WATER SUPPLY & SANITATION

FAISALABAD REGIONAL DEVELOPMENT PLAN

MAIN REPORT

VOLUME I

The Urban Unit

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Executive Summary

With an enormous population of 14.1 Million people, Faisalabad Division stands third in row of divisions of Punjab province with respect to its population size. Unfortunate for the public residing in the division, the most basic necessity of life, which is water, is not of drinkable properties in most parts due to its high salinity. As such, two of its district, Faisalabad and Toba Tek Singh fulfil their most of water demand from canal-based sources. In addition to it, sanitation arrangements in the division are also not very well-performing due to deteriorated and outdated sewers and unavailability or under-capacitated Waste Water Treatment Plants (WWTP). UNICEF study on WASH sector in year 2019 for the district (Urban) of Faisalabad, Jhang, Chiniot, & Toba Tek Singh indicates the WASH ranking (Urban) of 29, 6, 8, and, 21, respectively. To make a comparison best and worst performing cities can be used as context, Narowal City tops the list with WASH rank of 1 whereas Khushab is the worst performing district (Urban) with rank of 35. For Rural, Faisalabad and Chiniot are categorized into one of the lowest ranks of 34 and 31 among all districts (Rural) of Punjab with respect to rural water and sanitation index, respectively, which highlights the need of immediate planning and respective interventions especially in these districts.

Faisalabad city is the second most populous city of Punjab which is based on Agri-industrial components contributing around 5$ billion to gross domestic product (GDP) at national level[1]. Water supply system in Faisalabad is dependent on groundwater and surface water sources. Groundwater is the main source of water supply in Faisalabad city and is managed by Water and Sanitation Agency-Faisalabad (WASA-Faisalabad). The groundwater is quite saline making it unfit for human consumption. Water supply network in Faisalabad has the capacity to provide 110 million Gallons per day (MGD) against a demand of 170 MGD (2023) resulting in a shortfall of 60 MGD. Faisalabad does not have any segregation mechanism for industrial and municipal effluents. The wastewater is discharged into Ravi River and Chenab River through an extensive drainage system comprising of Paharang and Madhuana drains along with major municipal drains of the city. Faisalabad has Punjab's first WWTP located at Chokera outfall disposal pumping station having a capacity of 20 MGD.

Chiniot City lies on the bank of the river Chenab. It is 29th largest city of Pakistan in-terms of population. Owing to its peculiar terrain, when compared with most of the cities in Faisalabad division, city have mostly plain land with rocky hills at around middle of the city which offers hinderance for clean water boring. This is the area where city is provided with MC owned Water Supply Schemes. Currently three schemes provide water through these schemes to an estimated population of 165,000. Although this means half (50%) of the current population but in quantified water demand and yield comparison, this carter to only 13% of the demand of water as there are only three tube-wells (one each) attached to these schemes. This reduces further as water supply pipelines is also outdated and is in deteriorating condition. However, most of the city fulfill their water needs from their household bores as ground water is sweet and of drinkable characteristics. This however is changing due to high extraction of water and contamination of ground water from sewerage infiltration especially at the seepage drains which passes through the outskirts to the Chenab River. These seepage drains carry water from

[1] https://www.finance.gov.pk/survey_2022.html

five disposal stations in the city which are functional and carter to the city's sewage which is mostly carried through sewers. Spatially, the coverage of the sewers is around 60%. It is also alarming that city currently have no Waste Water Treatment Plant (WWTP) which is prompting the both ground water and the river Chenab water contamination.

Historically Toba Tek Singh city catches it names from a kind-hearted man, who served water and shelter to the travelers by a small pond (Toba In Punjabi). Today, the city lacks proper water supply in the city which is mostly due to outdated distribution network which in-turn increases Non-Revenue Water (NRW) proportion. Water is fetched from seepage tube-wells based on mainly two sources (T.S. Link Canal and Lower Gujera Branch). In addition to these, there are four small scale direct WS schemes also based on canals. Most of the city WS pipeline is in deteriorated condition where sewage infiltration from also deteriorated sewers is inevitable. There is also no WWTP plant in the city which again is another hazardous concern which need dire attention.

In Jhang city, the water supply system uses tube wells for ground water extraction, with overhead reservoirs providing storage and distribution to adjacent areas. However, the water supply system is barely operational due to limited public interest due to abundant availability of ground water at reasonable depth. The sewerage system of Jhang City uses a number of disposal stations, wastewater drains and sewer lines for disposal of sewage to the outskirts of the city. Sewage is then disposed either into nearby agricultural fields or the Khair Wala Drain; which bypasses the city towards the west. The infrastructure has aged beyond its design life and is in deteriorated condition. Crown failure and choking due to accumulation of solid waste in the sewer lines are the most prominent issues, creating nuisance and health problems for the residents.

Provision of safely managed drinking water and sanitation services to divisional rural population (8.9 Million) is responsibility of the Government in achieving the Sustainable Development Goals (SDGs) Target by 2030. PHED, CBOs and PAPA are main responsible bodies striving to provide Water and Sanitation services to the inhabitants of rural areas of division. Data and statistics reflected that despite of all efforts and investments, water supply coverage is present only in 800/2403 villages (33%) and sewerage system exist in form of open drains in some of villages with disposal of wastewater in to Agriculture Land, Seim Nullah and Irrigation Drains. Presence of 7-60% brackish contamination of water, bearing lowest WASH index (31st and 34th ranking among 36 districts of Punjab), 30% Non-Functional infrastructure and 67% unserved water supply villages and complete absence of wastewater treatment reflect the need of attention towards investment in rural WSS to uplift the quality of locals residing in villages.

To uplift the current grave issues relating to Water Supply & Sanitation in aforementioned cities (Faisalabad, Chiniot, Toba Tek Singh, and Jhang), it requires around 24.1 Billion with respective cost of 6.8, 5.3, 5.3, and 6.6 Billion, for the planning period of 10 years (till Year 2033) which includes rehabilitating and imperialized extension of WSS services. Whereas, Rural WSS plan requires an investment of around 10.6 Billion in next 10 years for rehabilitation & upgradation of already installed WSS assets; Need based new installation of water filtration plants and canal-based water supply schemes in brackish zone; provision of public toilets; and open drains-based sewerage system in 257 villages and last but not the least establishment of a prototype model village in each district.

1 Scope of the Study and Methodology

Detail of Area of concern, Scope of Study, Planning Years, Field Visits, and relevant Methodology adopted is as follow:

1.1 Area of Concern

Areas covered under the Faisalabad Regional Development were stretched to the whole divisions which includes all four urban headquarters which are, Faisalabad, Jhang, Chiniot, and Toba Tek Singh, of its four districts and the all the rural areas. Surveys of the remaining urban centers (Cities and Towns) was also conducted in detail and it was concluded that these cities and towns require more attention and more in-depth study hence they shall be Master Plan under the project titled "1983- Digitization / Mapping of WATSAN Infrastructure in Punjab" and be submitted as separate deliverables under aforementioned project.

1.2 Scope of the Study

Scope of this study was as under:

- Rehabilitation of WSS Infrastructure
- Replacement of Poorly Served WSS Piped Network
- Rural WSS Planning
- Extension to the Unserved Areas for WSS Services
- Machinery Procurement
- Establishment of Store for quick fix
- SCADA (Supervisory Control and Data Acquisition)
- Design Period of 10 Years (2033) with further prioritization of 2, 5, & 10 Years

1.3 Planning Year

Planning year opted for this plan are 2, 5, and 10 counted from the present year i.e. 2023. Detail of this as below:

Table 1 Planning Years

Term	Years	Planning Year
Short	2	2025
Medium	5	2028
Long	10	2033

1.4 Methodology

Adopted methodology for the development of Regional Development Plan was as follow:

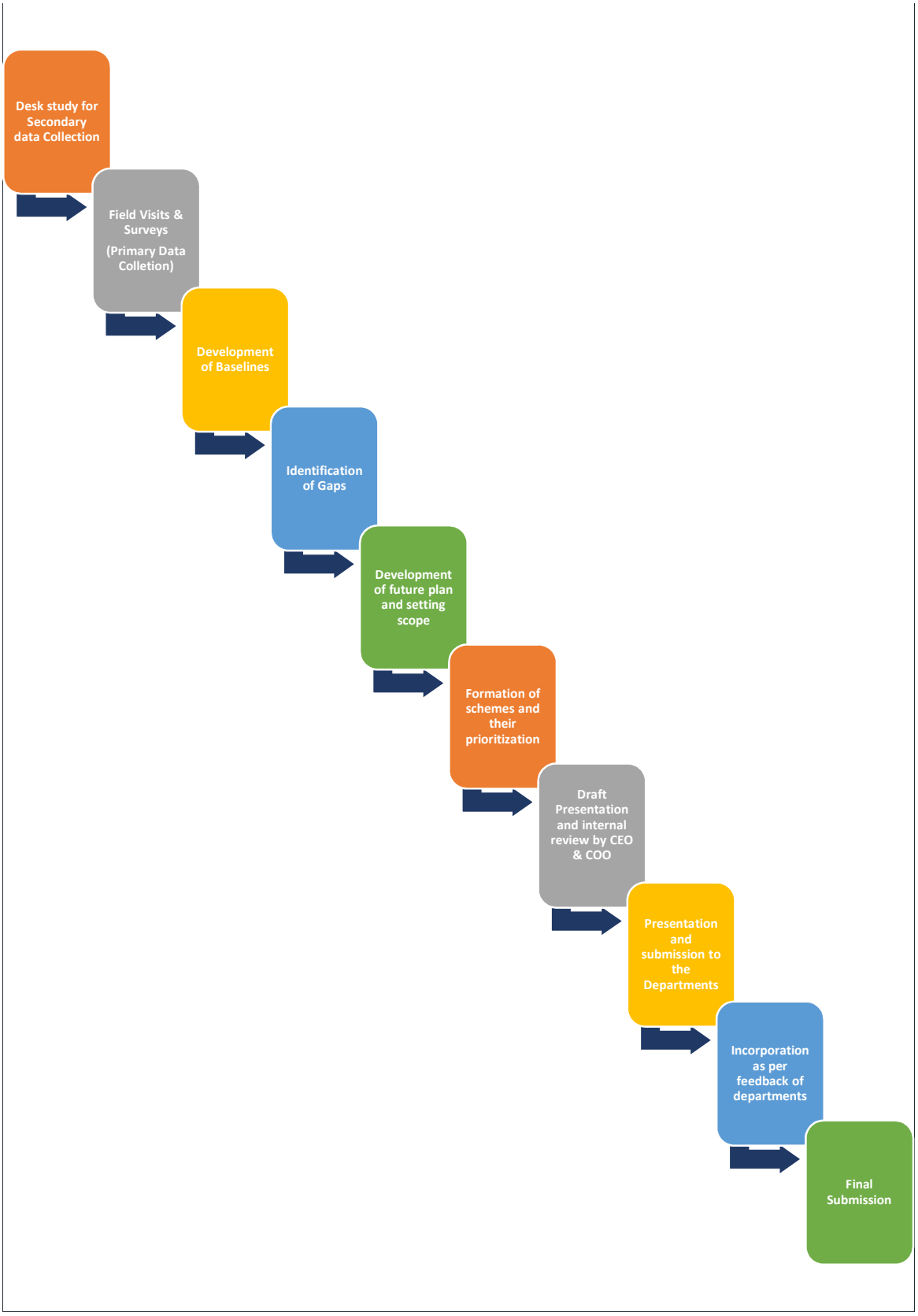


Figure 1 Steps Involved

1.5 Field Visits:

A total of 4 field visits were conducted, this includes inception visit, and then the detail field assessment, which included, condition asset mapping of WSS Infrastructure, GIS tagging of WSS service lines with attributes, Rapid Water Quality Testing, meeting with stakeholder, etc.

Figure 2 Detail of Field Visits

1.6 Framework for Asset Mapping

Following framework was adopted for the purpose of asset Mapping of the existing WSS infrastructures (Civil, Electrical, & Mechanical). All of the existing WSS utilities were rated using below framework which is internationally accepted generalized framework for condition assessment.

Table 2 Asset Condition Assessment Framework

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 Existing Situation

UNICEF rated all the areas in Pakistan, district-wise, to rate the services of (water, Sanitation and Hygiene (WASH). Together, the overall sum of scores of access to WASH is defined as WASH Index. Three main components of this WASH Index Rating are as below:

1. Water Indicators
    - Improved Source Piped, Hand Pump/ Motorized
    - Located in Premises
    - Water Available 24 Hours
    - Free from Contamination
    - Safely Managed Water
2. Sanitation Indicators
    - Improved Sanitation
    - Safe disposal in Situ (On site excreta treatment)
    - Safely Managed Sanitation
3. Hygiene Indicators
    - The dedicated place for Hand-Washing with water and soap

2.1 Urban WASH Index

The WASH Index (Urban) for the cities of Faisalabad, Jhang, Chiniot, & Toba Tek Singh is of 29, 6, 8, and, 21, respectively. To make a comparison best and worst performing cities are shown. Narowal City tops the comparison of WASH Index with rank of 1 whereas Khushab is the worst performing city with rank of 35.

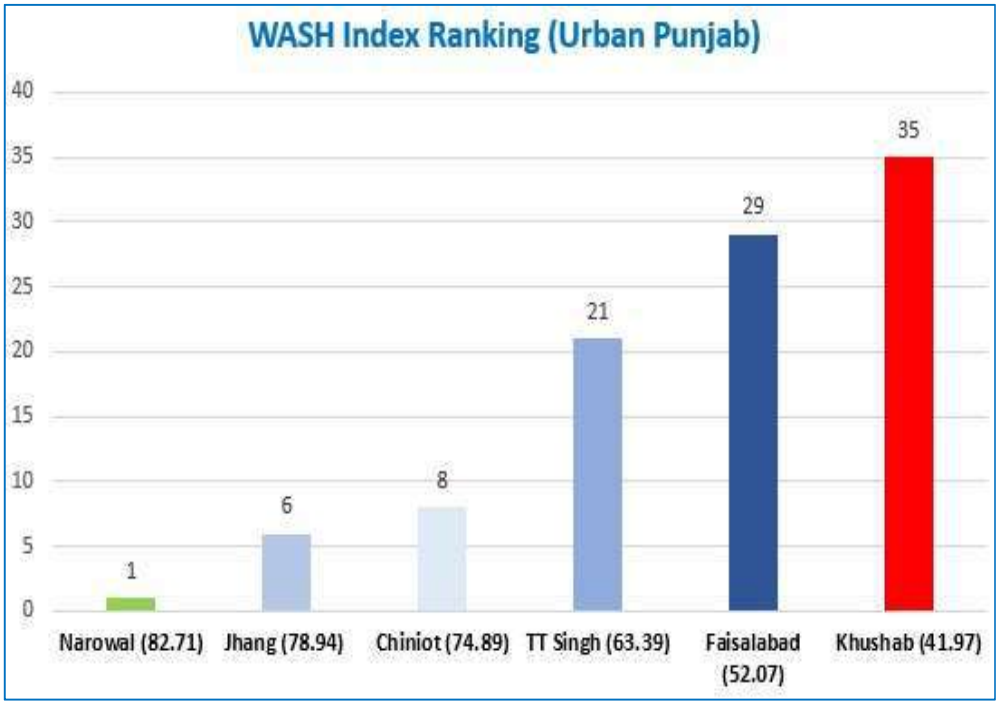


Figure 3 WASH Index Ranking (Urban)

2.2 Rural WASH Index

In the case of Rural areas, Water Supply, Chiniot is better performing district with rank of 3 whereas Jhang, Toba Tek Singh, and Faisalabad stands at 6, 26 and 34 respectively.

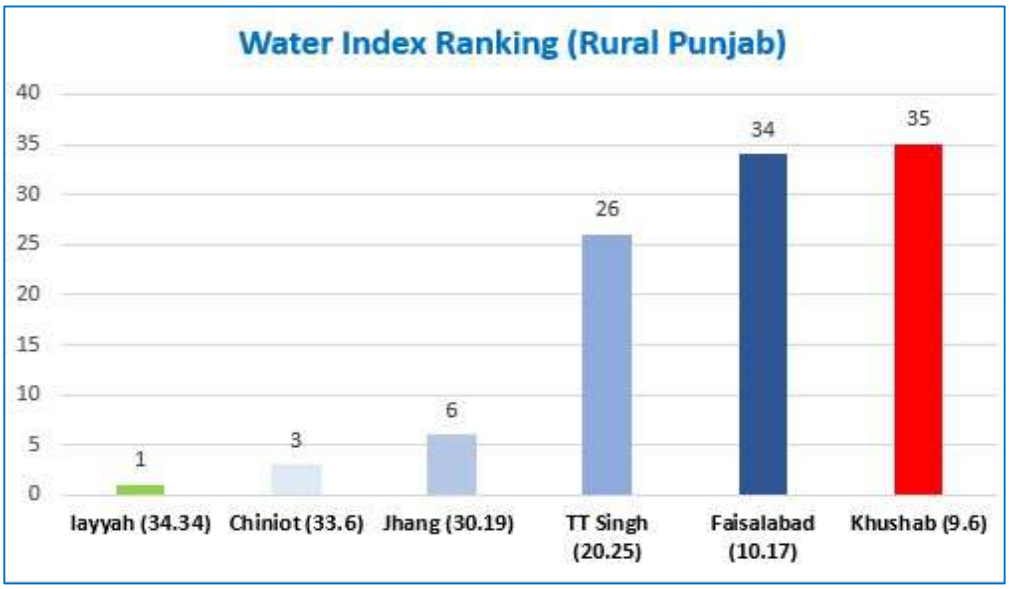


Figure 4 Water Index Ranking (Rural)

For Rural – Sanitation, Toba Tek Singh is best performing district which stands at 14 whereas Faisalabad, Jhang, and Chiniot stands at 21, 28, and 31, ranks, respectively.

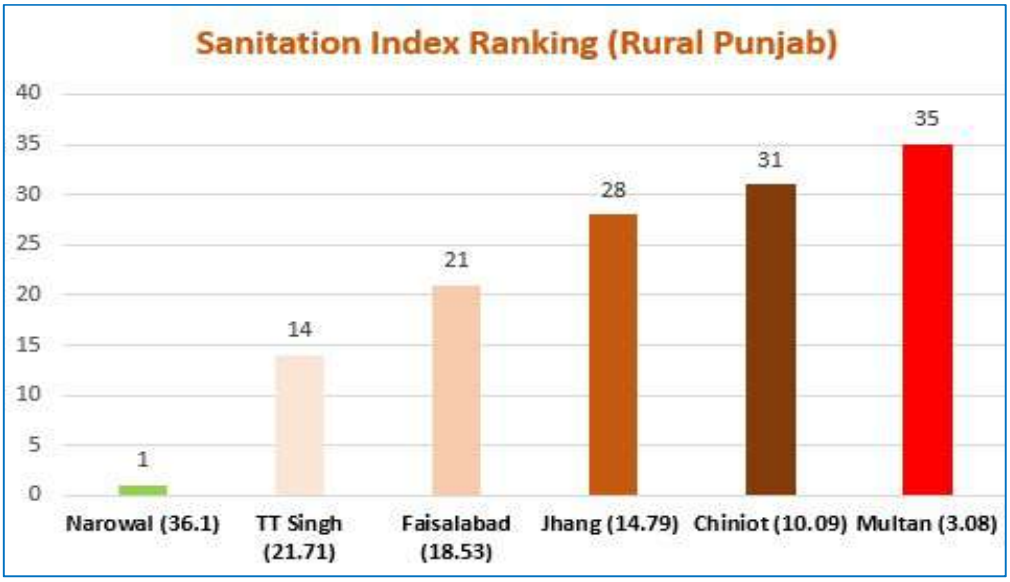


Figure 5 Sanitation Index Ranking

3 Socio Economic Profile

3.1 Economic Profile of Faisalabad

According to the population census of 2017, Faisalabad's rural population is calculated as 4,113,582 whereas, urban population is 3,760,328 and in total, population of Faisalabad district is estimated as 7,873,910. Faisalabad is the second most populous district of Punjab based on Agri-industrial components contributing around 1.91 to annual growth rate national level[2]. This city has huge significance as it has been the central point of many development projects. However, still there is a lack of sufficient infrastructure in order to cater the increasing demand of export and import. The precipitation rate usually varies from 111 mm or 4 inches between the wettest months to driest months in Faisalabad. However, temperature of the division differs between 39.7° C to 18.9°C. Highest humidity in Faisalabad is observed in the month of January, approximately around 66.02%. On the other hand, in may lowest humidity which is 28.89% is estimated. Similarly, in the month of July maximum number of rainy days (15) has been observed whereas, in month of November minimum number of rainy days (1) are estimated[3]

Moving further, educational landscape of Faisalabad is also the same as compared to other cities of Punjab and literacy rate is estimated as 60% with the division of 52% of females and 47% of males. There are 1042 educational institutes/ government school for boys and for girls there are 1126 schools making in total 2208 in Faisalabad. Total enrolment rate of the district is 843,640[4].

Major occupations of the division are civil, services, trading and farming. However, shedding light on the hospitals and health facilities of Faisalabad, it is stated that there are 5 territory hospitals in total whereas, 312 total health facilities comprising of 5592 total beds are present in Faisalabad. Due to its's central location in the region, this division has huge importance as it is contributing significantly in the growth of the country.

3.2 Economic Profile of Toba Tek Singh

Toba Tek Singh is known as a separate district of Punjab located between 30°33′ to 31°23′ north latitudes and 72°08′ to 72°48′ longitudes. According to Pakistan census, 2017, total population of this district is estimated as 2,190,015 depicting about 1.6% annual rise in the district. Rural population of the district is estimated as 1,748,085 and urban population is 441,930. Total area of the district is 3,252 Square kilo meters however population density is calculated as 673.9/km· This district has 4 main cities named Gojra city, Pir Mahal, Kamalia and Toba Tek Singh. Total population of Pir Mahal is estimated as 63,266. Moving with the same pattern, total population of Kamalia, Gojra and Toba Tek Singh is estimated as 136,439,

[2]census 2017

[3] https://en.climate-data.org/

[4] https://sis.punjab.gov.pk/dashboard

174860 and 103,009 respectively[5]. The precipitation rate usually differs from 88 mm or 3 inches from dry months to rainy months in district Toba Tek Singh. High temperature in the district prevails from April to July and temperature in these months differs from 40'C to 28'C. Similarly, low temperature in the district is usually varies from 5.5'C to 19.4'C in the months from December to February[6].

Below graph depicts about the precipitation rate in district Toba Tek Singh indicating that in July and August, the precipitation rate is higher as compared to other months[7].

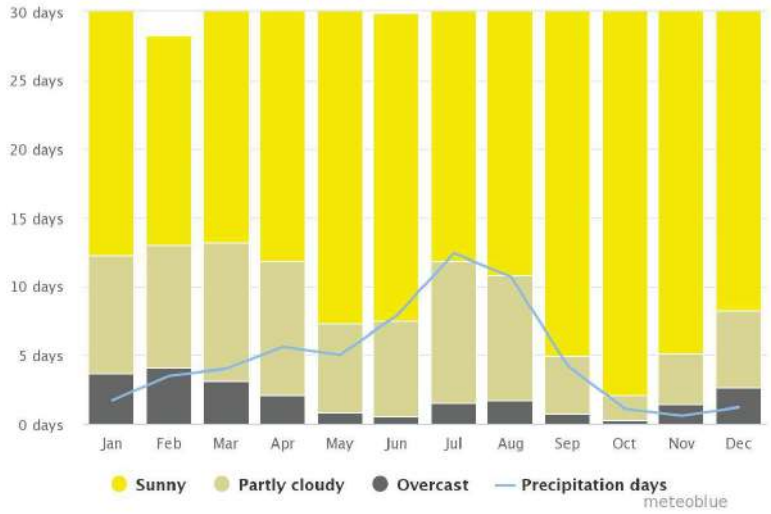


Figure 6 Depiction of Precipitation Rate in Toba Tek Singh

Furthermore, educational landscape of Toba Tek Singh depicts gross enrolment ratio of high school that is 68% however net enrolment ratio of high school is calculated as only 18%. Literacy rate of the district is 68%. Similarly total enrolment rate of the district is calculated as 341,877. According to the latest data, 52.4% of girls are enrolled in schools whereas 47.59% of boys are enrolled in schools of district Toba Tek Singh[8].

[5] Census 2017.
[6] https://weatherspark.com/
[7] https://en.climate-data.org/
[8] https://sis.punjab.gov.pk/dashboard

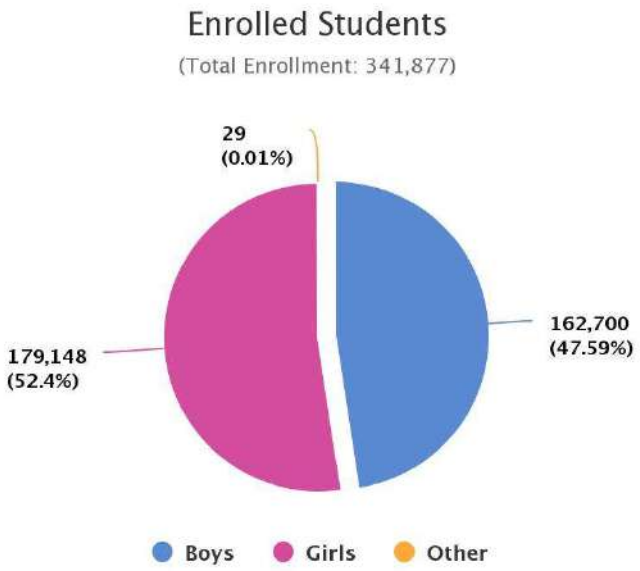


Figure 7 Depiction of Enrolment Rate in Toba Tek Singh

From the perspective of health facilities in Toba Tek Singh, it is depicted that there are 70 behavioral health units (BHU's) and 10 rural health clinics (RHC's) with the availability of 788 beds in the district[9]. Despite of the existence of the small health facilities in the district, patients have to travel to main cities due to insufficient health provisions and equipment in the district.

3.3 Economic Profile of JHANG

Jhang district is located in the South Punjab adjoint by district Toba Tek Singh and Faisalabad. According to the population census 2017, total population of district Jhang is 2,743,416 comprising of 2,145, 226 rural population and 598,190 urban population[10] However, total population of city Ahmad Pur Sial is estimated as 33,692 Shorkot's total population is calculated as 48,078. Similarly, according to the census 2017, total population of Hazari is estimated as 19,395. Total population of Gar Maharaja, Hassu Balail and Rodu Sultan is calculated as 37,463, 21,575 and 22,800 respectively[11].

District Jhang is known for its extreme weather conditions. Hottest months in the district are usually from April to October comprises maximum and minimum temperature from 45'C to 30'C. Similarly, from November to March, temperature varies from 27'C to 6'C. On average, Precipitation rate of Jhang is calculated as 288 mm[12]. Moving further, there are 58 behavioural health units (BHU's) and 11 rural health clinics (RHC's) in the district Jhang. 1 DHQ hospital is also present in the district but health facilities are not optimal and satisfactory for patients[13].

[9] https://tobateksingh.punjab.gov.pk/district_profile
[10] Census 2017.
[11] Census 2017.
[12] https://jhang.punjab.gov.pk/climate
[13] https://jhang.punjab.gov.pk/district-profile

There exist physical and financial barriers for patients to get adequate health facilities in district.

Moreover, literacy rate of the district is around 65%. Total number of public schools in the district are calculated as 14,73 and 5 colleges are present including 2 vocational training institutes. Furthermore, total enrolment rate of district Jhang is 358,657 comprising of 47.21% of girl enrolment percentage and 52.78% of boy enrolment in schools[14].

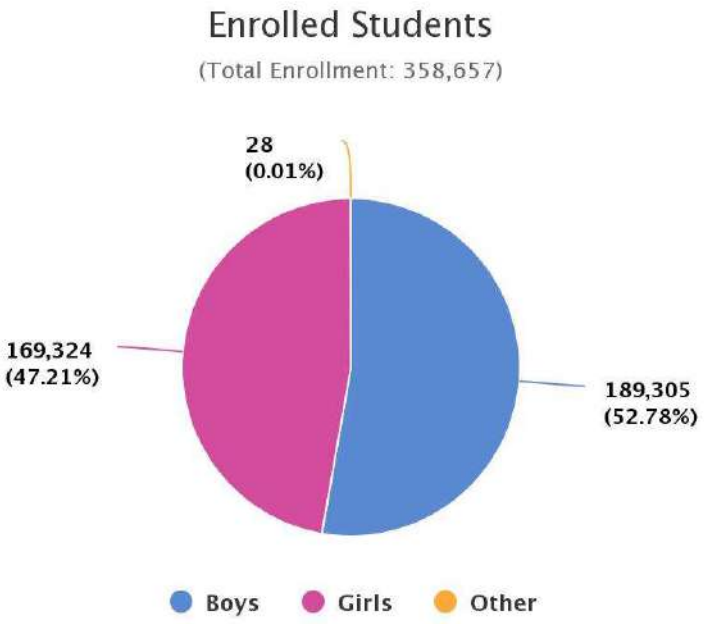


Figure 8 Depiction of Enrolment Rate in Jhang

[14] https://sis.punjab.gov.pk/dashboard

3.4 Economic Profile of Chiniot

Chiniot city is situated at the intersection of the Lahore to Jhang roads and on Faisalabad to Sargodha roads. According to the population census 2017, total population of the district is 1,369,740 making it 947,202 of rural population and 422,538 urban population of the district[15]. In Chiniot, winters usually occurs for the short period of time and are very dry as compared to summers which are more humid and sweltering. The hottest months of the district are from April to August and average temperature during this period is usually 36'C. Similarly, winters in Chiniot, lasts from December to February with the temperature of 23'C on average basis. However, precipitation rate of the district in the rainy days is estimated as 3.6 inches with an average of 12 days[16].

Figure 9 Depiction of Precipitation Rate in District Chiniot

Similarly, above graph depicts the fact that least rainy days of the district occurs in the month of November with the precipitation rate is 0.2 inches[17].

Furthermore, in Chiniot 36 behavioral health units (BHU's) and 3 rural health clinics (RHC's) with the availability of 549 beds are present to provide health facilities to the patients[18] Educational landscape of the district portrays 70% literacy rate. However, net enrolment rate of the high school in the district is only 17.

[15] Census 2017.
[16] https://en.climate-data.org/
[17] https://weatherspark.com/
[18] https://chiniot.punjab.gov.pk/district_profile

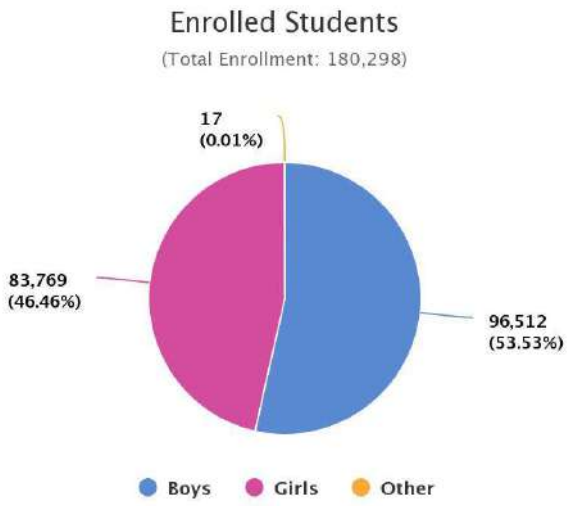


Figure 10 Depiction of Enrolment Rate in Chiniot

Above graph shows that 83,769 girls are enrolled in schools and 96,512 boys are enrolled in schools. Whereas, total enrolment rate of the district is 180,298 depicting around more than half of the ratio being enrolled in the schools[19].

[19] https://sis.punjab.gov.pk/

4 Design Parameters and Considerations

The design criteria of Public Health & Engineering Department (PHED) have been broadly opted for this exercise however, where used, any different factors are rationalized and referred to, in relevant section.

4.1 Population Projection

Population projection is based on assumption that the past trends will continue to operate in the future. The reliability and usefulness of projections depend on the assumptions and their closeness to reality. In general, population projections are treated as predictions and should never be termed as final and fully accurate population. Following equation has been used in order to project population of the whole region and of Zones.

$Pn = P0 (1 + R) n$

Where:

Pn = Population in the required year
P0 = Population in the base year (known year)
R = Annual rate of growth in percentage
N = No. of years counted from base year (Census 2017 Population)

4.2 Water Supply

For Water Supply following parameters are considered for planning or cost estimation purposes. It must be mentioned here that these parameters or any improved substitute values should be made sure of in the detail design phase of proposed schemes prior to their execution.

4.3 Water Demand

Considering the population growth of the area 30 Gallons Per Capita Per Day may be considered as an appropriate figure to fulfil the demand[20]. This figure is inclusive of unaccounted for water. It must be mentioned here that this figure for water demand is considered adequate and is aligned with the United Nations Human Right guidelines (Rapporteur) as it recommends minimum of 11 to 22 GPCD of water supply to ensure full realization of right of water. For divisional headquarter i.e. Faisalabad City, 40 gallons per capita per day (gpcd) is taken.

4.4 Variations in Water Demand

The Following standers to be followed for computation of variations in Water Demand:

A. Maximum day demand is to be taken as 1.5 times the average day demand
B. Peak hour demand to be taken as 1.5 times the maximum day demand

4.5 Operational Hours

Working or operational hours for water supplying source is proposed to be 16 Hours however in case of high or low demand, working hours can be adjusted accordingly. For seepage tube-wells on canals where issues related to bore failure due to low canal seepage and suction of

[20] Design Standards for Water Supply Schemes in Pakistan by Iqbal Ahmad Beg

saline underground water due to excessive pumping was reported, different working hours are opted for and which are mentioned in the report.

4.6 Velocity Flow in Pipes

The following standards shall be adopted for the velocity of pipes for detail design while installation of any water supply scheme:

- Distribution mains 0.5 to 2 m/sec
- Rising mains 0.3 to 1.5 m/sec

4.7 Earth Cover

The minimum depth of cover for water distribution systems and sanitary force mains shall be 0.9 meters or 3 feet, measured from the top of the pipe to the established finished grade above the pipe however all road cuts are to be filled in with pit sand / river sand. During detail design, site layout of other infrastructure (i.e. storm sewer, gravity sanitary sewer, etc.) shall be considered in minimizing the need to have deep pressure mains.

4.8 Minimum Size of Pipe

Minimum size recommended for distribution mains is taken as 3 inches however exact sizing can only be determined after detail design of the area while installing any water supply scheme.

4.9 Sluice Valves

Sluice valves will be located at main control points for balancing and regulating the flows. The sluice valves shall be Cast Iron Flanged or non-rising stem.

4.10 Non-Retune Valves

The Non-Return valve shall meet the following minimum standards:

- Outside the delivery main of the Tubewells
- In the rising main after every 1000 meters or as per site requirement of the area

4.11 Air Relief Valve

The Air relief valve shall meet the following minimum standards:

- At the summits and after 2000 meters intervals in straight reaches to facilities escape of trapped air or as per site requirement of the area
- The material of the air relief valve shall be Cast Iron

4.12 Washout

Washout to be located at the lowest points to wash out all kinds of debris.

4.13 Tubewells Pump House

The existing standard for the design period of pump houses on tube wells for water supply schemes is 25 years. Although, it has been experienced that majority of tube-well pumping chambers constructed in 1960s, are still in good working condition with proper maintenance

and repair, it is proposed that the existing standard of their design period as 25 years should be preferably continued.

4.14 Pumping Machinery

The existing standard for design period of pumping machinery to be provided on water supply schemes is 10 years. However, it is not possible for pumping machinery to work for 10 years without proper maintenance and repair and replacement of the pumping unit is necessary after every 10 years of its operation.

4.15 Tubewells Design Specification

The Tubewells will be designed to meet Maximum day demand. Following parameters are suggested for detail design.

- **Entrance Velocity:** The Entrance Velocity 0.05 ft / sec in the strainer is recommended against the allowable value of 0.1 ft /sec to 0.2 ft / sec to check the entry of fine sand into the screen
- **Opening Area of the Strainer:** Opening area normally ranges from 10% to 12%, the lower limit of 10% is recommended for design purposes
- **Slot Size:** Slot size 1"X 1/30" is recommended for the screen. Shrouding shall be provided.
- **House Pipe:** The diameter of House Pipe will be based on the design discharge of tube well
- **Sanitary Seal:** To control and check the surface and ground contamination at shallow depths sanitary seal consisting 1:2:4 plain cement concrete is recommended
- **Shrouded Material**: The shrouding material will be of pea gravels having size 1/8" to 3/8" and its thickness will be in the range of 3" to 6", however the later one is preferred and used
- **Shrouding Pipes:** Shrouding shall be done through 3" diameter P.V.C. Pipe or equivalent. Suitable values of the parameters shall be carefully selected
- **Delivery Pipes**: Length of delivery pipe in pump house should be 6-9ft to have proper installation of measuring instruments like portable Ultrasonic flow meter for energy audit purpose. Pressure gauge should be installed on the delivery pipe for pressure head measurements

4.16 Storage Tanks (Ground and Over-Head)

- Ground water storage tank at intermediate point to be provided due to excessive head
- Capacity of ground water storage tank @ $1/4^{th}$ of average daily demand will be provided
- Overhead storage reservoirs should be essentially provided in all urban and rural water supply schemes except in cases of such hilly / semi hilly areas where appropriately located ground storage reservoirs can provide and maintain requisite minimum terminal pressure in the system

- Capacity of overhead reservoirs in case of communities having population more than 10,000 persons should be based on around 1/10th of average day demand [21]
- Minimum capacity of overhead reservoir should be 10,000 gallons

4.17 Sewage Generation

Design Flow will be the summation of Peak Sewerage Flow, Industrial / Non-domestic flow, Infiltration, and Storm Water allowances.

a) The sewage contribution of the water consumed will be as follows:
   - For Urban area: 80%-85%
b) Infiltration Rate
   - 5% is assumed for infiltration of open drains and sullage carrier
c) Peak Factor
   - 2.00 as projected population is 100-200 thousand
d) Allowance for industrial waste as per actual assessment on treated industrial waste as per National Environmental Quality Standards (NEQS) is also to be allowed. 5% is taken as industrial / non-domestic sewerage flow
e) Storm water allowance: 50% of Peak Sewage Flow (Northern side areas of Punjab)

4.18 Sewage Conveying Medium

Sewers of Reinforced Concrete (RC) are proposed as sewage conveying medium as they are cost effective and have following benefits:

- Cement pipes are corrosion resistant.
- Asbestos cement pipes have smooth internal face.
- They can provide working pressures up to 1.25 MPa (12.5 kgf/cm2)

Conduits i.e. open drains and sullage carriers are also have been opted for sewage conveying purpose where it is not possible to lay sewers.

4.19 Sullage Carrier Sizing

For sizing and opting the right size of sewers and of sullage carriers, Manning's equation is used to calculate the Maximum carrying discharge and flow velocity against a slope which is assumed. This has been done for main sewers and where possible. Detail Hydraulic Statement must be made part of detail design for proper sizing of the sewers of the schemes prior to their execution.

$$\mathbf{Q = A\ V = \left(\frac{1.00}{n}\right) A R^{\frac{2}{3}} \sqrt{S}\ \ (SI\ Units)}$$

Where,
R= Hydraulic Radius in meters
P= Wetted Perimeter in meters
S= Slope in m/m

[21] Technical and Service Delivery Standards for Water Supply and Sanitation Sectors - April 2008

n= Manning's coefficient of roughness of flow carrying material (here it is assumed as 0.013 for brickwork with rough plaster)
Q= Maximum Flow Carrying capacity in m^3/sec
V= Velocity of flow in m/s against assumed slope

4.20 Drains and Sullage Carriers Top Cover / Grating

As per the Urban Stormwater Management Manual of Malaysian Standards, drains or sullage carrier of depth more than 0.6 m or 2 ft shall be covered. For this following may also be established according to the aforementioned standard. Two type of covering are mentioned:

1- Drains subjected to traffic loading or inflow of surface runoff can be covered with precast reinforced concrete covers. Covers should be sized such that the weight is limited to what can be easily carried by 2 workmen to gain access for maintenance
2- Drains subject to vehicular traffic flow or inflow of surface runoff shall be covered using solid plate, metal grating. Traffic loading shall be calculated as per the future traffic flow of the area in order to provide grating accordingly

Social behavior i.e. stealing of metal grating should also be considered while provision of grating.

The depth of drain shall include minimum freeboard of 50mm (2 inches) as per criteria however around 6 inches have been provided for sullage carrier as they are often subject to silting and/or solid waste accumulation. Minimum size of drain is opted as 9 x 9 inches (inside) considering the common practices in Pakistan and available width of the pathways or roads.

4.21 Waste Water Treatment Criteria

Stabilization ponds are proposed for the domestic waste water treatment purposes. All unit processes and unit operations may be carried out in the same unit, or a combination of similar units may be used. If only one stage of treatment is used, the pond will normally be anaerobic. However, if required, a secondary pond for additional aerobic biological treatment should follow an anaerobic pond which is termed as facultative pond. If required, mutation pond may also be provided after facultative pond however this in-turn causes high land acquisition cost. The design criteria for each of the above three ponds are given below.

a) Anaerobic Ponds

From the available literature, all existing procedures adopt one of the following three criteria as basis:

- Surface loading rate (in term of kg BOD/ha/d)
- Volumetric loading rate (in term of BOD5 or volatile solids as g/m3/d)
- Hydraulic retention time

Table 3 Anaerobic Ponds Design Criteria

Loading	280-4500 kg BOD5/ha/d
Depth of pond	2.5-5 m
BOD removal	50-80 %

- Volumetric loading is expressed in term of grams BOD5 per cubic meter per day.

Table 4 Volumetric Loading

Loading	300 g BOD5/m3/d
Depth of pond	2.5-5 m
BOD removal	50%

Table 5 Hydraulic Retention Time

Hydraulic Retention Time	5 Days
BOD removal	80 %

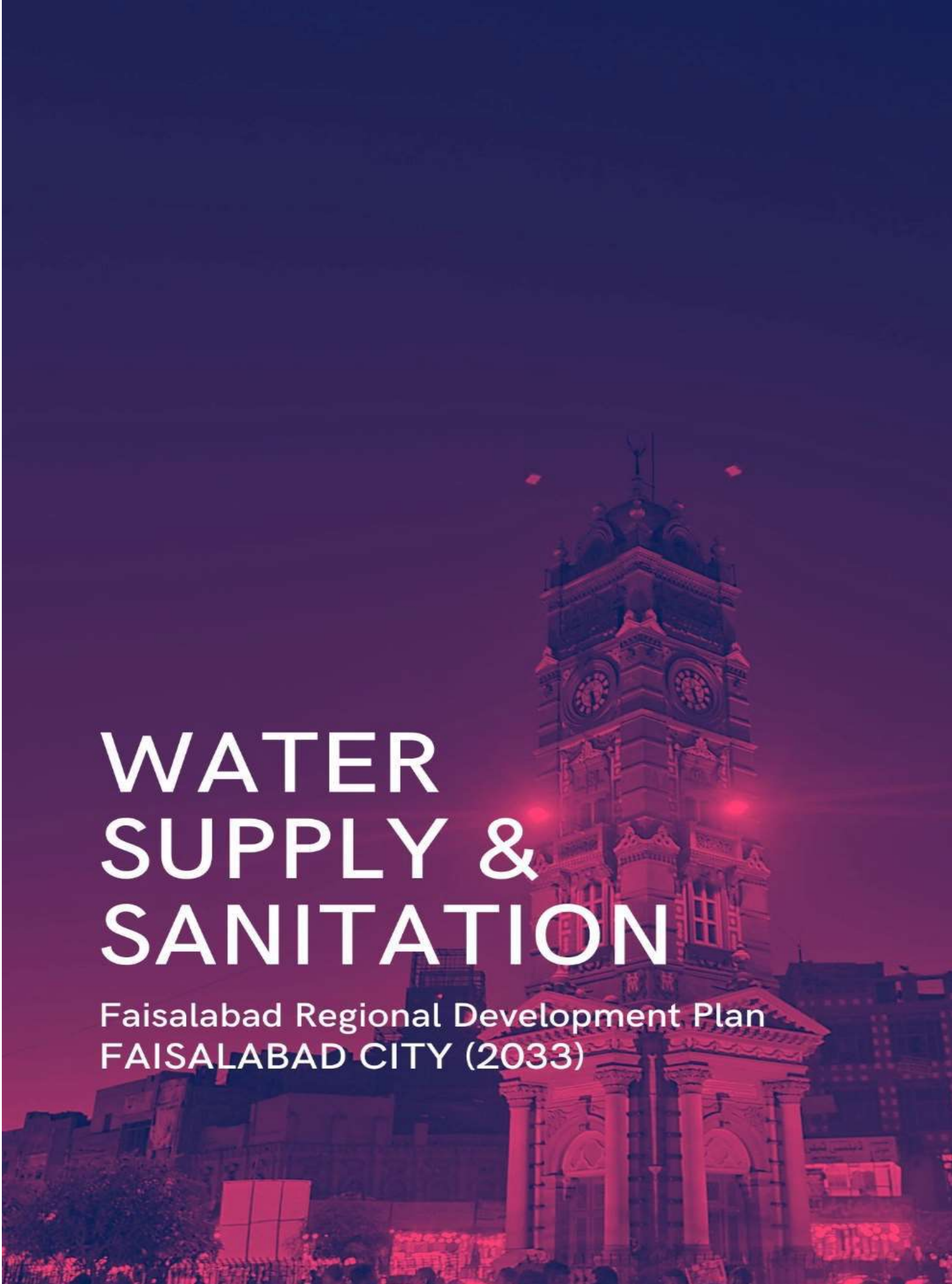
- The BOD5 removal efficiency also depends on the ambient air temperature.
- Coliform Removal = Negligible

b) Facultative Ponds

Design criteria adopted for facultative pond plan is as follow:

Table 6 Facultative Ponds Design Criteria

Surface Area Loading (Temp 20-25 degree C)	200 -- 400 kgBOD5/ha/day
Surface Area Loading (Temp 30 degree C)	300-- 400 kgBOD5/ha/day
Depth of facultative pond	1.5 m
BOD5 removal efficiency	80 %
Settled sludge accumulation	30 liters per person per year
Retention time	5 Days
Coliform Removal	99 %
Volume Evaporation	10 %



WATER SUPPLY & SANITATION

Faisalabad Regional Development Plan
FAISALABAD CITY (2033)

5 Faisalabad City

Faisalabad is the second largest city of Punjab, with a population of 2.0 million in 1998 and 3.2 million in 2017 in its urban area (Population Census, 2017). Known as Manchester of Pakistan, the city has grown rapidly over the past three decades with a growth rate of 2.49 percent[22]. This rapid growth has made it difficult for the service providers to provide adequate quantity of basic necessities to the residents of city. Water and Sanitation Agency (WASA) Faisalabad, established in 1978, is responsible for the provision of municipal services in the urban area of Faisalabad. The agency has the mandate to plan, design, construct, operate & maintain water supply, sewerage & drainage facilities for the city.

Faisalabad is located in Rechna Doab, the land between Chenab and Ravi rivers. The lower Chenab canal provides water to 80% of the cultivated lands making it the main source of irrigation[23]. Rakh Branch canal passes through the city area whereas Jhang Branch canal and Gogera Branch canal is flowing on the western and eastern sides respectively. Unfortunately, groundwater of the city is quite saline which makes it unfit for human consumption. Pakistan Council of Research in Water Resources (PCRWR) tested water quality at 22 different locations in Faisalabad and reported that 59% of the sources have excessive concentrations of Total Dissolved Solids (TDS), fluoride and sulphates[24]. WASA Faisalabad is extracting ground water from aquifers along canals and treating surface water to provide portable water to the residents of the city. The current water supply capacity is around 110 MGD against the demand of 170 MGD (at 40 gpcd) resulting in a shortfall of 60 MGD. It is important to mention here that most of the population meets their water demands by extracting groundwater through private wells on their premises in addition to limited supply of municipal tap water. WASA Faisalabad reports 70% water supply coverage which is estimated based on the spread of distribution network. On the other hand, rapid urbanization and industrialization has been causing serious challenges for WASA Faisalabad to provide sanitation services to the residents. The city does not have any segregation mechanism for industrial and municipal effluents. The waste water is being disposed in to Ravi and Chenab rivers mainly through Paharang and Madhuana drains. Existing sewerage infrastructure faces severe challenges of insufficient conveyance capacity, sedimentation inside pipes, and overburdened machinery at disposal pumping stations. Faisalabad is the first city in Punjab to have waste water treatment plant (Waste Stabilization Ponds) having a capacity of 20 MGD constructed in 1998. The sewerage coverage ratio in current service area is 72% which is divided in to two zones: Eastern zone and western zone.

