PRE-FEASIBILITY REPORT

FOR

Extension, Remodeling and Modernization Project of Kosi Canal System (24250 Hectare) District, Rampur, Uttar Pradesh.

Project Proponent
Irrigation and Water Resources Department
Lucknow , Uttar Pradesh.

EXECUTIVE SUMMARY

1.0 EXECUTIVE SUMMARY

The project is for extension /remodeling /modernization of Kosi canal system taking off from Lalpur weir across Kosi river in Rampur district of Uttar Pradesh and is under jurisdiction of the Irrigation Department, Uttar Pradesh. Built in 1895, by the then Nawab of Rampur, it encompasses a 272m long weir structure on well foundation for diverting water into Kosi canal by means of falling wooden shutters. The canal, authorized head discharge 400 cusec, comprises of 197.63 km. long distribution system to cater to CCA of 24250 ha (59921acre) with annual proposed Kharif and Rabi being 15% and 12% respectively. The irrigation intensities were subsequently raised to 32% and 25% during 1975 when the supplies were augmented from Tumariya dam through Bhalla-Kosi Feeder to the tune of 250 cusec. A single lane steel road bridge, connecting to Tanda, was subsequently added to the weir in 1932. During 1988 the piers of few bays of the weir developed serious cracks since then the bridge has been closed for heavy vehicular traffic. The road bridge on the weir is vital life line between Rampur to Tanda.

The falling shutters, which invariably drop during first flood during July, also lower the pond level and consequently render the weir unable to divert the required/authorized discharge into canal and the system does not get sufficient water for Kharif irrigation, although the flow passes over the crest to the downstream without being diverted. The shutters are again enacted only after monsoon during October when river supplies are low and water becomes available in canals. Thus, Rabi irrigation is also adversely affected. Against the irrigation intensities of 32% and 25% during Kharif and Rabi respectively an average Kharif and Rabi potential achieved is 6184 ha (26%) and 5825 ha (24%) respectively.

Being more than 122 year old and after having withstood the on-slaught of fury of historical floods in 1924 (0.94 lakh cusec), in 1947 (0.69 lakh cusec) and 2010 (1.278lakh cusec) and many flash floods, the weir had been under severe stress with its few bays, wells and downstream floor getting scoured, damaged and cracks have appeared in the downstream floor and piers and frequent boiling was encountered in d/s bays. Damages observed from 1969 revealed that the structure of Lalpur weir has outlived its useful life because some of the damages cannot be repaired and are of permanent type Therefore, immediate construction of a new replacement barrage on the downstream was vehemently and urgently required to obviate any unfortunate situation of the sudden failure of the structure thereby dislodging altogether the irrigation facilities in the command area of the age old system and leaving the farmers hapless.

The maintenance of the old weir had become quite costly proposition and the danger of its collapse had been looming large. In the wake of afore-mentioned technical grounds and to ward of the most frightening exigency of the irrigation system being severely affected, it is, judicious and prudent to construct a new barrage on war-footing in lieu of more than centaury old weir well in advance before

any calamity happens. The old weir had been in precarious condition for long and its sudden washing out would have created damage to the downstream, therefore, it has been dismantled in year 2016 in a scientific and phased manner except for the wells which are below the riverbed level.The single lane bridge has also been razed to the ground and the work of construction of a new bridge at the same site by the PWD is in progress. The canal is being run by creating a temporary bund for diverting the water and shall be fed so till the ongoing work of diversion barrage on downstream is completed.

The project envisages construction of replacement barrage and appurtenant works in lieu of age old Lalpur weir, which has been dismantled now. It also involves remodeling of canal and distribution system to cope with the increase in discharge from 400 cusecs to 600 cusecs, with increase in FSL at existing head regulator from 194.127 mamsl to 194.600 mamsl, and by adapting to strengthening of banks and lining of bed and sides of canal and distributaries. Due to remodeling/modernization of canal and distribution system the existing irrigation intensities of 32% (7760 ha) and 25% (6063 ha) during Kharif and Rabi respectively shall be increased to 55% (13337 ha) and 35% (8487 ha respectively. The location and vicinity map is shown in **Figure-1** and the photographic view of the old weir and head regulator in **Figure-2**. The index map of the project showing location of old weir and location of new barrage and the Kosi canal system and the T-diagram of the system is shown in **Figure-3** and **Figure-4** respectively.

For construction of the new headwork and appurtenant works, afflux bunds at Nabiganj village, about 147.36 ha land will be required of which 119.85 ha shall be acquired from private owners and balance 27.51 ha shall be the revenue land. Private land shall be acquired from private owners by the project proponent by mutual consent as per U.P. G.O. No.2/2015/215/F-13-20(48)/2011, date 19.3.2015.

No diversion of forest land is involved. No archaeological monument of national importance either lies in the project area or in its submergence area. No National Park, Sanctuary, Defense Establishments, Archeological Monuments, Notified Eco-sensitive areas or protected area under Wild Life (Protection) Act exists within the project area or within 15 km distance from it.

The project is likely to be completed in time-frame of three years. The competent authority has accorded technical sanction of INR 23631.77 lakh to the project, while during appraisal the Expenditure Finance Committee of the State has accorded sanction for INR 21635.90 lakh only.

Status of diversion of Forest Land for the Project

No diversion of forest land is involved.

Status of Environmental Clearance for the Project

Therefore, in pursuance of philosophy behind the EIA Notification, dated 14th September 2006 and its subsequent amendments, it is imperative to bring the ERM project, an infra-structure project for irrigation of command of age old Kosi canal system, which used to take off from old Lalpur weir which has been dismantled of now, in compliance with the environmental laws at the earliest. Therefore, the EAC is requested to consider for grant of scoping clearance and prescribe the appropriate ToR for carrying out EIA study and preparation of environment management plan. As per EIA Notification dated 14th September 2006, and subsequent amendments, the project is category "A" and is covered under1(c) ii- Irrigation projects. Being modernization project, in terms of provision under clause7 III Stage (3) (i) (a), it is exempt from public consultation. Since the system is running from more than a century, it is prayed that scoping clearance may be granted to the project with one season monitoring (monsoon).

