

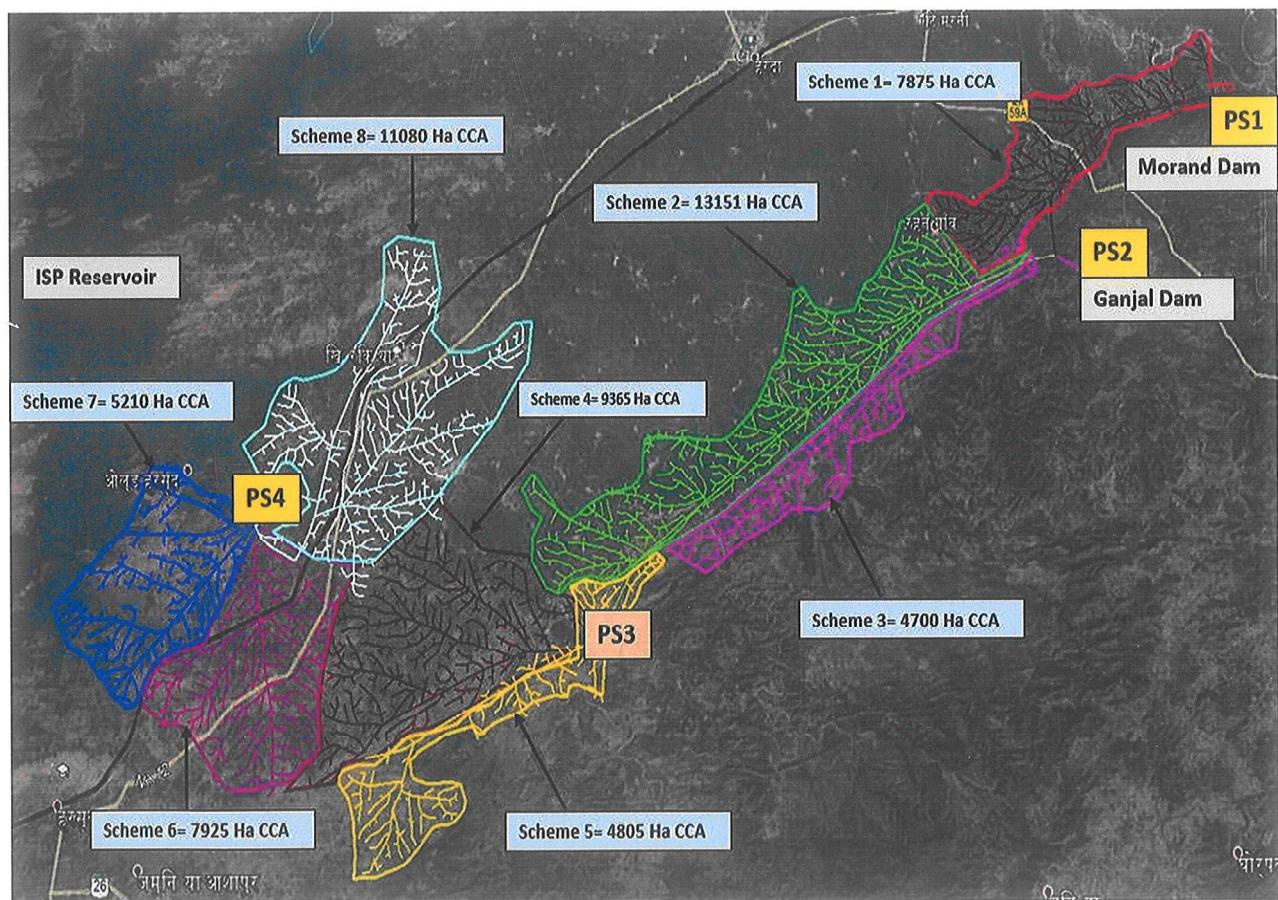


## GOVERNMENT OF MADHYA PRADESH



### Broad Conceptual Plan, Design and GAD Report for Morand and Ganjal Dams Pressurized Pipe Irrigation Project

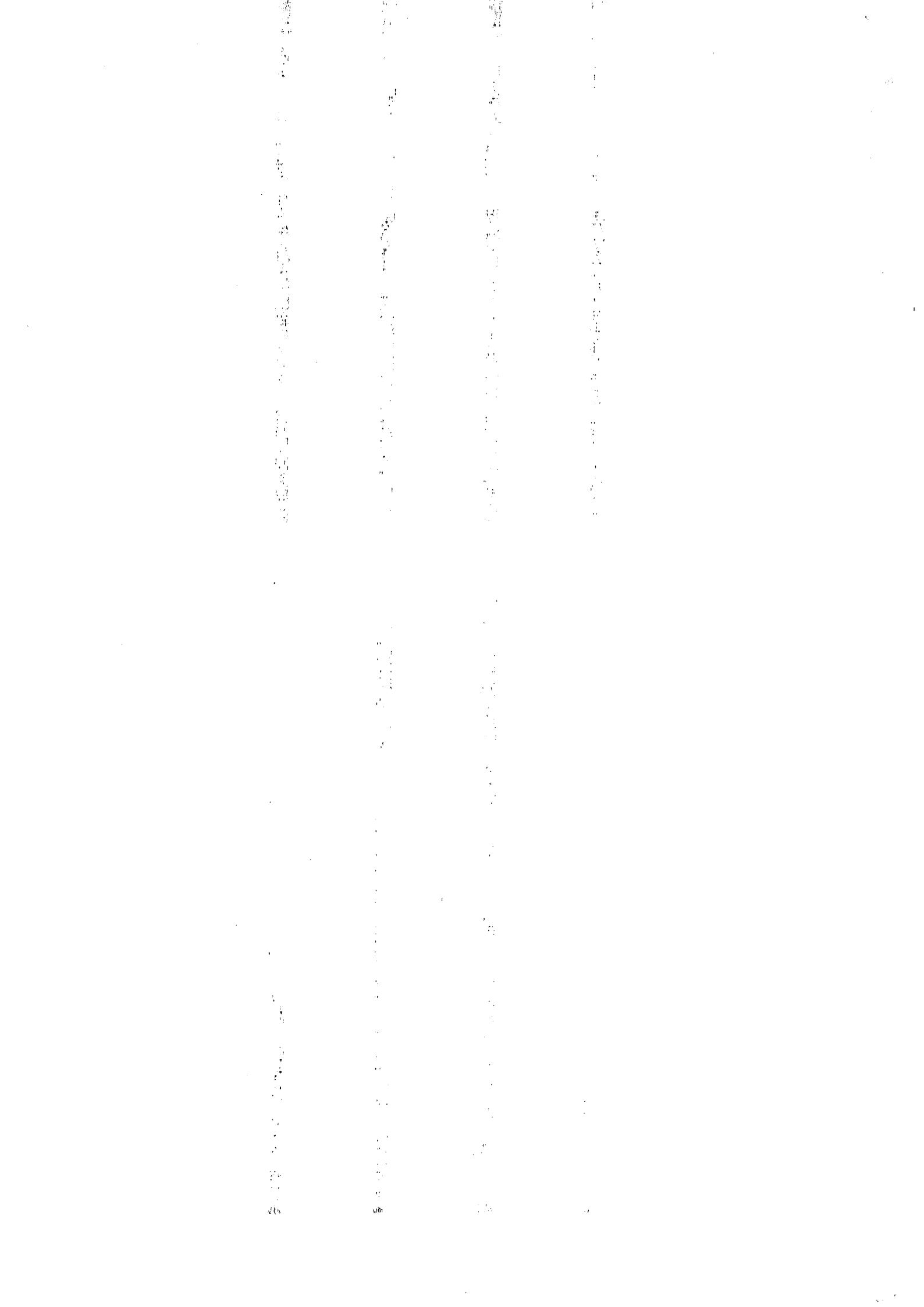
**Morand and Ganjal Project - Total Area = 64,111 Ha CCA**



**TEHSIL:** Khalwa, Seoni Malwa, Rahatgaon, Harda, Sirali, Khirkiya and Harsud

**DISTRICT:** Hoshangabad, Harda and Khandwa

Client: Narmada Valley Development Authority (NVDA)	MORAND & GANJAL DAMS PRESSURIZED PIPE IRRIGATION PROJECT	
Contractor : M/S NEC-PEL (JV), Indore	Broad Concept Design and Layout Report	
	Revision 0	1 of 566



**INDEX:**

S.No	Particulars	Page No	
		From	To
1.0	Introduction	03	
1.1	Background	03	
1.2	Intake Location details	03	
1.3	Scope & Salient Features	03	06
1.4	Area Selection	07	
1.5	Survey, Investigation & Chak Planning	09	
2.0	Design of Rising Main and Distribution Network up to 20Ha Chaks	10	17
2.1	Design Philosophy	10	
2.2	Design Criteria	12	
2.3	Network Modelling Philosophy	14	
2.4	Building of Pipe Network Model	14	
2.5	Methodology of Calculations	14	
2.6	Outlet Management system	15	15
3.0	Summary of Results	16	17
	Table-1.0 – Village wise Area Statement	18	25
	Table -2.0 -Pump Head and Power calculations	26	30
	Table -3.0 -Design of Rising mains	31	
	Table -4.0 -Abstract of Diameter Wise Pipe Lengths up to 20 ha chak	32	
	Table -5.0 Pipeline Thickness Allowable pressures	33	
	Table -6.0 Head loss calculations for Disnet Systems	34	42
	Table -7.0- HGL STATEMENTS from Pump house to 20 ha chak	43	566

Client: Narmada Valley Development Authority  
(NVDA)

MORAND & GANJAL DAMS PRESSURIZED PIPE  
IRRIGATION PROJECT

Contractor : M/S NEC-PEL (JV), Indore

Broad Concept Design and Layout Report

Revision 0

2 of 566



## 1.0 Introduction

The design and layout report describe the design criteria, parameters and methods of analysis for Morand and Ganjal Dams Pressurized Pipe Irrigation System to be executed from Morand, Ganjal Dams and existing Indira Sagar Reservoir for providing water with micro irrigation up to 2.50 hectare chak with residual head of 23 meters at 2.50 hectare chak. Command area is from Hoshangabad, Harda and Khandwa District of Madhya Pradesh under NVDA, to be executed by the EPC Contractor M/s NEC-PEL (JV), Indore. All components of the LIS will be designed as per terms and conditions laid out in the Agreement documents and in accordance with relevant IS codes and other institutional guidelines.

