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**Supplemental Report  
on the Removal and  
Disposal of Sediment & Debris  
at  
Roseires Dam Powerplant Intake  
on the  
Blue Nile in Sudan**

**September 1983**

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

CONTENTS

	<u>Page</u>
Introduction.....	1
Field Review.....	2
Related Items Observed.....	8
Recommendations. ..	12

Appendix

Memo on Meeting With Sir Alexander Gibb and Partners.....	A
Memo on Meeting With Chevron Oil Company of Sudan.....	B
Memo on Meeting With Royal Netherlands Embassy and DEMAS... C	
Memo on Meeting with ARKEL-Talab Cargo Services, Ltd.....	D
Memo on Closeout Meeting at Ministry of Agriculture & Irrigation ...	E

References

- October 1980 Report by Nelson and Blanton, Bureau of Reclamation,  
Denver
- October 1981 Report by Pemberton, Bureau of Reclamation, Denver,  
and Heineman, Corps of Engineers, Portland

SUPPLEMENTAL REPORT ON THE REMOVAL  
AND DISPOSAL OF SEDIMENT AND DEBRIS  
AT ROSEIRES DAM POWERPLANT INTAKE  
ON THE BLUE NILE IN SUDAN

INTRODUCTION

This is a supplement to the reports prepared in 1980 and 1981 to develop a plan of action to improve conditions in the vicinity of the powerplant intakes at Roseires Dam

The mission was undertaken at the request of AID/Washington following a request from the American Embassy in Khartoum. A crisis had developed in the Blue Nile grid, primarily as a result of plugging of the intakes of Roseires powerplant. Request was for travel to Sudan on immediate basis to recommend emergency measures which might be undertaken with locally available equipment pending arrival of the Commodity Import Program financed dredging equipment currently under construction in the United States. The Sudan Minister of Agriculture and Irrigation indicated fears that there will be only limited use of the new equipment prior to the 1984 flood season

After review of the matter with Bureau of Reclamation representatives in Denver (Mr Pemberton has retired), and Mr Keith Lawrence, Marine Design Division, Philadelphia, it was determined that Adam Heineman would make the trip as soon as possible. Mr. Heineman arrived at Khartoum 9 September 1983, and after making the initial contacts in USAID/Sudan traveled to Damazin by charter aircraft on 11 September accompanied by Mr. Jay Carter, Energy Advisor for USAID in Sudan.

## FIELD REVIEW

1. Great concern has been expressed by the National Electricity Corporation (NEC) regarding the delay in construction and delivery of the 4 cubic yard grab dredge and associated equipment which is expected to alleviate the shoaling problems at Roseires Dam. The current scheduled delivery date at POE (New Orleans) is 24 November, 1983, a delay of about 75 days over the original schedule which resulted primarily from strikes in the equipment suppliers' plants. Original desires provided for delivery of equipment early in 1983, but time required for planning, design and procurement precluded this being met. In addition to delay of start of dredging activities at Roseires, the late delivery increases the challenges for assembly and launching of the equipment at the dam. Preparation of the launching facility is the responsibility of the Government of Sudan (GOS) who have limited resources with which to provide the facilities. Roseires reservoir will be at full pool of 481 meters until about 1 January 1984 so launching before that date would be of great benefit to the program. Later launching will require development of a launching area requiring a great deal more time and resources than would be required at full pool.

2. The GOS has been exploring alternative means to improve conditions at Roseires before the 1984 flood season which begins in July 1984 in an effort to assure that there would not be a complete blockage of the powerplant again. One of the alternatives to be examined is the possible use of a 100 ton American crawler crane which is reported to be nearly new and is available from ARKEL-Talab Cargo Services, Ltd. The equipment is currently located at Kost1 on the White Nile and has been engaged in river dredging operations for Chevron. A sectional barge is available at no cost

from Chevron at Kostı but would require assurance that replacement transport capability would be provided by GOS if needed while the sectional barge is on loan.

3. Accompanied by Mr Jay Carter, Energy Adviser for USAID/Khartoum I flew to Damazin on 11 September in a NEC chartered aircraft. Also on the trip was Ibrahim Ali Mohamed Saleh, Resident Mechanical Engineer for Merz and McLellan, Consulting Engineers on installation of units 5 and 6 at Roseires Powerplant.

4. Discussions at Damazin included the following

Mohamed Nasr Abu Bakr, Director of Electricity, NEC

Tag El Sir Ahmed, Director of Dams, Ministry of Agriculture and Irrigation

Kamal El Din Tayfour, Resident Engineer, Roseires Dam

Abbas Elhassan Elhasseen, Director of Projects, NEC

Elamin Mohamed Yassin, Director of Operation, NEC

Hassab Eluabi Musa Mohamed, Oper. Engr., MOA&I

A R. O'Dowd, Acting Res. Engineer, Sir Alexander Gibb and Partners

Jay Carter, USAID/Khartoum

Ibrahim Ali Mohamed Saleh, Merz & McLellan.

5. Conditions at Roseires had improved considerably by the time of our arrival. The GOS had mobilized all available trucks in the Damazin area together with 2 front end loaders and the 3 cubic yard American truck crane (Provided by AID in 1981) to clean the powerplant intake. The upper two-thirds of the trash racks in front of units 1-4 had been cleaned.

The rubber tire equipment was idle at the time of our visit. Units 1, 2 and 4 were on line producing about 90 MW. Unit 3 was still out of service because sediment and debris had filled the area between the trash racks and the gate. This additional loading prevented the gate from being opened. Divers using water jets were working during nighttime hours when units 2 and 4 were shut down to clear the area so the gate can be opened. Plans included removing some of the trash racks to facilitate the cleaning operation.

6 Discussion regarding planned dredging operations raised several issues of concern. Late arrival of the dredging equipment makes completion of the total deposition basin before the 1984 flood season impractical. Priority of areas to be dredged needs to be established. Alternatives for supplementing the new dredging equipment are under investigation. Expediting shipment of the tug and split hull hopper barges has been initiated by MDC. Arrival at Port Sudan is currently scheduled on or about 24 November 1983

7. Concern was expressed by GOS officials regarding the recommended closing of the deep slot in the sediment deposits adjacent to the dam west of the deep sluices as shown on Figure 1. The 1981 report recommends this to provide a weir between the deep sluices (thalweg of the river) and the powerplant intake in an effort to reduce the quantity of coarse sediment and large sunken debris approaching the powerplant intakes. It should be noted that the weir effect created at units #3 and #4 this year was very short, possibly as little as 60 meters, whereas the planned program provides a weir about 200 meters in length so the velocity will be

relatively low. A layout of the proposed closure is shown on Figure 1. It is proposed that this be initially constructed by depositing the coarsest material available from the dredging operation together with large sunken debris in an effort to provide some reinforcement and armor against erosion. The total quantity of material involved is less than 15,000 cu m so if the use of dredged material is not successful, the contribution to additional sediment at the powerplant is relatively small compared to the total annual movement. The closure should not be made before the deposition basin is excavated to at least elevation 455. If the initial plan is not successful, quarry rock should be used to create the closure. The relatively slow velocity that will exist over the weir (estimated 0.2 to 0.3 meters per second) would not move the rock materials. Minimum depth of water over the planned weir is 1.3 meters. The weir is considered an integral part of the plan to reduce the quantity and size of sediment and debris reaching the intakes.

8. Concern was expressed by GOS officials regarding recommended disposal of excavated material in the thalweg of the river for later erosion and transport through the deep sluices. The quantity to be disposed annually is relatively small. Deposit of material farther east of the thalweg of the river would preclude future erosion with only minimal effect on long term storage capacity. Disposal of granular material on the upstream face of the dam east of the deep sluices is still recommended as a means of providing access for trucks to the port area for easy transfer of material to the ferries. Deposit of material will allow for subsequent grading of a ramp down the face of the dam without disturbing the structure. The area of the disposal

berm upstream of the powerplant can be extended to the south and can also be increased in height as soon as stability of the dredged slope is assured. A proposed slope of 3 l has been shown whereas it is expected that the deposits will stand on a greater slope. The berm is shown to retain space for providing a 4 l slope without interfering with the deposited materials. Deposit of material on the east side of the thalweg is still considered an adequate disposal area with most, if not all, the material expected to be carried through the deep sluices during subsequent floods. The maximum annual dredging is expected to be on the order of 300-400,000 c. m. which is a relatively small quantity when compared to the total annual transport of the river. Another suggestion for consideration made by GOS officials is for agitation dredging of the material. Where the material is 90% fine grained material it was suggested that it could be excavated and redeposited in the water near the powerplant to be carried downstream through the turbines. This should be tried on an experimental basis to determine the magnitude of additional trashrack cleaning required in comparison to the cost and time for loading and hauling by barge. Velocity is expected to be too low to transport the material except where it can be dropped close to the intakes by sidecasting.

