JESS THIRD CONSULTANCY REPORT ON WATER QUALITY AND PUBLIC HEALTH ENGINEERING

JESS Report No. 15

Prepared by:

William R. Jobin, Sc.D.
Associates in Rural Development, Inc.
110 Main Street, Fourth Floor
P.O. Box 1397
Burlington, VT 05402
U.S.A.
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ACRONYMS AND ABBREVIATIONS

AID	U.S. Agency for International Development
ARD	Associates in Rural Development, Inc.
cumecs	cubic meters per second
DAP	disodium ammonium phosphate
EC	electrical conductivity
GSDR	Government of the Somali Democratic Republic
ha	hectare
JESS	Jubba Environmental and Socioeconomic Studies
JuDAS	Jubba Development Analytical Studies
MJVD	Ministry of Jubba Valley Development, GSDR
MOH	Ministry of Health, GSDR
MSL	mean sea level
NUS	National University of Somalia
PHC	Primary Health Care
UNHCR	United Nations High Commission for Refugees
UNICEF	United Nations Children's Fund
USAID	U.S. Agency for International Development
WHO	World Health Organization

PREFACE

The Jubba Environmental and Socioeconomic Studies (JESS) (number 649-0134) are jointly funded by the government of the Somali Democratic Republic (GSDR) and U.S. Agency for International Development (USAID). JESS is part of a larger project funded by AID and the GSDR, the Jubba Development Analytical Sudies (JuDAS) project. Technical assistance and JESS management are being provided to the Ministry of Jubba Valley Development (MJVD) by Associates in Rural Development, Inc. (ARD) of Burlington, Vermont, under AID contract number AFR-0134-C-00-5047-00. This report describes activities that occurred in the middle of Phase II of JESS, during an ARD consultancy by Dr. William R. Jobin of Blue Nile Associates.

Special thanks are given to faculty and staff of the Faculty of Chemistry, National University of Somalia; Professors Ali Worxame, Mohamed Abukar Ahmed, Abdel Ghaffar Abdel Allahi Sheikh and Bashir Musa for their assistance in collection and analysis of the water quality samples.

NOTES TO THE READER

For most readers, the Executive Summary should provide sufficient information. The body of the report is quite detailed and will be of interest primarily to those who are directly involved with JESS. The appendices provide a complete field and laboratory data record and are not intended for the casual reader. Table 1 provides typical values of selected water-quality parameters in the Jubba Valley as well as comparable norms for fresh water and salt water. Tables 2 and 3 indicate the maximum permissible concentrations of certain chemicals. This information will assist the reader in interpreting the data in the report.

Table 1. Typical Values of Selected Water Quality Parameters

Parameter	Minimum	Maximum	Normal Range for Fresh Water	Normal for Ocean
pH	5.0	9.0	7.5-8.5	
Conductivity (EC)	100	5,000	200-3,000	5,000
Salinity (%0)	0	40	0-1	40
Secchi depth (cm)	0	500	1-200	
Color units	1	20	2-5	
Turbidity units	1	500	1-200	
Chlorides (mg/l)	1.0	19,000	1-500	19,000
Sulfates as SO4 (mg/l)	1.0	200	1-50	
Nitrates as N (mg/l)	0.1	20	1-5	
Phosphates as P (mg/l)	.001	5	0.1-1	

Table 2. Standards for Drinking Water Relevant to Jubba River Valley

Contaminant	Units	Maximum Permissible Level
Arsenic	mg/L	0.05
Nitrate (as N)	"	10
Selenium	"	0.01
Methoxychlor insecticide	"	0.1
2,4-D herbicide	"	0.1
Turbidity	National Turbidity Units	1-5
Conductivity-EC_{25}	micromhos/cm	500 (1500 for camels)

Table 3. Standards for Agricultural Use

Parameters	Units	Degree of Restriction of Use: None	Slight to Moderate	Severe
EC	millimhos/cm	<.7	0.7-3	>3
TDS	mg/l	<450	450-2000	>2000
Sodium	SAR	<3	3-9	>9
Chloride	meq/L	<4	4-10	>10
Boron	mg/L	<0.7	0.7-2	>2

I. EXECUTIVE SUMMARY

This third consultancy for Phase II of JESS, in April 1987, was to assess the water quality problems encountered at the end of the long dry Jilaal season, and to monitor the first flushes of the Gu season flood near the proposed Baardheere Dam site. Aquatic habitats for mosquitos and snails in the agricultural systems were also surveyed.

By the end of March, flow in the lower Jubba River was zero at Kamsuma Bridge, Araare Bridge and downstream (see map, Figure 1). At the same time, maximum high tides occurred and drove ocean water upstream to Yontooy, creating the maximum sea water intrusion to be expected. Groundwater had become highly saline by that time, both from agricultural drainage between Fanoole Weir and the equator, and from extraction of the perched sweet water layer in the aquifer by community wells, especially around Jilib. Conductivity of the groundwater varied from 1,000 to 2,500 conductivity units (micromhos per centimeter), but infiltration flow rates were small, probably a few cubic meters per second (cumecs).

Conductivity of well water in Jilib rose to 1,450 units by early April, a value normally considered too salty even for camels. Shortly thereafter the Jubba River began to rise, but the initial flow was turbid and salty for at least the first two weeks. Local rains in the Jilib area were light, however, and people were forced to drink the salty well water in April. Thus, this was an unhealthy period because of excess salt and also because people were driven to use early rainwater collections in natural depressions. These were highly turbid and contaminated from accumulated organic material. By early May, the sweet water layer in the aquifer should be replenished from river infiltration, and the drinking water supplies should become more palatable.

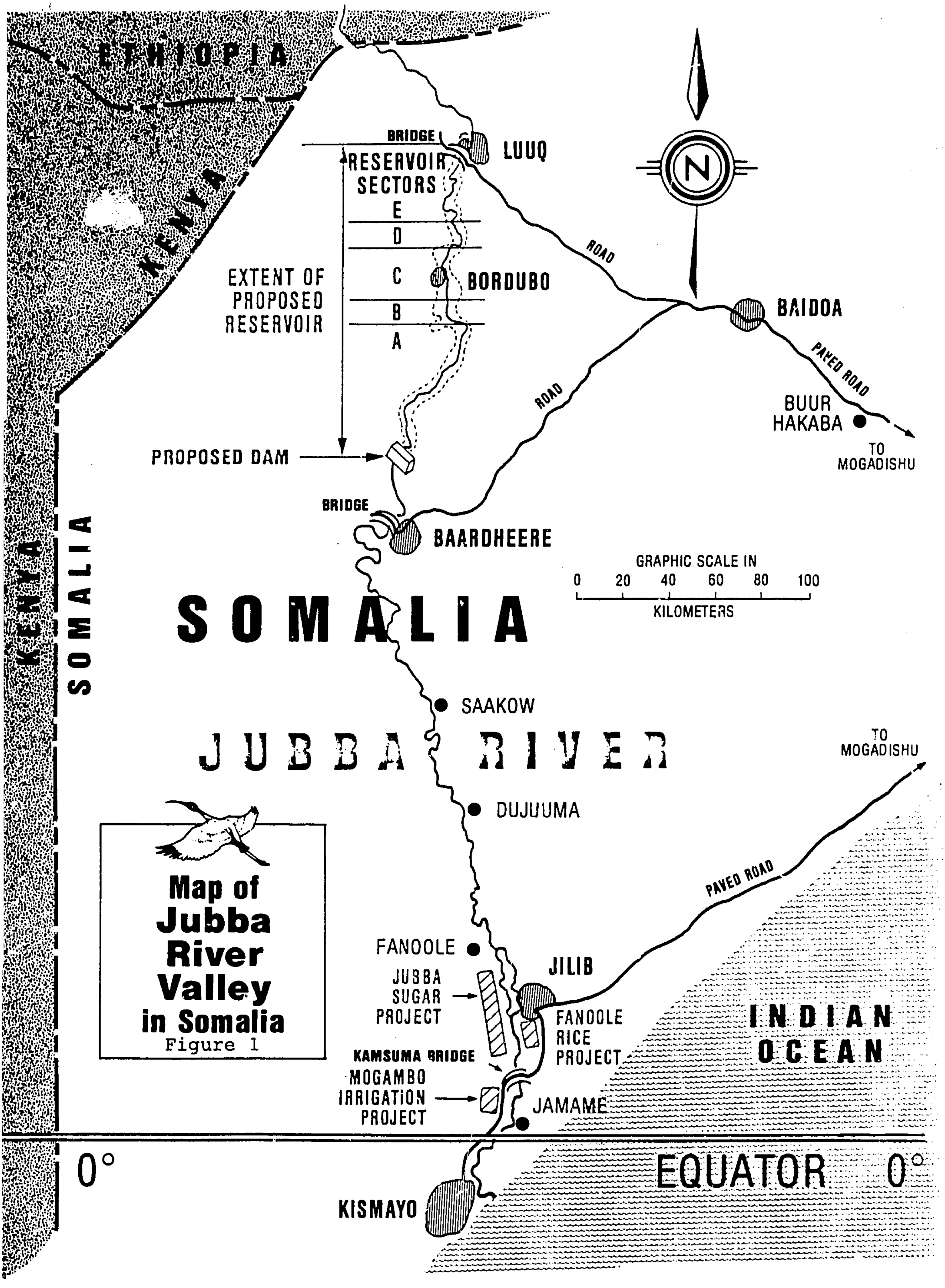
The water quality monitoring program with the National University of Somalia (NUS) continued to operate satisfactorily through April, and the last monthly sample series were taken during the latter part of May. Daily sampling in April showed that the travel time in the river from Baardheere to Jamaame was 13 days at low flow (less than 100 cumecs) and that the early flushes of salty water at the beginning of the Gu flood were of limited importance due to their short duration. The high concentrations of salt exceeded 1,000 units of conductivity, but seldom lasted more than a day and did not coincide with flow surges. The salt apparently came from localized storms, not from major runoff in the Ethiopian mountains.