To improve the level of service, WASA Faisalabad has been executing several development schemes under Annual Development Program (ADP). List of on-going schemes under ADP 2022-2023 is shown in Table 1. Japanese International Cooperation Agency (JICA) has

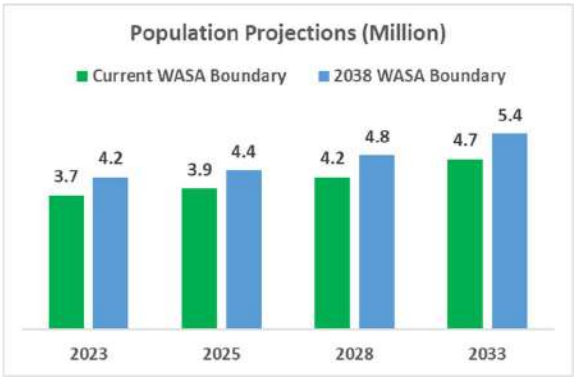
[22] https://www.pbs.gov.pk/sites/default/files/population/2017/tables/punjab/Table02p.pdf

[23] https://en.wikipedia.org/wiki/Faisalabad

[24] Hifza, R., Fauzia. A., Kiran, A., and M. Ashraf (2021). Drinking Water Quality in Pakistan: Current Status and Challenges. Pakistan Council of Research in Water Resources (PCRWR), Islamabad, pp. 141.

developed an integrated Master Plan (2038) for water supply, sewerage, and drainage services in Faisalabad city. In this context, WASA Faisalabad has also been executing foreign funded water supply and sewerage schemes from 2018 onwards. Foreign funded on-going schemes are listed in Table 2.

The requirement of improved water and sanitation infrastructure for any region is essential for the welfare of its inhabitants as improved coverage of municipal services add to socio-economic development of the area. The Faisalabad Regional Development Plan (2033) aims to highlight priority areas of interventions based on field assessments and stakeholder engagements to improve the service delivery and customer satisfaction. In this regard, population projections are estimated according to the official population figures in Population Census, 2017. The chart displays the population projection for current WASA Faisalabad boundary as well as projected boundary as per JICA Master Plan (2038). Projects are prioritized in short (2023), medium (2026) and long-term (2031) phases with respect to their priority requirement.



Graph 1 Population Projection

Table 7 On-going schemes under ADP (2022-2023)

Sr. No.	G.S No.	Name of Scheme	Cost (Million)	Allocation 2022-23
1	4328	Construction of Arterial Main Secondary and Distribution Network in the Areas in the Eastern Part of City.	4,993	320
2	4329	Enhancement of pumping capacity and improvement of civil structures of different disposal stations of WASA Faisalabad.	400	50
3	4330	Construction of Parking Yard	56	25
4	4331	Strom water drainage and temporary storage system on Dijkot road Faisalabad.	374	45
5	4332	Supply of Automatic Dewatering sets and Machinery for operation and Urban Flood Mitigation WASA, Faisalabad	371.116	70
Total			**6194.116**	**510**

Table 8 On-going Foreign Funded Development Projects

Sr. No.	Name of Project	Cost (Million)
1	Extension of Water Resources for Faisalabad City (Phase-II) – AFD Soft Loan	14,636.928
2	Construction of Distribution Center, Rehabilitation of old Jhal Khanuana Water Treatment Plant – JICA Grant-in-Aid	7,250
3	Construction of Eastern Wastewater Treatment Plant (44 MGD) Of Faisalabad City (Phase-I) – DANIDA Soft Loan	19,071
Total		**40,957.928**

5.1 Existing Water Supply Infrastructure

The water supply system of Faisalabad city is based on multi-stage pumping. Currently, the primary source of water supply in Faisalabad city is ground water from tube wells in the Chenab Well Field and along Jhang Branch Canal (JBC). Water from these tube wells is collected in booster pumping stations and then pumped to large ground storage tanks called Terminal Reservoirs (TR) located 27 km from Chenab Well Field and 13 Km from Jhang Branch Canal. Tube wells at these sources are operated for 16-18 hours per day whereas pumping station at TR supplies water in the distribution network for 6 hours per day. WASA Faisalabad is also using Rakh Branch Canal (RBC) as a secondary source of water which is the oldest source of water in Faisalabad. Tube wells are installed at seepage aquifers along Rakh Branch Canal (RBC) as well as surface water is also used as a supplementary source. Cumulatively, the capacity of existing water supply is around 110 MGD whereas the actual supply is estimated nearly 100 MGD due to non-functional tube wells and water works. Distribution network receives water in ground storage tanks which is filled in overhead reservoirs to supply water on gravity. However, it is also noted that most of the storage reservoirs are non-operational and water is being supplied to the consumers through direct pumping. The list of existing water supply sources with current status is shown in the tables below.

Table 9 List of existing water supply infrastructure

Sr. No.	Water Supply Resources (110 MGD)	Capacity	Status
1	Chenab Well Field Tube Wells (29-Tube wells)	56 MGD	28 Functional
2	Jhang Branch Tube Wells (JICA) (25-Tube wells)	20 MGD	25 Functional
3	Rakh Branch Tube Wells (34-Tube wells)	13 MGD	23 Functional
4	French Project WTP Phase 1	15 MGD	Functional
5	RO Filtration and Bottling Plant	3000 LPH	Functional

6	Old Jhal Kanuana Water Works	3.5 MGD	Under Rehabilitation
7	Millat Town Water Works	1 MGD	Non-functional
8	Gulfishan Colony Water Works	1.5 MGD	Non-functional

Table 10 Terminal Reservoir (TR) Station (Intermediate)

Sr. No.	Name	Storage (Cubic Meter)	Pumping Capacity (Cusecs)	Status
1	ADB Reservoir	47,000	202	Functional
2	JICA Reservoir	36,000	149	Functional

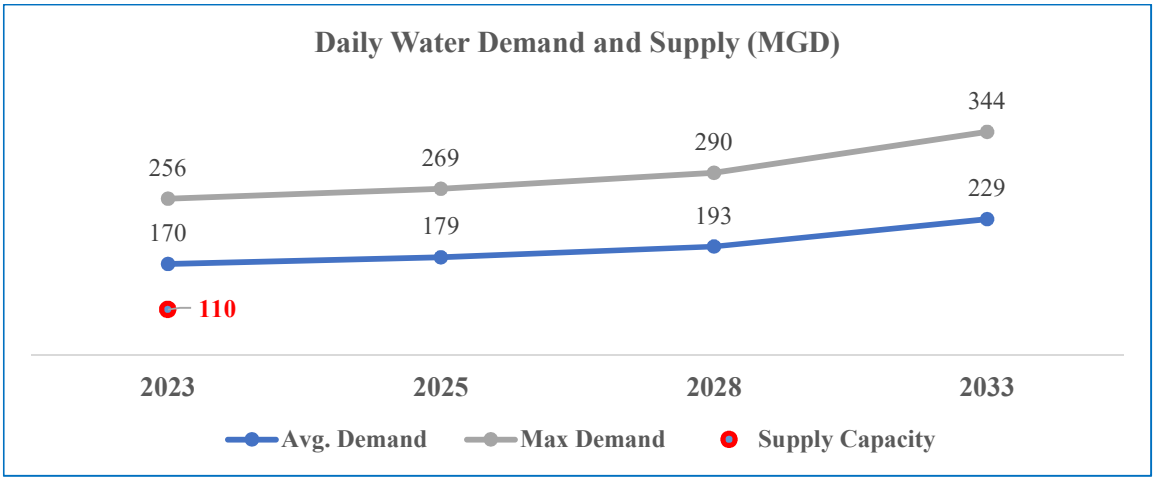
Table 11 List of storage facilities (Distribution Network)

Division	Storage	Installed Capacity (Gallons)	Functional Capacity (Gallons)
East	Overhead Reservoir	1,600,000	1,050,000
	Ground Storage Tank	3,900,000	2,500,000
West	Overhead Reservoir	1,605,000	925,000
	Ground Storage Tank	2,680,000	1,430,000
Total		**9,785,000**	**5,905,000**

5.2 Water Demand and Supply Analysis

Water is a crucial resource for socio-economic development, healthy ecosystems and human survival itself. Rapid urbanization and population growth make Faisalabad vulnerable to water scarcity. According to national Population Census 2017, nearly 3.2 million people reside under WASA Faisalabad boundary. It is estimated that the population has exceeded to 3.7 million in the year 2023 and expected to reach 4.7 million in the year 2033[25]. Keeping in view the already limited water resources, per capita water demand in this plan is taken as 40 gallons per capita per day (gpcd). Similarly, in addition to domestic demand, total average day demand is calculated by incorporating 15 percent non-domestic water demand which caters commercial and industrial consumers. Additionally, the maximum daily demand is estimated at 1.5 times daily average demand. The chart in Figure 1 shows the daily water demand projections from 2023 to 2033.

[25] Design Criteria, Public Health Engineering Department (PHED), Punjab Pakistan

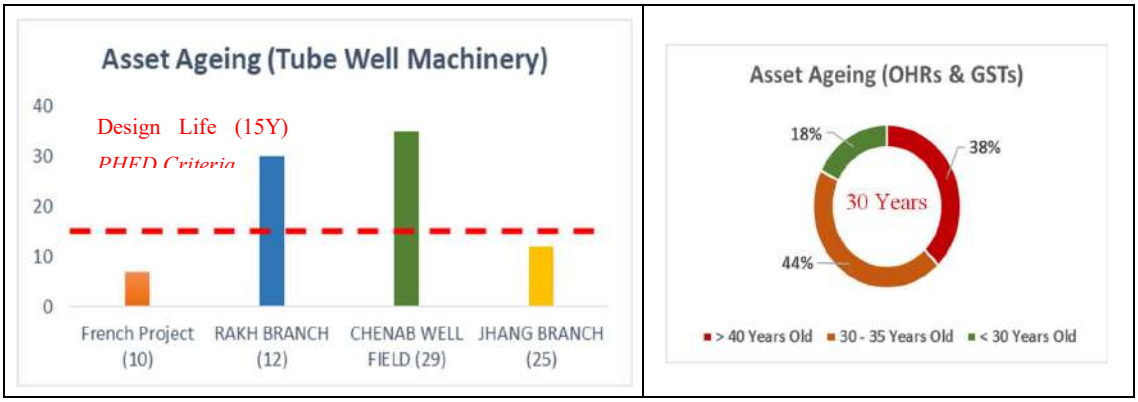


Graph 2 Daily Water Demand Projections

It is evident from the chart that there is a gap of 60 MGD in existing demand and supply capacity. However, it was noted during the visit that 11 tube wells on Rakh Branch Canal are not functional owing to outlived and malfunctioned machinery and damaged distribution network. In addition to this, it was also reported that surface water treatment plants at Millat Town and Gulfishan Colony are also not in operation due to waste water contamination at source. Therefore, the actual supply further decreases to nearly 100 MGD and the gap becomes 70 MGD between existing demand and supply. To meet the forecasted water demands as shown in the chart, WASA Faisalabad requires stringent efforts to tap and acquire additional water resources and also improve the efficiency of existing infrastructure. In this regard, JICA Master Plan (2038) has identified new water resources to enhance the existing supply capacity which are more focused on surface water instead of ground water.

5.3 Condition Assessment of Water Supply Infrastructure

The objective of condition assessment is to identify potential problems and challenges in the existing infrastructure causing or may cause hinderance in the service delivery. It was noted during the field visit that less attention has been paid to the preventive maintenance of water supply assets in Faisalabad. The asset is mostly repaired and rehabilitated in case of any breakdown. According to the data gathered and received from WASA Faisalabad, pumping machinery at Chenab Well Field Area and Rakh Branch canal have been in service for around 30 years. However, the design criteria of Public Health Engineering Department (PHED) recommends that the useful life of pumping machinery is 15 years in case of no preventive maintenance. Asset ageing analysis is performed on the civil and electromechanical assets and displayed in Figure 2.



Graph 3 Asset Ageing Analysis of Civil and Electromechanical Assets

Moreover, it was also found that the distribution panel containing electrical safety equipment was never replaced or maintained since its installation. Apart from tube wells at Jhang Branch Canal and some newly installed machinery, the electrical infrastructure at other tube wells has either expired its life or in deteriorating condition. Similarly, the civil structures have outlived their useful life and need immediate attention (See Figure 3). Continuous operation of tube wells not only causes overburdening of machinery but also affects the water table. It is reported by WASA Faisalabad that overall decline in ground water table in the city is 2 feet per year, which is alarming. Therefore, it is a matter of paramount importance that WASA Faisalabad may shift the focus from ground water extraction to utilizing surface water.

Tube Well (Rakh Branch)

Pump Room (Rakh Branch)

Elec. Panel (Chenab)

Figure 11 Water Supply Assets in Faisalabad City

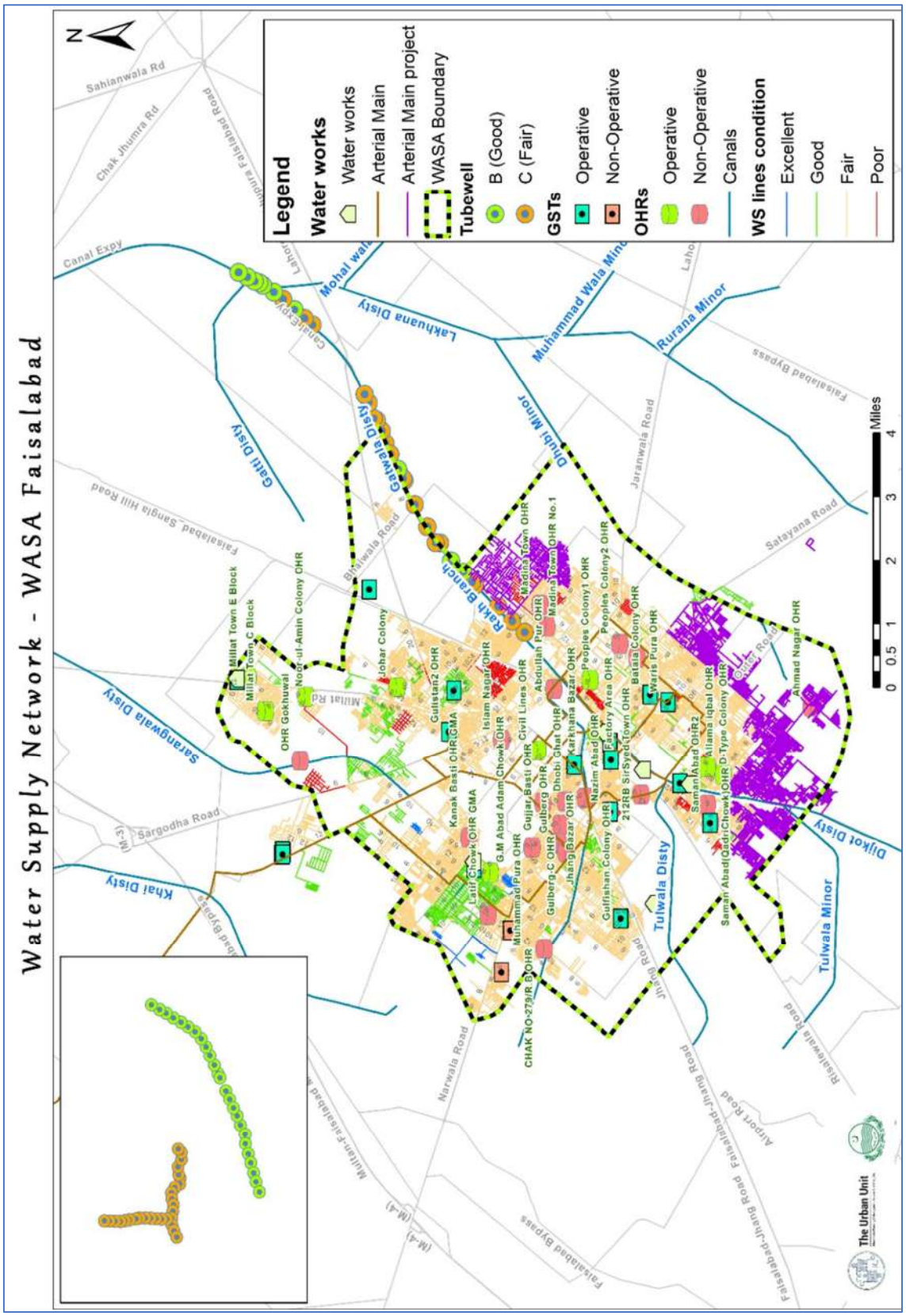


Figure 12 Water Supply Baseline – Faisalabad

5.4 Water Supply Interventions

On basis of gap analysis and need assessment, team jotted down the priority neglected/problematic areas, most severe problems and identified the list of interventions. Projects are prioritized in short (2025), medium (2028) and long-term (2033) phases with respect to their priority requirement to fill in the gaps and provide the efficient level of municipal services to citizens. It is pertinent to mention here that WASA Faisalabad is already executing development schemes as per JICA Master Plan (2038) which presents a comprehensive and integrated approach in tapping additional resources to enhance the service delivery and meet the water demands. Therefore, the following interventions are more focused on evidence-based improvement projects and introduce new avenues in the development horizon which have been remained unattended.

- **Short Term Plan (2025)**

Current supply capacity is short of 10 MGD due to non-functional water supply schemes. Therefore, the short-term planning mainly focuses on rehabilitation and improvement project to augment the existing infrastructure and target the high priority interventions. Similarly, the low-pressure areas are identified and storage facilities are proposed to improve the service delivery without relying on machinery. Moreover, it also introduces small scale renewable energy projects to make the assets energy self-sufficient.

- **Medium Term Plan (2028)**

In the medium-term plan, it is planned to enhance the existing storage capacity by reconstructing the infrastructure. In addition to it, it is also planned to target the densely populated areas and replace the Asbestos Cement (AC) based secondary and tertiary distribution network with HDPE pipe to address the leakages and breakdowns. It also adds to the renewable energy initiative by introducing solar plant at Terminal Reservoir to share the electrical load of pumping machinery.

- **Long Term Plan (2033)**

This term extends the replacement of distribution networks of adjacent areas with HDPE pipe and also adds to the storage capacity of the water supply network. The long-term planning also incorporates the unserved areas and new settlements around the WASA boundary. Target areas are marked to extend the distribution network and provide services to the population in future. The following table describes the list of interventions in priority areas with brief scope of work and rough cost estimate.

Table 12 Proposed Schemes

Planning Term	Proposed Schemes	Scope	Cost (Million)
Short (2025)	1. Augmentation and rehabilitation of water supply schemes of Mansoorabad, Madina Town and French Tube Wells at Rakh Branch Canal	▸ Rehabilitation of 11 non-functional tube wells, replacement of electromechanical infrastructure, civil structures and allied works	55
	2. Laying of 24" HDPE main from Novelty Bridge to Gulfishan Colony Water Works	▸ 24" HDPE main pipeline of 3 Km from Novelty Bridge to Gulfishan Colony Water Works to provide uncontaminated water from source to operationalize the water works.	127
	3. Construction of RO Filtration Plant (5000 LPH) with bottling unit at Jhal Khanuana Water Works, Millat Town Water Works and Kalma Wali Tanky.	▸ New construction of three Reverse Osmosis (RO) plants having capacity of 5000 LPH along with bottling unit	42
	4. Rehabilitation and upgradation of warehouse/store at Jhal Khanuana Water Works	▸ Rehabilitation of structures, storage area and offices with computerized inventory management system.	29
	5. Solarization of WASA Headquarter, WASA Academy and WASA Bottling Plant	▸ Complete rooftop solar system of 150 kW, 65 kW	76

		and 50 kW respectively	
	6. Construction of five (05) Overhead Reservoirs (200,000 gallons) in existing water works	▸ New OHRs (200,000 gallons each) in Jhal Khanuana Water Works, Allama Iqbal Water Works, GMA Water Works, Gulfishan Water Works and Millat Town Water Works	346
	7. Rehabilitation and replacement of distribution network in highly problematic areas of Nighebanpura, Fatehabad, Dhuddiwala, areas of Madina Town,	▸ Replacement of outlived and failing distribution pipes (3" to 24") with HDPE pipes of 59.67 Km.	425
	8. Construction of five (05) Ground storage tanks (200,000 gallons) in high priority areas of Gulfishan Colony, Johar Colony No. 1, Jinnah Colony, Kaleem Shaheed Colony and Peoples colony.	▸ Capacity enhancement of existing storage by constructing new GSTs (200,000 gallons each) in the mentioned areas	283
Medium (2028)	9. Provision of eight (08) Overhead Reservoirs (100,000 gallons) in high priority areas (Gulfishan Colony C-Block, Millat Town C & E Block, Noor-ul-Ameen, Kaleem Shaheed Colony 1 & 2, Gulberg Colony and Mohammadpura.)	▸ Dismantling and reconstruction of existing 08 OHRs (100,000 gallons each)	659

	10. Replacement of tube well machinery and rehabilitation of civil works at Chenab Well Field Area	▸ Rehabilitation of 29 tube wells in Chenab Well Field Area, replacement of outlived electromechanical infrastructure, civil structures and Chlorine Gas Injecting Station	145
	11. Replacement and augmentation of existing water supply distribution network in high priority areas (Mansoorabad, Naseerabad, Hajveri Town, Taj Colony, Mustafabad, Bilal Gunj, Peoples colony, Officers colony, D-Ground and Clock Tower)	▸ Replacement of secondary and tertiary network (3" to 12") of Asbestos Cement (AC) pipes with HDPE pipes of 554.6 Km.	1,653
	12. Solarization of WASA Terminal Reservoir and JBC Balancing Reservoir	▸ Complete ground mounted solar system of 2 MW and 170 kW for WASA Terminal Reservoir and JBC Balancing Reservoir respectively.	456
Long (2033)	13. Dismantling and reconstruction of twelve (12) Overhead Reservoirs (100,000 gallons) in priority area	▸ Reconstruction of 12 OHRs (100,000 gallons each) in Kanak Basti, Jinnah Colony, Chak No. 279, Peoples Colony No. 2, Fatehabad, Chamra Mandi, Samnabad, Dogar Basti, D-Type Colony, Johar Colony (Zibba	989

		Khana), Bagh-e-Jinnah and Madina Town.	
	14. Replacement and augmentation of existing water supply distribution network in areas of Allama Iqbal Colony, Siddiqia Mil Colony, Bilal Nagar, Kehkashan Colony 3, Khayban Colony 1& 2, Ashrafabad, Nishat abad and GM Abad.	▸ Replacement of secondary and tertiary network (3" to 12") of Asbestos Cement (AC) pipes with HDPE pipes of 735.73 Km.	2,078
	15. Extension of water supply services to the unserved areas in WASA boundary	▸ Extension of water supply infrastructure in the unserved areas [Secondary network: 50.8 Km, Tertiary network: 493 km]	772
Grand Total (Million PKR)		**8,135**	

For Rough Cost Estimation MRS, 1st Bi-Annual-2023 (01.01.2023 to 30.06.2023) District Faisalabad has been Applied. The 2% contingencies and 5% PST are also added in estimates. This is further subject to detailed design of the proposed schemes upon PC-1 formation.

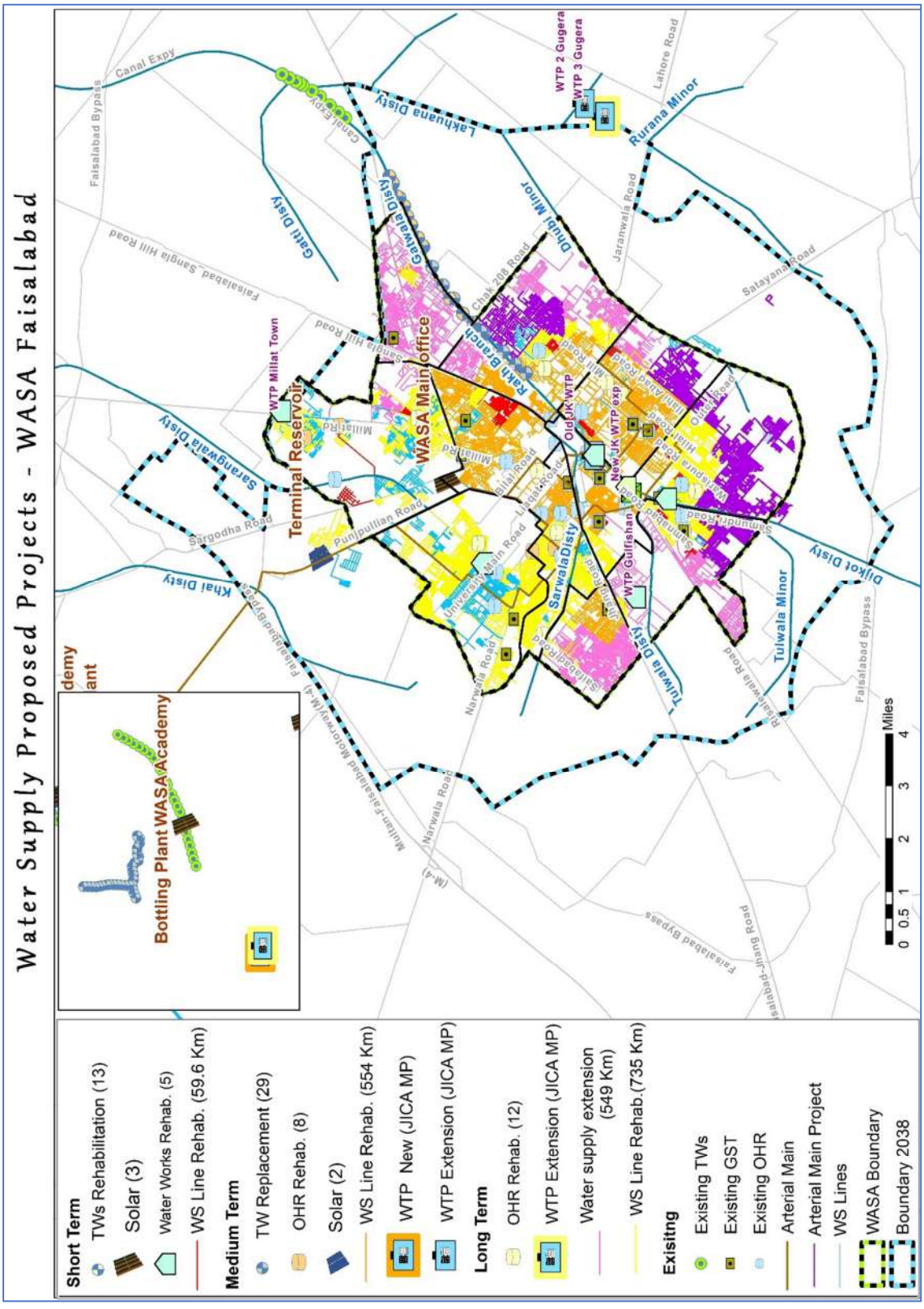


Figure 13 Water Supply Intervention Map

5.5 Drawings

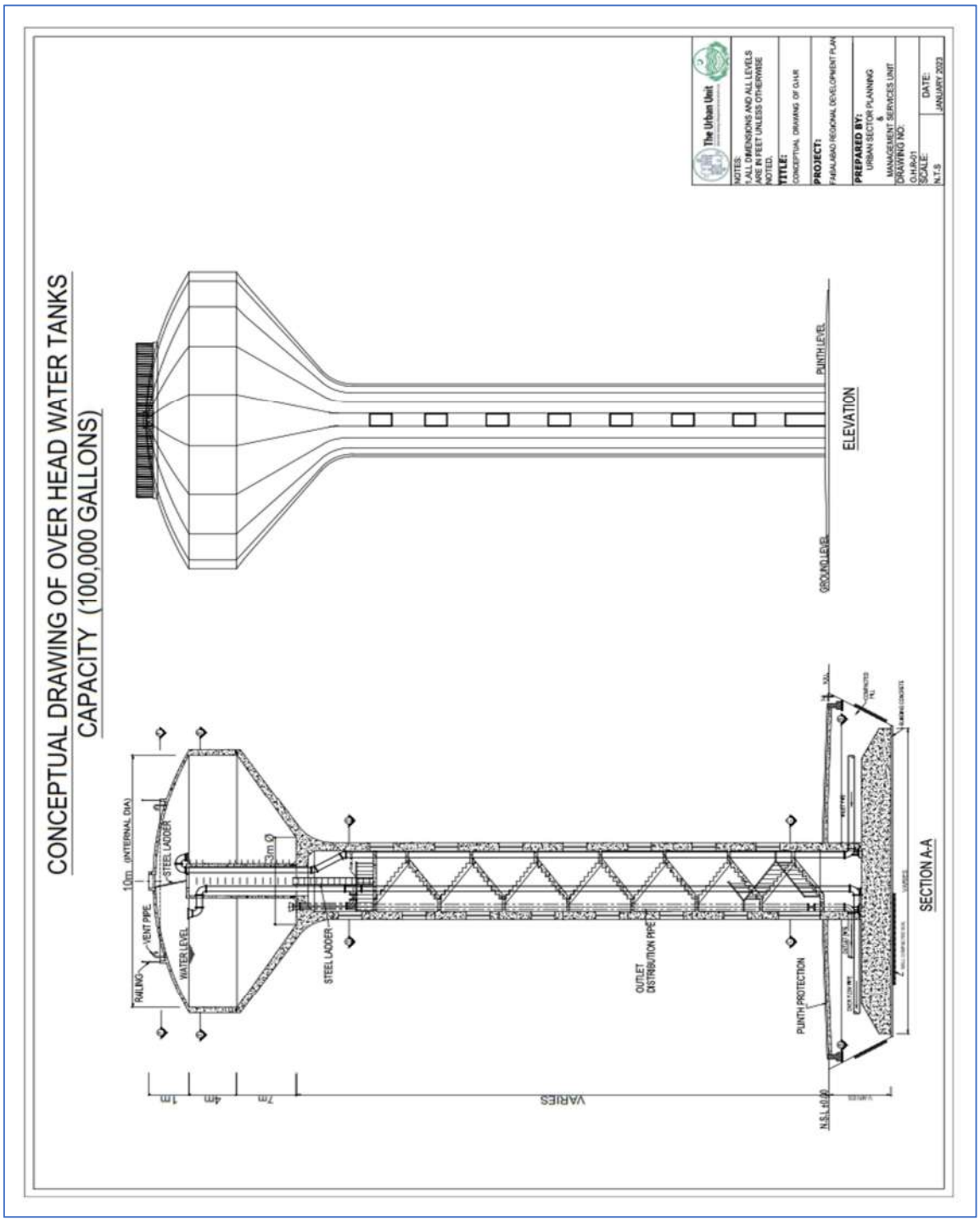


Figure 14 OHR 100,000 Gallons

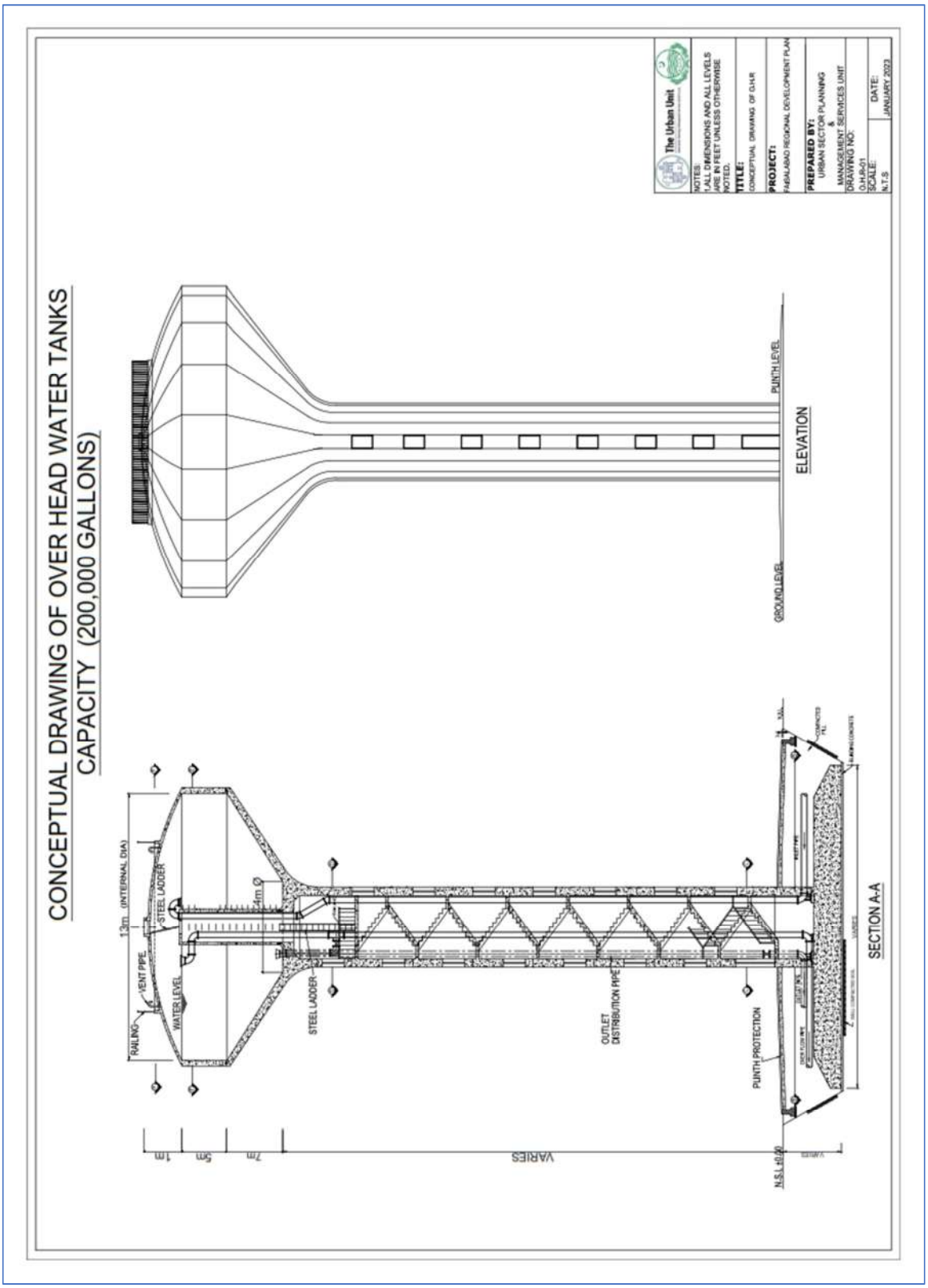


Figure 15 OHR 200,000 Gallons

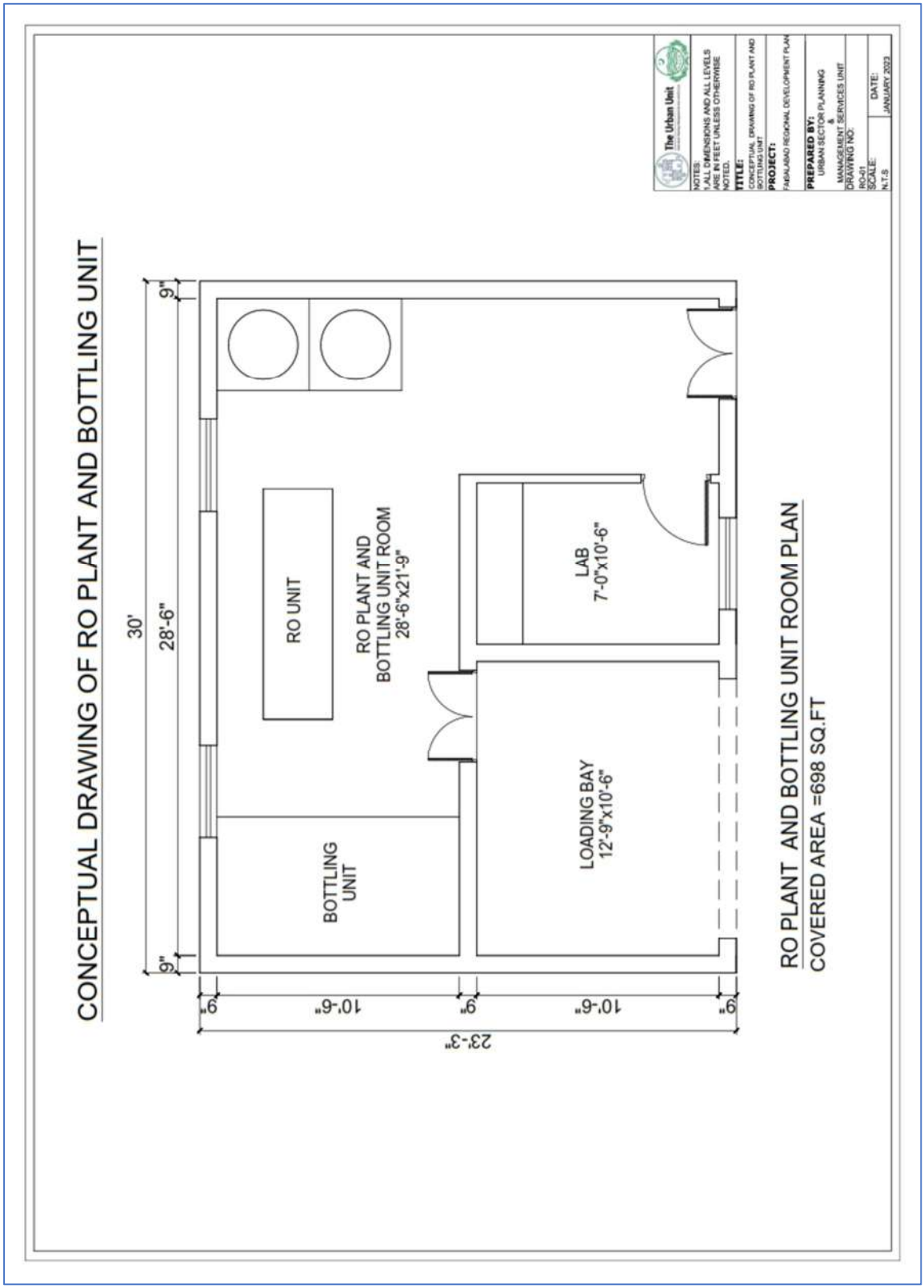


Figure 16 RO Plant

5.6 Existing Sewerage and Drainage Infrastructure

The service area of sewerage network is divided into two zones i.e., Eastern and Western zones. These two zones are further divided into ten (10) sub-divisions. The waste water generated in the city is managed by sewer pipe network of 1975 Km with the help of 37 pumping stations (19 disposal stations and 18 lift stations). Drainage network of 14 Km is also laid for the conveyance of waste water to seepage drains.

Currently, there is no wastewater treatment facility in the Eastern Zone. Untreated wastewater is directly sent through disposal pumping stations into the Madhuana drain, where it eventually runs into the Ravi River. However, it was told that waste water treatment plant for Eastern zone has been approved and the process of execution has been started. On the other hand, the wastewater produced in Ghulam Muhammad Abad (GM Abad) sub division is pumped into the drains in the Western Zone, and Chokera Waste Water Treatment Plant (WWTP) treats about 20 MGD of the total wastewater. The Paharang Drain is used to dispose of the residual untreated effluent. The wastewater generated from Civil Line, Madina Town, Gulberg and all other adjacent areas is collected and carried untreated through Paharang drain by disposal pumping stations into Chenab River.

Table 13 Sewerage Infrastructure Detail

Division	Sub Division	Pumping Stations	Sewer Network	Sewer Connections	Disposal
East	Madina Town Samnabad Allama Iqbal Town Peoples Colony Shamsabad	**D/S:** 8 Nos **L/S:** 10 Nos	**1957 Km**	165,214	Madhuana Drain
West	Civil Lines Gulberg GM Abad Saifabad Millat Town	**D/S:** 11 Nos **L/S:** 8 Nos		166,590	Paharang Drain

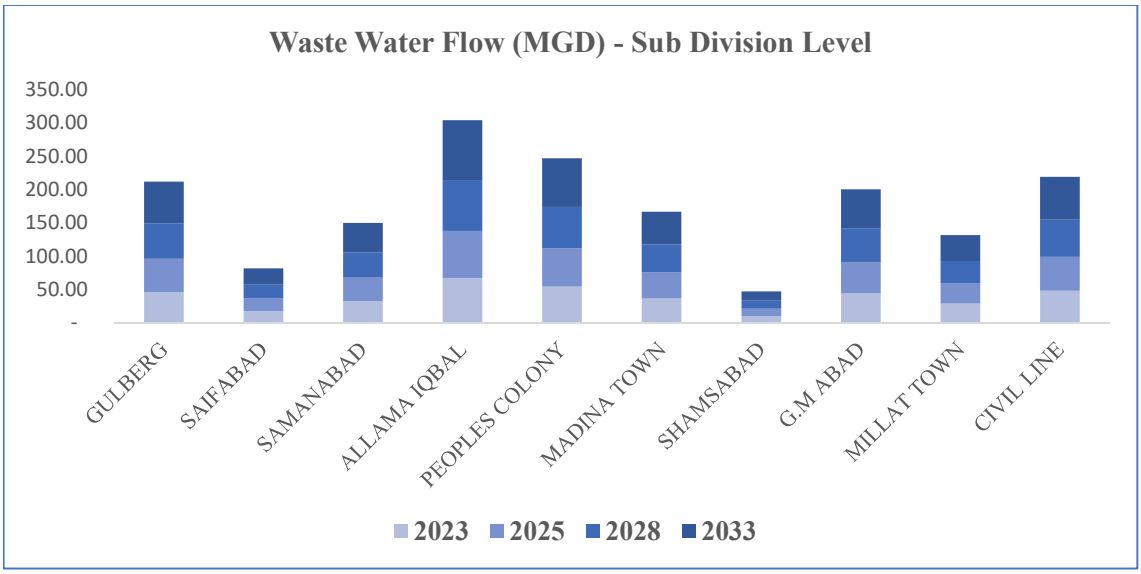
5.7 Waste Water Generation

The waste water generation of Faisalabad city (under WASA Boundary) is estimated corresponding to per capita water demand. As per PHED design criteria, per capita waste water generation is taken 85% of the water demand. Furthermore, peak factor allowance of 2, storm water allowance (50% of peak flow), infiltration allowance (5% of average flow) and non-domestic allowance (5% of average flow) are considered to estimate the total generated waste water over the projected years. The table 6 displays the estimated flows according to aforementioned considerations. In addition, the chart shown in figure 6 is displaying the projected waste water flow at sub-division level. It is estimated that currently the city is

generating roughly 390 MGD of waste water which is expected to reach more than 500 MGD in the year 2023 owing to increase in population of approximately 1 million.

Table 14 Projection of Waste Water Generation

Criteria	Waste Water Generation (MGD)			
	2023	2025	2028	2033
Population (WASA Boundary)	3,703,832	3,896,655	4,204,874	4,773,696
Avg. Waste Water Generation	125.93	132.48	142.97	162.31
Peak Sewage Flow (PF: 2)	251.86	264.97	285.93	324.61
Storm Water Flow (50% PF)	125.93	132.49	142.97	162.31
Infiltration Flows (5%)	6.30	6.62	7.15	8.12
Non-Domestic Flows (5%)	6.30	6.62	7.15	8.12
Total Waste Water Flow	**390.3**	**410.7**	**443.2**	**503.2**



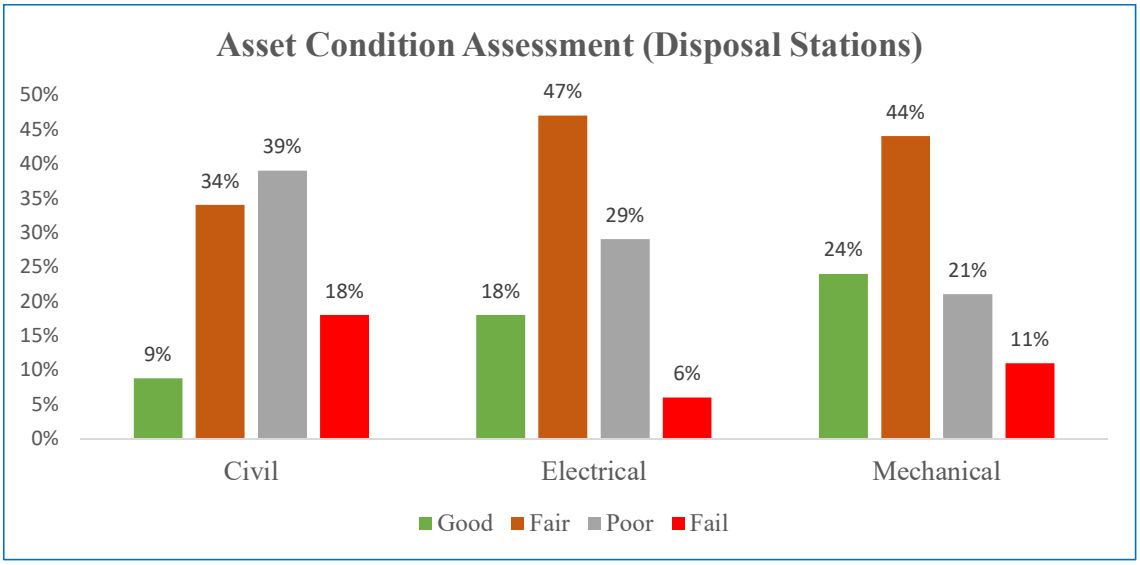
Graph 4 Waste Water Flow Projections (Sub-division Level)

5.8 Condition Assessment of Sewerage and Drainage Infrastructure

Faisalabad city has a combined sewerage and drainage system. Large volumes of industrial and storm water flow cause severe overflowing problems during rainy seasons especially monsoon period. In addition, clogging of branch sewers with solid waste is most raised complaint as reported by WASA Faisalabad. The current sewerage system is operating 37 disposal pumping stations in the city to handle the generated waste water and dispose it off to the drains. The pumping station receives waste water in a screening chamber where coarse screens are installed to remove solid waste. However, corrosive secretions from waste water damages the screens which remain of no use a very short time after its installation.

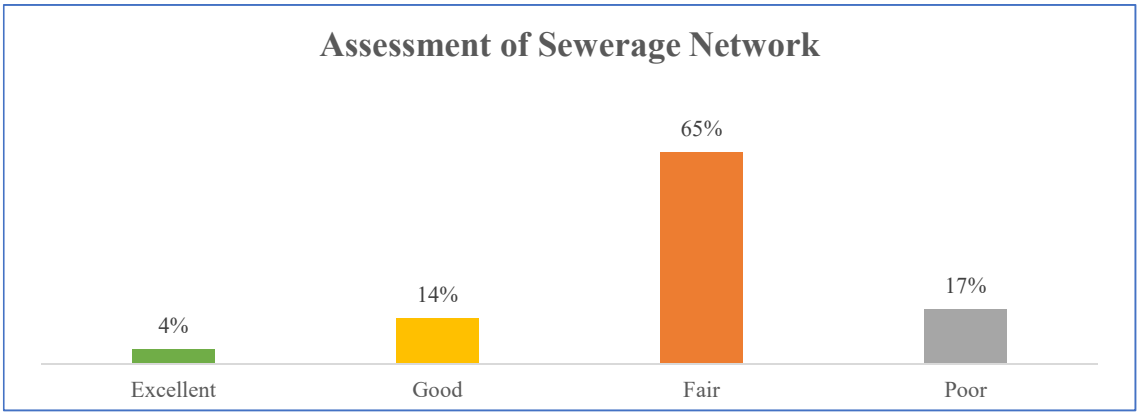
The field survey team of Urban Unit visited all the major disposal stations for baseline data gathering and conducted the condition assessment exercise in the form of visual inspections

and electrical assessment (especially power factor) using measuring tools. It was found that corrosive secretions from waste water have damaged the screening chambers on more than 75% of disposal stations. Similarly, gases from these secretions have also affected the electrical precautionary components on electrical panels due to carbon accumulation on metal parts which cause sparks and burns the component. Therefore, more than 50% of power factor improvement panels available on disposal stations are not working which has resulted in low power of pumping machinery eventually low efficiency. In addition, apart from newly constructed disposal stations, pumping machinery on all the disposal pumping stations is assembled without pump room which is reducing its lifespan due to extreme weather conditions. The results of these assessments are displayed in Figure 7.



