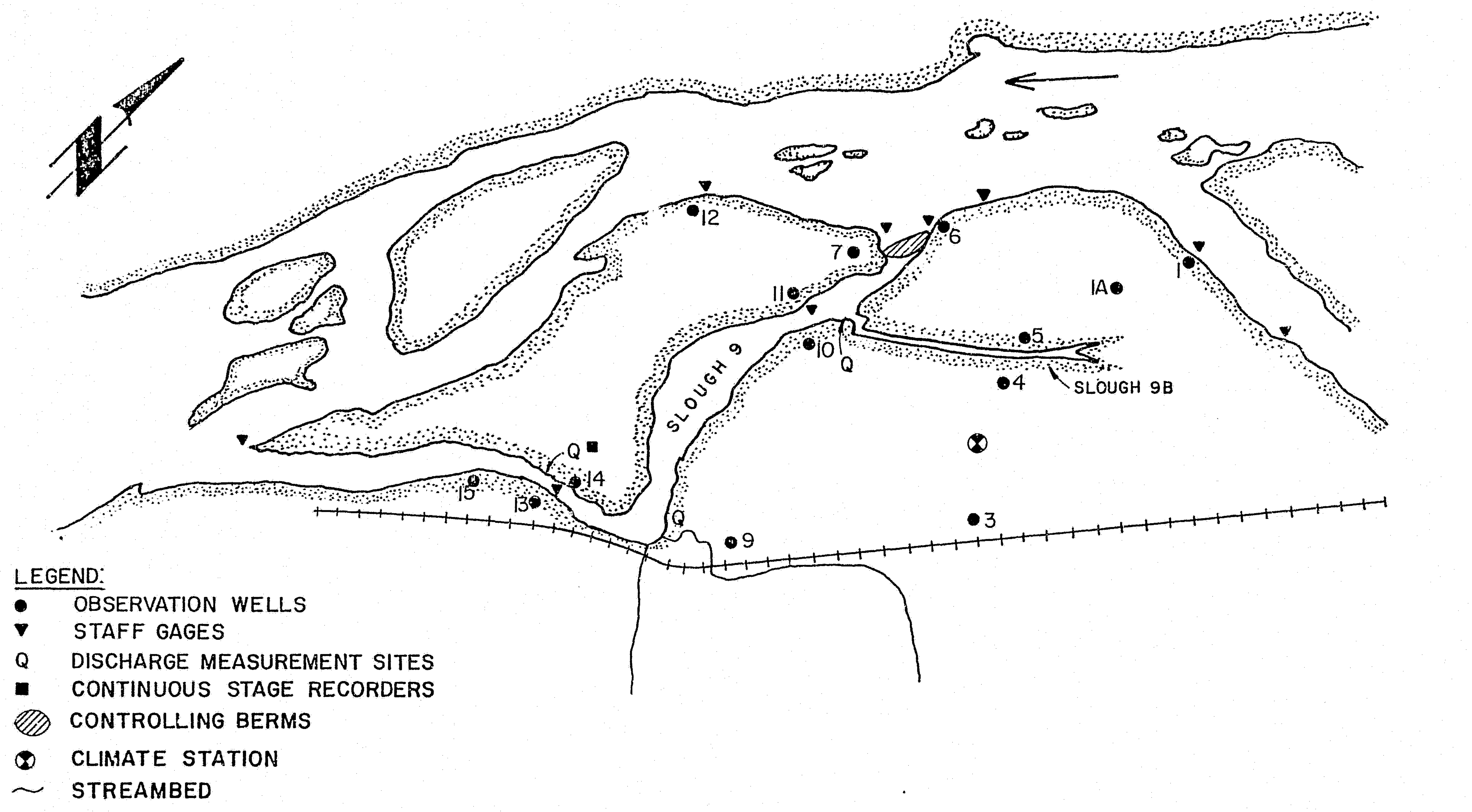




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**FIG. 1.2 SLOUGHS 9 & 9B**

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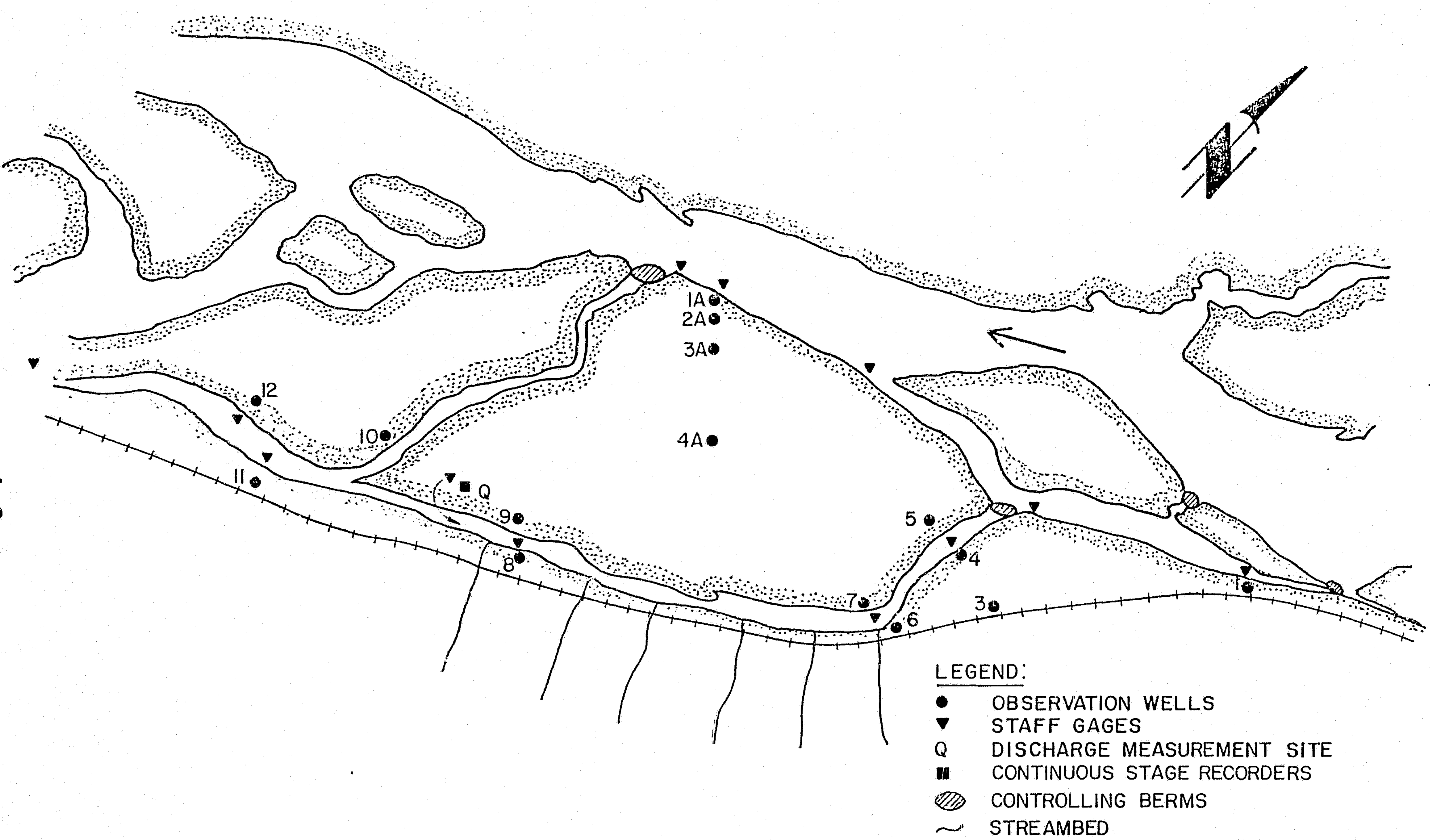




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**FIG. 1.3** **SLOUGH 8 A**

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## 2 - FLOW REGIME

### 2.1 - Relationship between Slough and Mainstem

The formation of a slough along the Susitna River appears to be caused by high water stages causing water to spill onto adjacent floodplains. This process may occur either during high summer flows or during ice jams on the main river channel. The flow of water, sometimes the entire discharge of the main river during ice jams, carves a side channel through the floodplain. Such an occurrence of a jam forcing water and ice into an existing slough was observed on May 15, 1982, at both Sloughs 8A and 9. Surface velocities of up to 10 feet per second were observed. Vegetation between the slough banks is relatively young, indicating that this ice jam flooding may be a frequent occurrence in these sloughs. Old ice scars on the trees on the slough banks also verify this.

Comparison of aerial photos from 30 years ago (Figures 2.1, 2.2 & 2.3) shows minor changes in both Sloughs 8A and 9 but verifies that these sloughs did exist then. This is not the case with Slough 11 (just downstream of Gold Creek) which did not exist in 1950.

At the present each slough is connected to surface flow from the mainstem Susitna only when the flow in the mainstem is high enough to overtop the berm at the upstream end (head) of the slough, or by backwater at the downstream end (mouth). The flows required to initiate these surface water connections are unique to each slough.

For Slough 9 the controlling berm at the upstream end begins to overtop at a discharge of approximately 23,000 c.f.s. at Susitna River at Gold Creek (visual observation). This berm is very unstable and shifted quite often during the time it was overtopped. Slough 8A has two entrances. The berm at the upstream entrance overtops at approximately 30,000 c.f.s. and the berm further downstream overtops at 26,000 c.f.s. Both of these berms seem quite stable and have a growth of small willows on them.

When a slough is overtopped the flow from the main river dominates flow conditions in the sloughs.

### 2.2 - Flow Regime in Sloughs When Upstream End is Closed

Each slough along the river is unique, and therefore must be looked at separately.

Slough 9 - When flow in the mainstem Susitna River is not enough to overtop the upstream berm at about 23,000 c.f.s. (Figure 2.4), then flow in the slough is derived from two sources, surface runoff from small streams and groundwater inflow. There are two small streams which originate off the hillside above the railroad tracks and which feed into Slough 9. Both of these enter the slough at its bend near the railroad tracks (Figure 1.2).

To quantify the respective amounts of water coming from surface runoff and groundwater, discharge measurements were made within a few hours of each other at each incoming source of water and at the downstream end of the slough. These measurements were made using standard discharge measurement techniques and a pygmy flow meter.

By documenting surface flows in Slough 9, theoretically the groundwater component of the slough flow could be determined through a simple summation process. For example, if the flow at the downstream end of the slough were 5 c.f.s. and the two small streams each input 2 c.f.s. this would mean there was a 1 c.f.s. contribution from other sources, which would be groundwater flow into the slough.

The measurement of open channel flows can never be more than an approximation. Under normal field conditions an error of at least 3 to 5 percent can be expected, and in low flow situations, such as were encountered in the sloughs, greater percentages of error exist. Understanding this we can look at the data obtained from these measurements.

SURFACE WATER MEASUREMENTS AT SLOUGH 9

| Date | Slough 9B | Stream #1 | Stream #2 | Downstream End of Slough 9 | % Groundwater | % Runoff |
|---|---|---|---|---|---|---|
| 8-25-82 | 1.00 | 0.68 | dry | 1.72 | 61 | 39 |
| 9-9-82 | 0.74 | 1.76 | 0.13 | 2.96 | 36 | 64 |

Surface runoff contributed approximately 39% and groundwater 61% of the downstream discharge in the slough during a relatively dry period of the summer on August 25. Measurements made during a rainy period (upstream berm of slough still not overtopped) showed percentages of 64% runoff contribution and 36% groundwater contribution.

The major percentage of the groundwater inflow originates near the upstream end of Slough 9 from an area referred to as Slough 9B in ADF&G reports. The flow from this area is assumed to be all groundwater as there is no obvious input of surface water. Other areas of groundwater seepage and upwelling were noted in the sloughs. These are detailed is Section 3.3. The actual origin of the groundwater (mainstem river or local) must be determined to assess the impact of the proposed hydroelectric development.

Slough 8 - The berm at the entrance to Slough 8 (Figure 2.5) is much higher than the one at Slough 9. Overtopping of the berm occurs at a flow of approximately 30,000 c.f.s. at Susitna River at Gold Creek. When the berm is not overtopped there is no surface flow in the slough until the area near well 8-6, where a small spring emerges. Downstream of this spring six small creeks flow into the slough. During rainy periods these streams provide the majority of the flow in Slough 8 when the berm is not overtopped. Some upwelling was observed but only near the shoreward side of this slough. It would be a difficult task to measure the flow in all these streams to determine their contributions but the streamflow record in these sloughs shows a large increase in flow during rainy periods when the upstream berm is not yet overtopped.

## 2.3 - Winter Regime of Sloughs

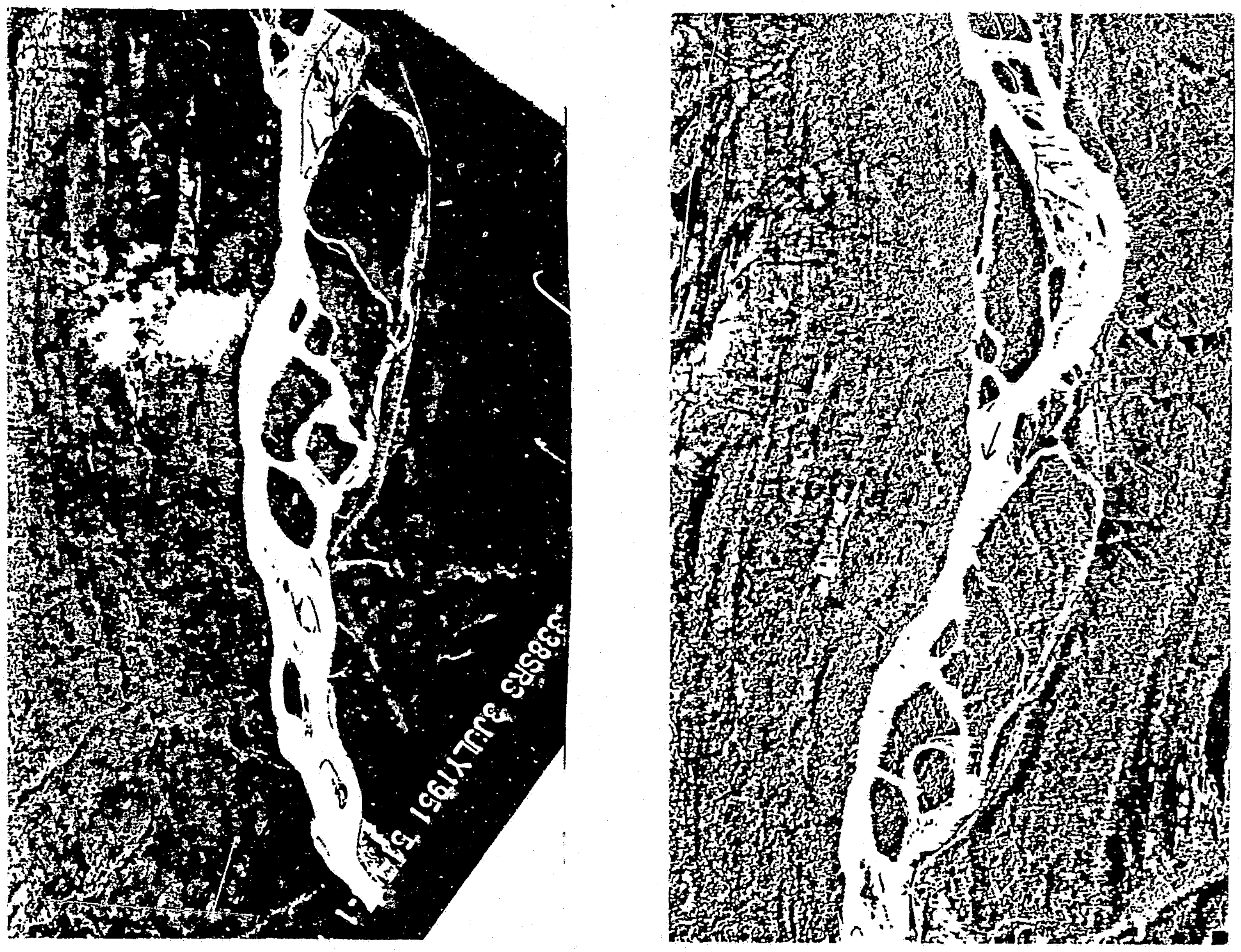
Based on limited observations from the beginning of the winter season of 1982, it appears that the ice cover in the mainstem plays a great role in determining the winter flow conditions in the slough.

The leading edge of the ice cover on the Susitna River reached the area of Slough 9 in mid-December. Measurements of water surface elevation were made in the vicinity of Slough 9 on November 22, 1982, when an ice cover was not present, and again on December 21, 1982, after a complete ice cover had formed. The ice cover staging and constriction of the channel caused water surface elevations in the mainstem to increase five to seven feet (see Table 2.1 and Figures 2.6 and 3.21). This winter water surface elevation is comparable to an open channel flow elevation of approximately 30-40,000 c.f.s.. It is not yet known how this will vary through the winter, or its affects on the water table in Slough 9B.

Comparable data on stage are not yet available for Slough 8A but an interesting occurrence took place in winter 1982. An ice cover formed in the mainstem near Slough 8A in late November. Once this happened the increased stage in the mainstem allowed water to flow into the side channel above Slough 8A. The downstream end of this side channel was obstructed by ice an thus this flow was shunted into Slough 8A. Estimates of this flow vary from 50 to 150 c.f.s. and have continued from the beginning of mainstem ice cover formation to the date of last field observation, December 21, 1982.

TABLE 2.1
Winter Water Surface Elevations
Mainstem Susitna near Sloughs 9, 8A and 21

| RM | Location (all WSE in Mainstem) | Elevation (M.S.L.) 11-22-82 | Elevation (M.S.L.) 12-21-82 |
|---|---|---|---|
| Mainstem near Slough 9 | | | |
| 130.1 | XS 33 | 611.65 | 612.10 |
| 129.7 | 200 yards upstream of xs 32 | 606.62 | 608.16 |
| 129.4 | near upstream end of Slough 9 | 599.89 | 606.50 |
| 128.9 | near upstream end of island | 594.05 | 601.66 |
| 128.5 | near downstream end of xs 30N3 | 593.12 | 597.88 |
| Mainstem near Slough 8A | | | |
| 126.5 | near upstream entrance to Slough 8A | | 572.77 |
| 126.2 | near groundwater [illegible] 8-1A | | 569.74 |
| 126.1 | xs 29 | | 568.80 |
| Mainstem near Slough 21 | | | |
| 142.3 | xs 57 | | 752.90 |
| 142.1 | xs 56 | | 752.67 |
| 141.8 | - | | 746.40 |

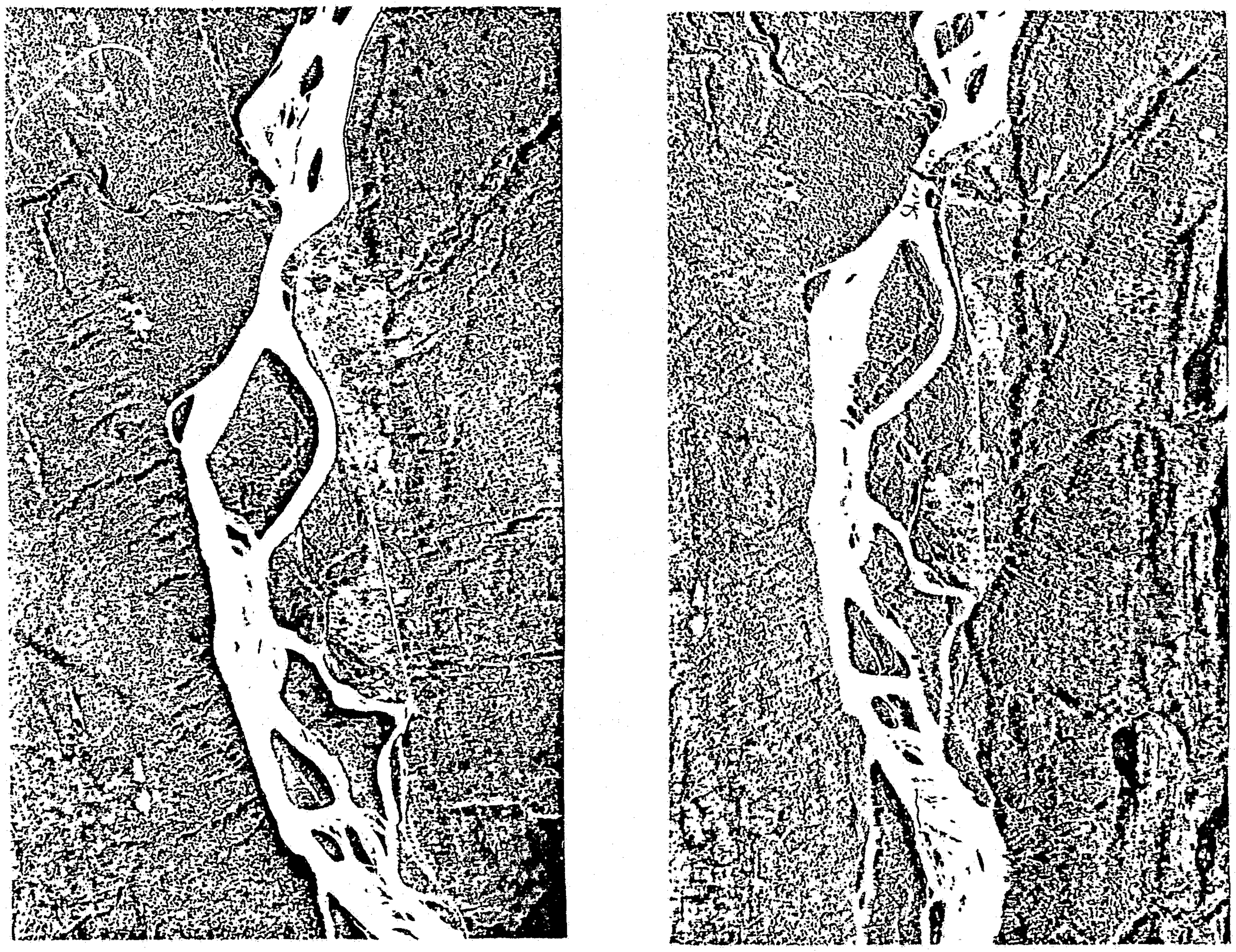


1951 1980

AERIAL PHOTO COMPARISON
1951 to 1980
SLOUGH 8A

**FIG. 2.1**

t/d1



1951 1980

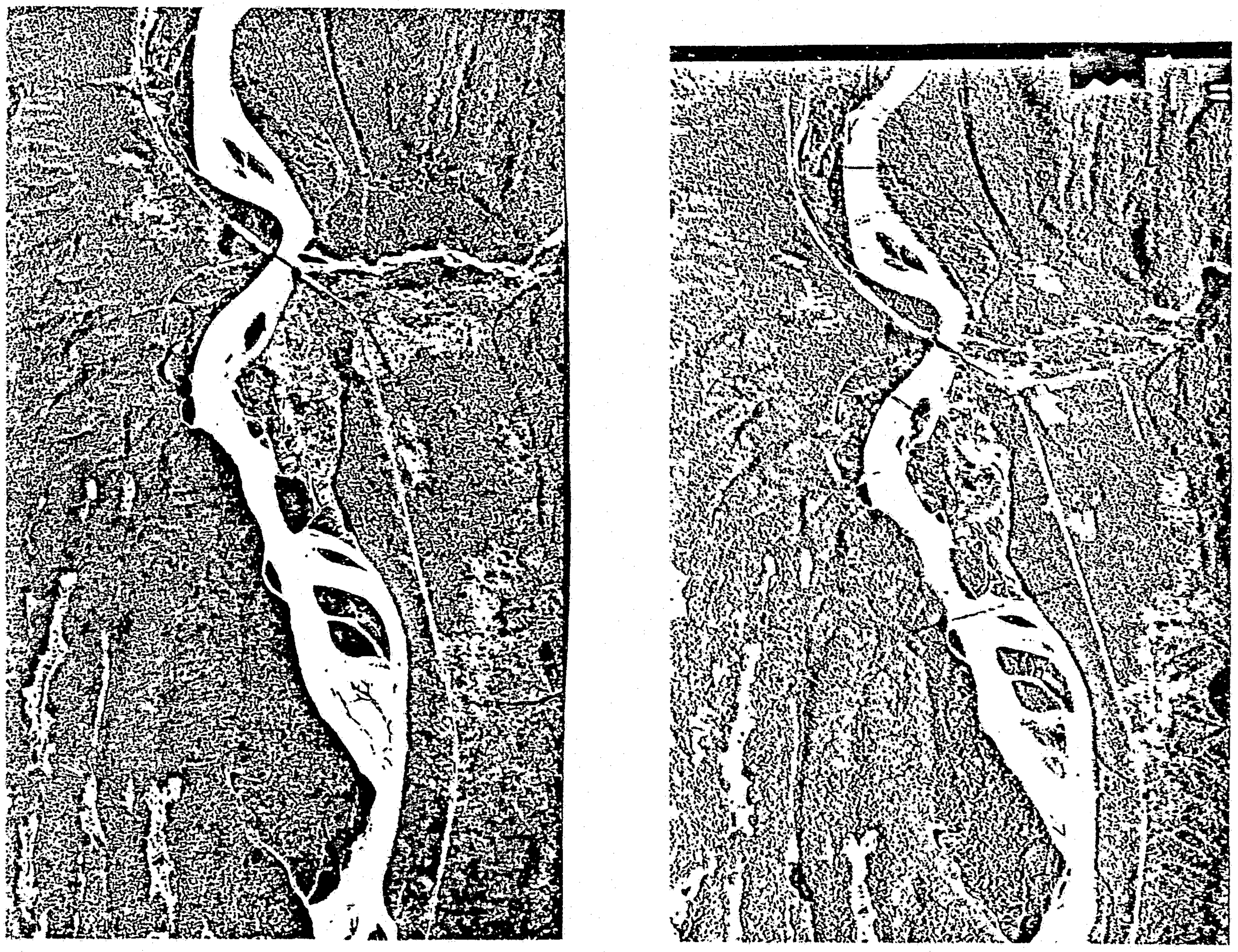
AERIAL PHOTO COMPARISON

1951 to 1980

SLOUGH 9

**FIG. 2.2**

t/d3



1951 1980

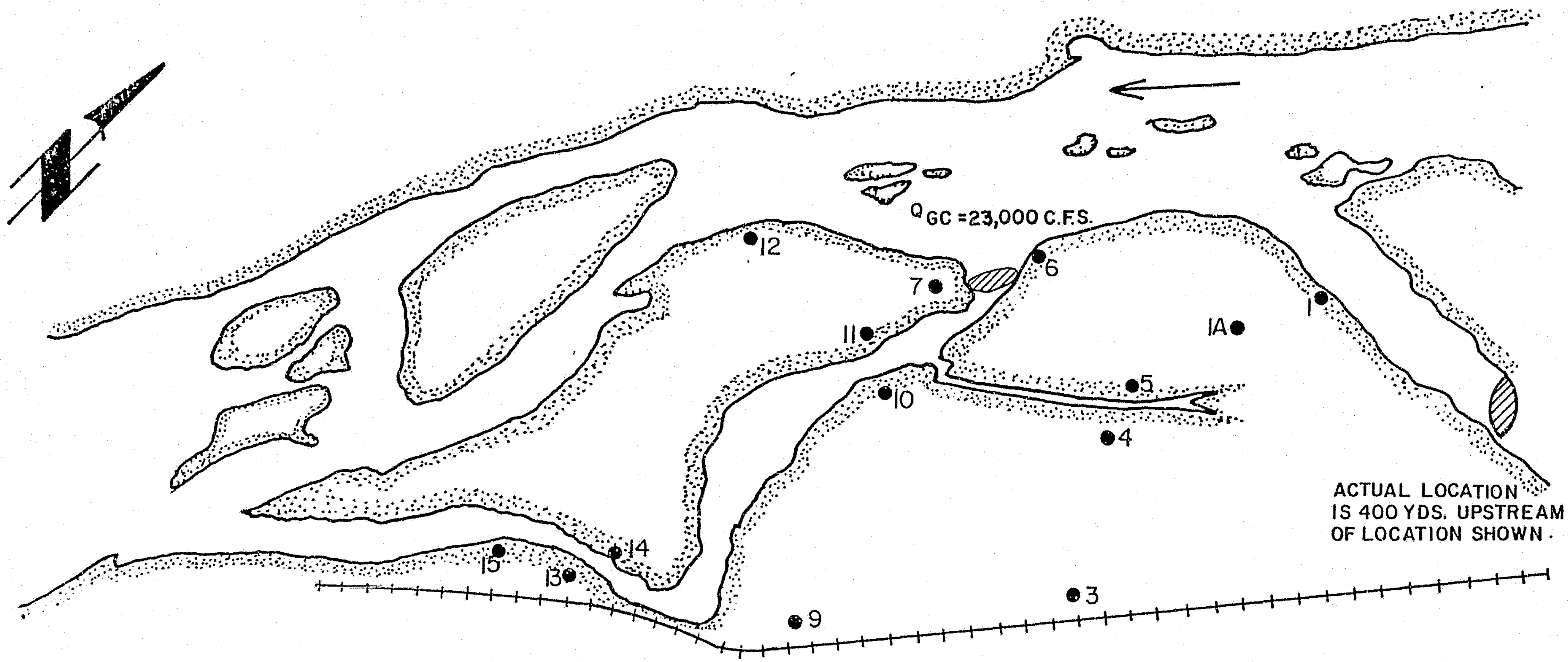
AERIAL PHOTO COMPARISON

1951 to 1980

SLOUGH 11

**FIG. 2.3**

t/d2




LOCATIONS OF BERMS CONTROLLING CONNECTION OF MAINSTEM FLOW INTO SLOUGH 9 AND MAINSTEM DISCHARGE AT GOLD CREEK WHEN FLOW IS INITIATED.



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**FIG. 2.4**

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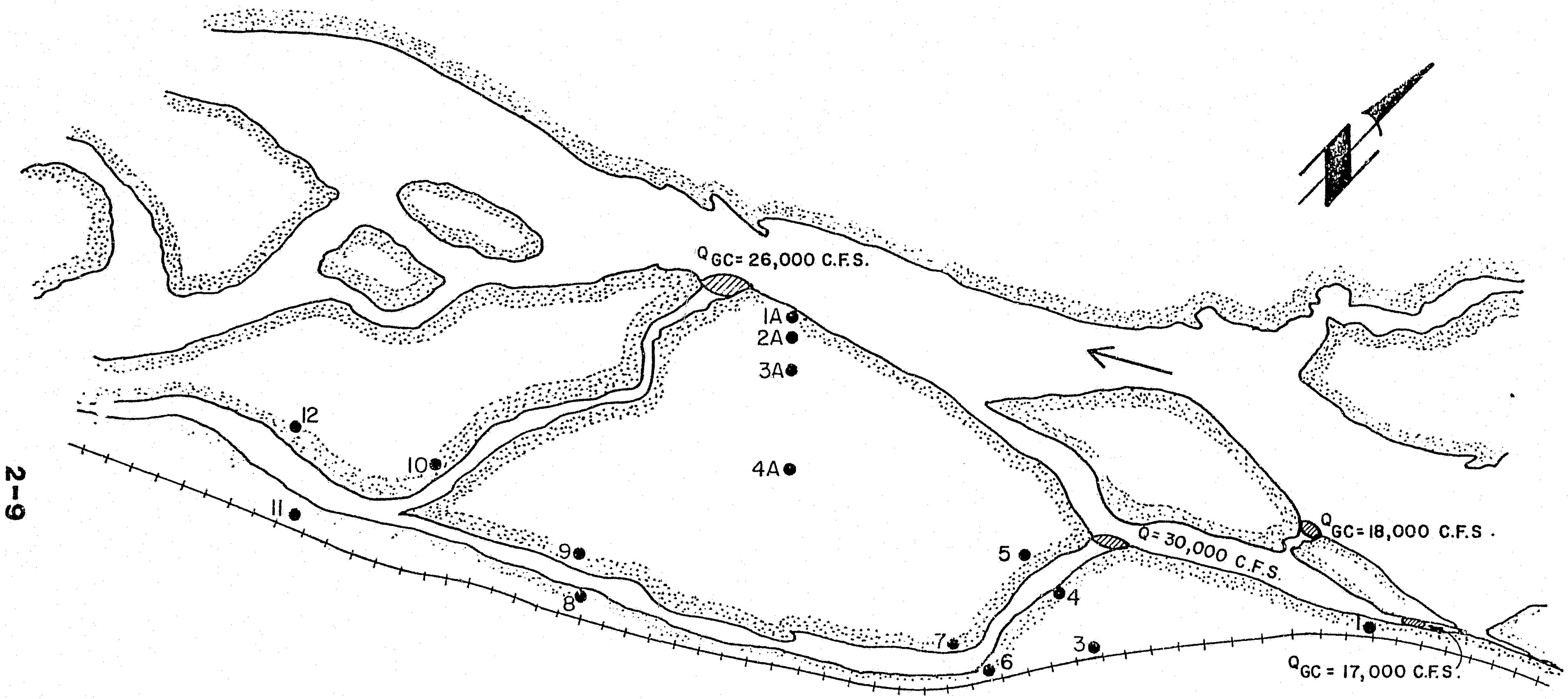


LOCATIONS OF BERMS CONTROLLING CONNECTION OF MAINSTEM FLOW INTO SLOUGH 8 AND MAINSTEM DISCHARGE AT GOLD CREEK WHEN FLOW IS INITIATED.



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**FIG. 2.5**

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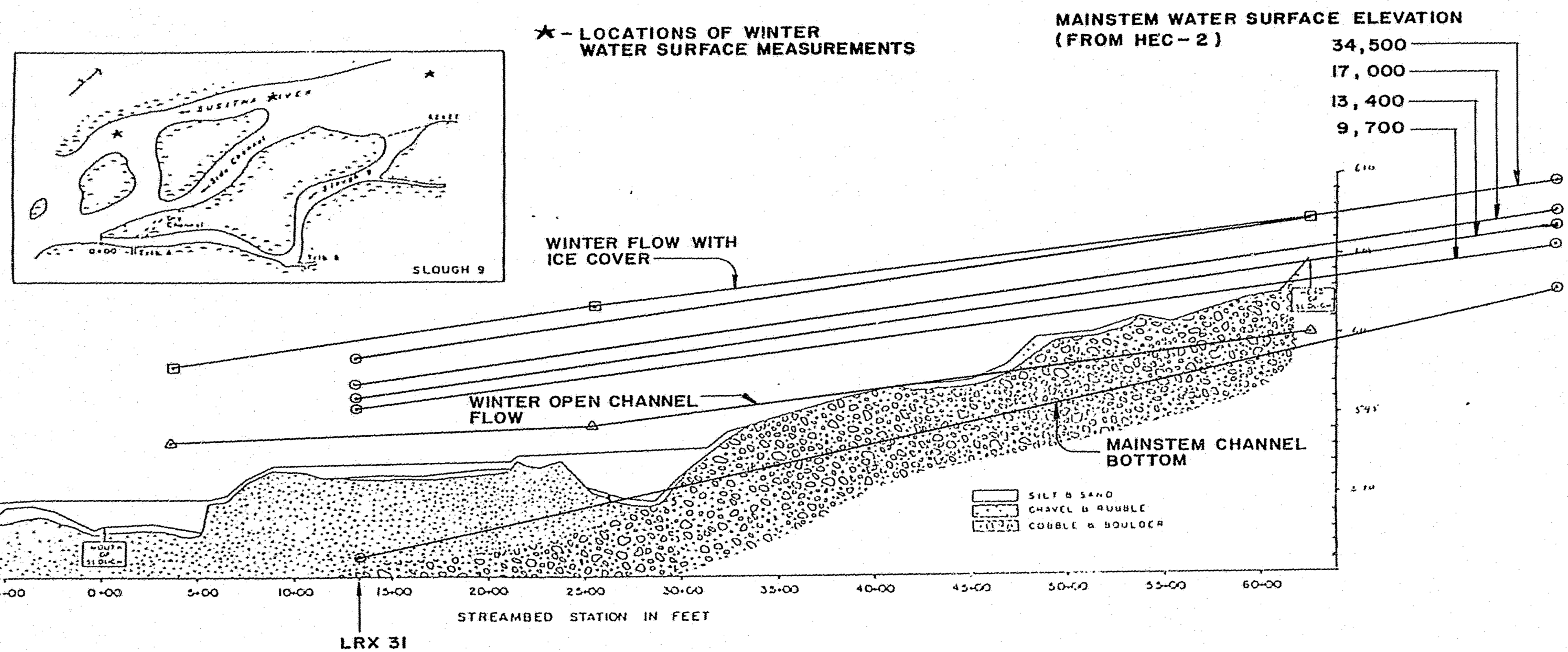


**FIG. 2.6**
**THALWEG PROFILE OF SLOUGH 9**
**WITH MAINSTEM WATER SURFACE ELEVATIONS**
( ADAPTED FROM ADF & G PROVISIONAL DRAWINGS 1982 )

# 3 - GROUNDWATER STUDY

## 3.1 - Introduction

Summer flow in the sloughs depends on local runoff and groundwater input into the sloughs. It was also observed (Trihey, 1982) that flow existed in these sloughs during winter when runoff was not contributing to the flow in the slough. This suggests that much of the slough flow during winter may be contributed by groundwater. It was also noted in 1981 that the intragravel water temperatures in the sloughs were 2-4°C. This elevated temperature caused the slough to stay unfrozen through the winter and it is believed to be an important factor in the survival of salmon embryos (Trihey, 1982).