9. GOS officials raised the question regarding the need for more dredging capacity to provide a complete solution and the need for a suction dredge which could work in front of the powerplant during the flood season. The earlier consideration of a combined grab dredge, plain suction dredge was reviewed. Our continuing concern was expressed about the difficulties in operating a cutterhead suction dredge in the debris which is mixed with the sediment at Roseires. It was suggested that we continue to consider the

possibility of adding a suction dredge to the program. A dredge with a reach of 21 meters (this is a further reduction of digging depth of 40 m to 30 m) could perform a large portion of the work as the reservoir is lowered and could reach the bottom of the cut during the July and August flood season. Operation would be limited to the area in front of the powerplant during the time the spillway is open. This would be the time the grab dredge work would be limited, because passage across the area in front of the spillway by the tug and barge is not advisable. Mr. Carter indicated that consideration could be given to adding a suction dredge as a part of a future CIP Budget. (Mr. Mudge confirmed this possibility if it is recommended). I advised the group that I would explore the matter further with MDC since they had expressed some concern regarding the production capability of a plain suction dredge. The suggestion of further reducing the depth capability over that proposed earlier assists in reconsideration of this matter. GOS officials feel that an adequate total solution requires the capacity of a suction dredge in addition to the grab dredge. Some GOS officials continue to mention a cutterhead requirement.

10. Our recommendation regarding early training of operators was reviewed. It was suggested that dredging of material from the area west of unit #1 be initiated and that this useful work be used as a training ground for crane operators. The work could be accomplished with the mobile American crane when it is available and by the mobile Koehring crane when the American is otherwise in use. Arrival of the two 10 cu yd dump trucks should assist in this operation. The area must be dredged to at least elevation 464 by May 1984, to provide a berthing area for the floating equipment during the flood season.

11. Related items observed

a. American Hoist truck crane - GOS has 2 operators trained for its operation. The crane worked a 2 shift operation during the crisis removing an estimated 500 c.m. per shift. Cycle time was reported to be every 2-3 minutes. Consideration was given to bringing in additional operators but due to the danger of training new operators to work close to the trash racks it was not done. At least 7 trucks from various agencies were working to transport the sediment to disposal areas. A large quantity of debris were spread along the road in both directions from the dam. Character of material included a large portion of granular material and small wood particles. GOS officials had high praise for the work of the American Hoist Crane.

b. Trash rake - The new trash rake procured following the 1980 visit by Bureau of Reclamation (BOR) staff has been further modified to improve its operation. Ibrahim Ali pointed out that the pan on the crane to drop material to the deck has been extended to provide good overlap with the rake during the dumping operation. This has reduced the amount of material lost back to the water during operation. The carriage for the rake has been shortened to eliminate interference with long material carried in the rake (see photo). The second rake and crane, originally scheduled to arrive in early 1982 is now scheduled to arrive in November 1983. The new crane will be equipped with a small hydraulic boom crane on top of the gantry to provide a means for handling logs that are pulled up by the rake. It was also indicated that

the fingers of the new rake have been extended to provide good penetration into the rack. Equipment was idle as the trash racks were reported to be clean down as far as dredging has been accomplished.

c. Reservoir Conditions - Reservoir was at about elevation 473. Following the blockage which occurred 15 - 17 August, it was determined that the reservoir should be raised early to reduce the velocity across the front of the powerplant and to increase the head on units 1 and 2. The spillway was partially closed on 2 September to raise the reservoir 1 meter and was further closed to raise the pool another 0.5 meter. This action allowed water to approach the powerhouse across the shoal area upstream from the intakes and reduced the amount of water approaching from the east across the face of the dam which had the greatest sediment and trash content. Peak flood flows occurred on 19 and 26 August (See chart in Appendix 1 by Sir Alexander Gibb and Partners' representative). All spillway gates were closed on 6 September in accordance with the rule curve to begin storage of the irrigation pool. This was considered a relatively high flood level for the Blue Nile. (Raising the reservoir was to have been one recommendation to be given upon arrival in order to alleviate the problem. This was concurred in by BOR staff and Mr. Pemberton before I departed U.S.) Results obtained this year confirms the advisability of this action in the future if partial blockage occurs. To allow for this condition in the future, the disposal berm proposed upstream of the powerplant should be modified to the extent it should not be connected to the shore west of the powerplant but remain an island as shown on Figure 1, until further review after several years of operation of the deposition basin. Soundings taken in February 1983, indicate a continued growth of the shoal across the front of the powerplant. The 467 contour extends to

a point east of unit 1 and about 60 meters upstream. The 465 contour extends to a point east of unit 2 and about 60 meters upstream. The 26 ft Monark survey vessel provided by AID in 1982 was used to make the latest surveys. It was reported the equipment worked very satisfactory. The sequence of events as reported indicates that the trash and sediment made a complete blockage of units 3 and 4 on 17 August (See Appendix 1 by Sir Alexander Gibb and Partners), and this blockage formed a weir over which water flowed at high velocity into a depression in front of units #1 and #2. These units were kept in operation 16 hrs. per day with shutdown during night hours to clean the trash rack area using the American crane and trash rake. Sediment sampling during peak flows indicate a peak transport rate of about 250,000 tons per hour ( $\pm$  4,000,000 cu. yd per day).

d. Reservoir flushing - There was some discussion about emptying the reservoir during the beginning of the flood season in a future year when alternate thermal power is in service in order to flush out some of the sediment that has collected (more than 600,000,000 c m.) since 1965.

e. Trash boom - The trash boom installed by GOS in 1981 was destroyed during the 1982 flood with a portion of it hanging in the spillway at this time.

f. Powerplant - Units #1, #2 and #3, are rated at 30 MW and Unit #4 is rated at 40 MW. Unit #5 rated at 40 MW is scheduled to go on line in November 1983 and unit #6 at 40 MW in April 1984. Only the structural portion of unit #7 is being installed at this time with no firm date

established for acquiring the generation equipment. Several contractors are working at the site on construction and installation of units 5 and 6. Housing at Damazin is apparently difficult to obtain so efforts to acquire needed quarters for Marine Design (MDC) and Dredgemasters International (DMI) staff during assembly and initial operation should be started as soon as possible. Arrival of DEMAS staff will further complicate the matter.

g. Diver Communication Equipment - Inquires with the divers disclosed that the diver communication equipment provided by AID did not function adequately to provide communication on their work. It was disclosed that the equipment was actually in use by the resident engineer for a communication system from his residence to the dam. It should be noted that the system provided was relatively inexpensive and the next level of quality would have cost a great deal more.

## RECOMMENDATIONS

1. As concluded in the meeting in Khartoum 15 September 1983, investigation of the feasibility of mobilizing the ARKEL-Talab 100-ton American Hoist crawler crane to Damazin for use as supplemental dredging capacity during the next 8 months should be continued. If it is determined to be feasible, it is recommended that full responsibility for mobilization of the crane, Flexifloats and other associated equipment be made a part of the contract with ARKEL-Talab. Preliminary information from American Hoist and Derrick Company indicates that a minimum size barge for supporting the 100-ton crane would be 20 feet X 60 feet. MDC is reviewing this requirement.

2. It is recommended that concurrence be given in the accelerated delivery of the tug, barges and work boat. It has been concluded that testing of all the dredge equipment will be completed in the United States prior to shipment

3. Training of additional operators should be initiated immediately. Excavation of material is required from the area immediately south of the powerplant. This is considered a good area to conduct training and is required dredging to provide a mooring area for the floating equipment during the next flood season. This dredging will also be useful in establishing a stable slope west of Unit #1. During the time the American truck crane is not available, it is recommended that the Koehring truck crane be used for this operation. It is recommended that efforts be made

to establish a loading operation directly into the trucks. To accommodate this activity, it may be necessary to construct a hopper to be stationed at the truck loading site, to accommodate this direct dumping operation.

Experimenting with agitation dredging could be accomplished (suggested by GOS officials at Damazin) by the American Truck crane working from the west end of the powerplant intake deck.

4. It is recommended that a closure be made to the deep slot along the face of the dam between the deep sluices and the powerplant as show on Figure 1.

5. It is recommended that only Phase I of the disposal berm be used during the initial dredging operations in order to permit water to flow over the shoaled area to the south and west of the powerplant, as was accomplished during the 1983 flood season. Phase II as shown on Figure 1 can be accomplished after establishment of the deposition basin. The remainder of the disposal plan shown in the 1981 report is considered still valid.

6. It is recommended that a log boom be reestablished to protect the powerplant approach from floating debris. It is recommended that the replacement boom be constructed of wooden logs in parallel rows, rather than using the oil drum construction used in the first boom. The log boom should extend from the east end of the disposal berm to the west side of the spillway. Plan of typical designs used on Corps of Engineers projects will be forwarded to USAID/Sudan.

7. It is recommended that the front end loader be used to level and spread the material hauled from the excavation operation on the top of the dam. The present mode of operation results in an increasing length of haul.

~~Concentration~~ of disposal immediately downstream of the dam will facilitate the hauling operation. Long term operation may require additional equipment such as a small crawler tractor.

8. The issue of potential need for suction dredge equipment should be kept open at this time. The first season of dredging activities will provide better data on character of material in the initial excavation and will provide some information on infill during the subsequent flood season. The suggestion by GOS officials that the dredging depth requirement for the suction dredge could be reduced to 21 meters should be a part of the review of this issue. The shorter ladder would permit dredging the most shoal areas during high pool while still permitting reaching the bottom of the deposition basin at minimum pool. Investigation of existing plain suction dredges in operation in the United States should be undertaken. It is recommended that USAID/Sudan request MDC to initiate this review.