Graph 5 Condition Assessment of Disposal Stations

During the survey, the Urban Unit team had detailed deliberations with WASA Faisalabad field staff which helped in gathering baseline data and condition of assets. After performing analysis on the gathered data, it can be seen that only 4% of the pipe network can be considered as Excellent (A), 14 % are Good (B) whereas 65% of the sewerage pipe network fall in to Fair (C) category and 17 % are in Poor (D) category of the condition assessment rating chart.



Graph 6 Condition assessment of Sewerage Network (Primary, Secondary & Tertiary)

Currently, the waste water is being disposed in river Ravi and Chenab without any treatment except some amount of water flowing through Chokera disposal pumping station. The wastewater treatment process of Chokera Waste Water Treatment Plant WWTP is a stabilization pond system consisting of anaerobic ponds and facultative ponds. It was noted that since its construction in 1998, there has been no rehabilitation works performed on this plant.

	
Condition of Pump Room	Condition of Pump
	
Power Factor Assessment	Open Pumping Machinery
	
Chokera WWTP Disposal Point	Damaged Electrical Panel

Figure 17 Glimpse of Condition Assessment Survey

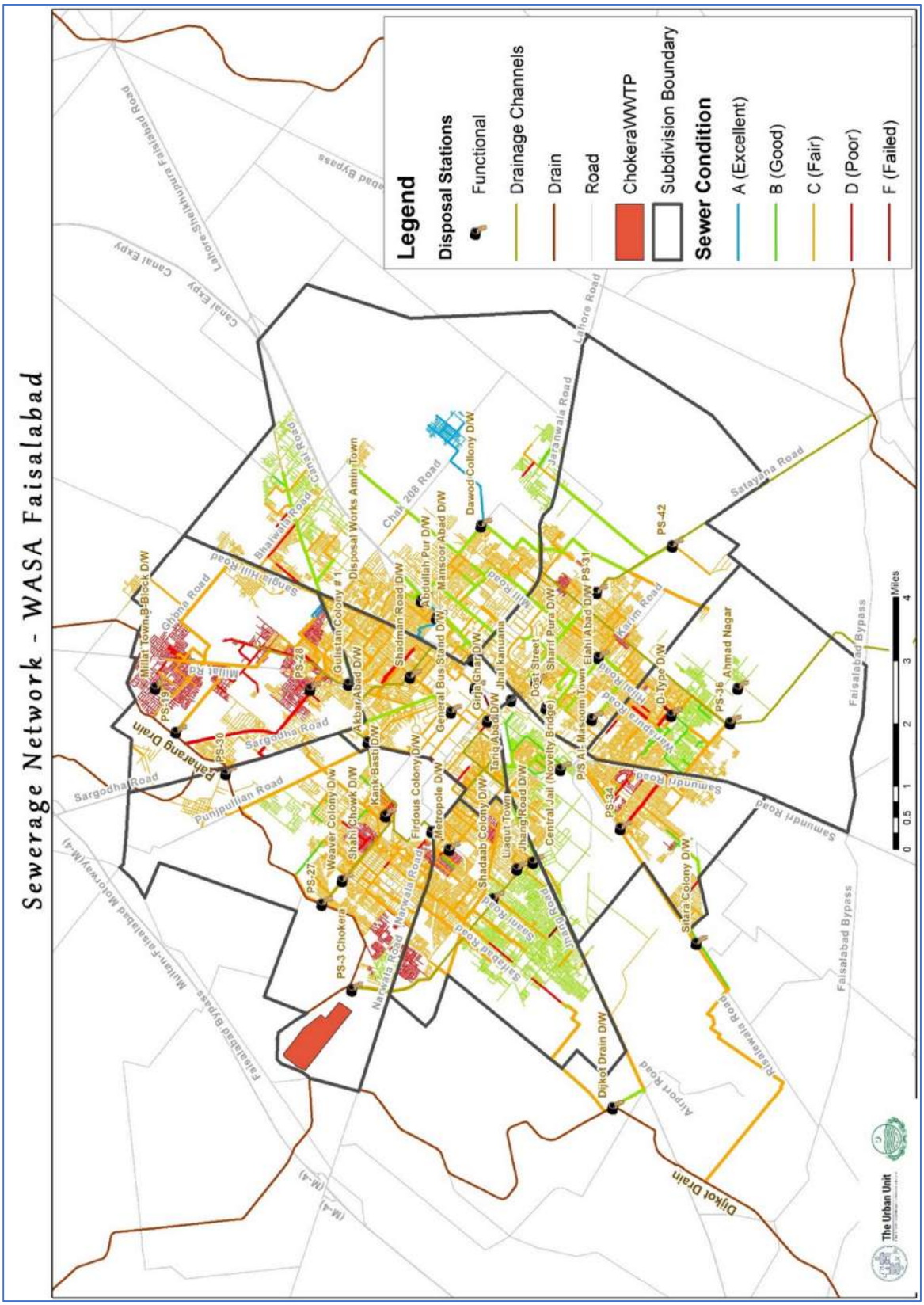


Figure 18 Sewerage and Drainage Interventions

Keeping in view the results of condition assessment, team jotted down the priority neglected/problematic areas, most severe problems and identified the list of interventions. Projects are prioritized in short (2025), medium (2028) and long-term (2033) phases with respect to their priority requirement to fill in the gaps and provide the efficient level of municipal services to citizens. Therefore, the following interventions are more focused on evidence-based improvement projects and introduce new avenues in the development horizon which have been remained unattended. It is important to note that all the calculations and figures in this plan are estimated values which may vary subject to detail designing.

- **Short Term Plan (2025)**

The short-term planning is focused on rehabilitation and improvement projects to capacitate the existing infrastructure and target the high priority interventions. The problematic sewerage infrastructure was identified and marked during the survey which is proposed to replace in short term plan. The waste water treatment plant in Chokera also requires immediate rehabilitation and cleaning for efficient treatment of sewage. Major disposal stations in the city are also considered in short term planning for rehabilitation and improvement of machinery, electrical infrastructure and civil works. Main highlight of the rehabilitation scheme is dedicated electrical room to avoid the damages caused by waste water secretions. During the visit, it was also noted that an industrial drain passing through Chenab well field area is polluting the ground water aquifers. Lining of this drain is also proposed in this plan.

- **Medium Term Plan (2028)**

In the medium-term plan, it is planned to continue the rehabilitation and augmentation of disposal stations. Sewerage pipeline network is also planned to replace in medium term planning to augment the capacity of network with increase in population. Due to continuous operation of machinery and high electricity tariffs, WASA Faisalabad faces difficulties in managing the electricity expenditures. Therefore, two potential sites which runs heavy pumping machinery are selected for installation of solar plant to share electrical load of the facility.

- **Long Term Plan (2033)**

This term extends the sewerage infrastructure to the newly established settlements and peri-urban areas marked in GIS map. As mentioned in the existing infrastructure section, a new waste water treatment plant is in the process of execution which has capacity of 55 MGD. It was noted that Chokera WWTP receives 210 cusecs (135 MGD) but the treatment capacity is only 20 MGD. Therefore, the extension of Chokera WWTP having capacity of 30 MGD is proposed in the long-term plan.

The following table describes the list of interventions in priority areas with brief scope of work and rough cost estimate.

Table 15 Proposed Schemes

Planning Term	Proposed Schemes	Scope	Cost (Million)
Short (2025)	1. Replacement of sewerage network in Millat Town (B-Block), NoorPur and Gulshan e Barkat, Weaver colony, Kanak Basti, Firdous Colony, Samanabad (B-Block)	▸ Replacement of outlived and problematic waste water conveyance network	704.4
	2. Lining of industrial drain in Chenab Well field Area (6.5 Km)	▸ Procurement of mentioned machinery	45.92
	3. Rehabilitation of Chokera Waste Water Treatment Plant	▸ Replacement of gates, de-silting and cleaning of ponds, rehabilitation of service roads	88.05
	4. Rehabilitation and augmentation of Disposal Stations in Faisalabad city (Phase- I)	▸ Augmentation of electromechanical equipment, dedicated electrical room, civil structures and allied works at Chokera DS, Abdullahpur DS, PS-34, PS-31 OLD, Elahiabad DS, PS-36, PS-28, PS-38, Shadab Colony DS and Jhang Road DS (10 Nos)	880.49
Medium (2028)	5. Replacement of sewerage network in Gulistan Colony, Akbarabad, Shadman Road, Abdullahpur, Mansoorabad, Sharifpura, Elahiabad, Al Masoom Town, Liaquat Town, Tariqabad, Shadab Colony,	▸ Replacement of outlived and problematic waste water conveyance network (250 Km)	557.70

	Firdous Colony, Sitara Colony, D -Type, Sumandri Road and Narwala Road.		
	6. Rehabilitation and augmentation of Disposal Stations in Faisalabad city (Phase- II)	▸ Augmentation of electromechanical equipment, dedicated electrical room, civil structures and allied works at Akbar Abad DS, Mansoor Abad DS, D-Type Colony, ▸ Gulshan Colony DS, Metropole DS, Tariq Abad DS, Liaqut Town DS, Dawood Colony, Ahmed Nagar, Kanak Basti, Weaver Colony, Girja Ghar, PS- 42, PS-19, PS-27, Gulshan Iqbal, Old Satyana (17 Nos)	1,496.84
	7. Solar PV plant at Jhang Road Disposal Station and Chokera Disposal Station	▸ Installation of Solar PV plant with allied works at Jhang Road Disposal Station (180 kW) and Chokera Disposal Station (4 MW) respectively	878.48
Long (2033)	8. Extension of sanitation services and pipe network in newly developed areas (unserved) of the city	▸ Provision of secondary and tertiary sewers for unserved pockets of 468 KM	499.17

	9. Extension of Chokera Waste Water Treatment Plant based on Waste Stabilization Ponds Technology (30 MGD)	▸ Construction of Anaerobic and Facultative ponds, civil works, waste water channels, flow control gates and boundary wall	849.93
Total Cost		**6,000**	

For Rough Cost Estimation MRS, 1st Bi-Annual-2023 (01.01.2023 to 30.06.2023) District Faisalabad has been Applied. The 2% contingencies and 5% PST are also added in estimates. This is further subject to detailed design of the proposed schemes upon PC-1 formation.

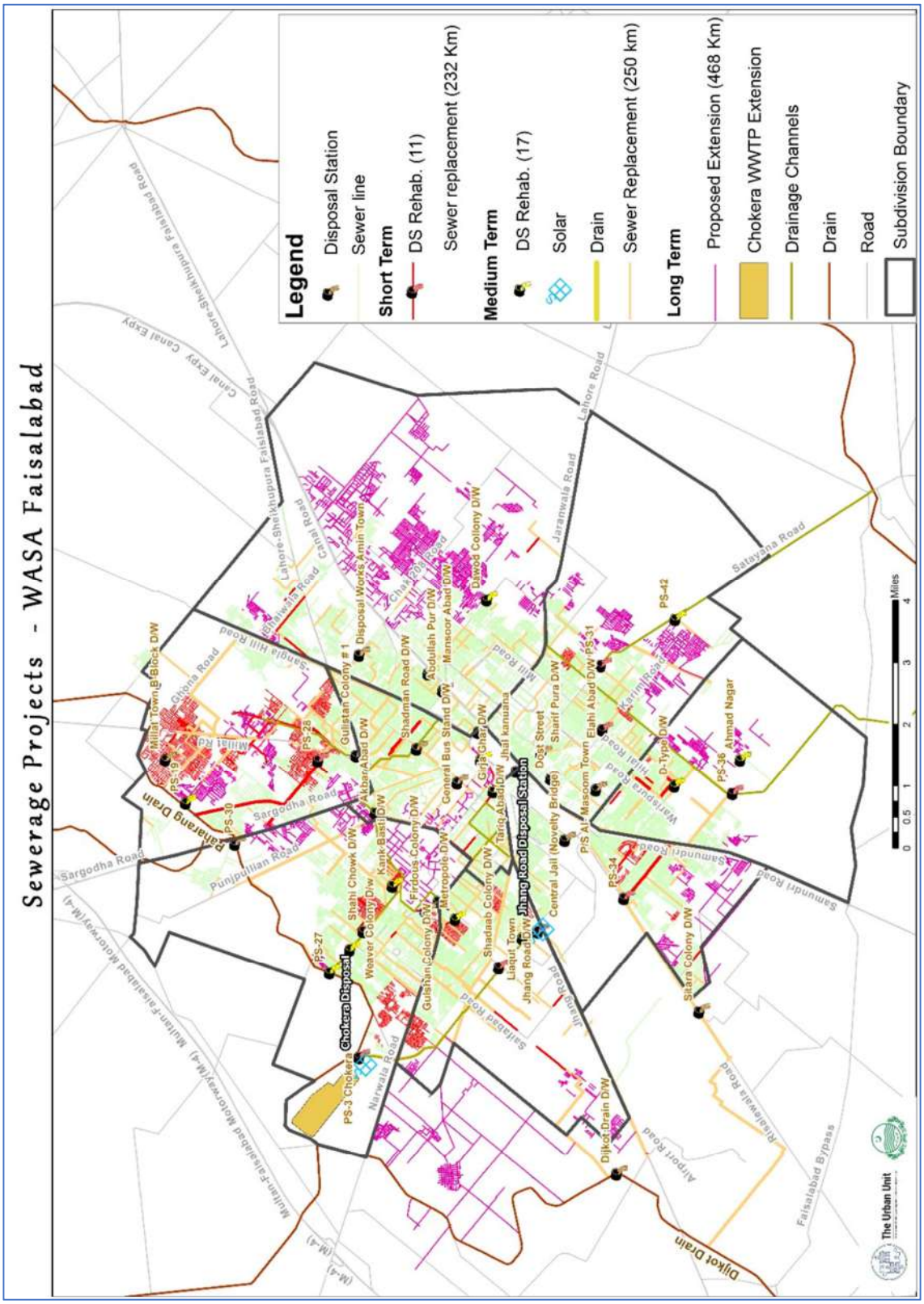


Figure 19 Proposed Interventions - Sewerage

5.9 Drawings

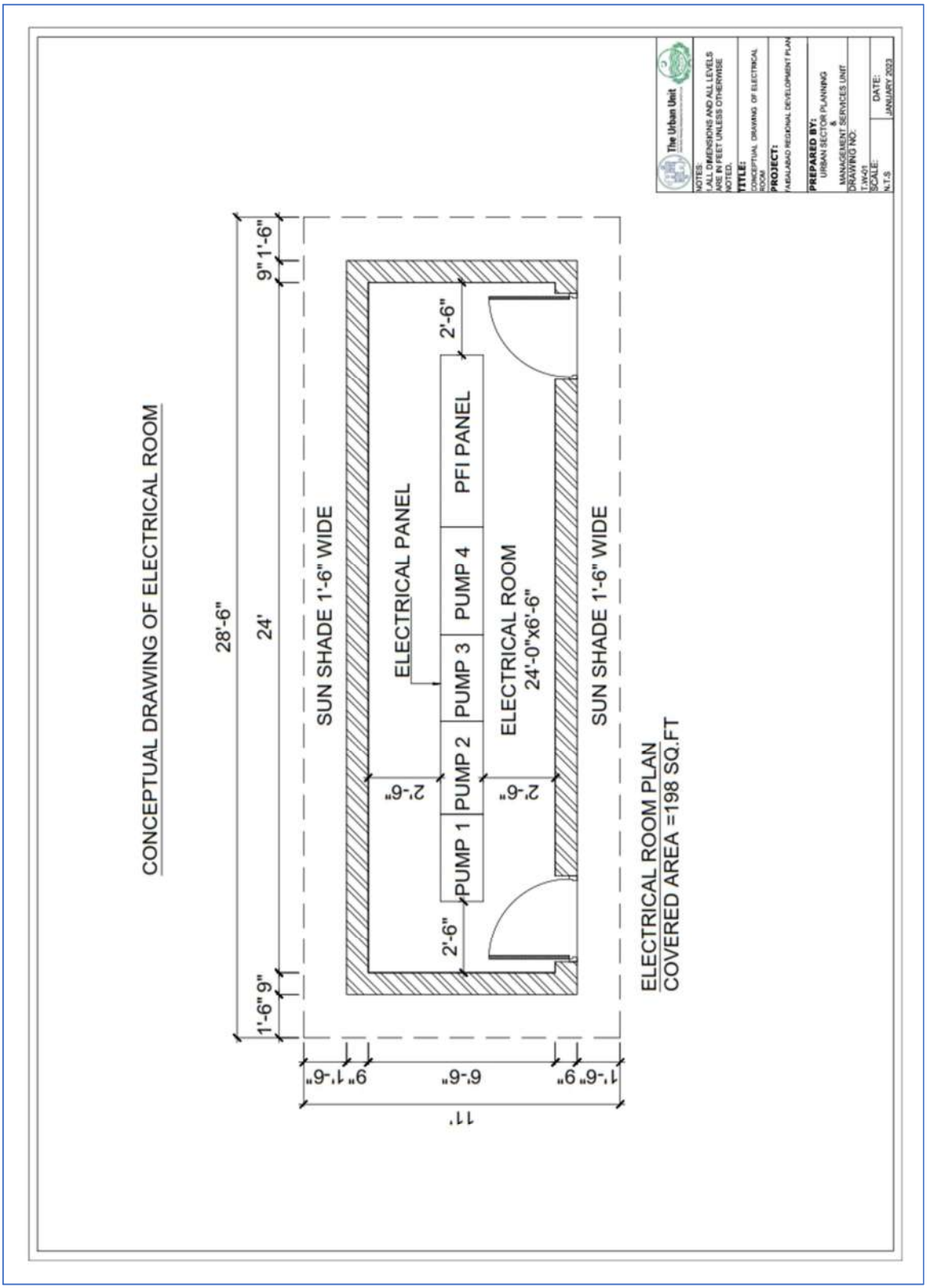


Figure 20 Electrical Room

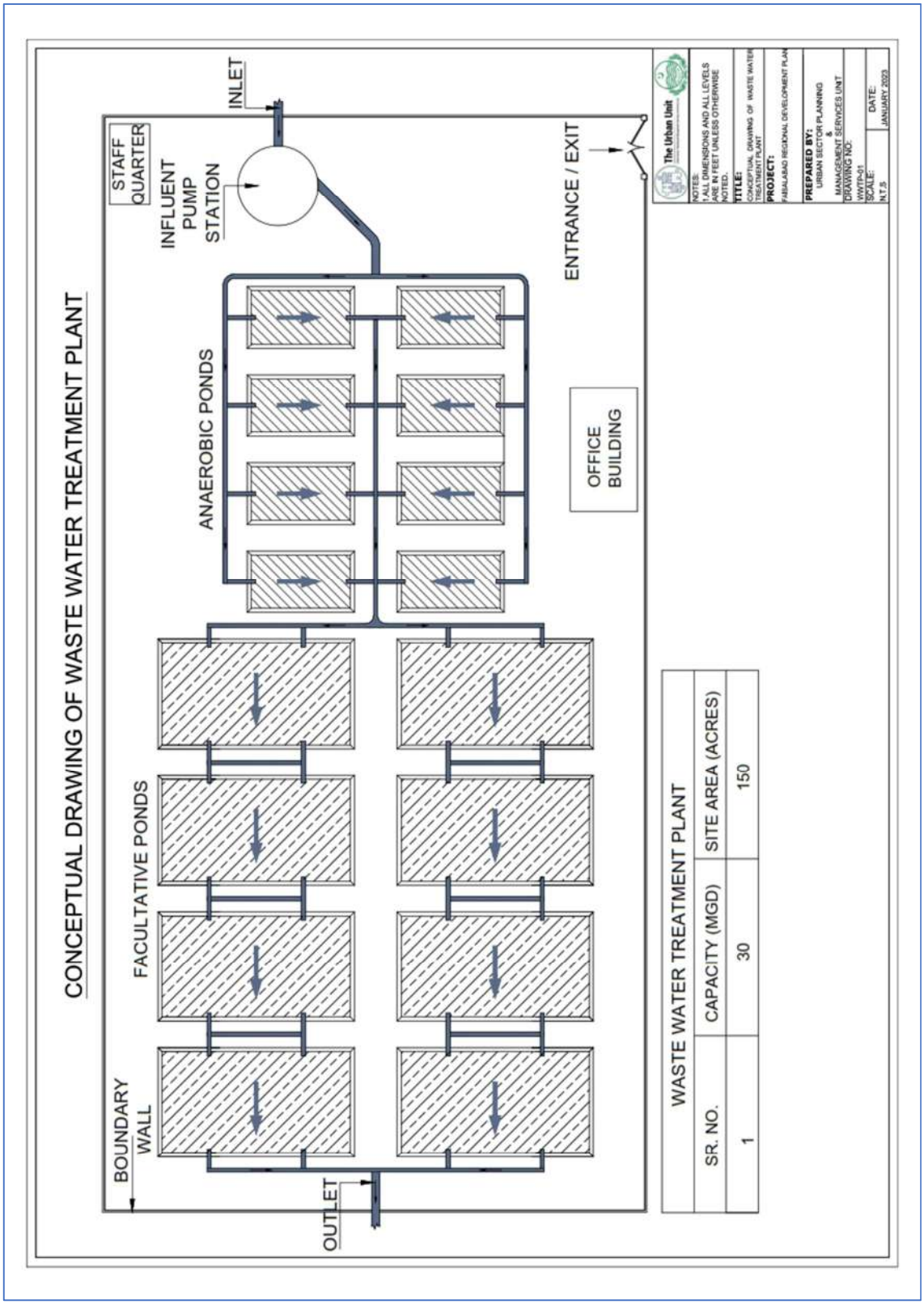
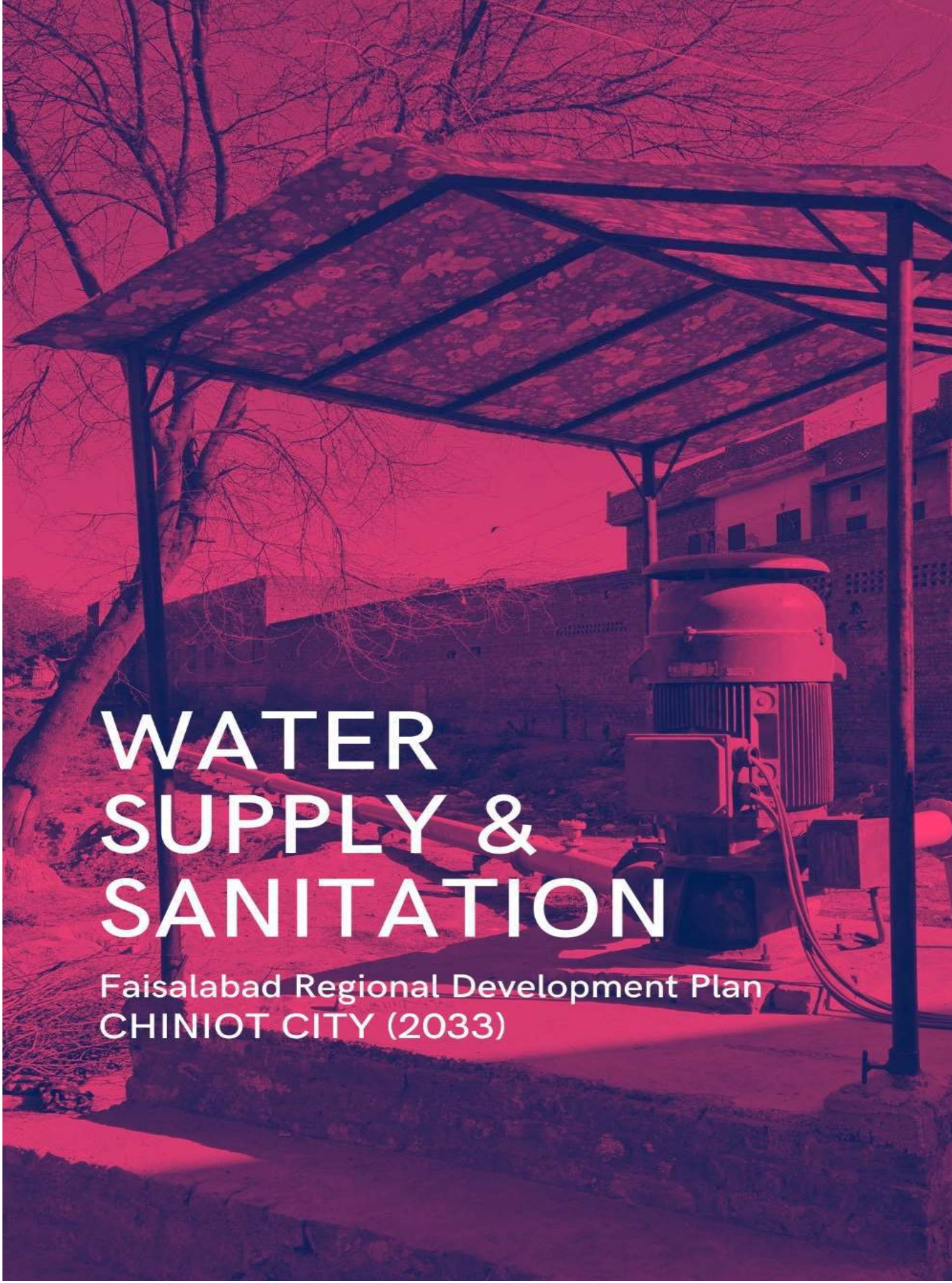


Figure 21 Waste Water Treatment Plant



WATER SUPPLY & SANITATION

Faisalabad Regional Development Plan
CHINIOT CITY (2033)

6 Chiniot City

Chiniot City lies on the bank of the river Chenab. It is 29th largest city of Pakistan in-terms of population. An estimated of 323,954 people resides in the city presently (year 2023) which will further increase to 416,715 in the year 2033, which is decided as planning year of this regional development plan.

Chiniot city have peculiar terrain when compared with rest of the cities in Faisalabad division. City is mostly plain land with rocky hills in around middle of the city which offers hinderance for clean water boring. This is the area where city is provided with MC owned Water Supply Schemes. Currently three (03) schemes provide water through these schemes to an estimated population of 165,000. Although this means half (50%) of the current population but in quantified water demand and yield comparison, this carter to only 13% of the demand of water as there are only three tube-wells (one each) attached to these schemes. This reduces further as water supply pipelines is also outdated and is in deteriorating condition. However, most of the city fulfill their water needs from their household bores as ground water is sweet and of drinkable characteristics. This however is changing due to high extraction of water and contamination of ground water from sewerage infiltration especially at the seepage drains which passes through the outskirts to the Chenab River. These seepage drains carry water from five disposal stations in the city which are functional and carter to the cities sewage which is mostly carried through sewers. Spatially the coverage of the sewers is around 60%. It is also alarming that city currently have no Waste Water Treatment Plant (WWTP) which is prompting the both ground water and the river (Chenab) water contamination.

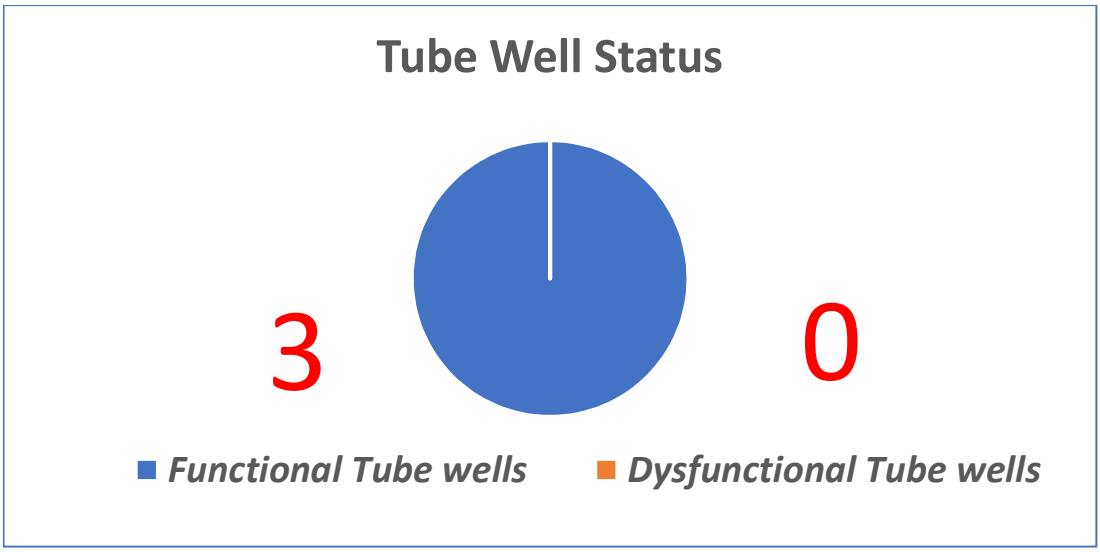
6.1 Existing Water Supply Infrastructure

WS Coverage is around 30% (spatially). Most of the City is served with domestic bores however 3 small schemes provide services to Hilly area and adjacent areas where bedrock offers hinderance to bore for Water. The Water Quality of Chiniot MC is mostly sweet and drinkable. Where tested, it showed (average) pH of 6.7, TDS of 328, and EC of 588. WS Pipeline is in deteriorated condition (D or Poor) and need replacement as per the demand of the area and appropriate sizes. Detail of the aforementioned schemes is as below:

Table 16 Existing Water Supply Schemes

Sr. No.	Tube-well (cusecs)	Year	Tube-well Condition	OHR (Capacity in G-Imp.)	OHR Condition	Pipeline length	Pipeline Condition
1	Mouzzam Shah	1971	4	100,000	C (Fair)	length 12KM of varying dias (4", 6", 8", 10", 12", 14", & 16")	D (Poor)
2	Maskin Pura	1977	1	10,000	B (Good)		
3	Chah Joggian Wala	1981	2	None	NA		

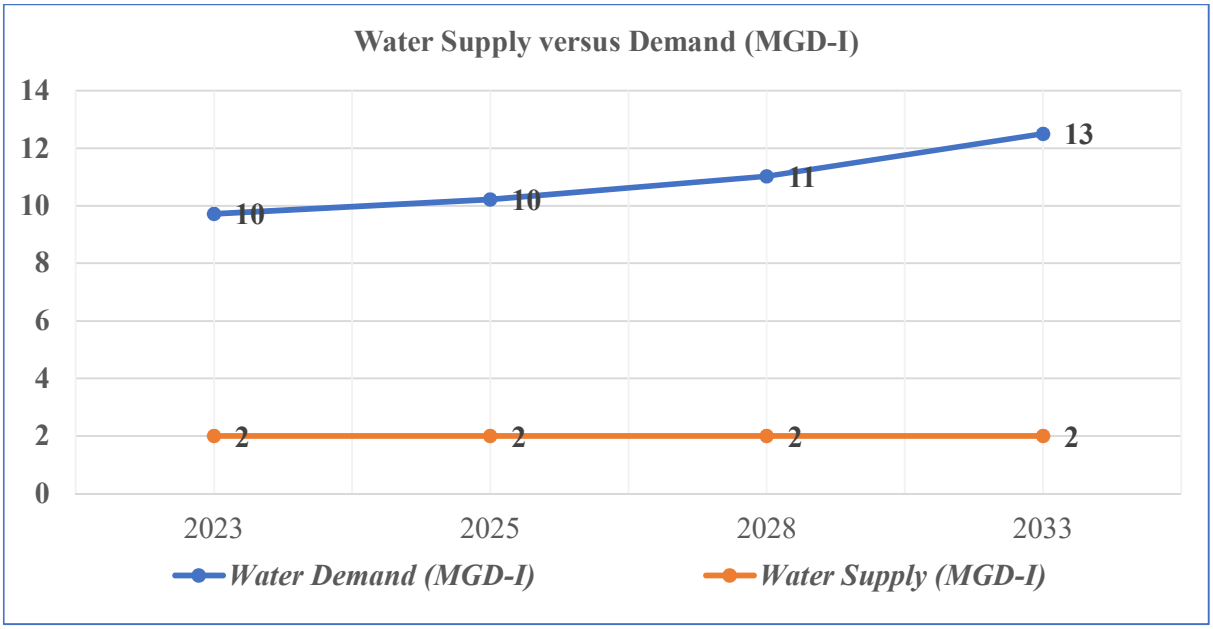
Following is the status of current Tubewells of aforementioned capacity.



Graph 7 Tube-well Status

6.2 Water Supply versus Water Demand

In quantified terms, Water Demand versus Water Supply can be illustrated as below which means as much as 8 MGD-I is the shortfall and being fulfilled by the private house-bores. This has been based with 16 Hours of water pumping. In current year (2023), deficit is as much as 8 MGD-I which will further increase to 11 MGD-I in year 2033.



Graph 8 Water Supply Demand vs Production

6.3 Condition Assessment of Water Supply Infrastructure

Following were major gaps identified during the detail condition assessment of the existing Water Supply infrastructure.

Outlived Infrastructure
(Around 30 Years)

Non-existent of Chlorinators & Meters

Deteriorated Civil Structures

Water Quality Testing

Electrical Assessment

Meeting with CO MC	Missing pump room - Mouzam Shah

Figure 22 In Pictures: Field Survey and Assessment

After detail condition assessment, following was established as overall condition and respective rating.

Table 17 Condition Assessment Outcome

Asset Attribute	Rating
Civil Structures	**D (Poor)**
Distribution Network	**D (Poor)**
Electro-Mechanical	**C (Fair)**

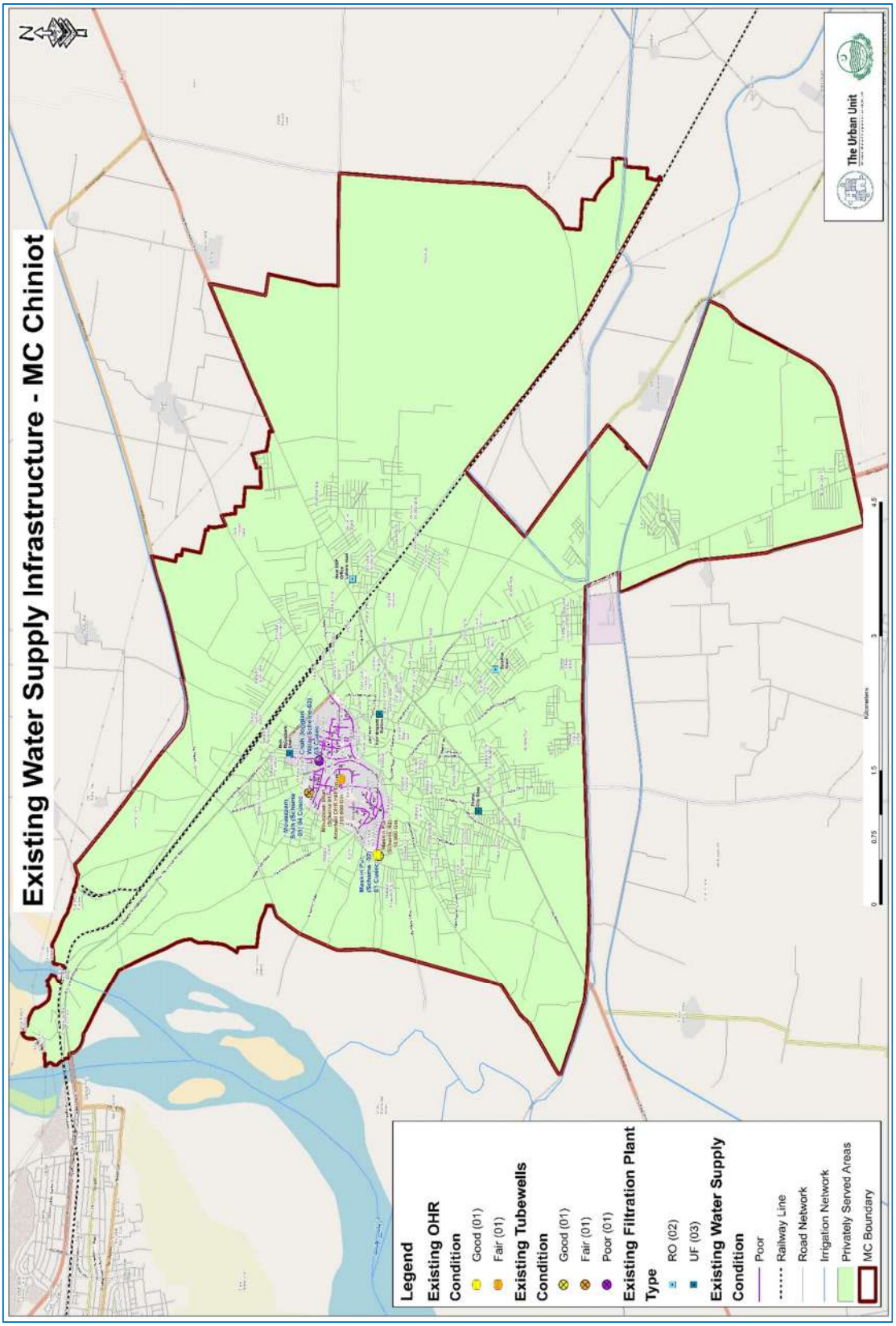


Figure 23 Water Supply Baseline

6.4 Water Supply Interventions

Afore-described gaps relating to the Water Supply were filled in the planning exercise in detail. Prioritization of these gaps is also done and hence schemes are proposed based on various factors such as essence of intervention, duration required to execute them, cost required, and their impact on public.

- **Short Term Plan**

As currently the water supply services are being provided to only limited portion of the city, first this infrastructure is planned to be fully capacitated by rehabilitating the current WS infrastructure. This include machinery replacement where required and repairs of civil structure like tube-wells and OHRs. This in turn will strengthen the supply to the areas which are being supplied water from Mouzzam Shah, Maskin Pur, & Chah Joggian Wala. Replacement of WS lines of varying dia and of length 12 KM is also proposed as current WS lines were reported to be in deteriorated condition. Establishment of store for quick fixing of this network in future 'is also proposed which is planned to have crucial tools and equipment. This plan will cost around 178 Million.

- **Medium Term Plan**

In Medium term, Water supply services extension is planned to increase the coverage of MC owned supply of water. Since unserved area is around 70% spatially. This may then be done in two phases. In the Phase – I, extension is planned for Thathi Gharbi, Mohallah Qasaban, Mohallah Insari, Eid Ghah, Noor Wala, Riaz Shah Road adjacent areas, Iqbal Abad, Sadique Abad, Club Road, Furniture market, Karman Abad, Jhumra Road, Gulistan Colony, Satellite Town, Ghalla Mandi, and all neighboring areas. This includes new Tube-wells, OHRs and WS pipeline network of 122 KM. This may cost around 1,271 Million.

- **Long Term Plan**

In the Long term, extension is planned for, Hakeem Colony, Thana City Road area, Rajoa Chowk, Noor Wala, Mohallah Dil Khushab, Rasheed Abad, Muza Rai Chand, Qasim Town, Ghafoor Abad, Mustafa Abad, Khayaban Colony, Bhotto colony and all neighboring areas. Establishment of SCADA Monitoring and Control Center in Chiniot City is also proposed for real-time monitoring of the supply. This may cost around 1,240 Million.

Following are proposed schemes for the Chiniot (MC):

Sr. #	Planning Term	Sector	Proposed Schemes	Scope	Cost (Million)
1	Short (2025)	Water Supply	Rehabilitation of 03 existing WS Schemes of Mouzzam Shah, Maskin Pur, & Chah Joggian Wala in Chiniot City	▸ Provision of Civil Structure on missing scheme, replacement of Pumps, minor repair of OHRs, and pipe	148

				replacement of outdated WS pipelines of total length 12KM of varying dias (4", 6", 8", 10", 12", 14", & 16")	
2			Establishment of store for Water Supply Equipment for quick fix in Chiniot City	▸ Construction of Store, Electro-Mechanical Spares & Tools, Equipment for WS	29
3	Medium (2028)		New Water Supply Schemes: Extension of Water Supply to unserved areas of Chiniot City (Thathi Gharbi, Mohallah Qasaban, Mohallah Insari, Eid Ghah, Noor Wala, Riaz Shah Road adjacent areas, Iqbal Abad, Sadique Abad, Club Road, Furniture market, Karman Abad, Jhumra Road, Gulistan Colony, Satellite Town, Ghalla Mandi, and all neighboring areas) in Chiniot City – Phase I	▸ Construction of 09 Tube wells (4 cusecs each), 09 OHRs (100,000 Gallons each), and WS pipeline (14" mains and 4" distributions) of length 122 KM	1,271
4	Long (2033)		New Water Supply Schemes: Extension of Water Supply to unserved areas of Chiniot City (Hakeem Colony, Thana City Road area, Rajoa Chowk, Noor Wala, Mohallah Dil Khushab, Rasheed Abad, Muza Rai Chand, Qasim	▸ Construction of 8 Tube wells (4 cusecs each), 8 OHRs (100,000 Gallons each), and WS pipeline (14" rising mains & 4" distributions) of length 90 KM	1,130

			Town, Ghafoor Abad, Mustafa Abad, Khayaban Colony, Bhotto Colony and all neighboring areas) in Chiniot City – Phase II		
5			Establishment of SCADA Monitoring and Control Center in Chiniot City	▸ Establishment of SCADA	110
5	**Total Water Supply – Chiniot MC**				**2,688**

For Rough Cost Estimation MRS, 1st BI-ANNUAL-2023 (01.01.2023 to 30.06.2023) District Chiniot has been Applied. The 2% Contingencies and 5% PST are also added in estimates. This is further subject to Detail Design of the proposed schemes upon PC-1 formation.