1.1 SALIENT FEATURES OF THE PROJECT

Sr. No.	Particular	Details
1	**NAME OF PROJECT**	Extension, Remodeling and Modernization of Kosi Canal System
2	**STATE/DIST./TEHSIL**	Uttar Pradesh/Rampur/Tanda
3	**RIVER**	Kosi River
4	**PROJECT SITE**	Near Nabi ganj village about 3 km d/s of Lalpur weir
5	**GEOGRAPHICAL CO- ORDINATES**	
(i)	Latitude	28^{o} 52' 42.11" N
(ii)	Longitude	79^{o} 00'24.69 "E
6	**HYDROLOGY**	
(i)	Catchment Area	2115.00 sq km
(ii)	Annual Rainfall	
	Maximum	1486 mm
	Average	967 mm
7	**FLOOD**	
(i)	Maximum observed at old weir site	2663.00 cumecs
(ii)	Design Flood (PMF) adopted for new barrage	5313.00 cumecs
8	**PRINCIPAL LEVELS**	
(i)	Lowest River bed level	El - 191.25 mamsl

(iii)	Crest level of under sluices bays	El - 191.25 mamsl
(iv)	Crest level of barrage bays	El - 192.25 mamsl
(v)	Full Reservoir level (FRL)	El - 196.00 mamsl
(vi)	Maximum water level (MWL)	El – 196.3 mamsl
(vii)	Top of u/s and d/s abuyment	El – 198/197mamsl
9	**BARRAGE**	
(i)	Total Length	352.02 m
(ii)	Clear waterway	306.00 m
(iii)	Under sluices	2, one each on left and right flank
(iv)	Bays/gate size	4 each of 18 m (18mx5.25m)
(v)	Spillway bays	13 each of 18 m (18mx4.25m)
(vi)	Gates	Vertical lift
(vii)	Width of piers	1.5m
(viii)	Divide wall on left bank	5m
(ix)	Divide wall on right bank	3m
(x)	Fish Ladder	1.5mx1.5m on left divide wall
10	**Head Regulator**	
(i)	Left bank	2 bays (3x2.50 m)
(ii)	Discharge	600 cusec
(iii)	Right bank	2 bays
(iv)	Discharge	150 cusec
(v)	Gates	Vertical lift
11	**Link Canal**	
(i)	Length	5.00 km
(ii)	Head Discharge	600 cusec (17 cumec)
(iii)	Bed width	9.50 m
(iv)	Canal bed level	El - 193.00 mamsl
(v)	Canal Full Supply level	El - 194.60 mamsl
(vi)	Lined	5.00 km
(iv)	Bed Slope	0.2m/km
(v)	Side Slope	2:1
12	**Irrigation**	
(i)	Gross Command Area (GCA)	27588 ha
(II)	Pre and post modernization CCA	24250 /24250 ha
(iii)	Existing Kharif	7760 ha (32%)
(iv)	Post- modernisation proposed Kharif	13337ha (55%)
(v)	Existing Rabi	6063 ha (25%)
(vi)	Post- modernisation proposed Rabi	8487 ha (35%)

1.2 PROPOSED PLANNING

The project was formulated and designed after careful detailed survey, planning and realistic approach for construction of a replacement barrage and appurtenant works

in lieu of age old Lalpur weir, which has outlived its useful life span and is dismantled as of now .It also involves remodeling of main canal and distribution system to cope with the increase in discharge from 400 cusec to 600 cusec, with increase in FSL at existing head regulator from 194.127 mamsl to 194.600 mamsl, and by adapting to strengthening of banks and lining of bed and sides of canal and distributaries.. All benefits under the project would accrue only if the pond can be created behind the new proposed barrage upto designed FRL (196 mamsl).

2.0 INTRODUCTION OF THE PROJECT/ BACKGROUND INFORMATION

2.1 Identification of Project and Project Proponent

As per nomenclature set forth by the Central Water Commission, New Delhi, projects with CCA exceeding 10000 ha was classified as Major Irrigation Scheme. The onerous task of judiciously harnessing the available water resources of the state for benefitting agriculture, industrial and domestic water for overall development of all region of the state, was entrusted to the Irrigation Department of the state.
The Irrigation and Water Resources Department of Uttar Pradesh represented through the Superintending Engineer, irrigation Works Circle Rampur, is the project Proponent.

2.2 Brief Information about the Project

The ERM project shall comprise of the following components:

- 352.02 m long gated barrage comprising of two under sluices on left and right flank each with two bays of 18m width with crest level 191.25 mamsl and gate size18mx5.35m; 13 barrage bays of 18m width each with crest level at 191.25 mammal ,with gate size 18mx4.35m, designed for PMF(5313 cumec).
- A fish ladder (1.5mx1.5m) in the left side divide wall.
- Left bank head regulator with two bays of 3m each separated by 1.5m wide pier with overall waterway of 7.5m designed for 600 cusecs (16.98 cumec).
- Right bank head regulator for 150 cusec capacities, for irrigating command on right bank in future, shall be concurrently constructed so as to obviate construction complexities in future.
- Guide bunds with top width 6m and side slope 2:1, with river face pitched with 0.5m thick paneled boulder pitching over 0.15m sand over geo-synthetic sheet with toe wall having 3 rows of boulder filled G.I. wire crates(1.5x1.5x0.9m) shall be provided.
- The existing Lalpur-Roohella bund on left flank shall function as left afflux bund. However, right afflux bund with top width 8m and side slope 2:1, shall be provided as double lane approach road.
- Construction of link canal (5km) from left head regulator with canal bed level at head 193mamsl.
- C.C. (M-15) cast in situ lining, over PCC laid on HDPE sheet, side and bed in full length of link channel & selective reaches of Upper Kosi canal, Lower Kosi canal, Khandia dy., Bagi dy., Param dy & Patwai dy shall be provided in 5.0, 5.9, 5.9, 8.2, 5.7, 2.23 and 7.3 km respectively.

