SAHIWAL REGIONAL DEVELOPMENT PLAN

IRRIGATION SECTOR REPORT

The Urban Unit

Urban Sector Planning & Management Services Unit (Pvt.) Ltd.

July 2024

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The Urban Unit
503-Shaheen Complex, Egerton Road, Lahore.
Tel: +42 992005316-22
Fax: +42 99205323
Email: uspmsu@punjab.gov.pk
Website: www.urbanunit.gov.pk

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1. Punjab Irrigation System

Surface-water resources in Pakistan are based on the flows of the Indus River and its tributaries (Jhelum, Chenab, Ravi, Sutlej, and Beas to the east and the Kabul River to the west). The Indus River has a total length of 2900 km and a drainage area of ~966,000 km-sq. The inflow to these rivers is mainly derived from snow and glacial melt and rainfall in the catchment areas. Outside the Indus Basin, most of the rivers are ephemeral streams, which only flow during the rainy season and thus do not meet the water needs of the Indus system inside the basin as do the other rivers. The irrigation network is shown in figure 1 below.

The Indus river basin in Pakistan is being divided into two plains i.e. upper and lower Indus plain. The upper Indus plain comprises of Himalayan piedmont, the doabs, and the Suleiman piedmont. The area between two rivers forms a Doab. The Indus river Basin consists of following four doabs:

1. Thal Doab (Area between Indus and Jhelum Rivers)
2. Chaj Doab (Area between Jhelum and Chenab Rivers)
3. Rachna Doab (Area between Chenab and Ravi Rivers)
4. Bari Doab (Area between Chenab / Ravi and Sutlej Rivers)

The Punjab Irrigation consist of eight (08) irrigation administrative zones which are:

1. Lahore Zone
2. Sargodha Zone
3. Faisalabad Zone
4. Sahiwal Zone
5. Multan Zone
6. Bahawalpur Zone
7. Dera Ghazi (D.G.) Khan Zone
8. Potohar Zone

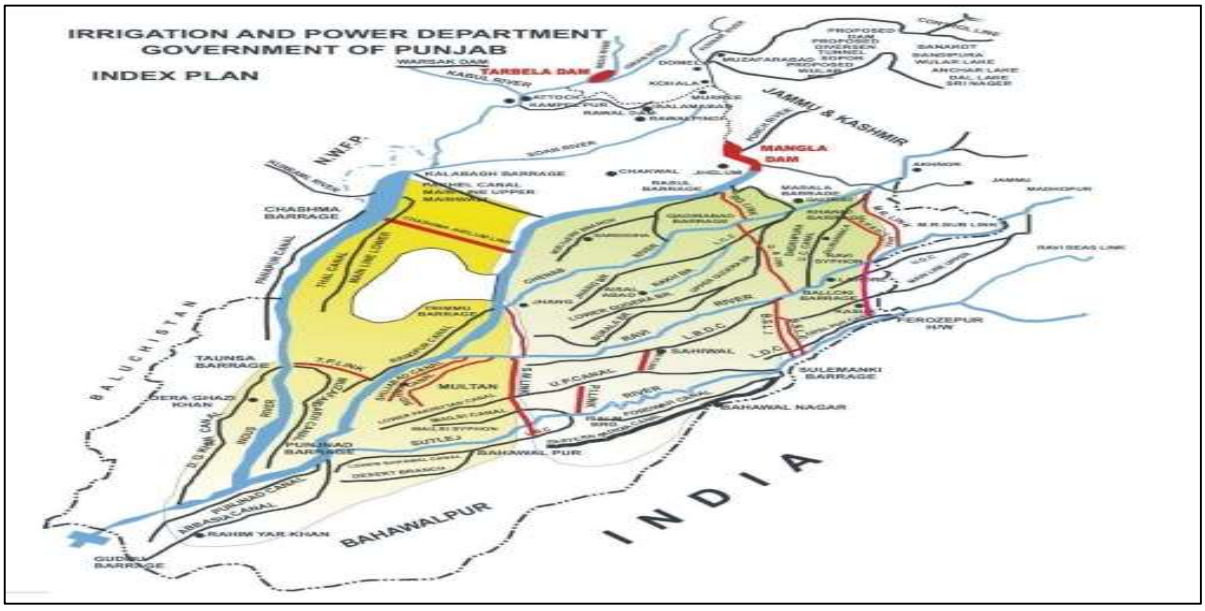

Figure 1 Punjab Irrigation Network Index Plan

There are following main salient features of Punjab Irrigation department.

Table 1: Salient features of Punjab Irrigation System

Assets	Quantities
Headworks / Barrages	13
Main Canals	25
Length of main canals and branches (Miles)	3,993
Length of distributaries and minors (Miles)	19,191
Length of inter river Link canals (Miles)	528
Main canals offtake discharge (Cusec)	120,000
Link canals offtake discharge (Cusec)	110,000
Total Outlets	58,000
Gross command area (million Acres)	23.35
Culturable command area (million Acres)	20.78
Perennial culturable command area (million Acres)	12.94
Non-Perennial culturable command area (million Acres)	7.84
Overall designed annual Intensity (%)	67
Actual intensity (%)	120-130
SCARP Tubewells	1,060
Private Tubewells	110,000
Length of flood embankments (Miles)	1,600
Length of surface drains (Miles)	4,800
Small Dams	57

The salient feature of irrigation zones is shown in Table 1.

Table 2: Salient Features of Punjab Irrigation Zones

Descriptions	Lahore Zone	Sargodha Zone	Faisalabad Zone	Sahiwal Zone	Multan Zone	Bahawalpur Zone	D.G. Khan Zone	Potohar Zone
No. of Channel	549	576	350	262	331	706	423	-
Length of main, branch, and link canals (Miles)	725	657.75	544.00	454.00	344.65	519.60	453.00	-
Outlets (No.)	12,499	9,046	8,380	6,709	6,100	7,812	8,197	-
Gross Command	4.50	4.69	3.44	3.76	1.83	3.50	2.33	-

Area (M. Acres)								
Culturable Command Area (M. Acres)	4.00	4.11	3.22	3.03	1.66	3.25	2.11	-
Design flow (Cusec)	29,767	23,225	21,294	15,528	9,292	3,593	20,088	-
Length of Drains (Miles)	527	1835.27	1500	1552.29	425	498.18	412	-
No. of Small Dams	-	-	-	-	-	-	-	57