In order to assess the effect of post-project changes of existing streamflow patterns on groundwater input to the sloughs, it is needed to determine the origin of the groundwater. To accomplish this three methods were tried:

1. assessment of the direction and rate of groundwater flow in the floodplain upon which these sloughs exist. Observations would be made through the year and during specific streamflow events on the mainstem Susitna River. This was accomplished through monitoring of a number of wells which were established in the areas of Sloughs 8A and 9.

2. modeling of the groundwater temperatures.

3. a test program to assess the feasibility of using environmental isotopes.

It was concluded in a separate report (R&M 1982b) that the use of dye for the tracking of groundwater would be unreliable because of the problems associated with the absorption of dyes in soils. Thus, this technique was not used for this study.

## 3.2 - Stratigraphy

Sloughs 8 and 9 and all sloughs along the river are part of the modern floodplain of the Susitna River. The modern floodplain consists predominately of cobbly sandy gravels with silty mantles in areas between and adjacent to the main channels. Above and immediately adjacent to the modern floodplain lie a series of fluvial and glaciofluvial terraces deposited as the Susitna River re-established its channel and adjusted to changes in grade following the late Wisconsin glaciations of Southcentral Alaska. The terrace deposits generally consist of coarse sandy gravels overlain by a few feet of sandy silt and silt overbank deposits. Alluvial fan deposits have formed on the floodplain and terraces where tributary streams encounter these lower gradient surfaces. The valley floor and side walls above the terraces are thought to consist of glacial tills composed of gravel, sand and silt, probably representing deposition during several glacial events (the last of which ended about 10,000 years ago). Older Pleistocene sequences of glacial and glaciofluvial drift may underlie the terraces and modern floodplains. Bedrock underlies the unconsolidated materials at an undetermined depth.

This stratification was partially verified during the installation of wells in the river floodplain. Well logs (Appendix A.6) show well graded sandy gravel overlain by 0 to 10 feet of silt and sand. The gravel contains well rounded cobbles and boulders ½ to 6 inches in diameter and contains no silt. This gravel existed in all holes drilled, although the density varied at different depths. Since no wells were established that were deeper than 43 feet, no data are available on the actual composition of the material below this depth, or on the depth of a boundary bedrock layer. It has been assumed for all calculations that this glacial till continues down to bedrock, and that its coefficient of permeability is the same at all points and in all directions. A reasonable assumed porosity for glacial till of this type would be close to 0.20. An estimate of permeability using a relationship between particle size and permeability develooped by Hazen (Lambe, 1969) gives a value of 69 m/day for the single sample analyzed. The U.S. Army Corps of Engineers estimated a permeability of 305 m/day in similar glaciofluvial alluvium near Fairbanks (Nelson, 1978). A permeability of 100 to 1000 m/day should be expected for this type of soil.

### 3.3 - Areas of Visual Groundwater Observations

Surface water discharge measurements at Slough 9 determined that a large portion of the water in the slough originates from groundwater input. This input was observed in many areas of the sloughs as seepage from the slough banks above the water surface in the slough. It was also observed as upwelling flow in numerous places, on both the river and shoreward edges side of the sloughs. This upwelling is a flow of water moving up through the slough channel. Locations of these upwelling areas are detailed on Figures 3.1 & 3.2. These locations were documented by ADF&G personnel during the first week of October.

Quantification of the rate of groundwater flow into the sloughs can be obtained using a device called a seepage meter (Figure 3.3). Seepage between the groundwater and the slough can be measured directly by covering an area of sediment with an open bottomed container, then measuring the time and change of water volume in a bag connected to the container.

Knowing the area covered by the container, the amount of seepage per unit area of slough bed can be determined. The Darcy velocity of flow through the soil can be estimated by the relationship $V = Q/A$. If a random pattern of samples of groundwater input to a slough are made, then a reasonable estimate of total groundwater input to the slough can be determined.

A single pre-freezeup test of a seepage meter yielded the following results.

Location: Slough 9B
Depth of Water: 1.5 feet
Sediment Type: Gravel and silt
Date: 10-15-82
Time: 1215-1600 = 225 minutes
Volume Change: greater than 3000 $cm^3$

$$\text{Seepage} = \frac{(\text{Volume Change, } cm^3)}{(\text{elapsed time, seconds})\ (\text{area, } m^2)}$$

$$= \frac{(3000)}{(13{,}500 \text{ sec.})\ (.255\ m^2)} = 0.87\ cm^3/m^2/\text{sec.} = 7.5 \text{ cm/day}$$

## 3.4 - Groundwater Contours

From the observation wells established in Sloughs 8A and 9 general contours of groundwater elevations were drawn for various times of the year. These contours were drawn based on the data obtained from the wells shown on the mapsheets, with intermediate elevations extrapolated from these known elevations. Figures 3.4 thru 3.11 illustrate these contours for Slough 8A. During periods of time when the river stage was stable the flow of water was through the island in a downstream direction, with a slight gradient away from the center of the island both towards the sloughs and towards the main channel. Limited sampling during the only hydrograph rise that occurred after the observation program was set up indicated that during rising river stage the groundwater contours and thus the flow of groundwater shifted rapidly toward the direction of the slough.

In Slough 9 analysis was concentrated around Slough 9B as this was shown to be the largest source of groundwater input. During periods of time when the river stage was stable the flow was directed into Slough 9B from both the river and from the area upland of the slough (Figures 3.12 through 3.21). Data during the occurrence of a rising river stage is not yet available, but it is likely that this rising river stage will increase the gradient of flow into Slough 9B. An early season (April 26, 1982) observance of well levels showed very little contribution of flow to Slough 9B from the upland area. An observation made after an ice cover had formed on the mainstem Susitna (December 21, 1982) showed no contribution of flow to 9B from the uplands yet noticeable flow was observed in the slough.

Continuous data from Datapod recorders operating on four of the wells in the area of Slough 9B since September 1982 are not yet available.

## 3.5 - Groundwater Hydraulic Calculation

The basic elements of groundwater flow are related by the Darcy equation:

$$Q = KA \frac{dh}{dL}$$

where Q is the flow of groundwater, A is the area through which flow occurs, dh/dL is the hydraulic gradient (the change in hydraulic head over a distance along the line of flow) and K is the hydraulic conductivity of the material.

Using Darcy's law and assuming isotopic soils in the river floodplains, the seepage velocity of the groundwater flow can be estimated where contour data are available. During July, which was fairly dry with the river stage very stable, the head difference between Slough 9B and the mainstem Susitna River was observed to be approximately 0.91 m (3 feet) on two occasions (July 1 and July 20). The distance along a flowline is 274 m (900 feet), resulting in a hydraulic gradient of 0.0033. Using this gradient, assuming k = 100 m/day and assuming horizontal flow, the Darcy velocity of flow through the soil can be estimated.

$$V = Ki = K \left( \frac{h_1 - h_2}{L} \right)$$

$$V = 100 \frac{m}{day} \left( \frac{0.91\ m}{274\ m} \right)$$

$$V = 100 \frac{m}{day} (0.0033) = .33 \frac{m}{day}$$

Assuming K = 1000 m/day

$$V = 1000 \frac{m}{day} (0.0033) = 3.3 \frac{m}{day}$$

In the area of Slough 8A the same type of calculations yield the following.

| Date | $h_1 - h_2$ (m) | Distance along Flowline (m) | i (m/m) | Assumed K (m/day) | V (m/day) | Comment |
|---|---|---|---|---|---|---|
| 4-26 | 0.91 | 335.4 | .0027 | 100<br>1000 | 0.27<br>2.70 | Ice cover |
| 9-3 | 1.52 | 701.2 | .0022 | 100<br>1000 | 0.22<br>2.20 | Stable flow<br>14,000 c.f.s. |
| 9-16 | 0.91 | 304.9 | .0030 | 100<br>1000 | 0.30<br>3.00 | Peak of hydrograph<br>31,000 c.f.s. |

Permeability for the gravels has not yet been defined, but assuming a range of 100 to 1000 m/day indicates that in either case the Darcy velocity through the gravels is fairly low, due to the small gradient which drives the flow.

Rapid rise and fall of the river stage, plus concurrent monitoring of the river stage and the groundwater levels, were needed to verify this movement of water and the permeability of the gravel. Only a single event of this type occurred during the observation period. The data obtained from this event were not complete enough to produce a value for permeability.

## 3.6 - Groundwater Temperature Analysis

As previously noted it was observed during the winter of 1981-82 that the temperature of the intragravel winter in the sloughs was 2 to 4°C. This elevated temperature in the sloughs is thought to be due to the influence of the lag time of the water moving through the ground to the sloughs.

Temperature measurements taken in shallow observation wells through the summer and fall are tabulated in Appendix A.2. Temperatures in the wells generally ranged from 2 to 6°C with temperatures increasing through the summer. Temperatures in the mainstem Susitna River ranged from 0 to 10°C.

Analysis of the ground thermal regime was undertaken by Acres American, Incorporated, and is described in a companion report to this one (Acres, 1983).

## 3.7 - Environmental Isotope Study

A test program to determine the feasibility of using environmental isotope tracers for water source studies was conducted in the fall of 1982. An environmental isotope is a naturally occurring or man made isotope (which the investigator cannot control) which may be useful in hydrologic studies. Oxygen-18 ($O^{18}$), tritium, and deuterium are three environmental isotopes which can be used as tracers of water. Depending on the source of the water the isotope content of the water will vary with the result that the water may attain an isotopic signature unique to that water source.

Samples from the mainstem Susitna River, from the groundwater originating from upland of from the sloughs, and from the sloughs were analyzed for their oxygen-18, tritium, and deuterium ratios. If the isotopic signatures from the different water sources are sufficiently different then the relative contributions to the sloughs of groundwater from upland of the sloughs and of intragravel flow from the river may be quantified through a simple mass balance equation.

Sample analysis was done by the Department of Earth Sciences at the University of Waterloo, Waterloo, Ontario. The samples from the area of Slough 8A were taken on July 18, 1982 ($Q_{GC}$ = 25,400). The samples from the area of Slough 9 were taken on July 20, 1982 ($Q_{GC}$ = 22,900). The results of this testing for tritium, oxygen-18, and deuterium are shown below.

RESULTS OF INITIAL ENVIRONMENTAL ISOTOPES ANALYSIS

| Sample | Tritium (±8 T.U.) | Oxygen-18 (± .2) | Deuterium (± 3) |
|---|---|---|---|
| Susitna River | +64 | -21.0 | -169 |
| Slough 9B | +82 | -19.3 | -148 |
| Well 9-3, upland groundwater | +39 | -17.7 | -137 |
| Stream entering Slough 8A | +49 | -17.8 | -143 |
| Slough 8A | +63 | -17.5 | -145 |

To understand these results some background on the two isotopes is needed.

Tritium is a isotope of hydrogen whose half life is 12.35 years. Its concentration is measured in tritium units (T.U.) where 1 TU = $10^{-18}$ tritium atoms per hydrogen atom. Tritium is produced both naturally by cosmic neutron bombardment of nitrogen -14 and by man as a by product of atmospheric nuclear testing. The natural production of tritium has been estimated to be from 4 to 25 T.U. but concentrations up to 3000 T.U. have been found in Alaska, since the advent of nuclear testing in 1952, which have completely masked the natural production.

A general guideline for the use of tritium isotope in hydrology studies is that if the water has less than 5 T.U., then it originated from precipitation which fell prior to 1953. If the water has more than 5 T.U., then it originated from precipitation which fell after 1953.

For this study it was hoped that a significant difference would be found between mainstem Susitna water which is partially composed of glacial melt (old precipitation) and local groundwater (new precipitation). Looking at the results there was a significant difference but not in the way hoped for. The mainstem sample (glacial melt and recent precipitation) contained a greater concentration of tritium than the local groundwater. Testing of the sample from the slough showed a higher concentration of tritium than either the mainstem or the local groundwater. This was not expected, as the concentration here should have been between the two extremes.

Oxygen-18 is a stable isotope of oxygen which occurs naturally in water. The concentration is expressed as a ratio of heavy to light oxygen ($O^{18}/O^{16}$) as per mil percent differences relative to a reference standard, Standard Mean Ocean Water. The oxygen-18 concentration of water is controlled mainly by the differences in vapor pressures and freezing points of oxygen-18 and oxygen-16. When water vapor condenses, the rain or snow which forms has a higher concentration of oxygen-18 than the vapor from which it formed. This process is called "fractionation". As the water vapor moves inland as part of a regional or continental circulation system, the process of condensation and precipitation is repeated several times, progressively depleting the residual water vapor with respect to oxygen-18. The isotopic composition of a rain or snow event is strongly controlled by temperature. For practical purposes, the temperature dependency results in (Sklash, 1982):

- An Altitude Effect: oxygen-18 becomes more deplete with altitude.

- A Distance to Source Effect: Continental precipitation is more depleted in oxygen-18 than coastal precipitation.

- A Paleoclimate Effect: Precipitation fallen under cooler climates which existed in the past would be depleted in oxygen-18.

- A Seasonal Effect: Winter precipitation is more depleted in oxygen-18 than summer precipitation.

All of these factors seem to point to the idea that the water in the mainstem Susitna, originating from areas of higher elevation and containing a large percentage of precipitation which had fallen under cooler climates or as snow, should have a lower concentration of heavy oxygen than the local groundwater near the sloughs. Our initial sample testing showed this to be the case.

Deuterium is an isotope of Hydrogen ($H^3$) which occurs naturally in water. Its response to the process of fractionation is similar to the oxygen-18 isotope.

There is a possibility that the components of slough flow can be determined by their isotopic signatures. The results from the initial tritium testing do not show much promise. Although only one sample was tested it is likely that future testing using this isotope would not be worthwhile. The oxygen-18 and deuterium initial results were more promising, as they followed the expected pattern. A significant problem in utilizing the environmental isotope technique is the travel time of Susitna River water as intragravel flow. The Darcy velocity of the groundwater is generally quite low because of the low driving head. The stratigraphy and permeability of the gravel islands and bars are quite variable, further complicating the interpretation. In addition, the isotopic signature of the river water is believed to vary throughout the year. Because of the variability in isotopic signatures and in travel time through the gravels, it is difficult to determine what isotopic signature for river water should be used when estimating the contributions from different sources.

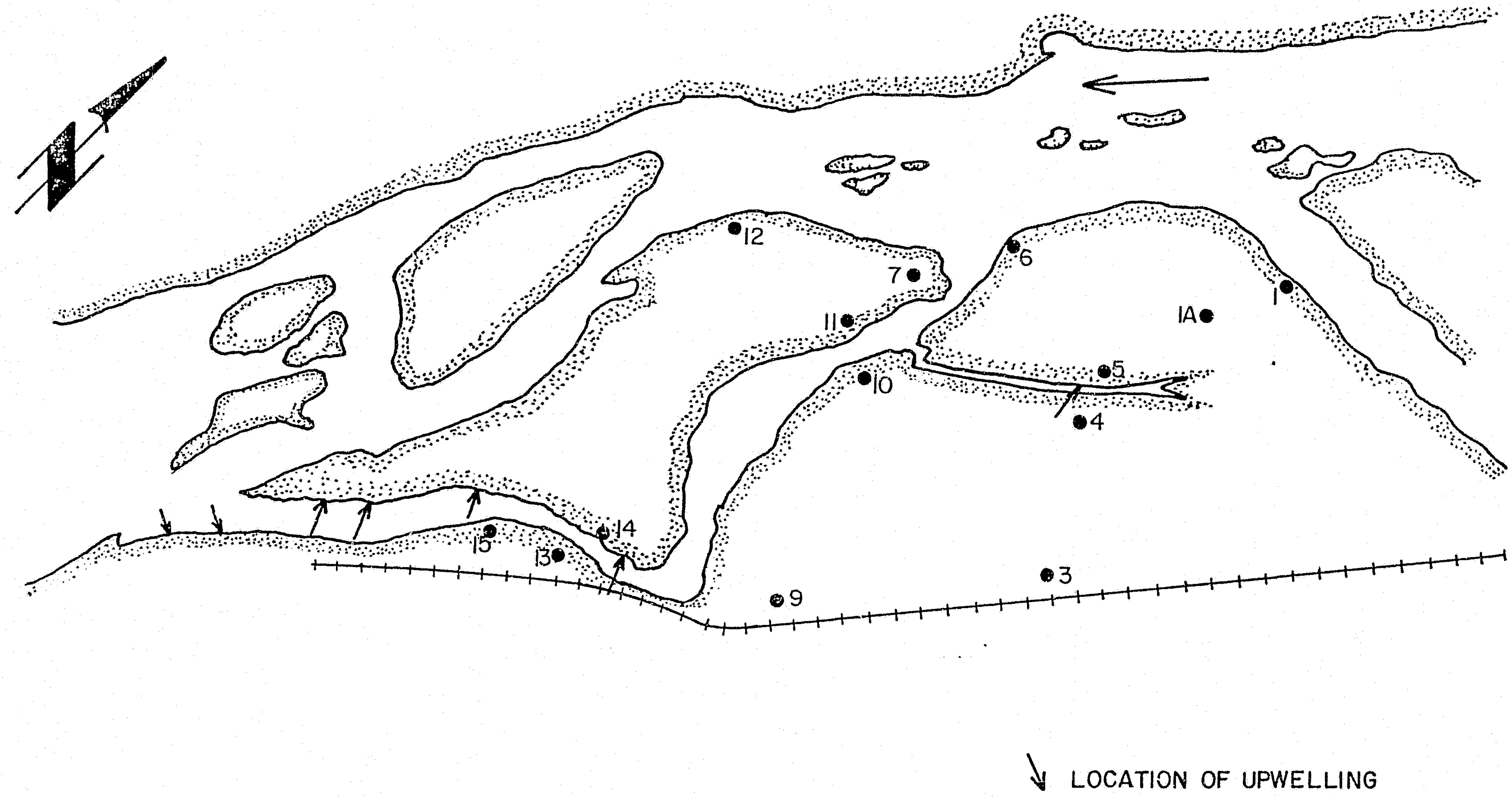


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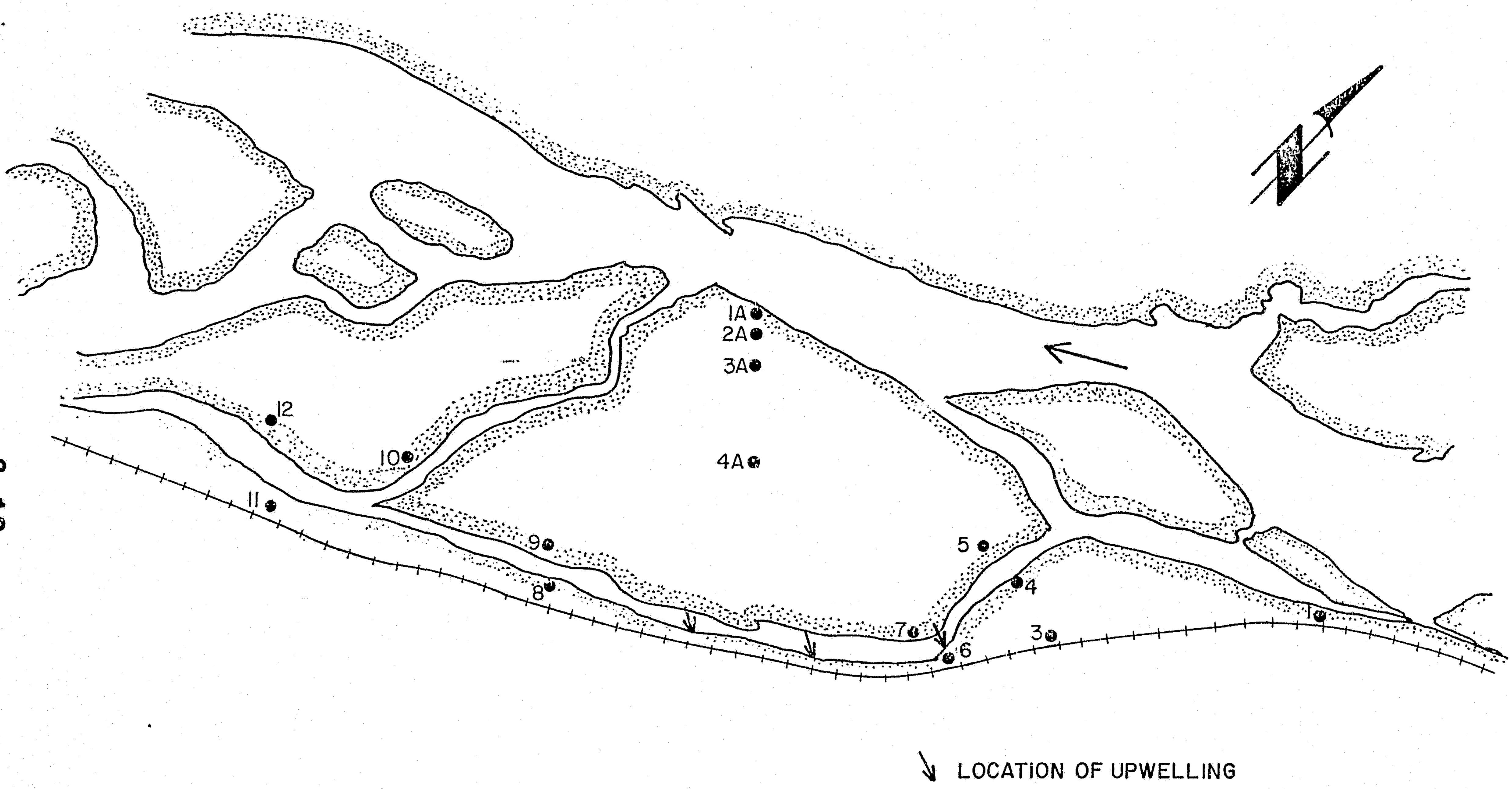
**FIG. 3.1**

**OBSERVED LOCATION OF GROUNDWATER UPWELLING**

**SLOUGH 9**

PREPARED FOR:

ACRES




PREPARED BY:

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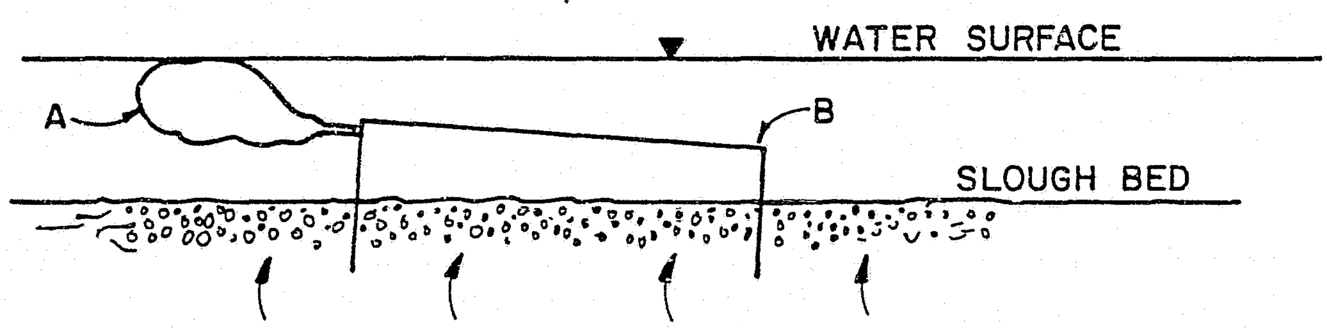
FIG. 3.2

**OBSERVED LOCATION OF GROUNDWATER UPWELLING**

**SLOUGH 8A**

PREPARED FOR:

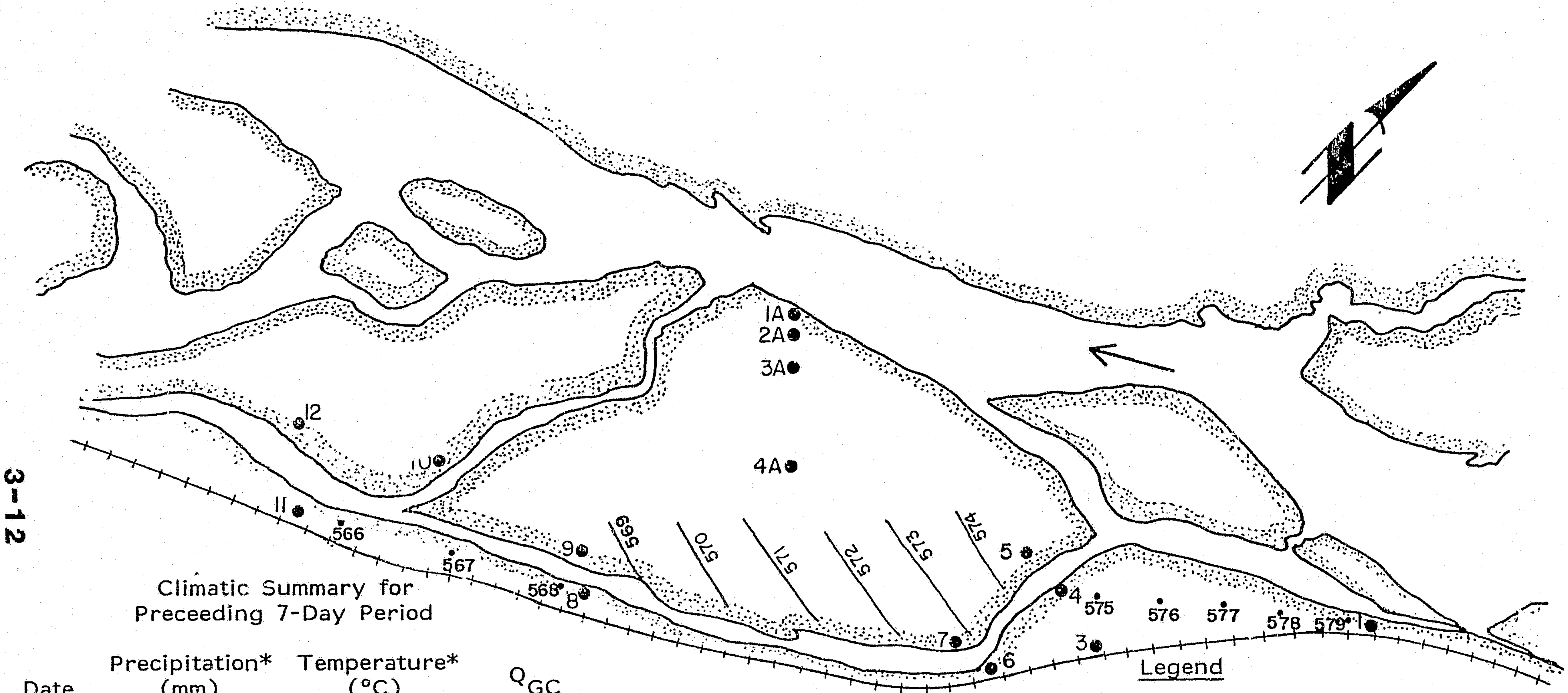
ACRES




A = Plastic bag to collect groundwater
B = End section of a 55 gallon drum

Figure 3.3

Seepage Meter




Climatic Summary for Preceeding 7-Day Period

| Date | Precipitation* (mm) | Temperature* (°C) | $Q_{GC}$ |
|---|---|---|---|
| 4-20 | 7.0 | 1.7 | Ice cover |
| 4-21 | 0.0 | 1.5 | Ice cover |
| 4-22 | 0.0 | 1.2 | Ice cover |
| 4-23 | 0.0 | 0.1 | Ice cover |
| 4-24 | 1.6 | 1.1 | Ice cover |
| 4-25 | 0.0 | 4.4 | Ice cover |
| 4-26 | 0.0 | 1.0 | Ice cover |

* Precip. and temp. data from Devil Canyon Climate Stations.

Legend

| | |
|---|---|
| o | observation well |
| "600" | groundwater elevation |
| Date: | 4-26-82 |
| $Q_{GC}$: | Ice Cover |

PREPARED BY:

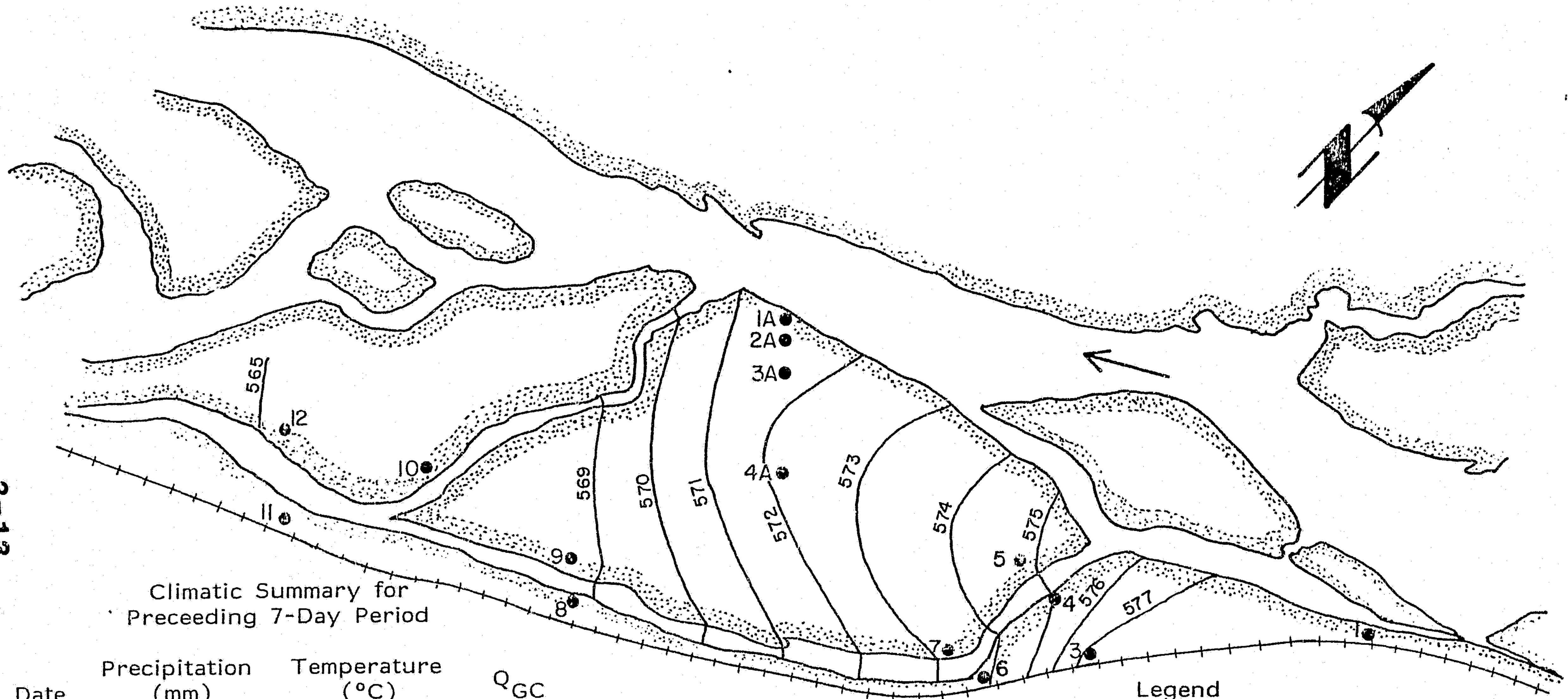
R&M CONSULTANTS, INC.

**FIG. 3.4** **GROUNDWATER CONTOURS SUSITNA RIVER AT SLOUGH 8A**

SCALE: 1" = 1000'

PREPARED FOR:

ACRES




Climatic Summary for Preceeding 7-Day Period

| Date | Precipitation (mm) | Temperature (°C) | $Q_{GC}$ |
|---|---|---|---|
| 8-28 | 3.2 | 9.8 | 12,400 |
| 8-29 | 13.2 | 9.8 | 12,200 |
| 8-30 | 27.2 | 8.5 | 13,100 |
| 8-31 | 7.8 | 9.8 | 16,000 |
| 9-1 | 9.4 | 10.3 | 17,900 |
| 9-2 | 11.6 | 9.2 | 16,000 |
| 9-3 | 7.8 | 8.3 | 14,600 |

Legend

o observation well

"600" groundwater elevation

Date: 9-3-82

$Q_{GC}$: 14,600

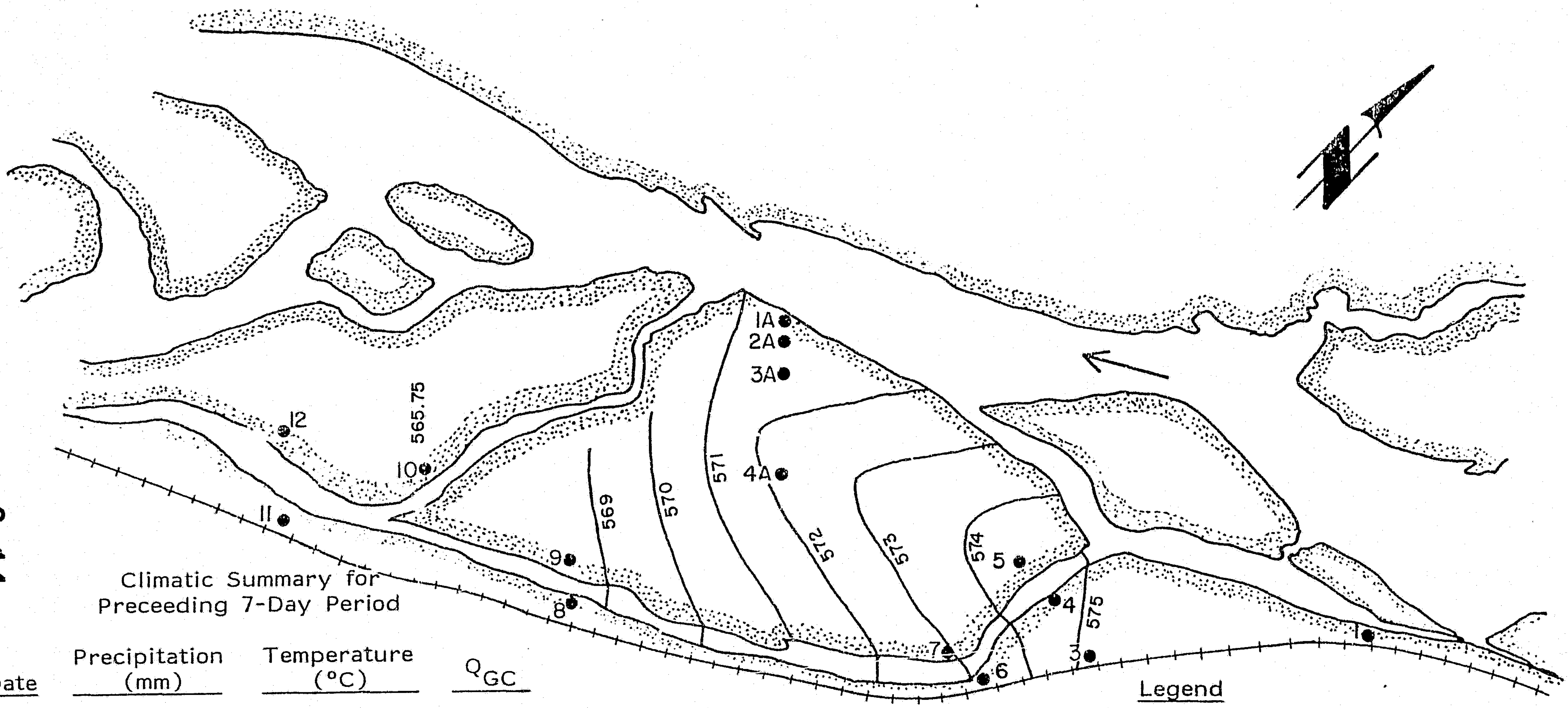
PREPARED FOR:

R&M CONSULTANTS, INC.