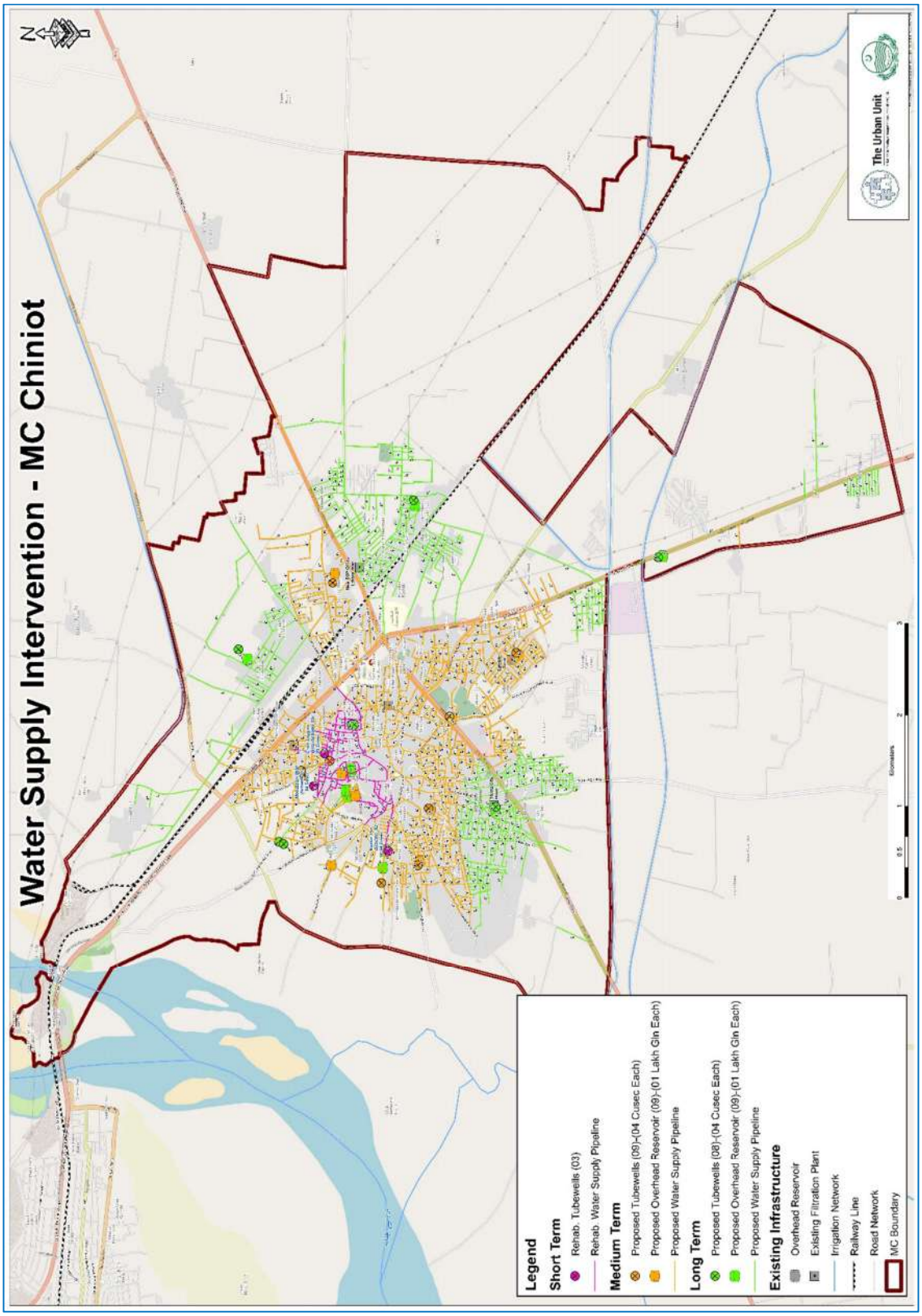


Figure 24 Water Supply Intervention

6.5 Drawings

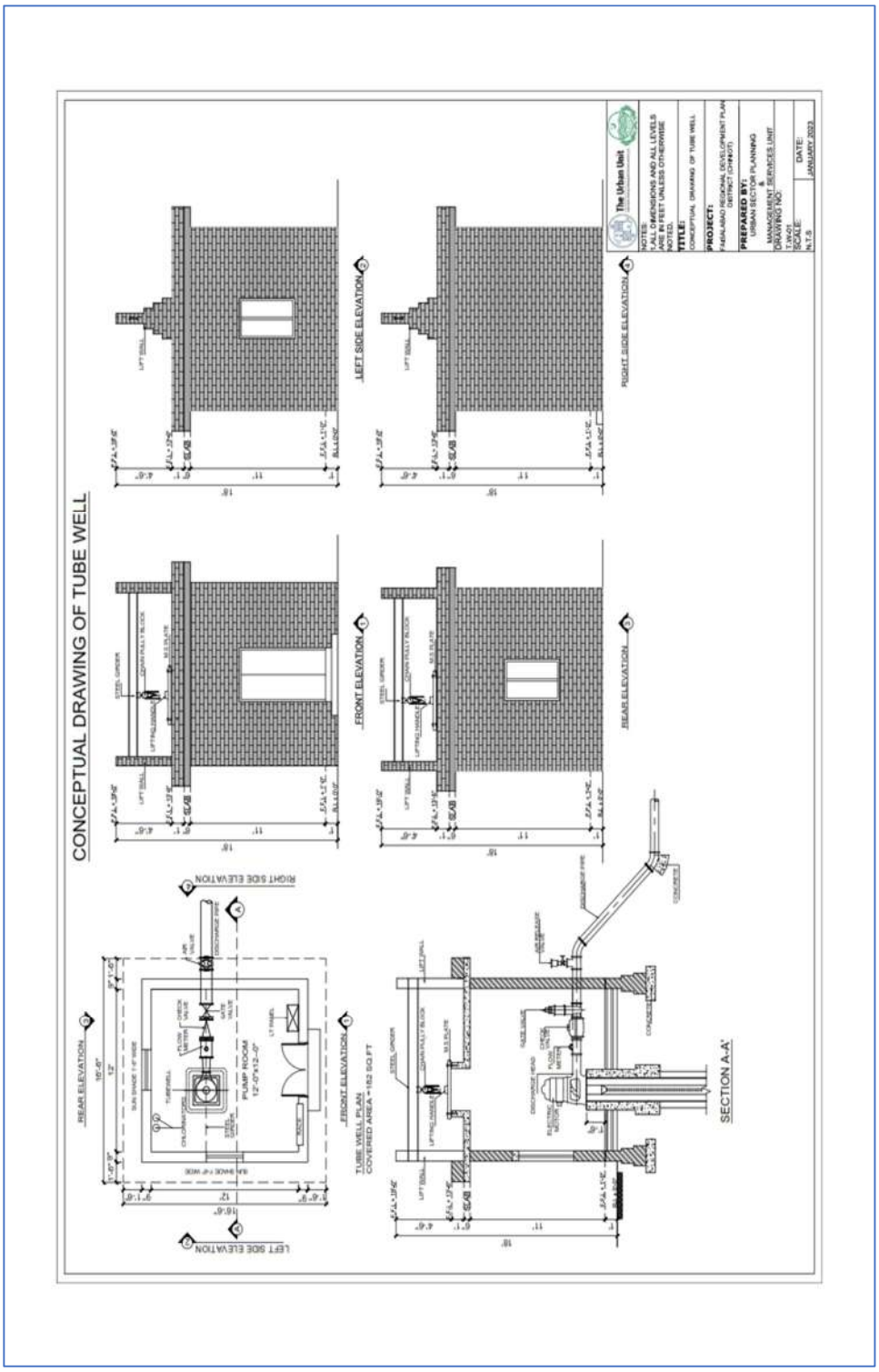


Figure 25 Tube-well

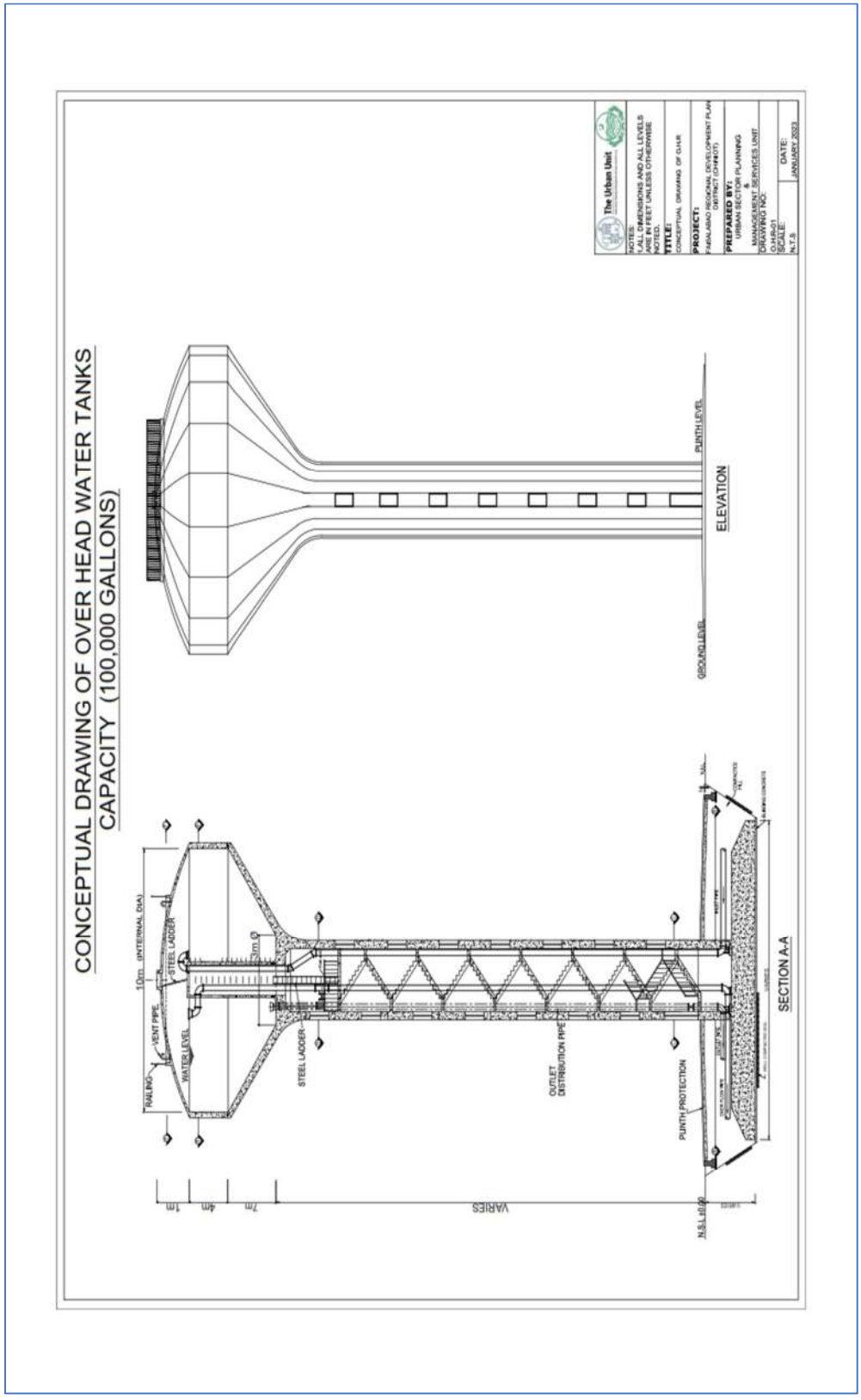


Figure 26 OHR 100,000 Gallons

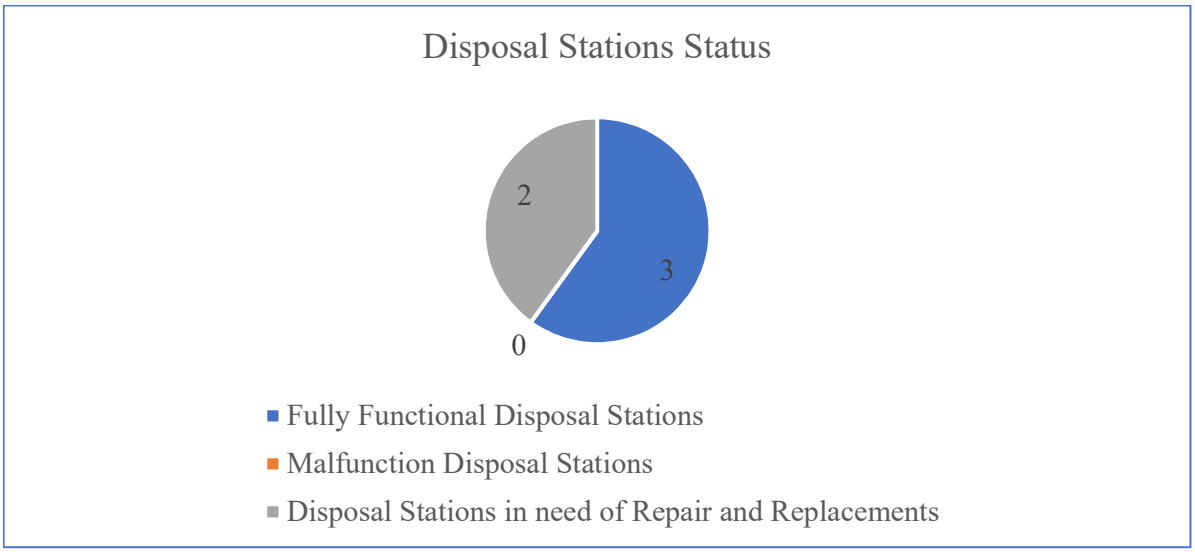
6.6 Existing Sewerage Infrastructure

Sewerage arrangements in the Chiniot City is mostly sewers of RC (Reinforced Concrete) material which dispose sewage to the five disposal stations which further ultimately dispose it off to River Chenab through either seim nullah (seepage drains) or sullage carriers. It is also alarming that city currently have no Waste Water Treatment Plant (WWTP) which is prompting the both ground water and the river (Chenab) water contamination. Detail of five disposal stations is as below:

Table 18 Sewerage Infrastructure Detail

Sr. No.	Disposal Station	DS Condition	Comments	Ultimate Disposal Station	Sewers Dias (Overall)	Sewer Condition (Overall)
1	Sargodha Road Bypass DS	C (Fair)	Fully Functional	Chenab River	Length 116 KM of varying dias (12", 18", 24", 27", 36", 42" 48")	C (Fair)
2	Tibian Wala DS	D (Poor)	Needs Pump replacements of failed pumps			
3	Noor Wala Jhang Road DS	D (Poor)	Needs Pump replacements of failed pumps			
4	Satellite Town DS	C (Fair)	Fully Functional			
5	Rai Chand DS	C (Fair)	Fully Functional			

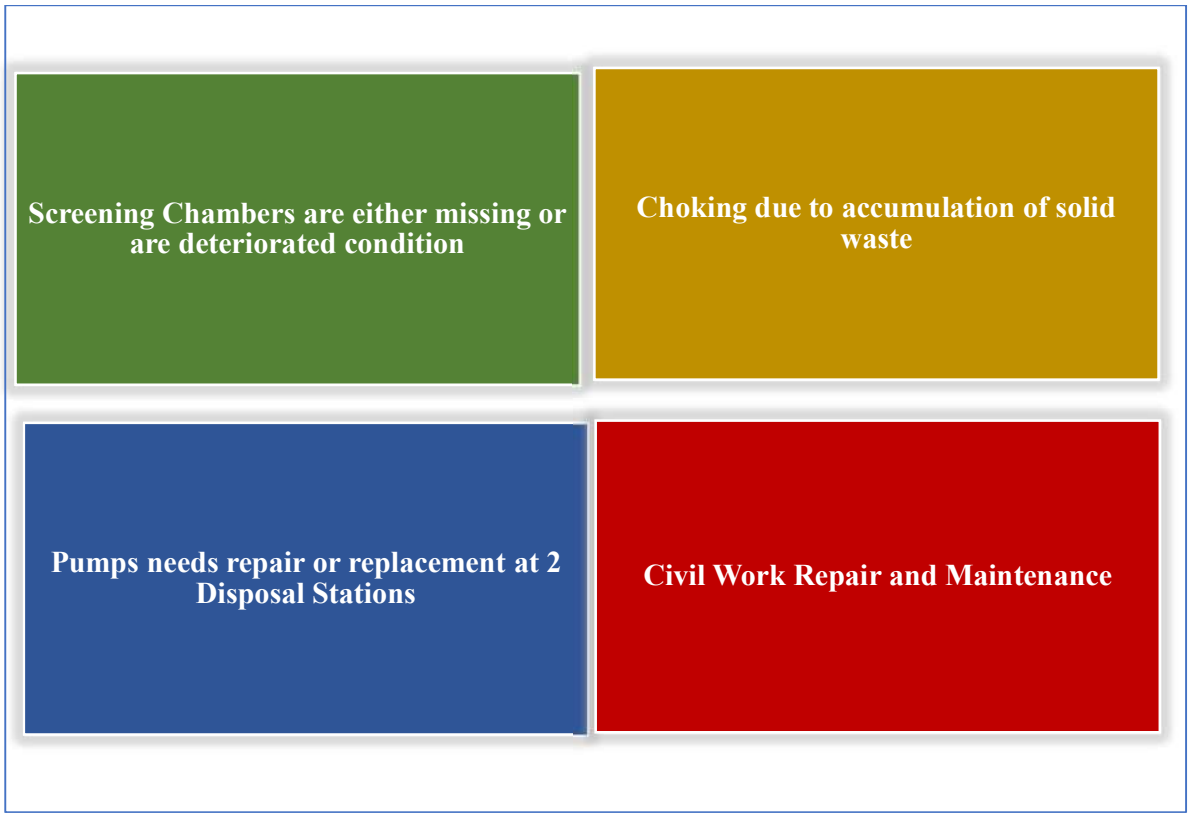
Following is the status of current Disposal Stations of aforementioned capacity.



Graph 9 Disposal Stations Status

6.7 Condition Assessment of Sewerage Infrastructure

Following was major gaps identified during the detail condition assessment of the existing Sewerage infrastructure.



Disposal Station Survey

Civil Structure Condition of Disposal Station

Outflow of Disposal Station to S. drain

Meeting with PHED

Figure 27 In Pictures: Field Survey and Assessment

After detail condition assessment, following was established as overall condition and respective rating.

Table 19 Condition Assessment Outcome

Asset Attribute	Rating
Civil Structures	**C (Fair)**
Electro-Mechanical	**C (Fair)**
Sewer	**C (Fair)**

6.8 Sewage Generation

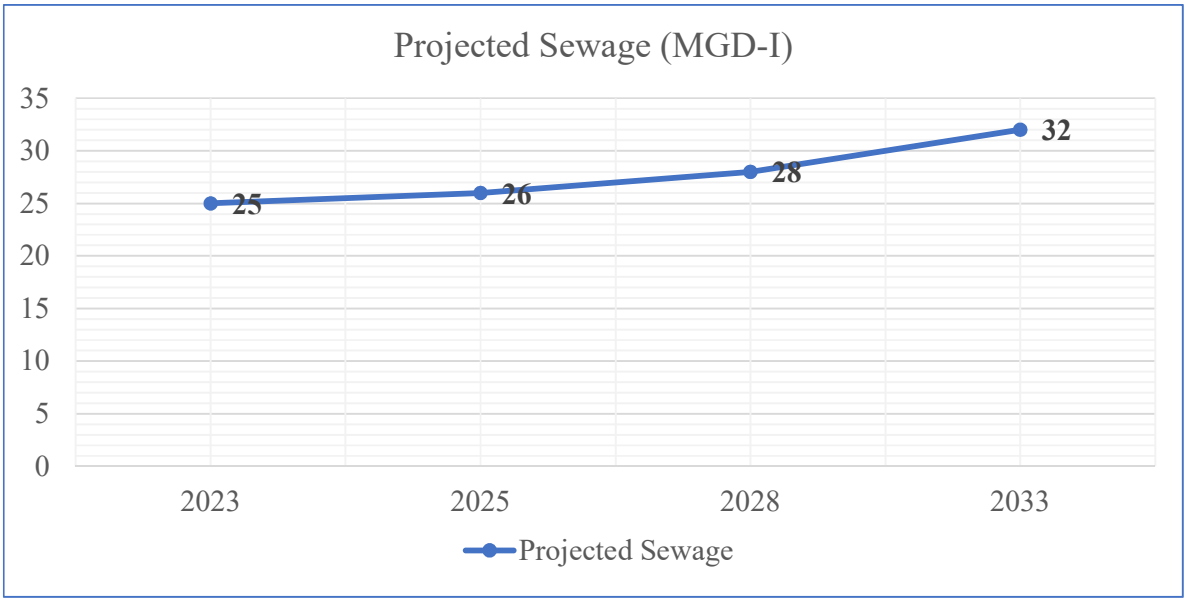
The sewage generation have been made corresponding to the 30 gallons per capita per day water demand i/c 20% unaccounted for water (NRW). A contribution of 50% for storm-water flow, 5% infiltration & 5% non-domestic flows have been included during the calculation of

the total sewerage flow. The current (2023) sewage generation and of the future (2025, 2028 and 2033) sewage generation are shown in the table below.

Table 20 Sewage Generation

Sewage Generation				
Year	**2023**	**2025**	**2028**	**2033**
Population	323,954	340,686	367,419	416,715
Peak Sewage Flow (MGD-I)	15.81	16.63	17.93	20.34
Storm Water Flow (MGD-I)	14.69	8.31	8.97	10.17
Infiltration Flows (MGD-I)	0.40	0.42	0.45	0.51
Non-Domestic Flows (MGD-I)	0.40	0.42	0.45	0.51
Total Sewage Flow (MGD-I)	**25**	**26**	**28**	**32**

Currently all the Disposal Stations are equipped with machinery adequate enough to carter to the current sewage flow after repairs and replacements. This however changes in future years where need for capacity enhancement has been felt, when calculated, at three DS, as per the proposed plan sewage generation, w.r.t. population of year 2033.



Graph 10 Projected Sewage

Elevation Map was also used for planning purposes as owing to Chiniot city semi-hilly terrain, it appears that elevation difference near city center can be one of the reasons for reported problematic sewers. Highest elevation and lowest elevation for Chiniot City are 229 and 173 meters (approx.) from the mean sea level. Difference is as high as 56 meters.

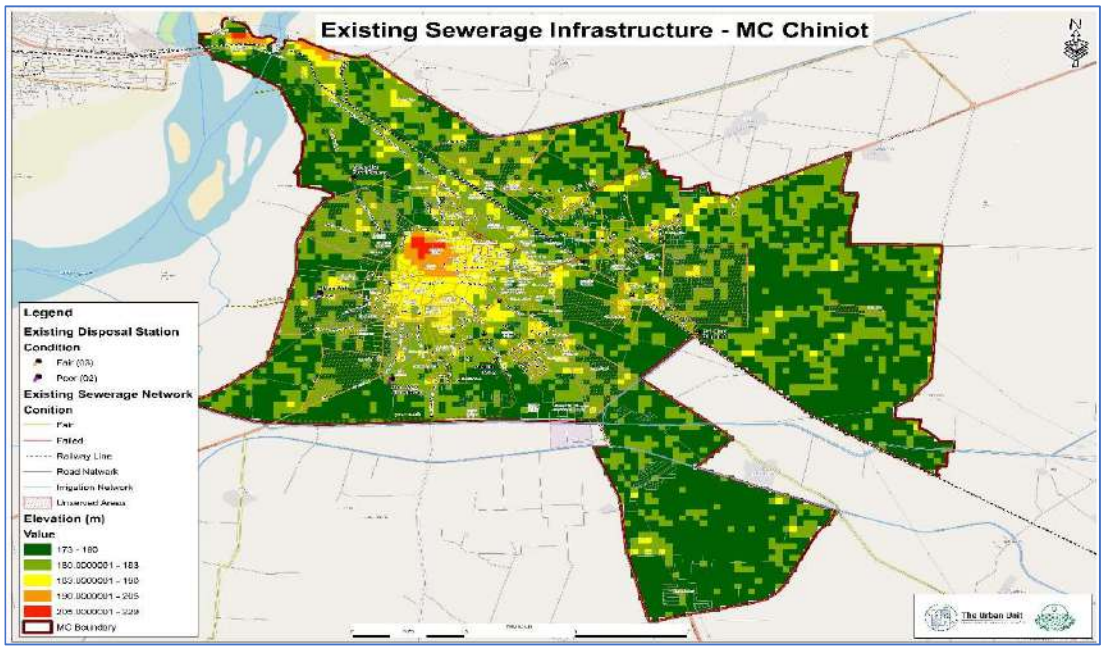


Figure 28 Elevation Map

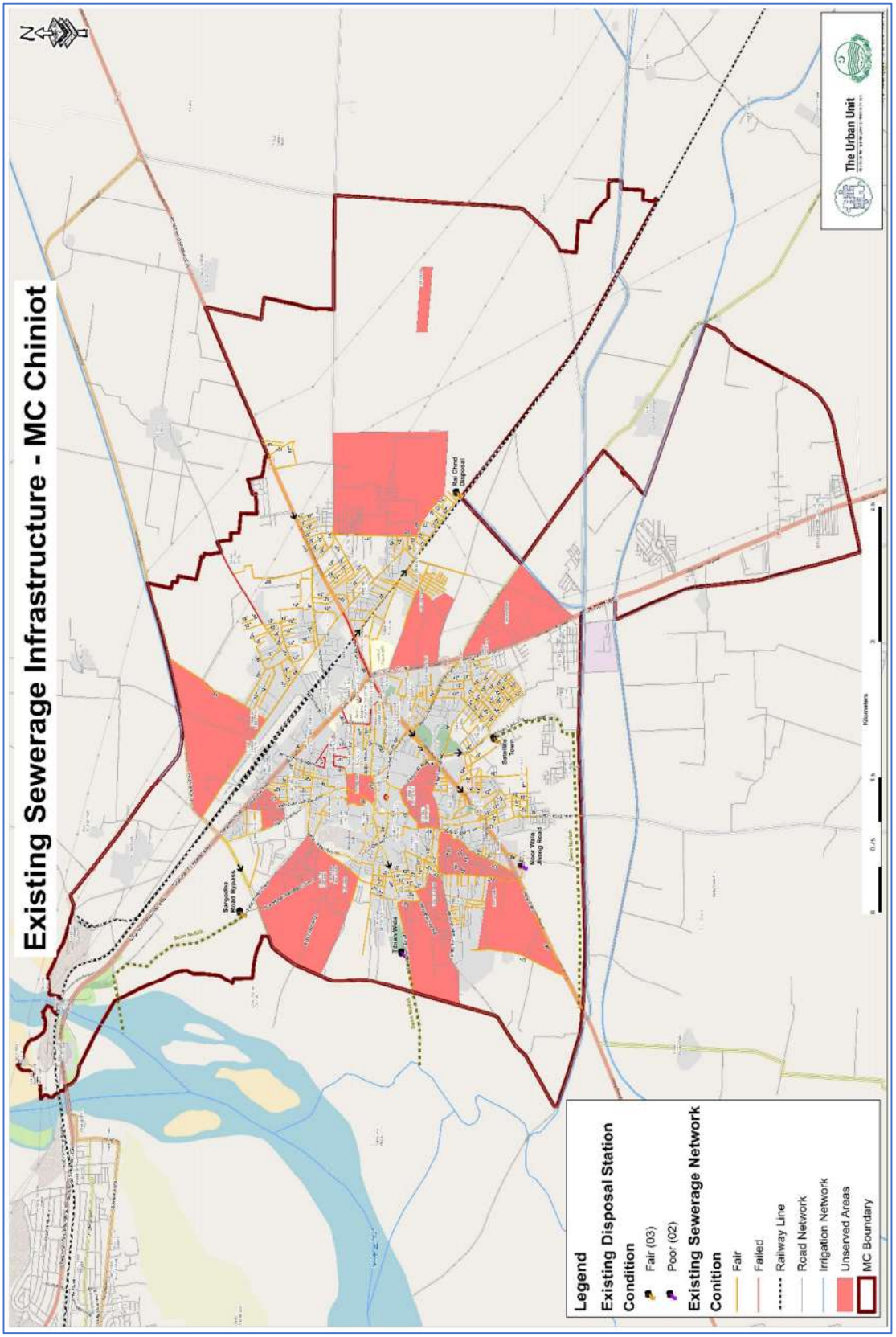


Figure 29 Sewerage Baseline

6.9 Sewerage Interventions

Afore-described gaps relating to the Sewerage issues were filled in the planning exercise in detail. Prioritization of these gaps is also done and hence schemes are proposed based on various factors such as essence of intervention, duration required to execute them, cost required, and their impact on public.

- **Short Term Plan**

To improve the sewerage condition of the city, it is important to first fully capacitate the current system first. This includes machinery replacement at two of the DS (Noor Wala near Jhang Road and Chah Tibbian Wala (near Darbar Khadam Hussain). Sewerage procurement for cleaning of sewers is also proposed. Impact of improvement of these schemes will be all over Chiniot city and may require around 204 Million.

- **Medium Term Plan**

In Medium term, main sewers provision for the unserved areas is planned which will then be connected to the carriers in the long term. Proposed sewers of varying sizes will be spread to the length of around 35 KM and cost around 558 Million.

- **Long Term Plan**

In the Long term, extension is planned for, Thathi Gharbi, Hameed Abad, Mohallah Dil Khushab, Saman Abad, Sham UI Hassan, Bhatti Colony etc. and all their neighboring areas. Capacity enhancement of three of the disposal stations is also required at Noor Wala DS, Sargodha Road Bypass and Satellite Town, to carter to future sewage (2033). For the safe disposal of sewage, four waste water treatment plants (stabilization ponds) are also proposed for four disposal stations whereas Satellite Town disposal station is proposed to carry its sewage to the Noor Wala DS and share the same treatment facility. Detail of these WWTP is as follow:

- 15 MGD WWTP at Noor Wala DS & Satellite Town DS of 50 Acre
- 4 MGD WWTP at Rai Chand of 13 Acre
- 4 MGD WWTP at Tibian Wala DS of 13 Acre
- 11 MGD WWTP at Sargodha Bypass Road DS of 38 Acre

These interventions may cost around 1,857 Million.
Following are proposed schemes for the Chiniot (MC):

Table 21 Proposed Projects

Sr. #	Planning Term	Sector	Proposed Schemes	Scope	Cost (Million)
1	Short (2025)	Sewerage	Rehabilitation of 02 Disposal Station at Noor Wala (near Jhang Road) and Chah Tibbian Wala (near Darbar Khadam Hussain) and pipe	▸ Pump replacement of failed pumps, electrical distribution	158

			replacement of 10 KM sewers (tentative figure) in Chiniot City	board provision, screening chambers, and minor civil work repairs at mentioned Disposal Stations	
2			Sewerage Machinery Procurement of 02 Sucker and 02 Jetting machines for Chiniot City	▸ Procurement of mentioned machinery	46
3	Medium (2028)		Laying of main sewers for extension to the unserved areas in future in Chiniot City	▸ Sewers of dia 18", 24", 27" 36", and 42" for future extension purposes of total length 35 KM	558
4	Long (2033)		Extension of sanitation services in unserved areas (Thathi Gharbi, Hameed Abad, Mohallah Dil Khushab, Saman Abad, Sham UI Hassan, Bhatti Colony etc.)	▸ Provision of 12" sewers for unserved pockets of 67 KM	449
5			Capacity Enhancement of 3 DS (Noor Wala DS, Sargodha Road Bypass and Satellite Town) to carter to future sewage (2033)	▸ Installation of new pumps & construction of new wells	128
6			Construction of 04 Waste Water Treatment Plants – Stabilization Ponds (Anaerobic and Facultative Type) - 50 Acre WWTP at Noor Wala DS & Satellite Town DS, 13 Acre	▸ Construction of 4 WWTP ▸ & ▸ Related Civil Works i.e. Sullage Carriers,	1,280

			WWTP at Rai Chand, 38 Acre WWTP at Sargodha Bypass Road DS, 13 Acre WWTP at Tibian Wala DS	Boundary Walls etc.	
6				**Total Sewerage – Chiniot MC**	**3,140**

For Rough Cost Estimation MRS, 1st BI-ANNUAL-2023 (01.01.2023 to 30.06.2023) District Chiniot has been Applied. The 2% Contingencies and 5% PST are also added in estimates. This is further subject to Detail Design of the proposed schemes upon PC-1 formation.

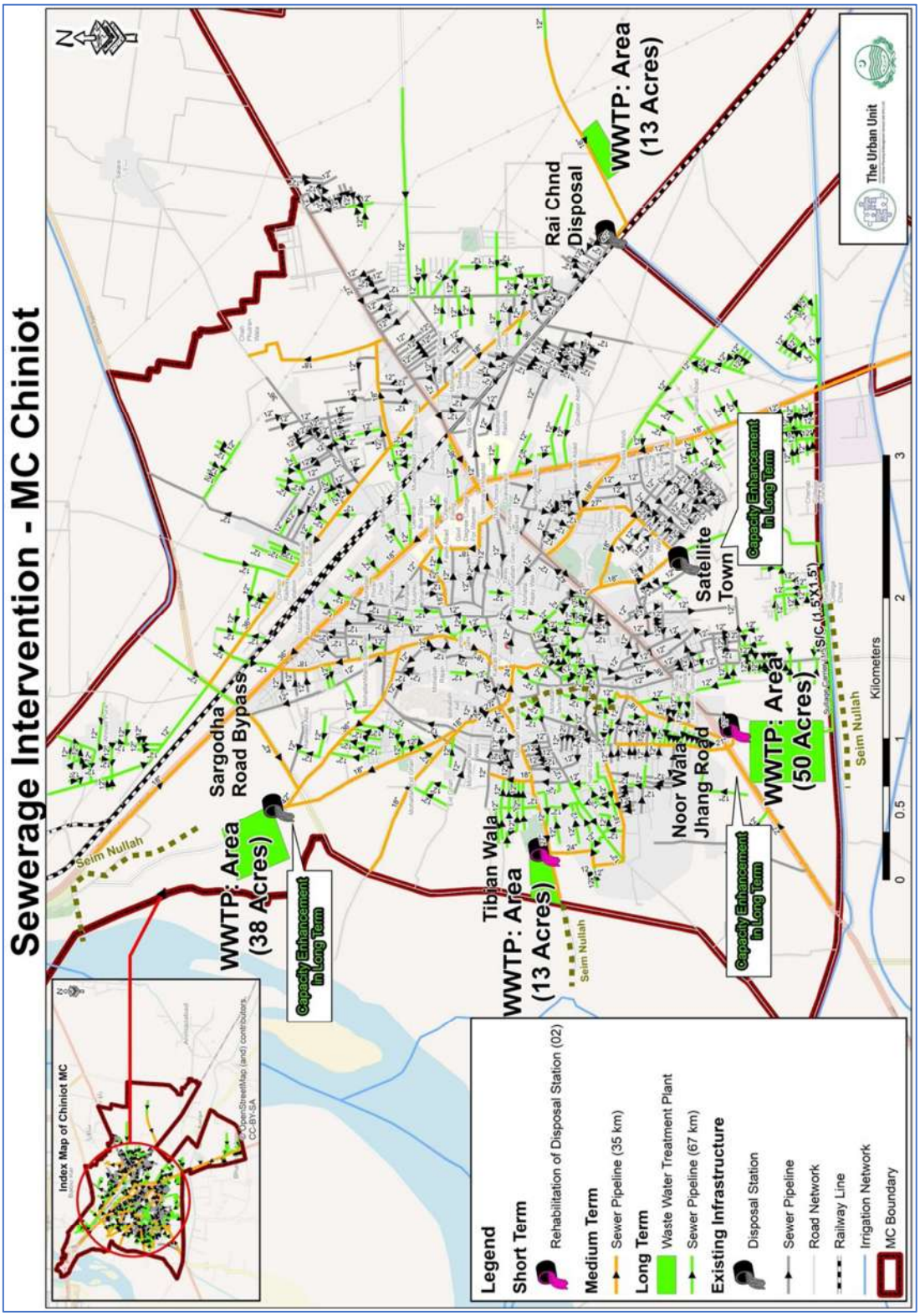


Figure 30 Sewerage Interventions

6.10 Drawings

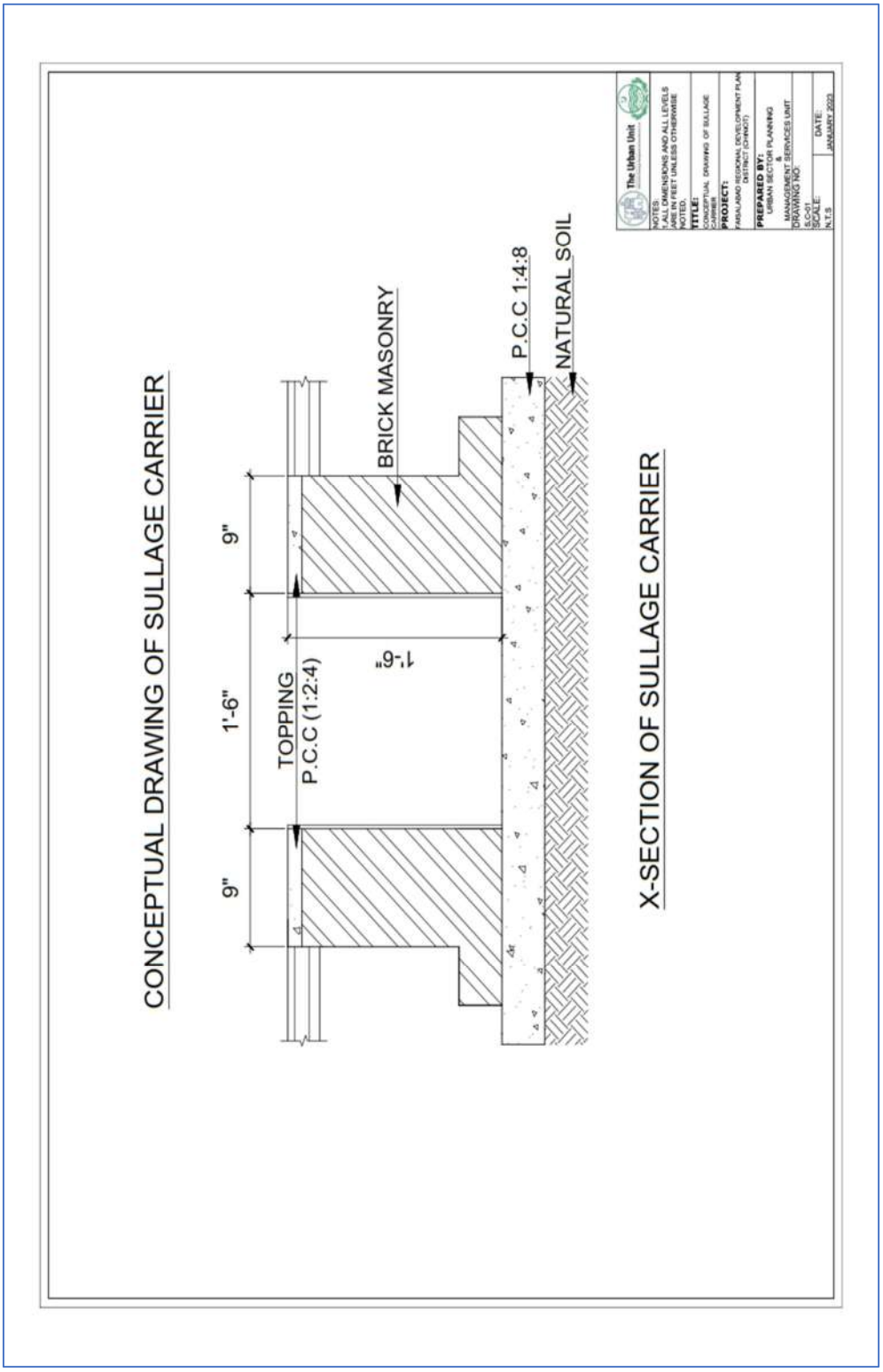


Figure 31 Sullage Carrier

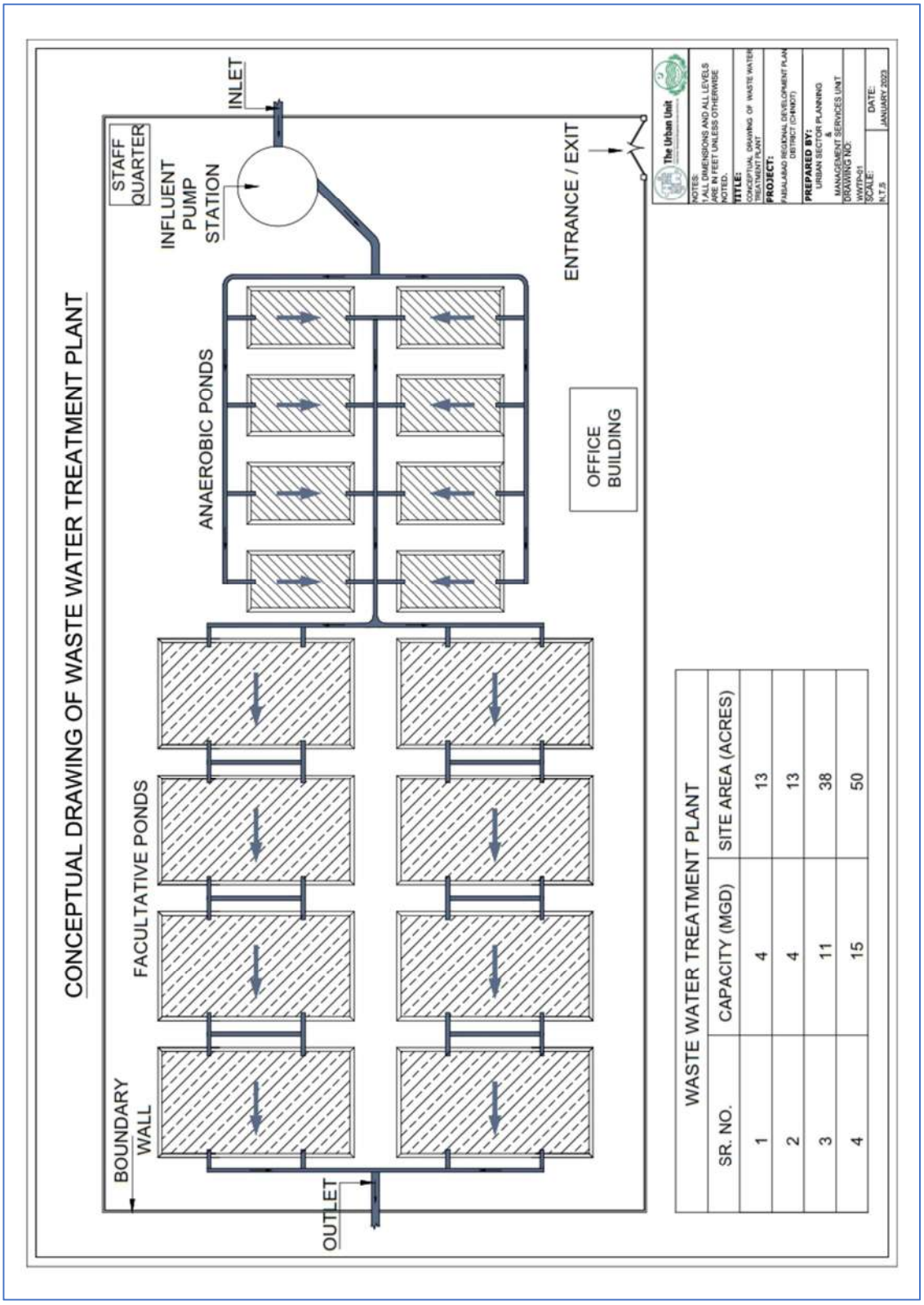
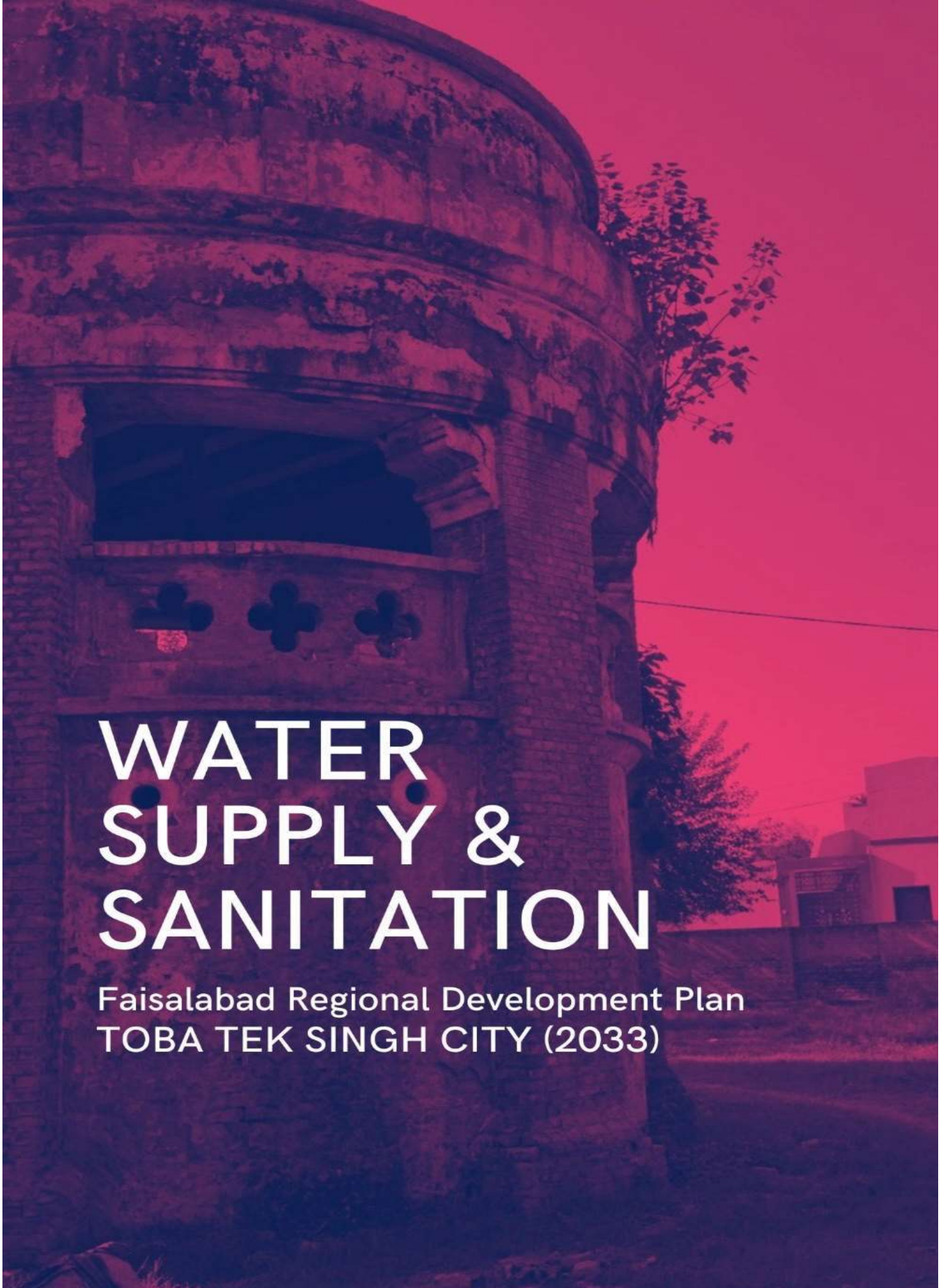


Figure 32 Waste Water Treatment Plant



WATER SUPPLY & SANITATION

Faisalabad Regional Development Plan
TOBA TEK SINGH CITY (2033)

7 Toba Tek Singh City

Historically Toba Tek Singh city catches it names from a kind-hearted man, who served water and shelter to the travelers by a small pond (Toba In Punjabi). Today, the city lacks proper water supply in the city which is mostly due to outdated distribution network which in-turn increases Non-revenue water (NRW) proportion. Water is fetched from seepage tube-wells based on mainly two sources (T.S. Link Canal & Lower Gujera Branch). In addition to these, there are four small scale direct WS schemes. Most of the city WS pipeline is in deteriorated condition where sewage infiltration from also deteriorated sewers is inevitable. There is also no WWTP plant in the city which again is another hazardous concern which need dire attention. The Water Supply and Sanitation plan is proposed for the next ten years (2033) for an estimated projected population of around 119,582.

7.1 Existing Water Supply Infrastructure

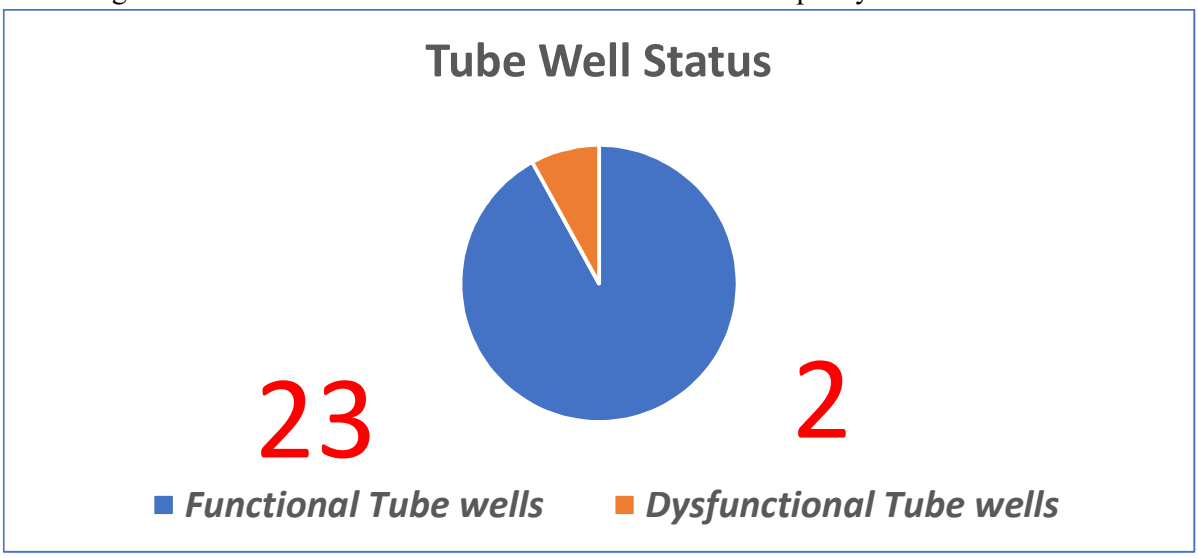
WS Coverage is around 80% (spatially). Most of the City is served with water connection where mostly left-out areas are the one which are currently developing and urbanizing. The Water Quality of the schemes in Toba Tek Singh MC is mostly sweet and drinkable. Where tested, it showed (average) pH of 7.5, TDS of 525, and EC of 747. Other than relatively new scheme (T.S. Link Canal), WS pipeline is mostly in deteriorated condition (D or Poor) and need replacement as per the demand of the area and appropriate sizes. Detail of the aforementioned schemes is as below:

Table 22 Water Supply Infrastructure

Sr. No.	Tube-well (cusecs)	Year	Source Detail	GST (Capacity in G-Imp.)	OHR Condition	Pipeline length	Pipeline Condition
1	T.S. Link Canal	2020	9 @ 2 Cusecs	200,000	B (Good)	length 188 KM of varying dias (3", 4", 6", 8", 10", 14", 16", 20", 32")	Mostly D (Poor), other than T.S. Link Canal scheme which is B (Good)
2	Bhagat WS scheme at Lower Gujera Branch	1990s	16 @ 0.6 Cusecs	200,000	C (Fair)		
3	Water Work No. 1 – Near Thana City	1990s	Direct	-	-		
4	Water Work No. 2 Iqbal Nagar	1990s	Direct	-	-		

5	Water Work No. 3 Housing Colony	1990s	Direct	-	-		
6	Water Work No. 4 Near District Court	1990s	Direct	-	-		

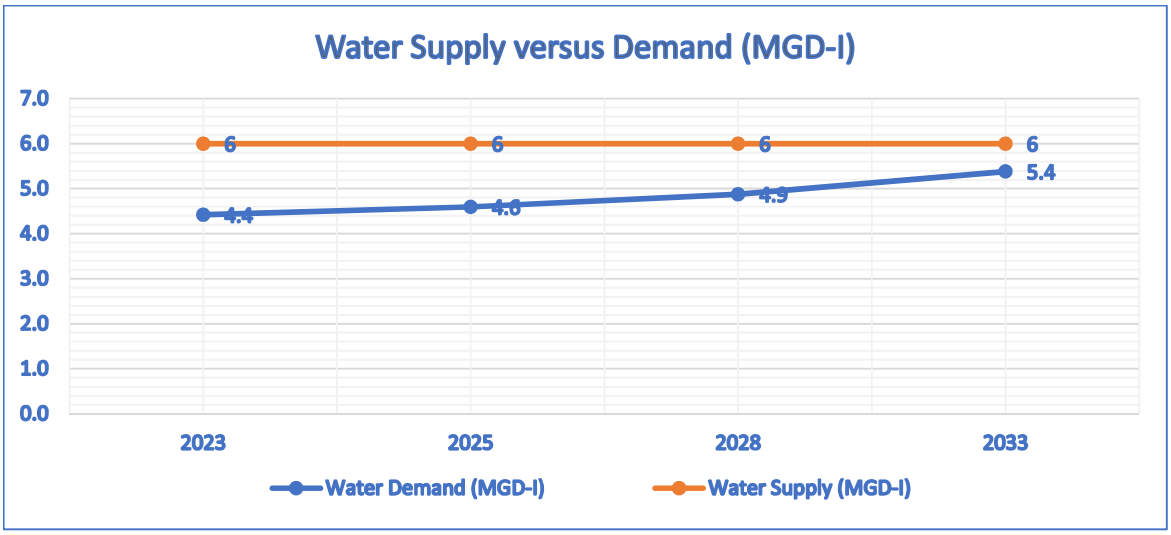
Following is the status of current Tubewells of aforementioned capacity.