Dhesheegs, seepage areas and virtually all natural waterbodies were dry in early April, with even the Jubba River reduced to disconnected pools below Fanoole Barrage. The occasional seepage areas in banana plantations around Jamaame were free of bilharzia snails. Fanoole Rice Scheme contained abundant water in canals, fields and drains, but no bilharzia snails were found in the system. Drainage water was very salty, reaching a conductivity of 2,400 units, exceeding limits for normal agricultural uses (Table 4).

Using Fanoole Main Canal as a simulation of the proposed impoundment behind Baardheere Dam, field tests indicated that highly turbid surface waters in the proposed reservoir at Baardheere would clarify to Secchi Disk readings of 100 centimeters within five to 10 days, although stagnant conditions could result in algae growth decreasing the clarity to 50 centimeters.

Malaria transmission was increasing significantly in Somalia even during the extremely dry conditions of 1986 and 1987. Normal transmission was magnified by resistance to chloroquine drugs developing in the parasite during 1986 and by an unfortunate shift of government strategy to a drug-based control effort through its nascent Primary Health Care System. Thus, severe malaria epidemics can be expected regularly in the future, especially after periods of heavy rain and flooding.

Negotiations were continued on possible health and vector surveys near the end of 1987. The schedule for development of the Master Plan for the valley indicates the desirability of completing the water quality and public health engineering reports by February 1988 when development of the Master Plan is to begin.



Map of Jubba River Valley in Somalia

Figure 1

II. INTRODUCTION

For readers not familiar with JESS, the long-range goals of the JESS program are to provide MJVD with necessary information on land use, natural resource utilization, social and environmental issues, staff training and technical support. The principal objective of JESS is to provide MJVD with information concerning implementation of a Master Plan for development of the Jubba Valley and to formulate guidelines and long-term monitoring systems that will improve the quality of development in the valley from environmental and socioeconomic perspectives.

This consultancy from 3 through 29 April 1987 was the fourth visit by the author to the JESS project in Somalia; however, it was the third and final field survey on water quality and public health engineering under Phase II of the JESS project.

The observations from this and three previous reports will be combined and presented in a final JESS Phase II report by the consultant. If the proposed epidemiological studies take place, the information from those studies will be incorporated into the consultant's Phase II final report. Further analysis of all of this information will take place during the third and final phase of JESS. Phase III will last three months and is scheduled to be completed by September 1988.

The major interest during this field survey was to monitor salt concentrations in water throughout the river valley, both at the end of the dry Jilaal season and during the early floods of the Gu season.

Fortunately, the field surveys coincided precisely with the beginning of the flood and the desired data were easily obtained. The Gu rains were light in April, but may increase later.

Because the Der rains failed in 1986, the dry season conditions in early April 1987 were extreme and gave reliable indications of worst-case conditions.

A sampling team collected samples three times per day throughout April at the Baardheere bridge. At the same time, another team made a field survey from Kismaayo up to Fanoole Barrage, and arrangements were made to obtain daily conductivity measurements from the Jubba Sugar Project at Mareerey. This system of simultaneous monitoring at three points along the river gave very valuable data for water quality predictions regarding both agricultural and domestic uses.

III. SALT INTRUSION FROM OCEAN

In late March, events combined to cause the maximum likely intrusion of ocean water at the mouth of the Jubba River. Littoral ocean currents had eliminated the sand bar usually blocking the river mouth. High tides of three and a half meters occurred on 28 and 29 March, at levels exceeding any seen in 1986 or 1987. Because the Der rains of 1986 had failed, the Jubba River flow had dwindled to a trickle by late March, and the riverbed was dry at the bridge crossings of Kamsuma, Jamaame, and downstream. The river was reduced to a series of disconnected pools which contained salty groundwater infiltrate, with a conductivity of about 2,000 units.

In the early evening of 28 March, the high tide drove ocean water upstream to Yontooy where it entered the intakes of the Kismaayo drinking water system. Slightly further upstream, at a pump one kilometer above Buulo Guduud, a tidal fluctuation was observed. However, the backed up water was not seawater, as it contained a conductivity of 1,350 units, which is typical of groundwater infiltrate. Also at Worcoy, 10 kilometers further upstream, a slight tidal fluctuation was seen but it was not ocean water. It was used for drinking by the people on the farm and thus was probably backed-up groundwater.

The maximum ocean intrusion to be expected on the river is to a point between Yontooy and Worcoy (see map). The river depth was quite shallow in this reach, only a fraction of a meter. Given the wide riverbed (200-500 meters), wind mixing would be strong and stratification not important. Even further down, at Gob Weyn, river depth does not exceed two meters.

IV. COMMUNITY WATER SUPPLIES

Evaluation of drinking water quality in Kismaayo, Jilib and Baardheere showed that the end of the dry season causes unhealthy conditions, with high concentrations of salts in subsurface waters as well as a reduction of surface waters to small, highly contaminated bodies. Due to the high turbidity and contamination of the local runoff as well as the salty nature of the first week or two of the Gu flood, these adverse conditions are not relieved until a few weeks after the onset of the rains. Thus, if the rains and flood are delayed into May, severe health hazards are created for the entire population in the Jubba Valley for several weeks.

As a result of intrusions of the ocean into the dry river channel, the Kismaayo Drinking Water System took in sea water on 28 March rendering tapwater in Kismaayo unfit for human consumption. The Gu river flood did not reach the Kismaayo intakes until 8 April and the flood flow was too salty and turbid to drink at that time. It was estimated that sweet water with a reasonable conductivity of 500 units would not be found in the Kismaayo system before late April 1987, resulting in almost a month without drinkable water. Shallow surface wells in Kismaayo were still sweet on 8 April, but were expected to yield increasing salinity by the following week.

By April 1987, there were two deep wells in Jilib and several shallow wells with hand pumps. Although normally sweet, the conductivity of all the Jilib wells rose sharply during the second week in April, reaching 1,450 units on 12 April as the normal sweet layer of water from the river became depleted. Although people drank the water, continued usage would cause physiological stress due to electrolytic imbalances in body fluids.