**FIG. 3.5**

**GROUNDWATER CONTOURS**
**SUSITNA RIVER AT SLOUGH 8A**
SCALE: 1" = 1000'

ACRES




Climatic Summary for
Preceeding 7-Day Period

| Date | Precipitation (mm) | Temperature (°C) | $Q_{GC}$ |
|---|---|---|---|
| 9-3 | 7.8 | 8.3 | 14,600 |
| 9-4 | 0.2 | 7.8 | 14,400 |
| 9-5 | 1.0 | 9.9 | 13,600 |
| 9-6 | 0.0 | 10.3 | 12,200 |
| 9-7 | 1.8 | 10.9 | 11,700 |
| 9-8 | 0.2 | 9.2 | 11,900 |
| 9-9 | 0.8 | 9.3 | 13,400 |
| 9-10 | 0.2 | 8.7 | 14,400 |

Legend

● observation well

"600" groundwater elevation

Date: 9-10-82

$Q_{GC}$: 14,400

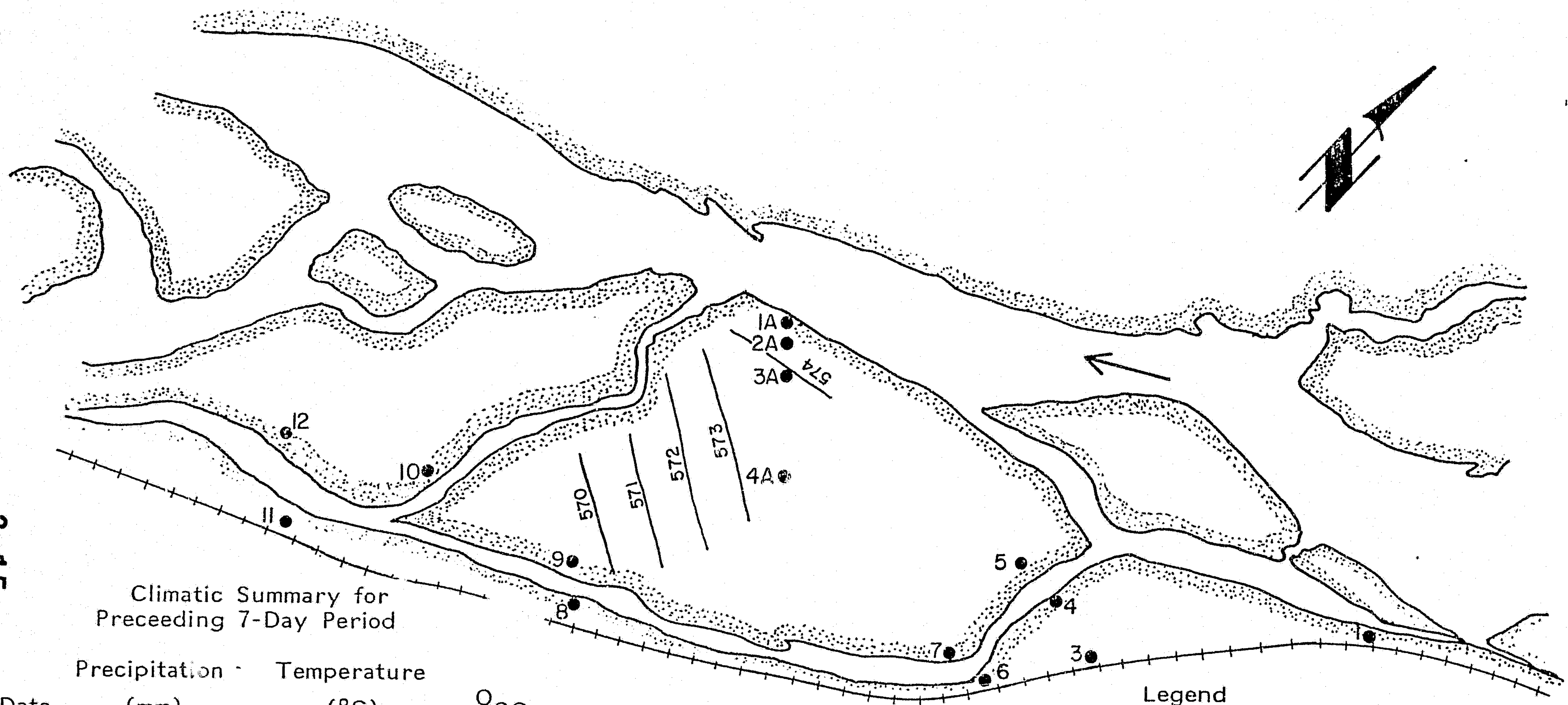
PREPARED FOR:

R&M CONSULTANTS, INC.

**FIG. 3.6**

**GROUNDWATER CONTOURS**
**SUSITNA RIVER AT SLOUGH 8A**
SCALE: 1"=1000'

ACRES




Climatic Summary for
Preceeding 7-Day Period

| Date | Precipitation (mm) | Temperature (°C) | $Q_{GC}$ |
|---|---|---|---|
| 9-10 | 0.2 | 8.7 | 14,400 |
| 9-11 | 7.6 | 3.7 | 13,600 |
| 9-12 | 3.6 | 5.7 | 13,200 |
| 9-13 | 28.6 | 6.6 | 15,200 |
| 9-14 | 19.0 | 8.9 | 20,200 |
| 9-15 | 29.8 | 12.2 | 28,200 |
| 9-16 | 11.2 | 8.6 | 32,500 |

Legend

- ● observation well
- "600" groundwater elevation

Date: 9-16-82

$Q_{GC}$: 31,400

PREPARED BY

PREPARED FOR:

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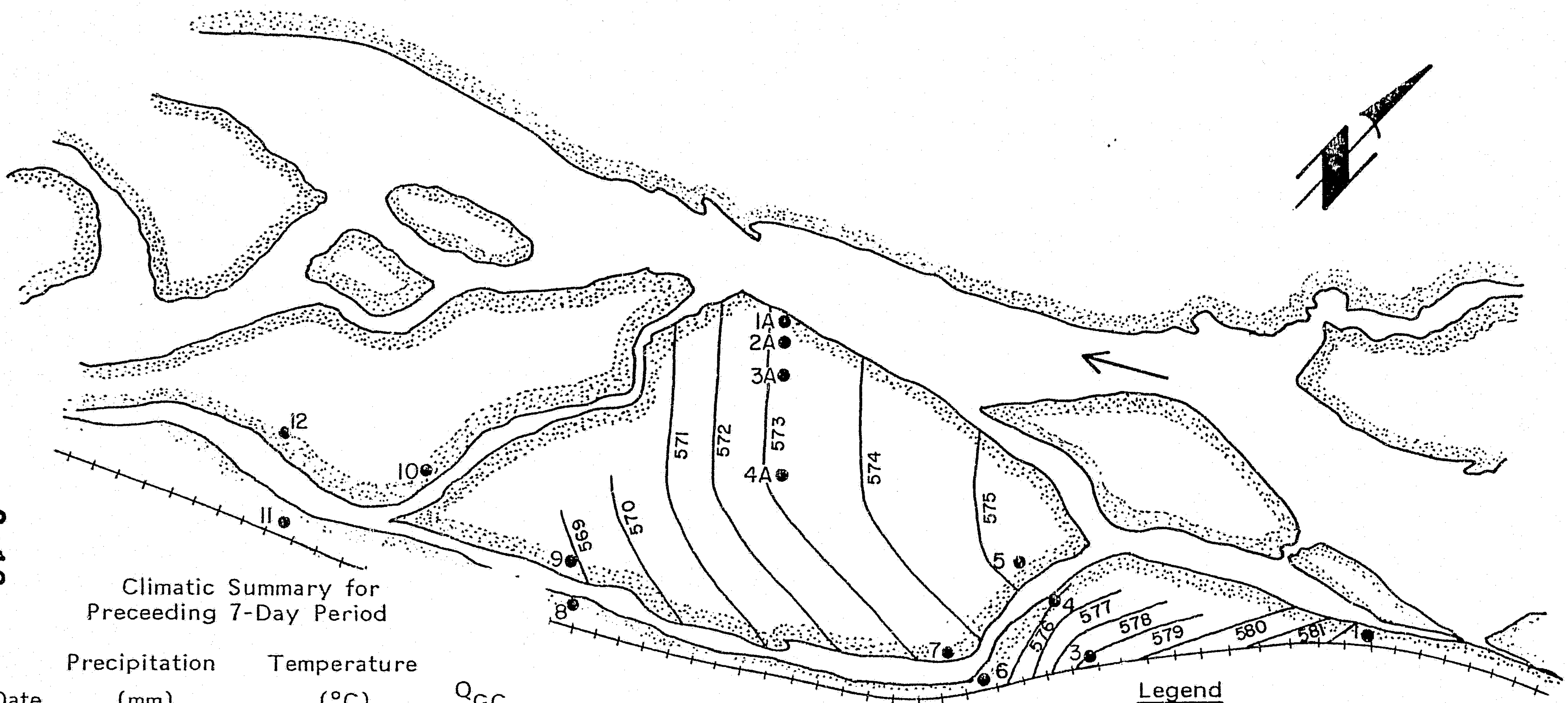
R&M CONSULTANTS, INC.

FIG. 3.7

GROUNDWATER CONTOURS
SUSITNA RIVER AT SLOUGH 8A
SCALE: 1" = 1000'

ACRES




Climatic Summary for Preceeding 7-Day Period

| Date | Precipitation (mm) | Temperature (°C) | $Q_{GC}$ |
|---|---|---|---|
| 9-14 | 19.0 | 8.9 | 20,200 |
| 9-15 | 29.8 | 12.2 | 28,200 |
| 9-16 | 11.2 | 8.6 | 32,500 |
| 9-17 | 9.4 | 5.4 | 32,000 |
| 9-18 | 10.0 | 7.9 | 27,500 |
| 9-19 | 18.6 | 7.7 | 24,100 |
| 9-20 | 6.0 | 7.5 | 24,000 |

Legend

● observation well

"600" groundwater elevation

Date: 9-20-82

$Q_{GC}$: 24,000

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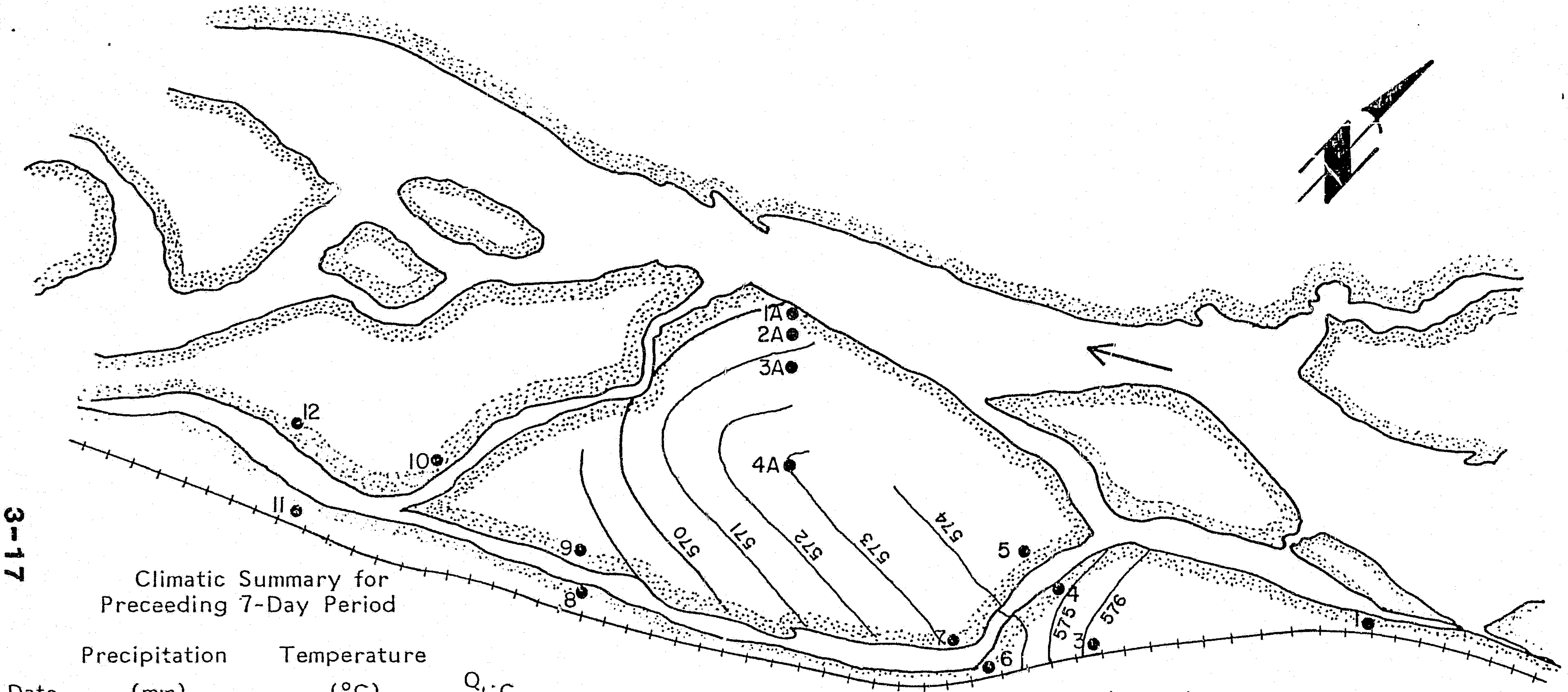
PREPARED FOR:

ACRES

**FIG. 3.8**

**GROUNDWATER CONTOURS SUSITNA RIVER AT SLOUGH 8A**

SCALE: 1" = 1000'




Climatic Summary for Preceeding 7-Day Period

| Date | Precipitation (mm) | Temperature (°C) | $Q_{GC}$ |
|---|---|---|---|
| 9-29 | 7.4 | 6.0 | 12,400 |
| 9-30 | 8.4 | 4.9 | 12,500 |
| 10-1 | - | 2.2 | 12,400 |
| 10-2 | - | 3.3 | 11,700 |
| 10-3 | - | 2.8 | 11,000 |
| 10-4 | - | 1.3 | 10,500 |
| 10-5 | - | 0.1 | 9,800 |

Legend

● observation well

"600" groundwater elevation

Date: 10-5-82

$Q_{GC}$: 8,300

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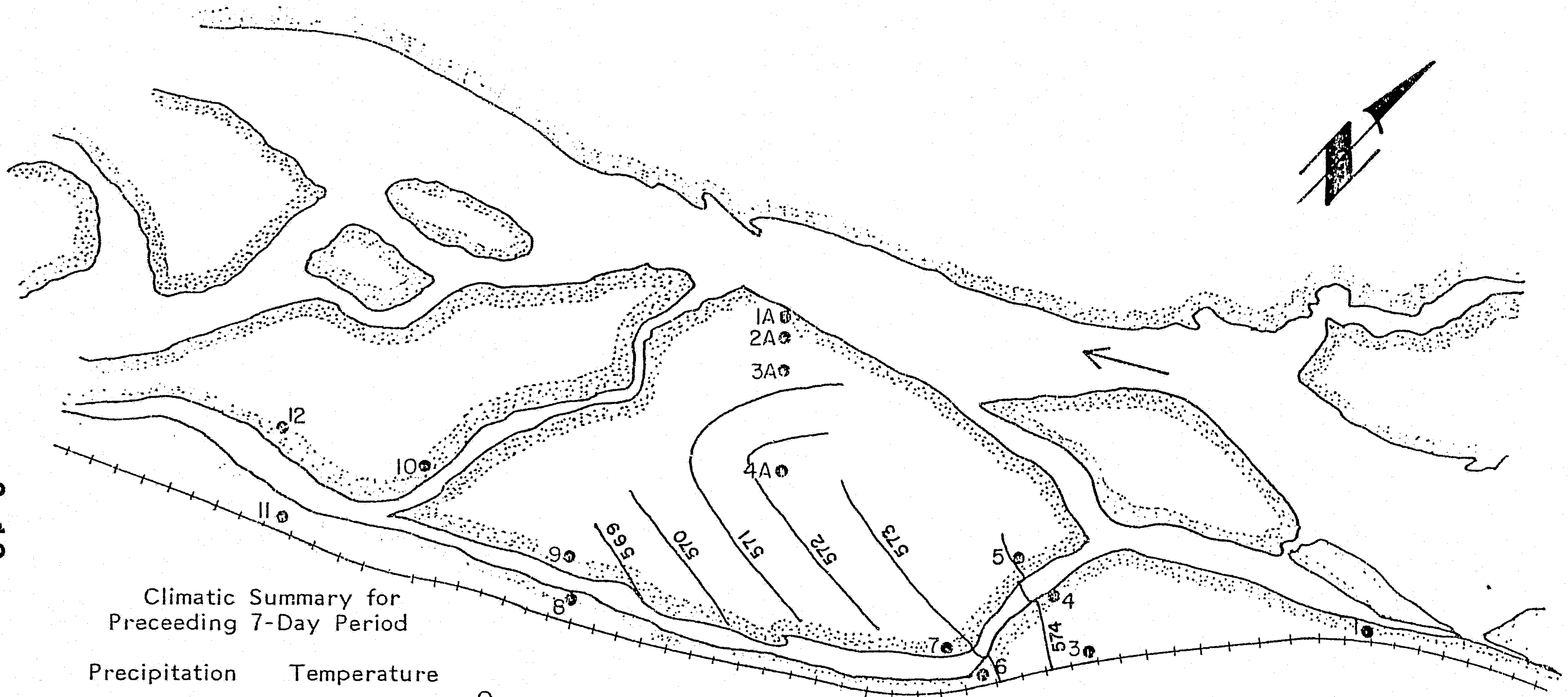
FIG. 3.9

GROUNDWATER CONTOURS
SUSITNA RIVER AT SLOUGH 8A
SCALE: 1" = 1000'

PREPARED FOR:

ACRES




Climatic Summary for
Preceeding 7-Day Period

| Date | Precipitation (mm) | Temperature (°C) | $Q_{GC}$ |
|---|---|---|---|
| 10-7 | - | 0.5 | 8,480 |
| 10-8 | - | 0.1 | 8,400 |
| 10-9 | - | 0.1 | 8,440 |
| 10-10 | - | -2.0 | 8,480 |
| 10-11 | - | -0.7 | - |
| 10-12 | - | 1.1 | - |
| 10-13 | - | -2.4 | 7,500 |

Legend

● observation well

"600" groundwater elevation

Date: 10-13-82

$Q_{GC}$: 7,500

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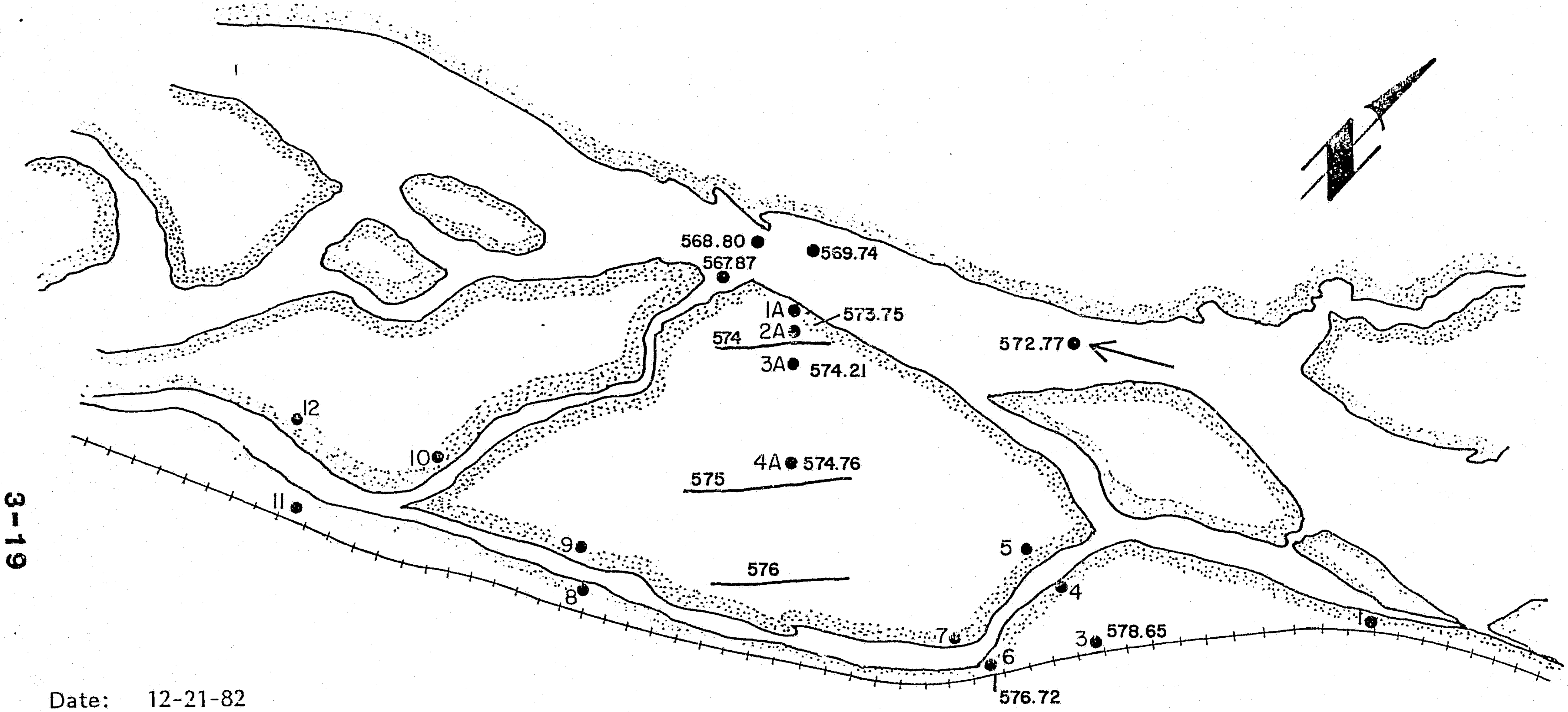
PREPARED FOR:

ACRES

FIG. 3.10

GROUNDWATER CONTOURS
SUSITNA RIVER AT SLOUGH 8A
SCALE: 1" = 1000'




Date: 12-21-82

Note: Winter flow, ice cover on mainstem. Jamming causing partial diversion of mainstem flow into slough

Legend

• observation well

"600" groundwater elevation

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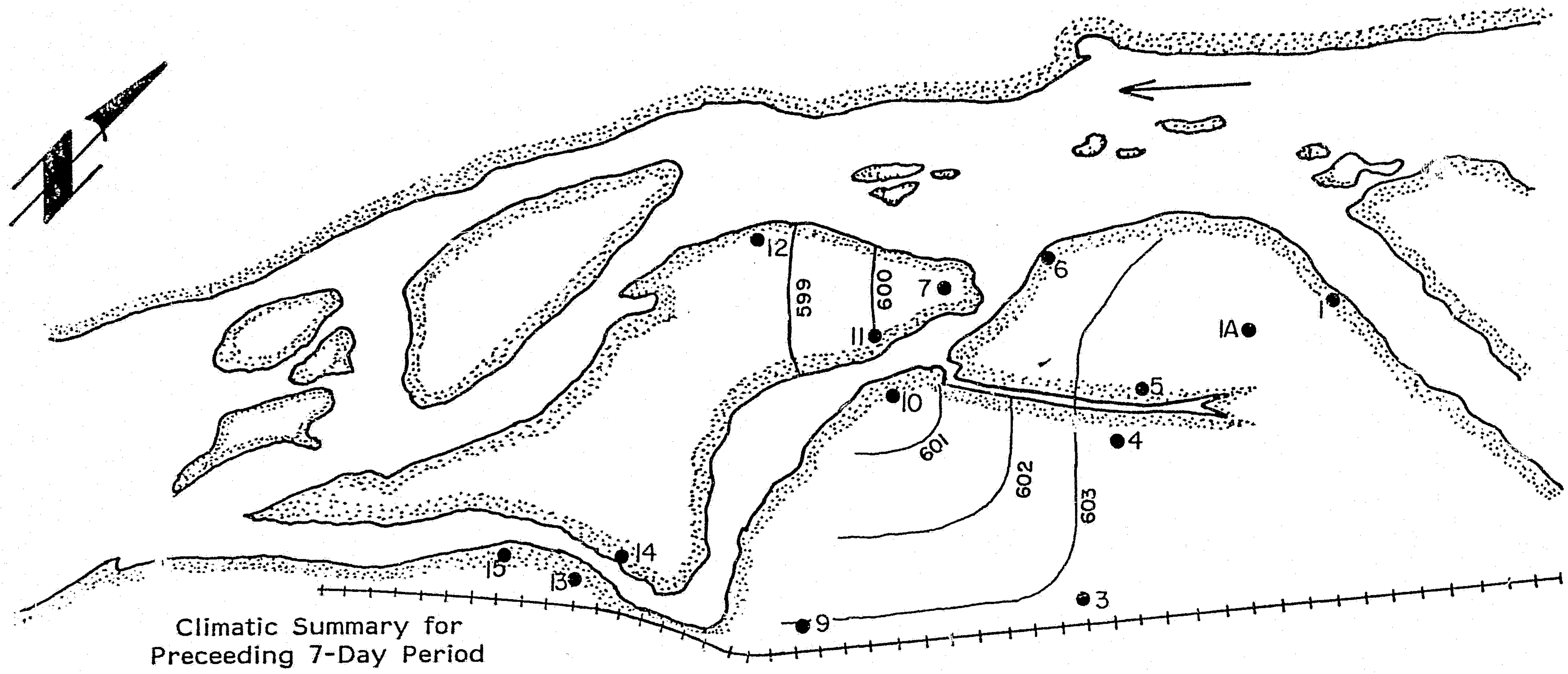
FIG. 3.11

**GROUNDWATER CONTOURS**
**SUSITNA RIVER AT SLOUGH 8A**

PREPARED FOR:

ACRES




Climatic Summary for
Preceeding 7-Day Period

| Date | Precipitation* (mm) | Temperature* (°C) | $Q_{GC}$ |
|---|---|---|---|
| 4-20 | 7.0 | 1.7 | Ice cover |
| 4-21 | 0.0 | 1.5 | Ice cover |
| 4-22 | 0.0 | 1.2 | Ice cover |
| 4-23 | 0.0 | 0.1 | Ice cover |
| 4-24 | 1.6 | 1.1 | Ice cover |
| 4-25 | 0.0 | 4.4 | Ice cover |
| 4-26 | 0.0 | 1.0 | Ice cover |

* Precip. and temp. data from Devil Canyon Climate Stations.

Legend

● observation well

"600" groundwater elevation

Date: 4-26-82

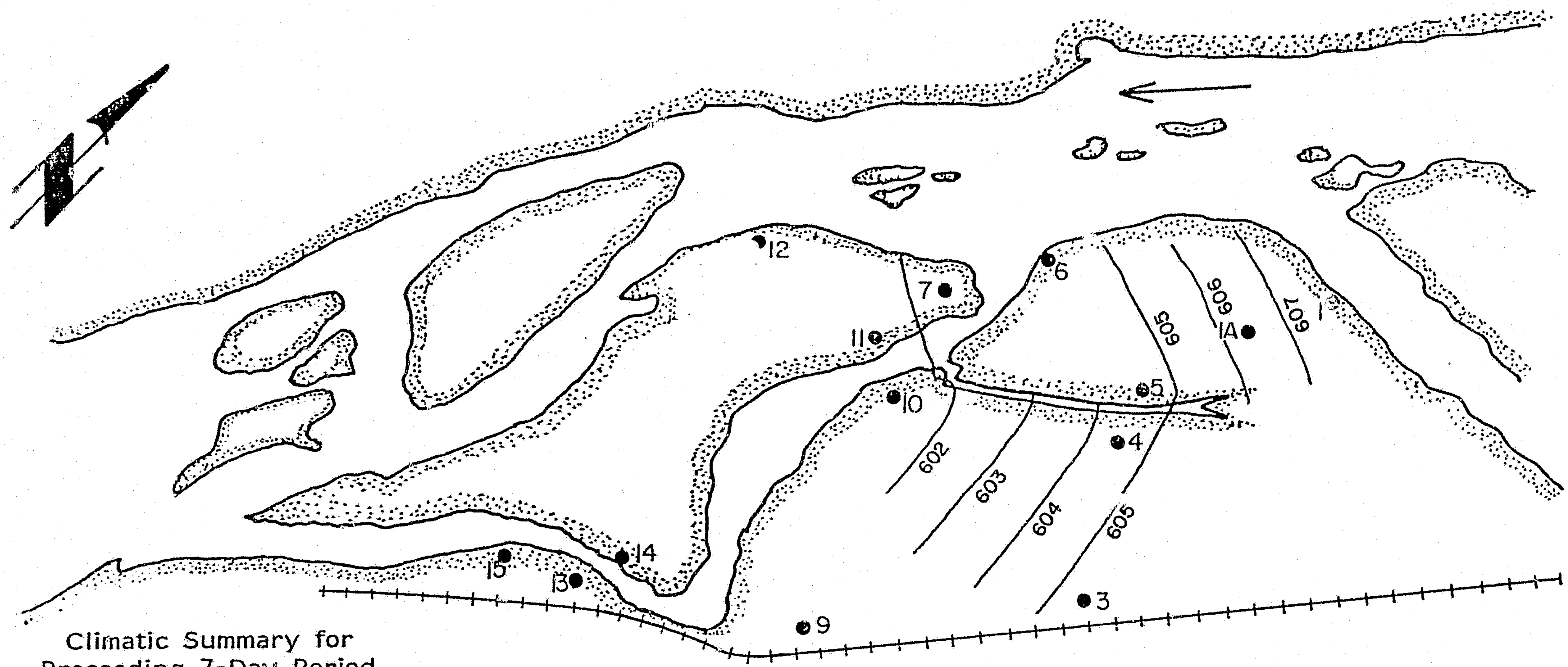
$Q_{GC}$: Ice Cover

PREPARED BY: R&M CONSULTANTS, INC.

FIG. 3.12

GROUNDWATER CONTOURS
SUSITNA RIVER AT SLOUGH 9
SCALE: 1" = 1000'

PREPARED FOR: ACRES




Climatic Summary for
Preceeding 7-Day Period

| Date | Precipitation (mm) | Temperature (°C) | $Q_{GC}$ |
|---|---|---|---|
| 5-5 | 0.0 | 0.9 | Ice cover |
| 5-6 | 0.0 | 4.7 | Ice cover |
| 5-7 | 0.2 | 5.1 | Ice cover |
| 5-8 | 0.6 | 4.9 | Ice cover |
| 5-9 | 4.4 | 3.0 | Ice cover |
| 5-10 | 3.2 | 5.1 | Ice cover |
| 5-11 | 3.2 | 3.0 | Ice cover |

Legend

● observation well

"600" groundwater elevation

Date: 5-11-82

$Q_{GC}$: Ice cover, just before breakup

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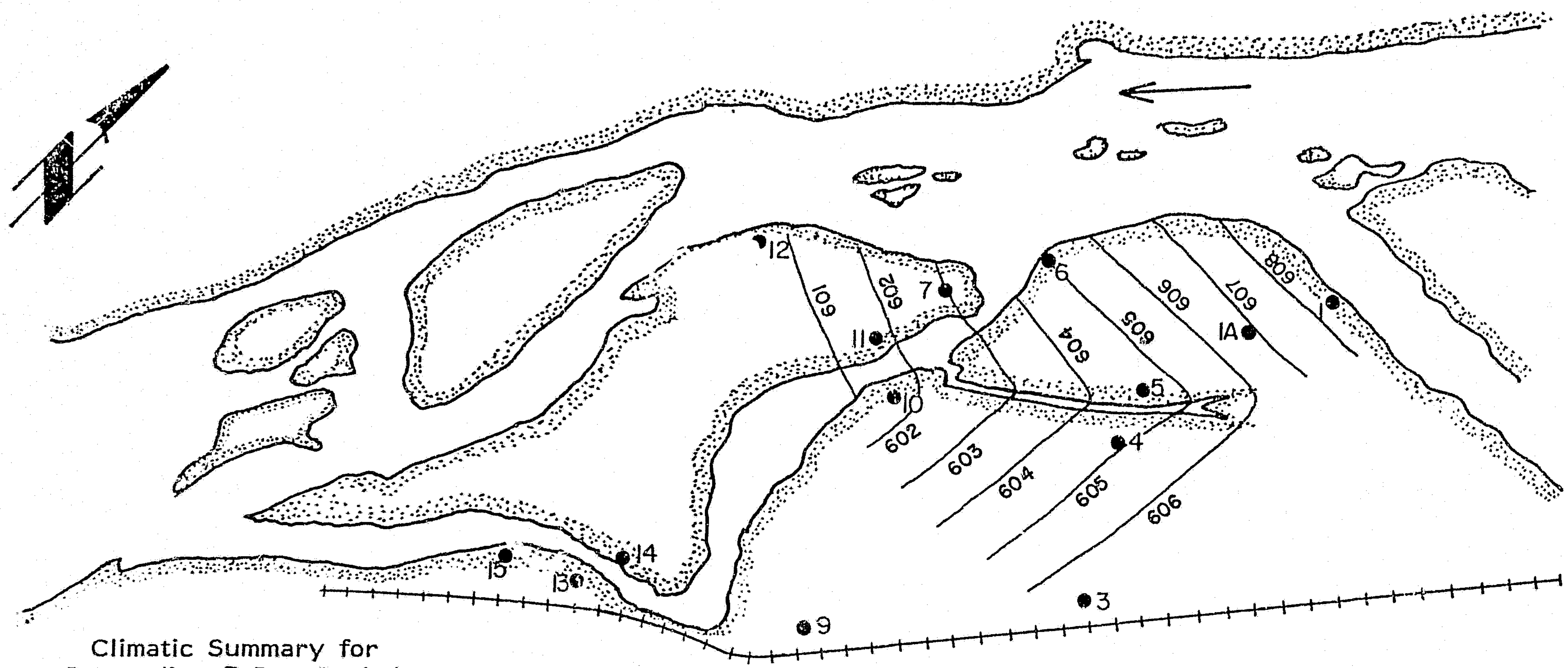
R&M CONSULTANTS, INC.

PREPARED FOR:

ACRES

**FIG. 3.13**

**GROUNDWATER CONTOURS**
**SUSITNA RIVER AT SLOUGH 9**
SCALE: 1" = 1000'




Climatic Summary for
Preceeding 7-Day Period

| Date | Precipitation (mm) | Temperature (°C) | $Q_{GC}$ |
|---|---|---|---|
| 6-17 | 0.0 | 11.4 | - |
| 6-18 | 1.8 | 10.9 | - |
| 6-19 | 0.0 | 14.3 | - |
| 6-20 | 10.8 | 8.3 | - |
| 6-21 | 0.4 | 10.5 | - |
| 6-22 | 0.0 | 11.8 | 24,000 |
| 6-23 | 0.0 | 14.2 | 25,000 |

Legend

● observation well

"600" groundwater elevation

Date: 6-23-82

$Q_{GC}$: 25,000

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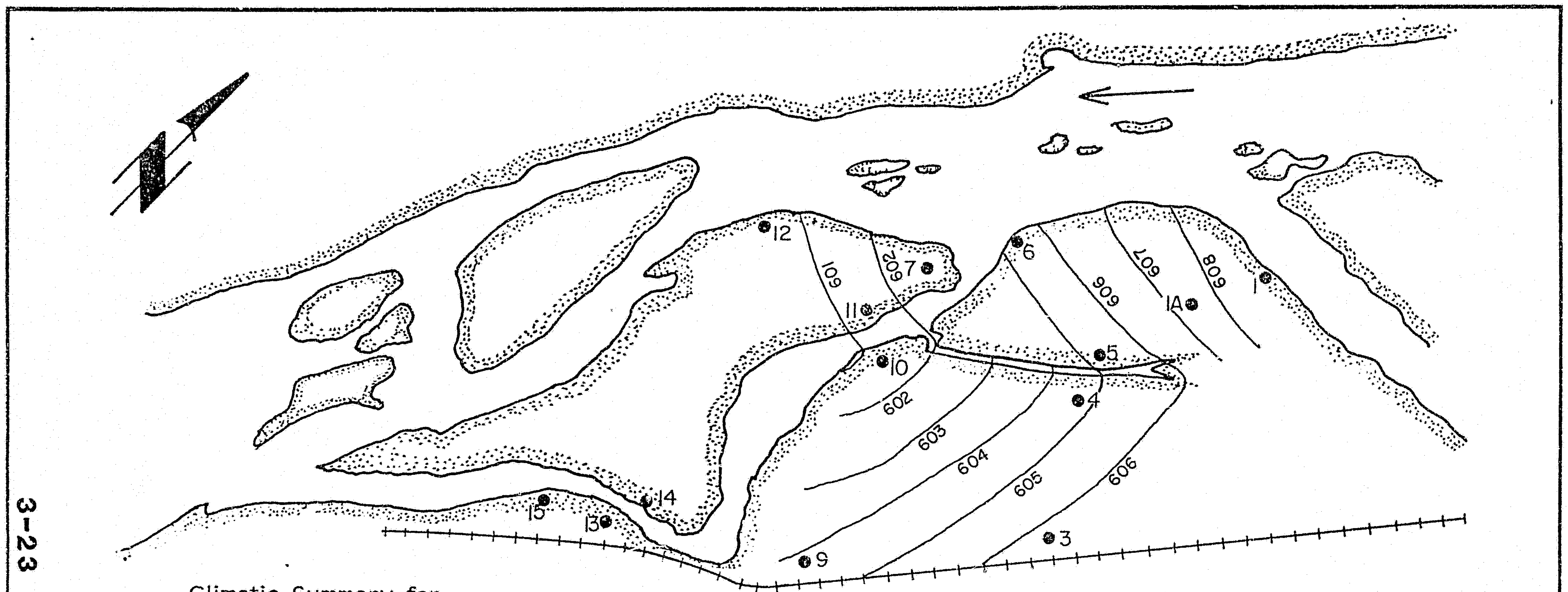
FIG . 3.14

**GROUNDWATER CONTOURS**
**SUSITNA RIVER AT SLOUGH 9**
SCALE: 1" = 1000'

PREPARED FOR:




3-23

Climatic Summary for
Preceeding 7-Day Period

| Date | Precipitation (mm) | Temperature (°C) | $Q_{GC}$ |
|---|---|---|---|
| 6-25 | 2.0 | 16.5 | 25,000 |
| 6-26 | 0.0 | 15.9 | - |
| 6-27 | 0.0 | 14.9 | - |
| 6-28 | 0.8 | 12.7 | - |
| 6-29 | 0.0 | 13.0 | 27,000 |
| 6-30 | 9.2 | 13.6 | 24,000 |
| 7-1 | 1.6 | 10.1 | 25,000 |

Legend

● observation well

"600" groundwater elevation

Date: 7-1-82

$Q_{GC}$: 25,000

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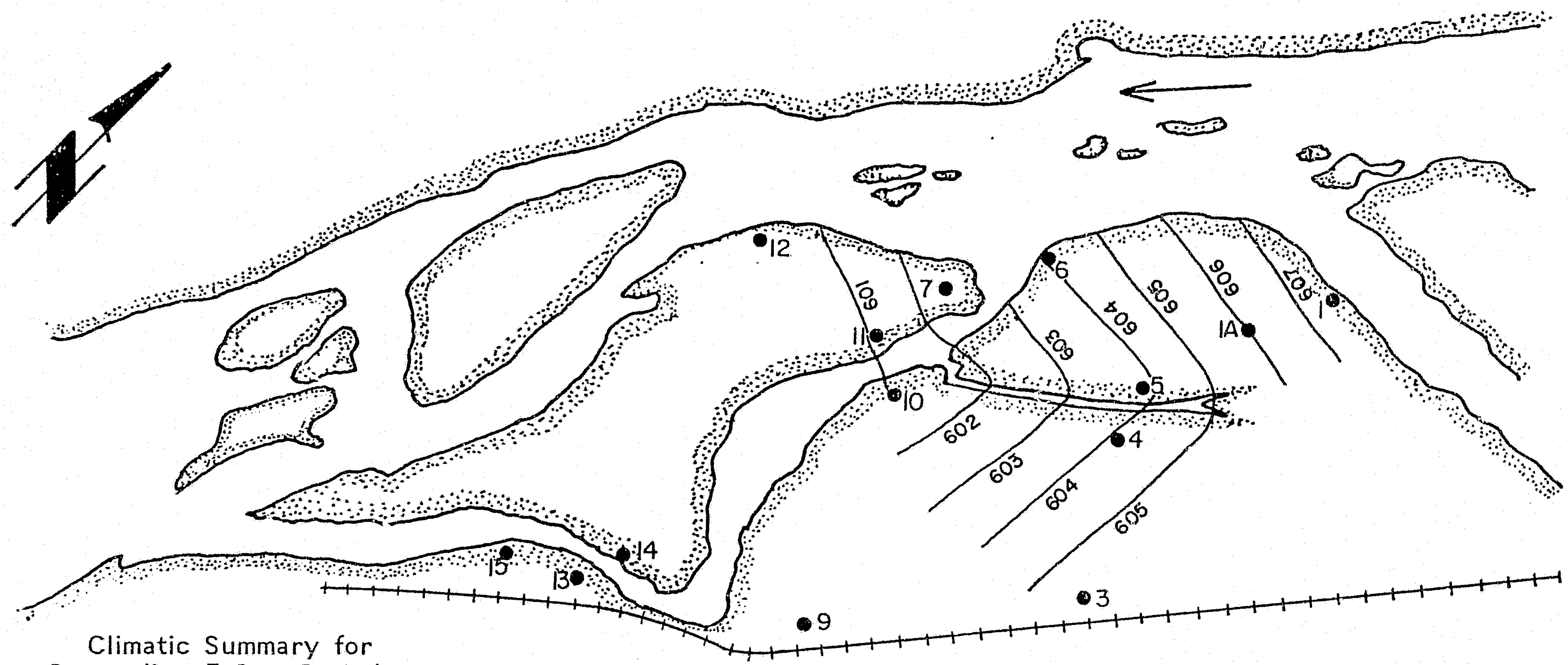
R&M CONSULTANTS, INC.

