UNIVERSAL WATER REGISTRY

Project Concept Note & Monitoring Report (PCNMR)	
Rainwater Offset Unit (RoU) Standard	Version 6.1
UWR RoU Scope (Annual RoU threshold limit)	**RoU Scope 2 (**1,000,000 RoUs)
UWR RoU Scope (Annual RoU threshold limit)	**RoU Scope 5 (**1,000,000 RoUs)
UNDP Human Development Indicator	0.644
National Water Security Index	2

Project Aggregator and Consultants	**SDG-CR CONSULTING LLP**
Project Proponent	**MILLENNIUM PARK HOLDINGS PVT. LTD.**
RoU Scope Description	1. Measures for conservation and storage of unutilized water for future requirements including freshwater ecosystems and wetlands. 2. Conservation measures taken to recycle and reuse water, spent wash, wastewater etc across or within specific industrial processes and systems.
Project Description	1. Rainwater Conservation by creating Surface water storage and gainful use for irrigation purposes. 2. Recycle sewage wastewater and gainful use of treated water for irrigation purposes.
Project Location	Kensville Golf and Country Club, Gujarat, Bharat
Monitoring Period:	01/06/2014 - 31/03/2024
Crediting Period:	2014 -2023
Document Title	Project Concept Note and Monitoring Report (PCNMR)
Purpose	**FOR VERIFICATION**
SDGC Project Number	**6960 – P-02**
Revision	R0
PCNMR report submission date:	January 2025

REVISION HISTORY

REV NO	DATE	DESCRIPTION	PREPARED BY	REVIEWED BY	APPROVED BY

PREFACE

SDG-CR CONSULTING LLP (SDGC) assists in implementing water credit programs to leverage a competitive market-based approach to incentivize voluntary environmental actions of various stakeholders. Apart from incentivizing individual/community behaviors, SDGC encourages private sector industries, companies, and other entities to meet their existing obligations, stemming from various legal frameworks by taking actions that can converge with activities relevant to generating or buying water credits. SDGC creates a digital data repository by integrating geographical information systems (GIS) with artificial intelligence (AI) to create various insights into ESG reporting, social impact assessments, and business value enhancement.

SDGC plays a vital role as a project aggregator and consultant to support institutions and civil societies to encourage them to initiate integrated water management practices to reverse the depletion of groundwater sources worldwide in the context of the Universal Water Registry water credit program. SDGC also assists in establishing a clear relationship between water's price and its value, to reflect attempts not only for cost recovery but also the value delivered for unique applications like business risk analysis, climate risk analysis, green credits, finance, business valuation, engineering design, and resource valuation.

SDGC has developed methodologies in alignment with the UWR RoU standards to reflect the ecosystem service value of water to support behavior change in favor of sustainable water use and management at various levels. Methodologies are not limited to the integration of various water verticals but also redefine the relationship between civil society and water. This initiative will also help to add to the water's social value and economic value through integrated, well-coordinated, and comprehensive design services while balancing between the triple bottom line of sustainability i.e. people, planet and profit.

SDGC adopts an integrated water source study and analysis by carrying out a WATERSHED STUDY, SURFACE WATER ANALYSIS, and GROUNDWATER STUDY to redefine water as a definite "SOURCE" while bringing a paradigm shift in people's lives and the surrounding environment. The study brings technical insights and the water footprint (WF) of society's domestic, industrial, and agricultural needs to save humanity before the economy. We apply the purposeful and functional logic between various water verticals to complete a hydraulic circle while balancing water elements on the earth.

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1 EXECUTIVE SUMMARY

The following recommendations have been provided by **SDGC**, by carrying out a hydrological and hydrogeological assessment for the brownfield facility of KENSVILLE GOLF AND COUNTRY CLUB (KENSVILLE), Dev Dholera Village, Nr. Baldana Village, Bavla-Rajkot Highway, Ahmedabad, Gujarat, Bharat. Points listed below are to be referred, reviewed, and articulated to derive water valuation of the premises and to design alternative water structures with suggested measures to seize future opportunities to bring water sustainability to make water-neutral premises while gaining water credits.

A.	The site was physically visited, and the water-holding reservoirs were verified on 29th March 2024.
B.	The site was again visited to verify the operational STP unit on 30th November 2024.
C.	The premises are assumed to be functional throughout the year irrespective of their occupancy.
D.	Statutory compliance for the premises may be revisited for GDCR (Gujarat Development Control Regulations and CGWA (Central Ground Water Authority)
E.	Water reservoirs were constructed in 2006 and operated from 2007 onwards.
F.	The STP unit was installed and put into use from 2015 onwards.
G. H. I. J. K. L.	The project has been commissioned with a conscious and sustainable design approach, however the same is now complying with the UN's Sustainability goals. SDG No. 6 - Drinking Water and Sanitation SDG No. 9 - Industry, Innovation and Infrastructure SDG No. 11 - Sustainable Cities and Communities SDG No. 12 - Responsible Consumption and Production SDG No. 13 - Climate Change.
M.	Annual rainfall pattern is observed in reducing trend and the minimum annual rainfall is observed as 280 mm in 2009.
N.	The first aquifer is ranging between C6 (48mt) to C14 (102mt) – A1, having saline properties.
O.	The second aquifer is ranging between C4 (186mt) to C30 (228mt) – A2, having fresh water.
P.	**Total water credits have been calculated for Scope 2 is 15,09,168 RoU**
Q.	**Total water credits have been calculated for Scope 5 is 44,120 RoU**
R.	**Total water credits have been calculated for both the Scope is 15,53,288 RoU**

2 ABOUT THE PROJECT PROPONENT

The proponent of the project (PP) is MILLENNIUM PARK HOLDINGS PVT. LTD., a visionary and futuristic project proponent, who has conceptualized not just to bring Golf to the state of Gujarat but to also introduce the idea of responsible and efficient infrastructural initiatives to the industry. Every aspect of the project was well thought through while keeping the importance of sustainability and green living at its core. Such projects are an inspiration to everyone in the industry, and proof that a luxurious lifestyle can be brought to many, without completely giving up on their responsibilities towards other living species and the planet.

KENSVILLE evokes a unique joy that soothes the soul with a tagline of FLORA, FUANA, and FAMILIES and has incredibly expansive landscapes, lush green grass, and wildflowers revolving lotus ponds. KENSVILLE is an idyllic base for migratory birds, making the space a natural hub for flora and fauna with 2L+ trees & 50+ bird species. The Master Plan of KENSVILLE is represented below showing all salient features as developed.

Club Mahindra at Kensville Golf Resort is admired for its peaceful location, free from noise and pollution, which contributes to a serene getaway. The resort boasts a variety of praised amenities, including activities catering to all ages, scrumptious dining options and all enveloped in a pristine and well-kept setting. Guests enjoy the spaciousness of the 72 rooms. The staff's friendliness and professionalism receive commendations, though the service occasionally falls short of expectations.

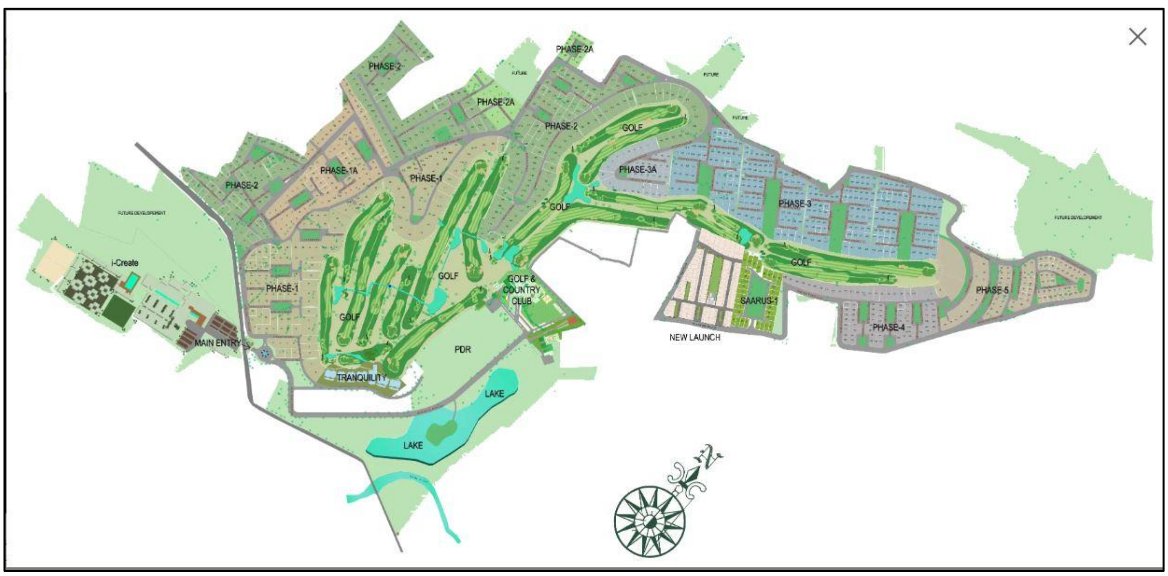


Figure 2.1: Master Plan

UWR requires projects that are real, verifiable, and must be currently operational. UWR Rules allow projects from domestic and developing nations as well. All UWR water conservation and recharge activities have prescriptive eligibility, evaluation, and verification requirements as outlined in their approved positive project list protocol requirements, as outlined in the UWR Rainwater Offset Standard Version 6.1.