9. Long term operation of the Roseires powerplant should provide for reduced power output during the peak flows of the annual floods to the extent that alternate thermal power is available. The extreme sediment and debris content of the Blue Nile makes it difficult to assure trapping of a majority of the sediment during these peak flows if the powerplant is in full operation. This will become a greater challenge when Units 5 and 6 are on line. The size of the deposition basin proposed in the 1981 report is as large as considered practical.

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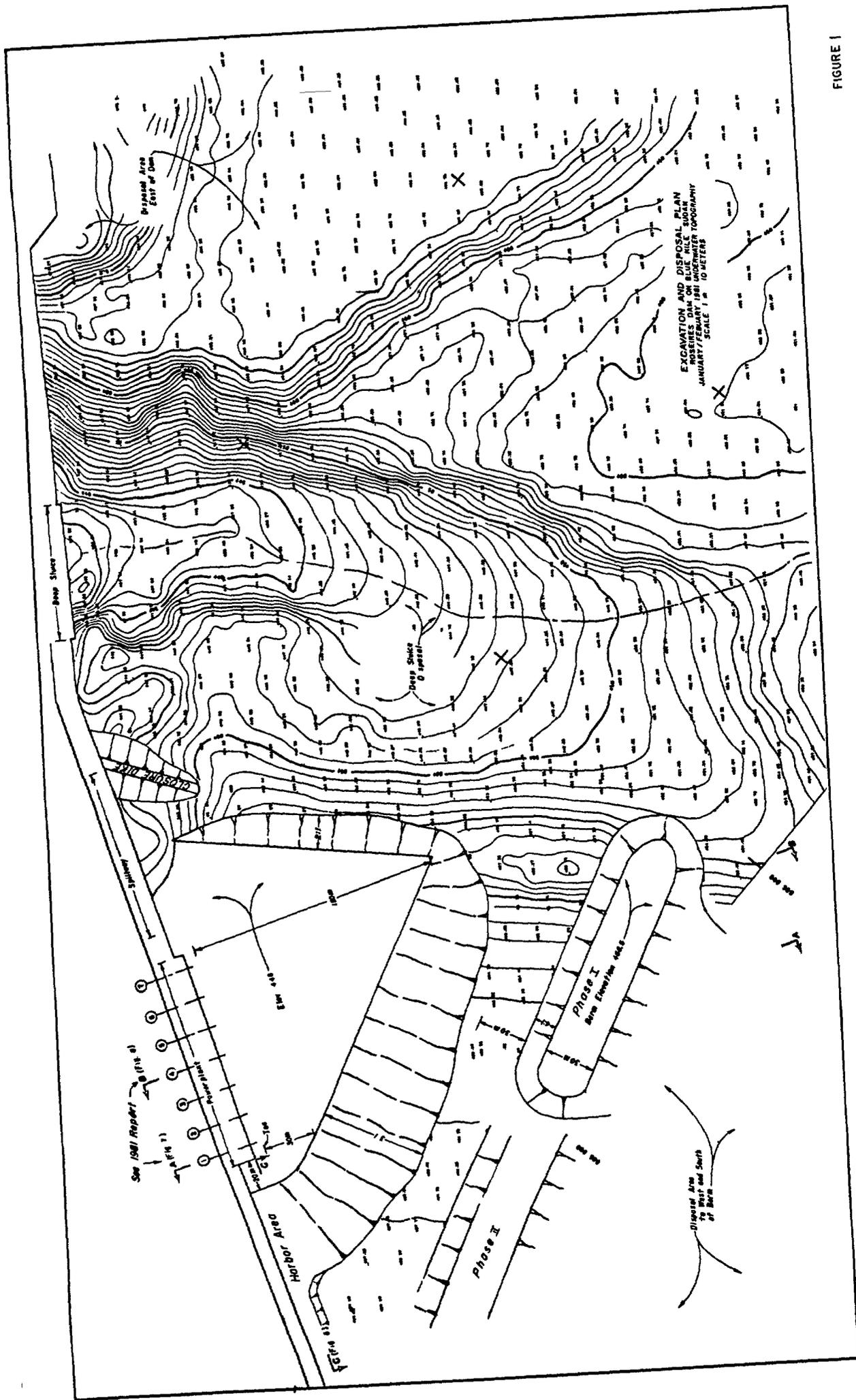
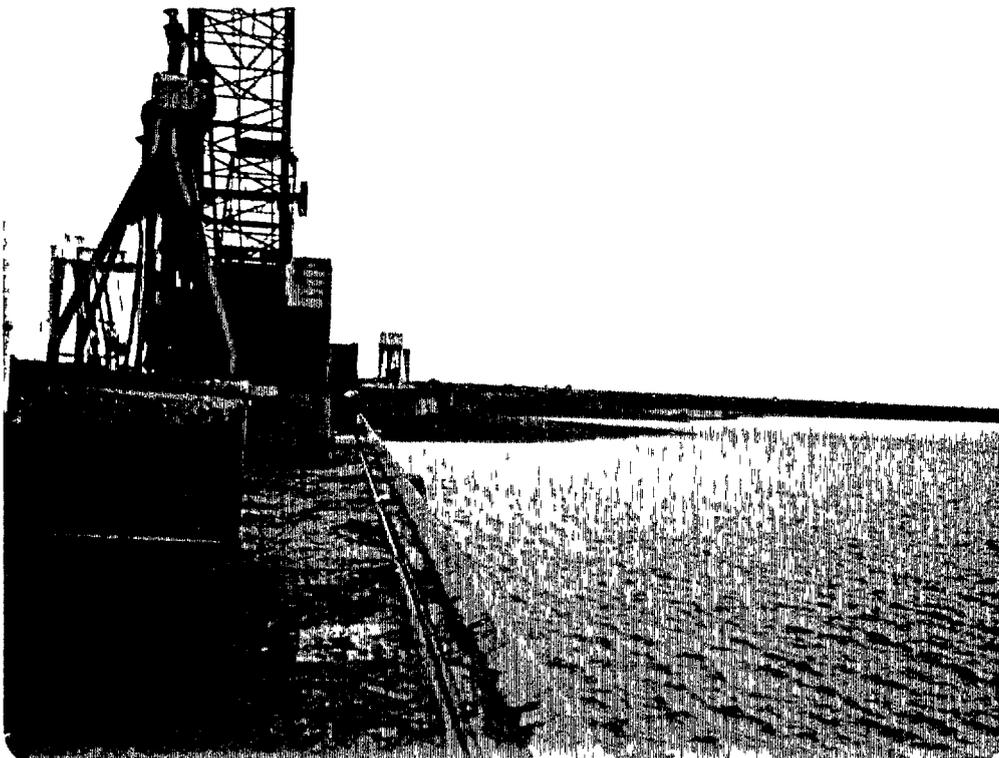
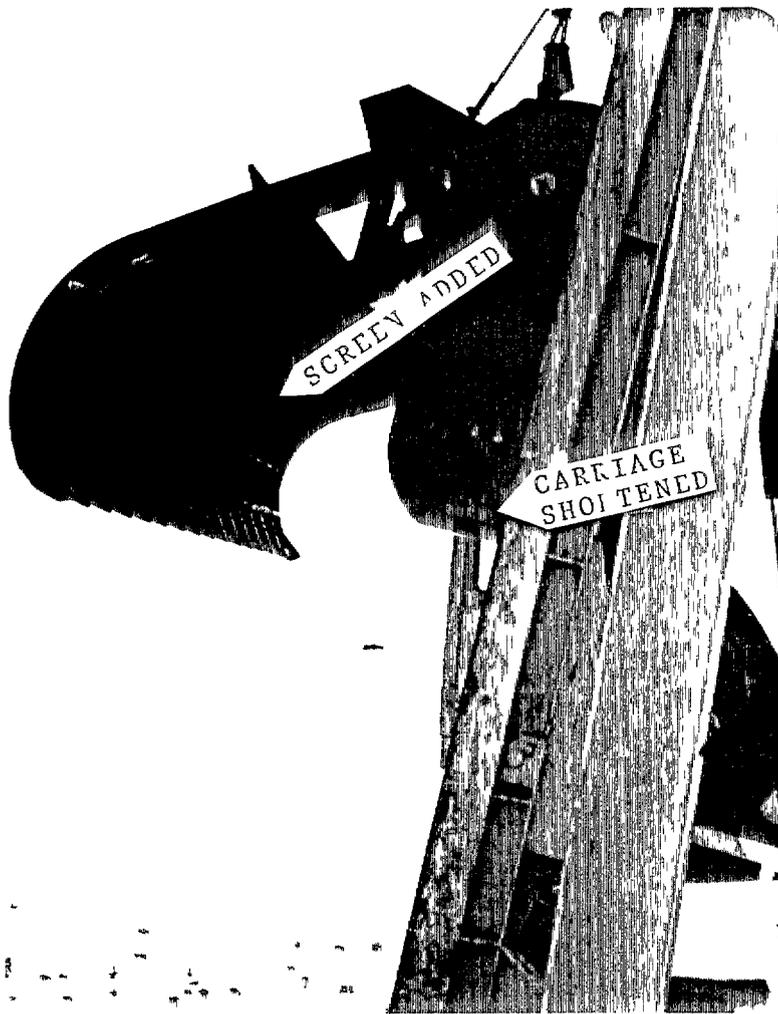