In Baardheere, the only source of drinking water is the river, as all wells are extremely salty the entire year. The dry weather flow had a conductivity of 300 to 400 units, and the first two weeks of the flood varied from 400 to 1,000 units. In addition to being salty, the flooding river was extremely turbid and discolored. Such turbidity prevents normal penetration of sunlight. Along with the high temperature and dissolved nutrients, the flood waters are thus an excellent medium for disease-causing bacteria and viruses. Therefore, people in the Baardheere region are also exposed to severe health risks from water-borne diseases for several weeks at the end of the Jilaal season, especially in years when the rains are delayed.

V. DRY SEASON INFILTRATION OF SALT TO RIVER

Conductivity of agricultural drainage water, seepage areas, riverine pools and wells in the lower valley indicated that groundwater conductivity rose to between 1,350 and 2,400 units by the end of the dry season in April, compared to between 300 and 500 units during the rainy season in June (Table 4).

Table 4. Conductivity of Drainage and Subsurface Waters in Lower Jubba Valley, April 1987

Site	Temperature in degrees C	Conductivity in standard units
Buulo Guduud Pond	32	1,350
Seepage at Worcoy	32	1,600
Well at Jilib	28	1,450
Fanoole Project:		
ricefield drain	32	2,400
main drain	31-33	2,100-2,250
drainage pump	32	2,000
irrigation ditch	32	1,500

VI. AQUATIC HABITATS IN AGRICULTURAL SYSTEMS

A brief survey of the agricultural systems from Fanoole Barrage down to Kismaayo showed that the effect of the prolonged drought was to virtually eliminate all waterbodies. The Mogambo and Jubba Sugar schemes could not be surveyed before the flood waters arrived, but the Fanoole Scheme and the Somalfruit banana plantations were thoroughly surveyed and were found to be similar to their condition in December 1986, as described in the previous consultancy report (see ARD Interim Report 11 of November 1986). No bilharzia snails were found in any of these systems. Seepage areas and standing waterbodies were virtually all dry and the large dhesheeg at kilometer 14 on the Fanoole Main Canal was completely dry, being grazed by cattle and goats.

VII. WATER QUALITY MONITORING

The cooperative arrangement with the Faculty of Chemistry at the National University of Somalia continued to operate very satisfactorily. The last monthly sampling series will be analyzed in late May 1987 and analyses should be completed in June. By the end of May, approximately 85 samples should be collected for full analysis (Table 5).

Table 5. Number of Samples Collected for Full Analysis by NUS Group for Jubba River, June 1986 to May 1987

Month	Sampling Runs	Stations	Samples Collected
June 1986	3	8	24
July	1	5	5
August	omitted*		
September	1	5	5
October	1	5	5
November	4	5	20
December	1	5	5
January 1987	1	5	5
February	omitted*		
March	1	5	5
April	4	1	4
May	1	5	5
TOTAL			83

* Vehicle shortages.

VIII. TRAVEL TIME IN JUBBA RIVER

In March, April and May, the time when the first Gu rains normally occur, sampling on the river was conducted simultaneously at Baardheere, Mareerey and the reach of river from Jamaame to the ocean, by coordinating two field crews and the daily monitoring by the Jubba Sugar Project. During the field surveys it was thus possible to catch the first flood of the Gu season as it passed Baardheere and then Jamaame. Spikes in conductivity were also monitored daily at Baardheere and Mareerey and this should add two or three measurements of the travel time along the river when the data are analyzed.

The first flood passed Baardheere bridge on 24 March and arrived at the bridge to Jamaame on 7 April, a travel time of 13 days. The gauge reading at Baardheere Bridge on 7 April was 0.60 meters, indicating a low discharge of 45 cumecs.

IX. CLARIFICATION RATE OF IMPOUNDED WATERS

A field experiment was arranged to simulate the conditions to be expected in the proposed Baardheere reservoir regarding natural clarification of the surface waters. This parameter is measured with a Secchi Disk and indicates the depth of the photic and illuminated shore zones, important determinants of the extent of suitable habitat for weeds, fish, mosquitos and snails.

Conditions in the Fanoole Main Canal on 12 April simulated the reservoir because the canal was full but the low flow of two to three cumecs caused low velocities of between one and five centimeters per second in most of the canal. Secchi Disk readings reached 100 centimeters, but algal growth reduced light penetration to 50 centimeters in the terminal section of the canal where the flow was stagnant (Table 6).

Table 6. Secchi Disk Readings in Fanoole Main Canal, April 1987

Canal Station in Kilometers	Secchi Disk in Centimeters
2	25
8	40
14	50
22	75
30	100
41	>100
45	50*

* Stagnant terminal portion of canal.

A subsequent experiment on 17 April, with water taken from the river at Baardheere, and placed in a 200-liter drum in a darkened room to avoid photosynthesis effects, showed that the Secchi Disk reading became greater than 75 centimeters in 13 days. The combined experiments indicate that the reservoir will normally have a photic zone of one meter, except during times of strong photosynthetic activity and very low velocities when the algal density may reduce the penetration of light to 0.5 meters.

X. FURTHER NEGOTIATIONS FOR HEALTH AND VECTOR SURVEYS

Pursuant to earlier proposals for epidemiological surveys as well as snail, mosquito and fly surveys originally made in Phase I of the JESS project, further negotiations were held with the following individuals working on health matters in Somalia, regarding a possible health survey in December and vector surveys the following year. A decision to proceed may be made by USAID in May, after which final arrangements can be made.

Dr. Caxmed Ali Siad - Malaria control, MOH
Dr. Gary Slutkin - USAID adviser to MOH on PHC
Madame Basra - Refugee Health Unit, MOH
Dr. Mariam Worxame - Faculty of Medicine, NUS

XI. MALARIA AND BILHARZIA OUTBREAKS

During the discussion with Ministry of Health and WHO personnel in Mogadishu, it was learned that the malaria control program is collapsing. This is primarily because of financial and policy restraints made worse by the development of parasite resistance to chloroquine, which WHO discovered in Somalia during 1986.

Because of shortages of fuel, the malaria program vehicles have not moved since the end of 1986. Thus, the only malaria control operations in the Jubba Valley have been passive case detection and treatment with chloroquine in six laboratories in the main towns. During this period, the slide positivity rate for malaria has been rising rapidly, despite the 1986-87 drought. The government's response to warnings from the malaria program has been to shift major responsibility to the Primary Health Care (PHC) system. The value of this for the Jubba Valley is limited since there are no government PHC posts in the valley. It is clear that severe malaria epidemics will be occurring in the Jubba Valley after every flood season, and no public health program exists to control them.

The same is true of the national program for bilharzia control, which also collapsed when the fuel rations were eliminated last year.

XII. PLANNING SCHEDULE

The primary value of these water quality and public health assessments produced under the JESS program will be in preparation of the Master Plan for the Jubba Valley. This task is entrusted to AHT of Germany, whose current schedule is:

Completion of data collection	October 1987
Define strategy for planning	January 1988
Begin elaboration of plan	February 1988
Complete Master Plan	December 1988

Thus, it is hoped that copies of all consultancy reports and interim reports in relation to water quality, public health and community water supplies can be delivered to AHT by October 1987. The final report on water quality and public health engineering will be completed in January or February 1988 and could thus be submitted before AHT begins its Master Plan.

APPENDIX A

Field Notes from Jubba Valley Somalia, April 1987

14 May 1987

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1. Ocean intrusion in Jubba River

Jilib - 9 April. River is flowing at about 1 m/s, maybe 1 m deep. Flood is said to have arrived about 5-7 April. Flood had reached Baardheere on 25 March as witnessed by Bashir Musa so travel time was about 12 days. During March, and up to at least April 3 the river at Jilib was a trickle covering 1/3 of channel, only ankle deep.