Graph 11 Tube-wells status

7.2 Water Supply versus Water Demand

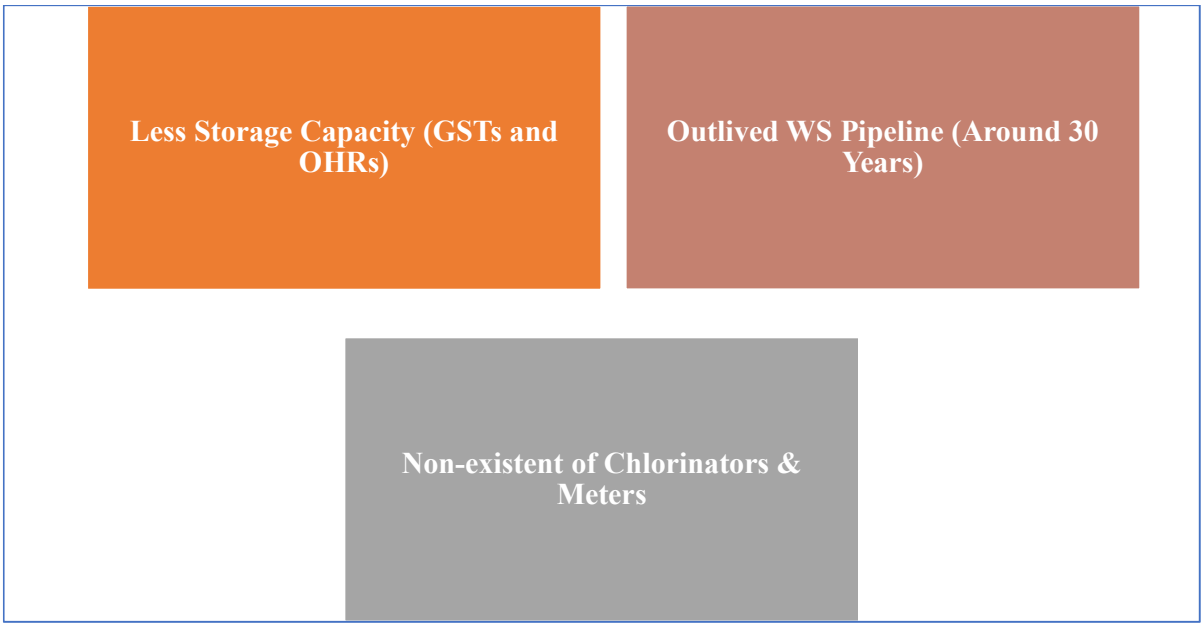
In quantified terms, Water Demand versus Water Supply can be illustrated as below which indicates water production is actually more (1.6 MGD-I currently) than the demand. This has established assuming the malfunctional tube-wells (2/25) are fixed and are worked 12 hours a day. For water works direct supply of 5 hours is assumed. This means that there is no need to install more tube-wells or water sources in future (till year 2033). As per the PHED standards and imperialized current storage capacity for further supply, it appears at there is lack of storage capacity which could be one of the reasons of the decreased supply at consumer end. Another reason which appears to be is outdated pipelines which may have high NRW proportion.



Graph 12 Water Supply versus Demand

7.3 Condition Assessment of Water Supply Infrastructure

Following were major gaps identified during the detail condition assessment of the existing Water Supply infrastructure.



<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Meeting with PHED</td><td>Main Water Works visit</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Water Quality Testing</td><td>Water Works visit</td></tr>
</table>

Figure 33 In Pictures: Field Survey and Assessment

After detail condition assessment, following was established as overall condition and respective rating.

Asset Attribute	Rating
Civil Structures	**C (Fair)**
Distribution Network	**D (Poor)**
Electro-Mechanical	**C (Fair)**

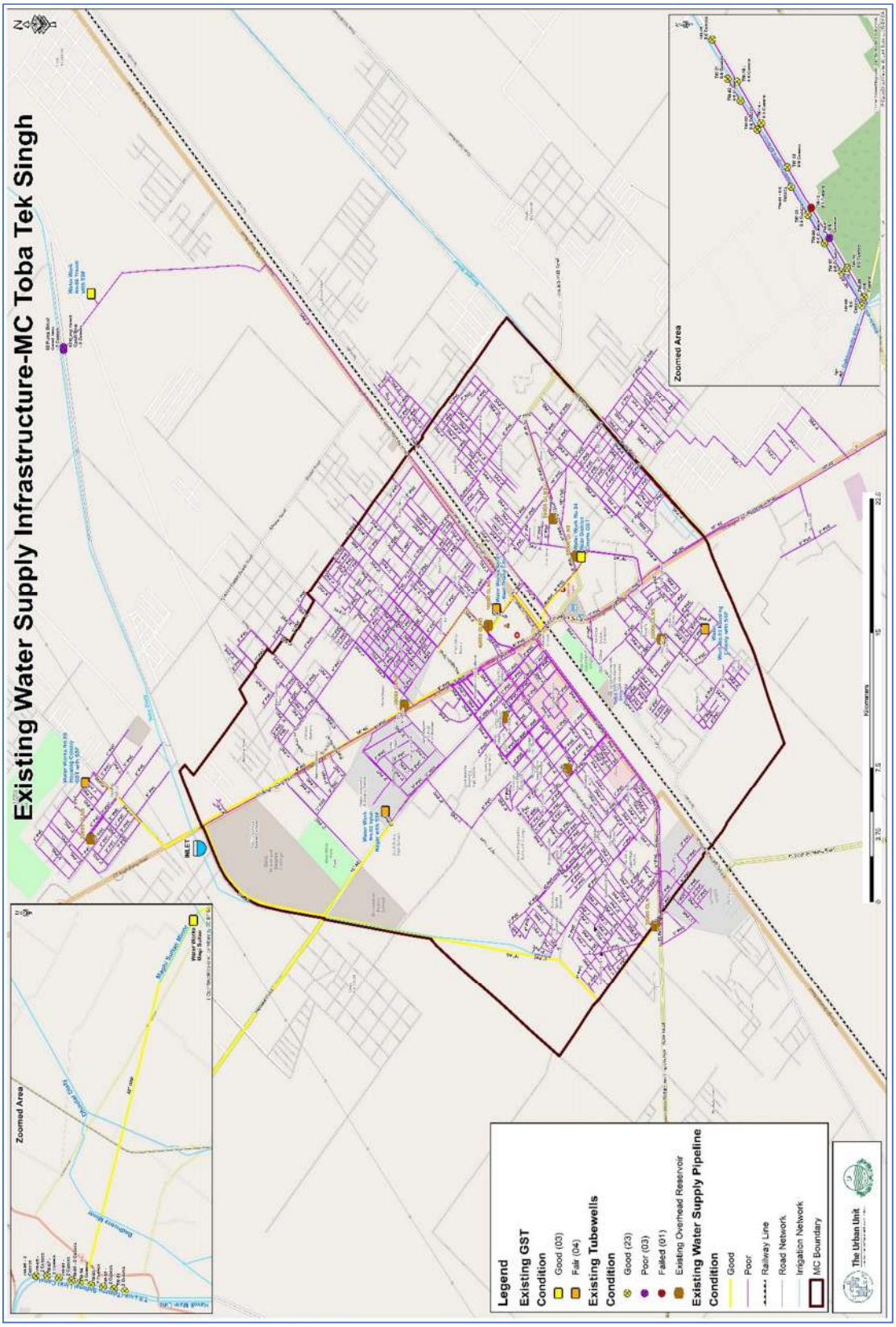


Figure 34 Water Supply Baseline

7.4 Water Supply Interventions

Afore-described gaps relating to the Water Supply were filled in the planning exercise in detail. Prioritization of these gaps is also done and hence schemes are proposed based on various factors such as essence of intervention, duration required to execute them, cost required, and their impact on public.

- **Short Term Plan**

Spatially covered area of city of Toba Tek Singh is around 80% and unserved pockets are being provided with private supply system. Although coverage area is high, public, and operating agencies still face issues related to Water Supply. To fix this, existing infrastructure needs be strengthened by rehabilitation of civil structures, machinery, etc. at Water Works and Tube-wells, and pipe replacement of rising main (from 16" AC to 20" HDPE) of the Bhagat WS scheme at Lower Gujera Branch which contributes highly to fulfil the need of the city's water demand. This plan will cost around 660 Million. This amount also includes construction of store, Electro-mechanical spares & tools, equipment for quick fixing of WS issues.

- **Medium Term Plan**

In Medium term, Water supply services is planned to be improved by changing the main pipelines which are in poor and deteriorated condition. Pipe of dia 6", 8", & 10" of total length 19 KM will be replaced and will cost around 172 Million.

- **Long Term Plan**

In the Long term, uplift of TTS city water supply schemes by provision of new GSTs, and OHRs to carter to the demand of year 2033. Pipe replacement of distribution pipe network is also planned to be replaced in this phase. Establishment of SCADA Monitoring and Control Center is also planned to be established for monitoring purposes. This may cost around 1,277 Million.

Following are proposed schemes for the Toba Tek Singh (MC):

Table 23 Proposed Schemes

Sr. #	Planning Term	Sector	Proposed Schemes	Scope	Cost (Million)
1	Short (2025)	Water Supply	Rehabilitation existing WS Schemes in TTS City	▸ Rehabilitation of 02 existing Tube-wells at Bhagat WS scheme ▸ Replacement of 16" AC pipe rising main with 20" HDPE	630

				▸ Pump replacement at Trandi WW ▸ Rehabilitation of 04 WW & GSTs	
2			Establishment of store in TTS City for Water Supply Equipment for quick fix	▸ Construction of Store, Electro-Mechanical Spares & Tools, Equipment for WS	29
3	Medium (2028)		WS main pipe replacements of existing WS Schemes in TTS City	▸ Pipe replacement of outlived and deteriorated main pipes of varying dias (6", 8", & 10") of length 19 KM	172
4	Long (2033)		Uplift of TTS City Water Supply Schemes by provision of new GSTs, OHRs, and distribution pipe replacement of the city to carter to the demand of year 2033	▸ Construction of 4 GSTs of 1@100,000, 2@200,000, & 1@250,000 Gallons and Construction of 6 OHRs of 50,000 Gallons ▸ Distribution network replacement of outdated lines assumed as 80%	1,130
5			Establishment of SCADA Monitoring and Control Center in Toba Tek Singh City	▸ Establishment of SCADA	53
5	**Total Water Supply – Toba Tek Singh MC**				**2,098**

For Rough Cost Estimation MRS, 1st BI-ANNUAL-2023 (01.01.2023 to 30.06.2023) District Toba Tek Singh has been Applied. The 2% Contingencies and 5% PST are also added in estimates. This is further subject to Detail Design of the proposed schemes upon PC-1 formation.

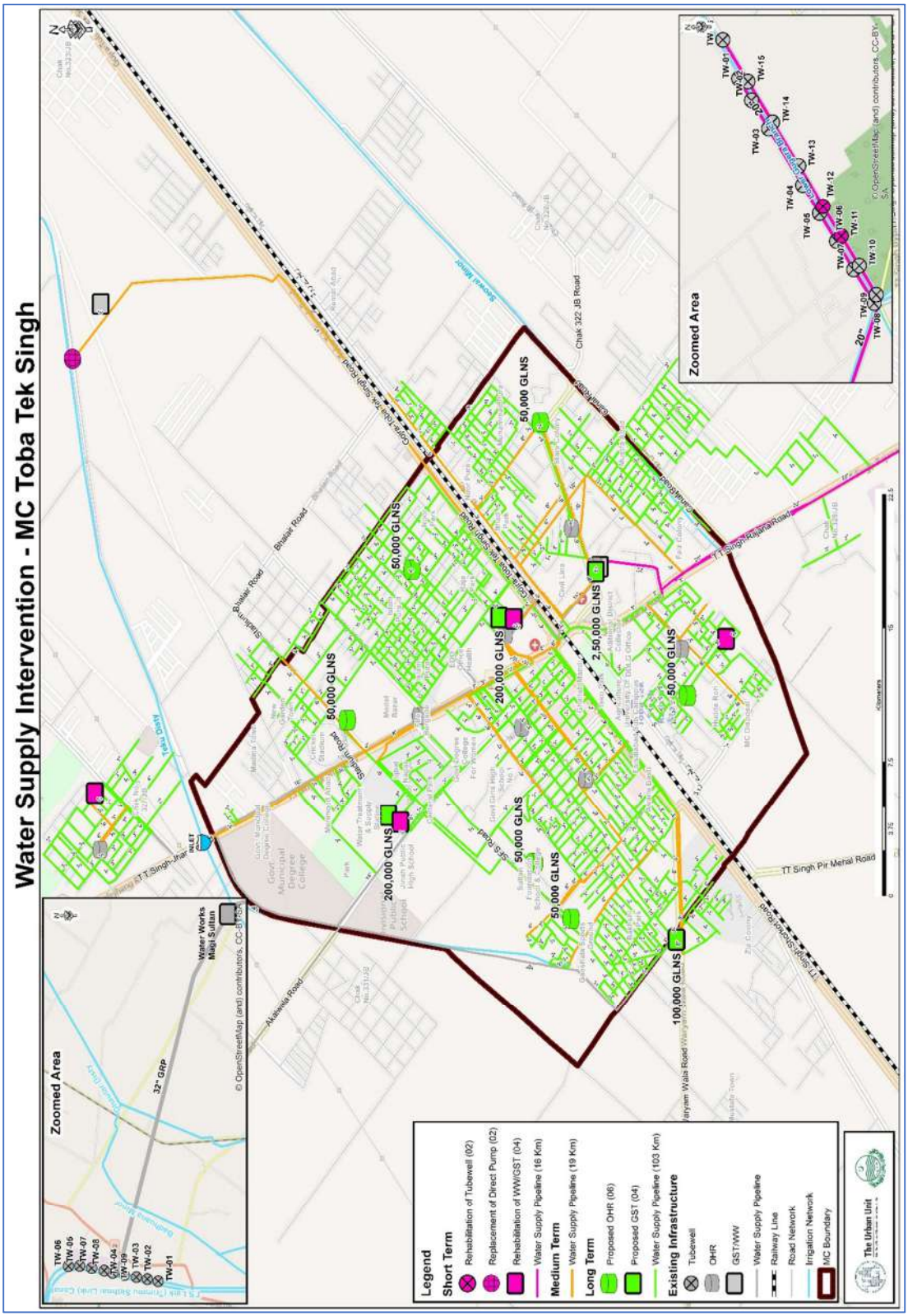


Figure 35 Water Supply Intervention

7.5 Drawings

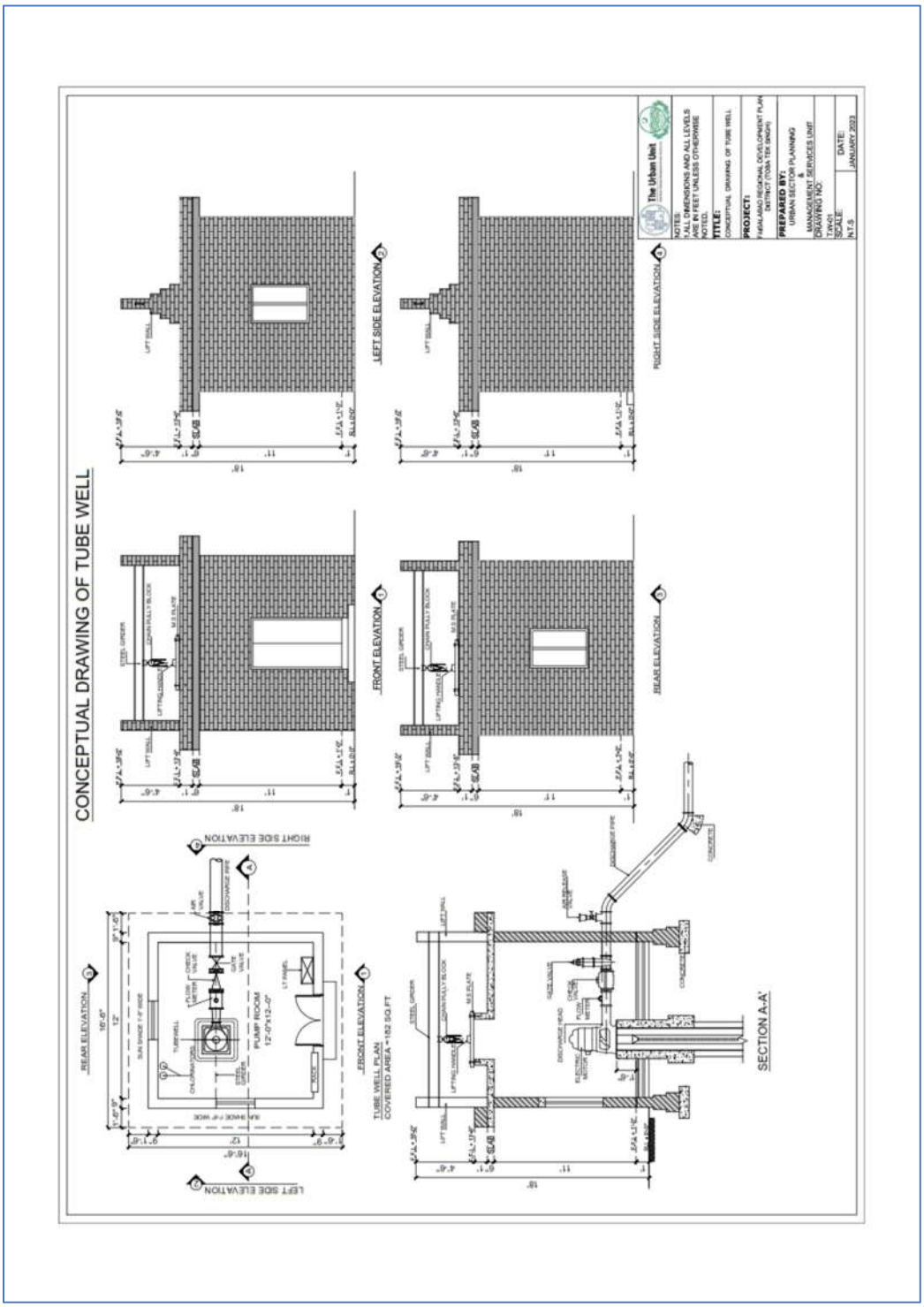


Figure 36 Tube-well

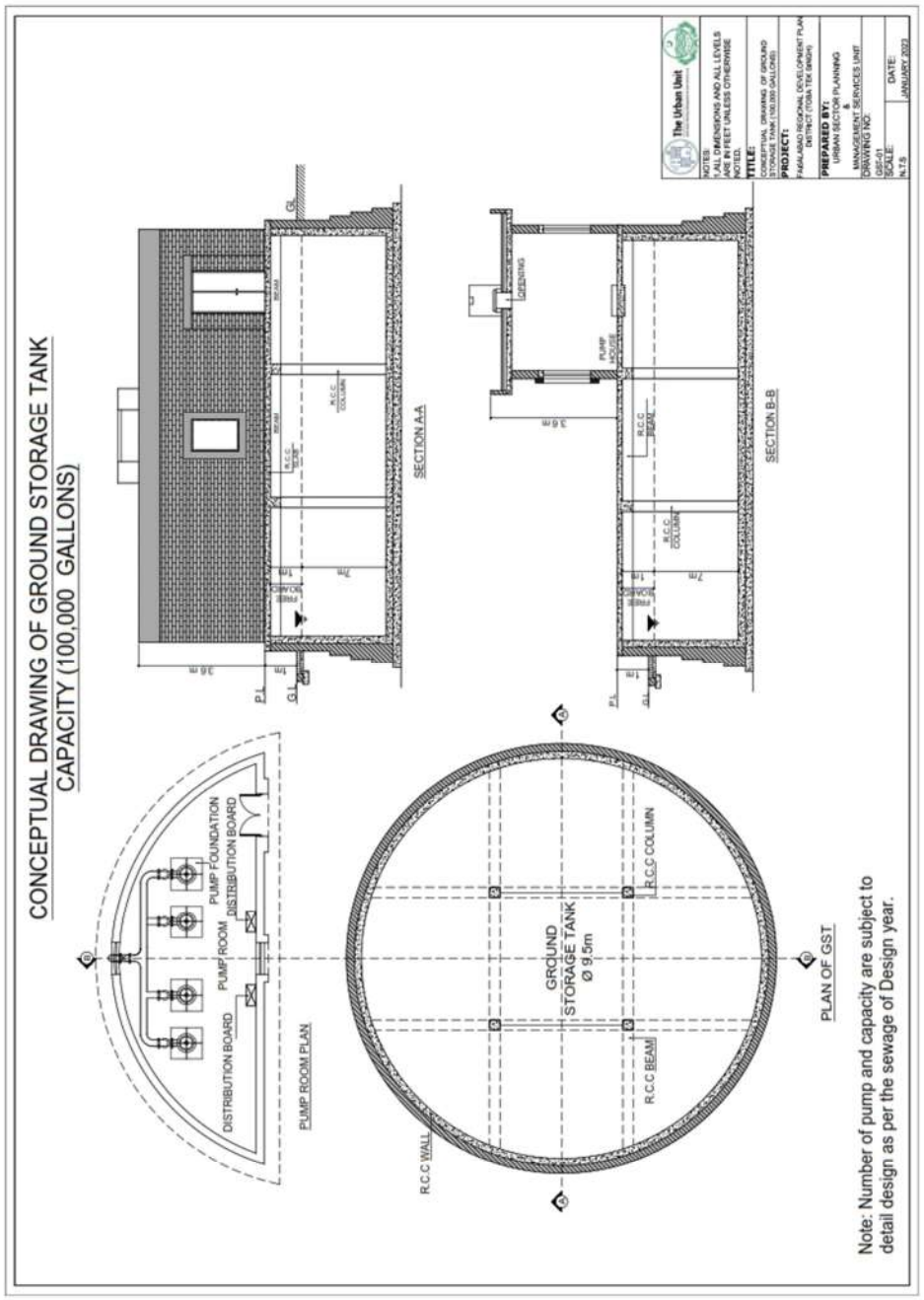


Figure 37 GST - 100,000 Gallons

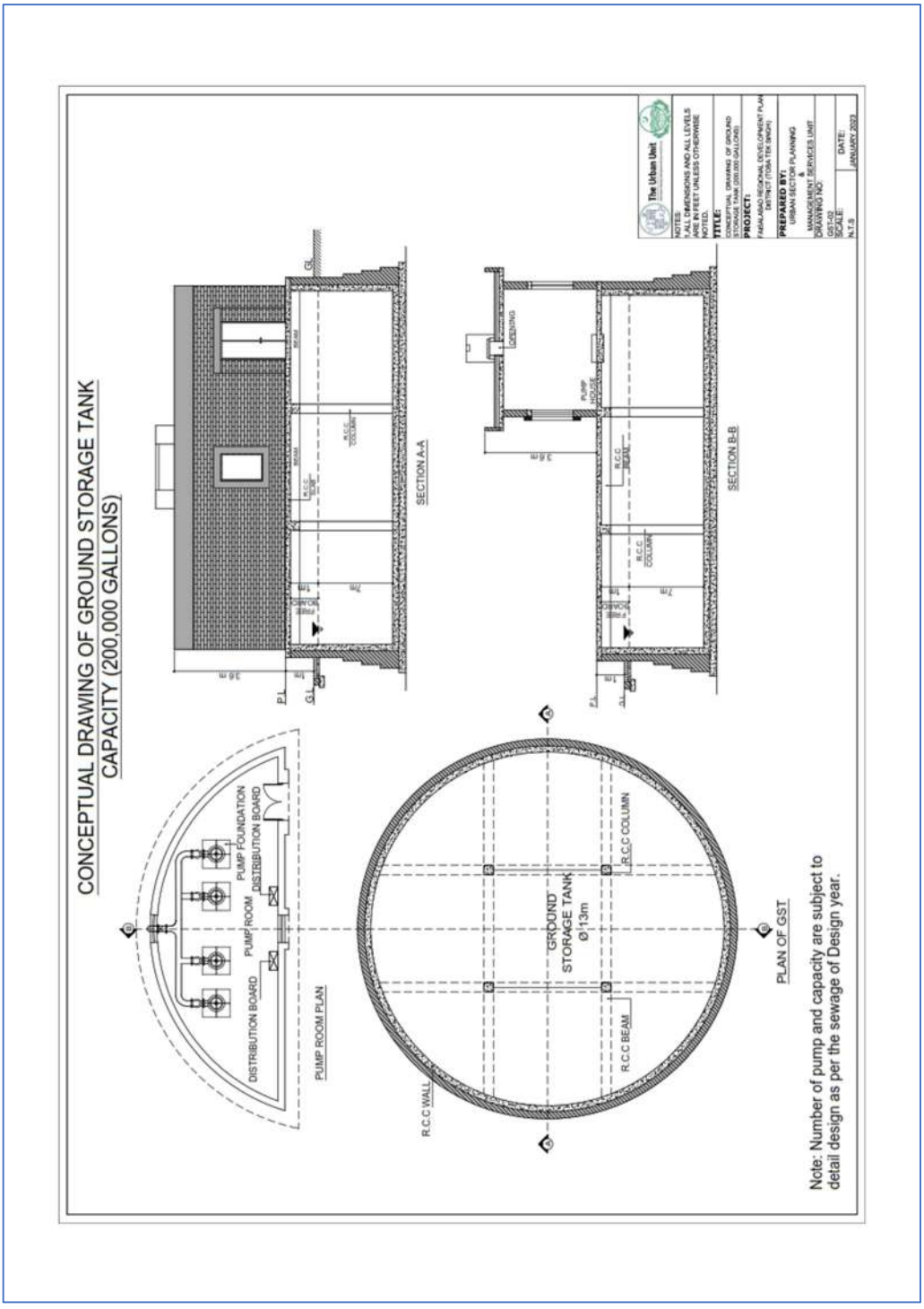


Figure 38 200,000 Gallons

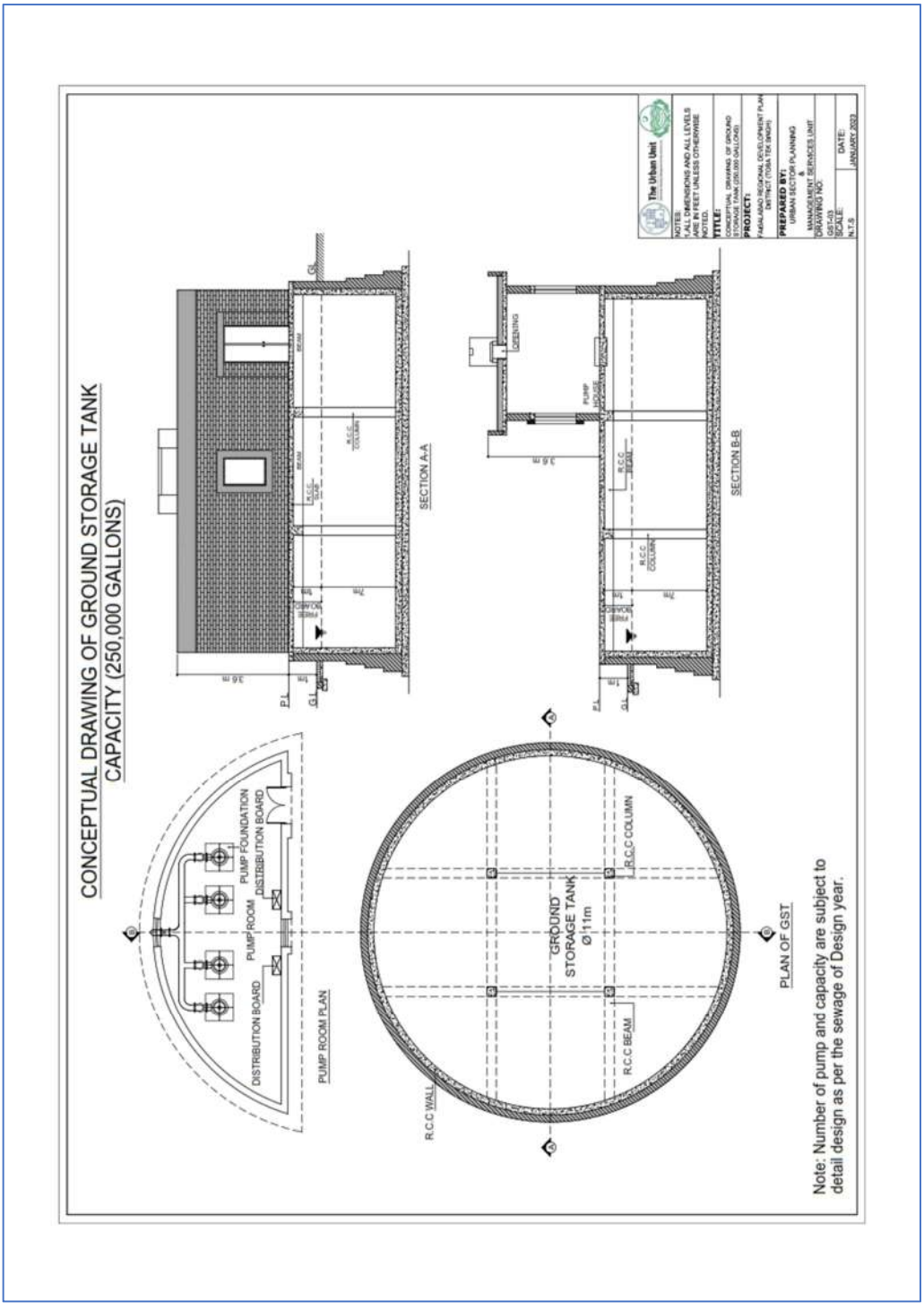


Figure 39 250,000 Gallons

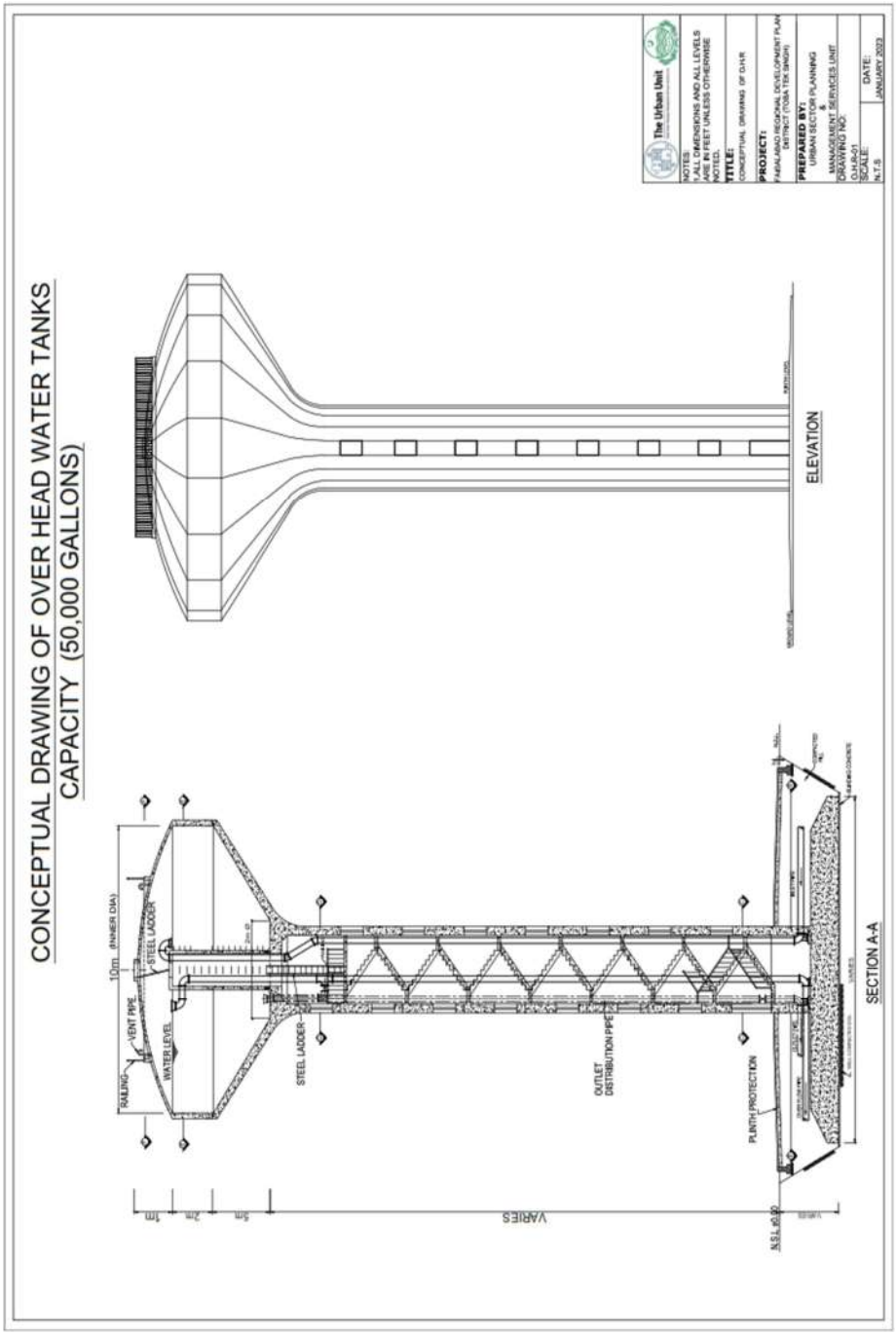


Figure 40 OHR - 50,000 Gallons

7.6 Existing Sewerage Infrastructure

Sewerage arrangements in the Toba Tek Singh City is mostly sewers of RC (Reinforced Concrete) material which dispose sewage to the six disposal stations which further ultimately dispose it off to agriculture land or open fields through either small nullah or sullage carriers. It is also alarming that city currently have no Waste Water Treatment Plant (WWTP) which is causing water contamination by infiltrating into WS pipeline. Detail of mentioned seven disposal stations is as below:

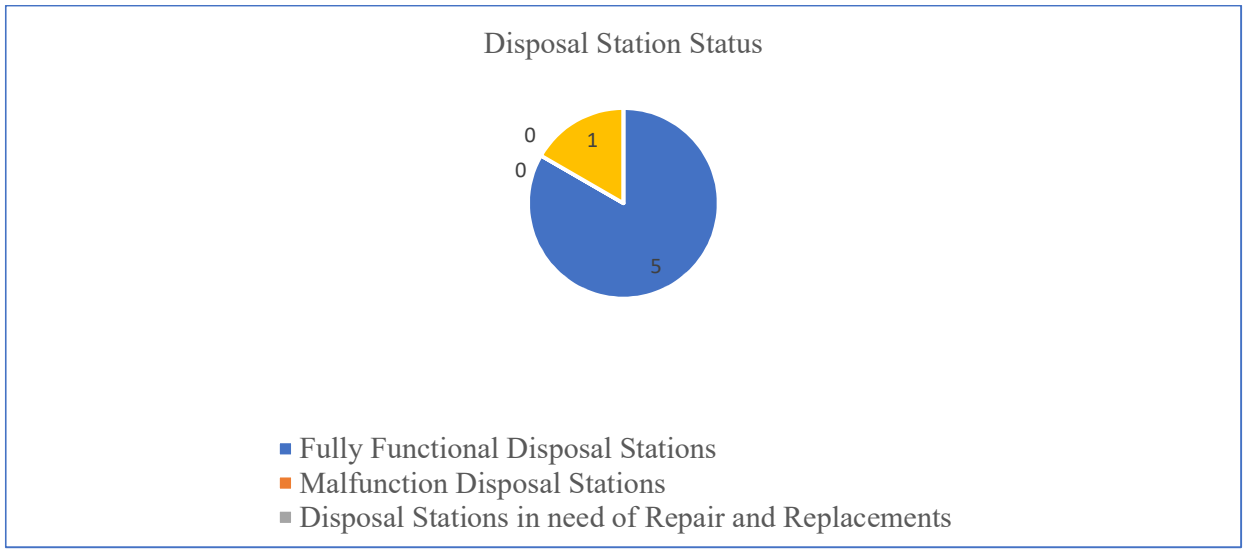
Table 24 Sewerage Infrastructure

Sr. No.	Disposal Station	DS Condition	Comments	Ultimate Disposal Station	Sewers Dias (Overall)	Sewer Condition (Overall)
1	Housing Colony DS	C (Fair)	Fully Functional	Agriculture Land or Open Fields	Length around 100 KM of varying dias (12", 15", 18", 21", 24", 27", 36", 42")	D (Poor)
2	Chak No. 328 JB DS	C (Fair)	Fully Functional			
3	DS Near Graveyard	C (Fair)	Fully Functional			
4	DS Near Fish Farm	C (Fair)	Fully Functional			
5	Railway Road DS	C (Fair)	Fully Functional			
6	PHED New Scheme DS	Under Construction	Planned DS			

Following is the status of current Disposal Stations of aforementioned capacity.

7.7 Condition Assessment of Sewerage Infrastructure

Following was major gaps identified during the detail condition assessment of the existing Sewerage infrastructure.



Graph 13 Disposal Station Status

Disposal Station Survey

DS Machinery Assessment

Disposal Station Survey

Meeting with CO MC & SDO PHED

Figure 41 In Pictures: Field Survey and Assessment

After detail condition assessment, following was established as overall condition and respective rating.

Table 25 Condition Assessment Outcome

Asset Attribute	Rating
Civil Structures	**C (Fair)**
Electro-Mechanical	**C (Fair)**
Sewer	**D (Poor)**

7.8 Sewage Generation

The sewage generation have been made corresponding to the 30 gallons per capita per day water demand i/c 20% unaccounted for water (NRW). A contribution of 50% for storm-water flow, 5% infiltration & 5% non-domestic flows have been included during the calculation of the total sewerage flow. The current (2023) sewage generation and of the future (2025, 2028 and 2033) sewage generation are shown in the table below.

Table 26 Sewage Generation

Sewage Generation				
Years	**2023**	**2025**	**2028**	**2033**
Population	98,195	102,142	108,363	119,582
Peak Sewage Flow (MGD-I)	4.79	4.98	5.29	5.84
Storm Water Flow (MGD-I)	2.40	2.49	2.64	2.92
Infiltration Flows (MGD-I)	0.12	0.12	0.13	0.15
Non-Domestic Flows (MGD-I)	0.12	0.12	0.13	0.15
Total Sewage Flow (MGD-I)	**7.43**	**7.73**	**8.20**	**9.05**

Currently all the Disposal Stations are equipped with machinery adequate enough to carter to the current and future sewage after minor repairs and replacements. One of these disposal stations, DS Near Graveyard, also appears to be redundant after PHED new scheme Disposal Stations is up and running. This may be eliminated in future to reduce the operation cost.

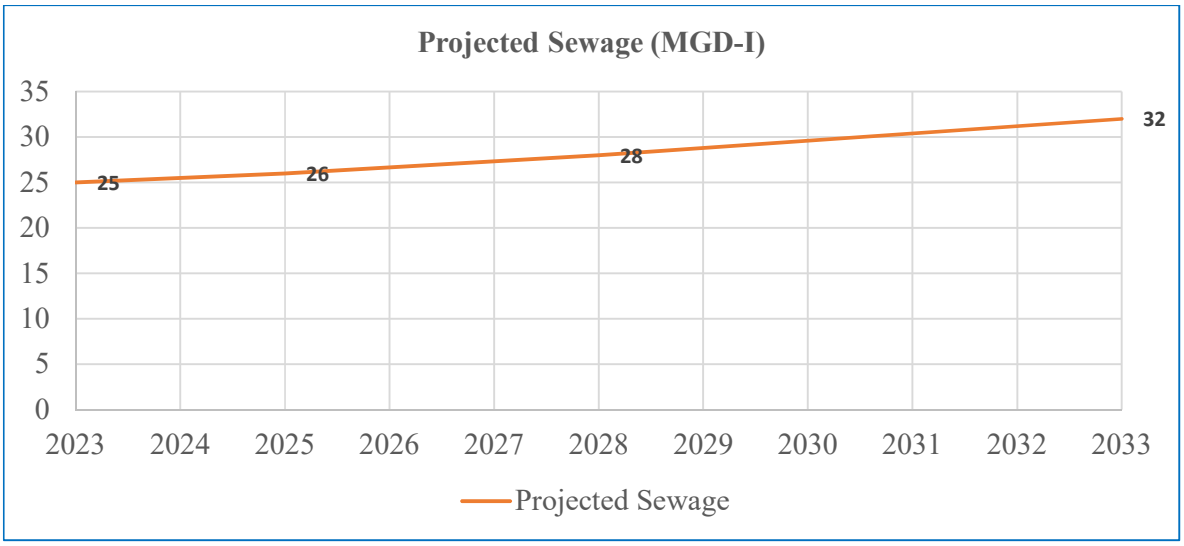


Figure 42 Projected Sewage

Elevation Map was also used for planning purposes. Elevation data shows that elevation difference near central half of the city are bit high and current Disposal Stations seems stationed at appropriate locations (slope-wise). Highest elevation and lowest elevation for Toba Tek Singh City are 166 and 156 meters (approx.) from the mean sea level. Maximum difference of city's elevation is around 10 meters.

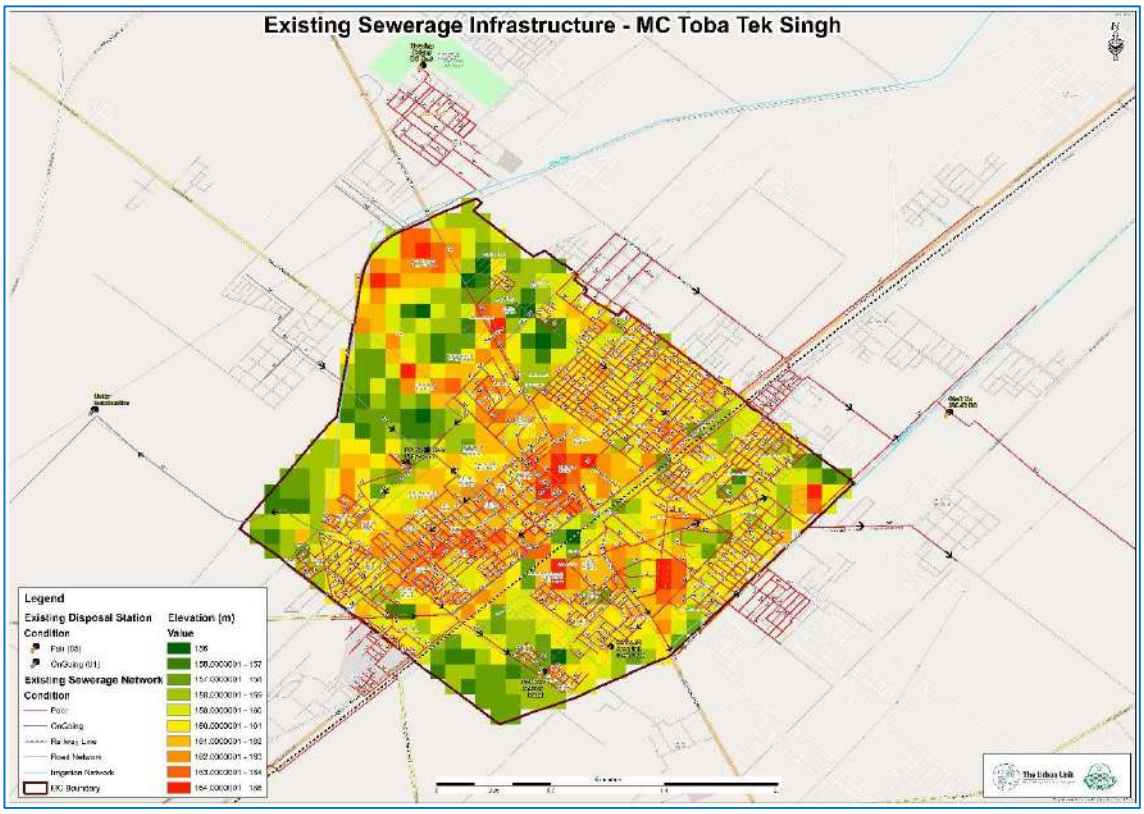


Figure 43 Elevation Map

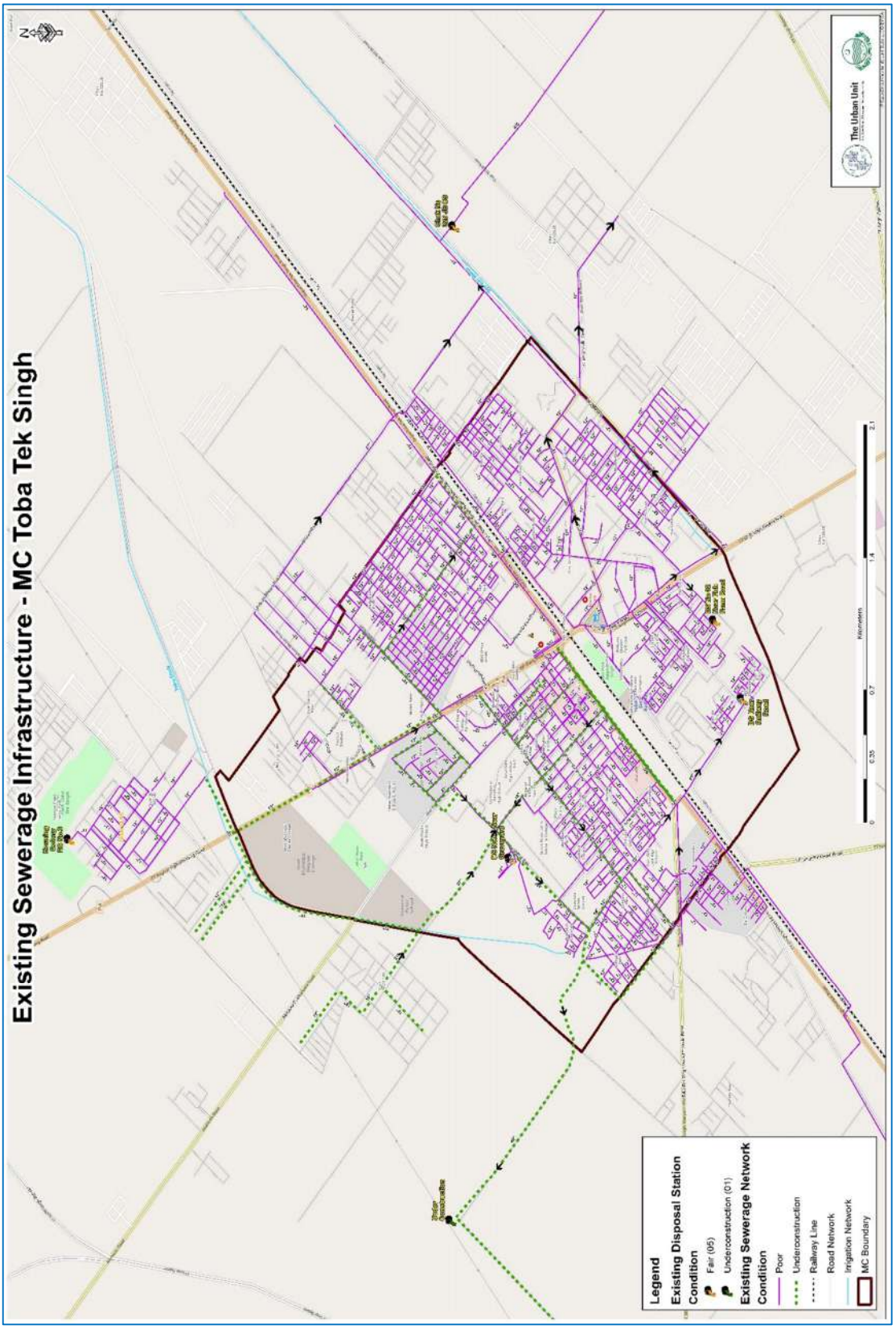


Figure 44 Sewerage Infrastructure

7.9 Sewerage Interventions

Afore-described gaps relating to the Sewerage issues were filled in the planning exercise in detail. Prioritization of these gaps is also done and hence schemes are proposed based on various factors such as essence of intervention, duration required to execute them, cost required, and their impact on public.