2.3 Need for the Project and its Importance to the Country or Region

The ever-increasing population in the state led to the demand for increasing in food and fiber production along with opportunity for opening vista of employment in rural areas by harnessing the available water resources of Kosi to the optimum by means of a new diversion barrage to cater to the increase in canal water supply at its head.

The need for the ERM project has therefore, been considered as the maintenance of the old weir had become quite costly proposition and the danger of its collapse was looming large. In the wake of afore-mentioned technical grounds and to ward of the most frightening exigency of the irrigation system being severely affected, it is, judicious and prudent to construct a new barrage on war-footing in lieu of more than centaury old weir well in advance before any calamity happens. The old weir had been in precarious condition for long and its sudden washing out would have created damage to the downstream.

2.4 Demand-Supply Gap

Though, there is large tract of cultivable and fertile land in command area under four Tehsils (Tanda, Rampur, Milak and Sahabad) of the district, yet short supplies have been depriving farmers of bringing it under irrigation and better yield. Due to enhanced canal water supply from 400 cusecs to 600 cusecs, due to the project, there shall be an increase in existing irrigation intensities of 32% (7760 ha) and 25% (6063 ha) during Kharif and Rabi respectively to 55% (13337 ha) and 35% (8487 ha respectively.

2.5 Imports vs. Indigenous Production

The project due to modernization and remodeling shall lead to substantial enhancement of indigenous food grain production in Kharif and Rabi crops because increased discharge/supply in canal and consequent to increased irrigation intensities.

2.6 Export Possibility

In wake of the Central Policy Food for all, the state must become self-sustainable for meeting its demand of food and fabric. Thus, neither any export possibility is plausible or there is any such demand.

2.7 Domestic/ Export Markets

The food grains, vegetables produced in project area have impacted the local market as these are available for sale to the non-growers. No export from the project produce was envisaged.

2.8 Employment Generation

The implementation of ERM project shall employment opportunities in the project area. The employment shall be associated with improved farming practices as well as the construction activities. About 200 skilled, semi-skilled and un-skilled labour shall be deployed during peak construction activity period

With irrigation additional farm labour would also be required because of higher cropping intensity providing employment opportunities to local people within and outside the vicinity of the project area Further establishment of agro and ancillary industries would give rise to employment to the local people.

3.0 PROJECT DESCRIPTION

3.1 Type of Project Including Interlinked and Interdependent Projects, If any

The project, basically a major irrigation project category "A" as per EIA notification dated 14th September,2006, is extension, remodeling and modernization of age old Kosi canal system which was last remodeled in 1975 when the canal supplies were augmented by 250 cusecs during Rabi crop through construction of Bhalla-Kosi Feeder. The T-diagram of Kosi canal system is shown in Figure-4. Under remodeling component it involves cement concrete lining in filling reaches of Upper and Lower Kosi Canal, Khandia dy., Bagi dy., Param dy & Patwai dy shall be provided in 5.9, 5.9, 8.2, 5.7, 2.23 and 7.3 km respectively to enable the system to cope with increased head discharge from 400 cusecs to 600 cusecs. Under modernization it involves construction of the major component like barrage and appurtenant works, two head regulators and a link canal. It is an intervention on Kosi river and per se an independent project and is not interlinked with any other project.

3.0 Location

The old Lalpur weir and head regulator were constructed on Kosi river at geo-graphical coordinates at latitude 28^0 54' 12.43" N and longitude 79^0 00' 43.53" E near village Lalpur Kalan in Tanda tehsil, district Rampur, while the new barrage shall be located about 3 km d/s of the former at latitude 28^0 52' 42.11" N and longitude 79^0 00' 24.69" E near village Nabiganj in Tanda tehsil, district Rampur. The project site is about 13 km from district head quarter. It is approachable from Nh-24 via Rampur Tanda ODR-20 and is about 16 km from Rampur Junction. Geographical locations of project area i.e. headwork and command area are covered under Survey of India Toposheet No. 53 P /1 and 53 P /2.

3.1 Details of Alternate Sites

Two alternative sites for replacing the age-old weir by a barrage were examined during different period by. The first alternative involved construction of a diversion barrage about 75m downstream of the existing barrage and utilizing existing head regulator and main canal and distribution system. The second alternative proposal envisaged construction of a barrage about 3km downstream of the existing weir site and has two options for feeding the canal either from the existing head regulator or by constructing a fresh regulator along with barrage construction and a link canal to connect with the existing main canal. The latter proposal was adopted as it will create extra storage of 3.6MCM and create a large pond for pisciculture and water sports as well as facilitating the groundwater recharge in adjoining Saidnagar and Chamrua blocks.

3.2 Size or Magnitude of Operation

Categorization of Irrigation projects has been prescribed by the Central Water Commission, New Delhi, based on the culturable command area (CCA). All projects having CCA less than 2000 ha belong to minor; above 2000 to less than 10000 ha as medium and above this threshold limit major irrigation projects. The current project is a major irrigation project. The outcome of an irrigation project is fathomed by the irrigation potential create and achieved.

Irrigation projects make consumptive use of water by application to the command area. Thus, as such unlike manufacturing /industrial/mining projects these do not bring out discrete production. However, the area benefitted under their command in different crop season as a corollary drawn from sectors mentioned ibid, could be termed as the production. The area brought under irrigation in different crop season during last ten years is given below:

Fasli Year	Christian year	Actual irrigation in Kharif (ha)	Actual irrigation in Rabi (ha)
1415	2007-08	1975	4995
1416	2008-09	2925	5050
1417	2009-10	2954	5198
1418	2010-11	3395	4917
1419	2011-12	4814	5308
1420	2012-13	4802	5061
1421	2013-14	5773	6958
1422	2014-15	7097	8060
1423	2015-16	6502	6623
1424	2016-17	6637	6517
Total		**93748**	**117374**

3.3 Project Description with Process Details

The project was conceived and constructed by the then Nawab of Rampur State as infra-structure project for benefit of the people as a well fare scheme. It involved construction of a weir to impound available discharge of the river in the small pond created for diverting water through Kosi canal and distribution networks for providing irrigation under its own command.

