Government of Rajasthan
Asian Development Bank

Technical Assistance

Project Number: 40031

India: Rajasthan Urban Sector Development Investment Program (RUSDIP)

INITIAL ENVIRONMENTAL EXAMINATION (DRAFT)

JHALAWAR AND JHALRAPATAN: WATER SUPPLY SUBPROJECT

FEBRUARY 2007

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I. INTRODUCTION

A. Purpose of the report

1. Rajasthan Urban Sector Development Investment Program (RUSDIP) is intended to optimize social and economic development in 15 selected towns in the State, particularly district headquarters and towns with significant tourism potential. This will be achieved through investments in urban infrastructure (water supply; sewerage and sanitation; solid waste management; urban drainage; urban transport and roads), urban community upgrading (community infrastructure; livelihood promotion) and civic infrastructure (art, culture, heritage and tourism; medical services and health; fire services; and other services). RUSDIP will also provide policy reforms to strengthen urban governance, management, and support for urban infrastructure and services. The assistance will be based on the State-level framework for urban reforms, and institutional and governance reforms recommended by the Government of India (GoI) through the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT).

2. RUSDIP will be implemented over a five year period beginning in late 2007, and will be funded by a loan via the Multitranche Financing Facility (MFF) of the ADB. The Executing Agency (EA) is the Local Self-Government Department (LSGD) of the Government of Rajasthan (GoR); and the Implementing Agency (IA) is the Project Management Unit (PMU) of the Rajasthan Urban Infrastructure Development Project (RUIDP), which is currently in the construction stage. Alwar, Jaisalmer and Jhalawar/Jhalrapatan are the towns chosen to benefit from the first tranche of RUSDIP investment.

3. RUSDIP will improve infrastructure through the design and implementation of a series of subprojects, each providing improvements in a particular sector (water supply, sewerage, etc) in one town. RUSDIP has been classified by ADB as environmental assessment category B (some negative impacts but less significant than category A). The impacts of subprojects prepared for the first tranche of funding were assessed by 13 Initial Environmental Examination (IEE) Reports and 3 Environmental Reviews, prepared according to ADB Environment Policy (2002) and Environmental Assessment Guidelines (2003). This document is the IEE report for the Jhalawar and Jhalrapatan Water Supply Subproject.

B. Extent of IEE study

4. Indian law and ADB policy require that the environmental impacts of development projects are identified and assessed as part of the planning and design process, and that action is taken to reduce those impacts to acceptable levels. This is done through the environmental assessment process, which has become an integral part of lending operations and project development and implementation worldwide.

1. ADB Policy

5. ADB's Environment Policy requires the consideration of environmental issues in all aspects of the Bank's operations, and the requirements for Environmental Assessment are described in Operations Manual (OM) 20: Environmental Considerations in ADB Operations. This states that ADB requires environmental assessment of all project loans, programme loans, sector loans, sector development programme loans, financial intermediation loans and private sector investment operations.

6. The nature of the assessment required for a project depends on the significance of its environmental impacts, which are related to the type and location of the project, the sensitivity, scale, nature and magnitude of its potential impacts, and the availability of cost-effective mitigation measures. Projects are screened for their expected environmental impacts and are assigned to one of the following categories:

Category A: Projects that could have significant environmental impacts. An Environmental Impact Assessment (EIA) is required.

Category B: Projects that could have some adverse environmental impacts, but of less significance than those for category A. An Initial Environmental Examination (IEE) is required to determine whether significant impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report.

Category C: Projects that are unlikely to have adverse environmental impacts. No EIA or IEE is required, although environmental implications are reviewed.

Category FI: Projects that involve a credit line through a financial intermediary (FI) or an equity investment in a FI. The FI must apply an environmental management system, unless all subprojects will result in insignificant impacts.

7. The Bank has classed this program as Category B and following normal procedure for MFF loans has determined that one IEE will be conducted for each subproject, with a subproject being the infrastructure improvements proposed in a particular sector (water supply, sewerage, etc) in one town.

2. National Law

8. The GoI EIA Notification of 2006 (replacing the EIA Notification of 1994), sets out the requirement for Environmental Assessment in India. This states that Environmental Clearance (EC) is required for specified activities/projects, and this must be obtained before any construction work or land preparation (except land acquisition) may commence. Projects are categorised as A or B depending on the scale of the project and the nature of its impacts.

9. Category A projects require EC from the national Ministry of Environment and Forests (MoEF). The proponent is required to provide preliminary details of the project in the form of a Notification, after which an Expert Appraisal Committee (EAC) of the MoEF prepares comprehensive Terms of Reference (ToR) for the EIA study, which are finalized within 60 days. On completion of the study and review of the report by the EAC, MoEF considers the recommendation of the EAC and provides the EC if appropriate.

10. Category B projects require environmental clearance from the State Environment Impact Assessment Authority (SEIAA). The State level EAC categorises the project as either B1 (requiring EIA study) or B2 (no EIA study), and prepares ToR for B1 projects within 60 days. On completion of the study and review of the report by the EAC, the SEIAA issues the EC based on the EAC recommendation. The Notification also provides that any project or activity classified as category B will be treated as category A if it is located in whole or in part within 10 km from the boundary of protected areas, notified areas or inter-state or international boundaries.

11. The only type of infrastructure provided by the RUSDIP that is specified in the EIA Notification is solid waste management, where EC is required for all Common Municipal Solid Waste Management Facilities (facilities that are shared by more than one town)[1]. EC is thus not required for the water supply sub-project that is the subject of this IEE.

3. Review and Approval Procedure

12. For Category B projects the Draft IEE report and its summary (SIEE) are reviewed by ADB's Regional Department sector division and Environment and Social Safeguards Division, and by the Executing Agency, and additional comments may be sought from project affected people and other stakeholders. All comments are incorporated in preparing the final documents, which are reviewed by the Executing Agency and the national environmental protection agency (MoEF in this case). The EA then officially submits the IEE and SIEE reports to ADB for consideration by the Board of Directors. Completed reports are made available worldwide by ADB, via the depository library system and the ADB website.

4. Scope of Study

13. This is the IEE for the Jhalawar and Jhalrapatan Water Supply subproject. It discusses the environmental impacts and mitigation measures relating to the location, design, construction and operation of all physical works proposed under this subproject. It is one of 18 documents describing the environmental impacts and mitigation of all subprojects proposed in Tranche 1. These were prepared in January and February 2007 by one International and one Domestic Environmental Specialist via inputs of two and three months respectively.

II. DESCRIPTION OF THE PROJECT

A. Type, Category and Need

14. This is a water supply sub-project, and as explained above it has been classified by ADB as Category B, because it is not expected to have major negative environmental impacts. Under ADB procedures such projects require an IEE to identify and mitigate the impacts, and to determine whether further study or a more detailed EIA may be required. The sub-project is needed because the present water supply infrastructure in Jhalawar and Jhalrapatan is inadequate for the needs of the growing population. The distribution system supplies 90% of the people in each town, but water is available for only 1-2 hours per day (and only on alternate days in the dry season), mainly because of system losses (estimated at 40%) and low and unequal network pressure. This is one of a series of subprojects designed by the RUSDIP that are intended to raise the standards of the municipal infrastructure and services of Jhalawar/ Jhalrapatan and the other urban centres to those expected of modern Asian towns.

B. Location, Size and Implementation Schedule

15. The sub-project is located in the two neighbouring towns of Jhalawar and Jhalrapatan, in Jhalawar District, in the south-east of Rajasthan in north-western India (Figures 1, 2 and 3). Improvements in the distribution system will affect most of the town, where a new network will

[1] According to the Rajasthan State Pollution Control Board, the MoEF intends to issue a clarification to the EIA Notification in due course, which will add all landfill facilities and Sewage Treatment Plants to the list of projects specified as requiring EC under the Notification. This has not yet been issued, so the text above indicates the correct legal position at the time of writing (February 2007)

be provided via pipes buried alongside roads and streets, and ten new Overhead Reservoirs (Photo 1) and chlorination plants will be built on small parcels of government land. Larger scale facilities, comprising new intake structures and Clear Water Reservoirs (CWR) will be built on government land outside each town (Photos 2 and 3), and new rising mains will be built alongside roads to transfer water from the CWRs to ORs.

16. Detailed design will begin in the middle of 2007 and should be completed by the end of the year, after which construction of the source augmentation works (intakes and CWRs) will take 6-8 months. The rising mains and network improvements will take up to 1½ years, so all work should be completed by the middle of 2009.

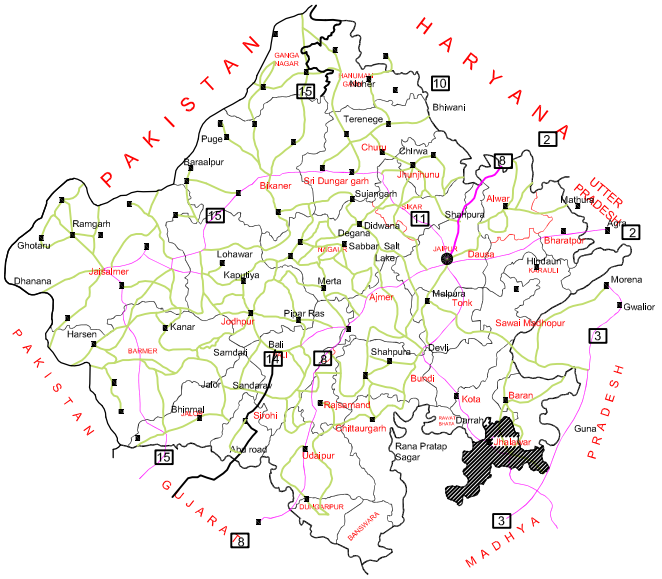
C. Description of the Sub-project

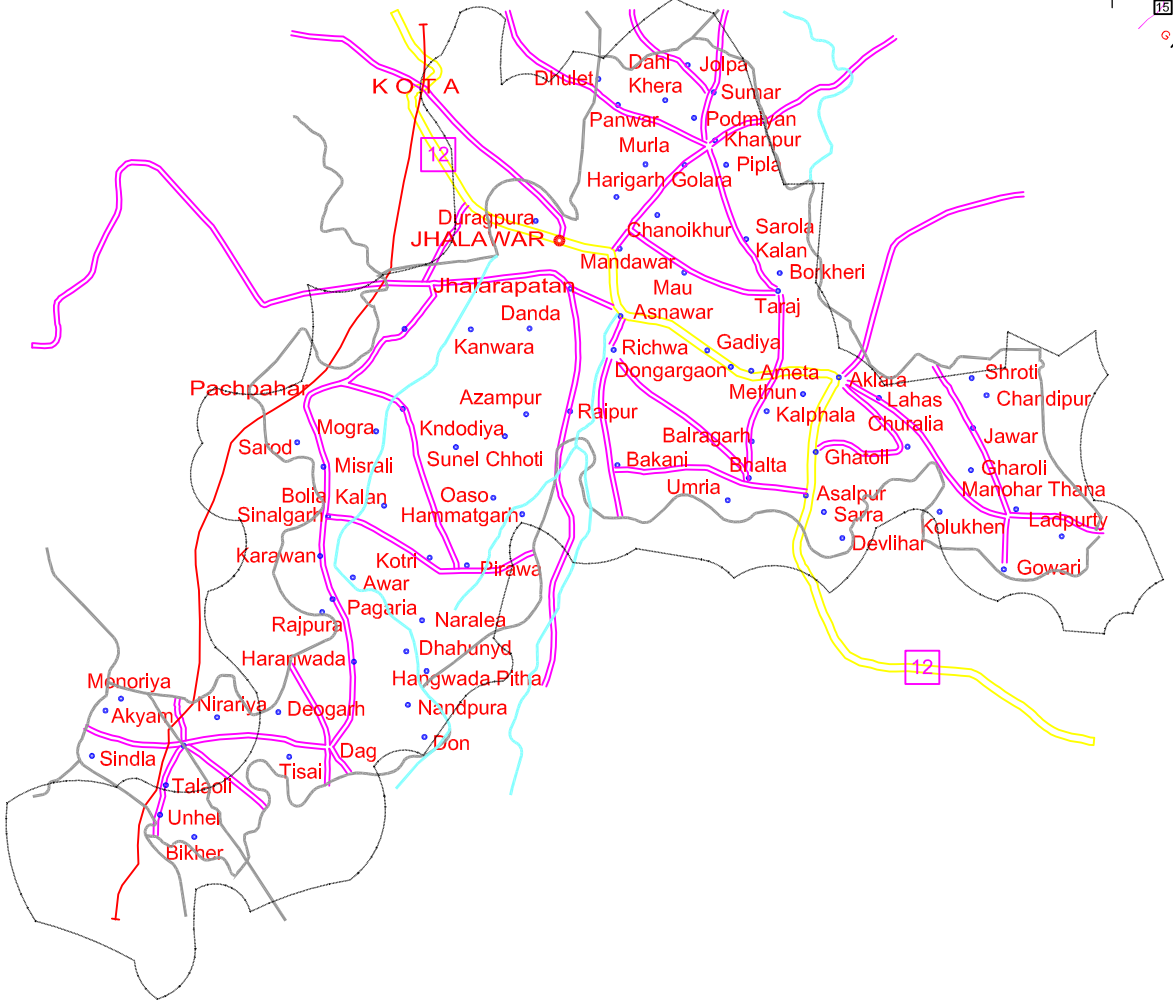
17. Table 1 shows the nature and size of the various components of the subproject. There are two main elements: augmentation of the water source and supply; and expansion and improvement of the distribution network. The descriptions shown in Table 1 are based on the present proposals, which are expected to be substantially correct, although certain details may change as development of the subproject progresses, particularly in the detailed design stage. It should also be noted that at this stage the infrastructure has been designed in outline only, to determine overall feasibility and budget costs, so certain aspects (such as exact locations of distribution pipes, etc) have not yet been finalised.

18. Augmentation of the water supply will involve construction of two new intakes to extract water from the Kalisindhi River, a Clear Water Reservoir (CWR) to store water at each of the existing Water Treatment Plants (WTP), and 43 km of rising mains to transfer water from each CWR to Overhead Reservoirs (OR) in each town. There will also be minor rehabilitation of equipment and machinery at the existing WTPs, principally replacement of damaged screens for the removal of debris.

19. The new intakes will be located on government land on the bank of the Kalisindhi River at Pipa Ji Deh and Bhawarasa Deh (Figures 4 and 5 and Photos 4-8). Each will consist of a brick-lined cylindrical dry intake well, approximately 6 m across and 20 m deep, plus a brick pump house (approximately 6 x 6 x 5 m) equipped with two turbine pumps and connecting pipe-work. A 3 m wide concrete access road will also be built to the intake from the main road, which is around 1 km away from each site. A CWR will be built on the site of the existing WTP in each town, at Radi ke Balaji and Mudhilya Kheri (Figures 2 and 3; Photos 2 and 3). Each CWR will consist of a Reinforced Cement Concrete (RCC) tank, 15 or 20 m in diameter and around 4 m deep, built with approximately 2 m above and below ground. A small pump house and inspection house will also be built nearby. The 43 km of rising main will be built from Ductile Iron (DI) pipe (Photo 9) of 250-400 mm diameter, which will be buried in trenches approximately 1.5 m deep in the Right of Way (RoW) alongside main roads in each town.