## 1.1 Background

The main objective of this Project is to increase production of agriculture and improve the living standard of farmers in the project area by constructing pressurized pipe irrigation system utilizing limited water resources efficiently and ensure equitable assured water supply to the designed command area. The Morand & Ganjal Project has been conceived to cater irrigation water to about 48874 ha CCA and after detailed survey of the command areas per discussions with department, the possible final area is worked out to 64111 Ha from the command area boundary specified within the tender document.

## 1.2 Intake Location:

The lifting points has been located near Morand Dam, Ganjal Dam and Indira Sagar Reservoir. From the proposed intake location total culturable command area (CCA) of 64,111 ha will be irrigated.

## 1.3 Scope:

Lifting of water from Intake to be constructed at Morand Dam, Ganjal Dam and Indira Sagar Reservoir and delivering at farmer's field with a duty of 0.35 lit/sec/ha by pressurized pipeline system for micro irrigation and in the Culturable command area of 64111 hectare out of gross command area 86660 hectare (the entire compact and contiguous possible arable area should be fully covered ) indicated in the index map. It includes all activities starting from survey, investigation, designing, procurement, construction, laying, installing, energizing of pumping system, rising and gravity mains, main line, branch lines, distribution network, controlling and regulation system etc for supply of water for irrigation under pressure with SCADA and automation. The work also includes Management, Operation and Maintenance (MOM) of complete scheme for the period of five years.

Client: Narmada Valley Development Authority  
(NVDA)

MORAND & GANJAL DAMS PRESSURIZED PIPE  
IRRIGATION PROJECT

Contractor : M/S NEC-PEL (JV), Indore

Broad Concept Design and Layout Report

Revision 0

3 of 566



Figure 1.2 shows the Google earth over view of the project.

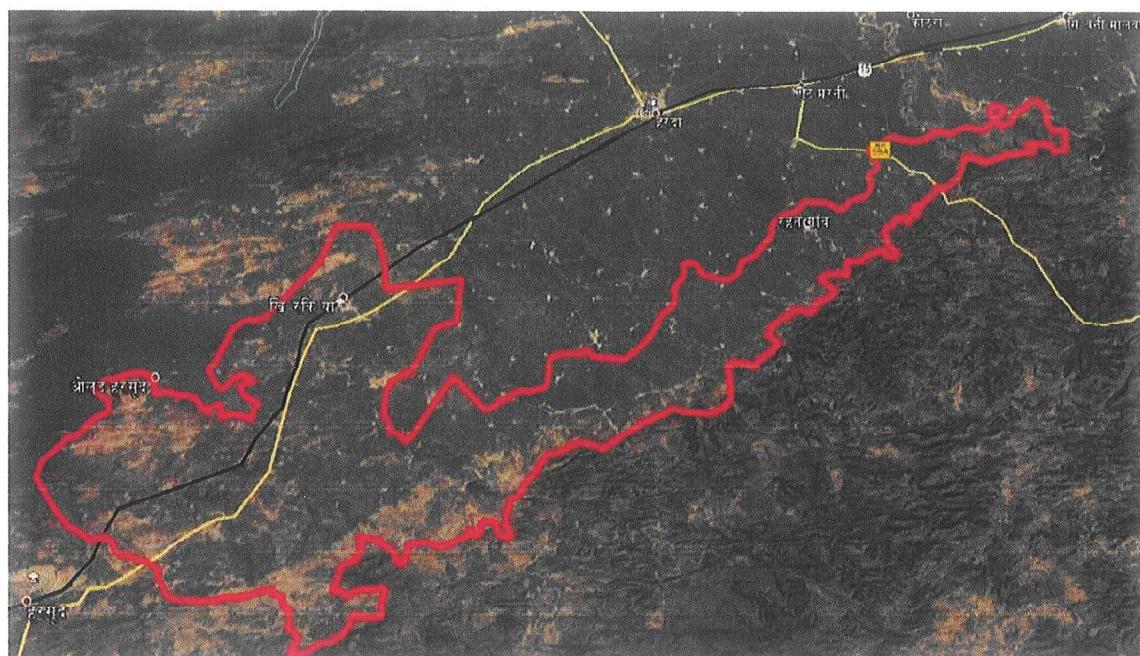


Figure 1.2 Scheme Boundary of Morand and Ganjal Dams Pressurized Pipe Irrigation Project

### 1.3.1 SALIENT FEATURES OF THE PROJECT:

Total 22.438 Cumecs of water lifted in this scheme which will be used for irrigating 64,111 hectare of command area. The details of distribution system are as below:

Pump House	Morand Dam	Ganjal Dam	ISP Reservoir	TOTAL
Area (in CCA ha) for irrigation	18490	21407	24214	64111
Irrigation module	0.35	0.35	0.35	0.35
Irrigation Discharge (m <sup>3</sup> /s)	6.471	7.492	8.475	22.438

Client: Narmada Valley Development Authority (NVDA)	MORAND & GANJAL DAMS PRESSURIZED PIPE IRRIGATION PROJECT	
Contractor : M/S NEC-PEL (JV), Indore	Broad Concept Design and Layout Report	
	Revision 0	4 of 566



### 1.3.2 Morand and Ganjal Dam Details :

Sl. No	Name	Gross Capacity (MCM)	Dead Storage & Evaporation Loss (MCM)	Live Capacity (MCM)	Water considered for Drinking and Industrial Supply (MCM)	E-Flow (MCM)	Water available for Irrigation (MCM)
1	Morand Dam	249.85	23.72	226.13	9.18	8.0	208.95
2	Ganjal Dam	96.35	9.55	86.80	6.0	3.0	77.80
	<b>Total</b>	<b>346.20</b>	<b>33.27</b>	<b>312.93</b>	<b>15.18</b>	<b>11.0</b>	<b>286.75</b>

**Note:**

1. Complete Drinking and industrial purpose water will be taken from Morand and Ganjal Dam.
2. Drinking , Industries ,E-Flow water requirements considered as per DPR submitted by SECON, Bangalore, (Refer Annexure-1)

Sl. No	Dam / Reservoir	Number of villages in command	ICA Proposed within Command Boundary (Ha)	ICA Proposed Outside of Command Boundary (Ha) in place of Killod LIS as shown in Tender boundary	Total Proposed ICA (Ha)	Water Requirement (MCM)
1	2	3	4	5	6	7
1	Indira Sagar Reservoir	60	15920	8261	24181	87.75
2	Ganjal Reservoir	72	18464	2976	21440	77.80
3	Morand Reservoir	68	18490	00	18490	67.10
	<b>Total</b>	<b>200</b>	<b>52874</b>	<b>11237</b>	<b>64111</b>	<b>232.66</b>

Client: Narmada Valley Development Authority (NVDA)

MORAND & GANJAL DAMS PRESSURIZED PIPE IRRIGATION PROJECT

Contractor : M/S NEC-PEL (JV), Indore

Broad Concept Design and Layout Report

**SALIENT FEATURES COMPARISION :**

S.no.	Description	Unit	As Per Tender	As per Actual
1	Source		Morand Dam, Ganjal Dam and ISP Reservoir	Morand Dam, Ganjal Dam and ISP Reservoir
2	Amount Of Contract	Crs	1753.50	2193.23
3	Completion Period	Months	48	48
4	Total Culturable Command Area	Ha	48874	64111
5	Total Discharge	m3/s	18.13	22.438
6	Discharge Rate	lps/ha	0.35	0.35
7	Power Allotted	MW	15.36	20.15
8	WUA Chak size	Ha	500 / 20	500 / 20
9	Automatic control chak size	Ha	20	20
10	Flow control chak size	Ha	500	500
11	Last chak size	Ha	2.5	2.5
12	Minimum Residual head at last chak size	m	23	23
13	Rising main velocity limit	m/s	2.1	2.1
14	Total Rising main	nos.	3	3
15	Total Pump House	nos.	3 for Rising main + 1 in command area for disnet = 4 nos. in total	4
16	Low water level -Morand Dam	m	352	352
17	Low water level -Ganjal Dam	m	355.4	355.4
18	Low water level -ISP Reservoir	m	248	247
19	Highest Elevation in command area	m	355	365
20	No. of Villages	nos.	191	200
21	GCA /CCA Ratio	Ha	63263 / 48874	86660 / 64111
22	Tehsil		Seoni Malwa, Rahatgaon , Harda, Sirali, Khirkiya & Harsud	Seoni Malwa, Rahatgaon , Harda, Sirali, Khirkiya, Harsud & Khalwa
23	District		Hoshangabad, Harda & Khandwa	Hoshangabad, Harda & Khandwa

Client: Narmada Valley Development Authority  
(NVDA)

MORAND & GANJAL DAMS PRESSURIZED PIPE  
IRRIGATION PROJECT

Contractor : M/S NEC-PEL (JV), Indore

Broad Concept Design and Layout Report

Revision 0

6 of 566

#### 1.4 AREA SELECTION:

**System description :** Water will be lifted from three different sources namely Morand Dam, Ganjal Dam and existing Indirasagar Reservoir through Approach channel / connecting pipeline to pumphouse. From respective pump houses, water will be pumped to 20 ha chaks directly. Low water level for pumping considered is 247m for ISP Reservoir, 352 m for Morand Dam and 355.4 m for Ganjal Dam respectively.

Morand Dam side command Area = 18490 Ha

Ganjal Dam side command Area = 21407 Ha

ISP Reservoir side command Area = 24214 Ha

Total Culturable command Area = 64111 Ha CCA

**Scheme -1:** Scheme -1 will get water from Morand Dam. Out of total 18490 ha from Morand side command, scheme-1 will cater irrigation for 7875 ha and balance water of 10615 ha (18490 – 7875 ha) will be delivered to Delivery chamber (DC) located at 383m GL. Total discharge from Morand Dam side Pump house (PH1) will be 6.471 m3/s and out of this Scheme 1 will cater for 2.756 m3/s which will be pumped from PH1 directly to the chaks size of up to 20 ha. Total 415 chaks catered from this scheme. Total Power required for this scheme 1 will be 3.775 MW. Average Elevation within this command area ranges from 306m to 362m.