- **Short Term Plan**

To improve the sewerage condition of the city, it is important to first fully capacitate the current system first but do that so as it can also carter to the need to the future years i.e. planning horizon year (2033). For this it is proposed that main sewers of TTS city be replaced or provided. Sewers of dia 15, 18", 21", 24", & 27" for future extension purposes of total length 28 KM are proposed. Machinery procurement for cleaning of sewers is also proposed which includes two sucker and two jetting machines. A total of 269 will be required to make these interventions.

- **Medium Term Plan**

In Medium term, provision of 12" sewers are proposed of around 28 KM length. As mostly of sewers in the city were reported to be in poor condition, they are also proposed to be replaced in two phases out of which phase-I (40 KM) is planned to be made part of Medium term which will revolve around most of the city center areas which will have more impact as these areas are densely populated. A new disposal station is also proposed to carry the sewage from nearby areas. These interventions will cost around 675 Million.

- **Long Term Plan**

In the Long term, Phase - II of outdated sewers is planned in which length of 59 KM will be replaced with 12" sewers. For the safe disposal of sewage, five waste water treatment plants (stabilization ponds) are also proposed for five disposal stations (four existing and one proposed DS). Detail of five Waste Water Treatment Plants – Stabilization Ponds (Anaerobic and Facultative Type) is as follow:

- 1 MGD WWTP at Housing Colony DS of 04 Acre
- 1.5 MGD WWTP at near Fish Farm of 7.5 Acre
- 2 MGD WWTP at 328 JB DS of 9 Acre
- 3 MGD WWTP at new proposed DS of 13 Acre
- 4 MGD WWTP at PHED DS of 15 Acres

These proposed interventions may cost around 2,270 Million.
Following are proposed schemes for the Toba Tek Singh (MC):

Table 27 Proposed Schemes

Sr. #	Planning Term	Sector	Proposed Schemes	Scope	Cost (Million)
1	Short (2025)	Sewerage	Provision of main sewers of TTS City: Provision of sewers for	▸ Sewers of dia 15, 18", 21",	269

			extension to the unserved areas in future and to carter to future sewage	24", & 27" for future extension purposes of total length 28 KM	
2			Sewerage Machinery Procurement of 02 Sucker and 02 Jetting machines for TTS City	▸ Procurement of mentioned machinery	
3	Medium (2028)		Laying of sewerage services to the unserved areas in TTS City	▸ Laying of sewers of dia 12" to extend the services for the unserved areas (length 28 KM)	675
4			Replacement of outdated sewers in TTS City (Phase – I)	▸ Replacement of sewers (length 40 KM) assumed as 80% ▸ Construction of one new Disposal Station	
5	Long (2033)		Replacement of outdated sewers of poorly served areas in TTS City (Phase – II)	▸ Replacement of 12" sewers for poorly served areas with outdated sewers (length 59 KM) assumed as 80%	441
6			Construction of 05 Waste Water Treatment Plants – Stabilization Ponds (Anaerobic and Facultative Type) TTS City- 04 Acre WWTP at Housing Colony DS, 7.5 Acre WWTP at near Fish Farm, 9 Acre WWTP at 328 JB DS, 13 Acre WWTP at new	▸ Construction of 5 WWTP ▸ Related Civil Works i.e. Sullage Carriers, Boundary Walls etc.	1,829

			proposed DS, 15 Acres at PHED DS		
6				**Total Sewerage – Toba Tek Singh MC**	**3,214**

For Rough Cost Estimation MRS, 1st BI-ANNUAL-2023 (01.01.2023 to 30.06.2023) District Toba Tek Singh has been Applied. The 2% Contingencies and 5% PST are also added in estimates. This is further subject to Detail Design of the proposed schemes upon PC-1 formation.

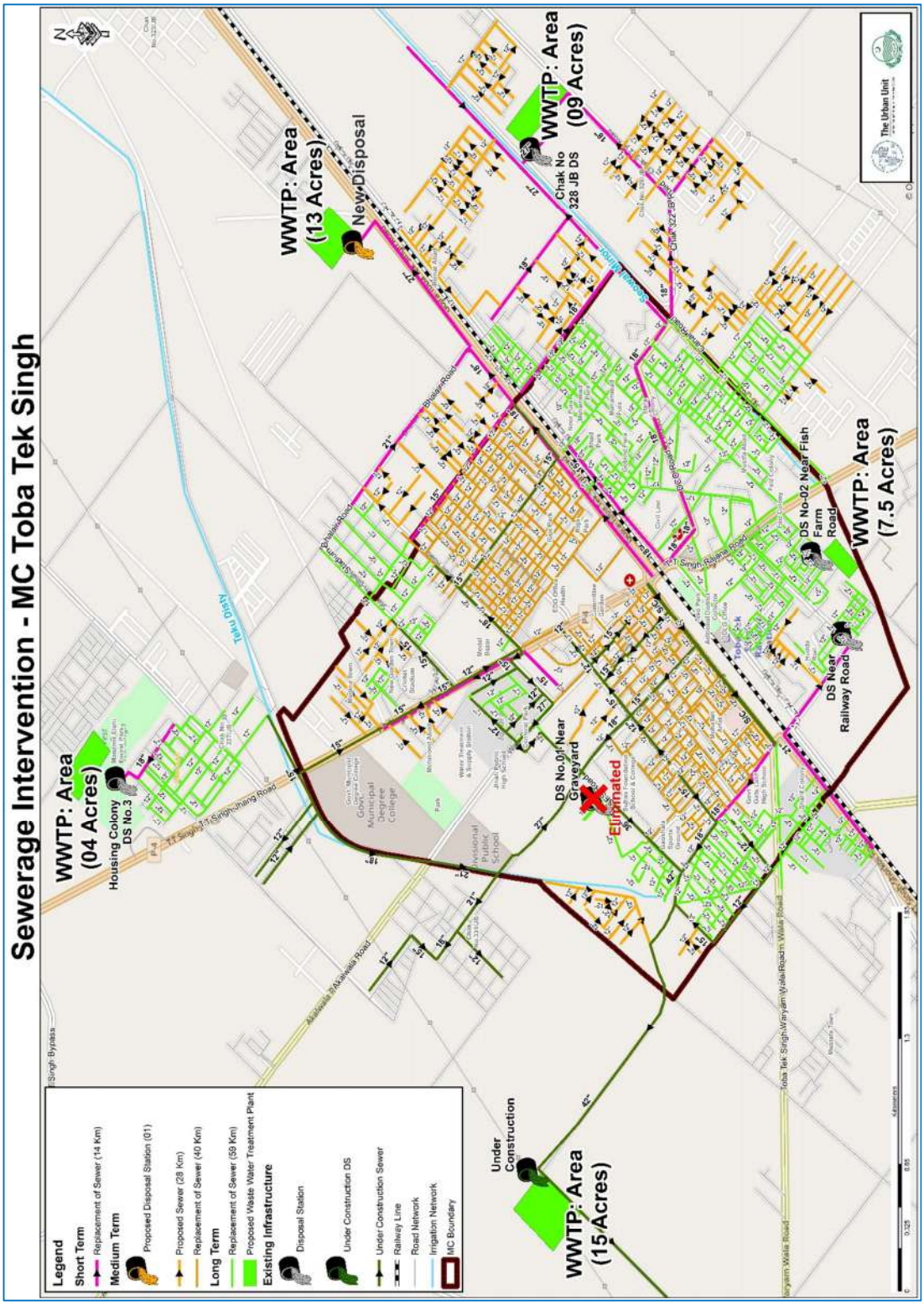


Figure 45 Sewerage Intervention

7.10 Drawings

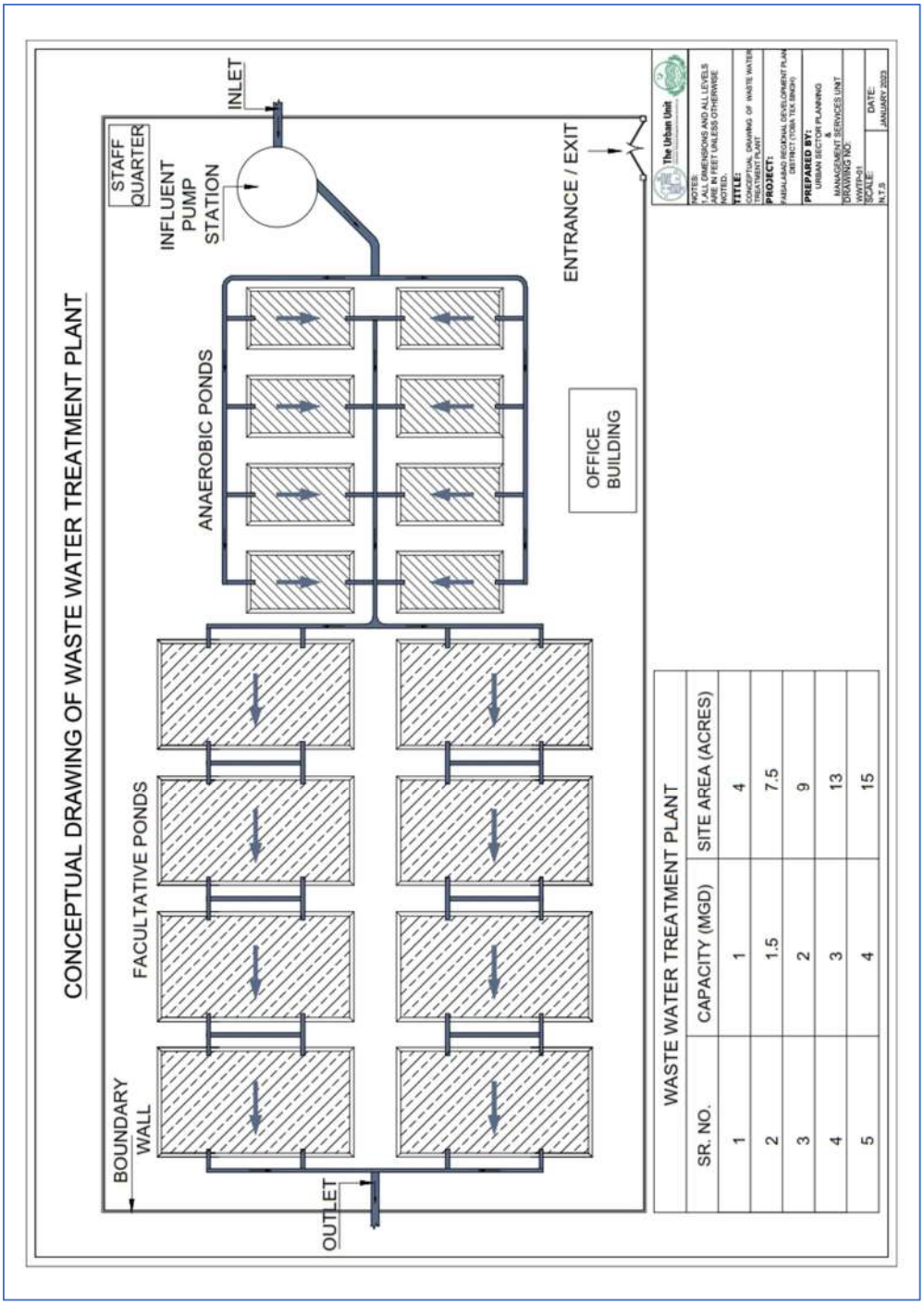


Figure 46 Waste Water Treatment Plant

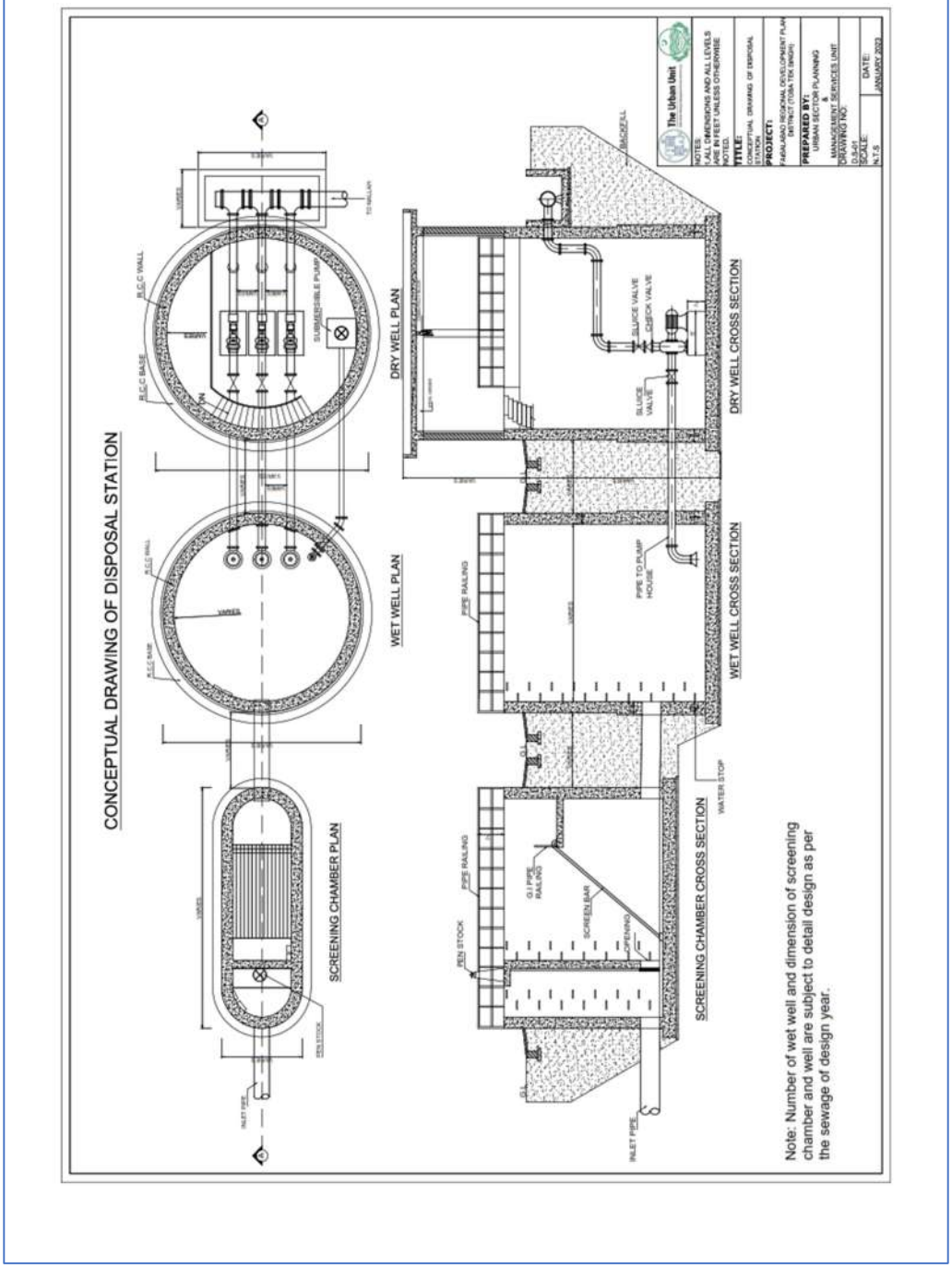
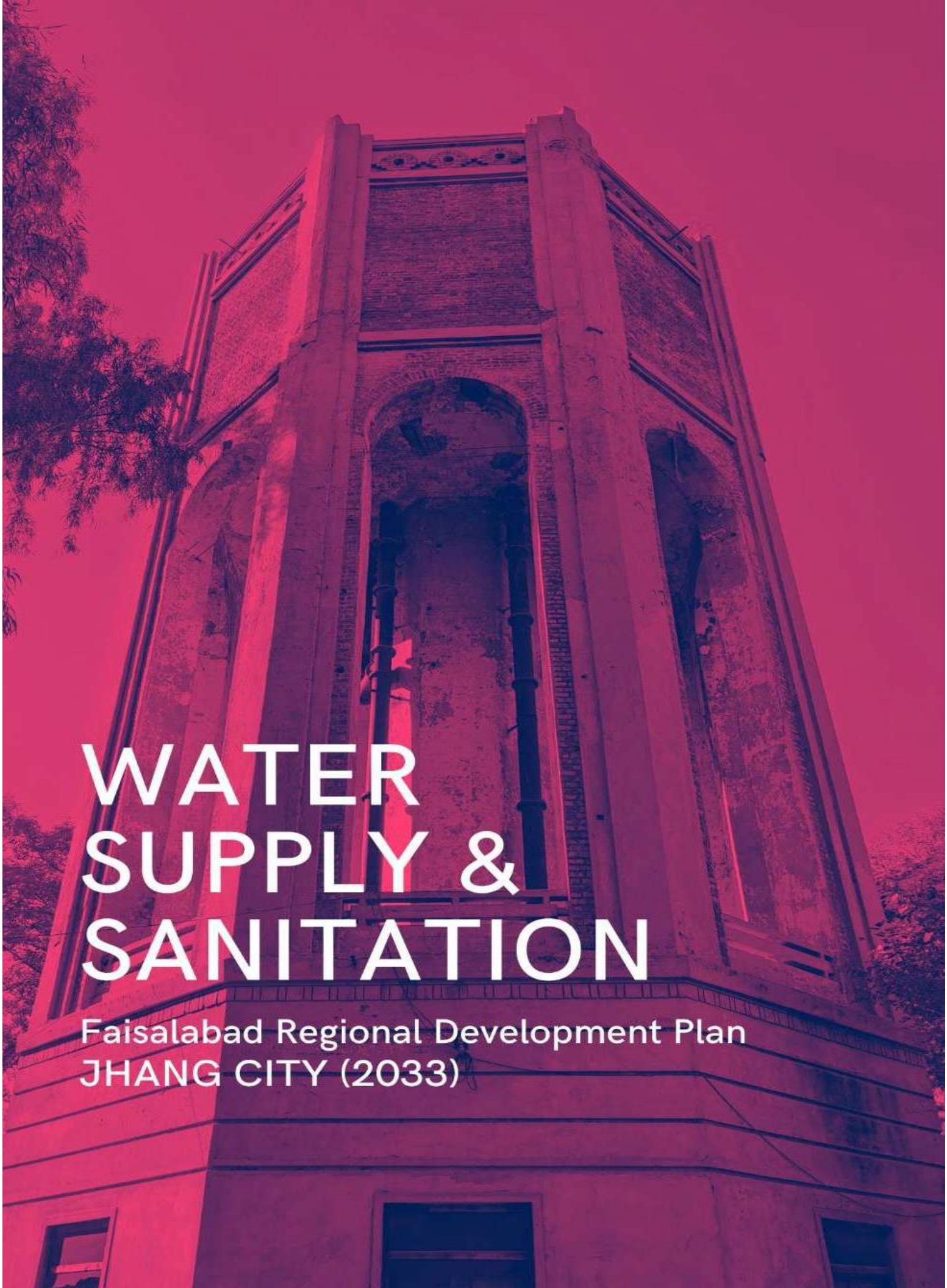


Figure 47 Disposal Station



WATER SUPPLY & SANITATION

Faisalabad Regional Development Plan
JHANG CITY (2033)

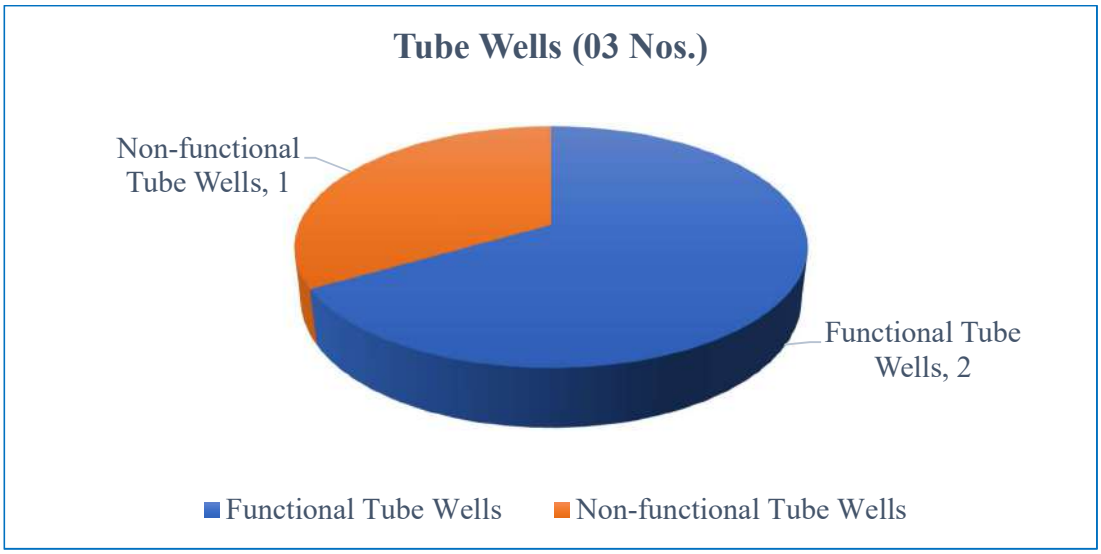
8 Jhang City

The water supply of Jhang City is based on the number of ground water based schemes, designed and installed by the Public Health Engineering Department (PHED), and operated and managed by the Municipal Corporation (MC) Jhang. These water supply schemes are based on tube wells, that extract ground water from sub-surface aquifers. Overhead Reservoirs are provided with these tube wells for storage and distribution of water to adjacent areas. However, the water supply system of the city is barely operational due to a number of reasons, the foremost being the limited interest of public due to abundant availability of ground water at reasonable depth. Most of the population caters to their water needs through private domestic bores, with only a small population currently being served by the municipal water supply. Approximately 10% area (spatially) of the city is currently being served by these water supply schemes, mostly in Satellite Town and areas adjacent to Municipal Corporation Office, and the rest of the city can be termed as privately served. However, the future planning prospects demand that a consolidated water supply scheme be proposed for the city to limit the uncontrolled extraction of this precious resource, and provide a sustainable solution to the water supply needs of the city.

The sewerage system of Jhang City is gravity-based and uses a number of disposal stations, wastewater drains and sewer lines for disposal of water to the outskirts of the city. The system was installed by Public Health Engineering Department (PHED), and operated and managed by the Municipal Corporation (MC) Jhang. Trunk lines are present in almost all main roads of the city which lead the wastewater to disposal stations. Water is then disposed either into nearby agricultural fields or the Khair Wala Drain; which bypasses the city towards the west. The sewerage system covers almost 90% of the city (spatially), however, the condition is dire. The infrastructure has aged beyond its design life and is in deteriorated condition. Pools of stagnant wastewater along roads is a common sight. Crown failure and choking due to accumulation of solid waste in the sewer lines are the most prominent issues, creating nuisance and health problems for the residents. Currently, a consolidated sewerage scheme for Jhang city is in execution. New trunk lines are proposed to be laid across the city along with construction of three mega disposals. However, the future planning prospects demand that secondary sewer network also be assessed and replaced where required, along with planning and provision of sewer network in unserved pockets throughout the city.

8.1 Existing Water Supply Infrastructure

The existing water supply infrastructure of the city consists of tube wells, overhead reservoirs and water filtration plants. The water quality of Jhang is mildly brackish. Where tested, it showed pH of 6.89–7.10, TDS of 678–688, and EC 1343–1374. The infrastructure is divided into two schemes, designed and installed by the Public Health Engineering Department (PHED) mostly from 1950-2000 with the oldest scheme dating back to 1954. Municipal Corporation Jhang currently owns, operates and maintains the water supply infrastructure of the city. Each scheme has tube wells source, and overhead reservoirs that provides storage to the system. The water is then distributed via water supply pipelines to the adjacent areas. Two out of the three tube wells in the system are currently operational and they cater to the demand of the population in their adjacent areas.



Graph 14 Operational Status of Tube Wells

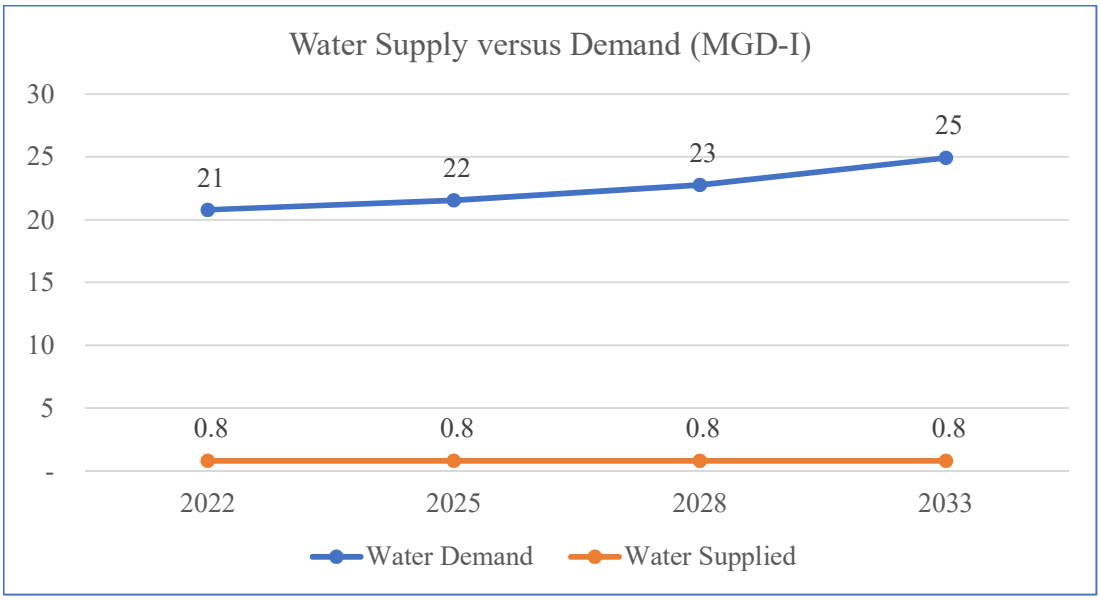
8.2 Water Supply versus Water Demand

This section of the report refers to the calculation of water demands in the city. The current population of Jhang City is 461,933 as is expected to reach 553,779 individuals by the end of 2033. The water demand is calculated for a proposed water demand of 30 gallons per capita per day i/c 20% as unaccounted for water (NRW).
The current (2023) water demand and future (2025, 2028 and 2033) water demands are shown in the table below.

Table 28: Current and Future Water Demand

Water Demand				
Year	2023	2025	2028	2033
Population	461,933	478,994	505,775	553,779
Per Capita Demand (including 20% NRW)	30	30	30	30
Domestic Demand (G/D)	13,857,985	14,369,828	15,173,257	16,613,362
Average Day Demand (MG/D)	13.86	14.37	15.17	16.61
Max Day Demand (MG/D)	20.79	21.55	22.76	24.92

The existing supply capacity of the system was also analyzed and stands at 0.8 MGD maximum for all the water supply appurtenances. This indicates a current water deficit between demand and supply of about 20 MGD where as the number is expected to increase up to 24.1 MGD by the end of 2033.



Graph 15: Water Supply versus Water Demand

8.3 Condition Assessment of Water Supply Infrastructure

The overall condition of water supply infrastructure in the city is evaluated based on a rating criteria, developed considering the physical and mechanical characteristics of the system. The details of the MC owned water supply infrastructure in Jhang is tabulated below:

Table 29: Detail of Water Supply Infrastructure

Tube Well Name	Condition	Installation Year	Storage (Gallons)	OHR Condition	Pipeline Length	Pipeline Condition
TW #1 Khokha Chowk (Satellite Town)	C (Fair)	1954	50,000	D (Poor)	Length 11 km of varying diameters (4"-6")	D (Poor)
TW#2 Bihari Colony (Satellite Town)	D (Poor)	1989	50,000	D (Poor)		
TW#1 Municipal Corporation Office	C (Fair)	-	100,000	B (Good)		

The table below shows the overall condition of various components of the water supply infrastructure.

Table 30: Conditional Assessment of Water Supply Infrastructure

Assets	Condition

Civil Structures	C (Fair)
Distribution Network	C (Fair)
Electro-mechanical Components	D (Poor)

Figure 48 Condition of Civil Components of Water Supply Assets

With regard to condition assessment of the water supply system, overall civil structure of different assets of the water supply infrastructure present in the city such as pump houses of tube wells and the structure of overhead reservoirs as well as the water supply distribution network has been evaluated as "**C**" which indicates that some deterioration or defects are evident but the function is not significantly affected. The condition can be termed as overall being fair and is evident from the pictures below.

The condition of electrical and mechanical components of the system can be evaluated as "**D**" indicating serious deterioration in at least some portion of the structure and the function being inadequate. Over-aging and lack of maintenance is the major contributor for poor condition of these components. The condition was observed during the field visit and is evident from the pictures below.

Figure 49 Condition of Electro-Mechanical Components of Water Supply Assets

The map below illustrates the spatial position of existing water supply infrastructure and its condition.

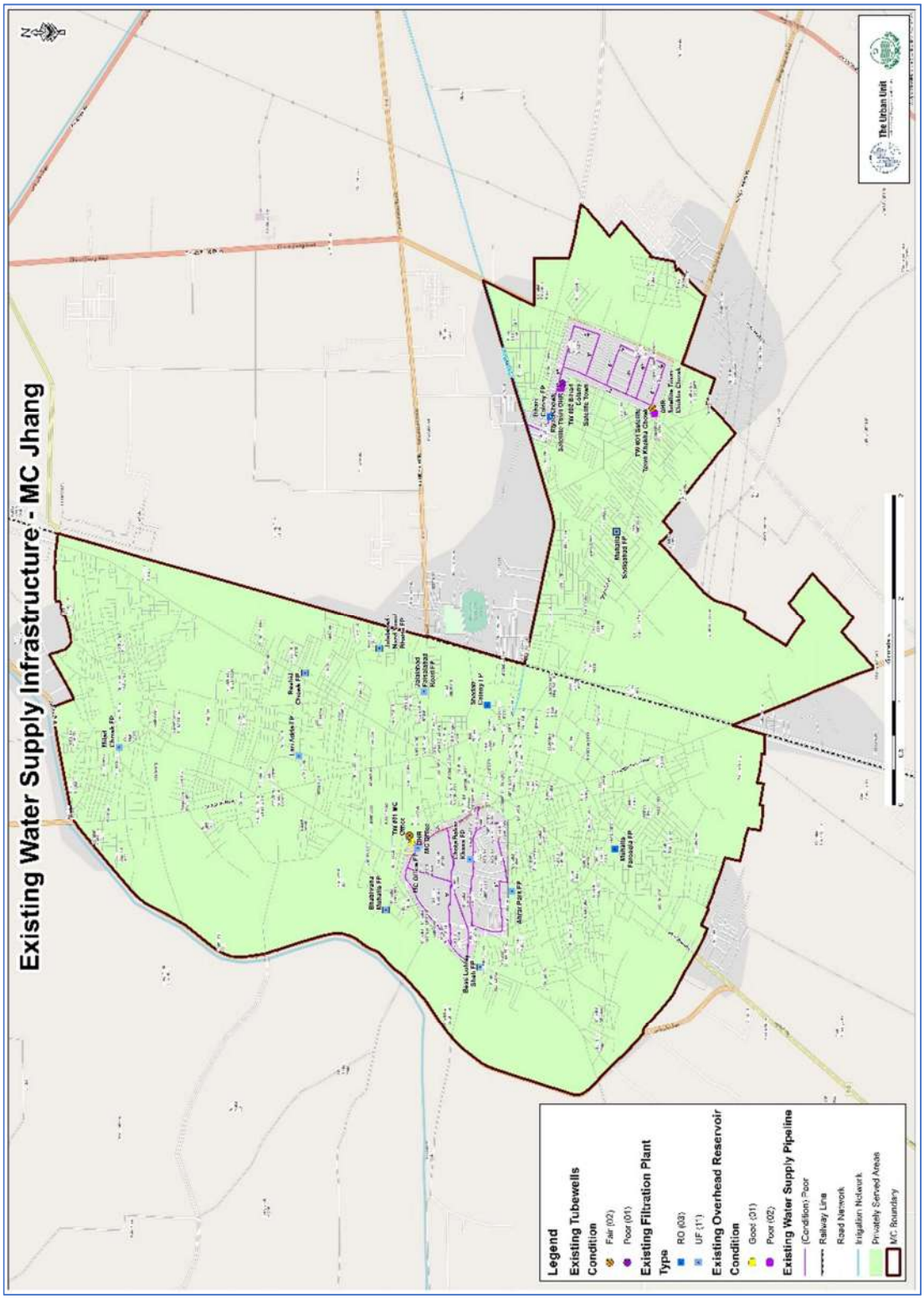


Figure 50 Water Supply Baseline

8.4 Water Supply Interventions

The conditional analysis of the existing water supply infrastructure has resulted in identification of the existing service delivery gaps that exist within the system. Appropriate interventions have been proposed for mitigation of these aforementioned gaps, to provide the most optimal, economical and sustainable solution. These identified projects have been bifurcated into three phases; Short Term (Year 2025), Medium Term (Year 2028) and Long Term (Year 2033), spread over the entire duration of planning phase (2023-2033) for minimal financial and operational stress.

- **Short Term Plan**

The Short-term Plan for the water supply involves the extension of water supply network to the unserved areas of the city. This involves rehabilitation and upgradation of the existing network as well as installation of new water supply infrastructure to increase the coverage of water supply system up to 40%. New tube wells, overhead reservoirs and water supply lines are proposed to be installed during this phase. A store is also proposed to be established during this phase to cope for the operational and maintenance needs of the water supply system by providing spare tools and equipment as per need. The total cost of the Short-term plan for Water Supply System in Jhang City amounts to approximately 1,176 Million.

- **Medium Term Plan**

The Medium-term Plan for the water supply involves the extension of water supply network to the unserved areas of the city, that were left unaddressed during Phase-I. The Phase-II of the water supply scheme is proposed for 80% coverage of the city. New tube wells, overhead reservoirs and water supply lines are proposed to be installed during this phase. The total cost of the Medium-term plan for Water Supply System in Jhang City amounts to approximately 840 Million.

- **Long Term Plan**

The Long-term Plan for the water supply involves the extension of water supply network to the unserved areas of the city, that were left unaddressed during Phase-I and Phase-II. The Phase-III of the water supply scheme is proposed for 100% coverage of the city. New tube wells, overhead reservoirs and water supply lines are proposed to be installed during this phase. The total cost of the Long-term plan for Water Supply System in Jhang City amounts to approximately 775 Million. A Supervisory Control & Data Acquisition (SCADA) monitoring and control center is also proposed to be established during this phase for digital monitoring of the system.

Table 31: Proposed Schemes

Sr. #	Planning Term	Sector	Proposed Schemes	Scope	Cost (Million)
1	SHORT TERM (2025)	Water Supply	**New Water Supply Schemes for Jhang City (Phase – I):** Extension of Water Supply to unserved areas of Jhang City (Islamabad, Lalazar Colony, Mohallah Noor Shah, Jhang Bazar, Milad Chowk, Hussainabad, Mohallah Bhabrana, Mohallah Hasnana, Piplian wala Mohallah Ayub Chowk, Mohallah Kapaiyan, Shadab Colony, and all neighbouring areas)	▸ Construction of 05 Tube wells (4 cusecs each), Rehabilitation /Upgradation of 03 Tube wells (4 cusecs) ▸ 04 new OHRs (1 Nos 100,000 Gallons & 3 Nos 200,000 Gallons), 1 OHR Rehab (100,000 Gallons) ▸ WS pipeline (14" rising mains and 4"-6" distributions) of length 149 KM	1147
2			Establishment of store for Water Supply Equipment for quick fix in Jhang City	▸ Construction of Store, Electro-Mechanical Spares & Tools, Equipment for WS	29

3	MEDIUM TERM (2028)		**New Water Supply Schemes for Jhang City (Phase – II)**: Extension of Water Supply to unserved areas of Jhang City (Amir Town, Ali Town, Basti Lakhiwala, Basti Rasool Pur, Zafarabad, Jalalabad, Yousafabad, Marzai pura, Samanabad, Mohallah Mohammadi, Gulshan Colony, Ghaziabad, Rehmat Colony, and all neighboring areas)	▸ Construction of 08 Tube wells (4 cusecs each) ▸ 04 OHRs (03 No 100,000 Gallons & 01 No 200,000 Gallons) ▸ WS pipeline (14" rising mains and 4"-6" distributions) of length 118 KM	840
4	LONG TERM (2033)		**New Water Supply Schemes for Jhang City (Phase – III):** Extension of Water Supply to unserved areas of Jhang City (Basti Ghooghay wali, Bismillah Colony, Basti Lolhay Shah, Mohallah Hasnana, Harmalpur, Chamanpura, Mohallah Ghousia, Akbar Pura, Basti Ata Wali and all neighboring areas)	▸ Construction of 08 Tube wells (4 cusecs each) ▸ 04 OHRs (100,000 Gallons each) ▸ WS pipeline (14" rising mains and 4"-6" distributions) of length 65 KM	640
5			Establishment of SCADA Monitoring and Control Center in Jhang City	▸ Establishment of SCADA	135
				Total Water Supply – Jhang MC	**2,791**

Rough Cost Estimation MRS, 1st BI-ANNUAL-2023 (01.01.2023 to 30.06.2023) District Jhang has been Applied. The 2% Contingencies and 5% PST are also added in estimates. This is further subject to Detail Design of the proposed schemes.

The projects for water supply have been geo-referenced and spatially shown in the map below.

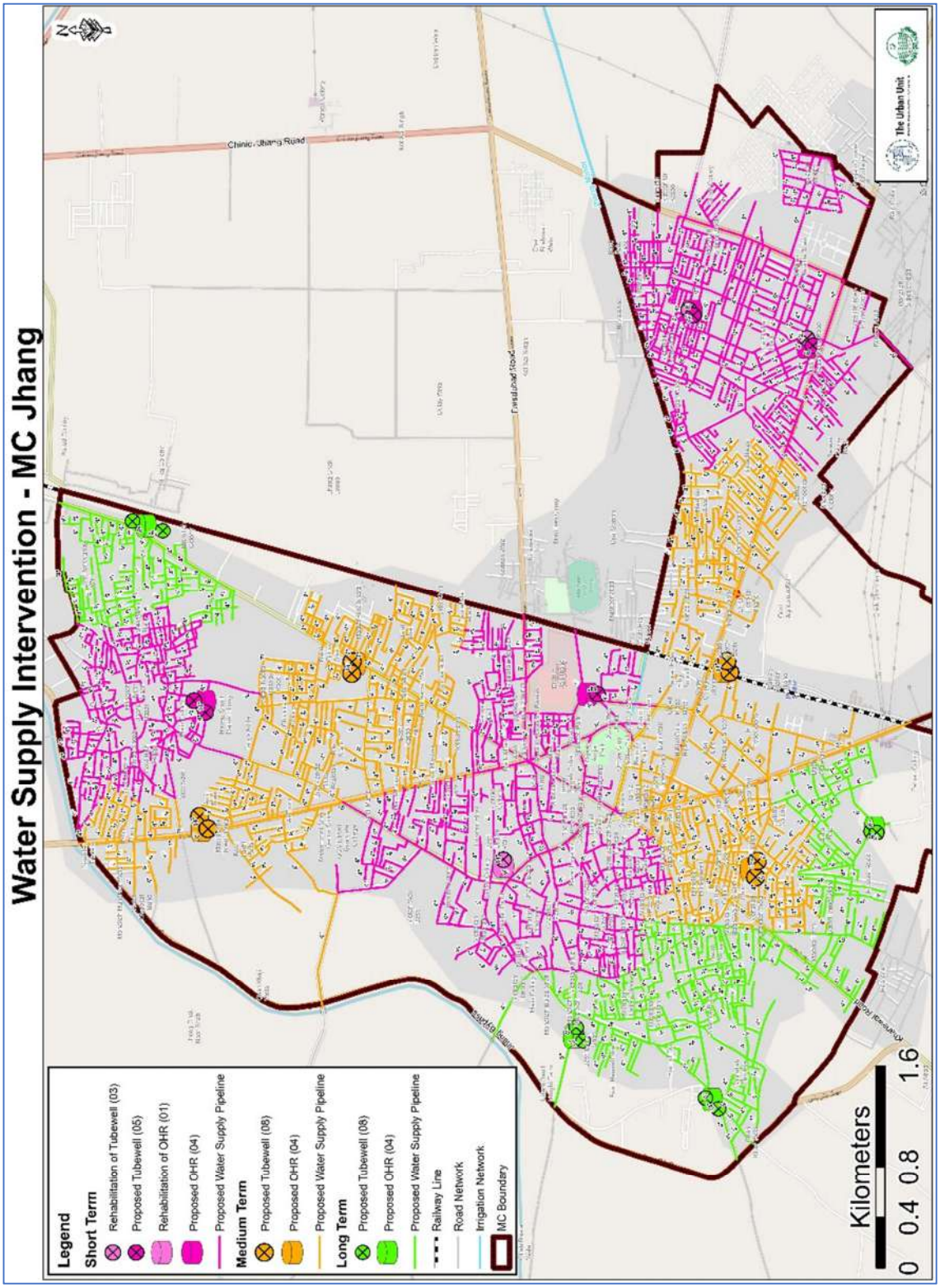


Figure 51 Water Supply Proposed Interventions

8.5 Drawings

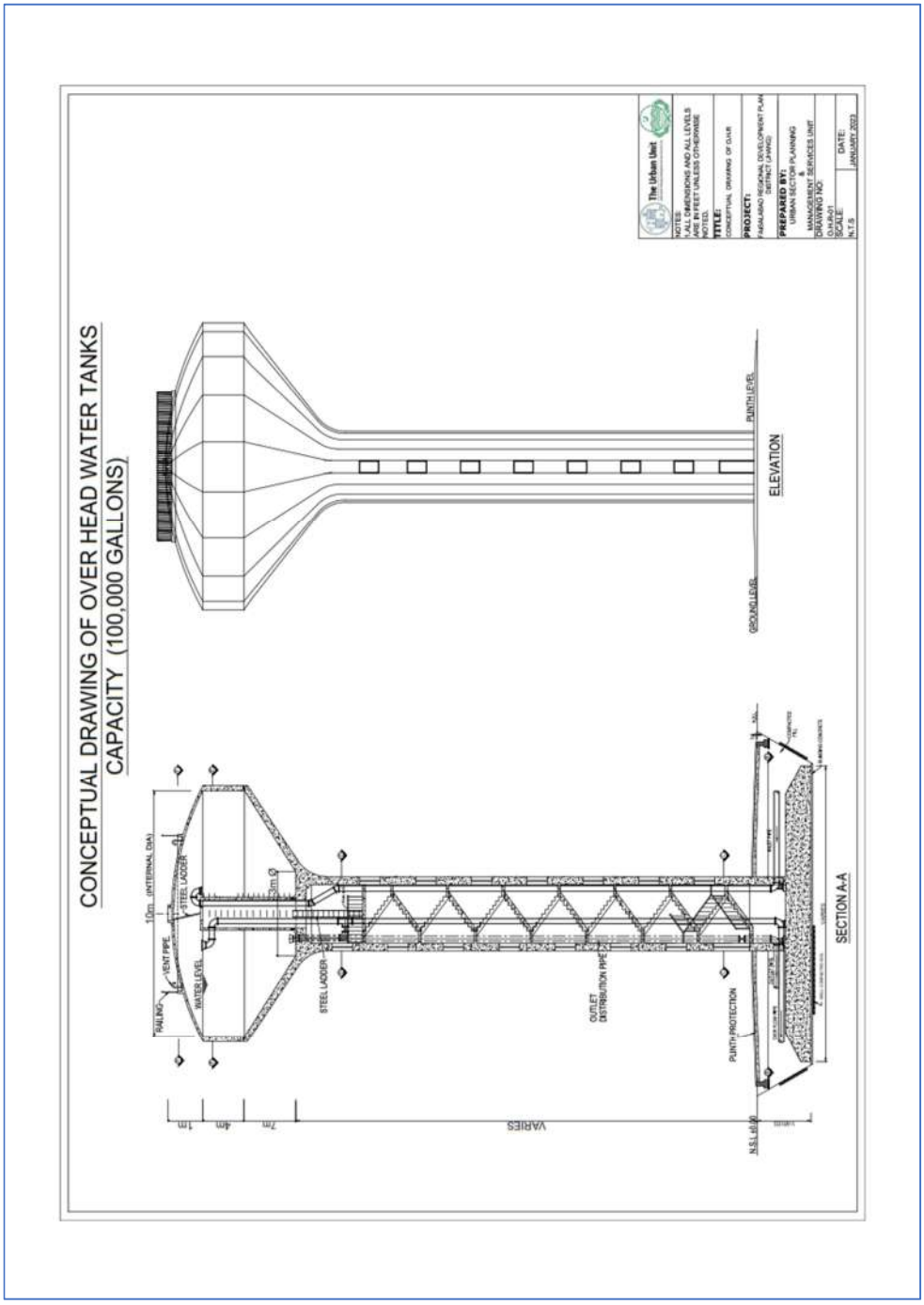


Figure 52: OHR - 100,000 Gallons

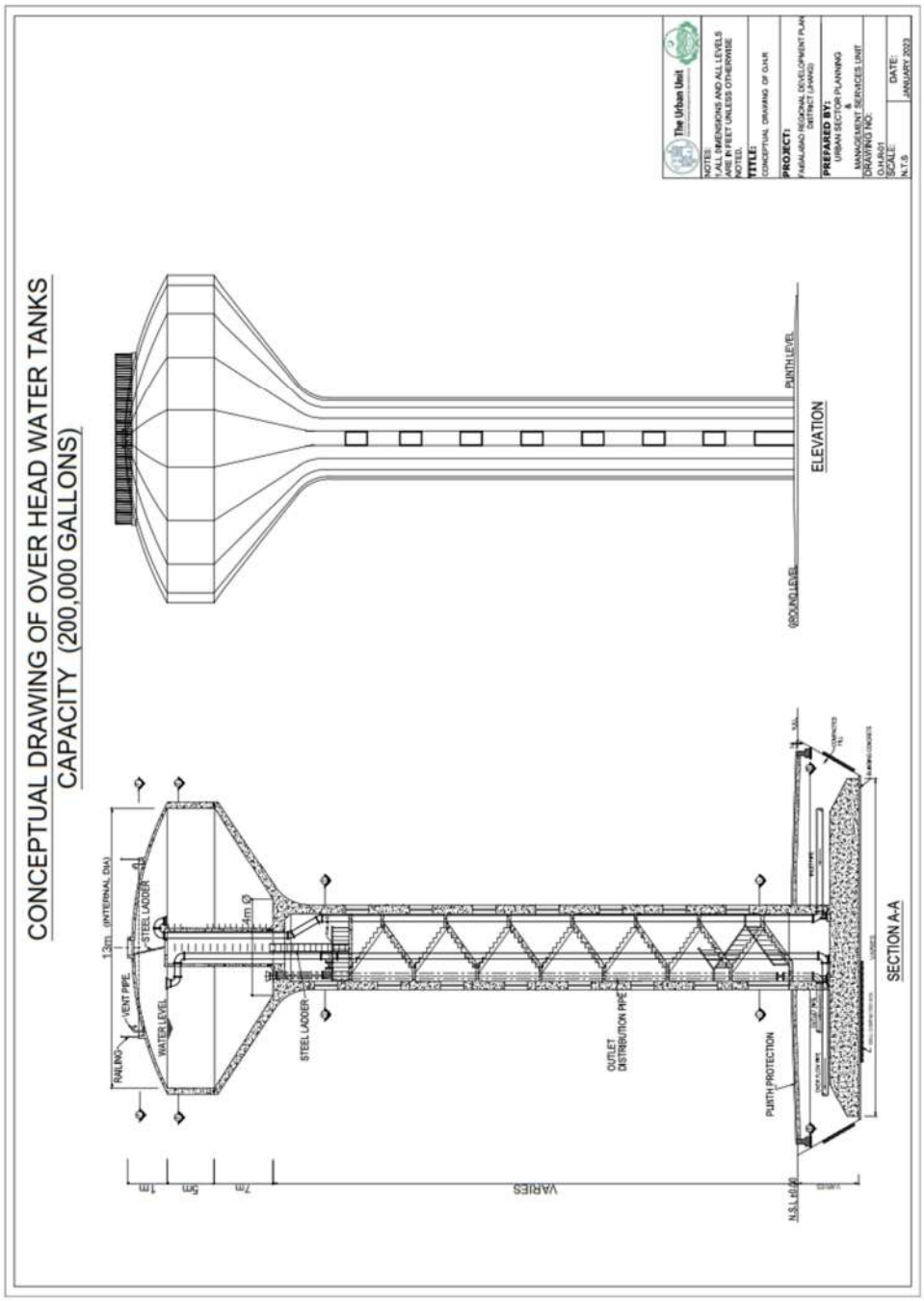


Figure 53: OHR - 200,000 Gallons

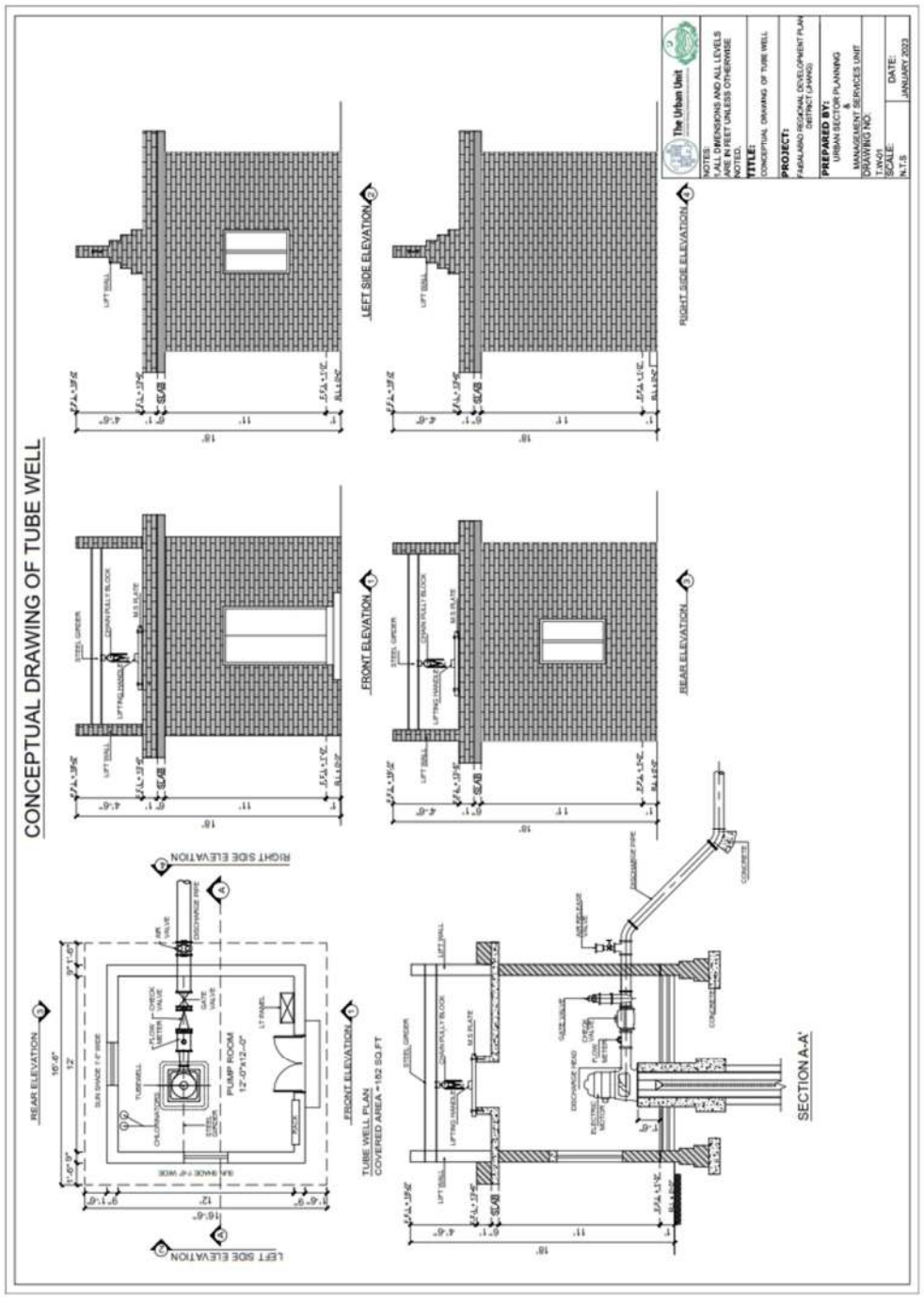
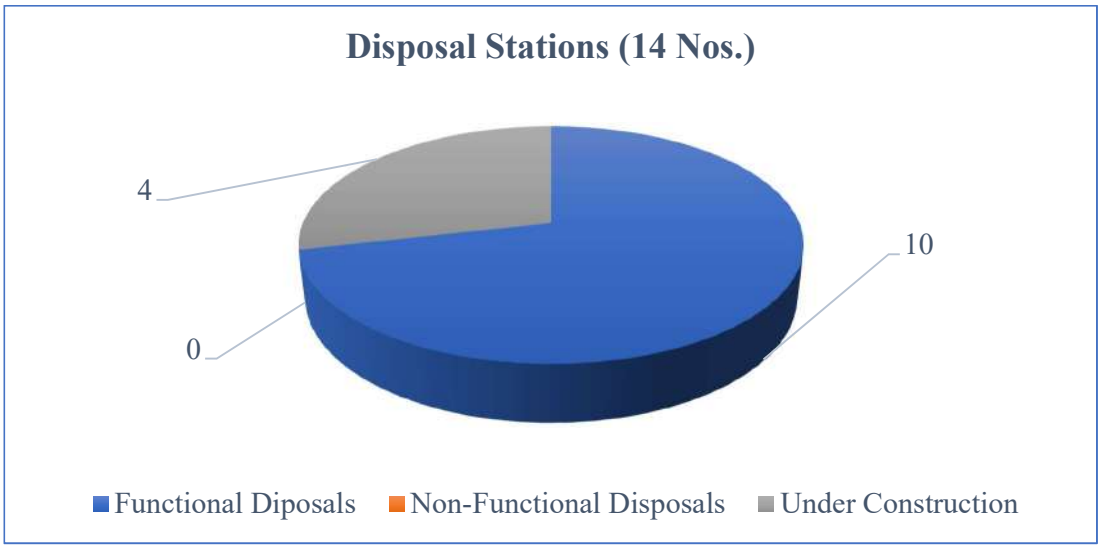


