PAPER No. 472

Construction of Khairwala Drainage Project

By

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SUMMARY

Lower Rechna Doab was introducted to canal irrigation with the commissioning of L.C.C system when the sub-soil water table was at about 60' to 80' depth and the rainfall scanty. With the passage of time and development, water table slowly and gradually started rising leading to serious problem of waterlogging and salinity. Such events proceeded along the land slope i.e. from North to South and necessitated provision of drainage systems. By 1978 the whole of Upper Rechna Doab had been covered with horizontal and vertival drainage. However, the areas lying west of Rakh Branch and South of Chakbandi Drainage Basin were still without any drainage facility.

At present a major part of Faisalabad Division is badly water logged. A vast area lying between Jhang Branch and Bhowana Branch, Rakh Branch and Nasrana Disty : consitituting base lines and depression is almost completely waterlogged. About 54% of the total area of 3,33,400 Acres (521 sq. miles) has a sub-soil water table depth of less than 5' and some thing like 14% remains submerged for the most part of the year.

To cover this area, the Irrigation and Power Department conducted detailed survey and prepared a project for construction of 124 miles of trunk drains named as Khairwala Drainage Project. The P.C-I for this project included not only the construction of the surface drains but also 98 major masonry structures and other allied minor structures, like water-course crossings and inlets, etc. The Project approved by the Federal Government for Rs.195 million in May, 1981, is nearing completion and is scheduled for completion by the end of this year.

The Author through this paper presents a resume of the construction process of various components of the Khairwala Drainage Project alongwith related problems, bottlenecks, hazards and the remedies adopted to mitigate them.

The concept, planning and design part of the project was presented by the Author in his earlier paper No.458 in the 59th Annual Session of the Pakistan Engineering Congress.

1.0 PROJECT LOCATION

The area covered by Khairwala Drainage Project, a unit of Lower Rechna remaining (Scarp-

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V) is located in the South Western part of Rechna Doab. The Project area falls between latitude 31-15' to 31-27' North and longitude 72-45' to 73-05' East, and extends from Dijkot dy: of Rakh Branch to Feeder Dy: of Jhang Branch. Faisalabad-Jhang road passes almost through the middle of the area. Administratively the area lies in Faisalabad Gojra and Jhang Tehsils of Faisalabad, Toba and Jhang Districts respectively. Location of the project has been shown in Fig-1.

2.0 THE PROJECT AREA

The project covers a gross area of 521 square miles (3,33,440 Acres). The District-wise break up of this area is as under :–

Faisalabad Distt:	1,47,000	Acres
Jhang Distt:	1,52,960	"
Toba Tek Singh Distt:	33,480	"

2.1 Physiographically, the project area consists of mainly bar up land category in the Indus plain where alluvial deposits date back to the late pleistocene period. The alluvium consists mainly of unconsolidated sand and silt with small amounts of clay and Kankar.

2.2 The area experiences large seasonal variations in rainfall. The average annual rainfall varies between 10 to 16 inches out of which almost 80% precipitates during monsoon season. The North Eastern part of the project area registers slightly higher precipitation as compared to the South Western part. The whole area is underlain with an aquifer of reasonable quality. An Index plan appears as Fig: 2

3.0 THE PROBLEM AND ITS EXTENT

Khairwala unit consists of best agricultural lands from which record yields of sugurcane, maize and wheat have been obtained till the recent past. These lands are now facing the tetra headed problem of salinity, waterlogging, rainfall run off flooding and shortage of irrigation supplies. Salinity is the effect of the water shortage on one hand and high watertable on the other hand. Water logging is the result of seepage from the irrigation system and infiltration of rainfall run-off due to the lack of surface drainage. Similarly, flooding is caused by the accumulation of rainfall run off for lack of storage capacity in the soils due to high watertable and absence of proper surface drainage facilities.

3.1 The project area has been under canal irrigation since 1892. These canals and their distribution systems are running on the local ridges and the lowest areas or these valleys are located almost in their middle. These low lying areas form the base lines which are also the irrigation boundaries between the two irrigation channels. Obviously the water table is relatively closer

to ground surface in these base line areas. The local rainfall run off travels towards the base lines and accumulates there. These base lines then act as the drainage routes for the surface run off. The flow towards these drainage lines is obstructed by farm roads, farm channels and irrigation water courses net works. In most locations these base lines have been brought under cultivation authorisedly or unauthorisedly. Also the construction of roads under the rural development schemes has obstructed these natural routes in many cases. Consequently, most of the rainfall run off remains stagnant in the fields and local low lying areas and does not reach any main natural drains i.e. river. This water ultimately either infiltrates into the ground or is lost to atmosphere through evoporation. In other cases, it travels from one sub-watershed where conditions are favourable to the main watershed and there causes damages to crops and property and ultimately developes into ponds and marshes. As this evaporates, the fringes of these marshes are converted into highly salinised area unfit for any type of crop. These marshes act as permanent source of reacharge to the ground water which causes waterlogging elswhere in the low lying areas along the slope. This vicious circle established due to lack of proper surface drainage facilities is discernible throughout the project area. Marshes surrounded by vast salinized area or wide tracts of salinized and unproductive land are present long the main base lines where surface drainage is obstructed.

3.2 The constraints in the development of agriculture in the area are multi-disciplinary and are encountered in all its component resources i.e. land, water and other agriculture inputs. The problems faced by present agriculture are high water table and poor surface drainage in the area. The water table depths in the project area are depicted below :—

Water Table Conditions

Depth to water table	Area		Percentage of Total
	Sq. miles	Acres	
0-5	281	179840	54%
5-10	100	64000	10.2%
10-15	140	83600	26.8%

3.3 REDUCTION IN CROP YIELDS AND RAIN FLOOD LOSSES

The high water table causes drastic reduction in crop yields. The sowing of Rabi crop is hampered as the soil remains too wet for sowing operation till late in the season. The reduction in corp yield due to rise in watertable is very drastic when the watertable comes to within

about 2' feet of the natural ground. For example wheat loses about 60 ℓ at this depth.*

3.3.1 In addition to reduction in crop yields frequent rainstorms and high watertable result in both agricultural and non agricultural damages. The average annual flood damages in the area are estimated at 6.31 million Rupees. The losses due to reduction in crop yields come to Rs.31.4 million annually.

4.0 THE PROJECT PROPOSAL

To ameliorate the hopeless condition of the effected area, it was proposed to construct/ provide the following facilities in the Khairwala basin.

Surface Drains

S.No.	Name of Drain	Length (Miles)	Catchment (Sq. miles)	Q at outfall (Cs)
1.	Khairwala main Drain	59.2	521	1042
2.	Dijkot Branch Drain.	49.2	282	564
3.	Nasrana Branch Drain.	15.6	81	162
		124.6		

4.1 In addition to above surface drains 96 Tubewells of 2.5 cs capacity each are to be installed in low lying pockets of Dijkot and Nasrana sub basins by Wapda in two phases of 48 Tubewells each work on the first phase has been started.

4.2 The project comprising surface drains only was approved by ECNEC on 21st May 1981 for Rs.195 Million to be financed out of Federal Government provision under Accelerated Programme for Reclamation and Drainage. Anticipatory approval for commencing the project had already been accorded by the ECNEC on 10th March, 1981.

Refer table (I-a) of paper No.458 (Bib-5).

5.0 PROJECT ORGANIZATION

Considering the magnitude of work, a new project Division was opened on 1.4.1981 for further planning and construction of the project works. An organization chart for this Division appears as Fig-10. This division was charged with not only the construction work, it was also supposed to handle all relevent surveys, data collection and design work also. This project office inspite of its evident short commings handled.the task in creditable manner.

6.0 CONSTRUCTION WORK

6.1 a) Buildings

The Building component comprising 39 huildings located at different sites was taken up first of all in May 1981 and completed very expeditiously in order to provide a good working base for the project staff.

6.1 b) Drains

After detailed surveys of all possible alignments for trunk drains, necessary alignment, plans were prepared and approved in September, 1981. Based on the alignment plan, detailed field investigations and other relevant steps were taken to arrive at the drain capacities, design of drain sections and construction parameters. Long sections of the drainsprepared after design computations based on usual Mannings relationships appear as Fig-3(a-e) and a typical x-section drawn for Khairwala main drain at RD 40500 is appended as Fig: 4 which exhibits the general construction parameters of the drain section. However, in locations where the drain bed is lower than sub soil water level, side slopes of 1½:1 were provided. The free board for banks has been provided as per standard for flood embankments as this reach is subject to back water effect of River Chenab.

6.2.1 The drain excavation process has been divided into two phases for ridge reaches of Dijkot and Khairwala drain. The first one comprising the excavation of dry earth above Sub Soil Water Level and the other covering wet excavation below S.S.W.L. The excavation above S.S.W.L was done through farm tractors and bulldozers deployed by the contractors. The farm machinery provided a great help in the absence of donkey labour which has now become a rare comodity. Out of a total quantity of over 250 MCF less than 1 million MCF could be done through donkey labour. The excavation below sub soil water level was done through drag lines owned by Department as well as by the contractor. Some reaches were excavated by departmental machinery while contractors owned machinery was deployed in some other reaches. The performance of machinery owned by private enterpreneures was found to be quite good and satisfactory.

6.3 STRUCTURES

6.3.1 BRIDGES

a) Railway Bridges.

Three Railway Bridges, one on Khairwala Main Drain and two on Dijkot Branch Drain were designed and constructed by the Railways themselves according to their own requirements and standards. Two bridges have since become operational while the third one will be opened to regular traffic shortly.

6.3.2 b) Highway Bridges

A total number of six AR bridges was provided for in the project. Before construction, the design and drawings were also vetted/approved by Highway Department. Four of these Arterial Bridges as detailed below have since been constructed and are already catering for traffic, the remaining two will be completed and opened during the current financial year.

6.3.3 c) District Road Bridges.

All the ten bridges on district roads have been completed and opened to traffic. Design of these bridges were got vetted from District Council concerned before commencing the construction work.

6.3.4 d) V.R. Bridges

Village road bridges are normally located on Village links and designed for lighter class "A" loading. A total Number of 49 such bridges was provided for in the project out of which only 8 number are in progress and will be completed within the current year, while the rest have been completed and are under operation.

6.3.5 e) Foot Bridges

A small number of Foot Bridges was also provided to handle padestrian traffic on important village paths and have since been completed and are under operation.

In general the construction of bridges did not pose any serious problem except sinking of foundation wells and dewatering operation for lowering water table to the designed level of transom slabs which had to be laid several feet below S.S.W.L on account of high water table. For some bridges the water table had to be lowered by 20' or so.