FIG 3.15

**GROUNDWATER CONTOURS**
**SUSITNA RIVER AT SLOUGH 9**
SCALE: 1" = 1000'

PREPARED FOR:

ACRES




Climatic Summary for
Preceeding 7-Day Period

| Date | Precipitation (mm) | Temperature (°C) | $Q_{GC}$ |
|---|---|---|---|
| 7-14 | 1.8 | 12.0 | 27,300 |
| 7-15 | 2.2 | 11.4 | 25,600 |
| 7-16 | 7.6 | 11.1 | 25,600 |
| 7-17 | 2.4 | 13.2 | 25,300 |
| 7-18 | 13.2 | 12.2 | 25,400 |
| 7-19 | 0.0 | 15.7 | 24,900 |
| 7-20 | 0.0 | 15.0 | 22,900 |

Legend

● observation well

"600" groundwater elevation

Date: 7-20-82

$Q_{GC}$: 22,900

PREPARED BY:

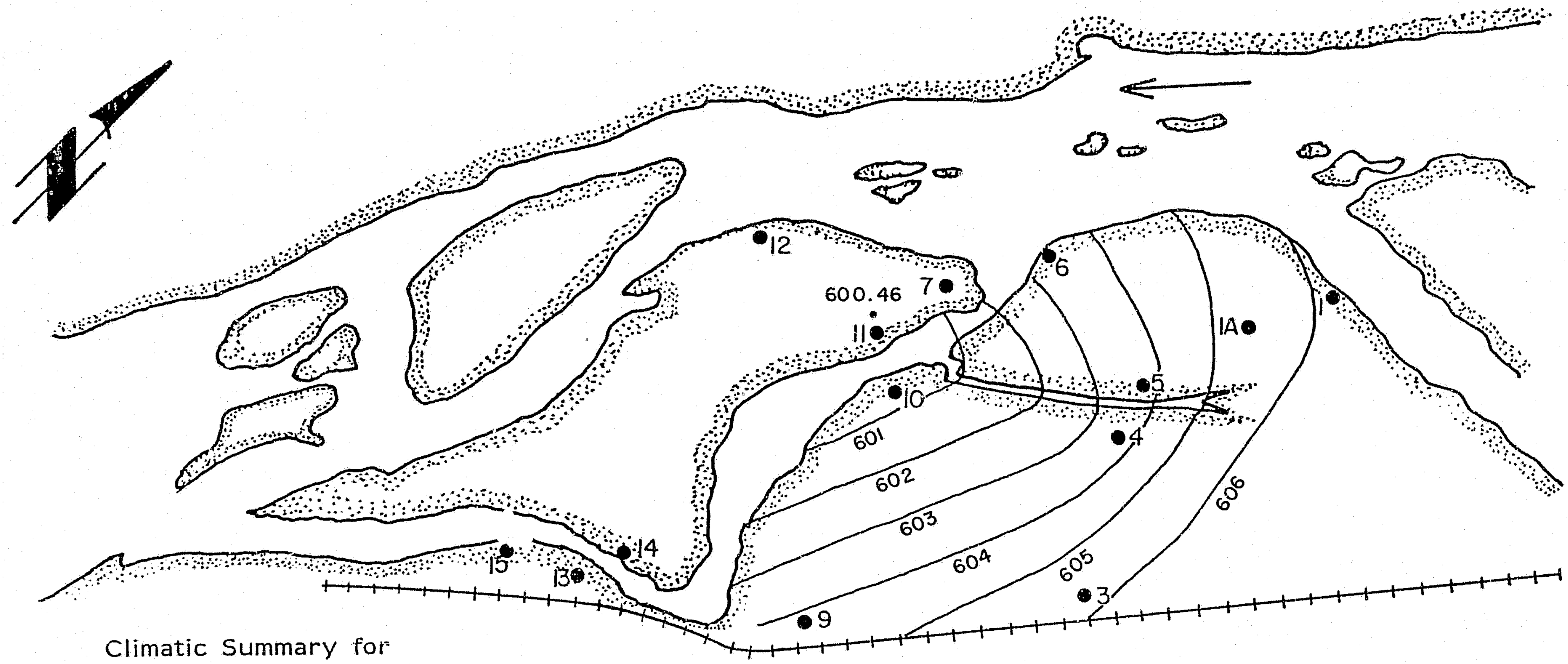
R&M CONSULTANTS, INC.

**FIG. 3.16**

**GROUNDWATER CONTOURS**
**SUSITNA RIVER AT SLOUGH 9**
SCALE: 1" = 1000'

PREPARED FOR:

ACRES




Climatic Summary for
Preceeding 7-Day Period

| Date | Precipitation (mm) | Temperature (°C) | $Q_{GC}$ |
|---|---|---|---|
| 8-31 | 7.8 | 9.8 | 16,000 |
| 9-1 | 9.4 | 10.3 | 17,900 |
| 9-2 | 11.6 | 9.2 | 16,000 |
| 9-3 | 7.8 | 8.3 | 14,600 |
| 9-4 | 0.2 | 7.8 | 14,400 |
| 9-5 | 1.0 | 9.9 | 13,600 |
| 9-6 | 0.0 | 10.3 | 12,200 |

Legend

● observation well

"600" groundwater elevation

Date: 9-6-82

$Q_{GC}$: 12,200

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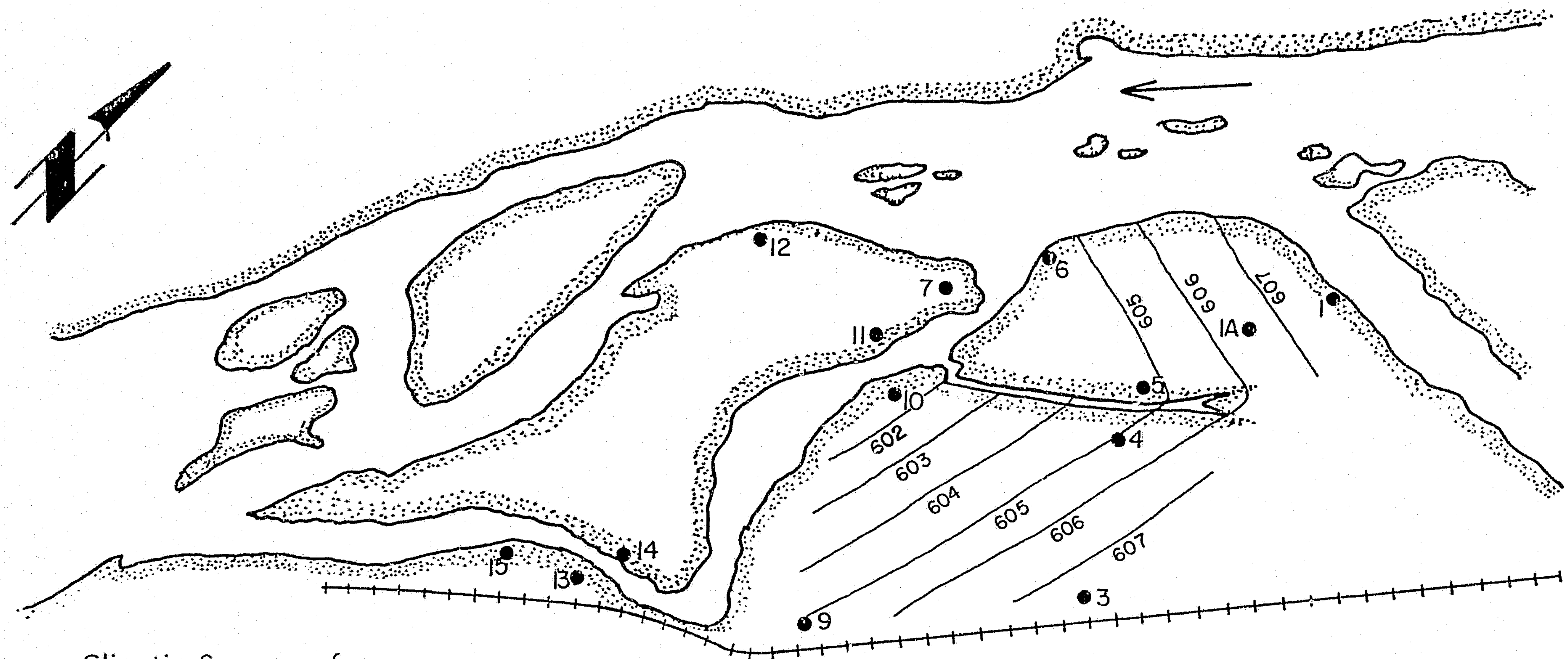
FIG. 3.17

GROUNDWATER CONTOURS
SUSITNA RIVER AT SLOUGH 9
SCALE: 1" = 1000'

PREPARED FOR:

ACRES




Climatic Summary for
Preceeding 7-Day Period

| Date | Precipitation (mm) | Temperature (°C) | $Q_{GC}$ |
|---|---|---|---|
| 9-14 | 19.0 | 8.9 | 20,200 |
| 9-15 | 29.8 | 12.3 | 28,200 |
| 9-16 | 11.2 | 8.6 | 32,500 |
| 9-17 | 9.4 | 5.4 | 32,000 |
| 9-18 | 10.0 | 7.9 | 27,500 |
| 9-19 | 18.6 | 7.7 | 24,100 |
| 9-20 | 6.0 | 7.5 | 24,000 |

Legend

● observation well

"600" groundwater elevation

Date: 9-20-82

$Q_{GC}$: 24,000

PREPARED BY:

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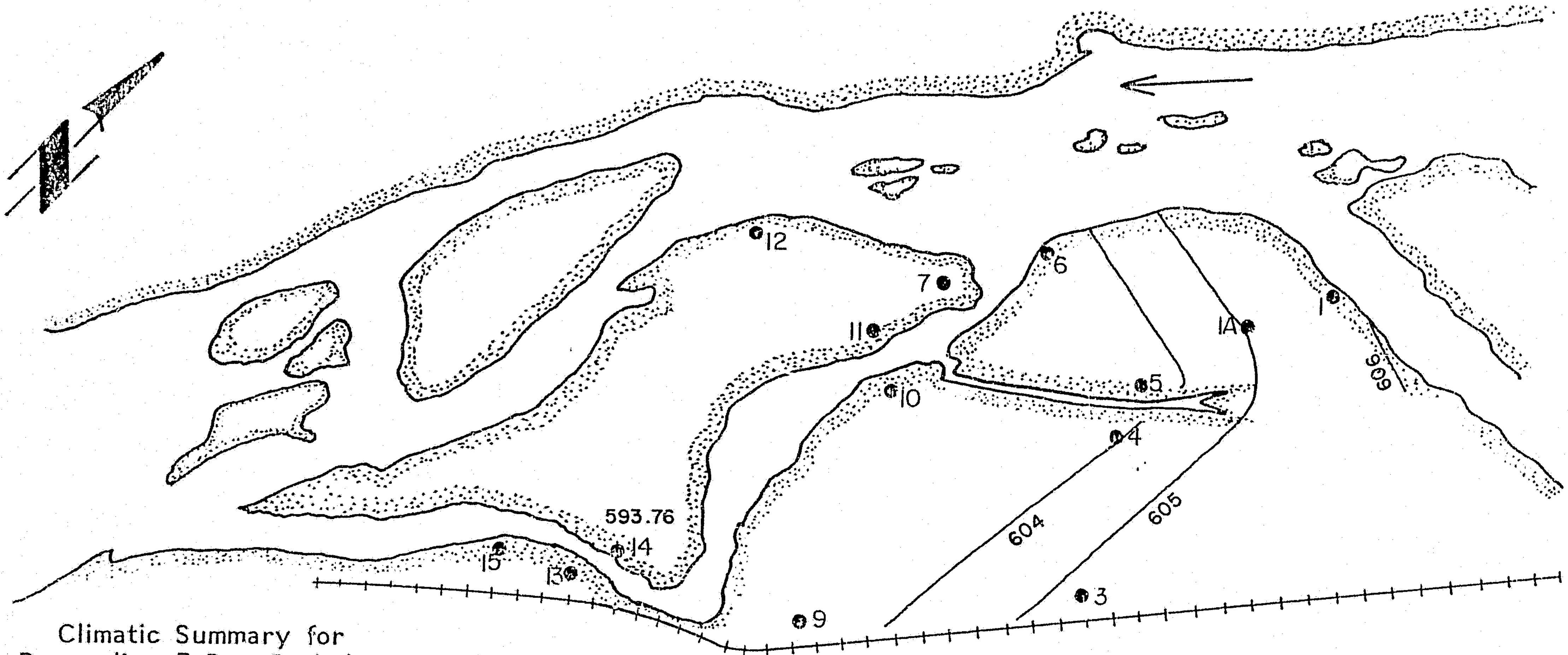
R&M CONSULTANTS, INC.

FIG. 3.18

GROUNDWATER CONTOURS
SUSITNA RIVER AT SLOUGH 9
SCALE: 1" = 1000'

PREPARED FOR:

ACRES




Climatic Summary for
Preceeding 7-Day Period

| Date | Precipitation (mm) | Temperature (°C) | $Q_{GC}$ |
|---|---|---|---|
| 10-1 | - | 2.2 | 12,400 |
| 10-2 | - | 3.3 | 11,700 |
| 10-3 | - | 2.8 | 11,000 |
| 10-4 | - | 1.3 | 10,500 |
| 10-5 | - | 0.1 | 9,800 |
| 10-6 | - | 2.3 | 8,960 |
| 10-7 | - | 0.5 | 8,480 |

Legend

● observation well
"600" groundwater elevation

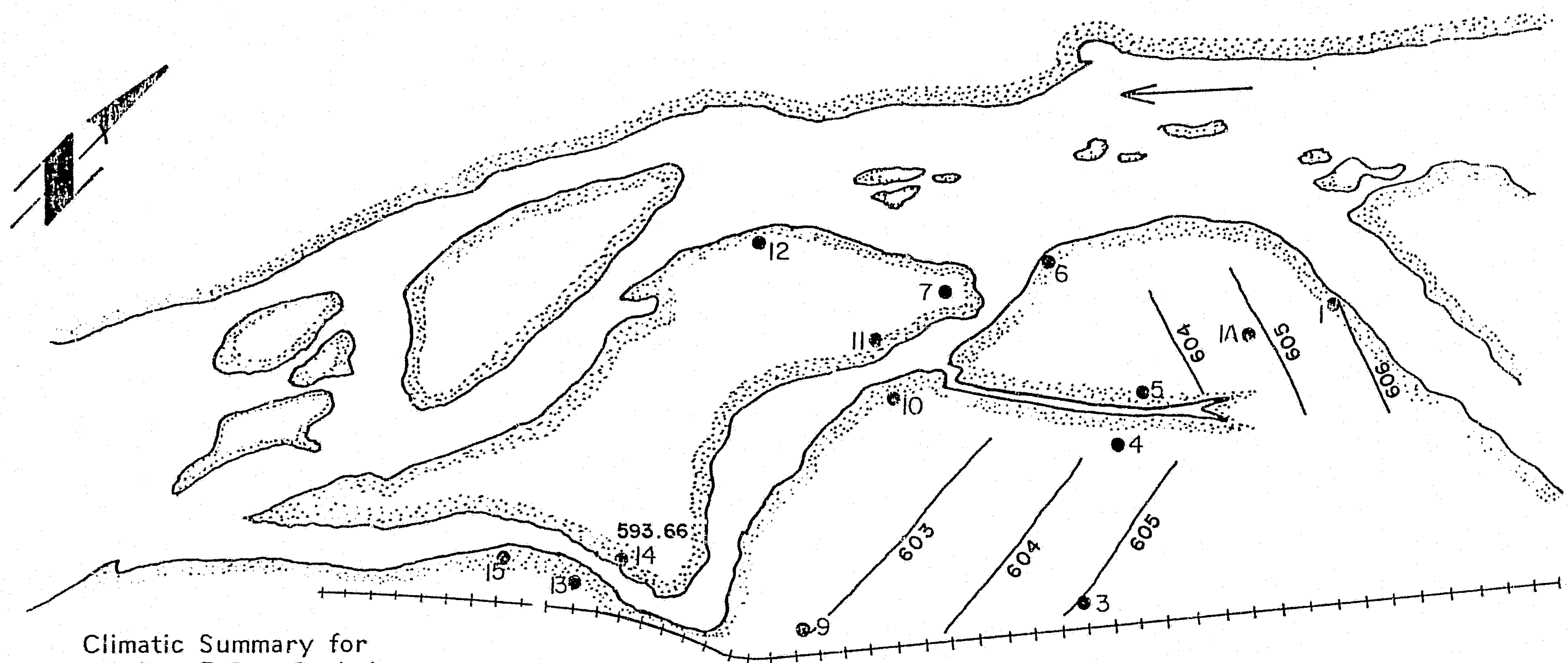
Date: 10-7-82
$Q_{GC}$: 8,480

PREPARED BY:
R&M
R&M CONSULTANTS, INC.

FIG. 3.19

**GROUNDWATER CONTOURS**
**SUSITNA RIVER AT SLOUGH 9**
SCALE: 1" = 1000'

PREPARED FOR:
ACRES




Climatic Summary for
Preceeding 7-Day Period

| Date | Precipitation (mm) | Temperature (°C) | $Q_{GC}$ |
|---|---|---|---|
| 10-9 | - | 0.1 | 8,440 |
| 10-10 | - | -2.0 | 8,480 |
| 10-11 | - | -0.7 | - |
| 10-12 | - | 1.1 | - |
| 10-13 | - | -2.4 | 7,500 |
| 10-14 | - | -5.1 | - |
| 10-15 | - | -6.6 | 7,000 |

Legend

● observation well

"600" groundwater elevation

Date: 10-15-82

$Q_{GC}$: 7,000

PREPARED BY:

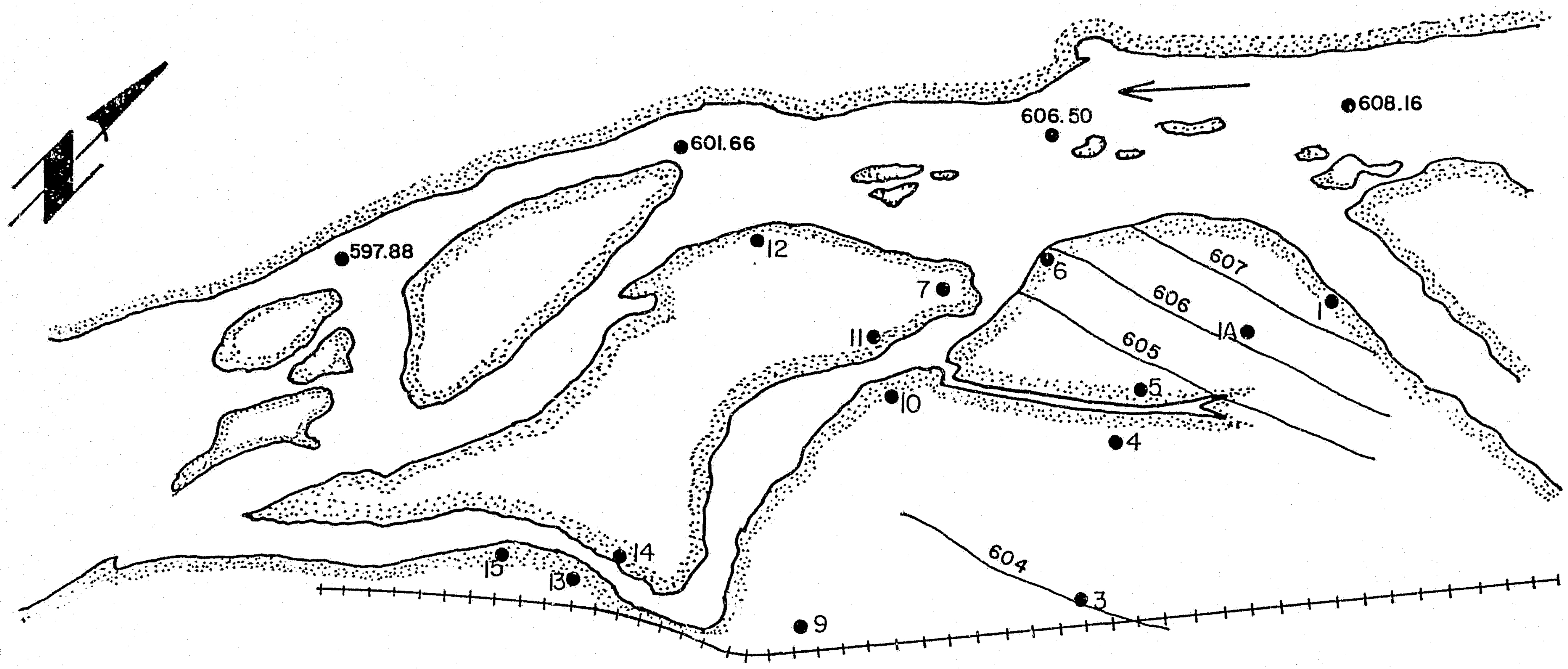
R&M CONSULTANTS, INC.

**FIG. 3.20**

**GROUNDWATER CONTOURS**
**SUSITNA RIVER AT SLOUGH 9**
SCALE: 1"= 1000

PREPARED FOR:

ACRES




Date: 12-22-82

Note: Winter flow, Ice cover on mainstem

Legend

● observation well

"600" groundwater elevation



PREPARED BY:

R&M CONSULTANTS, INC.

FIG. 3.21

GROUNDWATER CONTOURS
SUSITNA RIVER AT SLOUGH 9

PREPARED FOR:

ACRES

## 4 - CONCLUSIONS AND RECOMMENDED FURTHER STUDIES

Much has been learned this season about the sources of water in Sloughs 8A and 9 during the summer and fall seasons. There are three contributing sources of water. Overflow from the Susitna River dominates at a stage unique to each slough. Surface runoff dominates during periods of wet weather when the berm is not overtopped. Although yet to be fully documented, groundwater input dominates during dry periods and winter.

Wells situated near the sloughs indicated they gained water from groundwater input from both their shoreward and river sides. Direction of flow of groundwater from the river was in all cases downvalley and toward the sloughs. Permeability for the soils in this area is high but the hydraulic gradient driving the flow is small, resulting in a low seepage velocity of the groundwater to the sloughs. Upwelling groundwater has been documented on the river side of the sloughs. This high seepage rate on the river side of the slough suggests that this water is coming from the river. This may be verified with data obtained from recently installed deeper wells at Slough 9B or possibly from a revised environmental isotope sampling program.

Although the surface flow in the sloughs is controlled by various factors, the groundwater component of this flow is partially controlled by the river. Variation of river stage due to project operation will affect the amount of groundwater input to the sloughs differently depending on the season. In summer when the flows are reduced from the mean natural streamflow, the amount of groundwater input to the sloughs from the river will be decreased due to a decreased driving head. In winter when flows are greater than the mean natural streamflow, the change imposed upon the slough will depend upon formation of an ice cover. If no ice cover were to form the input of groundwater to the slough may be decreased due to the lack of staging that accompanies a pre-project winter flow, although increased flows will partially or completely offset this. If an ice cover were to form stage would increase beneath the ice cover, resulting in a relatively large gradient pushing the groundwater toward the sloughs. The driving head would be somewhat reduced along the islands if the upstream berms were overtopped, allowing water to flow into the side-channel.

Recommended future studies include:

1. Continued observations of sloughs through the winter.

2. Continued observation of well levels and temperatures through winter, with monthly readings and maintenance of Datapods. As part of these observations, more emphasis should be placed on water surface elevations in

the mainstem Susitna near to the sloughs studied. Importance should be placed on obtaining data during the spring hydrograph when a rise in river stage will demonstrate the affect of river stage change on the groundwater, although snowmelt and possibly rainfall infiltration will have to be allowed for.

3. Quantification of groundwater input to sloughs through use of a seepage meter. Although this input has been documented visually it has not been quantified and this method may be applicable to other sloughs.

4. An environmental isotope program making use of the recently established wells near Slough 9B and the oxygen-18 isotope. A study of this type may determine the origin of this upwelling groundwater with more confidence than has been previously obtained.

5. Use of surveyed elevations of other non-studied sloughs and the mainstem nearby to determine the relationship of the slough thalweg to the mainstem water surface elevations.

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APPENDIX A.1

GROUNDWATER ELEVATION DATA AT
SLOUGH 8A & 9

s17/i4

# APPENDIX A.1
## GROUNDWATER ELEVATION AT SLOUGH 8A

| Date | S.G. x-s 29 | 8-1 | 8-3 | 8-4 | 8-5 | 8-6 | 8-7 | 8-8 | 8-9 |
|---|---|---|---|---|---|---|---|---|---|
| | | Well No. | | | | | | | |
| Apr. 26 | | 579.47 | 575.42 | 574.39 | 574.76 | d | 572.79 | 568.24 | 568.42 |
| May 15 | | | | | | 576.31 | | | |
| May 27 | | 581.16 | 577.87 | 573.94 | 574.91 | 573.22 | 573.43 | 569.91 | 568.62 |
| June 24 | | 581.42 | 577.54 | 575.06 | 574.99 | 573.11 | 573.32 | 569.36 | 568.56 |
| June 29 | 573.45 | 581.26 | 576.38 | 575.00 | 574.94 | 572.98 | 573.23 | 569.03 | 568.55 |
| July 18 | | 580.99 | 575.69 | 574.89 | 574.83 | 572.89 | 573.13 | 568.61 | 568.40 |
| Aug. 3 | | | | | | | | | |
| Aug. 5 | | | | | | | | | |
| Aug. 6 | 571.61 | | | | | | | | |
| Aug. 9 | 571.61 | 580.41 | 576.18 | 574.87 | 574.77 | 572.97 | 573.12 | 569.09 | 568.43 |
| Aug. 27 | | | | | | | | | |
| Sep. 3 | 571.06 | - | 577.41 | 575.10 | 574.97 | 573.17 | 573.32 | 569.66 | 568.52 |
| Sep. 5 | | | | | | | | | |
| Sep. 10 | 570.97 | - | 575.54 | 574.64 | 574.56 | 572.90 | 572.96 | 569.12 | 568.31 |
| Sep. 20 | 572.84 | 581.41 | 578.45 | 575.32 | 575.30 | 573.44 | 573.58 | 570.33 | 568.91 |
| Oct. 5 | 569.80 | d | 576.57 | 574.90 | 574.77 | 573.03 | 573.15 | 569.64 | 568.37 |
| Oct. 13 | - | d | 574.74 | 574.06 | d | 572.78 | 572.78 | - | 568.16 |

- = not observed
s = silted
d = dry

# APPENDIX A.1
## GROUNDWATER ELEVATION AT SLOUGH 8A
## (Continued)

| Date | Well No. 8-10 | 8-11 | 8-12 | S.G. 8-1A | 8-1A | 8-2A | 8-3A | 8-4A | $Q_{GC}$ |
|---|---|---|---|---|---|---|---|---|---|
| Apr. 26 | 566.15 | 565.64 | 566.33 | | | | | | Ice Cover |
| May 15 | | | | | | | | | Breakup |
| May 27 | 565.30 | 565.49 | s | | | | | | - |
| June 24 | 565.15 | 565.79 | s | | | | | | 25,200 |
| June 29 | 565.34 | - | s | | | | | | 27,000 |
| July 18 | 565.54 | 565.51 | 564.38 | 572.63 | 572.32 | 572.23 | | | 23,550 |
| Aug. 3 | | | | 572.19 | 572.33 | 572.35 | | | 17,800 |
| Aug. 5 | | | | 571.85 | 571.86 | 571.83 | | | 16,300 |
| Aug. 6 | | | | 571.79 | 571.75 | 571.73 | 571.87 | | 16,000 |
| Aug. 9 | 565.56 | 565.83 | 564.29 | 571.81 | d | 571.61 | 571.81 | | 16,300 |
| Aug. 27 | | | | | d | d | 571.05 | 571.26 | 12,000 |
| Sep. 3 | 565.76 | 566.28 | d | 571.24 | d | 571.41 | 571.87 | 572.32 | 13,800 |
| Sep. 5 | | | | 570.99 | d | - | 571.74 | 572.28 | - |
| Sep. 10 | 565.75 | - | - | 571.16 | d | d | 571.36 | 572.24 | 13,400 |
| Sep. 20 | 566.00 | 566.70 | 564.44 | 573.24 | 573.33 | 573.25 | 573.42 | 573.72 | 22,900 |
| Oct. 5 | 565.70 | 566.12 | d | 570.39 | d | d | 571.22 | 573.09 | 8,300 |
| Oct. 13 | - | - | d | - | d | d | 570.48 | 572.58 | 7,500 |

- = not observed
s = silted
d = dry

# APPENDIX A.1
## GROUNDWATER ELEVATION AT SLOUGH 9

| | Well No. | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 9-1 | 9-1A | 9-3 | 9-4 | 9-5 | 9-6 | 9-7 | 9-9 | 9-10 | 9-11 | 9-12 | 9-13 | 9-14 | 9-15 | $Q_{GC}$ |
| Apr. 26 | - | | 603.06 | 603.62 | 603.33 | d | d | 603.01 | 600.32 | 600.06 | 598.53 | d | 594.14 | d | Ice Cover |
| May 11 | 607.71 | | 605.42 | 604.46 | 604.51 | 604.15 | 602.68 | - | 601.20 | 601.21 | - | 694.09 | 594.57 | 593.90 | Ice Cover |
| May 15 | - | | - | - | - | - | - | - | 604.00 | - | - | - | - | - | Breakup |
| May 27 | 607.58 | | 606.62 | 604.47 | 604.76 | 604.34 | 602.45 | - | s | 601.16 | 599.94 | s | s | s | - |
| June 23 | 608.50 | | 606.66 | 604.77 | 604.40 | 604.91 | 603.02 | - | s | 601.69 | 600.64 | s | s | s | 25,000 |
| July 1 | 607.94 | | 606.22 | 604.67 | 604.11 | 604.48 | 602.78 | 604.08 | s | 601.38 | 600.40 | s | s | s | 23,300 |
| July 20 | 607.32 | | 605.67 | 604.03 | 603.81 | 604.08 | 602.30 | - | 600.99 | 601.07 | 599.55 | s | s | s | 21,500 |
| Aug. 25 | 605.99 | | 604.69 | d | 603 34 | d | 601.05 | 602.56 | 600.34 | 600.28 | d | d | 593.66 | 592.74 | 12,000 |
| Sep. 6 | 606.16 | 605.50 | 605.70 | 604.16 | 603.61 | d | 601.32 | 604.37 | 600.50 | 600.46 | - | - | - | - | 11,000 |
| Sep. 9 | 606.08 | 605.27 | 605.49 | d | 603.60 | d | 601.14 | 604.22 | 600.43 | 600.35 | d | d | 593.74 | 592.83 | 12,800 |
| Sep. 20 | 608.01 | 607.07 | 607.65 | 605.23 | 604.74 | 604.62 | 602.78 | 605.07 | 601.37 | 601.49 | d | 594.29 | 594.77 | - | 22,900 |
| Oct. 7 | 605.88 | 605.21 | 605.29 | 603.97 | 603.52 | d | d | 603.26 | d | d | d | d | 593.76 | d | 7,500 |
| Oct. 15 | 605.81 | 604.85 | 604.91 | d | 603.39 | d | d | 602.91 | d | d | d | d | 593.66 | d | 7,000 |