Kamsuma - On April 3 the gage at Kamsuma Bridge read 0.04 m, essentially zero flow. Peak flow came in about 6 April but was receding by 9 April when the gage at Kamsuma read 1.45 m. Flood water had been fairly clear until 8 April when it came in red.

Jamaame - On April 3 there was zero flow at Jamaame Bridge. On April 7 K.Craven saw flood come in at Jamaame Bridge at noon, a travel time of 13 days from Baardheere. She took sample of floodwater at 3 pm that day.

Kismayo - 9 April - Drinking water in Kismayo was very salty, undrinkable since 28 March when ocean reached intakes. High tide at ocean of 3.1 m occurred at 3 am on March 28. 3.4 m occurred at 1628 on Mar 29, and the maximum of 3.5 m occurred at 1659 on Mar 30, repeated on Mar 31 and April 1,2 and 3.

Yontooy - 9 April. Pump operator Abdi Mh'd Ismael for Kismayo Water Agency said they had adequate flow during February and March, although it was slightly salty (heavy) by mid-March. Thinks ocean intrusion came in 2.5 weeks ago (March 23). Fresh water from upstream came in 8 April. Kismayo pumps deliver 363 cu m/hr, 16 hrs/day and consume 4,000 liters/week of diesel fuel.

Buulo Gudud - 9 April. At Awalik Farm, located 6 km ds from Worcoy and 1 km us from B. Gudud, they said ocean water did not come up this year, nor has it ever come up in 7 years since the farm started. Water sample stored since April 4 showed salinity of 1% and EC of 1350 micromhos/cm.

Worcoy - 9 April. Farm mgr said they had tidal fluctuations in late March when bed went dry at low flow but flow returned from ds at high tide. At that time the water had been slightly salty but not ocean, they could drink it and they used it for crops. A banana drain near river showed EC of 1600. It contained clear water, lily pads and large ampullarid snails but no bilharzia snails.

2. Human and animal communities along waterbodies

During dry period in early April Fanoole Main Canal became a good example - a forerunner - of what will happen on edge of Baardheere reservoir. Villages are springing up along the canal. Huts appear at every bridge crossing. Camels, cows and goats are brought in during dry season. Also birds, monkeys, wart hogs and mule deer continually go to the canal. All steps and bridges along canal had high human contact with water.

3. Settling characteristics in Fanoole Main Canal

During early April the Fanoole Main Canal was a good settling basin to simulate conditions expected for Baardheere reservoir. Travel time from K0 to k40 was 5-10 days, assuming mean velocities of 5-10 cm/s.

4. Fanoole Scheme - general

11 April. Interview with Caxmed Ali Haji, agronomist and acting general manager for Fanoole Rice Scheme.

Flushing of salt in rice fields requires extra irrigation water. Application rate is 18,000-20,000 cu m/ha. This is probably per crop, and they usually double crop. Gu rice crop was sown on 21 Feb, 700 ha. It is 140 day rice, 5 months to harvest in late July. Der crop will be sown in August, 900 ha expected, to be harvested in January 1988. There is no fallow rotation, and no other crops are planted although a legume is being considered. Yield for Jan 1987 was 4.4 metric tons/ha. Area was 635 ha, giving 2,800 tons.
Rice seed is drilled, then light water applied until day 16 when field is dried and herbicides applied. At day 30 (for Gu season this is March 23, a week before rains) they flood field with 5-20 cm, continuing until day 115, about end of June. Sometimes the field may be drained temporarily during this season to make second application of herbicide. The field is then dried until harvest at day 140, late August. Urea fertilizer is applied to water. Thus there is continuous standing water maintained for 85 days during each crop, unless this is broken in two for second herbicide application.

Problems - weeds, lack of labor, bird pests and soil alkalinity. For weed control in ricefields they spray propanyl, MCPA and 2-4D. Chemicals are applied on dry ground by tractor sprayers at beginning of season, propanyl at 10 l/ha/crop. MCPA is applied at 1 l/ha/crop and 2-4D at 1 l/ha/crop. Weeds in canals and drains are also a problem and they use manual cutting. Labor shortage is acute during rainy season when there is competition from private farms.

5. Fanoole Scheme - alkaline soils

11 April - interview with Prof Hsieh at Fanoole lab in Jilib

Major problem is alkalinity, measured as ESP, Exchangeable Sodium Present. When sodium is greater than 0.1 meq/l in irrigation water, it causes trouble with soil.
However mean conductivity is ok, ranges from 200-600 micromhos/cm while limit for rice is 1000. When conductivity exceeds 1000 they divert water.

ESP = meq/100g of Na divided by meq/100g of cations (EC).

10-15	slightly alk soil	corrected in one year
15-20	strongly alk	two years
20+	alkalkine soil	three years

Basic solution to alkalinity problem is to use quick irrigation and quick drainage. After harvest they plow stalks back into soil. This technique has cleared up half of the problem areas already. It has yielded higher rice production than any other project. About 2,000 ha are good for rice in first and second development areas, and could be developed in next two years.

6. Fanoole Main Canal Survey

10 April W. Jobin, A/Gadir, A/Salaam
Meeting with Chief Dam Engineer A/Rahim
Main Canal is delivering 2-3 cu m/s although capacity is 33.5 cu m/s. Irrigating 600 ha now, adding 100 ha/yr with goal of 7,000 ha. Problems in ricefields are holding up expansion. Rice mill is operating. Dredging program underway in main canal. 8 km finished with goal of 16 km. River flow peaked 7-8 April but is dropping fast so they may have to stop generating again.

TABLE OF VECTOR HABITAT CONDITIONS IN FANOOLE MAIN CANAL

11 April

Km	time	tmp C	Secc cm	color	vel cm/s	EC	Vegetation	Snails	Animals
2	0945	32	25	brown	5	600	light reeds 5% cover	L,C+++	cattle crocs people birds
8	1000	31	40	brown	10	700	mrng glry 50% cover	L+++ C+++	camels sheep people
14	1030	30	50	br-gr	5	650	reeds,vines 80% cover	C	monkeys people
22	1100	30	75		2-5	700	pistia ceratoph reeds (dara) 50%	C	camels people
30	1130	31	100	green	2	1000	ceratph 10% cover	L,C	people
41	1200	32	100+	green		2100	light reeds 5% cover	L	depth 1.0 m
45	1630	32	50	green	0	1800	light reeds scum 5% cover	(end of flow)	

L = Lanistes   C = Cleopatra

7. Fanoole Drainage Survey

11 April -Main Drain starts 1 km West of km 44 on Main Canal

TABLE OF VECTOR HABITAT CONDITIONS IN FANOOLE DRAINAGES

Sta	time	tmp C	Secc cm	color	vel cm/s	EC	Vegetation	Snails	Animals
a. begin of main drain, 5m x 0.5 m, no rice in fields									
	1645	31	20	green	0	2100	none	L bivalve	egrets
b. first curve, drain 2m x 0.5m, rice about 20 cm high									
	1700	33	30	green	1	2250	none	L,C	S.Ibis
c. ricefield underdrain pipe of 25 cm dia, flowing 10 l/s									
	1710					2400			
d. old main drainage pump fore-bay. Pump off-friday. Rice is 20 cm high. 25% of fields have 10 cm water, rest dry.									
	1720	32	40		0	2000	bay is 1m+ deep, x 5m wide		
When pumps operating, discharge goes to swampy bank of river. New pumps half finished.									
e. primary irrig canal with 1:1 sides, 3m x 0.6m deep, feeds ricefields near pumping sta									
	1730	32	60+		20	1500	grasses on edges 10% cover		

LEGEND: L = LANISTES, C = CLEOPATRA

8. Master Plan Status - AHT

26 April - discussion with Heikko Brunken

a. AHT still favors development of dhesheks. Cost will be $1,500/ha compared to $15,000/ha for rice projects on marine plain. Dhesheks would need artificial flood during March and then August-September, normally the last month of the dry seasons. This conflicts seriously with hydrel need to store all water in case of low rains. I suggested it might be possible to flood dhesheks after rains instead of before, thus harmonizing with health needs for reservoir fluctuations.

b. Schedule for Master Plan . They want all input data by end Oct 87. From Oct 87-Jan 88 they will develop strategy for making Master Plan. From Feb 88-Dec 88 they will elaborate the Master Plan. Thus we should submit our interim reports and data records to AHT by end Oct 87, and our final report by Feb 88.