2.1 UNDP HUMAN DEVELOPMENT INDICATOR

All projects using this methodology must be ideally located in a country or region with a recent UNDP Human Development Indicator below 0.900. However, countries and regions with higher HDI's will also be considered taking the goal of UN SDG 17 into account, especially water conservation and recharge projects that encourage and promote effective public, public-private, and civil society partnerships, building on the experience and resourcing strategies of partnerships.

India falls into 2022 HDI value 0.644 which is represented in the below image.

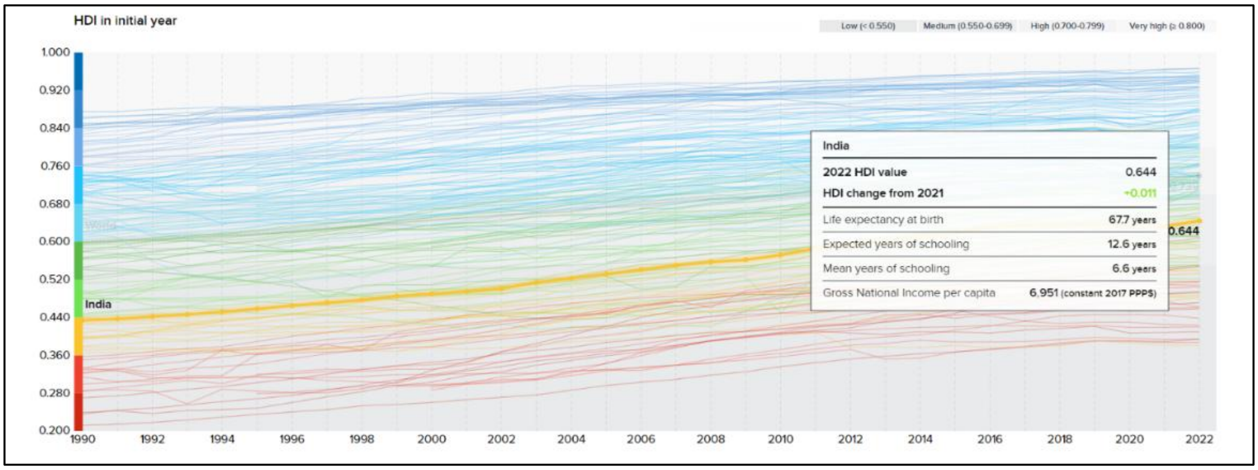


Figure 2.2: UNDP Human Development Indicator

2.2 NATIONAL WATER SECURITY INDEX

The five Key Dimensions form the National Water Security Index (NWSI). The maximum score for each KD is 20. The maximum NWS score—the sum of the KDs—is 100. At NWSI Stage 1, the water situation is encouraging, however there is a large gap between the current state and the acceptable level of water security. At NWSI Stage 5, the country may be considered a model for its management of water services and resources, and as water secure as possible under current circumstances.

All projects using this methodology are ideally below the NWS score of 60 and NWSI equal to or lower than 2 (NWSI ≤ 2). However, projects above the NWS score of 60 can also use the methodologies outlined in the UWR RoU Standard and be eligible for RoUs under the program.

Table 2.1: National Water Security Stages

NWSI	NWS Score	NWS Stage	Description
5	96 and above	Model	All people have access to safe, affordable, and reliable drinking water and sanitation facilities. Economic activities are not constrained by water availability. Environmental governance is good, and pressure on aquatic ecosystems is limited. Water-related risks are acceptable and relatively easy to deal with.
4	78–96	Effective	Nearly all people have access to affordable safe drinking water and sanitation facilities. Economic water security is high. Environmental governance is generally acceptable, and attention is given to ecological restoration. There are systematic commitments to reduce disaster risk.
3	60–78	Capable	Access to safe drinking water and sanitation facilities is improving. Economic water security is moderate. Environmental governance is moderate, with clear pressure on the ecosystem. There are some institutional commitments to reduce disaster risk.
2	42–60	Engaged	A significant majority of rural and urban households have access to basic water supply but less to sanitation. Economic water security is low. Environmental governance is moderate, with severe pressures on aquatic ecosystems. Progress in achieving disaster risk security is low.
1	0–42	Nascent	A low proportion of rural and urban households have access to basic water supply and sanitation. Economic water security is low. Environmental governance is poor, with significant pressures on the aquatic ecosystems. Hardly any attention is given to disaster risk reduction.

India falls into the Engaged Stage (2) of the National Water Security Index in 2020 which is represented in the below image.

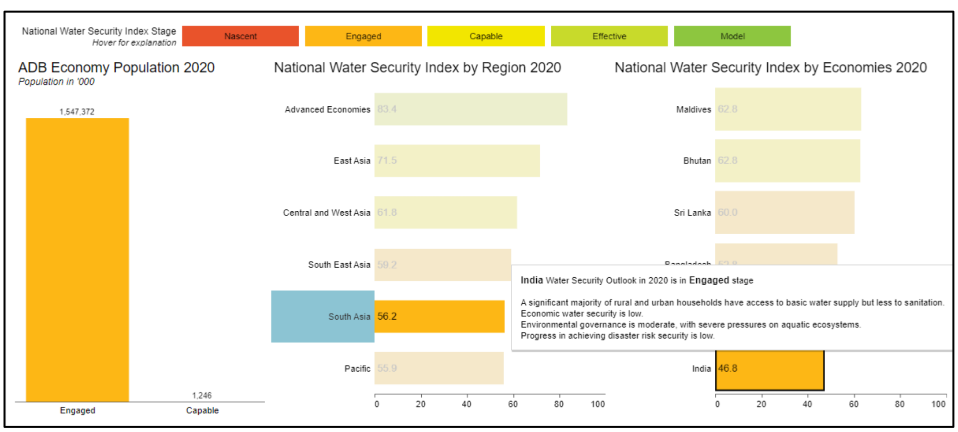


Figure 2.3: National Water Security Index

2.3 LOCATION OF PROJECT ACTIVITIES

KENSVILLE is located at an idyllic location of Dev Dholera, 40 km from Ahmedabad, Gujarat. This makes it closely located around culturally, historically, and environmentally important places like – Lothal – the seat of one of the most ancient civilizations. The home of the Tarnetar Mela is an event attended by folks from all over sanctuaries like Nalsarovar, Zainabad, and Veravadar.

The brownfield site is under operation for recreational activities and weekend villas on global coordinates 22.78341 N, 72.2058 E over 665 acres of land. The same is represented in the below location map.