6.3.6 f) Falls

Four falls have been constructed out of which two are located on Dijkot Branch drain, one on Khairwala main drain and one on Nasrana Branch drain. Like bridges, the problem of well sinking and lowering of sub soil were the main challenges which were met quite successfully and the structures constructed as planned. These structures have been provided with pressure pipes for determination of up lift pressures below the floor which will be the basic data for assessment of safety of these structures and decision regarding remedial measures in case of any contingency requiring the same. Another special feature of all these falls is the laminated construction of their crests which will facilitate gradual lowering of the crest in layers of small tickness whenever need be. The main advantage of this provision is that the slopes on these drain can be safely increased later on by lowering the crest, thus improving the flow conditions and capacity of the drain section. At the moment the drain slopes have been restricted in the ridge reaches on account of heavy cuttings involved.

6.3.7 g) Aqueducts

The drains in Khairwala project have to cross irrigation channels at three points. Khairwala main drain crosses Jhang minor at the drain RD 57200 while Dijkot Branch drain crosses Nasrana dy: at RD 143100 and Jhang Branch lower RD 91380 and drain RDs 74000 and 47800 respectively. All the three aqueducts are trough type, the trough conveying the irrigation water over the drain. The designed discharge capacities of the troughs have been kept as 10 to 25% over and above the discharge of irrigation channel, they have to carry, so that future development of areas on concerned channel and consequent increase in discharge may be safely accommodated.

6.3.7.1 Considering the paramount importance of these structures, and Bridges in ridge reach of Dijkot Branch Drain extendable spans to cater for better discharge management and future extension have been provided.

6.3.7.2 The aqueduct at RD 91380 Jhang Branch Lower is the largest single structure of the Project. This structure costing 10.5 million Rupees remained under construction for a period of over 24 months. Most of this time was consumed in sinking of 112 foundation wells, each of which had to be sunk through a depth of over thirty feet. The water table had to be lowered by over 19' in the large foundation pit. Salient data of this structure appears in table 8.(a-b).

6.3.8 h) Miscellaneous structures

These structures include cross drainage works across gas supply lines of Sui Northern and coaxial cables of the T&T Department.

6.3.8.1 The main Sui Gas transmission artery consisting of two sixteen inches dia supply lines has been crossed twice, once at RD 192-93 of Dijkot Branch Drain and again at RD 74000 of the same drain. The crossing at RD 192 Dijkot Branch Drain involved only a lowering of abour 4½' at the centre line of the drain. This job was done by Sui Northern Gas Pipelines Ltd. themselve. The other crossing at RD 74000 Dijkot Branch drain required a lowering of over sixteen feet which was not agreed to by the Gas Transmission company and a trough type structure had to be constructed to provide a safe crossing for the gas mains which carry the gas to almost two third the area lying North of the crossing. This crossing therefore became the most sensitive structure and in a way, the most difficult too.

6.3.8.2 The whole of the structure had to be constructed underneath the pipe line which had to be provided proper anchorage/loading in the exposed state to safe guard against vibrations which if set in could precipitate a catastrophic situation by causing a big explosion.

6.3.8.3 All the construction process had therefore to be undertaken with utmost care underneath these highly explosive units. Well sinking became the most difficult component of the work. Laying the trough slab and walls was another sensitive job to be executed in close proximity of the transmission line. The structure was however, completed without any untoward incident.

6.3.9 j) Inlets

Inlets are minor but very important part of a drainage project 198 No Inlets were proposed to be constructed at the depression siteson the three drains. A substantial number has already been completed while the remaining are either in progress or under process and will be completed by the end of the year. Almost all the Inlets are barrel type. Those located in depression areas have been provided with double acting flap valves to stop the reverse flow from the drain into the depression. The capacity of Inlets located at the junction of some minor base lines is sufficient to cater for discharge for discharge from the catchment of that particular base line to save on the expenditure for outfall when such base lines are converted into tributary drains in future.

6.3.10 k) Water Course Crossings

Water Course Crossings are simply concrete trough's supported on masonery piers and well foundation and in construction are almost mini aqueducts.

7.0 DEWATERING FOR FOUNDATION OF STRUCTURES

The water table in a major part of Khairwala Drainage project area is within 5' and in a substantial area specially in Khairwala Budh, extensive marshes and large extents of stagnant water occupy the maximum area. This causes a severe problem for construction of masonary

structures. Almost all the structures in Khairwala Budh area were constructed in stagnant water by first enclosing the location of the structure with a ring bund, connecting it with roads through a specially made track, vacating the water from the enclosure and only then the actual work could start.

7.1 The lowering of sub soil water level had to be done against a constant static head of the water standing around the enclosure bund in addition to the sub surface flow, from a sandy aquifer with high yield. This required more pumpage over a longer duration as compared to other areas. Fig: 8 (a+b) show the arrangement of Tubewells installed for lowering sub soil water level in the foundation pit of Aqueduct RD 47800 Dijkot Branch Drain and the fall at RD 28750 of the same drain.

8.0 MATERIALS OF CONSTRUCTION

The main materialsused in hydraulic structures are cement, bricks, aggregates, steel and earth etc. The brief resume of the quality and type of material used for structures of this project, appears below :–

8.1 a) Bricks

The bricks are the most important and most mishandled material of construction. The quality of bricks has badly deteriorated since the departmental Kilns were closed, simply because there is no control over the manufacturing process with the result that the Kiln owners neither care to produce good bricks nor they feel any necessity for doing so because all their produce good or bad is readily sold out at the rates they demand. The result is obvious.

8.1.1 The search for good bricks was therefore a constant source for anxiety for the supervisory, staff, whose unceasing efforts paid dividends and reasonably good bricks were used.

8.2 b) Steel

Manufacture of steel products has also sufferred because it has gone into small industry sector also. The small units do not have adequate technological and the laboratory testing support. Moreover, some of them use scrap instead of billet steel as raw material for rolling of bars and other structural sections. As a result products of low quality and uncertain properties are produced

8.2.1 Only deformed steel with working tensile stress of 18000 psi has been used on all the structures. A lot of efforts both coaxing and commanding, had to be put in to make the contractors working under composite system to purchase the steel of proper quality from realiable manufacturers.

8.3 c) Aggregates

8.3.1 i) Crushed Stone

The coarse aggregate for concrete (crushed stone) was brought in from Margalla Hills or good quality Sikhanwala stone.

8.3.2 ii) Sand

Clean pit/river sand was used for general purposes but for reinforced concrete in deck slabs, coarse haro sand was also added in the ratio of 1 : 1 in the pit sand.

8.4 d) Cement

Normal portland cement has been used in all the structures, the main sources are Gharibwal, Dandot, Maple leaf and Zealpak cement factories.

9.0 SPECIFICATIONS

For all works the departmental specifications invogue have been used. The stresses used for R.C.C design are 18000-750-18.

10.0 QUALITY CONTROL

The quality control on any project is only possible if the supervisory staff knows the job and stays at the site of work. To achieve this, site offices were set up on every component work and manned by the supervisory staff, where relevant plans and other record alongwith Inspection Registers were kept available.

10.1 A complete soils laboratory was set up and remained operative during the construction of banks effected by back water from river Chenab for testing of compaction and determination of soil characteristics. In addition to field checks, steel and concrete were tested at the central testing laboratory and Engineering University.

11.0 WORKING OF MACHINERY

Various types of machinery, deployed on the project has been detailed in the Table-7.

12.0 PROGRESS REVIEW

Regular progress review is a useful tool to assess the pace of execution. Bar charts were used for preparation of work schedule and monitoring of progress. Triangular diagrams were used for monitoring sub works. A schematic diagram showing the major project works appears as Fig-6 and the project construction schedule is presented in Fig-7. Detailed physical progress

for the project as a whole is shown in Table 6.

12.1 Financial utilization was contained in monthly progress Reports. Detailed financial utilization for the project with component-wise break-up is contained in Table 5 and salient financial features appear in Table 4. A bar diagram depicting the annual utilization and cumulative figures over the gestation period appears as Fig-9(a).

12.2 The peoject was originally proposed to be completed by June, 1985, but on account of inadequacy of funds, the gestation period of the project has been extended by another year.

13.0 FUNDING

The project as mentioned earlier is being financed out of the Federal Government provision under accelerated programme for reclamation and drainage. Table-4 depicts the planned and actual figures of fund allocations, which also indicates that the funds provided during 1982-83 and 83-84 were much lower than the planned figures thus increasing the construction period.

14.0 PROBLEMS & BOTTLENECKS

14.1 A. Procedural

14.1.1 i) Land Acuisition

The Land Acquisition procedure presently inforce is not only long and cumbersome, it is also highly prone to litigation in Civil Courts which prolongs over long period and thus causes delay in execution. A detailed analysis of the issue is beyond the scope of this paper, but one thing is sure that the present structure of land Acquisition instructions does need substantial modification.

14.1.3 The project staff had to face a lot many Civil Suits in this behalf and some cases are still awaiting final decision.

14.1.2 ii) In the absence of a proper and effective public relation wing in the department the projection of Government activities in the development field suffers quite a large set back.

14.2 B Constructional

14.2.1 a) The major problem is the procurement of quality materials for construction like bricks and steel etc. It required a lot of efforts to cope with this problem as already mentioned in earlier paragraphs.

14.2.2 In some cases lenses of imprevious hard clays presented serious problems. In most cases the wells get stuck and are hard to dislodge. In one particular case a clay lense was found to cover only a part of well line. The result was that the wells tilted beyond rectification and had to be replaced with a lot of effort.

15.0 SUGGESTIONS

The following suggestions are offered for consideration at proper level for better management of major construction projects :–

15.1 i) The land acquisition process should be simplified. Either the project Engineers should be delegated with the powers of land acquisition Collectors or a proper land acquisition cell héaded by an officer having full powers of District Collector may be created and attached to each major project. The land acquisition Act and relevant rules may be modified on the lines of the housing Act.

15.2 ii) Ways and means including necessary infra-structure for control over manufacture of important construction materials is the need of the day.

To ensure quality of bricks, revival of departmental kilns in addition to other steps is suggested.

15.3 Manufacturers of structural steel products should be stopped from using scrap for the rolling process of structural products, and they should arrange to clearly specify the structural properties of their manufactured goods. Each establishment should have effective quality control and laboratory testing support.

15.4 iii) Funding should correspond to the projected phasing of expenditure as deviation results in delay and increase in cost due to escalation and higher interest charges.

16.0 BENIFITS

The annual average benefits of the project as computed in the project proposal come to Rs.37.71 million. The project is expected to meet the targets as the benifits are already apparent in the source reach of Dijkot Branch Drain and Nasrana sub-basin as a whole, where pools of stagna.. water and marshy areas are dis-appearing at a rapid pace.