**Rising Main 1 (RM1):** Rising main -1 will be connected from Ganjal Dam side pump house (PH2). Total culturable command Area from Ganjal Dam is proposed for 21407 Ha. From this, area of 16707 ha will be pumped through Rising main-1 pipeline with discharge of 5.847 Cumecs and with pump head of 31.0m to lift water from Pump house 2 (PH2) to Delivery Chamber (DC) through 1900mm MS Pipeline. Lifting level at PH2 will be 355.4m and delivery level at DC will be 383m. Total Power required for this Rising main 1 will be 2.115 MW

**From PH2 command area of 4700 ha CCA (21407-16707 ha) will also be irrigated by direct pressurized system to scheme-2 directly up to 20 ha chaks.**

**Scheme -2:** Scheme -2 will get water from Ganjal Dam. Out of total 21407 ha from Ganjal side command, scheme-2 will cater irrigation for 4700 ha and balance water of 16707 ha (21407 – 4700 ha) will be delivered to Delivery chamber (DC) located at 383m GL through Rising main-1 pipeline. Total discharge from PH2 towards scheme-2 direct pressurized system will be 1.645 m3/s which will be pumped from PH2 directly to the chaks size of up to 20 ha. Total 239 chaks catered from this scheme. Total Power required for this scheme 2 will be 1.363 MW. Average Elevation within this command area ranges from 315m to 365m.

**Scheme -3:** Scheme -3 will get water from Delivery chamber (water received from Morand Dam and Ganjal Dam respectively). Total Morand side command area will be 18490 ha and from Ganjal Dam command area will be 21407 and total area will be 39897 ha. Out of total 39897 ha, Scheme1 will be irrigating 7875 ha and scheme2 will

Client: Narmada Valley Development Authority (NVDA)	MORAND & GANJAL DAMS PRESSURIZED PIPE IRRIGATION PROJECT	
Contractor : M/S NEC-PEL (JV), Indore	Broad Concept Design and Layout Report	
	Revision 0	7 of 566

be irrigating 4700 ha and balance area to be irrigated will be 27322 Ha. The water for 27322 ha will be available at Delivery chamber (DC) by receiving water equivalent to 10615 ha from Morand Dam and 16707 ha from Ganjal Dam respectively.

Scheme -3 will receive water from DC directly to 20 ha chaks through Gravity distribution system. Out of 27322 ha, scheme-3 will be irrigating about 13150 ha only and balance area 14171 ha equivalent water will go to Pump house-3 (PH3) situated in Kothami village. Total discharge from scheme-3 will be 9.563 m<sup>3</sup>/s, and Scheme 3 will cater for 4.603 m<sup>3</sup>/s which will be from DC directly to the command area of total 13151 Ha CCA with chaks size of up to 20 ha. Total 689 chaks catered from this scheme. Average Elevation with in this command area ranges from 300m to 347m. From scheme-3, balance water for 14171 ha will go to Pump house-3 (PH3).

**Scheme -4:** Scheme -4 will get water from Pump house -3 (PH3). Area to be irrigated from this scheme will be 9365 Ha. Discharge of 3.277 m<sup>3</sup>/s which will be pumped from PH3 directly to the command area of total 9365 Ha CCA with chaks size of up to 20 ha. Total 497 chaks catered from this scheme. Total Power required for this scheme 4 will be 1.032 MW. Average Elevation with in this command area ranges from 271m to 348m.

**Scheme -5:** Scheme -5 will get water from Pump house -3 (PH3). Area to be irrigated from this scheme will be 4806 Ha. Discharge of 1.682 m<sup>3</sup>/s which will be pumped from PH3 directly to the command area of total 4806Ha CCA with chaks size of up to 20 ha. Total 249 chaks catered from this scheme. Total Power required for this scheme 5 will be 1.089 MW. Average Elevation with in this command area ranges from 309m to 372m.

**Scheme -6:** Scheme -6 will get water from Pump house -4 (PH4) from ISP Reservoir as source. Out of total 24214 ha from ISP Reservoir side command, scheme-6 will cater irrigation for 7925 ha. Total discharge for this Scheme 6 will be 2.774 m<sup>3</sup>/s which will be pumped from PH4 directly to the chaks size of up to 20 ha. Total 415 chaks catered from this scheme. Total Power required for this scheme 6 will be 2.977 MW. Average Elevation with in this command area ranges from 262m to 301m.

**Scheme -7:** Scheme -7 will get water from Pump house -4 (PH4) from ISP Reservoir as source. Out of total 24214 ha from ISP Reservoir side command, scheme-7 will cater irrigation for 11080 ha. Total discharge for this Scheme 7 will be 3.878m<sup>3</sup>/s which will be pumped from PH4 directly to the chaks size of up to 20 ha. Total 567 chaks catered from this scheme. Total Power required for this scheme 7 will be 4.705 MW. Average Elevation with in this command area ranges from 262m to 300m.

Client: Narmada Valley Development Authority (NVDA)	MORAND & GANJAL DAMS PRESSURIZED PIPE IRRIGATION PROJECT	
Contractor : M/S NEC-PEL (JV), Indore	Broad Concept Design and Layout Report	
	Revision 0	8 of 566

**Scheme -8:** Scheme -8 will get water from Pump house -4 (PH4) from ISP Reservoir as source. Out of total 24214 ha from ISP Reservoir side command, scheme-8 will cater irrigation for 5210 ha. Total discharge for this Scheme 8 will be 1.823m<sup>3</sup>/s which will be pumped from PH4 directly to the chaks size of up to 20 ha. Total 284 chaks catered from this scheme. Total Power required for this scheme 8 will be 1.957 MW. Average Elevation within in this command area ranges from 262m to 297m.

**Total command area from scheme 1, scheme 2, Scheme 3 , Scheme 4, scheme 5, scheme 6, scheme 7 and scheme 8 will be 7875+ 4700+ 13150+ 9365+ 4806+7925+11080+5210 = 64111 Ha CCA.**

#### 1.5 Survey ,Investigation & Chak Planning:

The general methodology followed for Survey and Investigation of this lift irrigation scheme is illustrated in the following.

- a. Spreading and constructing Temporary Bench Marks (TBM) in the command area from Great Trigonometrically Survey (GTS) values.
- b. Alignment survey with level at every 15m interval and preparation of combined revenue village map of the command area showing contours and prominent field details as per the detailed specifications.

The design of the Morand and Ganjal Project is prepared with the help of the survey data which includes fixation of headwork location and alignment. This data will be utilized in the pipe hydraulics software for determining the diameter of the pipeline. Layout and design of the distribution network is prepared which as well includes command area finalization, chak planning, alignment planning, and diameter fixation of the rising main and distribution network.

Survey data includes the following details.

- a. Grid survey at the headwork location as per the network analysis made as per the survey details.
- b. L-section of the rising main with all crossing details.
- c. Demarcation of outlet points for each chak with verification and confirmation of the ground levels.
- d. L-section of distribution network lines with all the crossing details.

As far as possible, average chak size is kept close to 20Ha (CCA). However, the CCA for each chak will be varying due to natural topographical features and other conveyance and boundary constraints. All the pipelines of Rising main and distribution network will be laid below ground with minimum depth of soil cover as 1.2m. Accordingly, the alignment of pipelines will not interfere with chak formation and its boundaries.

Client: Narmada Valley Development Authority (NVDA)	MORAND & GANJAL DAMS PRESSURIZED PIPE IRRIGATION PROJECT	
Contractor : M/S NEC-PEL (JV), Indore	Broad Concept Design and Layout Report	
	Revision 0	9 of 566

## 2.0 DESIGN OF RISING MAIN LINE AND DISTRIBUTION NETWORK:

Average ground levels from command within the culturable land range from 262m to 365m. Total of 22.438 cumecs of water will be delivered through various pipe diameter ranging from 63 mm to 2600mm till 20 ha chak outlets and from there water is diverted to cater up to 2.50 ha chak outlet.

The entire pipeline system is designed to take 0.35 lps/ha and to meet minimum of 23m pressures at each 2.50 ha chak outlet and accordingly hydraulic design at 20 ha level is done. Total of 3355 chaks size each varying from 5 to 40 ha and averaging close to 20 ha covering total area of 64,111 ha is covered under this Project.

A minimum residual pressure of 27m will be maintained at all 20 Ha chak outlets and also restricting maximum of 2.1 m/s velocity in the entire network system. Minimum of 63mm and maximum of 2600mm pipe diameter been used for distribution network. An outlet management system that does not require any external source of electric power will be placed at 20 Ha chak outlets in order to ensure equitable supply of water. An efficient air management system with feedback control (connected to SCADA) will be designed to ensure trouble free operation of the lift irrigation scheme and protect the pipeline system from dangerous air slam pressures.

### 2.1 Design Philosophy:

The main objective of the Morand and Ganjal Project is to empower the farmers in the Hoshangabad, Harda and Khandwa district with reliable and equitable supply of water for irrigating Agriculture. At the same time, the lift irrigation schemes should be designed to satisfy other criteria mentioned in the tender documents while keeping the power requirements to the lowest possible levels. This can be achieved by performing optimal design and life cycle cost analysis, so the farmers will receive right quantities of water at adequate pressures, while the government will conserve precious electrical energy and save on annual electricity expenditure. The design should also look at the potential pitfalls associated with piped irrigation systems and make use of advanced design and other technological solutions to avert such pitfalls and ensure reliable and equitable supply of water to all farmers identified under the lift irrigation scheme. The most critical component of the LIS is the pipe distribution network. A careful and efficient design of this component is essential for long-term trouble-free and fail-safe performance of the lift irrigation scheme. Efficient design of a piped irrigation system always starts at the consumer end.

Client: Narmada Valley Development Authority (NVDA)	MORAND & GANJAL DAMS PRESSURIZED PIPE IRRIGATION PROJECT	
Contractor : M/S NEC-PEL (JV), Indore	Broad Concept Design and Layout Report	
	Revision 0	10 of 566

Higher residual pressures are naturally available at many chak outlets because of the undulating terrains of upland agricultural areas and careful design can ensure higher residual heads at most chak outlets. Further increase in residual heads can drop the water requirements at chak outlets dramatically as the farmers can then go for micro irrigation systems without the need for additional pumping and the associated energy burden. As micro irrigation boosts crop yield significantly, the best and most efficient design for the lift irrigation scheme would be the one that delivers crop water requirements at higher residual heads while keeping the energy requirements to the lowest possible levels (and certainly below the tender time estimates). In general, the minimum residual head at chak outlet for drip or sprinkler irrigation would be around 20m and this can ensure adequate residual pressure at drip/sprinkler emitters after all the pressure losses downstream of chak outlets.