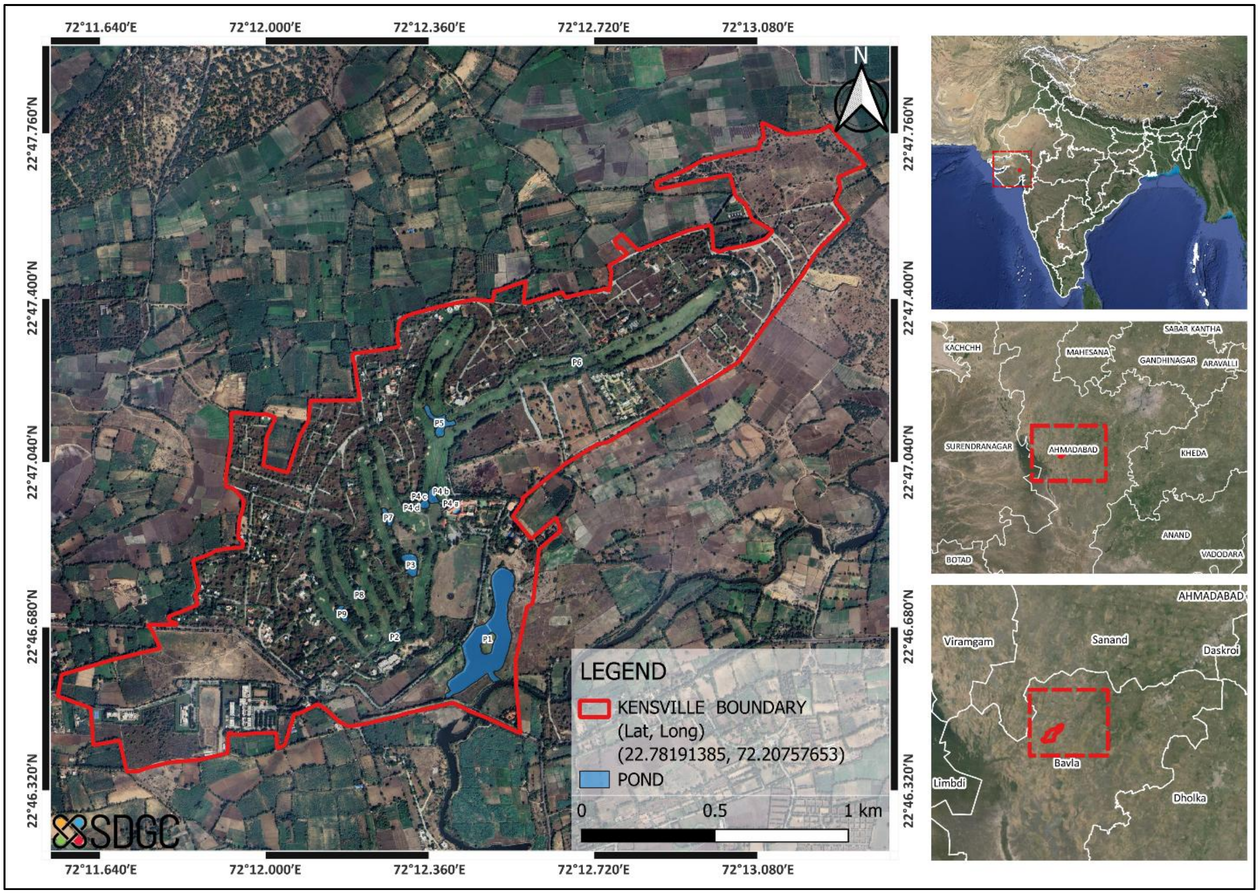


Figure 2.4: Location Map

2.4 PROJECT BRIEF

The following site-specific information and details are to be referred to get acquainted with the water condition of the premises.

Table 2.2: Project Brief

SN	SPECIFICS	DESCRIPTION
1	Address of the project activity	Kensville Golf and Country Club, Dev Dholera Village, Nr. Baldana Village, Bavla-Rajkot Highway.
2	District	Ahmedabad
3	State	Gujarat
4	Country	Bharat
5	Latitude – Longitude	22.78341 N, 72.2058 E
6	Land use type	Commercial use
7	Project type	Infrastructure project
8	Industry type	Recreational infrastructure (Resort)
9	MSME Type	No
9	Plot area	667 acres
10	Block basin	Sabarmati Basin
11	Sub-basin	Sabarmati Lower Basin
12	Assessment Unit Type	Safe
13	Primary water supply source	Pond (Surface water storage)
14	Secondary water supply source	Production borewell (Groundwater storage)
15	Annual irrigation water demand	4,00,000 CuMt Approximate (Reference - chapter 12)
16	Annual domestic water consumption	882,205 CuMt
17	Installed STP Capacity	50 CuMt/ day
18	Topo sheet No	46B/1

2.5 KEY ROLES AND RESPONSIBILITIES

The Project Proponent and Owner (PP) possess all the necessary permits and ownership documents for the uncontested legal land title for the project area within the project boundary of the project.

The KENSVILLE team was very conscious of how every action of theirs would have an exponential impact on multiple aspects. Considering that Golf courses require regular maintenance and water, they were very conscious of how important it was to secure a way to source water sustainably. As can be seen in the Master Plan above, water management at the premises was given due importance and the creation of ponds/ lakes was ensured.

The most important aspect of the project conceptualization was the location, it was built on and how the project works to mitigate the challenges being faced at the location, especially the availability of water.

PP enabled and funded all the activities necessary for the digging and creation of the ponds which was ready in October 2006 and put it in the operational phase to implement the rainwater harvesting initiative in the monsoon of 2007. The PP carries out regular de-silting of the ponds and consumes the water from the same for irrigation activities on the premises. Maintenance of the ponds will continue to be done by PP for upcoming years for efficient use of harvested rainwater.

PP enabled and funded the installation of the STP unit at Club Mahindra to recycle sewage wastewater and gainful use of treated water for irrigation purposes. The STP unit was installed and put into use from 2015 onwards. PP does the scheduled preventive maintenance of the STP unit for the efficient use of the unit.

Project proponent and owner	MILLENIUM PARKS HOLDINGS PVT. LTD.
Project proponent and owner's address	Kensville Golf & Country Club, Dev Dholera Village, Nr. Baldana Village, Opp. Lane of Sahyog Restaurant, Kerala GIDC, Bavla-Rajkot Highway, Ahmedabad, Gujarat, Bharat.
Project aggregator and consultant	SDGC
Project aggregator and consultant's address	4th Floor, Shreeji House, Behind M. J. Library, Ellisbridge, Amdavad 380006, Gujarat, Bharat.
Date PCNMR Prepared	15TH June 2024

The project **RWH for developing ponds/reservoirs and setting up an STP unit for water reuse at KENSVILLE, Gujarat, Bharat** is an initiative for water conservation, storage of unutilized water for future requirements, and reusing water. The timelapse study is carried out by sourcing relevant satellite images of the site and the surrounding regions to understand the morphological changes within the site boundary. Relevant images have been sourced to visualize the particular man-made structure during rainy days. The ponds were constructed in 2006 to conserve rainwater within the premises. Since the monsoon of 2007, water started accumulating for a significant period.

PROJECT NAME	**KENSVILLE**
UWR Scope:	Scope 2 & 5
Date PCNMR Submitted	January 2025
Catchment Area	5100 acres (Refer to Chapter 9)
Month and Year of Construction of Pond	September - October 2006
Month and Year of STP unit installation	May 2015

The capacity of the ponds was designed based on yearly water demand primarily for irrigation requirements. Ponds were designed at strategic locations to ensure continuous replenishment of rainwater during rainy days. Below is the sequence of important events based on the timelapse of satellite images.

Table 2.3: Data Source

Data Source	Launched in 1999, Landsat 7 is a satellite that captures images of the Earth's surface
How is it generated?	It carries the Enhanced Thematic Mapper Plus (ETM+) sensor, which collects data in eight spectral bands. These bands provide information about the Earth's surface in different wavelengths of light, including visible, near-infrared, and thermal infrared.
What does it provide?	Landsat 7's images have bad lines due to a malfunction in its Scan Line Corrector (SLC) that occurred in 2003. The SLC is responsible for ensuring that the satellite's sensor scans across the Earth in a precise, linear fashion. With a malfunctioning SLC, the sensor's field of view deviates from a straight line, resulting in data gaps and appearing as horizontal lines of missing data in the captured images.
What are its applications?	Applications including land cover mapping, monitoring deforestation, and tracking changes in earth surfaces can be obtained from Landsat 7 data, that is freely available.

Satellite Image September 2006

Satellite Image October 2006

Figure 2.5: Pond Formation Satellite image

Both the pictures shown above are sourced from Landsat 7 ETM sensor of 2006 in represented in True color composition. The circled area shows the KENSVILLE pond position, in September 2006, the pond began to dig up until October, which is highlighted in the second image.

2.6 SITE VISIT

The following images were captured during a physical field visit in March 2024 and November 2024 to identify various geophysical features of the study area, to understand the terrain, and to carry out an accuracy check of digital elevation data, while observing the physiography of the study area. The ground-truthing study helps the further mapping requirements of the site such as geography, climate, elevation modeling land-use dynamics, etc.

Figure 2.6: Site Visit

The capacity of the STP was designed based on estimated occupancy and water consumption patterns for the facility, which will generate sewage water. The installed STP unit at Club Mahindra, which has been in operation since 2015 has a capacity of 50KLD catering to 72 guest rooms. Treated water will be stored and used for irrigation requirements.

3 STATUTORY COMPLIANCE

Groundwater usage laws and their enforcement are taking shape in Bharat. The policies also reach the end users, who are expected to be key stakeholders in a way they would understand its provisions and their role. Therefore, the UWR RoU program and methodologies are introduced to employ the broad monitoring and accounting framework to promote available technologies like GIS and remote sensing, where water security plans encompass a watershed for a large number of entities.

Yet the water security concept in its true sense has not become institutionalized enough, which is expected to capture the impacts of various water recharging, harvesting, recycling, and conservation practices, that are aimed at enhancing groundwater supply stocks. Therefore, it is mandatory to comply with statutory guidelines to obtain various " No Objection Certificates" to put the building in use, while claiming the water credits.

Groundwater abstraction guidelines have been prepared to regulate groundwater extraction and conserve the scarce groundwater resources in the country to have sustainable management of water resources. These guidelines come into force in 2020, 24th September through Gazette Notification number CG-DL-E-24092020-221952 and will supersede all earlier guidelines issued by the Central Ground Water Authority (CGWA).

The authority has been regulating groundwater development and management by issuing 'No Objection Certificates' for groundwater extraction to all new/ existing residential, industries or infrastructure projects unless specifically exempted. Framed guidelines apply to PAN India.

(Reference - THE GAZETTE OF INDIA: EXTRAORDINARY [PART II—SEC. 3(ii)] Clause no 4.3 – page no 38 – 39).