Notwithstanding the implementation of new barrage, the process involved shall be its regulation, as per regulation manual, by gradually operating the gates to divert water into canal without exceeding the pond level, and by surpassing the flood waters through operation of gates without bringing a sudden drawdown in the pond level and without exceeding the maximum allowable differential level on either side of divide walls and piers from the structure safety consideration. Utmost round the clock vigil shall be carried out during monsoon season by inspecting the downstream floor of the barrage, flow pattern of the river on upstream and regulating gates for avoiding any flow parallel to barrage The regular inspection of downstream slope of guide bunds/ marginal and afflux bunds to see, if any, sweating of the surface or boiling is noticed and immediately carrying out the mitigating measure by resorting to sand and filter loading at affected place till clear water appears. Operation of canal and distribution system shall be carried out as per irrigation demand and as per roaster. Regular watch and maintenance of hydro-dynamic structures are some of the process details.

3.4 Raw Material Required along with Estimated Quantity, Likely Source, Marketing area of Final Product/S, Mode of Transport of Raw Material and Finished Product

The total raw material requirement for coarse and fine aggregate and boulder comes to 0.61 lakh cum ,0.37 lakh cum and 0.32 lakh cum respectively, which shall be met from the approved stone crushers in nearby area (Haldwani / Lalkunwa) Cement shall be transported from Departmental Central Store at Okhla by existing road network.

3.5 Resource Optimization/ Recycling and Reuse

Resource Optimization / recycling and reuse is envisaged in this project as the surface excavation in the river bed and other components of project shall result in generation of excavated muck (1.97 lakh cum). The excavated material shall be consumed in formation of coffer dam, guide bunds/marginal/ afflux bunds.

3.6 Availability of Water Its Source, Energy / Power Requirement and Source

3.6.1 Water Requirement

The water requirement (100kld) for construction shall be mainly met from the river water and the domestic/drinking water from underground sources from nearby private tube well.

3.6.2 Power

Electrical power shall be required for illumination of project area specially barrage and appurtenant works for facilitating the regulation of barrage and canal and from the point of view of safety of structures and vigil during night, besides for operation of hydrodynamic structure i.e., vertical gates.

3.7 Quantity of Wastes to be Generated (Liquid and Solid) and Scheme for their Management/ Disposal

3.7.1 Solid Waste Generation& its Disposal

The solid municipal waste shall be generated from project colony and labour camps. The collected bio-degradable waste shall be disposed at suitable landfill sites, organic waste will be suitably processed to for compost while the non-bio-degradable waste shall be incinerated. Commercial waste shall be stored and periodically disposed by auction.

3.7.2 Liquid Effluent

There will be no waste water generation from project activities as regulation of barrage and canal involves no effluent per se. The surplus water from the pond during flood shall be passed through by opening the barrage and under sluice bays into the river course. The liquid effluent resulting through the Headwork colony shall be treated through septic tank and soak pit.

4.0 SITE ANALYSIS

4.1 Connectivity:

The project site is approachable upto Rampur via NH-24 and thereafter by Rampur - Tanda ODR-20.

4.2 Landform, Landuse and Land Ownership

4.2.1 Landform

The project area lies in famous Central Ganga Alluvial plain.

4.2.2 Land Use

The predominant land use of the area is agriculture land followed by forests/plantation, river body and water body (ponds).

4.2.3 Land Ownership

The ownership of the private land acquired or to be acquired from villagers shall vest with the project proponent (state). The ownership of the revenue land to be transferred to the project proponent shall vest with them.

4.3 Topography

Physiographically the project area, which is covered under Rampur district, is part of Central Ganga Alluvial Plain and is represented by high slopes in the north, which gradually becomes flatter towards south. The drainage of the area is controlled by the river Ram Ganga and its tributaries like Kosi, Ghuga, Bauri, Pilakhau, Saijni, Nahal, Dhimri, Baigul etc. The Ram Ganga river enters the area near south west part of the area and flows in the south-eastern direction. The highest altitude in the district is at village Manunagar (224 mamsl) and lowest being at village Gangapur (172 mamsl) in the Ram Ganga flood plain.

4.4 Geology and Seismicity

The area forms a part of Central Ganga Alluvial plain and is underlain by alluvial deposits of quaternary age. The deposits attain significant thickness ranging between 400 and 500 m in the northern part of Indo gangatic alluvial plain. This alluvium, a pile of unconsolidated sediments made up of sequence of clay, silt, kankar and different grades of sand and occurrence of gravel is also occasionally seen.
Geologically in Ganga basin, the basement is assumed to be continuation of Satpura folded belt, overlain by Vindhyans and Neogene sequences. The tentative succession, worked out with the help of ONGC drilling specially those at Mohand (Haridwar district), Puranpur (Pilibhit district) and Ujhani (Badaun district). Two boreholes drilled by CGWB in north-eastern part of the district at Budhnagar and Dilari down to 450m suggest that the sediments are dominantly arenaceous and there is a change in lithofacies between depth 390 and 400m, which may well correspond to the post shiwalik break.
The sequence of the strata in the project and adjoining area is given below:

TIME UNIT	Rock type	Time rock unit	Basin	Basin sedimentation sequence	Thickness
Recent to 0.1m year	Sandy	Alluvium	Ram-Ganga	Ganga Alluvium	300 to 500m.
Holocene Less than 1m. Year	Sand, clay. pebble, gravel and kankar	Piedmont Fan Deposits	Ram-Ganga	Ganga Alluvium	---
DISCONFORMITY					
Pleistocene 1m. year	Conglomerate Sand. Sand Stone	Upper Siwalik	Ram Ganga	Kamalgarh and Neogarh	---
Pliocene to lower Miocene	Argillaceous Sediments	Middle and Lower Siwalik	Ram Ganga	Gar-Chandi	---

4.5 Seismicity

As per seismic zoning map of India (IS: 1893:2000), the area of the project falls within Zone-IV.