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6. Construction documents and records of Khairwala Drainage Project 1981-1985.

LIST OF TABLES

S.No.	Title
1.	Khairwala Drainage Project at a glance.
2.	Khairwala Drainage Project, Abstract of Cost
3.	Salient Physical Features/Data of Khairwala Drainage Project
4.	Salient Financial Features
5.	Detailed Financial Utilization
6.	Detailed Physical Progress.
7.	Statement showing Machinery Deployed on Project Works.
8.	Salient Data of Aqueduct at RD 91380 Jhang Branch Lower over Dijkot Branch Drain.

TABLE – 1

KHAIRWALA DRAINAGE PROJECT AT A GLANCE

1.		COST OF PROJECT	Rs. 194.84	MILLION
2.		LENGTH OF DRAINS	124.2	MILES
	i)	KHAIRWALA MAIN DRAIN	59.2	"
	ii)	DIJKOT BRANCH DRAIN	49.4	"
	iii)	NASRANA BRANCH DRAIN	15.6	"
3.		DISCHARGE CAPACITY OF DRAINS AT OUT FALL		
	i)	KHAIRWALA MAIN DRAIN	1042	CS :
	ii)	DIJKOT BRANCH DRAIN	564	"
	iii)	NASRANA BRANCH	162	"
4.		AREA TO BE PROVIDED DRAINAGE FACILITIES		
	i)	KHAIRWALA MAIN DRAIN	521	SQ. MILES
	ii)	DIJKOT BRANCH DRAIN	282	"
	iii)	NASRANA BRANCH DRAIN	81	"
5.		TOTAL QUANTITY OF EARCH WORK	262.77	M.CFT
6.		NO OF STRUCTURES VIZ AQUEDUCTS FALLS/OUT FALLS AND BRIDGES OF ALL SORTS	98	NOS :
7.		INLETS	189	NOS :
8.		BENEFIT COST RATIO	1 : 13 : 1	
9.		INTERNAL RATE OF RETURN	16%	

TABLE – 2

KHAIRWALA DRAINAGE PROJECT

ABSTRACT OF COST

(ORIGINAL APPROVED)

	MILLION RS.
I – WORK	
A – PRELIMINARY	0.16
B – LAND	15.93
C – WORKS	47.23
K – BUILDINGS	4.67
L – EARTH WORK	60.17
M – PLANTATION	0.37
O – MISCELLANEOUS	3.36
P – MAINTENANCE	1.16
LOSSES OF STOCK	0.10
SPECIAL T & P	0.81
UNFORESEEN	1.34
TOTAL OF I – WORK	135.30
ii – ESTABLISHMENT CHARGES	26.78
iii – T & P	1.35
INDIRECT CHARGES	2.15
TOTAL OF DIRECT & INDIRECT CHARGES	165.58
INTEREST CHARGES	29.26
GRAND TOTAL	194.84

TABLE–3

SALIENT PHYSICAL FEATURES/DATA OF KHAIRWALA DRAINAGE PROJECT

Items	Khairwala Main Drain	Dijkot Branch Drain	Nasrana Branch Drain	Total
a. Lengths (Canal Miles)	59.02	49.04	15.06	124.02
b. Catchment Area (Sq. Miles)	239.00	201.00	81.00	521.00
c. Land (Acres)	1198.05	904.31	153.28	2256.09
d. Railway Bridges	1	2	–	3
e. A.R. Bridges	4	1	1	6
f. D.R. Bridges	3	3	1	7
g. V.R. Bridges	22	20	7	49
h. Acqueducts	1	3	–	4
i. W/C Crossing	9	10	–	19
j. Falls/Outfalls	1	2	1	4
k. Drainage Inlets	59	98	32	189
l. Miscelleanous (Sui Gas, Telephone Crossing etc.)	4	2	–	6
m. Earth Work (Mcf)	142.0	109.3	11.5	262.8

TABLE – 4

SALIENT FINANCIAL FEATURES (All costs in Million Rs)

Year	Planned phasing	Funds allocated	Funds released	Expenditure	Remarks
1979-80	–	–	–	–	
1980-81	23.45	15	15	14.93	
1981-82	51.92	51.78	51.78	36.32	
1982-83	61.57	22.72	22.72	30.02	
1983-84	53.37	29.20	29.20	37.63	
1984-85	23.47	60.00	60.00	50.68	
1985-86	–	44.23	3.5	2.82	
			44.23	44.23	
			(Anticipated)	(Anticipated)	

TABLE – 5

DETAILED FINANCIAL UTILIZATION

Fiscal Yearwise Expenditure (All Figures in Million Rs.)

Item No.	Description	Total cost original P.C-1	Ist Yr. 1980-81	2nd Yr. 1981-82	3rd Yr. 1982-83	4th Yr. 1983-84	5th Yr. 1984-85	6th Yr. 1985-86	Total Expen-diture	Remarks
1.	Land Acquisition.	15.93	7.500	8.530	0.195	0.119	15.670	1.140	33.154	
2.	Works/Structures of sorts	47.23	6.660	9.186	13.650	19.940	21.300	11.190	81.926	
3.	Earth Work	61.49	0.015	12.22	8.136	6.998	8.033	18.020	53.422	
4.	Buildings	4.67	0.084	3.76	0.97	0.063	0.008	–	4.965	
5.	Plantation	0.37	–	–	–	0.02	0.034	0.06	0.114	
6.	Miscellaneous	6.96	0.670	0.44	0.34	0.18	0.85	4.49	6.970	
7.	Establishment charges	26.78	–	–	–	–	–	–	–	
8.	Interest + Indirect charges	31.41	–	2.178	6.720	10.305	4.700	9.33	33.23	
	Total :	194.84	14.929	36.314	30.011	37.625	50.675	44.230	213.784	

NOTE : Figures for 85-86 are firm anticipated.

TABLE–6

DETAILED PHYSICAL PROGRESS

Item No.	Description	YEARS 1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	Total
1.	Land Acquisition	25%	30%	[illegible]	1%	40%	30%	100%
2.	Works/Structures of sorts	–	18.6%	16.04%	23.44%	25.05%	16.87%	100%
3.	Earth Work	–	33.7%	21.50%	12.70%	7.20%	24.99%	100%
4.	Buildings	2%	76%	19.5%	2.5%	–	–	100%
5.	Plantation	–	–	–	6.5%	–	18.5%	25%
6.	Miscellaneous	9.62%	6.32%	4.8%	2.6%	12.21%	64.45%	100%

NOTE : Figures for 85-86 are firm anticipated.

TABLE–7

STATEMENT SHOWING MACHINERY DEPLOYED ON WORK IN KHAIRWALA DRAINAGE PROJECT

S.No.	Type of Machinery	Departmental	Contractor	Total	Remarks
1.	Farm Tractors	–	250	250	
2.	Bulldozers	4	4	4	
3.	Draglines, Clamshell etc.	5	10	15	
4.	Pumping Sets	2	70	72	
5.	Generating Sets	–	3	3	
6.	Jeeps	3	5	8	
7.	Pick-ups	1	4	5	
8.	Sheep Foot Rollers	1	1	2	
9.	Water Tankers	–	1	1	
10.	Scrapers (Fractional Capacity)	–	6	6	

TABLE–(8-a)

SALIENT FEATURES OF AQUEDUCT AT R.D. 91380 JHANG BRANCH LOWER

S.No.	(i) Hydraulic	
1.	Number of bays	3 No
2.	Width of Each day	36 ft.
3.	Bed R.L of trough	566.46
4.	Full supply depth in trough	7.5 ft
5.	Full supply level in trough	573.96
6.	Top R.L of side walls of trough	575.46
7.	Width of Road of D.R. Bridges	12 ft.
8.	Road R.L.	577.78
9.	Loading for Bridges	Class "A"
10.	Bed width of trough	50 ft.
11.	Discharge capacity	1500 cusecs
	(ii) Structural	
1.	Cost	Rs.1,03,20,000/-
2.	Earth work	20.04 lacs Cft
3.	Brick Masonary	206244 Cft
4.	Concrete P.C.C. (1 : 2 : 4)	2714 Cft
5.	Concrete P.C.C. (1 : 3 : 6)	33409 Cft
6.	R.C.C. (1 ; 2 : 4)	44778 Cft
7.	Number of wells in foundation	112 No.
8.	Sinking of wells	3360 Lft
9.	Stone work	25100 Cft
10.	Deformed Reinforcement Bars	156723 Kg
11.	Cement	1060 tons.
12.	Bricks	30 lacs.
13.	Course Aggregate	72000 Cft

TABLE –

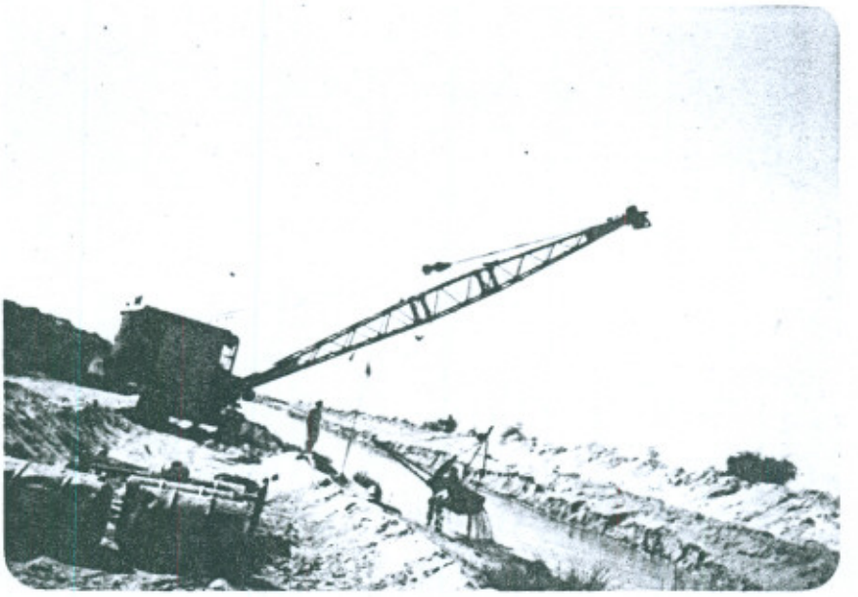
TABLE – (8-b)

CANAL AND DRAIN DATA AT AQUEDUCT RD 91380 JBL

S.No.		Canal Data	Drain Data
1.	Bed width	83 ft	36 ft
2.	Bed level	566.46	546.31
3.	Full supply Depth	7.5 ft	5.6'/8.3'
4.	Full Supply Level	573.96	551.91/554.61
5.	Full Supply Discharge	1200 cs	564/1128 cs
6.	Bed Slope	0.2%	0.2%
7.	Side Slope	–	1.5 : 1
8.	Angle of crossing	90°	
9.	R.D	91380	47800 D. Br : Drain
10.	Catchment Area	–	282 sq. miles.

