HARZA-EBASCO SUSITNA JOINT VENTURE

INTRA-OFFICE MEMORANDUM

JAN 16 1985

LOCATION Anchorage

DATE December 20, 1984

TO L. Gilbertson

NUMBER 4.3.1.1

FROM H. Teas

SUBJECT Side Channel Flow Rate Dye Study

On 5 December 1984 I travelled to Talkeetna with T. Withrow of ADF&G. On 6 December a flow-rate dye study was performed in the lower part of slough 11. On 7 December similar studies were performed in sloughs 21 and 10. A sufficient number of measurements were made to determine the flows in all three sloughs. The flow fromslough 9 was not measured, due to interference effects of the ice front.

Slough 11

Measurements were made in the lower part of slough 11 (see figure 1). A Geofilter peristaltic pump was used to inject dye a sufficient distance above passage reach I(PR-I) to give complete mixing at the base of the reach. Discrete samples were taken at the base of PR-I and at the mouth of the slough. Mixing was complete below PR-I. Considerable upwelling and seepage below PR-I was too close to the mouth to give complete mixing. The result is a range of flow rates for measurements at the mouth. The study was conducted only in the lower slough due to time constraints involving time of travel of the dye.

Slough 21

The dye injection point in Slough 21 was between PR-II and the fork in the slough (figure 2). Samples were taken in PR-II and below PR-I. Samples from both sides of the slough at each sampling location showed complete mixing of the dye.

Slough 10

The location chosen for dye injection was about 200 feet up the northwest arm from the fork with the smaller northeast arm. Mixing was complete near the mouth of the slough, but showed some non-uniformity at a sampling site just above the fork in the slough. The range, however, was insignificant (less than 0.1. cfs).

Results

Location		Flow Rate
Slough 11	below PR-I	1.0 cfs
	at mouth	1.1 to 1.3
Slough 21	in PR-II	0.4 cfs
	below PR-I	2.4 cfs
Slough 10	above the mouth of the NE arm	0.8 cfs
	at the mouth of the slough	0.9 cfs