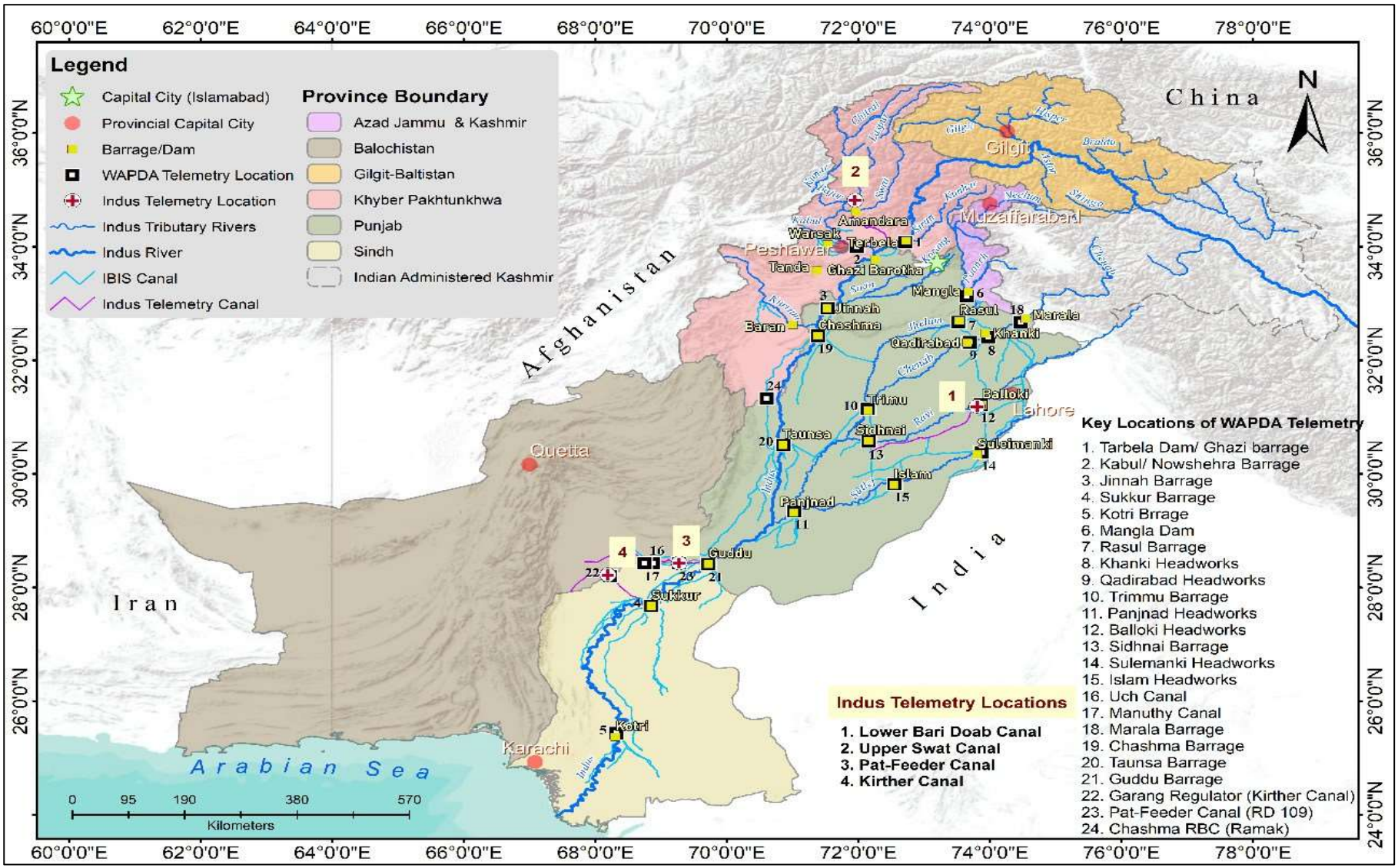

Figure 2 Irrigation Network of Indus Basin in Pakistan

2. About Sahiwal Irrigation System

Sahiwal Division was formed by merging parts of Lahore Division and Multan Division and took its name Sahiwal from the district and city of the same name. About 18 miles (29 km) southwest of Sahiwal is Harappa; an ancient city of the Indus Valley Civilization. Sahiwal Division is bordered by Faisalabad Division to the west, Lahore Division to the north, Bahawalpur division and India to the east, and Multan Division to the south. It includes districts of Sahiwal, Okara and Pakpattan with a combined population of about 7.3 million (census 2017). The district yields variety of fruits (Orange, Guava, Lemon, Mango, Dates, Jambul etc.), vegetables (Potato, Onion, Cauliflower, Peas, Carrot, Turnip, and Ladyfinger), and agricultural products (Wheat, Sugarcane, Cotton, Tobacco, Rice, Maize, Oilseed, Mustard Seed).

2.1. Agriculture Products

Being located in the rich Indus plain, Agriculture is by far the main economic activity in the Sahiwal region. The division is a major producer of high value-added crops. There are some crops which have yields better than Punjab province's average yield. The main crops, during Rabi, are wheat, gram, rapeseed, mustard, barley and oil seeds. During Kharif, crops include cotton, Sorghum, sugarcane, pearl millet, maize, and rice. In addition, there are subsidiary crops known as Zaid Rabi, such as muskmelon, tobacco and potatoes, and also Zaid Kharif crops, such as potatoes and chilies. The main fruits grown are oranges, watermelon, muskmelon, guava, citrus, grewia asiatica, java plum, and pomegranate. When cultivation began, the inhabitants ate pilu and bair, the only wild fruits that grows, intermittently, in the region. With the introduction of canal irrigation, other fruits are now being grown on a commercial basis. However, wheat, cotton, sugarcane and rice remain the major crops. The vegetables are grown in abundance, as the water and soil are suitable for cultivation. Crops include potatoes, carrots, ladyfingers, chilies, onions and cauliflower. Bitter gourd, turmeric and garlic are also grown to meet public demand. Other vegetables include radish, apple gourd, and bringal are also widely cultivated in the Sahiwal region.

2.2. Ground Water

Ground water is the primary source of fresh water in the Sahiwal region. Sahiwal division falls within the mix cropping zone, primarily relying on canals and groundwater for its water supply. The extensive use of groundwater significantly affects the reservoirs, which are depleting rapidly. Moreover, there is a risk of exacerbating water scarcity by obtaining three crops in a year, leading to the rapid depletion of groundwater resources. This is because of pumping, and decreased rainfall and recharge.

The groundwater depths have generally increased across the districts, indicating a decrease in water levels over the specified period. The water table has declined from 2010 to 2023 in the Sahiwal Division. The southwest region has witnessed a significant decline in the water table as a large portion of urban population is inhabiting there. The decrease in water table level of Sahiwal Division from 2010 to 2023 is depicted in a comparison below. The average ground water depth in Sahiwal Division is decreased from 157 feet (47.8 meters) in 2010 to 232 feet (70.7 meters) in 2023. The comparison of ground water depth in three districts of Sahiwal Division is also provided below. The excessive Groundwater exploitation in Sahiwal division effects the agricultural activities in the region as most

of them source their water through tube wells. A strong canal system is necessary to make the shift from tube wells to through canal irrigated agriculture. There is existing a strong canal system in Punjab. The existing canal system needs to be made more efficient for the agriculture of the region.

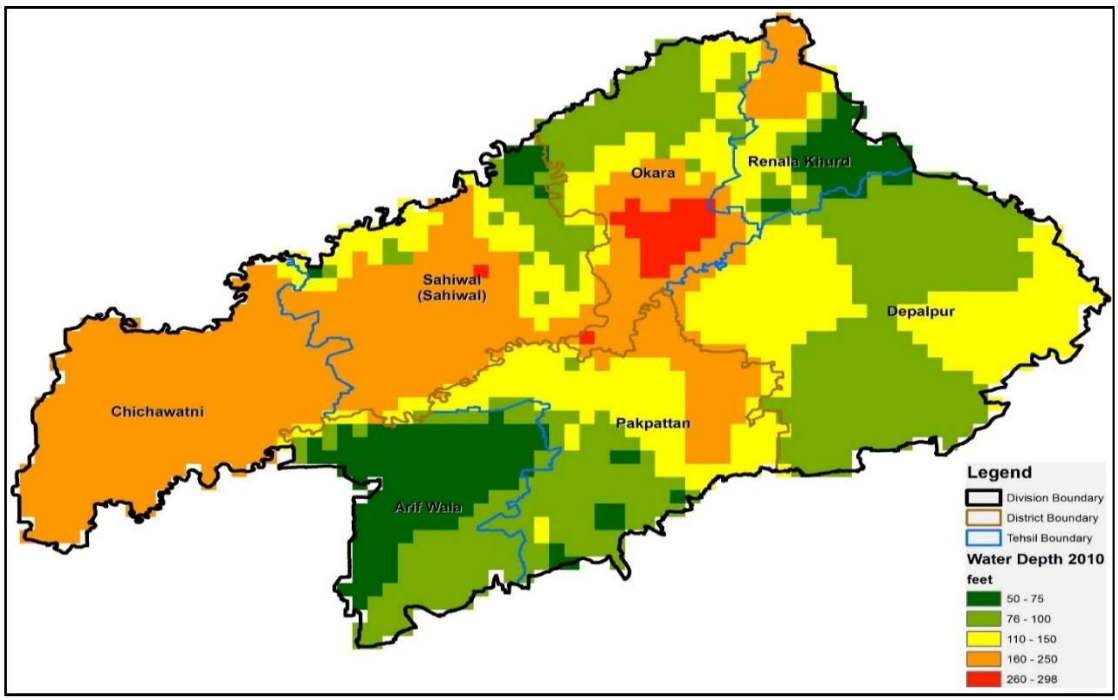

Figure 3 Ground Water Depth (2010)