LIST OF FIGURES

S.No.	TITLE
1.	Project Location
2.	Index Plan
3. (a)	Long section of Khairwala Main Drain RD 0 – 90
(b)	Long section of Khairwala Main Drain RD 90 – 255 (source)
(c)	Long section of Dijkot Branch Drain RD 0 – 115
(d)	Long section of Dijkot Branch Drain RD 115 – 221500 (source)
(e)	Long section of Nasrana Branch Drain RD 0 – 70 (source)
4.	Cross section at RD 40500 Khairwala Main Drain
5.	Typical elevation of an extended span Bridge
6.	Schematic Diagram of Khairwala Drainage Project
7.	Project construction schedule
8. (a)	Lay out plan showing arrangement of Tubewells for lowering S.S.W.L at Aqueduct site RD 91380 Jhang Branch Lower.
(b)	-------- Do---------- Fall site RD 28750 Dijkot Branch Drain.
	Financial utilization chart.
10.	Organisation Chart of Khairwala Drainage Division.

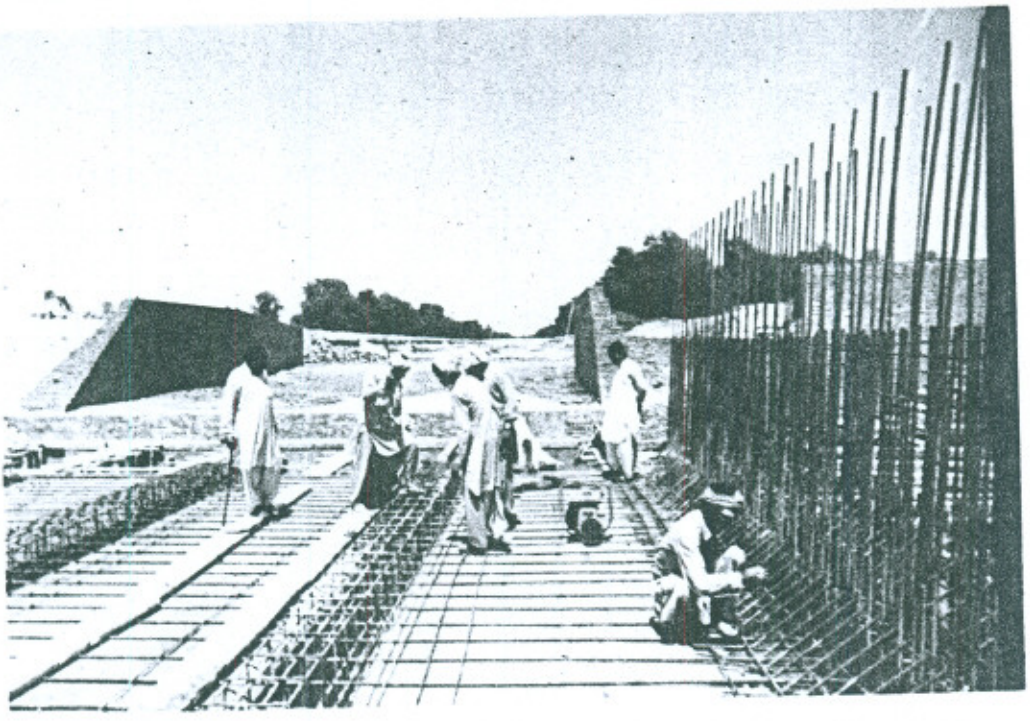


Excavation by drag lineson Khairwala Main Drain. See how the slush flows through the bucket drain holes.

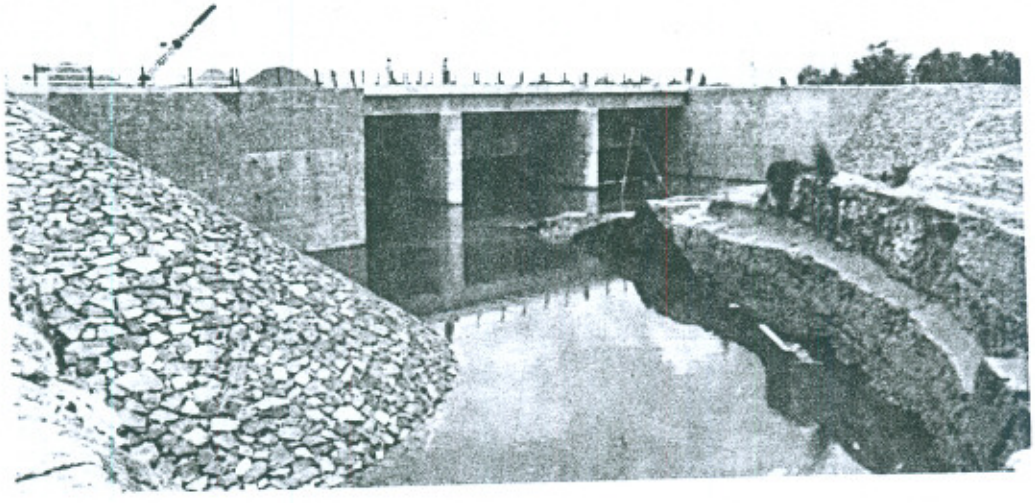


Excavators at work on Khairwala Main Drain.

PROJECT EXECUTION PICTORIAL



Laying and Binding of steel in the trough
walls of the Aqueduct RD 47800 D.Br. Drain

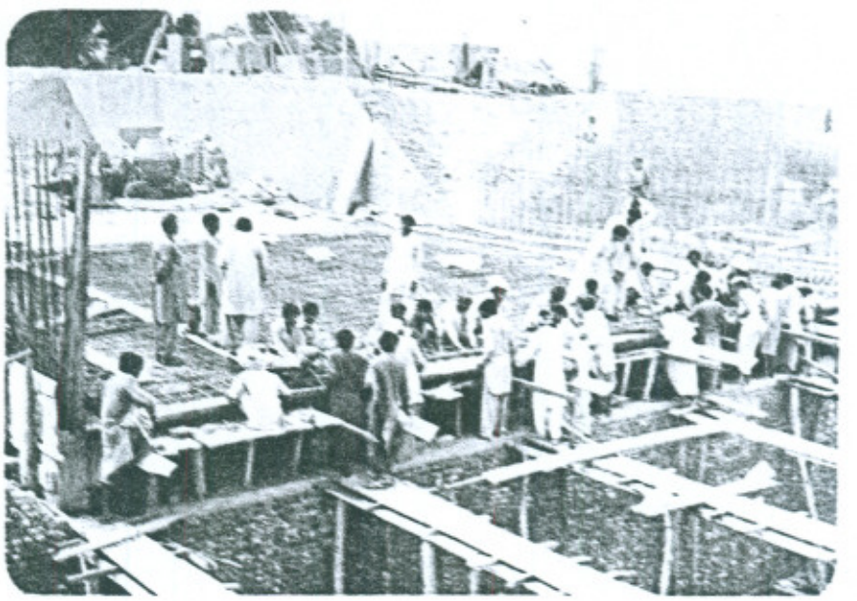


A general view of the above Aqueduct

PROJECT EXECUTION PICTORIAL



An excavated portion portion in Budh Depression

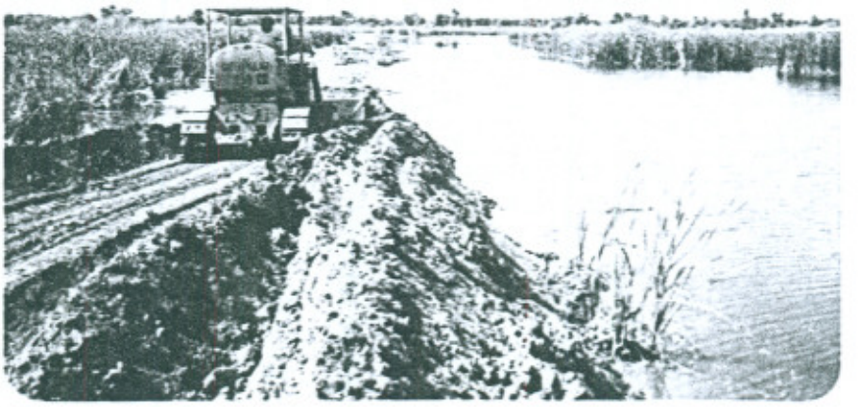


Form work and copper flashing being installed
at Aqueduct on Jhang Branch Lower.

PROJECT EXECUTION PICTORIAL



Excavation with form machinery on
Dijkot Branch Drain R.D. 40-41



Preparation of working pad for excavators
in Budh Depression.

PROJECT EXECUTION PICTORIAL



A drag line topples over into the drain
it was excavating.