\- = not observed
s = silted
d = dry

# APPENDIX A.2

# GROUNDWATER TEMPERATURE DATA AT SLOUGH 8A & 9

# APPENDIX A.2
# TEMPERATURE DATA FROM OBSERVATION WELLS AT SLOUGH 8A

| | Date | | | | | | |
|---|---|---|---|---|---|---|---|
| Well No. | May 27 | June 24 | June 29 | Aug. 9 | Sep. 3 | Sep. 10 | Sep. 20 |
| 8-1 | 0.5 | 0.01 | 0.06 | 5.9 | - | - | 6.6 |
| 8-3 | 0.0 | 5.0 | 4.9 | 7.3 | 8.1 | 8.1 | 8.1 |
| 8-4 | 4.5 | 7.0 | 7.5 | 7.4 | 7.4 | 6.5 | 6.7 |
| 8-5 | 4.5 | 5.5 | 5.6 | 6.1 | 8.7 | 8.4 | 6.7 |
| 8-6 | 2.1 | 3.0 | 3.5 | 6.4 | 6.6 | 6.8 | 6.8 |
| 8-7 | 7.0 | 8.3 | 8.6 | 8.2 | 7.7 | 7.0 | 6.8 |
| 8-8 | ow | 8.0 | - | 7.4 | 7.4 | 6.8 | 6.8 |
| 8-9 | 6.1 | 10.0 | - | 9.2 | 10.0 | 9.0 | 7.9 |
| 8-10 | 7.5 | 6.0 | - | 6.6 | 7.0 | 6.5 | 6.5 |
| 8-11 | 0.05 | - | - | 6.2 | 6.0 | - | 6.1 |
| 8-12 | s | s | s | d | d | - | 5.8 |
| 8-1A | | | | d | d | d | 7.6 |
| 8-2A | | | | 6.3 | 6.3 | d | 6.6 |
| 8-3A | | | | 4.5 | 4.9 | 5.3 | 5.4 |
| 8-4A | | | | | 6.4 | 6.7 | 7.2 |
| | | | | | | | |
| Mainstem | | | | 9.0 | 8.8 | - | 6.5 |

d = dry well

ow = open water no temperature data

\- = not observed

s = silted well

# APPENDIX A.2
## TEMPERATURE DATA FROM OBSERVATION WELLS AT SLOUGH 8A
(Continued)

| Well No. | Date Oct. 5 | Oct. 13 |
|---|---|---|
| 8-1 | d | d |
| 8-3 | 6.2 | 5.4 |
| 8-4 | 4.5 | 3.2 |
| 8-5 | 5.4 | 4.0 |
| 8-6 | 6.1 | 5.0 |
| 8-7 | 5.0 | 3.6 |
| 8-8 | 4.0 | - |
| 8-9 | 5.0 | 2.8 |
| 8-10 | 5.1 | - |
| 8-11 | 5.1 | - |
| 8-12 | d | d |
| 8-1A | d | d |
| 8-2A | d | d |
| 8-3A | 5.0 | 4.4 |
| 8-4A | 5.1 | 4.1 |
| | | |
| Mainstem | 1.9 | 0.0 |

d = dry well

ow = open water no temperature data

\- = not observed

s = silted well

# APPENDIX A.2
## TEMPERATURE DATA FOR OBSERVATION WELLS AT SLOUGH 9

| | Date | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Well No. | May 11 | May 27 | June 23 | July 1 | Aug. 25 | Sep. 6 | Sep. 9 | Sep. 20 |
| 9-1 | 1.2 | 0.05 | 2.3 | - | 7.8 | 7.0 | 6.8 | 7.2 |
| 9-1A | | | | | | | 6.0 | 6.1 |
| 9-3 | 2.0 | 0.05 | 2.4 | 1.4 | 4.8 | 5.8 | 6.0 | 7.0 |
| 9-4 | 1.8 | 2.0 | 3.6 | 6.0 | d | 6.3 | d | 5.8 |
| 9-5 | 4.0 | 1.0 | 3.2 | 4.5 | 6.6 | 6.4 | 6.3 | 6.7 |
| 9-6 | 2.0 | 1.0 | 4.9 | 5.5 | d | d | d | 7.4 |
| 9-7 | 1.3 | 0.0 | 5.5 | 6.4 | d | 11.3 | 11.1 | 10.3 |
| 9-9 | ow | ow | ow | ow | ow | ow | ow | 7.8 |
| 9-10 | 1.0 | s | s | s | 5.9 | 6.5 | 6.5 | 6.5 |
| 9-11 | 0.5 | 1.0 | 0.5 | 0.8 | 5.2 | 8.3 | 8.5 | 8.4 |
| 9-12 | - | 1.0 | 4.0 | 4.5 | d | - | d | - |
| 9-13 | - | s | s | s | d | - | d | 5.7 |
| 9-14 | 2.0 | s | s | s | 4.5 | - | 4.7 | 5.1 |
| 9-15 | 3.0 | s | s | s | 7.4 | - | 7.6 | - |
| Mainstem | - | - | 9.4 | - | 10.0 | 8.5 | 8.4 | 6.6 |

d = dry well

ow = open water no temperature data

\- = not observed

s = silted well

# APPENDIX A.2
## TEMPERATURE DATA FOR OBSERVATION WELLS AT SLOUGH 9
## (Continued)

| Well No. | Date Oct. 7 | Date Oct. 15 |
|---|---|---|
| 9-1 | 5.2 | 2.7 |
| 9-1A | 4.5 | 3.4 |
| 9-3 | 6.2 | 6.2 |
| 9-4 | 4.0 | d |
| 9-5 | 4.7 | 3.6 |
| 9-6 | d | d |
| 9-7 | d | d |
| 9-9 | 4.2 | 3.8 |
| 9-10 | d | d |
| 9-11 | d | d |
| 9-12 | d | d |
| 9-13 | d | d |
| 9-14 | 4.3 | 4.0 |
| 9-15 | - | - |
| Mainstem | 1.9 | 0.0 |

d = dry well
ow = open water no temperature data
\- = not observed
s = silted well

APPENDIX A.3

CLIMATE SUMMARIES FOR SHERMAN WEATHER STATION
MAY-OCTOBER 1982

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

MONTHLY SUMMARY FOR SHERMAN WEATHER STATION
DATA TAKEN DURING May, 1982

| DAY | MAX. TEMP. DEG C | MIN. TEMP. DEG C | MEAN TEMP. DEG C | RES. WIND DIR. DEG | RES. WIND SPD. M/S | AVG. WIND SPD. M/S | MAX. GUST DIR. DEG | MAX. GUST SPD. M/S | P'VAL DIR. | MEAN RH % | MEAN DP DEG C | PRECIP MM | DAY'S SOLAR ENERGY WH/SQM | DAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ***** | ***** | ***** | *** | **** | **** | *** | **** | *** | ** | ***** | **** | ****** | 1 |
| 2 | ***** | ***** | ***** | *** | **** | **** | *** | **** | *** | ** | ***** | **** | ****** | 2 |
| 3 | ***** | ***** | ***** | *** | **** | **** | *** | **** | *** | ** | ***** | **** | ****** | 3 |
| 4 | ***** | ***** | ***** | *** | **** | **** | *** | **** | *** | ** | ***** | **** | ****** | 4 |
| 5 | ***** | ***** | ***** | *** | **** | **** | *** | **** | *** | ** | ***** | **** | ****** | 5 |
| 6 | ***** | ***** | ***** | *** | **** | **** | *** | **** | *** | ** | ***** | **** | ****** | 6 |
| 7 | ***** | ***** | ***** | *** | **** | **** | *** | **** | *** | ** | ***** | **** | ****** | 7 |
| 8 | ***** | ***** | ***** | *** | **** | **** | *** | **** | *** | ** | ***** | **** | ****** | 8 |
| 9 | ***** | ***** | ***** | *** | **** | **** | *** | **** | *** | ** | ***** | **** | ****** | 9 |
| 10 | ***** | ***** | ***** | *** | **** | **** | *** | **** | *** | ** | ***** | **** | ****** | 10 |
| 11 | ***** | ***** | ***** | *** | **** | **** | *** | **** | *** | ** | ***** | **** | ****** | 11 |
| 12 | ***** | ***** | ***** | *** | **** | **** | *** | **** | *** | ** | ***** | **** | ****** | 12 |
| 13 | ***** | ***** | ***** | *** | **** | **** | *** | **** | *** | ** | ***** | **** | ****** | 13 |
| 14 | ***** | ***** | ***** | *** | **** | **** | *** | **** | *** | ** | ***** | **** | ****** | 14 |
| 15 | 12.7 | -1.8 | 5.5 | 253 | .5 | .8 | 295 | 4.4 | W | 17 | -19.4 | 0.0 | 7080 | 15 |
| 16 | 13.9 | -3.4 | 5.3 | 043 | .9 | 1.0 | 035 | 5.7 | NE | 22 | -25.0 | 0.0 | 8150 | 16 |
| 17 | 12.6 | -1.8 | 5.4 | 176 | .6 | 1.3 | 148 | 6.3 | SSW | 23 | -21.4 | 0.0 | 6788 | 17 |
| 18 | 11.4 | -.6 | 5.4 | 198 | .7 | 1.1 | 199 | 5.7 | SSW | 34 | -15.1 | .2 | 4478 | 18 |
| 19 | 12.1 | -1.7 | 5.2 | 046 | .4 | 1.1 | 215 | 7.6 | NNE | 26 | -23.2 | 0.0 | 6795 | 19 |
| 20 | 10.6 | -1.6 | 4.5 | 175 | 1.2 | 1.7 | 143 | 7.6 | S | 29 | -19.8 | 0.0 | 4990 | 20 |
| 21 | 12.2 | -2.0 | 5.1 | 233 | .7 | 1.4 | 305 | 5.7 | S | 27 | -19.9 | 0.0 | 6700 | 21 |
| 22 | 14.9 | -3.9 | 5.5 | 165 | .4 | 1.1 | 142 | 4.4 | S | 19 | -25.1 | 0.0 | 7715 | 22 |
| 23 | 15.8 | -1.5 | 7.2 | 033 | 1.3 | 1.5 | 026 | 6.3 | NNE | 16 | -24.9 | 0.0 | 7945 | 23 |
| 24 | 14.7 | -.8 | 7.0 | 184 | .6 | 1.4 | 181 | 7.0 | SSW | 18 | -21.5 | 0.0 | 5008 | 24 |
| 25 | 11.1 | 2.1 | 6.6 | 178 | .2 | .9 | 213 | 5.1 | S | 45 | -6.6 | 2.4 | 3155 | 25 |
| 26 | 10.5 | 1.1 | 5.8 | 202 | .6 | .9 | 188 | 3.8 | SSW | 41 | -14.7 | .2 | 2880 | 26 |
| 27 | 12.3 | 2.6 | 7.5 | 205 | .4 | .9 | 179 | 5.7 | SSW | 54 | -9.6 | 1.2 | 3015 | 27 |
| 28 | 11.2 | 3.4 | 7.3 | 225 | 1.3 | 1.4 | 229 | 8.3 | SW | 42 | -7.6 | 2.8 | 4458 | 28 |
| 29 | 10.8 | 4.8 | 7.8 | 220 | 1.5 | 1.7 | 232 | 4.4 | SSW | 27 | -14.3 | .4 | 3460 | 29 |
| 30 | 16.0 | 1.1 | 8.6 | 302 | .2 | .9 | 142 | 3.8 | N | 39 | -17.2 | .2 | 5933 | 30 |
| 31 | 20.9 | -1.0 | 10.0 | 052 | .9 | 1.2 | 072 | 5.7 | E | 23 | -22.1 | 0.0 | 8378 | 31 |
| MONTH | 20.9 | -3.9 | 6.4 | 193 | .3 | 1.2 | 229 | 8.3 | SSW | 30 | -18.1 | 7.4 | 97125 | |

GUST VEL. AT MAX. GUST MINUS 2 INTERVALS 6.3
GUST VEL. AT MAX. GUST MINUS 1 INTERVAL 5.7
GUST VEL. AT MAX. GUST PLUS 1 INTERVAL 3.2
GUST VEL. AT MAX. GUST PLUS 2 INTERVALS 3.2

NOTE: RELATIVE HUMIDITY READINGS ARE UNRELIABLE WHEN WIND SPEEDS ARE LESS THAN ONE METER PER SECOND. SUCH READINGS HAVE NOT BEEN INCLUDED IN THE DAILY OR MONTHLY MEAN FOR RELATIVE HUMIDITY AND DEW POINT.

**** SEE NOTES AT THE BACK OF THIS REPORT ****

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

HOURLY PRECIPITATION SUMMARY FOR SHERMAN WEATHER STATION
DATA TAKEN DURING May, 1982

PRECIPITATION VALUES ARE IN MILLIMETERS

HOUR ENDING

| DATE | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | 1 |
| 2 | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | 2 |
| 3 | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | 3 |
| 4 | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | 4 |
| 5 | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | 5 |
| 6 | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | 6 |
| 7 | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | 7 |
| 8 | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | 8 |
| 9 | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | 9 |
| 10 | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | 10 |
| 11 | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | 11 |
| 12 | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | 12 |
| 13 | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | 13 |
| 14 | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | 14 |
| 15 | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | **** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 15 |
| 16 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16 |
| 17 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17 |
| 18 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 18 |
| 19 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 19 |
| 20 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 20 |
| 21 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 21 |
| 22 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 22 |
| 23 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 23 |
| 24 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 24 |
| 25 | 0.0 | 0.0 | .2 | .4 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .4 | .2 | 0.0 | .2 | .8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 25 |
| 26 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | 26 |
| 27 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | .2 | 0.0 | 0.0 | 0.0 | .4 | 0.0 | 0.0 | .2 | .2 | 27 |
| 28 | .2 | 0.0 | .2 | .2 | .4 | .4 | .2 | .4 | 0.0 | 0.0 | .4 | .2 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 28 |
| 29 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | .2 | 0.0 | 29 |
| 30 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 30 |
| 31 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 31 |

# R & M CONSULTANTS, INC.

# SUSITNA HYDROELECTRIC PROJECT

MONTHLY SUMMARY FOR SHERMAN WEATHER STATION
DATA TAKEN DURING June, 1982

| DAY | MAX. TEMP. DEG C | MIN. TEMP. DEG C | MEAN TEMP. DEG C | RES. WIND DIR. DEG | RES. WIND SPD. M/S | AVG. WIND SPD. M/S | MAX. GUST DIR. DEG | MAX. GUST SPD. M/S | P'VAL DIR. | MEAN RH % | MEAN DP DEG C | PRECIP MM | DAY'S SOLAR ENERGY WH/SQM | DAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 20.0 | -.4 | 9.8 | 224 | 1.2 | 1.5 | 239 | 7.6 | SW | 18 | -21.7 | 0.0 | 6800 | 1 |
| 2 | 9.7 | 3.0 | 6.4 | 176 | .2 | .9 | 213 | 3.8 | SW | 59 | -1.0 | 19.4 | 1898 | 2 |
| 3 | 15.3 | .6 | 8.0 | 293 | .4 | .9 | 186 | 3.8 | NW | 34 | -19.1 | 0.0 | 6685 | 3 |
| 4 | 16.6 | -1.2 | 7.7 | 241 | 1.0 | 1.5 | 226 | 8.3 | WSW | 28 | -19.4 | 1.0 | 5920 | 4 |
| 5 | 10.4 | 6.0 | 8.2 | 036 | .2 | .4 | 026 | 1.9 | NE | 65 | -2.1 | 12.0 | 2298 | 5 |
| 6 | 11.5 | 6.4 | 9.0 | 269 | .2 | .6 | 012 | 2.5 | SW | 61 | 2.2 | 10.4 | 2388 | 6 |
| 7 | 11.6 | 5.7 | 8.7 | 231 | .3 | .7 | 232 | 5.1 | SW | 58 | -.5 | 6.8 | 2573 | 7 |
| 8 | 17.2 | 4.3 | 10.8 | 226 | .5 | 1.0 | 232 | 5.1 | SW | 43 | -15.8 | .2 | 5645 | 8 |
| 9 | 14.6 | 4.5 | 9.6 | 048 | .2 | .5 | 346 | 2.5 | ENE | 44 | -4.1 | .4 | 3380 | 9 |
| 10 | 17.7 | 6.9 | 12.3 | 226 | .3 | .8 | 228 | 7.0 | SW | 49 | -5.2 | 3.8 | 2965 | 10 |
| 11 | 13.9 | 6.1 | 10.0 | 218 | .5 | .9 | 229 | 3.8 | SSW | 31 | -11.3 | 1.0 | 3853 | 11 |
| 12 | 13.8 | .3 | 7.1 | 241 | .1 | .7 | 212 | 6.3 | SSW | 55 | -3.2 | 4.2 | 3380 | 12 |
| 13 | 14.6 | .6 | 7.6 | 205 | .2 | .6 | 246 | 3.2 | SW | 37 | -21.2 | 0.0 | 4705 | 13 |
| 14 | 17.2 | 2.9 | 10.1 | 224 | 1.6 | 1.7 | 243 | 7.0 | SW | 30 | -14.7 | 0.0 | 6813 | 14 |
| 15 | 8.3 | 5.9 | 7.1 | 208 | 1.0 | 1.1 | 232 | 3.2 | SSW | 53 | -3.0 | 12.6 | 2205 | 15 |
| 16 | 9.2 | 5.9 | 7.6 | 214 | .9 | 1.0 | 253 | 4.4 | SSW | 53 | -2.5 | 4.4 | 2068 | 16 |
| 17 | 19.2 | 3.5 | 11.4 | 251 | .3 | .8 | 184 | 3.2 | SSW | 36 | -19.4 | 0.0 | 6965 | 17 |
| 18 | 20.1 | 1.7 | 10.9 | 058 | .7 | .9 | 051 | 5.1 | NE | 43 | -22.3 | 1.8 | 4558 | 18 |
| 19 | 20.9 | 7.7 | 14.3 | 230 | .9 | 1.3 | 237 | 6.3 | SW | 23 | -13.7 | 0.0 | 6740 | 19 |
| 20 | 9.5 | 7.0 | 8.3 | 225 | 1.1 | 1.2 | 229 | 4.4 | SW | 55 | -1.5 | 10.8 | 2240 | 20 |
| 21 | 15.9 | 5.1 | 10.5 | 221 | 1.2 | 1.3 | 245 | 5.1 | SW | 37 | -12.5 | .4 | 5733 | 21 |
| 22 | 18.5 | 5.0 | 11.8 | 222 | .8 | 1.0 | 217 | 5.1 | SW | 30 | -19.2 | 0.0 | 6413 | 22 |
| 23 | 23.0 | 5.4 | 14.2 | 237 | .5 | .8 | 219 | 3.8 | SW | 30 | -24.9 | 0.0 | 7355 | 23 |
| 24 | 26.4 | 3.1 | 14.8 | 219 | .5 | .8 | 207 | 3.8 | SW | 33 | -25.0 | 0.0 | 8468 | 24 |
| 25 | 27.9 | 5.0 | 16.5 | 125 | .1 | .7 | 213 | 3.8 | ENE | 42 | -13.8 | 2.0 | 7298 | 25 |
| 26 | 25.6 | 6.2 | 15.9 | 236 | .4 | .7 | 207 | 3.8 | SW | 28 | -30.0 | 0.0 | 6833 | 26 |
| 27 | 25.9 | 3.9 | 14.9 | 213 | .3 | .8 | 221 | 5.7 | SW | 35 | -19.6 | 0.0 | 5430 | 27 |
| 28 | 18.4 | 6.9 | 12.7 | 215 | 1.1 | 1.3 | 265 | 5.1 | SSW | 33 | -8.7 | .8 | 5455 | 28 |
| 29 | 18.8 | 7.2 | 13.0 | 257 | .3 | .8 | 117 | 3.8 | SSW | 23 | -16.6 | 0.0 | 6103 | 29 |
| 30 | 20.0 | 7.2 | 13.6 | 057 | .1 | .8 | 224 | 6.3 | NE | 42 | -11.8 | 9.2 | 3823 | 30 |
| MONTH | 27.9 | -1.2 | 10.7 | 224 | .5 | .6 | 226 | 8.3 | SW | 40 | -12.7 | 101.2 | 146985 | |

GUST VEL. AT MAX. GUST MINUS 2 INTERVALS 7.0
GUST VEL. AT MAX. GUST MINUS 1 INTERVAL 6.3
GUST VEL. AT MAX. GUST PLUS 1 INTERVAL 5.7
GUST VEL. AT MAX. GUST PLUS 2 INTERVALS 7.0

NOTE: RELATIVE HUMIDITY READINGS ARE UNRELIABLE WHEN WIND SPEEDS ARE LESS THAN ONE METER PER SECOND. SUCH READINGS HAVE NOT BEEN INCLUDED IN THE DAILY OR MONTHLY MEAN FOR RELATIVE HUMIDITY AND DEW POINT.

**** SEE NOTES AT THE BACK OF THIS REPORT ****

# R & M CONSULTANTS, INC.

## SUSITNA HYDROELECTRIC PROJECT

HOURLY PRECIPITATION SUMMARY FOR SHERMAN WEATHER STATION
DATA TAKEN DURING June, 1982

PRECIPITATION VALUES ARE IN MILLIMETERS

HOUR ENDING

| DATE | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1 |
| 2 | 1.2 | 1.2 | 1.8 | 1.0 | 1.8 | 1.8 | 2.2 | 2.4 | 2.2 | .6 | .2 | .4 | .2 | .2 | 0.0 | .4 | 0.0 | 1.6 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2 |
| 3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 |
| 4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | .4 | .4 | 4 |
| 5 | 1.0 | 1.2 | 1.2 | 1.6 | .8 | .8 | 0.0 | .4 | .2 | .4 | 0.0 | 0.0 | .2 | .2 | .4 | .2 | 0.0 | .2 | .4 | .4 | .8 | .6 | .6 | .4 | 5 |
| 6 | .6 | 1.8 | 1.0 | .6 | .2 | .2 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 1.0 | .6 | .4 | .4 | .4 | .8 | .6 | .2 | .2 | .6 | .4 | .2 | 0.0 | 6 |
| 7 | 0.0 | .4 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.8 | .8 | 1.4 | 1.0 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | .6 | .2 | .2 | 0.0 | 0.0 | 7 |
| 8 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 8 |
| 9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 9 |
| 10 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .4 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .4 | 1.0 | .4 | 1.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 10 |
| 11 | .2 | 0.0 | 0.0 | .2 | 0.0 | .2 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 11 |
| 12 | .4 | .2 | 0.0 | .2 | 0.0 | 0.0 | .2 | .2 | .2 | 0.0 | 0.0 | 0.0 | .8 | 1.2 | .6 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 12 |
| 13 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 13 |
| 14 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 14 |
| 15 | 0.0 | 0.0 | 0.0 | 0.0 | .8 | 2.2 | 2.2 | 2.6 | 1.0 | 1.0 | 1.0 | .8 | .2 | .2 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .4 | 0.0 | 0.0 | 15 |
| 16 | .2 | .4 | .6 | .4 | 1.0 | .8 | .6 | .2 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16 |
| 17 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17 |
| 18 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | .2 | .8 | .4 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | 18 |
| 19 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 19 |
| 20 | 0.0 | .2 | .8 | 1.0 | 1.0 | 1.2 | 1.2 | .6 | .6 | .6 | .6 | .2 | .2 | .2 | .4 | .6 | .2 | .2 | 0.0 | .4 | 0.0 | .2 | 0.0 | .4 | 20 |
| 21 | .2 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 21 |
| 22 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 22 |
| 23 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 23 |
| 24 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 24 |
| 25 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .8 | 1.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 25 |
| 26 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 26 |
| 27 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 27 |
| 28 | 0.0 | 0.0 | .2 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 28 |
| 29 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 29 |
| 30 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.2 | 1.0 | 0.0 | 1.8 | 2.4 | .8 | 1.8 | .2 | 0.0 | 0.0 | 30 |

MONTHLY SUMMARY FOR SHERMAN WEATHER STATION
DATA TAKEN DURING July, 1982

| DAY | MAX. TEMP. DEG C | MIN. TEMP. DEG C | MEAN TEMP. DEG C | RES. WIND DIR. DEG | RES. WIND SPD. M/S | AVG. WIND SPD. M/S | MAX. GUST DIR. DEG | MAX. GUST SPD. M/S | P'VAL DIR. | MEAN RH % | MEAN DP DEG C | PRECIP MM | DAY'S SOLAR ENERGY WH/SQM | DAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 14.3 | 5.9 | 10.1 | 224 | 1.0 | 1.2 | 245 | 7.0 | SW | 32 | -9.9 | 1.6 | 5283 | 1 |
| 2 | 17.2 | 3.6 | 10.4 | 217 | .3 | .7 | 204 | 3.8 | SSW | 32 | -19.6 | .2 | 5740 | 2 |
| 3 | 20.7 | 1.6 | 11.2 | 220 | 5 | 1.0 | 216 | 5.1 | SW | 24 | -25.5 | 0.0 | 8320 | 3 |
| 4 | 21.5 | 2.3 | 11.9 | 228 | .9 | 1.3 | 219 | 7.0 | SW | 30 | -19.0 | 0.0 | 7173 | 4 |
| 5 | 19.9 | 5.0 | 12.5 | 209 | .7 | 1.1 | 212 | 4.4 | SSW | 28 | -19.1 | 0.0 | 7458 | 5 |
| 6 | 21.1 | 5.5 | 13.3 | 220 | .4 | .8 | 225 | 3.8 | SW | 26 | -25.2 | 0.0 | 5948 | 6 |
| 7 | 29.6 | 2.5 | 16.1 | 036 | .6 | .8 | 358 | 5.1 | ENE | 46 | 3.0 | 0.0 | 8283 | 7 |
| 8 | 19.5 | 7.1 | 13.3 | 221 | 1.5 | 1.7 | 237 | 7.0 | SSW | 38 | -4.4 | .2 | 5235 | 8 |
| 9 | 21.4 | 9.7 | 15.6 | 211 | .5 | .7 | 222 | 3.8 | SSW | 38 | -11.4 | 0.0 | 5585 | 9 |
| 10 | 15.6 | 9.4 | 12.5 | 215 | .9 | 1.1 | 239 | 5.1 | SSW | 62 | 3.2 | 1.6 | 2173 | 10 |
| 11 | 17.1 | 10.5 | 13.8 | 216 | 1.2 | 1.2 | 222 | 4.4 | SSW | 47 | .7 | .4 | 4348 | 11 |
| 12 | 14.3 | 9.4 | 11.9 | 202 | 1.1 | 1.1 | 200 | 4.4 | SSW | 50 | 1.0 | 3.2 | 2505 | 12 |
| 13 | 19.5 | 7.7 | 13.6 | 278 | .2 | .5 | 019 | 3.8 | S | 49 | -11.8 | .4 | 5508 | 13 |
| 14 | 19.6 | 4.3 | 12.0 | 208 | .7 | .9 | 201 | 3.8 | SSW | 49 | -3.0 | 1.8 | 4695 | 14 |
| 15 | 14.6 | 8.2 | 11.4 | 215 | 1.2 | 1.3 | 228 | 5.1 | SSW | 51 | -.5 | 2.2 | 4350 | 15 |
| 16 | 14.6 | 7.6 | 11.1 | 225 | .5 | .8 | 214 | 4.4 | SW | 51 | -1.8 | 7.6 | 4000 | 16 |
| 17 | 18.2 | 8.2 | 13.2 | 209 | 1.0 | 1.1 | 208 | 3.8 | SSW | 50 | -3.4 | 2.4 | 5610 | 17 |
| 18 | 18.1 | 6.2 | 12.2 | 236 | .4 | .7 | 211 | 3.2 | SSW | 44 | 1.9 | 13.2 | 3995 | 18 |
| 19 | 27.7 | 3.6 | 15.7 | 058 | .2 | .6 | 052 | 3.2 | ENE | 32 | -14.0 | 0.0 | 7688 | 19 |
| 20 | 25.0 | 4.9 | 15.0 | 220 | .8 | 1.1 | 208 | 5.7 | SW | 23 | -17.5 | 0.0 | 7395 | 20 |
| 21 | 15.3 | 9.7 | 12.5 | 214 | .7 | .8 | 218 | 3.8 | SSW | 53 | 2.0 | 11.4 | 1735 | 21 |
| 22 | 15.3 | 9.7 | 12.5 | 228 | 1.2 | 1.3 | 244 | 5.1 | SW | 52 | -.1 | 11.6 | 2815 | 22 |
| 23 | 13.9 | 9.5 | 11.7 | 229 | 1.1 | 1.2 | 246 | 5.7 | SW | 59 | 5.2 | 31.0 | 1643 | 23 |
| 24 | 13.6 | 10.2 | 11.9 | 217 | 1.2 | 1.3 | 242 | 5.7 | SSW | 61 | 2.9 | 16.2 | 1903 | 24 |
| 25 | 15.2 | 10.5 | 12.9 | 218 | .8 | 1.0 | 230 | 5.1 | SSW | 63 | 4.6 | 33.6 | 2225 | 25 |
| 26 | 17.1 | 8.5 | 12.8 | 348 | .0 | .5 | 209 | 2.5 | N | 51 | -1.0 | 0.0 | 3055 | 26 |
| 27 | 18.3 | 10.2 | 14.3 | 210 | .5 | .6 | 203 | 3.8 | SSW | 44 | 2.9 | .2 | 3310 | 27 |
| 28 | 21.1 | 7.0 | 14.1 | 228 | .6 | .9 | 239 | 4.4 | SW | 29 | -2.6 | .2 | 4450 | 28 |
| 29 | 14.3 | 10.2 | 12.3 | 223 | .9 | 1.0 | 220 | 4.4 | SSW | 63 | 3.9 | 8.4 | 3150 | 29 |
| 30 | 12.7 | 10.0 | 11.4 | 210 | .5 | .7 | 227 | 5.7 | SSW | 60 | 3.6 | 23.6 | 1890 | 30 |
| 31 | 18.8 | 7.1 | 13.0 | 239 | .0 | .5 | 339 | 3.2 | ESE | 30 | -6.6 | 0.0 | 4843 | 31 |
| MONTH | 29.6 | 1.6 | 12.8 | 219 | .7 | .9 | 245 | 7.0 | SSW | 44 | -5.2 | 171.0 | 142307 | |

GUST VEL. AT MAX. GUST MINUS 2 INTERVALS 3.8
GUST VEL. AT MAX. GUST MINUS 1 INTERVAL 2.5
GUST VEL. AT MAX. GUST PLUS 1 INTERVAL 1.9
GUST VEL. AT MAX. GUST PLUS 2 INTERVALS 1.3

NOTE: RELATIVE HUMIDITY READINGS ARE UNRELIABLE WHEN WIND SPEEDS ARE LESS THAN ONE METER PER SECOND. SUCH READINGS HAVE NOT BEEN INCLUDED IN THE DAILY OR MONTHLY MEAN FOR RELATIVE HUMIDITY AND DEW POINT.

**** SEE NOTES AT THE BACK OF THIS REPORT ****

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

HOURLY PRECIPITATION SUMMARY FOR SHERMAN WEATHER STATION
DATA TAKEN DURING July, 1982

PRECIPITATION VALUES ARE IN MILLIMETERS

HOUR ENDING

| DATE | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | .8 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 1 |
| 2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2 |
| 3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 |
| 4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 |
| 5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 |
| 6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6 |
| 7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 7 |
| 8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 8 |
| 9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 9 |
| 10 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | .8 | 0.0 | .2 | .2 | 10 |
| 11 | .2 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 11 |
| 12 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .6 | .2 | .4 | .8 | .4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .4 | .4 | 12 |
| 13 | .2 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 13 |
| 14 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .4 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 1.2 | 14 |
| 15 | 1.4 | .2 | 0.0 | .2 | .4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 15 |
| 16 | 0.0 | .2 | .4 | .6 | .6 | 1.0 | 1.0 | .4 | .4 | .2 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | .2 | 0.0 | 0.0 | .8 | .4 | .6 | .4 | 16 |
| 17 | .6 | .2 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .4 | .2 | .4 | 17 |
| 18 | .6 | 1.0 | 2.8 | 2.4 | 1.6 | 1.8 | 1.6 | .6 | .8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 18 |
| 19 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 19 |
| 20 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 20 |
| 21 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | .2 | .2 | .4 | .4 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | 1.8 | 4.2 | 1.6 | 1.6 | .6 | 0.0 | 21 |
| 22 | 0.0 | 1.4 | .6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .6 | 1.2 | 1.4 | 2.4 | 2.0 | 2.0 | 22 |
| 23 | 2.2 | 4.2 | 4.2 | 3.6 | 1.6 | 1.8 | 2.8 | 3.4 | 1.4 | 1.4 | .8 | 1.0 | .8 | .6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .6 | .4 | .2 | 23 |
| 24 | 0.0 | 0.0 | .2 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .4 | 1.0 | 1.6 | 1.8 | 2.2 | 3.0 | 2.2 | 1.8 | 1.8 | 24 |
| 25 | 1.8 | 2.0 | 2.0 | 2.6 | 4.2 | 4.4 | 4.0 | 4.0 | 4.0 | 2.6 | 1.4 | .4 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 25 |
| 26 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 26 |
| 27 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 27 |
| 28 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 28 |
| 29 | 0.0 | .2 | 0.0 | .6 | 1.4 | .4 | .2 | .4 | 1.0 | .2 | 0.0 | .2 | 0.0 | 0.0 | .2 | 1.0 | .2 | .2 | .4 | .2 | .2 | .4 | .8 | .2 | 29 |
| 30 | 2.4 | 4.2 | 1.8 | 1.2 | 1.2 | 1.2 | .4 | .2 | 0.0 | 1.0 | .4 | .4 | 1.8 | 1.8 | 2.4 | 1.6 | 1.4 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 30 |
| 31 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 31 |

# R & M CONSULTANTS, INC.

# SUSITNA HYDROELECTRIC PROJECT

MONTHLY SUMMARY FOR SHERMAN WEATHER STATION
DATA TAKEN DURING August, 1982

| DAY | MAX. TEMP. DEG C | MIN. TEMP. DEG C | MEAN TEMP. DEG C | RES. WIND DIR. DEG | RES. WIND SPD. M/S | AVG. WIND SPD. M/S | MAX. GUST DIR. DEG | MAX. GUST SPD. M/S | P'VAL DIR. | MEAN RH % | MEAN DP DEG C | PRECIP MM | DAY'S SOLAR ENERGY WH/SQM | DAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 20.2 | 2.5 | 11.4 | 057 | .7 | .8 | 071 | 4.4 | ENE | 42 | -23.1 | 0.0 | 6840 | 1 |
| 2 | 22.8 | .9 | 11.9 | 050 | .6 | .7 | 011 | 3.8 | NE | 41 | -21.0 | 0.0 | 7455 | 2 |
| 3 | 22.7 | 1.3 | 12.0 | 212 | .3 | .6 | 204 | 3.2 | ESE | 47 | -24.4 | 0.0 | 6820 | 3 |
| 4 | 22.9 | 2.2 | 12.6 | 212 | .4 | .6 | 214 | 3.2 | SW | 48 | -18.9 | 0.0 | 6590 | 4 |
| 5 | 22.0 | 5.7 | 13.9 | 212 | .7 | .8 | 193 | 3.8 | SW | 32 | -6.9 | .2 | 5450 | 5 |
| 6 | 24.3 | 3.5 | 13.9 | 056 | .1 | .5 | 222 | 3.2 | E | 29 | -18.0 | 0.0 | 5045 | 6 |
| 7 | 17.8 | 4.1 | 11.0 | 216 | .4 | .7 | 253 | 5.1 | E | 41 | -.3 | 9.6 | 3203 | 7 |
| 8 | 20.7 | 2.7 | 11.7 | 059 | .2 | .8 | 219 | 3.8 | NNE | 30 | -8.9 | 9.2 | 4788 | 8 |
| 9 | 13.3 | 8.3 | 10.8 | 211 | .5 | .6 | 235 | 5.1 | SSW | 42 | -.1 | 6.4 | 2370 | 9 |
| 10 | 13.2 | 7.9 | 10.6 | 210 | .6 | .6 | 216 | 5.7 | SSW | 50 | 1.2 | 4.6 | 2428 | 10 |
| 11 | 20.0 | 3.6 | 11.8 | 203 | .1 | .6 | 088 | 2.5 | SW | 26 | -16.8 | .2 | 5905 | 11 |
| 12 | 21.3 | 1.5 | 11.4 | 207 | .3 | .6 | 237 | 3.8 | SW | 21 | -20.8 | 0.0 | 6178 | 12 |
| 13 | 22.0 | 5.6 | 13.8 | 220 | .4 | .7 | 250 | 4.4 | E | 28 | -17.3 | 0.0 | 5970 | 13 |
| 14 | 16.3 | 9.9 | 13.1 | 200 | .2 | .4 | 208 | 3.2 | SSW | 57 | 1.0 | 2.4 | 1798 | 14 |
| 15 | 17.7 | 8.0 | 12.9 | 214 | .7 | .9 | 212 | 3.8 | SSW | 50 | -3.9 | 2.0 | 4220 | 15 |
| 16 | 15.3 | 7.8 | 11.6 | 214 | .9 | 1.1 | 221 | 5.7 | SSW | 44 | -7.1 | .4 | 5710 | 16 |
| 17 | 15.3 | 7.5 | 11.4 | 119 | .1 | .5 | 216 | 2.5 | SSW | 58 | -3.3 | 4.0 | 2603 | 17 |
| 18 | 16.1 | 3.1 | 9.6 | 023 | .1 | .3 | 022 | 1.9 | ESE | 41 | ***** | 0.0 | 2628 | 18 |
| 19 | 19.9 | 2.8 | 11.4 | 058 | .2 | .3 | 048 | 1.9 | ESE | 32 | ***** | 0.0 | 3783 | 19 |
| 20 | 22.9 | 2.6 | 12.8 | 060 | .2 | .4 | 054 | 2.5 | ENE | 29 | -18.7 | 0.0 | 5388 | 20 |
| 21 | 21.2 | 2.0 | 11.6 | 212 | .5 | .7 | 190 | 3.8 | SW | 26 | -11.8 | 0.0 | 5530 | 21 |
| 22 | 21.3 | 1.8 | 11.6 | 212 | .4 | .6 | 249 | 3.8 | SSW | 24 | -14.8 | 0.0 | 5140 | 22 |
| 23 | 17.0 | 8.6 | 12.8 | 209 | .6 | .7 | 247 | 3.2 | SSW | 52 | 1.0 | 1.2 | 2790 | 23 |
| 24 | 18.6 | 8.3 | 13.5 | 214 | .5 | .7 | 225 | 3.8 | SW | 36 | -2.9 | .2 | 3733 | 24 |
| 25 | 16.4 | 8.4 | 12.4 | 204 | .7 | .8 | 208 | 3.2 | SSW | 50 | -4.2 | 1.2 | 3335 | 25 |
| 26 | 20.0 | 2.3 | 11.2 | 276 | .1 | .5 | 230 | 3.2 | E | 30 | -7.9 | 1.0 | [illegible]63 | 26 |
| 27 | 21.0 | .1 | 10.6 | 041 | .5 | .6 | 037 | 4.4 | NE | 27 | -23.6 | 0.0 | 4925 | 27 |
| 28 | 17.3 | 2.3 | 9.8 | 185 | .1 | .5 | 201 | 4.4 | ENE | 30 | -4.2 | 3.2 | 2483 | 28 |
| 29 | 11.1 | 8.5 | 9.8 | 007 | .1 | .2 | 047 | 1.9 | NE | 43 | ***** | 13.2 | 1708 | 29 |
| 30 | 10.2 | 6.8 | 8.5 | 042 | .2 | .3 | 043 | 1.9 | NE | 51 | ***** | 27.2 | 1080 | 30 |
| 31 | 13.0 | 6.5 | 9.8 | 091 | .1 | .5 | 204 | 3.2 | NE | 53 | -.9 | 7.8 | 2203 | 31 |
| MONTH | 24.3 | .1 | 11.6 | 202 | .2 | .6 | 216 | 5.7 | SSW | 39 | -10.2 | 94.0 | 132158 | |

GUST VEL. AT MAX. GUST MINUS 2 INTERVALS 3.2
GUST VEL. AT MAX. GUST MINUS 1 INTERVAL 2.5
GUST VEL. AT MAX. GUST PLUS 1 INTERVAL 3.8
GUST VEL. AT MAX. GUST PLUS 2 INTERVALS 2.5

NOTE: RELATIVE HUMIDITY READINGS ARE UNRELIABLE WHEN WIND SPEEDS ARE LESS THAN ONE METER PER SECOND. SUCH READINGS HAVE NOT BEEN INCLUDED IN THE DAILY OR MONTHLY MEAN FOR RELATIVE HUMIDITY AND DEW POINT.

