Proposal for

SABARMATI RIVERFRONT DEVELOPMENT

AHMEDABAD

Prepared for

Sabarmati River Front Development Corporation Limited (SRFDCL)

Prepared by

Environmental Planning Collaborative (EPC)

'Paritosh' Usmanpura, Ahmedabad

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MAY 1998

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Responsible for developing the slum resettlement and rehabilitation strategy

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Responsible for analyzing water retention and ground water issues

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A- INTRODUCTION

Since a long time, the Sabarmati River, which passes through the center of Ahmedabad, has been subjected to severe pressure and abuse owing to the fast pace of urban and industrial growth of the city. At present the riverfront lies neglected and is characterized by unimaginative and unplanned development. Its potential to provide city level social infrastructure and recreation facilities lies untapped. Though it is a major source of water for the city and despite the building of a major barrage to retain water, except for a few months during the monsoon the river is dry. Sewage contaminated storm water outfalls and the dumping of industrial waste pose a major health and environmental hazard. Though the riverbanks and bed provide a place to stay and a source of livelihood for many poor citizens, the riverbank slums are disastrously flood prone and lack basic infrastructure services. The slums located along the riverbed also pose a major impediment to efficient management of monsoon floods in the river.

It has long been acknowledged that appropriate development of the riverfront can turn the river into a major asset, which can improve the quality of environment and life in Ahmedabad and improve the efficiency of its infrastructure. In May 1997, the Ahmedabad Municipal Corporation established the Sabarmati River Front Development Corporation Limited (SRFDCL) under Section 149 (3) of the Companies Act 1956. The SRFDCL was provided with a seed capital of Rs. one crore and charged with the responsibility of developing the Sabarmati Riverfront. In August 1997, the SRFDCL appointed Environmental Planning Collaborative (EPC), a citybased not for profit urban planning and urban development management consulting firm, to prepare a comprehensive proposal for the development of the Sabarmati Riverfront. This report presents the Sabarmati Riverfront Development Proposal (SRFD Proposal).

EARLIER STUDIES AND THE SRFD PROPOSAL

This section briefly reviews studies and proposals that have been made over the last four decades for the development of the Sabarmati Riverfront. These include four design proposals and two technical studies.

A) Proposal for Integrated Planning and Development of the Sabarmati Riverfront by Mr Bernard Kohn (1961).

Mr Bernard Kohn, a French architect residing in Ahmedabad during the early 60s, visualized the development of the Sabarmati Riverfront with a mix of commercial, recreational and residential development along both the banks of the river from Gandhi Bridge to Sardar Bridge. Information about this proposal is available in Issue No. 11 of 'Amdavadma'. The proposal called for reclamation of about 30 ha of land, of which a part was to be sold or leased for commercial development. This was to provide the revenue for capital works visualized in the project. The proposal showed that the entire development could be self-financing. It also suggested the formation of an independent development authority to implement the project.
The present SRFD proposal, in view of the extensive development of the city since the sixties, envisages reclamation of a larger amount of land than the Kohn Proposal. However, the financing strategy is identical to that envisaged by the Kohn Proposal. The present proposal also envisages a mix of commercial, residential and recreational developments. Compared to the Kohn proposal, it proposes higher investments in infrastructure works.

B) Technical Studies Commissioned by the Government of Gujarat.

In the late sixties, two technical studies were commissioned by the Government of Gujarat to examine the feasibility of the Kohn Proposal. These studies also formed the basis of the subsequent proposals for developing the riverfront.

- **Technical Feasibility Study by CWPRS, Khadakvasla (1966)**

Hydraulic studies using physical models were conducted to simulate water flows in the river. The models included embankments designed by the Central Design Organization. These embankments were slightly modified versions of the Kohn Proposal. The CWPRS study concluded that the Kohn Proposal was technically feasible.

- **Contour Survey**

The Sabarmati Barrage Division around the same time as the CWPRS Study carried out a detailed contour survey of the river. Findings of both these studies are now invalid due to

1. Changes in the physical features of the river
2. The building of the Dharoi Dam
3. The building of the Vasna Barrage
4. The availability of considerably more sophisticated and computerized analytical techniques.

For the present proposal a detailed physical survey of the river was commissioned and extensive hydraulic analysis was conducted.

C) The River Front Development Group Proposal – RFDG (1976).

This proposal was prepared by a group of local professional firms and NGOs: Ahmedabad Study Action Group; Design Associates, Architects; M/s Hasmukh C Patel; Architects, M/s K B Mehta, Builders and Engineers and Vakil-Mehta-Sheth, Consulting Engineers. It was conceptually similar to the Kohn Proposal but suggested an incremental approach to reduce the need for initial capital outlay. It proposed the strengthening of the Pirana Sewage Treatment Plant to check the discharge of untreated sewage into the river, the development of publicly owned river bank facilities and properties and, subsequently the construction of retaining walls and the development of reclaimed land. It also suggested the creation of a separate autonomous authority to implement the project.

The specific proposals of the RFDG are no longer valid due to the extensive development of the city, changes in the physical features of the river and the development of sophisticated project financing and implementation mechanisms since the late seventies. However, many of the thematic concerns have been incorporated in the present SRFD Proposal.

D) National River Conservation Plan – NRCP (1992).

In 1992, Sabarmati River was included in the National River Conservation Plan (NRCP). A sum of Rs 100 crores was allocated for eliminating river pollution. The main thrust of the Sabarmati River Cleaning Project (SRCP) under NRCP Project is to stop the sewage from entering the river through the storm water drainage system. More specifically it proposes: interception and diversion works; the construction of trunk sewers and pumping stations in the periphery of the city; the desilting of storm water drains; the up-gradation of existing sewage treatment plants and; the provision of sanitation infrastructure in river bank slums. At present, this project is under implementation by the Ahmedabad Municipal Corporation.

The present SRFD proposal presumes that the completion of the ongoing NRCP project will eliminate the flow of sewage into the river through the storm water system. It may be necessary to divert a part of the sewage into the trunk sewers proposed as part of the SRFD Proposal. At this stage it is not possible to estimate the quantity of sewage that will be diverted. Therefore, the trunk sewers have been designed to take thrice the load required for the proposed new developments on the reclaimed land. The design of the trunk sewers can be modified whenever more accurate data is available (see B7 below for further details). The slum resettlement and rehabilitation strategy proposed in the SRFD Proposal will considerably reduce requirement for the provision of sanitation infrastructure in riverbank slums through the NRCP Project.

E) Sabarmati River Front Development – Feasibility Report, CEPT (1997).

The CEPT Proposal envisages the riverfront from Subhash Bridge to Vasna Barrage as a set of publicly accessible open spaces and recreational areas connected by walkways and promenades. It envisages the reclamation of 30 ha proposed by the Kohn Proposal and in addition to it, reclamation of a strip of 20 meters along the west bank and 10 meters along the east bank. On the reclaimed land it proposes the development of very low density mixed use (recreational and light commercial) buildings and walkways to be built on two levels. The proposal presumes the completion of the ongoing NRCP project to tackle the problem of sewage entering the river. The proposal suggests the formation of detailed urban design guidelines for each zone. The proposal includes a preliminary cost estimate and an estimate of revenues from the sale of land or buildings. It suggests that the entire riverfront development can be self-financing.

The CEPT proposal is conceptual and schematic since it is based on data from technical studies done in the late sixties and drawings that do not accurately describe the physical features of the river. Many of its thematic proposals have been considered and included in the present SRFD Proposal including the proposal to make the riverfront development a self-financing project.

The SRFD Proposal in Brief

This section briefly outlines the key features of the Sabarmati River Front Development Proposal prepared by EPC.

The SRFD Proposal prepared by EPC is based on the following surveys and studies:

- A detailed survey of the physical features of the river, bridges and adjacent areas.
- An analysis of river hydraulics.
- A study of existing land use, built form and property values and options for the use of reclaimed land.
- A study of various options for retaining water in the river.
- A study of various land reclamation and embankment construction techniques.
- A study of existing land ownership.
- A survey of existing land values and an estimation of the value of reclaimed land.
- A comprehensive survey and analysis of riverbank slums.
- A detailed survey of storm water out falls and options for preventing the discharge of sewage into the river.
- A schematic study of various implementation and financing mechanisms.

The SRFD proposal envisages a comprehensive development of both banks of Sabarmati River from Subhash Bridge to Vasna barrage. The distance from Subhash Bridge to Vasna Barrage is approximately 9 km. The salient features of the proposed development are as follows:

- Construction of embankments on both sides of the river along the entire stretch from Subhash Bridge to Vasna Barrage.
- Reclamation of 162 ha of land.
- Retention of water in the river for the whole year.
- Development of seven new public gardens and the extension of Tilak Baug (Victoria Garden) and Bhikhabhai Jivabhai Park.
- Development of wide public promenades along the entire length of the river with adequate on street parking facilities.
- Allocation of adequate, serviced land along the river for relocation of households affected by the project. The establishment of programs for rehabilitation/relocation of those who are economically dependent on the riverbed.
- Development of a 6 lane wide and 9 km long road along the entire length of the east bank and other new roads on both banks. Improvement of the immediate secondary and tertiary road network providing access to the reclaimed land.
- The laying of water supply lines, trunk sewers and pumping stations along both the banks of the river to serve the development on the reclaimed land and some of the existing developments. The extension of storm water drains flowing into the river.
- The allocation of land for a new bus terminal and other public facilities including fire stations and schools.
- Development of sites for informal markets with adequate services such as parking space, public toilets and water supply.
- Selling of a portion of the reclaimed land for residential and commercial development to finance all of the above developments.
- Developement of urban design guidelines to control residental and commercial developements on the reclaimed land.

The SRFD project is expected to generate major city level benefits. Some of these are briefly discussed below:

1.Recharge of the ground water aquifers of the city

Ahmedabad is heavily dependent on ground water to meet its water requirements. A significant component of Ahmedabad's water supply (nearly 42%) is met by the ground water sources, which are rapidly depleting. It has been estimated that the ground water table falls 2.5 m annually. The building of embankments on either side of the river will make it possible to retain water up to the top of the Vasna Barrage. Retaining water in the river will result in recharging of the ground water aquifers and arrest the rapid fall in the ground water table in the city area.

2.Strengthening of the transportation network of the city

At present Ahmedabad has only one major north-south link which is Ashram Road on the western side of the city. The addition of a major north-south road link on the east bank and strengthening of other roads will significantly add to the road network of the city, reduce traffic congestion and result in a more efficient flow of traffic.

3.Elimination of flood hazard

At present in the event of a 4 lakh cusec flood nearly 10,000 slum households located on and adjacent to river can get washed away by the flood. The magnitude of this problem is likely to intensify over time as the number of slum households increases. Also, several low-lying areas in southern Ahmedabad are flood prone even with a 4 lakh cusecs flood. The 'afflux bunds' or embankments constructed on both the banks as a part of SRFD Proposal are designed to provide protection against a 5 lakh cusecs flood which will not only eliminate the annual flooding of the low lying areas of the city but also prevent the washing away of many slum households. In addition, developement of the riverfront will also eliminate the possibility of increase in the number of riverbed slums.

4.Relocation and rehabilitation of slums

The slum relocation and rehabilitation component of the project will result in the transformation of slums affected by the project. Affected households will be provided elevated and serviced land. This will eliminate the risk of flooding for many poor communities. Rehabilitation packages will improve the economic well being of households whose incomes are dependent on the river.

5.Flood management

At present flood management in the river Sabarmati is constrained by the presence of slum settlements along the riverbanks. The relocation of these settlements on elevated land will ease the constraints on flood management

6.Provision for informal markets

At present the informal markets (Gujari and Phool Bazar), which are of economic importance to the poor, lack accessibility, parking space, water supply, public toilets and ancillary facilities and take place in a unorganized manner. In addition they are disrupted due to flooding during the monsoon. The SRFD Project will strengthen, upgrade and enlarge the existing two markets and develop two additional markets near Gandhi Bridge on the east bank and at Usmanpura on the west bank, thereby benefiting the vendors and creating additional employment opportunities. It is estimated that the four markets will generate a direct employment of approximately 14,000 jobs. All the informal markets will be developed on elevated land and have a planned layout with semi permanent stalls, plinths and facilities

such as parking spaces, water supply and public toilets. The informal vending activities thus can occur all the year round without the danger of being disrupted by floods. The provision of facilities will also mean that the high-income people of the city would frequent these markets.

7.City level recreational spaces

Ahmedabad lacks adequate open spaces, gardens and city level cultural facilities. The SRFD project will add forty hectares of parks and gardens, and spaces for cultural facili-ties. In addition, about ten hectares of riverfront promenades will also be developed. These will provide a peaceful environment for all, particularly the old and the very young. These additions in the heart of the city will considerably enhance the availability of open space for the densest areas of the city.

8.Beautification of the city

Ultimately, implementation of the riverfront development project and the enforcement of appropriate urban design guidelines can transform the riverfront into a vibrant and aesthetically pleasing environment in the heart of the city – an environment that links the eastern and western parts of the city.

B- THE SRFD PROPOSAL

B1 Physical Features of the River

B2 River Hydraulics

B3 Land Reclamation and Embankments

B4 Land Ownership

B5 Water Retention and Ground Water Recharge

B6 Land Use and Road Network

B7 Infrastructure Services

B8 Resettlement and Rehabilitation

B1 PHYSICAL FEATURES OF THE RIVER

This section and Drawing No. 1 describe the scope, methodology and key findings of the detailed survey of the river and adjacent areas undertaken for developing the SRFD Proposal.

Scope of the Survey

A total of 1033.17 ha was surveyed. This included a 10 km stretch of the river from the Sabarmati Railway Bridge at Dufnala up to one km downstream of Vasna Barrage. On the eastern side, the survey covered up to 100 m from the riverbank or up to the immediate major road (whichever was more). On the western side the survey extended up to Ashram Road. Drawing No. 1 shows the extent of the survey.

The survey included the following:

- Cross-sections of the riverbed at every 100 m interval.
- Longitudinal sections of the riverbed at every 30 m interval along the cross section line.
- All bridges - alignments, pier positions and reduced levels of bridge tops and soffits (with reference to the Great Trigonometric Survey (GTS) benchmark).
- Vasna Barrage - gate positions and reduced levels of the top of the walkway and the spillway.
- Reduced level and position of the discernible top edge of the riverbank.
- Location of storm water outfalls along both the banks and their top and invert levels.
- Building footprints, compound walls, fences, electric poles, telephone poles, trees, manholes, wells, high tension lines and spot levels in the areas adjacent to the river.
- About 35 km of road length in the area adjacent to the river.

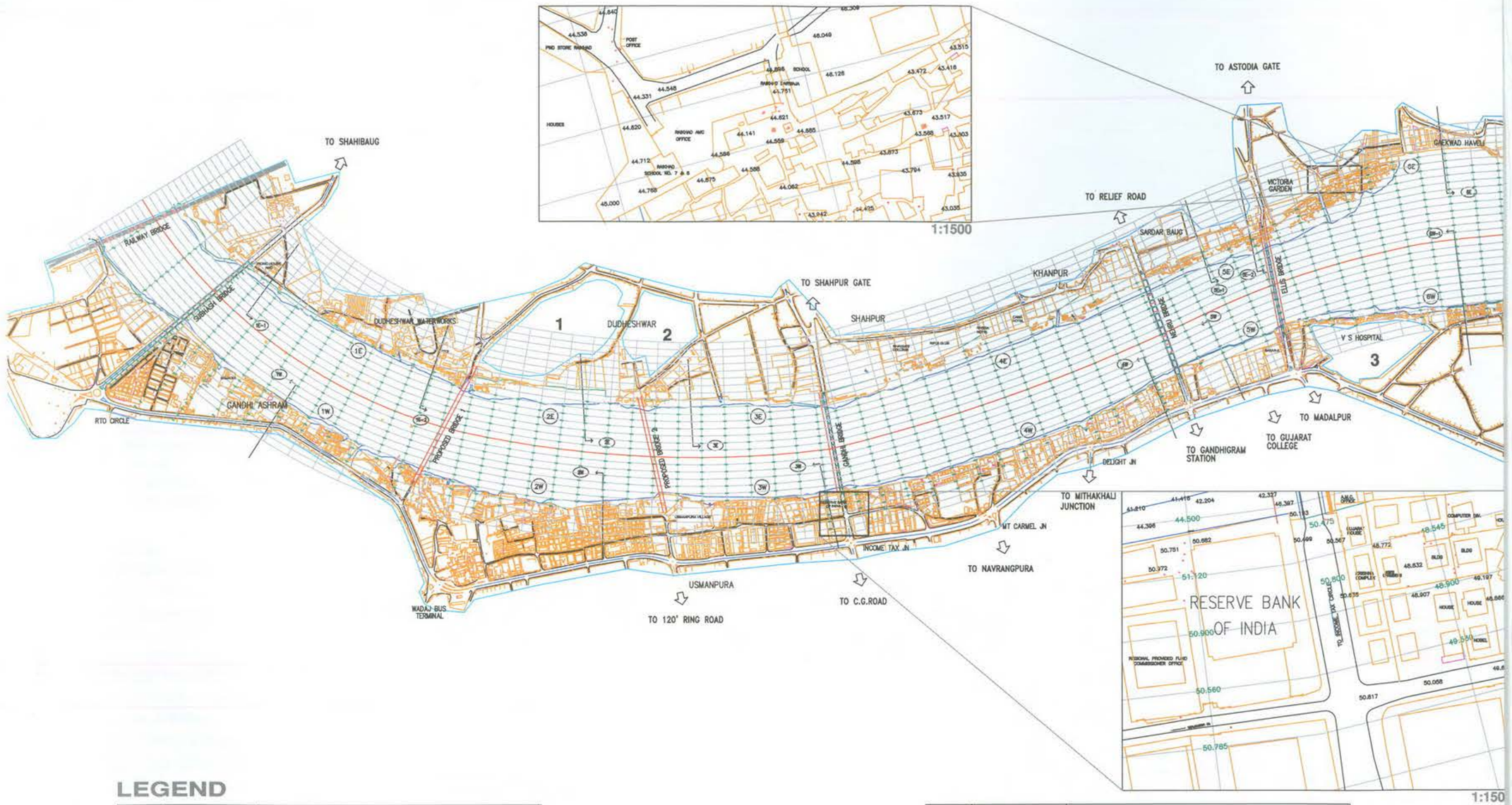
Methodology of the Survey

The survey work included horizontal control and vertical control while conducting the survey. Horizontal control was obtained by using Power Set series Total Station Set 2000 and vertical control was obtained by Automatic Levels.

For horizontal control, the grid was considered parallel to the magnetic north as taken at the site on 12 July 1997. The coordinates of the first control point were assumed as N: 50000 and E: 50000 as arbitrary points of origin. For vertical control, the level was transferred from GTS bench mark situated at traffic island opposite Ahmedabad Jilla Panchayat Building at Lal Darwaja which is 49.335 m above MSL.

Triangulation network observation, elevation and all detail observation were directly downloaded from the Power Set equipment to the computer via magnetic card. Triangulation network was balanced with using traverse software. The drawings were prepared using Autocad R-12 software.

Equipment employed to carry out the survey, process the data and prepare the output included:



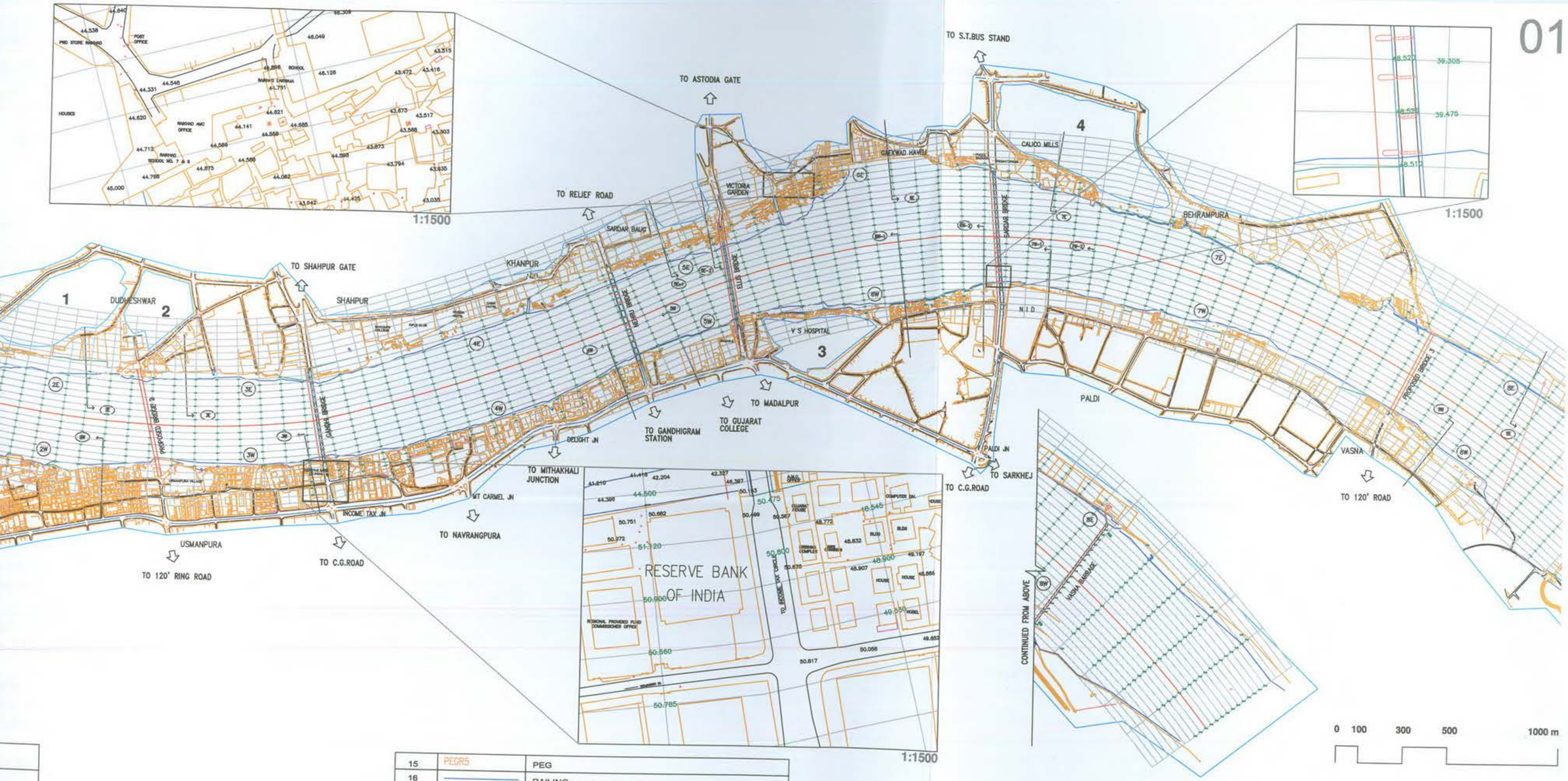
LEGEND

Sr.No.	NOTATION	DESCRIPTION
1		VERTICAL SURVEY GRID (E-W)
2		HORIZONTAL SURVEY GRID WITH CENTER LINE (N-S)
3	48.358	CROSS SECTION LEVELS ON THE RIVER BED
4		RIVER BED LINE
5	M	MANHOLES
6		BRIDGE PIERS
7		TREE
8	48.358	BOTTOM LEVEL OF TREE
9	TR	TREE NAME
10		WELL
11		WELL IN THE RIVER BED
12		BUILDINGS
13	48.358	GROUND SPOT LEVELS
14		OTTA (SURVEY)
15	PEGRS	PEG
16		RAILING
17		TOP EDGE OF THE RIVER
18		RAILWAY LINE
19		ROAD
20	E/@	ELECTRIC POLE
21		BUILDING FENCE LINE
22		HIGH TENSION LINE
23	T	TELEPHONE POLE
24		SURVEY BOUNDARY
25	4	AREAS NOT SURVEYED
26		BRIDGE EXPANSION / PROPOSED BRIDGE
27	9W	SECTION LINE AND SECTION No.
28	8W	RIVER BANK BETWEEN TWO CONSECUTIVE BRIDGES

NOTE : TOTAL AREA SURVEYED IS 1033.1661 ha.

01

1:1500



1:1500

1:1500

0 100 300 500 1000 m

15	PEGRS	PEG
16		RAILING
17		TOP EDGE OF THE RIVER
18		RAILWAY LINE
19		ROAD
20	E/e	ELECTRIC POLE
21		BUILDING FENCE LINE
22		HIGH TENSION LINE
23	T	TELEPHONE POLE
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28	8W	RIVER BANK BETWEEN TWO CONSECUTIVE BRIDGES

NOTE : TOTAL AREA SURVEYED IS 1033.1661 ha.

PHYSICAL SURVEY

1:17500

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

Information contained in this map is based on data provided by Theotech Engineers, Survey Consultants, Vadodara

May 1998

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No.	Equipment	Make	Quantity
1	Total Station (Power set series, set 2000) Angle Display 0.5 second Distance Measurement 4200 with triple prism unit	Sokia, Japan	2
	Total Station Accessories In built memory 128 K (1300 points) Memory card 128 K (2000 points) Memory card 64 K (1000 points) Single Prism Unit (APS 12) Range Pole (2.1 m long) Extension Pole (2.0 m long)		 1 3 3 3 3 3
	General Accessories Card Reader for data down loading Interface to connect card reader Interface cable t connect Total Station Car Battery Cable		 1 1 1 1
2	Second Theodolite	Topcon, Japan	1
3	Auto Level	Wild, Swiss	2
4	Auto Level	Zeiss, German	3
5	Auto Level	Sokkia, Japan	1
6	Computer (80586 Pentium)	Indian	3
7	Computer (80586 DX2)	Indian	1
8	Digitizer		1
9	Plotter (A0 Size)		1
10	Printer (Desk Jet 670 color)	HP	1

Key Findings

- The river runs a meandering course of about 9 km from Subhash Bridge up to the Vasna Barrage through the city with an average width varying from 340 to 600 m.
- On observing the alignment of the river, there are two meandering loops. Wherever the river has meandered or turned its course, the river gorge has widened due to scouring. This is evident at Gaikwad Haveli and at Wadaj.
- The average reduced levels (RL) of the riverbed at Subhash bridge and Vasna Barrage are 39.2 m and 37.4 m respectively, the slope of the river is 1:5000. The height of the banks ranges from 4 to 9 m.
- A negative slope is observed from Sardar Bridge to Vasna Barrage.
- The edge is not clearly defined by embankments or retaining walls at most places. The river edge gently slopes down to the riverbed at several places, which have vegetation and have been encroached by slum settlements.
- The RL of top of gate of Vasna Barrage is 41.756 m. Filling Vasna Barrage up to this level results in flooding of the nearby areas in monsoons.

Further Work Required

- Though the survey (carried out by Theotech Engineers) was adequately monitored by EPC, it will be necessary to have it verified by an independent third party before commencement of detailed planning work.

B2 RIVER HYDRAULICS

This section and Drawing Nos. 2 to 4 describe the scope, methodology and key findings of the hydraulic analysis conducted to evaluate the impact of the SRFD Proposal on the dynamics of the river.

Scope of the Analysis

The impact of building embankments and reclaiming land along the riverfront on the dynamics of the river, scouring of the riverbed and on the stability of bridges was analyzed in detail. Various heights of embankments and various waterway widths were taken into consideration to arrive at the proposed design.

The fundamental objective of the design was to ensure that the building of the embankments and narrowing of the waterway does not in any way raise the high flood level beyond what can be expected in the present condition of the river. A secondary objective was to ensure flood control in the low-lying areas of Ahmedabad.

Analytical and Design Methodology

- The analysis used the WSPRO Model for Water Surface Profile, a standard program used by the US Department of Transportation, to arrive at the estimated high flood levels (HFLs).
- Data regarding the physical profile of the river and the bridges along the river was obtained from the survey described in section B1 of this report. It should be noted that the ongoing bridge widening projects propose to build new bridges at the same height as the existing bridges.
- The variable parameters were the width of the waterway (250, 275 and 300 m) and the intensity of the flood (4, 5 and 7.5 lakh cusecs). In determining these parameters, the objectives of the design (stated above) and the following were taken into consideration:

1. The linear waterway required for bridges on the Sabarmati (as per the Flood Estimate Report for Mahi and Sabarmati – sub-zone 3a by the Central Water Commission, New Delhi) is 176 m.
2. Subhash Bridge, Gandhi Bridge (and its widening), Nehru Bridge and Sardar Bridge (and its widening) are all designed for an estimated flood of 4 lakh cusecs. Ellis Bridge (and its widening) are designed for an estimated flood of 5 lakh cusecs. This data was obtained from Bridges in Gujarat (published by Roads and Buildings Dept., Government of Gujarat 1989) and the Ahmedabad Municipal Corporation.
3. The flood observed in 1973, prior to the construction of the Dharoi Dam was estimated at being 5 lakh cusecs. However, no verification of this estimate is available.
4. Drawing No. 2 shows the Sabarmati River Basin and the location of the three dams on the rivers Dharoi, Hathmati and Guhai. The following table shows the catchment area of the Sabarmati River Basin.

No.	Name of the sub basin	C.A. (sq km)
1	Sabarmati up to Dharoi Dam	5540
2	Free catchment from down stream of Dharoi Dam to the confluence of Sabarmati and Hathmati	1684
3	Guhai up to Guhai Dam	422
4	Hathmati up to Hathmati Dam	596
5	Free catchment from down stream of Hathmati Dam of Guhai Dam up to the confluence of Sabarmati and Hathmati	492
6	Remainder of the catchment from the downstream of Sabarmati and Hathmati confluence up to the Narmada main Canal crossing	1684

(Source : Sub-basin Map of Sabarmati River Basin, SSNNL, Gujarat, 1990)

The spillway discharge into the three dams from their catchment areas is:

Dharoi Dam	4,67,107 cusecs
Guhai Dam	12,771 cusecs
Hathmati Dam	71,265 cusecs

(Source: Large Dams in India, Central Board of Irrigation and Power, New Delhi, 1997)

5. The maximum flood discharge of Vasna Barrage is 7,50,000 cusecs.

   (Source: Site Office at Vasna Barrage, Ahmedabad)

6. The Kharicut Canal System is being remodeled to prevent flooding in eastern Ahmedabad. As part of this remodeling it is proposed to divert some water from the canal into the Sabarmati River. As per the initial calculations of the remodeling exercise the quantum of this diversion when compared to the flood estimated for the river is likely to be insignificant. This is indicated below:

   - Near Jethipur village between Dhanap Muthia Drain and existing natural drain — 1,764 cusecs
   - Near Valad village natural Drain — 7,056 cusecs
   - By a drain parallel to NMC — 6,457 cusecs
   - Near Khari Village

   Total — **15,277 cusecs**

   The above flood values are for 1 in 10 year return period.

   (Source: A Report on Comprehensive Planning for the Remodelling of Kharicut Canal System, Narmada Water Resources and Water Supply Department, Government of Gujarat, January 1998.)

- Data obtained from the soil investigation carried out by the Government of Gujarat in 1992 for designing the Hansol Bridge was used for analyzing scour in the river.

Findings

A) The estimation of HFLs for a 5 lakh cusecs flood, analysis of required embankment heights and existing riverbank levels showed that, of the three waterway widths (250, 275 and 300 m), a width of 275 m was optimal to achieve the objectives of the design.

B) Drawing Nos. 3 & 4 summarize the findings of the detailed analysis for a 275 m width and the existing waterway width for east and west banks. They show the following:

1. The profile of the existing riverbed.
2. The profile of the riverbed following excavation of the bed for reclamation works.
3. The profiles of the existing river banks.
4. Height of the proposed embankments.
5. Soffits and tops of existing bridges.
6. HFLs for 5 and 7.5 lakh cusecs floods for the natural waterway.
7. HFLs for 5 and 7.5 lakh cusecs floods for the proposed 275 m waterway.
8. The level of the water proposed to be retained by the Vasna Barrage.

C) The following table presents the data for the HFL in relation to bridge levels in the case of a 5 lakh cuses flood.

	Bridge	Bridge Levels (m)		HFLs (m)	
		Top of Bridge	Soffit of Bridge	Natural Condition	275 m Waterway
1	Sardar Bridge	48.520	46.225	49.14	46.95
2	Ellis Bridge	50.655	49.015	49.46	47.50
3	Nehru Bridge	52.130	49.114	49.63	47.73
4	Gandhi Bridge	50.450	48.257	50.28	48.41
5	Subhash Bridge	55.500	52.920	51.03	49.61

The above and Drawing Nos. 3 & 4 indicate that in the case of a 5 lakh cusec flood, in the natural condition, the HFL is higher than the existing riverbanks in almost all sections of the river. The HFL is higher than the soffit levels of Nehru Bridge, Gandhi Bridge and Ellis Bridge. The HFL for a 5 lakh cusec flood, with the proposed embankments and a waterway width of 275 m, is lower than that for the natural waterway by nearly 1.5 to 2.5m. The level of the top of the proposed embankment is 0.6 m above the HFL of 5 lakh cusecs flood through out the stretch. The embankments would prevent flooding along the length of the river from Subhash Bridge to Vasna Barrage and the HFL will be lower that the soffits of all the bridges. This implies that the building of embankments and modification of the waterway as proposed eliminates the flood hazard for a 5 lakh cusecs flood.

D) The following table presents the data for the HFL in relation to bridge levels in the case of a 7.5 lakh cusecs flood.

	Bridge	Bridge Levels (m)		HFLs (m)	
		Top of Bridge	Soffit of Bridge	Natural Condition	275 m Waterway
1	Sardar Bridge	48.520	46.225	51.75	50.43
2	Ellis Bridge	50.655	49.015	52.70	51.13
3	Nehru Bridge	52.130	49.114	52.23	51.42
4	Gandhi Bridge	50.450	48.257	52.86	52.23
5	Subhash Bridge	55.500	52.920	53.59	53.59

The above and Drawing Nos. 3 and 4 indicate that the HFL in the case of a 7.5 lakh cusecs flood for the natural waterway, is also higher than the existing riverbanks in almost all sections of the river. The HFL is also higher than the soffit of the Subhash Bridge and the tops of Gandhi, Nehru, Ellis and Sardar Bridges. The HFL for the proposed embankments and 275 m waterway is lower by 0.0 to 2.5 m. However, the embankments do not ensure flood control.

E) Findings in C and D above are consistent with the objectives of the design in that:
1) The embankments and modified waterways do not raise the high flood level beyond that estimated for the natural waterway and,
2) The embankments help in preventing flooding in the low lying areas of Ahmedabad.

F) Constricting the waterway to 275 m results in an increase in the discharge velocity. The velocities at different bridges and the scour depth are indicated in the following tables:

Velocity

	Bridge	5 lakh cusecs	
		Under Natural Condition (m/s)	For 275 m width (m/s)
1	Sardar Bridge	2.47	4.52
2	Ellis Bridge	2.75	4.58
3	Nehru Bridge	2.93	4.60
4	Gandhi Bridge	2.63	4.65
5	Subhash Bridge	2.37	4.70

Scour Depth

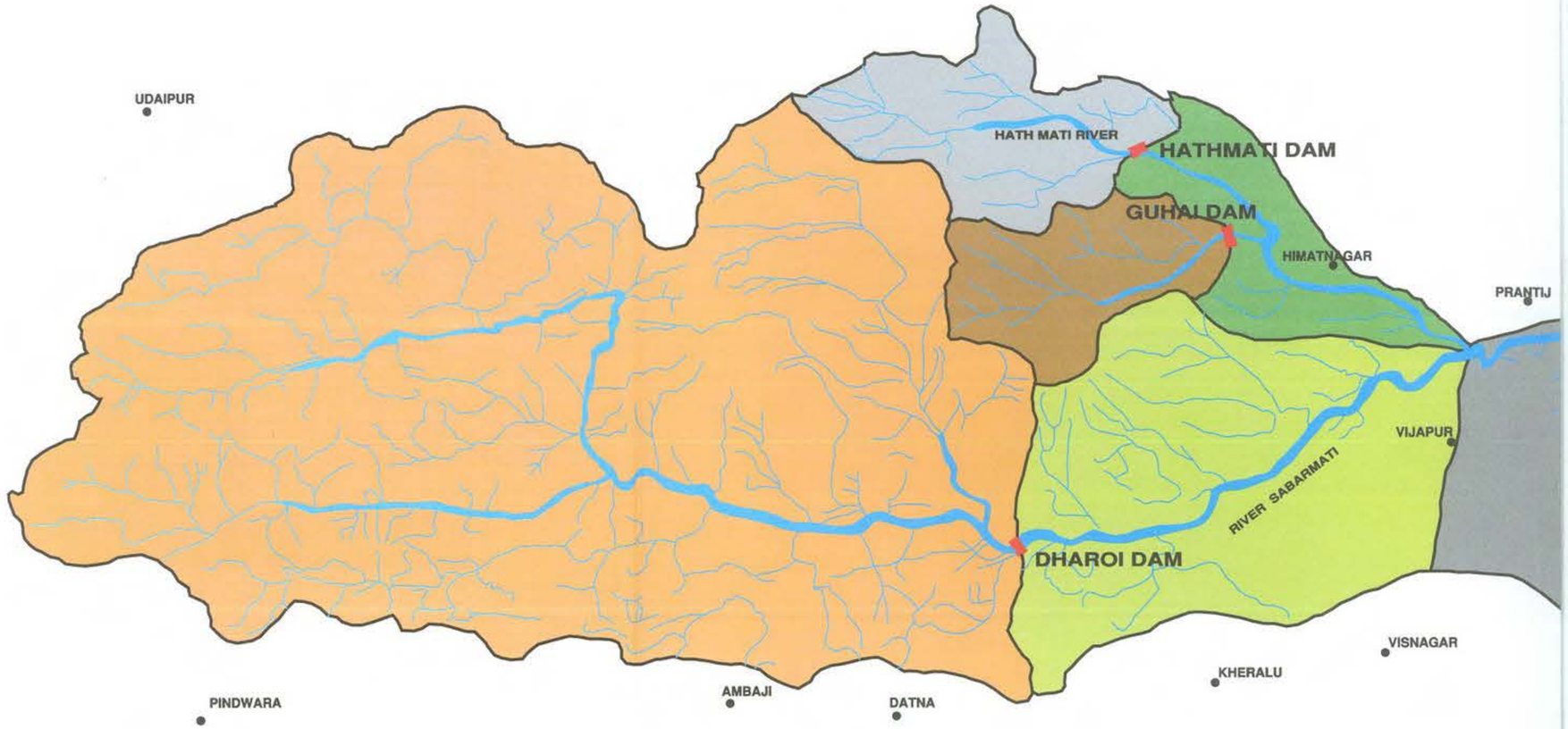
No.	Description	Scour depth below riverbed (m)
1	Existing Sabarmati River (present IRC provisions)	1.960
2	275 m water way of the Sabarmati River	7.545

G) Due to the constriction of the waterway of the river to 275 m, the scour depth is calculated as 7.545 m below the existing riverbed. To prevent exposure of the foundations of existing bridges due to scouring, it is proposed to garland them with PCC Blocks. The cost for these works is estimated at Rs. 6.33 crores (refer Section C).

H) Findings in C (above) shows that in the case of a 5 lakh cusecs flood the HFLs with the natural waterway are higher than the soffits of all bridges. Therefore all existing bridges at present are unsafe during a 5 lakh cusec flood. HFLs for the 275 m waterway are lower by 1.5 to 2.5 m. However, they are higher than the soffit levels of Gandhi and Sardar Bridges. To ensure the safety of these bridges it is proposed to anchor the super structures with the piers. The cost for these works is estimated at Rs. 2.07 crores (refer Section C).

Further Work Required

- It will be necessary to conduct a more detailed river hydraulic and scour analysis before embarking on detailed design for executing construction works.
- It will be necessary to have the above hydraulic analysis verified by an independent agency before execution work commences.
- It will be necessary to initiate a dialogue with the irrigation department with respect to the hydraulic analysis.
- It will be necessary to estimate the impact of the Kharicut Canal Remodeling to ensure that the impact of this on the estimated flood is insignificant.
- It will be necessary to determine the impact on the functioning of the french wells on the riverbed.

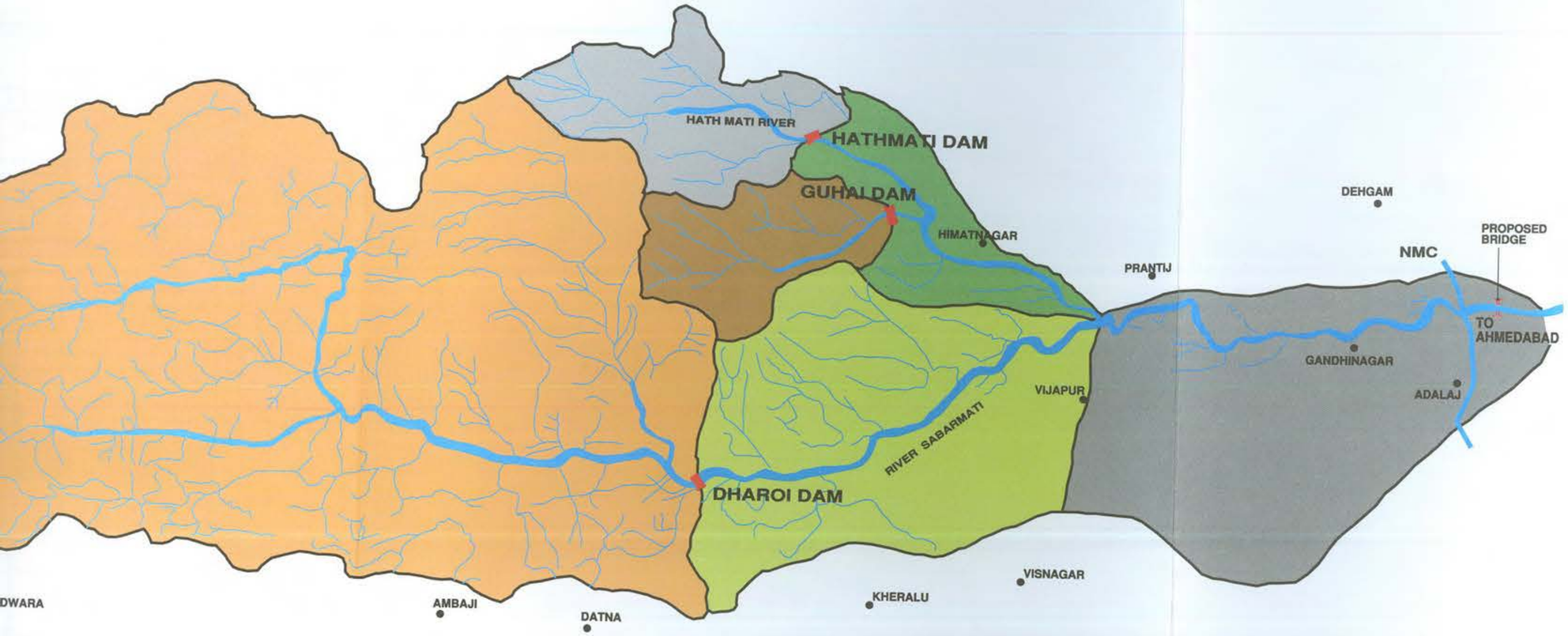


LEGEND

Nos.	NOTATION	DESCRIPTION
1		WATER CHANNEL
2		DAM
3		NARMADA MAIN CANAL (NMC)

DETAILS OF SABARMATI SUB-BASINS FOR AHMEDABAD

NO OF SUB BASIN	NAME OF SUB BASIN	CATCHMENT AREA sq km	SLOPE m/km
1	SABARMATI RIVER UP TO DHAROI DAM	5540	2.28
2	FREE CATCHMENT FROM D/S OF DHAROI DAM TO THE CONFLUENCE OF SABARMATI & HATHMATI RIVER	1684	1.31
3	GUHAI RIVER UPTO GUHAI DAM	422	2.13
4	HATHMATI RIVER UPTO HATHMATI DAM	596	2.37
5	FREE CATCHMENT FROM D/S OF HATHMATI DAM & GUHAI DAM TO CONFLUENCE POINT OF SABARMATI & HATHMATI RIVER	492	1.74
6	REMAINDER OF THE CATCHMENT FROM D/S OF OF SABARMATI & HATHMATI RIVER CONFLUENCE UP TO NMC CROSSING	1684	0.84



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CATCHMENT - River Sabarmati

1:5,00,000

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

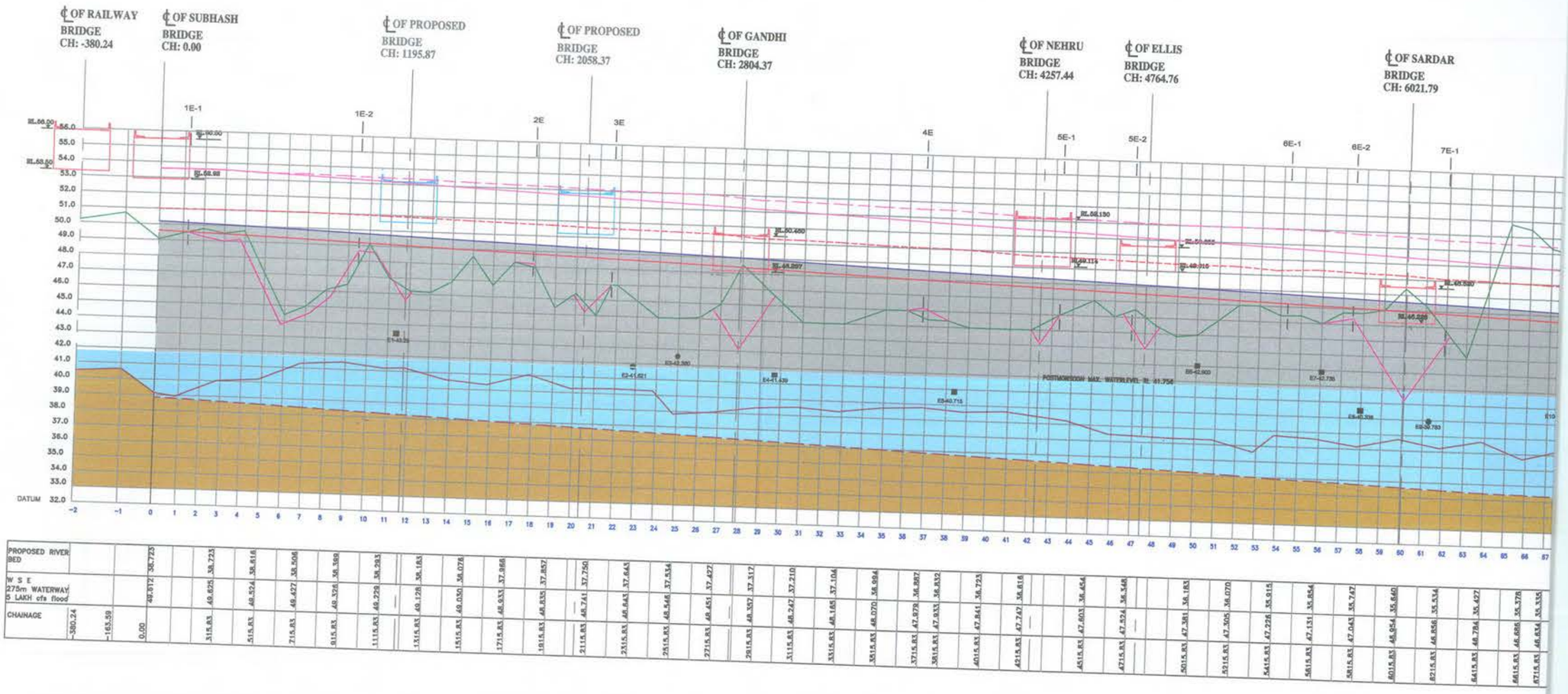
Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

Digitized from map prepared by Sheladia Associates from toposheets, Survey of India. May 1998

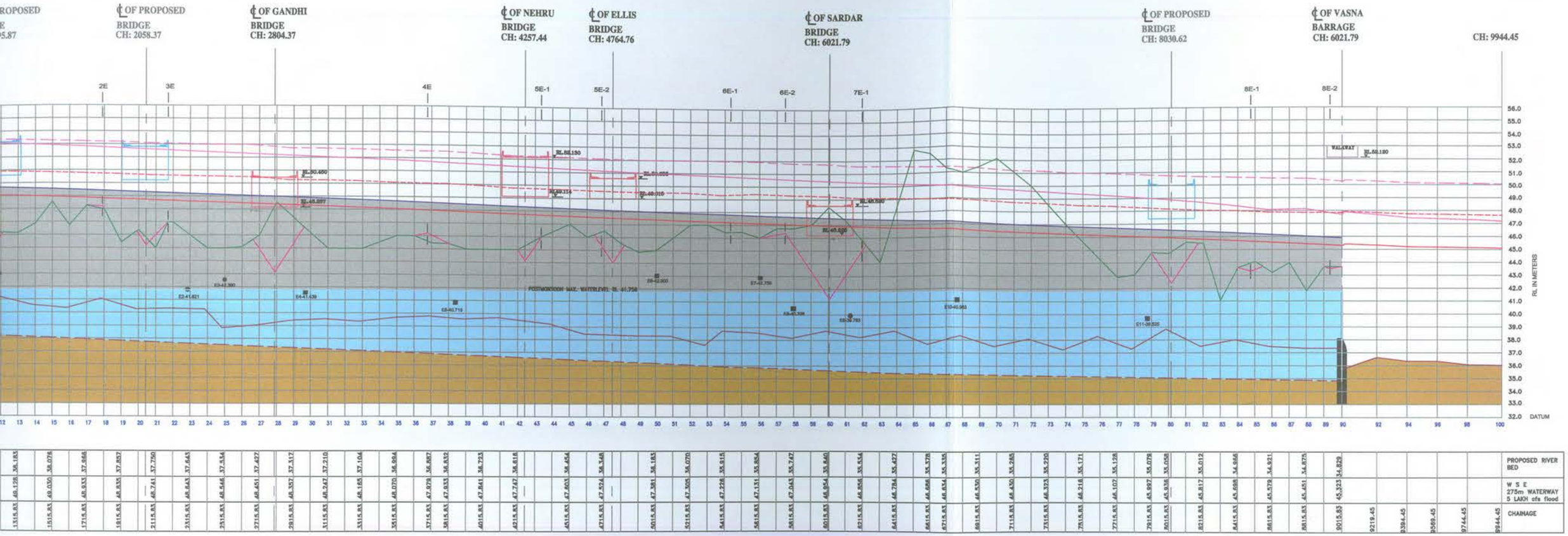
EPC ENVIRONMENTAL PLANNING COLLABORATIVE
701 Paritosh, Usmanpura, Ahmedabad-380 013, India Ph : (91) (079) 75501 Fax : (91) (079) 7550649

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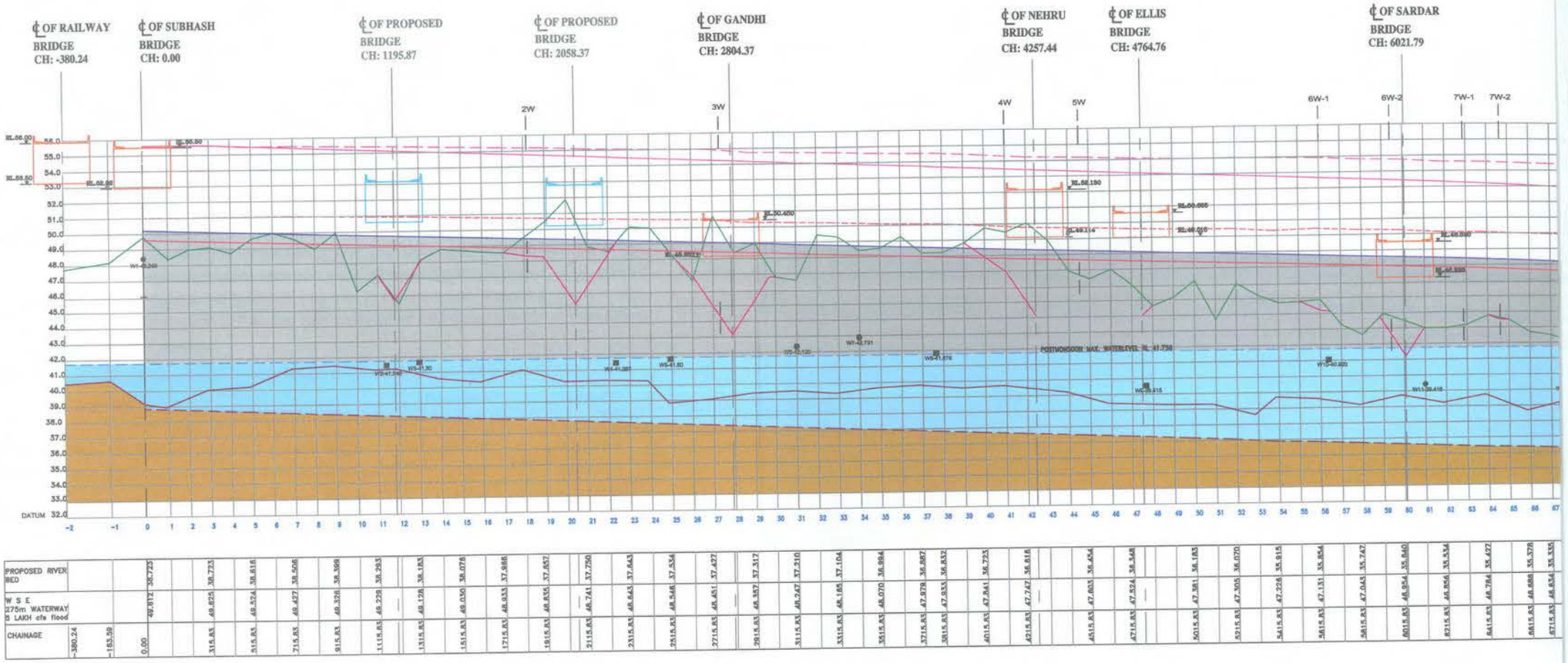
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℄ OF RAILWAY BRIDGE CH: -380.24
℄ OF SUBHASH BRIDGE CH: 0.00
℄ OF PROPOSED BRIDGE CH: 1195.87
℄ OF PROPOSED BRIDGE CH: 2058.37
℄ OF GANDHI BRIDGE CH: 2804.37
℄ OF NEHRU BRIDGE CH: 4257.44
℄ OF ELLIS BRIDGE CH: 4764.76
℄ OF SARDAR BRIDGE CH: 6021.79
1E-1
1E-2
2E
3E
4E
5E-1
5E-2
6E-1
6E-2
7E-1
DATUM 32.0
POSTMONSOON MAX. WATERLEVEL: RL 41.756

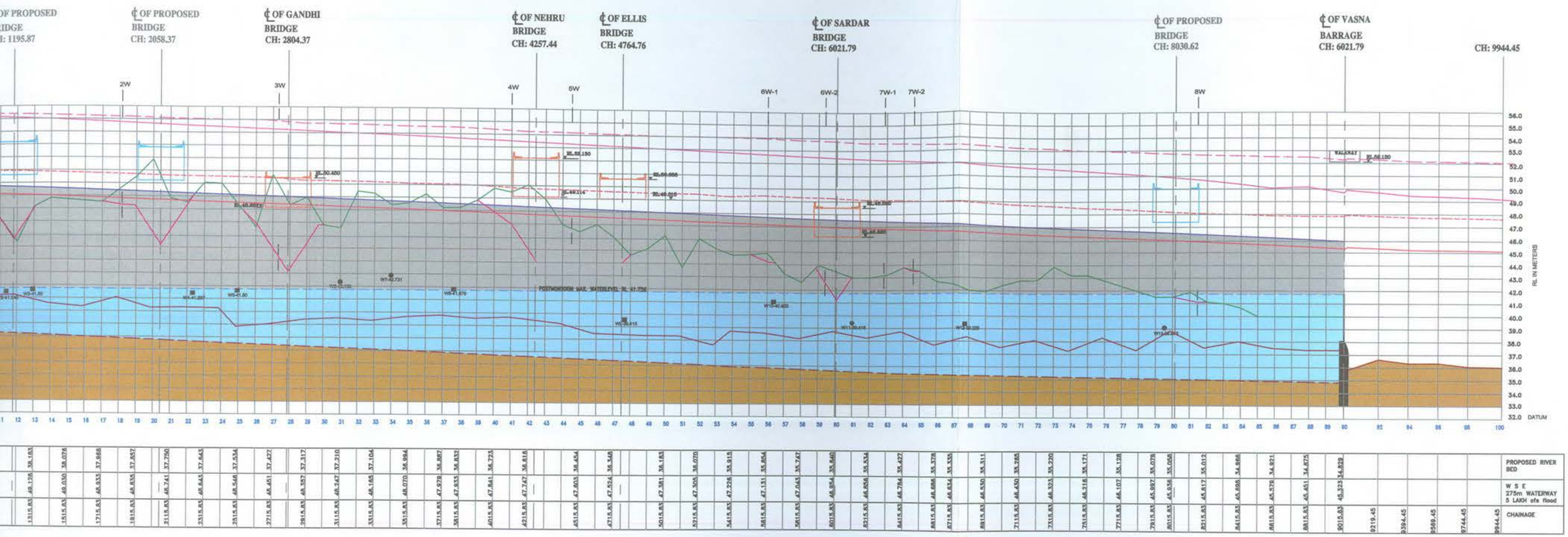
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℄ OF GANDHI
BRIDGE
CH: 2804.37
℄ OF NEHRU
BRIDGE
CH: 4257.44
℄ OF ELLIS
BRIDGE
CH: 4764.76
℄ OF SARDAR
BRIDGE
CH: 6021.79
℄ OF PROPOSED
BRIDGE
CH: 8030.62
℄ OF VASNA
BARRAGE
CH: 6021.79
CH: 9944.45
2E
3E
4E
5E-1
5E-2
6E-1
6E-2
7E-1
8E-1
8E-2
WALKWAY
POSTMONSOON MAX. WATERLEVEL EL. 41.750
RL IN METERS
DATUM

| | | |


℄ OF RAILWAY BRIDGE CH: -380.24
℄ OF SUBHASH BRIDGE CH: 0.00
℄ OF PROPOSED BRIDGE CH: 1195.87
℄ OF PROPOSED BRIDGE CH: 2058.37
℄ OF GANDHI BRIDGE CH: 2804.37
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℄ OF SARDAR BRIDGE CH: 6021.79
2W
3W
4W
5W
6W-1
6W-2
7W-1
7W-2
DATUM 32.0

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℄ OF PROPOSED BRIDGE CH: 1195.87
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℄ OF VASNA BARRAGE CH: 6021.79
CH: 9944.45
2W
3W
4W
5W
6W-1
6W-2
7W-1
7W-2
8W
WALKWAY
POSTMONSOON NAVL WATERLEVEL RL 41.756
RL IN METERS
DATUM

| | | |

B3 LAND RECLAMATION AND EMBANKMENTS

This section and Drawing Nos. 5 to10 describe the extent of land reclamation, quantum of earth-fill required, various options for constructing the embankments and the design of the diaphragm wall.