Whether the distribution system is designed for a minimum residual pressure of 0m, 2m, or 20m, the actual residual pressures available at different chak outlets for specified demand conditions will always be greater than the minimum required value (except at one or two outlets where the minimum residual pressure is maintained). Unless the additional residual pressure at outlets is dissipated by some smart technology, water will NOT be delivered equitably to all chaks. Lack of proper outlet management system can result in many unforeseen problems and eventual declaring of failure of the entire lift irrigation scheme. Some of these problems include; periodic filling and draining of pipelines leading to air lock, pipe joint failure and eventual leakage; pumps operating well beyond rated conditions resulting in premature breakdown from excessive heating, vibration etc.; longer travel times to chak outlets; significant inequity in supply of water. Orifice or manual/motorized control valves based dissipation of residual pressures cannot work, as the water supply system will be designed for peak demand conditions but the system must work for many variable demand conditions - demands vary significantly during different stages of crop growth. The use of rugged field channels for delivery of water from chak outlet to farm boundary can make the matters worse with orifice control. Outlet Management System is essential to ensure equitable supply of water during the entire growth period without having to run pumps beyond rated conditions. However, Outlet Management System that requires little or no maintenance requirement and no additional energy requirement (that is, hydraulically actuated) can also be expensive and might only be possible with exceptionally good optimized pipe network design satisfying the tender conditions.

Client: Narmada Valley Development Authority  
(NVDA)

MORAND & GANJAL DAMS PRESSURIZED PIPE  
IRRIGATION PROJECT

Contractor : M/S NEC-PEL (JV), Indore

Broad Concept Design and Layout Report

Revision 0

11 of 566

Pump station flowrates will be designed based on bottom-up approach starting at the field channel level downstream of chak outlet working towards the pump station. The design flowrate for each chak will be at the rate of 0.35 lps/ha. This flowrate will ensure minimum required flowrate condition for efficient delivery of water from chak outlet to individual farms when the minimum chak size is not significantly below 20 ha ( $20 \times 0.35$ ) = 7.00 lps/chak, while 12-15 lps is the suggested lower limit for field channel flow. Reference: Design and operation of irrigation systems for smallholder agriculture in South Asia by D. E. Campbell, FAO, ISBN: 9789251024812, 1987). The proposed chak outlet management system will provide flexibility to run the LIS similar to Warabandi system as practiced in M.P. For example, the group of Pani Panchayats under the LIS may decide on the rotation of water supply on a weekly basis (that is a group of chaks will receive water for one week continuously and water will be directed to another group of chaks the following week), biweekly basis, or even on an alternate day basis per crop water requirement and availability of water. Supply of water on longer time intervals (one week on and week off) is suitable for flood irrigation while water should be supplied at closer intervals (alternate day basis for example) for micro irrigation systems. This provides flexibility for farmers within the chak that offers adequate residual pressure head to collectively switch from flood irrigation to micro irrigation whenever they are ready.

## 2.2 Design criteria

The general design criteria for this LIS are listed in the following:

- Water will be lifted from three different resources namely Morand Dam, Ganjal Dam and Existing Indira Sagar Reservoir Right side through an pump house, and pressurized pipe network to approximately 20 ha chaks of the command area.
- Each chak outlet should be designed for the respective flow rate based on total area under the chak and a duty flow rate of 0.35 lps per hectare.
- Minimum pressure head at each 20 ha chak outlet should be 27m and at 2.50 ha pressure will be 23m, so the farmers can go for micro irrigation whenever they are ready without the need for additional power supply and pump set.
- The network system will use MS, DI, GRP and HDPE pipes of appropriate pressure ratings will be used for distribution network and following size limitations stipulated in tender specifications. Pipe diameter up to 280 mm will be HDPE pipe diameter and from 300 mm and above will be Mild steel /DI/GRP with suitable thickness mentioned as per tender.
- Hazen-William friction equation will be used for computing head loss within the pipelines with a roughness coefficient Cr value of 140.

Client: Narmada Valley Development Authority (NVDA)	MORAND & GANJAL DAMS PRESSURIZED PIPE IRRIGATION PROJECT		
Contractor : M/S NEC-PEL (JV), Indore	Broad Concept Design and Layout Report		
	Revision 0		12 of 566

- Chak markings will be done making use of manual command area survey, digital contour maps, village maps and RoRs.
- Chak and distribution system layouts will be marked in such a way as to minimize the railway, highway and major stream crossings.
- Detailed field alignment survey will be carried out from source to all chak outlets to obtain accurate elevations along all critical areas of the piped distribution system.
- All Chaks (20 ha level) with residual pressures of 27m will be provided with Outlet Management System (OMS) to ensure equitable supply of water to all chaks. The OMS will be capable of measuring the volume of water delivered, limit the flow rate to designed capacity of the chak outlet, automatically close the valve when pumps are turned off thereby preventing periodic filling and draining of the pipelines which ensures enhanced project life. In addition, the opening and closing of these valves will be automatically done in a controlled manner so as to eliminate dangerously high surge pressures associated with rapid changes in velocity and hence enhanced life for the project. Unlike orifice plate based flow control, OMS will preserve the available residual head (while limiting the flow rate at chak outlet to required value) so the farmers can go for micro irrigation whenever they are ready. Orifice plate based flow control will also necessitate massive redesign and replacement of orifice plates in order to make use of available residual head and this process may need to be undertaken every time one water user association is ready for migrating to micro irrigation system.
- A detailed air management system will be designed and this will help eliminate air blockages and reduce travel time from pump start to flow reaching the tail end chak outlets.
- Adequate number of isolation valves and scour valves of appropriate size will be provided throughout the distribution network to enhance the operational feasibility and periodic flushing of pipes preventing siltation problems.
- Bladder Vessel based Surge protection arrangements will be provided to the entire network of the pipeline system.
- User friendly SCADA and Outlet management system with automation system will be designed for seamless integration and operation of pump station and outlet management system for efficient and most cost effective operation of each LIS. The proposed system will be capable of providing periodic updates and the overall operation of the LIS to all concerned officials.

Client: Narmada Valley Development Authority (NVDA)	MORAND & GANJAL DAMS PRESSURIZED PIPE IRRIGATION PROJECT		
Contractor : M/S NEC-PEL (JV), Indore	Broad Concept Design and Layout Report		
	Revision 0		13 of 566

### 2.3 Network modeling philosophy

The rising main and distribution network models will be designed using the latest version of the most popular hydraulic network modeling software – Pipe2000 developed at University of Kentucky, USA. The entire network pipeline system associated with the distribution will be designed in such a way to minimize the life cycle costs of the project. Once the chak formation is complete following the procedure outlined in the tender specifications, a layout for the network model will be prepared that ensures minimal railway, highway and major stream crossings. The Pipe2000 software will be used to analyze the model as well as to optimize the annualized capital and operational costs of the project. Use of well-established network modeling software will not only ensure accurate results but also the most cost effective solution which can potentially provide significant savings in energy costs. The velocity considered for pipeline is maximum 2.1 m/sec and minimum 0.3 m/sec (subject to diameter constraint).

### 2.4 Building of pipe network model

After completion of chak planning, a detailed CAD map showing all salient and relevant features within the command area (including ground level contours) was prepared. This map included chak boundaries, highest elevations points within the chak boundaries, CCA of each chak etc. These maps were used for building the pipe network model in Pipe2000 software. Automated CAD to model conversion tools were used wherever possible in order to eliminate errors in model development. The pipe network model is comprised of a reservoir node representing the Pump house, an intricate network of rising, gravity mains, and a distribution system.

### 2.5 Methodology of calculations

Following methodology is adopted for the optimization study,

- Minimum required velocity in M.S /HDPE Pipeline = 0.3m/sec as per CPHEEO Manual.
- Maximum permissible velocity in M.S /HDPE pipeline =2.1m/sec as per CPHEEO Manual.
- Head loss in friction in rising and gravity mains is worked out using Hazen William formula:
- Other losses in bends, valves etc are taken as 10 % of pipe frictional losses.

Client: Narmada Valley Development Authority  
(NVDA)

MORAND & GANJAL DAMS PRESSURIZED PIPE  
IRRIGATION PROJECT

Contractor : M/S NEC-PEL (JV), Indore

Broad Concept Design and Layout Report

Revision 0

14 of 566

## 2.6 Outlet Management System

Chaks are designed for covering around 20Ha area and precautions will be taken that farmer's gut boundary will come in the maximum one chak only. The residual pressures at chak outlets are maintained to be no less than 27m. On a peak demand day, it is very highly likely that all outlets in distributaries are fully open and deliver peak flows to chak outlets. On the other hand (for example the days of unexpected heavy rains during a peak demand period) all outlets may need to be turned off to prevent excess watering and consequent damage to crops.

In between these two extremes, the number of outlets operating at any given time may vary from 0 to total number of outlets in the distributaries. In addition, the outlets may be operated only for certain number of hours in a day depending on their consumption etc. so it is required to control and monitor the chak outlet with effective control system. Also, operation of the system during non-peak demand months is the most critical to implement as outflow to chak from an outlet depends on the available residual pressure at that outlet and higher residual pressure at outlet means higher flow to chak unless there is a control to restrict the flow to the maximum allowable value. Therefore, it is essential to have control at all chak outlets and more importantly these controls should be set to maximum flow limits so the outlets cannot draw more water even when there is higher residual pressure at that location and so sufficient flow will be available at the outlets where pressure is low or at the higher elevation.

An outlet management system, which will control the maximum flow at the chak outlets wherever necessary irrespective of pressure available at that outlet, will be provided for all lift irrigation schemes under this cluster. The outlet management system will have the feature of anti-drain to enable to keep the network always full of water which will avoid the air entry in the pipe and will keep the network full of water. This will enable to start the flow from the outlet immediately when the outlet will be started again in operation. We will control and monitor the distribution network at downstream instead of control at upstream as it has many more advantages such as,

1. Outlet management system with downstream control will prevent the draining of water from the network.
2. Outlet management system avoid the air entry in pipeline and so reduces the problems associated with air lock such as less/partial flow, leakages etc.
3. Outlet management system enables the uniform & equitable distribution of water irrespective of its elevation and distance from the supply source. In Upstream Control the

Client: Narmada Valley Development Authority (NVDA)	MORAND & GANJAL DAMS PRESSURIZED PIPE IRRIGATION PROJECT	
Contractor : M/S NEC-PEL (JV), Indore	Broad Concept Design and Layout Report	
	Revision 0	15 of 566

outlets at lower elevation and near to supply source will get the more water and other will get may be less or NIL water.