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# R & M CONSULTANTS, INC.

## SUSITNA HYDROELECTRIC PROJECT

HOURLY PRECIPITATION SUMMARY FOR SHERMAN WEATHER STATION
DATA TAKEN DURING August, 1982

PRECIPITATION VALUES ARE IN MILLIMETERS

HOUR ENDING

| DATE | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1 |
| 2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2 |
| 3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 |
| 4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 |
| 5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 |
| 6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6 |
| 7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.6 | 1.2 | 1.2 | 1.8 | 2.2 | 1.2 | .4 | 0.0 | 0.0 | 0.0 | 7 |
| 8 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .4 | .6 | 2.2 | 2.6 | 2.4 | .4 | .4 | 8 |
| 9 | .2 | .6 | 0.0 | 0.0 | 0.0 | .6 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | .2 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | .4 | 3.0 | .8 | 0.0 | 9 |
| 10 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .4 | .8 | .6 | 1.0 | .2 | 0.0 | 0.0 | 0.0 | .6 | 0.0 | .2 | 0.0 | .4 | 0.0 | 0.0 | .2 | .2 | 0.0 | 0.0 | 10 |
| 11 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 11 |
| 12 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 12 |
| 13 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 13 |
| 14 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | .2 | .2 | 0.0 | .4 | 1.0 | .4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 14 |
| 15 | 0.0 | .4 | 1.2 | .2 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 15 |
| 16 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | .2 | 16 |
| 17 | .2 | 0.0 | .2 | 0.0 | .2 | 0.0 | .4 | .6 | .8 | .4 | .4 | .4 | .2 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17 |
| 18 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 18 |
| 19 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 19 |
| 20 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 20 |
| 21 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 21 |
| 22 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 22 |
| 23 | 0.0 | 0.0 | .4 | 0.0 | .2 | .2 | 0.0 | .2 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 23 |
| 24 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 24 |
| 25 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .8 | .2 | 25 |
| 26 | 0.0 | .6 | .2 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 26 |
| 27 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 27 |
| 28 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.4 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | .2 | 0.0 | 0.0 | .4 | 0.0 | 28 |
| 29 | 0.0 | 0.0 | 0.0 | .6 | 1.2 | 1.4 | 1.6 | 1.4 | 1.4 | .6 | .2 | .2 | .8 | 0.0 | .6 | .8 | .2 | 0.0 | .6 | 0.0 | .2 | .6 | .4 | .4 | 29 |
| 30 | .6 | 1.0 | .8 | 2.2 | 1.4 | 1.0 | 1.2 | 4.2 | 2.4 | 2.2 | 1.6 | 2.4 | 1.2 | 1.0 | .8 | 0.0 | .2 | .4 | .6 | .2 | .2 | .4 | .6 | .6 | 30 |
| 31 | .6 | .8 | .6 | .8 | 1.0 | .2 | .4 | .2 | 0.0 | .4 | .2 | .2 | .6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .6 | 1.0 | 0.0 | .2 | 0.0 | 31 |

# R & M CONSULTANTS, INC.

# SUSITNA HYDROELECTRIC PROJECT

MONTHLY SUMMARY FOR SHERMAN WEATHER STATION
DATA TAKEN DURING September, 1982

| DAY | MAX. TEMP. DEG C | MIN. TEMP. DEG C | MEAN TEMP. DEG C | RES. WIND DIR. DEG | RES. WIND SPD. M/S | AVG. WIND SPD. M/S | MAX. GUST DIR. DEG | MAX. GUST SPD. M/S | P'VAL DIR. | MEAN RH % | MEAN DP DEG C | PRECIP MM | DAY'S SOLAR ENERGY WH/SQM | DAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 16.6 | 3.9 | 10.3 | 045 | .2 | .5 | 186 | 5.7 | NNE | 36 | -4.3 | 9.4 | 3155 | 1 |
| 2 | 14.7 | 3.7 | 9.2 | 223 | .3 | .6 | 220 | 3.2 | SW | 27 | -7.5 | 11.6 | 2835 | 2 |
| 3 | 11.5 | 5.0 | 8.3 | 043 | .2 | .4 | 043 | 2.5 | NE | 50 | -.6 | 7.8 | 1845 | 3 |
| 4 | 13.8 | 1.8 | 7.8 | 202 | .1 | .4 | 187 | 2.5 | SSW | 16 | -12.9 | .2 | 3073 | 4 |
| 5 | 16.7 | 3.1 | 9.9 | 050 | .9 | 1.0 | 047 | 5.1 | NE | 20 | -9.9 | 1.0 | 2255 | 5 |
| 6 | 15.3 | 5.2 | 10.3 | 186 | .5 | 1.1 | 135 | 6.3 | SSW | 32 | -5.7 | 0.0 | 1578 | 6 |
| 7 | 14.3 | 7.5 | 10.9 | 214 | .9 | .9 | 213 | 4.4 | SSW | 40 | -3.7 | 1.8 | 2615 | 7 |
| 8 | 11.9 | 6.4 | 9.2 | 208 | .6 | .7 | 208 | 3.8 | SSW | 33 | -4.6 | .2 | 1878 | 8 |
| 9 | 12.9 | 5.6 | 9.3 | 202 | .0 | .3 | 215 | 2.5 | ESE | ** | ***** | .8 | 1718 | 9 |
| 10 | 12.6 | 4.8 | 8.7 | 037 | .1 | .3 | 021 | 2.5 | NE | ** | ***** | .2 | 2030 | 10 |
| 11 | 7.9 | -.6 | 3.7 | 044 | .1 | .5 | 238 | 5.1 | E | 51 | -3.2 | 7.6 | 1190 | 11 |
| 12 | 11.8 | -.4 | 5.7 | 051 | .4 | .5 | 074 | 2.5 | ENE | 46 | -7.6 | 3.6 | 2968 | 12 |
| 13 | 8.7 | 4.4 | 6.6 | 037 | .3 | .6 | 055 | 2.5 | NNE | 61 | .2 | 28.6 | 978 | 13 |
| 14 | 10.6 | 7.1 | 8.9 | 047 | .2 | .3 | 213 | 1.9 | NNE | ** | ***** | 19.0 | 940 | 14 |
| 15 | 17.0 | 7.3 | 12.2 | 246 | .1 | .8 | 220 | 5.1 | NNE | 48 | 1.6 | 29.8 | 2093 | 15 |
| 16 | 12.1 | 5.0 | 8.6 | 223 | 1.7 | 1.9 | 220 | 10.2 | SW | 33 | -7.8 | 11.2 | 2313 | 16 |
| 17 | 8.2 | 2.5 | 5.4 | 053 | .4 | .4 | 065 | 3.2 | NE | 72 | -.1 | 9.4 | 1198 | 17 |
| 18 | 12.0 | 3.7 | 7.9 | 033 | .3 | .5 | 212 | 3.2 | E | 52 | -1.4 | 10.0 | 1488 | 18 |
| 19 | 9.4 | 6.0 | 7.7 | 204 | .1 | .4 | 224 | 3.8 | SW | 62 | .9 | 18.6 | 775 | 19 |
| 20 | 9.5 | 5.5 | 7.5 | 153 | .0 | .3 | 243 | 1.9 | ENE | 53 | .1 | 6.0 | 1265 | 20 |
| 21 | 10.0 | 5.1 | 7.6 | 169 | .1 | .6 | 217 | 3.8 | NE | ** | ***** | 3.4 | 1291 | 21 |
| 22 | 10.2 | -.9 | 4.7 | 239 | .2 | .6 | 214 | 5.7 | WSW | ** | ***** | 5.0 | 2150 | 22 |
| 23 | 11.8 | -3.3 | 4.3 | 034 | .4 | .6 | 005 | 3.2 | NNW | ** | ***** | .2 | 3365 | 23 |
| 24 | 9.9 | -5.1 | 2.4 | 070 | .3 | .5 | 239 | 3.2 | E | ** | ***** | 0.0 | 2418 | 24 |
| 25 | 11.1 | -3.0 | 4.1 | 129 | .1 | .6 | 218 | 3.8 | E | ** | ***** | 0.0 | 2200 | 25 |
| 26 | 8.1 | 2.2 | 5.2 | 049 | .3 | .5 | 083 | 2.5 | ENE | ** | ***** | 19.4 | 1248 | 26 |
| 27 | 9.9 | -1.4 | 4.3 | 072 | .2 | .7 | 207 | 3.2 | ESE | ** | ***** | 6.2 | 1770 | 27 |
| 28 | 7.3 | -3.0 | 2.2 | 081 | .4 | .5 | 110 | 1.9 | ESE | ** | ***** | 5.4 | 1340 | 28 |
| 29 | 9.4 | 2.6 | 6.0 | 074 | .3 | .9 | 208 | 4.4 | ENE | ** | ***** | 7.4 | 1605 | 29 |
| 30 | 7.2 | 2.5 | 4.9 | 215 | 1.0 | 1.1 | 198 | 5.1 | SSW | ** | ***** | 8.4 | 1785 | 30 |
| MONTH | 17.0 | -5.1 | 7.1 | 155 | .1 | .6 | 220 | 10.2 | ENE | 35 | -3.9 | 232.2 | 57356 | |

GUST VEL. AT MAX. GUST MINUS 2 INTERVALS 5.7
GUST VEL. AT MAX. GUST MINUS 1 INTERVAL 8.9
GUST VEL. AT MAX. GUST PLUS 1 INTERVAL 8.9
GUST VEL. AT MAX. GUST PLUS 2 INTERVALS 8.9

NOTE: RELATIVE HUMIDITY READINGS ARE UNRELIABLE WHEN WIND SPEEDS ARE LESS THAN ONE METER PER SECOND. SUCH READINGS HAVE NOT BEEN INCLUDED IN THE DAILY OR MONTHLY MEAN FOR RELATIVE HUMIDITY AND DEW POINT.

**** SEE NOTES AT THE BACK OF THIS REPORT ****

# R & M CONSULTANTS, INC.

## SUSITNA HYDROELECTRIC PROJECT

HOURLY PRECIPITATION SUMMARY FOR SHERMAN WEATHER STATION
DATA TAKEN DURING September, 1982

PRECIPITATION VALUES ARE IN MILLIMETERS

HOUR ENDING

| DATE | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .2 | 2.0 | 1.2 | 0.0 | 1.2 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.6 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1 |
| 2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 4.0 | 2.2 | .2 | 0.0 | .6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .4 | 0.0 | .6 | 2.6 | 2 |
| 3 | 2.2 | 1.2 | 1.6 | .2 | .2 | .2 | 0.0 | .4 | .8 | .6 | .2 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 |
| 4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 |
| 5 | 0.0 | 0.0 | .4 | .4 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 |
| 6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6 |
| 7 | 0.0 | 0.0 | .2 | .6 | .8 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 7 |
| 8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 8 |
| 9 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .6 | 0.0 | 0.0 | 0.0 | 0.0 | 9 |
| 10 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 10 |
| 11 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | .4 | 1.4 | .6 | .8 | 1.8 | .6 | 0.0 | .4 | 1.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 11 |
| 12 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .4 | .6 | .2 | 1.2 | 1.2 | 12 |
| 13 | 1.2 | 2.2 | 2.2 | 1.8 | 1.8 | 1.6 | 3.0 | 2.2 | 1.8 | 1.6 | 1.0 | 1.0 | 1.6 | .4 | 0.0 | 0.0 | 0.0 | 1.0 | 2.0 | 0.0 | .6 | .6 | 1.0 | 0.0 | 13 |
| 14 | .2 | .2 | .2 | .4 | .4 | 0.0 | .2 | 0.0 | 0.0 | .2 | .2 | 0.0 | 0.0 | 0.0 | .4 | 1.0 | ..8 | 3.0 | 1.6 | 2.0 | .2 | 1.8 | 2.4 | 2.8 | 14 |
| 15 | 2.8 | 2.2 | 1.4 | 2.0 | 3.2 | 3.0 | 2.4 | .6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.2 | 4.0 | 5.2 | 1.6 | 0.0 | 0.0 | .2 | 15 |
| 16 | .2 | .4 | 2.2 | 4.0 | 1.0 | .2 | .2 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | .6 | 1.0 | 1.0 | 16 |
| 17 | 2.0 | 1.8 | 2.0 | 1.0 | .2 | .4 | 1.2 | .8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17 |
| 18 | .2 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | .8 | 1.2 | 1.0 | .8 | 1.6 | 2.2 | .8 | .8 | 0.0 | 18 |
| 19 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | .6 | .2 | .2 | .2 | .2 | .8 | 1.4 | 1.0 | 2.4 | 1.6 | 1.2 | .8 | 1.0 | .6 | 1.4 | .6 | .4 | 1.4 | 2.4 | 19 |
| 20 | .2 | .4 | .6 | .4 | .4 | 0.0 | .4 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | .4 | .8 | .4 | .2 | .2 | .2 | 0.0 | .2 | .2 | 0.0 | .6 | .2 | 20 |
| 21 | 0.0 | 0.0 | .2 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .4 | 1.8 | .6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 21 |
| 22 | 0.0 | 0.0 | 0.0 | .2 | .4 | 0.0 | 0.0 | .2 | 1.2 | 1.0 | 1.6 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 22 |
| 23 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 23 |
| 24 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 24 |
| 25 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 25 |
| 26 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | .2 | .6 | .6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.6 | 2.0 | 2.0 | 2.2 | 0.0 | .4 | .8 | 2.2 | 2.0 | 3.0 | 1.6 | 26 |
| 27 | 1.0 | .4 | .6 | .6 | .4 | .4 | .4 | .2 | .2 | 0.0 | .6 | .2 | 1.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 27 |
| 28 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | .8 | .8 | .6 | .4 | .4 | 1.0 | .8 | .4 | 28 |
| 29 | .6 | .8 | .2 | 0.0 | .2 | 0.0 | .4 | 0.0 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | .6 | 1.2 | 1.6 | 1.4 | 29 |
| 30 | .6 | .2 | .2 | .2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | .2 | .8 | .4 | .6 | 1.4 | .4 | .4 | .2 | .2 | 2.6 | 30 |

# R & M CONSULTANTS, INC.

## SUSITNA HYDROELECTRIC PROJECT

MONTHLY SUMMARY FOR SHERMAN WEATHER STATION
DATA TAKEN DURING October, 1982

| DAY | MAX. TEMP. DEG C | MIN. TEMP. DEG C | MEAN TEMP. DEG C | RES. WIND DIR. DEG | RES. WIND SPD. M/S | AVG. WIND SPD. M/S | MAX. GUST DIR. DEG | MAX. GUST SPD. M/S | P'VAL DIR. | MEAN RH % | MEAN DP DEG C | PRECIP MM | DAY'S SOLAR ENERGY WH/SQM | DAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.5 | -.1 | 2.2 | 059 | .2 | .4 | 210 | 2.5 | ENE | ** | ***** | **** | 1308 | 1 |
| 2 | 7.6 | -1.0 | 3.3 | 064 | .3 | .4 | 349 | 2.5 | ESE | ** | ***** | **** | 2088 | 2 |
| 3 | 7.4 | -1.8 | 2.8 | 067 | .9 | .7 | 050 | 4.4 | ENE | ** | ***** | **** | 2350 | 3 |
| 4 | 7.8 | -5.2 | 1.3 | 073 | .8 | .8 | 096 | 3.8 | ENE | ** | ***** | **** | 2733 | 4 |
| 5 | 6.1 | -5.9 | .1 | 063 | 1.6 | 1.7 | 047 | 7.6 | NE | ** | ***** | **** | 2758 | 5 |
| 6 | 5.6 | -1.1 | 2.3 | 060 | 1.4 | 1.5 | 075 | 6.3 | ENE | ** | ***** | **** | 1920 | 6 |
| 7 | 1.8 | -.8 | .5 | 061 | .8 | 1.0 | 062 | 4.4 | ENE | ** | ***** | **** | 755 | 7 |
| 8 | 1.8 | -1.6 | .1 | 048 | .4 | 1.0 | 027 | 3.2 | ENE | ** | ***** | **** | 855 | 8 |
| 9 | 2.4 | -2.2 | .1 | 216 | 1.1 | .8 | 212 | 3.8 | SSW | ** | ***** | **** | 763 | 9 |
| 10 | -.4 | -3.5 | -2.0 | 214 | 2.3 | 1.2 | 219 | 5.1 | SSW | ** | ***** | **** | 1020 | 10 |
| 11 | 2.0 | -3.3 | -.7 | 060 | 1.1 | 1.1 | 043 | 5.7 | ENE | ** | ***** | **** | 765 | 11 |
| 12 | 2.0 | .1 | 1.1 | 060 | .4 | .4 | 047 | 1.9 | NE | ** | ***** | **** | 538 | 12 |
| 13 | .5 | -5.2 | -2.4 | 031 | .4 | .6 | 214 | 3.2 | NE | ** | ***** | **** | 345 | 13 |
| 14 | 1.3 | -11.5 | -5.1 | 079 | 1.0 | .7 | 072 | 3.8 | E | ** | ***** | **** | 623 | 14 |
| 15 | 1.2 | -14.3 | -6.6 | 048 | .7 | .6 | 028 | 2.5 | E | ** | ***** | **** | 1506 | 15 |
| 16 | -.8 | -7.5 | -4.2 | *** | **** | .7 | *** | **** | *** | ** | ***** | **** | 293 | 16 |
| 17 | 5.0 | -8.4 | -1.7 | 026 | .3 | .4 | 026 | 1.9 | NNE | ** | ***** | **** | 835 | 17 |
| 18 | 2.4 | -11.0 | -4.3 | 153 | .1 | .4 | 046 | 1.9 | S | ** | ***** | **** | 1540 | 18 |
| 19 | .8 | -4.2 | -1.7 | *** | **** | .3 | *** | **** | *** | ** | ***** | **** | 243 | 19 |
| 20 | .7 | -13.8 | -6.6 | *** | **** | .6 | *** | **** | *** | ** | ***** | **** | 630 | 20 |
| 21 | -2.8 | -12.8 | -7.8 | 067 | 2.3 | 2.2 | 084 | 7.6 | ENE | ** | ***** | **** | 893 | 21 |
| 22 | -1.5 | -10.6 | -6.1 | 058 | 2.1 | 2.3 | 057 | 7.0 | NE | ** | ***** | **** | 1485 | 22 |
| 23 | -2.0 | -15.5 | -8.8 | 080 | 1.5 | 1.6 | 055 | 6.3 | E | ** | ***** | **** | 1248 | 23 |
| 24 | -3.4 | -19.4 | -11.4 | 076 | .6 | .7 | 081 | 3.8 | E | ** | ***** | **** | 1323 | 24 |
| 25 | -4.3 | -21.5 | -12.9 | 096 | .2 | .4 | 124 | 1.3 | E | ** | ***** | **** | 1193 | 25 |
| 26 | -20.8 | -24.6 | -22.7 | 079 | .5 | .5 | 077 | 2.5 | ENE | ** | ***** | **** | 153 | 26 |
| 27 | ***** | ***** | ***** | *** | **** | **** | *** | **** | *** | ** | ***** | **** | ****** | 27 |
| 28 | ***** | ***** | ***** | *** | **** | **** | *** | **** | *** | ** | ***** | **** | ****** | 28 |
| 29 | ***** | ***** | ***** | *** | **** | **** | *** | **** | *** | ** | ***** | **** | ****** | 29 |
| 30 | ***** | ***** | ***** | *** | **** | **** | *** | **** | *** | ** | ***** | **** | ****** | 30 |
| 31 | ***** | ***** | ***** | *** | **** | **** | *** | **** | *** | ** | ***** | **** | ****** | 31 |
| MONTH | 7.8 | -24.6 | -3.5 | 068 | .8 | .5 | 047 | 7.6 | ENE | ** | ***** | **** | 30135 | |

GUST VEL. AT MAX. GUST MINUS 2 INTERVALS 5.1
GUST VEL. AT MAX. GUST MINUS 1 INTERVAL 5.1
GUST VEL. AT MAX. GUST PLUS 1 INTERVAL 5.7
GUST VEL. AT MAX. GUST PLUS 2 INTERVALS 5.1

NOTE: RELATIVE HUMIDITY READINGS ARE UNRELIABLE WHEN WIND SPEEDS ARE LESS THAN ONE METER PER SECOND. SUCH READINGS HAVE NOT BEEN INCLUDED IN THE DAILY OR MONTHLY MEAN FOR RELATIVE HUMIDITY AND DEW POINT.

**** SEE NOTES AT THE BACK OF THIS REPORT ****

APPENDIX A.4

DAILY DISCHARGE SLOUGH 9

TABLE 2.1.3

DAILY DISCHARGE SLOUGH 9: 8/10/82 - 10/14/82

| Date | Gage Height (ft) | Water Surface (ft, msl) | Discharge (cfs) |
|---|---|---|---|
| 8/10/82 | 1.03 | 593.71 | 10.0 |
| 8/11/82 | 1.01 | 593.69 | 8.7 |
| 8/12/82 | 0.98 | 593.66 | 6.9 |
| 8/13/82 | 0.96 | 593.64 | 5.9 |
| 8/14/82 | 0.95 | 593.63 | 5.5 |
| 8/15/82 | 0.95 | 593.63 | 5.5 |
| 8/16/82 | 0.94 | 593.62 | 5.0 |
| 8/17/82 | 0.94 | 593.62 | 5.0 |
| 8/18/82 | 0.93 | 593.61 | 4.6 |
| 8/19/82 | 0.93 | 593.61 | 4.6 |
| 8/20/82 | 0.91 | 593.59 | 3.9 |
| 8/21/82 | 0.90 | 593.58 | 3.6 |
| 8/22/82 | 0.89 | 593.57 | 3.3 |
| 8/23/82 | 0.88 | 593.56 | 3.0 |
| 8/24/82 | 0.87 | 593.55 | 2.7 |
| 8/25/82 | - | - | - |
| 8/26/82 | - | - | - |
| 8/27/82 | - | - | - |
| 8/28/82 | - | - | - |
| 8/29/82 | - | - | - |
| 8/30/82 | - | - | - |
| 8/31/82 | - | - | - |
| 9/1/82 | - | - | - |
| 9/2/82 | - | - | - |
| 9/3/82 | - | - | - |
| 9/4/82 | - | - | - |
| 9/5/82 | - | - | - |
| 9/6/82 | - | - | - |
| 9/7/82 | - | - | - |
| 9/8/82 | - | - | - |
| 9/9/82 | 0.88 | 593.56 | 3.0 |
| 9/10/82 | 0.88 | 593.56 | 3.0 |
| 9/11/82 | 0.89 | 593.57 | 3.3 |
| 9/12/82 | 0.89 | 593.57 | 3.3 |
| 9/13/82 | 0.98 | 593.66 | 6.9 |
| 9/14/82 | 1.06 | 593.74 | 12.4 |
| 9/15/82 | - | - | - |
| 9/16/82 | - | - | - |
| 9/17/82 | - | - | - |
| 9/18/82 | - | - | - |

TABLE 2.1.3 (Continued)

DAILY DISCHARGE SLOUGH 9: 8/10/82 - 10/14/82

| Date | Gage Height (ft) | Water Surface (ft, msl) | Discharge (cfs) |
|---|---|---|---|
| 9/19/82 | - | - | - |
| 9/20/82 | 1.74 | 594.42 | 339 |
| 9/21/82 | 1.72 | 594.40 | 315 |
| 9/22/82 | 1.51 | 594.19 | 138 |
| 9/23/82 | 1.24 | 593.92 | 37.3 |
| 9/24/82 | 1.11 | 593.79 | 17.2 |
| 9/25/82 | 1.02 | 593.70 | 9.3 |
| 9/26/82 | 1.00 | 593.68 | 8.0 |
| 9/27/82 | 1.07 | 593.75 | 13.2 |
| 9/28/82 | 1.02 | 593.70 | 9.3 |
| 9/29/82 | 1.01 | 593.69 | 8.7 |
| 9/30/82 | 1.02 | 593.70 | 9.3 |
| 10/1/82 | 1.03 | 593.71 | 10.0 |
| 10/2/82 | 0.98 | 593.66 | 6.9 |
| 10/3/82 | 0.95 | 593.63 | 5.5 |
| 10/4/82 | 0.98 | 593.66 | 6.9 |
| 10/5/82 | 0.92 | 593.60 | 4.3 |
| 10/6/82 | 0.90 | 593.58 | 3.6 |
| 10/7/82 | 0.92 | 593.60 | 4.3 |
| 10/8/82 | 0.88 | 593.56 | 3.0 |
| 10/9/82 | 0.87 | 593.55 | 2.7 |
| 10/10/82 | 0.86 | 593.54 | 2.5 |
| 10/11/82 | 0.86 | 593.54 | 2.5 |
| 10/12/82 | 0.87 | 593.55 | 2.7 |
| 10/13/82 | 0.85 | 593.53 | 2.3 |
| 10/14/82 | 0.84 | 593.52 | 2.1 |

Note: A dash (-) indicates missing records.

APPENDIX A.5

LABORATORY TEST REPORT ON GRAVEL GRADATION

s17/i8

## LABORATORY TEST REPORT

**R&M CONSULTANTS, INC.**
ENGINEERS GEOLOGISTS PLANNERS SURVEYORS

TEST ON Susitna Subsurface Investigation R&M PROJECT NO. 252314
CLIENT/PROJECT LAB NO. G-1
SOURCE SUBMITTED BY R&M FIELD NO.
SAMPLED FROM Slough 9 Island DATE SAMPLED 9-21-82 DATE REPORTED 9-22-82
LOCATION Bank of Slough DEPTH DATE RECEIVED 9-22-82

| GRAIN SIZE DISTRIBUTION % PASSING SIEVE | AS RECEIVED | -3/8" | SPEC. |
|---|---|---|---|
| 5" | | | |
| 4" | | | |
| 3" | | | |
| 2" | | | |
| 1 1/2" | 100 | | |
| 1" | 89 | | |
| 3/4" | 82 | | |
| 1/2" | 69 | | |
| 3/8" | 60 | 100 | |
| # 4 | 48 | 79 | |
| # 8 | | | |
| # 10 | 40 | 68 | |
| # 16 | | | |
| # 20 | 31 | 52 | |
| # 30 | | | |
| # 40 | 16 | 27 | |
| # 50 | | | |
| # 80 | 3 | 5 | |
| # 100 | 2 | 3 | |
| # 200 | 0.1 | 0.1 | |
| .02MM | | | |
| .005MM | | | |

| CLASSIFICATION | UNIFIED | AASHO | FAA |
|---|---|---|---|
| % + 10 | | | |
| % + 3 | | | |
| % GRAVEL | | | |
| % SAND | | | |
| % SILT | | | |
| % CLAY | | | |
| FSV | | | |
| LL | | | |
| PL | | | |
| PI | | | |
| CLASS | | | |

**COMPACTION**

OPTIMUM MOISTURE
MAX. WET DENSITY
MAX. DRY DENSITY
CORR. MAX. DRY DENSITY
% FRACTURE
METHOD
NATURAL DENSITY
NATURAL MOISTURE
WEIGHT LOOSE
WEIGHT RODDED

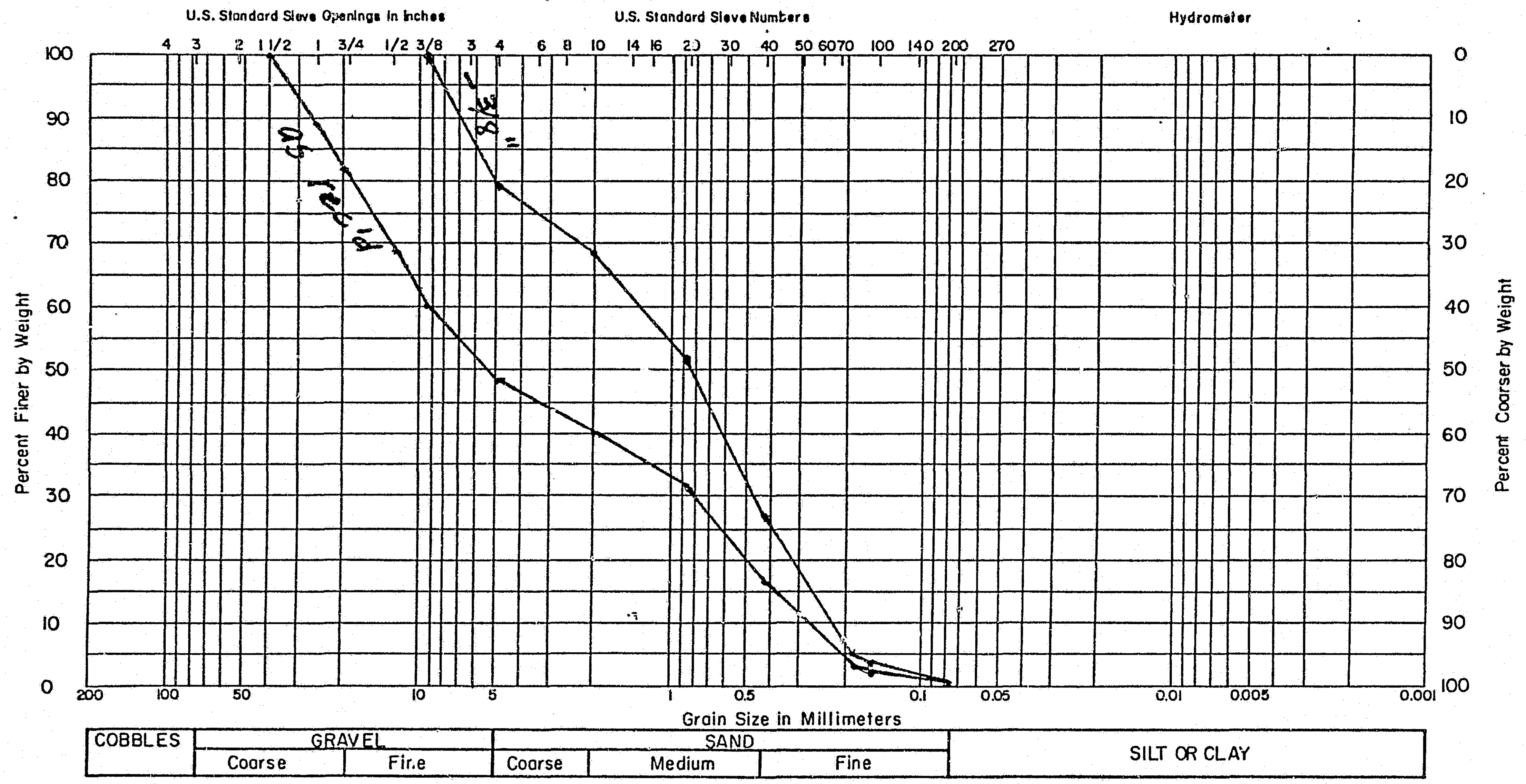
TOTAL WT. TESTED GMS
REMARKS

| COARSE | SPEC | FINE | SPEC |
|---|---|---|---|
| | | | |

DELETERIOUS MAT.
MINUS #200 MESH
SOFT FRAGMENTS
COAL & LIG. OR LT.WT.PT.
CLAY LUMPS
STICKS & ROOTS
FRIABLE PARTICLES
SPECIFIC GRAVITY
ABSORPTION
FINENESS MODULUS
SULFATE SOUNDNESS
FREEZE — THAW RATIO

L. A. ABRASION LOSS GRADE
DEGRADATION VALUE
THIN-ELONGATED
ORGANIC COLOR

DRY DENSITY — PCF
MOISTURE — PERCENT




| SAMPLE NO. | MOISTURE CONTENT | DRY DENSITY | LL | PI | CLASSIFICATION & DESCRIPTION |
|---|---|---|---|---|---|
| | | | | | Sample taken from banks of downstream end of slough 9. |

R&M CONSULTANTS, INC.

DRAWN BY
APPROVED BY
DATE 9-23
PROJECT NO. 253314

# APPENDIX A.6

# OBSERVATION WELL HOLE LOGS

s17/i9

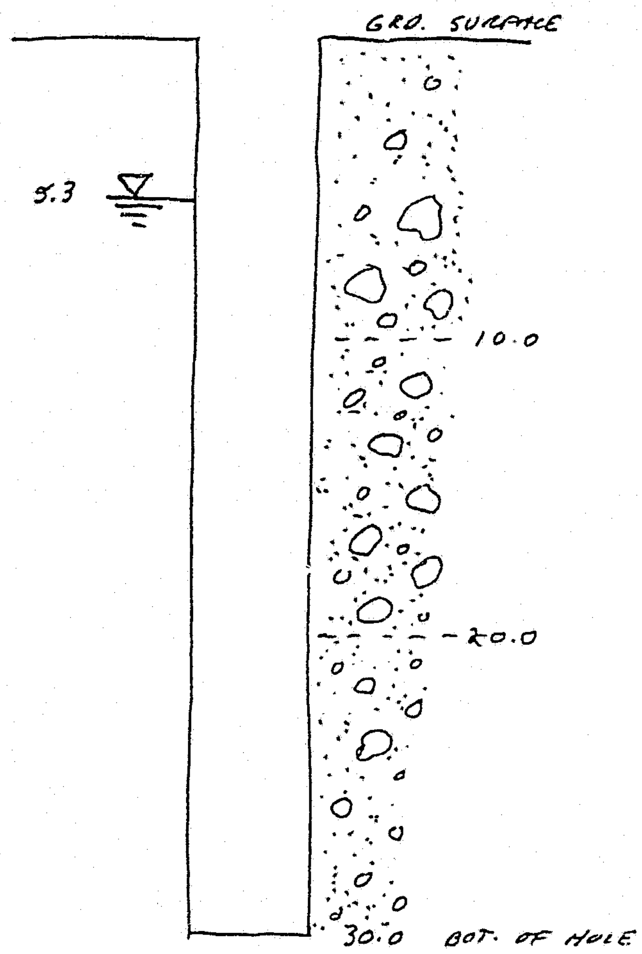
ACRES

# Calculations

SUBJECT: SLOUGH 9

AH - 1 GEOLOGY

JOB NUMBER 25701.77
FILE NUMBER
SHEET 3 OF 5
BY RAH DATE 1/2/83
APP DATE




MED BROWN, FINE TO MED GRAINED SAND WITH SOME GRAVEL AND COBBLES, DAMP TO MOIST, PARTICLES WELL ROUNDED, UP TO 4" DIAM. EASY TO HARD DRILLING.