421431/12

FIGURE 1

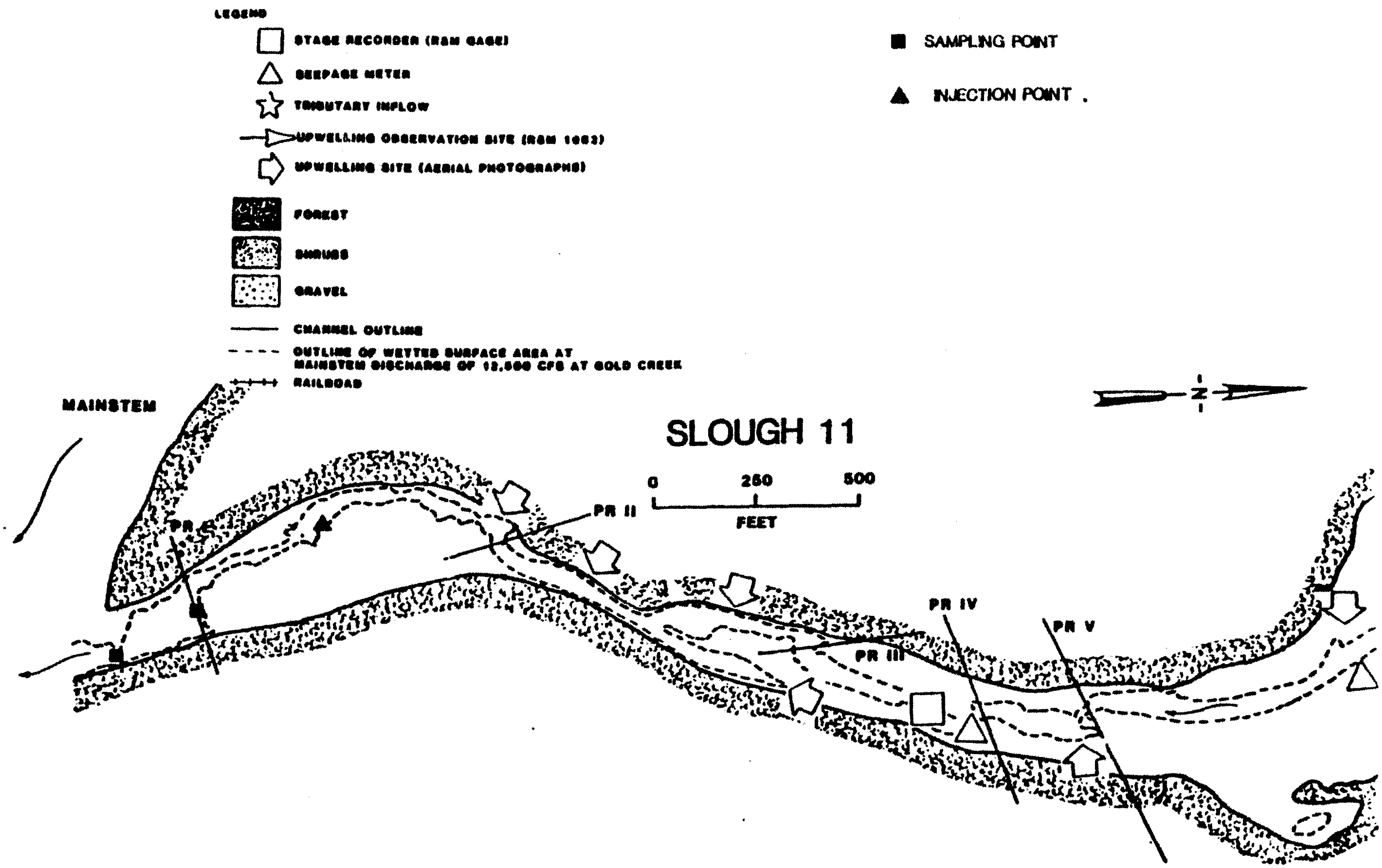
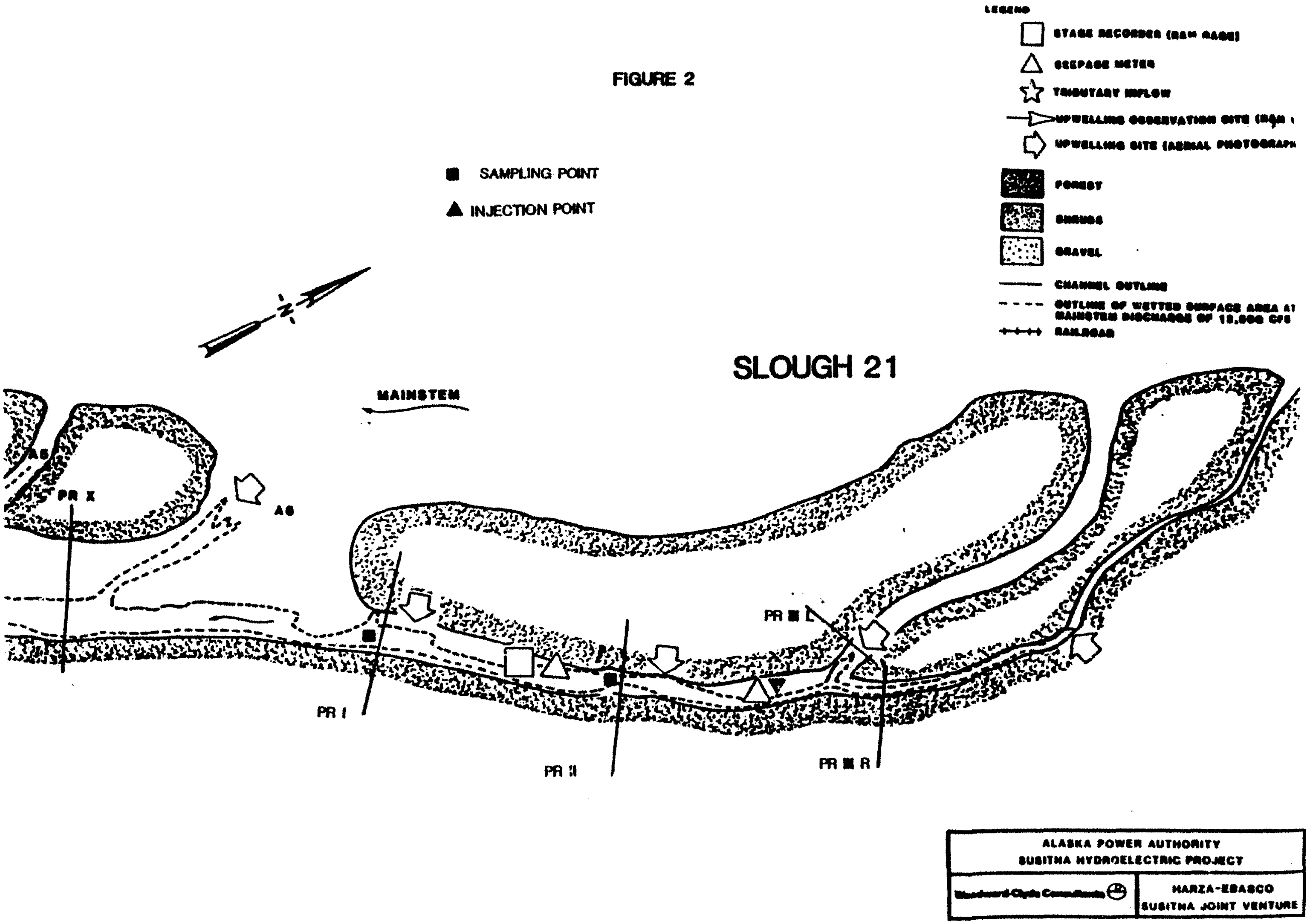