FIGURE 1

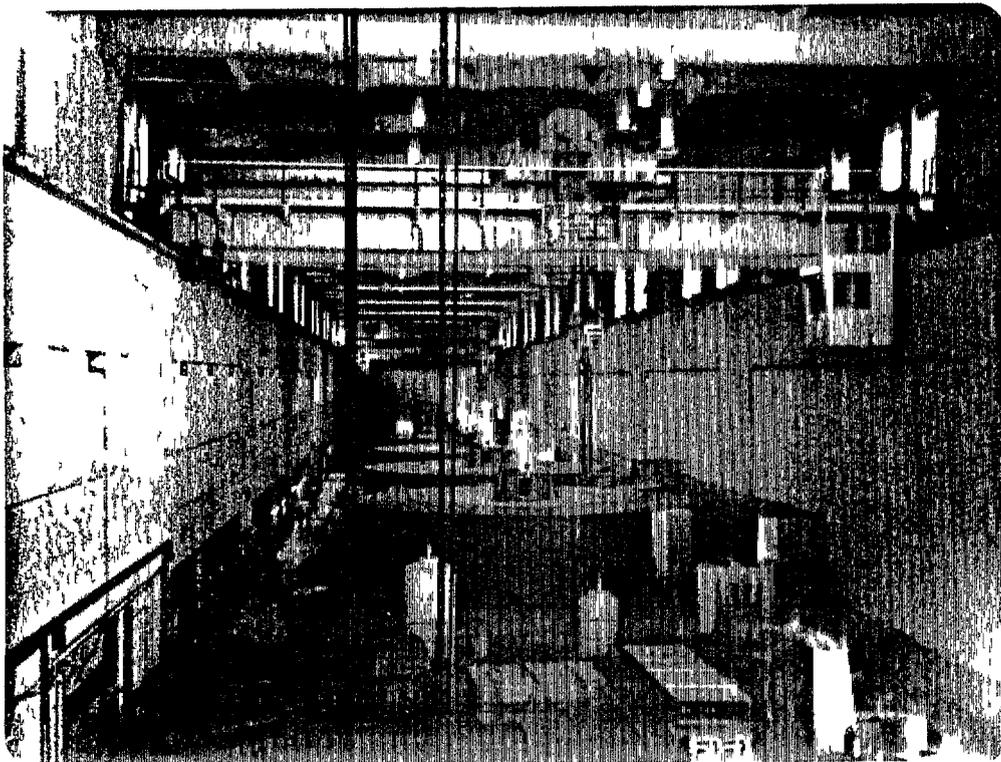
View looking West across  
powerplant intake deck  
Trashrake hoist in  
standby mode Koehring  
truck crane in background  
Material from trashrake  
operation in foreground



3 cu yd American Hoist truck crane on  
powerplant intake deck



Trashrake--roller carriage  
shortened, screen added  
to rake for fine debris



Roseires Powerplant 3 x 30 MW and 1 x 40 MW  
installed 2 x 40 MW scheduled for operation in  
November 1983 and April 1984 1 x 40 MW to be  
added at later date

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27 September 1983

MEMORANDUM FOR RECORD

SUBJECT Meeting with Sir Alexander Gibb and Partners

1 On 10 September 1983, I was contacted by Messrs Jim H Johnston and E J M Hepper of Sir Alexander Gibb and Partners Mr Johnston had just returned from a visit to Roseires Dam to review the difficulties being experienced with the plugging of the powerplant intake He indicated that he had made a report of his findings and would provide me with a copy

2 Mr Johnston indicated that his plot of the powerplant output indicated a gradual decrease of power production starting in late July up to 15 August He indicated that this probably denoted a gradual buildup rather than a rapid sloughing of material from the shoal upstream from the powerplant intake This appeared to be the general consensus of others in discussions during the remainder of my visit in Sudan

3 A copy of the graphs prepared by Mr Johnston are attached He indicated that this was a flood a little higher than normal, but not a real excessive flood height Their sampling of sediment during the peak flow indicated a transport rate of 250,000 T/hr (approximately 4,000,000 c y /day)

4 Construction of the civil portion of units 5, 6, and 7 is proceeding satisfactorily with units 5 and 6 to go on line in next 8 months

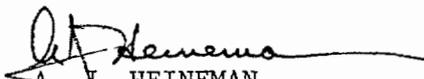
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27 September 1983

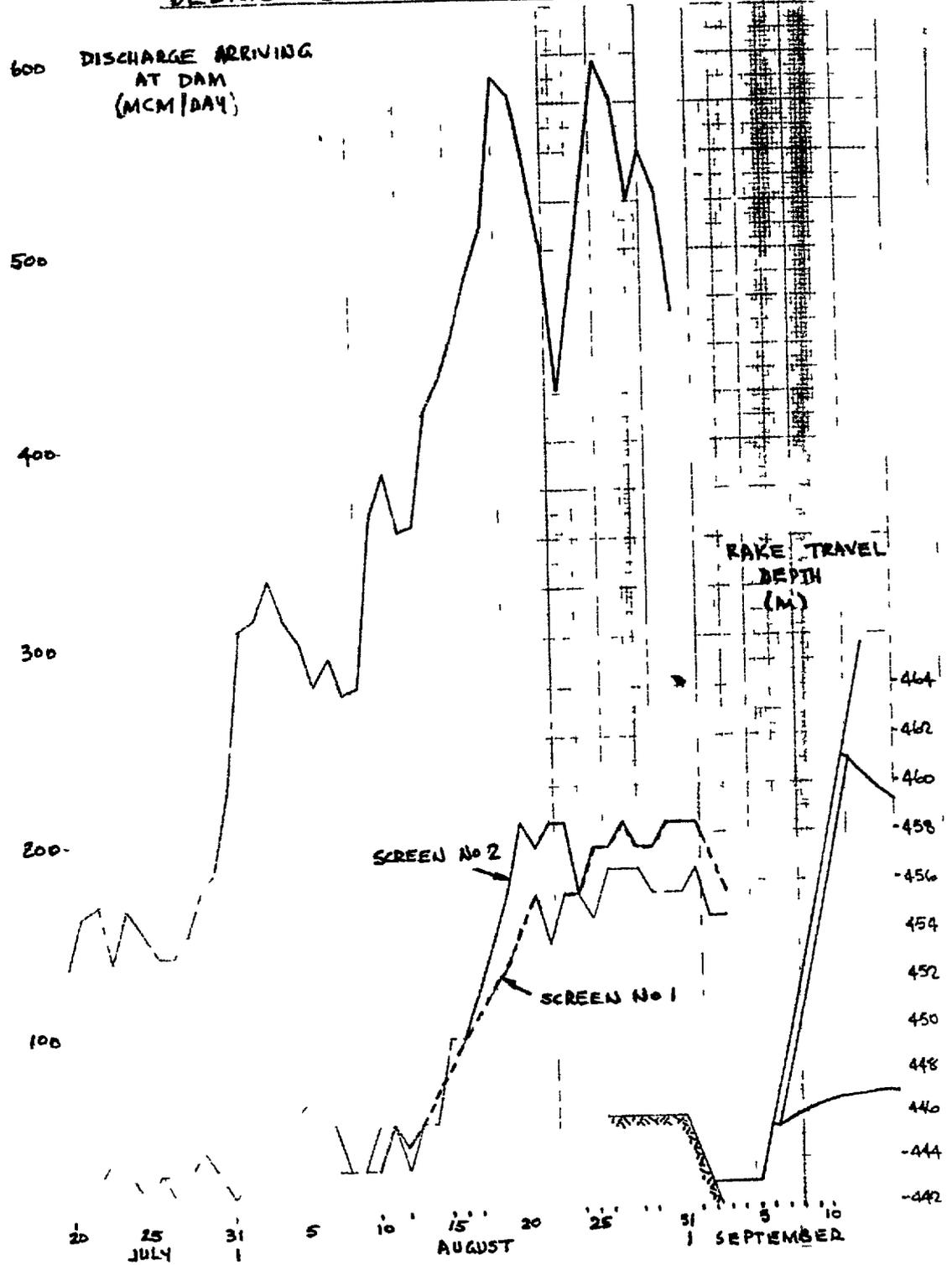
SUBJECT Meeting with Sir Alexander Gibb and Partners