9. Community Water Supplies

12 April. The Jilib well near Fanoole canal was getting salty, with EC of 1450 at 28 C. This was a change from 2 or 3 days previously when it tasted fine. Also water at restaurant on main road had become salty. Apparently upper fresh water layer in aquifer was being depleted at this time.

10. National Malaria Control Program

26 April
Interview with Dr. Caxmed Ali Siad (Mire)

Dr Mire gave grim picture of malaria in Somalia. He said their monitoring is decreasing, spraying has stopped completely, drug resistance is spreading, and the positivity rate is climbing even in the last few years of drought. The MOH has no plan to deal with this crisis, except to turn responsibility for malaria control over to PHC system which will use passive case detection and treatment with chloroquine. They do not have Fansidar to treat resistant cases. DISASTER IS PREDICTED, SOON.

1979	118,000 blood slides were examined,	13% + (floods)
1983	70,000	4%
1985	45,000	9.6%

He has field labs in
- Baardheere (good L.Rover)
- Dujuuma
- Mareerey at JSP
- Jilib (pick-up)
- Jamaame (L.Rover needs tires, battery)
- Mogambo

He also has 6 microscopes in valley with 1-2 lab techs at each station. Maybe he could supply one extra person for each field lab from the Moq staff - but only for 10-15 days.

11. Planning for Health and Vector Surveys

14 April - Meeting with S.Patton, Gary Slutkin, Basra, Gus Tillman and K.Craven

I outlined plans for nutrition surveys in households, and schoolboy surveys for malaria and bilharzia in November-December 87, then vector surveys in June 88.

For cooperation on nutritional survey, Gary recommends contacting:
Dr. Xasim PS , to get Basra (tel 21248) and co-workers from RHU
Swedish Church Relief Dr. Ruut Abramson tel 22122
World Concern Dan Maxon tel 80184
Unicef - Chris Bentley, starting in Kismayo

Gary suggests measure anemia (haemaglobin) in 6-36 months old kids. We should operate out of PHC centers, utilizing CHW's for community arrangments. We should buy ($300) Hemocue digital display haemoglobin machine with disposable cuvettes ($0.75 each), from

Hemocue, sold by AB Leo Diagnostics, PO Box 941, S-251 09 Helsingborg, Sweden, telex 72533. (could WHO buy this for us?)

Next day S. Patton said go ahead on nutrition, household, mosquitos and snails, but hold on blackflies, tsetse flies and fecal exams, for decision at NAS meeting in Washington in May.

According to Jim Merrman there are 32 JESS sample villages plus 8 district towns. We might do households in villages and schools in towns.

Later talked to Dr. Mariam Warsame of Medical School who did epidemiology thesis on malaria, in Sweden. She would be available to assist after August.

APPENDIX B

Daily River Sampling Record from Baardheere, April 1987

Explanation of Column Heading

ATN	Sampling Statn (Baardheere Bridge)
MPLE NO.	Code: A = 6am, B = 12 noon, C = 6pm, Digit = day in April
EWS	Person code: See log card below for code
ALYSIS	Code: 1 = Daily sample
E DDMMYY	Day, Month, Year of Sample Collection
H	Weather code, see log card
N	Rain code, see log card
ER STAGE	Gage reading in cm at Baardheere Bridge
A IN	Date of Data entry
RIFY	Date Data file was checked
MICAL PARAMETERS	as noted

JUBBA RIVER COOPERATIVE STUDY ON WATER QUALITY IN SOMALIA

FIRST DIGIT IN PERSONNEL CODE - INSTITUTION

MINISTRY OF JUBBA VALLEY DEVELOPMENT	1
NUS - FACULTY OF CHEMISTRY	2
ASSOCIATES IN RURAL DEVELOPMENT - JESS	3
BLUE NILE ASSOCIATES - RUMFORD RIVER LABORATORIES	4

(SUPERVISORI) ANALYSIS DESIRED? ☐ 1-DAILY, 2-WEEKLY, 3-MONTHLY

OPTIONAL PROJECT CODE ☐☐☐☐☐

FIELD DATA

PERSONNEL CODE FOR FIELD CREW — INSTIT. PERSON — NAME ______

SAMPLE NO. ☐☐☐ SOURCE ______

STATION NO. ☐☐ – ☐☐ DESCRIPTION ______

COLLECTION TIME ☐☐☐☐ DATE D D M M Y Y ☐☐☐☐☐☐ pH ☐☐.☐

WATER TEMP ☐☐.☐ °C CONDUCTIVITY ☐☐☐☐ MS/CM SALINITY ☐☐ 0/00

SAMPLE DEPTH ☐☐.☐ M SECCHI DEPTH ☐☐.☐☐ M TOTAL DEPTH ☐☐.☐ M

WEATHER CODE ☐ 1 - CLEAR, 2 - LIGHT CLOUDS, 3 - HEAVY CLOUDS, 4 - RAIN

RAIN ON PREVIOUS DAY? ☐ 1 - YES, 2 - NO

TIDE CODE ☐ 1 - HIGH, 2 - LOW, 3 - EBB, 4 - FLOOD

RIVER STAGE READING AT ______ ☐☐☐

DATA PROCESSING

FILE NAME ______

DATES D D M M Y Y ENTERED ☐☐☐☐☐☐ VERIFIED ☐☐☐☐☐☐

PERSONNEL CODE INSTIT. PERSON — NAME ______

STATN	SAMPLE NO.	C R E W S FIELD	LAB	ANALY SIS	DATE DDMMYY	TIME	PROJECT
JR-08	A09	21.00	21.00	1	90487	600	JESS86
JR-08	B09	21.00	21.00	1	90487	1200	JESS86
JR-08	C09	21.00	21.00	1	90487	1800	JESS86
JR-08	A10	21.00	21.00	1	100487	600	JESS86
JR-08	B10	21.00	21.00	1	100487	1200	JESS86
JR-08	C10	21.00	21.00	1	100487	1800	JESS86
JR-08	A11	21.00	21.00	1	110487	600	JESS86
JR-08	B11	21.00	21.00	1	110487	1200	JESS86
JR-08	C11	21.00	21.00	1	110487	1800	JESS86
JR-08	A12	21.00	21.00	1	120487	600	JESS86
JR-08	B12	21.00	21.00	1	120487	1200	JESS86
JR-08	C12	21.00	21.00	1	120487	1800	JESS86
JR-08	A13	21.00	21.00	1	130487	600	JESS86
JR-08	B13	21.00	21.00	1	130487	1200	JESS86
JR-08	C13	21.00	21.00	1	130487	1800	JESS86
JR-08	A14	21.00	21.00	1	140487	600	JESS86
JR-08	B14	21.00	21.00	1	140487	1200	JESS86
JR-08	C14	21.00	21.00	1	140487	1800	JESS86
JR-08	A15	21.00	21.00	1	150487	600	JESS86
JR-08	B15	21.00	21.00	1	150487	1200	JESS86
JR-08	C15	21.23	21.23	1	150487	1800	JESS86
JR-08	A16	23.21	23.21	1	160487	600	JESS86
JR-08	B16	23.00	23.00	1	160487	1200	JESS86
JR-08	C16	23.00	23.00	1	160487	1800	JESS86
JR-08	A17	23.00	23.00	1	170487	600	JESS86
JR-08	B17	23.00	23.00	1	170487	1200	JESS86
JR-08	C17	23.00	23.00	1	170487	1800	JESS86
JR-08	A18	23.00	23.00	1	180487	600	JESS86
JR-08	B18	23.00	23.00	1	180487	1200	JESS86
JR-08	C18	23.00	23.00	1	180487	1800	JESS86
JR-08	A19	23.00	23.00	1	190487	600	JESS86
JR-08	B19	23.00	23.00	1	190487	1200	JESS86
JR-08	C19	23.00	23.00	1	190487	1800	JESS86
JR-08	A20	23.00	23.00	1	200487	600	JESS86