4.6 EXISTING LAND USE PATTERN

The predominant land use of the area is agriculture land followed by forests/plantation, river body and water body (ponds).

4.7 EXISTING INFRASTRUCTURE &SENSITIVE ECOLOGICAL LOCATIONS

S. No.	Sensitive Ecological Features	Name	Aerial Distance (in km.) from project boundary
1.	National Park/Wildlife Sanctuary	None	0.00
2.	Tiger Reserve/Elephant Reserve / Turtle Nesting Ground	None	0.00
3.	Core Zone of Biosphere Reserve	None	-
4.	Habitat for migratory birds	Tumaria dam	25.00
5.	Lakes/Reservoir/Dams	Tumaria dam	25.00
6.	Stream/Rivers	Kosi	0.00
7.	Estuary/Sea	None	-
8.	Mangroves	None	-
9.	Mountains/Hills	None	-
10.	Notified Archaeological sites	None	-
11.	Industries/Thermal Power Plants	None	-
12.	Defense Installation	None	-
13.	Airports	I.G. International, Delhi	190
14.	Railway Lines	Rampur Junction	16
15.	National / State Highways	ODR-20	3
		NH-24	13

4.7 Soil Classification

The soils of the study area belong to the soils of Gangetic Plain. The soil lying in the present and old courses of the Ramganga and its tributaries is formed as a result of meandering action and are classified as “Soils of Active Flood Plain”. The soils, in general, are deep, well drained, coarse-loamy / fine-loamy / sandy over coarse loamy. The soil of the major portion of command area is categorized as “Soils of Recent Alluvial Plain”, which is presently free from flood activities. The major soils

are deep, well drained, coarse-loamy / fine-loamy. The soils are normal soils neither saline nor sodic and are slightly erosion prone. Soils are sandy loam/loamy sand and are neutral

4.8 Climatic Data from Secondary Sources

The climate is sub-tropical interspersed between cold weather, hot weather and southwest monsoon. The cold weather commences in December continues till the end of January and is characterized by cloudless days and cold nights with much fog and dew. The temperature is as low as 0.60C has been recorded at Bareilly (nearest IMD Station) during winter recorded on January 31, 1905. May and June are usually the hottest months and temperature as high as 46.70C has been recorded on May 29, 1884. During monsoon period June to October, the weather remains humid.

Month	Air Temperature Average		Rainfall	Relative Humidity		Mean Wind Speed
	Highest in the month, ^{0}C	Lowest in the month, ^{0}C	Monthly Rain Fall	Max. %	Min. %	Average, Kmph
January	25.4	5.5	22.1	81	56	3.9
February	29.6	6.7	20.3	72	45	5.6
March	36.1	10.7	17.6	59	34	6.6
April	41.6	16.3	6.2	41	24	6.8
May	44.4	20.7	18.2	40	26	7.3
June	43.9	22.6	111.8	60	45	7.3
July	38.8	22.8	299.7	81	71	6.1
August	36.2	23.2	317.0	85	76	5.0
September	36.2	21.3	166.0	80	69	4.6
October	35.3	15.0	85.8	75	58	2.9
November	31.7	9.7	3.1	73	63	2.3
December	26.9	5.5	4.1	79	57	2.9

- **Temperature**

The highest temperature recorded is 44.4^{0}C in the month of May and lowest 5.5^{0}C during December and January month. The average temperature during April to June is 43.3^{0}C reflecting moderate summer in the region. The average temperature during July to September is 37.1^{0}C shows very little variation in temperature during monsoon season.

- **Relative Humidity**

The average annual relative humidity is about 68%. The relative humidity of the area varies from 24% -85% with April being lowest whereas the maximum humidity is observed in the month of August.

- **Wind Pattern/ Direction**

Winds are generally moderate throughout the season and lie in the range of 2.3 to 7.3 km/hr during the season. However, strong wind has also been observed for short duration during May and June. The pre-dominant wind direction during May-June is

from E, W, NW. Wind speed during monsoon varies from 4.6 to 7.3 km/hr. The pre-dominant wind direction during the season is E, SE and W. The pre-dominant wind direction during post monsoon season is from W and NW.

- **Cloudiness and Special Weather Phenomena**

The skies are generally moderately to heavily cloud during the monsoon season and in winter season. The skies are mainly clear or lightly clouded during the December to March months. The highest incidences of thunderstorms occur in the period March to October. Hail, dust storm, squalls are rare in the region. Occasional fog occurs in the winter season

- **Rainfall**

The average annual rainfall is 1071.9 mm and upto 85% occurs during monsoon i.e. from June to October. The southwest monsoon sets in by June and withdrawal takes place in October. June to September is main rainy months though it continues till October.

4.9 Social Infrastructure

The social infrastructure like educational facilities (primary and higher secondary schools), drinking water supply, post and telegraph, public transportation and hospitals are by and large are available in the study area.

5.0 PLANNING BRIEF

5.1 Planning Concept

Based on the criterion fixed by the Central Water Commission, New Delhi, for design of hydraulic structure on permeable foundation, the new replacement barrage has been designed. For planning and design all relevant code of practices as laid down under various BIS codes and guidelines fixed for hydrological studies by the CWC were followed. The principal levels were fixed based on detail studies for various past floods at the site and other nearby structures and governing levels of the command area etc., keeping in mind the least submergence area and the least displacement principle. The following specifications have been followed:

IS: 7720 - 1991- Criteria for investigation, planning and layout for barrages and weirs.
IS: 6966 - 1989 - Hydraulic design of barrages and weirs – Guidelines
IS: 6531- 1994 - Canal head regulators Criteria for design
IS: 7349 -1989- Barrages and weirs – Operation and maintenance – Guidelines.