4. In Outlet Management System, the water will be immediately available at outlet once the supply will start. In Upstream Control due to draining of network it will take time for the water to reach the outlets.
5. In Outlet Management system as water always remains in pipe network it will increase the life and efficiency of pipeline.

Entire Distribution Network System will cover through Outlet Management System, Air Management System, Washout / Scour System.

In summary, the pipe network designed as per tender requirement of 0.3204 lps/ha for this LIS. The salient features of the design pertaining to this LIS are shown in the following:

- Each 20 Ha chak outlet is designed for 0.35 lps/ha
- Outlet management system is provided to allow for rotation of water similar to Warabandi system at 20 ha chak level.
- Problems associated with field channels are minimized
- Minimum pressure at 20 ha chak outlet is minimum 27m.
- Minimum pressure at 2.50 ha chak outlet is minimum 23m.
- Highest steady state pressures and pump head is 104m (for Scheme 8 Pumping).
- Highest steady state pressures in the entire Distribution network is 90m.

### 3.0 Summary of results

As per the above mentioned design criteria and the guidelines, the Broad conceptual design & layout hydraulic design of distribution system is prepared, showing the following and presented in various tables and drawings section of this report.

- Chak boundaries.
- GCA/CCA of each Chak.
- Location of outlet for each Chak.
- Horizontal alignments of the distribution network along with its nomenclature.
- Node numbers at each offtake point and irrigation outlet point.
- Discharge between nodes.
- Diameter of the pipe between nodes.

Client: Narmada Valley Development Authority (NVDA)	MORAND & GANJAL DAMS PRESSURIZED PIPE IRRIGATION PROJECT	
Contractor : M/S NEC-PEL (JV), Indore	Broad Concept Design and Layout Report	
	Revision 0	16 of 566

After this report, the detailed engineering report of distribution network with kilometer wise L-sections along each alignment will be prepared and will be submitted separately (after approval of this Report) including the following details.

- Chainage, G.L., Invert R.L of Pipe, H.G.L.
- Location of various types of valves such as air valves, scour valves (washout valves), sluice / butterfly valves for discharge control etc. and its diameters.
- Position of various structures at crossings of Nallas, Roads etc. & its typical design.
- Design of surge protection system.
- Pipe Pressure classification of Pipes.
- Typical outlet management /Air management /SCADA (wireless and energyless based) arrangement at 20 ha chak head.
- Position of thrust blocks / anchor blocks & their typical design.

31/9/21

**Sub-Divisional Officer,**

**Narmada Development**

**Hydrometeorology Sub-Division No. 1**

**(N.V.D.A.) Hoshangabad (M.P.)**

**Chief Engineer**

Indira Sagar Project (Canals)  
Sanawad, Distt. Khargone (M.P.)

**Assistant Engineer**

**Narmada Development**

**Division No.23, Bhopal**

**Executive Engineer**

**Narmada Development**

**Division No.23, Bhopal**

**Superintending Engineer**

**N.D. Circle No. 08**

**Sanawad Distt. Khargone**

**Project Administrator**

**Morand, Ganjal And Hoshangabad Barrage**

**Project Implementation Unit**

**Seoni Malwa Distt. Hoshangabad (M.P.)**

**Project Manager**

**Client: Narmada Valley Development Authority  
(NVDA)**

**MORAND & GANJAL DAMS PRESSURIZED PIPE  
IRRIGATION PROJECT**

**Contractor : M/S NEC-PEL (JV), Indore**

**Broad Concept Design and Layout Report**

**Revision 0**

**17 of 566**

TABLE 1- VILLAGEWISE AREA STATEMENT:

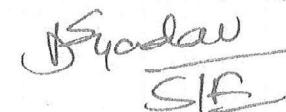
S.No.	S.N. of DPR/ Additional Village	Village Name	Name of Tehsil & Name of District	GCA in Hac (As per Survey land record)	Govt. Land in Hac (As per Survey land record)	CCA in Hac (As per Survey land record) (5- 6)	ICA considered (in Hac), under the proposal
1	2	3	4	5.00	6.00	7.00	8.00
1	DPR-1	Sirupura	Seoni Malwa & Hoshangabad	428.42	252.28	176.14	176.14
2	DPR-2	Moriya	Seoni Malwa & Hoshangabad	495.64	331.19	164.45	83.04
3	DPR-3	Lokhartalai	Seoni Malwa & Hoshangabad	551.15	233.68	317.47	291.93
4	DPR-4	Santai	Seoni Malwa & Hoshangabad	850.81	325.33	525.48	525.48
5	DPR-5	Ranipur	Seoni Malwa & Hoshangabad	166.17	47.00	119.17	124.23
6	DPR-6	Ghana	Seoni Malwa & Hoshangabad	467.87	114.80	353.07	353.07
7	DPR-7	Bandarkhoh	Seoni Malwa & Hoshangabad	288.424	53.99	234.43	234.44
8	DPR-8	Gangia	Seoni Malwa & Hoshangabad	423.63	185.68	237.94	237.94
9	DPR-9	USKALLI	Rahatgaon & Harda	499.44	259.24	240.20	240.24
10	DPR-10	BARURGHAT	Rahatgaon & Harda	403.78	124.25	279.53	279.53
11	DPR-11	BHADUGAON	Rahatgaon & Harda	445.75	27.57	418.18	418.54
12	DPR-12	KAPASI	Rahatgaon & Harda	441.15	220.00	221.15	221.15
13	DPR-13	TEMAGOV	Rahatgaon & Harda	974.87	77.29	897.58	897.58
14	DPR-14	UNDRAKUTCH	Rahatgaon & Harda	110.33	3.10	107.22	107.22
15	DPR-15	JOGIKHEDA	Rahatgaon & Harda	273.44	23.09	250.35	250.35
16	DPR-16	JHIRKHEDA	Rahatgaon & Harda	229.17	14.13	215.04	215.04
17	DPR-17	DOLARIA	Rahatgaon & Harda	411.77	28.13	383.64	383.64
18	DPR-18	JINIWANI	Rahatgaon & Harda	450.01	180.31	269.70	269.70
19	DPR-19	PADAWAN	Rahatgaon & Harda	246.82	20.41	226.41	250.10
20	DPR-20	NANDWA	Rahatgaon & Harda	166.38	5.43	160.95	160.95
21	DPR-21	JAMDIHAR (VEERAN)	Rahatgaon & Harda	98.77	5.04	93.73	93.73

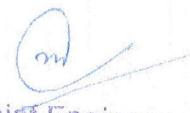
Client: Narmada Valley Development Authority (NVDA)	MORAND & GANJAL DAMS PRESSURIZED PIPE IRRIGATION PROJECT
Contractor : M/S NEC-PEL (JV), Indore	Broad Concept Design and Layout Report Revision 0

After this report, the detailed engineering report of distribution network with kilometer wise L-sections along each alignment will be prepared and will be submitted separately (after approval of this Report) including the following details.

- Chainage, G.L., Invert R.L of Pipe, H.G.L.
- Location of various types of valves such as air valves, scour valves (washout valves), sluice / butterfly valves for discharge control etc. and its diameters.
- Position of various structures at crossings of Nallas, Roads etc. & its typical design.
- Design of surge protection system.
- Pipe Pressure classification of Pipes.
- Typical outlet management /Air management /SCADA (wireless and energyless based) arrangement at 20 ha chak head.
- Position of thrust blocks / anchor blocks & their typical design.

  
 3/9/22  
 Assistant Engineer  
 Narmada Development  
 Division No.23, Bhopal  
 Sub-Divisional Officer  
 Sanawad, Distt. Khargone (M.P.)  


  
 SIE

  
 Chief Engineer  
 Indira Sagar Project (Canals)  
 Sanawad, Distt. Khargone (M.P.)

  
 Project Administrator  
 Morand, Ganjal And Hoshangabad Barrage  
 Project Implementation Unit  
 Seoni Malwa Distt. Hoshangabad (M.P.)

  
 Project Manager  
 P.I.U.

Client: Narmada Valley Development Authority (NVDA)	MORAND & GANJAL DAMS PRESSURIZED PIPE IRRIGATION PROJECT		
Contractor : M/S NEC-PEL (JV), Indore	Broad Concept Design and Layout Report		
	Revision 0		17 of 566

TABLE 1- VILLAGEWISE AREA STATEMENT:

Sl.No.	S.N. of DPR/ Additional Village	Village Name	Name of Tehsil & Name of District	GCA in Hac (As per Survey land record)	Govt. Land in Hac (As per Survey land record)	CCA in Hac (As per Survey land record) (5-6)	ICA considered (in Hac). under the proposal
1	2	3	4	5	6	7	8
1	DPR-1	Sirupura	Seoni Malwa & Hoshangabad	428.415	252.278	176.137	176.137
2	DPR-2	Moriya	Seoni Malwa & Hoshangabad	495.635	331.185	164.450	164.450
3	DPR-3	Lokhartalai	Seoni Malwa & Hoshangabad	551.147	233.682	317.465	317.465
4	DPR-4	Santai	Seoni Malwa & Hoshangabad	850.806	325.329	525.477	525.477
5	DPR-5	Ranipur	Seoni Malwa & Hoshangabad	166.166	46.995	119.171	119.171
6	DPR-6	Ghana	Seoni Malwa & Hoshangabad	467.865	114.799	353.066	353.066
7	DPR-7	Bandarkhoh	Seoni Malwa & Hoshangabad	742.405	249.397	493.008	234.432
8	DPR-8	Gangie	Seoni Malwa & Hoshangabad	423.626	185.682	237.944	237.944
9	DPR-9	USKALLI	Rahatgaon & Harda	499.437	259.235	240.202	240.202
10	DPR-10	BARURGHAT	Rahatgaon & Harda	403.781	124.249	279.532	279.532
11	DPR-11	BHADUGAON	Rahatgaon & Harda	1007.256	142.135	865.121	418.179
12	DPR-12	KAPASI	Rahatgaon & Harda	441.147	220.000	221.147	221.147
13	DPR-13	TEMAGOV	Rahatgaon & Harda	974.870	77.290	897.580	897.580
14	DPR-14	UNDRAKUTCH	Rahatgaon & Harda	622.882	78.883	543.999	107.224
15	DPR-15	JOGIKHEDA	Rahatgaon & Harda	273.440	23.087	250.353	250.353
16	DPR-16	JHIRIKHEDA	Rahatgaon & Harda	229.172	14.133	215.039	215.039
17	DPR-17	DOLARIA	Rahatgaon & Harda	419.097	28.125	390.972	383.643
18	DPR-18	JINIWANI	Rahatgaon & Harda	450.005	180.306	269.699	269.699
19	DPR-19	PADAWAN	Rahatgaon & Harda	388.345	55.022	333.323	226.413
20	DPR-20	NANDWA	Rahatgaon & Harda	395.695	73.541	322.154	160.952
21	DPR-21	JAMIDHAR (VEERAN)	Rahatgaon & Harda	98.771	5.039	93.732	93.732