STATN	SAMPLE NO.	CREWS FIELD	CREWS LAB	ANALYSIS	DATE DDMMYY	TIME	PROJECT
JR-08	B20	23.00	23.00	1	200487	1200	JESS86
JR-08	C20	23.00	23.00	1	200487	1800	JESS86
JR-08	A21	23.00	23.00	1	210487	600	JESS86
JR-08	B21	23.00	23.00	1	210487	1200	JESS86
JR-08	C21	23.00	23.00	1	210487	1800	JESS86
JR-08	A22	23.21	23.21	1	220487	600	JESS86
JR-08	B22	23.21	23.21	1	220487	1200	JESS86
JR-08	C22	23.21	23.21	1	220487	1800	JESS86
JR-08	A23	21.23	21.23	1	230487	600	JESS86
JR-08	B23	21.00	21.00	1	230487	1200	JESS86
JR-08	C23	21.00	21.00	1	230487	1800	JESS86
JR-08	A24	21.00	21.00	1	240487	600	JESS86
JR-08	B24	21.00	21.00	1	240487	1200	JESS86
JR-08	C24	21.00	21.00	1	240487	1800	JESS86
JR-08	A25	21.00	21.00	1	250487	600	JESS86
JR-08	B25	21.00	21.00	1	250487	1200	JESS86
JR-08	C25	21.00	21.00	1	250487	1800	JESS86
JR-08	A26	21.00	21.00	1	260487	600	JESS86
JR-08	B26	21.00	21.00	1	260487	1200	JESS86
JR-08	C26	21.00	21.00	1	260487	1800	JESS86
JR-08	A27	21.00	21.00	1	270487	600	JESS86
JR-08	B27	21.00	21.00	1	270487	1200	JESS86
JR-08	C27	21.00	21.00	1	270487	1800	JESS86
JR-08	A28	21.00	21.00	1	280487	600	JESS86
JR-08	B28	21.00	21.00	1	280487	1200	JESS86
JR-08	C28	21.00	21.00	1	280487	1800	JESS86
JR-08	A29	21.00	21.00	1	290487	600	JESS86
JR-08	B29	21.00	21.00	1	290487	1200	JESS86
JR-08	C29	21.00	21.00	1	290487	1800	JESS86

SAMPL	WE TH	RA IN	TI DE	RIVER STAGE	DATA IN DDMMYY	VERIFY DDMMYY	FIELD PH	TEMP DEG
A09	3	2		60	150587	180587		29.8
B09	2	2		60	150587	180587		31.0
C09	1	2		60	150587	180587		32.5
A10	1	2		75	150587	180587		30.0
B10	1	2		80	150587	180587		33.0
C10	3	2		85	150587	180587		32.7
A11	1	2		85	150587	180587		30.3
B11	2	2		80	150587	180587		31.0
C11	1	2		78	150587	180587		32.7
A12	2	2		80	150587	180587		30.5
B12	1	2		85	150587	180587		31.0
C12	2	2		88	150587	180587		32.5
A13	1	2		95	150587	180587		30.0
B13	2	2		90	150587	180587		31.5
C13	1	2		94	150587	180587		32.7
A14	2	2		94	150587	180587		30.0
B14	1	2		94	150587	180587		31.3
C14	1	2		94	150587	180587		32.3
A15	1	2		88	150587	180587		29.5
B15	1	2		95	150587	180587		31.0
C15	1	2		94	150587	180587		32.3
A16	1	2		136	150587	180587		30.6
B16	1	2		150	150587	180587		31.5
C16	1	2		153	150587	180587		32.2
A17	1	2		162	150587	180587		30.5
B17	1	2		165	150587	180587		31.2
C17	2	2		168	150587	180587		31.7
A18	1	2		168	150587	180587		30.2
B18	1	2		166	150587	180587		31.2
C18	2	2		165	150587	180587		32.2
A19	1	2		164	150587	180587		30.4
B19	2	2		164	150587	180587		31.8
C19	1	2		165	150587	180587		31.5
A20	3	2		168	150587	180587		30.9

SAMPL	WE TH	RA IN	RIVER STAGE	DATA IN DDMMYY	VERIFY DDMMYY	FIELD PH	TEMP DEG
B20	2	2	180	150587	180587		31.5
C20	2	2	200	150587	180587		31.2
A21	2	2	218	150587	180587		30.5
B21	1	2	218	150587	180587		31.2
C21	1	2	208	150587	180587		31.3
A22			194	230687	250687	7.90	30.6
B22			192	230687	250687	7.95	31.1
C22			192	230687	250687	7.80	31.8
A23			195	230687	250687	7.70	30.0
B23			190	230687	250687	7.95	31.2
C23			185	230687	250687	7.90	31.8
A24			175	230687	250687	7.75	30.5
B24			170	230687	250687	7.80	31.5
C24			165	230687	250687	7.65	31.8
A25			162	230687	250687	8.60	30.4
B25			160	230687	250687	7.80	31.0
C25			160	230687	250687	7.60	31.5
A26			155	230687	250687	7.70	30.4
B26			150	230687	250687	7.40	31.2
C26			146	230687	250687	7.40	31.8
A27			145	230687	250687	7.60	30.0
B27			140	230687	250687	7.50	31.3
C27			140	230687	250687	7.60	31.5
A28			145	230687	250687	8.10	30.0
B28			150	230687	250687	8.05	30.6
C28			150	230687	250687	8.00	31.2
A29			150	230687	250687	7.35	30.0
B29			150	230687	250687	7.40	31.2
C29			150	230687	250687	7.80	30.6

SMPL	FIELD CONDUCT	SETTL SOLIDS ML/L	CHLORIDE MG/L	T HARD AS CACO3 MG/L	CALCIUM MG/L	MAGNESM MG/L
A09	450	.1	39.63	311	38	52
B09	449	.5	38.92	176	41	18
C09	480	.3	48.39	161	44	12
A10	489	.3	47.68	149	43	10
B10	472	.4	47.68	168	37	18
C10	466	.6	46.62	176	45	16
A11	476	.5	41.90	157	44	12
B11	463	.3	40.16	202	46	21
C11	462	.5	45.94	168	39	17
A12	513	.6	68.10	180	42	18
B12	471	.6	50.13	172	41	17
C12	443	.5	37.54	149	36	14
A13	521	5.5	57.64	157	55	5
B13	612	1.0	66.36	199	51	18
C13	724	2.5	58.85	281	51	37
A14	702	1.7		314	66	36
B14	617	1.1	51.86	183	51	14
C14	540	.7		199	57	14
A15	438	.6	40.16	152	47	8
B15	402	.4	31.44	140	29	15
C15	398	.4	34.92	101	32	5
A16	412	.7	39.28	146	52	4
B16	1083	1.3	190.33	253	83	11
C16	1173	1.4	213.05	281	70	26
A17	443	1.6	50.66	146	45	8
B17	393	1.4	33.18	146	45	8
C17	669	1.6	103.02	146	43	10
A18	579	2.5	73.35	123	29	12
B18	487	1.8	55.87	180	54	11
C18	416	1.7	38.43	123	36	8
A19	377	2.0	27.93	135	41	8
B19	336	1.5	26.16		32	
C19	330	2.1	24.46		36	
A20	323	1.6	22.69		40	