IS: 4997-1969- Criteria for design of Hydraulic jump type stilling basin with horizontal and sloping apron.
IS: 8237- 1985- Code of practice for protection of slope for reservoir embankment.
IS: 11130 – 1984 Criteria for structural design of barrages and weirs.
IS: 456 - 2000 Plain and reinforced concrete – Code of practice.

5.2 Assessment of Infrastructure Demand (Physical & Social)

The socio-economic assessment will be made at the time of socio economic survey during EIA study.

5.3 Amenities/Facilities

Residential/Non-residential buildings

Under sub-head "K-Building" residential facilities (Type IV-2, Type III-4 and Type I-8) shall be created at project colony near headwork. The offices of the Executive Engineers and other engineers have been functional at Rampur and other places since long. A well planned project colony exists at Rampur. Besides, a control cabin, inspection house-cum-meeting hall, a temporary small site office and stores shall be developed at other location near project site.

Water Supply

Potable water shall be supplied for human consumption.

Power Supply

Domestic power/ lighting arrangement shall be made in the project colony as well as project site beside construction power for dewatering.

Transport of Men and Material

Most of the employee shall stay put in the colony which shall be located very near to the project site and those who live outside report to the duty on own means.

Communication

Land line and Mobile phones shall be used for communication.

6.0 PROPOSED INFRASTRUCTURE

6.1 Industrial Area (Processing Area)

Arrangements like site office, control cabin, project road from ODR to new barrage shall be provided. Service roads on bank of canal and distributaries already exist.

6.2 Residential Area (Non Processing Area)

A well planned project colony exists at Rampur. Besides, a small colony and site office shall be developed at headwork for the staff looking after the operation and maintenance of the works created.

6.3 Green Belt

The green belt shall be developed in area around headwork and vacant government land. It has been developed along service road of canal and distributaries. The spoil

banks have stabilized with vegetal cover. The places where the vegetal cover is less, avenue plantation shall be carried out along service roads and on spoil banks.

6.4 Social Infrastructure

As there shall be no displacement of people no social infrastructure needs to be created, and thus no Resettlement and Rehabilitation site shall be warranted.

6.5 Connectivity

Project site is well connected to existing road and rail network. There is no proposal to developing new road and rail links.

6.6 Drinking Water Management

Water requirement for drinking in colony and at site shall be met from ground water resource (bore well)

6.7 Sewerage System

The size of head works colony is not big .The sewerage system shall consist of a small STP.

6.8 Industrial Waste Management

Not applicable, as the operation and maintenance of the completed project components shall not generate any effluent and industrial waste.

6.9 Solid Waste Management

The excavated material from excavation of foundation of barrage and appurtenant works in river bed shall be consumed in formation of coffer dam, guide bunds/marginal/ afflux bunds

6.10 Power Requirement & Supply/ Source

Electrical power requirement for operation of vertical gates, lighting in the head work area and bunds; construction power and domestic power in colony shall be met from the Western Uttar Pradesh Power Distribution Corporation.

7.0 Rehabilitation and Resettlement (R&R) Plan

The private land required for project mainly lies within the flood plain of the river. The total private land requirement under the project covered under 4 revenue villages was assessed as 119.85 ha. None of the villages shall be submerged due to the project and it is only agriculture land in flood plain that shall fall in submergence. In fact 17.533 ha private land has been acquired from private owners by the project proponent by mutual consent. The landowners were compensated for the assets acquired and grants as mentioned under:

- Compensation for land as per U.P. Government norms i.e., maximum @4 times the circle rate fixed by the collector and as determined by the distinct committee, formulated as per U.P. G.O. No.2/2015/215/F-13-20(48)/2011 ,date 19.3.2015.

- Compensation for assets attached to the land including crop compensation, if any.

8.0 PROJECT SCHEDULE & COST ESTIMATES

8.1 Likely Date of Start of Construction and Likely Date of Completion

All the works are likely to be completed within 3 years, after the grant of statutory environmental clearance.

8.2 Estimated Project Cost along with Analysis in terms of Economic Viability of The Project

The status of Administrative approval to the project is shown below:

- The Technical sanction was issued by the competent authority i.e., Chief Engineer Eastern Ganga Canal, Moradabad, vide letter 11957/CE (Eastern Ganga Canal) dated 14.8.2014 for INR 23631.77 lakh only.
- The Expenditure Finance Committee of the State, during November2014, has accorded sanction to the project for INR 21635.90 lakh only

9.0 ANALYSIS OF PROPOSAL

9.1 Financial and Social Benefits with Special Emphasis on the Benefit to the Local People Including Tribal Population, If any, In the Area

The B.C. ratio of project is 1.24:1. The benefits from the project shall be in terms of increase in irrigation intensity and increase in area brought under irrigation which shall lead to increase in net annual additional increased production of food grains shall be INR 3048.16. The employment opportunity shall be created with improved farming practices as well as the construction of the barrage, canal and lining works of distribution networks and due to implementation of other labour oriented works.