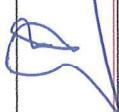
Client: Narmada Valley Development Authority (NVDA)	MORAND & GANJAL DAMS PRESSURIZED PIPE IRRIGATION PROJECT
Contractor : M/S NEC-PEL (JV), Indore	Broad Concept Design and Layout Report Revision 0      18 of 566

22	DPR-22	JHARBERA	Rahatgaon & Harda	721.688	209.346	512.342	512.342
23	DPR-23	PANDERMATI	Rahatgaon & Harda	699.385	171.224	528.161	528.161
24	DPR-24	UMRADHA	Rahatgaon & Harda	534.900	32.766	502.134	502.134
25	DPR-25	KALPI	Rahatgaon & Harda	260.508	48.271	212.237	93.012
26	DPR-26	KHATMAKHEDA	Rahatgaon & Harda	191.284	75.085	116.199	116.199
27	DPR-27	CHHIRPURA	Rahatgaon & Harda	660.027	81.447	578.580	578.580
28	DPR-28	NAZARPURA(MOHANDURA)	Rahatgaon & Harda	500.995	58.011	442.984	442.984
29	DPR-29	MALAGAV KHURD	Rahatgaon & Harda	308.213	27.319	280.894	80.740
30	DPR-30	DHANGAON	Rahatgaon & Harda	405.961	61.810	344.151	66.097
31	DPR-31	DHANPADA	Rahatgaon & Harda	339.693	15.702	323.991	323.991
32	DPR-32	JUNAPANI	Rahatgaon & Harda	178.824	5.848	172.976	172.976
33	DPR-33	RAHATGAON	Rahatgaon & Harda	1032.184	106.949	925.235	925.235
34	DPR-34	PHULADI	Rahatgaon & Harda	700.802	90.854	609.948	34.442
35	DPR-35	DOKERTALAI	Rahatgaon & Harda	130.670	14.371	116.299	41.320
36	DPR-36	KHAMGAON	Rahatgaon & Harda	542.431	65.720	476.711	295.207
37	DPR-38	LUCHGAON (VEERAN)	Rahatgaon & Harda	325.191	36.257	288.934	163.556
38	DPR-39	KASRANI	Rahatgaon & Harda	636.560	105.574	530.986	530.986
39	DPR-40	NARANPURA	Rahatgaon & Harda	381.446	199.146	182.300	182.300
40	DPR-41	SINGANPUR	Rahatgaon & Harda	287.028	35.835	251.193	251.193
41	DPR-42	RAISALPUR	Harda & Harda	679.100	354.512	324.588	324.588
42	DPR-43	JHADAPA	Harda & Harda	1070.025	69.882	1000.143	1000.143
43	DPR-44	GUTHANIA	Harda & Harda	352.553	95.888	256.665	256.665
44	DPR-45	JHIRI	Harda & Harda	648.795	157.859	490.936	490.936
45	DPR-46	JHUNDGAON	Harda & Harda	374.683	27.862	346.821	346.821
46	DPR-47	BARKHEDI	Harda & Harda	352.807	15.150	337.657	337.657
47	DPR-48	SIRKAMBAN	Harda & Harda	641.944	37.997	603.947	603.947
48	DPR-49	DINKARPURA	Harda & Harda	309.633	44.009	265.624	17.047
49	DPR-50	NAKWADA	Harda & Harda	376.202	42.171	334.031	154.313
50	DPR-51	JUGAON KHURD	Harda & Harda	627.077	62.850	564.227	9.744

32

Client: Narmada Valley Development Authority  
(NVDA)

MORAND & GANJAL DAMS PRESSURIZED PIPE  
IRRIGATION PROJECT

Contractor : M/S NEC-PEL (JV), Indore  


Revision 0	Broad Concept Design and Layout Report
	19 of 566

51	DPR-52	GAHAL	Harda & Harda	1385.373	153.207	1232.166	21.644
52	DPR-53	JAMNIYA	Harda & Harda	204.114	11.744	192.370	4.200
53	DPR-54	MOHANPUR	Harda & Harda	431.067	33.148	397.919	167.859
54	DPR-55	DULIYA	Harda & Harda	355.120	60.680	294.440	232.823
55	DPR-56	KUNIPURA	Harda & Harda	282.854	36.296	246.558	246.558
56	DPR-57	KOSAGHATI	Harda & Harda	85.677	11.114	74.563	74.563
57	DPR-58	MAGARADHA	Harda & Harda	875.849	98.064	777.785	777.785
58	DPR-59	JAMANYA KALAAN	Sirali & Harda	395.791	161.552	234.239	204.239
59	DPR-60	RATANPUR	Sirali & Harda	299.507	256.612	42.895	42.895
60	DPR-61	AMAKHAL	Sirali & Harda	261.781	82.032	179.749	78.749
61	DPR-62	KHUTWAL	Sirali & Harda	412.198	52.690	359.508	359.508
62	DPR-63	CHAUKADI	Sirali & Harda	288.361	8.867	279.494	167.494
63	DPR-64	MAHANDGAON	Sirali & Harda	405.693	41.122	364.571	349.741
64	DPR-65	DEEPGAON KHIRUD	Sirali & Harda	483.203	17.503	465.700	22.351
65	DPR-66	BAWDIYA	Sirali & Harda	452.020	29.622	422.398	217.137
66	DPR-68	GOMGAON	Sirali & Harda	641.211	54.076	587.135	169.580
67	DPR-69	MORTALAI	Sirali & Harda	225.261	85.191	140.070	140.070
68	DPR-70	PIPAL PAANI	Sirali & Harda	135.323	36.867	98.456	98.456
69	DPR-71	UMRI	Sirali & Harda	670.939	203.099	467.840	467.840
70	DPR-72	DAGPALPUR	Sirali & Harda	147.373	77.295	70.078	70.078
71	DPR-73	PIPLYA	Sirali & Harda	653.986	51.945	602.041	602.041
72	DPR-74	KASHIPURA	Sirali & Harda	285.945	8.437	277.508	277.508
73	DPR-75	GOMGAON VALI	Sirali & Harda	332.159	15.427	316.732	19.461
74	DPR-76	MALAPUR	Sirali & Harda	72.348	2.726	69.622	23.397
75	DPR-77	RAMPURI	Sirali & Harda	244.682	10.191	234.491	73.491
76	DPR-78	VIKRAMPUR KALAN	Sirali & Harda	404.125	24.951	379.174	379.174
77	DPR-79	KUDHIYA	Sirali & Harda	749.767	80.139	669.628	669.628
78	DPR-80	SONPURA	Sirali & Harda	240.229	120.999	119.230	66.230
79	DPR-81	Nani Makrai	Sirali & Harda	307.579	221.768	85.811	85.811

Client: Narmada Valley Development Authority  
(NVDA)

MORAND & GANJAL DAMS PRESSURIZED PIPE  
IRRIGATION PROJECT

  
Broad Concept Design and Layout Report

Contractor : M/s NEC-PEL (JV), Indore  
Revision 0

20 of 566

80	DPR-82	JUNAPANI	Sirali & Harda	324.011	78.344	245.667	245.667
81	DPR-83	KEWALARI	Sirali & Harda	152.411	11.741	140.670	140.670
82	DPR-84	BAHADA MAL	Sirali & Harda	111.209	25.740	85.469	85.469
83	DPR-85	HINDALABAD	Sirali & Harda	307.169	6.470	300.699	300.699
84	DPR-86	MANPURA	Sirali & Harda	264.378	21.096	243.282	243.282
85	DPR-87	JINWANYA	Sirali & Harda	317.104	33.944	283.160	4.200
86	DPR-88	LOLAGRA	Sirali & Harda	676.884	28.939	647.945	79.170
87	DPR-89	PATKALA	Sirali & Harda	238.626	4.679	233.947	69.001
88	DPR-90	LALYA CHAPAD	Sirali & Harda	268.323	164.090	104.233	86.630
89	DPR-91	BICHPURI CIRCULAR	Sirali & Harda	144.600	21.904	122.696	122.696
90	DPR-92	BICHPURI RYT	Sirali & Harda	96.566	36.941	59.625	59.625
91	DPR-93	BAHADA RYOT	Sirali & Harda	109.510	3.916	105.594	105.594
92	DPR-94	BICHPURI MAL	Sirali & Harda	206.611	34.889	171.722	171.722
93	DPR-95	MUDASEL	Sirali & Harda	255.509	26.645	228.964	228.964
94	DPR-96	MADHISEL	Sirali & Harda	704.908	29.078	675.830	71.645
95	DPR-97	NAHALI KALAAN	Sirali & Harda	337.763	26.395	311.368	177.198
96	DPR-98	BHAGWANPURA	Sirali & Harda	924.418	77.233	847.185	847.185
97	DPR-99	RICHADIA	Sirali & Harda	259.581	128.820	130.761	130.761
98	DPR-100	RAKTAYA	Sirali & Harda	314.551	19.335	295.216	295.216
99	DPR-101	SOMGAON KALAA	Sirali & Harda	585.294	38.856	546.438	546.438
100	DPR-102	DEEPGAON KALAA	Sirali & Harda	1518.351	157.634	1360.717	75.223
101	DPR-103	KADOLA RADHO	Sirali & Harda	895.584	100.482	795.102	200.085
102	DPR-104	CHOUKI	Sirali & Harda	412.476	29.779	382.697	254.697
103	DPR-105	HASANPURA RAYAT	Sirali & Harda	584.819	35.969	548.850	496.850
104	DPR-106	RAMTEK RYOT	Sirali & Harda	551.731	68.014	483.717	457.717
105	DPR-107	KUKADA PANI	Sirali & Harda	792.272	249.549	542.723	412.790
106	DPR-108	MORGARHI	Khirkiya & Harda	729.608	42.007	687.601	557.178
107	DPR-109	CHURIKHAL	Khirkiya & Harda	884.901	151.589	733.312	672.780
108	DPR-110	RAJNHUN	Khirkiya & Harda	819.185	91.123	728.062	640.930