SMPL	FIELD CONDUCT	SETTL SOLIDS ML/L	CHLORIDE MG/L	T HARD AS CACO3 MG/L	CALCIUM MG/L	MAGNESIUM MG/L
B20	268	1.4	20.95		36	
C20	264	1.4	19.21		45	
A21	275	1.3	19.21		36	
B21	316	2.0				
C21	280	2.2				
A22	240	2.5				
B22	242	2.5				
C22	243	2.4				
A23	239	2.6	11.03			
B23	239	2.5	10.64			
C23	240	2.5	9.97			
A24	242	2.2	10.64			
B24	537	3.0	68.46			
C24	603	3.3	72.32			
A25	382	2.5	20.56			
B25	356	2.8	19.85			
C25	329	2.8	15.95			
A26	318	2.4	15.60			
B26	316	2.0	12.41			
C26	313	2.0	13.47			
A27	301	1.2	12.41			
B27	294	1.0	12.05			
C27	278	1.0	12.05			
A28	301	.8	13.47			
B28	302	1.0	13.83			
C28	284	1.3	11.34			
A29	301	.9	13.47			
B29	297	.8	13.83			
C29	278	1.0	12.41			

APPENDIX C

Tides at Kismaayo, 1987

DATE	DAY	TIME	METERS
MAR 27	FRI	0249	2.9
		0910	0.2
		1522	2.8
		2119	0.2
MAR 28	SAT	0331	3.1
		0942	-0.1
		1556	3.1
		2157	0.0
MAR 29	SUN	0407	3.3
		1013	-0.2
		1628	3.4
		2233	-0.2
MAR 30	MON	0440	3.3
		1042	-0.3
		1659	3.5
		2305	-0.2
MAR 31	TUE	0512	3.2
		1111	-0.3
		1730	3.5
		2337	-0.1
APR 1	WED	0542	3.1
		1139	-0.2
		1800	3.4
APR 2	THU	0008	0.0
		0608	2.9
		1205	0.0
		1828	3.2
APR 3	FRI	0038	0.2
		0635	2.6
		1231	0.2
		1856	3.4
APR 4	SAT	0110	0.5
		0702	2.3
		1257	0.5
		1927	2.7
APR 5	SUN	0145	0.8
		0730	2.1
		1325	0.7
		2005	2.4
APR 6	MON	0230	1.1
		0811	1.8
		1402	1.0
		2105	2.2

APR	7	TUE	0427	1.3
			1014	1.6
			1529	1.3
			2334	2.1

Tides on following page -- May to August 1986

AFRICA, EAST COAST - KILINDINI

LAT 4°04'S LONG 39°39'E

TIME ZONE -0300

TIMES AND HEIGHTS OF HIGH AND LOW WATERS

YEAR 1986

MAY

Day	TIME	M	Day	TIME	M
1 TH	0317	1.1	16 F	0229	1.1
	0935	2.3		0834	2.3
	1519	1.4		1420	1.3
	2212	2.6		2053	2.7
2 F	0502	1.3	17 SA	0341	1.2
	1130	2.3		0957	2.3
	1732	1.4		1548	1.5
	2358	2.6		2219	2.5
3 SA	0639	1.2	18 SU	0506	1.2
	1307	2.5		1147	2.4
	1909	1.3		1737	1.5
				2358	2.6
4 SU	0123	2.7	19 M	0622	1.1
	0742	1.0		1256	2.7
	1405	2.8		1903	1.2
	2009	1.0			
5 M	0219	2.8	20 TU	0109	2.7
	0826	0.8		0720	0.9
	1447	3.1		1347	3.0
	2054	0.8		1959	0.9
6 TU	0303	3.0	21 W	0205	2.9
	0900	0.7		0806	0.7
	1522	3.4		1432	3.4
	2129	0.6		2047	0.6
7 W	0341	3.0	22 TH	0254	3.0
	0931	0.6		0847	0.5
	1555	3.5		1512	3.7
	2200	0.5		2129	0.3
8 TH	0412	3.1	23 F	0339	3.1
	0957	0.6		0928	0.4
	1621	3.6		1553	3.8
	[illegible]	[illegible]		O 2212	0.2
9 F	0440	3.0	24 SA	0423	3.1
	1024	0.5		1009	0.3
	1645	3.6		1635	3.9
	2258	0.4		2254	0.1
10 SA	0505	3.0	25 SU	0505	3.1
	1051	0.6		1049	0.3
	1709	3.5		1718	3.9
	2326	0.4		2336	0.2
11 SU	0529	2.9	26 M	0547	3.0
	1116	0.6		1132	0.4
	1734	3.5		1801	3.7
	2354	0.5			
12 M	0556	2.8	27 TU	0021	0.3
	1144	0.7		0632	2.9
	1803	3.4		1217	0.5
				1848	3.5
13 TU	0024	0.6	28 W	0109	[illegible]
	0625	2.7		0721	2.8
	1214	0.8		1306	0.8
	1834	3.2		1940	3.2
14 W	0057	0.8	29 TH	0202	0.7
	0659	2.6		0818	2.6
	1248	1.0		1405	1.0
	1910	3.0		2037	2.9
15 TH	0137	0.9	30 F	0304	0.9
	0740	2.5		0927	2.5
	1327	1.2		1519	1.2
	1954	2.8		2148	2.7
			31 SA	0416	1.1
				1048	2.5
				1652	1.3
				2308	2.5

JUNE

Day	TIME	M	Day	TIME	M
1 SU	0532	1.1	16 M	0402	1.0
	1208	2.7		1041	2.7
	1825	1.3		1644	1.3
				2255	2.5
2 M	0027	2.5	17 TU	0508	1.0
	0641	1.1		1151	2.8
	1313	2.9		1810	1.1
	1934	1.1			
3 TU	0134	2.6	18 W	0014	2.5
	0734	1.0		0614	0.9
	1405	3.0		1253	3.1
	2023	0.9		1921	0.9
4 W	0229	2.6	19 TH	0123	2.6
	0818	0.9		0717	0.8
	1446	3.2		1349	3.3
	2104	0.8		2020	0.7
5 TH	0311	2.7	20 F	0225	2.7
	0856	0.8		0813	0.7
	1519	3.3		1443	3.5
	2139	0.6		2112	0.4
6 F	0346	2.7	21 SA	0321	2.8
	0929	0.8		0905	0.6
	1550	3.4		1535	3.7
	2210	0.5		2200	0.3
7 SA	0417	2.8	22 SU	0412	2.9
	1000	0.7		0953	0.5
	1620	3.4		1624	3.8
	● 2241	0.5		O 2245	0.2
8 SU	0445	2.8	23 M	0458	2.9
	1031	0.7		1041	0.4
	1649	3.4		1712	3.8
	2312	0.5		2330	0.2
9 M	0515	2.8	24 TU	0543	3.0
	1101	0.7		1126	0.4
	1720	3.4		1757	3.7
	2343	0.5			
10 TU	0546	2.8	25 W	0014	0.3
	1132	0.7		0628	3.0
	1753	3.3		1212	0.5
				1843	3.5
11 W	0015	0.6	26 TH	0057	0.4
	0618	2.7		0714	3.0
	1205	0.8		1300	0.6
	1827	3.2		1928	3.3
12 TH	0050	0.7	27 F	0142	0.5
	0655	2.7		0804	2.9
	1243	0.9		1352	0.8
	1903	3.1		2015	3.0
13 F	0128	0.8	28 SA	0229	0.7
	0737	2.6		0857	2.8
	1324	1.0		1451	1.0
	1945	3.0		2107	2.8
14 SA	0212	0.8	29 SU	0319	0.9
	0826	2.6		0957	2.8
	1416	1.2		1600	1.2
	2033	2.8		2207	2.5
15 SU	0303	0.9	30 M	0416	1.0
	0928	2.6		1105	2.7
	1521	1.3		[illegible]	1.3
	2136	2.7		[illegible]	2.3