SAND AND GRAVEL WITH NUMEROUS COBBLES. MODERATELY HARD, BUT STEADY DRILLING SOME FLOWING SAND

SAND AND GRAVEL WITH OCCASIONAL COBBLES EASIER DRILLING. DOWN TO 25. ft. SAND IS VERY FINE GRAINED AND FLOWS EASILY

COBBLES AND BOULDERS AT 30ft - REFUSAL

AH-1 A&B (9-1A)

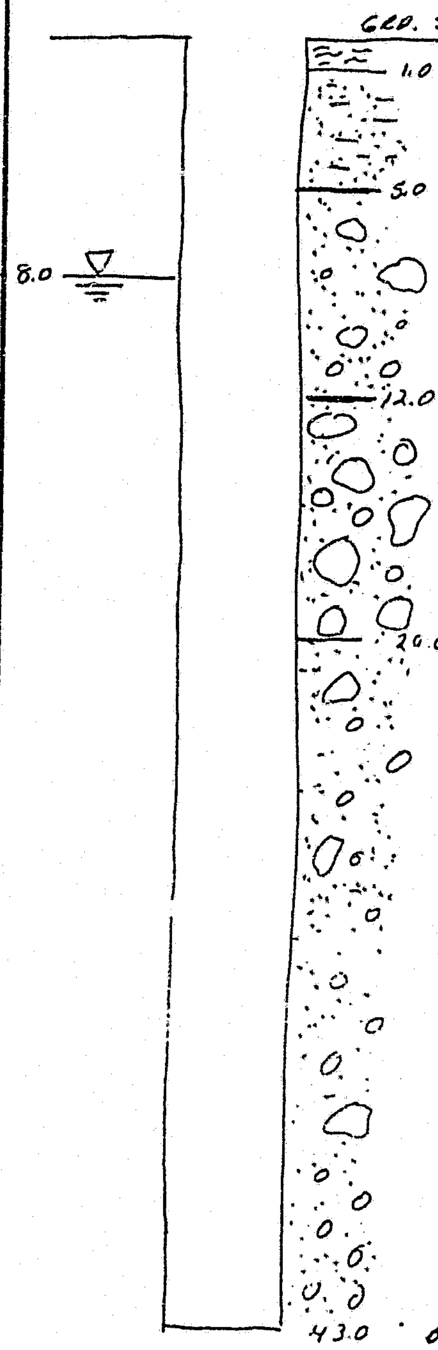
FORM NO. 152 REV. 1

# Calculations

ACRES

**SUBJECT:** SLOUGH 9 - GEOLOGY - AUGER HOLES -

JOB NUMBER PS701.77
FILE NUMBER
SHEET 2 OF 5
BY R Itenschel DATE 1/3/83
APP DATE




1.0 — ORGANIC MAT

DK. BROWN, VERY FINE GRAINED SAND, TO SILTY SAND, LOOSE, MOIST EASY DRILLING

5.0

GRAVEL AND COBBLES WITH SAND MATRIX, ALLUVIAL
WELL ROUNDED PARTICLES, ½ - 6" DIAMETER
HARD DRILLING

12.0

GRAVEL, COBBLES AND BOULDERS WITH SAND MATRIX
LARGER PARTICLES THAN LAYER ABOVE
VERY HARD DRILLING, WELL PACKED

20.0

SAND AND GRAVEL WITH OCCASIONAL COBBLES
EASY DRILLING, LOOSE TO MED DENSE
20.0 - 22' - BROWN-GRAY [illegible]
22 - 23' - BROWN
23' - - GRAY

43.0 BOT. OF HOLE

AH-4 (9-3A)

SCALE ¼" = 2ft

**ACRES**

# Calculations

**SUBJECT:** SLOUGH 9

AH-3 GEOLOGY

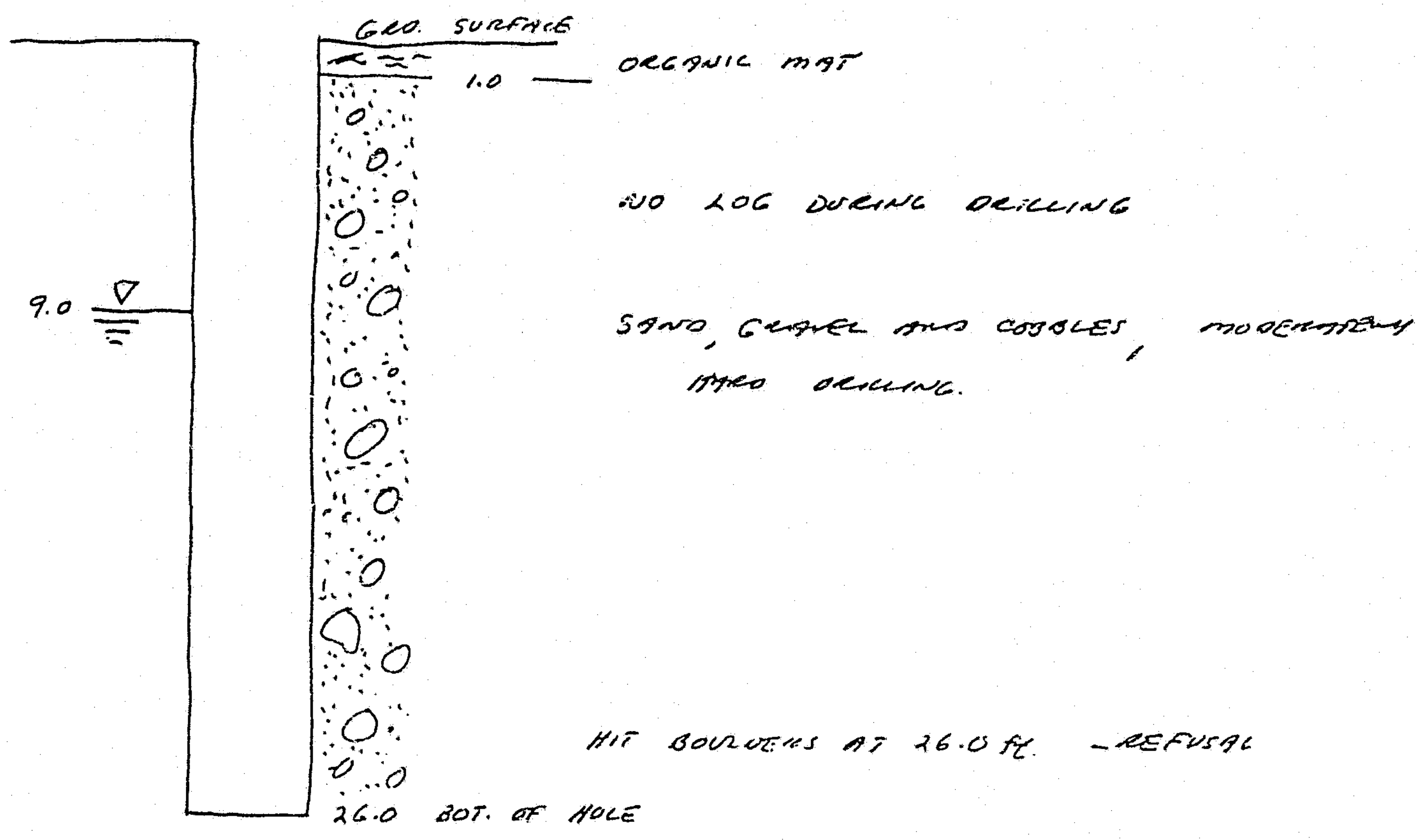
JOB NUMBER P5701.77

FILE NUMBER

SHEET 5 OF 5

BY RMH DATE 1/2/81

APP DATE




AH-3 (9-4A)

FORM NO. 152 REV. 1

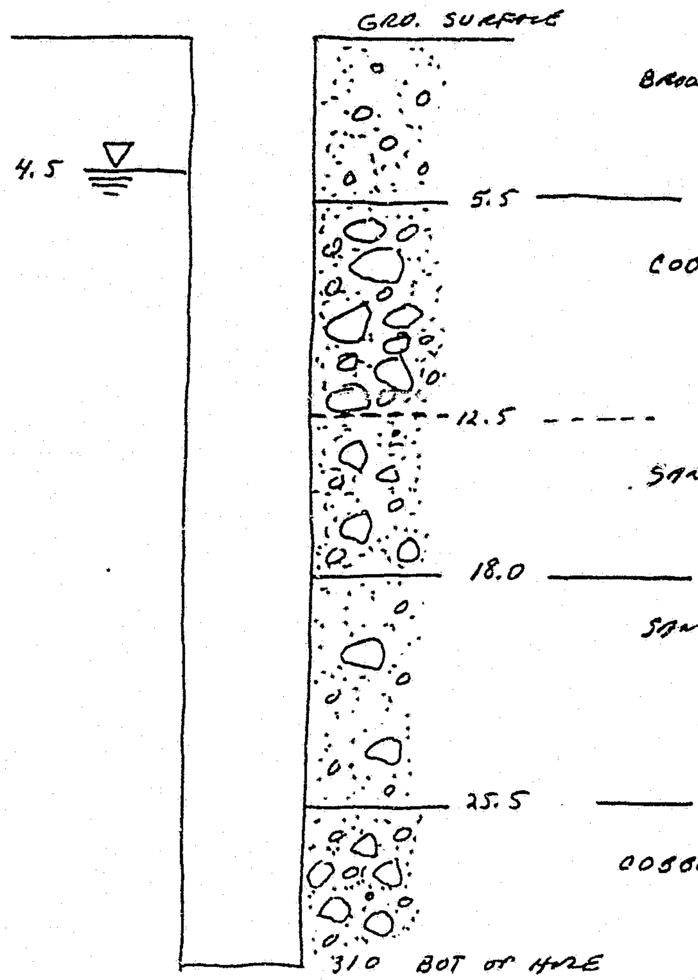
# Calculations

ACRES

**SUBJECT:** SLOUGH 9

AH - 2 GEOLOGY

JOB NUMBER 15701.37
FILE NUMBER
SHEET 4 OF 5
BY RAH DATE 1/2/83
APP DATE




BROWN, FINE TO COARSE GRAINED SAND AND GRAVEL, WET, EASY DRILLING, LOOSE, GRADES INTO GRAVEL AND COBBLES

COBBLES AND SMALL BOULDERS WITH GRAVEL AND SAND MATRIX, MODERATELY HARD DRILLING

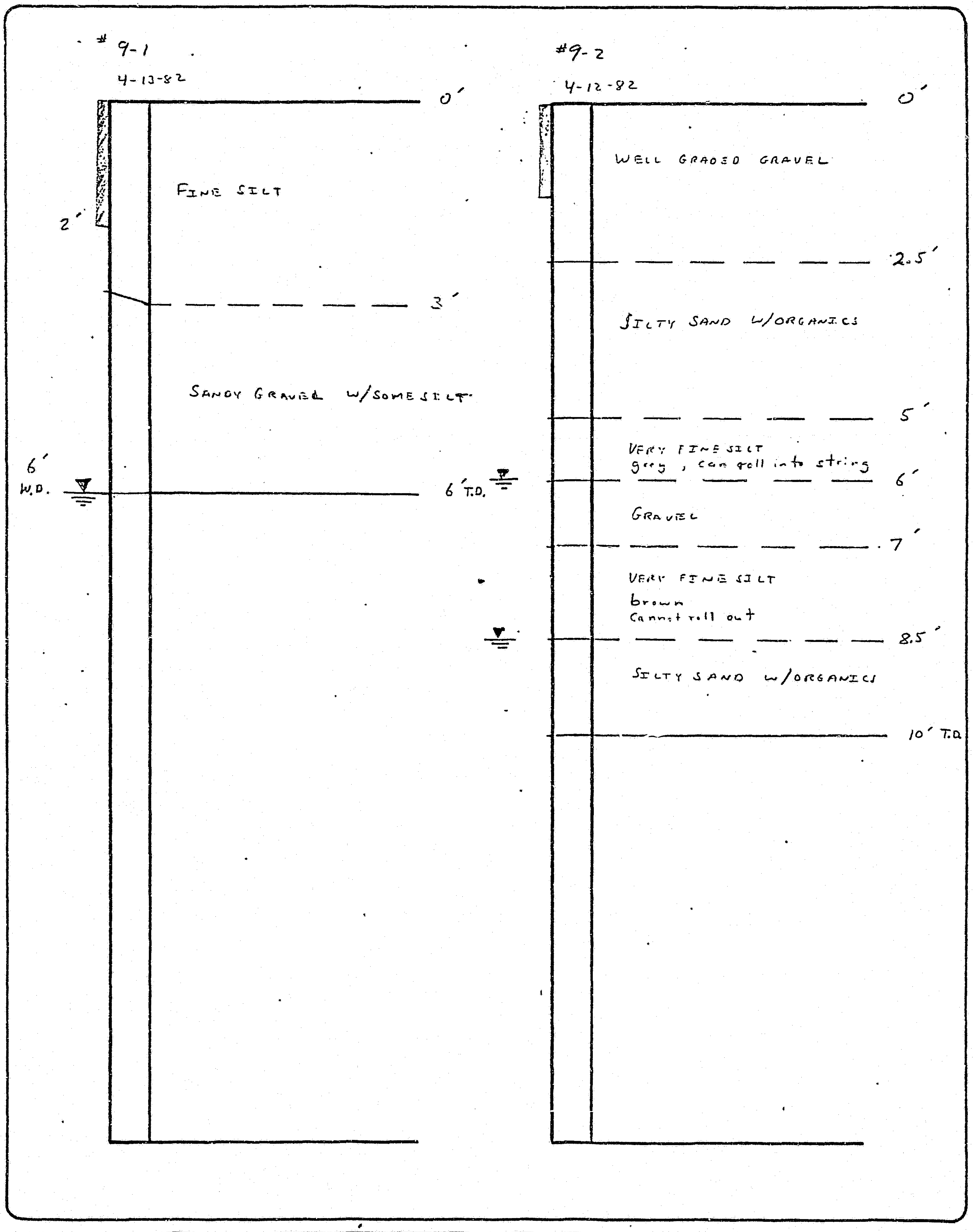
SAND, GRAVEL AND COBBLES, DENSE, SLIGHTLY EASIER DRILLING, STEADY

SAND AND GRAVEL WITH OCCASIONAL COBBLES EASY DRILLING

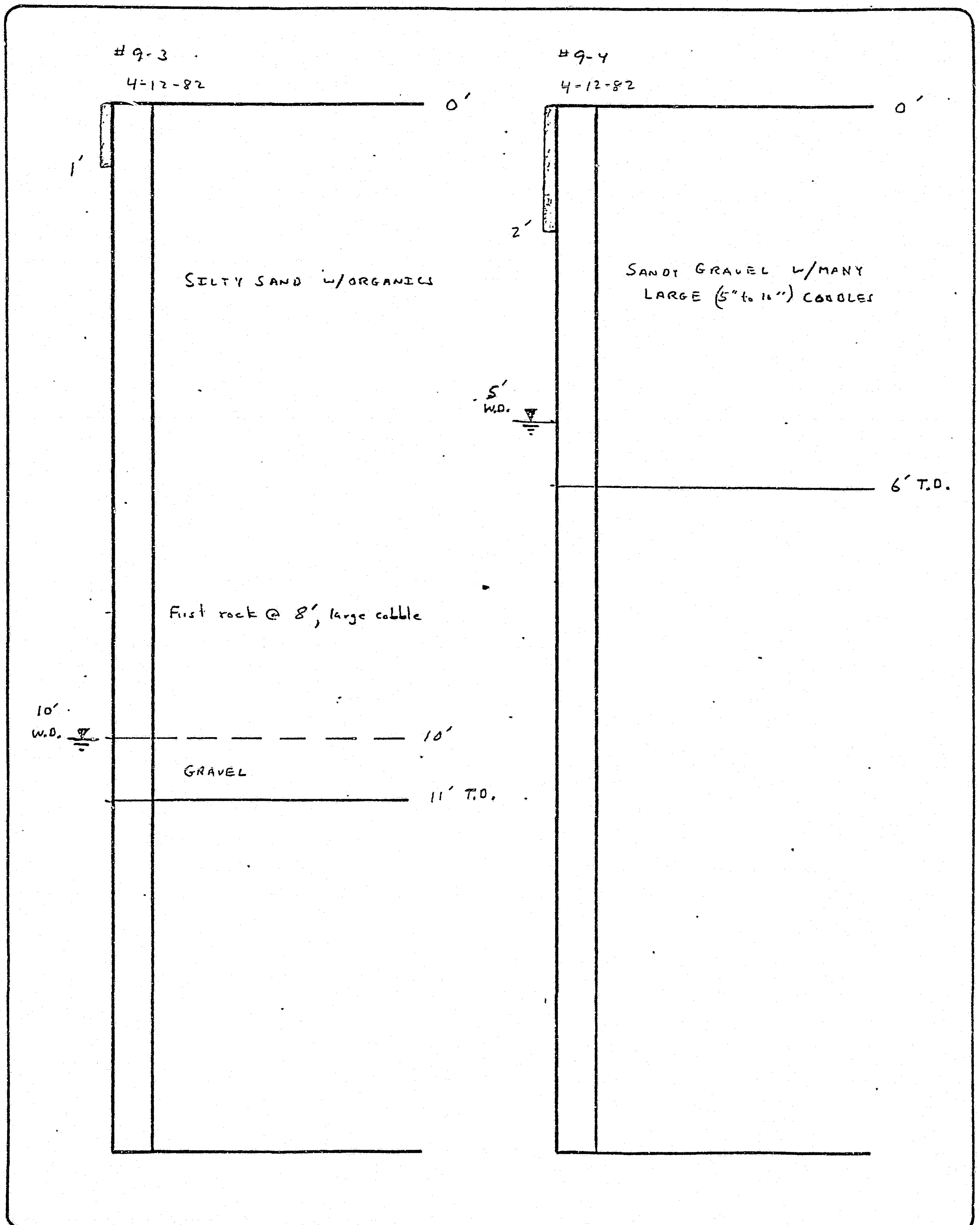
COBBLES AND GRAVEL WITH SAND MATRIX. OCCASIONAL BOULDERS. MOD. HARD TO VERY HARD DRILLING

AH-2 A&B (9-5A)

FORM NO. 152 REV. 1




| | | | |
|---|---|---|---|
| DWN. RB | R&M CONSULTANTS, INC. ENGINEERS GEOLOGISTS PLANNERS SURVEYORS | WELL HOLE LOGS | F.B. |
| CKD. | | SUSITNA GROUND WATER STUDY | GRID. |
| DATE. 4-82 | | | PROJ.NO. 052314 |
| SCALE. 1 : 2' | | | DWG NO. |

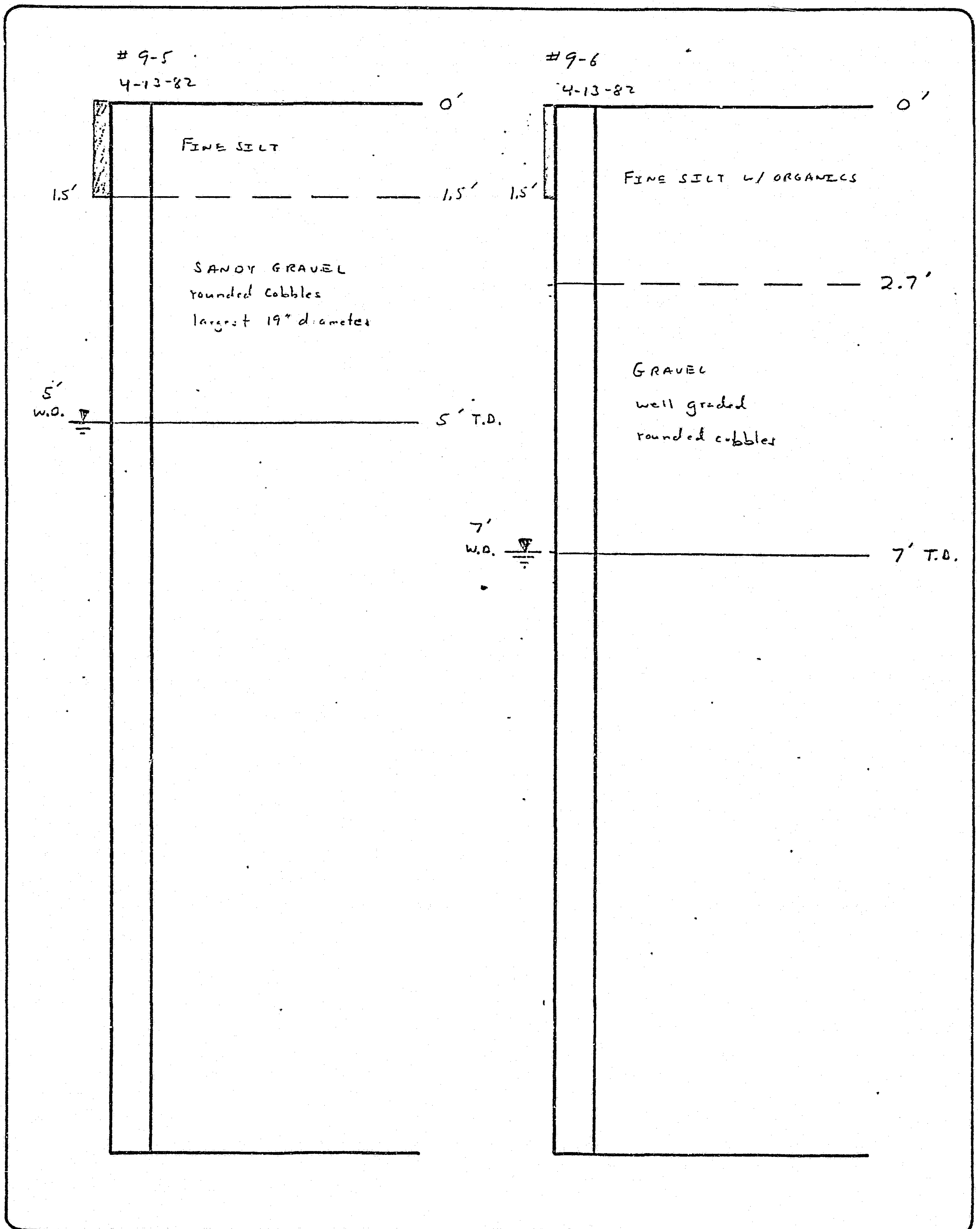



| | |
|---|---|
| DWN. | RB |
| CKD. | |
| DATE. | 4-82 |
| SCALE | |

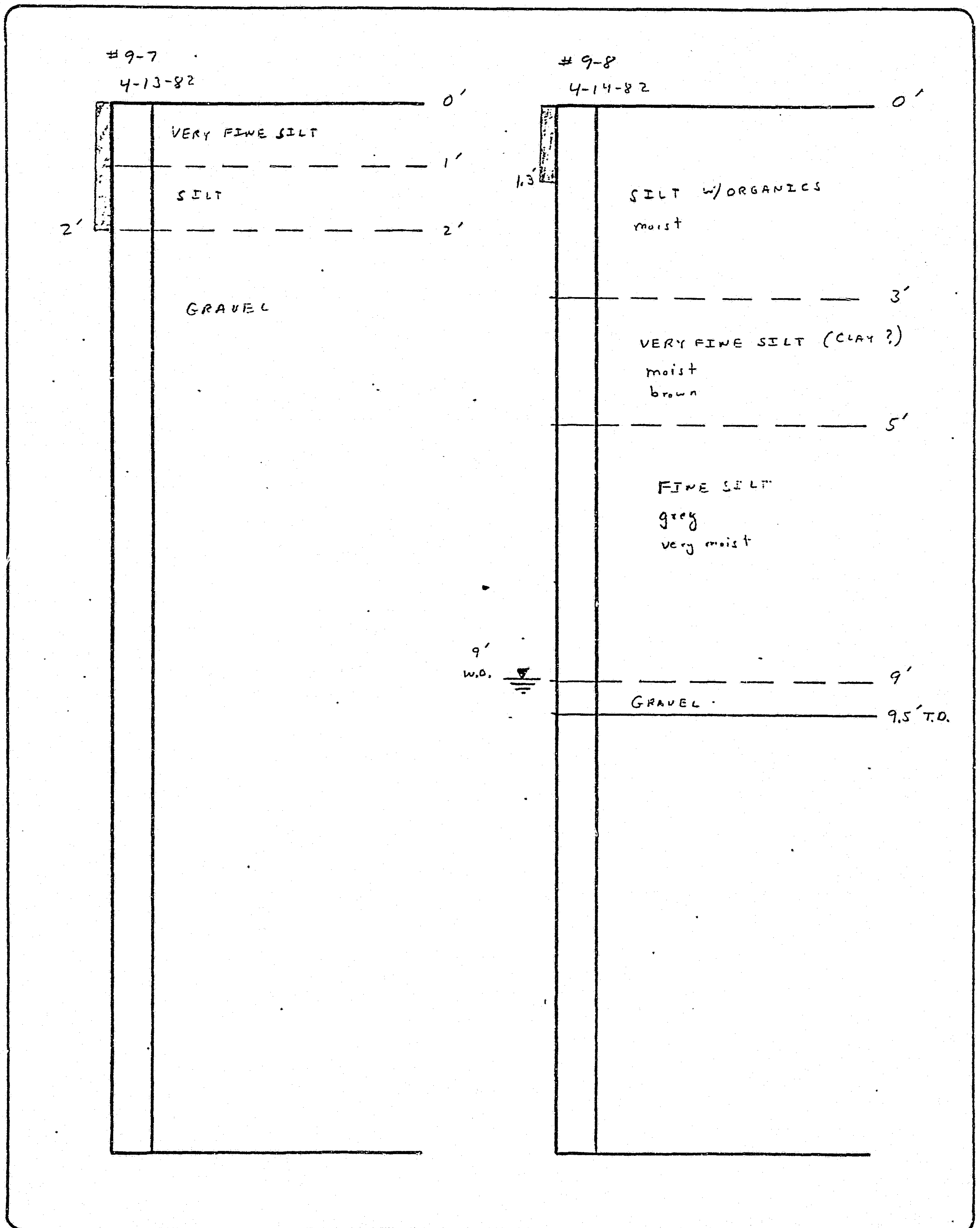
R&M CONSULTANTS, INC.
ENGINEERS GEOLOGISTS PLANNERS SURVEYORS

WELL HOLE LOGS
SUSITNA GROUND WATER STUDY

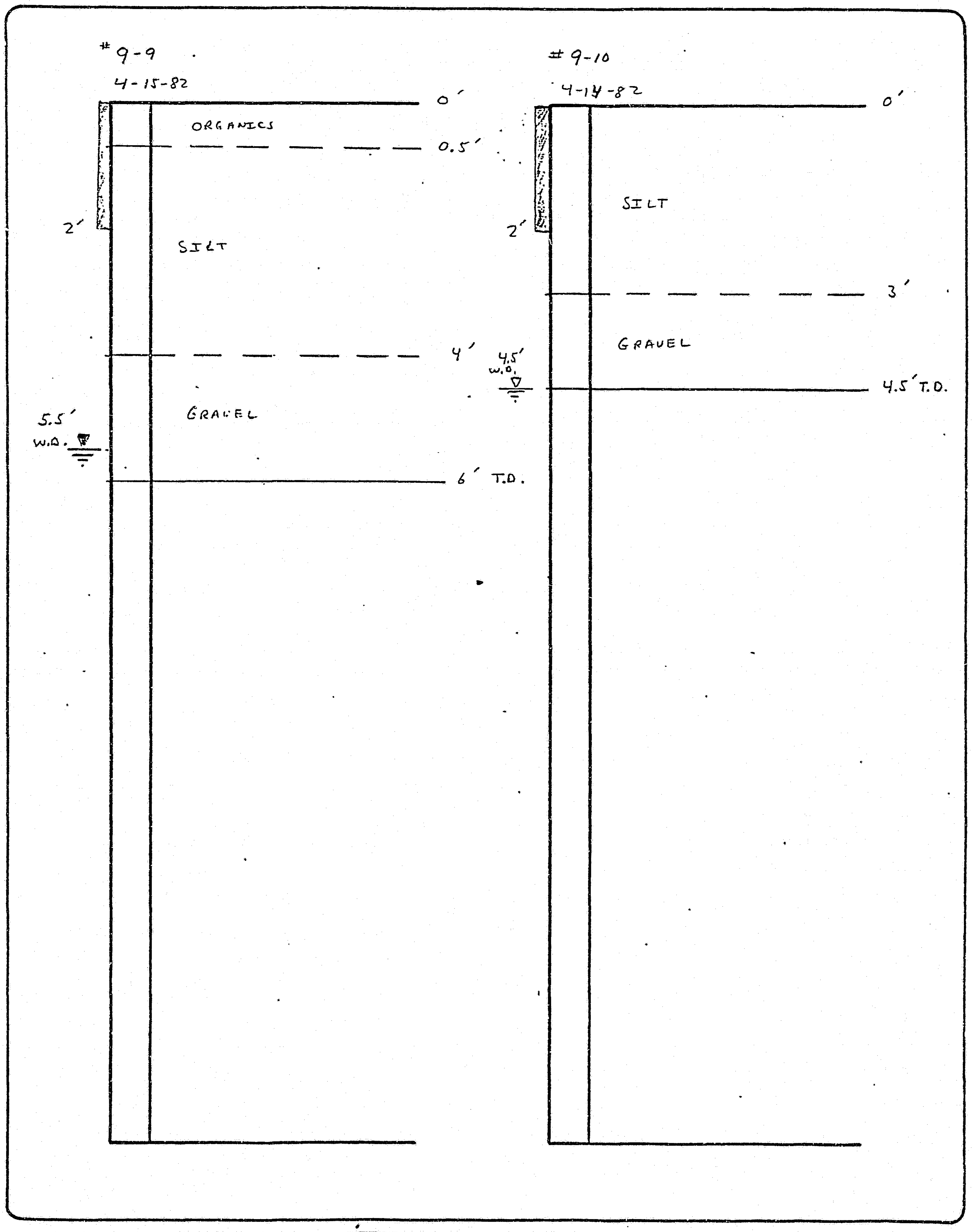
| | |
|---|---|
| F.B. | |
| GRID. | |
| PROJ. NO. | 052314 |
| DWG. NO. | |




| | | | |
|---|---|---|---|
| DWN. R.B. | R&M CONSULTANTS, INC. ENGINEERS GEOLOGISTS PLANNERS SURVEYORS | WELL HOLE LOGS | F.B. |
| CKD. | | SUSITNA GROUND WATER STUDY | GRID. |
| DATE. 4-82 | | | PROJ.NO. 052314 |
| SCALE. 1" = 1' | | | DWG.NO. |




| | | | |
|---|---|---|---|
| DWN. RC | R&M CONSULTANTS, INC. ENGINEERS GEOLOGISTS PLANNERS SURVEYORS | WELL HOLE LOGS | F.B. |
| CKD. | | SUSITNA GROUND WATER STUDY | GRID. |
| DATE. 4-82 | | | PROJ.NO. 052304 |
| SCALE. 1" - 1' | | | DWG.NO. |