5 I indicated I would provide a copy of my report when it is completed and expressed appreciation for their assistance

Incl  
as

  
A. V. HEINEMAN  
Chief, Navigation

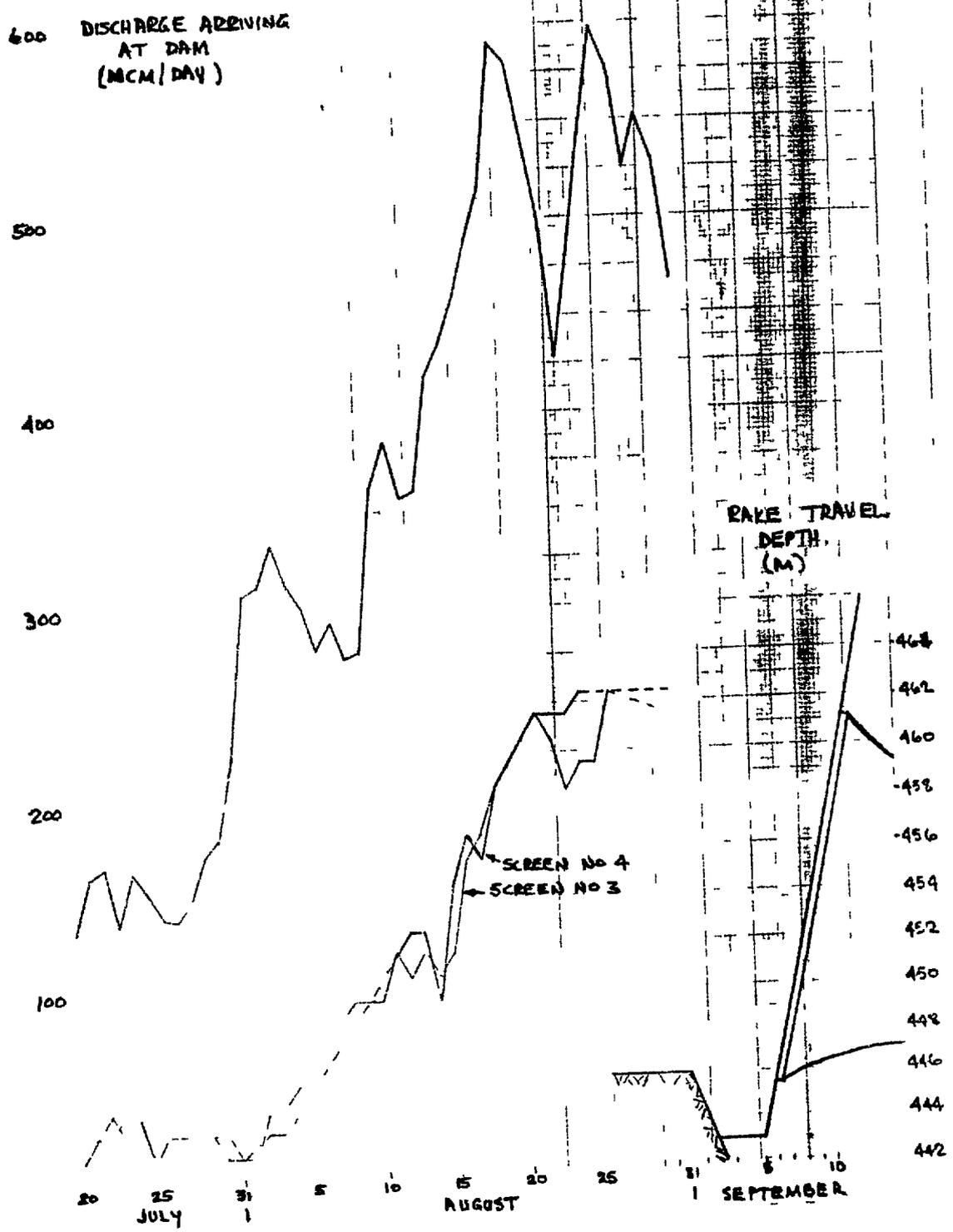
# DEBRIS BUILD-UP ON SCREENS 1 & 2



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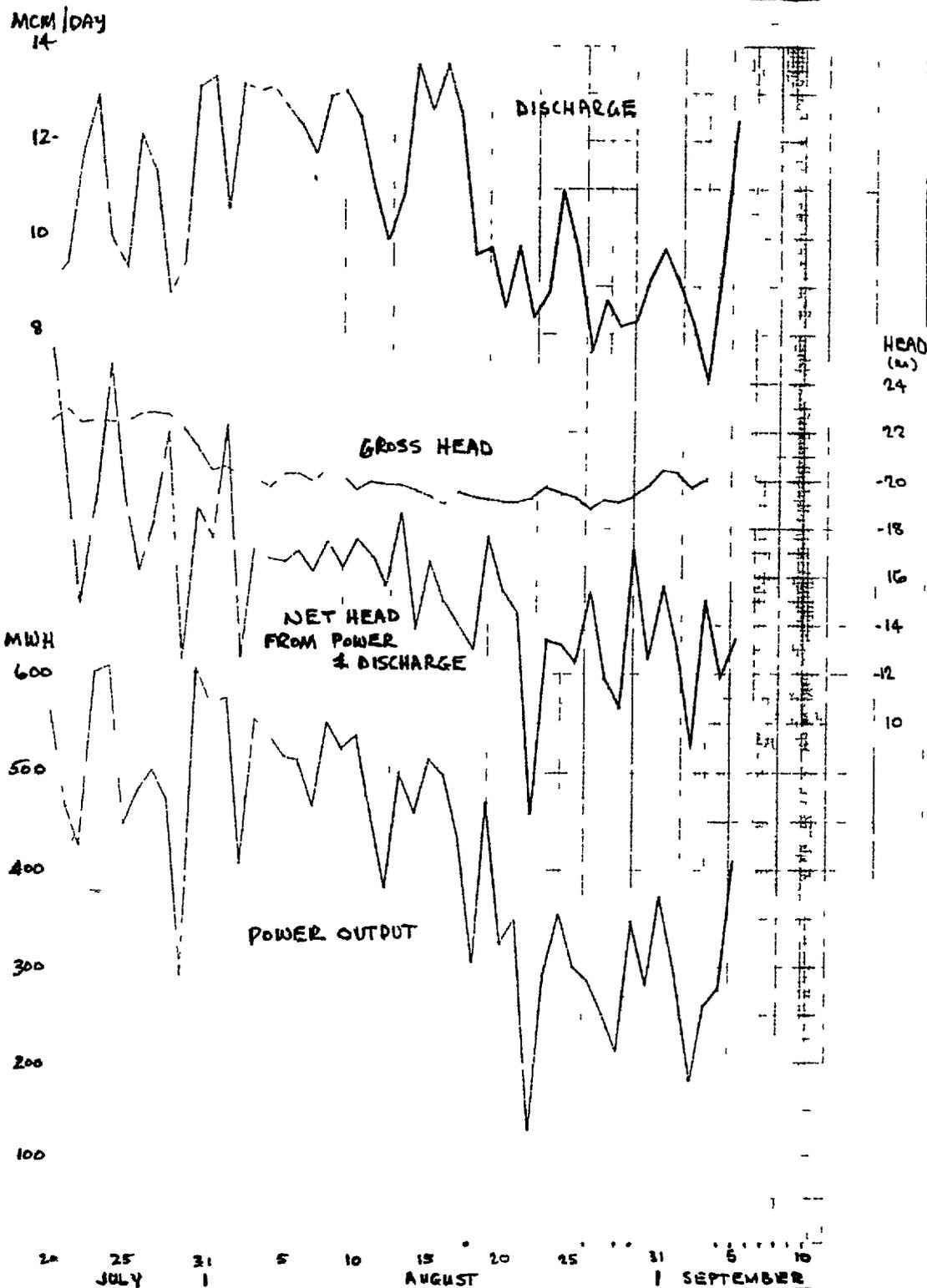
# DEBRIS BUILD-UP ON SCREENS 3 + 4