Land Reclamation

The pattern of existing land uses, potential for incorporating new developments and technical issues (pertaining to river hydraulics and embankment design) were prime considerations in determining the alignment of the proposed 275 m waterway. Drawing No. 5 describes the alignment and the extent of the reclamation. It is proposed that a total of 162.799 ha of land be reclaimed.

For the purpose of presentation, the length of the river from Subhash Bridge to Vasna Barrage has been divided into eight segments between existing and proposed bridges. The area of land reclaimed and the quantum of earth-fill required in each section is given in the following table. The varying cross section of the river has been taken into consideration in calculating the quantum of earth-fill required.

No.	Segment	Reclaimed Area (ha)	Earth Fill (m^3)
1E	Between Subhash Bridge & Proposed Bridge 1	13.575	104122259
2E	Between Proposed Bridge 1 & Proposed Bridge 2	11.331	85893293
3E	Between Proposed Bridge 2 & Gandhi Bridge	6.759	51754814
4E	Between Gandhi Bridge & Nehru Bridge	11.299	81310640
5E	Between Nehru Bridge & Ellis Bridge	3.226	25485400
6E	Between Ellis Bridge & Sardar Bridge	12.15	91277069
7E	Between Sardar Bridge & Proposed Bridge 3	11.800	92105310
8E	Between Proposed Bridge 3 & Vasna Barrage	5.117	39940543
	Subtotal	**75.257**	**571889328**
1W	Between Subhash Bridge & Proposed Bridge 1	3.543	27728431
2W	Between Proposed Bridge 1 & Proposed Bridge 2	3.870	29617589
3W	Between Proposed Bridge 2 & Gandhi Bridge	3.630	27310613
4W	Between Gandhi Bridge & Nehru Bridge	16.087	115510166
5W	Between Nehru Bridge & Ellis Bridge	3.597	28285568
6W	Between Ellis Bridge & Sardar Bridge	29.096	208058903
7W	Between Sardar Bridge & Proposed Bridge 3	13.622	104247436
8W	Between Proposed Bridge 3 & Vasna Barrage	14.097	103484287
	Subtotal	**87.542**	**644242993**
	Total	**162.799**	**1216132321**

In addition to the above, earth fill will be required upstream of Subhash Bridge, on both banks. Pending detailed design, the quantum of filling required here is estimated to be approximately 67,500 cubic meters.

In section 1W the alignment of the waterway requires an area of 0.192 ha to be cut. This was not considered to be of consequence since the area of land is small and since it does not seem to be privately owned.

It is proposed that the soil from the riverbed be used for filling. The soil being sandy will considerably ease the process of filling and compaction. The extent by which the riverbed will be lowered is shown in Drawing Nos. 3 and 4. The consequence of lowering of the riverbed on river hydraulics and bridge foundations has been taken into consideration in the previous section.

Embankments

It is proposed that, since it is most cost effective, Reinforced Earth Panel Technology be used for constructing the embankments. The following presents a comparative analysis of four techniques of building embankments.

1) Reinforced Earth Panel Technology,
2) Geogrid and Pre-cast Block Technology,
3) Pre-stressed Soil Anchor Technology and,
4) Conventional RCC Retaining Wall Technology.

1. Reinforced Earth Panels

Description

Reinforced earth is a composite material formed by embedding reinforcements in soil fill at regular intervals. See Drawing No. 6 for details. The interlacing of compacted soil and reinforcements develops friction at their points of contact and forms a permanent bond between the two. The most popular/common application of this technology is in the construction of retaining walls, wherein the reinforcement is best provided in the form of galvanized steel strips. The soil thus reinforced is provided with a skin of facing elements usually pre-cast concrete panels–so as to facilitate soil confinement with a vertical face.

Salient features

- Flexibility, since it is possible to build directly on weak to very weak foundation soils or on unstable slopes.
- Very high resistance to both static and dynamic loads.
- Ease of installation, since the use of completely prefabricated facing and reinforcing elements is possible.
- Excellent appearance of the finished structure. The precast facing elements are adaptable to various architectural finishes.
- Cost effective (see table on p. 18).

Applications/ Examples

Predominant applications have been for highways, railway walls and bridge support structures. Following the transportation sector, a large number of structures have been constructed for industrial and commercial uses. These include sloped wall bunkers for coal and ore storage safety containment dykes around cryogenic liquid and crude oil storage tanks and hydraulic structures such as dams, canal and river walls, coastal defense structures, marine walls and reservoirs. These structures have withstood the most varied and severe climatic conditions and external stresses. These include static loads, vibration, explosions, high amplitude earthquakes, extremely low temperatures and effect of waves and storms in marine environments.

The Reinforced Earth Panel Technology for a retaining wall has recently been employed for the Arterial Expressway Project in Jammu. This was the first time that Reinforced Earth Technology was used in India. The length of the wall constructed was 325 m and the height of wall varied from 2.5 m to 8.0 m.

2. Geogrid and Pre-cast Blocks

Description

Geogrid technology uses layers of Tensar grid (high strength polymer grid) laid at regular intervals to reinforce the earth. See Drawing No. 7 for details. Tensar geogrids permit the use of a wide variety of fill materials and facing details. The horizontal grid layers provide structural stability whilst the facing contains the fill and provides a suitable aesthetic appearance. The facing can be constructed of full length concrete panels, mortar-less modular concrete units, timber, stone or gabions.

Salient features

- Offers excellent soil creep resistance.
- Develops high block-to-grid connection strength.
- Provides high long-term strength.
- Modular block walls offer cost savings of 10 to 15% over conventional cast-in-place concrete walls.
- Geogrid's high modules and low long term tensile strain makes it strain compatible with the soil structure.

Applications/Examples

Geogrid technology is used for control of soil erosion, embankments over poor foundations, steep slopes, blast bunds, environmental/noise barriers, retaining walls and bridge abutments.

3. Pre-stressed Soil Anchors

Description

In this method, RCC walls of requisite thickness are constructed in stages. At every stage a pre-stressed anchor is introduced with a free tendon length of 7 m. To permit checking of residual forces, electric load cells are used. Before installation of anchors, a group of test anchors are constructed to check the bond strength. (see Drawing No. 8 for details).

Salient features

- Strutting and earth slopes are eliminated.
- Greater mechanization of work is possible.

Applications/ Examples

This technology has been employed for railway bridges, off-shore platforms, excavation platforms and excavation walls.

Cost Comparison

The following table compares the cost of the three techniques described above with the cost of building conventional RCC Retaining Walls. See Drawing No. 9 for details used to arrive at the cost of RCC Retaining Wall Technology.

	Reinforced Earth Technology	Reinforced Earth With Geo-grid	Pre-stressed Soil Anchors	RCC Retaining Walls
1	**Galvanized Strip** Strip size 45 mmx5 mm x5 m No. of strips in 1m wall length with 10 m height =17.7 (4per panel, 4.44 panels) Weight of strips 17.7x8.83 kg =156.29 kg Cost of Strip @ Rs.40 x156.29kg **Rs. 6251.6 for 1 m wall length and 10 m height Blocks**	**Blocks** Block size 0.6 mx0.6 m x0.3 m = 0.108 cu m No of blocks in 1 meter wall length with 10 m height 10 sq m / 0.18 sq m = 55.55 blocks Block Cost @Rs. 2500 / cu m 0.108x2500 =Rs.270/ block Rs. 270x55.55= **Rs.14998.5 for 1m wall length and 10 m height**	**Concrete work** Quantity for 1 m length wall having 10m height and 0.3m thickness 1m x10m x0.3m = 3 cu m Cost of concrete @Rs.4000/cu m 3x4000=Rs. 12000 Quantity of reinforcement @100 kg / cu m= 300 kg for 3 cu m Cost of reinforcement @Rs 22/kg =Rs.6600 **Rs.18600 for 1m wall length and 10 m height.**	**Concrete work** Quantity for 1m length wall having 10 m height Stem 1mx10mx (0.2+1)/2m = 6 cu m Base 1m x1m x 7m = 7 cu m Total =13 cu m Cost of concrete @Rs.3500/cu m 13x3500=Rs. 45500 Quantity of reinforcement @100 kg / cu m= 1300 kg for 13 cu m Cost of reinforcement @Rs 22/kg = Rs.28600 **Rs. 74100 for 1m wall length and 10 m height.**
2	**Precast Concrete Panel** Panel size 1.5mx1.5mx0.18m Cost of Concrete Rs.720/sq mx10m ht = Rs.7200 for 1m wall length for 10 m height Cost of Steel Reinf Vol of 1 panel = 0.405cu m Steel in 1 panel (2.25 sq m)= 40.5 kg @100 kg / cub m Qty of steel = 180 kg in 10 sq m Cost of reinforcement @ Rs 22/kg=Rs.3960 **Rs.11160 for 1m wall length and 10 m height**	**Tensar Geo-grid** Grid Quantity for 1m length wall having 10m height and 7 m width From bottom to 5 m @ 0.6 m c/c 8.33 layersx7mx1m = 58.31 sq m From 5m to top @ 0.9 m c/c 5.55 layersx7mx1m = 38.85 sq m Total 97.16 sq m Cost= Rs. 160/ sq m Total cost= Rs. 160x97.16= **Rs.15545.6 for 1 m wall length and 10 m height**	**Pre - stressing Anchorage & Sheating** Cables (12T13 anchorage) 3 required Weight per Rm = 102 kg Cost with sheathing = Rs. 7650 Cost with sheathing = Rs. 7650 End Blocks per rm 1 block = 1m x 1m x 0.5 m = 0.5 cu m Cost @ Rs. 3500 /cu m 0.5 x 3500 = Rs. 1750 per block 2 blocks / rm Total Cost = Rs.3500 **Rs.11150 for 1 meter wall length and 10 m height**	

3	**Soil Embankment*** Quantity of soil for 1m length wall having 10 m height and 7 m width 1 m x 10 m x 7 m =70cu m Cost of soil @Rs. 40 / cu m **Rs. 2800 for 1 m wall length and 10 m height**	**Soil Embankment*** Quantity of soil for 1m length wall having 10 m height and 7m width 1 m x 10 m x 7 m =70cu m Cost of soil @Rs. 40 / cu m **Rs. 2800 for 1 m wall length and 10 m height**	**Soil Embankment*** Quantity of soil for 1 m length wall having 10 m height and 7m width 1 m x 10 m x 7 m = 70cu m Cost of soil @Rs. 40 / cu m **Rs. 2800 for 1 m wall length and 10 m height**	**Soil Embankment*** Quantity of soil for 1m length wall having 10 m height and 7m width 1 m x 10 m x 7 m =70cu m Cost of soil @Rs. 40 / cu m **Rs. 2800 for 1 m wall length and 10 m height**
4	**Cost** (1+2+3) **Rs. 20211.6 for 1 m wall length and 10 m height**	**Cost** (1+2+3) **Rs. 33344.1 for 1 m wall length and 10 m height**	**Cost** (1+2+3) **Rs. 32550 for 1 m wall length and 10 m height**	**Cost** (1+3) **Rs. 76900 for 1 m wall length and 10 m height**
5	**Total Cost with Labour** @5% of Cost **Rs. 21222.18 for 1 meter wall length and 10 m height** **≅ Rs. 2123 for 1 sq m**	**Total Cost with Labour** @5% of Cost **Rs. 35011.3 for 1 meter wall length and 10 m height** **≅ Rs. 3502 for 1 sq m**	**Total Cost with Labour** @5% of Cost **Rs. 34177.5 for 1 meter wall length and 10 m height** **≅ Rs. 3418 for 1 sqm**	**Total Cost with Labour** @5% of Cost **Rs. 80745 for 1 meter wall length and 10 m height** **≅ Rs. 8075 for 1 sq m**
6	**Cost of Retaining Wall (SB to VB)** Length of both Sides 18000 m Height = 7.5 m Area = 135000sq m **Cost =Rs. 28.66 crores**	**Cost of Retaining Wall (SB to VB)** Length of both Sides 18000 m Height = 7.5 m Area = 135000sq m **Cost =Rs. 47.28 crores**	**Cost of Retaining Wall (SB to VB)** Length of both Sides 18000 m Height = 7.5 m Area = 135000sq m **Cost =Rs. 46.14 crores**	**Cost of Retaining Wall (SB to VB)** Length of both Sides 18000 m Height = 7.5 m Area = 135000sq m **Cost =Rs. 109 crores**

control lift of 15 cm with vibratory roller with river sand to maximum dry density.

Using the Reinforced Earth Panel Technology, the cost of construction of embankments for the entire length of 18000 m for both sides works out to Rs. 28.66 crores.

Diaphragm Walls

Embankments will require the construction of 50 cm wide and 9.545 m high diaphragm walls below the riverbed level. The height of the diaphragm wall is determined by the scour depth (7.545 meters for a 5 lakh cusecs flood) and the requisite grip length (2 m). The calculations below and Drawing No. 10 shows schematic details and cost estimate of the proposed diaphragm wall.

Design discharge (Q)		=	14172.33 cumecs (5 lakh cusecs)
As per IRC-5 Section 1			
Dsm		=	1.35 (Db^2 /ksf)$^{1/3}$
Where,	d_{sm}	=	Scour Depth (m)
l		=	Effective linear waterway = 275m
	Db	=	Design discharge = Q/l
	ksf	=	Silt factor = 1.25
			(Source: Geo-technical investigation data of Hansol Bridge)
Scour Depth		=	1.35 $(14172.33/275)^2$ / 1.25)$^{1/3}$
			17.36 m

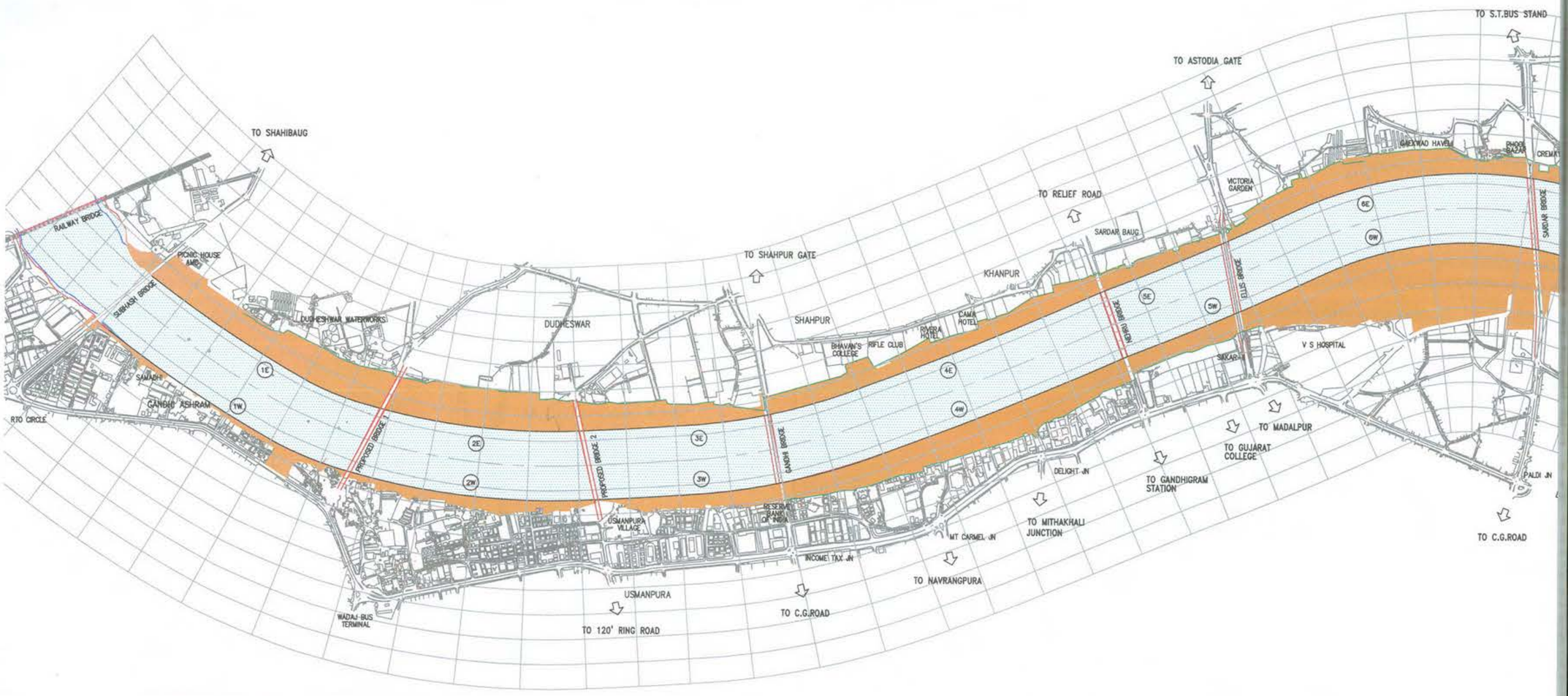
HFL at Gandhi Bridge for 275 m width is RL 48.41 m

Scour level	=	HFL – Scour depth
		48.41 – 17.36 m
		31.05 m
Scour depth below the riverbed	=	Avg. riverbed level (at Gandhi Bridge) – Scour depth
		38.595 m – 31.05 m
		7.545 m
Grip length		2 m
Depth of cutoff wall		7.545 m + 2 m = 9.545 m

The cost of the cutoff wall per running meter is estimated as Rs. 45,908. The cost of the wall for the entire length of 18000 m for both sides works out to Rs. 82.63 crores.

Further Work Required

- It will be necessary to carry out detailed soil tests and detailed design of embankments with respect to different conditions before detailed execution commences.
- It is also advisable to detail design a portion of the embankment and study the full implications of building on reclaimed land before detail planning is undertaken.
- At this stage only a schematic design of the embankments has been prepared. The embankments will also require the construction, at various locations, of steps (ghats) leading down to the water, jetties for boating and other recreational facilities. The cost estimate presented at the end of this proposal includes a lump sum cost for adding these features to the embankments. It will be necessary to schematically design them to refine the cost estimate.



LEGEND

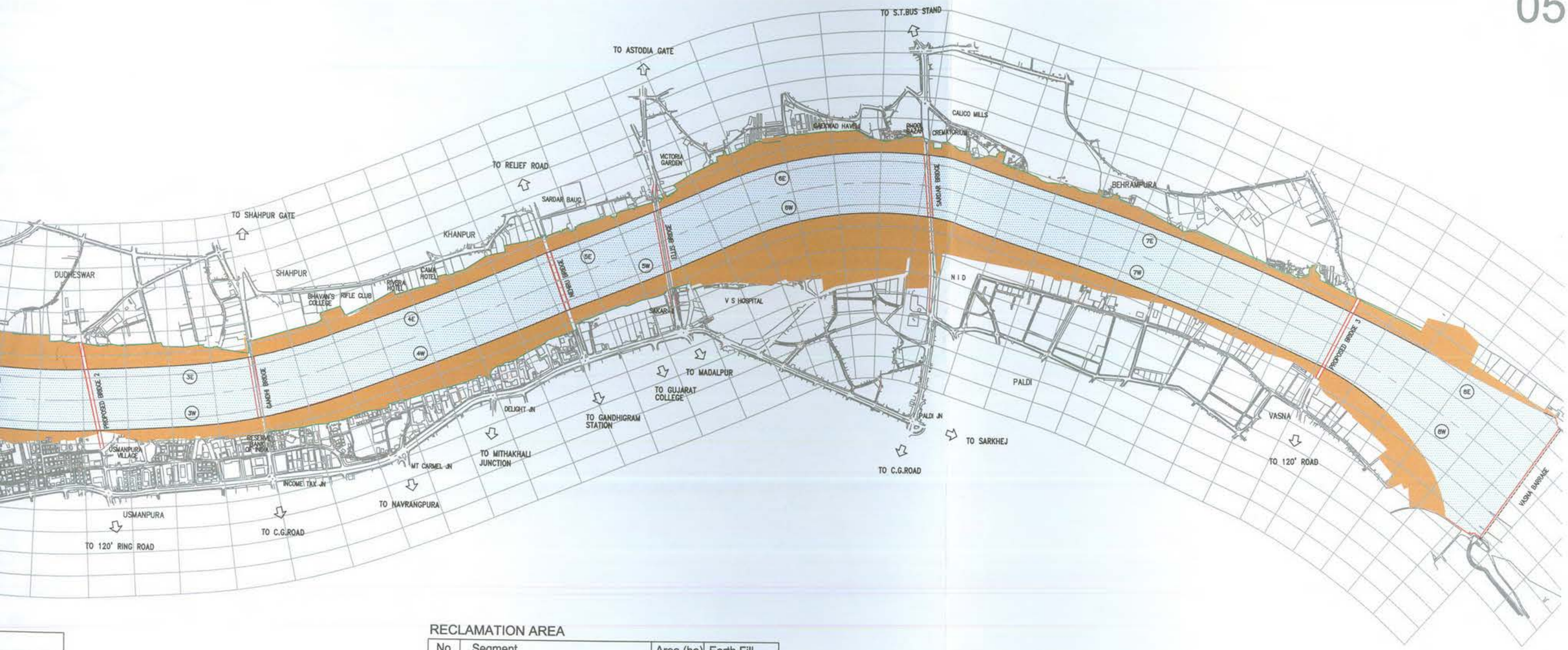
Sr.No.	NOTATION	DESCRIPTION
1		AREA TO BE RECLAIMED
2		AREA TO BE CUT
3		TOP EDGE OF THE RIVER
4		BRIDGE EXPANSION / PROPOSED BRIDGE
5	(8E)	SECTION No. BETWEEN TWO BRIDGES

RECLAMATION AREA

No.	Segment	Area (ha)	Earth Fill (cu m)
1E	Between Subhash Bridge & Prop Bridge 1	13.575	1041222.59
2E	Between Prop Bridge 1 & Prop Bridge 2	11.331	858932.93
3E	Between Prop Bridge 2 & Gandhi Bridge	6.759	517548.14
4E	Between Gandhi Bridge & Nehru Bridge	11.299	813106.40
5E	Between Nehru Bridge and Ellis Bridge	3.226	254854.00
6E	Between Ellis Bridge & Sardar Bridge	12.150	912770.69
7E	Between Sardar Bridge & Prop Bridge 3	11.800	921053.10
8E	Between Prop Bridge 3 & Vasna Barrage	5.117	399405.43
	Subtotal	75.257	5718893.28

1W	Between Subhash Bridge & Prop Bridge 1	3.543	277284.312
2W	Between Prop Bridge 1 & Prop Bridge 2	3.870	296175.890
3W	Between Prop Bridge 2 & Gandhi Bridge	3.630	273106.1284
4W	Between Gandhi Bridge & Nehru Bridge	16.087	1154888.3600
5W	Between Nehru Bridge and Ellis Bridge	3.597	282855.6800
6W	Between Ellis Bridge & Sardar Bridge	29.096	2080589.03
7W	Between Sardar Bridge & Prop Bridge 3	13.622	1042474.36
8W	Between Prop Bridge 3 & Vasna Barrage	14.097	1034842.87
	Subtotal	87.542	6442216.63
	Total	162.799	121,61,109.91

NOTE : [1] Earth fill upstream of Subhash Bridge (East) : 58317cu m.
[2] Earth fill upstream of Subhash Bridge (West) : 9122cu m.



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NOTE : [1] Earth fill upstream of Subhash Bridge (East) : 58317cu m.
[2] Earth fill upstream of Subhash Bridge (West) : 9122cu m.

0 100 300 500 1000 m

LAND RECLAMATION

1:17500

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

May 1998

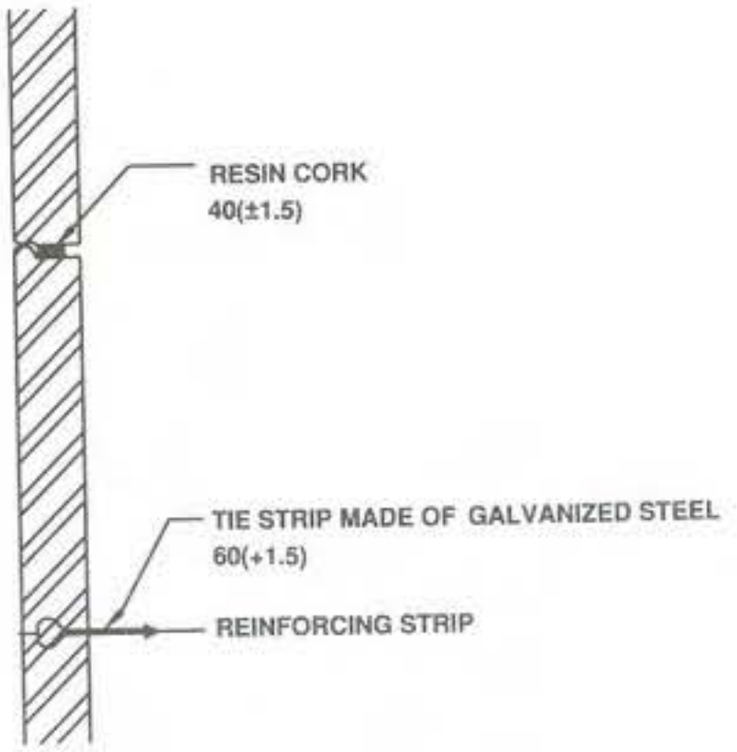
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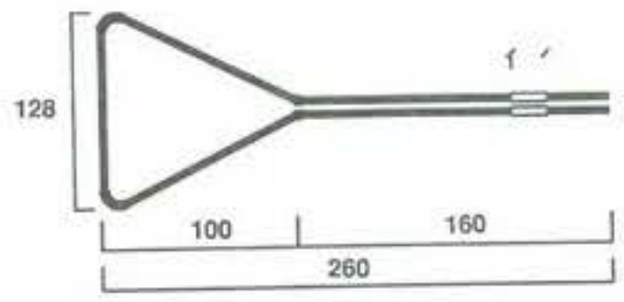
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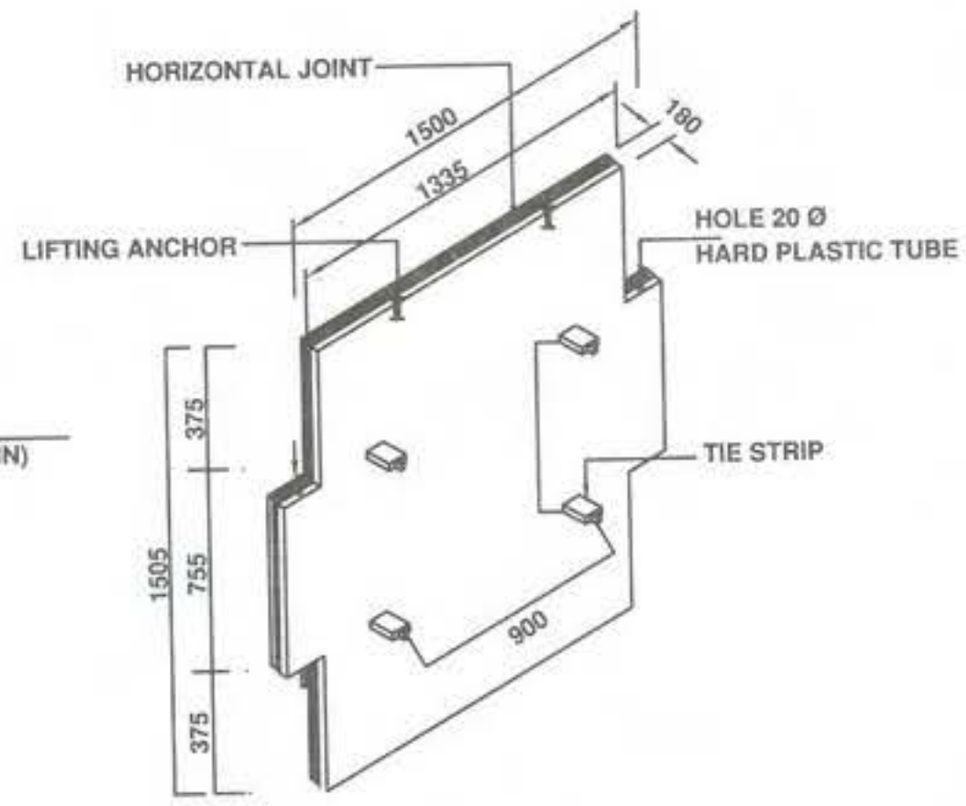
REINFORCED EARTH PANELS - Alternative 1

06

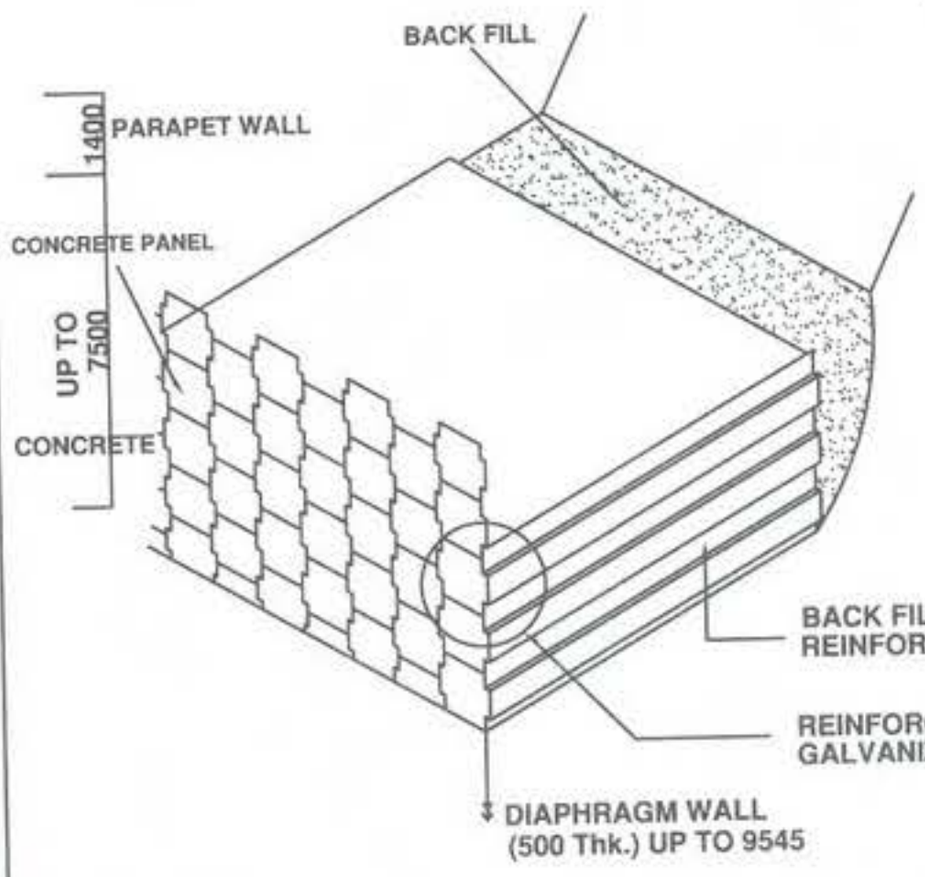




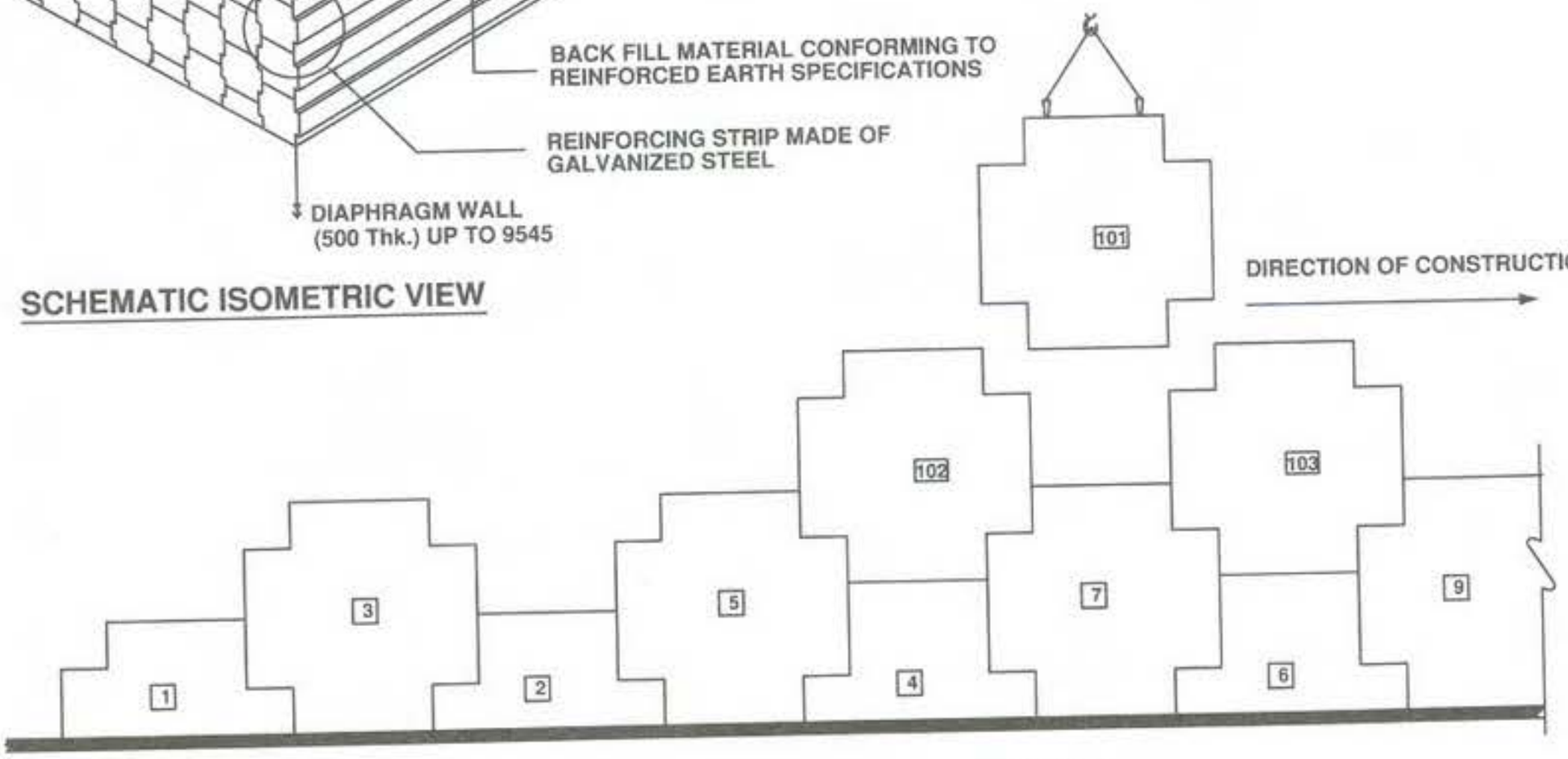
DETAILS OF TIE STRIP



CHARACTERISTICS OF
CONCRETE - FACING PANEL



SCHEMATIC ISOMETRIC VIEW



PLACEMENT SEQUENCE
FOR SECOND PANEL COURSE

NOTE: * Numbers in squares show order of placement
* All dimensions are in mm
* Not to scale

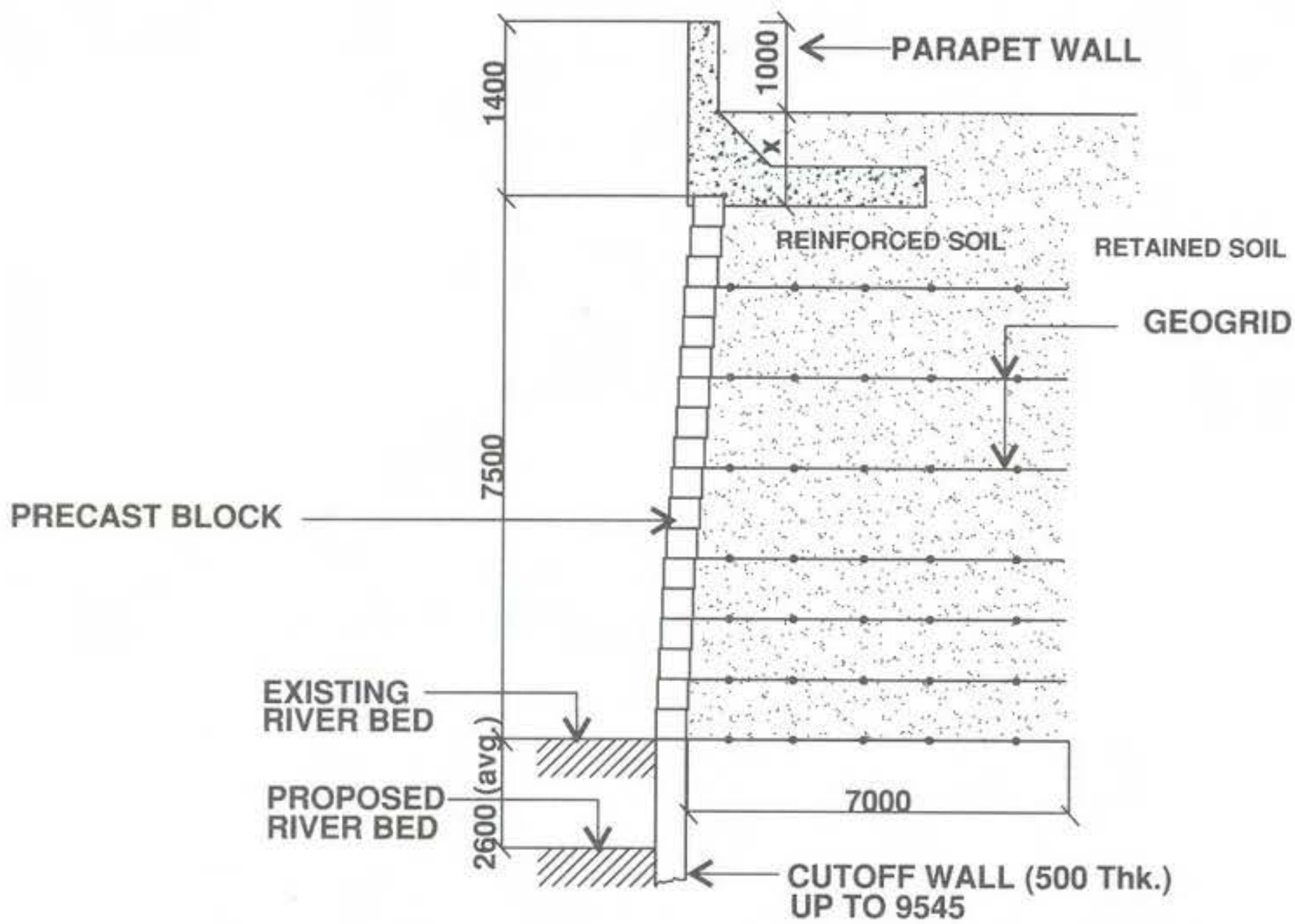
SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

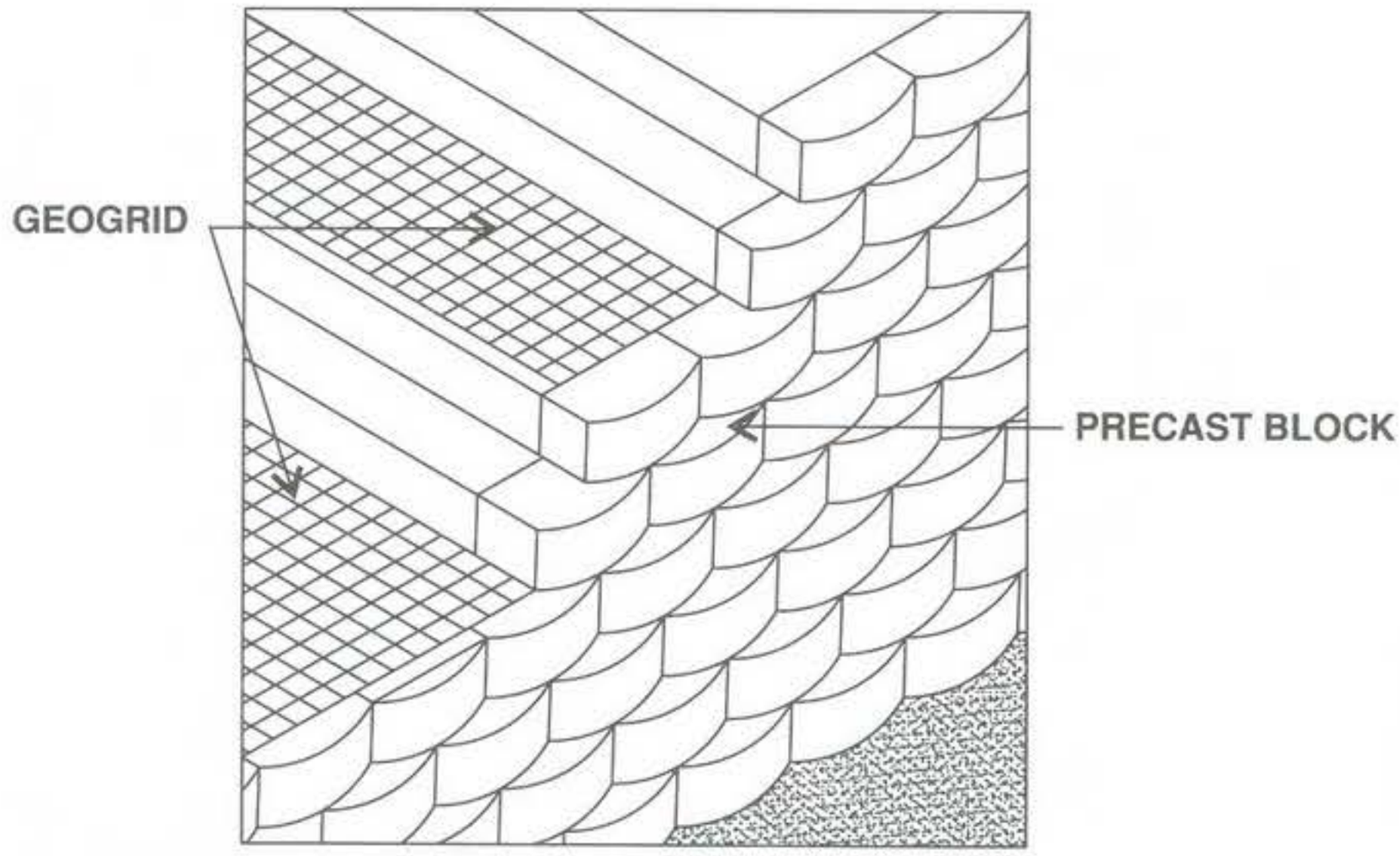
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PRECAST BLOCKS WITH GEOGRID - Alternative 2

07





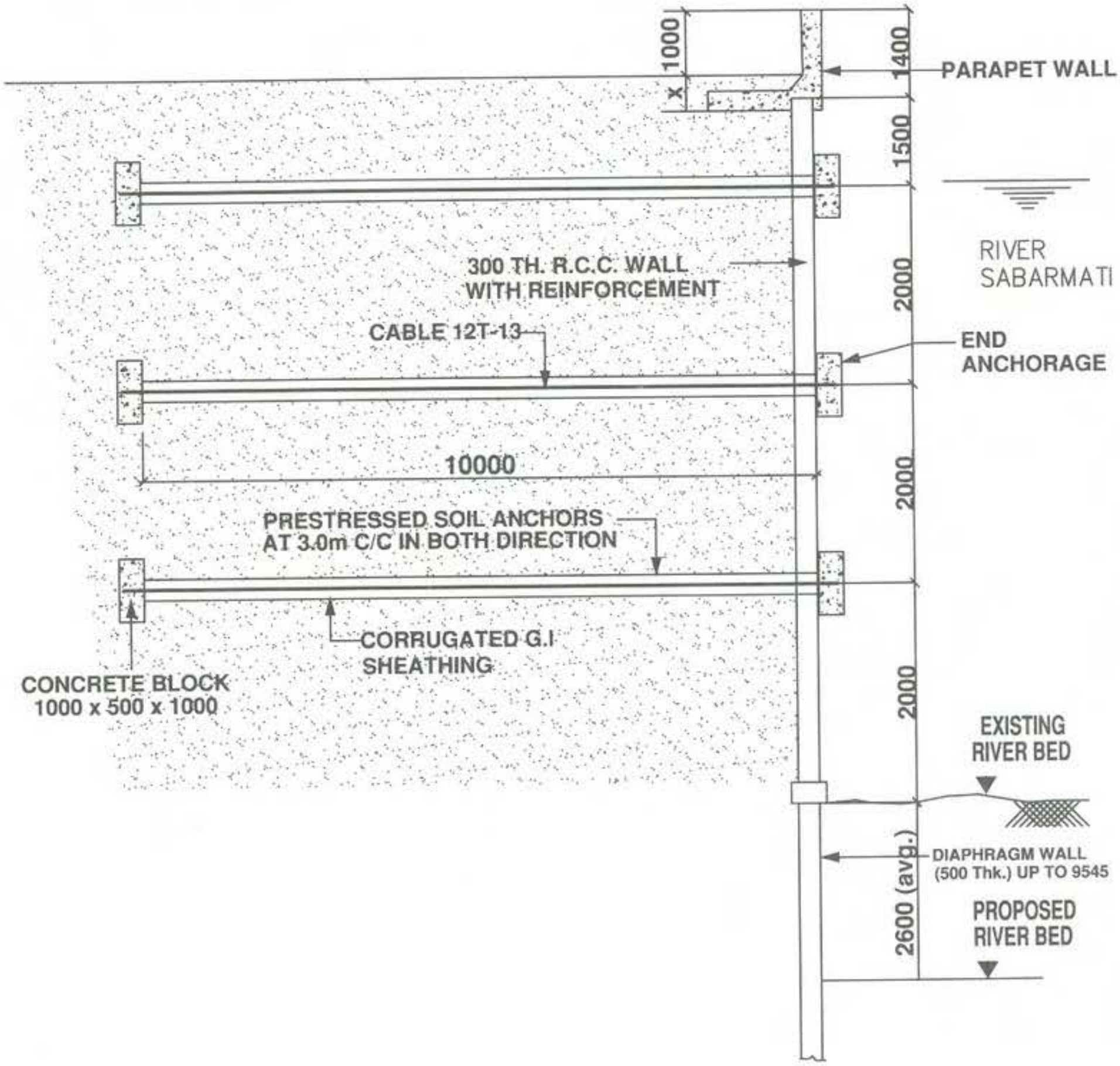
NOTE:
* All dimensions are in mm
* Not to scale
* x will depend on detailed design of parapet wall