20. Expansion and improvement of the distribution system will involve: the provision of piped water to all parts of the town using DI pipes to replace the existing system of Asbestos Concrete (AC) pipes; construction of overhead storage reservoirs and chlorination plants to improve the pressure and quality of the water supplied; and provision of bulk and household water meters to monitor and regulate flow and facilitate cost recovery.





Rajasthan Urban Sector
Development Investment Program
ADB TA 4814-IND

Jhalawar & Jhalrapatan
Regional Map

LEGEND:-

- National Highway
- State Boundary
- State Road Network
- State Capital

OVERLAY LEGEND:-

GOVT. OF RAJASTHAN
ASIAN DEVELOPMENT BANK

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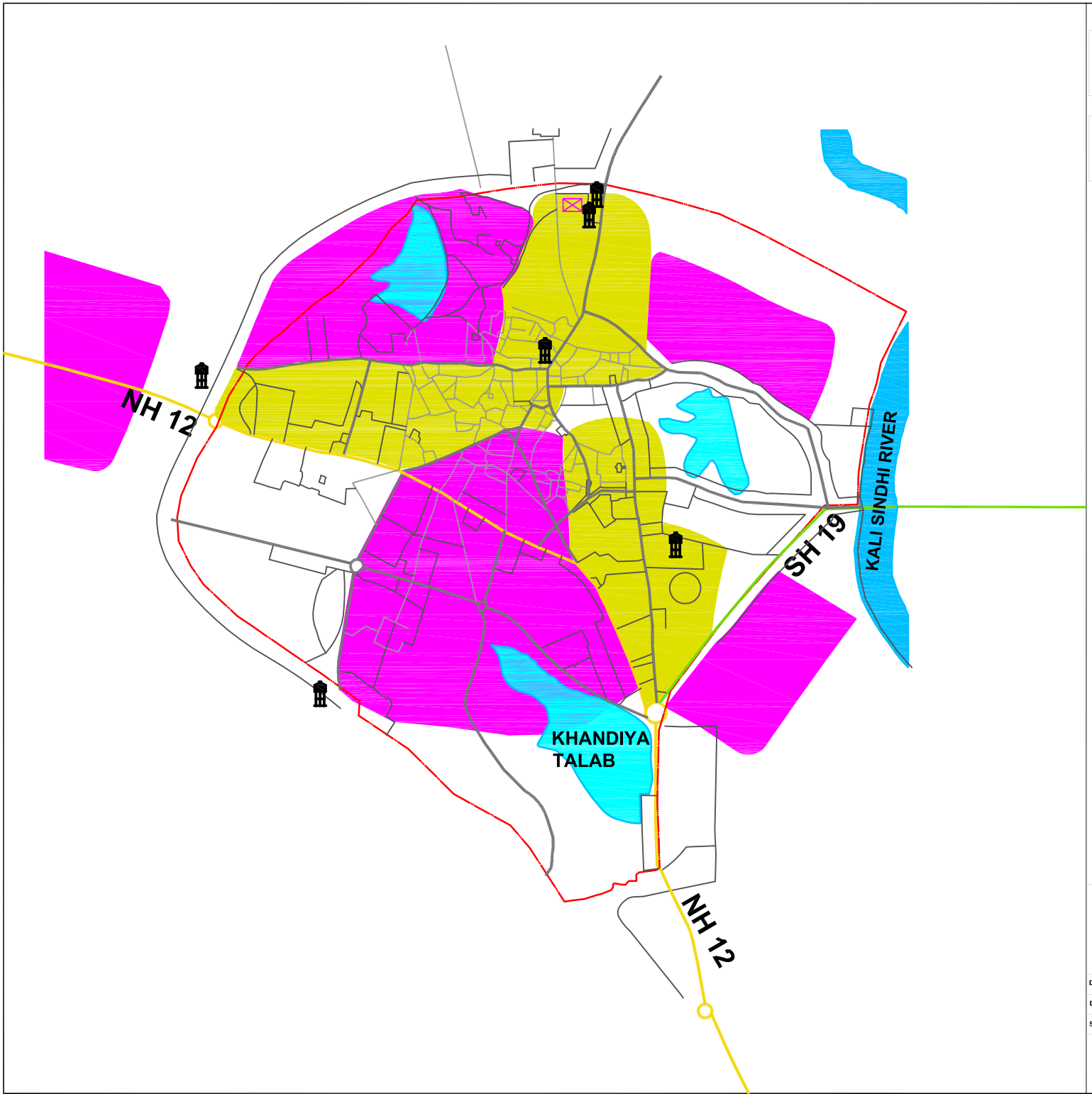

RAJASTHAN URBAN SECTOR DEVELOPMENT INVESTMENT PROGRAM
(ADB TA 4814 - IND)

JHALAWAR
Water Supply System

LEGEND:

- Municipal Limit
- Water Bodies
- National Highway
- State Highway
- River

OVERLAY LEGEND:

- Arterial Roads
- Sub Arterial Roads
- Other Roads
- Existing water supply zone
- Proposed water supply zone
- Existing water treatment plant
- Storage Reservoir

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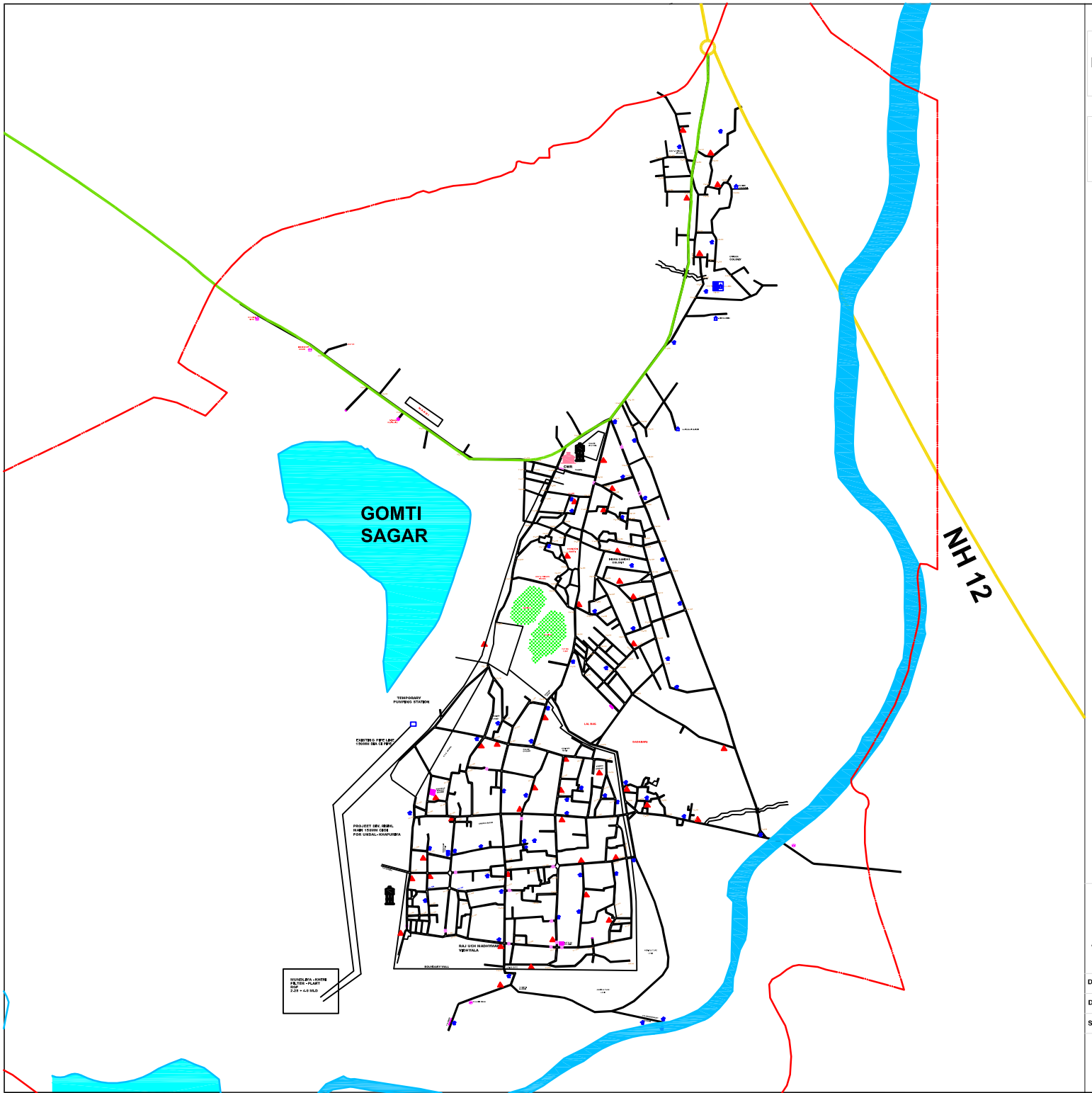

RAJASTHAN URBAN SECTOR
DEVELOPMENT INVESTMENT PROGRAM
(ADB TA 4814 - IND)

JHALRAPATAN
Water Supply System

LEGEND:

- Municipal Limit
- Water Bodies
- National Highway
- State Highway
- River

OVERLAY LEGEND:

- PSP
- Handpump
- Storage Reservoir
- Storage Reservoir

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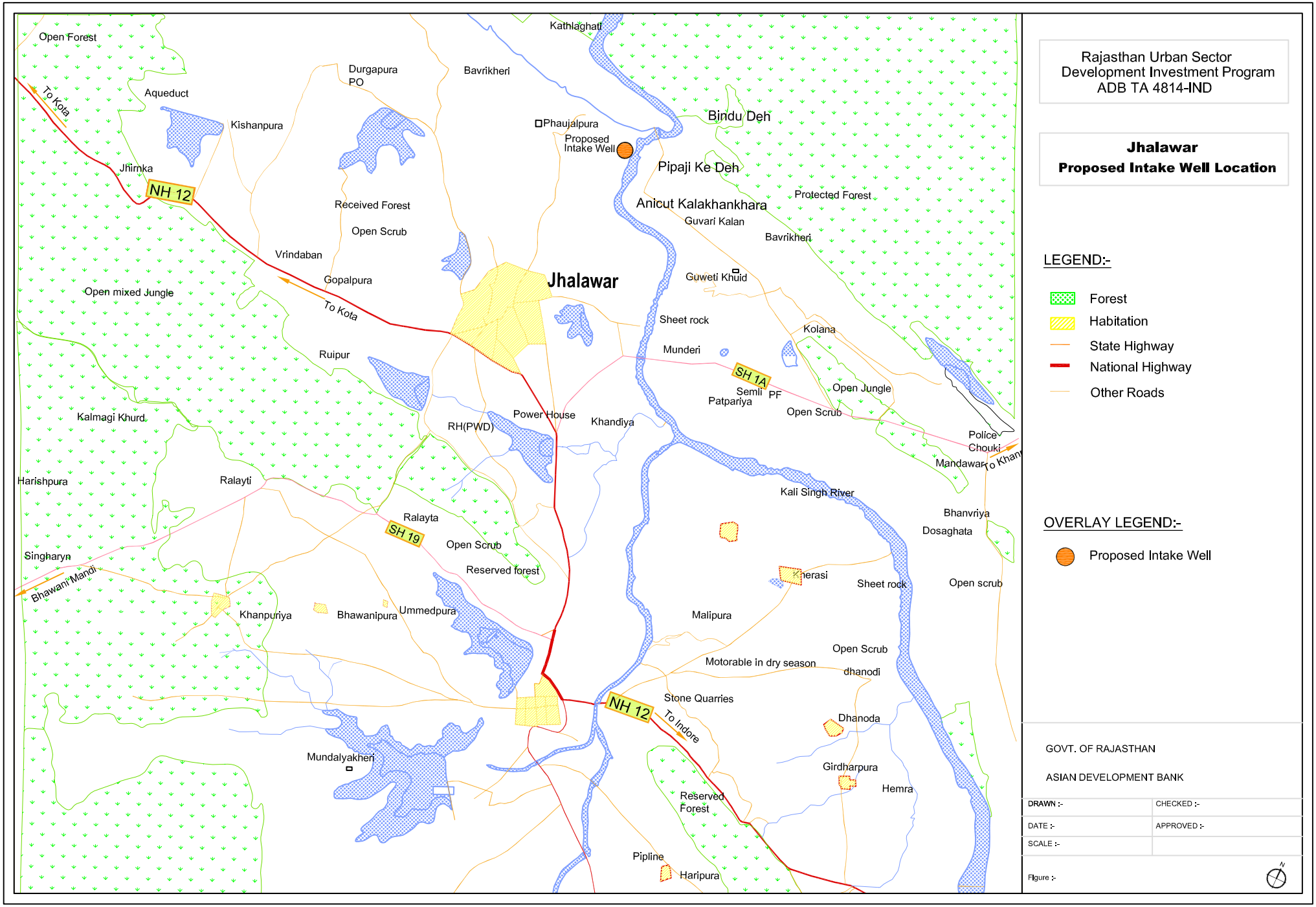