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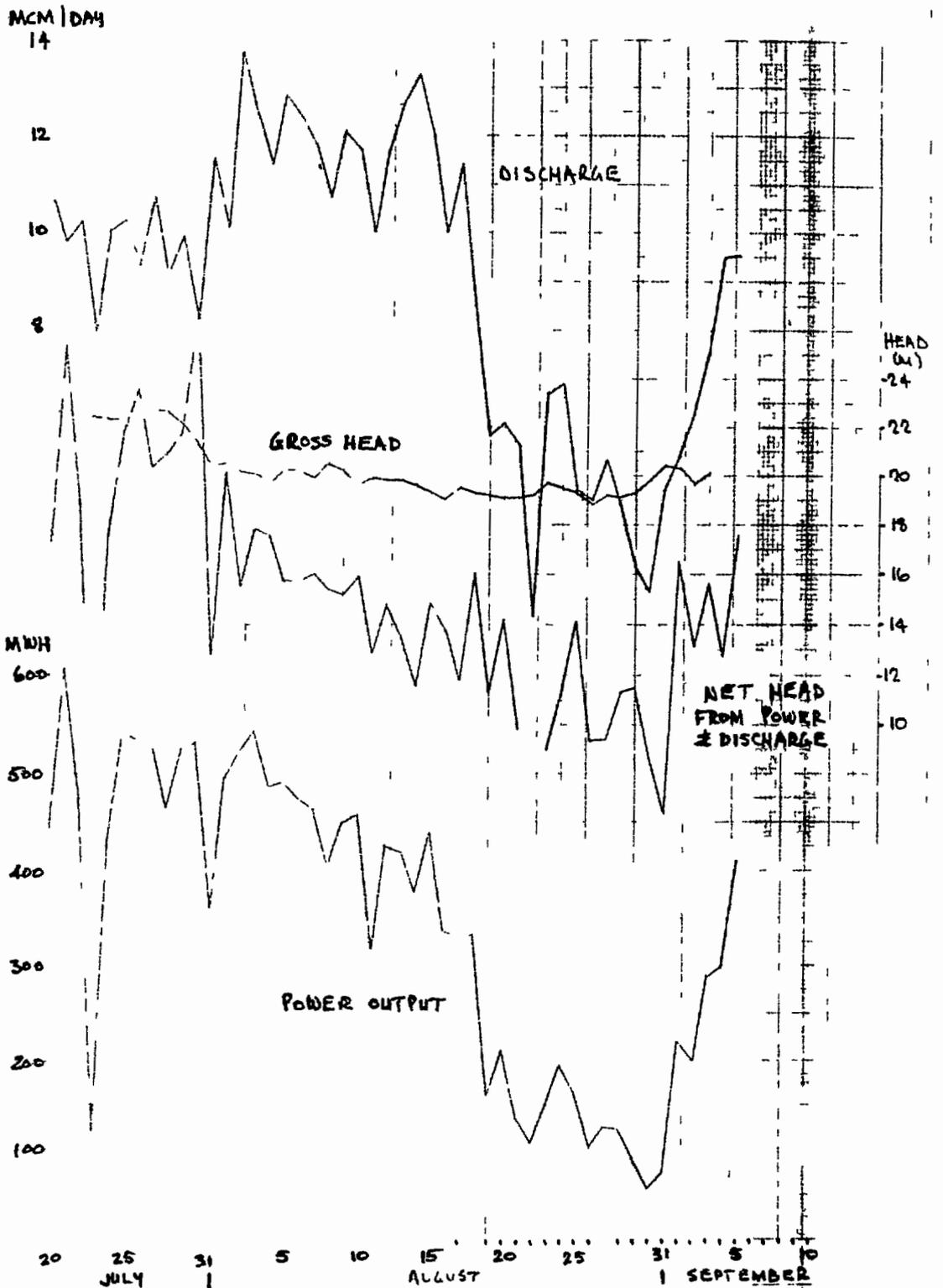
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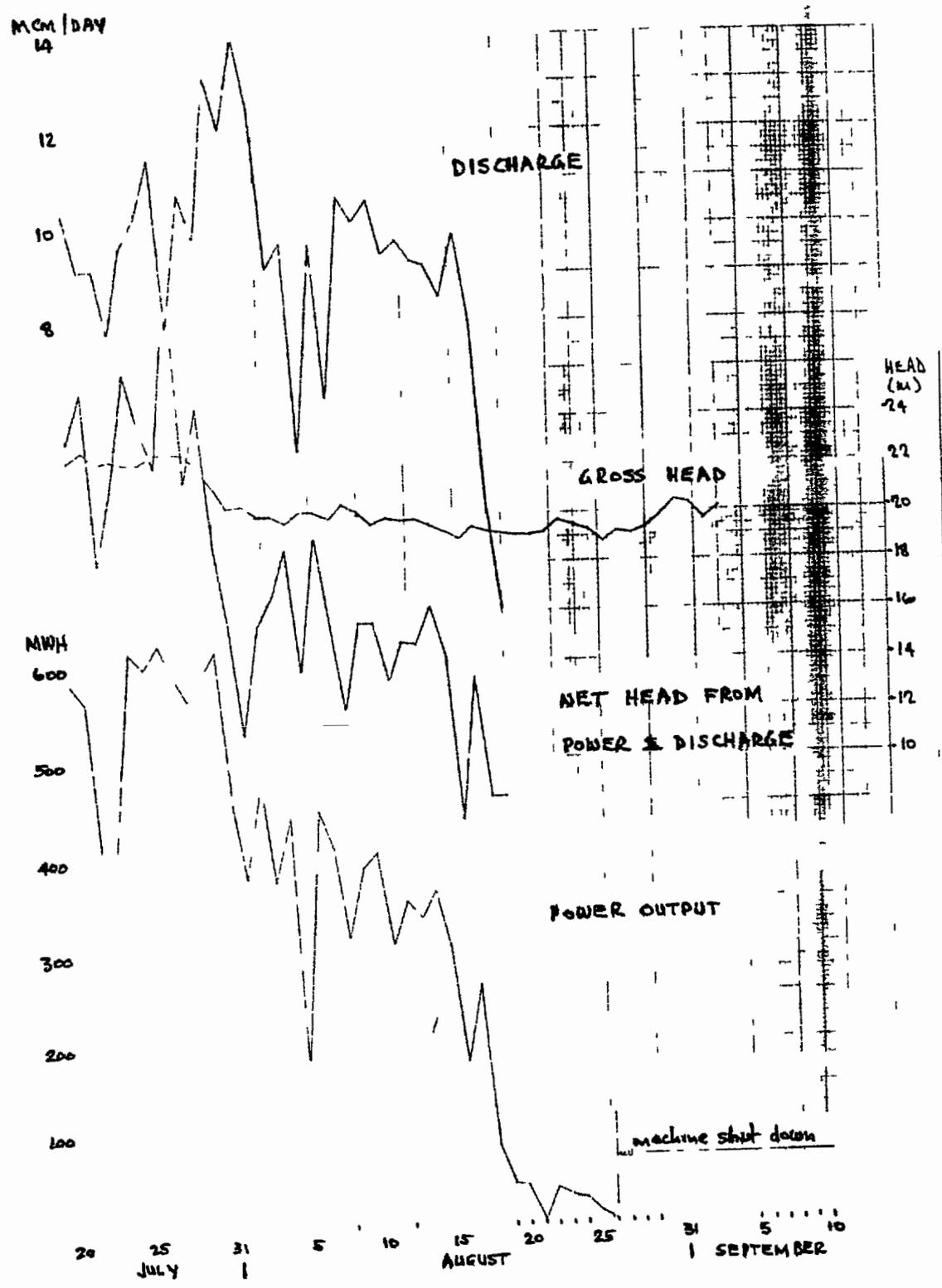
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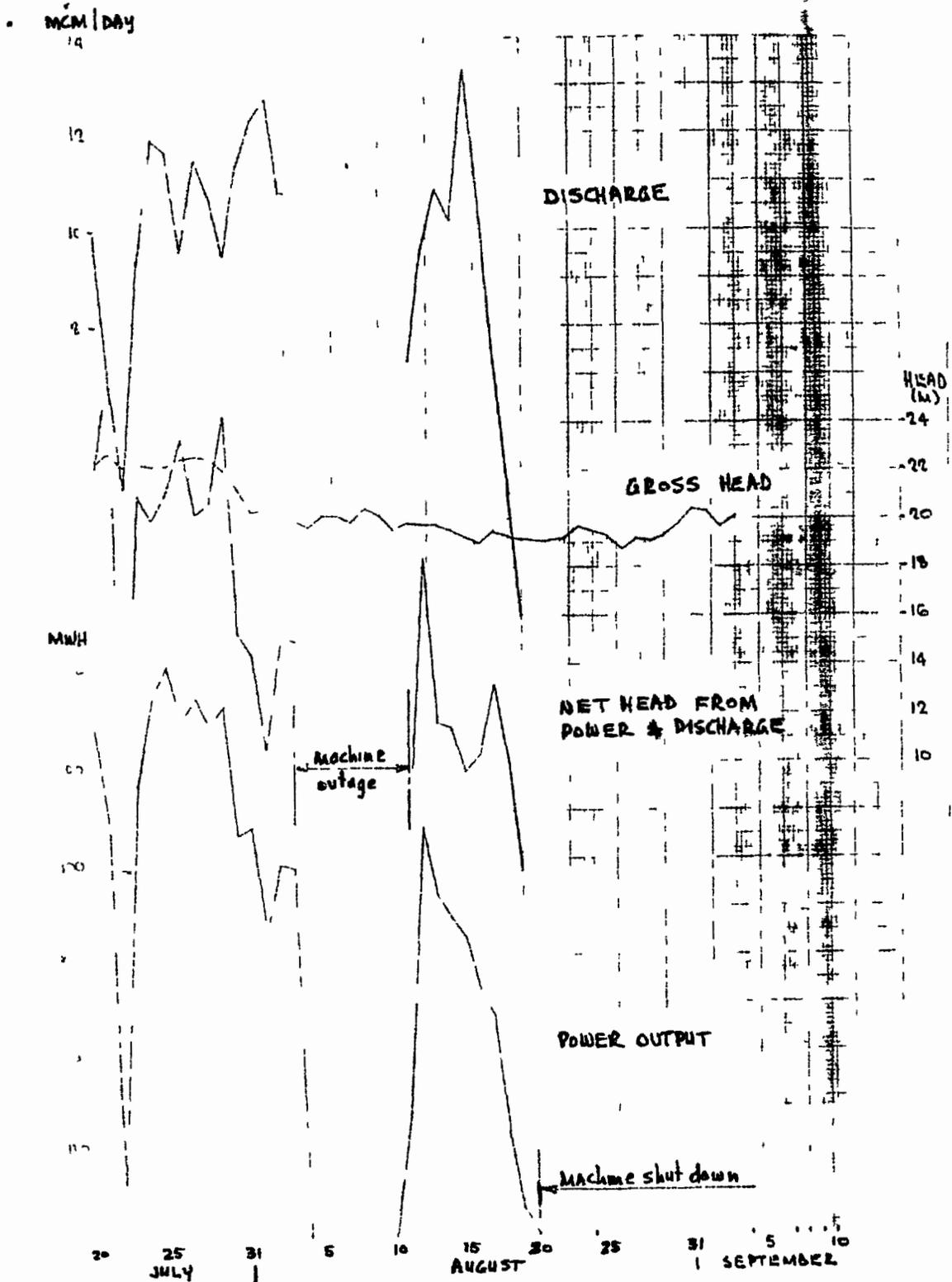