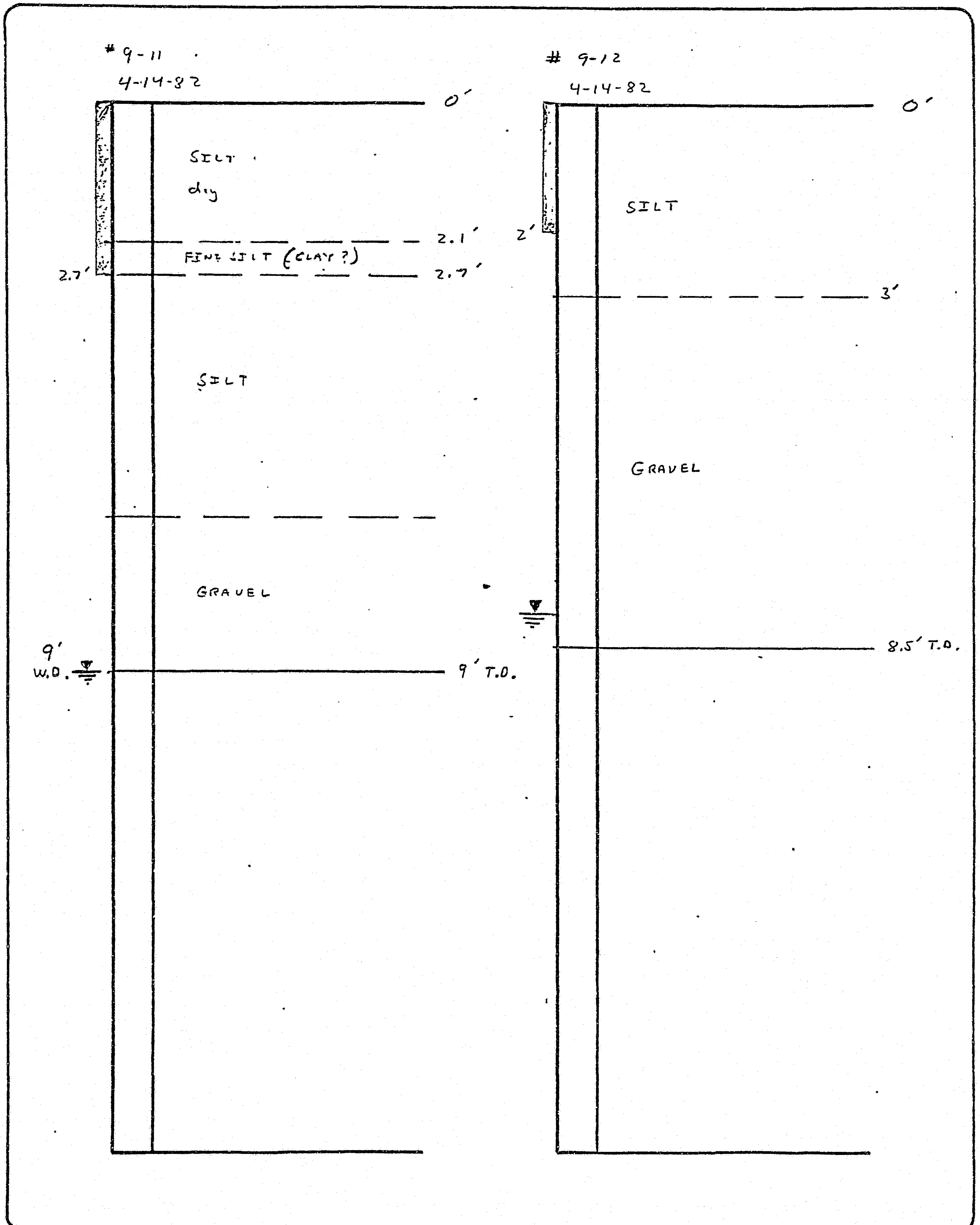

| | |
|---|---|
| DWN. | RB |
| CKD. | |
| DATE. | 4-82 |
| SCALE. | 1" - |

R&M CONSULTANTS, INC.
ENGINEERS GEOLOGISTS PLANNERS SURVEYORS

WELL HOLE LOGS

SUSITNA GROUND WATER STUDY

| | |
|---|---|
| F.B. | |
| GRID. | |
| PROJ. NO. | 052314 |
| DWG NO. | |

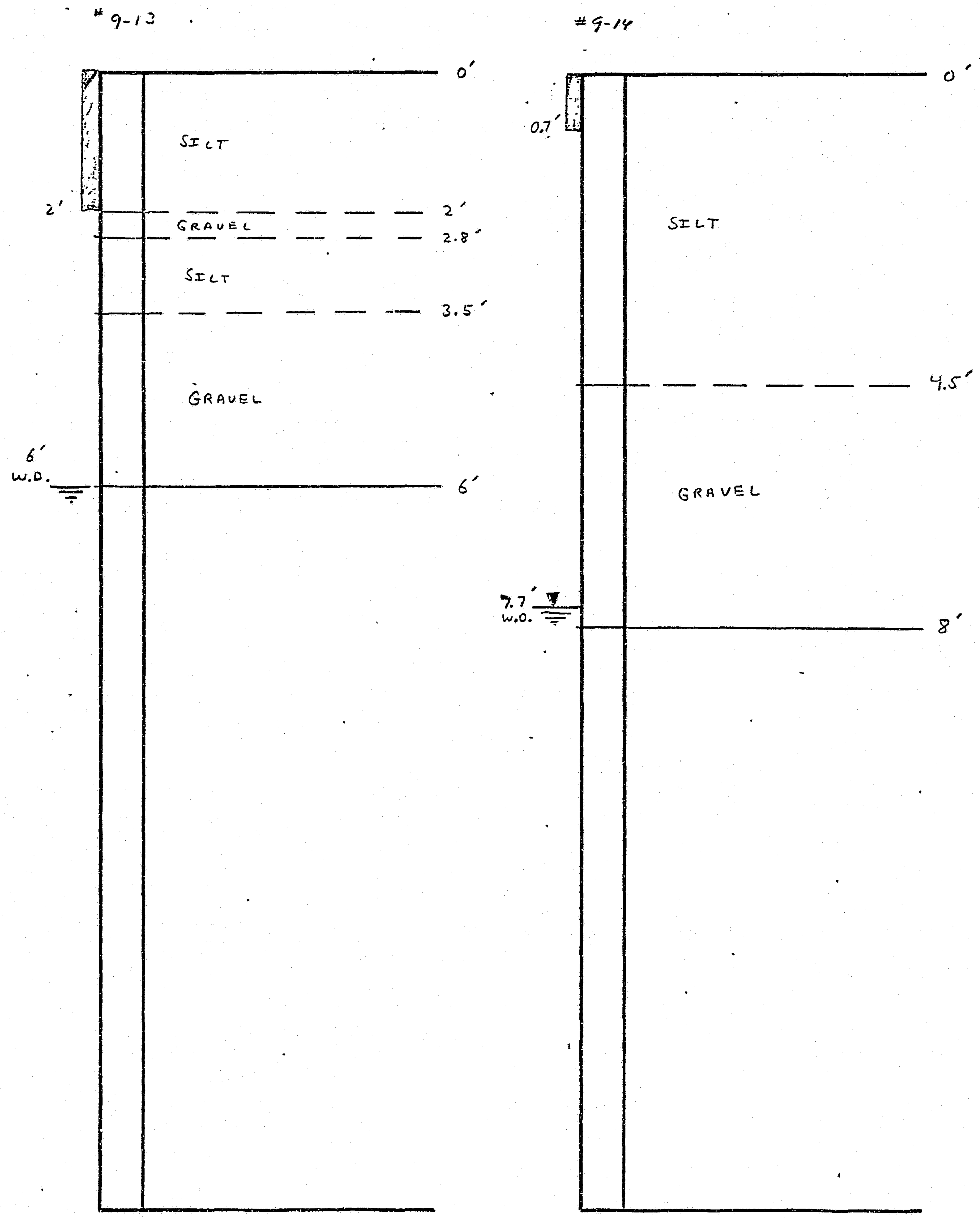



| | |
|---|---|
| DWN. | RB |
| CKD. | |
| DATE. | 4-82 |
| SCALE | 1"=1' |

R&M CONSULTANTS, INC.
ENGINEERS GEOLOGISTS PLANNERS SURVEYORS

WELL HOLE LOGS
Susitna Ground Water Study

| | |
|---|---|
| F.B. | |
| GRID. | |
| PROJ. NO. | 052314 |
| DWG NO. | |

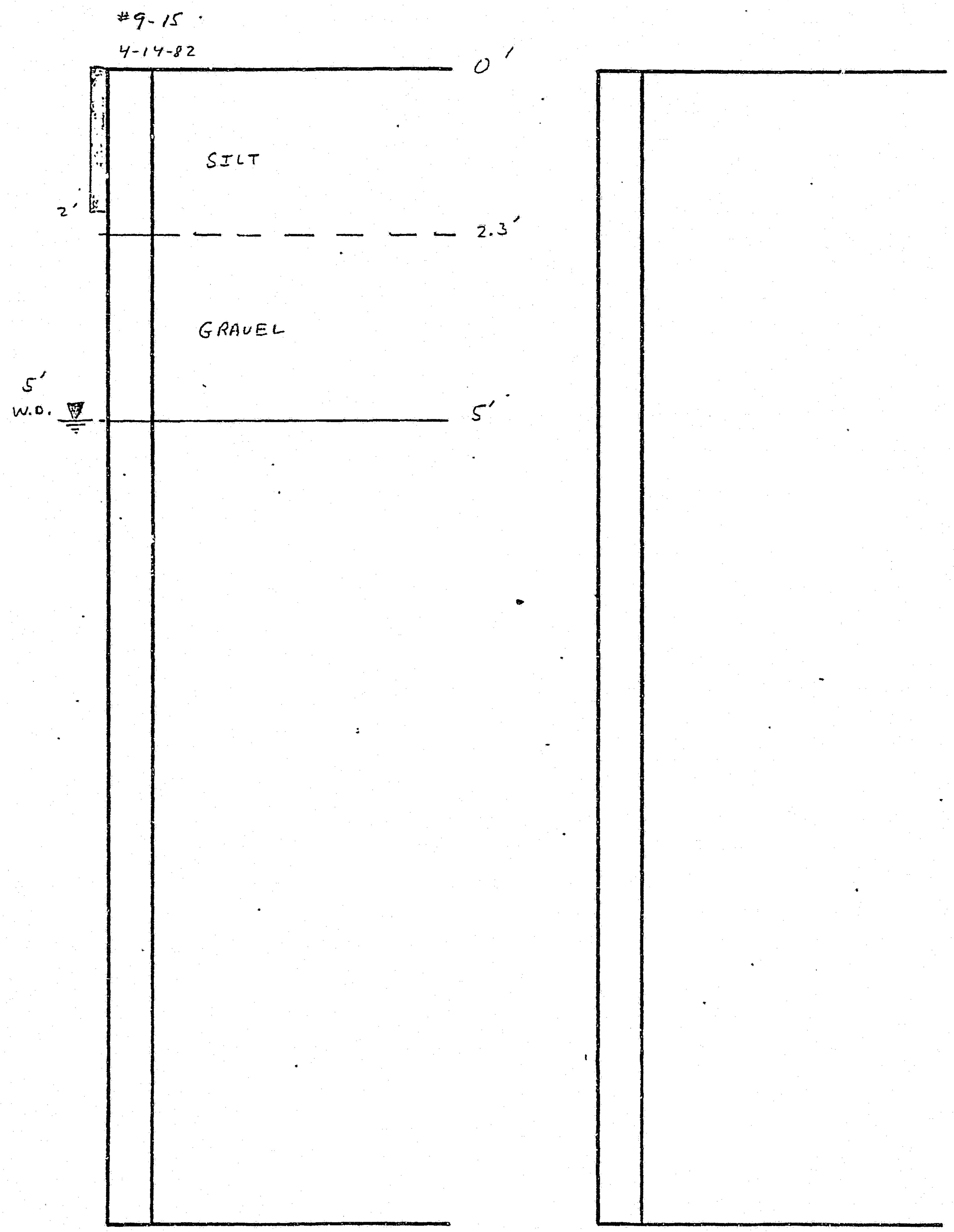



| | |
|---|---|
| DWN. R.B. | F.B. |
| CKD. | GRID. |
| DATE. 4-82 | PROJ.NO. 052314 |
| SCALE. | DWG.NO. |

R&M CONSULTANTS, INC.
ENGINEERS GEOLOGISTS PLANNERS SURVEYORS

WELL HOLE LOGS

SUSITNA GROUND WATER PROJECT

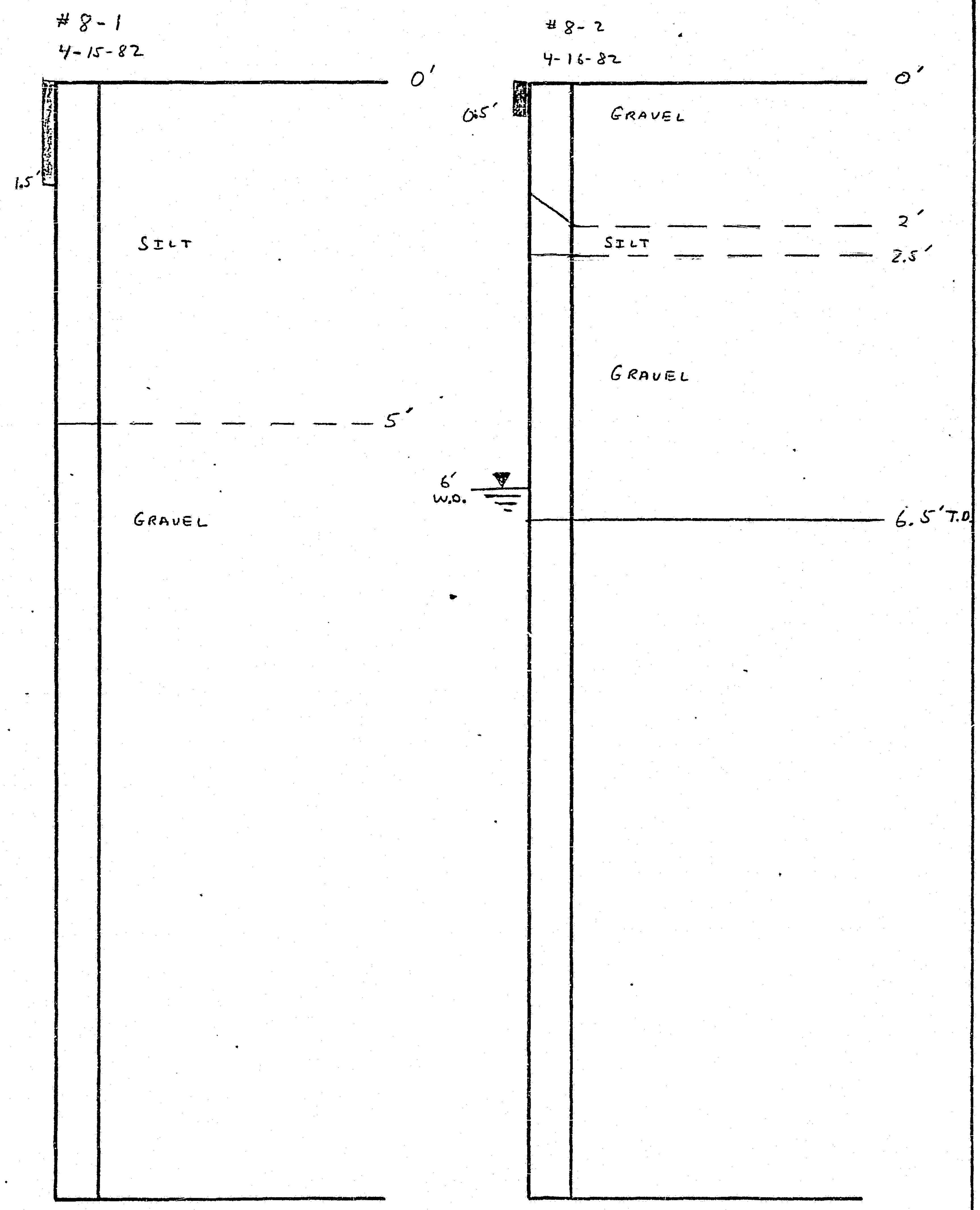



| | |
|---|---|
| DWN. | RB |
| CKD. | |
| DATE. | 4-82 |
| SCALE. | 1" = 2' |

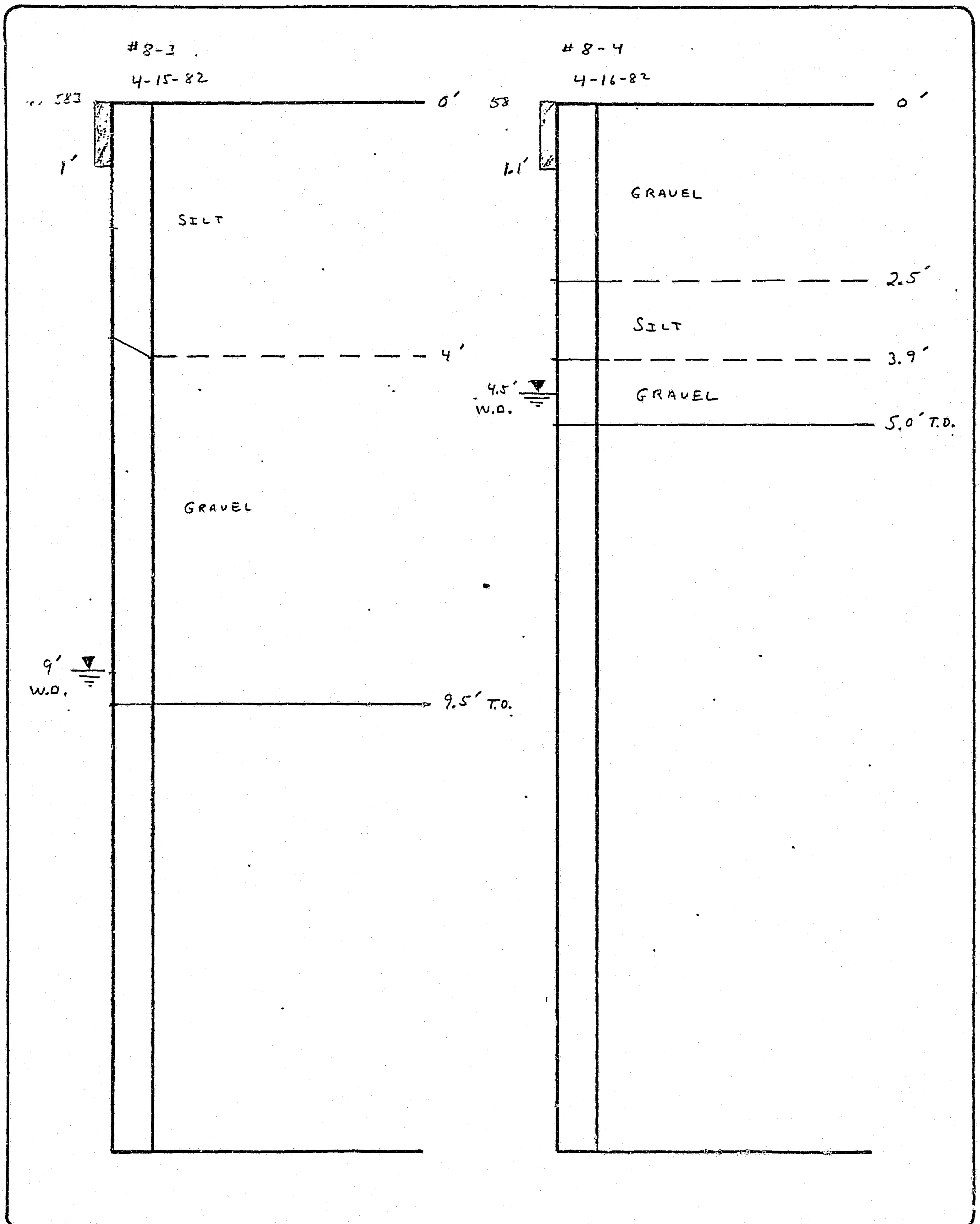
R&M CONSULTANTS, INC.
ENGINEERS GEOLOGISTS PLANNERS SURVEYORS

WELL HOLE LOGS
SUSITNA GROUND WATER STUDY

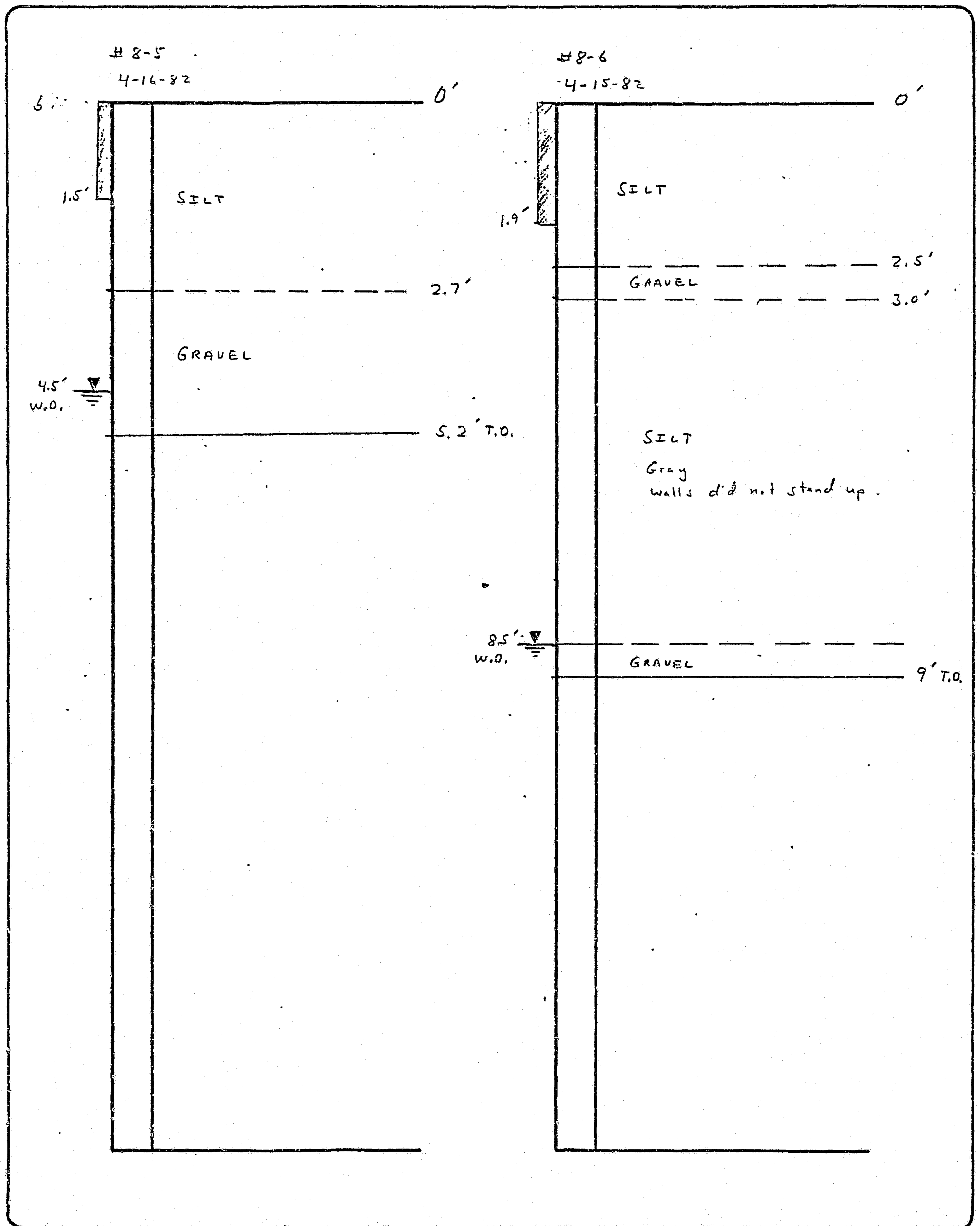
| | |
|---|---|
| F.B. | |
| GRID. | |
| PROJ.NO. | 052314 |
| DWG.NO. | |



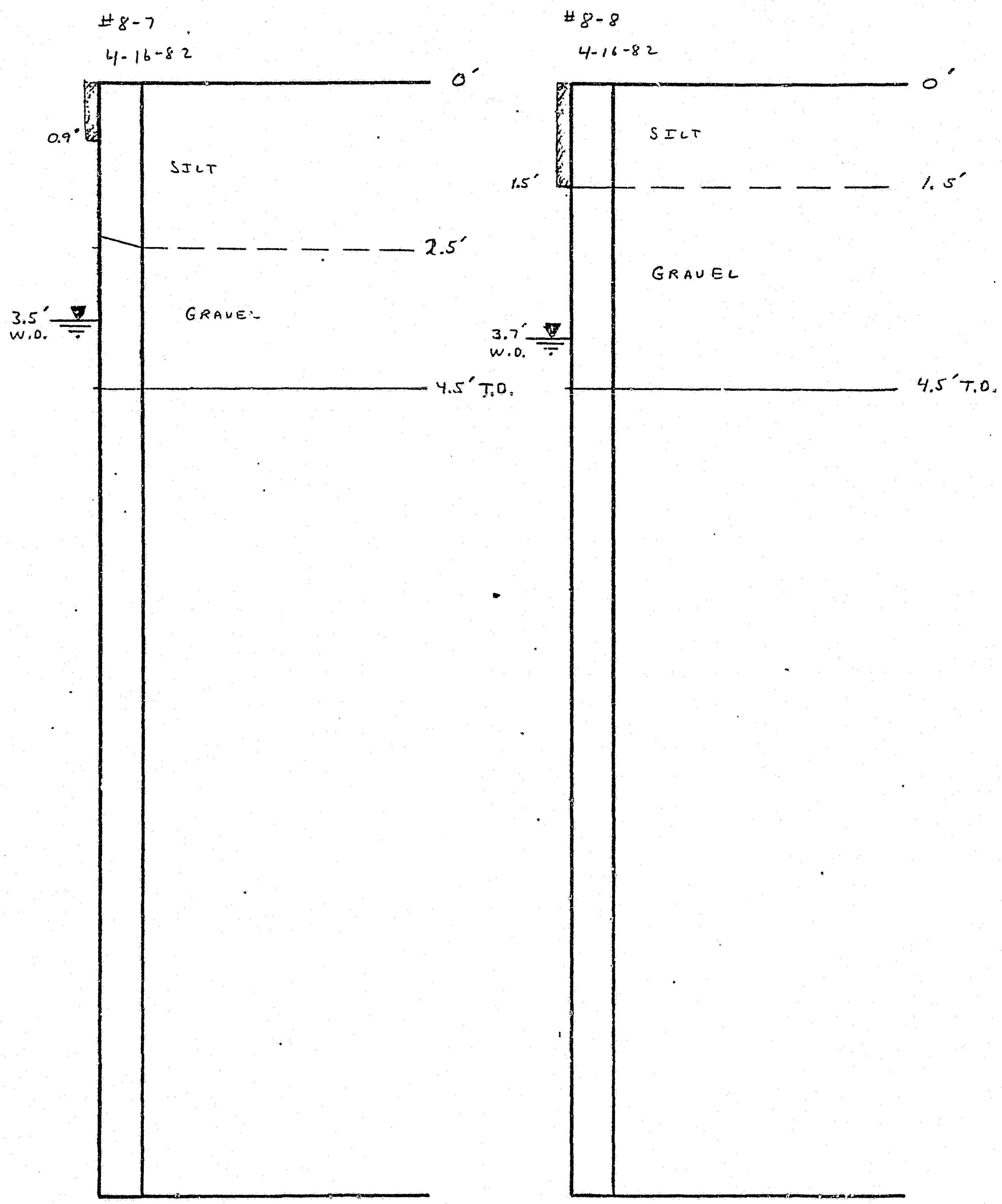

| | | | |
|---|---|---|---|
| DWN. R.B. | R&M CONSULTANTS, INC. ENGINEERS GEOLOGISTS PLANNERS SURVEYORS | WELL HOLE LOGS | F.B. |
| CKD. | | SUSITNA GROUND WATER STUDY | GRID. |
| DATE. 4/82 | | | PROJ. NO. 052314 |
| SCALE. 1"=2' | | | DWG. NO. |



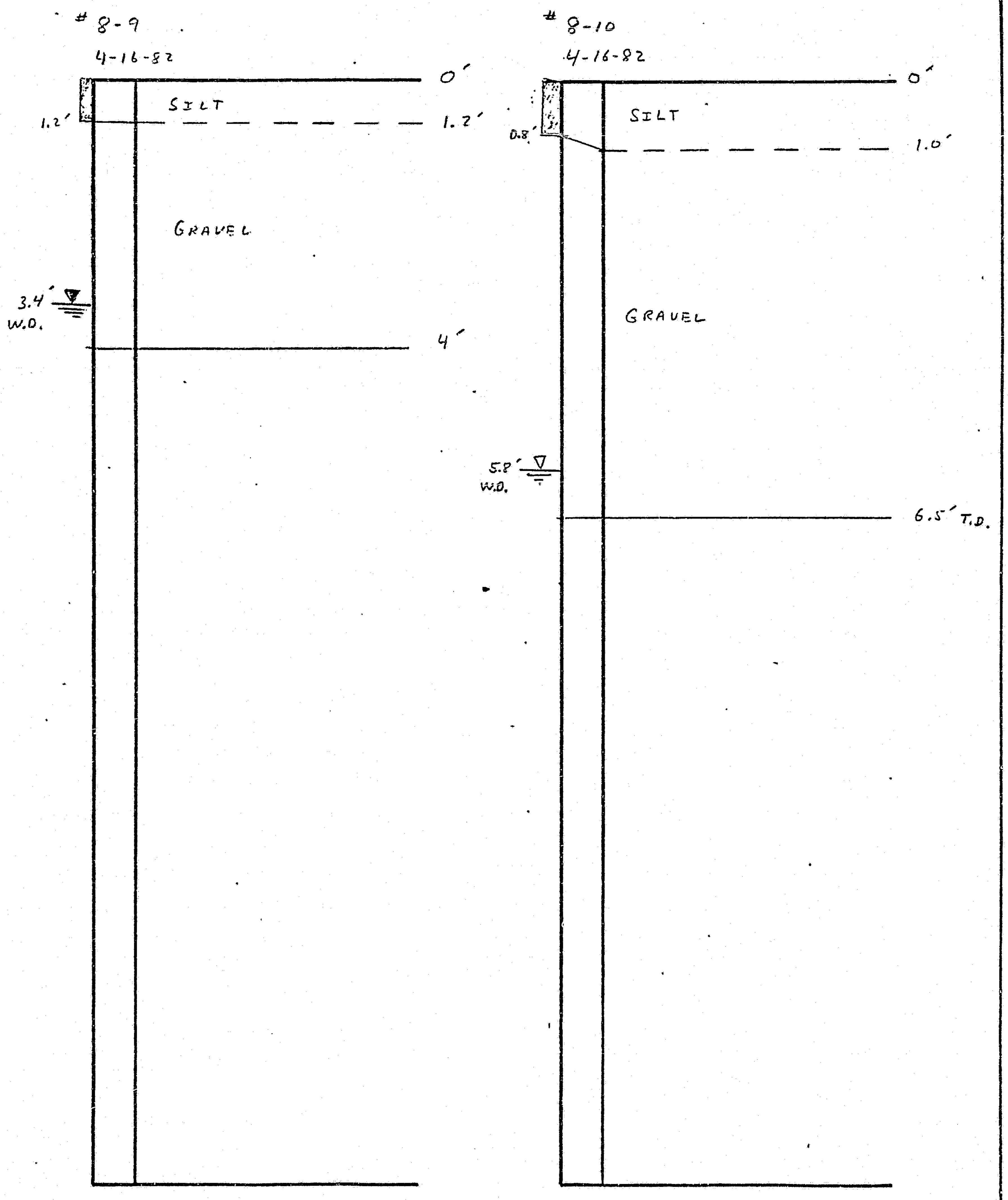

| | | | |
|---|---|---|---|
| DWN. R.B. | R&M CONSULTANTS, INC. ENGINEERS GEOLOGISTS PLANNERS SURVEYORS | WELL HOLE LOGS | FB. |
| CKD. | | SUSITNA GROUND WATER STUDY | GRID. |
| DATE. 4/82 | | | PROJ.NO. 052314 |
| SCALE. 1"= 2' | | | DWG.NO. |



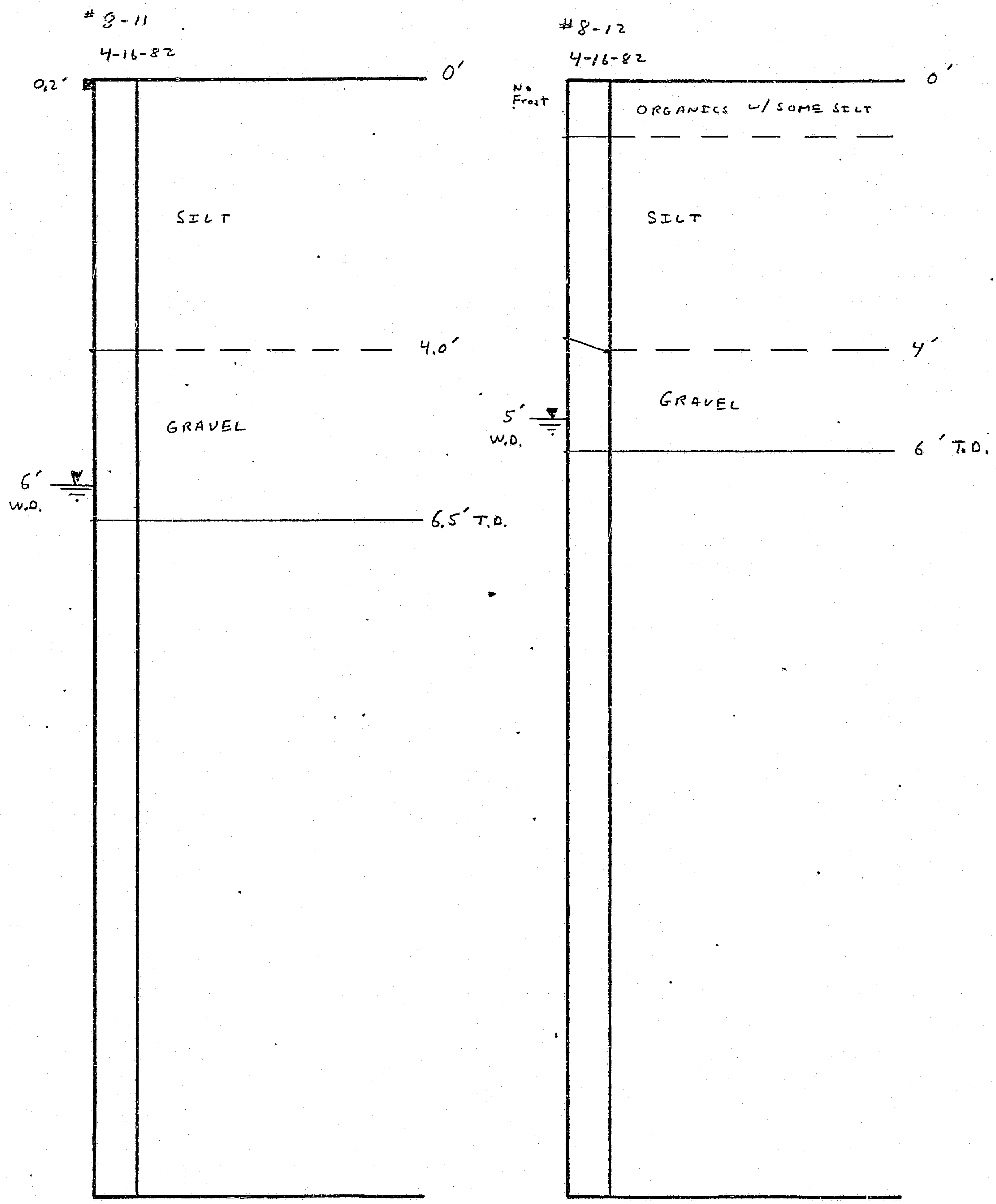

| | | | |
|---|---|---|---|
| DWN. RB | R&M CONSULTANTS, INC. ENGINEERS GEOLOGISTS PLANNERS SURVEYORS | WELL HOLE LOGS | F.B. |
| CKD. | | SUSITNA GROUND WATER STUDY | GRID. |
| DATE. 4/82 | | | PROJ. NO. 052314 |
| SCALE. 1" = 2' | | | DWG. NO. |




| | | | |
|---|---|---|---|
| DWN. RB | R&M CONSULTANTS, INC. ENGINEERS GEOLOGISTS PLANNERS SURVEYORS | WELL HOLE LOGS | F.B. |
| CKD. | | Susitna Ground Water Study | GRID. |
| DATE. 4-82 | | | PROJ. NO. 052314 |
| SCALE. [illegible] | | | DWG. NO. |




| | | | |
|---|---|---|---|
| DWN. R.B | R&M CONSULTANTS, INC. ENGINEERS GEOLOGISTS PLANNERS SURVEYORS | WELL HOLE LOGS | F.B. |
| CKD. | | SUSITNA GROUND WATER STUDY | GRID. |
| DATE. 4-82 | | | PROJ. NO. 052314 |
| SCALE. 1" = 2' | | | DWG. NO. |




| | |
|---|---|
| DWN. | RB |
| CKD. | |
| DATE. | 4-82 |
| SCALE. | 1" - [illegible] |

R&M CONSULTANTS, INC.
ENGINEERS GEOLOGISTS PLANNERS SURVEYORS

WELL HOLE LOGS
SUSITNA GROUND WATER STUDY

| | |
|---|---|
| F.B. | |
| GRID. | |
| PROJ.NO. | 052314 |
| DWG.NO. | |

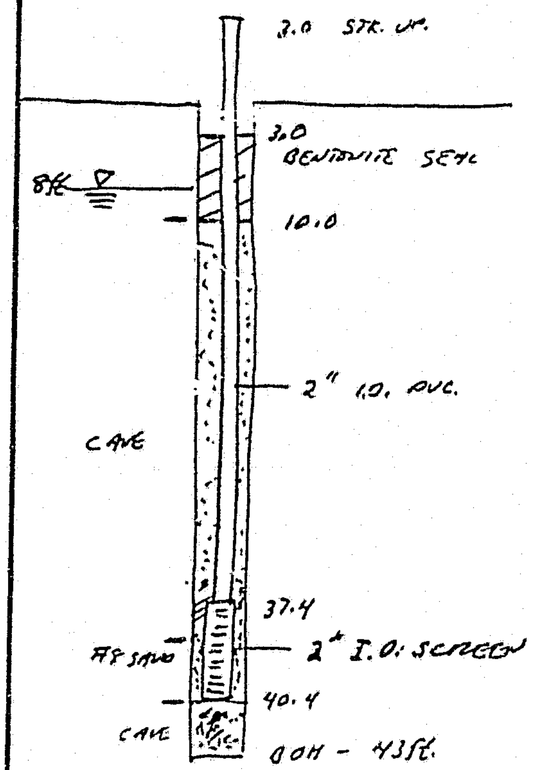
APPENDIX A.7

DETAILS OF WELL INSTALLATIONS AT SLOUGH 9B

# ACRES Calculations

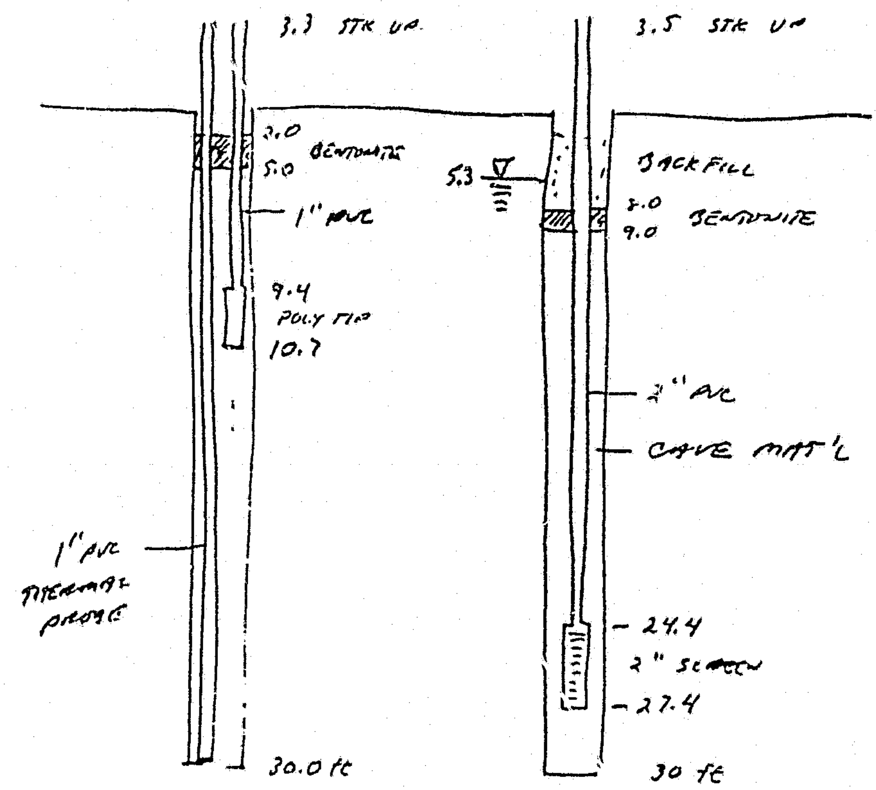
SUBJECT: DETAILS OF PIEZ. INSTALLATIONS
SLOUGH NO 9

JOB NUMBER P5701.77
FILE NUMBER
SHEET 1 OF 5
BY R. HENSCHEL DATE 11/3
APP DATE



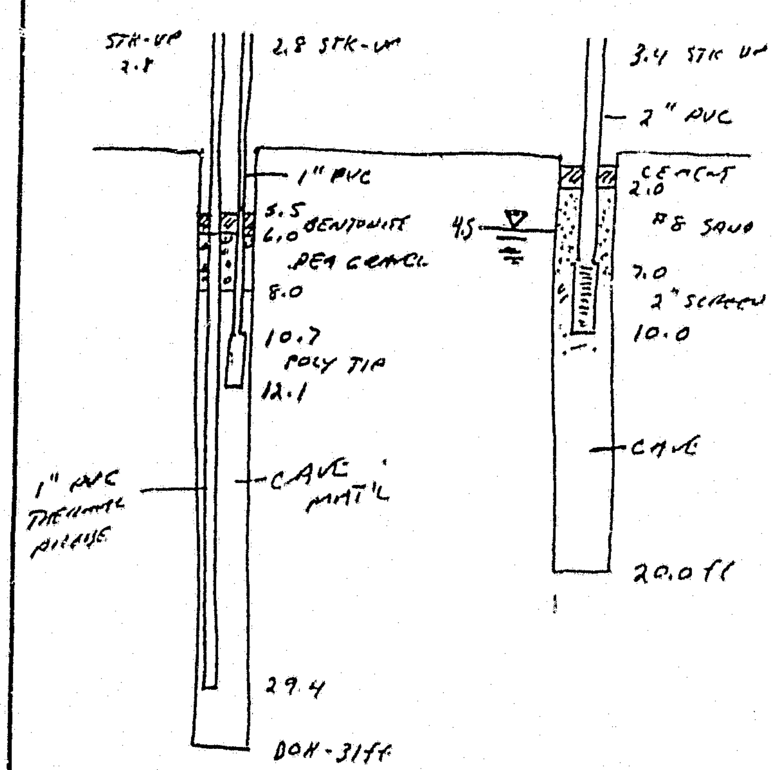

4C

AH-4 (9-3A)



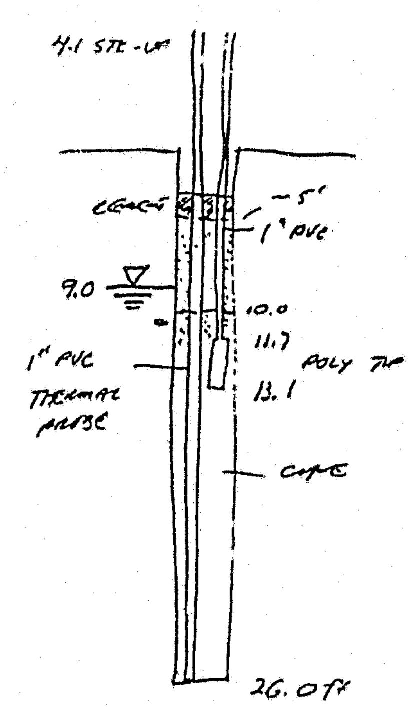

1A    1B

AH-1 (9-1A)




2A    2B

AH-2 (9-5A)




AH-3 (9-4A)

NOTE - THERMAL PROBES - PVC CUT AT ANGLE

FORM NO. 152 REV. 1