Another casuality

PROJECT EXECUTION PICTORIAL

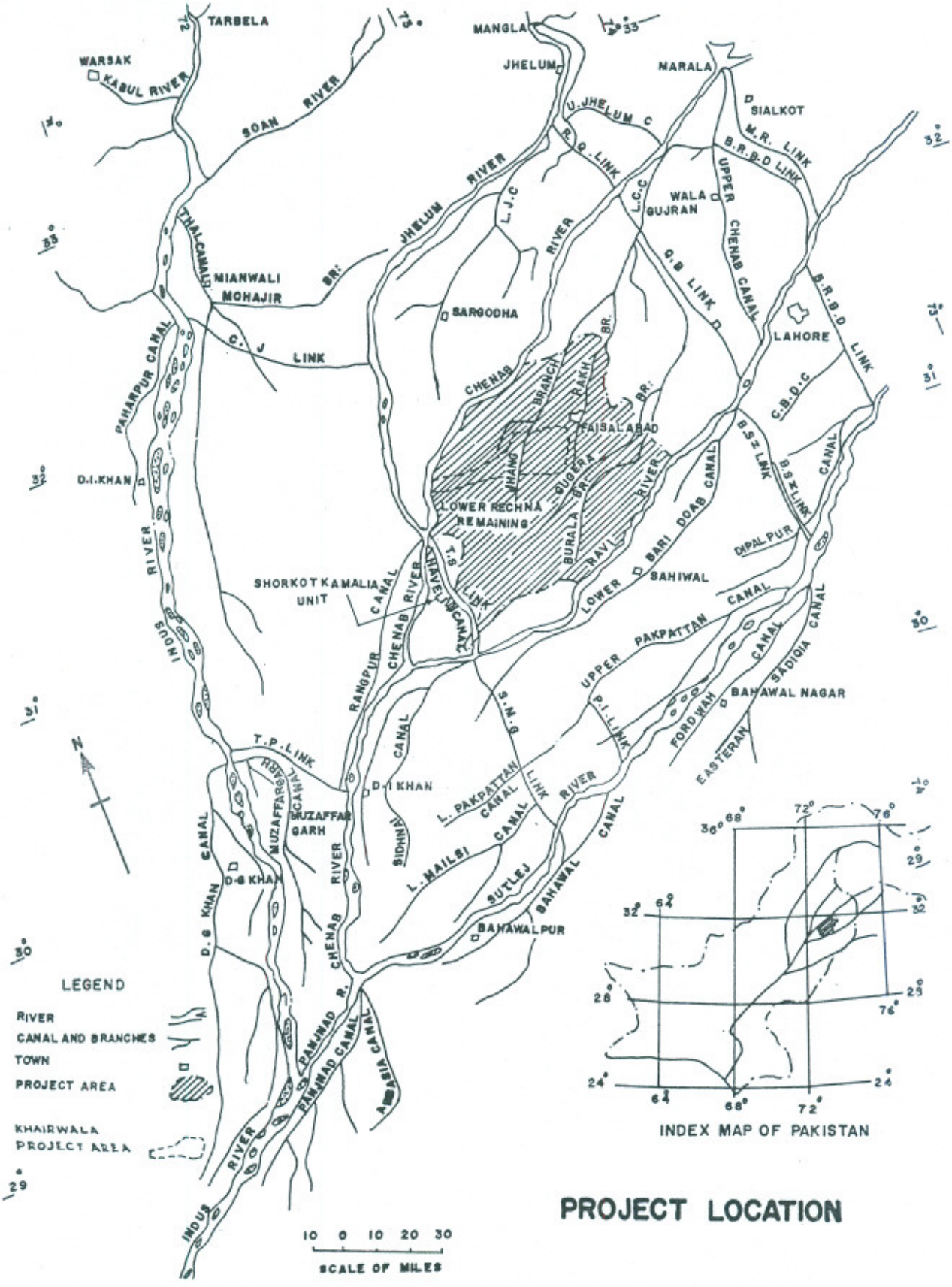


Khairwala Depression
The alignment of Khairwala Main Drain

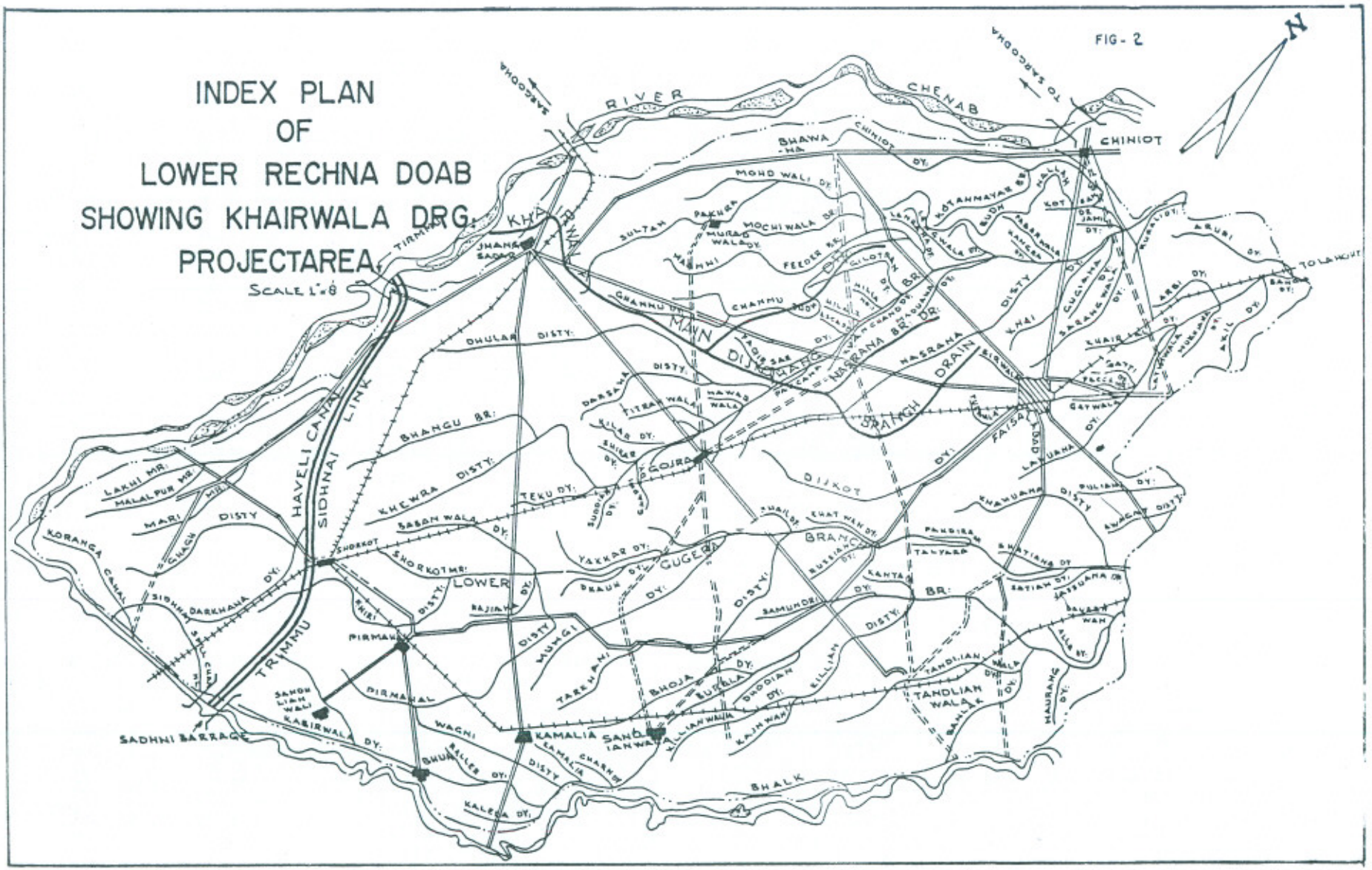


A sample out of the vast salinised tract
in the Project area.

FIG - 1



PROJECT LOCATION


INDEX PLAN
OF
LOWER RECHNA DOAB
SHOWING KHAIRWALA DRG.
PROJECTAREA
SCALE 1"=8
FIG- 2
N
RIVER CHENAB
TO SARGODHA
SARGODHA
CHINIOT
BHAWA-HA
KHAIRWALA
TIRMMU
JHANG SADAR
MOHD WALI DY:
SULTAN
PAKHER
MURAD WALA DY.
MOCHIWALA BR:
FEEDER
GHANNU DY:
CHANNU
MAIN DIJKMANG
NASRANA BR:
NASRANA DRAIN
DHULAR DISTY:
BHANGU BR:
KHEWRA DISTY:
HAVELI CANAL
SIDHNAI LINK
TRIMMU
LAKHI MR:
MALALPUR MR:
MARI DISTY
CHAGH MR:
KORANGA CANAL
SIDHNAI DARKHANA DY:
SHORKOT
SHORKOT MR:
LOWER DISTY:
KHIRI
PIRMAHAL
SADHNI BARRAGE
SANGHLIANWALI
KABIRWALA DY:
WAGHI
BHUMLER DY:
KALERA DY:
KAMALIA SANGHLIANWALA
KAMALIA
CHANNU
MUNGI DISTY:
TAREHANI
BHOJA
SURLA DY:
DRODIAN DY:
KAJHWAH
BHALK
GUGERA
DIJKOT
BRANCH
DARAMGH
FAISAL
KHAIRA
GATWALA DY:
KHAWANA
KHAWANA DISTY:
PANDIRAN
TALYARA
KANTA BR:
SAMUNDRI DISTY:
TANDLIAN WALA
TANDLIAN WALA BR:
HAURANG DY:
ARJUNI DY:
TOLAMOUT
AKIL DY:
KHAIRA
GATI
SIKHWALA
KHAI
DISTY
BHAGWANA BR:
DARSANA
FITRAH WALA
NAWAB WALA
SUBDY:
KHAIRA DY:
TEKU DY:
SABAN WALA DY:
YAKHAR DY:
DHAUN DY:
KHAIRA
KHAT WEH DY:
BUREANA DY:
SAMUNDRI DY:
DISTY:
SATIAH DY:
KHUSHANA DY:
BAKHAR WAH
ALLA DY:
BULIANA DY:
AWAGANA DISTY:
BHATIANA DY:

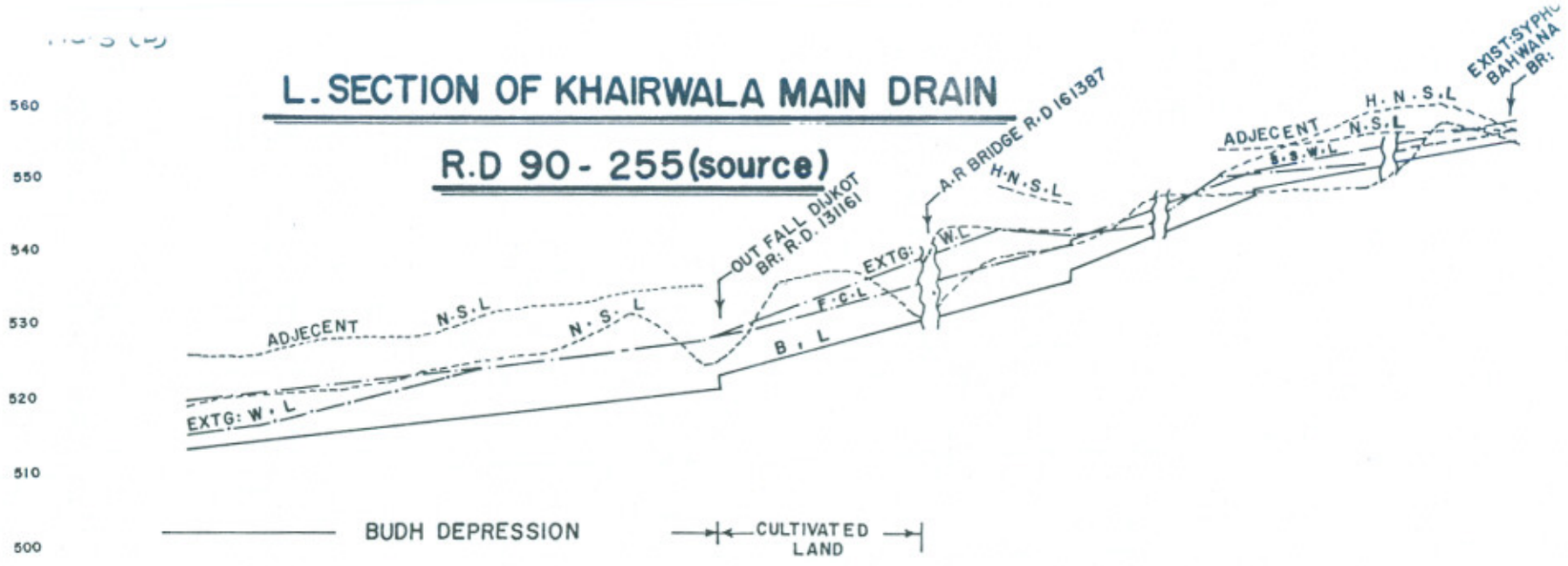
LONG SECTION OF KHAIRWALA MAIN DRAIN

RD. 0 - 30,000

FIG-3 (a)