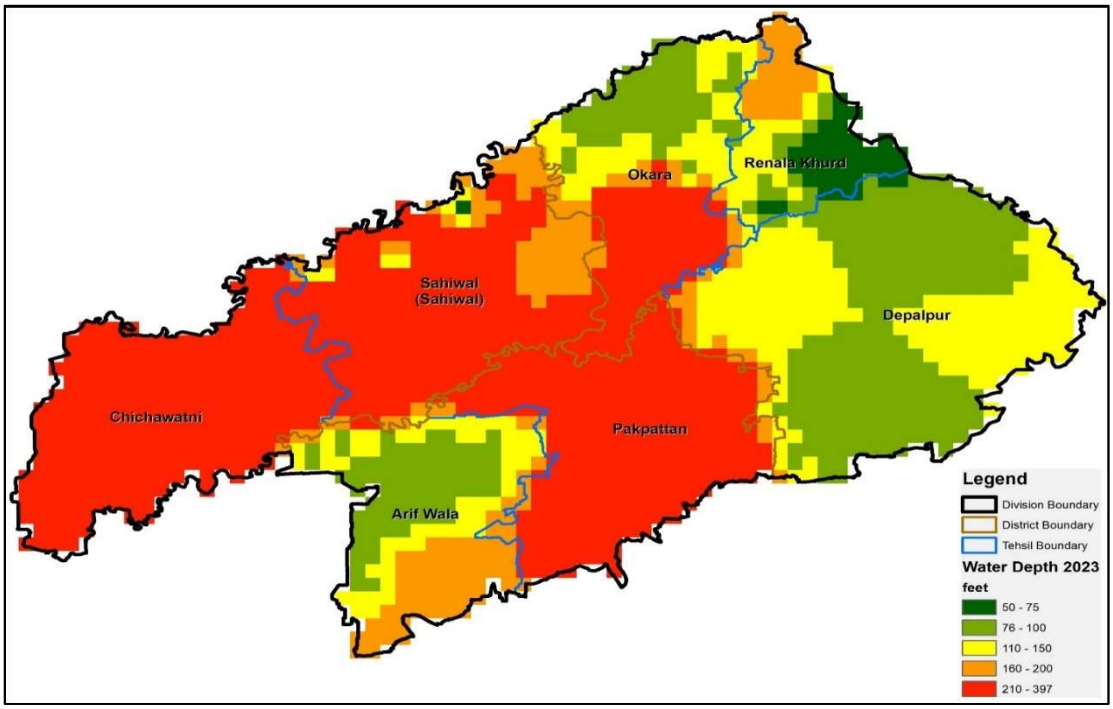

Figure 4 Ground Water Depth (2023)

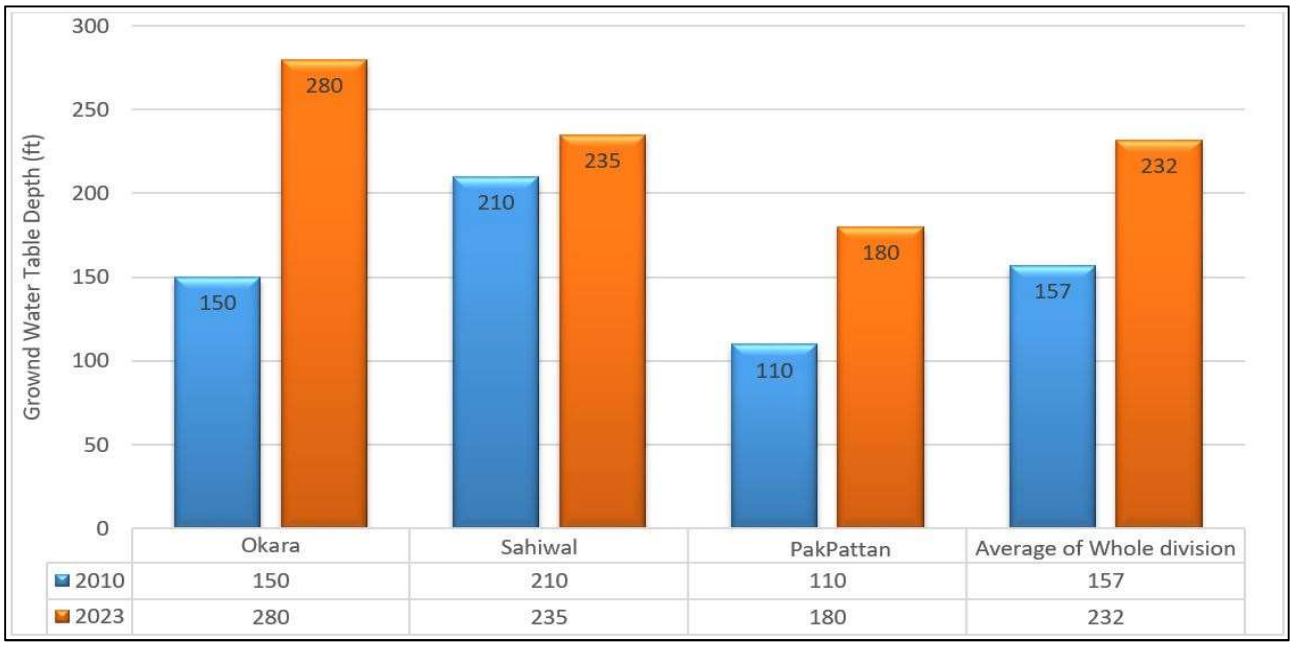

Figure 5 Comparison between ground water depths

2.3. Irrigation System

The most of irrigation network and its infrastructure has been developed mostly before the independence of Pakistan. Therefore, field administrative setups such as rest-houses, barrages/ headworks, canals head/cross regulators, official residencies, and their offices reflect historical importance. This infrastructure was assessed on the basis of following existing observations.

Table 3: Field Assessment Criteria

Rating	Asset Condition	Description
A	Excellent	No noticeable defects. Some aging or wear may be visible
B	Good	Only minor deterioration or defects are evident
C	Fair	Some deterioration or defects are evident, but function is not significantly affected
D	Poor	Serious deterioration in at least some portion of the structure. Function is inadequate
F	Failing	No longer functional. General failure or complete failure of a major structural component

2.4. Key Gaps

The irrigation network of Punjab is divided into zones which are further divided into canal circles. The Sahiwal division irrigation zone is divided into three following main canal circles.

I. Lower Bari Doab Canal Circle
II. Nilli Bar Canal Circle
III. Sukhrawa Canal Circle

Following is circle-wise detail of gaps which were identified during field assessment and survey:

2.4.1. Lower Bari Doab Canal Circle (LBDCC)

Lower Bari Doab Canal Circle covers the western part of the Sahiwal division covering the cities of Chichawatni, Sahiwal City, Okara and Renala Khurd. This circle lies on the east bank of the river Ravi.

- **Canal Banks Deterioration:**

  Several canal banks at different distributaries are damaged and needs rehabilitation. The damaged banks allow water to infiltrate resulting in the reduction of water supply at the tail level. Some interventions are required at different distributaries in this regard.

i. Required Lining of Gugera disty from RD 224+500 to tail RD
ii. Required Lining of Gugera disty from RD 32+500 to tail RD 224+500
iii. Earthen Banks of Gugera disty from RD 116+000 to 127+000 needs to be raised

- **Inadequate Canal Infrastructure:**

  There are some missing canal structures at different distributaries. These structures facilitate in the proper distribution of water among different fields. Some interventions are proposed in the LBDCC are:

i. Required new construction of head regulators gate at 9/L disty RD 172+000 of LBDCC
ii. Construction of head regulators gate at LBDCC RD 227+000
iii. Construction of head regulators gate on Gugera disty RD 94+500
iv. Required upgradation of water regulation through gates at five falls on Gugera disty
v. Required construction of head regulator gates, and escape channel of 1000RFT at 9/L disty RD 172+000 of LBDCC

- **Absence of Telemetry:**

  There is absence of Telemetry at different locations in the LBDCC. Telemetry is necessary to collect data and to send it to servers at remote collection. This data is used for the planning and better management and distribution of Irrigation water resources.
  Following interventions are proposed to install telemetry at required locations

i. Requirement of installation of telemetry and SCADA at Cool-wala Rest House on LBDCC
ii. Installation of telemetry and SCADA at 9/L disty RD 172+000 of LBDCC
iii. Installation of telemetry and SCADA at LBDCC RD 227+000
iv. Installation of telemetry and SCADA on Gugera disty RD 94+500

- **Lacking Staff Residences**

  The rest houses for officials are in deteriorating condition and they need to be upgraded. Some interventions are proposed to cater this issue which are as follow:

i. Required restoration of staff residencies at Joya rest house on Gugera disty RD 94+500
ii. Required restoration of rest house in Okara canal colony for LBDCC RD 227+000
iii. Required construction of water filtration plant, water supply lines with OHR, renewable electric source, groundwater recharge well and restoration of staff residencies at Cool-wala rest house on LBDCC

2.4.2. Nilli Bar Canal Circle (NBCC)

Nilli bar canal circle is stretched over the southern part of the Sahiwal division covering the city of Pakpattan and its nearby areas. The Nili Bar Canal Circle lies on the west bank of the river Sutlej.

- **Inadequate Canal Infrastructure:**

  There are some missing canal structures at different distributaries. These structures facilitate in the proper distribution of water among different fields. Some interventions are proposed in NBCC are:

i. Cross regulators at canal/distributary offtakes need to be built so that water supply to the farms is maintained properly

- **Canal Banks Deterioration:**

  Several canal banks at different distributaries are damaged and needs rehabilitation. The damaged banks allow water to infiltrate resulting in the reduction of water supply at the tail level. Canal linings of several distributaries are required.