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PRESTRESSED SOIL ANCHORS - Alternative 3



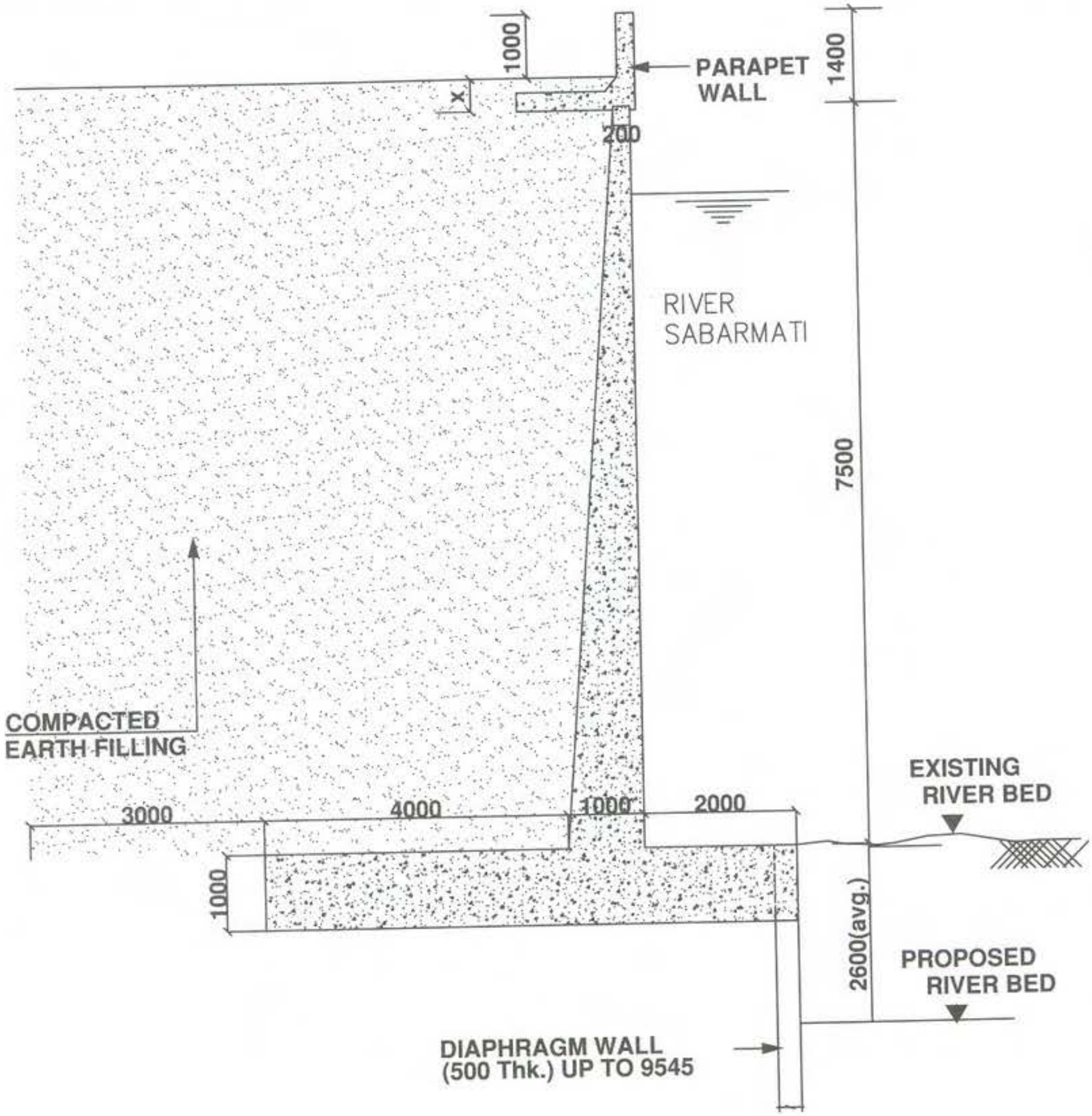
NOTE:
* All dimensions are in mm
* Not to scale
* x will depend on detailed design of parapet wall

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R.C.C RETAINING WALL - Alternative 4

09



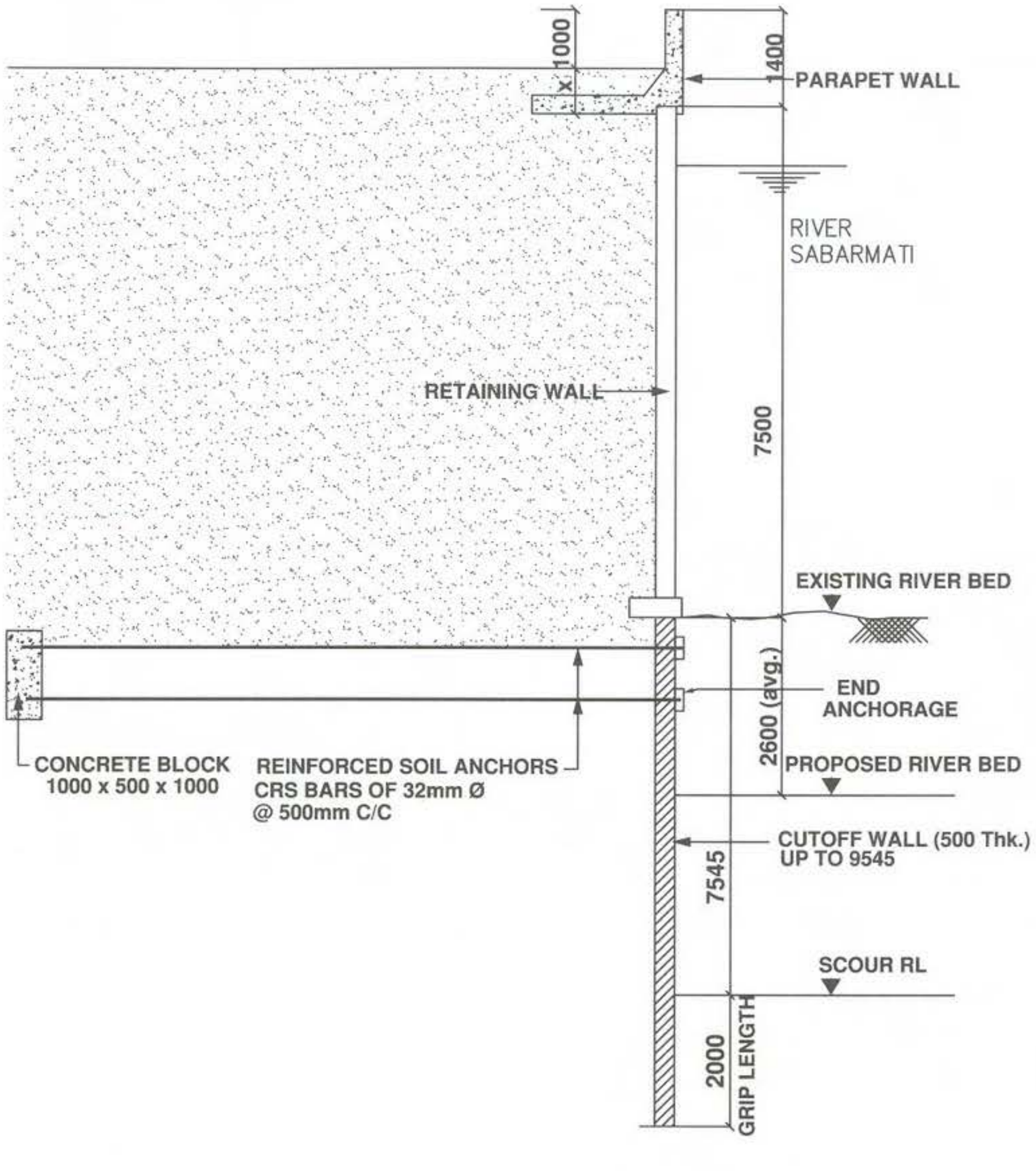
NOTE:
* All dimensions are in mm
* Not to scale
* x will depend on detailed design of parapet wall

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DIAPHRAGM WALL



NOTE:
* All dimensions are in mm
* Not to scale
* x will depend on detailed design of parapet wall

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B4 LAND OWNERSHIP

This section and Drawing No. 11 discuss issues pertaining to ownership of the land proposed to be reclaimed for development of the Sabarmati Riverfront.

Delineation of Property Rights

At present it is not possible to accurately define the extent of plots abutting on to the riverfront. The reasons for this are as follows. The physical survey undertaken for developing this proposal shows existing plot boundaries, ie fences, compound walls, etc. However, these do not conform to the legal extents of the plots along the riverbanks. In many case floods have eroded the plots and fences have been built within the plots rather than along the legal boundary. In other cases it seems that plot owners have encroached onto the riverbed.

The legally valid extents of plots are defined as extents of final plots in the relevant TP Scheme Drawings prepared by the Ahmedabad Municipal Corporation. Since many of these drawings were prepared a long time ago using relatively crude survey methods they do not conform with the existing physical situation. Therefore, to define the extents of plot boundaries on the ground without resorting to lengthy litigation, it will be necessary to set up a 'due process' to reconcile discrepancies in a manner that is both, legally valid and acceptable to property owners. This 'due process' will have to be defined in collaboration with the Ahmedabad Municipal Corporation and will require its active involvement. It will be necessary to initiate this 'due process' along with commencement of detailed planning.

A result of the establishment of such a 'due process' may well be that a part of the land reclaimed under this project, which at present seems to be riverbed land, will have to be handed over to property owners along the riverbank. In some cases, where owners have encroached onto the riverbed, land will accrue to the project. To estimate the extent of the proposed 162:80 ha of reclaimed land that might not be available for development under this project a sample 'Final Plot Reconciliation Exercise' was undertaken in collaboration with the Estate and Town Planning Dept. of the Ahmedabad Municipal Corporation. This exercise suggests that approximately 4 per cent of the reclaimed land may not be available for development.

The Final Plot Reconciliation Exercise studied the stretch from Subhash Bridge to Nehru Bridge along the east bank and three stretches along the west bank. These are indicated in Drawing No. 11. The following TP Scheme and City Survey sheets were referred to:

East Side:

TP Scheme 14	Sheet Nos. 2, 6, 16, 17, 18, 19, 29, 34, 44, 45
TP Scheme 3/2	Sheet Nos. 4, 11, 12
TP Scheme 3/1	Sheet Nos. 1, 6, 8, 14, 15, 16, 17, 21, 22, 23, 24
City Survey	Sheet Nos. 48, 51, 52, 55, 56, 59, 60, 60, 62, 77, 78, 87, 88

West Side:

TP Scheme 15	Sheet Nos. 5, 8,19
TP Scheme 28	Sheet Nos. 29, 30, 43, 44, 57

The following table states findings of the sample exercise:

Section	Reclaimed Land (ha)	Land under private ownership (ha)	Land not privately owned (ha)
East Bank (Subhash-Gandhi Bridge)	41.823	2.030	39.793
West Bank (Stretch 1)	13.949	0.221	13.728
West Bank (Stretch 2)	2.826	0.000	2.826
Total	**58.598**	**2.251**	**56.347**

For the purpose of estimating project costs, the cost of reclaiming the entire 162.80 ha has been considered. Therefore the cost of reclaiming the area that may not eventually be available for development has been included.

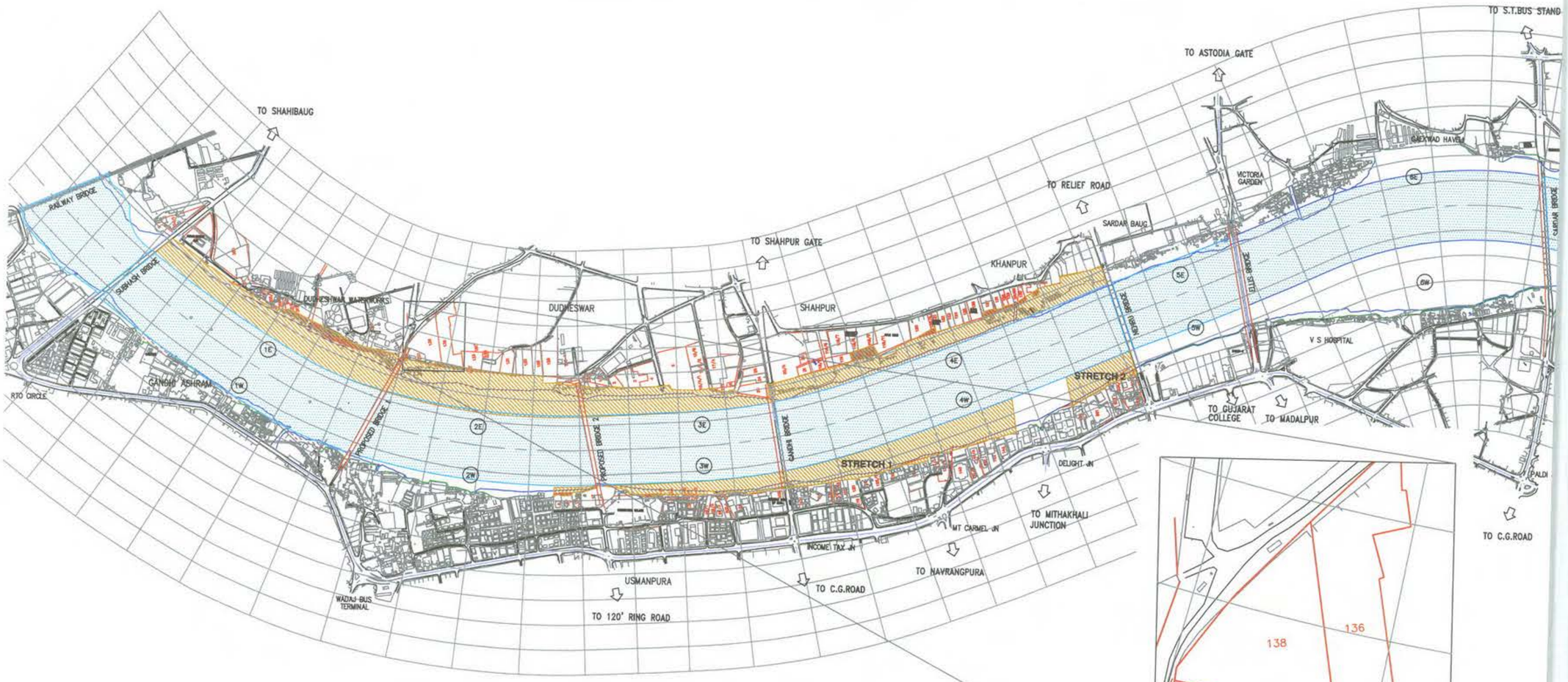
Riverbed Land

The SRFD Proposal envisages a comprehensive development of the reclaimed portion of the riverbed in a manner that a maximum number of public facilities and benefits are created for Ahmedabad. To make this financially feasible without having to rely on public expenditure the proposal envisages the sale of a portion of the reclaimed land to raise resources for the entire development. This is in keeping with all earlier riverfront development proposals. Details regarding use / sale of the reclaimed land are discussed in Section B6.

It is proposed that the SRFDCL undertake the entire project of developing the riverfront which includes all the constructon work, raising of finances and sale of land for raising revenues. However, at present the riverbed is considered to be a property of the Government of Gujarat and is under control of the District Collector of Ahmedabad. To empowrer the SRFDCL to effectively undertake the developement of the riverfront and to enable it to raise short term finance from private sources - against revenue expected from sale of part of the reclaimed land - it will be necessary to work out an adequate mechanism that effectively vests the ownership of the riverbed land within the SRFDCL. It will be necessary for the SRFDCL to initiate a dialogue with the Government of Gujarat to work out this mechanism.

Further Work Required

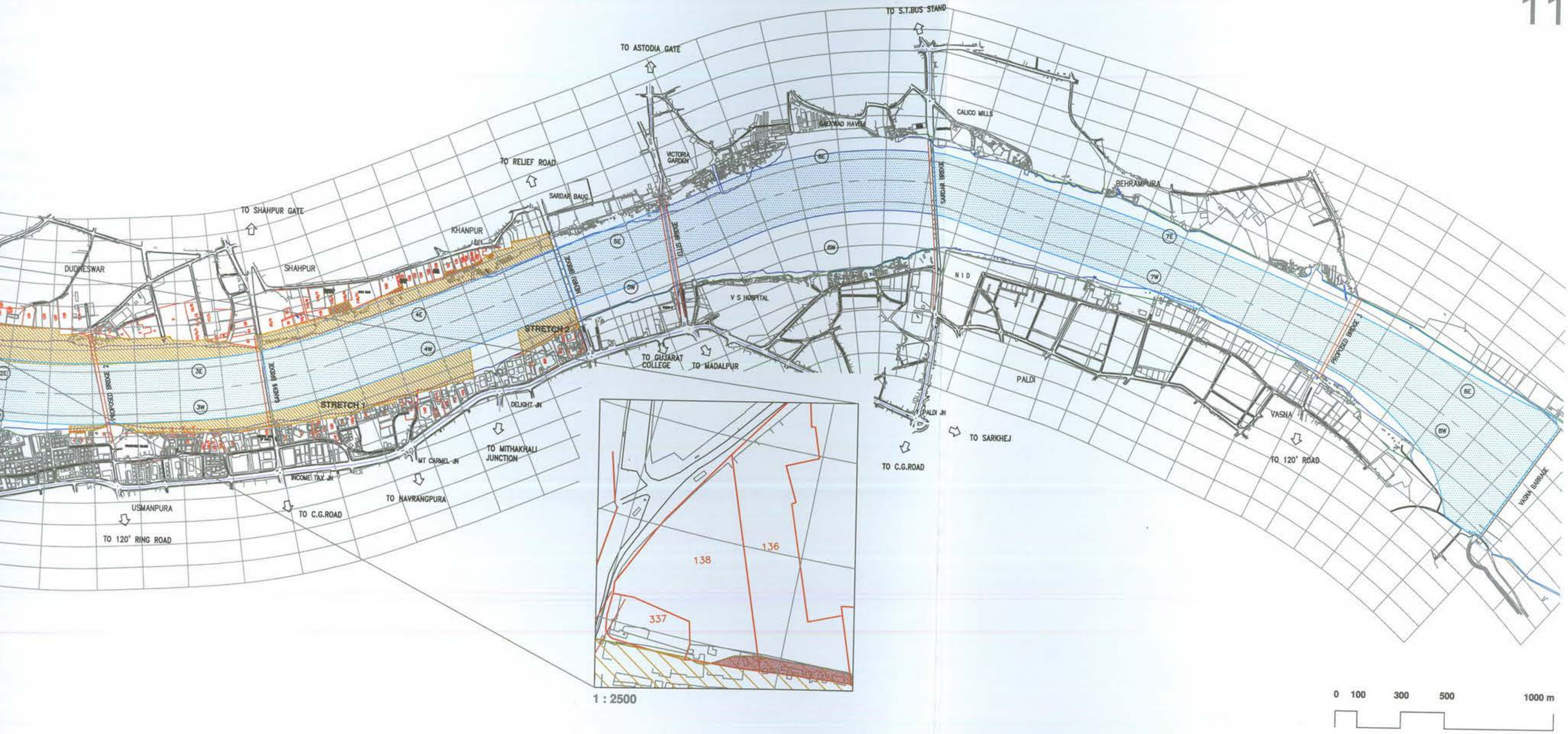
- Though the Final Plot Reconciliation Exercise has clarified technical/surveying issues pertaining to the delineation of property rights, legal issues pertaining to the establishment of a valid 'due process' are yet to be clarified.
- Along with the initiation of a dialogue with the Government of Gujarat, with respect to the vesting of the riverbed land, it will be necessary to fully clarify the legal issues pertaining to ownership of the reclaimed land.



LEGEND

Sr.No.	NOTATION	DESCRIPTION
1		BED LINE
2		TOP EDGE
3		FINAL PLOT BOUNDARY AS INTERPRETED FROM FP SHEETS
4		LAND NOT PRIVATELY OWNED
5		LAND UNDER PRIVATE OWNERSHIP
6	136	FINAL PLOT NUMBERS

SECTION	LAND NOT PRIVATELY OWNED (ha)	LAND UNDER PRIVATE OWNERSHIP (ha)	RECLAMATION AREA (ha)
EAST BANK			
SUBHASH BRIDGE-GANDHI BRIDGE	39.793	2.03	42.823
WEST BANK			
STRETCH 1	13.728	0.221	13.949
STRETCH 2	2.8263.	-	2.826



1 : 2500

SECTION	LAND NOT PRIVATELY OWNED (ha)	LAND UNDER PRIVATE OWNERSHIP (ha)	RECLAMATION AREA (ha)
EAST BANK			
SUBHASH BRIDGE-GANDHI BRIDGE	39.793	2.03	42.823
WEST BANK			
STRETCH 1	13.728	0.221	13.949
STRETCH 2	2.8263.	-	2.826

TED FROM FP SHEETS

FINAL PLOT RECONCILIATION - SAMPLE STUDY 1:17500

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

Contents are based on final plot sheets from Ahmedabad Municipal Corporation. May 1998

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B5 WATER RETENTION AND GROUND WATER RECHARGE

This section and Drawing Nos. 12 and 13 discuss issues pertaining to retention of water in the river, examine options for replenishing water losses due to evaporation and seepage and the effects of retaining water in the river.

Water Retention, Seepage and Evaporation Losses

With the construction of the proposed embankments, it will be possible to retain water up to the top of the Vasna Barrage, the level of which is 41.7 m. At present it is not possible to do this since the riverbanks in southern Ahmedabad are lower than the top of the Vasna Barrage. See Drawing Nos. 3 and 4 for details. Drawing No. 12 shows that if water is retained up to the top of Vasna Barrage, (which it will be possible to do after the SRFD Proposal is executed) the depth of water retained at Vasna Barrage will be approximately 7 m and at Subhash Bridge will be approximately 3 m. It also shows that approximately 15 km of riverbed upstream from the Vasna Barrage will be submerged. However, the water level will decrease with time due to seepage and evaporation.

Drawing No. 12 describes the level of the water at every 2-month interval taking into account the estimated seepage and evaporation losses. The rate of seepage loss adopted for the seepage loss calculations is 25×10^{-6} MLD/m^2 (million liters per day per square meter). This rate of seepage is estimated using a mathematical modeling study carried out by Physical Research Laboratory, Ahmedabad. The model considered characteristics of the Sabarmati River passing through Ahmedabad - approximately from Vasna Barrage up to Subhash Bridge. The evaporation loss calculations are based on evaporation rates recommended by Water Resources Research Foundation, Ahmedabad. These are based on data from the Agro-Climatic Atlas of India, 1978. The values obtained from this source are corrected with a factor of approximately 0.75 owing to larger area of evaporation as compared to a pan-evaporimeter, and are indicated in the following table:

Time Period	mm/day	Period (days)	Evaporation in the period (m)
1 August – 30 September	4	60	0.24
1 October – 30 November	6	60	0.36
1 December – 31 January	6	60	0.36
1 February – 31 March	8	60	0.48
1 April – 30 May	14	60	0.84
1 June – 15 June	8	15	0.12
16 June – 31 July	4	45	0.18
Total			**2.58**

(Source: Adapted from Agro - climatatic Atlas of India, 1978)

Assuming that, following normal monsoon discharge, water will be filled up to the top of the Vasna Barrage on the 1st of August, Drawing No. 12 shows the following:

- On 1st of August the depth of water at Vasna Barrage will be 6.93 m and at Subhash Bridge will be 3 m. The water level will become zero at Koteshwar village, which is 6 km upstream of Subhash Bridge.
- On 1st of October, the depth of the water at Vasna Barrage will be 4.88 m and at Subhash Bridge it will be 1 m. The water level will be zero at 2 km upstream of Subhash Bridge.

- On 1st of December, the depth of the water at Vasna Barrage will be 2.51 m and will reach up to 250 m down stream of Gandhi Bridge.
- On 1st of January, the depth of water of water at Vasna Barrage is 1.34 m and the water level will be nearly zero at Sardar Bridge.
- On 12th of January the river will be empty.

As on	Water depth (m) at Vasna Barrage	Length of the water body	Volume of water (cu m)
1 August	6.93	15016	172,47,460
1 October	4.88	10958	83,47,460
1 December	2.51	5802	22,50,000
1 January	1.34	3094	6,50,000
12 January	0.00	0	0
1 June to 30 July	Monsoon		

The following table summarizes the situation:

Calculations for the above do not take the effect of ponding into consideration. They also do not take the impact of the change in ground water conditions, over time that would result as a consequence of the seepage into the riverbed. It is very likely that over time, as the ground gets relatively more saturated with water, the rate of seepage will decrease.

Regardless of the above and pending the availability of more accurate information through a ground water monitoring system it is amply evident that, if it is important to retain water in the river to revitalize the riverfront, it will be necessary to periodically replenish the water in the river.

Water Retention and the Fatehwadi Irrigation Scheme

At present, following the monsoon, water retained upstream of the Vasna Barrage is released into the Fatehwadi Canal (which has a total discharge capacity of 45.3 cumecs) for irrigating the Fatehwadi Command Area (see Drawing No. 13). If water is to be retained through out the year - up stream of the Vasna Barrage - it is imperative that an alternative way of irrigating the Fatehwadi Command Area be identified. The following discusses two viable alternatives.

1. **Using Water from the Narmada Main Canal for irrigating the Fatehwadi Command Area:**

   Since water cannot be retained to the top of the Vasna Barrage it is not possible to serve the entire Fatehwadi Command Area - as conceived in the original Fatehwadi Irrigation Plan. The Sardar Sarovar Narmada Nigam Ltd (SSNNL) has already proposed that the deficient areas be served by branches from the Narmada Main Canal (NMC) namely, Narshingpur Branch, Sanand Branch and Dholka Branch (refer Drawing No.13).

   In addition, it is also proposed that the area north of Fatehwadi Command Area between Chekhala drain and Sabarmati River be served by the Dholka Branch of the Narmada Main Canal. To be able to do this it is envisioned that the Dholka Branch Canal will off-take from the NMC at ch : 246.366 near Ognaj Village and that its total discharge capacity will be 56 cumecs. However, since this was envisioned,

the area (north of the Fatehwadi Command Area between Chekhala Drain and the Sabarmati River) has become considerably more industrialized and urbanized. This process of urbanization/industrialization is likely to continue and intensify in the near future and the requirement of water in this area for irrigation is likely to fall drastically. Taking this into consideration and the discharge capacities of the Fatehwadi Canal and the Dholka Branch, it seems imminently possible to serve the Fatehwadi Command Area using surplus water from the Dholka Branch.This can be done in two ways. First, it may be possible to link the existing Fatehwadi System with the Dholka Branch Canal at some point and provide uninterrupted supply to Fatehwadi Irrigation Scheme. Second, the Sabarmati River between Vasna Barrage and Nabhoi Village (where the Sabarmati intersects the Narmada Main Canal), a length of approximately 21 km, can be seen as a canal of the Narmada Canal System. Water meant to be channeled into the Dholka Branch Canal (and other canals) for the Fatehwadi Command Area could be diverted through the Sabarmati River to the Fatehwadi Canal. This option could also reduce investments required to link the Narmada Main Canal to the Fatehwadi Canal System through the Dholka and other branch canals mentioned above.It should be noted however that none of the above has been discussed with the SSNNL and that the feasibility of various alternatives discussed above will have to be studied in greater detail in collaboration with the SSNNL.

2. **Using Treated Water from the Proposed Sewage Treatment Plants for the Ahmedabad Urban Area to Irrigate the Fatehwadi Command Area:**

   Trunk sewers along the 132 feet wide ring road encircling a large portion of Ahmedabad will terminate at sewage treatment plants near the Vasna Barrage. It is possible to use treated water from the sewage treatment plants to serve the Fatehwadi Command Area. If it is properly planned this option to irrigate the Fatehwadi Command Area seems viable and may also provide uninterrupted supply. However, feasibility of this alternative has to be studied in greater detail.

Replenishing Water

It is proposed that, at the very least, throughout the year the depth of water at Subhash Bridge should be 1 m (which it will be in the first week of October). To ensure this, as discussed above, first of all it will be necessary to eliminate the requirement of irrigating the Fatehwadi Command Area by using water retained by the Vasna Barrage. Secondly it will be necessary to replenish seepage and evaporation losses to the extent that water depth at Subhash Bridge remains 1 m. The table below shows the replenishment requirement at two month intervals. The following section discusses various options for replenishing water in the river.

- **Using Water from the Narmada Main Canal**

  It is possible to replenish seepage and evaporation losses by using water from the Narmada Main Canal. The total requirement is stated in the table above. The viability of this option and its cost have to be discussed with the SSNNL.

- **Using Water released from the Dharoi Dam:**

  At present Ahmedabad's water supply, in the AMC area, is dependent on water released from the Dharoi Dam (See Drawing No. 2). The total quantity of water from Dharoi that reaches Ahmedbad is 260 MLD. Of this, about 180 MLD is drawn through the french wells in Sabarmati. The AMC has also been allocated water from the Narmada Main

Period	Water quantity (cu m)		Replenishment requirement			Water loss (cu m)	
	Beginning	End	cu m	MLD	cusecs	Seepage	Evaporation
1 Oct - 30 Nov	8347460	1881249	6466211	108	44	5218751	1247460
1 Dec - 30 Jan	8347460	1881249	6466211	108	44	5218751	1247460
1 Feb - 30 Mar	8347460	1531249	6816211	114	46	5218751	1597460
1 Apr - 30 May	8347460	431249	7916211	132	54	5218751	2697460
1 Jun - 15 Jun	8347460	6245312	2102148	140	57	1304688	797460
Total	29766992						

Canal under the Municipal and Industrial Use Scheme - though the quantum of supply is undecided. This water is to be supplied to the Kotarpur Water Works. Under these circumstances, it may be possible to use water released from the Dharoi Dam to replenish water in the river. However, it must be kept in mind that demand for Dharoi water for irrigation in areas upstream of Ahmedabad is very strong and, even at present, supply for Ahmedabad is contested and constrained.

- **Using Treated Sewage Water (Soil Aquifer Treatment, SAT):**

  It is possible to use treated sewage water to replenish seepage and evaporation losses. To ensure that the treated water is of the desired quality, the Soil Aquifer Treatment (SAT) method tested by the Water Resources Research Foundation in Ahmedabad may be used. In the SAT system domestic wastewater after primary treatment is let into infiltration basins (approximately 200 m x 200 m) that are constructed for the purpose. From the infiltration basins the wastewater percolates into the aquifer below and in the process it interacts with both the soil particles and aquifer media. Purification occurs due to infiltration, aerobic and anaerobic oxidation processes. Further deeper down, due to trans verse dispersion and dilution, the percolated water undergoes additional treatment. The water after it gets renovated/purified is pumped out (through radial collector wells that are constructed between the infiltration wells) as renovated wastewater suitable for unre stricted irrigation. A prerequisite to SAT is the availability of primary treated sewage and permeable soils to give high infiltration rates. The infiltration basins are operated by alternately flooding and drying.

  Infiltration basins required for the SAT system can be constructed in the Sabarmati river bed downstream of Vasna Barrage so that it can receive the primary treated sewage from the Vasna and Pirana treatment plants that would be in the vicinity. Also the width of the riverbed in this portion is greater than 500 m. This would facilitate the construction of infiltration basins (a large number would be required). But most importantly the soil in this area has an unconsolidated sand aquifer more than 15 m thick, that is permeable enough to give high infiltration rates.

  Using simple earthwork the riverbed can be subdivided into several infiltration beds which can be alternately flooded and left for drying. Radial collector wells can be constructed between the infiltration beds to pump out the renovated wastewater. The renovated waste water can be pumped upstream of Vasna Barrage to maintain water in the river and to effect groundwater recharge.

A pilot project of 1 MLD (10^6 litres/day) capacity downstream of Vasna Barrage was built by NEERI-PRL-AMC team. This system was operated for six months. The results in terms of the quality of effluent were more than satisfactory (the Biological Oxygen Demand (BOD) of the effluent was less than 10 mg/l and Suspended Solids (SS) were less than 20 mg/l). Also the bacteriological quality of SAT treated effluent from the pilot project conformed with CPCB and WHO guidelines for use as unrestricted irrigation water, which is not the case with wastewater treated by conventional methods. The details of the SAT system and costs are in the process of being worked out.

Issues pertaining to Water Retention

- **Effect / Impact on Dudheshwar Water Works:**

  The infiltration wells located near the Subhash Bridge will need to be strengthened as a consequence of the increase in the velocity and scour depth of the river. Alternatively, in view of the costs required for strengthening these wells, they can be abandoned and a new French / Jack Well can be constructed upstream of Subhash Bridge. A study is required to understand this issue in greater detail and to estimate the cost of any measures that might have to be taken to protect old wells or build new ones.

- **Mosquito menace:**

  A detailed analysis of the extent to which water retained in the river will pose a malarial hazard is required. The effect of retaining water from Vasna Barrage to Subhash Bridge will be eqivalent to having 10 new Kankaria Lakes in the middle of the city. Various options for reducing the breeding of mosquitoes such as aeration, breeding of appropriate fishes, effect of recharging and making the river a part of the Namada Canal System to irrigate the Fatehwadi Command area have to be analyzed in greater detail.

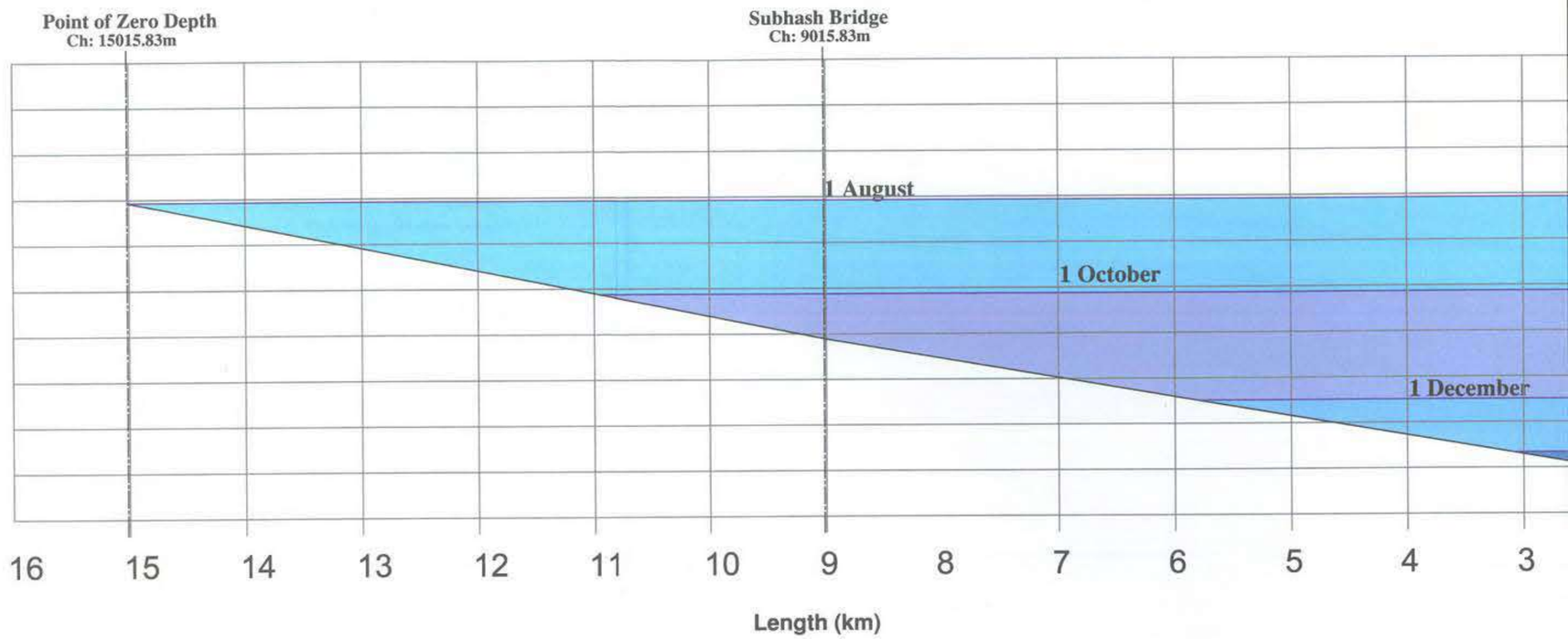
- **Ground water recharge:**

  At present the AMC water supply system provides about 430 MLD of water to a population of 28 lakhs, at an average of 100 to 145 lpcd. The waterworks on the Sabarmati riverbed, using infiltration wells and french (radial) wells, account for 180 MLD (42%) of the total AMC supply. In addition to the area within the jurisdiction of the AMC, the entire development in the fringe areas depends on the ground water, which is pumped out through the private tube wells. The pressure on the ground water resources is enormous. The combination of city owned and private tube-wells is depleting the supplies resulting in rapid drop of 2.5 m per year in the water table. This pattern of water consumption is obviously unsustainable in the long run.

  Since the river is not perennial, the recharge of the ground water aquifers is insufficient. The construction of embankments will make it possible to retain water till the top of Vasna Barrage. Retaining water in the river will have a positive effect on the recharging of ground water aquifers and considerably decrease the presently rapid fall in the water table in the city area. However, to better understand the effect of retaining water in the river on the ground water system of the city, it will be necessary to set up a ground water monitoring system.

Further Work Required

- Establishment of ground water monitoring system and detailed quantitative analysis of the various impacts of ground water recharge.
- Feasibility study for using water from the Narmada Main Canal for irrigating the Fatehwadi Command Area.
- Feasibility study for using treated water from sewage treatment plants for irrigating the Fatehwadi Command Area.
- Feasibility study for using treated water from sewage treatment plants for replenishing seepage and evaporation losses.
- Dialogue with the SSNNL to review the options discussed above.



LEGEND

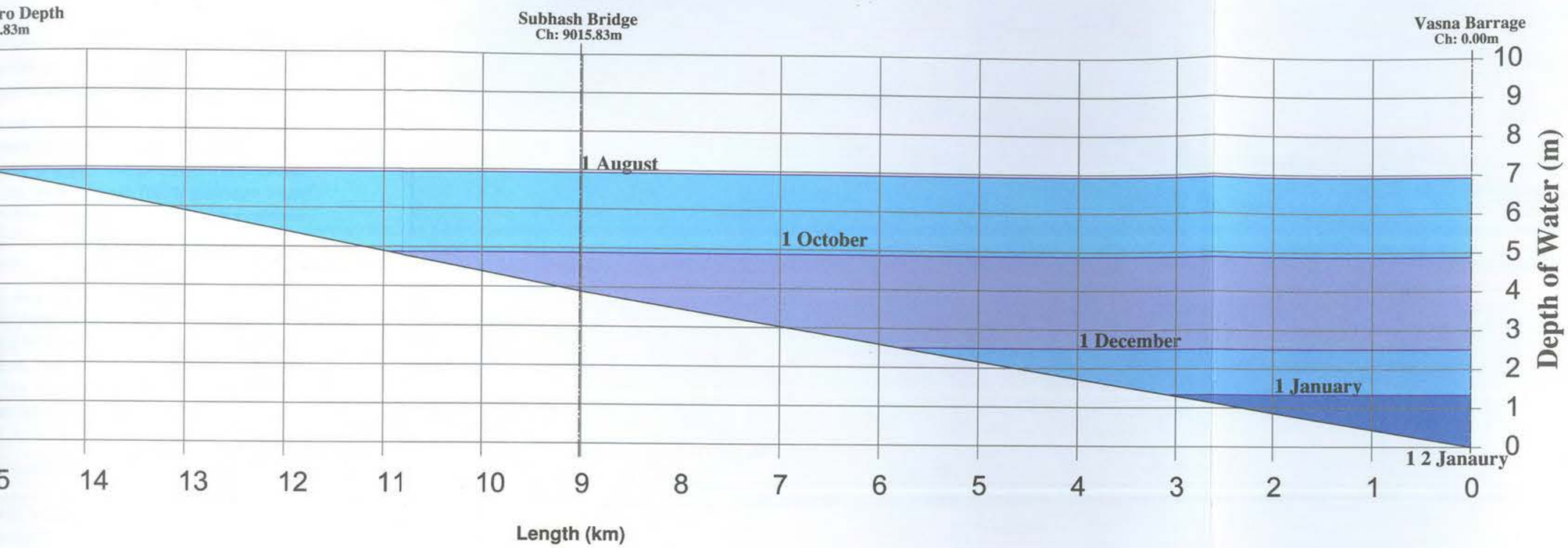
As on	Depth of water at Vasna Barrage
1 August	6.93m
1 October	4.88m
1 December	2.51m
1 January	1.34m
12 January	0.00m

NOTE :

[1] This calculation assumes that there is no inflow of water and the water loss is due to seepage and evaporation only.

[2] 12 January to 14 June there is no water in the river.

[3] 15 June to 31 July is considered as monsoon.



LEGEND

As on	Depth of water at Vasna Barrage
1 August	6.93m
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NOTE :

[1] This calculation assumes that there is no inflow of water and the water loss is due to seepage and evaporation only.

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[3] 15 June to 31 July is considered as monsoon.

SCHEMATIC WATER RETENTION DIAGRAM Grid : H-1000m V-1m

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

Certified by Dr S K Gupta, Physical Research Laboratory, Ahmedabad. May 1998

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B6 LAND USE AND ROAD NETWORK

This section and Drawing Nos. 14 to 23 describe the existing land use along the river and the proposed use of reclaimed land. The road network on the reclaimed land and its position in the structural road network of the city is also shown here.

Land Use Proposals

The land use pattern along the riverbanks from Subhash Bridge to Vasna Barrage is shown in Drawing No. 14. This drawing is based on information gathered through a reconnaissance survey. Value of the land along the river was also systematically surveyed.

Of the total of 162.8 ha of land reclaimed, as discussed in Section B4 above, it is estimated that 4% of the land will not be available for development. However, pending final delineation of the property rights along the river and for the purpose of clarity and simplicity this proposal assumes that the entire 162.8 ha will be available for development. This is justifiable since revenue potential is dependent on the use of only 21.3% of the land and not all of the revenue earning portions of the reclaimed land will be affected by the reconciliation of property rights (see, Drawing No. 15 and Section C1 for details).

The main considerations in allocating land uses were: existing land uses along the river; extent, location and configuration of reclaimed land available; potential for development; the structural road network and form of the city; bridges proposed in the Ahmedabad Development Plan and; the possibility of providing adequate infrastructure. The primary objective of the planning exercise was to maximize city level benefits by the provision of ample public facilities. A secondary objective was to optimize revenue potential of land allocated for sale - to finance the project.

Drawing No. 15 describes the allocation of the reclaimed land for various uses. The proposed uses include the following: gardens, promenades, public facilities, cultural facilities, school, relocation sites, new residential and commercial areas, informal markets and roads. Drawing Nos. 19 to 22 show various schematic sections, which further describe the proposed land uses. The following table gives a break up of the manner in which the land is used.

No.	Proposed Land Uses	Area (Ha)	Area (%)
1	Roads	46.45	28.53
2	Gardens	42.80	26.29
3	Promenades	9.80	6.02
4	Relocation Sites	15.48	9.50
5	Informal Markets	5.86	3.60
6	Commercial Areas (to be sold)	22.15	13.61
7	Residential Areas (to be sold)	12.47	7.66
8	Public Utilities	0.77	0.47
8	Extension of Public Facilities	0.94	0.58
9	Residual/ Unallocated	6.08	3.74
	Total	**162.80**	**100.00**

The following describes use of the reclaimed land in greater detail.

Roads

Drawing No. 18 illustrates the proposed road network. The total area allocated for the road network is 46.45 ha. A 6 lane wide road, the 'East River Drive', is proposed along the east bank and a 4 lane wide road, the 'West River Drive', is proposed along the west bank. In addition to these two major arterial roads, it is proposed to widen and upgrade roads providing access to the reclaimed area, to establish new access roads and to improve/rationalize key road junctions. All of the foregoing will not only serve the proposed new developments along the river and dissipate the traffic that they will generate but also contribute to the strengthening of the transportation network of the city and to alleviating the traffic problem. The detailed proposals are as follows:

East Bank

- ***The East River Drive:***
  A six lane wide road is proposed along the entire river edge starting from Subhash Bridge till Proposed Bridge 3. In future this road will be connected to the 120' wide Road. The road runs below the existing bridges. Its level at various places takes into account the soffit level of the bridges and the positions of their piers (refer Drawing Nos.19, 20, Section No. 1E, 7E). On the west an on-street parking bay and promenades / gardens flank the road. This will ensure that the river edge is accessible for recreational uses. Other key features of this road are:
- 3.5 meter wide lanes (resulting in a total carriage way width of 21 meters)
- Footpaths (2.5 m wide)
- Central Verge (1 m wide)
- Angular/ parallel on-street parking where required.
- ***Connections with Bridges:***
  The East River Drive is connected to the existing bridges (and therefore the existing road network of the city) by one-way 'on' and 'off' ramps running parallel to the bridges. In some cases it will be necessary to acquire additional land to provide the connecting ramps.
- ***Junction Improvements:***
  The existing road junctions proposed to be improved/rationalized are indicated in Box Nos. 1, 4, 6, 7, 9, 11, 18 and 21 on Drawing No. 16.
- ***Access Road Improvements and Widening:***
  The access roads proposed to be improved, widened and extended are shown in Box Nos. 2, 4, 5, 6, 11, 12, 13, 16, 17, 19, 20 and 22 on Drawing No. 16.

West Bank

- ***The West River Drive:***
  A four lane wide road is proposed along the river edge starting from Proposed Bridge 1 till Nehru Bridge. The road continues further from the Ellis Bridge junction with the Ashram Road and ends at Proposed Bridge 3. The road runs below the existing bridges. Its level at various places takes into account the soffit level of the bridges and the positions of their piers (refer Drawing Nos. 21, 22, Section Nos. 2W, 7W). On the east side on-street parking bays and promenades/ gardens flank the road. This will ensure that the river edge is accessible for recreational uses.

Other key features of this road are:

- 3.5 meter wide lanes (resulting in a total carriage way width of 14 meters)
- Footpaths (2.5 m wide)
- Central Verge (1 m wide)
- Angular/ parallel on-street parking.
- ***Connections with Bridges:***
  The West River Drive is connected to the existing bridges (and therefore the existing road network of the city) by one-way 'on' and 'off' ramps running parallel to the bridges. In some cases it will be necessary to acquire additional land to provide the connecting ramps.
- ***Junction Improvements:***
  The existing road junctions proposed to be rationalized are indicated in Box Nos. 25, 27, 29, 34, 36, 41 and 46 on Drawing No.18.
- ***Access Road Improvements and Widening:***
  The access roads proposed to be improved, widened and extended are shown in Box Nos. 26, 30, 31, 32, 33, 35, 37, 49, 50 and 51 on Drawing No. 16.

To enable the implementation of the above road proposals (particularly widening proposals requiring acquisition of land) a River Front Development Zone (RFD Zone) encompassing the entire project area was delineated on the Revised Draft Development Plan of the Ahmedabad Urban Development Authority (published on 28 November 1997). New building activity was restricted in this area until 31 December 1997. The road proposals described above (on which the project's realization is critically dependent) are worked out in schematic form. It is anticipated that, at the very latest, by 31 December 1997 detailed proposals will be ready. Following this it will be possible to allow building on plots in the RFD Zone provided that such building does not hinder the River Front Development Project Road Proposals.

Parks and Gardens

Nearly 42.8 hectares of parks and gardens have been envisaged along the river edge to serve different recreational functions and to cater to the needs of different citizen groups. Some of these are expected to serve as city level green spaces while others as neighborhood parks. These additions in the heart of the city will considerably enhance the availability of open space for the densest areas of the city. The various parks and gardens are described below:

East Bank

- ***Dudheshwar Garden (5.52 ha):***
  Located between Subhash Bridge and Proposed Bridge 2 this linear garden is nearly thirty meters wide and 1521 m long. The area of this garden is 5.52 ha. It runs parallel to the river. At various locations steps/ ghats will lead down to the water and jetties. The on-street parking bay of the East River Drive flanks it on the east. This will provide easy access to the garden without causing a traffic problem along the road. It may be noted that the level of the garden is higher than that of the East River Drive. This will reduce disturbance of the traffic in the garden. The garden will also be easily accessible to residents of the Dudheshwar Relocation Site.
- ***Heritage Park (1.33 ha):***
  In front of the Fort Wall between Nehru Bridge and Ellis Bridge it is proposed to develop a Heritage Park. This portion of the Fort Wall is better preserved and may be restored.

If properly lit it can provide a dramatic setting to the Heritage Park. Though it is to be detailed further it is proposed that the Heritage Park will have a large 'hard landscape' component with sculptures, exhibits, pavilions, subterranean spaces and structures to present the diverse and rich heritage of Ahmedabad. The Proposed Heritage Park can become an important Tourist Destination in the City. On the west, a C G Road type side lane and parking bay will flank the Heritage Park to provide easy accessibility to it without disturbing the through traffic on the East River Drive.

- ***Victoria Garden Extension (1.26 ha):***
  It is proposed to extend the Victoria Garden up to the East River Drive. This will not only increase the size of the existing garden but also make it more accessible, since it will abut onto the East River Drive. A portion of the extension will also be used to provide parking for the garden. The Sunday Market (Gujari) which at present is held on the land to be used for the Victoria Garden Extension will be moved to the adjacent plot.

- ***Pirana Forest (4.73 ha):***
  The area reclaimed near the Vasna Barrage is proposed to be a forested garden. Easily accessible from the East River Drive and having adequate parking facilities, it will be particularly beneficial for people in the industrial area on the south-eastern part of the city.

West Bank

- ***Gandhi Ashram Park (2.57 ha):***
  The entire stretch of the reclaimed land from Subhash Bridge till Proposed Bridge 1 is proposed to be developed as a green space. This linear green space will be accessible from Gandhi Ashram and become an extension of the Gandhi Ashram. The Ashram will be the only property along the river, which will front directly onto the river. On account of this the present relationship between Gandhiji's Kutir and the river will be maintained and enhanced. In all other cases the edge of the river is publicly accessible. The area around the historic Dandi Pul, which at present is an open space/ drain, will be developed as a park and will be linked to the linear park.

- ***B J Park Extension (2.91 ha):***
  It is proposed that the land reclaimed in front of the B J Park be merged with it. This will approximately double the present area of the park. This park will be linked to the City Park under the Ellis Bridge.

- ***City Park (15.79 ha):***
  The entire stretch from Nehru Bridge till the National Institute of Design is proposed to be developed as the City Park. The width of the park will be approximately 90 m and the total length (inclusive of the B J Park Extension) will be 1970 m. This park will also be connected with the Sanskar Kendra/ Tagore Hall grounds. It is also proposed that several cultural and recreational institutions (eg. planetarium, arts and crafts museum etc.) be added/ built within the environs of the City Park. If this is done, this portion of the riverfront development will provide the city with an important city level recreational and cultural space. The embankments along the City Park, articulated in the manner of a fort wall, will provide access to the water. The City Park will be accessed from a wide road connecting the Ellis Bridge Junction and the Sardar Bridge Junction. This road will be wide enough to provide ample on-street parking. Additional parking space will be provided in garages below the proposed cultural facilities in the park.

- ***V S Hospital Park (1.51 ha):***
  It is proposed that the area adjacent to the crematorium near the V S Hospital be developed as a neighborhood park. This park will enhance the quality of life for residents in the vicinity.

- ***Vasna Forest (7.18 ha):***
  The area reclaimed near the Vasna Barrage is proposed to be a forested garden. Easily accessible from the West River Drive and provided with parking facilities, it will be particularly beneficial for people in the Vasna area.

Promenades

A major concern in planning the development of the Sabarmati riverfront has been that the entire frontage to the river should be accessible and available for the public. That it should be a safe tree lined pedestrian zone available for strolling and other recreational uses; that it should be possible to access the river water from this zone and; that it should have parking facilities. While it is envisaged that when detailed designs for the proposed parks and gardens along the river edge are developed the above will be taken into consideration, the plan contains specific proposals for the development of promenades along the river. A total of 9.8 ha of reclaimed land is proposed to be used for promenades. The following describes them in detail.