Rajasthan Urban Sector Development Investment Program
ADB TA 4814-IND

Jhalawar
Proposed Intake Well Location

LEGEND:-

- Forest
- Habitation
- State Highway
- National Highway
- Other Roads

OVERLAY LEGEND:-

- Proposed Intake Well

GOVT. OF RAJASTHAN

ASIAN DEVELOPMENT BANK

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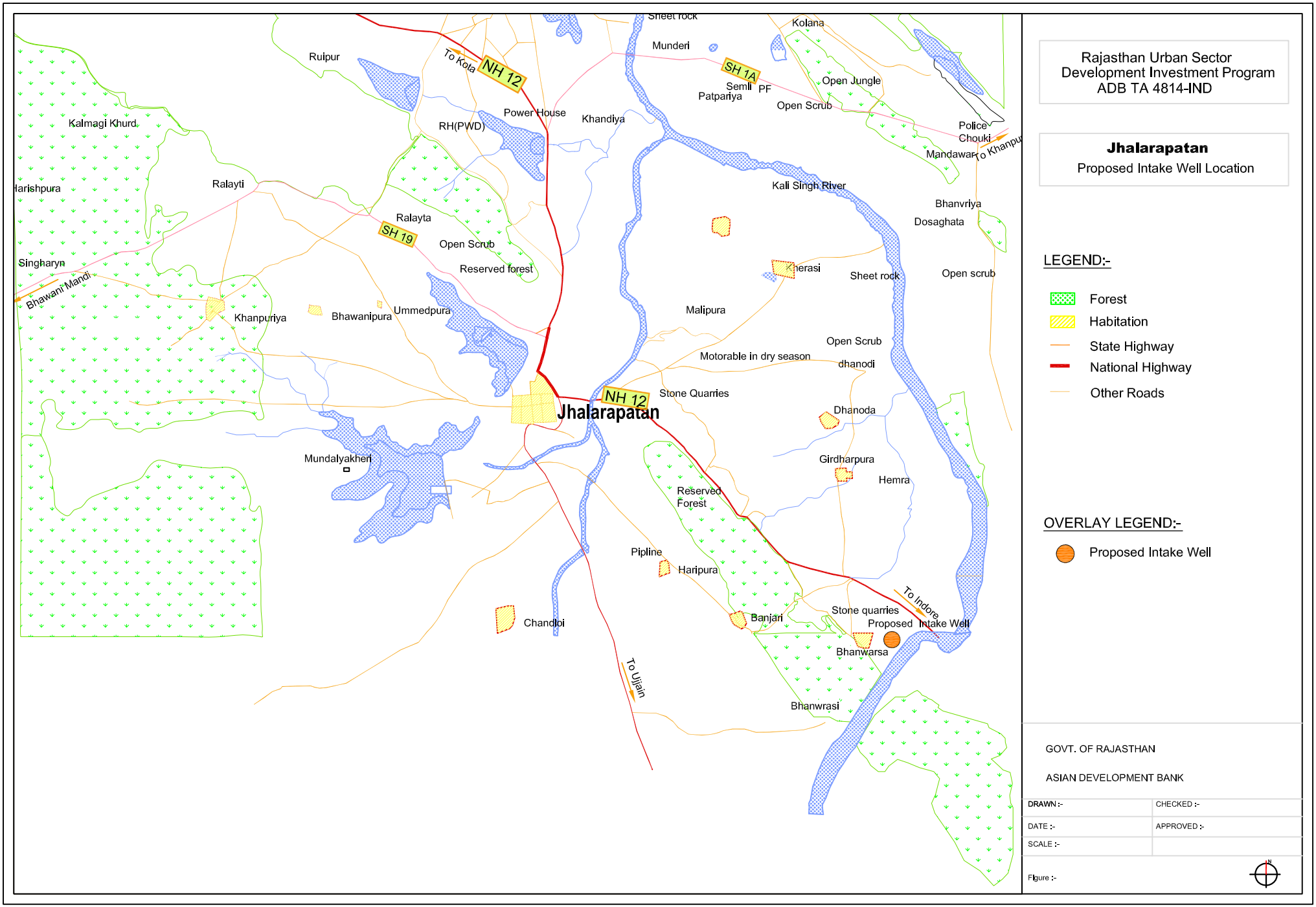
Rajasthan Urban Sector
Development Investment Program
ADB TA 4814-IND
Jhalarapatan
Proposed Intake Well Location
LEGEND:-
Forest
Habitation
State Highway
National Highway
Other Roads
OVERLAY LEGEND:-
Proposed Intake Well
GOVT. OF RAJASTHAN
ASIAN DEVELOPMENT BANK
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SCALE :-
Figure :-
Jhalarapatan
NH 12
To Kota
SH 1A
SH 19
Ruipur
Munderi
Kolana
Semli Patpariya
PF
Open Jungle
Open Scrub
Power House
RH(PWD)
Khandiya
Police Chouki
Mandawar
To Khanpur
Kalmagi Khurd
Harishpura
Ralayti
Ralayta
Kali Singh River
Bhanvriya
Dosaghata
Singharyn
Bhawani Mandi
Reserved forest
Sheet rock
Open scrub
Khanpuriya
Bhawanipura
Ummedpura
Malipura
Motorable in dry season
dhanodi
Stone Quarries
Dhanoda
Mundalyakheri
Girdharpura
Hemra
Reserved Forest
Pipline
Haripura
Chandloi
Banjari
Stone quarries
Proposed Intake Well
To Indore
Bhanwarsa
To Ujjain
Bhanwrasi

Table 1: Improvements in water supply infrastructure proposed in Jhalawar and Jhalrapatan

Infrastructure	Function	Description	Location
1. Source and Supply Augmentation			
Intakes	Increase the quantity of water available by extracting groundwater from alongside the Kalisindhi River	Two intakes: each consisting of a brick lined dry intake well, approximately 6 m across and 20 m deep, with piped connections to an adjacent raw water pump house (ca 6 x 6 x 5 m). A new concrete access road will also be built, approximately 3 m wide and 1 km in length, from each intake to main road	Intakes will be located alongside the river at Pipa Ji Deh (for Jhalawar) and Bhawarasa Deh (for Jhalrapatan). Intakes, pump houses and access roads will all be built on government land
Clear Water Reservoirs (CWR)	Store treated water before entry to the rising main	Two open Reinforced Cement Concrete (RCC) tanks, 15 and 20 m in diameter, 0.75 and 1 ML capacity. Plus pump house, inspection house and power lines	Within the compounds of the existing Water Treatment Plants at Radi ke Balaji (Jhalawar) and Mudhilya Kheri (Jhalrapatan)
Rising Mains	Convey water from each Clear Water Reservoir to new Overhead Reservoirs (OR) in each town	43 km of 250-400 mm diameter Ductile Iron (DI) pipe (4.5 km of 400 mm; 2 km of 350 mm; 33.5 km of 300 mm; 3 km of 250 mm)	Buried in a trench, mainly in the Right of Way (ROW) alongside main roads in each town
Rehabilitation at WTPs	Improve water treatment	Replacement of old screens and other machinery	Two existing WTPs, one outside each town
2. Expansion and Improvement of Distribution Network			
Distribution mains	Supply water to all parts of each town, replacing the existing Asbestos Concrete (AC) distribution pipeline	117.5 km of 100-400 mm diameter DI pipe (9.5 km of 400 mm; 7.4 km of 250 mm; 11.6 km of 200 mm; 89 km of 100-150 mm)	Buried in trenches alongside main roads and neighbourhood streets in each town
Overhead Reservoirs (OR)	Provide increased water storage and a head of water required for gravity flow of water through the distribution system	10 sealed RCC tanks (ca 15 x 10 x 3 m), mounted 20 m above the ground on RCC supporting framework	On small parcels of government owned land in each town, each <35 m in diameter.
Chlorination Plants 1 Jhalawar and 1 at Patan	Water treatment	17 brick-built houses (ca 8 x 4 x 4 m) with small sump and chlorine injection cylinders	10 at new ORs and 7 at existing ORs, directly beneath the OR
Pump replacement	Improve water supply and pressure	Replace 8 old and inefficient pumps	At existing OR pump houses
Bulk flow meters	Monitor water flow in the improved network	21 small meters and 2 ultrasonic flow meters located in brick-built houses	In brick houses at each OR and pumping station
Replacement of non-functional water meters	Monitor and regulate water usage by consumers and improve cost recovery	5,000 small meters	Attached to the outside of houses
District Laboratory	Monitor the quality of water in the municipal system	Brick building, with water, electricity and wastewater services, and laboratory furniture and equipment	At the existing Public Health Engineering Department (PHED) compound in Jhalawar

21. The new network will be provided from 117.5 km of 100-400 mm diameter DI pipe, which will be located in trenches alongside roads and neighbourhood streets in each town. The ten new overhead reservoirs (OR) will be located on small parcels of government-owned land at various locations in each town (Figure 4). All will be constructed from RCC, will measure approximately 15 x 10 m x 3 m, and will be mounted on RCC supports approximately 20 m above the ground (Photo 1). Small brick houses (ca 8 x 4 x 4 m) will be built below each OR, each housing a small sump and cylinders for chlorine injection for water treatment. Eight new water pumps will also be provided, to replace old and inefficient units (Photo 10).

22. A total of 21 bulk flow meters and 2 ultrasonic meters will be installed in pump houses and at OR sites, and a further 5,000 household meters will be provided outside individual dwellings (Photo 11), to enable water use to be monitored. Finally a small laboratory will be built and equipped at the existing PHED site in Jhalawar to enable the quality of municipal water to be monitored regularly.

III. DESCRIPTION OF THE ENVIRONMENT

A. Physical Resources

1. Location

23. Jhalawar District is located in the south-east of Rajasthan, between the longitudes of 75° 27’ 35” to 76° 56’ 48” East and latitudes of 23° 45’ 20” to 24° 52’ 17” North, adjoining the neighbouring state of Madhya Pradesh (Figure 1). Jhalawar Town is the district headquarters and lies towards the centre, with the smaller Jhalrapatan 20 km to the south-east. The two towns share a single municipal boundary, which is why they are considered jointly by RUSDIP. The municipality is an average of 316 m above Mean Sea Level, and the State capital Jaipur lies 330 km to the north and the town of Kota is 85 km to the north-west.

2. Topography, soil and geology

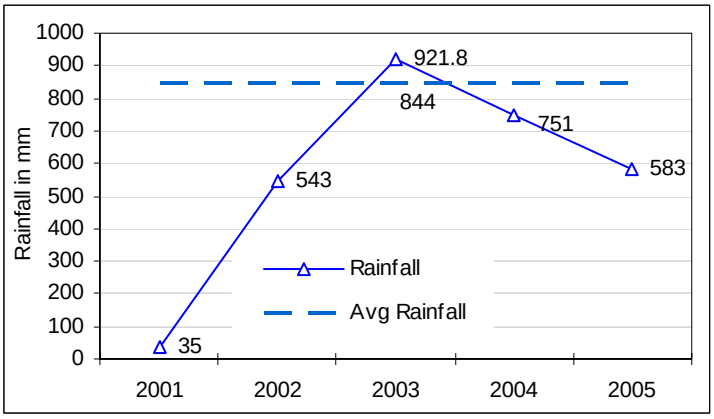
24. Both towns are located in the Jhalawar Plain, which is bounded in the north, south and east by the Mukunda hills. This is a fertile plain of mainly alluvial soil and is crossed by the Kalisindhi and Ahu rivers and a number of smaller streams. North-east of Jhalawar, between two ridges of hills, lies a long valley containing the artificial lakes of Kadila and Manasarowar.

25. Jhalawar District is at the edge of the Malawa plateau on Vindhyan strata at the northern edge of the great spread of basaltic rocks known as the Deccan trap formation. There are vast deposits of sandstone lying in horizontal strata around Jhalawar and Jhalrapatan, below which is a hard black rock stratum. Soil is mainly dark in colour, produced by weathering of the underlying rock, and is generally high in organic matter but low in nitrogen. The influence of the sandstone is also seen in places, where soil is looser and granular, with a more sandy texture.

26. According to the Vulnerability Atlas of India, Jhalawar District is in an area of low earthquake risk (Zone II), characterised by old and geologically stable rock formations. Rajasthan has not experienced a major earthquake in the recent past, but there have been 37 events with a magnitude of 5-7 since 1720. The most recent occurred in 2001 and measured 6.9 on the Richter Scale, but because the epicentre was in neighbouring Gujarat, there was only limited damage in Rajasthan, and none reported in Jhalawar or Jhalrapatan.

3. Climate

27. Like most of Rajasthan the climate of Jhalawar and Jhalrapatan is mainly dry, with significant rainfall only during the monsoon season. Winter extends from November to March, and the coolest period occurs in January when daytime temperatures average around 25 °C and often fall below 10 °C at night. Temperatures begin to rise in March and peak in May-June, when daytime values sometimes reach 48 °C. The south-west monsoon arrives in June, causing a sudden drop in temperature and increase in humidity. The long-term average rainfall is 844 mm, of which over 90% falls in the monsoon period. However, like the rest of Rajasthan rainfall has been relatively low in the past few years, and was above average only in 2003 (Figure 6). The monsoon ends in mid-September and air temperatures rise briefly, only to fall again a few weeks later with the onset of winter. Winds are generally light and northerly or north-easterly in winter and moderate to strong from the west and south-west in the monsoon.



Source: Agriculture Dept 2007

Figure 6: Average Annual Rainfall in Jhalawar 2001-2005

4. Air Quality

28. There are no data on ambient air quality in Jhalawar or Jhalrapatan, but there is a station monitored by the Rajasthan State Pollution Control Board (RPCB) at Kota, which should be representative of the general area. Data from 2004 (Table 2) shows that suspended matter is high because of the dry atmosphere and dusty roads, and Respirable Suspended Particulate Matter (RSPM: <10μm) and Suspended Particulate Matter (SPM) frequently exceed National Ambient Air Quality Standards (NAAQS). In contrast, levels of chemical pollutants (oxides of sulphur and nitrogen) are relatively low because of the limited heavy industry, which is also the case in both Jhalawar and Jhalrapatan.

Table 2: Ambient Air Quality in Kota (Annual Average, 2004; units in μg/m^3)

M. Station	Land use	SOx	NOx	RSPM	SPM
Municipal Office	Residential	6	24	90	256
Samcore Glass	Residential	6	24	99	237
NAAQ Standard	*Residential*	*60*	*60*	*60*	*140*
RSPCB Office	Industrial	7	25	98	279
NAAQ Standard	*Industrial*	*80*	*80*	*120*	*360*

RSPM: Respirable Suspended Particulate Matter; SPM: Suspended Particulate Matter
Source: Central Pollution Control Board (CPCB) 2004

5. Surface Water

29. Jhalawar District receives the most rainfall in Rajasthan and is relatively well provided with surface water as a result. All of the rivers and streams are part of the Chambal system, which is the only perennial river in the state. Kalisindhi and Ahu (Photo 12) are the main rivers, and both originate in Madhya Pradesh and flow north through Jhalawar into Kota District. All of the rivers and streams are full and swiftly flowing in the monsoon, but most are dry throughout the rest of the year, except for the Kalisindhi and Ahu, which retain water in depressions known locally as *deh* (Photo 13 and 14). These areas were the main source of water supply for Jhalawar and Jhalrapatan until recently, when two weirs were constructed in the Kalisindhi to provide a more secure supply, at Manpur 4 km northeast of Jhalawar (2001), and at Bhawrasa 6 km southeast of Jhalrapatan (2004).

30. The Public Health Engineering Department (PHED) monitors the quality of water from the Kalisindhi River at the intakes for the Jhalawar and Jhalrapatan water supply systems, and recent data (Table 3) shows that the quality is relatively good.

Table 3: Water Quality in the Kalisindhi River, December 2006

Parameter	Units	Monitoring Location		BIS Drinking Water Standard	
		Manpura	Bhawrasa	Desirable Level	Acceptable Level
pH	-	8.3	8.1	6.5-9.0	NR
Turbidity	NTU	70	130	Unobjectionable	
Total Alkalinity	µg/m^3	80	120	NS	NS
Chloride	µg/m^3	10	15	250	1000
Sulphate	µg/m^3	ND	ND	200	400
Total Dissolved Solids	µg/m^3	104	258	500	2000
Nitrate	µg/m^3	7.5	12.5	45	100
Total Hardness	µg/m^3	70	140	300	600
Fluoride	µg/m^3	0.40	0.34	1.0	1.5

Source: PHED; BIS = Bureau of Indian Standards

31. There are no natural lakes in Jhalawar district, but there are a number of artificial lakes and tanks in and around both towns, the water from which is mainly used for irrigation. These include Chandra Sarovar, Khandia Tank, Durgapura Tank and Naya Talab in Jhalawar, and Gomti Sagar and Mundliakheri (formed by damming the Chandrabhaga River) in Jhalrapatan.

6. Groundwater

32. Jhalawar and Jhalrapatan are in the south-eastern plateau region of Rajasthan, where groundwater is mainly found in layers of basalt, sandstone and shale, intercalated with sandstone. The groundwater resource of the Jhalrapatan block covers over 1300 km^2, but is heavily exploited, mainly by abstraction for agricultural use (Table 4). The water table varies from 7 m to 15 m below ground level, and rises to 2-7 m after the monsoon.