3.1 COMMERCIAL USE – INFRASTRUCTURE PROJECTS

Since infrastructure projects are location-specific, granting of No Objection Certificate to such projects located in over-exploited assessment units shall not be banned. New infrastructure projects/ residential buildings may require dewatering during construction activity and/ or use groundwater for construction. In both cases, applicants shall seek a No Objection Certificate from CGWA before the commencement of work. However, in over-exploited assessment units, groundwater use for construction activity shall be permitted only if no treated sewage water is available within a 10 km radius of the site.

3.1.1 NO OBJECTION CERTIFICATE

New, as well as existing Infrastructure projects, shall also be required to seek a No Objection Certificate for the abstraction of groundwater.

3.1.2 DIGITAL WATER FLOW METER

In the case of infrastructure projects that require dewatering, the proponent shall be required to carry out regular monitoring of the dewatering discharge rate (using a digital water flow meter) and submit the data through the web portal to CGWA/SGWA as applicable. Monitoring records and results should be retained by the proponent for two years, for inspection or reporting as required by CGWA/ SGWA.

3.1.3 SEWAGE TREATMENT PLANT

Installation of Sewage Treatment Plants (STP) shall be mandatory for new projects, where the groundwater requirement is more than 20 m3 /day. The water from STP shall be utilized for toilet flushing, car washing, gardening, etc.

3.1.4 VALIDITY – NOC

For infrastructure dewatering/ construction activity, a No Objection Certificate shall be valid for a specific period as per the detailed proposal submitted by the project proponent.

3.1.5 PIEZOMETER

A piezometer is one of the borewell/tube wells being used only for measuring the water level/piezometric head and to take water samples periodically but not to be used for groundwater abstraction. It is also being used to take a water sample for water quality testing whenever needed. The groundwater quality must be monitored and tested once a year during the pre-monsoon (April/ May) and post-monsoon (Oct/ Dec) period by industries drawing groundwater.

Construction of a Piezometer(s) (An observation well(s)) is mandatory for the premises since the water extraction quantity is more than 10 m3 /day of groundwater. The Piezometer is suggested to be installed within the premises and monitored for water level monitoring as statutory compliance. Monthly water level data shall be submitted to the CGWA through the web portal. The piezometer (observation well) is proposed at a minimum distance of 15 m from the borewell/production well. The depth and aquifer zone tapped in the piezometer shall be the same as that of the pumping well/ wells. (Reference - THE GAZETTE OF INDIA: EXTRAORDINARY [PART II—SEC. 3(ii)] Clause no 14 – page no 45).

Table 3.1: No. of Piezometers to be constructed & Type of Water Level Monitoring Mechanism

Table 14.1 No. of Piezometers to be constructed & Type of Water Level Monitoring Mechanism					
S.No.	Quantum of Ground water withdrawal (cum/d)	No. of piezometer required	Monitoring mechanism		
			Manual	DWLR	DWLR with Telemetry
1	<10	0	0	0	0
2	11-50	1	1	0	0
3	51-500	1	0	1	0
4	>500	2	0	1	1

3.1.6 WETLAND

Since groundwater is very crucial for the survival of the wetland area, any excessive groundwater development within the zone of the wetland area would affect the volume of water in that wetland. Projects falling within 500 m. from the periphery of demarcated wetland areas shall mandatorily submit a detailed proposal indicating that any groundwater abstraction by the project proponent does not affect the protected wetland areas. Furthermore, before seeking permission from CGWA, the projects shall take consent/approval from the appropriate Wetland Authorities to establish their projects in the area.

3.1.7 CAUTION

Aquifers are to be enhanced by artificial recharge and to be used as potable aquifers. Hence, it must be ensured that the water that is to be recharged is free from any type of contaminant. The water quality of the pumping tube wells should be monitored periodically. Injection of treated/ untreated wastewater into the aquifer system is strictly prohibited.

4 BASELINE SCENARIO

The baseline scenario is established by referring topographic map, that is typically produced by government agencies, such as the Survey of India (SOI). The toposheet no. 46B/1 concerning the Kensville Golf and Country Club was generated in 2006 by the concerned authority. The Kensville Golf and Country Club is geo-referenced on a toposheet with good accuracy to obtain basic information and different structures; green spots become trees, shrubs, grass, rivers, ponds, and lakes within and around the project boundaries as registered in official records.

Table 4.1: Data Source

What is Toposheet?	Topographic maps are detailed representations of the Earth's surface that represent both natural and man-made features. The toposheet generally refers to the official document that exists in records.
How is it generated?	Toposheets are generally created using aerial photography, satellite imagery, ground surveys, and geographic information systems (GIS) technology.
What does it provide?	Topographic maps typically include information such as relative elevation, water bodies, vegetation, roads, trails, buildings, and other natural/man-made features.
What are its applications?	This map has been referred to establish a baseline scenario to verify with other satellite imaginaries and establish the authenticity of the rainwater conservation initiatives undertaken by PP.

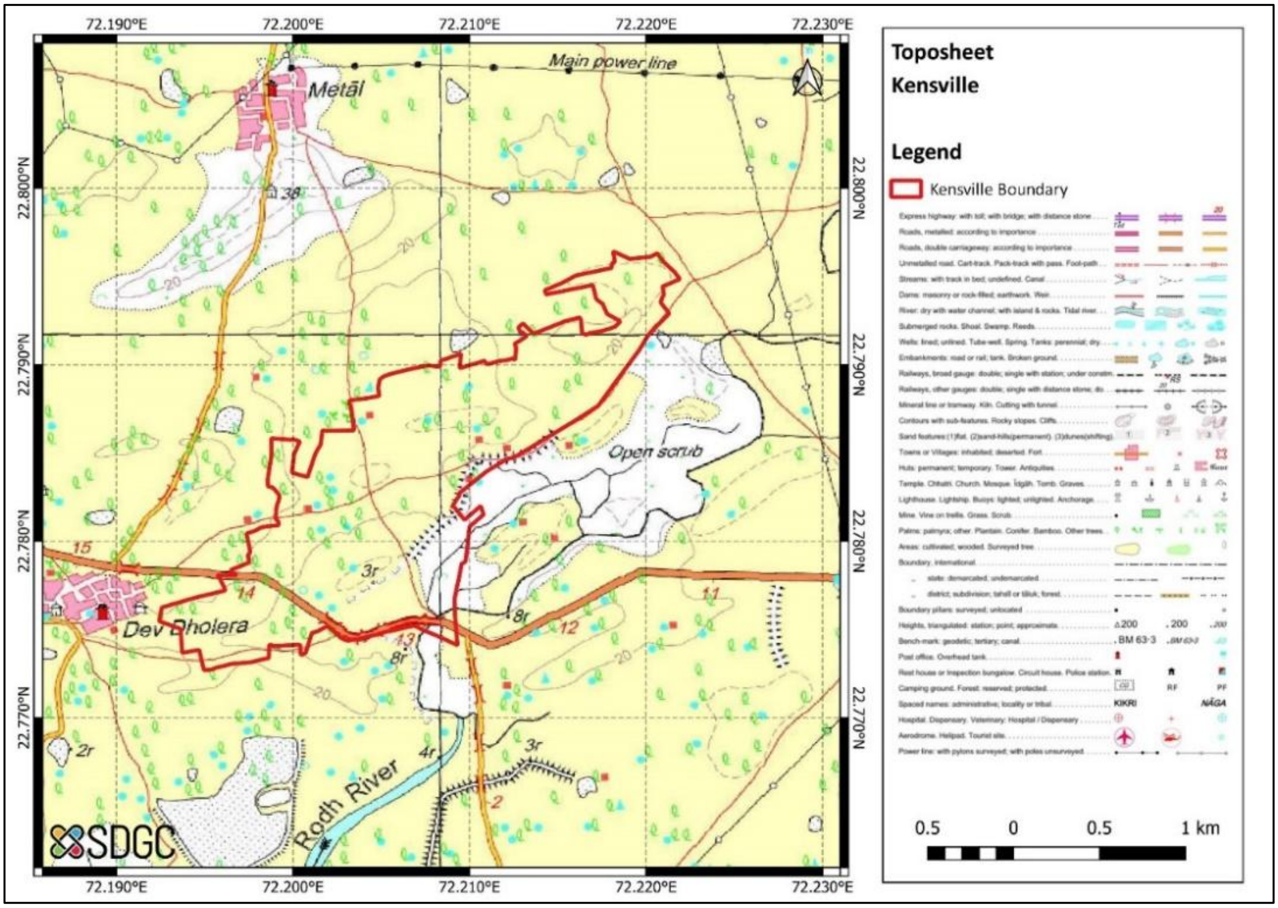


Figure 4.1: Toposheet

The following technical insights have been discovered from the toposheet.

Table 4.2: Technical Insights

SN	TECHNICAL INSIGHTS
1	The survey was carried out in 1998-99
2	The part of the open scrub land falls within the site boundary.
3	The earthen dam is observed within the scrubland to protect the part of the premises.
4	It is observed that there was no surface water storage structure within the site boundary before 2006.
5	The scrubland is observed as a floodplain of Rodh River to convey rainwater from upstream to downstream.
6	The Rodh River delta is the Gulf of Khambhat.