JULY

Day	TIME	M	Day	TIME	M
1 TU	0519	1.1	16 W	0404	0.9
	1212	2.8		1057	2.9
	1848	1.2		1725	1.1
				2326	2.3
2 W	0041	2.3	17 TH	0516	1.0
	0631	1.2		1211	3.0
	1314	2.8		1853	1.0
	1952	1.1			
3 TH	0152	2.3	18 F	0052	2.3
	0735	1.1		0639	1.0
	1406	2.9		1324	3.1
	2042	0.9		2008	0.8
4 F	0246	2.4	19 SA	0213	2.4
	0826	1.1		0758	0.9
	1450	3.0		1433	3.3
	2121	0.8		2107	0.6
5 SA	0327	2.5	20 SU	0318	2.6
	0908	1.0		0900	0.7
	1528	3.1		1531	3.5
	2157	0.6		2157	0.4
6 SU	0400	2.6	21 M	0409	2.8
	0945	0.9		0950	0.5
	1603	3.2		1621	3.7
	2230	0.5		O 2241	0.2
7 M	0433	2.7	22 TU	0454	3.0
	1019	0.8		1037	0.4
	1637	3.3		1706	3.7
	● 2302	3.5		2320	0.2
8 TU	0505	2.8	23 W	0536	3.1
	1051	0.7		1120	0.3
	1711	3.4		1749	3.7
	2333	0.5		2358	0.2
9 W	0537	2.8	24 TH	0615	3.2
	1125	0.7		1201	0.4
	1744	3.4		1827	3.6
10 TH	0004	0.5	25 F	0034	0.2
	0611	2.9		0655	3.2
	1158	0.7		1243	0.5
	1818	3.3		1904	3.4
11 F	0036	0.5	26 SA	0110	0.3
	0646	2.9		0734	3.2
	1234	0.7		1326	0.7
	1852	3.3		1941	3.1
12 SA	0109	0.5	27 SU	0145	0.5
	0723	2.9		0815	3.1
	1313	0.8		1412	0.9
	1927	3.1		2019	2.8
13 SU	0145	0.6	28 M	0223	0.7
	0804	2.9		0858	2.9
	1358	0.9		1505	1.1
	2008	2.9		2103	2.5
14 M	0223	0.7	29 TU	0305	1.0
	0850	2.9		0950	2.8
	1450	1.0		1612	1.3
	2057	2.7		2200	2.2
15 TU	0308	0.8	30 W	0400	1.2
	0948	2.9		1101	2.6
	1559	1.1		1742	1.3
	2203	2.5		2339	2.0
			31 TH	0519	1.3
				1224	2.6
				1920	1.2

AUGUST

Day	TIME	M	Day	TIME	M
1 F	0121	2.1	16 SA	0049	2.1
	0656	1.4		0635	1.2
	1335	2.7		1323	2.9
	2026	1.1		2011	0.9
2 SA	0229	2.2	17 SU	0222	2.4
	0808	1.2		0804	1.0
	1430	2.8		1437	3.2
	2111	0.9		2107	0.6
3 SU	0312	2.4	18 M	0318	2.7
	0857	1.1		0903	0.7
	1514	3.0		1531	3.5
	2146	0.7		2152	0.4
4 M	0348	2.6	19 TU	0403	3.0
	0935	0.9		0949	0.4
	1550	3.2		1616	3.6
	2219	0.6		O 2228	0.2
5 TU	0420	2.7	20 W	0442	3.2
	1007	0.7		1030	0.3
	1626	3.4		1655	3.7
	● 2247	0.4		2302	0.1
6 W	0451	2.9	21 TH	0518	3.4
	1040	0.6		1105	0.2
	1558	3.5		1730	3.7
	2315	0.3		2332	0.1
7 TH	0523	3.0	22 F	0551	3.5
	1111	0.5		1143	0.2
	1730	3.5		1803	3.6
	2342	0.3			
8 F	0554	3.2	23 SA	0001	0.2
	1143	0.5		0624	3.5
	1801	3.5		1218	0.3
				1832	3.3
9 SA	0010	0.3	24 SU	0032	0.3
	0625	3.2		0655	3.4
	1217	0.5		1253	0.5
	1832	3.4		1902	3.1
10 SU	0039	0.3	25 M	0102	0.5
	0657	3.3		0726	3.3
	1253	0.6		1331	0.7
	1903	3.2		1933	2.8
11 M	0112	0.4	26 TU	0131	0.7
	0731	3.2		0758	3.0
	1334	0.7		1411	1.0
	1940	2.9		2005	2.5
12 TU	0145	0.6	27 W	0202	1.0
	0811	3.1		0836	2.8
	1419	0.8		1501	1.2
	2020	2.7		2049	2.2
13 W	0223	0.8	28 TH	0239	1.2
	0900	3.0		0929	2.5
	1518	1.0		1626	1.4
	2118	2.4		2204	1.9
14 TH	0312	1.0	29 F	0353	1.5
	1010	2.8		1122	2.4
	1648	1.2		1846	1.4
	2251	2.1			
15 F	0434	1.2	30 SA	0100	1.9
	1144	2.8		0628	1.6
	1846	1.1		1313	2.4
				2015	1.2
			31 SU	0220	2.2
				0801	1.4
				1416	2.7
				2057	1.0

APPENDIX D

SCOPE OF WORK -- WILLIAM JOBIN -- JESS PHASE II

1. The contractor will conduct a consultancy in Somalia of up to six weeks during April and May 1987 and complete analyses for Associates in Rural Development, Inc. (ARD) during June through December of 1987.

2. The general objectives of this consultancy will be to complete work in relation to JESS studies of water quality, community water supply and sanitation, vector habitats in agricultural schemes, and the use of pesticides or biocides in development activities.

3. Prior to departure for Somalia, the consultant will hold a telephone briefing with ARD project manager Richard Donovan or his duly appointed representative.

4. Upon arrival in Somalia, the consultant will hold briefing meetings with USAID project manager Sally Patton and JESS chief of party Gus Tillman to discuss the consultant's scope of work. At these meetings, a means of progress reporting during the consultancies will be defined.

5. The consultant will complete water quality-related data collection (including pesticides and fertilizers) and analyses. Analyses will include completion and presentation of water quality models for the Jubba River and suggestions for long-term water quality monitoring of developments in the Jubba Valley.

6. The consultant will complete the collection and analysis of data for agriculture-related health studies. The analysis will include the completion and presentation of disease models based on available secondary data on health conditions and in relation to proposed and/or existing agricultural schemes in the Jubba Valley.

7. Based on previous inspections of major and minor towns in the Jubba Valley, the consultant will describe options for community water supply and sanitation in existing or potential (or proposed) settlements in the Jubba Valley.

8. While in Somalia, and using #5-7 above as a basis, the consultant should discuss with the JESS chief of party and ARD project manager the specific issues and elements relating to each topic (water quality, agricultural crops and diseases, and community water supply and sanitation) and how they should be discussed in the consultant's final Phase II report (described below).

Jobin SOW, Continued

9. A draft typewritten or word-processed trip report for the field work component of this consultancy should be delivered to the JESS chief of party one full day before departure from Somalia. This report should be written in a format that meets guidelines which the consultant should obtain from the JESS chief of party. This report will be the basis for a final briefing with the USAID project manager, JESS chief of party and project personnel from MJVD. Revisions to the trip report should be completed within two weeks after the consultant's return to the United States and delivered to the ARD home office in Burlington, Vermont.

10. Based on the field work conducted in Somalia during this and other previous consultancies, the consultant will complete a final Phase II report after ensuing analyses take place back in the U.S. An outline for this final Phase II report should be prepared by the consultant and approved by the JESS project manager. The draft final report should be completed by November 15, 1987, and delivered to the ARD home office in Burlington, Vermont, for review at ARD/Burlington and by the JESS field team in Somalia. This final Phase II report will address the following topics:

- water quality,
- agricultural crops and diseases, and
- community water supply and sanitation.

Within two weeks of receipt of comments from ARD/Burlington and the JESS team in Somalia, a revised final report should be delivered to ARD in Burlington.

11. The consultant may be required to present a training seminar near the end of the field work in Somalia on a topic related to this consultancy as determined by the JESS chief of party.

12. A final briefing will be required at the ARD home office in Burlington, Vermont.