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27 September 1983

## MEMORANDUM FOR RECORD

SUBJECT Meeting with Chevron Oil Company of Sudan

1. On 13 September 1983, contact was made with Mr. D. M. Mahura, General Manager, Operations, for Chevron Oil Company of Sudan. Contact had been made earlier by Mr. Jay Carter of USAID/Sudan regarding the potential use of Flexifloats owned by Chevron.
2. Discussions with Mr. Mahura disclosed that the Flexifloats are located across the river from Kosti on the White Nile south of Khartoum. He indicated that the floats are not currently in use, but on occasions are used for transport of material to their drilling operations to the south of Kosti on the White Nile. Mr. Mahura indicated that the floats could be loaned to the Government of Sudan (GOS) provided that they had an agreement for GOS to provide replacement barge capacity if it were needed in transporting materials for their operation. GOS equipment is used in the same area for transport of equipment and materials.
3. I explained to Mr. Mahura that the investigation involved the possible use of one of the 100-ton American crawler cranes, which are currently under contract to Chevron, for excavation of material from the Roseires Reservoir in the vicinity of the powerplant. He indicated that the two cranes are under contract until 15 December to Chevron, but they could be released earlier since they are not actually in use at this time. He

NPPND

27 September 1983

Subject Meeting with Chevron Oil, Sudan

stated that the contract provides for Chevron to pay for shipment of the cranes out of country, but so far as he knows, ARKEL has no current need for the equipment elsewhere. In discussions of the size of the floats and numbers of sections available, he referred me to Mr. Tom Stelzner, Manager, Design and Construction Engineering.

4. Discussions with Mr Stelzner disclosed that one of the American cranes has been used for doing some dredging on the White Nile in the vicinity of Kost1. At that time it was installed on Flexifloats. He indicated that the Flexifloats are to be used at a later date for holding a drilling platform when working in the Sud, but at the present time has no required use other than potentially for transport of equipment. After discussing the proposed use, he indicated concern about the loading operation at Damazin. One of the cranes slid into the water at Kost1 while being loaded on the barge. He estimated that the Flexifloats would make up a barge about 15 meters by 50 meters, but did not have the information immediately available regarding the number of sections available. He thought that there would be a problem of transport of the equipment to Damazin before about December or January, but possibly the equipment could be loaded on the railroad to Damazin prior to that time.

5. Mr. Stelzner suggested the possibility of using the crawler crane from the top of the dam rather than on the barge. The 100-ton crane is equipped with as much as 140 feet of boom.

NPPND

27 September 1983

Subject Meeting with Chevron Oil, Sudan

6. If it is determined that the Flexifloats are needed at Damazin, Chevron prefers that arrangements be made through ARKEL to be responsible for the disassembly, transport, assembly and use of the equipment at Damazin, and the subsequent return of the floats to their present location. The use would be at no cost to GOS, but subject to return in like condition as received and, as indicated above, a commitment to provide equal transport capacity if needed for Chevron operations while the Flexifloats are not available.

7. I expressed appreciation to both gentlemen for their kind offer to assist in this emergency and indicated that others would be in further contact with them

  
A. J. HEINEMAN  
Chief, Navigation Division

NPPND

27 September 1983

## MEMORANDUM FOR RECORD

SUBJECT Visit with Royal Netherlands Embassy and DEMAS Representatives

1. Contact was made with Mr. Burt J. Ronhaar, Second Secretary, Royal Netherlands Embassy in Khartoum, on 14 September 1983 and the following day he and Mr. Paul Verheyen, DEMAS representative in Khartoum, contacted Mr. Jay Carter and I at USAID.
2. The Netherlands Government has signed an agreement with the Ministry of Agriculture and Irrigation for training of Sudanese staff to operate the equipment to be furnished by USAID for dredging at Roseires Reservoir. The program will include a study of the shoaling conditions as dredging progresses and is planned to extend over a 5-year period. A total of 8 million Dutch Guilders has been committed to this program (about \$2,600,000). Mr. Ronhaar indicated that he would provide a copy of their contract to Mr. Carter.
3. We outlined the program for equipment delivery as it is now envisioned and advised that we would provide the schedule of arrival when it is firm. Mr. Ronhaar indicated that an item to be checked is that currently the Sudan Government is charging duty on all imports with the proviso that where appropriate a refund is to be applied for by the importer. He said it is his understanding that this applies to GOS agencies as well as private organizations.

NPPND

27 September 1983

Subject Visit with Royal Netherlands Embassy and DEMAS Representatives

4. This was later pointed out to Tag El Sir Ahmed, and he indicated that he would investigate this, but did not feel it was a problem according to a commitment he has from the GOS officials at Port Sudan.

5. Mr. Verheyen is nearing the end of his 3-year assignment in Sudan, but will continue to be involved in the dredging activities from his new position in the DEMAS organization and will be instructing his replacement prior to departure. There are currently two Dutch dredges working in Sudan which were provided by the Dutch Government. A 12-inch cutterhead pipeline dredge is currently under tow upstream from Sennar Dam to dredge out the pumping intakes for irrigation water on the east side of the Blue Nile. This dredge has been in-country for four years and works only on the Blue Nile, between the Sennar Dam and Damazin. Mr. Verheyen has been involved in the training of a crew for operation of this dredge. He indicated that the normal crew on the dredge consists of six persons, with others on the small tow boat and other equipment assigned. They also have a small dredge designed for working in the irrigation canals of the Gezera Irrigation Project. He indicated that there was also an English built 8 cutterhead pipeline dredge stationed at Sennar Dam and is used for cleaning out the canal entrance.

6. In discussions of the proposed program for training and study at Roseires Dam Mr. Verheyen indicated that the plans provide for a staff of up to 14 persons. They plan to have two persons on site during the assembly activities

NPPND

27 September 1983

Subject Visit with Royal Netherlands Embassy and DEMAS Representatives

and then bring the others on as needed when the equipment is complete. It is their intention that they would take delivery of the equipment from GOS as soon as it is ready for acceptance and will initiate operation with their own operators on a two 8-hour shift basis. Mr. Verheyen indicated that his plan provides for starting with untrained Sudanese and selecting from the assigned people for the various tasks to be performed.

7. In discussing the equipment being provided he indicated that he plans to anchor the downstream side of the dredge to the dam so that only two of the anchors will be used initially. It was suggested, however, that spare anchors should be provided as a part of the initial equipment. He asked if anchor buoys were included in the equipment. I advised that I would check this matter and get back to him.

8. In discussing the various delays, which have been experienced in delivery of the equipment, it was interesting to find that he personally agrees that we should not have a cutterhead dredge for the work at Roseires. He feels that possibly it would be determined later that some type of suction dredge would be appropriate, however, he feels that for initial operations the grab dredge is the proper equipment. He feels it is better to start with something that we know will work and then observe what the material is and other factors before determining the additional equipment needed. In discussing the possibility of considering a suction dredge to be added next year, he indicated that he would

Subject Visit with Royal Netherlands Embassy and DEMAS Representatives

prefer that to be on a separate barge, due to the limitations which would be placed on the grab dredge by having the additional equipment adjoined.

9. In discussion of the dredging plan and the proposed closure of the deep slot near the face of the dam, he indicated his understanding of our proposed layout and particularly regarding the gradual lowering from the top down of the shoal in the front of the powerhouse. I explained to him that I would provide a new sketch leaving the berm disconnected from the west shore, in order to allow for early raising of the reservoir should a major flood threaten blockage of the powerplant similar to what occurred this year. I suggested that he begin discussions soon with MOA&I officials to plan the first phase dredging since it was unlikely that a significant portion of the deposition basin, as shown in our 1981 report, can be accomplished before next July. It has been determined that the Ministry of Agriculture and Irrigation will be responsible for the dredging equipment at Roseires Dam.

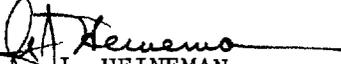
10. Mr. Verheyen indicated that he planned to work during the flood season, with the grab dredge if there is sufficient room in front of the powerplant, by unloading the barges into trucks on the top of the dam. This plan during the first season will depend on the dredging of a port area west of the powerplant to provide access during minimum pool level. This discussion led to the suggestion of possible construction of a hopper, so that a truck crane working from the top of the dam can load directly into the trucks rather than dumping on the deck and then rehandling the material into the trucks with the front end loader

NPPND

27 September 1983

SUBJECT Visit with Royal Netherlands Embassy and DEMAS Representatives

11. I wished him well in his new assignment in the Netherlands and expressed our appreciation for the interest of the Dutch Government in overcoming the problems at Roseires.

  
A. J. HEINEMAN

Chief, Navigation Division

NPPND

28 September 1983

## MEMORANDUM FOR RECORD

SUBJECT Meeting with ARKEL-Talab Cargo Services, Ltd.