Client: Narmada Valley Development Authority (NVDA)	MORAND & GANJAL DAMS PRESSURIZED PIPE IRRIGATION PROJECT
Contractor : M/S NEC-PEL (JV), Indore 	Broad Concept Design and Layout Report Revision 0 21 of 566

109	DPR-111	KHEDI CIRCULAR	Khirkiya & Harda	138.253	14.014	124.239	124.240
110	DPR-112	KHEDI MAL	Khirkiya & Harda	147.185	15.129	132.056	132.060
111	DPR-113	SHOBHAPUR	Khirkiya & Harda	311.805	28.760	283.045	283.050
112	DPR-114	DEDGAON MAAL	Khirkiya & Harda	396.512	26.337	370.175	370.170
113	DPR-115	DEDGAON CIRCULAR	Khirkiya & Harda	293.286	21.918	271.368	271.370
114	DPR-116	DAMODARPURA	Khirkiya & Harda	252.573	18.568	234.005	234.010
115	DPR-117	KANPURA	Khirkiya & Harda	825.534	91.291	734.243	734.240
116	DPR-118	TEMALWARI MAL	Khirkiya & Harda	824.497	50.731	773.766	773.770
117	DPR-119	TEMALWARI RAYAT	Khirkiya & Harda	459.677	32.553	427.124	427.120
118	DPR-120	MAKTAPUR	Khirkiya & Harda	633.346	86.978	546.368	546.370
119	DPR-121	BHAWARDI RYT	Khirkiya & Harda	244.406	18.900	225.506	225.510
120	DPR-122	BHAWARDI MAL	Khirkiya & Harda	242.275	18.363	223.912	223.910
121	DPR-123	PRATAP PURA	Khirkiya & Harda	468.993	35.486	433.507	433.510
122	DPR-124	GANJ PURA	Khirkiya & Harda	230.562	6.949	223.613	223.610
123	DPR-125	HIRAPUR	Khirkiya & Harda	356.130	24.030	332.100	332.100
124	DPR-126	JAI MALAPURA	Khirkiya & Harda	304.528	26.972	277.556	277.560
125	DPR-127	GOPAL PURA	Khirkiya & Harda	738.426	73.258	665.168	674.710
126	DPR-128	BHAWRDHA MAFI	Khirkiya & Harda	67.199	9.644	57.555	57.550
127	DPR-129	JUNAPANI	Khirkiya & Harda	628.871	77.033	551.838	551.840
128	DPR-130	Damdama	Harsud & Khandwa	609.660	109.020	500.640	369.960
129	DPR-131	Chapakund	Harsud & Khandwa	618.389	143.079	475.310	475.310
130	DPR-132	Bothia kala	Harsud & Khandwa	459.269	34.539	424.730	424.730
131	DPR-133	Bothia Khurd	Harsud & Khandwa	594.870	140.160	454.710	454.710
132	DPR-134	Dagad khedi maal	Harsud & Khandwa	1013.357	384.730	628.627	459.347
133	DPR-135	Bahedi riyaat	Harsud & Khandwa	383.190	34.260	348.930	348.930
134	DPR-136	Chich Ryt	Harsud & Khandwa	545.467	180.167	365.300	365.300
135	DPR-137	Dhanora	Harsud & Khandwa	508.303	101.503	406.800	406.800
136	DPR-138	Kadouli	Harsud & Khandwa	660.980	82.260	578.720	578.720
137	DPR-139	Igariya	Harsud & Khandwa	852.530	101.660	750.870	386.190

22

Client: Narmada Valley Development Authority (NVDA)	MORAND & GANUL DAMS PRESSURIZED PIPE IRRIGATION PROJECT
Contractor : M/S NEC-PEL (JV), Indore	Broad Concept Design and Layout Report Revision 0      22 of 566

138	DPR-140	Pipalani	Harsud & Khandwa	607.450	87.930	519.520	519.520
139	DPR-141	Bhawrali	Harsud & Khandwa	316.330	171.830	144.500	144.500
140	DPR-142	Chikali	Harsud & Khandwa	787.690	52.920	734.770	343.350
141	DPR-143	Sonkhedi	Harsud & Khandwa	597.220	131.000	466.220	466.220
142	DPR-144	Ramjipura	Harsud & Khandwa	866.250	123.650	742.600	742.600
143	DPR-145	Bori saray	Harsud & Khandwa	1334.390	102.370	1232.020	1091.910
144	DPR-146	Dharukhedi	Harsud & Khandwa	805.220	35.370	769.850	769.850
145	DPR-147	Palaani mal	Harsud & Khandwa	736.570	219.180	517.390	517.390
146	DPR-148	Shahhpura Maal	Harsud & Khandwa	702.530	92.710	609.820	609.820
147	DPR-149	Palani Ryt	Harsud & Khandwa	174.620	38.500	136.120	136.120
148	DPR-150	Hathnaura Ryot	Harsud & Khandwa	643.360	358.560	284.800	284.800
149	DPR-151	Brahmdhad Mal	Harsud & Khandwa	320.170	21.990	298.180	298.180
150	DPR-152	Maujwadi Raiyat	Harsud & Khandwa	232.340	30.640	201.700	201.700
151	DPR-153	Kashipura Ryot	Harsud & Khandwa	488.400	152.200	336.200	307.507
152	DPR-154	Mojwadi maal	Harsud & Khandwa	919.260	214.490	704.770	704.770
153	DPR-155	Mugal Ryt	Harsud & Khandwa	596.810	368.810	228.000	228.000
154	DPR-156	Badkhaliya mal	Harsud & Khandwa	839.063	136.560	702.503	329.320
155	DPR-157	Bailwadi	Harsud & Khandwa	337.650	43.220	294.430	294.430
156	DPR-158	Rewapur Ryt	Harsud & Khandwa	780.090	69.120	710.970	710.970
157	DPR-159	Sonpura	Harsud & Khandwa	641.146	285.786	355.360	355.360
158	DPR-160	Bharadi	Harsud & Khandwa	729.331	118.656	610.675	366.800
159	DPR-161	Imlani Ryt	Harsud & Khandwa	706.410	560.470	145.940	145.940
160	DPR-162	Khutia Ryt	Harsud & Khandwa	311.070	293.950	17.120	17.120
161	Within Command	RAMPURA	Sirali & Harda	667.439	35.816	631.623	125.210
162	- DO -	AIROOD RYT	Sirali & Harda	245.261	18.195	227.066	100.066
163	- DO -	MUHAL CIRCULAR	Sirali & Harda	241.577	111.174	130.403	89.403
164	- DO -	SAGWA CIRCULAR	Khirkiya & Harda	343.080	57.873	285.207	112.207
165	- DO -	AIROOD MAL	Khirkiya & Harda	124.006	17.239	106.767	18.767

Client: Narmada Valley Development Authority (NVDA)	MORAND & GANJAL DAMS PRESSURIZED PIPE IRRIGATION PROJECT
Contractor : M/S NEC-PEL (JV), Indore 	Broad Concept Design and Layout Report Revision 0 23 of 566

166	- DO -	MOHIR YT	Harsud & Khandwa	431.475	156.753	274.722	274.722
167	- DO -	MOHIM AL	Harsud & Khandwa	107.108	4.158	102.950	102.950
168	- DO -	NAVALPURA	Harsud & Khandwa	527.170	396.690	130.480	130.480
169	<b>Out of Command</b>	<b>SAVAL KHEDI YT</b>	<b>Sirali/Harda</b>	<b>609.724</b>	<b>75.092</b>	<b>534.632</b>	<b>429.510</b>
170	- DO -	KOTHAMI	Sirali/Harda	458.223	323.429	134.794	126.794
171	- DO -	LAFANG DHANA	Sirali/Harda	292.936	89.132	203.804	203.804
172	- DO -	BHIMPURA	Sirali/Harda	746.159	541.016	205.143	201.143
173	- DO -	Khumbhi dhana	Khawla & Khandwa	480.050	67.310	412.740	412.740
174	- DO -	Khamlay	Khawla & Khandwa	511.190	94.360	416.830	416.830
175	- DO -	Timarni	Khawla & Khandwa	783.390	169.390	614.000	614.000
176	- DO -	Khari	Khawla & Khandwa	551.210	50.620	500.590	500.590
177	- DO -	POKHARNI	Khirkiya & Harda	1026.266	68.215	958.051	958.051
178	- DO -	CHHIPABAD	Khirkiya & Harda	1854.828	143.746	1711.082	774.638
179	- DO -	BASAT PURA	Khirkiya & Harda	344.568	13.913	330.655	279.655
180	- DO -	PADWA	Khirkiya & Harda	673.950	63.855	610.095	250.095
181	- DO -	TARAPUR	Khirkiya & Harda	575.625	13.943	561.682	171.682
182	- DO -	ATRALIYA	Khirkiya & Harda	213.808	8.596	205.212	125.212
183	- DO -	KALDHAD	Khirkiya & Harda	513.262	50.321	462.941	382.941
184	- DO -	HATHNORI	Khirkiya & Harda	88.080	2.611	85.469	64.469
185	- DO -	CHARUWA	Khirkiya & Harda	26.761	20.181	6.580	6.580
186	- DO -	HARIJPURA MAL	Khirkiya & Harda	292.897	47.568	245.329	159.329
187	- DO -	Pipliya Bharat	Khirkiya & Harda	370.062	29.626	340.436	340.436
188	- DO -	MAHTYA KHEDI	Khirkiya & Harda	198.008	5.484	192.524	98.524
189	<b>Out of Command</b>	<b>NISANIYA MAL</b>	<b>Harsud &amp; Khandwa</b>	<b>1014.610</b>	<b>109.400</b>	<b>905.210</b>	<b>905.210</b>
190	- DO -	RAMPURI YT	Harsud & Khandwa	1042.220	165.390	876.830	876.830
191	- DO -	TORNIYA YT	Harsud & Khandwa	895.400	95.740	798.660	798.660
192	- DO -	CHIPUPURA	Harsud & Khandwa	424.510	58.690	365.820	365.820
193	- DO -	DOT KHEDA	Harsud & Khandwa	840.504	259.185	581.319	581.319

Client: Narmada Valley Development Authority (NVDA)	MORAND & GANUAL DAMS PRESSURIZED PIPE IRRIGATION PROJECT	
Contractor : M/s NEC-PEL (JV), Indore	Revision 0	24 of 566