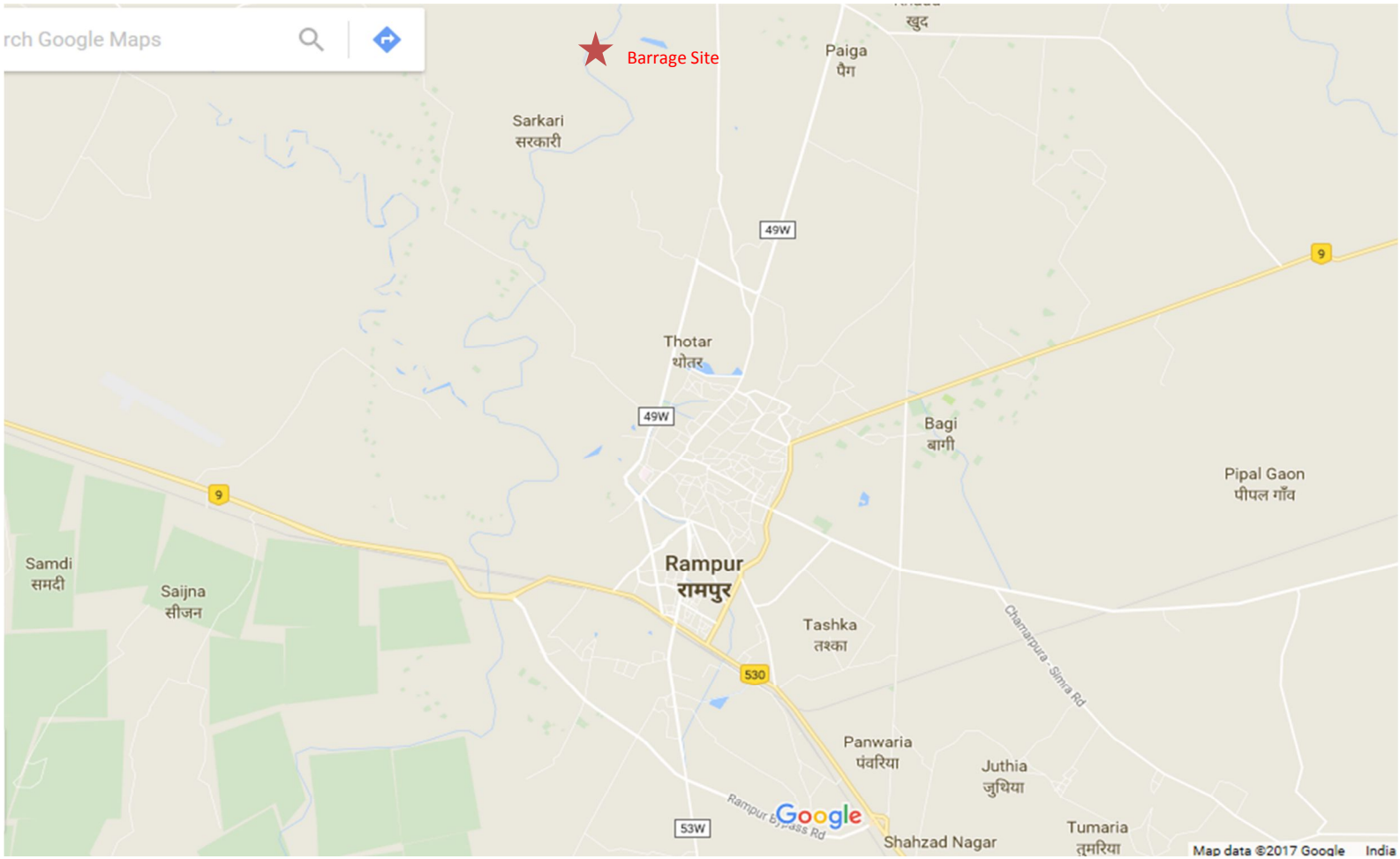


Figure – 1: Location and Vicinity Map of Project

Figure – 2: Site Photographs of Dam/ Reservoir/ Feedar Canal

Downstream view of Lalpur Weir

Upstream view of Lalpur Weir

View of Head Regulator of Kosi Canal

Figure – 3: Index Map of Kosi Canal System

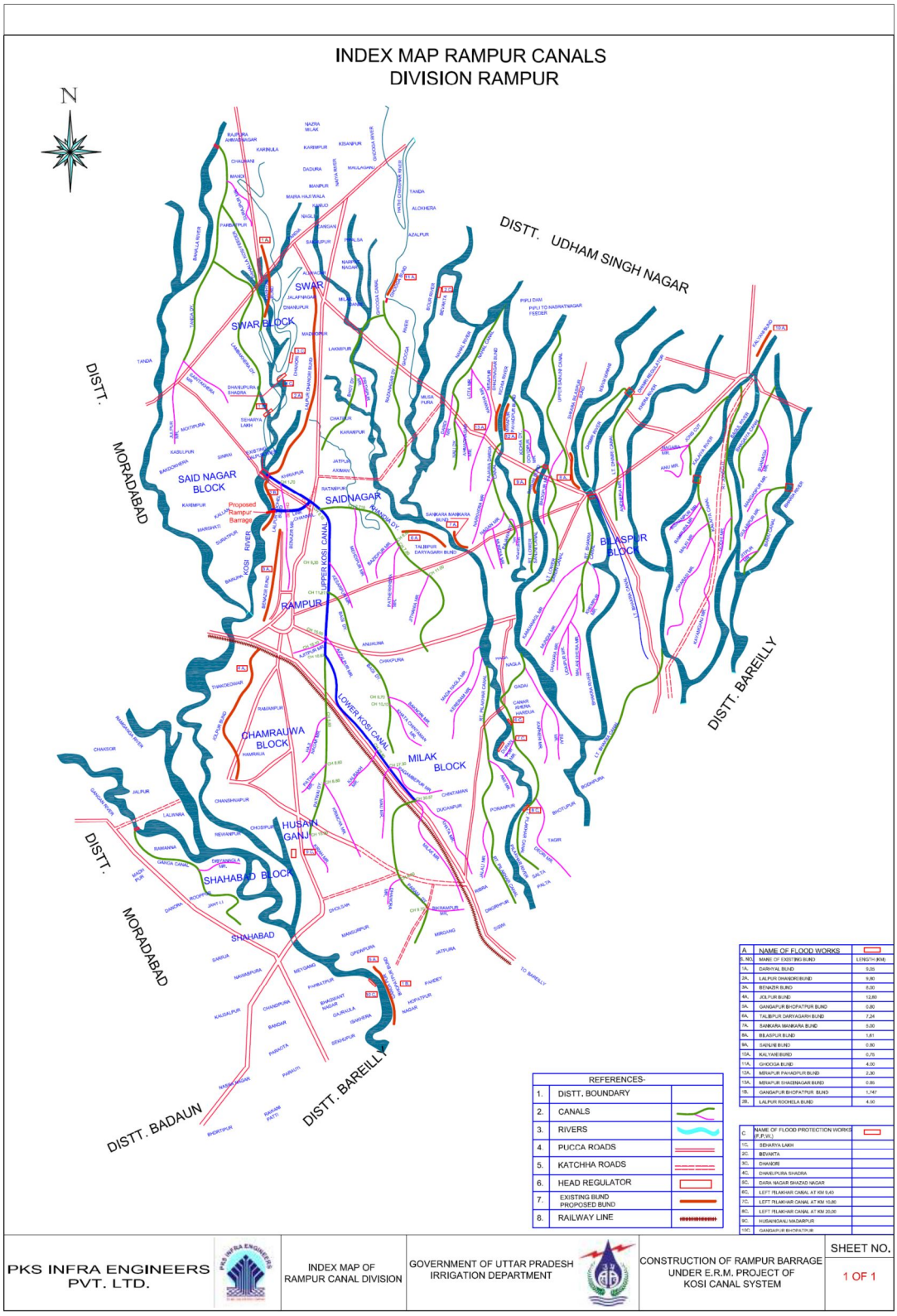
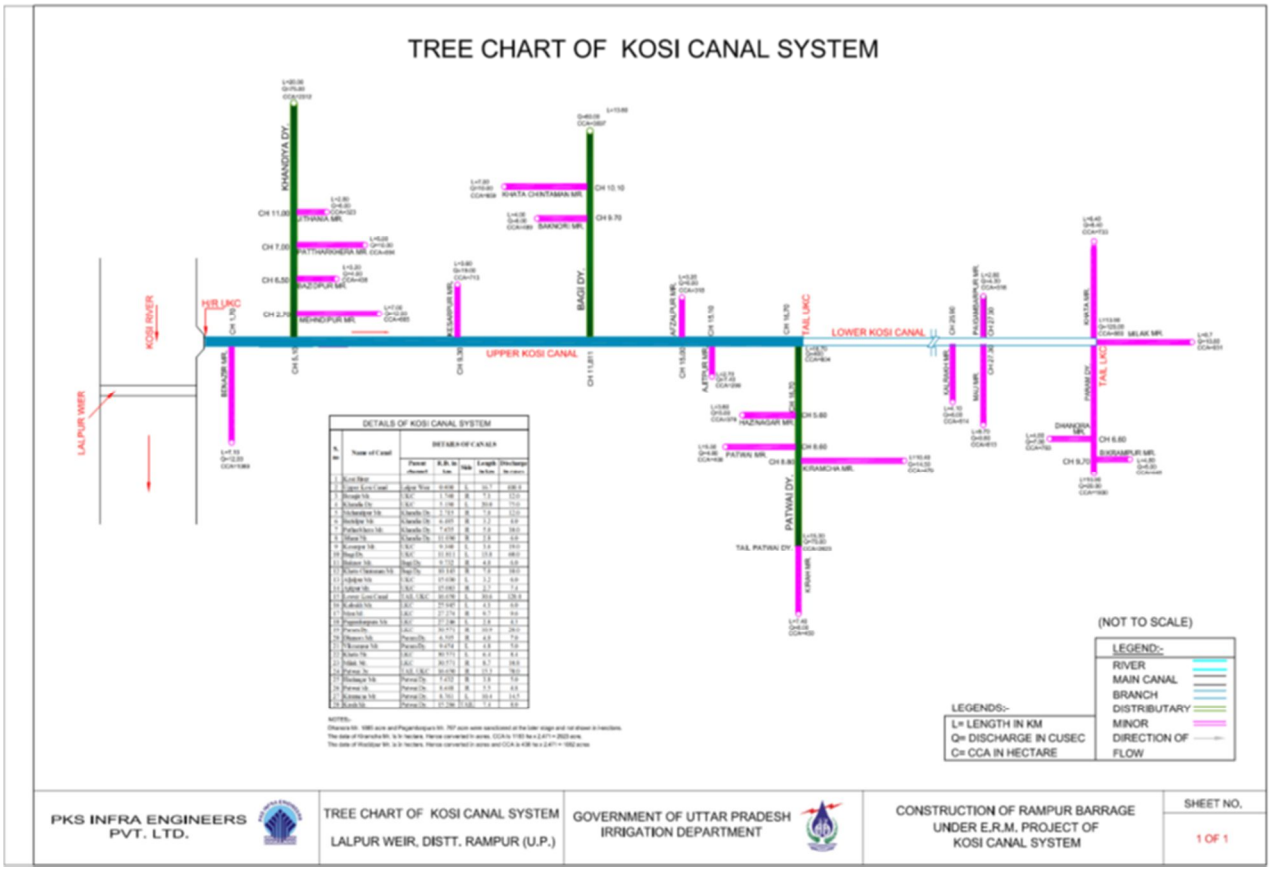


Figure – 4: T-Diagram of Kosi Canal System


TREE CHART OF KOSI CANAL SYSTEM
KOSI RIVER
HIR LMC
LALPUR WEIR
UPPER KOSI CANAL
LOWER KOSI CANAL
TAIL LMC
TAIL LKC
BAGI DY
PATWAI DY
KHANDIYA DY
(NOT TO SCALE)
LEGEND:-
RIVER
MAIN CANAL
BRANCH
DISTRIBUTARY
MINOR
DIRECTION OF FLOW
LEGENDS:-
L= LENGTH IN KM
Q= DISCHARGE IN CUSEC
C= CCA IN HECTARE
PKS INFRA ENGINEERS PVT. LTD.
TREE CHART OF KOSI CANAL SYSTEM
LALPUR WEIR, DISTT. RAMPUR (U.P.)
GOVERNMENT OF UTTAR PRADESH
IRRIGATION DEPARTMENT
CONSTRUCTION OF RAMPUR BARRAGE UNDER E.R.M. PROJECT OF KOSI CANAL SYSTEM
SHEET NO.
1 OF 1