- **Required Flood Risk Reduction Infrastructure:**

  Flood protection bunds or escape channels are either missing or are in failing condition. This situation increases the vulnerability of local community towards the flash flood disaster. Following interventions are proposed in this respect:

i. Flood escape channels or flood protection works are required at different locations so that the risk of farm flooding can be eliminated or minimized

- **Water Contamination:**

  The situation of sewerage system is defective and unplanned which brings the community towards the risk of fatal diseases. There is absence of proper sewage treatment hence it is being disposed in nearby canal system without any treatment which is compromising the water quality for irrigation

- **Lacking Staff Residences:**

  The rest houses for official individuals are in a deficient condition and they need to be upgraded. There is absence of boundary wall at different locations

i. Official residencies like rest houses or staff houses and related infrastructure is required for the officials of irrigation department
ii. Construction of boundary wall is required

2.4.3. Sukhrawa Canal Circle (SCC)

Sukhrawa canal circles covers the eastern part of the Sahiwal division and is spread over the city of Depalpur and some part of Pakpattan district. It lies to the west bank of the river Sutlej. The major issues in Sukhrawa canal circle are following:

- **Canal Banks Deterioration:**

  Several canal banks at different distributaries are damaged and needs rehabilitation. The damaged banks allow water to infiltrate resulting in the reduction of water supply at the tail level. Some interventions are required at different distributaries in this regard.

i. Required concrete lining for seven distributaries and minors

- **Inadequate Canal Infrastructure:**

There are some missing canal structures at different distributaries such as cross regulators and head regulators. These structures facilitate in the proper distribution of water among different fields. Some interventions are proposed in SCC are:

i. Construction of cross regulator at head of all Seven disty

- **Lacking Staff Residences:**

  The rest houses for official individuals are in a dire condition. There is absence of boundary wall at different locations. Some interventions are proposed to cater this issue which are as follow:

i. Construction of boundary wall, staff residencies and upgradation of rest-house in TAHAR sub-division
ii. Upgradation of rest house in Canal Colony Depalpur
iii. Construction of water supply lines, overhead water reservoir and installation of renewable energy source, in Canal Colony Depalpur is required

Following are some of the pictures of field assessment on different irrigation structures:

	
Lower Bari Doab Canal 5R Bhawani Sahiwal Canal Circle	Gugera Canal (Okara)
	
Minor Khanwah Canal Depalpur	9/L disty RD 172+000 (Sahiwal)
	
Minor Khanwah Canal Depalpur	Gugera Canal (Okara)

Figure 6 In-pictures: Various canal circles and their conditions

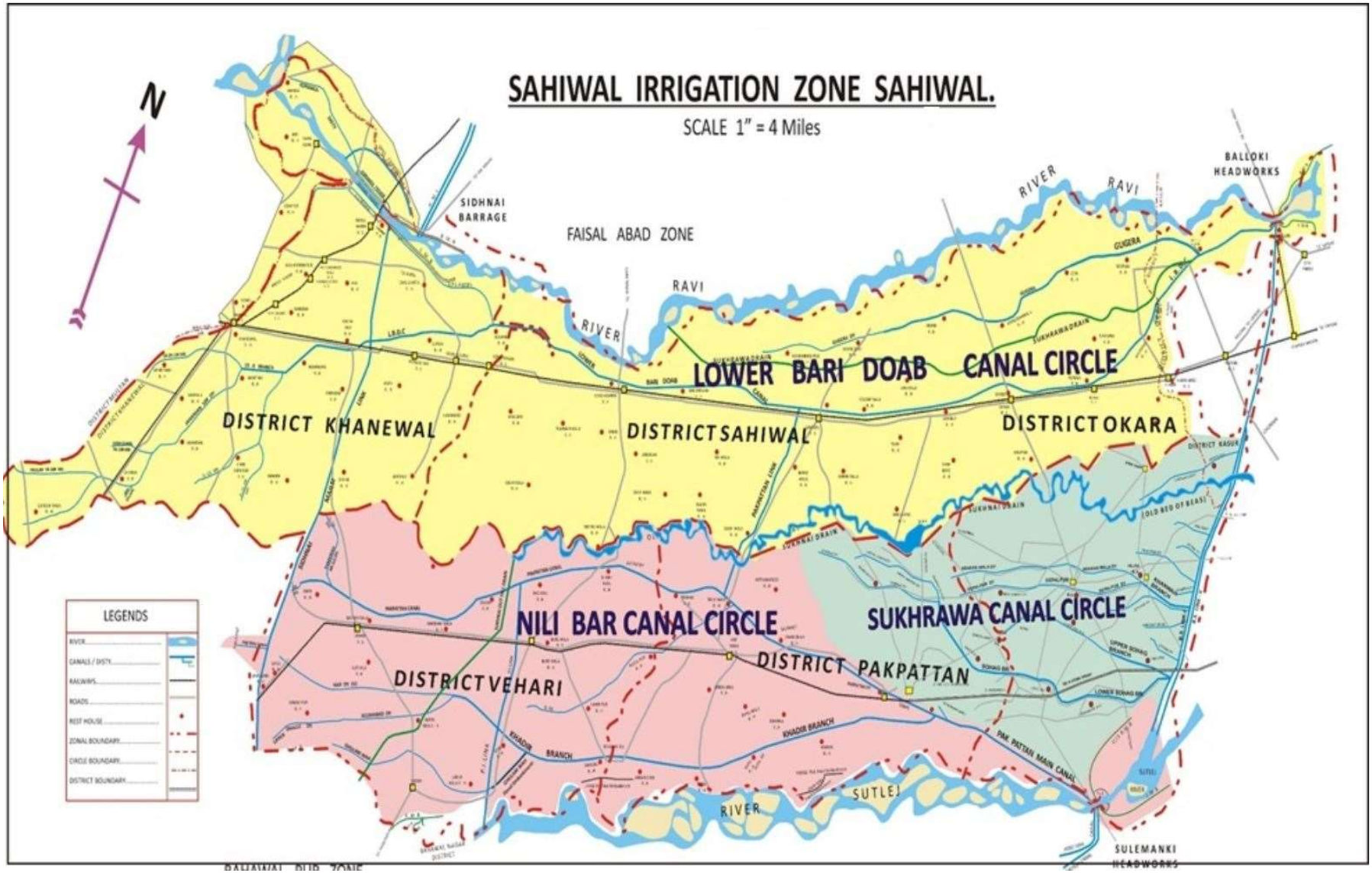

Figure 7 Map of the Irrigation Zone of the Sahiwal Division

3. Proposed Interventions

The water resources and irrigation development plans were prepared for three planning periods i.e.:

- Short Term Plans (02 Years Plans, 2024-2026)
- Medium Term Plans (05 Years Plans, 2026-2029)
- Long Term Plans (10 Years Plans, 2029-2034)

These plans developed after conducting conditions and requirement assessments of existing infrastructures. These water resources and irrigation short, medium, and long-term plans are as followed:

3.1. Short-term Plan

Short- term plan for Sahiwal Region mainly involves the rehabilitation of all identified failures in Irrigation Networks at different locations, provision of missing facilities (i.e. head regulators) and Rest houses for Official Residencies as stated below, for which 442 million is estimated as rough cost estimate for mentioned interventions, which is further subject to detail assessment, prior to physical execution of the project.

Table 4: Short-term Plan

Proposed Schemes	Cost (Million PKR)
Rehabilitation of Irrigation Network	
1. Rehabilitation of Saline Sodic / Sodic Soils of Lower Bari Doab Canal (LBDCC) areas using chemical amendments (Gypsum)	76.30
2. Construction of Telemetry, Head Regulator Gates, and Escape Channel of 1000RFT at 9/L disty RD 172+000 of LBDCC	71.54
3. Raising of Earthen Banks of Gugera disty from RD 116+000 to 127+000	115.54
Sub-Total:	**263.38**
Rehabilitation of Rest houses/ canal colonies for Officials Residencies	
1. Water Filtration plant UF 2000 LPH With Room 12x12 ft in Sahiwal Canal Colony	7.96
2. Construction of Telemetry, Water filtration plant, Water Supply Lines with OHR, Renewable Electric Source, GroundWater Recharge Well and	170.77

Restoration of Staff Residencies at Cool-wala Rest House on LBDCC	
Sub-Total:	**178.73**
Grand Total:	**442.11**

3.2. Medium-term Plan

Medium- term plan for Sahiwal Region mainly involves the rehabilitation of all identified failures in Irrigation Networks at different locations, provision of missing facilities (i.e. head regulators) and Rest houses for Official Residencies as stated below, 4233 million is estimated as rough cost estimate for mentioned interventions, which is further subject to detail assessment, prior to physical execution of the project.