1. Mr. Jay Carter and I had a meeting on 14 September 1983 with representatives of ARKEL-Talab to discuss the feasibility of having one of their 100-ton American cranes transported to Damazin for use in dredging at Roseires Dam.
2. Persons contacted included Mr. Richard Cockerham, Executive Director, Mr. B. K. Anderson, General Manager, and Mr. Earl H. Carpenter, Jr.
3. Our discussions disclosed that the ARKEL-Talab organization is primarily engaged in providing equipment transport in Sudan. They currently have two 7260 American crawler cranes, at Kost1, which are on charter to Chevron Oil Company of Sudan. They indicated that the cranes have been used very little since arriving in Sudan. One is equipped primarily for lifting, while the other has been equipped for dragline or clamshell work. In addition to the dragline bucket, they have a 3 cubic yard clamshell bucket and a 3 cubic yard orange peel bucket. It was indicated that one of the cranes had been used on the Chevron Flexifloats working in about 2 meters of water depth. To accommodate this work they had rigged up spuds on the Chevron barge. We indicated what the proposed work would require and that the initial dredging depth would be at least 16 meters. They will have to check whether the crane can handle the required

Subject Meeting with ARKEL-Talab Cargo Services, Ltd.

length of line on the drum for digging 16 to 40 meters in depth and whether they have the required anchors and anchor winches to control the barge.

4. Mr. Anderson indicated that they have mats which could be used for spreading the load on the barge, and also suggested the possibility that the crane might be worked from the top of the dam to assist in the dredging operation. It was estimated that the reach with the 140 foot boom would be about 30 meters.

5. Mr. Anderson estimated about 3 weeks to disassemble the equipment and move it to Damazin. He indicated that they have low boy trucks available and, in fact, moved a 90-ton transformer to Damazin before the start of the rainy season.

6. Mr. Anderson indicated that the crane would be off charter from Chevron on 15 December and it would cost about \$200,000 to move the two cranes back to the States. Chevron is required to pay for moving the cranes to the States. They currently have no work in the States for the equipment and are planning to try to place it on construction of the pipeline, which is to be built in Sudan shortly. This potential commitment will affect their discussions regarding use of the equipment at Damazin. They want to sell or place the equipment on long-term lease. They have asked Chevron for a

Subject Meeting with ARKEL-Talab Cargo Services, Ltd.

120-day grace period after 15 December to see if they can place the equipment on a job in Sudan. They have not yet received approval.

7. The asking price is currently \$500,000 but the company would consider taking payment in Sudanese pounds.

8. They indicated that Mr. Omar Mohamed Ali, from the Ministry of Agriculture and Irrigation, was in their office the day before discussing the potential use of the crane at Roseires and then possible later use on the Gezera irrigation project. Mr. Anderson indicated that this crane would be larger than any other that they currently have on the irrigation project for cleaning the canals.

9 The ARKEL-Talab organization was very interested in getting involved in the transport of the equipment to be supplied from the States for the dredging operations at Roseires Dam. They provided a brochure showing the various types of hauling equipment and lifting equipment they have available. They have a large truck crane at Port Sudan and are normally involved in handling a large number of the imports carried to Port Sudan by Waterman Steamship Company. Mr. Cockerham indicated that they had furnished a proposal to several of the freight forwarders who were bidding on the shipment of the equipment from New Orleans to Port Sudan, but had

NPPND

28 September 1983

Subject Meeting with ARKEL-Talab Cargo Services, Ltd.

heard nothing definitive regarding their proposal from the successful bidder. They feel that ARKEL-Talab is the best equipped for the transport of the estimated 32 loads of equipment from Port Sudan to the dam site.

10. We expressed our appreciation for the in-depth discussion of the program and indicated that we would see them the next day in the meeting at the Ministry.

  
A. J. HEINEMAN  
Chief, Navigation Division

NPPND

27 September 1983

MEMORANDUM FOR FILE

SUBJECT Meeting at the Ministry of Agriculture and Irrigation,  
15 September 1983

1. The meeting was called to discuss the various possibilities for supplementing the programmed dredging capability at Roseires Dam before the 1984 flood season. Various delays have resulted in the 4 cubic yard dredge being supplied under the Commodity Import Program of AID being delivered considerably later than originally planned.

2. Persons in attendance at the meeting included

Tag El Sir Ahmed, Director of Dams, Ministry of Agriculture and Irrigation (MOA&I)

Omar Mohamed Ali, MOA&I

Paul H. M. Verheyen, Civil Engineer, DEMAS

Richard Cockerham, Executive Director, ARKEL-Talab

B. K. Anderson, General Manager, ARKEL-Talab

Earl H. Carpenter, Jr , ARKEL-Talab

J. B. Carter, Energy Advisor, USAID/Sudan

Lynn Sheldon, Engineer, USAID/Sudan

Adam J. Heineman, Corps of Engineers

3. Tag El Sir Ahmed opened the meeting and asked what potential solutions there were in providing dredging capability at El Roseires prior to the

NPPND

27 September 1983

Subject Meeting at the Ministry of Agriculture and Irrigation,  
15 September 1983

1984 flood season, so that they would not experience the difficulties in generation that they had during August of 1983.

4. Mr. Carter indicated that we had received the latest information regarding the shipment of equipment. The schedule indicates that the dredge tender, split hull barges and workboat are to be delivered to the port of embarkation (New Orleans) during the week of 10 October 1983. If a separate shipment of this equipment is desired, the equipment could leave New Orleans about 30 October and arrive at Port Sudan on or about 24 November 1983.

5. Testing of the grab dredge will take place during the week of 31 October with arrival in New Orleans during the week of 14 November. In response to the question regarding delaying the testing of the dredge until it arrived at Roseires Dam, it was indicated that the Marine Design Center and Dredgemasters International strongly advise against this option. It was agreed that this matter would not be pursued further. It was also agreed that the early shipment of the other equipment should proceed provided the additional cost is acceptable. I was requested to have MDC provide this information to USAID/Sudan as soon as possible.

6. The potential use of the ARKEL-Talab crane was discussed. It was indicated that at present there was no definite knowledge regarding the

Subject Meeting at the Ministry of Agriculture and Irrigation,  
15 September 1983

number of barge sections available from Chevron to know whether there are sufficient sections to support the 100-ton crane for dredging and other sections to provide a transport barge for material. I indicated that Chevron officials thought that there were sufficient barges to make up a unit about 15 meters by 50 meters. Mr. Anderson suggested the possibility of working the crane from the top of the dam, but Tag El Sir Ahmed indicated that this would not be possible because of the loading on the powerplant intake deck being very critical. The truck crane outriggers can be placed only at specified points. It was also determined that the crane could only reach about 13 meters more than the American Hoist truck crane. Excavating from deck does not accommodate gradual lowering of the shoal to maintain a stable slope. In discussing the requirement for transport barges, Mr. Anderson suggested the possibility of obtaining one of the 80-ton barges from the GOS River Transport Agency. This could be cut apart and rewelded at the dam. The best alternative is the Chevron equipment if sufficient sections are available. Unloading of the flat deck barge would be by front end loader as suggested in the 1981 report. It was indicated that the soonest travel by road to Damazin would be 15 October.

7. In discussing the need to expedite the movement of the USAID dredging equipment from Port Sudan to Damazin, it was suggested that consideration be given by GOS for use of ARKEL-Talab to provide the transport equipment. GOS officials indicated that they had equipment to do this, and currently plan to undertake this work themselves.

NPPND

27 September 1983

Subject Meeting at the Ministry of Agriculture and Irrigation,  
15 September 1983

8. It was concluded that ARKEL-Talab will prepare a price proposal for furnishing the 100-ton crane and all related equipment required for dredging at Roseires Dam using the Chevron floats and will include use of their operators to train Sudanese operators for operation of the equipment. Early arrival of the bottom dump barges, together with the deep digging required while the reservoir is full, indicates the possibility that one more transport barge would provide the capacity needed for the two dredges working simultaneously. Written request from MOA&I to USAID Khartoum was handed to Mr. Carter at the meeting requesting that ARKEL-Talab be requested to provide a specialist from the States to assist in preparing their proposal and to plan the move of the 100-ton crane and associated equipment from Kost1 to Damazin and assembly for work as a dredge. It is expected that this person will be in Khartoum by 21 September. After receipt of the priced proposal, a determination will be made regarding the feasibility of this option.

9. In discussing the dredging required, Tag El Sir Ahmed mentioned that at least 25,000 cubic meters must be removed to complete the cleaning of the powerplant intake. Only about two-thirds of the dredging to open the trash rack area on each of the units has been completed to date. Unit No. 3 is still plugged between the trash rack and the sliding gate so they are rigging a pump to assist in this cleanup operation in order to start Unit No. 3.

NPPND

27 September 1983

Subject Meeting at the Ministry of Agriculture and Irrigation,  
15 September 1983

10. I suggested to Mr. Paul Verheyen that he should work with USAID and GOS in preparing an estimate of the initial quantity that needs to be dredged to clean out in the immediate vicinity of the powerplant before the next flood season, and also estimate a range of capability using only the one dredge being delivered from the States, and the additional capability which can be provided using the ARKEL-Talab equipment, and one additional barge for transport providing a total of three barges.

11. It was determined that several benefits can accrue from shipping the transport barges, tug and workboat early. These include working with the ARKEL-Talab dredging equipment before the new grab dredge is assembled, and also distributes the transport requirements between Port Sudan and Damazin. The 12 loads included in the first shipment will demonstrate the challenges to be overcome in handling the 20 loads required for transporting the grab dredge. Also, assembly of the tug and barges can be underway at Roseires before the grab dredge arrives.

12. Tag El Sir Ahmed expressed his appreciation for the assistance of everyone in working on solutions to the problem

  
A.J. HEINEMAN  
Chief, Navigation Division