5 CONCEPT

It is pertinent to look back at ancient Sanskrit literature for valuable insights from age-old wisdom, containing highly advanced scientific concepts regarding the hydrological cycle. The present report refers to **'Conceptual Aspect of Hydrological Cycle in Indian Mythology of Kishkindha Kanda, Ramayana'**, to arrive at the representational approach for aquifer mapping in the modern context. The concept of modern hydrology can be transformed based on a conceptual model of how water circulates between the earth and atmosphere in different states as water vapour, liquid or solid.

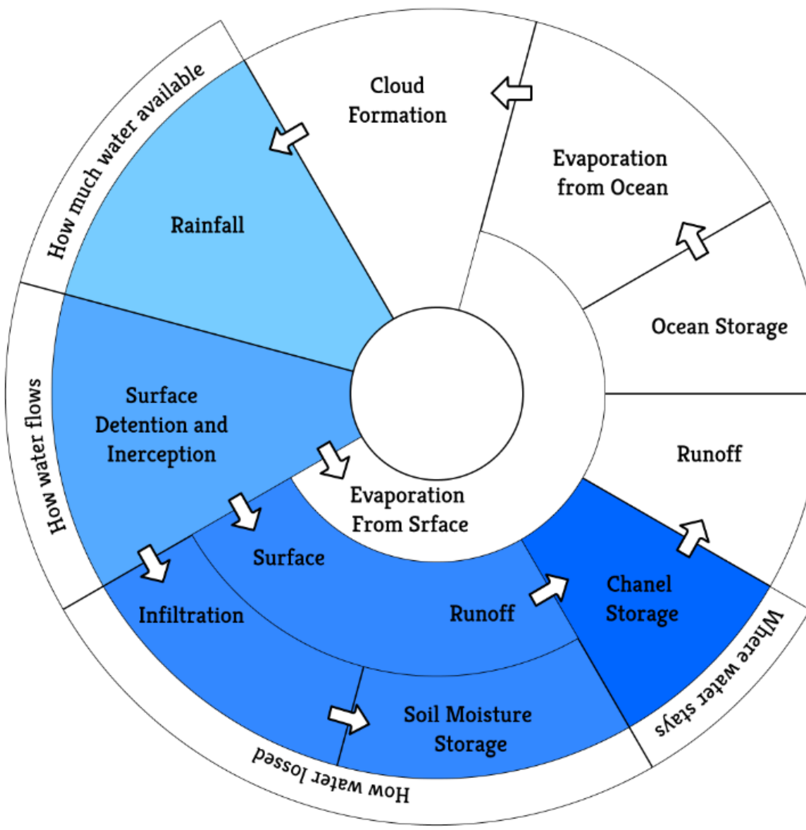


Figure 5.1: Ancient Hydrological Cycle from 800 to 500 B.C.

The present report uses these insights during the study as well as analysis of the data being generated at various stages. The Aquifer Management Plan will be based on the interdependencies of various stages to generate a contemporary understanding of the hydrological cycle with all important facets. It is required to base modern hydrological study approaches on ancient insights to obtain contextual reference and strengthen the modern approaches in terms of accuracy. Therefore, it is proposed to revisit ancient Indian water management practices to design the methodology statement to generate water credits.

6 OBJECTIVE

The objective of this voluntary water offset program is supported by the Universal Water Registry Rainwater Offset Unit Standard Version 6.1 (UWR RoU Standard or Programme). This initiative is to drive unutilized water harvesting, recharge, and conservation efforts, defined as the catchment-based initiatives independent of water quality parameters undertaken for capturing/recycling/reusing unutilized water that is in consonance with the triple bottom line of sustainability i.e. People, Planet and Profit.

As this initiative will benefit the whole premises of KENSVILLE, rainwater conservation is done by creating a farm pond as an effective solution. Sufficient water is made available for agricultural irrigation purposes throughout the year, to reduce the consumption of Groundwater. The overall goal of this project is to promote sustainable water development to maintain groundwater reserves and ensure water security in Bharat to attain the Sustainable Development Goals (SDGs) 6, 9, 11, 12 and 13.

Figure 6.1: Sustainable Development Goals

7 METHODOLOGY

The UWR RoU program and methodology employs a broad monitoring and accounting framework that is expected to capture the impacts of various water recharging, harvesting, recycling, and conservation practices aimed at unutilized water savings and enhancing groundwater supply stocks. This methodology and protocol are aimed at the voluntary water conservation market and address the potential to quantify unutilized water units from water conservation, harvesting, restoration, and recharge projects.

This methodology addresses Managed Aquifer Recharge (MAR) processes, defined as a holistic approach to preserving groundwater by surface water storage/ rainwater conservation. This project is applied for rainwater conservation as a practice, and not combined with other practices in this document.

The detailed methodology statement and work sequence have been developed to carry out integrated water resource planning and designing for pre-defined study objectives. Effective regional hydrology and site hydraulics are studied using an integrated approach of Geospatial technique and multiple criteria decision-making technique. Datasets based on Geographic Information Systems (GIS) are used as criteria and sub-criteria. A wide range of spatial datasets for the study area is generated, analyzed, and integrated by using various historical data like topographical, meteorological, geological, and geophysical within the context of the project.

A geographic Information System (GIS) is an essential tool to analyze and study such a large surface by remote sensing methods. Information about the physical characteristics and climatic parameters of the land has been acquired to understand its response to the business operation of the project premises for the design phase as well as for the operation/ maintenance phase. The information generated from the study may be analyzed, interpreted, and articulated as strategies to implement future water credit opportunities within the premises.

The below flowchart represents the detailed methodology statement and work sequence developed for pre-defined study objectives, where we deliberately transform and convert the ancient Indian water management practices into modern hydrology based on how water moves around between the earth and atmosphere in different states as a gas, liquid, or solid in terms of accuracy to calculate water credit and water valuation.

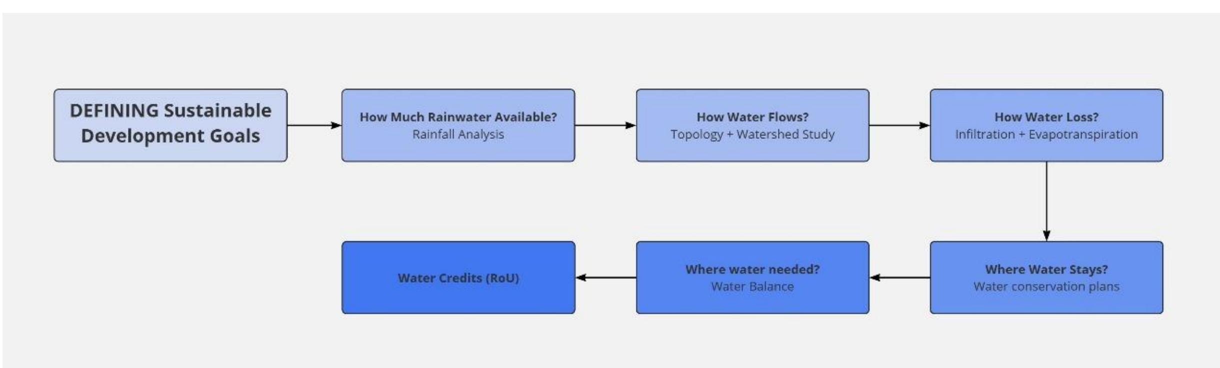


Figure 7.1: Flow Chart

8 RAINFALL ANALYSIS (How much rainwater is available?)

The southwest (June to September) is crucial for Bharat's economy, and this monsoon plays a pivotal role in water management and water security. Bharat receives around 76% of its total annual rainfall during four months – June, July, August, and September called the southwest monsoon. However, monsoonal variability triggers contrasting wet and dry conditions, leading to hydro-meteorological disasters. It's important to highlight that rainfall assessment primarily aims to provide fundamental insights into changing rainfall patterns in a simplified manner.

We undertook this assessment at the study area to quantify and understand trends in changes in rainfall during the southwest monsoon (between June and September), while analyzing the trends over the past 42 years (1980–2022) approximately, with a particular focus on the quantification of changes over the past decade, between 2014 and 2023. Our primary aim with this assessment is to offer fundamental insights into calculating rainwater conservation to quantify the water credits. These insights are intended to serve to derive water valuation for stakeholders across various sectors, including water management, agriculture, energy, and urban planning, among others, to help them make climate-informed decisions.

Rainfall frequency analyses have been generated by using historical precipitation data obtained from the nearest Dholka rain gauge station of the Indian Metrological Department (IMD), which is situated approximately 25 km far from the site location as represented in the following map.

Figure 8.1: Raingauge Station- Dholka

8.1 Annual Rainfall

Rainfall also varies from one year to another in arid/semi-arid zones, this can easily be confirmed by looking at rainfall statistics over time for the area of interest. The difference between the lowest and highest rainfall recorded in different years can be substantial. Annual rainfall for the Dholka rain-gauge station in the last 42 years is represented below as a line chart.