Table 5: Medium-term Plan

Proposed Schemes	Cost (Million PKR)
Rehabilitation of Irrigation Network	
1. Installation of Gates, Groove, Sill, Hoist Bridge, and Winch Machine at falls at RD 60+250 (04 Bays), 81+150 (04 Bays), 153+250 (02 Bays), and 185+500 (03 Bays) of Gugera Distributary in Okara Canal Circle	2184.00
2. Concrete Lining of Probyanbad Minor RD 0+000 to 63+530 Tail	328.00
3. Concrete Lining of Depalpur Disty from RD 115+850 to 152+825 Tail	164.00
4. Concrete Lining of Battak Disty RD 48+204 to 82+484 Tail	161.00
5. Concrete Lining of Mustafabad Minor RD 26+965 to 75+496 Tail	273.00
6. Concrete Lining of Maroof Minor RD 0+000 to 29+817 Tail	165.00
7. Concrete Lining of Ali Minor RD 0+000 to 30+180 Tail	167.00
8. Concrete Lining of Bunga Saleh Disty RD 0+000 to 25+846 Tail	164.00

9. Construction of Cross Regulator at head of all Seven Distributaries and Minors	273.00
Sub-Total:	**3879.00**
Rehabilitation and Construction of official residencies	
1. Installation of Renewable Electric supply, SCADA with Data Depositary of Irrigation Zones Data	56.86
2. Upgradation of Soil and Water Testing Lab, Water Research Zone Sahiwal	21.80
3. Construction of Telemetry, Head regulator gates, and SCADA & restoration of staff residencies at Joya rest house on Gugera disty RD 94+500	209.97
4. Construction of Boundary Wall, Staff Residencies and Upgradation of Rest House in TAHAR Sub-division	66.00
Sub-Total:	**354.63**
Grand Total:	**4233.63**

3.3. Long-term Plan

Long-term plan for Sahiwal Region mainly involves the rehabilitation of all identified failures in Irrigation Networks at different locations, provision of missing facilities (i.e. head regulators) and Rest houses for Official Residencies as stated below, 2374 million is estimated as rough cost estimate for mentioned interventions, which is further subject to detail assessment, prior to physical execution of the project.

Table 6: Long-term Plan

Proposed Schemes	Cost (Million PKR)
Rehabilitation of Irrigation Network	
1. Concrete Lining of Gugera Distributary from RD 224+500 to tail RD	506.15
2. Concreter lining of Gugera Distributary from RD 32+500 to tail RD 224+500	585.27

3. Revival of Sulaimanki Canal Colony through amended PC-I for reconstruction of residences and allied structures in Canal Colony Sulaimanki Barrage	717.07
Sub-Total:	**1808.49**
Rehabilitation and Construction of Official residencies	
1. Construction of Water supply lines, Over-head Water Reservoir, Renewable Electric Source, SCADA and Upgradation of Rest House in Canal Colony Depalpur	287.00
2. Construction of Telemetry, Head Regulator Gates, and SCADA & Restoration of Rest House in Okara Canal Colony for LBDC RD 227+000	279.22
Sub-Total:	**566.22**
Grand Total:	**2374.71**