L. SECTION OF KHAIRWALA MAIN DRAIN

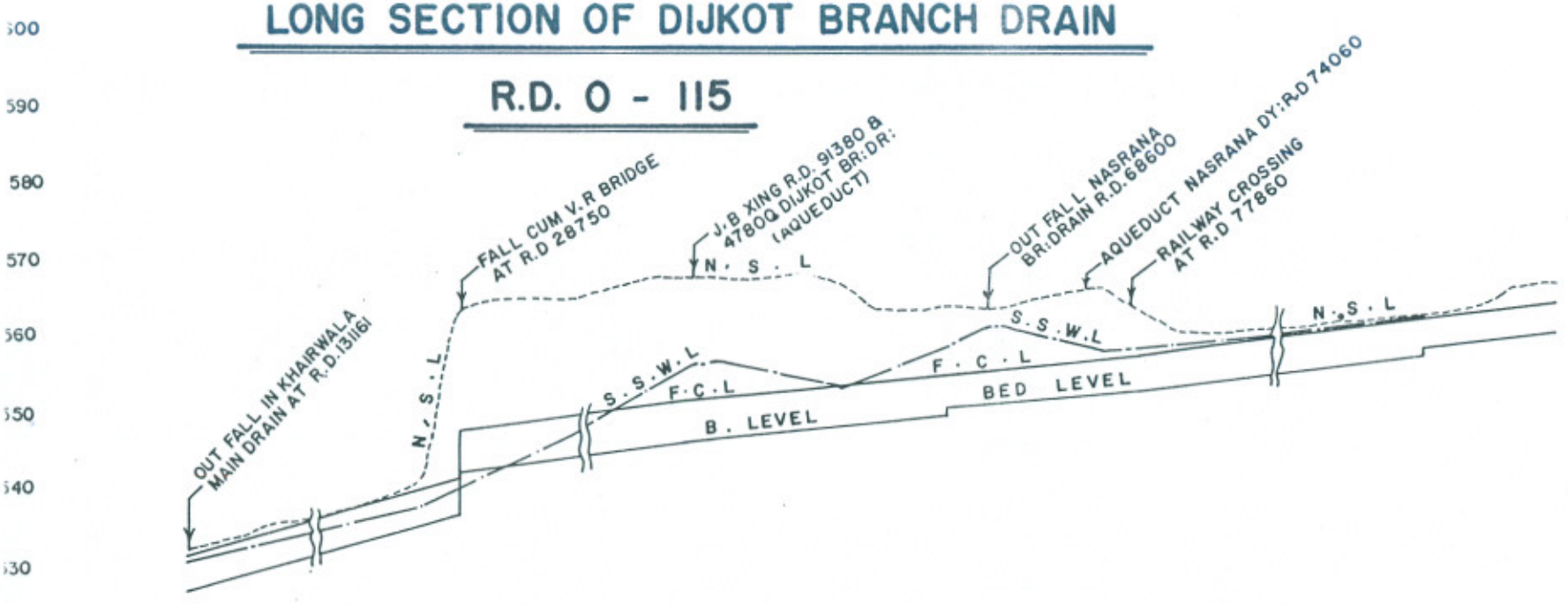
R.D 90 - 255 (source)



| | | |

LONG SECTION OF DIJKOT BRANCH DRAIN

R.D. 0 - 115

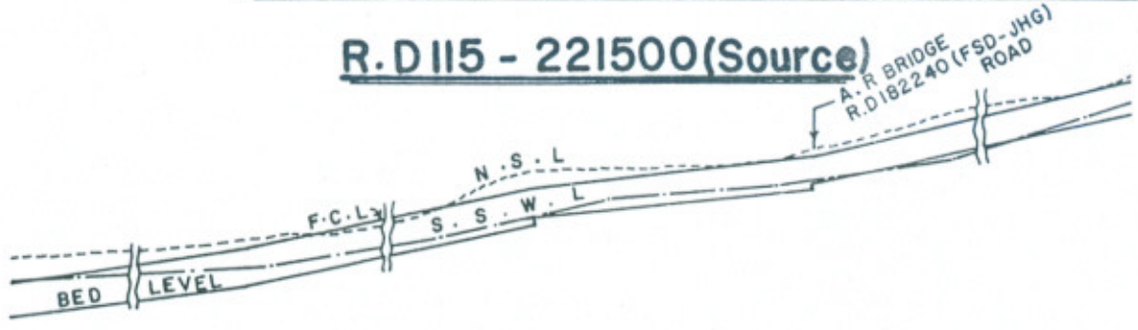


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FIG-3(d)

L-SECTION OF DIJKOT BRANCH DRAIN

R.D 115 - 221500 (Source)

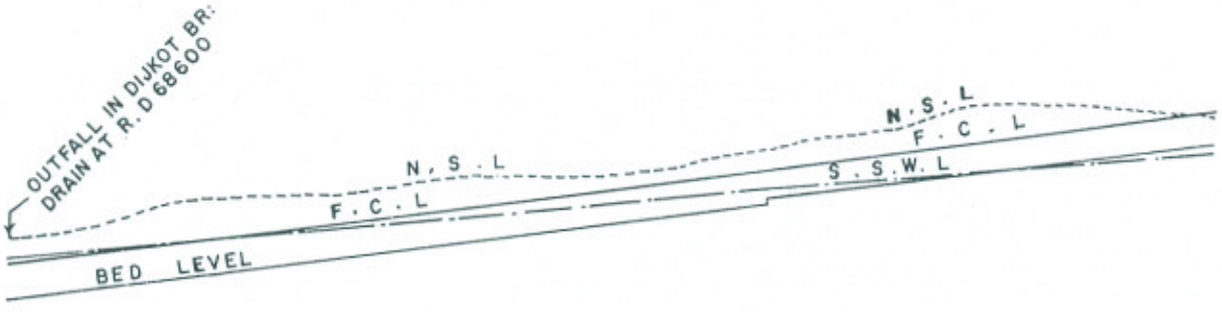


| | | |

FIG-3(e

LONG SECTION OF NASRANA BR: DRAIN

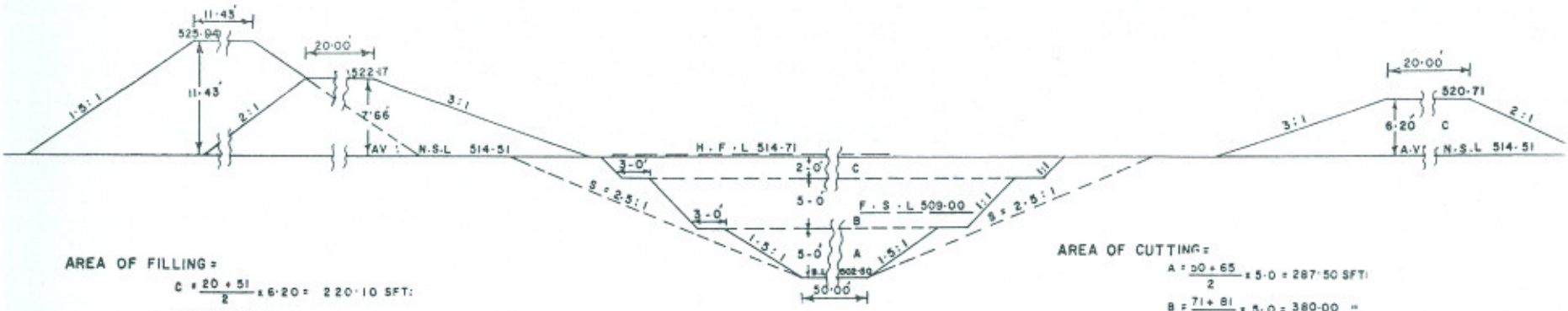
R.D. 0 - 70,000 (Source)



S.S.W.L	61·40					66·10				70·05						74·20	
CATCHMENT AREA	←		81·0 SQUARE MILES						→	←	56·0 SQ! MILES					→	
SLOPE	←		0·25 ‰						→	←	0·25 ‰					→	
DISCHARGE	←		162 CS:						→	←	112 CS:					→	
F·C. DEPTH	←		3·9′ / 5·8′						→	←	3·5′ / 5·0′					→	
BED WIDTH	←		18·0′						→	←	15·0′					→	
F·C·L	561·00	62·28	63·50	64·75	66·00	67·25	68·50	69·75	71·00	71·99	72·25	73·50	74·75	76·00	77·25	78·50	
BED LEVEL	557·10	558·38	59·60	60·85	67·10	63·35	64·60	65·85	67·10	68·09 / 68·49	68·75	70·00	71·25	72·50	73·75	575·00	
N. S. L	564·63	65·73	68·83	68·84	69·27	71·23	71·05	71·34	73·55	74·04	74·63	76·27	78·83	79·00	78·70	78·00	(SOURCE)
R.DS	0	5	10	15	20	25	30	35	40	43950	45	50	55	60	65	70	

CROSS SECTION AT R.D. 40500 KHAIRWALA MAIN DRAIN

FIG- 4



AREA OF FILLING =

C = $\frac{20 + 51}{2}$ x 6·20 = 220·10 SFT:

D = $\frac{20 + 58·30}{2}$ x 7·66 = 299·89 "

519·99 SFT:

AREA OF CUTTING =

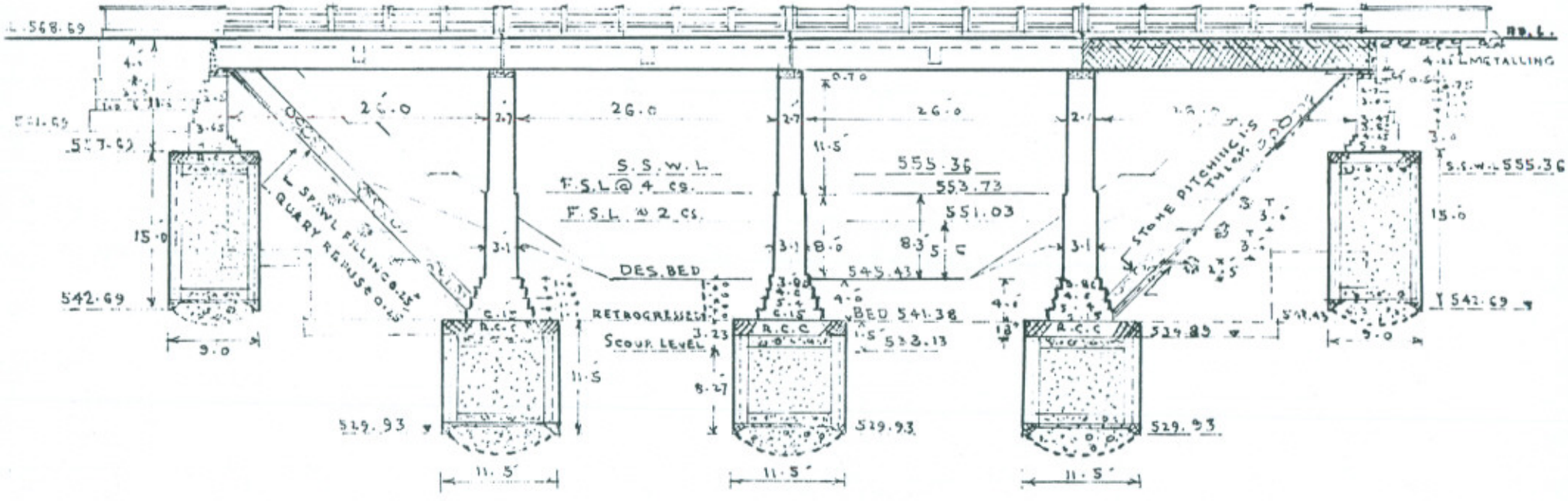
A = $\frac{50 + 65}{2}$ x 5·0 = 287·50 SFT:

B = $\frac{71 + 81}{2}$ x 5·0 = 380·00 "

C = $\frac{87 + 91·02}{2}$ x 2·01 = 178·91 "

846·41 SFT:

FIG: 5



TYPICAL ELEVATION OF AN EXTENDED SPAN BRIDGE

FIG: 6

Schematic Diagram of Khairwala Drainage Project

Khairwala Flood protection Bund

River Chenab

Khairwala

Main Drain

Nasrana Br. Drain

Branch Drain

Dijkot

Outfall / V.R. Bridge R.D. 7370

V.R. Bridge R.D. 14440

V.R. Bridge R.D. 23000

Fall cum V.R Bridge R.D. 28750

V.R. Bridge R.D. 37000

D.R. Bridge R.D 43400

Aqueduct J.B.L R.D (91380) 47800

V.R. Bridge R.D 51430

D.R. Bridge R.D. — 57875

D.R. Bridge R.D. 64975

Sui Gas xing R.D. 74000

Aqueduct 74080

D.R. Bridge 77780

RLY. Bridge R.D. 77860

V.R. Bridge R.D. 80

V.R. Bridge 30

A.R. Bridge 42431

V.R. Bridge 37070

Foot Bridge 47960

Aqueduct/V.R.B. 57748

Foot Bridge 60650

A.R. Bridge 61600

V.R. Bridge 56800

V.R. Bridge 71593

V.R. Bridge Cum W/C crossing R.D. 87500

V.R. Bridge 93755

V.R. Bridge 104555

D.R. Bridge 115195

V.R. Bridge 123000

D.R. Bridge 128303

V.R. Bridge R.D. 135255

W/C xing R.D. 140000

A.R. Bridge R.D. 145387

V.R. Bridge R.D. 148820

V.R. Bridge R.D. 154000

V.R. Bridge R.D. 174000

V.R. Bridge R.D. 183200

V.R. Bridge R.D. 194300

V.R. Bridge R.D. 204990

V.R. Bridge R.D. 214600

V.R. Bridge R.D. 231500

V.R. Bridge R.D. 237000

V.R. Bridge R.D. 243030

Source 253

V.R. Bridge 21210

A.R. Bridge 22900

V.R. Bridge 15690

V.R. Bridge 11840

V.R. Bridge 35000

V.R. Bridge R.D. 69400

Source 70000

V.R. Bridge R.D. 61215

V.R. Bridge R.D. 53752

D.R. Bridge R.D. 48845

D.R. Bridge R.D. 43950

V.R. Bridge R.D. 34306

V.R. Bridge R.D. 27406

V.R. Bridge R.D. 21483

V.R. Bridge R.D. 15677

Foot Bridge R.D. 9755

V.R. Bridge R.D. 4550

Outfall

D.R. Bridge R.D. 211500

Source 212500

V.R. Bridge R.D. 208340

V.R. Bridge R.D. 194934

V.R. & W/C xing R.D. 192215

A.R. Bridge R.D. 182240

Sui Gas xing R.D. 186835

V.R. Bridge R.D. 173140

V.R. Bridge R.D. 163630

V.R. Bridge R.D. 153103

V.R. Bridge R.D. 150235

V.R. Bridge R.D. 147200

Legend

i) = E-Work in Progress

ii) = E-Work Completed

iii) = E-Work Proposed to be Completed

iv) = Structure in Progress

v) = Structure Completed

FIG: 7

KHAIRWALA DRAINAGE PROJECT

PROJECT CONSTRUCTION SCHEDULE

PLANNED ▬▬

ACTUAL ▬▬

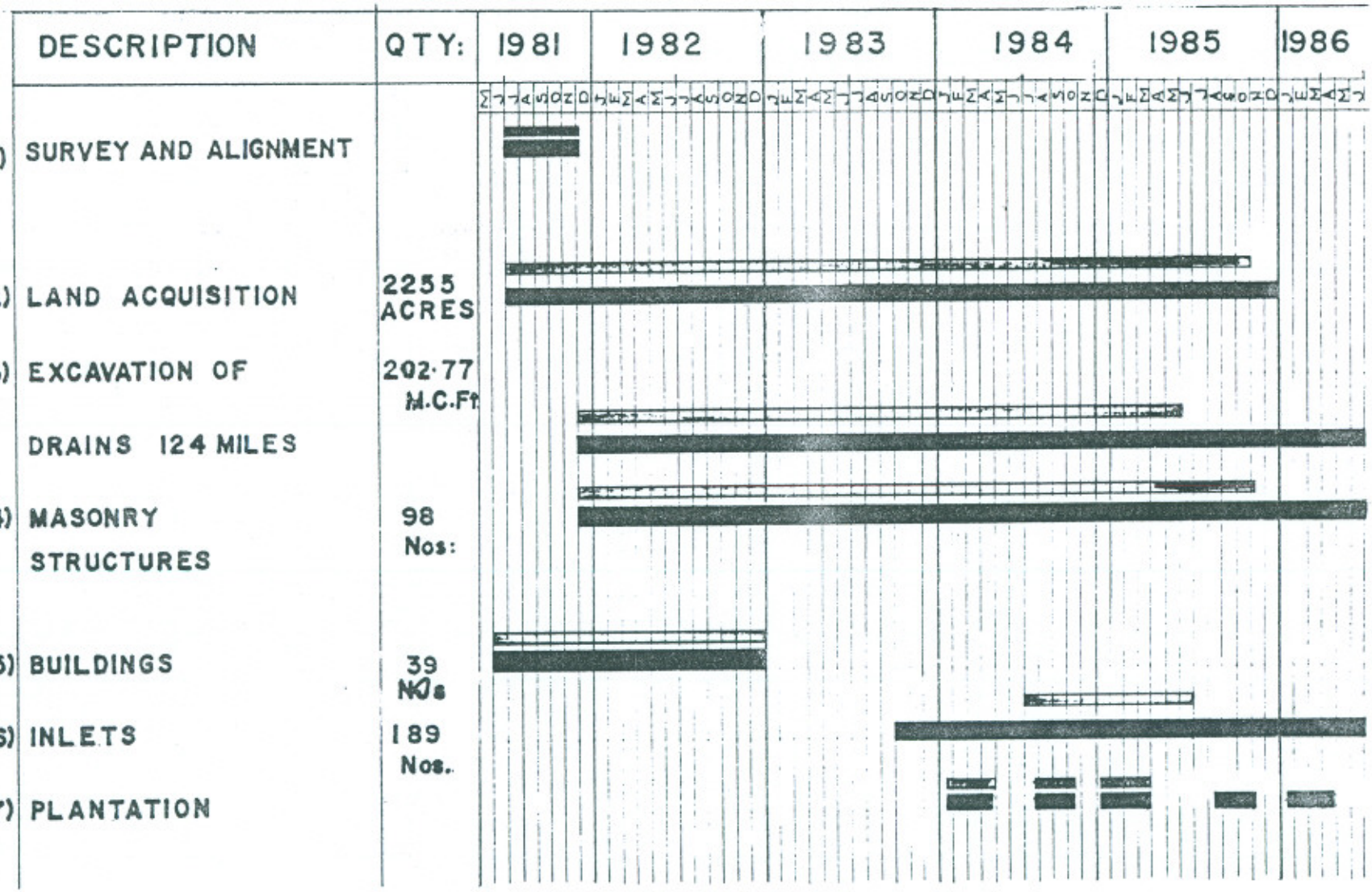


FIG 8(b)