194	- DO -	BARUD	Harsud & Khandwa	932.630	328.740	603.890	603.890
195	- DO -	KASRAWAD	Harsud & Khandwa	857.700	544.960	312.740	312.740
196	- DO -	BRAMOGAON	Harsud & Khandwa	611.770	75.940	535.830	366.550
197	- DO -	GONDI KHEDA	Harsud & Khandwa	637.150	589.590	47.560	47.560
198	- DO -	Khirkiya (np)	Khirkiya & Harda	986.077	136.546	849.531	774.531
199	- DO -	Choukadi	Khirkiya & Harda	1408.757	89.728	1319.029	824.029
200	- DO -	Lodhiya khedi	Khirkiya & Harda	357.845	20.902	336.943	136.943
201	- DO -	Golpura	Khirkiya & Harda	130.518	3.205	127.313	127.313
		<b>TOTAL</b>		<b>101839.807</b>	<b>20016.198</b>	<b>81823.609</b>	<b>64110.643</b>

For NEC-PEL JV

*[Signature]*  
(Authorised signature)

Client: Narmada Valley Development Authority (NVDA)	MORAND & GANJAL DAMS PRESSURIZED PIPE IRRIGATION PROJECT
Contractor : M/S NEC-PEL (JV), Indore	Broad Concept Design and Layout Report Revision 0

Table 2.0. PUMP HEAD AND POWER CALCULATIONS:

Power calculation for MORAND COMMAND (PH1 to Morand Command): SCHEME-1			
Item	Unit	Value	Remarks
Low water level	m	352	
Ground level (m)	m	372	
Pump Floor level (m)	m	373	
Highest level in command area (m)	m	362	
Static head	m	10	
Headlosses including minor losses	m	13.7	
Residual head at 20Ha chak	m	26.3	
Total Head (H)	m	50.03	
Discharge (Q)	m <sup>3</sup> /hr	23297	For Area of 18490 Ha CCA
Pump Efficiency ( Eff)	%	88	Minimum as per Tender
Motor Efficiency ( Eff)	%	95.5	Minimum as per Tender
<b>Power calculations</b>			
Formula			
$P (Kw) = (Q * H) / (367.2 * Eff)$			
$P (Kw) = (23297 * 50) / (367.2 * 0.88 * 0.955)$			Calculated with comb eff of 84.04%
Total power	Kw	3792.15	
Total power	MW	3.792	

Power calculation for GANJAL COMMAND (PH2 to Delivery Chamber): RISING MAIN 1:			
Item	Unit	Value	Remarks
Low water level	m	355.4	
Ground level (m)	m	362	
Pump Floor level (m)	m	363	
Highest level in command area (m)	m	383	
Static head	m	27.6	
Headlosses including minor losses	m	3.4	
Residual head at 20Ha chak	m	0	
Total Head (H)	m	31.0	
Discharge (Q)	m <sup>3</sup> /hr	21051	For Area of 16707 Ha CCA
Pump Efficiency ( Eff)	%	88	Minimum as per Tender
Motor Efficiency ( Eff)	%	95.5	Minimum as per Tender
<b>Power calculations</b>			
Formula			
$P (Kw) = (Q * H) / (367.2 * Eff)$			
$P (Kw) = (21051 * 31) / (367.2 * 0.88 * 0.955)$			Calculated with comb eff of 84.04%
Total power	Kw	2114.67	
Total power	MW	2.115	

Client: Narmada Valley Development Authority (NVDA)	MORAND & GANJAL DAMS PRESSURIZED PIPE IRRIGATION PROJECT		
Contractor : M/S NEC-PEL (JV), Indore	Broad Concept Design and Layout Report		
	Revision 0		26 of 566

**Power calculation for GANJAL COMMAND (PH2 to GANJAL Command): SCHEME -2:**

Item	Unit	Value	Remarks
Low water level	m	355.4	
Ground level (m)	m	362	
Pump Floor level (m)	m	363	
Highest level in command area (m)	m	363	
Static head	m	7.6	
Headlosses including minor losses	m	36.4	
Residual head at 20Ha chak	m	27 ✓	
Total Head (H)	m	71.0	
Discharge (Q)	m³/hr	5922	For Area of 4700 Ha CCA
Pump Efficiency ( Eff)	%	88	Minimum as per Tender
Motor Efficiency ( Eff)	%	95.5	Minimum as per Tender
<b>Power calculations</b>			
Formula			
$P (Kw) = (Q* H) / (367.2 * Eff)$			
$P (Kw) = (5922*71) / (367.2 * 0.88*0.955)$			Calculated with comb eff of 84.04%
Total power	Kw	1362.50	
Total power	MW	1.363	

**Power calculation for GANJAL COMMAND (PH3 to GANJAL Command): SCHEME-4:**

Item	Unit	Value	Remarks
Low water level	m	348	
Ground level (m)	m	350	
Pump Floor level (m)	m	351	
Highest level in command area (m)	m	348.324	
Static head	m	0	
Headlosses including minor losses	m	24.29 ✓	
Residual head at 20Ha chak	m	2.71 26.7	
Total Head (H)	m	27.0 ✓	
Discharge (Q)	m³/hr	11800	For Area of 9365 Ha CCA ✓
Pump Efficiency ( Eff)	%	88	Minimum as per Tender
Motor Efficiency ( Eff)	%	95.5	Minimum as per Tender
<b>Power calculations</b>			
Formula			
$P (Kw) = (Q* H) / (367.2 * Eff)$			
$P (Kw) = (11800*27) / (367.2 * 0.88*0.955)$			Calculated with comb eff of 84.04%
Total power	Kw	1032.41	
Total power	MW	1.032 ✓	

Client: Narmada Valley Development Authority  
(NVDA)

MORAND & GANJAL DAMS PRESSURIZED PIPE  
IRRIGATION PROJECT

Contractor : M/S NEC-PEL (JV), Indore

Broad Concept Design and Layout Report

Revision 0

27 of 566

Power calculation for GANJAL COMMAND (PH3 to GANJAL Command): SCHEME-5:				
Item	Unit	Value	Remarks	
Low water level	m	348		
Ground level (m)	m	350		
Pump Floor level (m)	m	351		
Highest level in command area (m)	m	360		
Static head	m	12		
Headlosses including minor losses	m	16.5		
Residual head at 20Ha chak	m	27		
Total Head (H)	m	55.5		
Discharge (Q)	m <sup>3</sup> /hr	6056	For Area of 4806 Ha CCA	
Pump Efficiency ( Eff)	%	88	Minimum as per Tender	
Motor Efficiency ( Eff)	%	95.5	Minimum as per Tender	
<b>Power calculations</b>				
Formula				
$P (Kw) = (Q * H) / (367.2 * Eff)$				
$P (Kw) = (6056 * 55.5) / (367.2 * 0.88 * 0.955)$			Calculated with comb eff of 84.04%	
Total power	Kw	1089.08		
Total power	MW	1.089		

Power calculation for ISP COMMAND (PH4 to ISP Command): SCHEME -6:				
Item	Unit	Value	Remarks	
Low water level	m	247		
Ground level (m)	m	262		
Pump Floor level (m)	m	263		
Highest level in command area (m)	m	300		
Static head	m	53		
Headlosses including minor losses	m	11.2		
Residual head at 20Ha chak	m	26.8		
Total Head (H)	m	92.0		
Discharge (Q)	m <sup>3</sup> /hr	9986	For Area of 7925 Ha CCA	
Pump Efficiency ( Eff)	%	88	Minimum as per Tender	
Motor Efficiency ( Eff)	%	95.5	Minimum as per Tender	
<b>Power calculations</b>				
Formula				
$P (Kw) = (Q * H) / (367.2 * Eff)$				
$P (Kw) = (9986 * 92) / (367.2 * 0.88 * 0.955)$			Calculated with comb eff of 84.04%	
Total power	Kw	2976.93		
Total power	MW	2.977		

Client: Narmada Valley Development Authority (NVDA)	MORAND & GANJAL DAMS PRESSURIZED PIPE IRRIGATION PROJECT		
Contractor : M/S NEC-PEL (JV), Indore	Broad Concept Design and Layout Report		
	Revision 0		28 of 566

**Power calculation for ISP COMMAND (PH4 to ISP Command): SCHEME-7:**

Item	Unit	Value	Remarks
Low water level	m	247	
Ground level (m)	m	262	
Pump Floor level (m)	m	263	
Highest level in command area (m)	m	297	
Static head	m	50	
Headlosses including minor losses	m	13	
Residual head at 20Ha chak	m	29	
Total Head (H)	m	92.0	
Discharge (Q)	m <sup>3</sup> /hr	6565	For Area of 5210 Ha CCA
Pump Efficiency ( Eff)	%	88	Minimum as per Tender
Motor Efficiency ( Eff)	%	95.5	Minimum as per Tender
<b>Power calculations</b>			
Formula			
$P (Kw) = (Q * H) / (367.2 * Eff)$			
$P (Kw) = (6565 * 92) / (367.2 * 0.88 * 0.955)$			Calculated with comb eff of 84.04%
Total power	Kw	1957.07	
Total power	MW	1.957	

**Power calculation for ISP COMMAND (PH4 to ISP Command): SCHEME-8:**

Item	Unit	Value	Remarks
Low water level	m	247	
Ground level (m)	m	262	
Pump Floor level (m)	m	263	
Highest level in command area (m)	m	300	
Static head	m	53	
Headlosses including minor losses	m	24	
Residual head at 20Ha chak	m	27	
Total Head (H)	m	104.0	
Discharge (Q)	m <sup>3</sup> /hr	13961	For Area of 11080 Ha CCA
Pump Efficiency ( Eff)	%	88	Minimum as per Tender
Motor Efficiency ( Eff)	%	95.5	Minimum as per Tender
<b>Power calculations</b>			
Formula			
$P (Kw) = (Q * H) / (367.2 * Eff)$			
$P (Kw) = (13961 * 104) / (367.2 * 0.88 * 0.955)$			Calculated with comb eff of 84.04%
Total power	Kw	4704.95	
Total power	MW	4.705	

Client: Narmada Valley Development Authority  
(NVDA)

MORAND & GANJAL DAMS PRESSURIZED PIPE  
IRRIGATION PROJECT

Contractor : M/S NEC-PEL (JV), Indore

Broad Concept Design and Layout Report

Revision 0 29 of 566