Figure 54 Tube Well

8.6 Existing Sewerage Infrastructure & Condition

The existing sewerage infrastructure of the city consists of disposal stations and the sewer network. The sewerage system has been designed by the Public Health Engineering Department (PHED), and is currently operated by the Municipal Corporation (MC) Jhang. There a total of 14 disposal stations in Jhang city owned by the MC, which are responsible for carrying of waste water towards the outskirts of the city. Eleven of these disposals are currently functional while three more are under construction.



Graph 16 Disposal Station Status

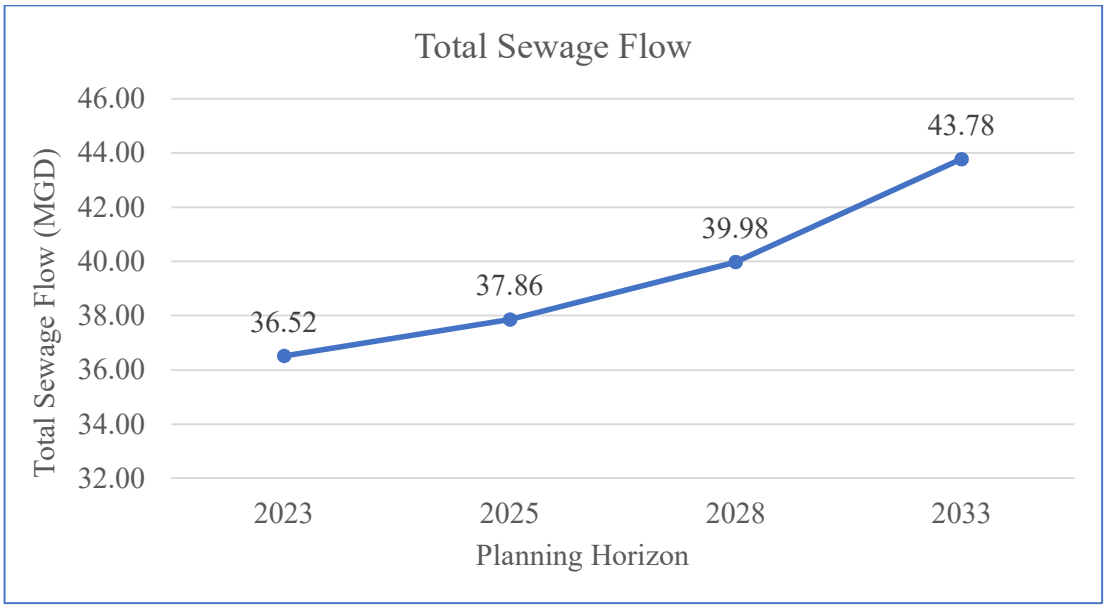
8.7 Sewage Generation

This section of the report refers to the calculation of wastewater generated in the city. The calculations have been made corresponding to the 30 gallons per capita per day water demand i/c 20% unaccounted for water (NRW). A contribution of 50% for storm-water flow, 5% infiltration & 5% non-domestic flows have been included during the calculation of the total sewerage flow. The current (2023) wastewater demand and future (2025, 2028 and 2033) wastewater generation are shown in the table below.

Table 32: Sewage Generation

Sewage Generation				
Year	**2023**	**2025**	**2028**	**2033**
Population	461,933	478,994	505,775	553,779
Peak Sewage Flow (MG/D)	23.56	24.43	25.79	28.24
Storm Water Flow (MG/D)	11.78	12.21	12.90	14.12
Infiltration Flows (MG/D)	0.59	0.61	0.64	0.71
Non-Domestic Flows (MG/D)	0.59	0.61	0.64	0.71

Total Sewage Flow (MG/D)	**36.52**	**37.86**	**39.98**	**43.78**



Graph 17 Sewage Generation

Elevation Map has been developed and used for indication of natural flow of the landscape, for appropriate and effective disposal of sewage flows. The highest elevation of level for Jhang city is approximately 164 meters and the lowest point lies at approximately 146 meters from the mean sea level. This indicates a level difference of as much as 18 meters.

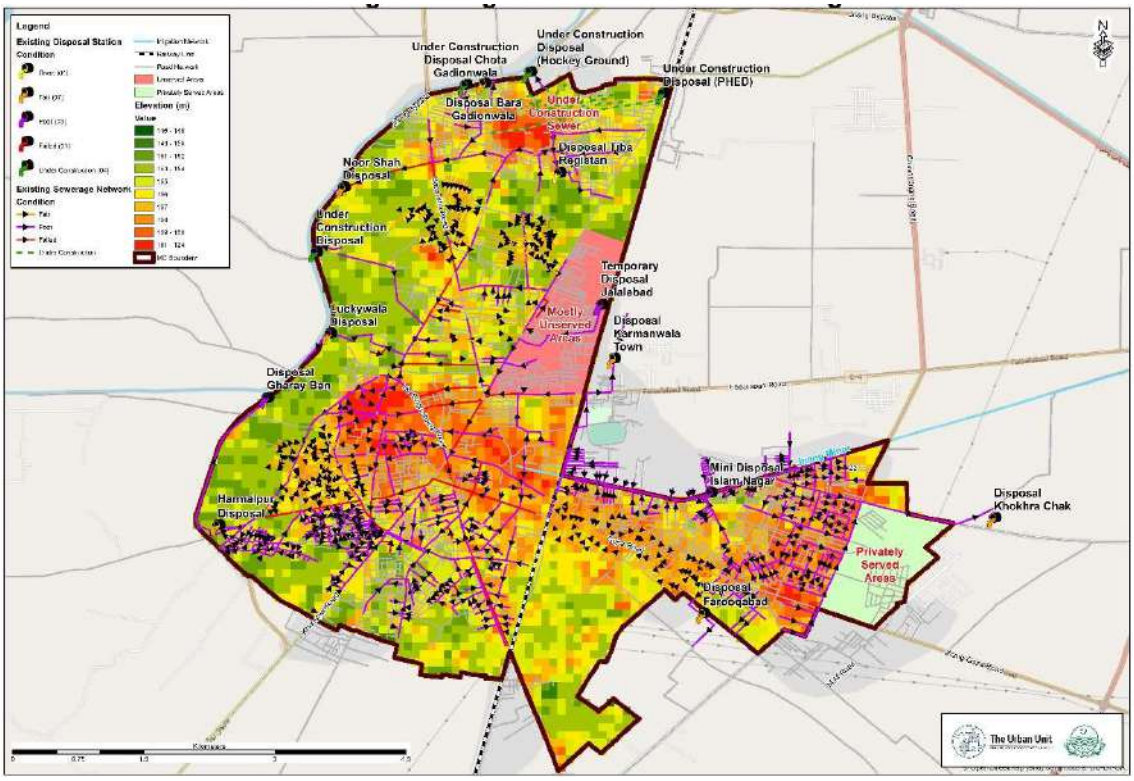


Figure 55 Elevation Map

8.8 Condition Assessment of Sewerage Infrastructure

The overall condition of sewerage infrastructure in the city is also evaluated based on a rating criteria, developed considering the physical and mechanical characteristics of the system. The condition of various components of the sewerage system were assessed during the field visit and each component of the system was granted a grade as per its cumulative performance. The details of the MC owned sewerage infrastructure in Jhang is tabulated below:

Table 33: Sewerage Infrastructure

Disposal Station Name	Condition	Status	Ultimate Disposal	Sewer Lines Length	Sewer Lines Condition
Disposal Khokhra Chak	C	Functional	Fields	Length 177 km of varying diameters (12”-42”)	C, D & F (Varies Fair to Failed)
Mini Disposal Islam Nagar	D	Functional	Drain		
Under Construction Disposal	-	Under Construction	Drain		
Harmalpur Disposal	C	Functional	Drain		
Disposal Gharay Ban	D	Functional	Drain		
Luckywala Disposal	C	Functional	Drain		
Under Construction Disposal	-	Under Construction	Drain		
Noor Shah Disposal	C	Functional	Drain		

Disposal Chota Gadionwala	-	Under Construction	Drain		
Disposal Bara Gadionwala	C	Functional	Drain		
Under Construction Disposal	-	Under Construction	Drain		
Disposal Tiba Registan	B	Functional	Fields		
Disposal Farooqabad	C	Functional	Fields		
Disposal Karmanwala Town	C	Functional	Fields		

The table below shows the overall condition of various components of the sewerage infrastructure.

Table 34: Conditional Assessment of Sewerage Infrastructure in Jhang

Assets	Condition
Civil Structures	C (Fair)
Electro-mechanical Components	C (Fair)
Sewer Lines	D (Poor)

Figure 56 Condition of Civil Components of Sewerage Infrastructure

With regard to condition assessment of the sewerage system, overall civil structure of different assets of the sewerage infrastructure present in the city such as pumping rooms for disposals, wet wells, dry well have been evaluated as "**C**" which indicates that some deterioration or defects are evident but the function is not significantly affected. The condition can be termed as overall being fair and is evident from the pictures below.

With regard to condition assessment of the sewerage system, overall electro-mechanical components such as motors and pumps have been evaluated as "**C**" which indicates that some deterioration or defects are evident but the function is not significantly affected. The condition can be termed as overall being fair and is evident from the pictures below.

Figure 57 Condition of Electro-Mechanical Components of Sewerage Infrastructure

Figure 58 Condition of Sewer Lines and Distribution Infrastructure

The condition of sewer lines can be evaluated as "**D**" indicating serious deterioration in at least some portion and the function being inadequate. Over-aging, crown failure and choking are the major contributor for their poor condition. The condition was observed during the field visit and is evident from the pictures below.

The map below illustrates the spatial position of existing sewerage infrastructure and its condition.

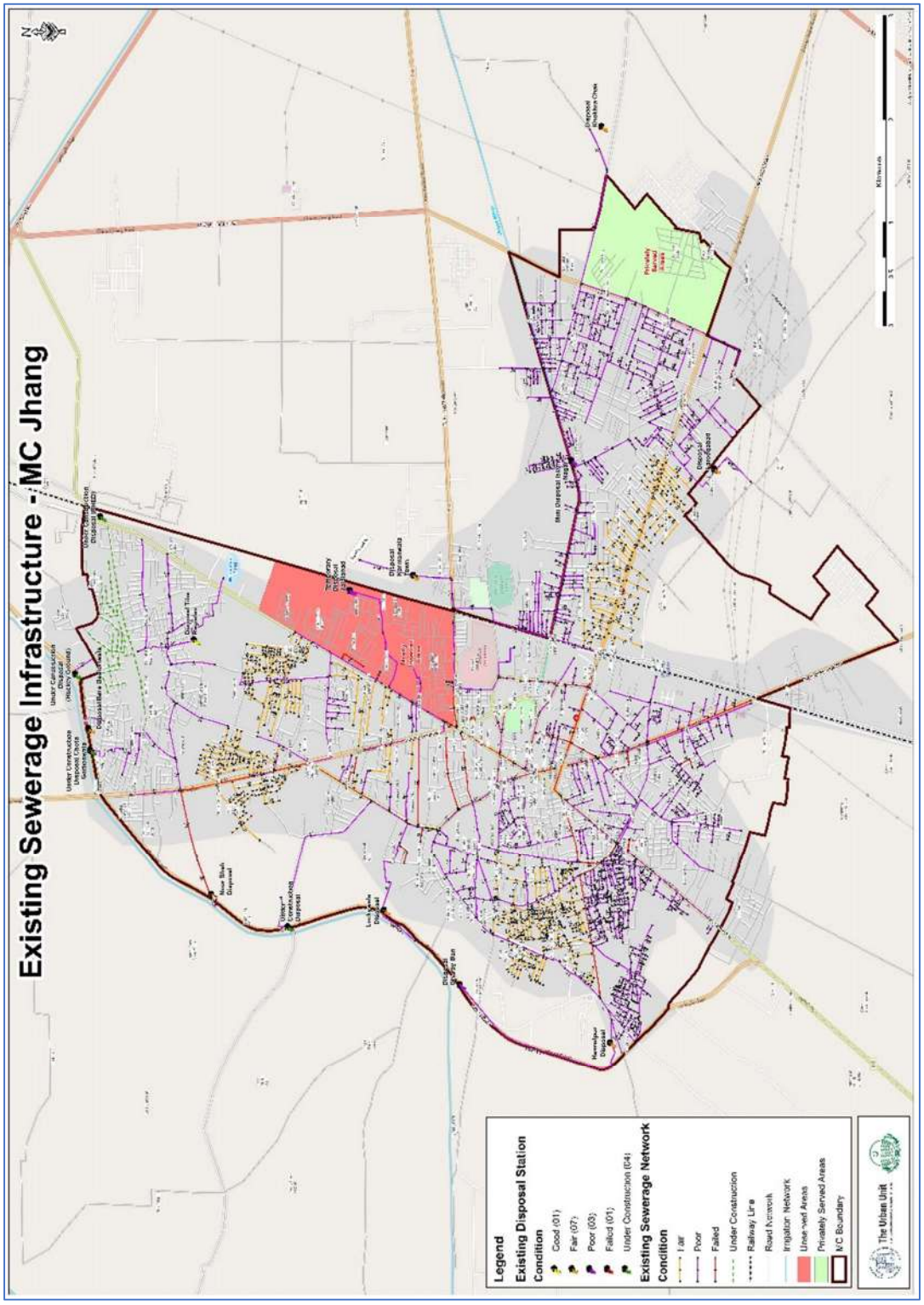


Figure 59: Sewerage Baseline

8.9 Sewerage Interventions

The conditional analysis of the existing sewerage infrastructure has resulted in identification of the existing service delivery gaps that exist within the system. Appropriate interventions

have been proposed for mitigation of these aforementioned gaps, to provide the most optimal, economical and sustainable solution. These identified projects have been bifurcated into three phases; Short Term (Year 2025), Medium Term (Year 2028) and Long Term (Year 2033), spread over the entire duration of planning phase (2023-2033) for minimal financial and operational stress.

- **Short Term Plan**

The Short Term Plan for the water supply involves the extension of sewerage network to the unserved areas of the city. This involves provision of secondary sewerage network during this phase. The total cost of the Short Term plan for Sewerage System in Jhang City amounts to approximately 138 Million.

- **Medium Term Plan**

The Medium Term Plan for the sewerage system involves replacement and rehabilitation of the existing sewerage network, for a phase wise replacement of lateral and secondary sewerage network in the city. A total of 127 km of sewer lines are expected to be replaced during this phase with a total cost of the Medium Term plan for Sewerage System in Jhang City amounting to approximately 1,152 Million.

- **Long Term Plan**

The Long Term Plan for the sewerage system involves replacement and rehabilitation of the existing sewerage network, for a phase wise replacement of lateral and secondary sewerage network in the areas of the city, previously left unaddressed. A total of 50 km of sewer lines are expected to be replaced during this phase. Waste Water Treatment Plants (Anaerobic and Facultative type) are also proposed to be provided at three different locations of the city as per the drainage topography. The total cost of the Long Term plan for Sewerage System in Jhang City amounts to approximately 2,196 Million.

Following are the proposed schemes for Jhang (MC):

Table 35: Sewerage Schemes

Sr. #	Planning Period	Sector	Proposed Schemes	Scope	Cost Million
1	SHORT TERM (2025)	Sewerage	**Provision of sewerage network in unserved areas of Jhang City** (Marzai Pura, Zafarabad, Jalalabad, Mohallah Kapaiyan & Pathan Colony)	▸ Sewerage network for future extension purposes of total length 16.5 KM	138

2	MEDIUM TERM (2028)		**Replacement of sewerage network in the poorly served areas of Jhang City** (Satellite Town, Behari Colony, Muskeenabad, Mohallah Bhabrana, Mohallah Hasnana, Piplian wala Mohallah, Samanabad, Chamanpura, Harmalpur, Hussainabad, Mohallah Bagh Wala and Gulshan Colony)	▸ Sewerage network replacement of total length 127 KM	1552
3	LONG TERM (2033)		**Replacement of Sewer network in the poorly served areas of Jhang City** (Basti Lakhiwala, Ali Town, Amir Town, Ayub Chowk, Basti Harmalpur, Rana Colony, Rehmat Colony & Ghaziabad areas)	▸ Lateral sewers for future extension purposes of total length 50 KM	499
4			Construction of **03 Waste Water Treatment Plants – Stabilization (Anaerobic and Facultative):** 50 Acre WWTP each	▸ Construction of 3 WWTP ▸ Related Civil Works i.e. Sullage Carriers, Boundary Walls etc.	1697
Total Sewerage – Jhang MC					3,386

Rough Cost Estimation MRS, 1st BI-ANNUAL-2023 (01.01.2023 to 30.06.2023) District Jhang has been Applied. The 2% Contingencies and 5% PST are also added in estimates. This is further subject to Detail Design of the proposed schemes. The projects for sewerage have been spatially shown in the map below.

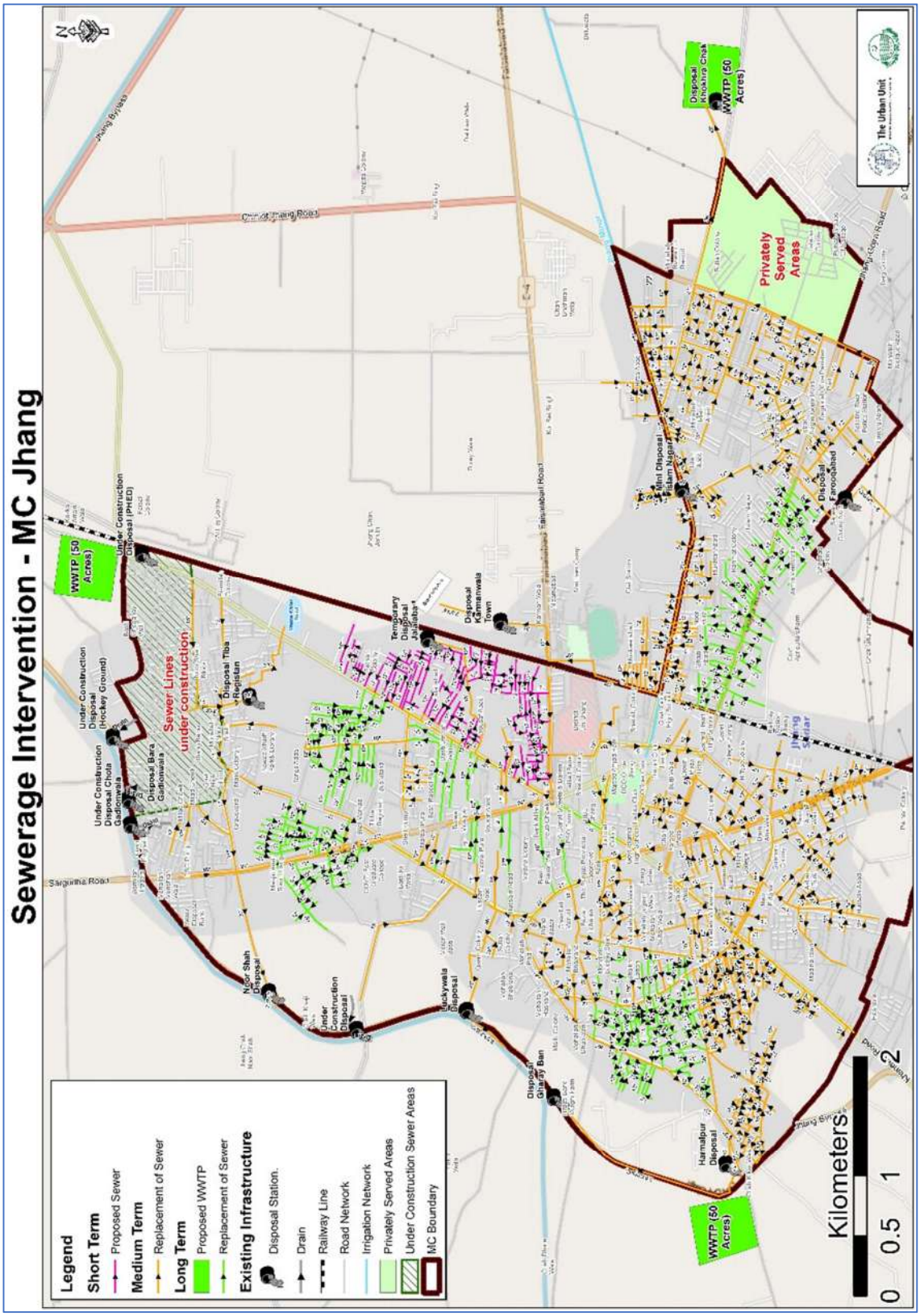


Figure 60 Sewerage Interventions

8.10 Drawings

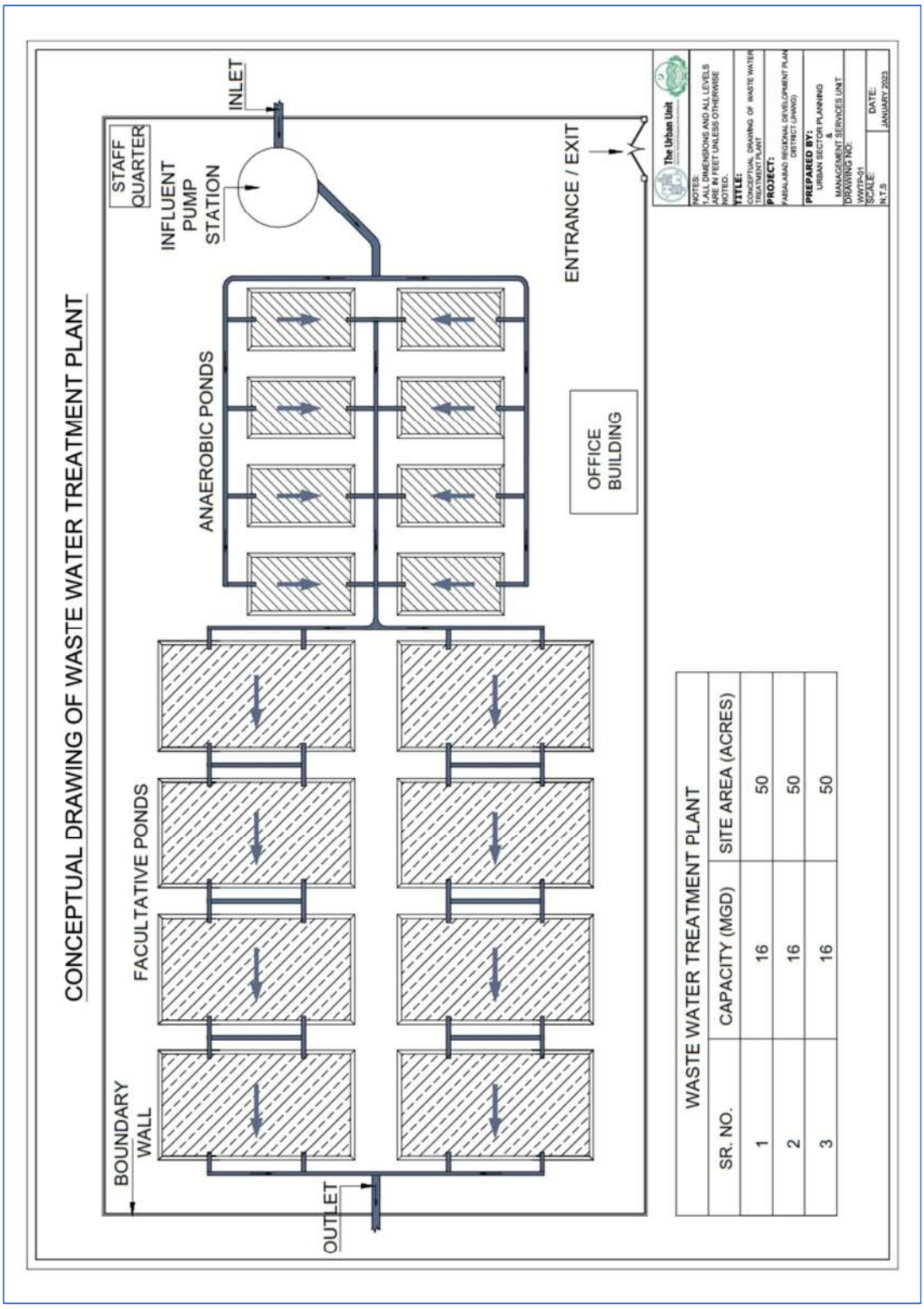


Figure 61 Waste Water Treatment Plant

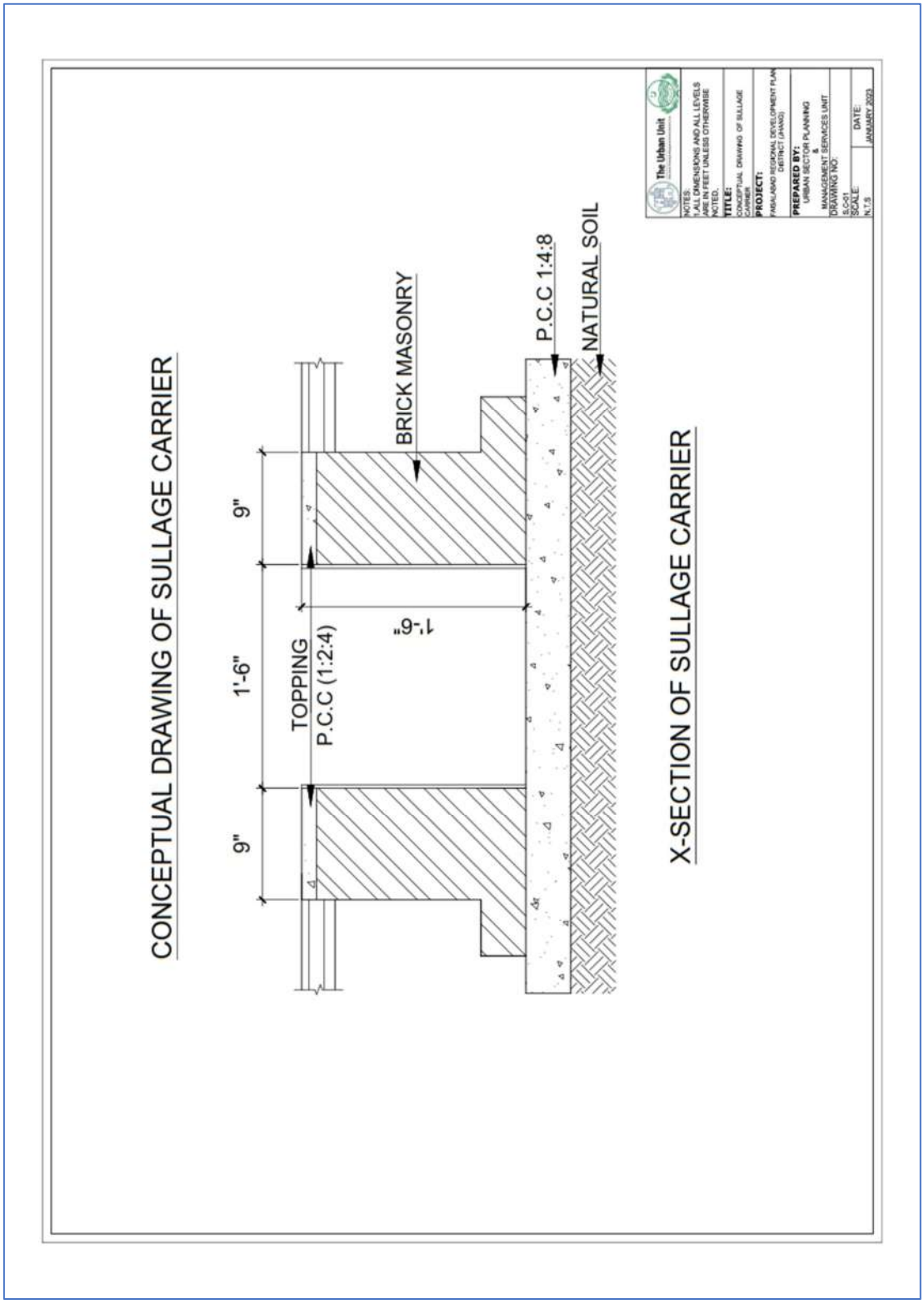
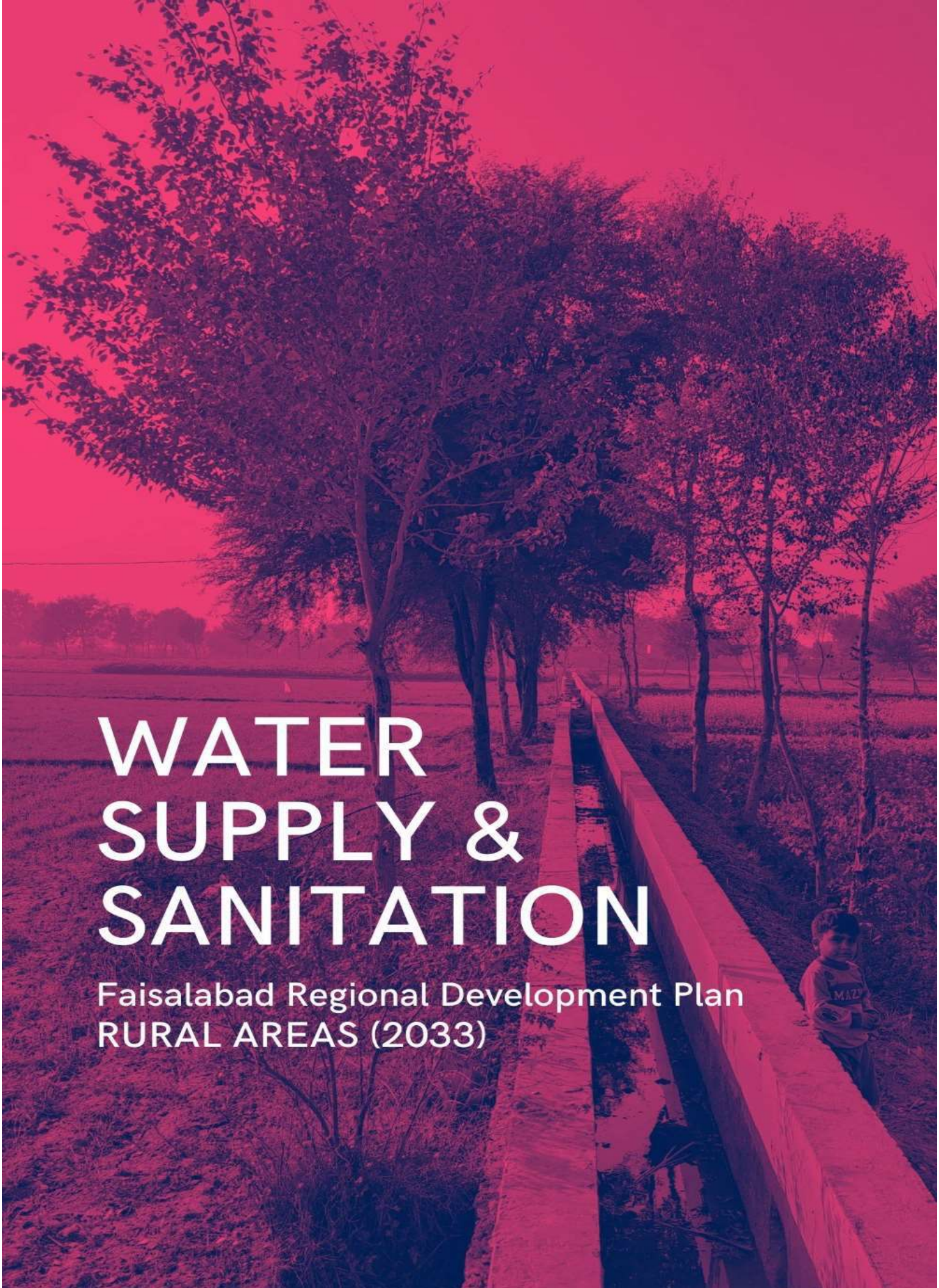


Figure 62 Sullage Carrier



WATER SUPPLY & SANITATION

Faisalabad Regional Development Plan
RURAL AREAS (2033)

9 Rural Areas - Faisalabad Division

Drinking Water and Sanitation are the most essential elements for human life and its dignity. The Government of Punjab also envisions providing safe drinking water and sanitation facilities to the entire rural and urban communities in an equitable, efficient and sustainable manner.

According to published data, currently only 48% Rural Punjab population is reported to have access to safely managed water supply services, which seems to be far behind in achieving SDG 6 targets and this clearly needs intervention by the higher end in order to improve the current situation of service delivery in rural settlements. By 2018, only 13 percent of rural households had access to piped water, as compared to 29 percent of urban households, but even where piped water was available, less than 4% was piped into dwellings. These figures bring attention towards existing disparities among urban and rural areas. Concerning sanitation situation, it is stated that 73 percent rural households are seen as having access to improved sanitation. However, only 4.9 percent have access to flush/pour-flush latrines connected to a sewer system, and another 50 percent have access to flush/pour-flush latrines connected to septic tanks with any overflow leading to a communal drain.

It goes without saying that the need of the hour is the need of addressing the prevalent disparities and inequalities of basic services in rural and urban settlements. This can truly stimulate significant progress in course of achieving equitable growth and actualizing our SDG commitments. Furthermore, Reliable and appropriate water infrastructure that allows for easy access to a safely managed water supply and sanitation services will lead to an improved lifestyle of rural people, produce resultantly fit and dynamic labor, escalate rural economies and create jobs.

Stakeholder Consultation in Inception Visit, Primary data collection from Public Health Engineering Department (PHED) and Punjab Aab e Pak Authority (PAPA), rapid community consultation in field and secondary data available on Water and Sanitation Sector (WSS) gave the team an insight about the existing state of WSS in rural areas of Faisalabad Division in Punjab. Current situational analysis stating average 42% water and sewerage coverage pronounce that medium level focus has been given in the past to invest for the provision of efficient municipal service delivery and improve the living condition of people in rural areas.

9.1 Existing Situation of Rural WSS System

Punjab is the most populous province of Pakistan with almost population of 110 million, out of which 63% (70 million) reside in the rural areas. Faisalabad is one of the administrative divisions of Punjab having 17 tehsils and rural population of approximately 8.9 million as per census of 2017 indicating that 13% rural population of Punjab residing over there. Rural area segment is very significant to be analyzed and considered while developing the regional sectoral plan as major chunk i.e. 63% population of division lie in rural settlements as compare to 37% in urban areas. Division comprises of four districts with Faisalabad district encompasses largest while Chiniot least proportion of rural divisional population. This section is written to cover the current situation as well as future endeavors of water and sewerage sector in rural areas of four districts namely Faisalabad, Jhang, Chiniot and Toba Tek Singh that lie in Faisalabad Division.

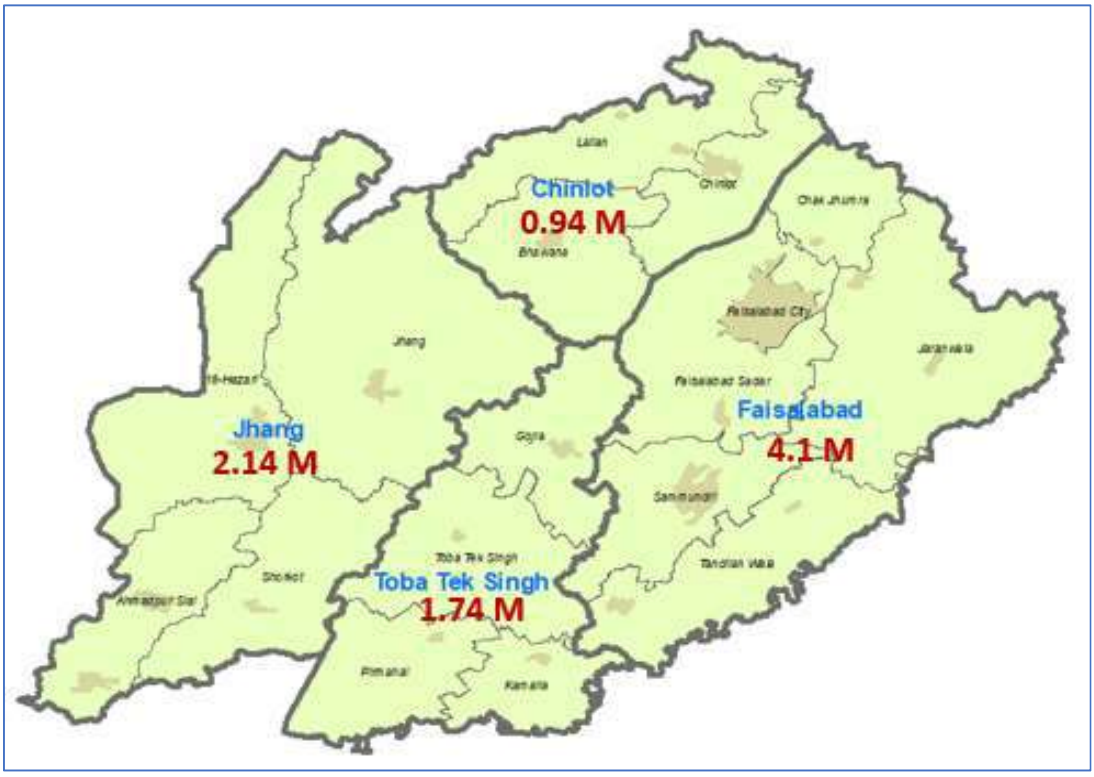


Figure 63: Districts of Faisalabad with Rural Population

The aspect of disparities and inequities in services are always found among districts as highlighted in one of the published WASH Scorecard report of UNICEF in 2019. Multiple indicators governs the WASH situation contribute towards the overall ranking of the districts with respect to water and sanitation. Faisalabad and Chiniot are categorized in to lowest rank of 34 and 31 among all districts of Punjab with respect to rural water and sanitation index respectively, which highlights the need of immediate planning and respective interventions in the district. Overall, the captured water and sanitation index and respective ranking of rural areas of four districts as depicted in figure below makes the basis for essential need of planning and implementing WASH interventions in the region.

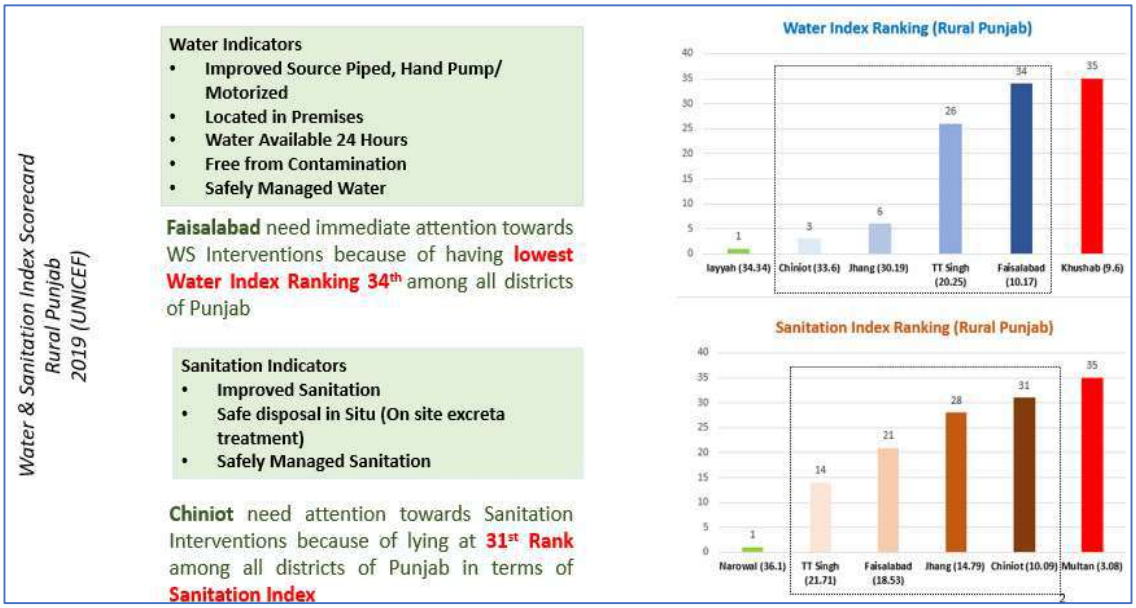


Figure 64: Rural Water and Sanitation Index in Faisalabad Division

Public Health Engineering Department (PHED) is the main department responsible for the installation or execution of water supply and sanitation schemes in rural areas of Punjab. One of the major challenges of Service Delivery in rural areas is the distribution of responsibilities to execute and operate the infrastructure. PHED is responsible for execution or installation of the municipal services infrastructure, which is currently handed-over to Community Based Organizations (CBOs) for its operation and maintenance (O&M). The significant constraints behind the scene are absence of technical and financial capacity of CBOs as well as conflicts and ownership concerns. Currently CBOs are carrying out the O&M of the installed water schemes, facing many challenges and issues due to low revenue collection, high electricity cost, and other legal bindings as highlighted during the rapid field assessment carried out by Urban Unit team in November 2022. Team carried out rapid community consultation and visited rural water schemes to have an overview of prevailing service delivery situation and Community opinion regarding WSS services. Community preferred Government' water supply scheme in brackish areas of the division. Glimpse of some of the consultation with rural community are highlighted in figure.