East bank:

- ***The Dudheshwar Promenade (0.52 ha):***
  A 6 m wide and 580 m long promenade is proposed from Subhash Bridge till the Dudheshwar Garden along the commercial development. The commercial development proposed here largely comprises of hotels and hence the promenade would turn into an attractive spot for visitors to the city.

- ***The East River Promenade (3.12 ha):***
  A 6 m wide and 6323 m long promenade is proposed along the entire east bank, starting from segment 3E and ending at the Vasna Forest in segment 8E. This promenade runs parallel to the embankment wall and the river drive.

West bank:

- ***Usmanpura Promenade (0.72 ha):***
  A 5 m wide and 1110 m long promenade is proposed along the riverside road between the Gandhi Ashram garden and the commercial development along the Ashram road. This will serve the residents of the nearby areas.

- ***Ashram Road Promenade (4.46 ha):***
  A 17 m. wide and 2295 m long promenade is proposed along the commercial development in segments 3W, 4W and 5W. The urban design guidelines for the commercial development will require that buildings along this promenade have a similarly designed street level arcade and that specific public functions be provided at the ground floor level. This will make it possible for this promenade to be used as a vibrant recreational area with ample recreational facilities.

- ***Vasna Promenade (0.98 ha):***
  A 5 m wide and 1956 m long promenade is proposed to be developed along the riverside road in segments 7W and 8W between the City Park and the Vasna Forest. Being along a predominantly residential area, this promenade is likely to be widely used by people from the nearby areas.

Resettlement and Rehabilitation

It is proposed that a total of 15.48 ha of the reclaimed land be used for relocation and rehabilitation of those people living in slums along the river who are affected by the project. The land is allocated in three pieces at separate locations. This ensures that none of the project affected persons will have to move too far from their present location. Depending on the phasing of the project it might also be possible to ensure that relocation is commenced only after the permanent relocation sites are ready. All three relocation sites abut onto the East or West River Drive ensuring easy accessibility.

A detailed survey has identified that 4400 households will be affected by the Sabarmati Riverfront Development Project (See Section B8 for more details regarding the survey and the slum resettlement and rehabilitation policy). To calculate the amount of land required for relocation the size of new dwelling units is considered to be 25 sq m. It is envisaged that ground plus three floor high terraced housing will be built. Though the design of the new housing has to be worked out in detail, it is envisaged that the FSI or density there will be approximately 1.2. The table below gives sizes of the three relocation sites.

No.	Relocation Site	Area (ha)
1	Dudheshwar Relocation Site	8.64
2	Gaikwad Haveli Relocation Site	2.81
3	Paldi Relocation Site	4.03
	Total	**15.48**

Informal Markets

At present there are two informal markets along and on the riverbed–the Sunday Market (Gujri) which functions at the foot of the Ellis Bridge and the Phool Bazar adjacent to the Sardar Bridge. Both of these are economically and culturally very significant - particularly for the poor. However, they lack easy accessibility, parking, toilet and other ancillary facilities. In addition to this they are prone to flooding during the monsoon. To ensure that these markets remain and so that they are further strengthened, a total of 3.46 ha of reclaimed land has been allocated for their expansion and upgrading. In addition to this it is proposed to create two new informal markets, one near Gandhi Bridge on the east bank (1.4 ha) and the other at Usmanpura on the west bank (1 ha). It is estimated that the four markets will generate a direct employment of approximately 14,000 jobs. The following gives more details regarding the three proposed informal markets.

- ***Sunday Market (2.86 ha):***
  This traditional market has been a feature of the city since a very long time. It is proposed to shift this market in the plot adjacent to its present location. The market would have a planned layout with semi permanent stalls, plinths, platforms and provision of facilities and services such as parking space, water supply, public toilets etc. A special area will be provided for service vehicles. A much larger area has been allocated for this market than which is under present use.
- ***Phool Bazar (0.60 ha):***
  At present, the Phool Bazar adjacent to the Sardar Bridge extends out to the riverbank. It is proposed to allocate a larger area to the flower market than which is under its present use, with a planned layout, semi permanent stalls, plinths, platforms and provision of facilities/ services such as parking space, water supply, public toilets, etc.

- ***Gandhi Bridge Market (1.4 ha):***
  This market will also be developed along the lines of the two above.
- ***Usmanpura Market (1 ha):***
  This market will also be developed along the lines of the two above.

Commercial Areas

It is proposed that a total of 22.15 ha of the reclaimed land be sold for commercial development. The land is allocated in five patches. Existing land use patterns and the potential for development were considered in locating these patches. It is envisaged that serviced land, strategically divided into final plots will be sold for development. Development in these plots will be controlled by urban design guidelines which, at this stage, are only schematically defined. This will ensure that though it will be built by a number of different persons (those who buy the final plots) the renewed waterfront of Ahmedabad will be harmoniously and aesthetically built. Care has also been taken to ensure that the proposed new developments are in keeping with the desired structural form of the city. The following describes the five patches earmarked for commercial development. Drawing No. 15 schematically shows one aspect of the proposed urban design guidelines–footprints of buildings in the commercial areas.

East Bank

- ***Subhash Bridge Commercial Development Area:***
  About 3.32 ha of the reclaimed land adjacent to the Subhash Bridge on the east bank is earmarked for commercial development. On account of its location (on the East River Drive, adjacent to the Subhash Bridge, on the route to the airport and opposite the proposed Gandhi Ashram Park) it is envisaged that the land will be particularly attractive for developing hotels. It will also be attractive for commercial office development. Depending on commercial and urban design parameters (yet to be worked out in detail) the land will be divided in three to five parcels.
- ***Gandhi Bridge to Nehru Bridge, Commercial Development Area:***
  It is proposed that a total of 9.37 hectares of the land reclaimed between Nehru Bridge and Gandhi Bridge be sold for commercial development. The land will be divided into smaller plots based on commercial and urban design considerations. It is available in the form of a narrow irregular strip the eastern edge of which will be affected by reconciliation of property rights. It is envisaged that approximately 17 m wide and five floor high buildings will be built along the western edge of the land. Property developers will be expected to build a specified arcade along the East River Drive and C G Road type on-street parking space has also been allocated. A higher intensity of development (higher FSI and higher ground coverage than is presently permitted by the AMC) is proposed for the plots. All the buildings will have to provide off street basement parking. On account of the location (center of the city, along the East River Drive and the riverfront) it is envisaged that plots in this patch will be attractive for retail (shopping) and commercial office development. They may also be attractive for hotel owners along this stretch, who may use them for expansion of their facilities.
- ***Proposed Bridge 3, Commercial Development Area:***
  It is proposed that 2.23 ha of reclaimed land on either side of Proposed Bridge 3 be sold for commercial development. This land will be divided into smaller plots based on commercial and urban design considerations. Once the bridge is built, because of its location on Ahmedabad's 120 feet Ring Road, the plots will be particularly attractive for commercial development related to industrial activity in the south-eastern areas of the

city. A higher intensity of development may be permitted on this land. Attendant urban design requirements will also have to be developed.

West Bank

- ***Gandhi Bridge to Nehru Bridge, Commercial Development Area:***
  It is proposed that 9.37 ha of land reclaimed between Gandhi Bridge and Nehru Bridge be divided into plots (based on commercial and urban design guidelines) and sold for commercial developments. This land is contiguous with the commercial developments along Ashram road and on account of this it is likely to be highly attractive for commercial development. Since the land available here is wide, two rows of plots separated by the West River Drive are envisaged. It is also envisaged that the plots on the riverside will be used to build 17 m wide five-floor high buildings and that the plots on the other side will be used to build high rise buildings. This will ensure that beyond five floors the riverfront will be visible for those building on the inner plots. The West River Drive will be connected with Ashram Road at various points up to the Vadaj area and this will ensure that traffic generated by the new commercial development will be dispersed evenly.

  Urban gesign guidelines for the development on the riverside plots envisage a uniform arcade, which will run parallel to the 17 m wide promenade along the river. This arcade will be publicly accessible. Guidelines will also specify certain mandatory uses along the ground floor of buildings to ensure that ample public facilities, necessary for making the promenade vibrant, are created. The plots sold here will have a higher intensity of use (a higher FSI and 100 per cent ground coverage) and attendant urban design regulations.

- ***Proposed Bridge 3, Commercial Development Area:***
  It is proposed that 1.95 ha of reclaimed land adjacent to Proposed Bridge 3 be sold for commercial development. This land will be divided into smaller plots based on commercial and urban design considerations. Once the bridge is built, because of its location on Ahmedabad's 120 feet Ring Road, the plots will be particularly attractive for commercial development related to industrial activity in the south-eastern areas of the city. A higher intensity of development may be permitted on this land.Attendant urban design requirements will also have to be developed.

Residential

It is proposed that a total of 12.47 ha of the reclaimed land be sold for residential development. The land is allocated in two patches. Existing land use patterns and the potential for development were considered in locating these patches. It is envisaged that serviced land, strategically divided into final plots will be sold for development. Development in these plots will be controlled by urban design guidelines which, at this stage, are only schematically defined. This will ensure that though it will be built by a number of different persons (those who buy the final plots) the renewed waterfront of Ahmedabad will be harmoniously and aesthetically built. Care has also been taken to ensure that the proposed new developments are in keeping with the desired structural form of the city. The following describes the two patches earmarked for residential development. Drawing No. 15 schematically shows one aspect of the proposed urban design guidelines - footprints of buildings in the residential areas.

East Bank

- ***Proposed Bridge 1, Residential Development Area:***
  It is proposed that 2.04 ha of land adjacent to the Proposed Bridge 1 on the east bank be earmarked for residential development. Located next to existing residential areas along

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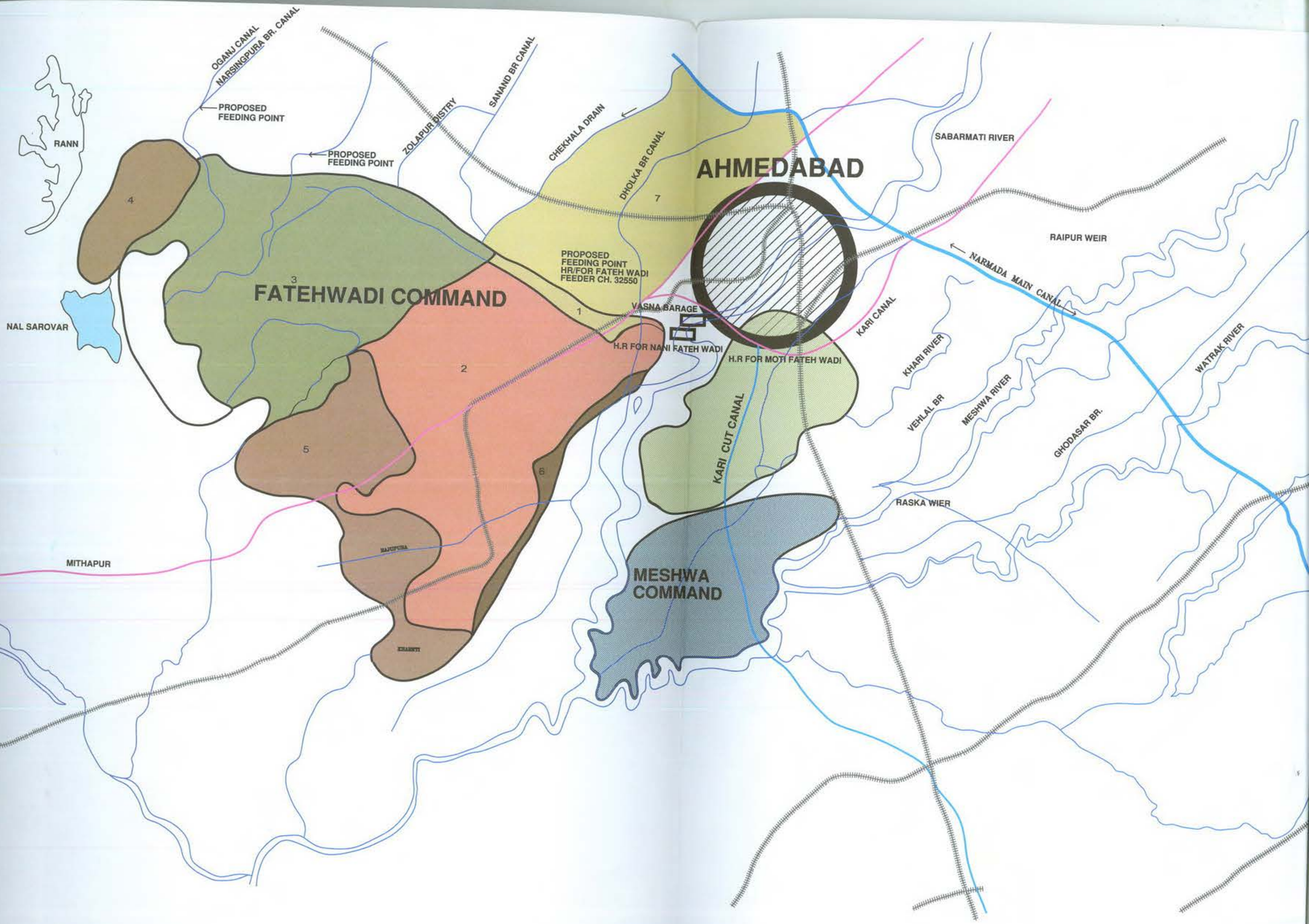
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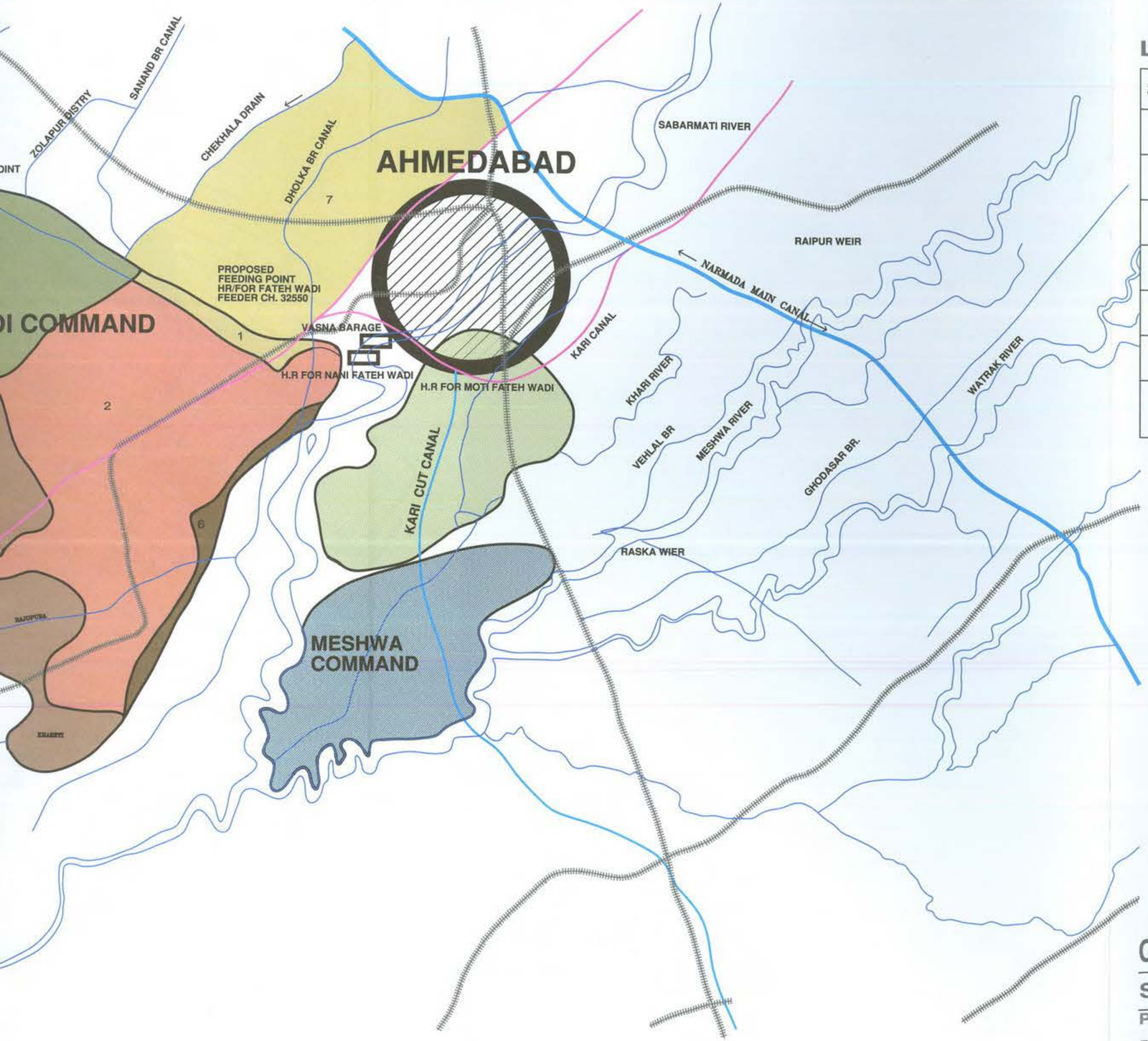
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LEGEND

Sr.No.	Sr.No.	COMMAND AREAS	TOTAL AREA (ha.)
1	1	AREA PROPOSED TO BE COMMANDED BY DHOLKA BRANCH CANAL	1,960
2	2	AREA CURRENTLY BEING COMMANDED BY FATEHWADI CANAL	39,035
3	3	AREA PROPOSED TO BE COMMANDED BY SANAND BRANCH CANAL	39,001
4	4	AREA PROPOSED TO BE COMMANDED BY NARSINGPURA BRANCH CANAL	6,467
5	5	AREA PROPOSED TO BE COMMANDED BY DHOLKA BRANCH CANAL	18,953
6	6	AREA PROPOSED TO BE COMMANDED BY DHOLKA BRANCH CANAL	2,520
7	7	AREA PROPOSED TO BE COMMANDED BY DHOLKA BRANCH CANAL (TO BE EXCLUDED DUE TO URBANIZATION)	28,631

COMMAND AREA - Narmada Branch Canal

1:320000

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

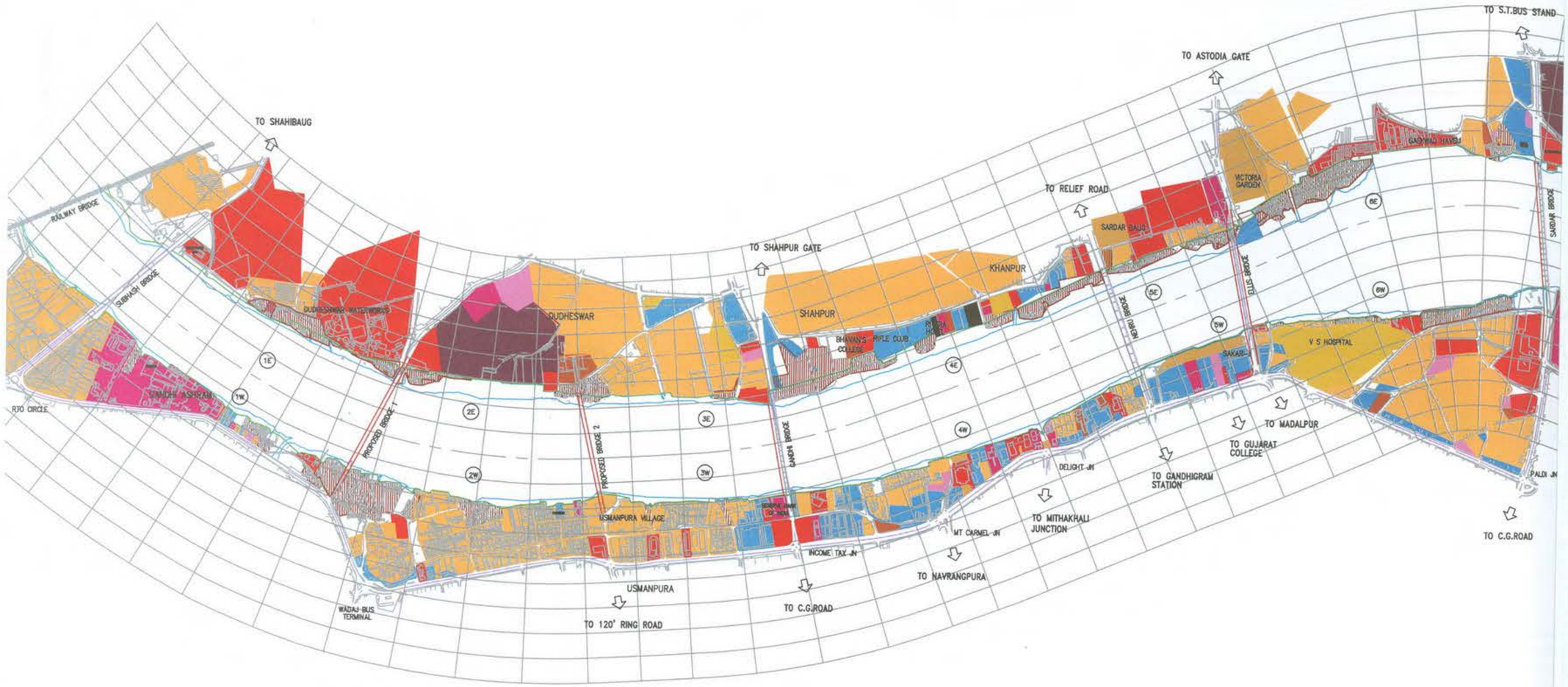
This map has been digitized from the index map of Narmada command area under the jurisdiction of Narmada project canal distribution system, Sardar Sarovar Narmada Nigam Ltd. Gandhinagar.

May 1998

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701 Paritosh, Usmanpura, Ahmedabad-380 013, India Ph : (91) (079) 75501 Fax : (91) (079) 7550649

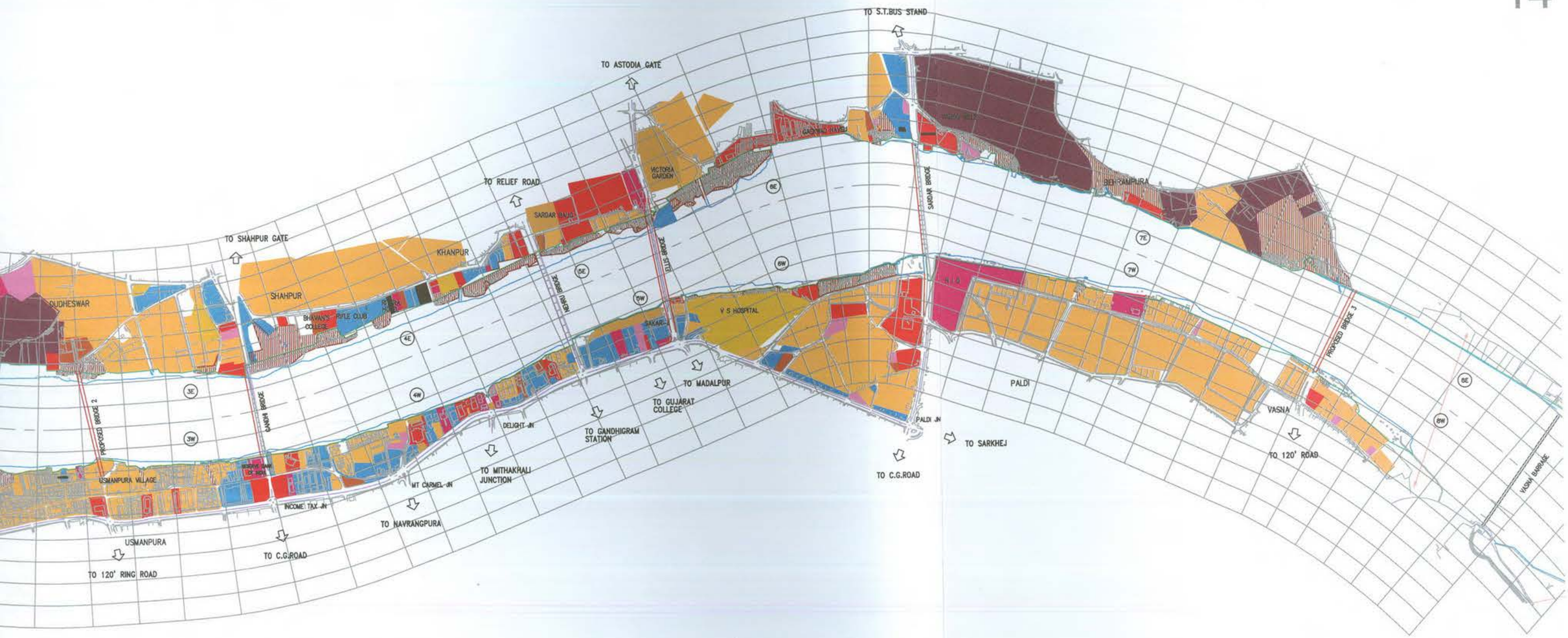
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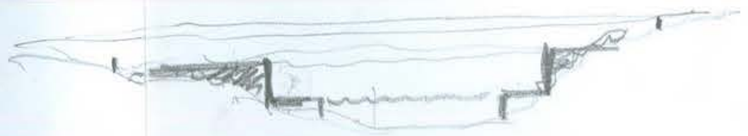
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LEGEND

Sr.No.	NOTATION	DESCRIPTION
1		RESIDENTIAL
2		COMMERCIAL
3		INDUSTRIAL
4		RELIGIOUS
5		INSTITUTIONAL
6		PUBLIC UTILITY
7		GARDEN
8		SLUMS
9		EDUCATIONAL
10		HEALTH
11		INFORMAL MARKET





0 100 300 500 1000 m

LEGEND

Sr.No.	NOTATION	DESCRIPTION
1		RESIDENTIAL
2		COMMERCIAL
3		INDUSTRIAL
4		RELIGIOUS
5		INSTITUTIONAL
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7		GARDEN
8		SLUMS
9		EDUCATIONAL
10		HEALTH
11		INFORMAL MARKET

LANDUSE - EXISTING

1:17500

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

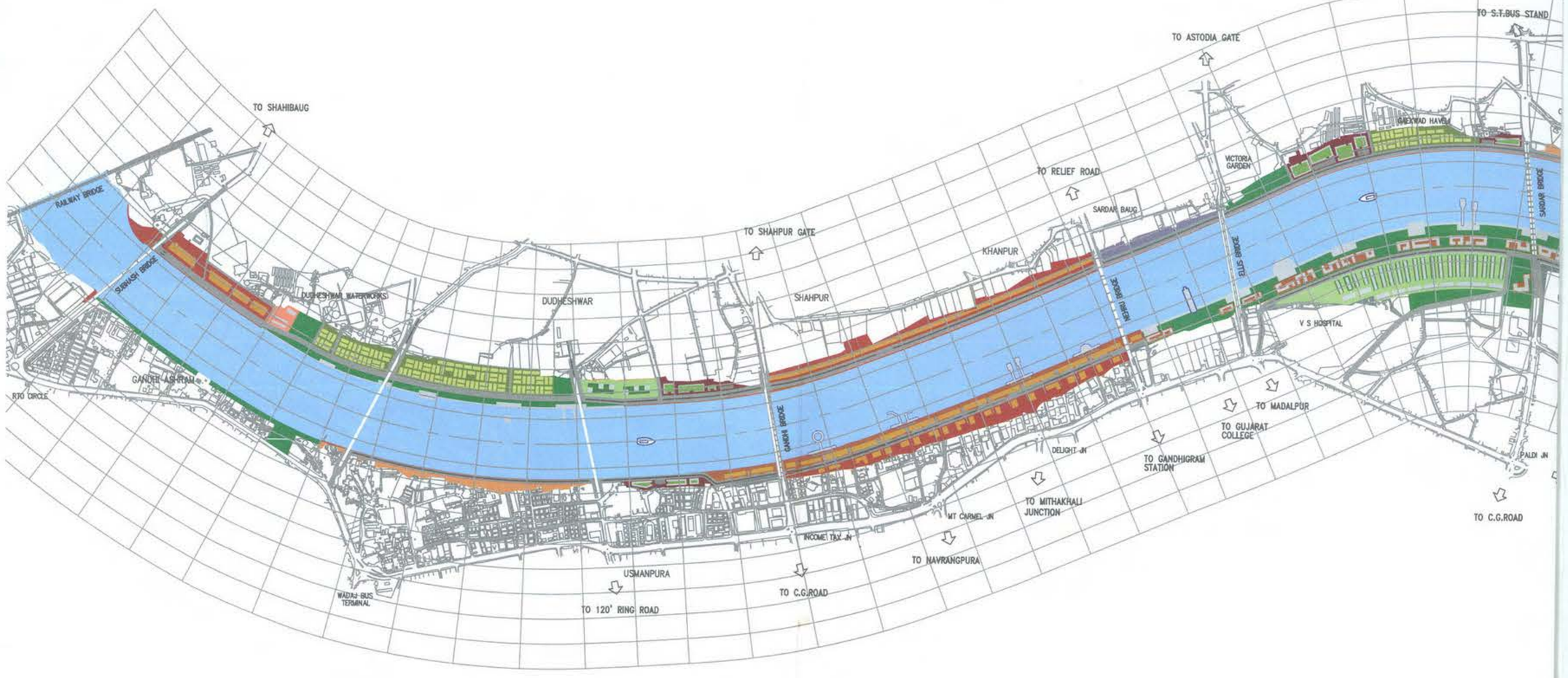
Contents are based on the primary survey carried out by EPC.

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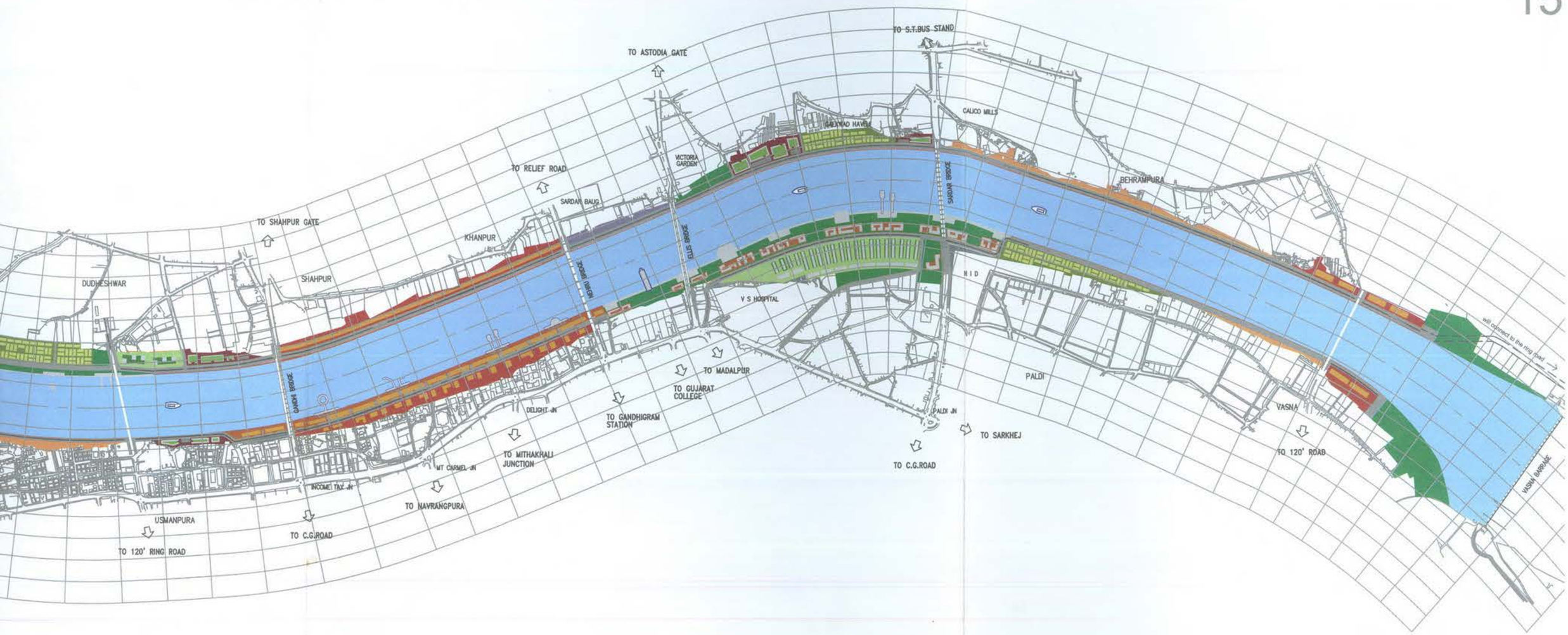
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LEGEND

	LAND USE	AREA (Ha)	AREA (%)
	ROADS	49.736	30.552
	GARDENS	41.454	25.463
	PROMENADE	9.800	6.020
	RELOCATION SITES	15.482	9.510
	INFORMAL MARKETS	5.859	3.600
	COMMERCIAL AREAS (TO BE SOLD)	20.209	12.413
	RESIDENTIAL (TO BE SOLD)	12.474	7.662
	PUBLIC UTILITIES	0.765	0.470
	EXTENTION OF PUBLIC FACILITIES	0.940	0.577
	RESIDUAL / UNALLOCATED	6.080	3.740
	TOTAL	162.799	100.00



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LANDUSE PROPOSAL

1:17500

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

May 1998

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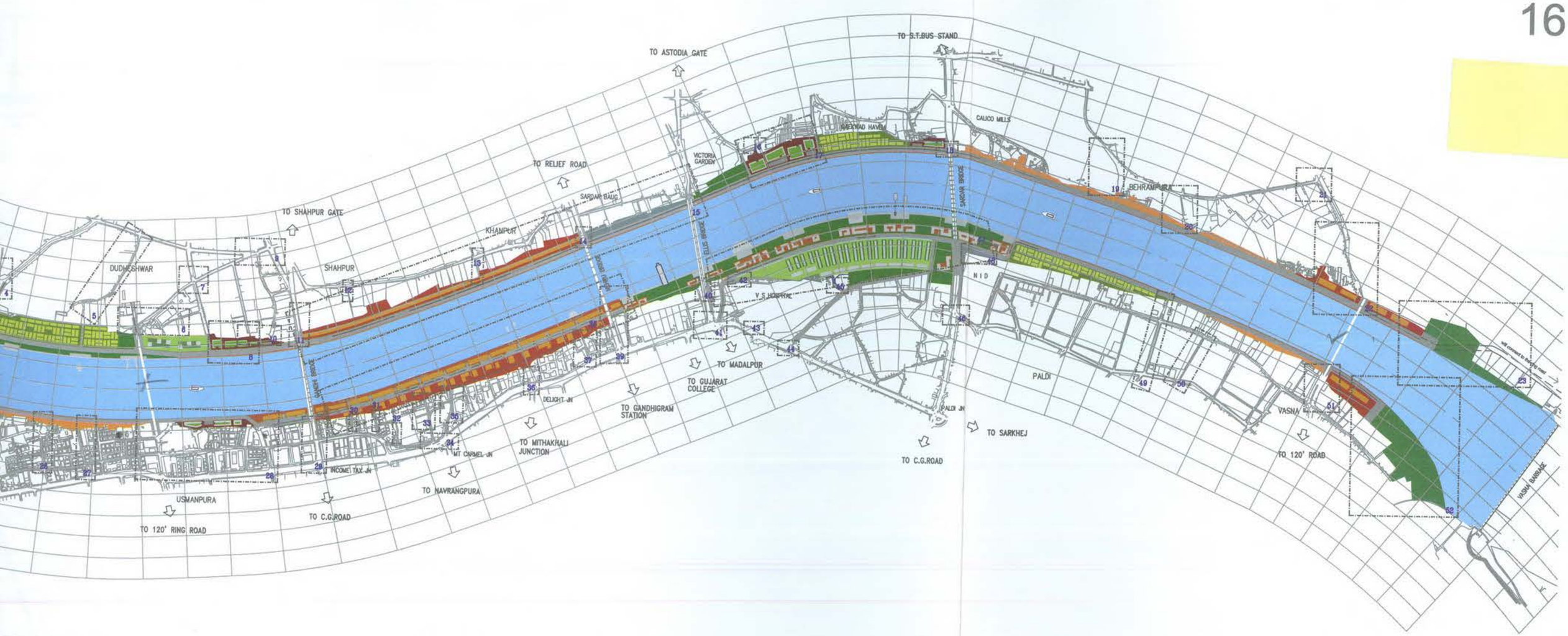
LEGEND

Box No.	Work required
1	Junction to be rationalized.
2	Proposed connector road network with Dudheshwar area to be detailed out and road network to be strengthened.
3	Nearest connection to the bridge to be designed.
4	Junction to be rationalized. Road widening of the existing connecting roads required.
5	New access road will require 20m width. Land acquisition required.
6	Proposed bridge junction to be designed. Road widening required to upgrade existing road network.
7	Junction to be rationalized. Road widening required.
8	Prepare detail design for Informal Market.
9	Junction improvement required.
10	Road widening may require land acquisition.
11	Junction to be rationalized. Road widening required. Traffic flow of proposed road to be checked.
12	Road widening required.
13	Road widening required.
14	Prepare detail design to link side connectors of the East River Drive to existing network.
15	Prepare detail plan for Heritage Park.
16	Road widening of road will require road widening.
17	Prepare detailed design for Informal Market. Provision for large parking.
18	Junction to be redesigned for new bridge along the existing bridge.
19	Road alignment to be established and detailed.
20	Road alignment to be established and detailed.
21	Junction to be rationalized.
22	Junction to be designed and existing road be widened.
23	Prepare detailed landscape design.
24	RTO junction to be rationalized.
25	Slope for the proposed bridge to be checked. Survey of illegal settlement on proposed bridge site is required. Junction with Ashram road to be rationalized.
26	Road widening may require land acquisition.
27	Junction to be rationalized. Road widening required.
28	Proposed bridge junction to be rationalized. Land acquisition needed for widening of road.
29	Junction redesigned and upgraded to accomodate side lanes along the bridge slope
30	Existing road to be widened and connected to West River Drive
31	Road widening required. Traffic flow direction to be established
32	Road widening required. Junction to be rationalized. Traffic flow direction to be established.
33	Road widening required. Junction to be rationalized. Traffic flow direction to be established.
34	Junction to be redesign perhaps as a circular roundabout.
35	Develop as a major entrance to river drive west.
36	Junction to be redesign for new road connection on the Rose Garden AMC plot with West River drive
37	Junction to be rationalized. Road widening required.
38	Detailed Urban Design guide line to be developed based on built form studies.
39	Redesign traffic junction for traffic from river drive-west.
40	Bridge junction to be redesigned for the new propoesed bridge and pedestrian connection.
41	Traffic junction to be resolved, perhaps using an elliptical roundabout (50x30m).
42	Amalgamate with V.S.Hospital.
43	Relocate entry to VSH - by either a setback entry or by being located off Ashram road to help decongest it.
44	Traffic to be regulated at junction.
45	Crematorium to be located beside the river.
46	Traffic junction to be rationalized. Perhaps NID entry may be relocated at the side or behind.
47	Prepare detail landscape design for the city park.
48	Plots need to be setback to accomodate ramp to access underpass.
49	Part of property to be acquired to establish connections.
50	Road widening required. Will require acquisition of properties.
51	Road and Junction to be designed to carry future traffic load.
52	Area to be designed and allocated for future recreation.

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EPC ENVIRO
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LANDUSE PROPOSAL

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SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

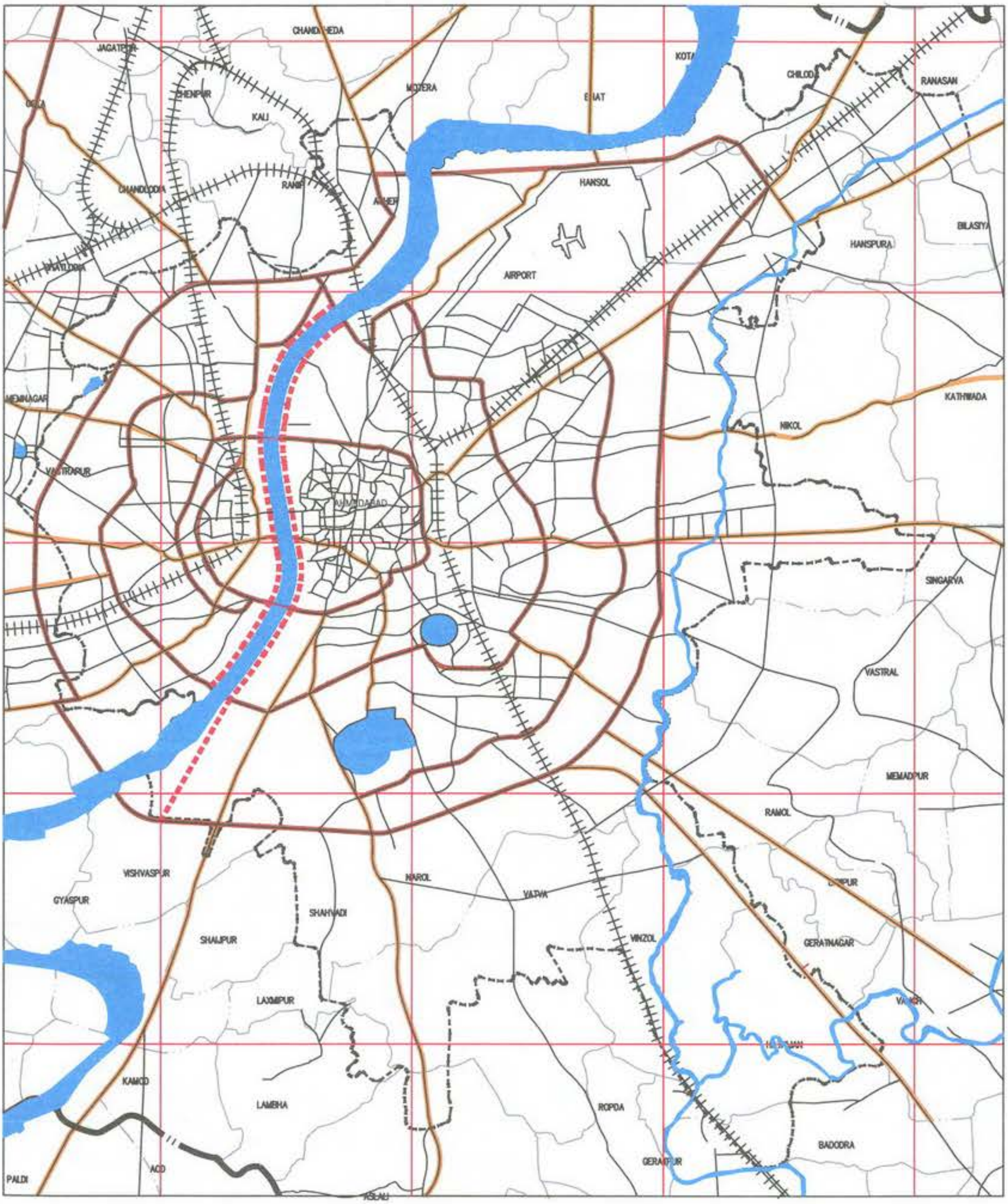
May 1998

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STRUCTURAL ROAD NETWORK - AHMEDABAD CITY



LEGEND

- AUDA BOUNDARY
- AMC BOUNDARY
- VILLAGE BOUNDARY
- RAILWAY
- WATER BODIES
- ARTERIAL RING ROADS
- ARTERIAL RADIAL ROADS
- STRUCTURAL NORTH-SOUTH LINKS (RIVER DRIVE ROAD)

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

EPC ENVIRONMENTAL PLANNING COLLABORATIVE
'Paritosh' Building, Near Darpan Dance Academy, Usmanpura, Ahmedabad–380013, INDIA Ph: 7550102

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LEGEND

Sr.No.	NOTATION	DESCRIPTION
1		LEVEL 1 ROAD (6-LANE)
2		LEVEL 2 ROAD (4-LANE)
3		LEVEL 3 ROAD (3-LANE)
4		EXISTING LEVEL 1 ROAD (ASHRAM ROAD)
5		EXISTING LEVEL 2 ROAD

PROPOSED RO

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LEGEND

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5		EXISTING LEVEL 2 ROAD

PROPOSED ROAD NETWORK

1:17500

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

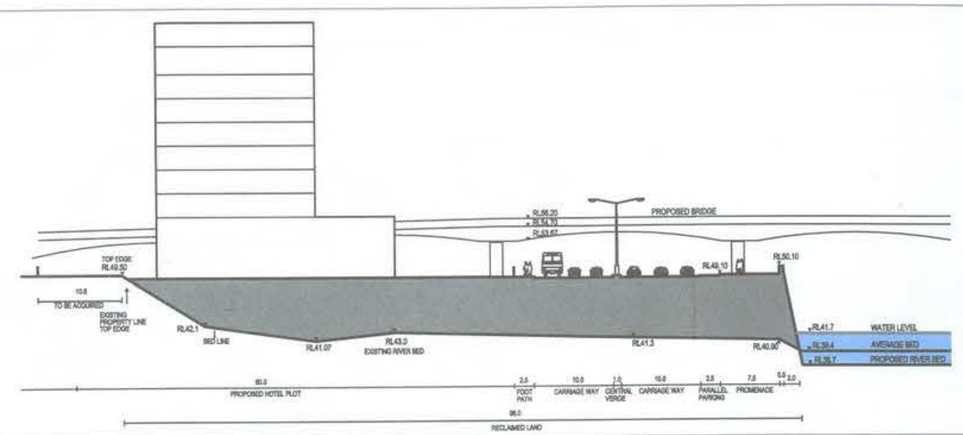
Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

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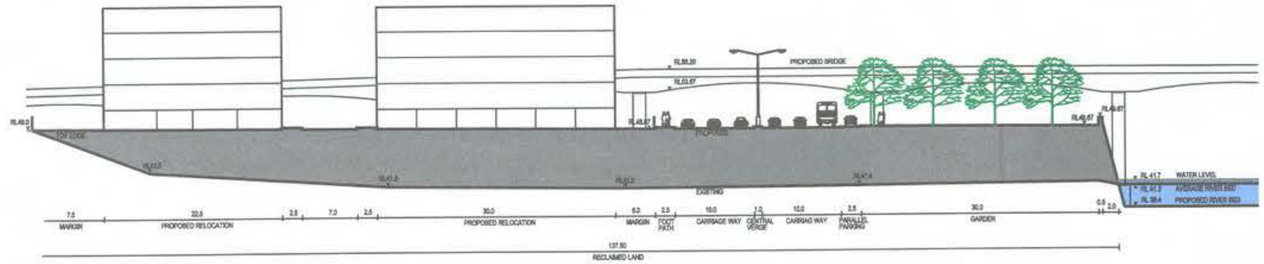
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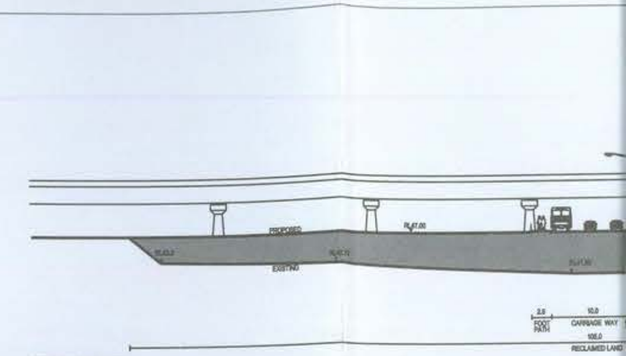
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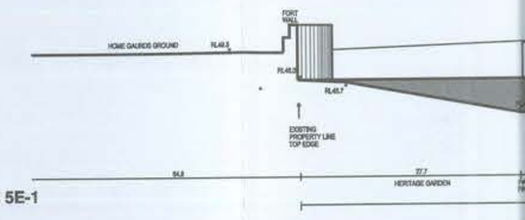
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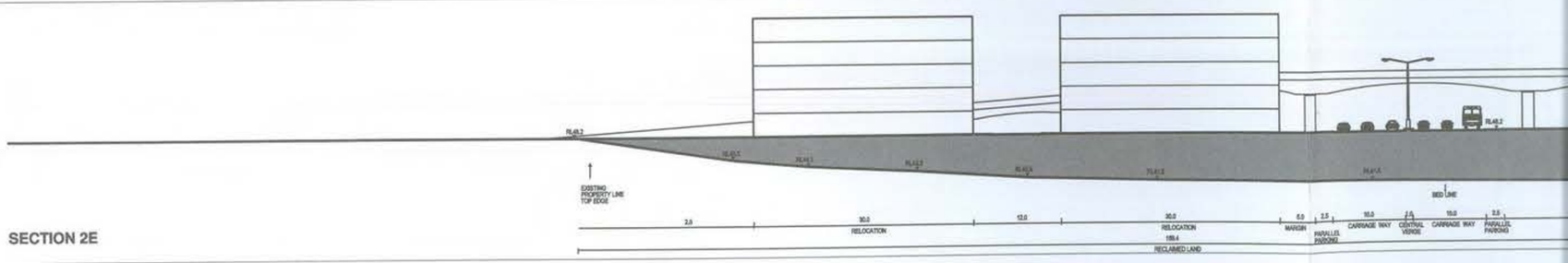
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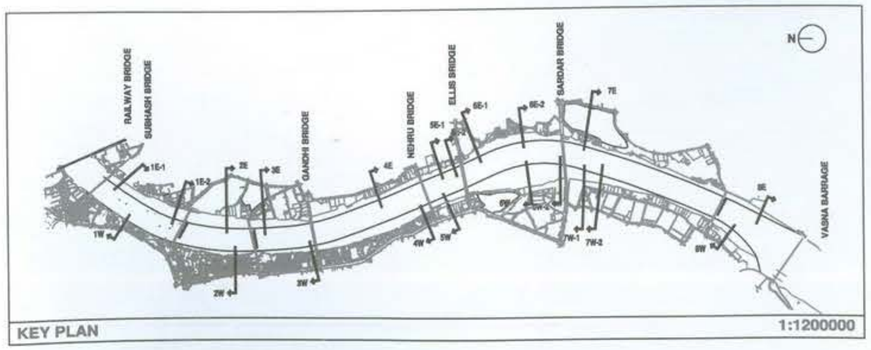
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SECTION 5E-1