Table 4: Groundwater Resources in Jhalawar and Jhalrapatan (2003-04)

Description	Basalt Strata	Sandstone and Shale Strata
Net annual groundwater availability	58.6219 MCM	34.4722 MCM
Annual irrigation extractions	57.8988 MCM	27.6108 MCM
Domestic extractions	2.8489 MCM	1.6859 MCM
Groundwater development stage	107 %	85 %
Category	Over exploited	Critical

Source: GoR Groundwater Department

B. Ecological Resources

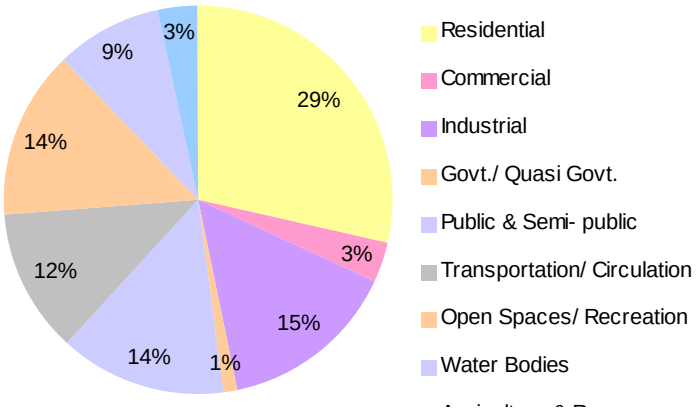
33. Jhalawar and Jhalrapatan are both urban areas surrounded by land that was converted for agricultural use many years ago (Photo 17). There is no remaining natural habitat in either town, where the flora is limited to artificially planted trees and shrubs, and the fauna comprises domesticated animals (cows, goats, pigs and chickens), plus other species able to live close to man (urban birds, rodents and some insects).

34. There are reserve forest areas in the north and north-east of Jhalawar and the north-west and south-east of Jhalrapatan, and although protected from building and most other types of activity, these contain little of ecological interest. Vegetation is sparse and comprises mainly domesticated species (Photo 18), and the fauna is also very limited. There are fish in most of the rivers and tanks outside the towns, but no aquatic areas are protected; rahu (*Labeo rihita*) and sanwal are the most common fish species.

C. Economic Development

1. Land use

35. Jhalawar Local Planning Area covers 33.09 km^2 and includes both Jhalawar (12.94 km^2) and Jhalrapatan (20.95 $km^{2)}$. According to the Master Plan for 1991-2011 (Figure 7) the main land use is residential (29%) and there are also relatively large areas of industry (15%), public land (14%), transportation (12%) and open space (14%).



Source: Jaisalmer Urban Improvement Trust

Figure 7: Land use in Jhalawar and Jhalrapatan

2. Industry and Agriculture

36. Both Jhalawar and Jhalrapatan are emerging as growing centres of commerce and industry. There are three industrial estates in Jhalawar and two in Jhalrapatan, which cover a total of 59 ha; and Rajasthan Industrial Infrastructure Corporation (RIICO) has also developed an industrial growth centre, which is currently partially occupied. Stone cutting and polishing is one of the main industries because of the large amounts of sandstone and other decorative materials quarried in surrounding hillsides, and also because of the proximity to Kota, which is famous for its stonework. There is also a large textile mill and various units related to fabrication, including PVC, agricultural accessories and handicrafts.

37. Agriculture is also important, because of the fertile plains and reasonably good rainfall, and Jhalawar District is the largest producer of coriander in the country and the second largest producer of oranges. Jhalawar and Jhalrapatan produce significant quantities of both of these crops, together with soya bean, wheat and opium. Many areas practice double cropping, and the main seasons are *kharif* (April-September: cotton, *jowar*, maize and groundnut) and *rabi* (October-March: wheat, gram, coriander, linseed, opium and sugarcane).

3. Infrastructure

38. PHED provides a piped municipal water supply to both towns (Photo 19) , which is extracted from the Kalisindhi River via two separate intakes (Photo 4 and 6), at a rate of 6 MLD (Jhalawar) and 3.5 MLD (Jhalrapatan). In the dry season water is trapped in natural depressions in the riverbed, and also by means of the two man-made weirs at Manpur and Bhawrasa mentioned above. Water is treated by chlorination at a Water Treatment Plant in each town, and the piped distribution system reaches 90% of the population. However because of system losses (estimated at 40%), water is available for only 1-2 hours per day, and only on alternate days in the summer.

39. There is no sewerage system in Jhalawar or Jhalrapatan, and although around one third of houses have individual sanitation facilities (septic tanks or pit latrines), the rest of the population uses community toilets provided by the Municipal Boards, illegal connections from latrines to storm water drains, or practice open defecation.

40. There are roadside drains in many areas, alongside 30% of the roads in Jhalawar (Photo 20) and 75% of the roads in Jhalrapatan. This includes both earth and concrete drains, but these are often poorly designed with inadequate gradients, and are frequently clogged with solid waste and polluted by sewage. There is also no drainage outfall, and water discharges onto areas of low-lying land in the town.

41. There is no proper solid waste management system in the towns, and although the Municipal Boards have designated 25 open collection points in Jhalawar and 15 in Jhalrapatan, refuse is mainly discarded in the streets and drains, and dumped on vacant plots of land (Photo 21). Jhalawar generates around 16 tons of solid waste per day and Jhalrapatan 9 tons, of which around 60% is collected, by manual street sweepers and irregular municipal collections by truck. Collected waste is transported on open vehicles to the outskirts of each town, where it is dumped on open ground (Photo 22).

42. Thermal power is the main source of energy in Rajasthan, contributing 89% of the electricity, compared to hydropower, which produces the remainder. State-level companies (Rajya Vidyut Utpadan Nigam Ltd, RVUN; and Rajya Vidyut Prasaran Nigam Ltd, RVPN) are

responsible for power generation and transmission respectively, and distribution is provided by a regional company, the Jaipur Vidyut Vitran Nigyam Ltd (JVVNL). Power is supplied from the central grid by overhead cables carried on metal and concrete poles, mainly located in public areas alongside roads. The power supply is erratic and there are frequent outages in warmer months, and large fluctuations in voltage.

4. Transportation

43. In both towns roads are very narrow and congested in the older central areas, and as these house most of the commercial activity, there is considerable pedestrian and vehicular traffic (Photo 23). There are 53 km of roads in Jhalawar and 19 km in Jhalrapatan, of which around 30-40% are surfaced with bitumen/tar, 20-40% are concrete, < 3% are WBM (Water-borne Macadam) and the remainder (20-30%) are unpaved earth roads. All roads in Jhalrapatan and 90% of the roads in Jhalawar are maintained by the Municipal Board, and the rest are maintained by the Public Works Department (PWD). The condition of the roads is generally poor, and many are in need of repairs and resurfacing.

44. Transport in the towns is mainly by personal vehicles (mostly motorcycles and bicycles) and auto- and bicycle-rickshaws. The towns are connected to each other and to neighbouring areas by a good road network. National Highway 12 (NH 12) passes through both towns and runs north through Kota to the state capital Jaipur, and also runs south to Bhopal, the capital of Madhya Pradesh. The nearest railway station is at Ramganj Mandi, 25 km north of Jhalawar, and the nearest airport is at Jaipur, 300 km away.

D. Social and Cultural Resources

1. Demography

45. According to the national census the population of Jhalawar was 38,671 in 1991 and 48,054 in 2001, an annual growth of 2.3% over the decade; whereas in Jhalrapatan there were 23,067 people in 1991 and 30,103 in 2001, a growth of 2.9%. With a combined total of 78,157 people in a municipal area of 33.12 km^2, the population density in 2001 was 2,360 persons per km^2.

46. Overall literacy is reported at 82.1% in Jhalawar (90.5% for males and 72.8% for females) and 80.4% in Jhalrapatan (90% for males and 70.2% for females). These are both considerably better than literacy in the state as a whole, which is 60.4% overall, and 75.7% for males and 44.0% for females. The sex ratio is however significantly below the natural 1:1 ratio, with 901 and 909 females per 1000 males in the two towns, which is higher than the state average (879) but lower than the national figure (929).

47. According to the census, in 2001 only 29% of the total population of the two towns was in paid employment, significantly lower than both the state and national averages (42.1 and 39.1% respectively). This indicates that most of the townspeople are engaged in the informal sector, earning a living where they can, from small trading, casual labour, etc. Of those that are employed, almost all (92%) are involved in the service and industrial sectors, with the remainder being mostly engaged in agricultural activities.

48. Over 90% of the people are Hindus, and the remainder are mainly Muslims and Jains. The main local language is Rajasthani, the principal dialect of the state, and almost all people also speak the national language of Hindi. Other languages spoken include Gujarati, Punjabi

and Kanjari. About 3.5% of the population are from Scheduled Tribes (ST), but these are part of the mainstream population; around 12.5% of the population belong to scheduled castes (SC).

2. Health and educational facilities

49. There are good basic educational facilities in Jhalawar and Jhalrapatan, which serve both townspeople and inhabitants of surrounding villages and towns in the hinterland. There are 31 primary schools, 52 secondary schools and 18 higher secondary schools in the twin towns, plus two general degree colleges and a professional training institute. The towns also benefit from the proximity of Kota city, which is one of the most important educational centres in Rajasthan.

50. As the district headquarters town, Jhalawar is the main centre for health facilities in the area. There are four hospitals (including the district hospital that is presently being upgraded to 300 bed capacity), plus a special TB hospital, two dispensaries, a mother and child welfare centre, two family welfare centres and three homeopathic hospitals.

3. History, culture and tourism

51. Jhalawar was named after its founder, Jhala Zalim Singh (I), who was the Dewan of Kota State and established the town in 1796 as a cantonment (administrative and military area) near the existing Jhalrapatan Fort. Jhalawar state separated from Kota state in 1838 under the rule of Jhala Madan Singh (grandson of Jhala Zalim Singh), who built the famous Garh Palace in 1840-1845.

52. Interlinked over the centuries, the two towns have a rich cultural heritage which includes a number of sites that are of interest both historically and more recently to tourists. These include:

- The Garh Palace (otherwise known as Jhalra Fort), which currently houses the district collectorate and other government administrative offices (Photo 24);
- The 14th century Gagraon Fort, 12 km north of Jhalawar is in a spectacular location on a remote hillside overlooking the Kalisindhi River, and is visible from the municipal water supply intakes (Photo 25);
- The ruins of the old city of Chandravati, which was largely demolished during the Muslim period, is on the left bank of the Chandrabagha River just south of Jhalrapatan;
- The 10th century Surya temple in the centre of Jhalrapatan (Photo 26), which contains one of the country's best preserved Surya (sun god) idols; the 11th century Shantinath Jain Temple; and the 14th century Chandrabhaga Temple (Photo 27), also in Jhalrapatan;
- There are also many events and festivals that attract visitors, of which the Kartik Fair held in Jhalrapatan in October and November is one of the most prominent, featuring earthen statues depicting the Hindu Ramayana epic (Photo 28).

IV. ENVIRONMENTAL IMPACTS AND MITIGATION: INFRASTRUCTURE CONSTRUCTION

A. Screening out areas of no significant impact

53. From the descriptions given in Section II.C it is clear that implementation of the project will affect quite long tracts of land inside both towns where the rising main and new network will be constructed, and also certain smaller locations, such as the new intake, existing WTP sites, and the sites of the new ORs.

54. However it is not expected that the construction work will cause major negative impacts. This is mainly because:

- Pipelines will be mainly located on unused ground alongside existing roads and can be constructed without causing major disruption to road users and adjacent houses, shops and other businesses;
- New facilities within and outside the towns (intakes, CWR and ORs) will be located on government-owned land that is not occupied or used for any other purpose;
- Most pipeline construction will be conducted by small teams working on short lengths at a time so most impacts will be localised and short in duration;
- The overall construction programme will be relatively short for a project of this nature, and is expected to be completed in 1.5 years.

55. As a result there are several aspects of the environment that are not expected to be affected by the construction process and these can be screened out of the assessment at this stage as required by ADB procedure. These are shown in Table 5, with an explanation of the reasoning in each case.

Table 5: Fields in which construction is not expected to have significant impacts

Field	Rationale
Climate	Short-term production of dust is the only effect on atmosphere
Geology and seismology	Excavation will not be large enough to affect these features
Fisheries & aquatic biology	There is no significant fishery or aquatic biology in the Kalisindhi River because of low dry season flows and construction of weirs to retain water for municipal use. There should thus be no ecological effect from abstraction of water from the river.
Wildlife and rare or endangered species	There is no wildlife or rare or endangered species in either town or on government owned areas where facilities will be built outside the towns
Coastal resources	Jhalawar and Jhalrapatan are not located in coastal areas
Population and communities	Construction will not affect population numbers, location or composition

56. These environmental factors have thus been screened out and will not be mentioned further in assessing the impacts of the construction process.

B. Source and supply augmentation

1. Construction method

57. As explained above, augmentation of the water source and supply will involve construction of the following:

- Two new intakes alongside the Kalisindhi River, each comprising a 20 m deep dry well, pump house and 1 km concrete approach road;
- A new Clear Water Reservoir plus pump house and inspection house at the existing WTP site in each town;
- 43 km of rising main (250-400 mm diameter DI) to carry water from the CWR to ORs in each town;
- Replacement of screens and machinery at the two existing WTPs.

58. The intakes will be located on the bank of the Kalisindhi River at Pipa Ji Deh (for Jhalawar) and Bhawarasa Deh (for Jhalrapatan), and each will consist of a 20 m deep brick-lined well (around 6 m in diameter), with a brick pump house nearby and a 1 km concrete access road (approximately 3 m wide) leading from the main highway.

59. The intake well will be dug by backhoe excavator, supplemented by hand digging, and soil will be loaded onto trucks for offsite disposal. A small trench will be dug at the bottom for foundations, into which concrete will be poured. A single skin of bricks will then be placed by hand to gradually form the circular wall of the well. The pump house (approximately 6 x 6 x 5 m) will be built in a similar manner. Foundations will be dug by backhoe and aggregate and concrete will be poured in to form the floor. Brick walls will then be built by hand by masons and finished with a plaster coating, after which roofing materials will be attached. Pumps and pipes will then be brought in on a truck and offloaded and positioned by a small crane, and connected up by hand.

60. Vegetation will be cleared from the route of the access road, after which the ground will be levelled by a small bulldozer and waste material will be taken offsite on trucks for disposal. The edges of the road will be delimited by small shuttering boards pegged into the ground. Aggregate will then be tipped in, followed by concrete (mixed on site) to form a thickness of around 200 mm. The surface will be flattened by hand using smoothing boards, and after drying the edge-boards will be removed.

61. Two Clear Water Reservoirs (CWR) will be built at the existing Water Treatment Plants (one in each town), at Radi ke Balaji (Jhalawar) and Mudhilya Kheri (Jhalrapatan), with all construction occurring within the existing compounds. The tanks will measure 20 m and 15 m in diameter and approximately 4 m in depth, and will be built from Reinforced Cement Concrete (RCC) with approximately 2 m above and below ground. The cavity will be dug by backhoe at each site, and waste soil will be loaded onto trucks for disposal. Metal reinforcing rods will then be positioned by hand in the locations of the floor and sides of the tank, after which concrete will be poured in to create the floor. The sides will then be encased in wooden shuttering and again concrete will be poured in to gradually create the structures. A small pump house and inspection house (ca 6 x 6 x 5 m) will be built nearby, following the same procedure as described above for the intake pump house. The various connecting pipes will then be added on the surface and in shallow trenches.

62. Construction of the 43 km of rising mains is described in Section IV.C below, as the approach and environmental impacts are similar to those of the distribution network, and are somewhat different from those of the facilities considered here.

63. The work at the WTP (such as replacement of screens for the removal of debris from the water) will be small in scale and conducted by hand. Replacement parts will be brought to site on a truck and offloaded and fitted by technicians.

2. Physical Resources

64. Although construction of these facilities will involve excavation and some ground clearing along the access road, the work will not be large in scale and will not produce especially large quantities of waste, so physical impacts should not be greatly significant.