LEGEND
STAGE RECORDER (R&M GAGE)
SEEPAGE METER
TRIBUTARY INFLOW
UPWELLING OBSERVATION SITE
UPWELLING SITE (AERIAL PHOTOGRAPHS)
FOREST
SHRUBS
GRAVEL
CHANNEL OUTLINE
OUTLINE OF WETTED SURFACE AREA AT MAINSTEM DISCHARGE OF 12,500 CFS AT GOLD CREEK
RAILROAD
SAMPLING POINT
INJECTION POINT
MAINSTEM
SLOUGH 11
0
250
500
FEET
N
PR II
PR III
PR IV
PR V

FIGURE 2



LEGEND
STAGE RECORDER
SEEPAGE METER
TRIBUTARY INFLOW
FOREST
GRAVEL
CHANNEL OUTLINE
RAILROAD
SAMPLING POINT
INJECTION POINT
SLOUGH 21
MAINSTEM
A5
A6
PR X
PR I
PR II
PR III L
PR III R
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT
Woodward-Clyde Consultants
HARZA-EBASCO
SUSITNA JOINT VENTURE

Attachment 3 December, 1984

DYE STUDY PROPOSAL

At present the relationship between mainstem Susitna flows and side sloughs from groundwater sources is not well defined, especially at very low flows. Mainstem flow is very low at present, and has been that way for several weeks. It is not likely to get any lower in the near future, and is presently lower than expected from any with-project conditions. Residual stored groundwater is likely to be very low, as there has been very little input since August from precipitation or presumed lateral flow from the mainstem. The ice cover has not yet reached the upper middle reach. We believe that under these conditions the source of side slough water is limited mostly to underlying longitudinal groundwater flow.

If this study is performed in the immediate future, before conditions change, we can get the desired slough flow measurements. The data will be valuable in defining slough flows under worst case conditions for slough access by salmon. The data will also provide information on the relationship between the mainstem and side sloughs at very low flows. These conditions are liable to be altered in the near future due to the upstream movement of the ice front, with its' attendant stage increase.

The procedure involved would be to use a fluorometer and fluorescent tracer dye to measure flows in side sloughs 11 and 21, and if conditions permit, in slough 9. The fluorometric technique yields direct flow rate measurements to $\pm$ 2%. The technique uses a mass balance equation to obtain the flow rate:

$$C_1 F_1 = C_2 F_2$$

Where C_1 = concentration of dye pumped into the slough, C_2 = concentration of dye measured at the slough mouth, F_1 = flow rate (ml/min) from the pump, and F_2 = flow rate (cfs) mesured at the mouth of the slough. Dye is injected into the upstream end of the open water in a slough. Turbulent mixing of the dye and upwelled groundwater occurs downstream of this point. The concentration of the diluted dye is measured at the mouth of the slough with the fluorometer. Uniformity of the mixing at the slough mouth will be checked by making several measurements across the channel. Dye concentration and flow rate will be adjusted so that measurements at the slough mouth will be at least ten times above minimum detectability if slough flows were 10 cfs. Since the fluoresence of Rhodamine WT is related to temperature, all values will be normalized to 20°C using:

$$C_{20} = C_s E^{.026(Ts-20)}$$

WhereC_{20} = the dye concentration at 20°C, C_s = the dye concentration at ambient temperature, and T_s = the temperature of the sample.

In order to complete this study before the ice front moves into the area of concern, it is suggested that the field work be performed during the first week of December, 1984.

Approximate Budget

2 warm bodies for 2 days
5-6 hr. helicopter time (jet ranger)
transporation to Talkeetna (1/2 day for 2 people)
food and lodging in Talkeetna, 2 people for 2 days
office and lab time:

preparation	1 man day
analysis	1 man day
short report	2 man days

equipment rental	somehwat over $100.00
fluorometer, metering pump	(ref: Jack Colinell)
dye, batteries, glassware,	
sampling pump	

421431/12