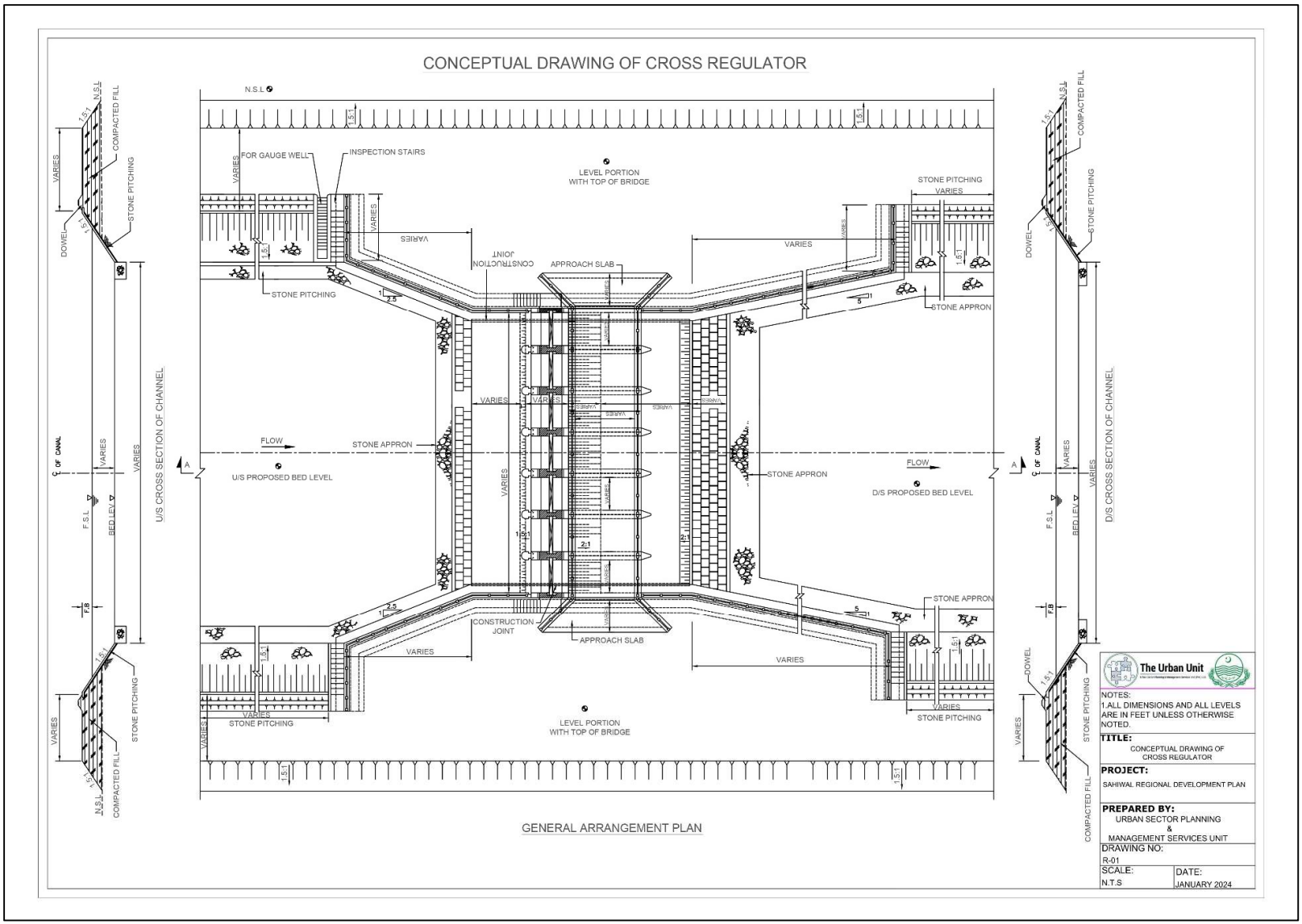

Figure 8 Head / Cross Regulator

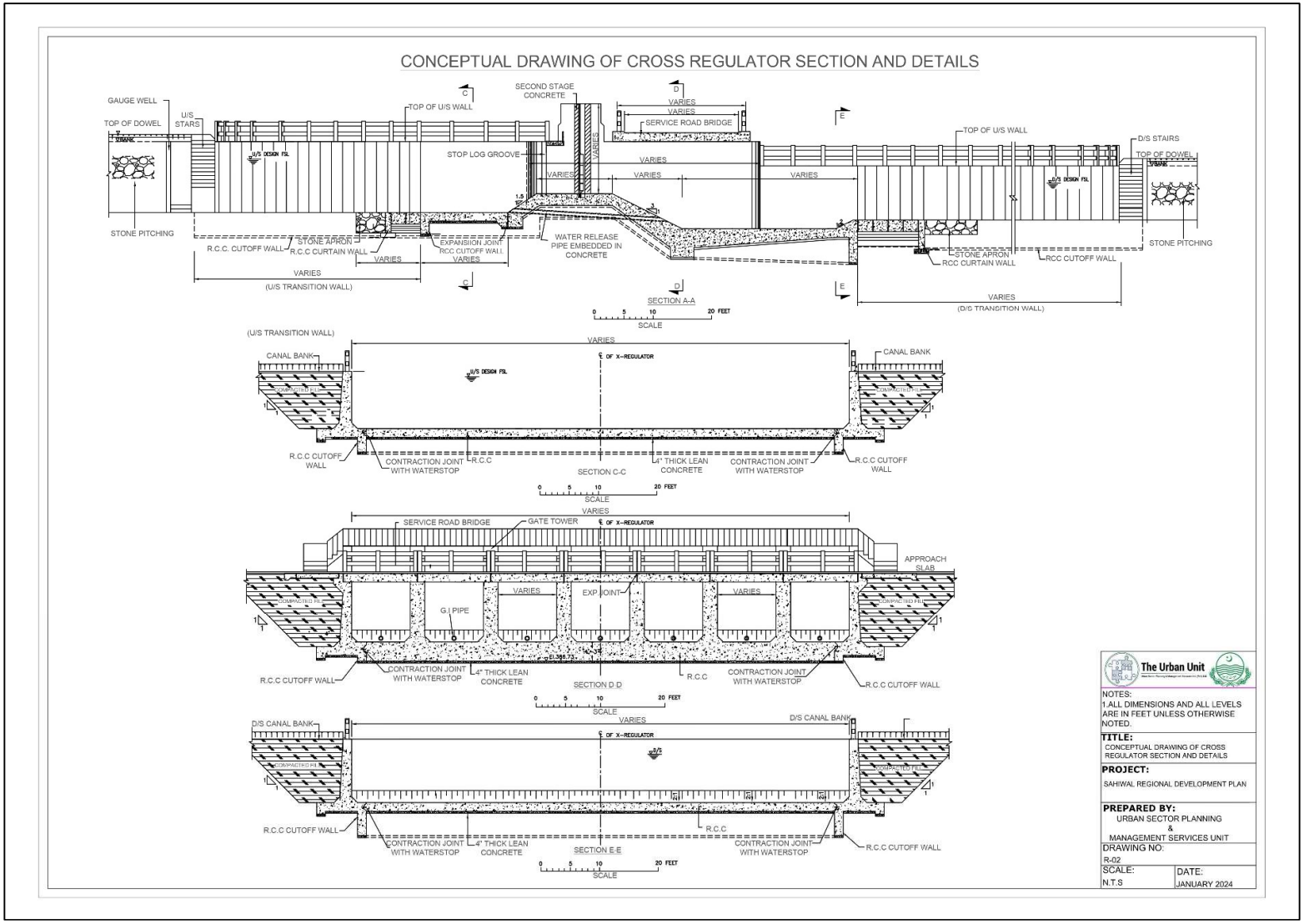

Figure 9 Head / Cross Regulator at fall

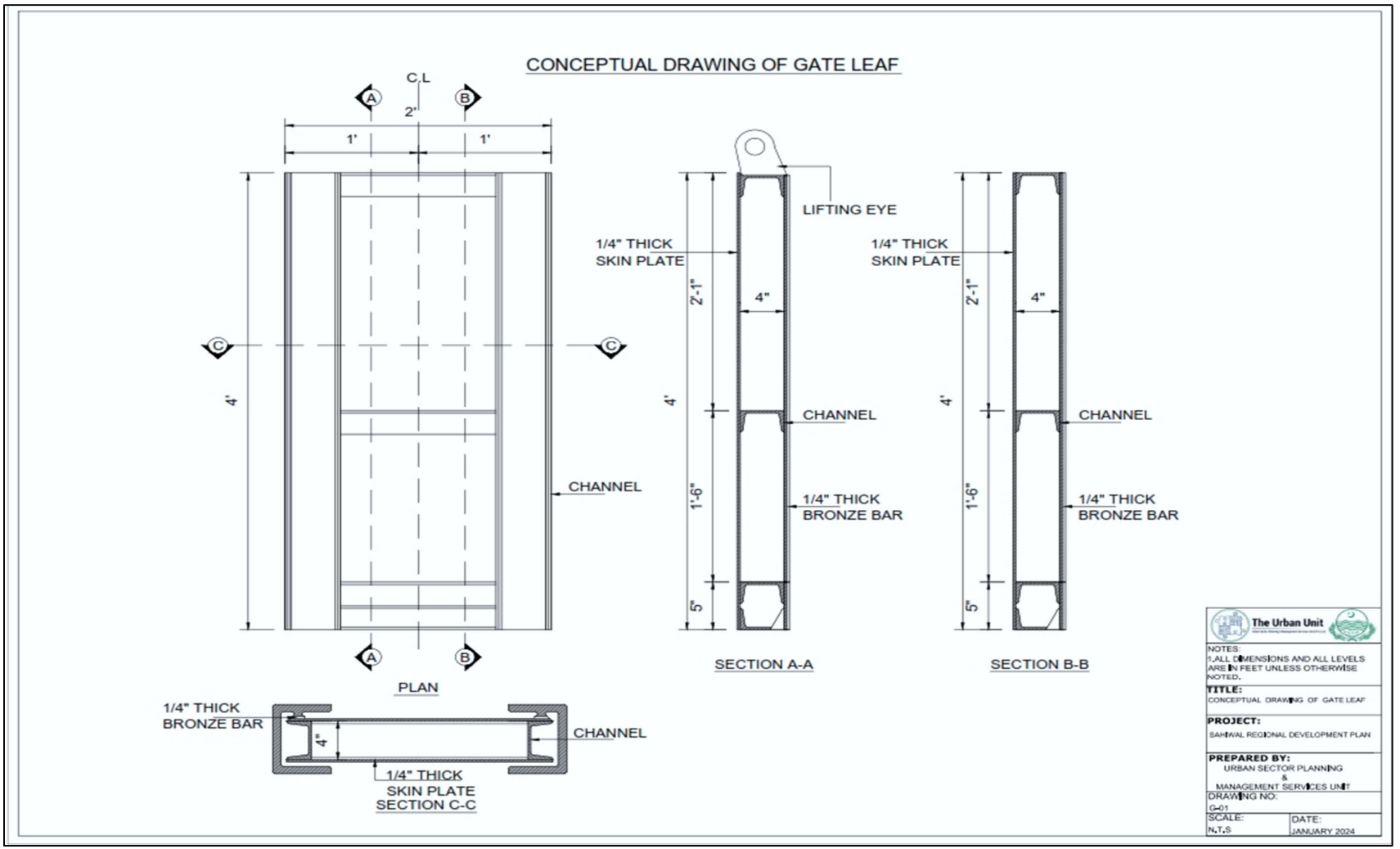

Figure 10 Weir / Gates

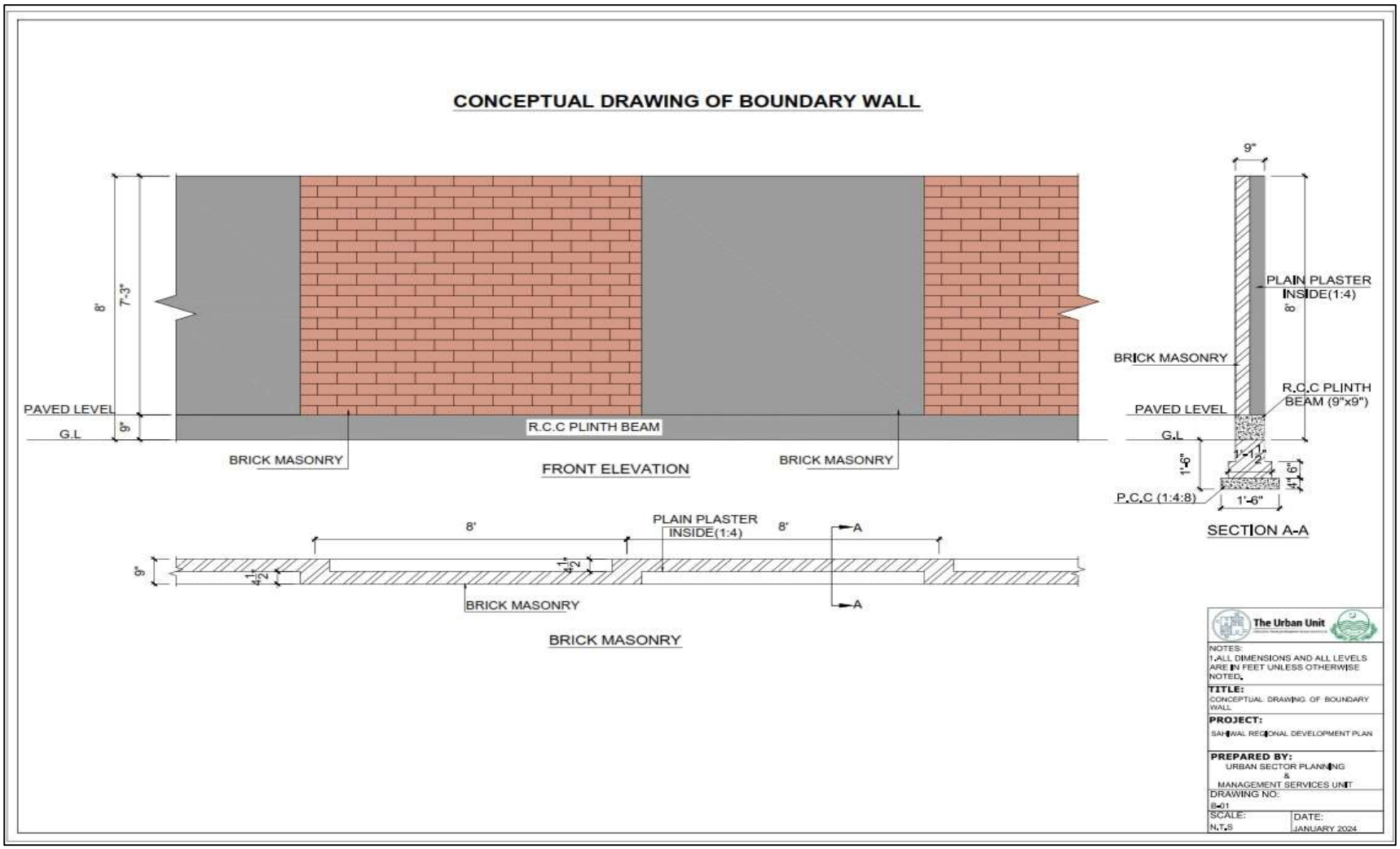

Figure 11 Boundary Wall