65. Excavation of the two intake wells will produce around 1,000 m^3 of waste soil and stone, and creation of the below-ground portions of the two CWRs will generate a similar amount. This quantity can be dumped via normal waste disposal procedures and there should be no need to take special precautions to reduce the amount of waste material. However, as the present system of waste disposal involves the municipality dumping garbage on open ground outside the towns, it would be beneficial if this work was scheduled to take place after the new landfill has been provided by the Solid Waste Management Subproject, so that the material can be disposed of appropriately at the new facility.

66. Excavation work often requires precautions to reduce dust during the operation, but this should also not be necessary in this case because the intake sites are in remote, uninhabited locations, and the CWRs will be built within existing WTP compounds, which are surrounded by high walls. Standard precautions should be taken however to control dust when waste soil is carried on trucks for disposal, by covering the material with tarpaulins.

67. The other physical impact that is often of concern in relation to excavation work is the effect on drainage and the local water table if groundwater and surface water collect in the voids. However this should also not be a problem in this case as work will almost certainly be conducted in the dry season, and if groundwater did collect in the intake wells during construction, it could be removed very easily by pumping into the adjacent river.

3. Ecological Resources

68. There are no protected areas or locations of any ecological interest at or near any of the sites affected by these works, so it is unlikely that the work will have any ecological impacts.

4. Economic Development

69. The intakes, pump stations and access roads will be located on government-owned land on the banks of the Kalisindhi River, and the CWRs, pump stations and inspection houses will be built entirely within existing WTP compounds, which are also owned by the government. There should therefore be no need to acquire land from private owners for these facilities, so there will be no related effects on the income and assets of landowners and tenants.

70. There should also be no effects on other features with economic implications (such as infrastructure, industry and commerce), as there are none of these facilities on or near these sites. Even the transportation of waste material to the proposed landfill should not require

precautions to avoid disruption of traffic by heavy vehicles, because there will be relatively few truckloads of waste, and the landfill sites are on the same side of the towns as the new intakes, so vehicles will not need to enter the urban areas.

5. Social and Cultural Resources

71. Rajasthan is an area with a rich and varied cultural heritage that includes many forts and palaces from the Rajput and Mughal periods, and large numbers of temples and other religious sites, so there is a risk that any work involving ground disturbance could uncover and damage archaeological and historical remains. Given that these facilities will involve small scale excavation at locations that are uninhabited and show no obvious signs of having been used to any extent in the past, then it could be that there is a low risk of such impacts at these sites. Nevertheless this should be ascertained by consulting the appropriate authorities, and appropriate steps should be taken according to the nature of the risk. This should involve:

- Consulting historical and archaeological authorities at both national and state level to obtain an expert assessment of the archaeological potential of the proposed sites;
- Selecting alternative sites for any work proposed in areas of medium or high risk;
- Including state and local archaeological, cultural and historical authorities and interest groups in consultation forums as project stakeholders so that their expertise can be made available to the project;
- Developing a protocol for use by the Contractor in conducting any excavation work, to ensure that any chance finds are recognised and measures are taken to ensure they are protected and conserved. This should involve:
    - Having excavation observed by a person with archaeological field training;
    - Stopping work immediately to allow further investigation if any finds are suspected;
    - Calling in the state archaeological authority if a find is suspected, and taking any action they require to ensure its removal or protection in situ.

72. There are no modern-day social and cultural resources (such as schools and hospitals) on or near these sites, and no areas that are used for religious or other purposes, so there is no risk of other impacts on such community assets.

73. Finally, there could be some short-term socio-economic benefits from the construction work if local people are able to gain employment in the construction workforce. To ensure that such gains are directed towards communities most directly affected by this part of the scheme, the Contractor should be required to employ at least 50% of this labour force from communities within a radius of say 2 km from each site, if sufficient people are available.

C. Network improvement

1. Construction method

74. Improvement of the distribution network will involve construction of:

- 117.5 km of distribution mains from 100-400 mm diameter DI pipe;
- 10 RCC Overhead Reservoirs (OR), each of <900,000 litres capacity;
- 17 chlorination plants in brick houses beneath new and existing ORs;

75. The following equipment will also be provided:

- 8 new centrifugal pumps at ORs;
- 21 bulk flow meters and 2 ultrasonic meters at new and existing ORs;
- 5,000 household meters;
- A new district laboratory at the existing PHED compound.

76. These all involve the same kinds of construction and will produce similar effects on the environment, so their impacts are considered together. As explained above, the impacts of the 43 km of rising main (250-400 mm DI pipe) are also considered here, for the same reasons.

77. The rising and distribution mains will be buried in trenches adjacent to roads in the two towns, in the un-used area within the ROW, at the edge of the paved area. The rising mains will run alongside main roads, where there is generally more than enough space for the pipeline. However the distribution mains will be located in smaller roads and streets, where in some places this area is occupied by drains or the edges of shops and houses etc (Photo 29), so to avoid damage to infrastructure and property some trenches may be dug into the edge of the road.

78. Trenches will be dug by a backhoe excavator (Photo 30), supplemented by manual digging where necessary (Photo 31). Excavated soil will be placed alongside, and the pipes (brought to site on trucks and stored on unused land nearby) will be placed in the trench by hand or using a small rig for the larger pipes (Photo 31, 32). Pipes will be joined by hand, after which sand from local quarries will be shovelled into the trench beneath and around the pipe for support and protection. Soil will then be replaced manually on top of the pipe and compacted by a vibrating compressor. Where trenches are dug into an existing roadway, the bitumen or concrete surface will be broken by hand-held pneumatic drills (Photo 33), after which the trench will be excavated by backhoe, and the appropriate surface will be reapplied on completion.

79. Pipes are normally covered by 1.2 m of soil, and a clearance of 100 mm is left between the pipe and each side of the trench to allow backfilling, so in this case trenches will be relatively small, between 1.4 and 1.7 m deep, and 0.3 to 0.6 m wide.

80. The ten new Overhead Reservoirs (OR) will be built on small plots of government land (< 30 m radius) at various locations in each town. Foundations will be excavated down to around 1 m by backhoe, with soil being loaded onto trucks for disposal. Aggregate and concrete will be tipped in to create the foundations and floor, after which metal reinforcing rods will be added to create the vertical supports. Sections of reinforcing will then be encased in wooden shuttering and concrete will be poured in, and this process will be repeated to gradually create each structure, including the storage tank at the top. Surfaces will be smoothed and finished where necessary by hand.

81. Small brick rooms will be built beneath the ORs to house the chlorination plants and/or new pumps. Foundations will be dug and aggregate and concrete poured in to create the floors, after which the brick walls and roof materials will be added by hand. Chlorine cylinders and other equipment (including flow-meters) will be brought in on trucks and offloaded and attached by hand. A small cavity for the chlorination sump and trenches for pipe-work will also be dug, and the sump will be constructed from concrete and brick. Pumps will be housed in a separate room and will also be brought in on trucks and put into place by means of a small crane. The 5,000 household meters will be located outside individual dwellings, either attached to a wall or

located on the ground (Photo 11). The laboratory at the PHED site will be housed in a small brick building, built in the same way as the chlorination sheds and pump-houses described above.

2. Physical Resources

82. This work will involve more extensive excavation than the source augmentation component and as the work will be located in the towns, the impacts could be more significant.

83. If average trench dimensions are 1.5 x 0.6 m, then excavation of 160 km of trenches will remove around 140,000 m^3 of material. After construction, approximately 25% of the trench will be occupied by the pipe, 50% by backfilled sand, and 25% by excavated soil replaced on top of the pipe. This means that around 70,000 m^3 of sand will be brought to site, 35,000 m^3 of soil will be retained for replacement in the trench, and 105,000 m^3 of waste material will be left over. Additional smaller quantities of waste will be produced by the other excavation work, including the foundations for ORs and the various small buildings. There will therefore be quite large physical changes at the construction sites, and this quantity of waste could not be dumped without causing further physical impacts (on air quality, topography, soil quality, etc) at the point of disposal. The work will almost certainly be conducted in the dry season, so there is also a lot of potential for the creation of dust, from the excavation of dry soil and its storage and removal for disposal, and from the importation and storage of large quantities of sand for backfill.

84. Action will therefore be needed to reduce physical impacts at both the construction and disposal sites, by controlling dust and reducing the amount of material to be dumped. The Contractor should therefore be required to:

- Contact the town authorities to find beneficial uses for as much waste material as possible, in construction projects, to raise the level of land prior to construction of roads or buildings, or to fill previously excavated areas, such as brickworks;
- Prevent the generation of dust by removing waste soil as soon as it is excavated (by loading directly into trucks);
- Plan the work carefully so that sand is only brought to site when it is needed;
- Cover or damp down sand and soil retained on site to reduce dust in windy weather;
- Use tarpaulins to cover loose material during transportation to and from the site.

85. The other physical impact commonly associated with large-scale excavation (effects on surface and groundwater drainage) should again be negated by the fact that this work will be conducted in the dry season, and by the low water table in the towns.

86. Physical impacts will also be reduced by the method of working, whereby the pipelines will probably be constructed by small teams working on short lengths at a time, so impacts will be mainly localised and short in duration. This will also be the case at the other sites, which are all small, and where construction of ORs, chlorination sheds, pump houses and the laboratory should take a few weeks at most. Because of this and the mitigation measures proposed above, impacts on the physical environment are not expected to be of major significance.

3. Ecological Resources

87. There are no significant ecological resources in the towns (protected areas or rare or important species or habitats), so constructing the network improvements should have no

ecological impacts. However, roadside trees should not be removed unnecessarily to build the trenches, and to mitigate any such losses the Contractor should be required to plant and maintain two new trees (of the same species) for each one that is removed.

4. Economic Development

88. This work will all be conducted on government owned land, either in the ROW of roads, or on small parcels of government land in the case of ORs and other facilities. There will therefore be no need to acquire land, so there should be no direct effects on the income or assets of landowners, or the livelihoods of tenants.

89. There could be some economic impacts however, if the presence of trenches, excavated material, workers and machinery discourage customers from visiting shops and businesses adjacent to network construction sites, and the businesses lose income as a result. These losses should be short in duration as most of the pipeline work should last for only a few days at any one site. Nevertheless the loss of income could still be significant for small traders and other businesses that exist on low profit margins. These impacts should therefore be mitigated by:

- Leaving spaces for access between mounds of excavated soil, and providing footbridges so that pedestrians can cross open trenches;
- Increasing the workforce in these areas to ensure that work is completed quickly;
- Consulting affected businesspeople and informing them in advance when work will occur.

90. ADB policy on Involuntary Resettlement requires that no-one should be worse off as a result of an ADB-funded project, and a separate Resettlement Plan and Resettlement Framework have been prepared to examine these issues and provide appropriate mitigation. This establishes that, in addition to the above practical measures to reduce the economic impact of the construction work, owners and tenants of affected businesses will also be compensated in cash for any income they lose.

91. Excavation could also damage existing infrastructure, in particular storm drains and sewers if these have been installed by the UIDSSMT project when the RUSDIP infrastructure is constructed. It will be particularly important to avoid damaging existing water pipes as these are mainly manufactured from Asbestos Cement (AC), which can be carcinogenic if inhaled, so there are serious health risks for both workers and citizens (see below). It will be important therefore to avoid these impacts by:

- Obtaining details from the Municipal Boards of the nature and location of all infrastructure, and planning pipeline routes carefully to avoid any conflict or damage;
- Integrating construction of the various infrastructure projects conducted in Jhalawar and Jhalrapatan (in particular water supply, drainage and sewerage) so that:
    - Different infrastructure is located on opposite sides of the road where feasible;
    - Roads and inhabitants are not subject to repeated disturbance by construction in the same area at different times for different purposes.

92. Transport is another type of infrastructure that will be affected by some of the work, particularly construction of pipelines in the narrower streets where there is not enough space for excavated soil to be piled off the road. The road itself may also be excavated in places where

there is no available land to locate pipelines alongside. Traffic will therefore be disrupted, and in some very narrow streets the whole road may need to be closed for short periods. The Contractor should therefore plan this work in conjunction with the town authorities and police, so that work can be carried out during periods when traffic is known to be lighter, and alternative routes and diversions can be provided where necessary. The Contractor should also increase the workforce in areas such as this, so that the work is completed in the shortest possible time.

93. It is inevitable that there will be an increase in the number of heavy vehicles in the town (particularly trucks removing waste and importing sand and other materials), and this could disrupt traffic and other activities, as well as damage fragile buildings if vibration is excessive. These impacts will therefore need to be mitigated by:

- Careful planning of transportation routes with the municipal authorities to avoid sensitive areas as far as possible, including narrow streets, congested roads, important or fragile buildings and key sites of religious, cultural or tourism importance;
- Scheduling the transportation of waste to avoid peak traffic periods, the main tourism season, and other important times.

5. Social and Cultural Resources

94. As was the case for the source and supply augmentation works, there is again a risk that the excavation work could damage undiscovered archaeological or historical remains, or even undiscovered sites. In this case the risks are more significant as the work will be conducted in Jhalawar and Jhalrapatan towns, which have been inhabited for long periods, and where there is thus a greater chance of artefacts being found. The preventative measures described in Section IV.B.5 will thus need to be employed and strictly enforced. These are:

- Consulting national and state historical and archaeological authorities to assess the archaeological potential of all construction sites;
- Selecting alternative routes or sites to avoid any areas of medium or high risk;
- Including state and local archaeological, cultural and historical authorities and interest groups as project stakeholders to benefit from their expertise;
- Developing a protocol for use in conducting all excavation, to recognise, protect and conserve any chance finds (see Section IV.B.5 for details).

95. The construction work will also disturb some more modern-day social and cultural resources, such as schools, hospitals, temples, and also sites that are of tourism importance. Impacts could include noise, dust, interrupted access for pedestrians and vehicles, and if pneumatic drills are used to break the surface of roads, there could be a risk of damage from vibration. Mitigation will therefore be needed to protect these resources and to enable usage by local people and visitors to continue throughout the construction work. This will be achieved through several of the measures recommended above, including:

- Consulting the town authorities to identify any buildings at risk from vibration damage and avoiding any use of pneumatic drills or heavy vehicles in the vicinity;
- Limiting dust by removing waste soil quickly, bringing sand to site only when necessary, covering and watering stockpiles, and covering soil and sand when carried on trucks;
- Increasing the workforce in sensitive areas to complete the work quickly;

- Providing wooden bridges for pedestrians and metal sheets for vehicles to allow access across open trenches where required (including access to houses);
- Using modern vehicles and machinery with standard adaptations to reduce noise and exhaust emissions, and ensuring they are maintained to manufacturers' specifications;

In addition the Executing Agency and Contractor should:

- Consult municipal authorities, custodians of important buildings, cultural and tourism authorities, and affected communities in advance of the work to identify and address key issues, and avoid working at sensitive times, such as religious and cultural festivals.

96. A different but no less significant impact is the effect on people and communities if water supplies are closed down for extended periods when work is conducted on the network. This would be inconvenient in the short term, and there could be health risks if the water supply was unavailable for several successive days or longer. It will therefore be important to take the necessary measures to avoid such a situation. This will require:

- Detailed planning of the construction programme to keep the cessation of water supplies to the minimum possible (in both area and duration);
- Provision of alternative potable water to affected households and businesses for the duration of the shut-down;
- Liaison with affected persons to inform them of any cessation in advance, and to ensure that they are provided with an alternative supply.