DEWATERING PLAN
FOR
FALL CUM V.R BRIDGE R.D 2875 ODIJKOT BR: DRAIN

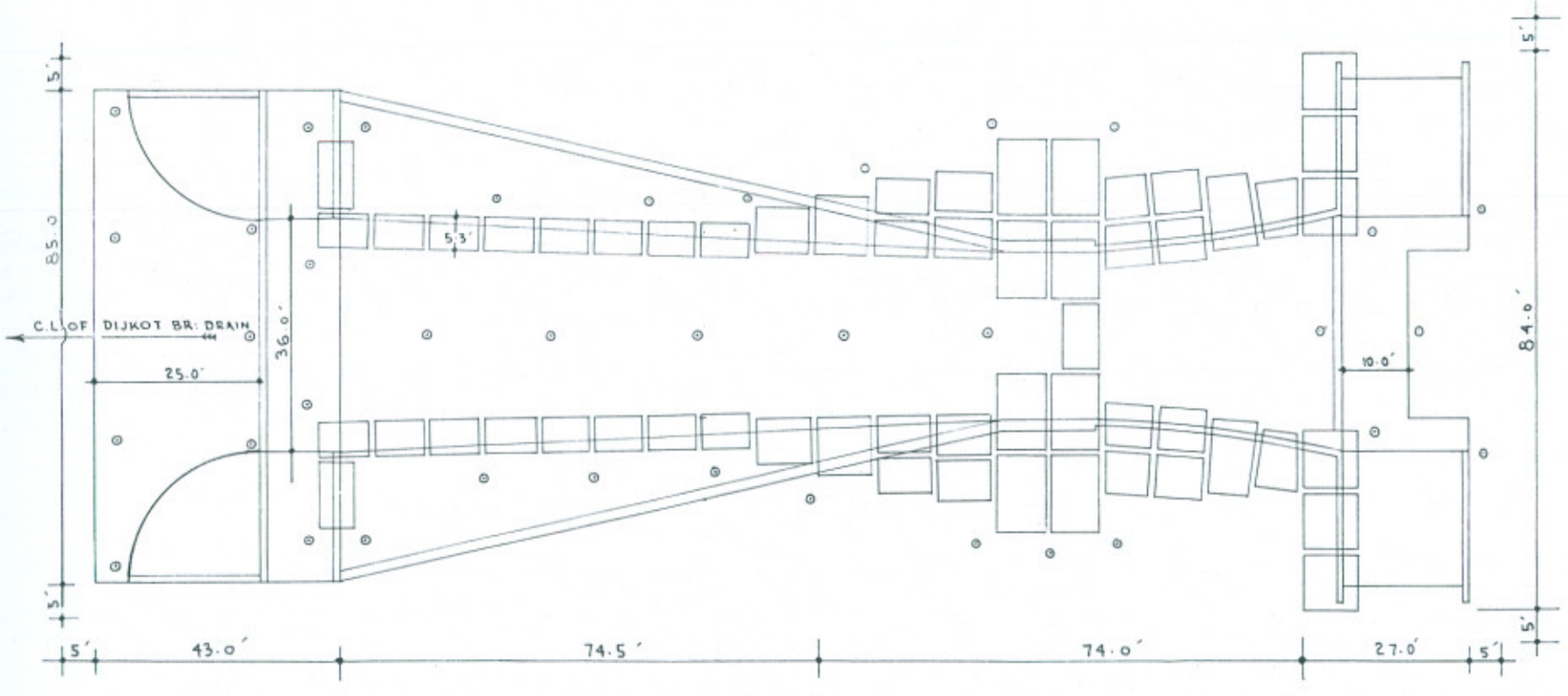
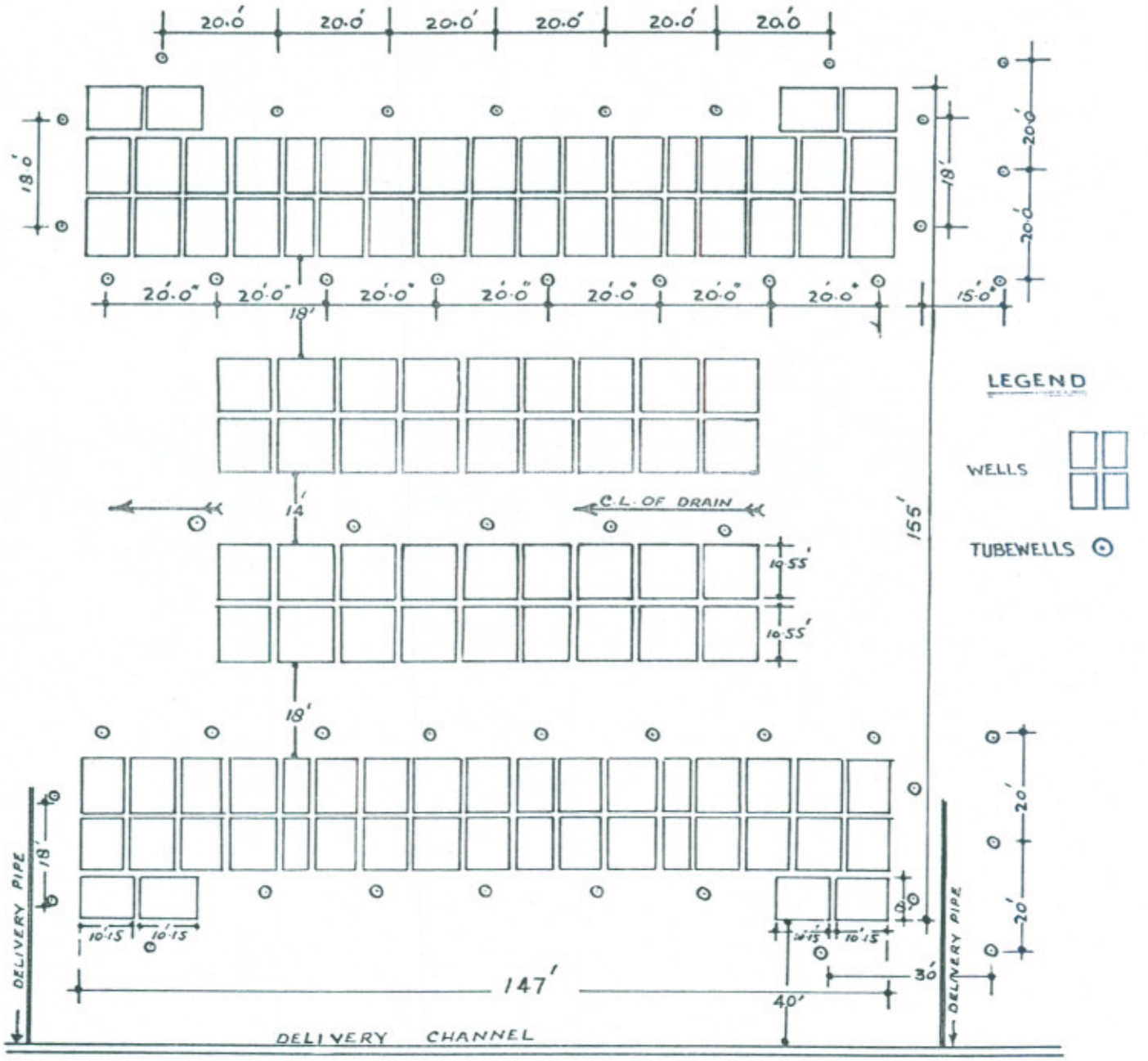


FIG: 8(a)

LAY OUT PLAN SHOWING ARRANGEMENT OF TUBEWELLS FOR LOWERING S.S.W.L AT AQUEDUCT SITE RD 91380 JHANG BR: LOWER



NOTE

S.S.W.L IS TO DEPRESSED BY 19.0'

FIG: 9

—KHAIRWALA DRAINAGE PROJECT

FINANCIAL UTILIZATION CHART—

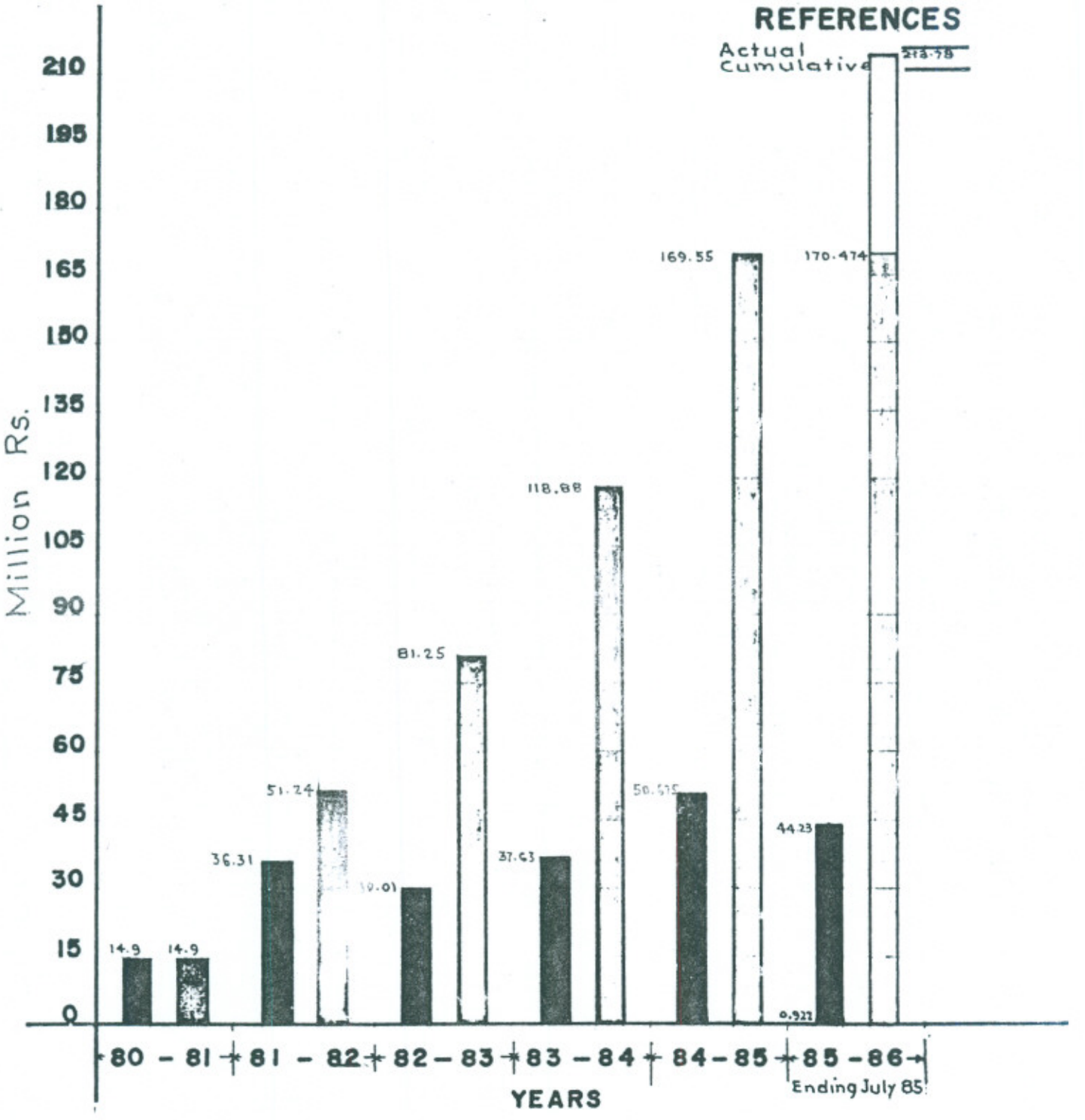


FIG 10

ORGANIZATION CHART OF KHAIRWALA DRAINAGE DIVISION FAISALABAD