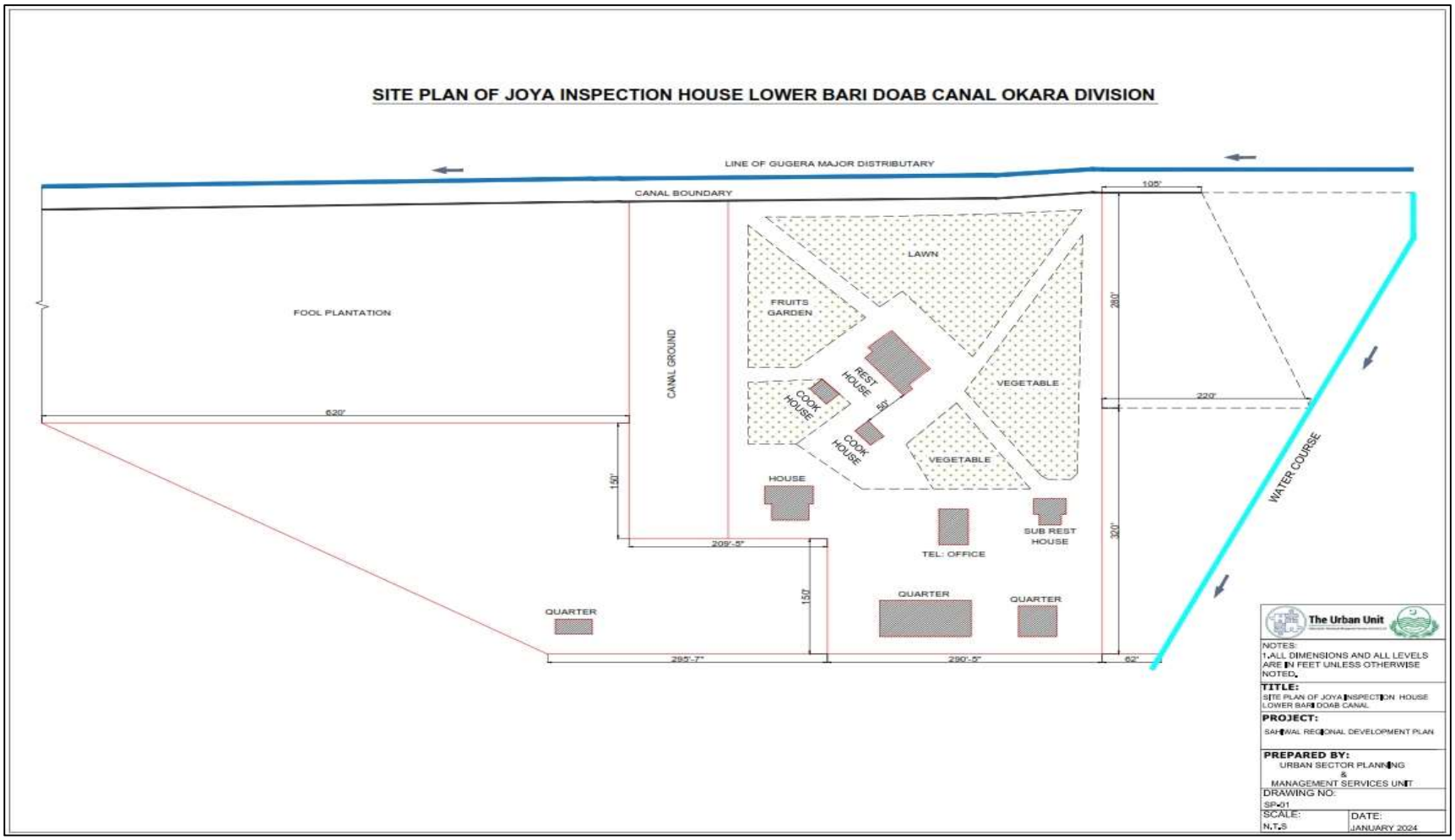

Figure 12 Rest House (RH) Layout Plan Joya RH

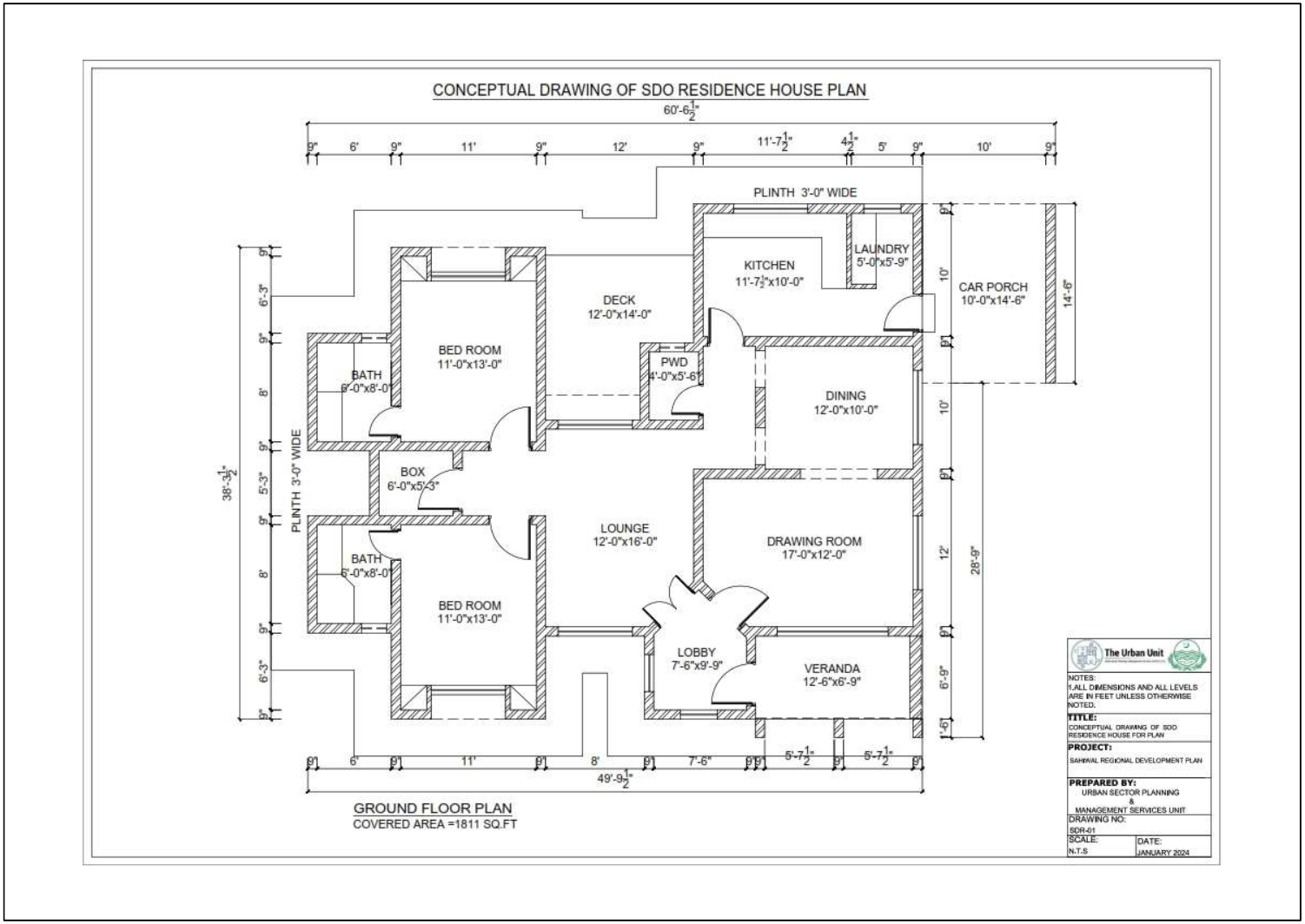

Figure 13 Sub-Divisional Officer (SDO) R

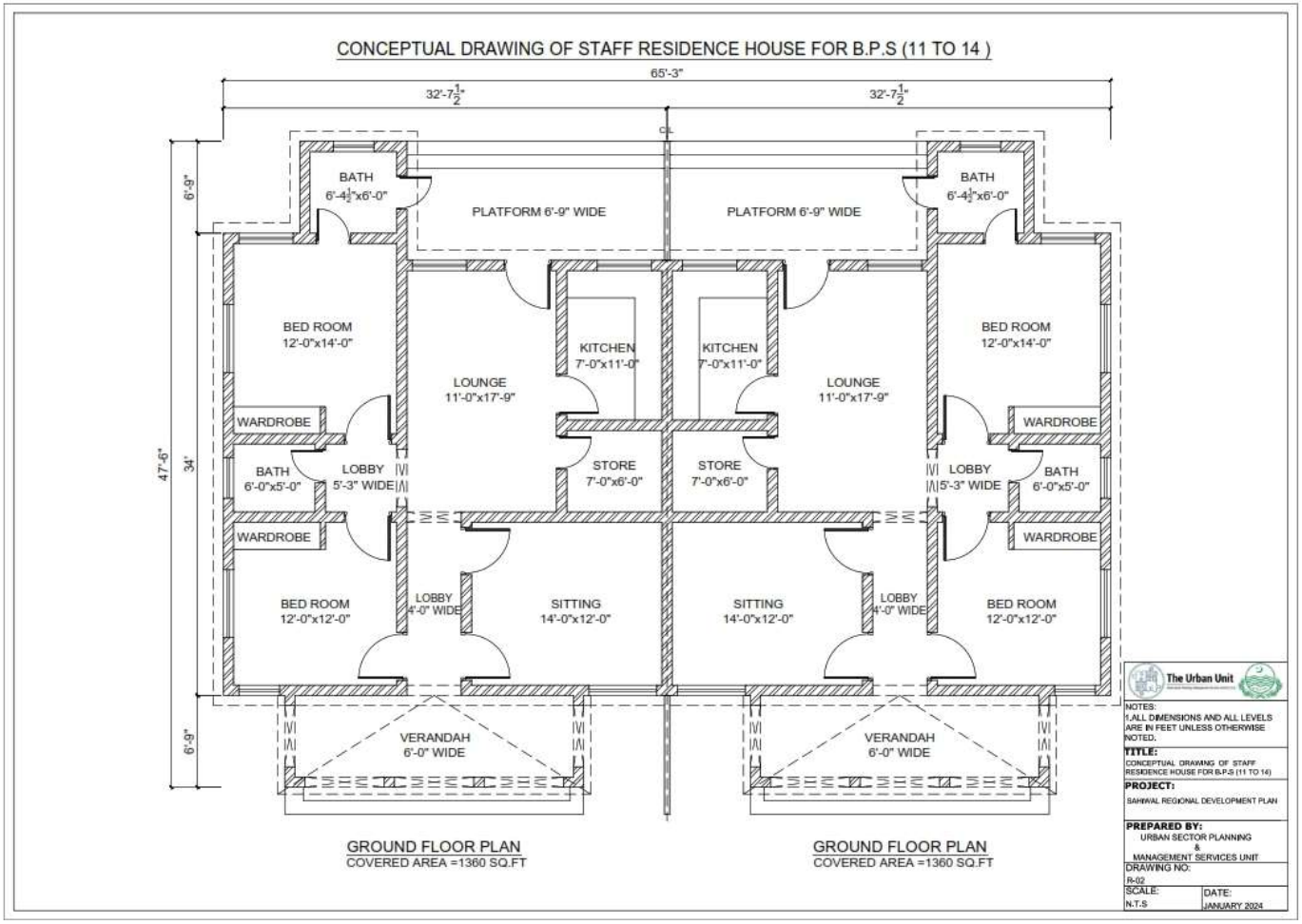

Figure 14 Sub-Engineer Residency