97. There is invariably a safety risk when substantial construction such as this is conducted in an urban area, and precautions will thus be needed to ensure the safety of both workers and citizens. The Contractor will be required to produce and implement a site Health and Safety Plan, and this should include such measures as:

- Excluding the public from the site;
- Ensuring that all workers are provided with and use appropriate Personal Protective Equipment;
- Health and Safety Training for all site personnel;
- Documented procedures to be followed for all site activities;
- Accident reports and records;
- Etc.

98. An additional, particularly acute health risk presented by this work derives from the fact that, as mentioned above, the existing water supply system comprises mainly AC pipes, so there is a risk of contact with carcinogenic material if these pipes are uncovered in the course of the work. Precautions have already been introduced into the design of the project to avoid this, of which the most important are that:

- The DI distribution main provided by this project will entirely replace the existing AC distribution network, from which there is heavy leakage at present;
- The AC network will be left in situ and there will be no deliberate excavation of AC pipes, and no need to join the new network to any AC pipes;
- The locations of the new network will be planned to avoid all locations of existing AC pipes so AC pipes should also not be discovered accidentally.

99. Given the dangerous nature of this material for both workers and citizens, one additional measure should be taken to protect the health of all parties in the event (however unlikely) that AC pipes are encountered. This is that, during design of the water supply system, the design consultant should develop a protocol to be applied in any instance that AC pipes are found, to ensure that appropriate action is taken. This should be based on the approach recommended by the United States Environmental Protection Agency (USEPA)[2], and amongst other things, should involve:

- Training of all personnel (including manual labourers) to enable them to understand the dangers of AC pipes and to be able to recognise them in situ;
- Reporting procedures to inform management immediately if AC pipes are encountered;
- Development and application of a detailed H&S procedure to protect both workers and citizens. This should comply with national and international standards for dealing with asbestos, and should include:
    - Removal of all persons to a safe distance;
    - Usage of appropriate breathing apparatus and protective equipment by persons delegated to deal with the AC material;
    - Procedures for the safe removal and long-term disposal of all asbestos-containing material encountered.

100. There could again be some short-term socio-economic benefits from the construction work if local people gain employment in the workforce. To ensure that these benefits are directed to communities that are affected by the work, as suggested in Section IV.B.5, the Contractor should be required to employ at least 50% of his labour force from communities in the vicinity of construction sites. Creating a workforce from mainly local people will bring additional benefits by avoiding problems that can occur if workers are imported, including social difficulties in the host community and issues of health and sanitation in poorly serviced temporary camps.

V. ENVIRONMENTAL IMPACTS AND MITIGATION: OPERATION AND MAINTENANCE

A. Screening out areas of no significant impact

101. Because a water supply system should operate without the need for major repair and maintenance (see below), there are several environmental sectors that should be unaffected once the system begins to function. These are identified in Table 6 below, with an explanation of the reasoning in each case. These factors are thus screened out of the impact assessment and will not be mentioned further.

[2] In the USA, standards and approaches for handling asbestos are prescribed by the Occupational Health and Safety Administration (OHSA) and the Environmental Protection Agency (EPA) and can be found at http://www.osha.gov/SLTC/asbestos

Table 6: Fields in which operation and maintenance of the completed water supply system is not expected to have significant impacts

Field	Rationale
Climate	Extraction and use of river water in the quantities proposed should not affect climate
Fisheries & aquatic biology	There is no significant flora or fauna in Kalisindhi River so abstraction from the river should have no impact on aquatic ecology
Wildlife, forests, rare species, protected areas	There are none of these features in or outside the towns
Coastal resources	Jhalawar and Jhalrapatan are not located in a coastal area
Industries	The water supplied by the new system will not be for industrial use

B. Operation and maintenance of the improved water supply system

102. The new source augmentation works (intakes and CWRs) should operate with little maintenance beyond routine actions required to keep the pumps and other equipment in working order. This will be straightforward, involving regular checking and recording of performance for signs of deterioration, servicing and replacement of parts, etc. A small number of men will be employed to operate and maintain each site.

103. The main requirement for maintenance of the new rising main and distribution system will be for the detection and repair of leaks. The generally flat topography and the usage of good quality DI pipes should mean that pipeline breaks are very rare, and that leaks are mainly limited to joints between pipes. The bulk meters installed at ORs and pumping stations will allow amounts of water flowing through individual parts of the network to be monitored, which will pinpoint areas where there are leaks. A small Leak Detection Team will then visit these areas with audio devices to locate individual leaks, which will then be repaired in essentially the same way that the pipes were installed. Trenches will be dug to reveal the leaking area and the faulty connection will be re-fitted, or the pipe will be removed and replaced if necessary.

104. There will also be some small scale maintenance required at the new OR sites, which will involve the same sort of checking of pumps and other equipment as conducted at the RWR, plus the regular replenishment of chlorination cylinders to maintain water treatment. Two or three men will be employed at each site for this purpose.

C. Environmental impacts and benefits of the operating system

1. Physical Resources

105. If trenches are dug to locate and repair leaks or remove and replace lengths of pipe, the work will follow the same procedure as occurred when the infrastructure was improved. In this case soil and backfilled sand will be removed to expose the leaking junction or pipe, and if necessary a new pipe will be brought to site and replaced. The trench will then be refilled and re-compacted. This work should be very infrequent, and will affect individual small locations for short periods only (an average of a few hours for most repairs). Physical impacts will therefore be negligible. Work will not be conducted during rainfall so there will be no effect on drainage, and the removed material will be replaced in the trench so there will be no waste. There should

also be no need to cover excavated material to prevent dust as it will have been wetted by the leaking water.

106. One of the main risks of improving a water supply system through increased abstraction is that the source will be used unsustainably, at a rate that is above the level of natural replenishment, and that the source becomes depleted as a result. In this case water will be extracted from the Kalisindhi River, in areas where weirs have recently been built to retain larger quantities of water in the dry season than the natural depressions in the river bed that are exploited by the present surface water intakes. This means that much more water is available throughout the year than is tapped by the present intakes, and the quantities are considerably greater than the abstraction proposed by the new schemes. Together with water conservation measures (in particular the replacement of the badly leaking distribution mains), this should mean that there is no depletion of supply, even in the dry season.

2. Ecological Resources

107. There are no significant ecological resources in or around either town, so any repairs or maintenance work can be conducted without ecological impacts. There is little permanent flora and fauna in Kalisindhi River because large areas dry out in the summer, so there should also not be any ecological impacts from the increase in abstraction.

3. Economic Development

108. Although network repairs could result in shops losing some business if the work means that access is difficult for customers, any losses will be small and short-lived and will probably be at the level of normal business fluctuations. It should therefore not be necessary to compensate for such losses. Nevertheless simple steps should be taken to reduce the inconvenience of the works, including:

- Informing all residents and businesses about the nature and duration of any work well in advance so that they can make preparations if necessary;
- Requiring contractors employed to conduct these works to provide wooden walkways across trenches for pedestrians and metal sheets where vehicle access is required;
- Consulting the local police regarding any such work so that it can be planned to avoid traffic disruption as far as possible, and road diversions can be organised if necessary.

109. As the improved water supply system will be provided to domestic users only, there are unlikely to be direct economic benefits for business or industry from the operating scheme. However businesses will almost certainly benefit from the expected improvement in the health and wellbeing of their workforce (see below) as this should result in fewer days lost through illness, and overall increased productivity.

4. Social and Cultural Resources

110. Although there is a high risk of excavation in the town discovering material of historical or archaeological importance, there will be no need to take precautions to protect such material when areas are excavated to repair leaks in the network, as all work will be conducted in trenches that have already been disturbed when the infrastructure was installed.

111. Repair work could cause some temporary disruption of activities at locations of social and cultural importance such as schools, hospitals, temples, tourist sites etc, so the same kinds of precautions as employed during the construction period should be adopted. These include:

- Consulting town authorities to identify any buildings nearby that could be at risk from vibration damage and avoiding use of pneumatic drills or heavy vehicles if necessary;
- Completing work in these areas quickly;
- Providing wooden bridges for pedestrians and metal sheets for vehicles to allow access across open trenches where required;
- Consulting municipal authorities, custodians of important buildings, cultural and tourism authorities and local communities to inform them of the work in advance, and avoid sensitive times, such as religious and cultural festivals.

112. The responsible authorities will employ local contractors to conduct repairs of the operating system, and contractors should be required to operate the same kinds of Health and Safety procedures as used during the construction phase (see Section IV.C.5) to protect workers and the public. This should include application of the asbestos protocol if any AC pipes are encountered, and prohibition of the use of AC pipes for any repair or maintenance work.

113. The use of local contractors will provide economic benefits to the companies and the workers they employ. There is however little prospect of directing these benefits to persons affected by any maintenance or repair works as contractors will utilise their existing workforce. To provide at least some economic benefits to affected communities, persons employed to maintain the intakes, CWR and ORs should be residents of the neighbouring areas.

114. The citizens of the towns will be the major beneficiaries of the improved water supply, as they will be provided with a constant supply of better quality water, piped into their homes. This should improve the social capital of the towns, and individual and community health and well-being. Diseases of poor sanitation, such as diarrhoea and dysentery, should be reduced, so people should spend less on healthcare and lose fewer working days due to illness, so their economic status should also improve, as well as their overall health.

VI. ENVIRONMENTAL IMPACTS AND MITIGATION: LOCATION AND DESIGN

115. ADB Environmental Assessment Guidelines require that an IEE should evaluate impacts due to the location, design, construction and operation of the project. Construction and operation are the two activities in which the project interacts physically with the environment, so they are the two activities during which the environmental impacts occur. In assessing the effects of these processes therefore, all potential impacts of the project are identified, and mitigation is devised for any negative impacts. This has been done in Sections IV and V above and no other impacts are expected.

116. In many environmental assessments there are certain effects that, although they will occur during either the construction or operation stage, should be considered as impacts primarily of the location or design of the project, as they would not occur if an alternative location or design was chosen. For example, if a river was depleted by excessive abstraction this would be an impact of both the location and design of the scheme, because the depletion would not have occurred if the design had used groundwater to augment the supply, and the particular river would not have been depleted if the intake was located elsewhere.

117. However in the case of this subproject it is not considered that there are any impacts that can clearly be said to result from either the design or location. This is because:

- The subproject is relatively small in scale and involves straightforward construction and low-maintenance operation, in an environment that is not especially sensitive, so it is unlikely that there will be major impacts;
- Most of the predicted impacts are associated with the construction process, and are produced because that process is invasive, involving trenching and other excavation. However the routine nature of the impacts means that most can be easily mitigated;
- In one of the major fields in which there could be significant impacts (archaeology), those impacts are clearly a result of the construction process rather than the project design or location, as they would not occur if this did not involve trenching or other ground disturbance.

VII. INSTITUTIONAL REQUIREMENTS AND ENVIRONMENTAL MONITORING PLAN

A. Summary of environmental impacts and mitigation measures

118. Table 7 lists the potential adverse impacts of the Jhalawar and Jhalrapatan Water Supply Subproject as identified and discussed in Sections IV, V and VI, and the mitigation proposed to reduce these impacts to acceptable levels. The table also shows how the mitigation will be implemented, who will be responsible, and where and when the mitigation activities will take place. The mitigation programme is shown as the quarter of each year in which each activity will occur, which relates to the project programme described in Section II.B. The final column assesses whether the proposed action will successfully mitigate the impact (shown as 0), and indicates that some of the measures will provide an additional benefit (shown as +).

B. Institutional arrangements for project implementation

119. The main agencies involved in managing and implementing the subproject are:

LSGD is the Executing Agency (EA) responsible for management, coordination and execution of all activities funded under the loan.

The Implementing Agency (IA) is the Project Management Unit of the ongoing RUIDP, which will be expanded to include a broader range of skills and representation from the Urban Local Bodies (ULB, the local government in each town). Assigned as the RUSDIP Investment Program Management Unit (IPMU), this body will coordinate construction of subprojects across all towns, and ensure consistency of approach and performance.

The IPMU will be assisted by Investment Program Management Consultants (IPMC) who will manage the program and assure technical quality of design and construction; and Design and Supervision Consultants (DSC), who will design the infrastructure, manage tendering of Contractors and supervise the construction process.

Investment Program Implementation Units (IPIU) will be established in seven zones across the State to manage implementation of subprojects in their area. IPIUs will be staffed by

Table 7: Environmental impacts and mitigation for the Jhalawar and Jhalrapatan Water Supply Subproject (Black = continuous activity; Grey = intermittent)

Potential Negative Impacts	Sig	Dur	Mitigation Activities and Method	Respon sibility	Location	07	2008				2009			[3]
Construction: Source Augmentation Works						D	1	2	3	4	1	2	Op	
Excavation will produce relatively small amounts of waste that can be dumped at the municipal landfill	NS	P	Schedule excavation to take place after the new landfill has been provided under the Solid Waste Subproject	DSC	Intake & CWR									0
Waste soil could produce dust when taken for disposal	M	T	Use tarpaulins to cover waste soil when carried on trucks	Contractor	All sites									0
Ground disturbance could damage archaeological and historical remains	S	P	Request state and local archaeological authorities to assess archaeological potential of all work sites	DSC	All sites									0
			Select alternatives if sites have medium-high potential	DSC										0
			Include state and town historical authorities as project stakeholders to benefit from their expertise	LSGD										0
			Develop and apply protocol to protect chance finds (excavation observed by archaeologist; stop work if finds are suspected; state authority to plan appropriate action)	DSC and Contractor										+
Economic benefits if local people are employed in Contractor's workforce	M	T	Contractor should employ at least 50% of workforce from communities in vicinity of work sites	Contractor	All sites									+
Construction: Network Improvements														
Excavation of pipeline trenches and foundations for ORs and buildings will produce large amounts of waste soil	M	P	Find beneficial uses for waste soil in construction, land raising and infilling of excavated areas	Contractor	Network sites									+
Waste soil and imported sand may create dust	M	T	Remove waste soil as soon as it is excavated	Contractor	Network sites									0
			Only bring sand (for backfill) to site when needed											0
			Cover or spray stockpiled sand and soil in during wind											0
			Cover soil and sand with tarpaulins when carried by truck	Contractor	All sites									0
Trees should not be removed unnecessarily for trenches	M	P	Plant and maintain two trees for every one removed	Contractor	Network									0
Shops and other businesses may lose income if customers' access is impeded	M	T	*Compensate businesses for lost income	Contractor	Network sites									0
			Leave spaces for access between mounds of soil											0
			Provide bridges to allow people & vehicles to cross trench											0
			Increase workforce in these areas to finish work quickly											0
			Inform businesspeople of work in advance											0
Trenching could damage other infrastructure	S	P	Confirm location of infrastructure and avoid these sites	DSC	Network & OR									0

Sig = Significance of Impact (NS = Not Significant; M = Moderately Significant; S = Significant). Dur = Duration of Impact (T = Temporary; P = Permanent)
D = Detailed Design period; Op = Period when infrastructure is operating
[3] This column shows impacts remaining after mitigation: 0 = zero impact (impact successfully mitigated); + = positive impact (mitigation provides a benefit)
* Mitigation of these impacts will be provided through a separate Resettlement Plan, see Section VII.B