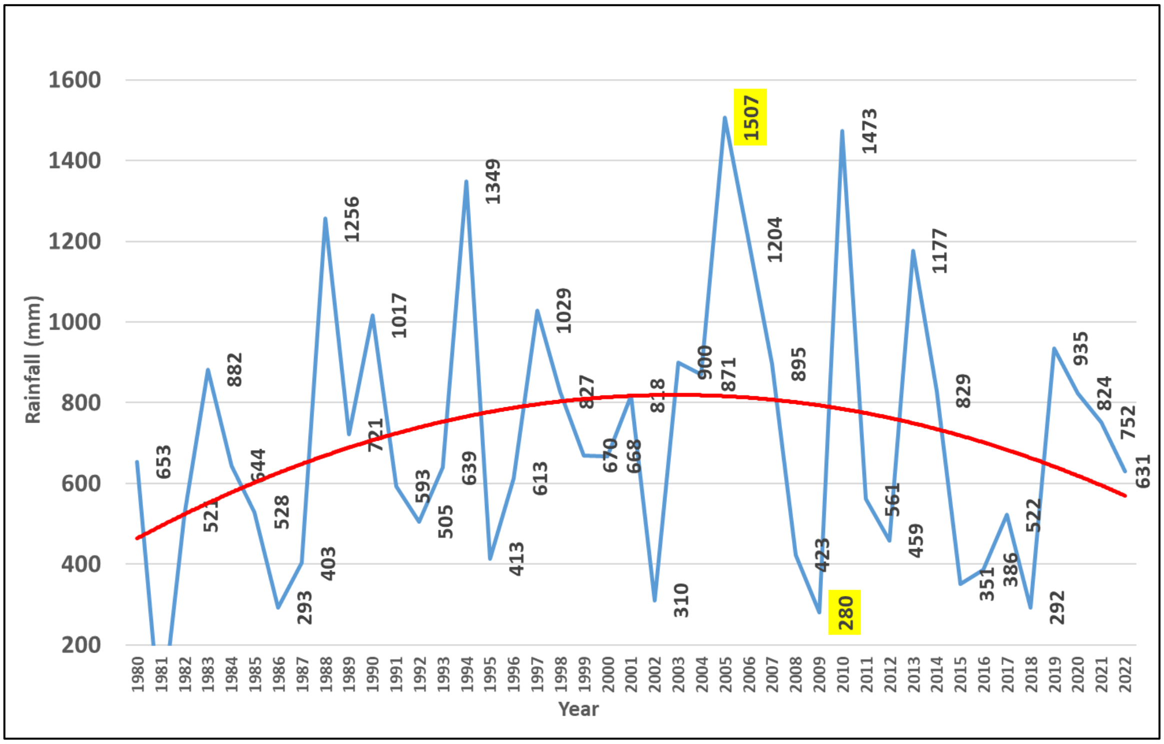


Figure 8.2: Annual Rainfall

The maximum observed annual rainfall for the Dholka rain gauge station is 1507 mm in the year 2005 and the minimum observed annual rainfall is 280 mm in the year 2009 as presented above. The trendline for rain gauge stations for annual rainfall is in decreasing trend substantially, post-2005. Annual rainfall data post-2005 will be used to design/verify water conservation structures like ponds, and reservoirs and check dams.

8.2 Monthly Mean Rainfall

June- July-August-September are observed as rainy months. The highest rainfall is observed in July month at 265mm. Unseasonal rainfall is also observed in the rest of the month marginally. This information can be used to plan maintenance activity/housekeeping activities like cleaning rainwater, harvesting filters, cleaning roofs and gutters, desilting reservoirs, and declogging stormwater networks as pre-monsoon / post-monsoon activities. The monthly mean rainfall for the Dholka rain gauge station is represented in the below graph.

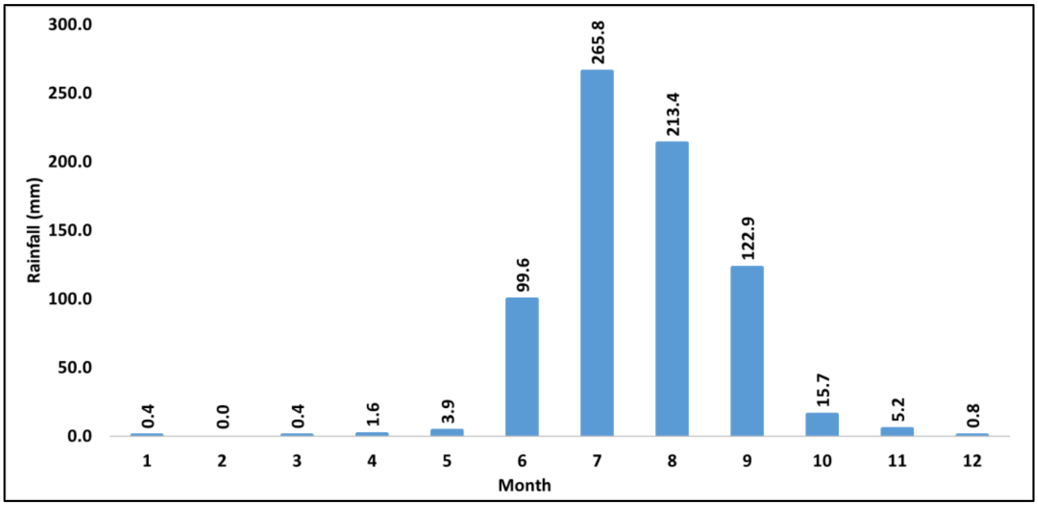


Figure 8.3: Monthly Mean Rainfall

8.3 Daily rainfall

The minimum daily rainfall for the last 42 years (1980 to 2022) observed at the Dholka rain gauge station is represented below the graph. The trendline for the rain gauge station for daily rainfall is in decreasing trend substantially. The minimum daily rainfall is observed at 48 in year 2016. This information will be used to design surface reservoirs for continuous replenishment during the rainy season and maximize rainwater conservation. Therefore, it is not required to add any climate change impact.

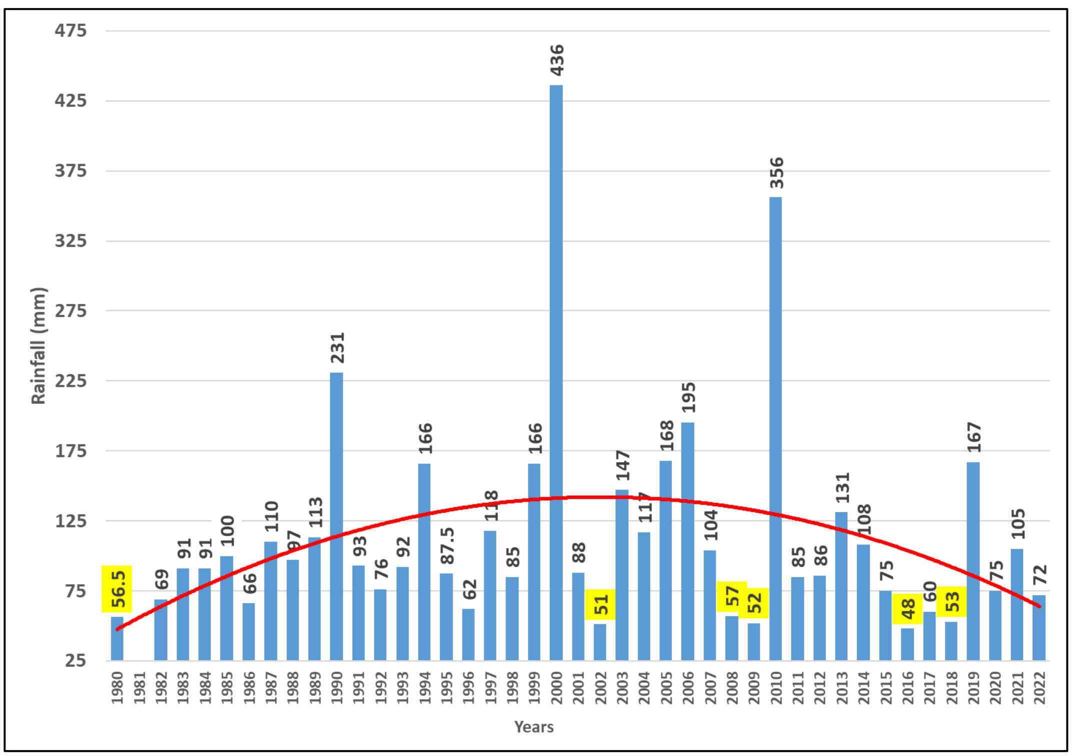


Figure 8.4: Daily Rainfall

8.4 Number of Rainy Days

The number of rainy days is useful to define the sizes of rainwater conservation structures and capital investment. The same can be further designed based on the minimum number of rainy days considering the worst-case scenario. By referring below represented graph below, minimum rainy days were observed in 2015 as 19 days in the last decade. However, the graph shows that rainy days are an increasing trend. Rainwater storage inventory for the number of years can also be decided based on this graph.