SECTION 2E



KEY PLAN 1:1200000

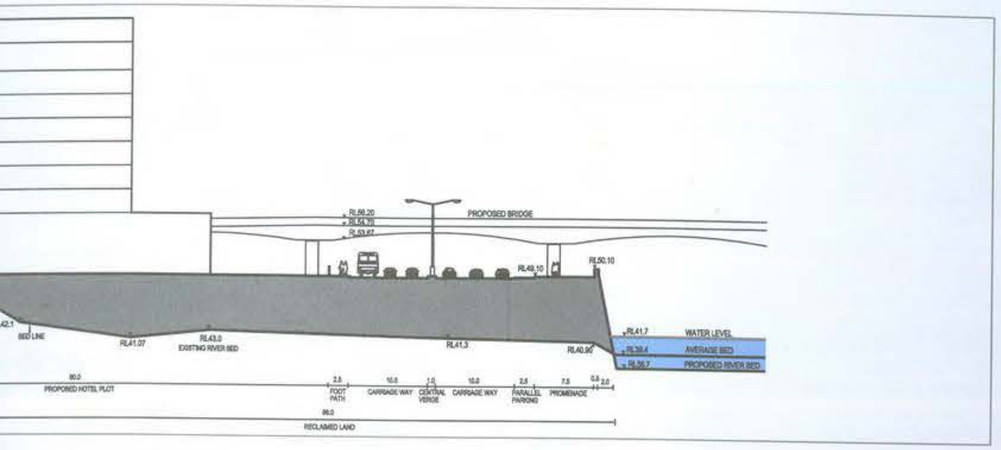
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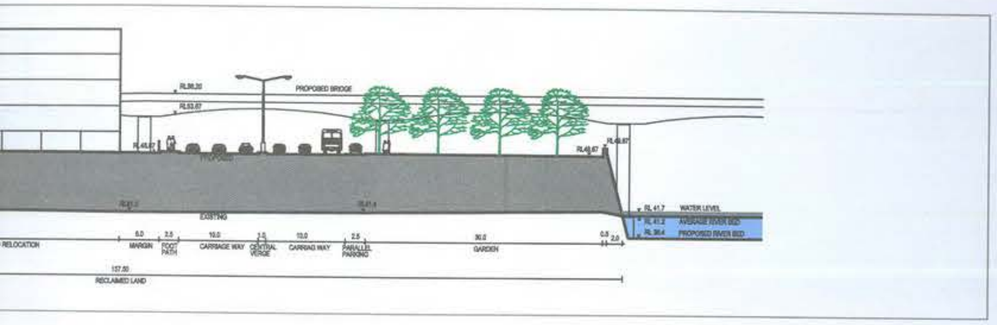
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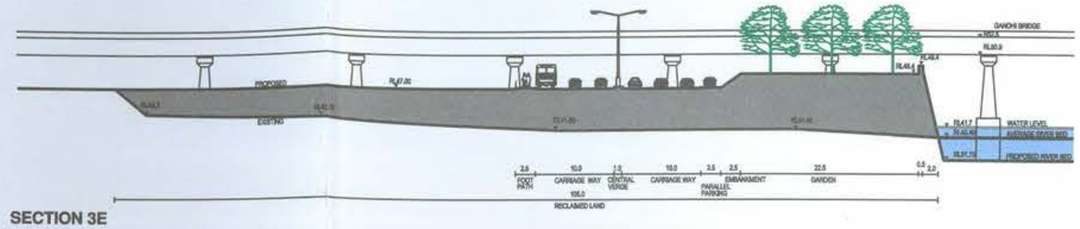
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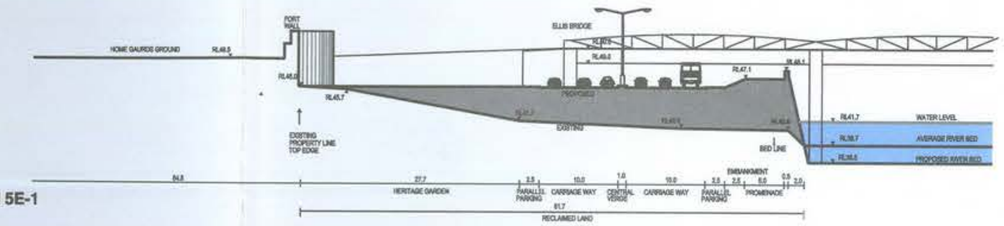
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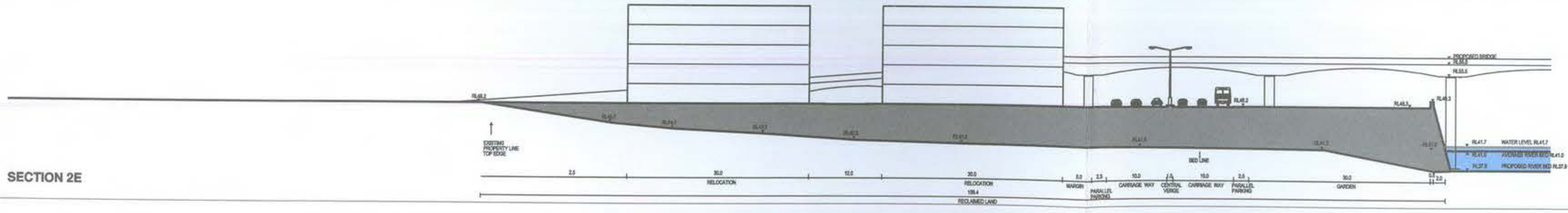




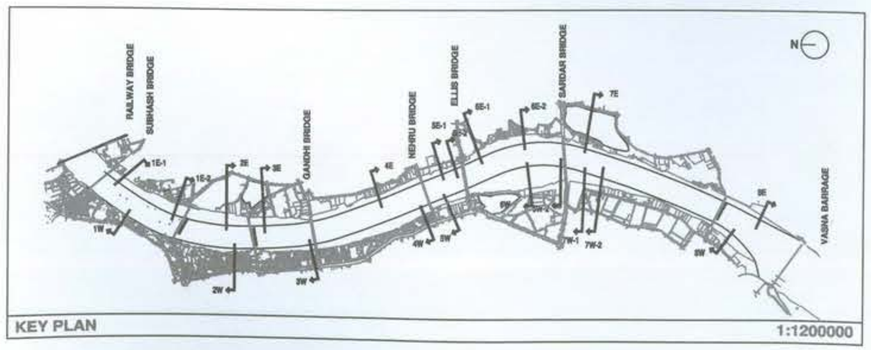
SECTION 3E



SECTION 5E-1



SECTION 2E



KEY PLAN 1:1200000

SECTIONS - LANDUSE

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SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

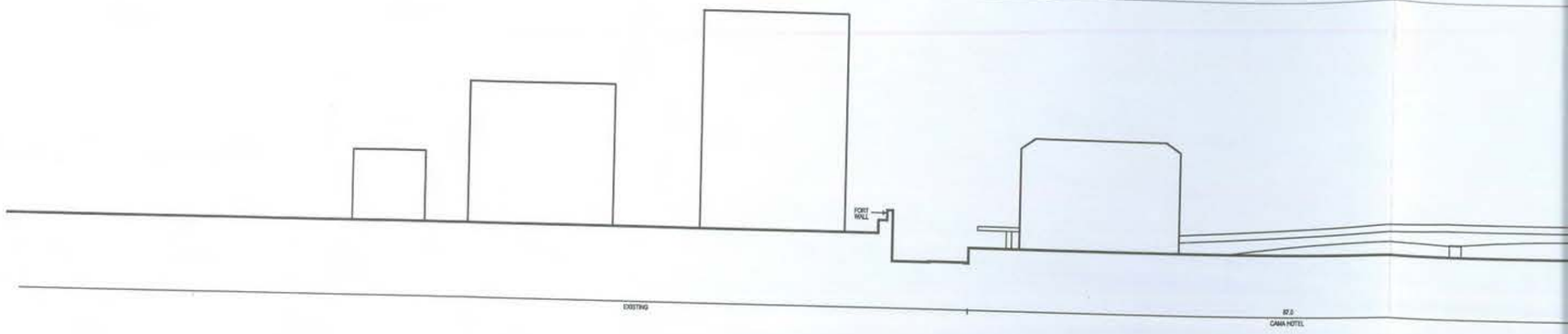
Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

May 1998

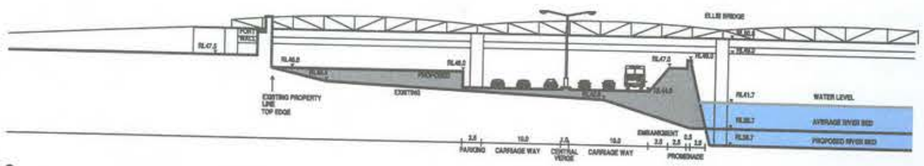
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701 Paritosh, Usmanpura, Ahmedabad–380 013, India Ph : (91) (079) 75501 Fax : (91) (079) 7550649

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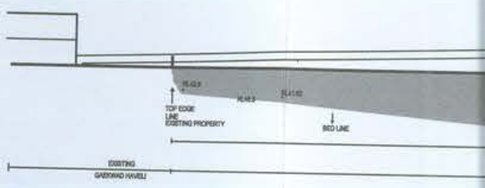
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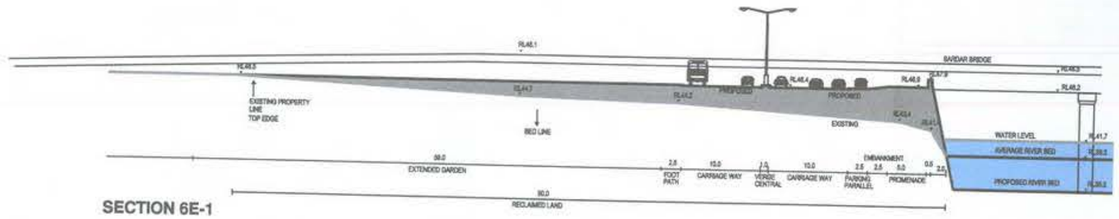
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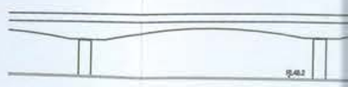
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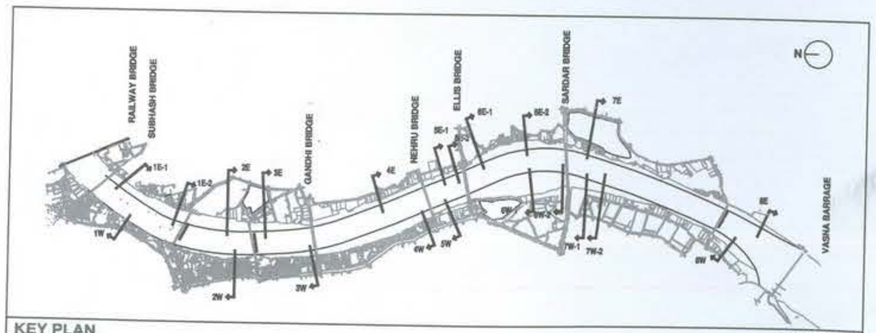
SECTION 6E-2



SECTION 6E-1



SECTION 7E



KEY PLAN

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SECTIONS -

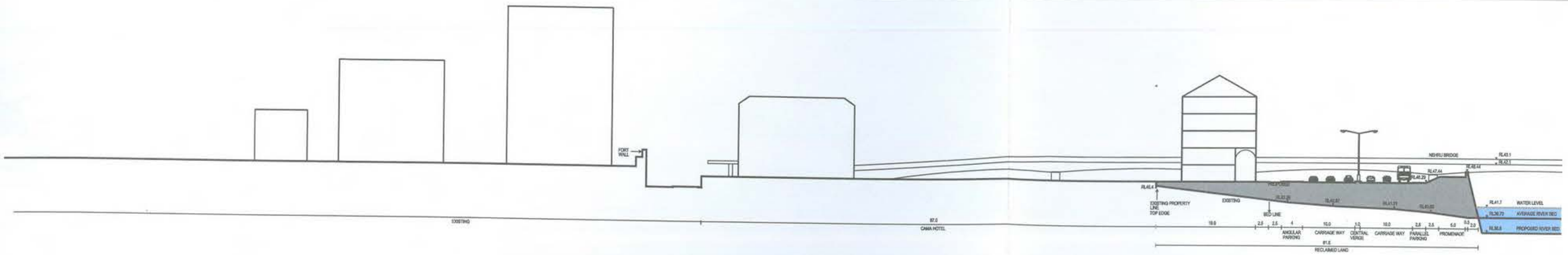
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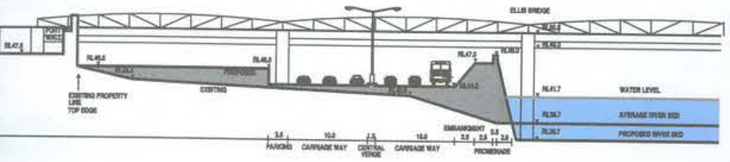
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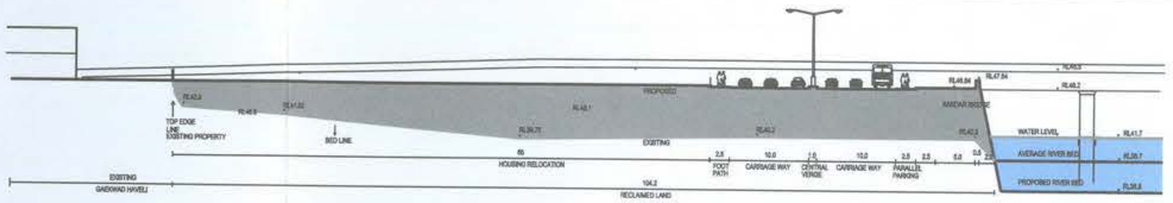
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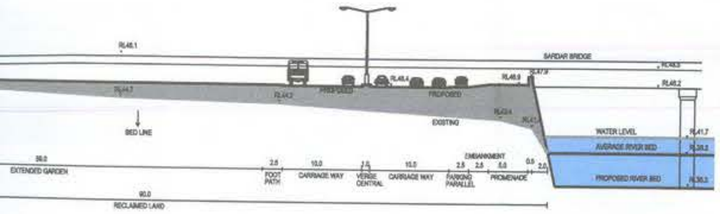
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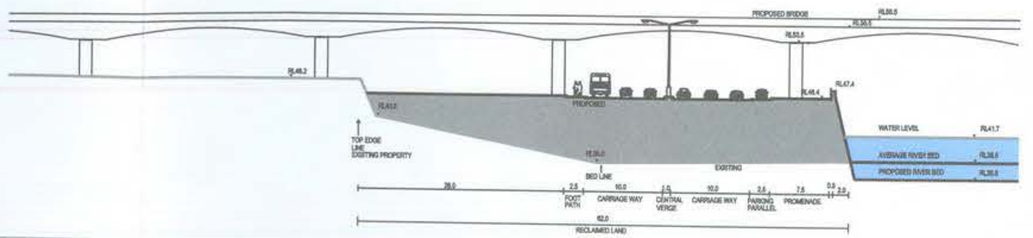




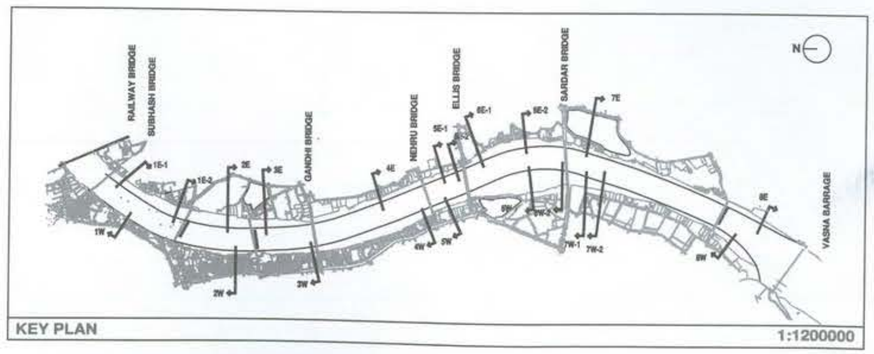


SECTION 6E-2





SECTION 7E



KEY PLAN 1:1200000

SECTIONS - LANDUSE

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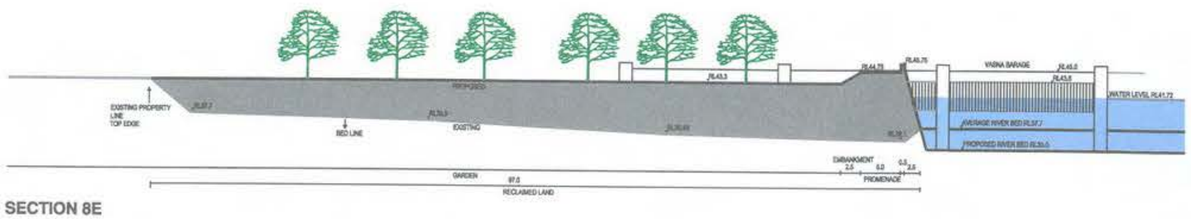
Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

May 1998

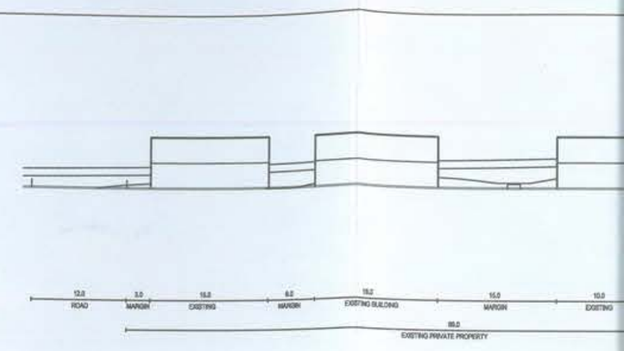
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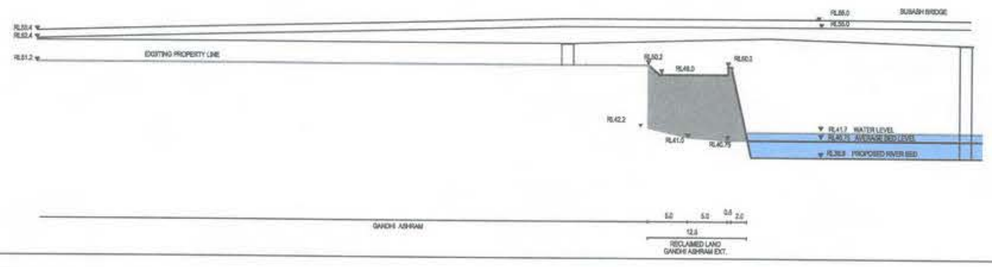
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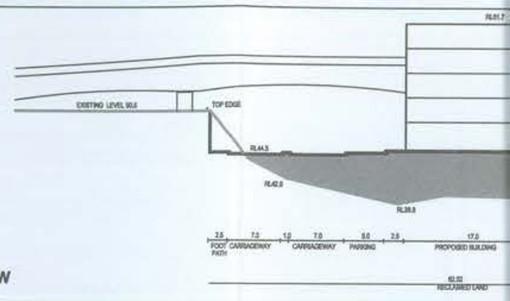
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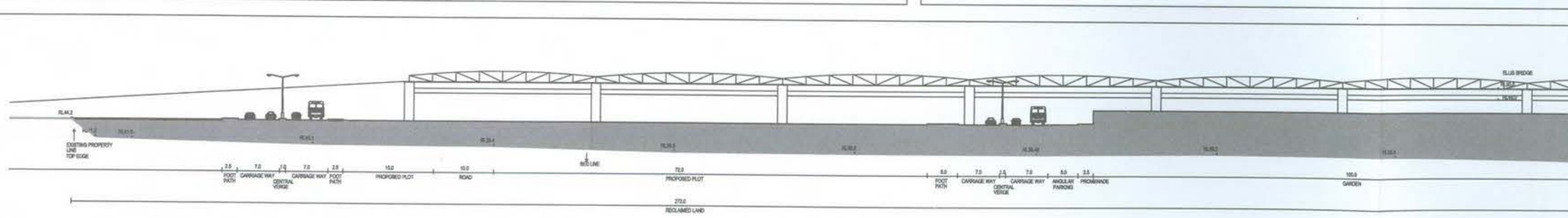
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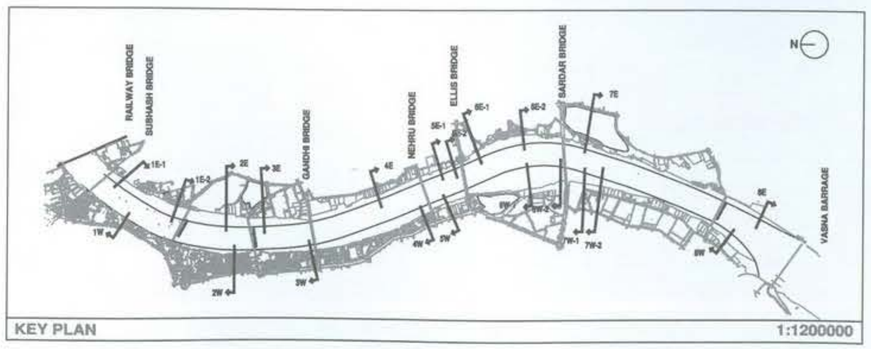
SECTION 1W



SECTION 3 W



SECTION 6W-1



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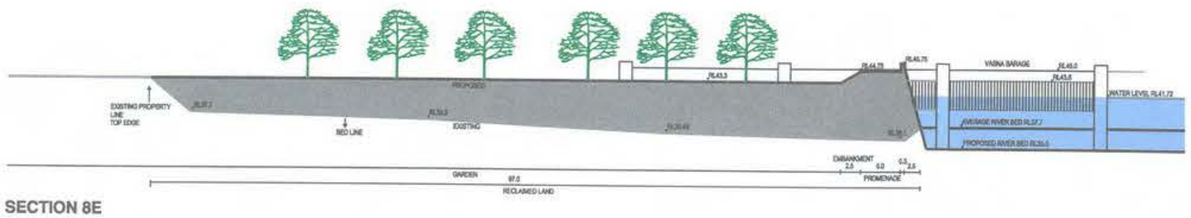
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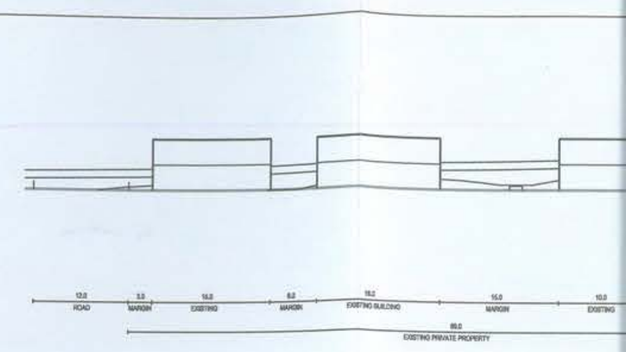
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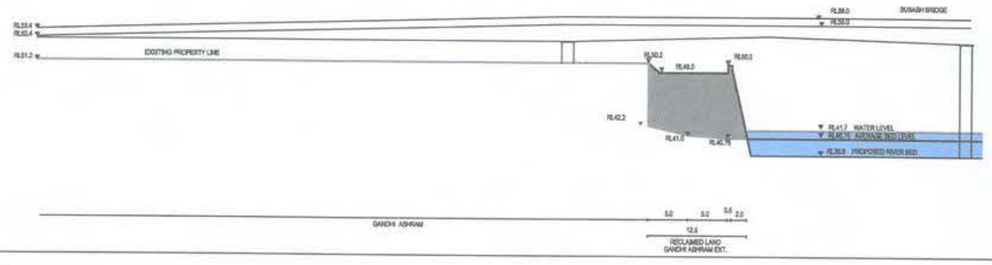
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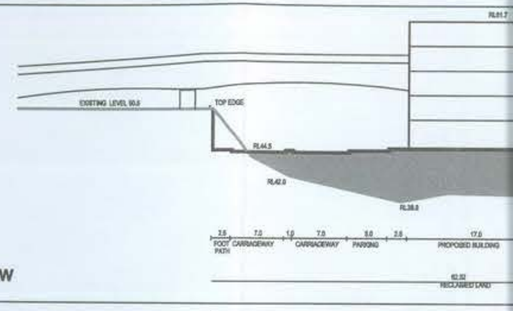
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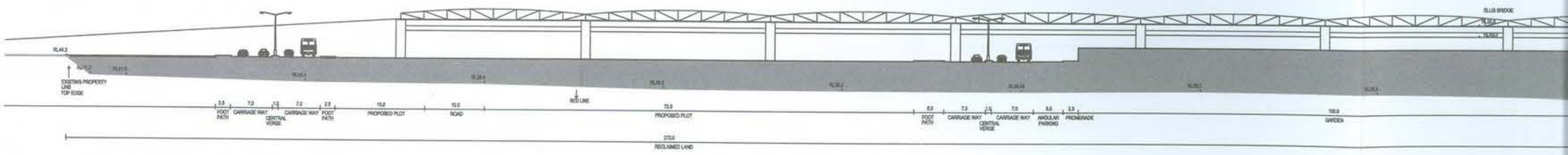
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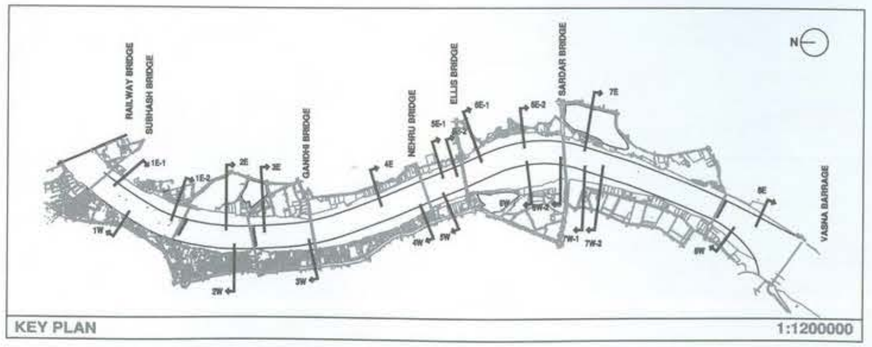
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SECTION 3 W



SECTION 6W-1



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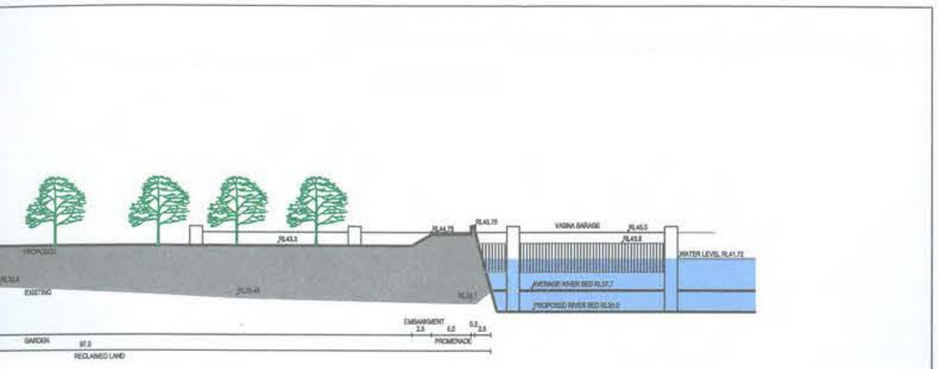
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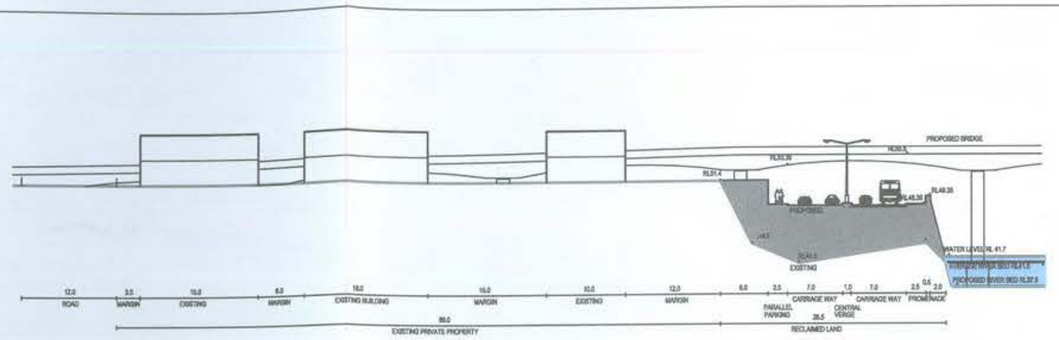
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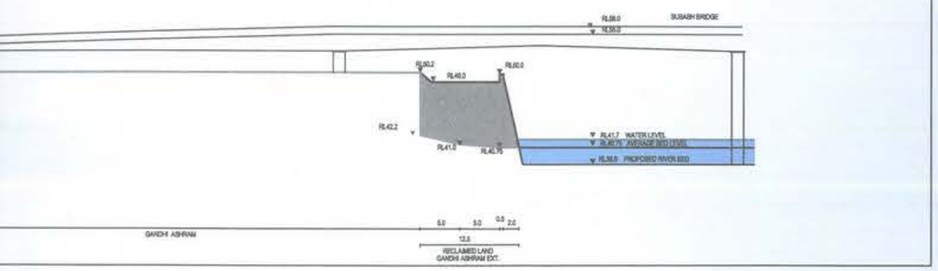
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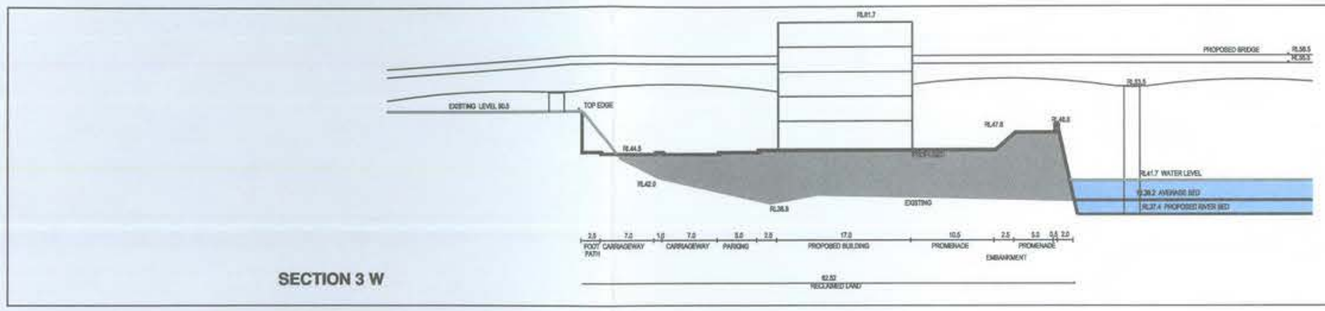
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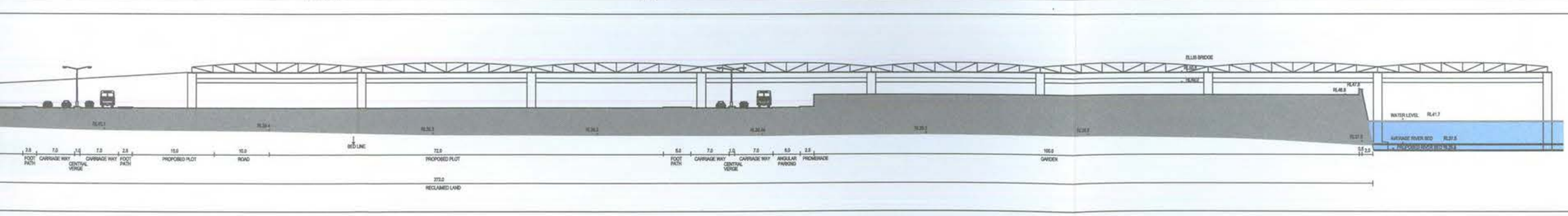


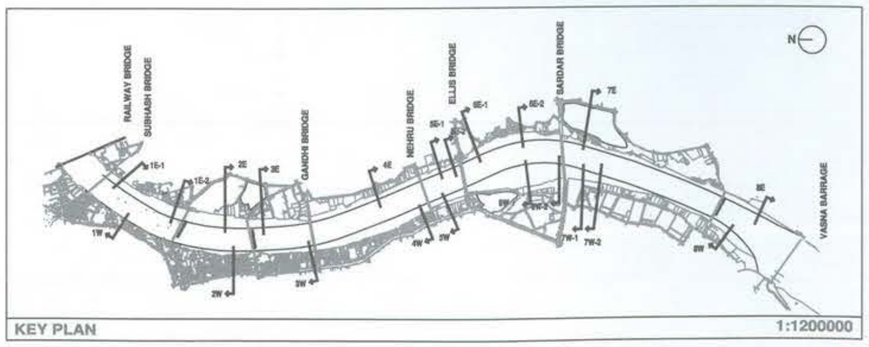
SECTION 2W





SECTION 3 W





KEY PLAN 1:1200000

SECTIONS - LANDUSE

1:750

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

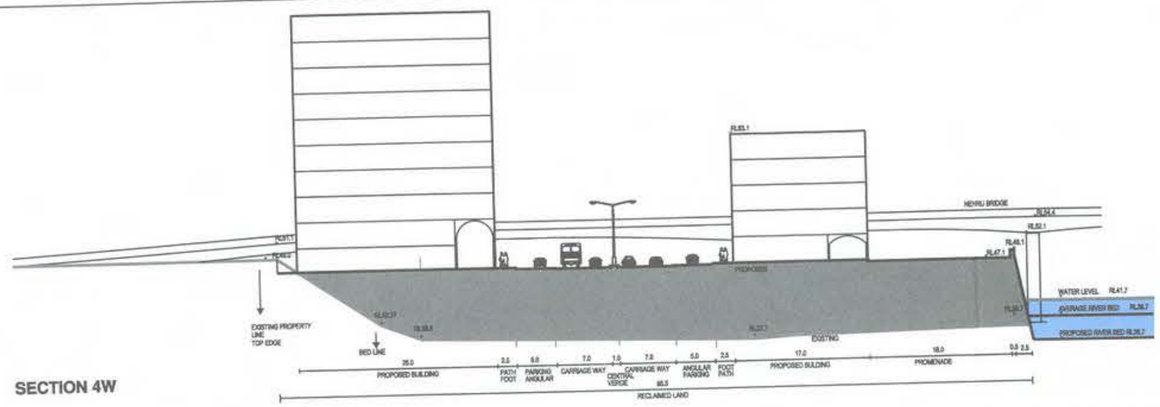
Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

May 1998

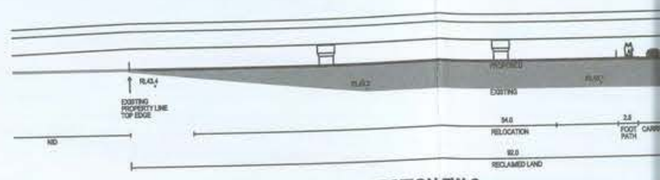
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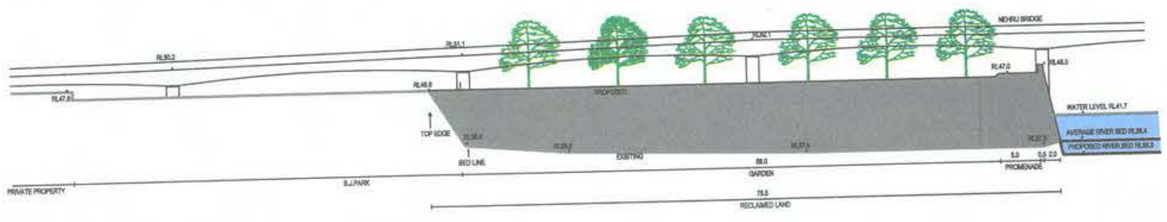
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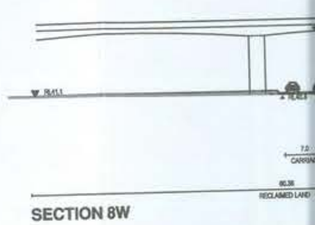
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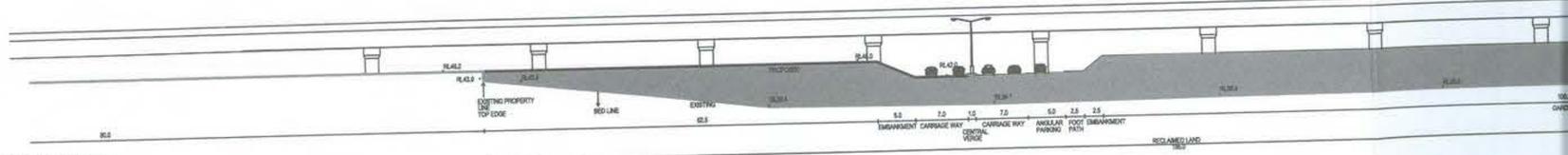
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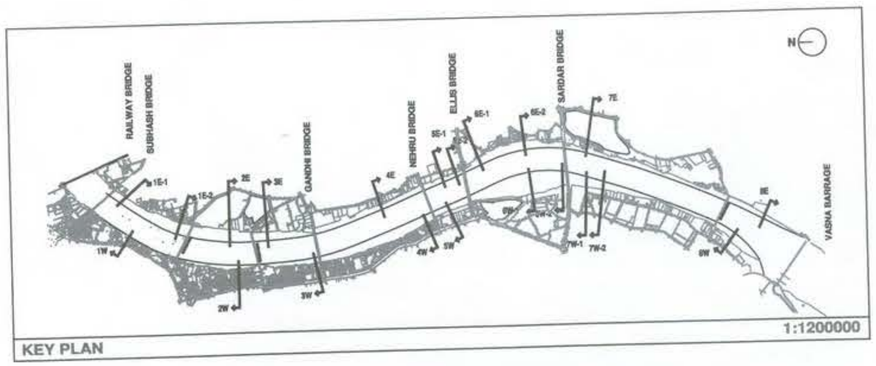
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SECTION 8W



SECTION 6W-2



KEY PLAN 1:1200000

SECTIONS

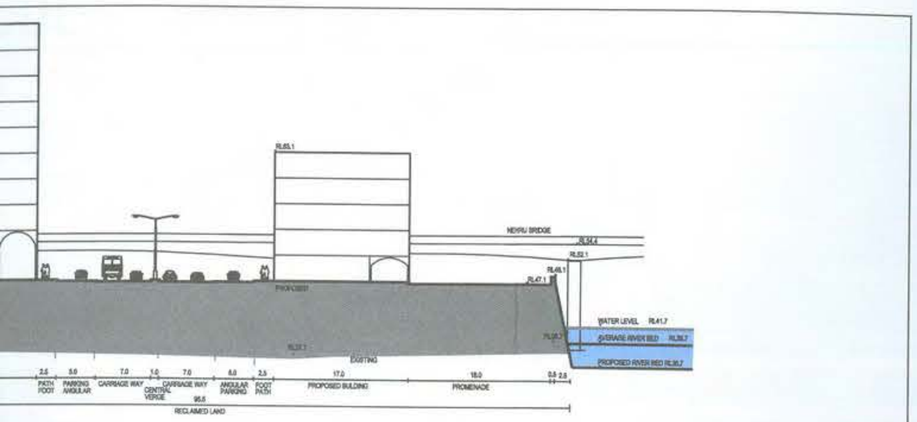
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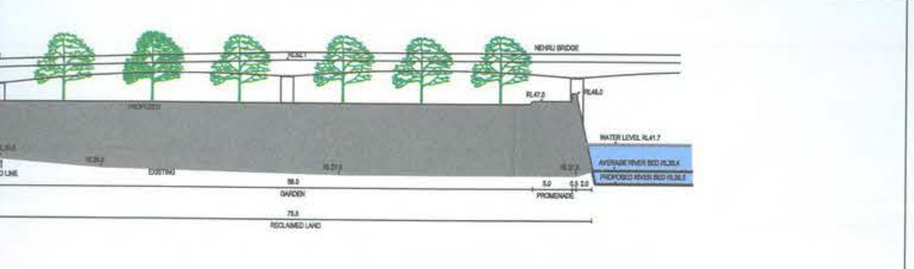
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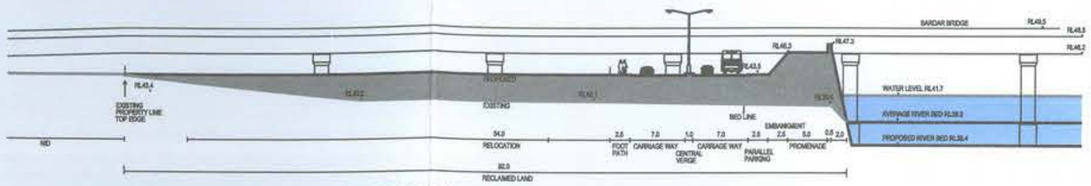
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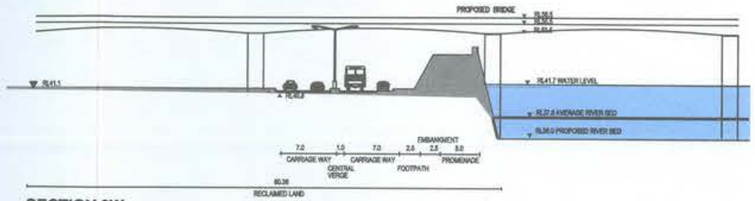
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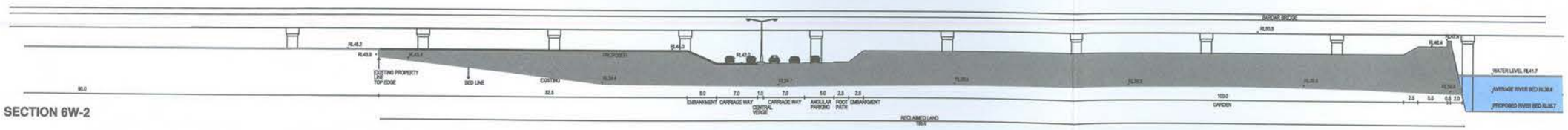




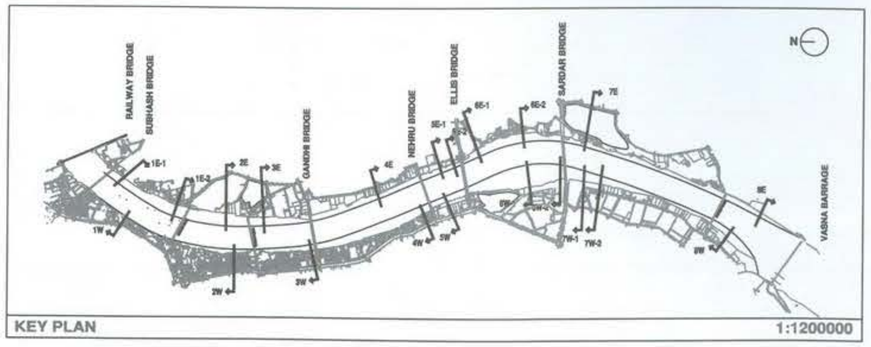
SECTION 7W-2



SECTION 8W



SECTION 6W-2



KEY PLAN 1:1200000

SECTIONS - LANDUSE

1:750

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

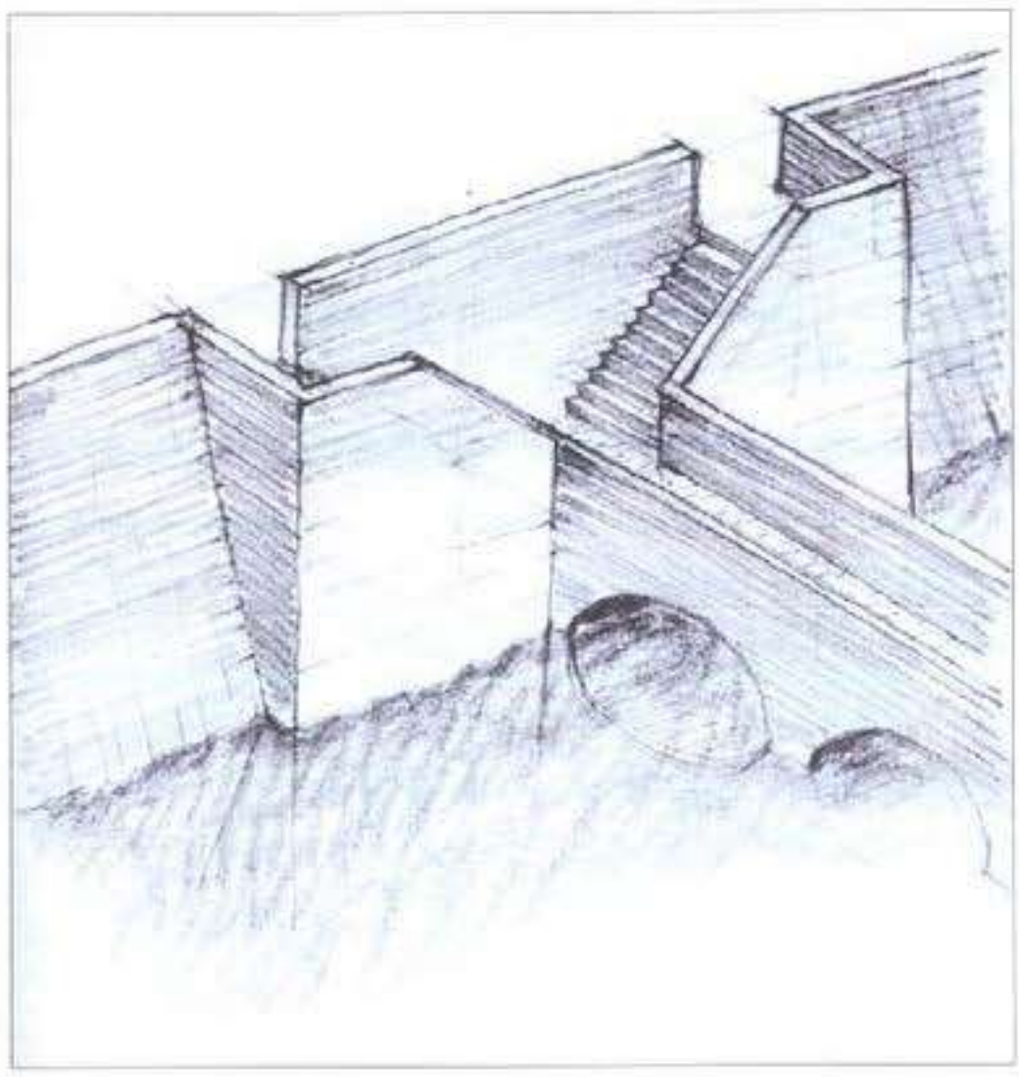
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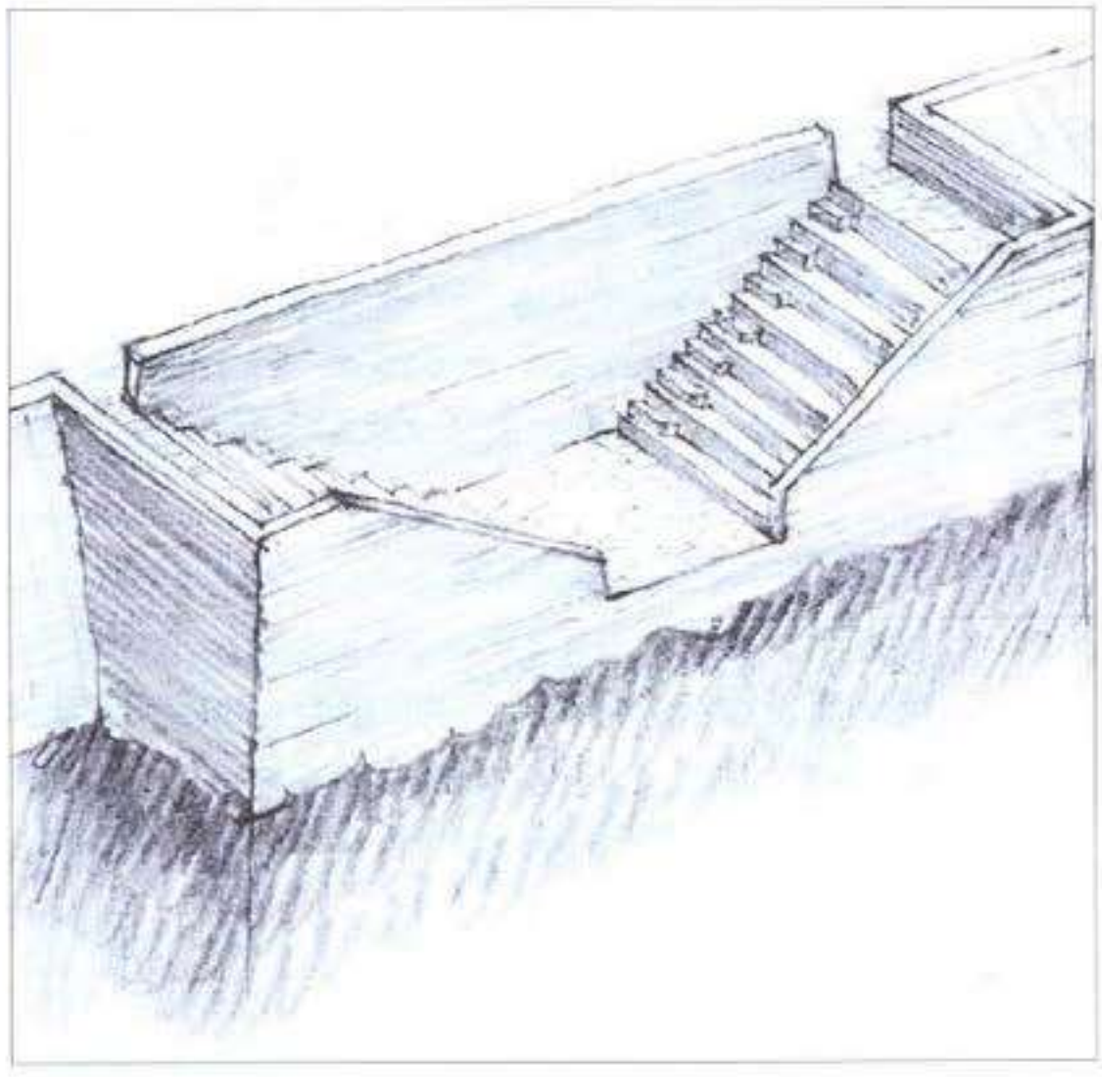
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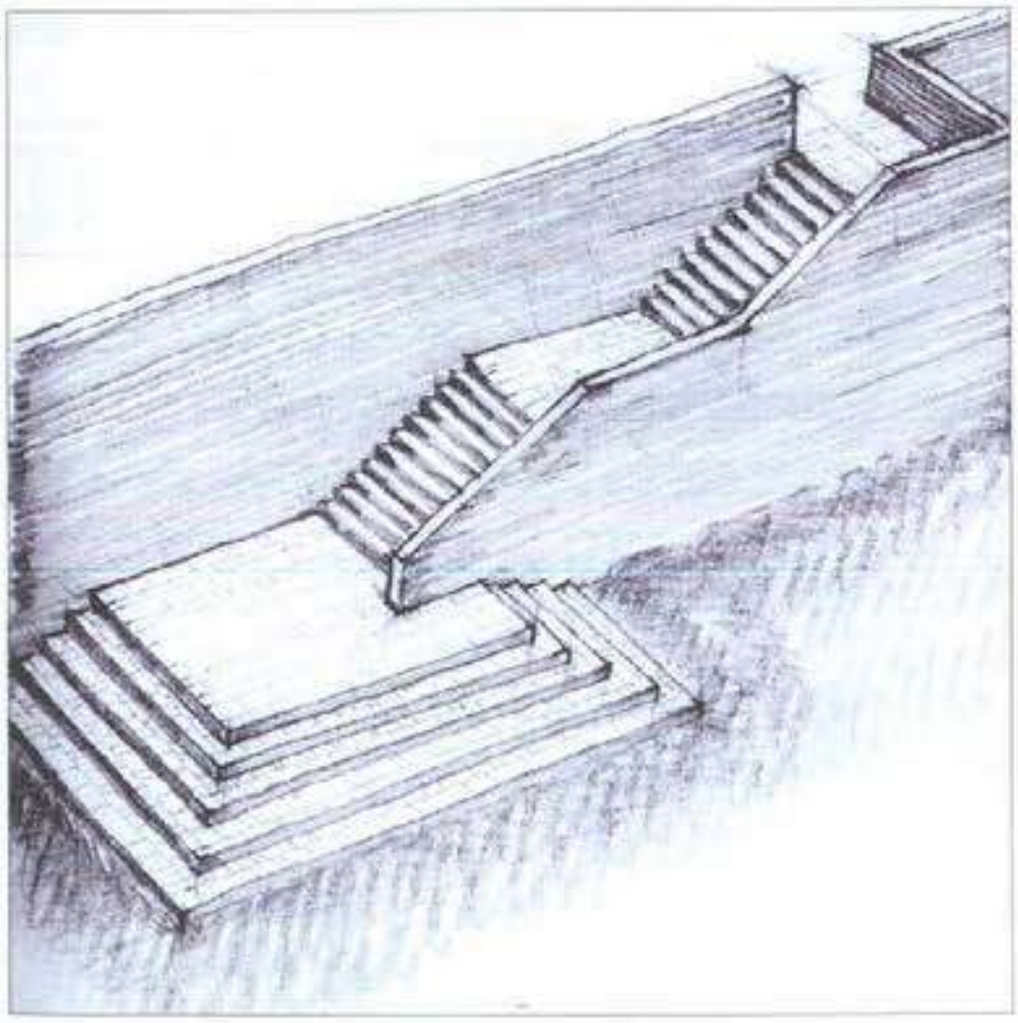
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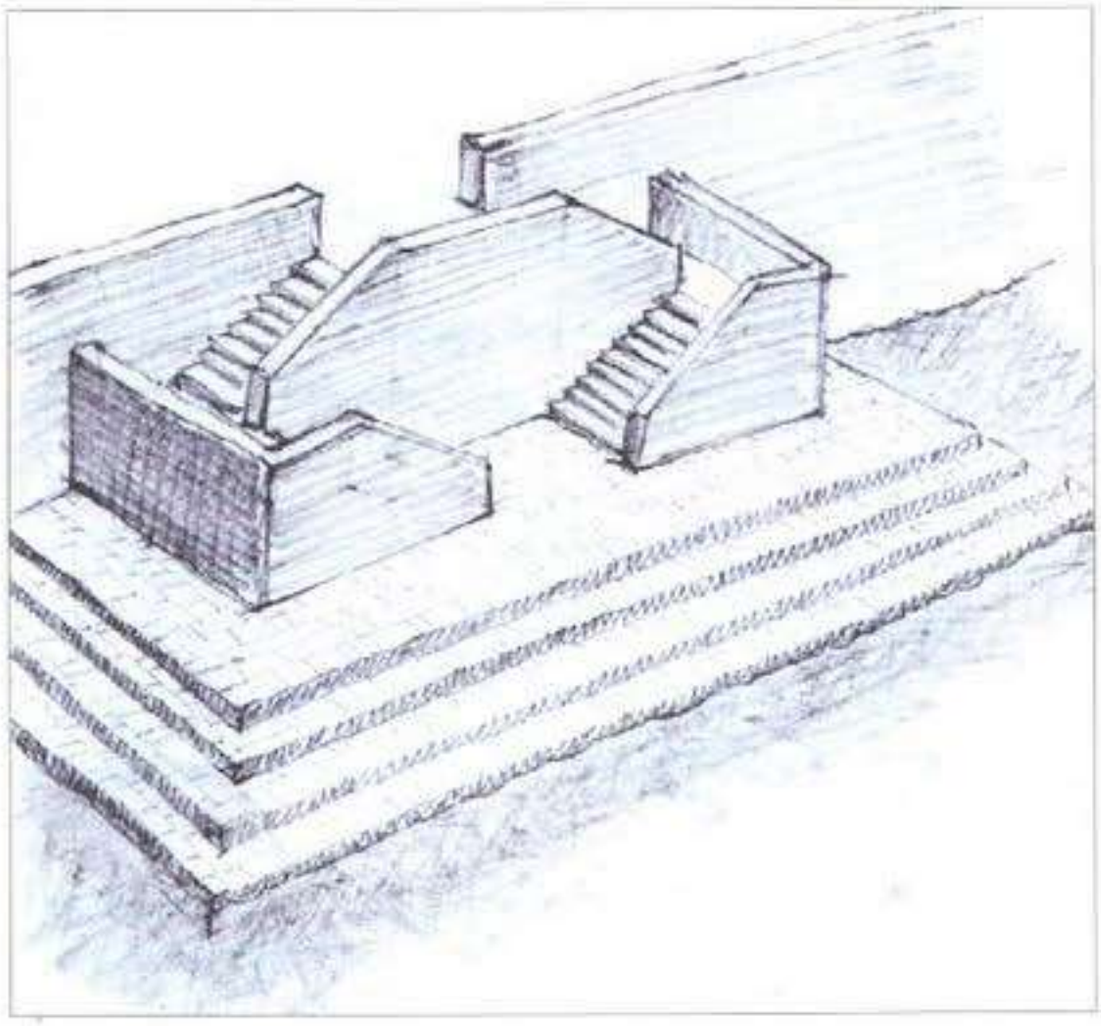
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RETAINING WALL ARTICULATION









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the East River Drive and with a river frontage, it is envisaged that this land will be attractive for high rise residential development. The land may be divided into two plots if required. A higher intensity of development may be permitted on this land. Attendant urban design requirements will also have to be developed.