			Locate water and sewer pipes on opposite sides of roads	DSC	Network sites									0
Roads/people may be disturbed by repeated trenching	M	T	Integrate subprojects to conduct trenching at same time	DSC/LGD	Network sites									0
Traffic will be disrupted if lack of space means that dug soil is placed on road and/or water pipes have to be located in the road itself	M	T	Plan work with town authorities – work when traffic is light	Contractor	Network sites									0
			Ensure police provide traffic diversions when necessary											0
			As above: increase workforce to finish this work quickly											0
Trucks removing waste could disrupt traffic and vibration could damage fragile buildings	M	T	Plan routes to avoid narrow streets, congested roads, important/fragile buildings, key religious & tourism sites	Contractor	Network sites									0
			Plan work to avoid peak traffic, main tourism season											0
Major risk that ground disturbance in town could damage archaeological and historical remains	S	P	As above: ask authorities to assess potential of all sites	DSC	All sites									0
			As above: alternative sites where risk is high/medium	DSC										0
			As above: include state/local authorities as stakeholders	LSGD										0
			As above: apply protocol to protect chance finds	DSC/CC										+
Sites of social/cultural importance (schools, hospitals, temples, tourism sites) may be disturbed by noise, dust, vibration and impeded access	M	T	Identify buildings at risk from vibration damage and avoid using pneumatic drills or heavy vehicles nearby	Contractor	Network sites									0
			As above: remove waste quickly, cover/spray stockpiles, import sand only when needed, cover soil/sand on trucks											0
			As above: increase workforce to finish work quickly											0
			As above: use bridges to allow access (people/vehicles)											0
			Use modern vehicles/machinery & maintain as specified	Contractor	All sites									0
			Consult relevant authorities, custodians of buildings, local people to address issues & avoid work at sensitive times											0
People will be inconvenienced and their health may be at risk if water supply system is shut down for long period	M	T	Plan work programme to keep shutdown to minimum	DSC	Network and OR									0
			Provide alternative water to affected residents	LSGD										0
			Inform communities of any shutdown in advance	LSGD										0
Workers and the public are at risk from accidents on site	M	T	Prepare and implement a site Health and Safety Plan that includes measures to:	Contractor	All sites									0
			- Exclude the public from site;											0
			- Ensure that workers use Personal Protective Equipment											0
			- Provide Health & Safety Training for all personnel;											0
			- Follow documented procedures for all site activities;											0
			- Keep accident reports and records.											0
Existing water supply system uses AC pipes, a material that can be carcinogenic if inhaled as dust particles	S	T	Train all construction personnel in dangers of AC pipes and how to recognise them in situ	Contractor	All sites									0
			Develop and apply protocol if AC pipes are encountered. This should include:	DSC and Contractor	All sites									0
			- immediate reporting of any occurrence to management											0

			- removal of all persons to a safe distance											0
			- use of appropriate breathing apparatus and protective suits by workers delegated to deal with AC material											0
			- safe removal and long-term disposal of AC material											+
Economic benefits for people employed in workforce	M	T	As above: 50% of workforce from affected communities	Contractor	All sites									+
Operation and Maintenance														
Shops may lose small amounts of income if customers' access is impeded by network repair works	NS	T	As before: inform shopkeepers of work in advance	GA	Network sites									0
			As before: provide walkways and bridges for vehicles	OMC										0
			As before: request police to divert traffic if necessary	OMC										0
Sites of social/cultural importance may be disturbed by noise, dust, vibration, impeded access for short time during network repairs	NS	T	As before: avoid using drills/trucks near fragile buildings	OMC	Network sites									0
			As before: complete work quickly in sensitive areas	OMC										0
			As before: provide walkways/bridges for people/vehicles	OMC										0
			As before: consult authorities and communities, inform them of work in advance, avoid sensitive periods	GA										0
Health and safety of workers & the public could be at risk from repair work and AC pipes of old water supply system	M	T	Prepare and operate H&S plan with same measures as used in construction phase	OMC	All sites									0
			Apply previously-developed protocol to protect all persons if AC pipes are encountered											0
Local people will benefit if employed by project	M	P	Workers employed to maintain intake, CWRs and ORs should be residents of neighbouring communities	GA	All sites									+

professionals seconded from government departments (PHED, PWD), ULBs, and other agencies, and will be assisted by consultants from the IPMC and DSC as necessary.

The IPMU will appoint Construction Contractors (CC) to build elements of the infrastructure in a particular town. The CCs will be managed by the IPIU, and construction will be supervised by the DSC.

LSGD will be assisted by an inter-ministerial Empowered Committee (EC), to provide policy guidance and coordination across all towns and subprojects. The EC will be chaired by the Minister of Urban Development and LSG, and members will include Ministers, Directors and/or representatives of other relevant Government Ministries and Departments.

City Level Committees (CLCs) have also been established in each town, chaired by the District Collector, with members including officials of the ULB, local representatives of state government agencies, the IPIU, and local NGOs and CBOs. The CLCs will monitor project implementation in the town and provide recommendations to the IPIU where necessary.

120. Resettlement issues will be coordinated centrally by a Resettlement Specialist within the IPMU, who will ensure consistency of approach between towns. A local Resettlement Specialist will also be appointed to IPIUs of zones in which there are resettlement impacts and they will prepare and implement local Resettlement Plans following the framework established in Tranche 1.

121. Environmental issues will be coordinated by an Environmental Specialist within the IPMU, who will ensure that all subprojects comply with environmental safeguards. An Environmental Monitoring Specialist (EMS) who is part of the DSC team will implement the Environmental Monitoring Plan from each IEE (see below), to ensure that mitigation measures are provided and protect the environment as intended. Domestic Environmental Consultants (DEC) will be appointed by each IPIU to update the existing IEEs in the detailed design stage, and to prepare IEEs or EIAs for new subprojects, where required to comply with national law and/or ADB procedure.

C. Environmental Monitoring Plan

122. Table 7 shows that most mitigation activities are the responsibility of the Construction Contractors (CC) employed to build the infrastructure during the construction stage, or the O&M Contractors employed to conduct maintenance or repair work when the system is operating. Responsibility for the relevant measures will be assigned to the Contractors via the contracts through which they are appointed (prepared by the DSC during the detailed design stage), so they will be legally required to take the necessary action. There are also some actions that need to be taken by LSGD in their role as project proponent, and some actions related to the design that will be implemented by the DSC.

123. A program of monitoring will be conducted to ensure that all parties take the specified action to provide the required mitigation, to assess whether the action has adequately protected the environment, and to determine whether any additional measures may be necessary. This will be conducted by a qualified Environmental Monitoring Specialist (EMS) from the DSC. The EMS will be responsible for all monitoring activities and reporting the results and conclusions to the IPMU, and will recommend remedial action if measures are not being provided or are not protecting the environment effectively. The EMS may be assisted by environmental specialists in particular technical fields, and junior or medium-level engineers who can make many of the

routine observations on site. Post-construction monitoring will be conducted by the relevant Government Agency (GA) to whom responsibility for the infrastructure will pass once it begins to operate[4].

124. Table 7 shows that most of the mitigation measures are fairly standard methods of minimising disturbance from building in urban areas (maintaining access, planning work to avoid sensitive times, finding uses for waste material, etc), and experienced Contractors should be familiar with most of the requirements. Monitoring of such measures normally involves making observations in the course of site visits, although some require more formal checking of records and other aspects. There will also be some surveys of residents, as most of the measures are aimed at preventing impacts on people and the human environment.

125. Table 8 shows the proposed Environmental Monitoring Plan (EMP) for this subproject, which specifies the various monitoring activities to be conducted during all phases. Some of the measures shown in Table 7 have been consolidated to avoid repetition, and there has been some re-ordering to present together those measures that relate to the same activity or site. The EMP describes: (i) mitigation measures, (ii) location, (iii) measurement method, (iv) frequency of monitoring and (v) responsibility (for both mitigation and monitoring). It does not show specific parameters to be measured because as indicated above, most measures will be checked by simple observation, by checking of records, or by interviews with residents or workers.

126. Given the scale of the investment in providing the infrastructure, LSGD will also wish to conduct monitoring during the operational period to confirm the long-term benefits of the scheme. Table 8 shows that this will cover two elements, which will monitor:

- The chemical and bacteriological quality of water provided by the municipal system;
- The health of the population and the prevalence of diseases of poor sanitation.

127. An accredited laboratory will be appointed to monitor the quality of water at the new intakes and at the point of supply to consumers (in houses), and a domestic social studies consultant will be appointed to monitor public health and the incidence of disease. These surveys will be conducted annually over the first five years of operation of the system, and require the initial collection of baseline data on pre-project conditions, during the construction period.

D. Environmental management and monitoring costs

128. Most of the mitigation measures require the contractors to adopt good site practice, which should be part of their normal procedures already, so there are unlikely to be major costs associated with compliance. Regardless of this, any costs of mitigation by the contractors (those employed to construct the infrastructure or the local companies employed to conduct O&M when the system is operating) are included in the budgets for the civil works and do not need to be estimated separately here. Mitigation that is the responsibility of LSGD will be provided as part of their management of the project, so this also does not need to be duplicated here. Costs of compensating shopkeepers for loss of income (Table 7) are calculated separately in the budgets for the Resettlement Framework and Resettlement Plans so are also excluded from this analysis.

[4] In the operational period some infrastructure will be the responsibility of the Municipal Boards/Councils, whilst others will be the responsibility of the appropriate branch of the State government (such as PWD, PHED, etc)

Table 8: Environmental Monitoring Plan

Mitigation Activities and Method	Location	Responsible for Mitigation	Monitoring Method	Monitoring Frequency	Responsible for Monitoring
CONSTRUCTION					
Excavate intake and CWR after new landfill is available	Intake/CWR	DSC	Site observation; design reports	As needed	EMS
Use tarpaulins to cover dry soil and sand when carried on trucks	All sites	Contractor	Observations on and off site	Weekly	EMS
Find beneficial uses for waste soil (construction, land raising, infill)	Network sites	Contractor	Site observations; CC records	Monthly	EMS
Remove waste soil as soon as it is excavated	Network sites	Contractor	Site observations	Weekly	EMS
Only bring sand (for backfill) to site when needed	Network sites	Contractor	Site observations; CC records	Weekly	EMS
Cover or damp down soil and sand stockpiled on site	Network sites	Contractor	Site observations	Weekly	EMS
Leave spaces for access between mounds of soil	Network sites	Contractor	Site observations	Weekly	EMS
Plan truck routes to avoid Jaisalmer Town, narrow or congested roads, important or fragile buildings, religious and tourist sites	Network sites	Contractor	Observations off site; CC record	Weekly	EMS
Plan transport of waste to avoid peak traffic and tourist season	Network sites	Contractor	Observations on and off site	Weekly	EMS
Plant and maintain two trees for every one removed	All sites	Contractor	Observations on/off site; CC records	Monthly	EMS
*Compensate businesses for lost income	Where required	LSGD	Shopkeeper survey; LSGD record	As needed	IMA[5]
Provide bridges to allow people & vehicles to cross trenches	Network sites	Contractor	Site observation; resident survey	Weekly	EMS
Increase workforce in inhabited areas to finish work quickly	Network sites	Contractor	Site observations; CC records	Monthly	EMS
Inform businesspeople and residents of work in advance	Network sites	LSGD	Resident surveys; CC records	Monthly	EMS
Consult town authority and avoid existing infrastructure	All sites	DSC	Site observation; design reports	Monthly	EMS
Locate water and sewer pipes on opposite sides of roads	Network sites	DSC	Site observation; design reports	Monthly	EMS
Integrate subprojects to conduct trenching at same time	Network sites	DSC/LSGD	Site observation; design reports	Monthly	EMS
Plan work with town authorities – work when traffic is light	Network sites	Contractor	Site observations; CC records	Monthly	EMS
Ensure police provide traffic diversions when necessary	Network sites	Contractor	Site observations; CC records	Monthly	EMS
Request archaeological authorities to assess potential of all sites	All sites	DSC	DSC records; design reports	As needed	EMS
Select alternatives if sites have medium or high potential	All sites	DSC	DSC records; design reports	As needed	EMS
Include state and town historical authorities as stakeholders	All sites	LSGD	CC records; observations at meetings	As needed	EMS
Develop and apply archaeological protocol to protect chance finds	All sites	DSC and CC	DSC and CC records; site	Weekly	EMS

[5] Resettlement issues (asterisked) will be monitored by an Independent Monitoring Agency (IMA) established under the Resettlement Framework

			observations		
Avoid using pneumatic drills near buildings at risk from vibration	Network sites	Contractor	Site observations; CC records	Weekly	EMS
Use modern vehicles and machinery and maintain as specified	All sites	Contractor	Site observations; CC records	Monthly	EMS
Consult authorities, custodians of buildings, communities: address key issues, avoid working at sensitive times	All sites	Contractor	Site observations; CC records; resident surveys	Monthly	EMS
Plan work to minimise shutdown of water supply system	All sites	DSC	Design reports; resident surveys	Monthly	EMS
Provide alternative water to affected residents	All sites	LSGD	Site observation; resident survey	Weekly	EMS
Inform communities of any shutdown in advance	All sites	LSGD	Site observation; resident survey	Weekly	EMS
Prepare and implement a site H&S Plan (safety of workers/public)	All sites	Contractor	Site observations; CC records	Monthly	EMS
Exclude public from the site	All sites	Contractor	Site observations; CC records	Monthly	EMS
Ensure that workers wear Personal Protective Equipment	All sites	Contractor	Site observations; CC records	Monthly	EMS
Provide Health and Safety training for all personnel	All sites	Contractor	CC records; worker interviews	Monthly	EMS
Follow documented procedures for all site activities	All sites	Contractor	Site observations; CC records	Monthly	EMS
Keep accident reports and records	All sites	Contractor	CC records	Monthly	EMS
Train all personnel in dangers and recognition of AC pipes	All sites	Contractor	Site observations; CC records	Monthly	EMS
Develop and apply protocol if AC pipes are encountered	All sites	DSC/CC	DSC & CC records; site observations	Weekly	EMS
If AC pipes are encountered, report to management immediately	All sites	Contractor	Site observations; CC records	Weekly	EMS
Remove all persons to safe distance	All sites	Contractor	Site observations; CC records	Weekly	EMS
Workers handling AC: wear breathing apparatus; protective suits	All sites	Contractor	Site observations; CC records	Weekly	EMS
All AC material must be removed and disposed of safely	All sites	Contractor	Observations on and off site; CC records	As needed	EMS
Employ at least 50% of workforce from communities near sites	All sites	Contractor	CC records; worker interviews	Monthly	EMS
OPERATION AND MAINTENANCE					
Inform shopkeepers and residents of work in advance	Network sites	GA	Resident surveys	Monthly	
Provide walkways and bridges for vehicles	Network sites	OM Contractor	Site observation; resident survey	Monthly	
Request police to divert traffic if necessary	Network sites	OM Contractor	Site observations	Monthly	
Avoid drilling and use of heavy vehicles near fragile buildings	Network sites	OM Contractor	Site observations	Monthly	
Increase workforce to finish work quickly in sensitive areas	Network sites	OM Contractor	Site observations; OMC records	Monthly	
Consult and inform authorities & people, avoid sensitive times	Network sites	OM Contractor	Site observation; resident survey	Monthly	
Prepare and operate H&S plan to protect workers and citizens	All sites	OM Contractor	Site observations; OMC records	Monthly	
Apply AC protocol to protect all persons if AC pipes encountered	All sites	OM Contractor	Site observations; OMC records	Monthly	

Employ people who live nearby to maintain intake, OR and CWR	All sites	GA	Employer record; worker survey	Monthly	
LONG-TERM SURVEYS					
Survey of chemical and bacteriological quality of municipal water	Intakes and Domestic sites	LSGD	Water quality sampling and analysis	Annual for 6 years	Consulting laboratory
Survey of public health and incidence of water borne disease	Both Towns	LSGD	Hospital records; resident surveys	Annual for 6 years	Social studies consultant

129. The remaining actions in the Environmental Management Plan are:

- the environmental monitoring during construction, conducted by the EMS; and
- the long-term post-construction surveys that will be commissioned by LSGD.