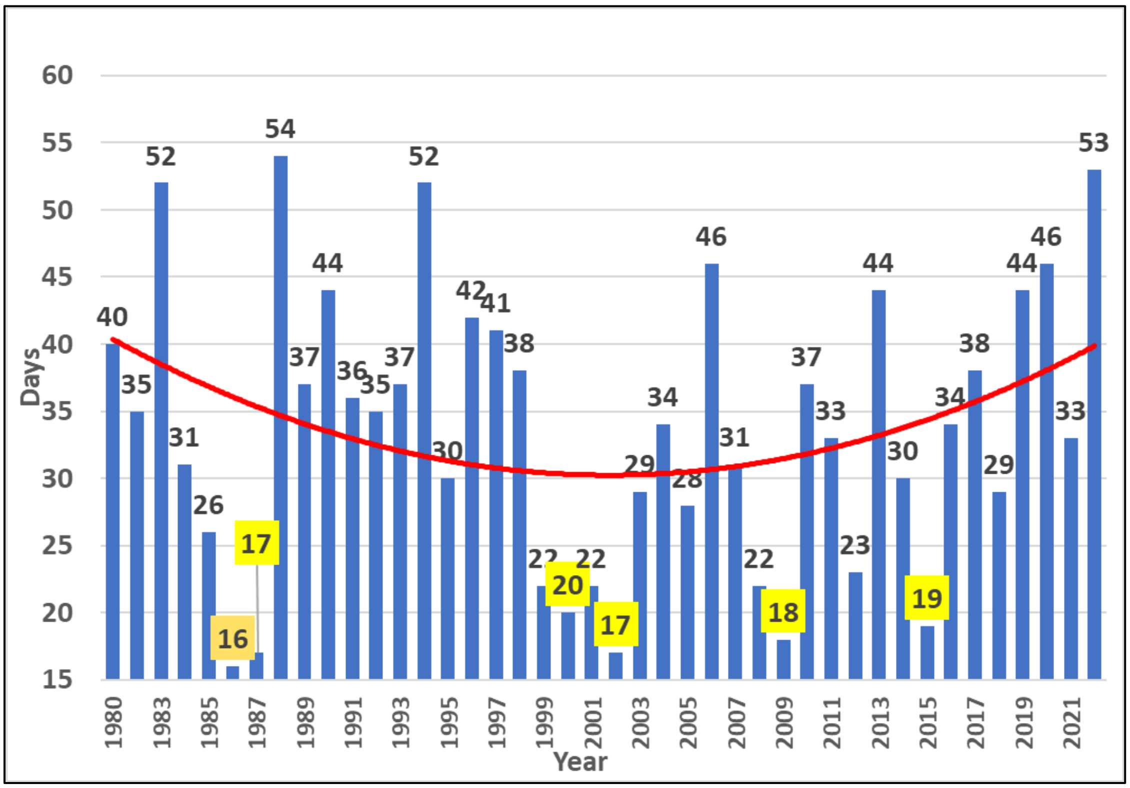


Figure 8.5: Number of Rainy Days

9 EARTH SURFACE ASSESSMENT

9.1 WATERSHED STUDY (How water flows?)

The UWR RoU Standard challenges the notion of using hydrological basins as the basic organizational focus and looks at how water (and other vectors) move — a view that suggests that a "water harvesting/conservation/recharge system" could be a city, an ecosystem, a farmer's field, or a factory setting within closed boundaries. Water security plans need to consider a new approach that includes water sources on the surface water and groundwater.

The geographical zone in which water is captured flows through and eventually discharges at one or more points. The concept includes both surface water catchment and groundwater catchment. A surface water catchment is defined by the area of land from which all precipitation received flows through a sequence of streams and rivers towards a single river mouth, as a tributary to a larger river, or the sea.

9.1.1 Topographical data

Topographical maps are represented by Digital Elevation Maps to understand the natural water flow direction being generated by natural terrain including effective water outfall locations downstream. The quality of the topographical data source is an important factor in the accuracy and reliability of the generated hydrology maps; thus, it is important to select the most suitable topographical data source.

Table 9.1: Data Source

What is a Digital Elevation Map?	Digital Elevation maps are detailed representations of natural water flow direction generated from the natural terrain of the earth's surface.
How is it generated?	Digital Elevation maps are generated by using a high-resolution 30 m grid capturing the extent of all possible (upstream) catchment areas.
What is the data source?	DEM (Digital Elevation Model) is taken from Copernicus European Space Agency. This is based on the radar satellite data acquired during the TanDEM-X Mission, which is funded by a Public Private Partnership between the German State.
What does it provide?	The digital elevation map typically includes information such as relative elevation using different colors, to indicate the slope of the study area.

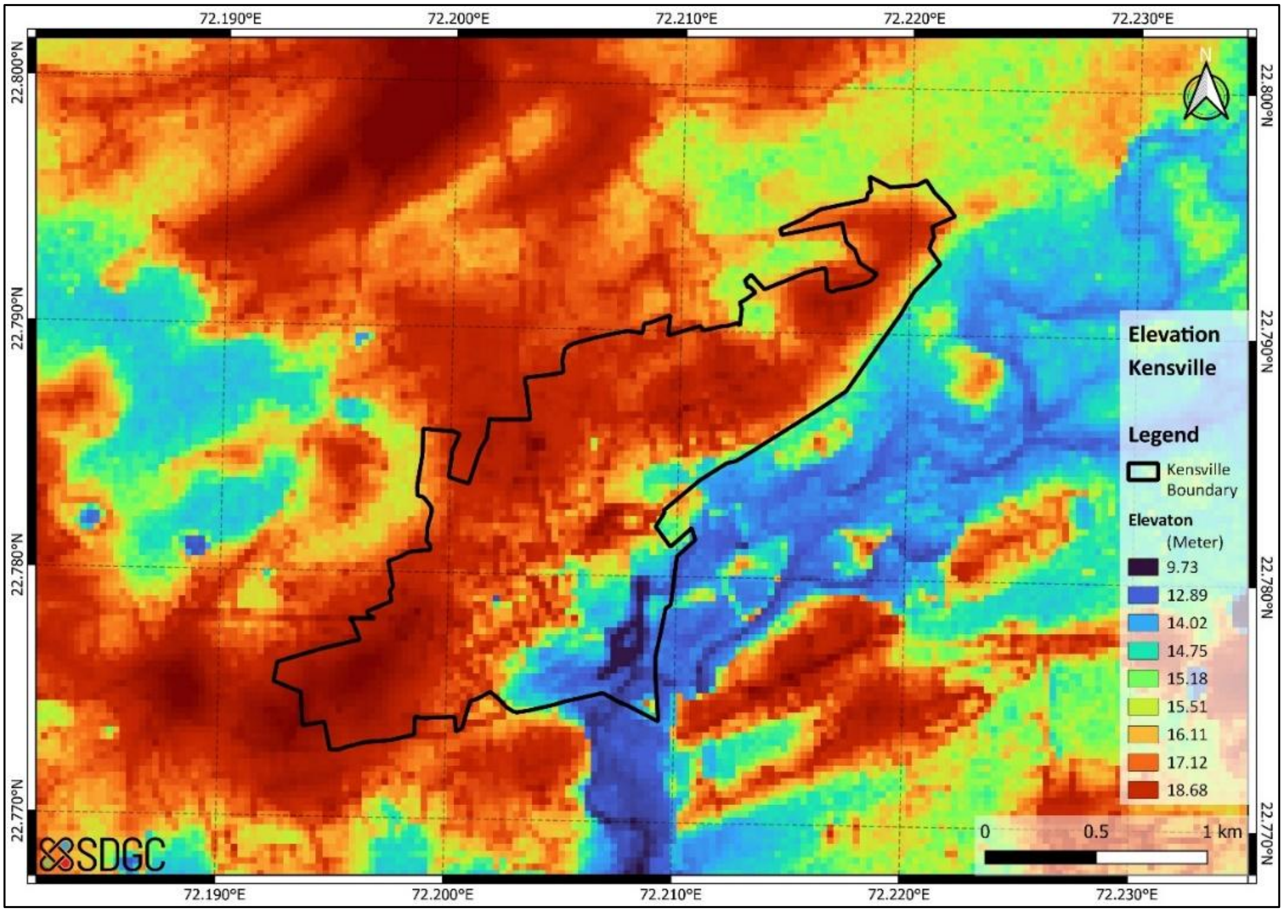


Figure 9.1: Digital Elevation Model Map

The following technical insights have been discovered from the Digital Elevation Map.

Table 9.2: Technical Insights

SN	TECHNICAL INSIGHTS
1	The dark brown shade indicates the upstream part of the study area
2	The dark blue color indicates the downstream part of the study area.
3	All the levels mentioned in the map are to be referred from the mean sea level.
4	The highest terrain of the study area is at an elevation of 18.68m.
5	The lowest terrain of the study area is at an elevation of 9.73m
6	The north and northeast parts of the study area indicate the highest elevation.
5	The southwest part of the study area has the lowest elevation that falls into a flood plain.