- ***V S Hospital Residential Development Area:***
  It is proposed that 10.43 ha of reclaimed land from the V S Hospital up to Sardar Bridge along the proposed City Park be sold for residential development. Based on commercial and urban design guidelines the land may be divided into smaller plots for sale. On account of its location in the center of the city and because this land is well serviced by roads and surrounded by parks it is envisaged that it will be particularly attractive for residential development. It may well be marketed by developers as a premier residential enclave in the middle of the city. Here too urban design guidelines envisage lower buildings with gardens along the riverside and high rise buildings behind them.

Public Utilities

It is proposed that 0.94 ha of the reclaimed land between Subhash Bridge and Proposed Bridge 1 be allocated for a bus terminal. It will be accessible from the six lane wide East River Drive and serve to augment the main public transport facility of the city. In addition to this it is proposed that strategically located portions of the unallocated land may be used for other city level public utilities such as the Municipal Corporation's fire service and water supply service.

Extension of Public Facilities

A few small and odd pockets of reclaimed land are left in between proposed roads and the V S Hospital and the National Institute of Design. Since they are otherwise difficult to develop into any substantial facility and since it is unlikely that they can be sold for development, it is proposed that they be amalgamated with the existing plots. The commercial modality for doing this is yet to be worked out. The total area of this land is 0.94 ha.

Unallocated/ Residual

A total of 6.08 ha of the reclaimed land is not allocated as yet. This area is likely to be reduced after reconciliation of property rights. Following more detailed planning some strategically located portions will be used for providing public utilities and informal markets on the west bank and some of the land will be available for sale for residential and commercial development.

Further Work Required

- Detailed design work for widening and improving access roads is required at the earliest to comply with the time limit stated for the River Front Development Zone in the Revised Draft Development Plan and to ensure that easy access is available for commencement of construction.
- Though viable land use and urban design proposals have been schematically developed they have to be detailed and modeled (on computer and using physical models) to envis age the proposed riverfront development in its totality. This will also be necessary to promote the project and gain support for it.
- Resolution of key traffic junctions and roads identified in Drawing No.18
- Formulation of urban design guidelines.

B7 INFRASTRUCTURE SERVICES

This section and Drawing Nos. 24 and 25 describe the proposals for the water supply, sewerage and storm water drainage systems to be provided in the reclaimed areas.

Water Supply

It is proposed to lay 0.5 m diameter HDPE (6 kg/sq cm) water mains on east and west banks and 0.15 m diameter HDPE (6 kg/sq cm) branch lines as shown in Drawing No.25 to serve the requirements of the proposed new developments. It is assumed that it will be possible to augment the capacity of the Dudheshwar Water Works to provide this additional supply. The population load has been estimated according to the proposed land uses and intensity of development and is indicated in the following table along with the water requirements:

East Bank	Persons	lcpd	litres/day
Commercial-Hotel (1E)	1,500	150	2,25,000
Relocation (1E,2E)	19,712	150	29,56,800
Residential (3E)	800	150	1,20,000
Informal Markets (3E)	3,450	50	1,72,500
Commercial (4E)	7,200	50	3,60,000
Informal Markets(6E)	6,981	50	3,49,050
Relocation (6E)	6,336	150	9,50,400
Informal market (6E)	1,459	50	72,950
Commercial (7E,8E)	6,000	50	3,00,000
Sub total	**53,438**		
Visitors to all areas (commercial, informal markets and gardens - for public toilets)@1 /person	53,438	10	5,34,380
Sub total	**1,06,876**		**60,41,080**
Gardens @ 8 litre / sq m / day (area:1,28,400sqm)			10,27,200
Trees along the roads @ 30,000 litre/km (for 9 km)			2,70,000
Total			**73,38,280**
West Bank			
Informal market	2421	50	1,21,050
Commercial (4W)	18,750	50	9,37,500
Residential (6W)	4620	150	6,93,000
Relocation (7W)	9152	150	13,72,800
Commercial (8W)	3000	50	1,50,000
Sub total	**37,943**		**0**
Visitors to all areas (commercial, informal markets and gardens for public toilets)@1 /person	37,943	10	3,79,430
Sub total	**75,886**		**36,53,780**
Gardens @ 8 litre / sq m / day (area: 2,99,600sqm)			23,96,800
Trees along the roads @ 30,000 litre/km (for 7 km)			2,10,000
Total			**60,50,580**

The calculations for obtaining the size of the water mains are shown below;

Symbol	Parameter	East Bank	West Bank
R	Requirement (litres/day)	73,38,280	60,50,580
v	Velocity of water flow (m/s)	5.000	5.000
h	Duration of supply (hrs)	4.000	4.000
Q	Discharge (cumecs) R / h	1.019	0.840
A	Cross sectional area of pipe (sq m) Q/v	0.204	0.168
d	Diameter of water mains (m)	0.509	0.463
	Adopted diameter (m)	**0.500**	**0.500**

(Note: For a more conservative estimate 4 hours of water supply is assumed. However, in the detailed design, if felt necessary the system could be designed for 24 hours of supply. In this case the cost would be lower.)

The cost of providing the water supply network is estimated at Rs. 12.73 crores (see Section C for details). The cost of augmenting capacity of the Dudheshwar Water Works remains to be estimated.

Sewerage

It is proposed to lay trunk sewers parallel to (underneath) the riverside roads on both banks - the East River Drive and the West River Drive. They will terminate at the sewage treatment facilities located near Vasna Barrage. The trunk sewers will serve both, proposed new developments on the reclaimed land and, if it is necessary, existing developments along the riverbank. The sewage load of the proposed new developments is assumed as 80% of the water supply load (excluding the water requirement for gardens and tree plantations - refer table above). Since it was not possible to estimate the quantity of sewage that may have to be diverted from existing areas into the proposed lines the estimated load of the new developments was tripled to leave enough excess capacity.

It is proposed to lay NP3 RCC hume pipe sewers (IS: 458) parallel to the riverside road on both banks. The proposed diameter of the east trunk sewer at the starting section is 300 mm fand in the final section is 750 mm ø. The proposed diameter of the west trunk at the starting section is 300 mm ø and in the final section is 600 mm ø. However for the purpose of estimating the cost, the diameter of the final section has been considered in both trunk sewers. It is proposed that the sewer will be laid on a granular sub base with a slope of 1:300. Manholes will be provided at a distance of 30 m center to center - amounting to 392 manholes on the east bank and 354 manholes on the east bank will be required. Four pumping stations are planned for each trunk sewer. The alignment of the sewer is shown in Drawing No. 24. The total cost for sewerage works is estimated at Rs 5.75 crores (Refer section C for details).

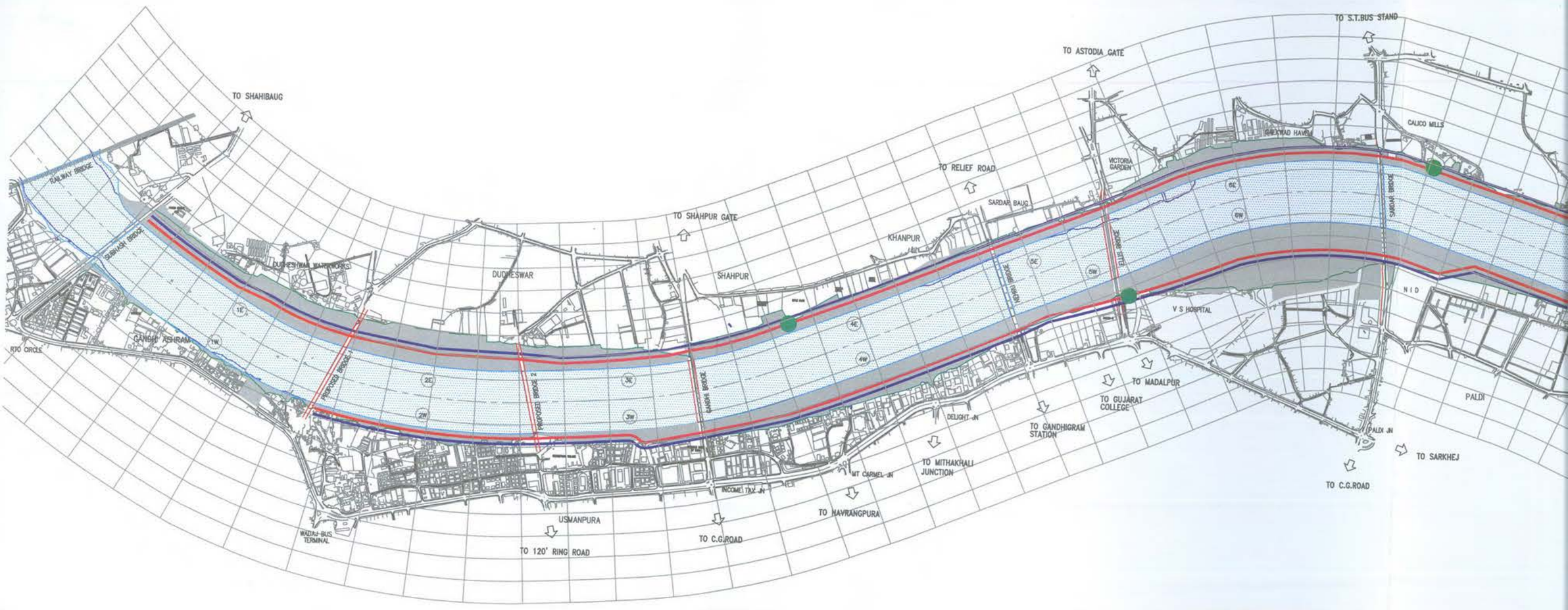
Symbol	Parameter	East Bank	West Bank
L	Load to be discharged (litres/day) 80% of the Water Supply load (excl the qty required for gardens and trees) has been taken, this load has been tripled to take the sewage of the adjoining areas	1,44,98,592 (0.168 cumecs)	87,69,072 (0.100 cumecs)
Q	Peak Factor	2.500	2.500
	Design Discharge 2.5 times L (cumecs)	0.420	0.250
s	Slope	1:300	1:300
d	Diameter (m) by Manning's formula	0.722	0.595
	Adopted diameter (m)	**0.750**	**0.600**

Storm Water Drainage

At present a number of storm water drains flow into the river, upstream from Vasna Barrage. Many of them are also being illegally used to drain sewage directly into the river. With the retention of water in the river and reclamation of land along the river it will be necessary to: 1) ensure that no sewage flows through the storm water drains and, 2) extend the storm water drains through the reclaimed land and embankments.

The Ahmedabad Municipal Corporation has already undertaken works to ensure that illegal connections with storm water drains are detected and disconnected. In addition to this additional trunk drainage lines are also being built to provide an alternative routing for the sewage. These works are being carried out as part of the National River Conservation Plan (See Section A for more details). In view of the above no action will be required on part of the Sabarmati River Front Development Project to ensure that sewage does not enter the river through storm water outfalls in the river.

In view of land reclamation along the river banks it is proposed to extend all existing storm water drains through the reclaimed area and the embankments. All of the existing storm water outfalls were located in the course of the physical survey and various details were obtained. These are indicated in the following table and shown in Drawing Nos. 3, 4 and 24. The length of extension required for each drain has also been worked out and is indicated next page:



LEGEND

	WATER SUPPLY MAINS HDPE pipe (6 kg/sq cm)	
	East Side (500 mm)	8774m
	West Side (500 mm)	7590m
	TRUNK SEWER RCC NP3 hume pipe conforming to IS:458	
	East Side (750 mm)	11758m
	West Side (600 mm)	10604m
	SEWAGE PUMPING STATION	
	East Side	4 Nos
	West Side	4 Nos

NOTE

[1] Branch lines for watersupply area 6" HDPE pipes (6 kg/sq cm) to be laid along connector road. The length is considered to be same as that of connector roads which is 4000m.

[2] Branch sewers are 9" dia stoneware pipes to be laid along connector roads. The length is considered to be same as that of connector roads which is 4000m.

SEWERAGE AND

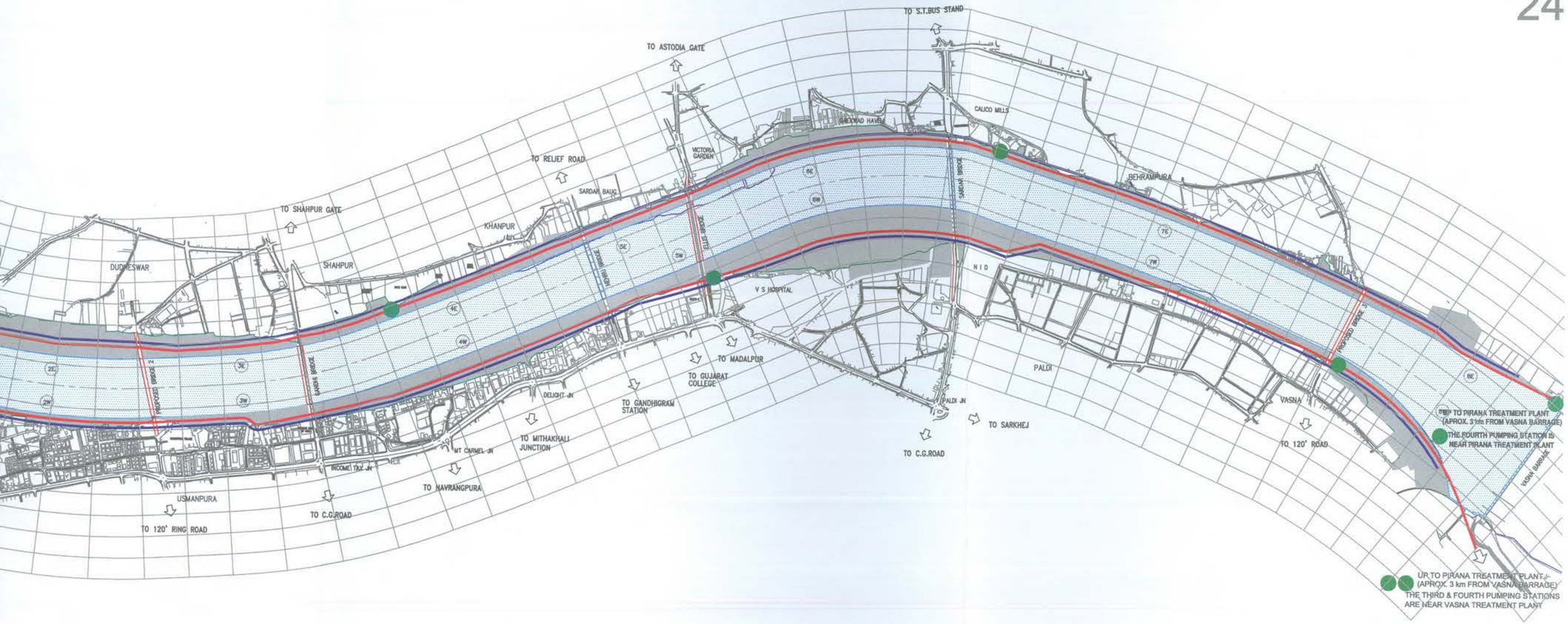
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0 100 300 500 1000 m

LEGEND

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SEWERAGE AND WATER SUPPLY

1:17500

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

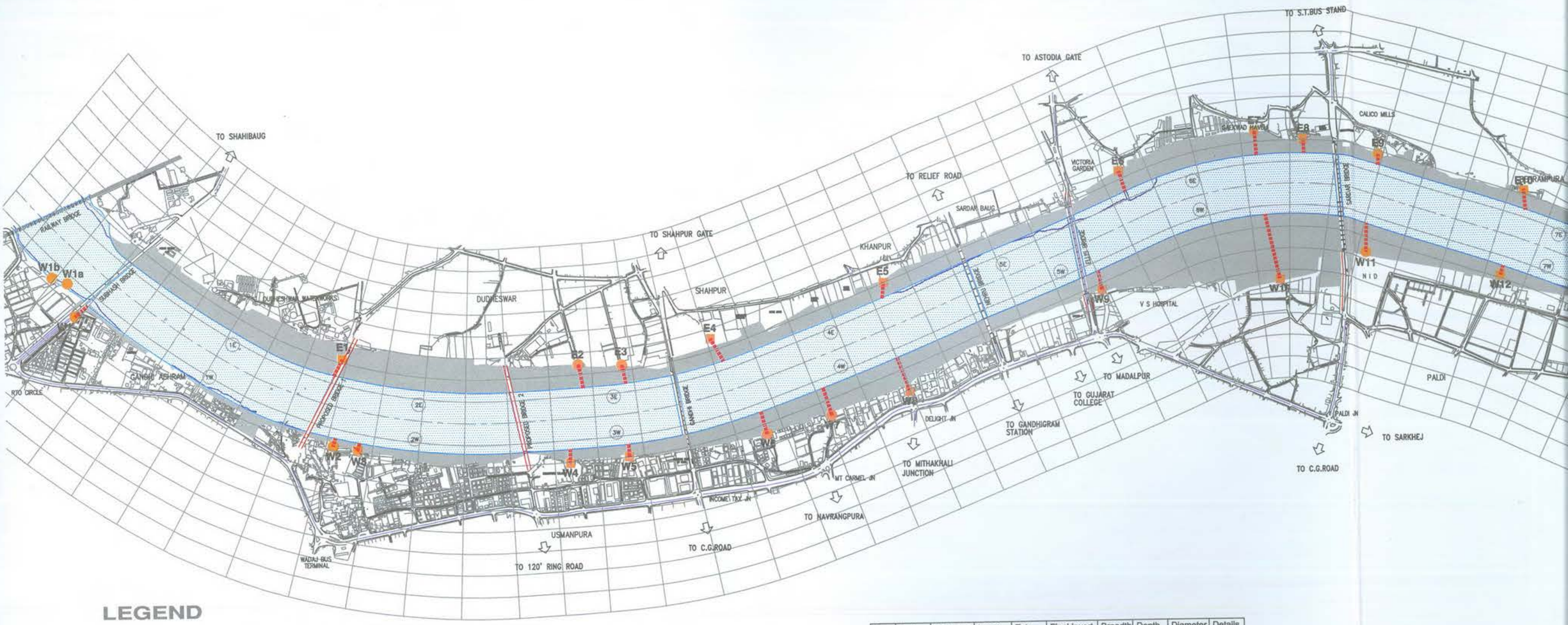
Contents are based on preliminary design based on Sheladia Associates.

May 1998

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LEGEND

■	SLAB CULVERT TYPE OUTFALL
●	PIPE CULVERT TYPE OUTFALL
▪▪▪▪	EXTENTION OF OUTFALL TO PROPOSED RETAINING WALL

Note: [1] Slope for extention for slab culvert is 1 in 1000.
[2] Slope for extention for pipe culvert is 1 in 300.
[3] All dimensions area in m.
[4] Outfalls E12, W1b, W1a fall outside the project area.

Sr. No.	Code	Chainage	Invert RL	Extn. Length	Final Invert RL	Breadth	Depth	Diameter	Details
1	E1	1134.75	43.280	81.65	43.198	1.85	1.13	na	slab
2	E2	2315.83	41.621	108.17	41.260	na	na	1.60	pipe
3	E3	2521.61	42.390	87.32	42.099	na	na	0.65	pipe
4	E4	3015.83	41.439	119.97	41.319	5.00	2.37	na	slab
5	E5	3820.48	40.715	72.13	40.643	3.60	3.10	na	slab*
6	E6	5021.61	42.900	97.01	42.803	3.75	2.00	na	slab#
7	E7	5608.00	42.735	110.09	42.625	1.00	1.00	na	slab
8	E8	5815.83	40.338	62.85	40.275	1.85	2.66	na	slab
9	E9	6146.96	39.783	47.63	39.624	na	na	1.23	pipe
10	E10	6815.83	40.963	94.59	40.868	3.70	2.10	na	slab
11	E11	7923.26	39.525	114.31	39.411	4.15	2.40	na	slab
12	E12	9221.21	39.313	na	na	na	4.45	na	slab
13	W1b	-201.55	42.577	na	na	na	na	1.15	pipe
14	W1a	-243.89	44.188	na	na	na	na	1.04	pipe
15	W1	0.00	48.249	75.96	47.996	na	na	0.80	pipe
16	W2	1202.95	41.340	38.31	41.212	na	na	0.80	pipe
17	W3	1310.23	41.500	33.88	41.466	1.85	3.00	na	slab
18	W4	2248.60	41.297	63.61	41.233	1.85	3.60	na	slab
19	W5	2510.58	41.500	55.59	41.444	1.85	2.00	na	slab
20	W6	3114.55	42.190	103.44	41.845	na	na	1.80	pipe
21	W7	3413.23	42.731	132.72	42.289	na	na	1.80	pipe
22	W8	3780.28	41.676	164.11	41.512	2.30	2.75	na	slab
23	W9	4793.56	39.415	86.06	39.329	1.85	3.50	na	slab
24	W10	5615.83	40.920	302.72	40.617	1.85	2.25	na	slab
25	W11	6101.95	39.416	131.46	38.978	na	na	1.00	pipe
26	W12	6790.49	39.225	42.58	39.182	1.85	2.50	na	slab
27	W13	7968.46	38.933	70.38	38.698	na	na	1.00	pipe

* Three openings of 1.20m with walls of 0.80m
\# Three openings of 1.25m with walls of 1.50m

SW DRAINAGE OU

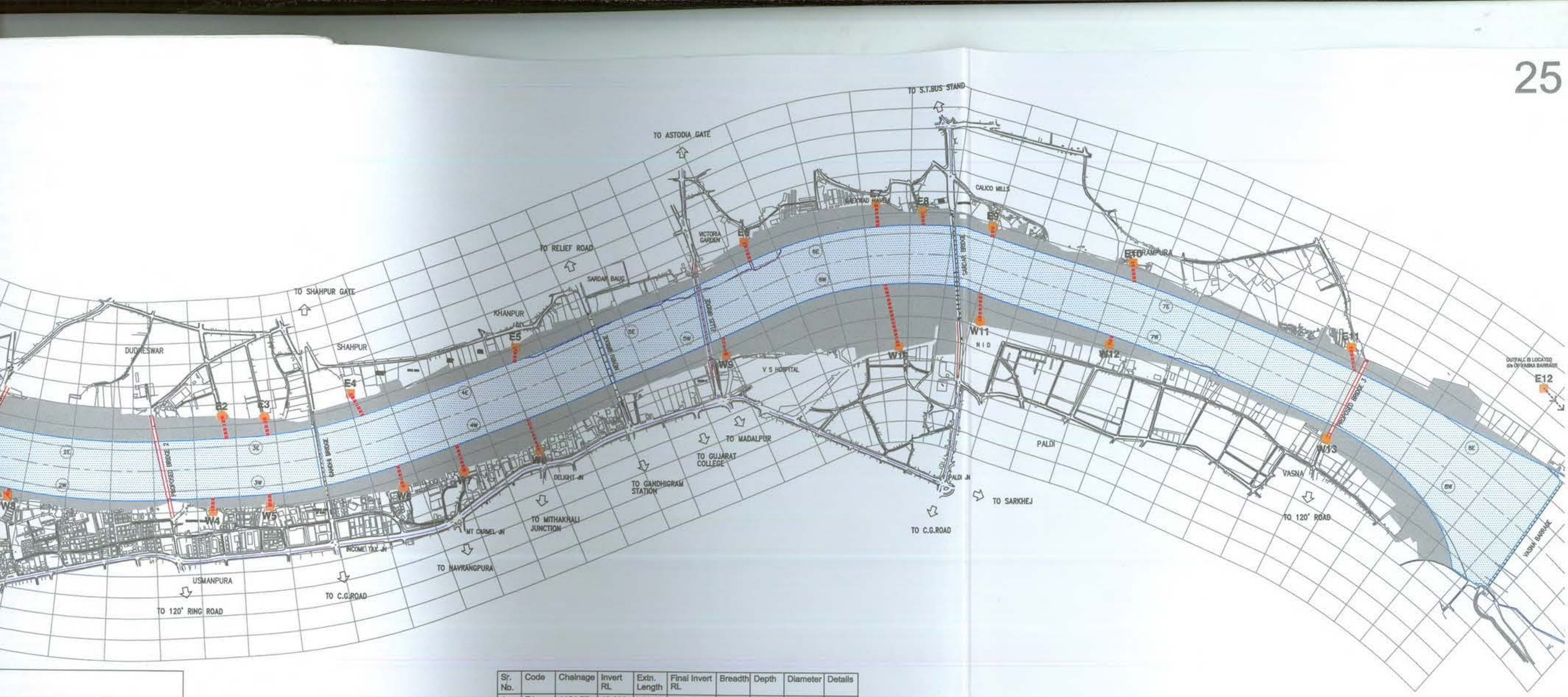
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OPOSED RETAINING WALL

Sr. No.	Code	Chainage	Invert RL	Extn. Length	Final Invert RL	Breadth	Depth	Diameter	Details
1	E1	1134.75	43.280	81.65	43.198	1.85	1.13	na	slab
2	E2	2315.83	41.621	108.17	41.260	na	na	1.60	pipe
3	E3	2521.61	42.390	87.32	42.099	na	na	0.65	pipe
4	E4	3015.83	41.439	119.97	41.319	5.00	2.37	na	slab
5	E5	3820.48	40.715	72.13	40.643	3.60	3.10	na	slab*
6	E6	5021.61	42.900	97.01	42.803	3.75	2.00	na	slab#
7	E7	5608.00	42.735	110.09	42.625	1.00	1.00	na	slab
8	E8	5815.83	40.338	62.85	40.275	1.85	2.66	na	slab
9	E9	6146.96	39.783	47.63	39.624	na	na	1.23	pipe
10	E10	6815.83	40.963	94.59	40.868	3.70	2.10	na	slab
11	E11	7923.26	39.525	114.31	39.411	4.15	2.40	na	slab
12	E12	9221.21	39.313	na	na	na	4.45	na	slab
13	W1b	-201.55	42.577	na	na	na	na	1.15	pipe
14	W1a	-243.89	44.188	na	na	na	na	1.04	pipe
15	W1	0.00	48.249	75.96	47.996	na	na	0.80	pipe
16	W2	1202.95	41.340	38.31	41.212	na	na	0.80	pipe
17	W3	1310.23	41.500	33.88	41.466	1.85	3.00	na	slab
18	W4	2248.60	41.297	63.61	41.233	1.85	3.60	na	slab
19	W5	2510.58	41.500	55.59	41.444	1.85	2.00	na	slab
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21	W7	3413.23	42.731	132.72	42.289	na	na	1.80	pipe
22	W8	3780.28	41.676	164.11	41.512	2.30	2.75	na	slab
23	W9	4793.56	39.415	86.06	39.329	1.85	3.50	na	slab
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27	W13	7968.46	38.933	70.38	38.698	na	na	1.00	pipe

* Three openings of 1.20m with walls of 0.80m
Three openings of 1.25m with walls of 1.50m

0 100 300 500 1000 m

SW DRAINAGE OUTFALLS

1:17500

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

Contents are based on data provided by
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May 1998

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No.	Type	Existing Levels		Dimensions			Extension Distance (m)	Final Invert RL (m)
		Top RL (m)	Invert RL (m)	Breadth (m)	Depth (m)	ø (m)		
E1	Slab	44.414	43.280	1.85	1.13	------	81.65	43.198
E2	Pipe	43.220	41.621	------	------	1.60	108.30	41.260
E3	Pipe	43.039	42.390	------	------	0.65	87.28	42.099
E4	Slab	43.756	41.439	5.00	2.37	------	119.97	41.319
E5	Slab	43.815	40.715	3.60	3.10	------	72.13	40.643
E6	Slab	44.900	42.900	3.75	2.00	------	97.01	42.803
E7	Pipe	43.735	42.735	1.00	1.00	------	110.09	42.625
E8	Slab	42.998	40.338	1.85	2.66	------	62.85	40.275
E9	Pipe	41.008	39.783	------	------	1.23	47.63	39.624
E10	Slab	43.063	40.963	3.70	2.10	------	94.59	40.868
E11	Slab	41.925	39.525	4.15	2.40	------	114.31	39.411
E12	Pipe	43.766	39.313	------	4.45	NA	------	------
W1b	Pipe	43.730	42.577	------	1.15	NA	------	------
W1a	Pipe	45.229	44.188	------	1.04	NA	------	------
W1	Pipe	49.049	48.249	------	------	0.80	75.97	47.996
W2	Pipe	42.140	41.340	------	------	0.80	38.31	41.212
W3	Slab	44.500	41.500	1.85	3.00	------	33.88	41.466
W4	Slab	44.897	41.297	1.85	3.60	------	63.61	41.233
W5	Slab	43.500	41.500	1.85	2.00	------	55.59	41.444
W6	Pipe	43.990	42.190	------	------	1.80	103.44	41.845
W7	Pipe	44.531	42.731	------	------	1.80	132.72	42.289
W8	Slab	44.425	41.676	2.30	2.75	------	164.89	41.512
W9	Slab	42.915	39.415	1.85	3.50	------	86.06	39.329
W10	Slab	43.170	40.920	1.85	2.25	------	302.72	40.617
W11	Pipe	40.416	39.416	------	------	1.00	131.46	38.978
W12	Slab	41.725	39.225	1.85	2.50	------	42.58	39.182
W13	Pipe	39.933	38.933	------	------	1.00	70.38	38.698

In addition to extending the storm water drains, stilling basins will also have to be provided adjacent to the embankments. The total cost of extending the storm water drains is estimated at Rs. 4.18 crores. This inciudes the cost of stilling basins which is estimated at Rs 0.32 crores. (see Section C for details).

Further Work Required

- Detailed design of the storm water drain extension and the stilling basins.
- Detailed design of the trunk sewer.
- Detailed design of the water supply network.
- Estimation of the cost of augmenting the capacity of the Dudheshwar Water Works.

B8 RESETTLEMENT AND REHABILITATION

This section and Drawing Nos. 26 to 28 discuss the: impacts of the SRFD Project on low-income settlements and activities along the river, objectives of the resettlement and rehabilitation component of the SRFD Project, and the strategy proposed to effectively relocate and rehabilitate persons and activities affected by the SRFD Project.

Project Affected Area, Households and Activities

Project Affected Area:

Drawing No. 5 (Section B3) shows the entire area in which it is proposed to reclaim land as part of the SRFD Project. This area lies between the top edges of the riverbanks and extends beyond the top edge in the Paldi area – between the road connecting the Ashram Road and the Sardar Bridge and the riverbank. Drawing No. 12 (Section B5) shows that approximately 15 km of riverbed upstream of the Vasna Barrage will be submerged if water is retained to the top of the Vasna Barrage. In view of the foregoing, the entire area where land reclamation is to take place (the area marked yellow in Drawing No. 5) and approximately 15 km of riverbed upstream of Vasna Barrage may be considered as the Project Affected Area (PAA).

Project Affected Households:

Drawing No. 26 shows all of the slums located along the Sabarmati riverbanks from Subhash Bridge to Vasna Barrage. There are a total of 86 slum settlements – 59 on the east bank and 27 on the west bank. In 1991 the Ahmedabad Study Action Group (ASAG) had carried out a census of slums for the Ahmedabad Municipal Corporation.Using information from this census and a reconnaissance survey (of new settlements) carried out by EPC it is estimated that approximately 10,000 families live in the slums located along the river.

Slum settlements along the river may be categorized into three groups:

1) Those located on the slope of the riverbanks;
2) Those spread out over both, the slope of the riverbank and adjacent land, and
3) Those which are entirely on land adjacent to the riverbank. In Drawing No. 26, the green line along the river indicates the top edge of the riverbanks and the blue line indicates the bottom edge of the banks. The space between the two lines is the slope of the riverbank.

In view of this it is proposed that the following households be considered as Project Affected Households (PAHs):

1. All households in those settlements which lie entirely within the PAA
2. All households in those settlements where more than 75 percent of the households lie within the PAA
3. Only those households which lie in the PAA, in settlements where less than 75 percent of households lie within the PAA

A detailed survey of all PAHs (between Vasna Barrage and Subhash Bridge) was conducted between the 4th week of February and 1st week of March 1998. Drawing No. 27 shows the location of all Project Affected Settlements and the number of households in those settlements. The total number of households physically affected by the works proposed as part of the SRFD Project is 4400. At this stage, no systematic survey of the riverbanks upstream of Subhash Bridge has been carried out. However, a reconnaissance survey was carried out and it suggests that the number of PAHs is not likely to increase since most of the slums are located between Subhash Bridge and the Vasna Barrage.

Project Affected Economic Activities:

Drawing No. 29 shows the location of economic activities that are carried out in the Project Affected Area between Subhash Bridge and the Vasna Barrage. They include:

1) Laundering,
2) (Vending in) informal markets,
3) Sand collection,
4) Cultivation – between December and April and,
5) Dyeing.

At this stage, no systematic survey has been carried out to chart the economic activities that are carried out upstream of the Subhash Bridge. However, a reconnaissance survey has suggested that upstream of Subhash Bridge sand collection and cultivation are the only activities being carried out between the riverbanks.

With the proposed submergence of the riverbed 15 km upstream of the Vasna Barrage it will not be possible to collect sand from the riverbed nor will cultivation be possible there. Laundering, dyeing and the holding of informal markets will also not be possible in the manner that these activities are presently being carried out. All five activities may therefore be considered as Project Affected Economic Activities (PAEAs).

Objectives of the Resettlement and Rehabilitation Component

1) It is proposed that as part of the SRFD Project those persons whose residences or activities are adversely affected by the proposed works should be adequately compensated through resettlement and rehabilitation measures.

2) It is proposed that, to the extent it is possible, the SRFD Project should bring about a positive transformation in the lives of people affected by the project. The project should be seen as an opportunity to improve the lives of people affected by the project and that the disruption caused by resettlement should be kept at a minimum. This criterion should be used to structure the resettlement and rehabilitation measures.

3) It is proposed that an innovative and effective mode of implementing the resettlement and rehabilitation component of the project should be adopted so that the project becomes a model that may guide future redevelopment projects. It is proposed that, to the extent that it is effective, project affected persons should be directly involved in the process of resettlement and rehabilitation.

Resettlement and Rehabilitation Measures

Provision of Serviced Resettlement Sites

Drawing No. 15 shows the three sites where it is proposed to resettle the 4400 Project Affected Households. The three sites are as follows:

Infrastructure Services available for the three sites are as follows:

a) Each of the sites is accessible by either the East River Drive or the West River Drive.
b) Each of the sites will be provided water through the water supply network proposed as part of the SRFD Project (see section B7).
c) Each of the sites will be provided connection with the sewerage network proposed as part of the SRFD Project (see section B7).

No.	Relocation Site	Area (ha)
1	Dudheshwar Relocation Site	8.64
2	Gaikwad Haveli Relocation Site	2.81
3	Paldi Relocation Site	4.03
	Total	**15.48**

d) Electrical connections will be available in same way as they are made available to commercial and residential development sites in SRFD Project.

The locations and areas of the sites have been determined taking into consideration the following aspects:

a) The sites should be as near as possible to the present location of the PAHs. Earlier experiences have shown that relocation of low-income communities at distant locations, by disrupting the close relationship between the place of work and residence, has a very negative impact on their economic and social well being. The proposed location of the resettlement sites will ensure that affected households will not have to move more than two or three kilometers upstream or down stream. The proposed new roads will ensure easy and improved accessibility.

b) Communal ties within low-income settlements are critical to the well being of household.s The sites should be large enough to accommodate entire settlements wherever it is necessary to do so.

c) To calculate the amount of land required for resettlement the size of dwelling units that affected household will build is considered to be 25 sq m. This is the standard adopted by the Housing and Urban Development Corporation (HUDCO) for its various projects and is also used by the Ahmedabad Municipal Corporation. Within this area one multipurpose room with a separate cooking area, a water closet and a bath unit can be built. The units can be organized into blocks that make terraces and open spaces available as additional space. For details regarding the nature of housing envisioned see Section B6. See below for details regarding how PAHs will be assisted with building their dwelling units.

d) The sites should be so located that it is possible to make the resettlement sites ready before actual relocation of PAHs – temporary relocation should be avoided as far as possible.

Relocation in the proposed Resettlement Sites has the potential of positively transforming the lives of affected household for the following reasons:

a) Existing settlements along the riverbank are prone to monsoon flooding. The proposed embankments will protect the resettlement sites, like the entire reclaimed area.

b) Unlike the existing situation where persons living in slums along the riverbank face a constant threat of eviction, the resettlement sites will provide the PAHs with secure tenure.

c) Unlike the present situation where slum settlements have no basic infrastructure services, the resettlement sites will be adequately serviced.

d) Unlike the present situation where slum settlements have inadequate access, the resettlement sites, because they are located along major proposed roads, will be adequately accessible.

The cost of the serviced land will be borne by the SRFD Project and is included in the cost estimate in Section C.

Construction of Housing within the Resettlement Sites

It is envisioned that the entire cost of constructing housing units on the Resettlement Sites will be borne by the Project Affected Households themselves. It is estimated that cost of building each housing unit will be Rs. 60,000 to Rs. 75,000. These units will be organized as terraced, ground plus three floor high, blocks. The SRFD Project will assist in making long term financing available to the affected families and the housing will have to conform to urban design guidelines of the SRFD Project. See below for how it is proposed to do this.

Provision of Infrastructure within Resettlement Sites

As a way of subsidizing part of the cost of constructing housing, it is proposed that the SRFD Project will bear the cost of providing common infrastructure within Resettlement Sites. It is estimated the cost of this will amount to Rs. 20,000 per household.

Provision of Economic Rehabilitation Packages

Informal Markets: So that vendors (in existing informal markets) benefit from the SRFD Project it is proposed to build at least three adequately serviced and upgraded markets on the reclaimed land. See Section B6 for more details. Though cost of developing the markets will be a part of the SRFD Project cost, reasonable user charges will be levied for vending in the informal markets.

Clothes Laundering and Dyeing Activities: It is proposed that upgraded facilities will be built to enable continuation of these activities. Portions of the unallocated reclaimed land will be used for this and the facilities will be built so that these activities do not pollute the river as they do today. Though the cost of developing the markets will be a part of the SRFD Project cost, reasonable user charges will be levied for the use of these facilities.

Sand Collection and Cultivation: Considering the proposed submergence of the riverbed these activities will have to be abandoned. However, it is proposed to develop a technical assistance package to enable sand collectors and cultivators to shift to other suitable economic activities. The package will include skill training and credit. The package may be linked with the Nehru Rojgar Yojna.

Implementation of Resettlement and Rehabilitation Measures

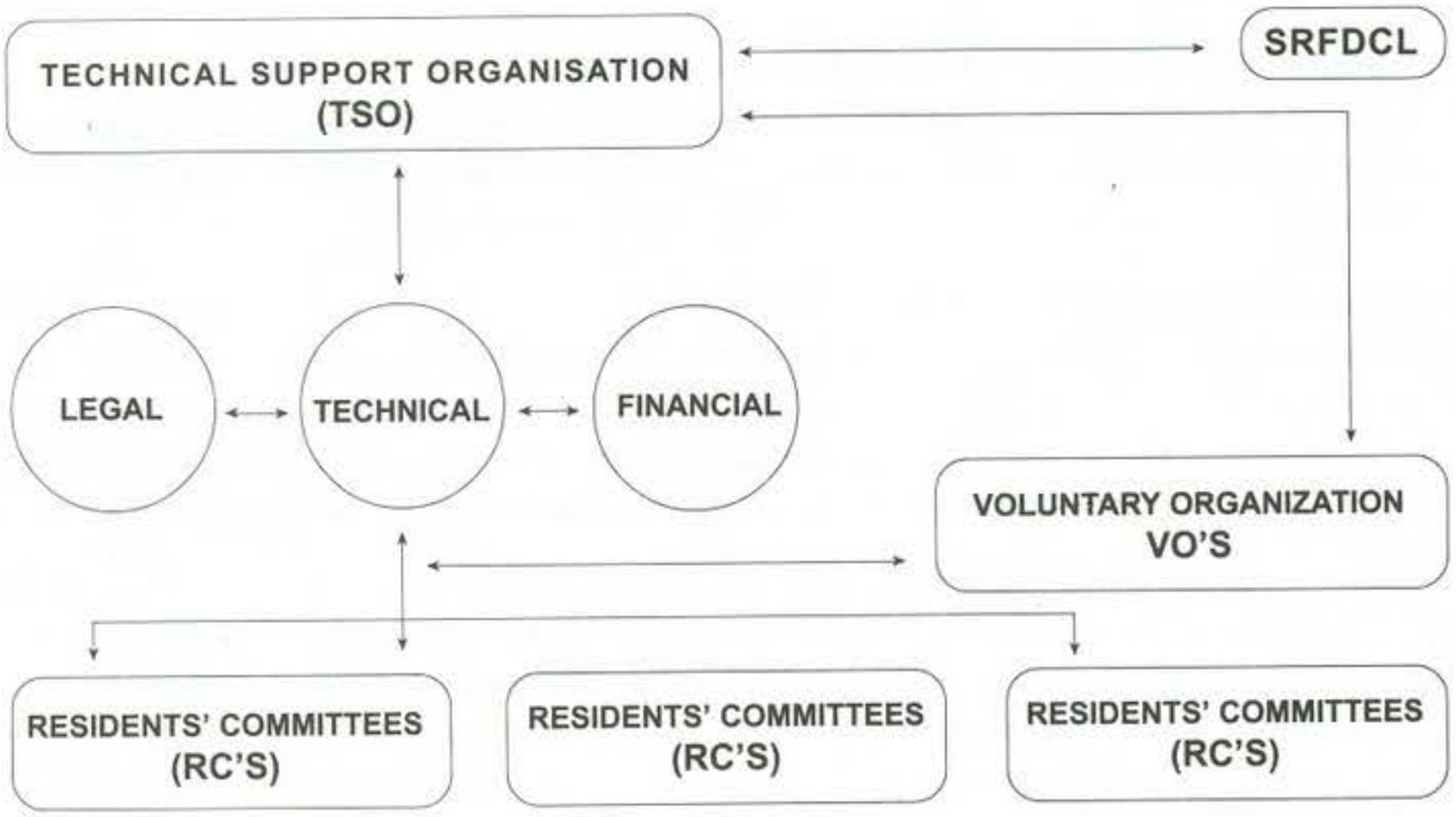
Entitlement of Persons Affected by the Project

Though a detailed survey identifying all Project Affected Households has already been carried out, they will have to be officially entitled in a legally tenable manner. This will have to be done by providing Project Affected Households with certificates entitling them to resettlement or rehabilitation benefits, as the case may be. To ensure that none of the affected households are left out and to ensure that the number of affected households does not increase, the official entitlement process will have to be carried out rapidly (in the shortest duration possible) and well before the SRFD Project is significantly underway. It is proposed that the SRFDCL collaborate with the Ahmedabad Municipal Corporation to do this. It may be possible to contract out a portion of this work to a competent Non Governmental Organization (NGO).

Creation of a Technical Support Organization

To ensure effective implementation of the Resettlement and Rehabilitation Component it is proposed to set up a Technical Support Organization (TSO), independent of the SRFDCL, which will be contracted with the responsibility of managing the entire process of resettlement and rehabilitation. It is envisioned that the TSO, which may be structured as a not-for-profit 'Section 25 Company', will be held by representatives of city based Voluntary Organizations, Community Based Organizations and Professionals. This, it is believed, will ensure a higher degree of transparency and acceptability amongst the affected households.

Professionals with technical, legal and financial skills will staff the TSO. The technical division will interact with affected households and design the housing in a manner that respects the aspiration and specific need of people, and so that it confirms with urban design guidelines of the SRFD Project. The legal division will look after legal aspects of providing ownership to the affected households and the financial division will provide linkage between formal financial institutions and affected households.



Voluntary Organizations interested in working with the TSO may be contracted the task of organizing Residents' Committees. The TSO may also take up this task by itself. The Residents' Committees will be charged with organizing operations at the settlement level and interacting with the TSO. They may be transformed into Cooperative Housing Societies, which will eventually manage the resettlement housing (see diagram below).

The cost of setting up the TSO will be a part of the cost of the SRFD Project. The work to be carried out by the TSO will be paid for by the SRFD Project

Further Work Required

- Systematic survey of impacts of the project in areas upstream of the Subhash bridge and assessment of the number of Project Affected Households.
- Detailed assessment of Project Affected Economic Activities and design of measures that will have to be taken to rehabilitate affected activities and persons
- Official entitlement of Project Affected Households
- Detailed design of the implementation strategy and estimation of implementation costs.



LEGEND

	SLUMS ESTABLISHED AFTER 1991
	SLUMS ESTABLISHED BEFORE 1991

SLUM LOCATIONS ON THE RIVER BANK

No.	Segment	No of Slums	No of HHs*
1E	Between Subhash Bridge & Prop Bridge 1	9	840
2E	Between Prop Bridge 1 & Prop Bridge 2	4	285
3E	Between Prop Bridge 2 & Gandhi Bridge	3	259
4E	Between Gandhi Bridge & Nehru Bridge	16	2195
5E	Between Nehru Bridge and Ellis Bridge	4	420
6E	Between Ellis Bridge & Sardar Bridge	8	792
7E	Between Sardar Bridge & Prop Bridge 3	15	2456
8E	Between Prop Bridge 3 & Vasna Barrage	0	0
	Subtotal	59	7247
1W	Between Subhash Bridge & Prop Bridge 1	4	245
2W	Between Prop Bridge 1 & Prop Bridge 2	10	1485
3W	Between Prop Bridge 2 & Gandhi Bridge	6	150
4W	Between Gandhi Bridge & Nehru Bridge	0	0
5W	Between Nehru Bridge and Ellis Bridge	0	0
6W	Between Ellis Bridge & Sardar Bridge	2	436
7W	Between Sardar Bridge & Prop Bridge 3	3	154
8W	Between Prop Bridge 3 & Vasna Barrage	2	73
	Subtotal	27	2523
	Total	86	9770 10000 (approx)

* This includes the slums established before 1991 and after 1991.

SLUMS ON

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SLUM LOCATIONS ON THE RIVER BANK

No.	Segment	No of Slums	No of HHs*
1E	Between Subhash Bridge & Prop Bridge 1	9	840
2E	Between Prop Bridge 1 & Prop Bridge 2	4	285
3E	Between Prop Bridge 2 & Gandhi Bridge	3	259
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5E	Between Nehru Bridge and Ellis Bridge	4	420
6E	Between Ellis Bridge & Sardar Bridge	8	792
7E	Between Sardar Bridge & Prop Bridge 3	15	2456
8E	Between Prop Bridge 3 & Vasna Barrage	0	0
	Subtotal	59	7247
1W	Between Subhash Bridge & Prop Bridge 1	4	245
2W	Between Prop Bridge 1 & Prop Bridge 2	10	1465
3W	Between Prop Bridge 2 & Gandhi Bridge	6	150
4W	Between Gandhi Bridge & Nehru Bridge	0	0
5W	Between Nehru Bridge and Ellis Bridge	0	0
6W	Between Ellis Bridge & Sardar Bridge	2	436
7W	Between Sardar Bridge & Prop Bridge 3	3	154
8W	Between Prop Bridge 3 & Vasna Barrage	2	73
	Subtotal	27	2523
	Total	86	9770 10000 (approx)

* This includes the slums established before 1991 and after 1991.

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SLUMS ON THE RIVER BANKS

1:17500

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

This map has been prepared on the basis of reconnaissance survey by EPC and Slums Census 1991 by ASAG for AMC.

May 1998

EPC ENVIRONMENTAL PLANNING COLLABORATIVE
701 Paritosh, Usmanpura, Ahmedabad-380 013, India Ph : (91) (079) 75501 Fax : (91) (079) 7550649

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LEGEND

	PROJECT AFFECTED SLUMS

PROJECT AFFECTED SLUMS

No.	Segment	No of Slums	No of HHs*
1E	Between Subhash Bridge & Prop Bridge 1	9	332
2E	Between Prop Bridge 1 & Prop Bridge 2	4	270
3E	Between Prop Bridge 2 & Gandhi Bridge	3	61
4E	Between Gandhi Bridge & Nehru Bridge	16	1661
5E	Between Nehru Bridge and Ellis Bridge	4	341
6E	Between Ellis Bridge & Sardar Bridge	8	976
7E	Between Sardar Bridge & Prop Bridge 3	15	28
8E	Between Prop Bridge 3 & Vasna Barrage	0	0
	Subtotal	59	3669
1W	Between Subhash Bridge & Prop Bridge 1	1	42
2W	Between Prop Bridge 1 & Prop Bridge 2	3	85
3W	Between Prop Bridge 2 & Gandhi Bridge	0	0
4W	Between Gandhi Bridge & Nehru Bridge	0	0
5W	Between Nehru Bridge and Ellis Bridge	0	0
6W	Between Ellis Bridge & Sardar Bridge	2	441
7W	Between Sardar Bridge & Prop Bridge 3	0	151
8W	Between Prop Bridge 3 & Vasna Barrage	0	0
	Missing		7
	Subtotal	6	726
	Total	65	4395 4400 (approx.)

* - HouseHolds

PROJECT AFFECT

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SLUMS

PROJECT AFFECTED SLUMS

No.	Segment	No of Slums	No of HHs*
1E	Between Subhash Bridge & Prop Bridge 1	9	332
2E	Between Prop Bridge 1 & Prop Bridge 2	4	270
3E	Between Prop Bridge 2 & Gandhi Bridge	3	61
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5E	Between Nehru Bridge and Ellis Bridge	4	341
6E	Between Ellis Bridge & Sardar Bridge	8	976
7E	Between Sardar Bridge & Prop Bridge 3	15	28
8E	Between Prop Bridge 3 & Vasna Barrage	0	0
	Subtotal	59	3669
1W	Between Subhash Bridge & Prop Bridge 1	1	42
2W	Between Prop Bridge 1 & Prop Bridge 2	3	85
3W	Between Prop Bridge 2 & Gandhi Bridge	0	0
4W	Between Gandhi Bridge & Nehru Bridge	0	0
5W	Between Nehru Bridge and Ellis Bridge	0	0
6W	Between Ellis Bridge & Sardar Bridge	2	441
7W	Between Sardar Bridge & Prop Bridge 3	0	151
8W	Between Prop Bridge 3 & Vasna Barrage	0	0
	Missing		7
	Subtotal	6	726
	Total	65	4395 4400 (approx.)