Figure 65: Shoots of Consultation with Rural Community and visit at rural schemes

9.2 Rural Water Supply Infrastructure

Currently both groundwater and canal water are used as source of water for domestic usage and especially for drinking purposes. Water is provided to the rural community through installed 580 **Rural Water Supply Schemes** (each of 0.25-0.5 cusecs capacity) installed by PHED and maintained by CBOs in division. According to data provided by PHED, currently there are total 422 water schemes in functional condition from total installed water schemes indicating that 27% of the infrastructure is Non-Functional. Functional schemes provide water for 1-8 hours a day.

It is noted that Water schemes are in non-working condition due to multiple reasons including failure of machinery, damaged rising main & distribution network, transformer & machinery theft, bore failure, expiry life, community conflicts and non-payment of WAPDA dues. Greater number of schemes (140) are non-functional in Faisalabad and minimum no (5) are observed in Chiniot. Jhang is the case where mostly fresh water aquifer is present and people are reluctant to pay for water, therefore, only 07 water schemes are present. People are using their own bores and hand pumps for meeting their water needs where PHED' water supply schemes are not present. However, it is pertinent to mention that division groundwater lies in sweet to brackish water zones.

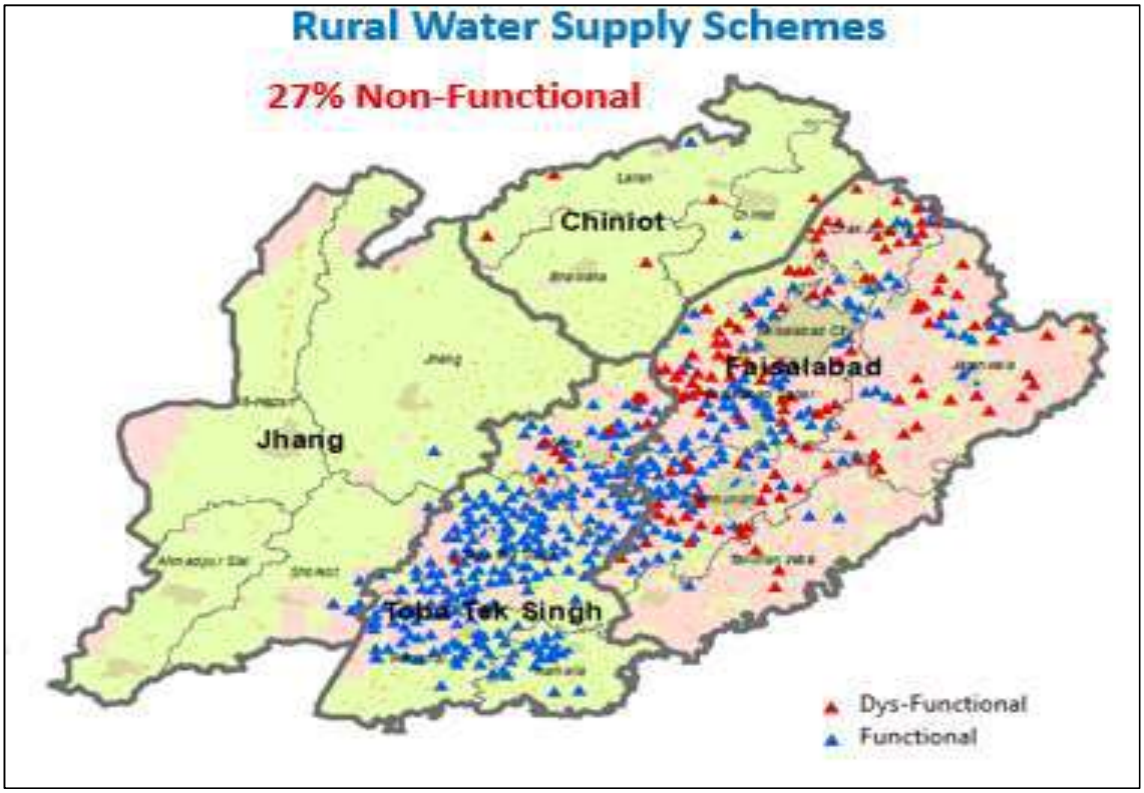


Figure 66: Rural Water Supply Schemes

Along with water supply schemes, a large number of **Rural Water Filtration Plants** are present in the region because of presence of brackish zone (7-60%) in division. PHED has installed total of 94 water filtration plants (UF/RO) during 2011-2021 in the whole division

among which only 4 are non-functional in Chiniot. It is pertinent to mention that Punjab Aaab e Pak Authority (PAPA) has a significant role in providing safe drinking water in rural areas. According to information provided by PAPA, total of 130 Filtration Plants have been installed in division in phase-I among which 115 were of standalone nature and 15 were cluster based plants. PAPA has also plan to install more standalone water filtration plants and cluster based plants based on already installed boreholes in Faisalabad division in Phase-II.

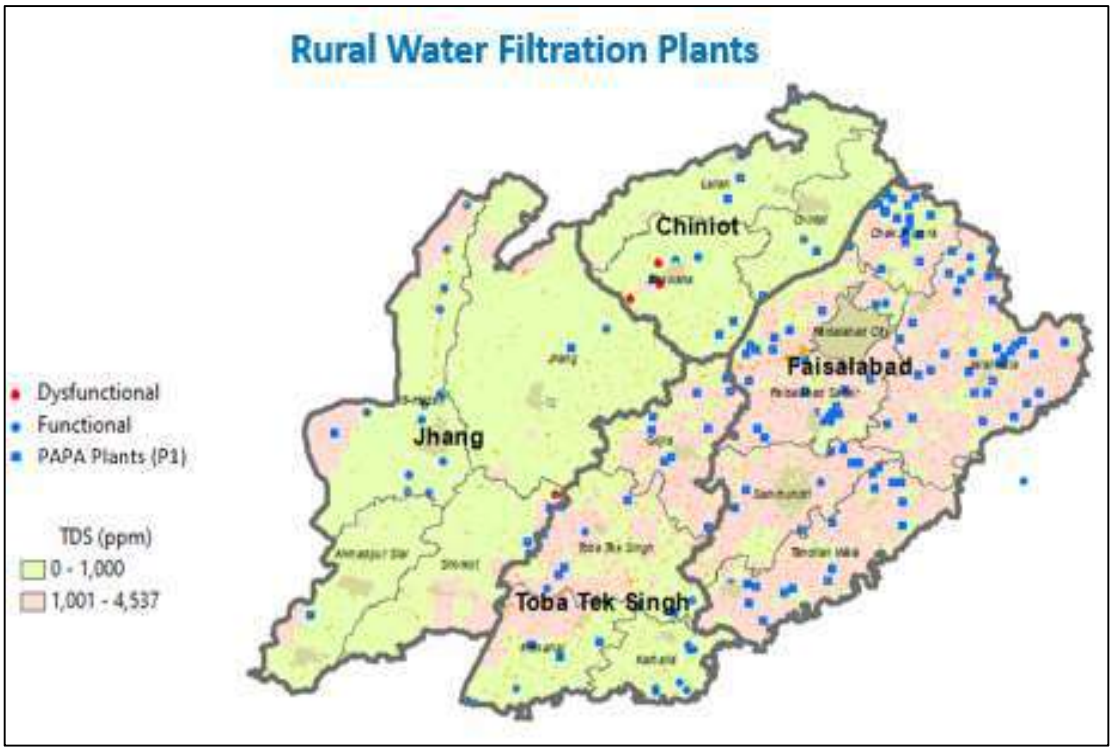


Figure 67: Rural Water Filtration Plants

It is envisaged that only 33% of villages in division are being served through these installed water supply schemes and water filtration plants.

Summary of water supply infrastructure in rural areas of all districts of Faisalabad is given in table while detailed attributes of all water schemes and water filtration plants are presented in Annexure. Functional and Non-Functional Rural Water Supply Schemes in districts of Faisalabad division are mapped and presented in map figure.

Table 36: Summary of Rural Water Infrastructure

	Faisalabad	Jhang	TTS	Chiniot
Pop. 2017	4.1 M	2.14 M	1.74 M	0.94 M
No of Villages	780	724	544	354
Total TWs	281	7	283	8
Functional TWs	141	7	271	3
Non-Functional TWs	140	0	12	5
Functional PHED/MC Filtration Plants	54	14	18	4

	Faisalabad	Jhang	TTS	Chiniot
Non-Functional PHED/MC Filtration Plants	0	1	0	3
PAPA Water Filtration Plants	96	7	19	8

9.3 Rural Water Quality

The Urban Unit has carried out an analysis of available UNICEF Water Quality Data, PSLM & MICS data about WASH in Punjab Spatial Strategy, which resulted in to Spatial Mapping of districts of Punjab. According to that analysis, medium to high level WASH Interventions are needed among districts of Faisalabad division.

UNICEF & PHED carried out detailed screening of water quality in rural areas of whole Punjab in 2014-16. This is only recent data set available on such a large scale in Punjab. Samples were taken from multiple sources and analysis of multiple water quality parameters was carried out at that time. Presence of 7-60% TDS pollution in water of Faisalabad division with minimum contamination of 7% in Chiniot and maximum in Faisalabad district clearly supports the need of immediate mitigation interventions in Faisalabad and TTS District. Faisalabad and TTS are classified as brackish zones while Jhang and Chiniot lie in medium to sweet water zone. Water quality condition with extremely high concentration of TDS say greater than 12,000 ppm in groundwater aquifer due to presence of salt rock aquifer in the region is alarming as imposes the serious health threats to human population residing and drinking that contaminated water.

Spatial overview of water quality situation presented in map with indication of Identified hotspots of brackish villages need attention towards the need of immediate interventions of installation of respective filtration plants to protect the human health. It is noted that PHED has its own water quality testing laboratory facility in each of its district but water testing is carried out only on water schemes sources or on demand basis.

Figure 68: Rural Water Quality (TDS)

9.4 Rural Sanitation Situation

Rural areas make major part of the districts because of having considerable population. It is very unfortunate to mention that usually rural extents are neglected in comparison to urban areas in terms of sanitation as indicated from disparity and inequity figures reported by UNICEF in its published reports. The negligence in investment consequently result in to the poor health and lower standard of living. Although the provision of equitable and safe drinking water and sanitation is the main responsibility of Government and as well as right of people. Provision of proper sewerage and drainage system in rural areas seems to be neglected because of multiple reasons such as absence of any company/organization responsible for proper operation and maintenance (O&M) of infrastructure, lack of funds, poor revenue collection, absence of technical expertise and machinery. Currently PHED plan, design and execute the sewerage and drainage schemes in rural areas whereas its operation and maintenance is mostly over-looked by concerned CBOs. Sewerage system in rural areas is normally consist of open drains while underground covered conduit system is rarely present in some villages. It is important to note that currently sewerage system with 99% open drain type and 1% underground sewers is present in approximately 2401 villages of Faisalabad division which make total of only approx. 57% coverage in rural areas. Brief information of sewerage system in rural areas of Faisalabad division is presented in table.

Table 37: Overview of Sewerage Situation in Rural Faisalabad

Districts	Total Villages	Total no of Sewerage Schemes installed	No of Open Drains Schemes	No of Underground sewerage system schemes	No of Unserved Villages	Unserved Coverage	Sewerage & drainage infrastructure condition	Wastewater Treatment Plants	Disposal Point	Major Issues regarding Rural Sewerage & Drainage
Chiniot	354	2	133	2	219	62 %	Average	No	Agriculture Land	O & M cost
Faisalabad	779	7	585	7	187	24 %	Good	No	Irrigation seepage drain	No proper cleaning, Solid waste dumping into sewerage line
Jhang	724	1	373	1	265	37 %	Average	No	Agriculture Land Irrigati	O&M cost, No proper cleaning and disposal,

									on Seepage Drain Seem Nullah	No proper infrastructure and community awareness
Toba Tek Singh	544	9	332	9	212	39 %	Average	No	Seem Nullah	No disposal points, No proper infrastructure, No community awareness about drainage/sewerage.

The baseline data summary collected from concerned PHED regarding existing situation of sewerage and drainage in villages of four districts of Faisalabad Division is presented in table while disparity of rural sewerage coverage among districts can be seen in Map as well.

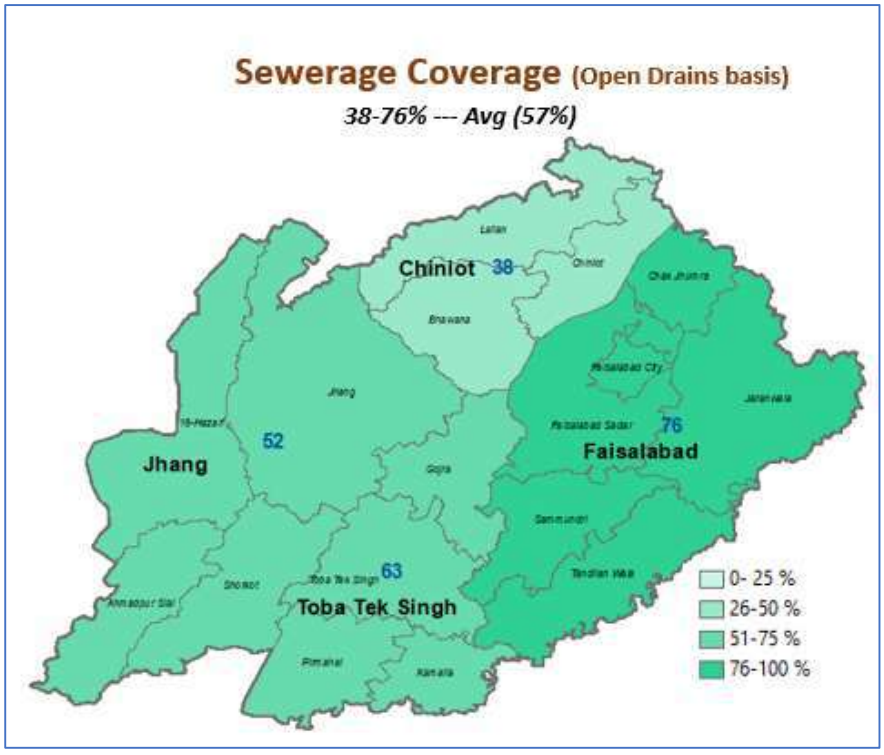


Figure 69: Sewerage Coverage in Rural Areas of Faisalabad Division

Faisalabad and Toba Tek Singh are districts where appropriate coverage is present as compare to Chiniot and Jhang which demands the need of attention and investment. Wastewater collected through these open drains is normally drained and dumped in to agriculture fields and nearly water bodies without any treatment which is also of concern regarding environmental pollution and human health.

9.5 Rural Water and Sanitation Interventions

The major broadly challenges in rural WSS sector articulated are abandoned Infrastructure, poor water quality- Brackish Zone, high electricity cost, less WSS coverage and financial & ownership issues. Large number of populations residing in these areas are badly affected or deprived of safe WSS facilities. These some of the challenges are taken in to account and resultant actions of interventions are identified to cater the issues as water and sanitation are considered basic services that need to be provided for health environment and human well-being.

Interventions are proposed by considering the existing infrastructure/assets and gaps present to meet the service delivery requirement. Interventions revolve around rehabilitation of existing non-functional assets and installation of new requisite infrastructure to provide WSS coverage in unserved and deprived areas. The summary of proposed interventions of Approximately PKR 10 Billion are reflected in figure below.

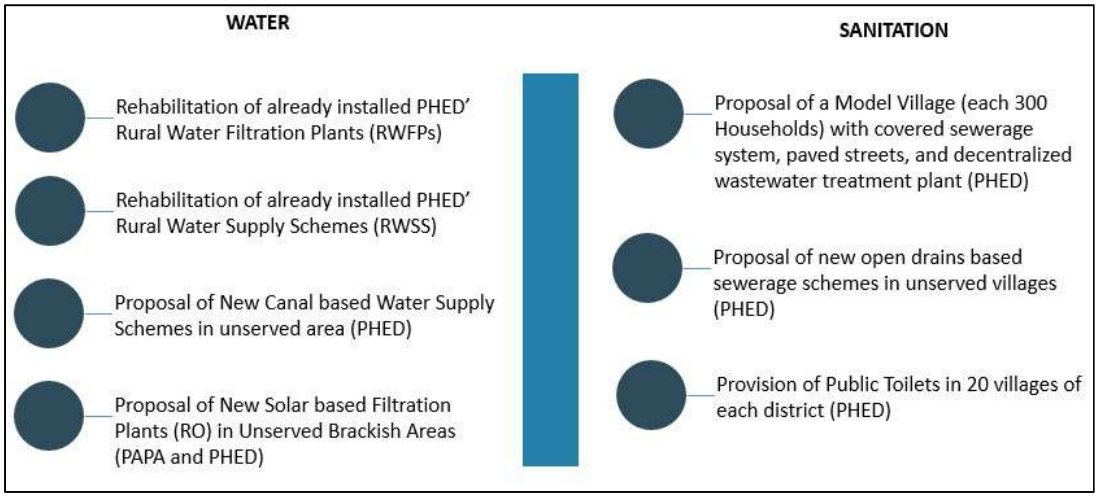


Figure 70: Proposed Rural WSS Interventions

9.6 Rural Water Supply projects

Water Supply interventions include rehabilitation of non-functional water filtration plants which are present in tehsils Bhowana and Chiniot. These are RO and UF plants of 1000 l/h capacity installed by PHED in 2011 and 2013. Similarly, huge cost was incurred on installation of water supply schemes and major chunk of that (157 Nos are non-functional) due to many reasons articulated in above section. Rehabilitation of 117 priority water supply schemes is proposed to revive the already installed assets by investing on upgradation of machinery, upgradation of rising mains, new borehole, repair of distribution lines and provision of transformer & chlorinators etc. New Canal based water supply schemes are also identified by spatially evaluating the available water quality data and existing infrastructure and settlements. New 11 canal based schemes are proposed majorly in TTS and Jhang to be executed by PHED in villages which are lying in brackish zone and where currently No water filtration plant or water scheme is executed.

Punjab Aaab-e-Pak Authority (PAPA) has mandate of installation and execution of water treatment plants and schemes in rural areas of Punjab. PAPA' plan for its second phase of

installation of water infrastructure in Faisalabad division was also considered. Among its proposed plants, some RO plants are selected for installation by considering unserved coverage and brackish zones area. Some new RO plants are also proposed in brackish area to be installed by PAPA for provision of safe drinking water facilities to residents especially where surface water source is not available in nearby vicinity. The concept of renewable energy is also proposed by proposing the installation of solar panels on new RO plants to save electricity cost. Hence, new 48 solar based RO plants are proposed spatially in whole division majorly in Faisalabad and Toba Tek Singh brackish villages.

List of Rural Sanitation Projects or Interventions in Faisalabad division is given in table while detailed names of villages along with coordinates is mentioned at Annexure.

Table 38: Rural Water Supply Interventions

Faisalabad	
1	Rehabilitation of 92 Faisalabad District Rural Water Supply Schemes
2	Provision of 14 Standalone solar based RO plants in rural FSD Brackish area (2000 l/h)
3	Rehabilitation and augmentation of Water Supply Schemes of Chak no.122 /GB, 56/GB, and 43/GB Jaranwala and Samundari
4	Provision of Water Filteration Plant in Chak No.39/GB, 121/GB & 105/GB Jaranwala. (2000 l/h RO)
5	Provision of canal based water supply scheme in Abadi Mohallah Danish Pura, Islam Pura &Saraj Pura Samundri City (0.5 cusecs each)
Toba Tek Singh	
1	Rehab and augmentation of 12 Rural Water Supply Schemes in TT Singh
2	Rehabilitation of 9 Dys-Functional Rural Water Schemes in tehsil Gojra of TT Singh
3	Provision of 12 Standalone RO plants in rural TT Singh Brackish area
4	Canal based new RWSS in 5 villages (Chak 704/GB, 696/GB, 697/GB, 698 GB, and 703/GB) TTS
Jhang	
1	Provision of standalone solar based 6 RO plants in brackish area of Jhang (2000 l/h)
2	Provision of 4 solar based RO plants in Brackish area of 18 Hazari
3	Provision of WS schemes in 5 villages in shorkot tehsil through surface water canal based (0.5 cusec each)
Chiniot	
1	Rehabilitation of Non-Functional scheme Adlana in Bhowana tehsil of Chiniot
2	Rehabilitation of 04 Non-Functional Water Filtration Plants in Bhowana tehsil of Chiniot
3	Provision of Standalone solar based RO plant in 34 JB Brackish area of Chiniot (2000 l/h)
4	Provision of solar base RO plants in 7 villages in brackish area of tehsil lalian and bhawana chiniot

Spatially marked WS interventions/projects are reflected in below presented map. It is envisaged that these proposed interventions having worth of PKR 5 Billion will benefit approximately 1.07 Million residents of rural areas in Faisalabad division over next 10 years.

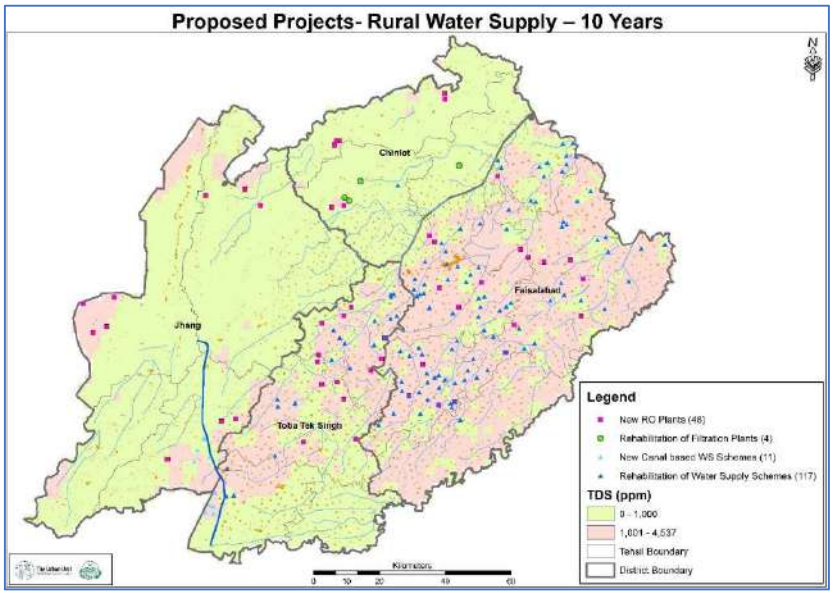


Figure 71: Spatial Representation of Rural Water Supply Interventions

9.7 Rural Sewerage Projects

It includes the execution of open drains-based sewerage drainage schemes, installation of public toilets and development of model villages in all districts of division.

Sewerage and Drainage schemes may include installation of open drains, Tuff tiles, PCC, Soling, Resoling, Drains and Sullage carrier, open ponds-based treatment before final disposal. These schemes are proposed in a manner that 42% villages in Jhang, 35% in Chiniot, 15% in TTS and 9% in Faisalabad will be covered to increase coverage in villages. Villages are selected spatially by considering unserved settlements or villages in an equitable manner. Comprehensive schemes with open drain based network are proposed in each district covering number of villages. List of villages are attached at Annexure. These schemes network are proposed to be executed and maintained by PHED as per their mandate.

The whole rural region is too large to be covered in one go, as only 177 villages are covered in proposed above mentioned comprehensive sewerage and drainage schemes package. Therefore, public toilets are also proposed on the other hand initially in 20 villages in each of district where currently no access or sewerage system is present.

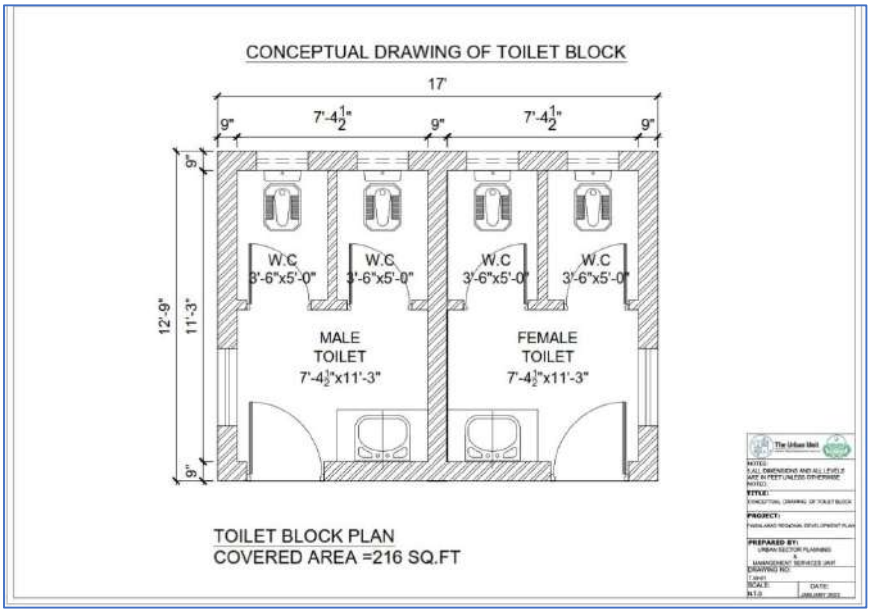


Figure 72: Conceptual Drawing of Public Toilet:

The concept of Model Village is introduced in which it is envisaged that underground sewerage lines will be laid along with paved soling streets and establishment of its associated decentralized wastewater treatment plant. A single village having 300 households and 2100 population in every district is selected as a prototype for establishment of a model village. Decentralized WWTP for 300 HH is proposed with anaerobic treatment requiring 4 Kanal with worth PKR 25 Million in each Model Village. NGO is recommended to be engaged for making a village as model prototype for O&M and sustainability.

Table 39: Wastewater Production in Decentralized WWTP

Total number of households	300
Design population	2400
Water consumption	360000 L/ day (150 L/capita/day)
Wastewater generation	80% of water consumption
Wastewater flow	288 m^3/day
Wastewater Flow (including Population Growth Rate)	324 m^3/day
No of treatment trains	02
Wastewater Flow for single train	162 m^3/day (6.75 m^3/hr.)
Total Cost (Design + Construction):	Rs. 23 Million

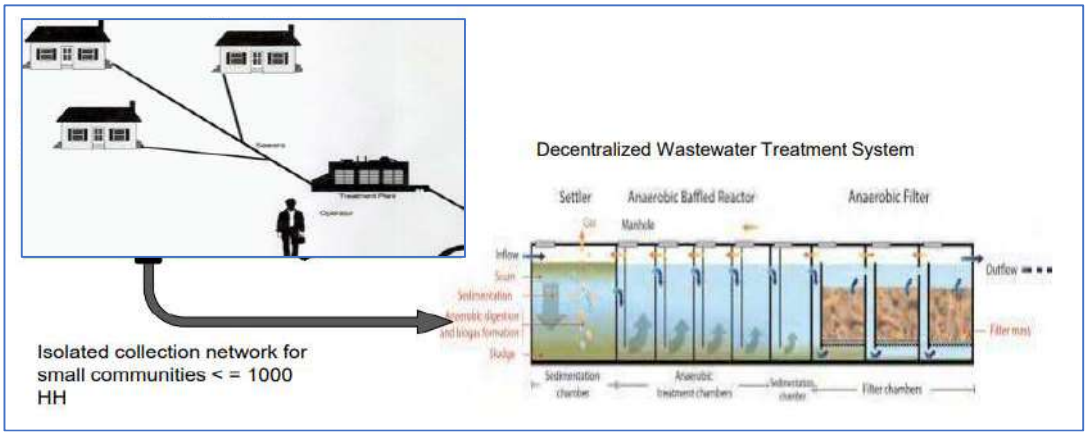


Figure 73: Conceptual Diagram of WWTP:

List of Rural Sanitation Projects or Interventions in Faisalabad division is given in table while detailed names of villages along with coordinates is mentioned at Annexure.

Table 40: Rural Sanitation Interventions

Faisalabad District	
1	Provision of Tuff Tile, PCC, Sewerage and Drainage in Municipal Colony, Alvi Park, Sadat Park, Gillani Mohalla, Amin town Jaranwala City.
2	Provision of Soling, Resoling, Drains and Sullage carrier in Chak No. 105/GB, 53/GB, 61/GB, 109/GB 64/GB & 560/GB Jaranwala.
3	Provision of Tuff Tile, PCC, Sewerage and Drainage in Abadi Old Ward No. 1, 2 &3 Ravi Mohallah, Mohallah City Town, New Samundri &Mohallah Shoukatabad, Samundri City
4	Provision of Soling, Resoling, Drains and Sullage carrier in Chak no. 228/GB, 468/GB, 141/GB, 142/GB 389/GB &390/GB Samundri
5	Provision of sewerage system and drainage schemes in Painsra, Faisalabad
6	Provision of sewerage scheme in Chak 52JB , Faisalabad
7	Provision of the Sewerage system at 209RB Faisalabad
8	Provision of Public Toilets in 20 village area/Chak
9	Model Village(Chak 431 GB) in which paved streets, covered drainage system , safe drinking water , Public toilets and decentralized waste water treatment plant
10	Provision of tuff tile, Pcc and drainage facilities in Garh Fateh Shah tehsil tandlianwala District FAISALABAD
11	Provision of drainage system at chak No. 420/GB tehsil tandlianwala district FAISALABAD
12	Provision of tuff tile, PCC and sewerage facilities at chak No 243/RB tehsil faisalabad district FAISALABAD
13	Provision of drainage facilities at chak No 253/ RB and 248/RB tehsil faisalabad district FAISALABAD
Toba Tek Singh District	

1	Provision of Soling / Resoling, Drains, Sullage Carrier, Sewer, WS Pipe, Tuff Tiles, PCC etc: in Rajana Tehsil T.T.Singh District T.T.Singh
2	Provision of Sewerage Drainage (Soling / Resoling, Drains, Sullage Carrier, Sewer, Tuff Tiles, PCC etc) in 5 villages of Toba Tek Singh
3	Provision of Public Toilets in 20 village area/Chak
4	Provision of Soling, Drains, Sullage Carrier, Sewer, Tuff Tiles, PCC etc: in 21 villages of tehsil gojra, TTS, pirmahal and kamalia District T.T.Singh
5	Model Village of 300 HH Chak 281 JB in which paved streets, covered drainage system ,Public toilets and decentralized waste water treatment plant
Jhang District	
1	Provision of Sewerage Drainage (Soling / Resoling, Drains, Sullage Carrier, Sewer, Tuff Tiles, PCC etc) in 71 villages of Jhang
2	Provision of Public Toilets in 20 village area/Chak
3	Model Village of 300 HH in Namdar Sial in which paved streets, covered drainage system, Public toilets and dentralized waste water treatment plant
Chiniot District	
1	Provision of Sewerage Drainage (Soling / Resoling, Drains, Sullage Carrier, Sewer, Tuff Tiles, PCC etc) in 60 villages of Chiniot
2	Provision of Public Toilets in 20 village area/Chak
3	Model Village of 300 HH in Chak 242 JB in which paved streets, covered drainage system, Public toilets and decentralized waste water treatment plant

Spatially marked Sewerage and Drainage interventions are reflected on projects map below. It is envisaged that these proposed interventions will increase 7% coverage in the rural areas of division.

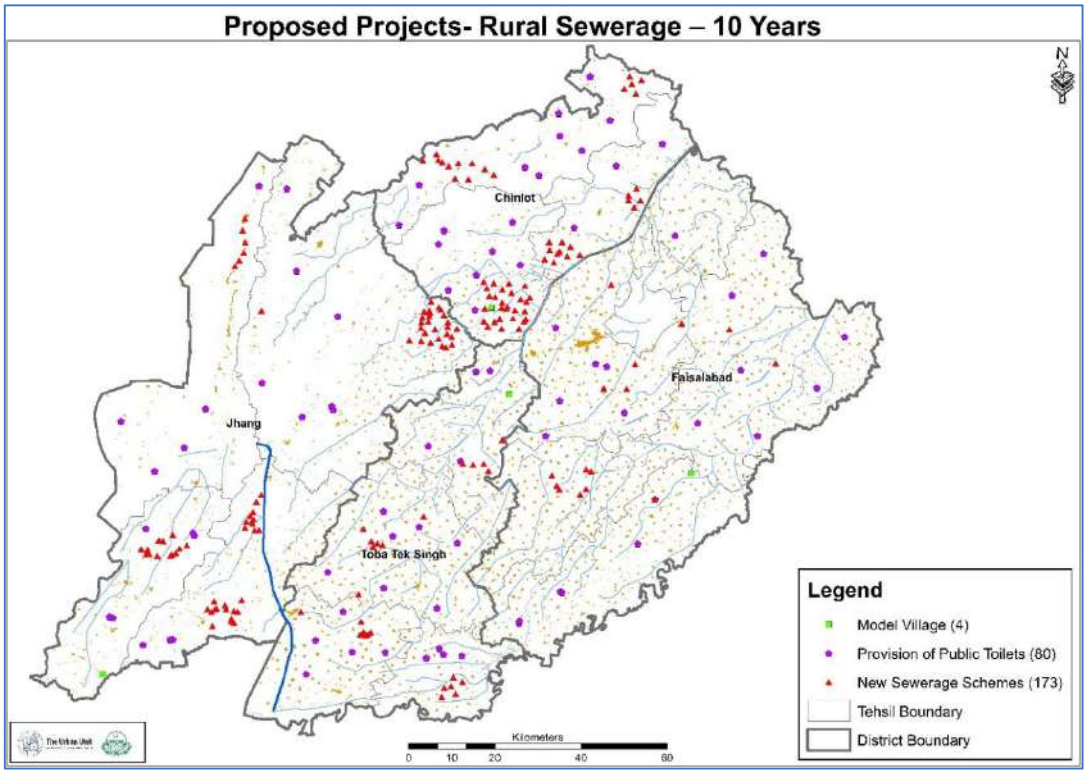


Figure 74: Spatial Representation of Rural Sanitation Interventions

9.8 Cost Summary Rural WSS

Summarized identified intervention projects of worth PKR 10.6 Billion over the next 10 years is articulated in table.

Table 41: Summary of Rural WSS Interventions

Rural WSS Costing Summary (2023-2033)		
Water Supply	**PKR**	**Million PKR**
Faisalabad	3,547,583,495	3,548
Toba Tek Singh	1,066,283,243	1,066
Jhang	346,138,602	346
Chiniot	152,489,032	152
Sub-Total -I		**5,112**
Sanitation	**PKR**	**Million PKR**
Faisalabad	1,098,234,155	1,098
Toba Tek Singh	797,947,097	798
Jhang	1,940,579,522	1,941
Chiniot	1,652,308,397	1,652
Sub-Total -II		**5,489**
Grand Total		**10,602**

10 Further Recommendations

Following are few further recommendations which are proposed for further improving the WSS services in the planned regions.

10.1 Establishment of GIS-based Asset Management Units in Operating Agencies Offices

The rising trend of population in cities of Punjab has resulted in ever-expanding urban centers. The surge in population is leading to hap-hazard and unplanned formation of municipal infrastructure, to cater to the needs of these growing cities, mostly due to lack of information which can also be made possible through GIS based system and officials proficient enough to perform analysis related to the planning of these emerging and densely populated urban centers. More infrastructure has made information availability indispensable for the successful management and operation of city's services i.e. Water Supply & Sanitation.

Team Urban Unit noticed the lack of digital resources and record-keeping in the municipalities of Faisalabad division during its survey. Most of the municipalities of Faisalabad specially the district MCs other than Faisalabad City, lack the necessary resources and expertise for mapping and planning of their water and sanitation systems. Hand-drawn drawings are still being used for proposing new schemes and it is the need of the hour to incorporate digital means of asset management and record in the current development scenario of Punjab. Lack of availability of resources for important analysis i.e., slope analysis, elevation profiling, etc. are also one of the reasons for poor services in visited areas even after hefty investments.

Establishment of GIS Cell (GIS-based Asset Management Units) in the offices of Operating Agencies like Municipal and District Committees is thus proposed. This would result in capacity enhancement of these departments and enable them to map, organize and manage their water and sanitation assets in a self-sustained manner. GIS inventories would be developed, which can be used for planning of new or assessment of proposed projects. The GIS Cell of WASA – Faisalabad is an excellent implementation of using digitization for the mapping and management of water appurtenances, and such practice needs to be replicated in all the other districts of Faisalabad Division.

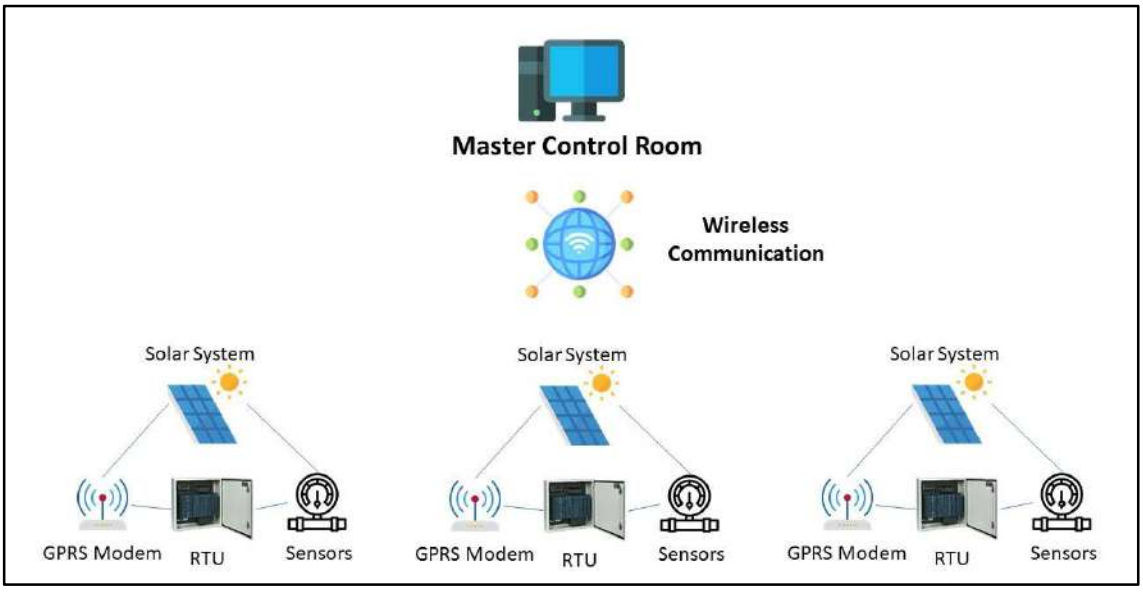


Figure 75 Concept of GIS Based Monitoring System

An advantage of geo-tagging and mapping is the ease with which information can be analyzed. Graphical and pictorial representations of data can be generated in minimal time and with minimal effort. The output can be configured to appear on specified portals or dashboards, increasing the effectiveness for operational and maintenance capabilities of these institutions. Integration of GIS and SCADA-based resources is another frontier that can be explored for real-time monitoring of system. The system can be calibrated with advanced data collection (SCADA enabled) sensors that can transmit data to a centralized control unit, for a real-time analysis of different features of the system. Water demand-supply, NRW analysis, Complaint redressal systems, Energy Analysis etc. are just some of the features that can be explored through this technology. This may in-turn help while imperializing the WSS services and hence investing accordingly.

10.2 Capacity Building Plan

During field assessment and consultation sessions, various issues were brought to light related to Capacity Building gaps in the organization which have operation and maintenance responsibility. As such, following is recommended as a Capacity Building program for all the operating agencies in order for them to get further capacitate.

- **Al-Jazari Water & Sanitation Academy**

The Government of the Punjab acknowledged these issues and realized the need of improvement of the O&M and management capabilities of WASAs and all other service providers (MCs and TCs) for better and improved Water Supply and Sanitation services. Training of management and field staff is essential in order to keep them updated with the recent developments in their field and to enhance their professional abilities. This have been made possible with establishment of Al-Jazari Water & Sanitation Academy in Lahore.
Al-Jazari Water & Sanitation Academy was established by the collaboration of WASA-Lahore, Government of Punjab and Government of Japan for the training and capacity building of

WASAs & other operating agencies of Water Supply & Sanitation services. Under the project titled, "Project for Improving the Capacity of WASAs in Punjab Province", Al-Jazari Academy has been working on the capacity building of the five (05) WASAs and operating agencies from all over Pakistan by conducting trainings and workshops to improve the capability for effective management of water and sanitation assets and Human Resources (HR).

Figure 76 Al-Jazari Water & Sanitation Academy

- **Modules Offered**

The institute offers multitude of courses and trainings modules in multiple disciplines the detail of few of which is tabulated below:

Table 42 Al-Jazari Courses Offered

Course	Module
O&M of Tube-well and Pump Facility	1. O&M of Water Distribution System
Leakage Detection	1. Basic knowledge of Leakage Prevention Work
	2. Leakage detection and repair at the site (OJT)

	3. Installation & operation of equipment at the site (OJT)
O&M of Sewer and Storm Water Drainage	1. Safety control and measure for sewerage and drainage
	2. Operation & Maintenance of sewer system
	3. Operation & Maintenance of drainage system
O&M of Electrical and Mechanical Equipment	1. Centrifugal Pumps, Induction Motors and Valves
	2. Electrical Panel and Instrumentation Equipment
	3. Generators
	4. Chlorinators and Filtration Systems
	5. Heavy Machines
	6. Supervisory Control and Data Acquisition System (SCADA)
	7. Water Meter Maintenance and Repair
Asset Management	1. Introduction to Asset Management
	2. Creating & Updating Asset Database in Asset Management Information System
	3. Asset Database Analysis
	4. Asset Replacement Plan
	5. Asset Conditions Survey & Analysis
	6. Use of GIS System in Asset Management
Business Planning	1. Business Plan & Operation of WASAs
	2. Strategies for Water and Sanitation Service Delivery Improvement

	3. Human Capita Development
	4. Financial Management System
	5. Implementation of Business Plan

		
Training on Energy Audit for staff members of WASA Rawalpindi	Hands on training of leakage detection of pipe	On-site assessment to measure the flows and evaluate the Condition of Pump House

Figure 77 In Pictures: Trainings

These diversified training includes multiple genre of courses which can help Capacity Building of operating agencies. Example of this is the GIS based software for Asset Management course. This course is aimed at training staff to mark and update the water supply and sewerage infrastructure with multiple attributes which includes its installation year and other technical properties. Lack of this capacity was also felt during the visit. These programs which are offered are customized to assist in planning of Operation & Maintenance and Asset Management. It is thus strongly recommended for all the operating agencies relevant officials to attend these courses which can further improves it service delivery in a more improved fashion.

10.3 Institutional Reformation

As per laws and regulations, Local Government & Community Development Department (LG&CDD) is responsible for provision of water and sanitation services in the cities. MCs are currently managing the Operation & Maintenance (O&M) of Water Supply and Sanitation (WSS) along with many other delegated functions in all of four districts of Faisalabad Division. MC consists of the Administrator, Chief Officer (CO), 5 Municipal Officers (MO) and other officials of the Local Council Service and officials of the offices delegated to the Municipal Committee. Administrator is the head of Municipal Committee and exercises all functions and powers as have been assigned to him. The Chief Officer is acting as coordinating and administrative officer in-charge of the Municipal Officers. Furthermore, Municipal Officers (MO), Deputy MOs and Assistant MOs support the above staff. These officers are looking into Infrastructure and Services (I&S), Finance, Regulation, Information Technology (IT), Planning & Architecture (P&A) head functions.

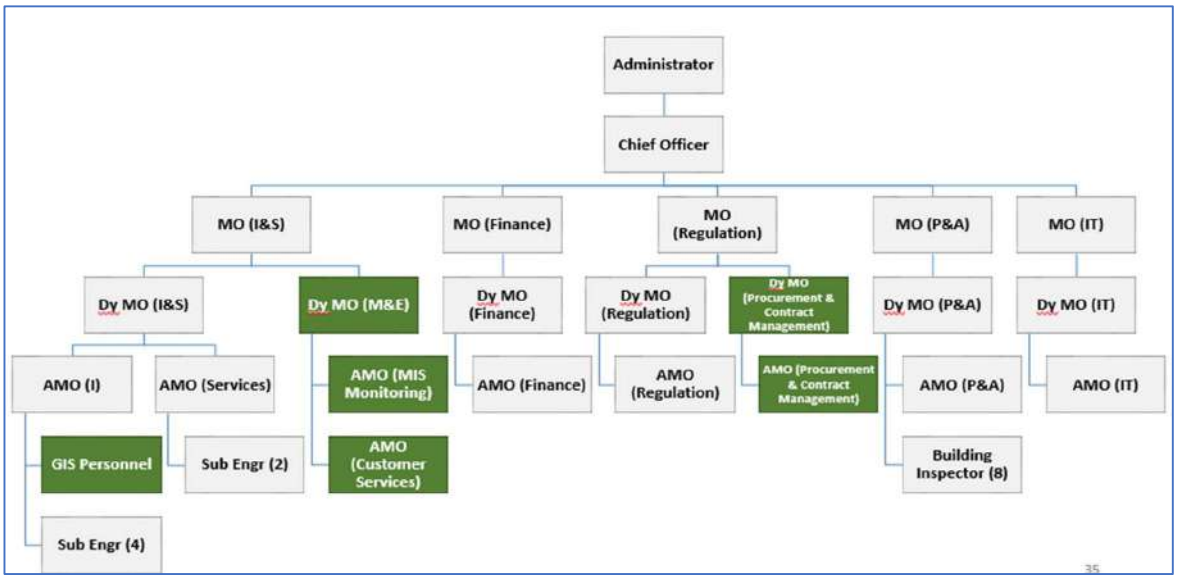


Figure 78 Proposed Institutional Structure for MCs

It is observed that some of the essential components of municipal services are neglected by the existing staff due to lack of proper relevant Human Resource (HR). The embedding of aspects of Asset Management, geo-tagging, mapping, and monitoring along with Complaint Management in service delivery results in to efficient management, accountability, and customer satisfaction. Geographical information System (GIS), Monitoring & Evaluation (M&E), Customer Services, MIS based Monitoring and Procurement & Contract Management are identified and proposed in green color to be added in the existing structure.

10.4 Renewable Energy Potential

Direct use of solar energy is the most preferred mean capable of ultimately supplanting current energy supply from non-renewable sources, but at the expense of a land area. To fulfill the growing municipal demands of our cities, it requires heavy reliance on machinery which is posing huge financial burdens on the service providers. As reported by WASA Faisalabad, the current electricity tariffs applied on their facilities are of industrial category which cost more than PKR 50 per unit. Seeing the growing demand of municipal services, increasing shortfalls and costs of electricity, shifting the reliance on solar energy is need of the hour. Therefore, during the WSS survey some potential sites were also identified to install solar system in Faisalabad and the same can be adopted in other three districts of the division.

Faisalabad region has the Solar Photovoltaics (PV) potential of approximately 1500 kWh/kW (Global Solar Atlas, World Bank). The potential areas for deployment of decentralized solar energy system (on-site) in Faisalabad city are identified during the visit. The on-site solar system will help utilization of existing space and reduced loss of generated energy. The generated energy will not only share the electricity burden of the facilities but also enable to keep facilities functional during loadshedding hours. These interventions are proposed in the form of projects in relevant sections (water and sanitation). The solar potential (DC) on identified sites are estimated considering the average sunshine hours (5-6 hours) and 250 annual sunny days. The table containing detailed estimations with annual generation are

attached in the annexures section. It displays the solar potential on identified sites which may vary as per actual atmospheric conditions, temperatures and shading effects. It can also subject to change depending upon the efficiency of system adopted for installation. The figure below displays the identified site for installation of on-site solar systems.

WASA Faisalabad, HQ

Terminal Reservoir (FSD City)

Chokera Disposal Station (FSD City)

Jhang Road Disposal Station (FSD City)

Figure 79 Identified sites for installation of Solar System (Faisalabad City)

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