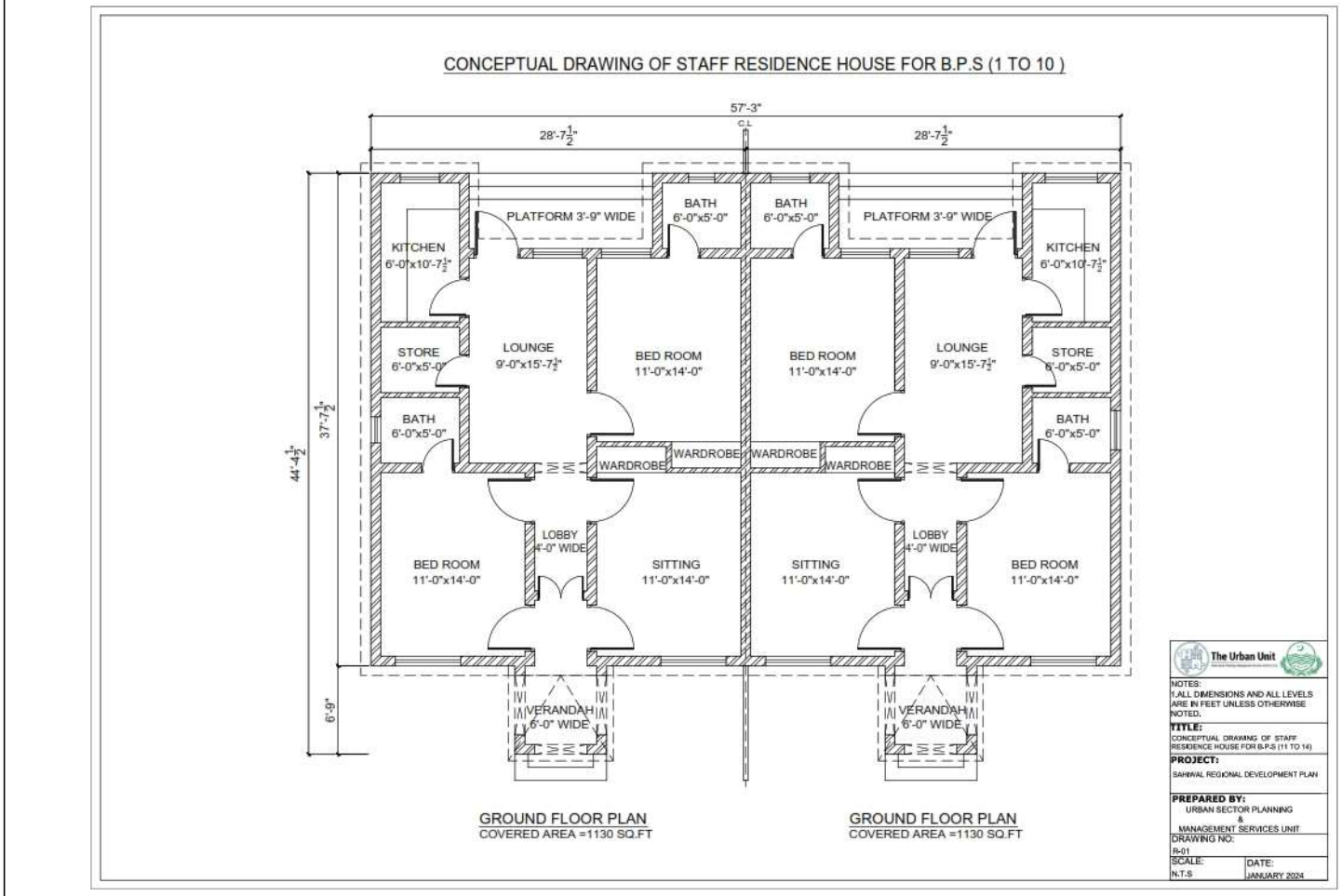

Figure 15 Support Staff (BPS 1-10) Residency / Mineral Quarters

The Urban Unit

TheUrbanUnit urbanunitGop urban_unit urban-unit

503 - Shaheen Complex, Edgerton Road, Lahore - Pakistan

042-99205316-22 042-99205323

uspmu@punjab.gov.pk www.urbanunit.gov.pk