* - HouseHolds

0 100 300 500 1000 m

PROJECT AFFECTED SLUMS

1:17500

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

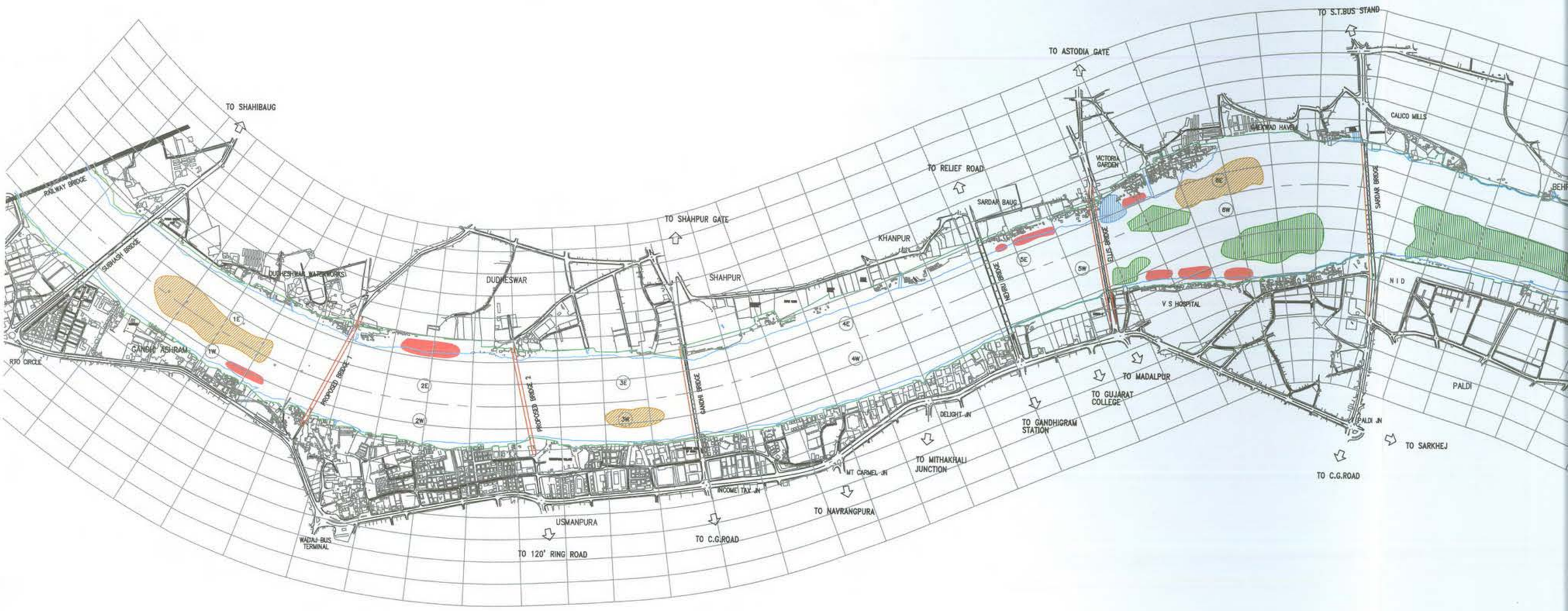
This map has been prepared on the basis of a survey conducted between 4th week of february and 1st week of march 1998, by Vikas Centre For Development.

May 1998

EPC ENVIRONMENTAL PLANNING COLLABORATIVE
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LEGEND

	WASHING AND DYEING
	INFORMAL MARKETS
	SAND COLLECTION
	CULTIVATION (DECEMBER - APRIL)

ECONOMIC ACTI

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LEGEND

	WASHING AND DYEING
	INFORMAL MARKETS
	SAND COLLECTION
	CULTIVATION (DECEMBER - APRIL)

ECONOMIC ACTIVITIES ON THE RIVER BED 1:17500

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

This map has been prepared on the basis of reconnaissance survey by EPC. **May 1998**

EPC ENVIRONMENTAL PLANNING COLLABORATIVE
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C- IMPLEMENTATION STRATEGY

C1. Project Costs and Revenue Potential

C2. Financing, Structure of the SRFDCL and Development Management

C1 PROJECT COSTS AND REVENUE POTENTIAL

This section and Drawing No. 29 present preliminary cost estimates and a preliminary estimate of the revenue potential.

Project Costs

At this stage of work the various SRFD Proposals have only been schematically defined. To arrive at the preliminary base cost estimate for the project, at various places, it has been necessary to use approximate quantity estimates. It has also been necessary to make assumptions regarding the eventual design of various components. Unit rates used to derive costs are based on these assumptions and prevailing market conditions. On account of this the project cost may vary when detailed design is undertaken. Effort has been made to include all foreseeable costs. Wherever it is not possible to estimate costs at this stage, it has been clearly indicated. Calculations for quantity estimation, design assumptions, and the sources used for determining unit costs have been adequately documented and are available with EPC. A value engineering exercise will be carried out in the next phase of work.

Preliminary cost estimates for the different components of the project are presented below. Drawing No. 29 shows the location of item numbers 7, 8 and 10 to 14.

No.	Item	Quantity	Unit	Unit Rate (Rs)	Amount (Rs Crores)	Item Total (Rs Crores)
1	Earthfilling	11,372,008	cu m	40	45.49	45.49
2	Retaining Wall (r/f earth +cc panels)	135,000	sq m	2,123	28.66	28.66
3	Parapet wall	18,000	m	8,928	16.07	16.07
4	Diaphragm wall	18,000	m	45,908	82.63	82.63
5	Bridge anchoring	188	girder	1,10,000	2.07	2.07
6	Bridge foundation garland blocks	1,090	cu m	3,000	6.33	6.33
7	Water Supply					
7.1	Mains (east)	8,774	m	7,544	6.62	
7.2	Mains (west)	7,590	m	7,544	5.73	
7.3	Branch lines (east + west)	4,000	m	954	0.38	12.73
8	Sewerage					
8.1	Trunk sewer (east)	11,758	m	1,600	1.88	
8.2	Trunk sewer (west)	10,604	m	1,300	1.38	
8.3	Branch lines (east + west)	4,000	m	500	0.20	
8.4	Man holes @ 30m c/c	746	No.	20,000	1.49	
8.5	Pumping stations	8	No.	1000,000	0.80	5.75
9	S.W. drain extensions					
9.1	Slab culvert (east)				2.02	
9.2	Slab culvert (west)				1.62	
9.3	Pipe culvert (east)				0.06	
9.4	Pipe culvert (west)				0.17	
9.5	Stilling basin	24	No.	1,31,760	0.32	4.18
10	Roads					
10.1	L1: Carriageway (east) (8400x21m)	176,400	sq m	725	12.79	
10.2	L1: Footpath (east) (8400x15m)	126,000	sq m	700	8.82	
10.3	L2: Carriageway (west) (6800x14m)	95,200	sq m	725	6.90	
10.4	L2: Footpath (west) (6800x16m)	108,800	sq m	700	7.62	
10.5	L3: Carriageway (3680x10m)	36,800	sq m	725	2.67	
10.6	L3: Footpath (3680x5m)	18,400	sq m	700	1.29	
10.7	L3: Cul-de-sac	3,500	sq m	725	0.25	40.34

No.	Item	Quantity	Unit	Unit Rate (Rs)	Amount (Rs Crores)	Item Total (Rs Crores)
11	Road upgrading					
11.1	Carriageway (east) (4156X10m)	41,560	sq m	725	3.01	
11.2	Footpath (east) (4156X5m)	20,780	sq m	700	1.45	
11.3	Carriageway (west) (4852x10m)	48,520	sq m	725	3.52	
11.4	Footpath (west) (4852X5m)	24,260	sq m	700	1.70	
11.5	Junctions	45	No.	2,00,000	0.90	**10.58**
12	Promenades	98,000	sq m	700	6.86	**6.86**
13	Garden development					
13.1	Dudheshwar Garden	55,200	sq m	600	3.31	
13.2	Heritage Park	13,300	sq m	600	0.80	
13.3	Victoria Garden Extension	12,600	sq m	600	0.76	
13.4	Pirana Forest	47,300	sq m	600	2.84	
13.5	Gandhi Ashram Park	25,700	sq m	600	1.54	
13.6	B J Park Extension	29,100	sq m	600	1.75	
13.7	City Park	1,57,900	sq m	600	9.47	
13.8	V S Hospital Park	15,100	sq m	600	0.91	
13.9	Vasna Forest	71,800	sq m	600	4.31	**25.68**
14	Relocation and Rehabilitation	4,400	H-Hold	20,000	8.80	**8.80**
15	Informal market development					
15.1	Built-up area (45% of total area)	26,395	sq m	2,000	5.28	
15.2	Paved area (55% of total area)	32,259	sq m	700	2.26	**7.54**
16	Ghats	10	No.	5,000,000	5.00	**5.00**
17	Communciations network	To be discussed and ascertained				
18	Approach roads and other special items	To be discussed and ascertained				
19	Water replenishment	To be ascertained				
	Capital cost					**308.70**
20	Contingencies @ 10%					**30.87**
21	Development management consultancy @ 2.5%					**7.72**
22	Detailed design @ 3.0%					**9.26**
23	Contracted professional services @ 1.5%[1]					**4.63**
24	O and M[2]	To be ascertained				
	Total Project cost[3]					**361.18**

Notes:

1 Contracted professional Services include: survey verification consultants, engineering design verification consultants, valuation verification consultants, technical support organization, law consultants, real estate brokers, tax consultants, advertisement agency and public relation firms.

2 Operation and maintenance cost have to be added

3 In the total project cost, the cost of capital (interest on loan funds) has not been included and will depend on phasing and cash flow analysis.

Revenue Potential

It is proposed that approximately 21 percent of the reclaimed land (34.6 ha) be sold for residential or commercial development. To estimate the revenues that are likely to accrue from the sale of land, a systematic analysis of land prices along the riverbanks during the last five years was undertaken. Based on this and the proposed development of infrastructure and other facilities on the reclaimed land a forecasting exercise was carried out. Each parcel of land for sale was treated separately – therefore each parcel's location, new facilities and existing developments surrounding it, and potential for development were taken into consideration.

The table below shows the revenue estimated from the sale of the land. Drawing No. 15 shows the location of the various parcels of land.

No	Location of Parcel of Land	Proposed Landuse	Area (sq m)	Estimate Land Price Rs/sq m	Estimate Revenue Rs Crores
1E	Between Subhash Bridge and Proposed Bridge 1	Commercial	33,246	10,000	33.25
2E	Between Proposed Bridge 1 and Proposed Bridge 2				
3E	Between Proposed Bridge 2 and Gandhi Bridge	Residential	20,441	6,000	12.26
4E	Between Gandhi Bridge and Nehru Bridge	Commercial	52,300	15,000	78.45
5E	Between Nehru Bridge and Ellis Bridge				
6E	Between Ellis Bridge and Sardar Bridge				
7E	Between Sardar and Proposed Bridge 3	Commercial	11,992	5,000	6.00
8E	Between Proposed Bridge 3 and Vasna Barrage	Commercial	10,779	5,000	5.39
	Subtotal		**128,758**		**135.35**
1W	Between Subhash Bridge and Proposed Bridge 1				
2W	Between Proposed Bridge 1 and Proposed Bridge 2				
3W	Between Proposed Bridge 2 and Gandhi Bridge	Commercial	3,040	7,500	2.28
4W	Between Gandhi Bridge and Nehru Bridge	Commercial	89,940	20,000	179.88
5W	Between Nehru Bridge and Ellis Bridge	Commercial	758	20,000	1.52
6W	Between Ellis Bridge and Sardar Bridge	Residential	104,302	12,000	125.16
7W	Between Sardar and Proposed Bridge 3				
8W	Between Proposed Bridge 3 and Vasna Barrage	Commercial	19,539	7,500	14.65
	Subtotal		**217,579**		**323.49**
	Total		**346,337**		**458.84**

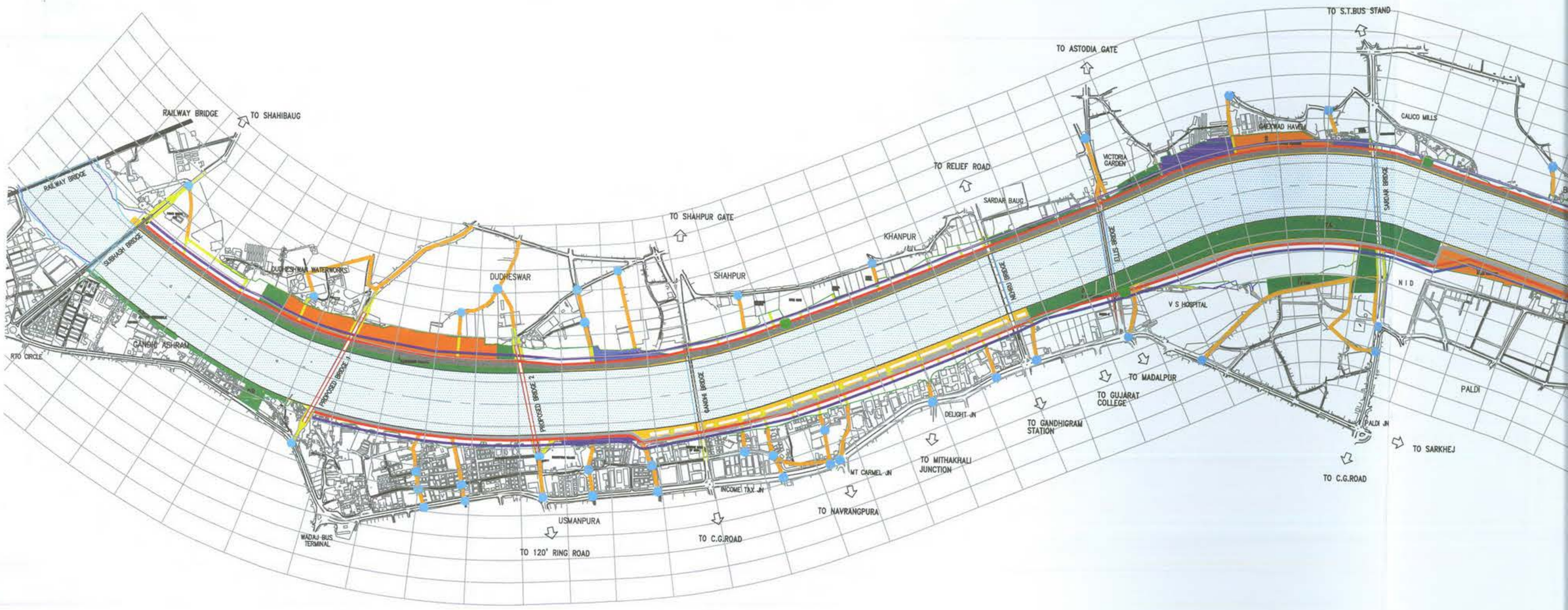
It should be noted that the cost of capital (interest on the loan funds) has not yet been added into the project costs. The entire costs mentioned in the above table on costs will be spread over a period of 5 years. The revenues estimated from the sale of land are likely to accrue over a longer period of time. The revenues would be dependant on a number of factors namely, the completion of the reclamation works, construction of embankments, provision of infrastructure services and establishment of major connecting roads. These factors are listed for each saleable parcel of land in the table next page:

Area	Factors
A Commercial Development Areas	
Subhash Bridge, East Bank	Construction of embankments Reclamation works Provision of infrastructure services Construction of the East River Drive Rationalization of the junction near Subhash Bridge ugradation of the connector road (Box No.1, Drawing No. 16)
Gandhi Bridge to Nehru Bridge, East Bank	Construction of embankments Reclamation works Provision of infrastructure services Construction of the East River Drive Rationalization of the junction near Gandhi Bridge and widening of roads (Box 11, 12 and 13, Drawing No. 15)
Gandhi Bridge to Nehru Bridge, West Bank	Construction of embankments Reclamation works Provision of infrastructure services Construction of the West River Drive Rationalization of the junctions near Income Tax, Mount Carmel, Delite and road widening (Box Nos. 29, 33, 34, 36, 37, 31and 32, Drawing No. 16)
Proposed Bridge 3, East Bank	Construction of Proposed Bridge 3 Construction of embankments Reclamation works Provision of infrastructure services Construction of the East River Drive Rationalization of the junction near Proposed Bridge 3 and widening of road (Box No. 22, Drawing No. 16)
Proposed Bridge 3, West Bank	Construction of Proposed Bridge 3 Construction of embankments Reclamation works Provision of infrastructure services Construction of the West River Drive Design and rationalization of the junction near Vasna (Box No. 51, Drawing No. 16)

B Residential Development Area	
Proposed Bridge 1, East Bank	Construction of Proposed Bridge 1 Construction of embankments Reclamation works Provision of infrastructure services Construction of the East River Drive Rationalization of the junction near Proposed Bridge 1 and widening of road (Box No. 6, Drawing No. 16)
V S Hospital, West Bank	Construction of embankments Reclamation works Provision of infrastructure services Construction of the West Drive Relocation of crematorium (Box No. 45, Drawing No. 16)

Further Work Required

- Obtain approval of the Gujarat State Government and determine the nature and extent of their participation in the project.
- Initiate a dialogue with the State Government to vest the land with SRFDCL.
- Study the real estate market for a detailed assessment of current market demand for land in Ahmedabad for use in the detailed planning work and initial phasing of the project.



LEGEND

Sr. No.	Items	Code	Nos	L (m)	B(m)	Area (sq m)	House Holds
7	WATERSUPPLY (HDPE PIPE-6 kg/sq cm)			8774			
7.1	Mains (east) 500 mm dia			7590			
7.2	Mains (west) 500 mm dia						
8	SEWERAGE (RCC NP3 HUME PIPE)						
8.1	Trunk Sewer (east) 750 mm dia			11758			
8.2	Trunk Sewer (west) 600 mm dia			10604			
8.5	Pumping Station		8				
10	ROADS						
10.1	Level 1 : Carriageway (east)			8400	21	176400	
10.2	Level 1 : Footpath (east)			8400	15	126000	
10.3	Level 2 : Carriageway (west)			6800	14	95200	
10.4	Level 2 : Footpath (west)			6800	16	108800	
10.5	Level 3 : Carriageway (east + west)			3680	10	36800	
10.6	Level 3 : Footpath (east)			3680	5	18400	
10.7	Level 3 : Cul-de-sac		24	25	10	3500	
11	ROAD UPGRADING						
11.1	Carriageway (east)			4156	10	41560	
11.2	Footpath (east)			4156	5	20780	
11.3	Carriageway (west)			4852	10	48520	
11.4	Footpath (west)			4852	5	24260	
11.5	Junctions		45				
12	PROMENADES					98000	
13	GARDENS						
13.1	Dudheshwar Garden					55200	
13.2	Heritage Park					13300	
13.3	Victoria Garden Extension					12600	
13.4	Pirana Forest					47300	
13.5	Gandhi Ashram Park					25700	
13.6	B J Park Extension					29100	
13.7	City Park					157900	
13.8	V S Hospital Park					15100	
13.9	Vasna Forest					71800	
14	RESETTLEMENT & REHABILITATION						4400
15	INFORMAL MARKETS (four in all)					58654	

NOTE
[1] Sr. No. correspond to item as numbered in the cost estimate table in the report.
[2] Right-of-way for Level 1, 2, 3 roads is 36m, 30m, 15m respectively.
[3] The alignment of water supply mains, trunk sewers and position of sewage pumping station are schematic.

COST ESTIMATE
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11.2	Footpath (east)			4156	5	20780	
11.3	Carriageway (west)			4852	10	48520	
11.4	Footpath (west)			4852	5	24260	
11.5	Junctions		45				
12	PROMENADES					98000	
13	GARDENS						
13.1	Dudheshwar Garden					55200	
13.2	Heritage Park					13300	
13.3	Victoria Garden Extension					12600	
13.4	Pirana Forest					47300	
13.5	Gandhi Ashram Park					25700	
13.6	B J Park Extension					29100	
13.7	City Park					157900	
13.8	V S Hospital Park					15100	
13.9	Vasna Forest					71800	
14	RESETTLEMENT & REHABILITATION						4400
15	INFORMAL MARKETS (four in all)					58654	

NOTE

[1] Sr. No. correspond to item as numbered in the cost estimate table in the report.
[2] Right-of-way for Level 1, 2, 3 roads is 36m, 30m, 15m respectively.
[3] The alignment of water supply mains, trunk sewers and position of sewage pumping station are schematic.

. (m)	B(m)	Area (sq m)	House Holds
8774			
7590			
11758			
10604			
8400	21	176400	
8400	15	126000	
6800	14	95200	
6800	16	108800	
3680	10	36800	
3680	5	18400	
25	10	3500	
4156	10	41560	

COST ESTIMATE (SUPPORT MAP)

1:17500

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

May 1998

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C2 FINANCING, STRUCTURE OF THE SRFDCL AND DEVELOPMENT MANAGEMENT

This section discusses issues pertaining to implementation of the SRFD Project.

The SRFD Project

The SRFD Project is a more complex project than most similar-sized public works projects. In addition to embankment and reclamation works, construction of major level-one roads, and installation of infrastructure (water, sewer, storm drainage) networks it also includes resettlement and rehabilitation works, the construction of relatively sophisticated promenades and gardens, maintenance of public spaces during the life of the project, development of urban design guidelines, strategic planning, reconciliation of property rights, management of unclear legal issues and, promotion and marketing of a portion of the reclaimed land. The project has been planned as a self-financing project. Revenues from the sale of a portion of the reclaimed land at current prices are estimated at approximately Rs 458.54 crores. This is roughly equivalent to the total cost of the project after the estimated base costs of Rs 361.18 crores are spread over the projected 5 year construction period, adjusted for inflation and interest costs are added. In short, the SRFD Project is a relatively large infrastructure, public amenities and land development project which is dependent on the sale of land to finance the project. Three issues are important to the successful implementation the project: source of funds, structure of the SRFDCL and the establishment of an adequate mechanism for managing the implementation of the project.

Sources of Funds

- Equity Capital: The AMC has committed to capitalize the SRFDCL. In addition, title to the land, which is to be created as a result of the project, must be vested in the SRDFCL.
- Loan Funds: Due to the timing of expenditures (over a 5 year period) and revenues (over a 10 to 12 year period), it will be necessary to borrow funds to cover the difference between the equity capital available and the cash flow requirements of the project. Every available alternative should be explored including commercial bank loans, special infrastructure loan funds and direct borrowing from the capital market through a special bond issue.
- Proceeds from Land Sales: If properly managed, the proceeds from the sale of land created by the project should cover the full cost of the project including the cost of interest paid on construction period loans and repayment of equity investments.

The Structure of the SRFDCL

The SRFDCL was established by the AMC as a distinct company registered under the Section 149 (3) of the Companies Act 1956. The AMC's intention was to create an autonomous entity (Special Purpose Vehicle), which can speedily and effectively implement the SRFD proposals. It is proposed that the structure of the SRFDCL should be reviewed (and modified if necessary) to ensure that it can effectively implement the proposals. Two issues are critical. The SRFDCL should be perceived as an autonomous company, which, beyond a point, is independent of changes in the political situation and, the SRFDCL should be able to develop an effective decision making system.

Options for Managing Implementation

The SRFD Project has a relatively short implementation period and demands a wide range of technical, financial and management skills to be successful (see the table below for a detailed list of conceptual planning, strategizing and coordination tasks required for implementing the project). For implementing the project, the SRFDCL can:

a) Hire in-house staff
b) Enter into a partnership with a real-estate development firm, or
c) Contract out for development management services.

a) Hire In-house Staff:

If this option is chosen the following should be noted. The range of experience and skillsrequired to manage the project is quite broad and will change over the projected implementation period. Therefore there will be a need to keep the staffing of the project flexible. Since individuals will be required to provide services for a relatively short duration, if effective staff is to be retained it will be necessary to totally disassociate their remuneration from normal levels of remuneration for public servants. All the risks involved in managing the project will remain with the SRFDCL.

b) Partner with a Real Estate Development Firm:

Since the financial success of the SRFD Project is the key to implementing the entire project it will be essential that SRFDCL obtain the services of persons who understand the real estate development process. Many international and a few national real estate development firms have most of the expertise required to implement the SRFDC Project. It may be difficult to enter into a fee-based development management contract with such developers. However, it may be possible for the SRFDCL to enter into a partnership with such a firm on the basis of potential profits. However, this approach will require a drastic restructuring of the SRFD Proposal. The proportion of land intended for sale (20 per cent of total reclaimed land) would need to be substantially increased and the proportion used for public amenities (80 per cent) decreased in order to generate adequate profit margins required to attract a developer of the size needed to implement the project. This will not only reduce the benefits accruing to the city but may also be politically hazardous.

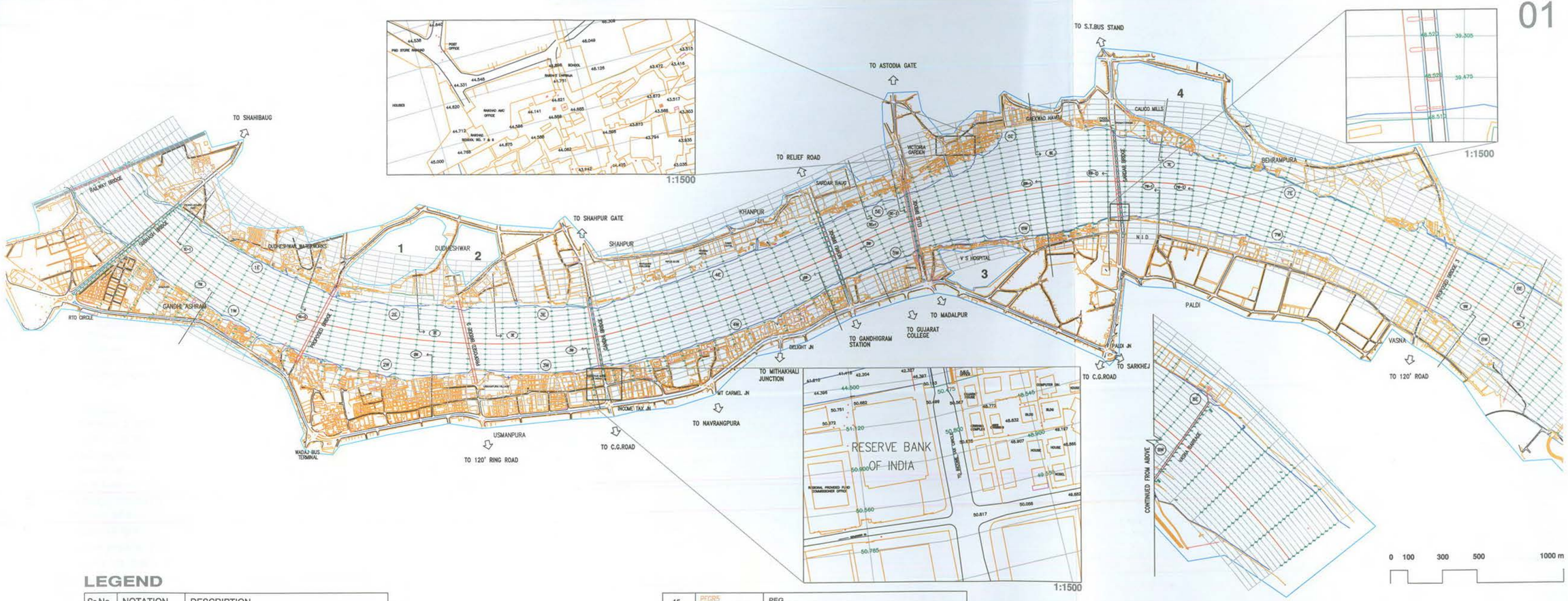
c) Contracting for Development Management Services:

The SRFDCL can retain a firm or a consortium of firms to implement the project under a fee-based development management contract. The firm/consortium thus retained would have the entire responsibility of providing all conceptual planning, strategizing and coordination services required to implement the project. If this option is chosen SRFDCL's staffing requirement will be minimal. Since the SRFDCL would retain all financial risks it will not be necessary to restructure the project.

If the SRFDCL contracts with a single firm for development management services the firm should have a good overall understanding of the project requirements to assume responsibility for forming and coordinating the team required for the work through sub-contracts with other firms for services as required. The development management firm may be contracted on a man-month basis. If the SRFDCL contracts with a consortium of firms formed specifically to provide the expertise required for this project consideration should be given to including detailed design and construction supervision services into the development management contract, as engineering firms with construction project management experience may otherwise be unwilling to participate. In either case, since the SRFDCL will retain all authority with itself (the development management firm will only be contracted to provide services) it will be necessary to work out an effective system to ensure prompt decision making by the SRFDCLBoard.

LIST OF ABBREVIATIONS

AMC	Ahmedabad Municipal Corporation
ASAG	Ahmedabad Study Action Group
BOD	Biological Oxygen Demand
CA	Catchment Area
CBO	Community Based Organization
CEPT	Center for Environmental Planning and Technology
CPCB	Central Pollution Control Board
CWPRS	Central Water and Power Research
EPC	Environmental Planning Collaborative
GTS	Great Trigonometric Survey
HFL	High Flood Level
IRC	Indian Roads Congress
MLD	Million Litres per Day
MSL	Mean Sea Level
NRCP	National River Conservation Plan
NEERI	National Environmental Engineering and Research Institute
NGO	Non Governmental Organization
NMC	Narmada Main Canal
O & M	Operations and Maintenance
PAA	Project Affected Area
PAEAs	Project Affected Economic Activities
PAHs	Project Affected Households
PCC	Plain Cement Concrete
PRL	Physical Research Laboratory
RCC	Reinforced Cement
RCs	Residents' Committees
RFD	Riverfront Development
RL	Reduced Level
SAT	Soil Aquifer Treatment
SB	Subhash Bridge
SPV	Special Purpose Vehicle
SRFD	Sabarmati Riverfront Development
SRFDCL	Sabarmati River Front Development Corporation
SRCP	Sabarmati River Conservation Project
SS	Suspended Solids
SSNNL	Sardar Sarovar Narmada Nigam Limited
TPS	Town Planning Scheme
TSO	Technical Support Organization
VB	Vasna Barrage
WHO	World Health Organization
WSPRO	Water Surface Profile
VOs	Voluntary Organizations



LEGEND

Sr.No.	NOTATION	DESCRIPTION
1		VERTICAL SURVEY GRID (E-W)
2		HORIZONTAL SURVEY GRID WITH CENTER LINE (N-S)
3	48.358	CROSS SECTION LEVELS ON THE RIVER BED
4		RIVER BED LINE
5	M	MANHOLES
6		BRIDGE PIERS
7		TREE
8	48.358	BOTTOM LEVEL OF TREE
9	TR	TREE NAME
10		WELL
11		WELL IN THE RIVER BED
12		BUILDINGS
13	48.358	GROUND SPOT LEVELS
14		OTTA (SURVEY)
15	PEGR5	PEG
16		RAILING
17		TOP EDGE OF THE RIVER
18		RAILWAY LINE
19		ROAD
20	E/@	ELECTRIC POLE
21		BUILDING FENCE LINE
22		HIGH TENSION LINE
23	T	TELEPHONE POLE
24		SURVEY BOUNDARY
25	4	AREAS NOT SURVEYED
26		BRIDGE EXPANSION / PROPOSED BRIDGE
27	2W	SECTION LINE AND SECTION No.
28	SW	RIVER BANK BETWEEN TWO CONSECUTIVE BRIDGES

NOTE : TOTAL AREA SURVEYED IS 1033.1661 ha.

PHYSICAL SURVEY

1:17500

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

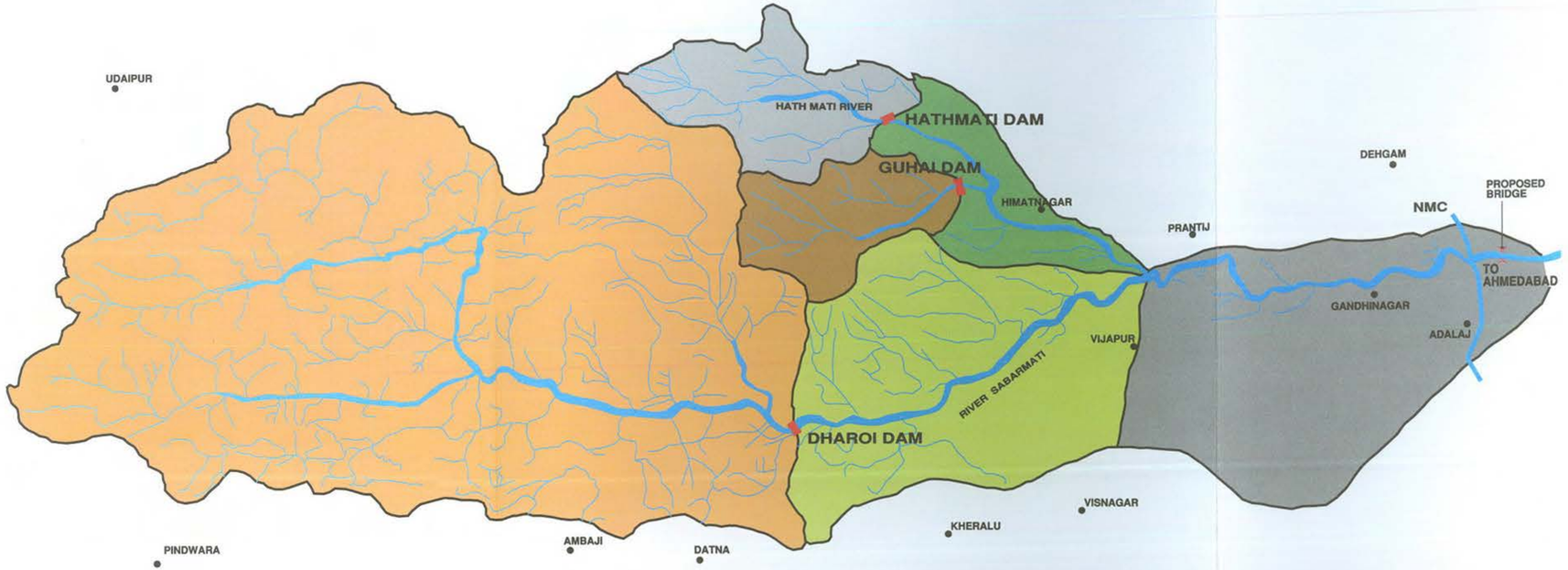
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LEGEND

Nos.	NOTATION	DESCRIPTION
1		WATER CHANNEL
2		DAM
3		NARMADA MAIN CANAL (NMC)

DETAILS OF SABARMATI SUB-BASINS FOR AHMEDABAD

NO OF SUB BASIN	NAME OF SUB BASIN	CATCHMENT AREA sq km	SLOPE m/km
1	SABARMATI RIVER UP TO DHAROI DAM	5540	2.28
2	FREE CATCHMENT FROM D/S OF DHAROI DAM TO THE CONFLUENCE OF SABARMATI & HATHMATI RIVER	1684	1.31
3	GUHAI RIVER UPTO GUHAI DAM	422	2.13
4	HATHMATI RIVER UPTO HATHMATI DAM	596	2.37
5	FREE CATCHMENT FROM D/S OF HATHMATI DAM & GUHAI DAM TO CONFLUENCE POINT OF SABARMATI & HATHMATI RIVER	492	1.74
6	REMAINDER OF THE CATCHMENT FROM D/S OF OF SABARMATI & HATHMATI RIVER CONFLUENCE UP TO NMC CROSSING	1684	0.84

CATCHMENT - River Sabarmati

1:5,00,000

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

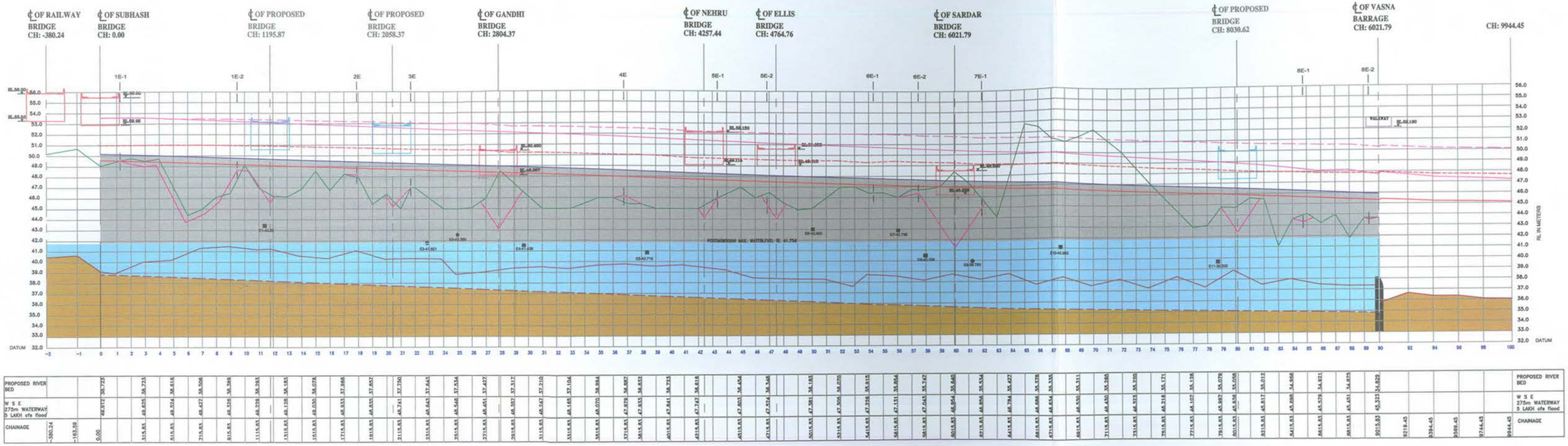
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EAST BANK

LEGEND

Sr.No.	NOTATION	DESCRIPTION
1		HIGH FLOOD LEVEL FOR NATURAL RIVER (7.5 LAKH CUSECS)
2		HIGH FLOOD LEVEL FOR 275 m WATERWAY (7.5 LAKH CUSECS) (with height of retaining wall as 0.6m above HFL of 5 lakh cusecs flood)
3		HIGH FLOOD LEVEL FOR NATURAL RIVER (5 LAKH CUSECS)
4		HIGH FLOOD LEVEL FOR 275m WATERWAY (5 LAKH CUSECS)
5		TOP OF EXISTING RIVER BANK
6		NATURAL RIVER BED
7		PROPOSED RIVER BED
8		TOP OF PROPOSED EMBANKMENT
9		PROPOSED ROAD
10		EXISTING DRAINAGE OUFALL (slab/pipe)
11		REDUCED LEVEL AT TOP OF BRIDGE
12		REDUCED LEVEL AT SOFFIT OF GIRDER

NOTE :

(1) ALL DIMENSIONS IN METRES.
(2) ALL REDUCED LEVELS IN METRES. W.R.T. GTS BENCH MARK.
(3) RL OF SOFFIT OF GIRDER FOR PROPOSED BRIDGES ASSUMED AT 1.5m ABOVE 5 LAKH HFL FOR 275m WATERWAY.
(4) PROPOSED ROAD WHERE NOT SHOWN FOLLOWS THE PROFILE OF THE EXISTING TOP EDGE.
(5) TOP OF RETAINING WALL INCLUDES PARAPET WALL.
(6) THE 275m WATERWAY IS FROM SUBHASH BRIDGE TO VASNA BARRAGE, WITH SPLAY OF RETAINING WALLS AS SHOWN IN LANDSUE PROPOSAL (MAP NO. 15).

HYDRAULIC ANALYSIS

GRID : H-100m V-1m

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

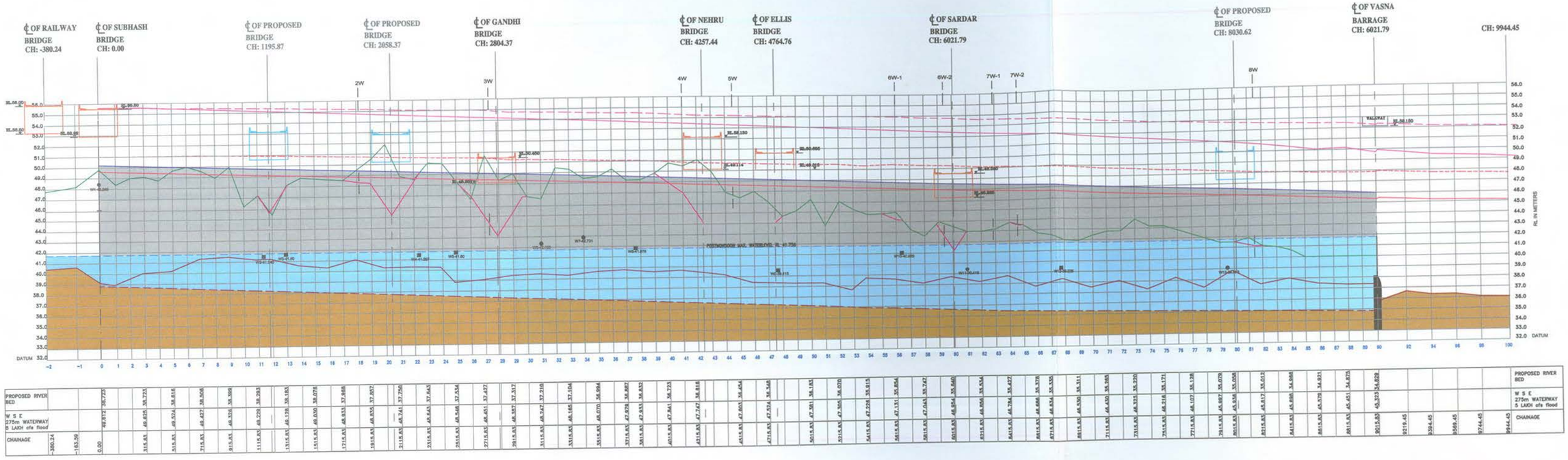
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WEST BANK

LEGEND

Sr.No.	NOTATION	DESCRIPTION
1		HIGH FLOOD LEVEL FOR NATURAL RIVER (7.5 LAKH CUSECS)
2		HIGH FLOOD LEVEL FOR 275 m WATERWAY (7.5 LAKH CUSECS) (with height of retaining wall as 0.6m above HFL of 5 lakh cusecs flood)
3		HIGH FLOOD LEVEL FOR NATURAL RIVER (5 LAKH CUSECS)
4		HIGH FLOOD LEVEL FOR 275m WATERWAY (5 LAKH CUSECS)
5		TOP OF EXISTING RIVER BANK
6		NATURAL RIVER BED
7		PROPOSED RIVER BED
8		TOP OF PROPOSED EMBANKMENT
9		PROPOSED ROAD
10		EXISTING DRAINAGE OUFALL (slab/pipe)
11		REDUCED LEVEL AT TOP OF BRIDGE
12		REDUCED LEVEL AT SOFFIT OF GIRDER

NOTE :

(1) ALL DIMENSIONS IN METRES.
(2) ALL REDUCED LEVELS IN METRES. W.R.T. GTS BENCH MARK.
(3) RL OF SOFFIT OF GIRDER FOR PROPOSED BRIDGES ASSUMED AT 1.5m ABOVE 5 LAKH HFL FOR 275m WATERWAY.
(4) PROPOSED ROAD WHERE NOT SHOWN FOLLOWS THE PROFILE OF THE EXISTING TOP EDGE.
(5) TOP OF RETAINING WALL INCLUDES PARAPET WALL.
(6) THE 275m WATERWAY IS FROM SUBHASH BRIDGE TO VASNA BARRAGE, WITH SPLAY OF RETAINING WALLS AS SHOWN IN LANDSUE PROPOSAL (MAP NO. 15).

HYDRAULIC ANALYSIS

GRID : H-100m V-1m

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

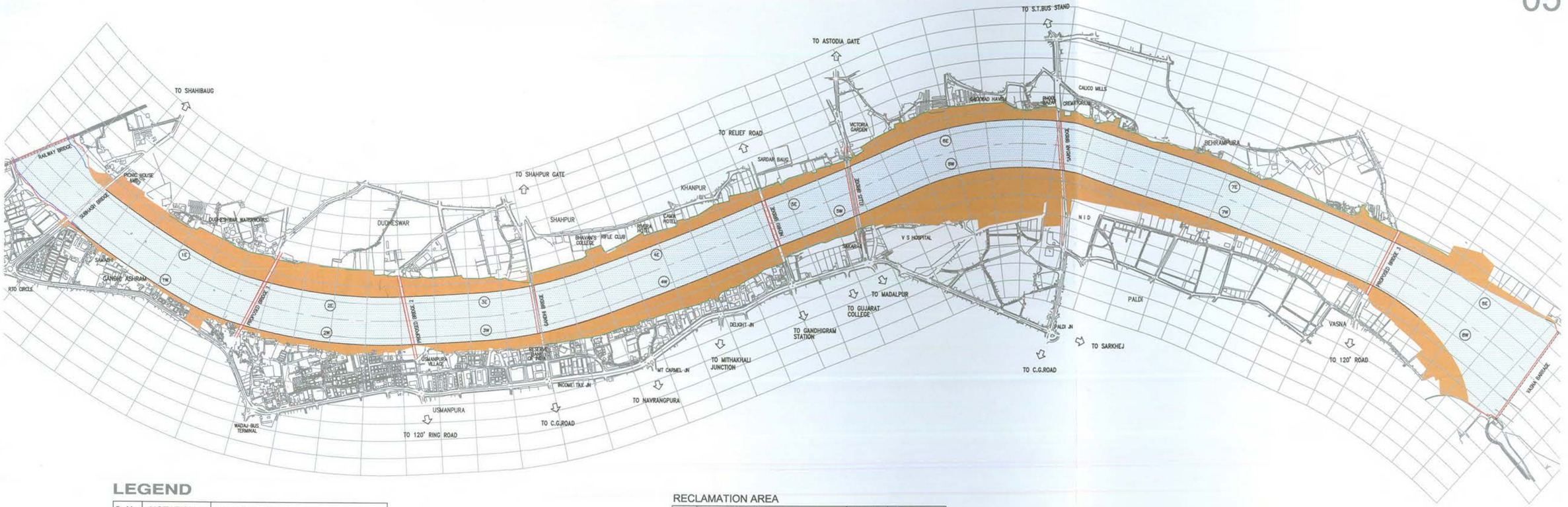
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LEGEND

Sr.No.	NOTATION	DESCRIPTION
1		AREA TO BE RECLAIMED
2		AREA TO BE CUT
3		TOP EDGE OF THE RIVER
4		BRIDGE EXPANSION / PROPOSED BRIDGE
5	(8E)	SECTION No. BETWEEN TWO BRIDGES

RECLAMATION AREA

No.	Segment	Area (ha)	Earth Fill (cu m)
1E	Between Subhash Bridge & Prop Bridge 1	13.575	1041222.59
2E	Between Prop Bridge 1 & Prop Bridge 2	11.331	858932.93
3E	Between Prop Bridge 2 & Gandhi Bridge	6.759	517548.14
4E	Between Gandhi Bridge & Nehru Bridge	11.299	813106.40
5E	Between Nehru Bridge and Ellis Bridge	3.226	254654.00
6E	Between Ellis Bridge & Sardar Bridge	12.150	912770.69
7E	Between Sardar Bridge & Prop Bridge 3	11.800	921053.10
8E	Between Prop Bridge 3 & Vasna Barrage	5.117	399405.43
	Subtotal	75.257	5718893.28

1W	Between Subhash Bridge & Prop Bridge 1	3.543	277284.312
2W	Between Prop Bridge 1 & Prop Bridge 2	3.870	296175.890
3W	Between Prop Bridge 2 & Gandhi Bridge	3.630	273106.1284
4W	Between Gandhi Bridge & Nehru Bridge	16.087	1154888.3600
5W	Between Nehru Bridge and Ellis Bridge	3.597	282855.6800
6W	Between Ellis Bridge & Sardar Bridge	29.096	2080589.03
7W	Between Sardar Bridge & Prop Bridge 3	13.622	1042474.36
8W	Between Prop Bridge 3 & Vasna Barrage	14.097	1034842.87
	Subtotal	87.542	6442216.63
	Total	162.799	121,61,109.91

NOTE : [1] Earth fill upstream of Subhash Bridge (East) : 58317cu m.
[2] Earth fill upstream of Subhash Bridge (West) : 9122cu m.

0 100 300 500 1000 m

LAND RECLAMATION

1:17500

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

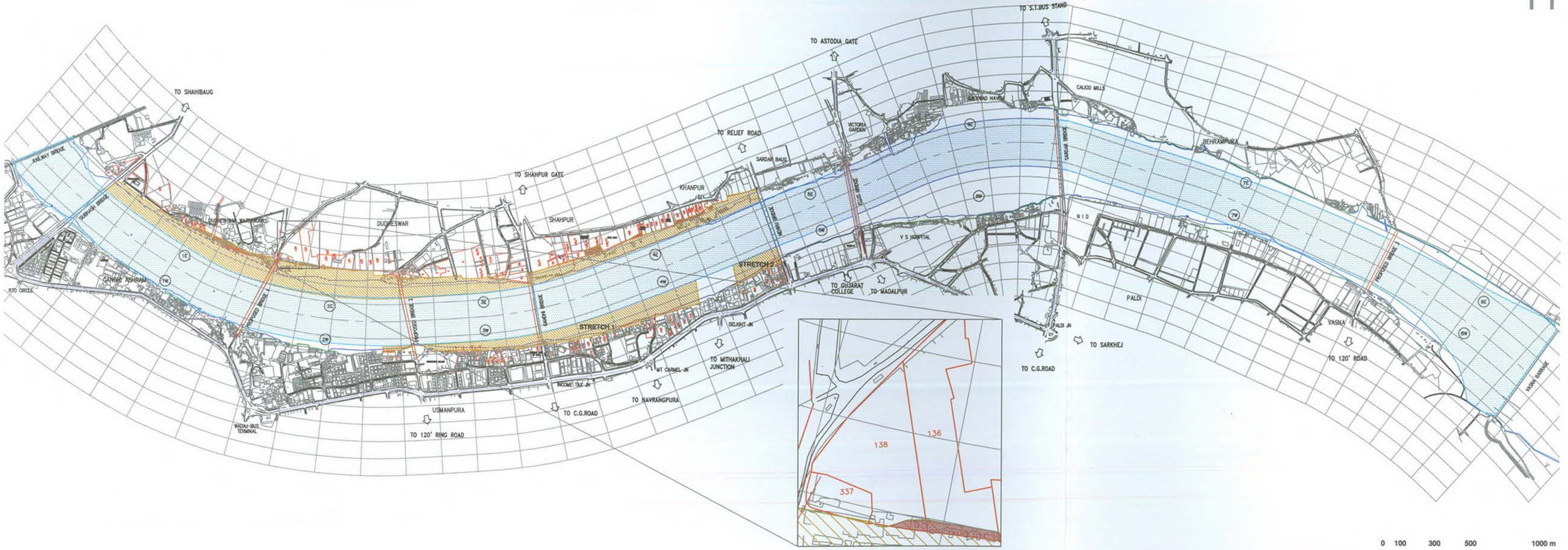
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1 : 2500

0 100 300 500 1000 m

LEGEND

Sr.No.	NOTATION	DESCRIPTION
1		BED LINE
2		TOP EDGE
3		FINAL PLOT BOUNDARY AS INTERPRETED FROM FP SHEETS
4		LAND NOT PRIVATELY OWNED
5		LAND UNDER PRIVATE OWNERSHIP
6	138	FINAL PLOT NUMBERS

SECTION	LAND NOT PRIVATELY OWNED (ha)	LAND UNDER PRIVATE OWNERSHIP (ha)	RECLAMATION AREA (ha)
EAST BANK			
SUBHASH BRIDGE-GANDHI BRIDGE	39.793	2.03	42.823
WEST BANK			
STRETCH 1	13.728	0.221	13.949
STRETCH 2	2.8263.	-	2.826

FINAL PLOT RECONCILIATION - SAMPLE STUDY 1:17500

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

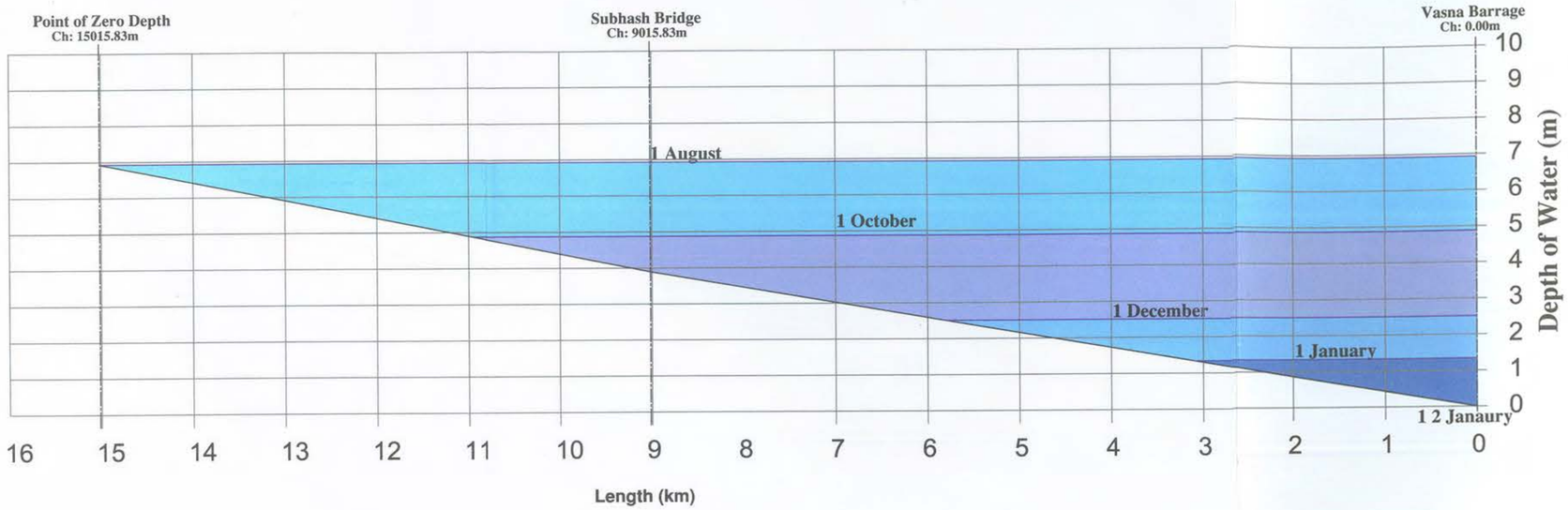
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LEGEND

As on	Depth of water at Vasna Barrage
1 August	6.93m
1 October	4.88m
1 December	2.51m
1 January	1.34m
12 January	0.00m

NOTE :

[1] This calculation assumes that there is no inflow of water and the water loss is due to seepage and evaporation only.