These have not been budgeted elsewhere, and their costs are shown in Table 9, with details of the calculations shown in footnotes beneath the table. The figures show that the total cost of environmental management and monitoring for the subproject as a whole (covering design, 1 ½ years of construction and the first five years of operation) is INR 1.8 million, ie US$ 40,000.

Table 9: Environmental management and monitoring costs (INR)

Item	Quantity	Unit Cost	Total Cost	Sub-total
1. Implementation of EMP (2 years)				
Domestic Environmental Monitoring Specialist	1 x 3 month	100,000[6]	300,000	
Survey Expenses	Sum	100,000	100,000	400,000
2. Survey of municipal water quality (6 years)				
Domestic Consultant	6 x ½ month	100,000	300,000	
Sample Analysis	6 x 20	3,000[7]	360,000	
Other Expenses	Sum	200,000	200,000	860,000
3. Survey of public health (6 years)				
Domestic Consultant	6 x ½ month	100,000	300,000	
Other Expenses	Sum	200,000	200,000	500,000
TOTAL				1,760,000

VIII. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

A. Project stakeholders

130. Most of the main stakeholders have already been identified and consulted during preparation of this IEE, and any others that are identified during project implementation will be brought into the process in the future. Primary stakeholders are:

- Residents, shopkeepers and businesspeople who live and work alongside the roads in which network improvements will be provided and near sites where facilities will be built (CWR, GR, intakes and access roads);
- Custodians and users of socially and culturally important buildings in affected areas;
- State and local authorities responsible for the protection and conservation of archaeological relics, historical sites and artefacts;
- State and local tourism authorities.

Secondary stakeholders are:

[6] Unit cost of domestic consultants include fee, travel, accommodation and subsistence
[7] Cost of a standard suite of drinking water quality parameters (pH, turbidity, chlorinity, alkalinity, conductivity, TDS, DO, total and faecal coliforms, and selected metals) is $65 (INR 3,000) per sample

- LSGD as the Executing Agency;
- Other government institutions whose remit includes areas or issues affected by the project (state and local planning authorities, Department of Public Health Engineering, Local Government Dept, Ministry of Environment and Forests, Roads and Highways Division, etc);
- NGOs and CBOs working in the affected communities;
- Other community representatives (prominent citizens, religious leaders, elders, women's groups);
- The beneficiary community in general; and
- The ADB.

B. Consultation and disclosure to date

131. Two forms of public consultation have been used during preparation of the IEE, to discuss the project and involve the community in planning the mitigation measures and develop the Environmental Monitoring Plan. These are:

- A public meeting was held in Jhalawar/Jhalrapatan in March 2007, to which representatives of primary and secondary stakeholders were invited. Attendees were informed about the aim of the various subprojects and the benefits they would bring, together with their likely impacts and the ways in which they would be mitigated. Participants were invited to discuss their views and concerns, which were then incorporated into the IEE. Appendix 1 contains a summary of the meetings;
- *Ad hoc* discussions were also held on site with people and communities who could be affected by the subprojects, so that views could be expressed in a less formal setting. These were also considered in preparing the IEE.

This IEE will be disclosed to the public by making it available on the ADB website, together with the IEEs prepared for the other subprojects and the summary IEE (SIEE) describing the impacts and mitigation of all subprojects.

C. Future consultation and disclosure

132. LSGD will extend and expand the consultation and disclosure process significantly during implementation of RUSDIP. They will appoint an experienced NGO to handle this key aspect of the programme, who will conduct a wide range of activities in relation to all subprojects in each town, to ensure that the needs and concerns of stakeholders are registered, and are addressed in project design, construction or operation where appropriate. The programme of activities will be developed during the detailed design stage, and is likely to include the following:

<u>Consultation during detailed design:</u>

- Focus-group discussions with affected persons and other stakeholders (including women's groups, NGOs and CBOs) to hear their views and concerns, so that these can be addressed in subproject design where necessary;
- Structured consultation meetings with the institutional stakeholders (government bodies and NGOs) to discuss and approve key aspects of the project.

Consultation during construction:

- Public meetings with affected communities to discuss and plan work programmes and allow issues to be raised and addressed once construction has started;
- Smaller-scale meetings to discuss and plan construction work with individual communities to reduce disturbance and other impacts, and provide a mechanism through which stakeholders can participate in subproject monitoring and evaluation;

Project disclosure:

- Public information campaigns (via newspaper, TV and radio) to explain the project to the wider city population and prepare them for disruption they may experience once the construction programme is underway;
- Public disclosure meetings at key project stages to inform the public of progress and future plans, and to provide copies of summary documents in Hindi;
- Formal disclosure of completed project reports by making copies available at convenient locations in the study towns, informing the public of their availability, and providing a mechanism through which comments can be made.

IX. FINDINGS AND RECOMMENDATIONS

A. Findings

133. The process described in this document has assessed the environmental impacts of all elements of the infrastructure proposed under the Jhalawar and Jhalrapatan Water Supply Subproject. Potential negative impacts were identified in relation to construction and operation of the improved infrastructure, but no impacts were identified as being due to either the project design or location. Mitigation measures have been developed to reduce all negative impacts to acceptable levels. These were discussed with specialists responsible for the engineering aspects, and as a result some measures have already been included in the outline designs for the infrastructure. These include:

- Locating all pipelines within the ROW of existing roads, to avoid the need to acquire land or relocate people;
- Locating pipelines on unused land adjacent to roads wherever possible, to avoid damaging roads and disrupting traffic and other activities;
- Designing the infrastructure so that the new DI distribution network will replace the existing AC network, which will be left in situ undisturbed.

This means that the number of impacts and their significance has already been reduced by amending the design.

134. Changes have also been made to the location of elements of the project to further reduce impacts. These include:

- Locating all facilities (intakes, access roads, ORs, CWRs) on government-owned land to avoid the need for land acquisition and relocation of people.

135. Regardless of these and various other actions taken during the IEE process and in developing the project, there will still be impacts on the environment when the infrastructure is built and when it is operating. This is mainly because of the invasive nature of trenching and other excavation; because the distribution network is located in two ancient towns where there are densely populated areas and sites of historical and tourism interest; and because Rajasthan is an area with a rich history, so there is a high risk that ground disturbance may uncover important remains. Because of these factors the most significant impacts are on the physical environment, the human environment, tourism, and the cultural heritage.

136. During the construction phase, impacts mainly arise from the need to dispose of large quantities of waste soil and import a similar amount of sand to support the pipes in the trenches; and from the disturbance of residents, businesses, traffic and important buildings by the construction work. These are common impacts of construction in urban areas, and there are well developed methods for their mitigation. These include:

- Finding beneficial uses for waste material;
- Covering soil and sand during transportation and when stored on site;
- Planning work to minimise disruption of traffic and communities;
- Providing temporary structures to maintain access across trenches where required.

137. Although there will be no need to acquire land or relocate people, roadside businesses will lose some income as access will be difficult for customers when work is in their vicinity. ADB policy requires that no-one should be worse off as a result of an ADB-funded project, so these losses will be compensated through a Resettlement Plan and Framework prepared to comply with Bank policy on Involuntary Resettlement.

138. One field in which impacts are much less routine is archaeology, and here a series of specific measures have been developed to avoid damaging important remains. These include:

- Assessing the archaeological potential of all proposed construction sites, and selecting alternative locations to avoid any areas of medium or high risk;
- Including archaeological, cultural and historical authorities and interest groups as project stakeholders to benefit from their expertise;
- Developing a protocol for use in conducting all excavation to ensure that any chance finds are recognised, protected and conserved.

139. The use of AC pipes in the existing water distribution network presents a particular problem, as workers and the public will need to be protected from inhalation of asbestos dust, which can be carcinogenic. This will be addressed by a number of measures, including:

- Provision of a new DI distribution network to entirely replace the old AC system, which will be left in situ undisturbed;
- Training staff and workers to raise awareness of the dangers of AC and enable early recognition of such pipes if encountered accidentally;
- Development of a protocol based on USEPA guidelines to protect workers and the public if AC pipes are encountered (including evacuation of the immediate area, use of protective equipment by workers, and safe removal and disposal of AC material).

140. There were limited opportunities to provide environmental enhancements, but certain measures were included. For example it is proposed that the project will:

- Employ in the workforce people who live in the vicinity of construction sites to provide them with a short-term economic gain;
- Ensure that people employed in the longer term to maintain and operate the new facilities are residents of nearby communities.

141. These and the other mitigation and enhancement measures are summarised in Table 7, which also shows the location of the impact, the body responsible for the mitigation, and the programme for its implementation.

142. Once the system is operating, most facilities (intake, CWRs, ORs) will operate with routine maintenance, which should not affect the environment. Leaks in the network will need to be repaired from time to time, but environmental impacts will be much less than those of the construction period as the work will be infrequent, affecting small areas only. It will also be conducted in areas that have already been excavated, so there will be no need to protect archaeological material.

143. Depletion of the water source from the increase in abstraction should also not be an issue as the water derives from parts of the Kalisindhi River in which weirs have been built to retain water throughout the year in quantities that are well in excess of those required for this scheme.

144. The main impacts of the operating water supply system will be beneficial as the citizens of both towns will be provided with a constant supply of better quality water. This will improve the quality of life of people as well as benefiting both individual and public health as the improvements in hygiene should reduce the incidence of disease associated with poor sanitation. This should lead to economic gains as people will be away from work less and will spend less on healthcare, so their incomes should increase.

145. Table 7 also assesses the effectiveness of each mitigation measure in reducing each impact to an acceptable level. This is shown as the level of significance of the residual impact (remaining after the mitigation is applied). This shows that all impacts will be rendered at least neutral (successfully mitigated), and that certain measures will produce a benefit (in addition to the major benefits provided by the operating schemes).

146. Mitigation will be assured by a programme of environmental monitoring conducted during both construction and operation to ensure that all measures are provided as intended, and to determine whether the environment is protected as envisaged. This will include observations on and off site, document checks, and interviews with workers and beneficiaries, and any requirements for remedial action will be reported to the PIU. There will also be longer-term surveys to monitor the expected improvements in the quality of domestic water and the health of the population.

147. Finally, stakeholders were involved in developing the IEE through both face-to-face discussions on site and a large public meeting held in each town, after which views expressed were incorporated into the IEE and the planning and development of the project. The IEE will be made available at public locations in the towns and will be disclosed to a wider audience via the ADB website. The consultation process will be continued and expanded during project

implementation, when a nationally-recognised NGO will be appointed to handle this key element to ensure that stakeholders are fully engaged in the project and have the opportunity to participate in its development and implementation.

B. Recommendations

148. There are two straightforward but essential recommendations that need to be followed to ensure that the environmental impacts of the project are successfully mitigated. These are that LSGD should ensure that:

- All mitigation, compensation and enhancement measures proposed in this IEE report (Table 7) and in the Resettlement Framework for the RUSDIP are implemented in full, as described in these two documents;
- The Environmental Monitoring Plan proposed in Section VI.C of this report and the internal and external monitoring proposed in the Resettlement Framework are also implemented in full.

X. CONCLUSIONS

149. The environmental impacts of the proposed improvements in water supply and distribution infrastructure in Jhalawar and Jhalrapatan have been assessed by the Initial Environmental Examination reported in this document, conducted according to ADB guidelines. Issues related to Involuntary Resettlement were assessed by a parallel process of resettlement planning and will be compensated by measures set out in detail in the Resettlement Framework for the subproject. These measures were integrated into the IEE and are summarised in this report.

150. The overall conclusion of both processes is that providing the mitigation, compensation and enhancement measures are implemented in full, there should be no significant negative environmental impacts as a result of location, design, construction or operation of the subproject. There should in fact be some small benefits from recommended mitigation and enhancement measures, and major improvements in quality of life and individual and public health once the scheme is in operation.

151. There are no uncertainties in the analysis, and no additional work is required to comply with ADB procedure or national law. There is thus no need for further study or Environmental Assessment.

Photo 1: Overhead Tank in Jhalawar

Photo 4: Jhalwar water intake, Pipaji ki deh

Photo 2: Site at Radi ke balaji for CWR, Jhalawar

Photo 5: Site for dry intake well, Pipaji ki deh

Photo 3: Site for CWR behind WTP, Jhalrapatan

Photo 6: Jhalrapatan intake, Bhavrasa deh

Photo 7: Site for dry intake well, Bhavarsa deh

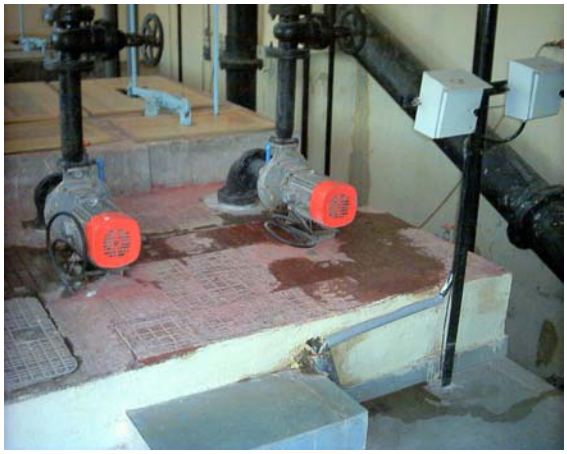


Photo 10: Existing pump station, Jhalawar

Photo 8: Pumping well at Pipaji ki deh

Photo 11: Household water meter

Photo 9: DI pipes

Photo 12: Kalisindh River

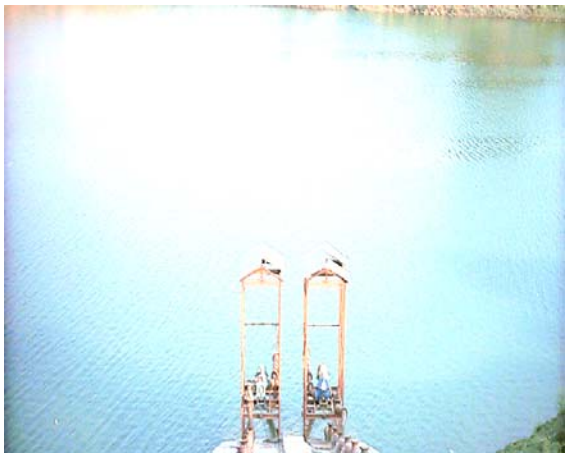


Photo 13: Pipaji ki deh

Photo 16: Ahu River

Photo 14: Bindu deh

Photo 17: Agriculture land in the outskirts

Photo 15: Jhalawar pumping main alignment

Photo 18: Domesticated bushes and shrubs

Photo 19: Piped water supply in Jhalrapatan

Photo 22: Open dumping of solid waste

Photo 20: Roadside drains in Jhalawar

Photo 23: Heavy vehicle & pedestrian traffic

Photo 21: Open dumping/buring of solid waste

Photo 24: Garh Palace

Photo 25: Gagroan fort

Photo 28: Earthen statues in Jalrapatan

Photo 26: Chndrabagha temple, Jhalrapatan

Photo 29: Encroachment onto drains

Photo 27: Surya temple, Jhalrapatan

Photo 30: Backhoe digger for trenching

Photo 31: Digging a trench by hand

Photo 32: Crane for laying pipes

Photo 33: Handheld pneumatic drill