[2] 12 January to 14 June there is no water in the river.

[3] 15 June to 31 July is considered as monsoon.

SCHEMATIC WATER RETENTION DIAGRAM Grid : H-1000m V-1m

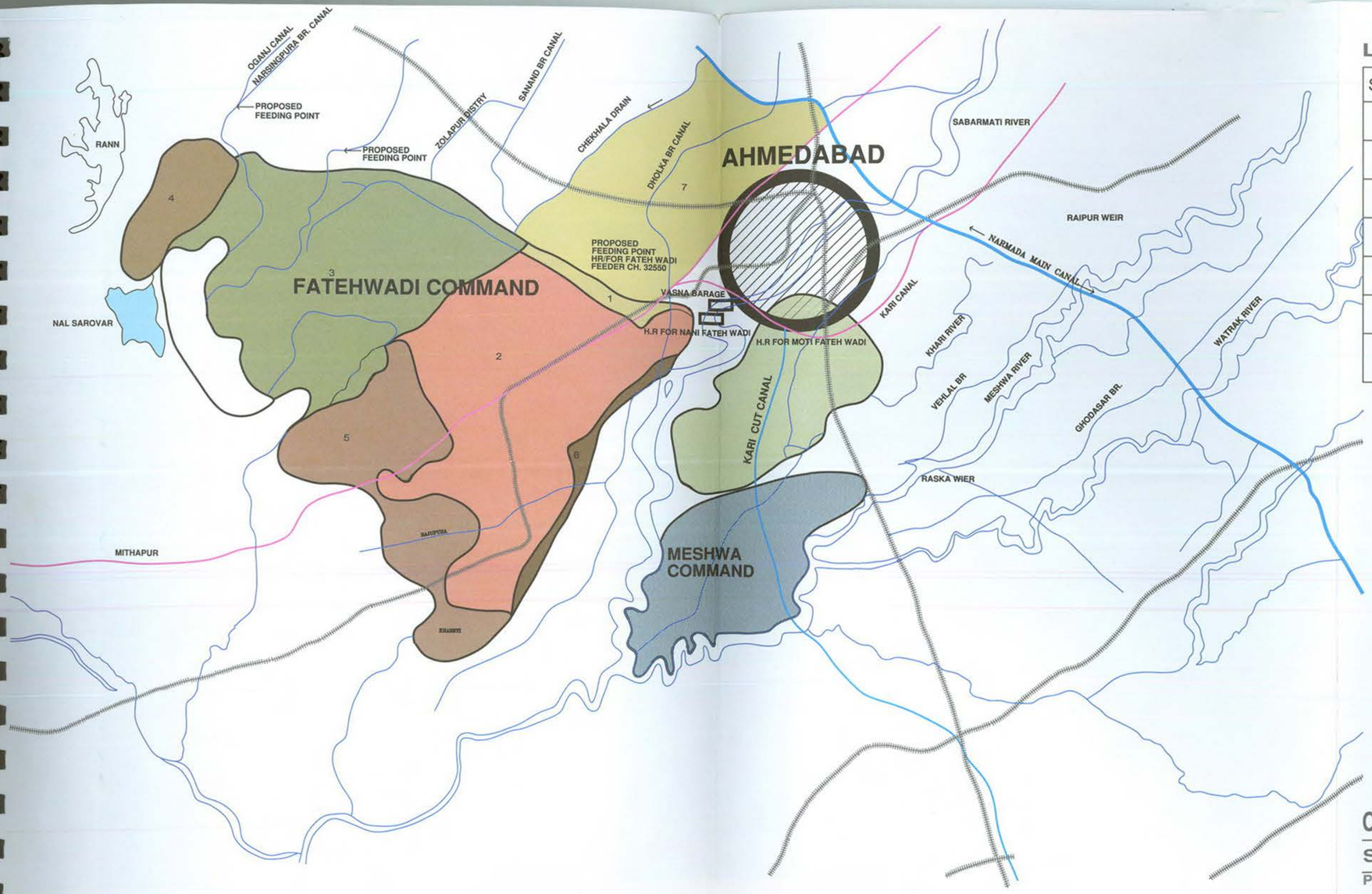
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Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

Certified by Dr S K Gupta, Physical Research Laboratory, Ahmedabad. May 1998

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LEGEND

Sr.No.	Sr.No.	COMMAND AREAS	TOTAL AREA (ha.)
1	1	AREA PROPOSED TO BE COMMANDED BY DHOLKA BRANCH CANAL	1,960
2	2	AREA CURRENTLY BEING COMMANDED BY FATEHWADI CANAL	39,035
3	3	AREA PROPOSED TO BE COMMANDED BY SANAND BRANCH CANAL	39,001
4	4	AREA PROPOSED TO BE COMMANDED BY NARSINGPURA BRANCH CANAL	6,467
5	5	AREA PROPOSED TO BE COMMANDED BY DHOLKA BRANCH CANAL	18,953
6	6	AREA PROPOSED TO BE COMMANDED BY DHOLKA BRANCH CANAL	2,520
7	7	AREA PROPOSED TO BE COMMANDED BY DHOLKA BRANCH CANAL (TO BE EXCLUDED DUE TO URBANIZATION)	28,631

COMMAND AREA - Narmada Branch Canal

1:320000

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

This map has been digitized from the index map of Narmada command area under the jurisdiction of Narmada project canal distribution system, Sardar Sarovar Narmada Nigam Ltd. Gandhinagar.

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0 100 300 500 1000 m

LEGEND

Sr.No.	NOTATION	DESCRIPTION
1		RESIDENTIAL
2		COMMERCIAL
3		INDUSTRIAL
4		RELIGIOUS
5		INSTITUTIONAL
6		PUBLIC UTILITY
7		GARDEN
8		SLUMS
9		EDUCATIONAL
10		HEALTH
11		INFORMAL MARKET

LANDUSE - EXISTING

1:17500

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

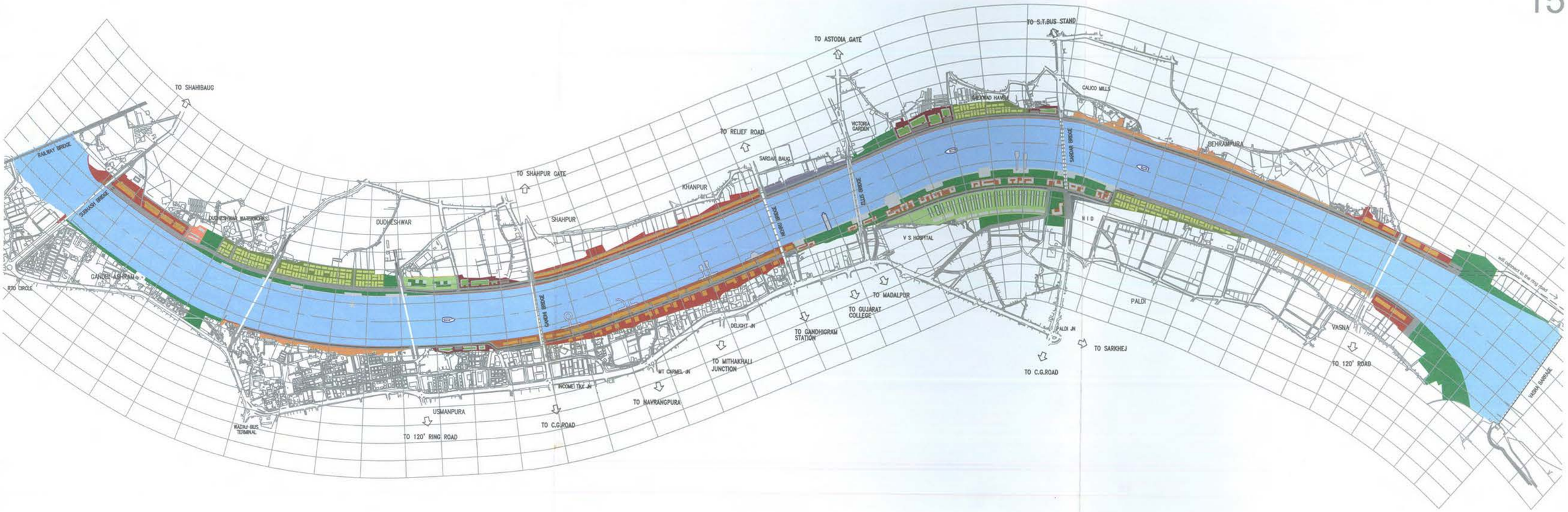
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0 100 300 500 1000 m

LEGEND

	LAND USE	AREA (Ha)	AREA (%)
	ROADS	49.736	30.552
	GARDENS	41.454	25.463
	PROMENADE	9.800	6.020
	RELOCATION SITES	15.482	9.510
	INFORMAL MARKETS	5.859	3.600
	COMMERCIAL AREAS (TO BE SOLD)	20.209	12.413
	RESIDENTIAL (TO BE SOLD)	12.474	7.662
	PUBLIC UTILITIES	0.765	0.470
	EXTENTION OF PUBLIC FACILITIES	0.940	0.577
	RESIDUAL / UNALLOCATED	6.080	3.740
	TOTAL	162.799	100.00

LANDUSE PROPOSAL

1:17500

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

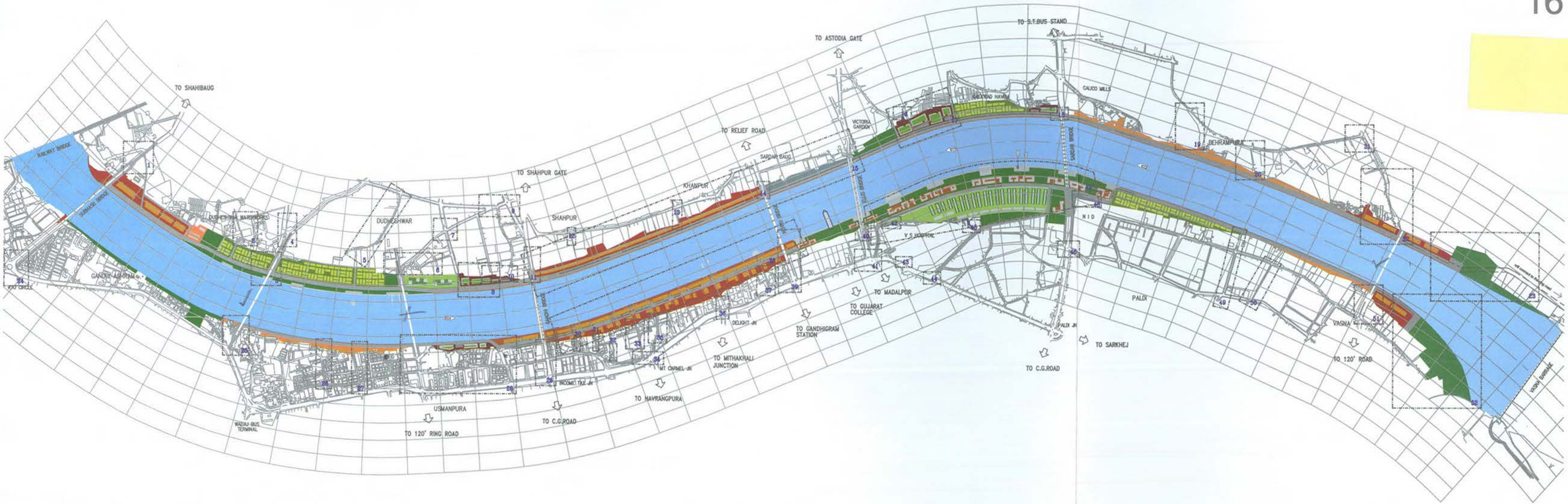
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May 1998

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LEGEND

Box No.	Work required
1	Junction to be rationalized.
2	Proposed connector road network with Dudheshwar area to be detailed out and road network to be strengthened.
3	Nearest connection to the bridge to be designed.
4	Junction to be rationalized. Road widening of the existing connecting roads required.
5	New access road will require 20m width. Land acquisition required.
6	Proposed bridge junction to be designed. Road widening required to upgrade existing road network.
7	Junction to be rationalized. Road widening required.
8	Prepare detail design for Informal Market.
9	Junction improvement required.
10	Road widening may require land acquisition.
11	Junction to be rationalized. Road widening required. Traffic flow of proposed road to be checked.
12	Road widening required.
13	Road widening required.
14	Prepare detail design to link side connectors of the East River Drive to existing network.
15	Prepare detail plan for Heritage Park.
16	Road widening of road will require road widening.
17	Prepare detailed design for Informal Market. Provision for large parking.
18	Junction to be redesigned for new bridge along the existing bridge.
19	Road alignment to be established and detailed.
20	Road alignment to be established and detailed.
21	Junction to be rationalized.
22	Junction to be designed and existing road be widened.
23	Prepare detailed landscape design.
24	RTO junction to be rationalized.
25	Slope for the proposed bridge to be checked. Survey of illegal settlement on proposed bridge site is required. Junction with Ashram road to be rationalized.
26	Road widening may require land acquisition.
27	Junction to be rationalized. Road widening required.
28	Proposed bridge junction to be rationalized. Land acquisition needed for widening of road.
29	Junction redesigned and upgraded to accomodate side lanes along the bridge slope
30	Existing road to be widened and connected to West River Drive
31	Road widening required. Traffic flow direction to be established
32	Road widening required. Junction to be rationalized. Traffic flow direction to be established.
33	Road widening required. Junction to be rationalized. Traffic flow direction to be established.
34	Junction to be redesign perhaps as a circular roundabout.
35	Develop as a major entrance to river drive west.
36	Junction to be redesign for new road connection on the Rose Garden AMC plot with West River drive
37	Junction to be rationalized. Road widening required.
38	Detailed Urban Design guide line to be developed based on built form studies.
39	Redesign traffic junction for traffic from river drive-west.
40	Bridge junction to be redesigned for the new propoesed bridge and pedestrian connection.
41	Traffic junction to be resolved, perhaps using an elliptical roundabout (50x30m).
42	Amalgamate with V.S.Hospital.
43	Relocate entry to VSH - by either a setback entry or by being located off Ashram road to help decongest it.
44	Traffic to be regulated at junction.
45	Crematorium to be located beside the river.
46	Traffic junction to be rationalized. Perhaps NID entry may be relocated at the side or behind.
47	Prepare detail landscape design for the city park.
48	Plots need to be setback to accomodate ramp to access underpass.
49	Part of property to be acquired to establish connections.
50	Road widening required. Will require acquisition of properties.
51	Road and Junction to be designed to carry future traffic load.
52	Area to be designed and allocated for future recreation.

0 100 300 500 1000 m

LANDUSE PROPOSAL

1:17500

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

May 1998

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0 100 300 500 1000 m

LEGEND

Sr.No.	NOTATION	DESCRIPTION
1		LEVEL 1 ROAD (6-LANE)
2		LEVEL 2 ROAD (4-LANE)
3		LEVEL 3 ROAD (3-LANE)
4		EXISTING LEVEL 1 ROAD (ASHRAM ROAD)
5		EXISTING LEVEL 2 ROAD

PROPOSED ROAD NETWORK

1:17500

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

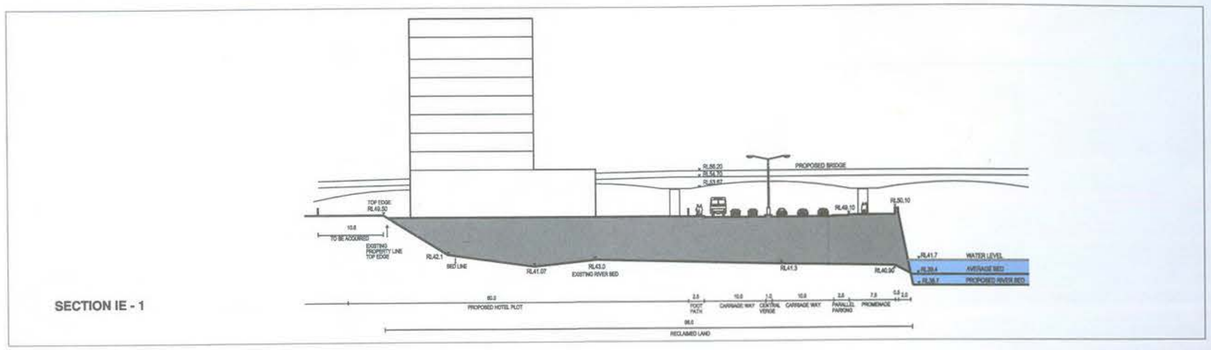
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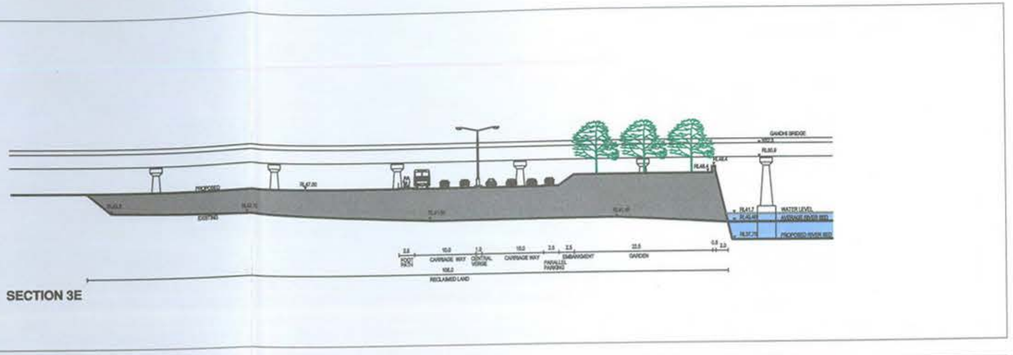
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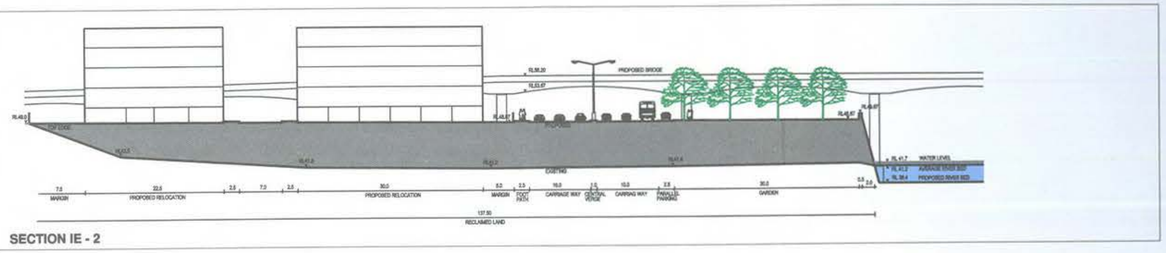
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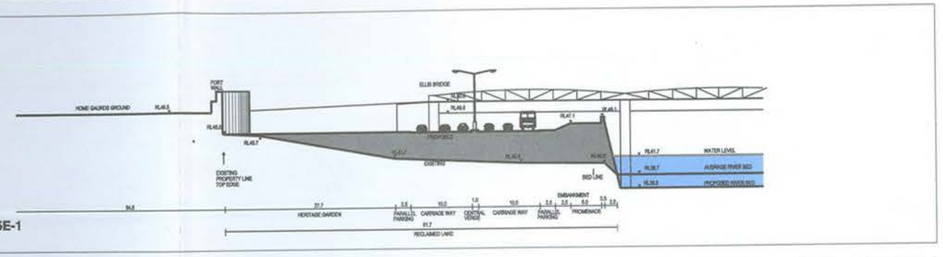
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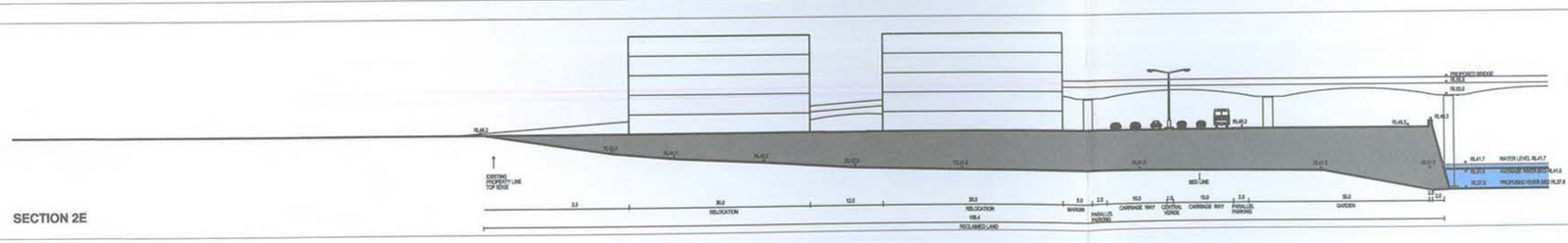
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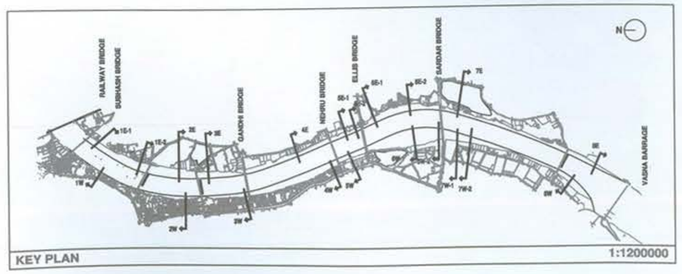
SECTION IE - 2



SECTION 5E-1



SECTION 2E



KEY PLAN 1:1200000

SECTIONS - LANDUSE

1:750

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

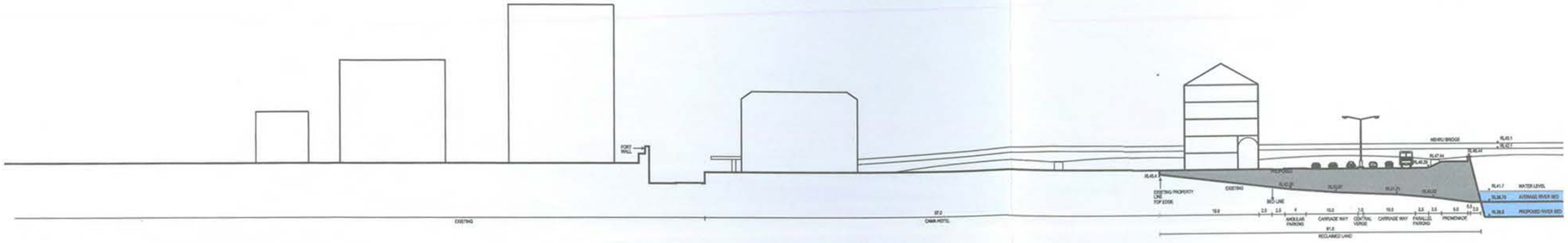
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May 1998

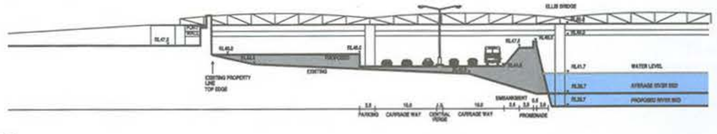
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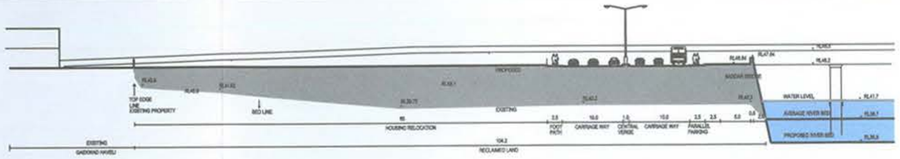
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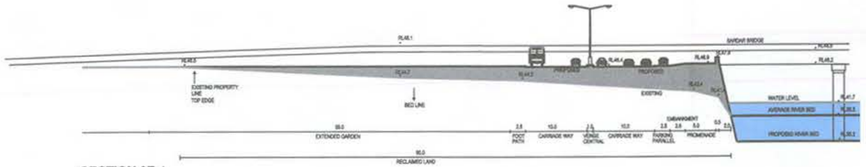
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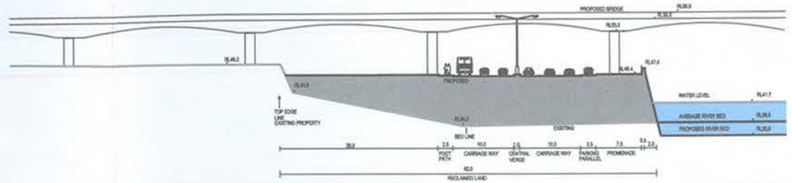
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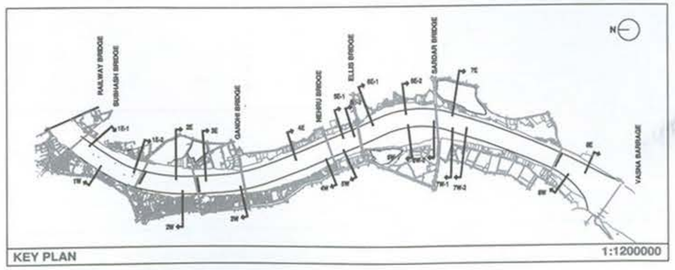
SECTION 6E-2



SECTION 6E-1



SECTION 7E



KEY PLAN 1:1200000

SECTIONS - LANDUSE

1:750

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

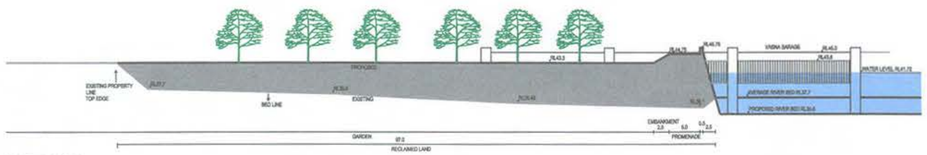
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May 1998

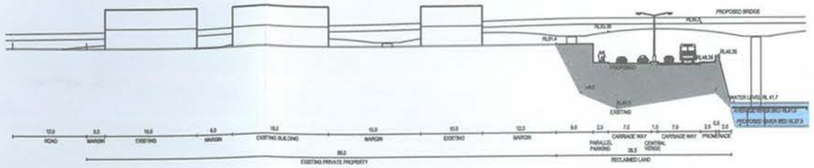
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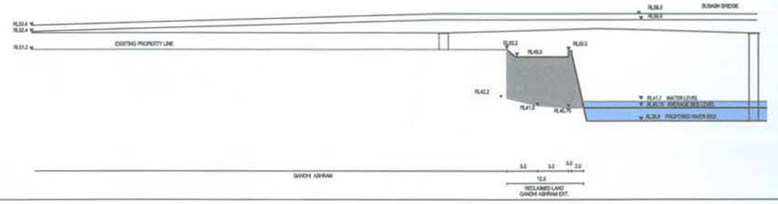
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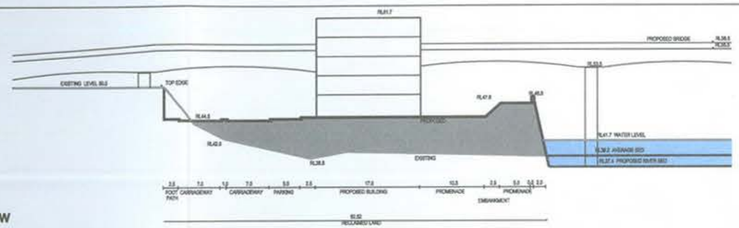
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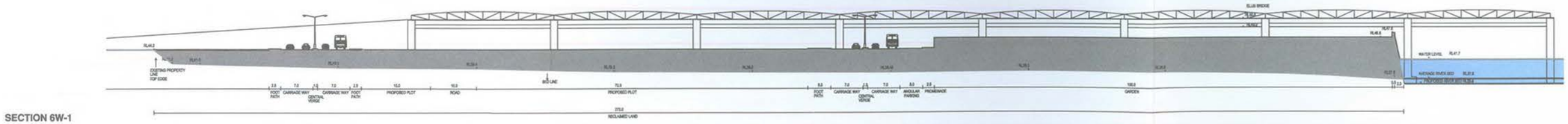
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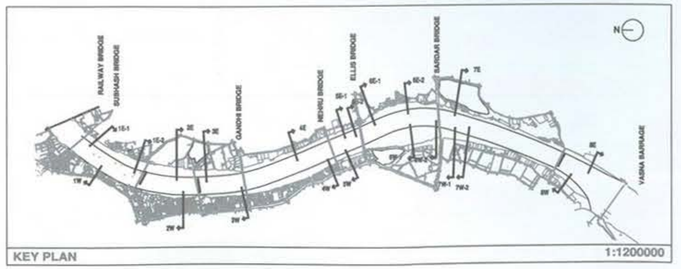
SECTION 1W



SECTION 3 W



SECTION 6W-1



KEY PLAN 1:1200000

SECTIONS - LANDUSE

1:750

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

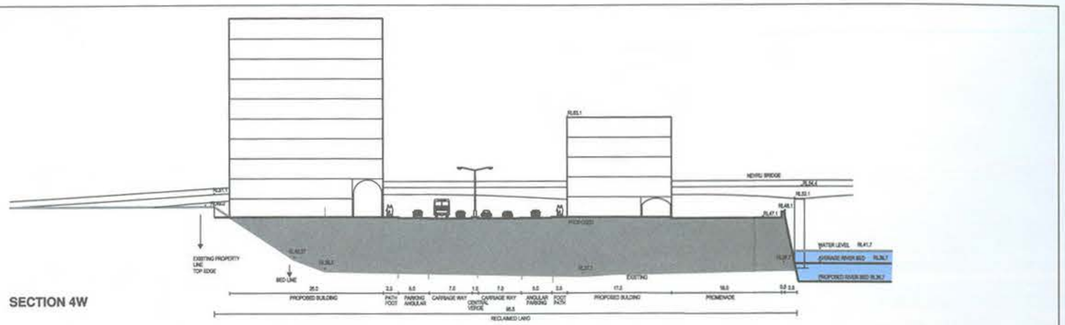
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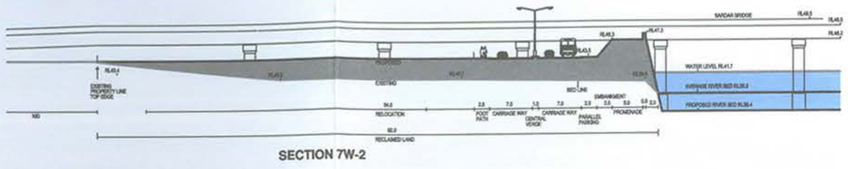
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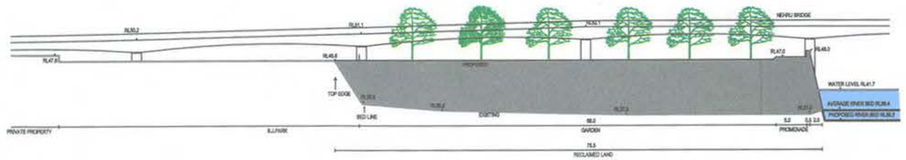
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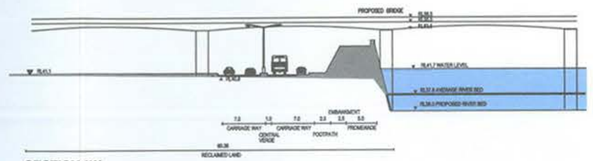
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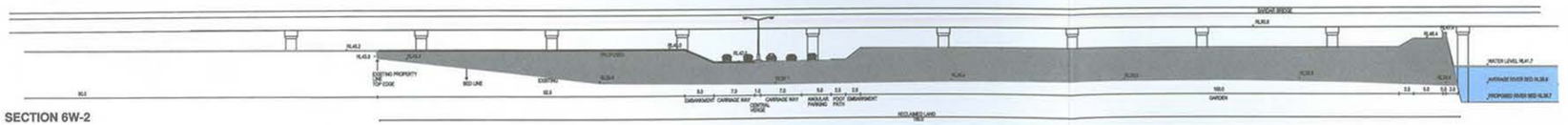
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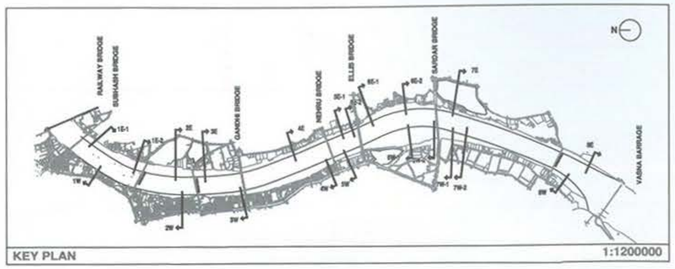
SECTION 5W-1



SECTION 8W



SECTION 6W-2



KEY PLAN 1:1200000

SECTIONS - LANDUSE

1:750

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

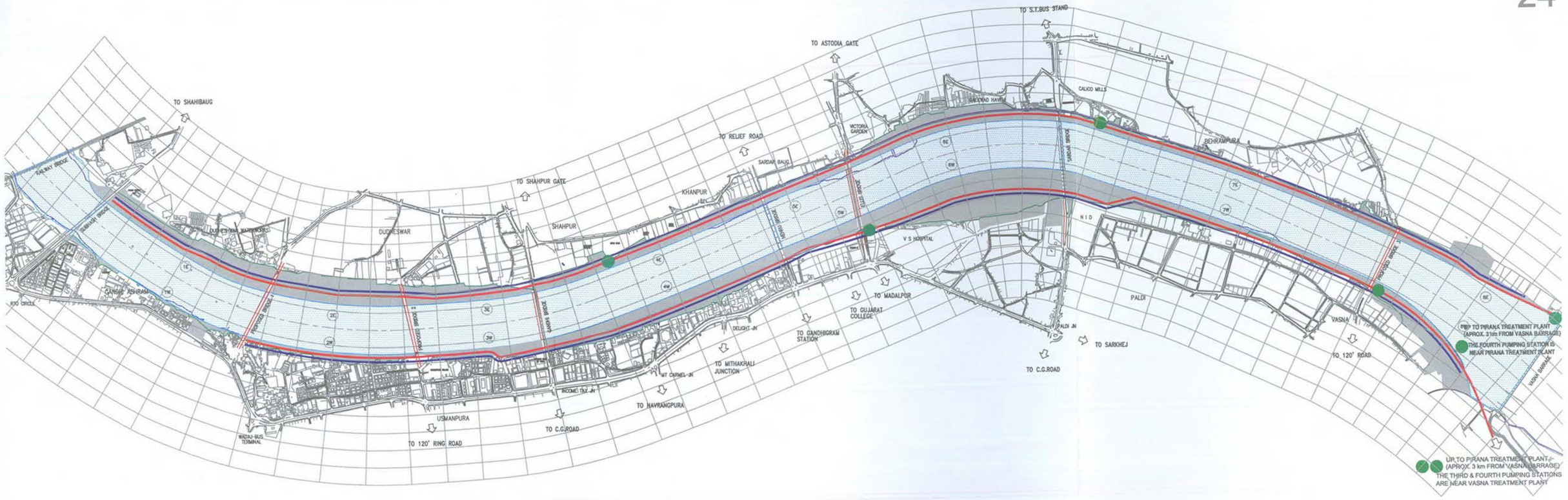
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0 100 300 500 1000 m

LEGEND

	WATER SUPPLY MAINS HDPE pipe (6 kg/sq cm)	
	East Side (500 mm)	8774m
	West Side (500 mm)	7590m
	TRUNK SEWER RCC NP3 hume pipe conforming to IS:458	
	East Side (750 mm)	11758m
	West Side (600 mm)	10604m
	SEWAGE PUMPING STATION	
	East Side	4 Nos
	West Side	4 Nos

NOTE

[1] Branch lines for watersupply area 6" HDPE pipes (6 kg/sq cm) to be laid along connector road. The length is considered to be same as that of connector roads which is 4000m.

[2] Branch sewers are 9" dia stoneware pipes to be laid along connector roads. The length is considered to be same as that of connector roads which is 4000m.

SEWERAGE AND WATER SUPPLY

1:17500

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

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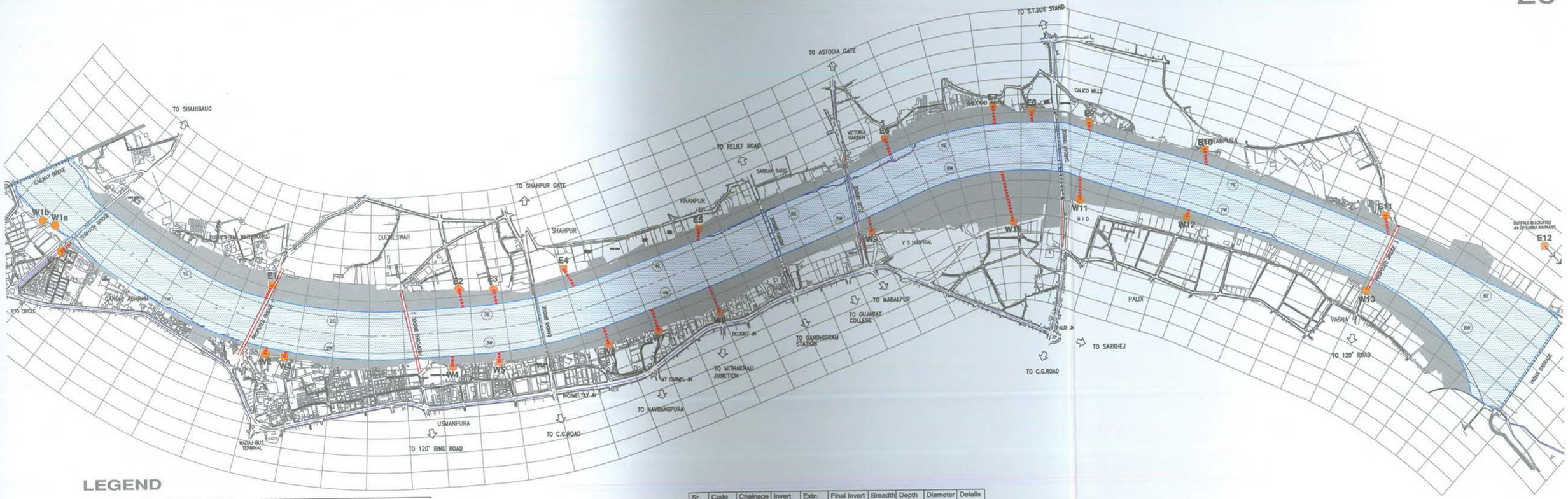
Contents are based on preliminary design based on Sheladia Associates.

May 1998

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LEGEND

■	SLAB CULVERT TYPE OUTFALL
●	PIPE CULVERT TYPE OUTFALL
▪▪▪▪	EXTENTION OF OUTFALL TO PROPOSED RETAINING WALL

Note: [1] Slope for extention for slab culvert is 1 in 1000.
[2] Slope for extention for pipe culvert is 1 in 300.
[3] All dimensions area in m.
[4] Outfalls E12, W1b, W1a fall outside the project area.

Sr. No.	Code	Chainage	Invert RL	Extn. Length	Final Invert RL	Breadth	Depth	Diameter	Details
1	E1	1134.75	43.280	81.65	43.198	1.85	1.13	na	slab
2	E2	2315.83	41.621	108.17	41.260	na	na	1.60	pipe
3	E3	2521.61	42.390	87.32	42.099	na	na	0.65	pipe
4	E4	3016.83	41.439	119.97	41.319	5.00	2.37	na	slab
5	E5	3820.48	40.715	72.13	40.643	3.60	3.10	na	slab*
6	E6	5021.61	42.900	97.01	42.803	3.75	2.00	na	slab#
7	E7	5608.00	42.735	110.09	42.625	1.00	1.00	na	slab
8	E8	5815.83	40.338	62.85	40.275	1.85	2.66	na	slab
9	E9	6146.96	39.783	47.63	39.624	na	na	1.23	pipe
10	E10	6815.83	40.963	94.59	40.868	3.70	2.10	na	slab
11	E11	7923.26	39.525	114.31	39.411	4.15	2.40	na	slab
12	E12	9221.21	39.313	na	na	na	4.45	na	slab
13	W1b	-201.55	42.577	na	na	na	na	1.15	pipe
14	W1a	-243.89	44.188	na	na	na	na	1.04	pipe
15	W1	0.00	48.249	75.96	47.996	na	na	0.80	pipe
16	W2	1202.95	41.340	38.31	41.212	na	na	0.80	pipe
17	W3	1310.23	41.500	33.88	41.466	1.85	3.00	na	slab
18	W4	2248.60	41.297	63.61	41.233	1.85	3.60	na	slab
19	W5	2510.58	41.500	55.59	41.444	1.85	2.00	na	slab
20	W6	3114.55	42.190	103.44	41.845	na	na	1.80	pipe
21	W7	3413.23	42.731	132.72	42.289	na	na	1.80	pipe
22	W8	3780.28	41.676	164.11	41.512	2.30	2.75	na	slab
23	W9	4793.56	39.415	86.06	39.329	1.85	3.50	na	slab
24	W10	5615.83	40.920	302.72	40.617	1.85	2.25	na	slab
25	W11	6101.95	39.416	131.46	38.978	na	na	1.00	pipe
26	W12	6790.49	39.225	42.58	39.182	1.85	2.50	na	slab
27	W13	7968.46	38.933	70.38	38.698	na	na	1.00	pipe

* Three openings of 1.20m with walls of 0.80m
\# Three openings of 1.25m with walls of 1.50m

0 100 300 500 1000 m

SW DRAINAGE OUTFALLS

1:17500

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

Prepared for Sabarmati River Front Development Corporation Limited (SRFDCL)

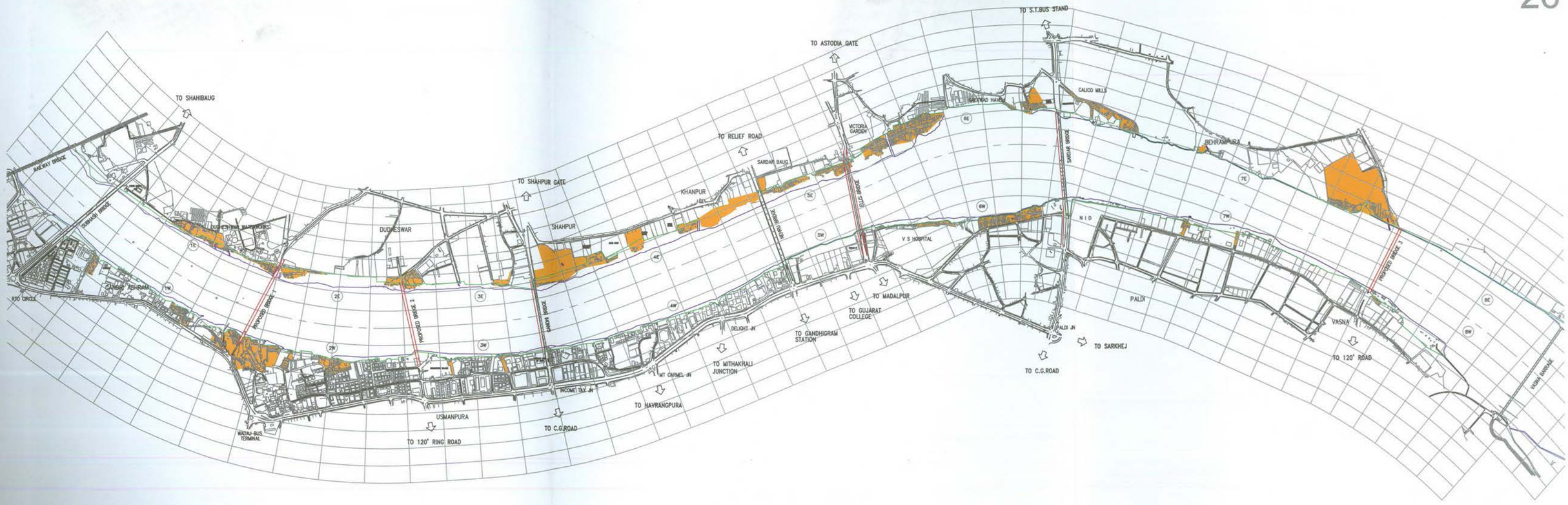
Contents are based on data provided by Theotech Engineers, Survey Consultants, Baroda.

May 1998

EPC ENVIRONMENTAL PLANNING COLLABORATIVE
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LEGEND

	SLUMS ESTABLISHED AFTER 1991
	SLUMS ESTABLISHED BEFORE 1991

SLUM LOCATIONS ON THE RIVER BANK

No.	Segment	No of Slums	No of HHs*
1E	Between Subhash Bridge & Prop Bridge 1	9	840
2E	Between Prop Bridge 1 & Prop Bridge 2	4	285
3E	Between Prop Bridge 2 & Gandhi Bridge	3	259
4E	Between Gandhi Bridge & Nehru Bridge	16	2195
5E	Between Nehru Bridge and Ellis Bridge	4	420
6E	Between Ellis Bridge & Sardar Bridge	8	792
7E	Between Sardar Bridge & Prop Bridge 3	15	2456
8E	Between Prop Bridge 3 & Vasna Barrage	0	0
	Subtotal	59	7247
1W	Between Subhash Bridge & Prop Bridge 1	4	245
2W	Between Prop Bridge 1 & Prop Bridge 2	10	1465
3W	Between Prop Bridge 2 & Gandhi Bridge	6	150
4W	Between Gandhi Bridge & Nehru Bridge	0	0
5W	Between Nehru Bridge and Ellis Bridge	0	0
6W	Between Ellis Bridge & Sardar Bridge	2	436
7W	Between Sardar Bridge & Prop Bridge 3	3	154
8W	Between Prop Bridge 3 & Vasna Barrage	2	73
	Subtotal	27	2523
	Total	86	9770 10000 (approx)

* This includes the slums established before 1991 and after 1991.

0 100 300 500 1000 m

SLUMS ON THE RIVER BANKS

1:17500

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This map has been prepared on the basis of reconnaissance survey by EPC and Slums Census 1991 by ASAG for AMC.

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LEGEND

PROJECT AFFECTED SLUMS

PROJECT AFFECTED SLUMS

No.	Segment	No of Slums	No of HHs*
1E	Between Subhash Bridge & Prop Bridge 1	9	332
2E	Between Prop Bridge 1 & Prop Bridge 2	4	270
3E	Between Prop Bridge 2 & Gandhi Bridge	3	61
4E	Between Gandhi Bridge & Nehru Bridge	16	1661
5E	Between Nehru Bridge and Ellis Bridge	4	341
6E	Between Ellis Bridge & Sardar Bridge	8	976
7E	Between Sardar Bridge & Prop Bridge 3	15	28
8E	Between Prop Bridge 3 & Vasna Barrage	0	0
	Subtotal	59	3669
1W	Between Subhash Bridge & Prop Bridge 1	1	42
2W	Between Prop Bridge 1 & Prop Bridge 2	3	85
3W	Between Prop Bridge 2 & Gandhi Bridge	0	0
4W	Between Gandhi Bridge & Nehru Bridge	0	0
5W	Between Nehru Bridge and Ellis Bridge	0	0
6W	Between Ellis Bridge & Sardar Bridge	2	441
7W	Between Sardar Bridge & Prop Bridge 3	0	151
8W	Between Prop Bridge 3 & Vasna Barrage	0	0
	Missing		7
	Subtotal	6	726
	Total	65	4395 4400 (approx.)

* - HouseHolds

0 100 300 500 1000 m

PROJECT AFFECTED SLUMS

1:17500

SABARMATI RIVER FRONT DEVELOPMENT, AHMEDABAD

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This map has been prepared on the basis of a survey conducted between 4th week of february and 1st week of march 1998, by Vikas Centre For Development.

May 1998

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0 100 300 500 1000 m

LEGEND

	WASHING AND DYEING
	INFORMAL MARKETS
	SAND COLLECTION
	CULTIVATION (DECEMBER - APRIL)

ECONOMIC ACTIVITIES ON THE RIVER BED

1:17500

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0 100 300 500 1000 m

LEGEND

Sr. No.	Items	Code	Nos	L (m)	B(m)	Area (sq m)	House Holds
7	WATERSUPPLY (HDPE PIPE-6 kg/sq cm)			8774			
7.1	Mains (east) 500 mm dia			7590			
7.2	Mains (west) 500 mm dia						
8	SEWERAGE (RCC NP3 HUME PIPE)						
8.1	Trunk Sewer (east) 750 mm dia			11758			
8.2	Trunk Sewer (west) 600 mm dia			10604			
8.5	Pumping Station		8				
10	ROADS						
10.1	Level 1 : Carriageway (east)			8400	21	176400	
10.2	Level 1 : Footpath (east)			8400	15	126000	
10.3	Level 2 : Carriageway (west)			6800	14	95200	
10.4	Level 2 : Footpath (west)			6800	16	108800	
10.5	Level 3 : Carriageway (east + west)			3680	10	36800	
10.6	Level 3 : Footpath (east)			3680	5	18400	
10.7	Level 3 : Cul-de-sac		24	25	10	3500	
11	ROAD UPGRADING						
11.1	Carriageway (east)			4156	10	41560	
11.2	Footpath (east)			4156	5	20780	
11.3	Carriageway (west)			4852	10	48520	
11.4	Footpath (west)			4852	5	24260	
11.5	Junctions		45				
12	PROMENADES					98000	
13	GARDENS						
13.1	Dudheshwar Garden					55200	
13.2	Heritage Park					13300	
13.3	Victoria Garden Extension					12800	
13.4	Pirana Forest					47300	
13.5	Gandhi Ashram Park					25700	
13.6	B J Park Extension					29100	
13.7	City Park					157900	
13.8	V S Hospital Park					15100	
13.9	Vasna Forest					71800	
14	RESETTLEMENT & REHABILITATION						4400
15	INFORMAL MARKETS (four in all)					58654	

NOTE
[1] Sr. No. correspond to item as numbered in the cost estimate table in the report.
[2] Right-of-way for Level 1, 2, 3 roads is 36m, 30m, 15m respectively.
[3] The alignment of water supply mains, trunk sewers and position of sewage pumping station are schematic.

COST ESTIMATE (SUPPORT MAP)

1:17500

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