9.1.2 Drainage pattern

It is necessary to break the area of interest into manageable units to analyze the hydrological properties of an area. Catchments are defined as: "The region draining into a river, river system, or body of water." Catchments are always physically delineated by the area upstream from a given outlet point. This generally means that the contributing region upstream to a separate ridgeline catchment from each other for a stream network.

Before landscapes can be managed as catchments, we need to delineate the boundaries of catchments to use common spatial terminology. Many GIS software applications contain routines to delineate catchment boundaries and perform other hydrologic analyses. This includes tools such as catchment delineation, flow accumulation and flow length.

Table 9.3: Data Source

What is Catchment Delineation?	Digital Elevation Maps are detailed representations of natural water flow direction generated from the natural terrain of the earth's surface.
How is it generated?	The drainage pattern is generated by using a Digital Elevation map (topographical map).
What is Catchment? (Alternative terms are watershed, basin, and river basin.)	Catchment of origin refers to a catchment, distinct from the site's catchment(s), where a product or service is manufactured or sourced. It may be anywhere from an adjacent catchment to the other side.
What does it provide?	The drainage pattern signifies the catchment delineation map, where the ridge is represented by higher elevation data and drainages (streams) are represented by lower elevation data showing the slope of the study area.

The boundary for the study is georeferenced to know an effective catchment, that is not restricted to a limited distance from the site boundary. The hydrological catchment of the proposed premises has been identified with the probable drain path location.

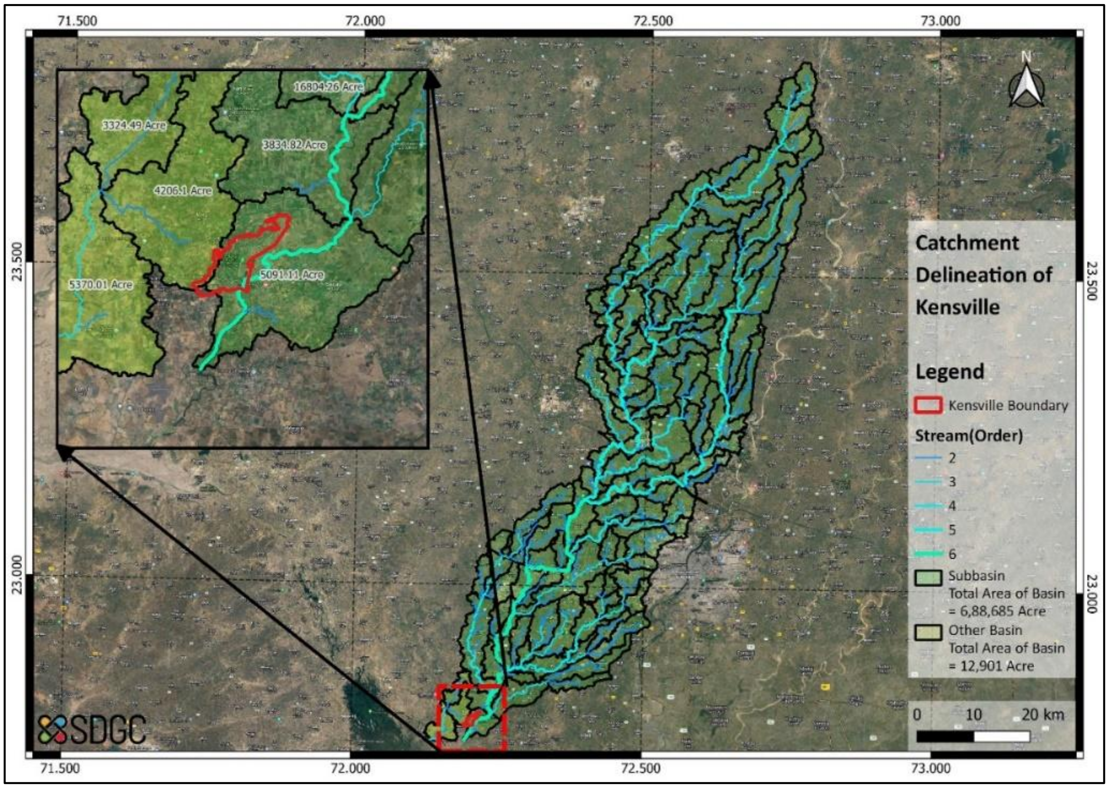


Figure 9.2 : Regional Catchment Delineation

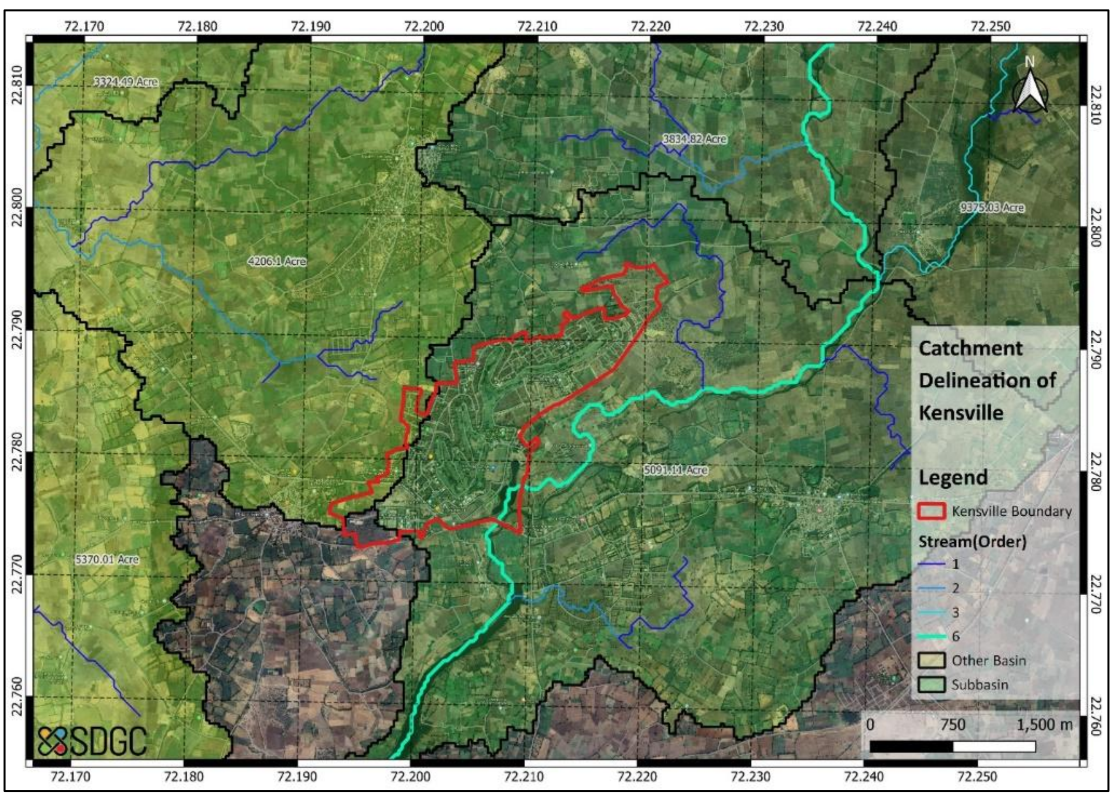


Figure 9.3: Study Area Catchment Delineation

The following technical insights have been generated and interpreted to analyze the hydrological impact of the study area from the above map. Tangible data and information will be further incorporated into water credit quantification.

Table 9.4: Technical Insights

SN	TECHNICAL INSIGHTS
1	The study area is demarketed with the red line, whereas sub-basins dedicated to the study area are represented in green color and black lines.
2	The whole study area is divided into three sub-basins having one major and two minor catchment areas
3	The main streamline which flows from northeast to south has stream orders 1,2,3 and 6.
4	The highest stream order indicates a high-water potential zone.
5	The main streamline has the highest stream order 6 which falls under the study area towards the south direction.
6	The major sub-basin of the study area which falls under the main catchment area covers a total area of 6,88,685 acres.
7	The minor sub-basin of the study area which falls under the secondary catchment area covers a total area of 12,901 acres.

9.2 HYDROLOGICAL LOSSES (How much water was lost?)

The amount of water losses depends on local climatic conditions like high air temperature, low humidity, strong winds and sunshine. Hydrological losses include interception, infiltration, evaporation and transpiration from the plant surface. The hydrological losses have no local economic value and are not usable, therefore it is essential to calculate such losses and discount that into available freshwater quantification.

9.2.1 Evapotranspiration

The rate of evapotranspiration (ET) depends on several factors such as temperature, wind, atmospheric pressure, impurities of water, and shape and size of water. Understanding evapotranspiration patterns is essential for various fields, including agriculture, water source management, climate studies, and environmental monitoring.

The Evapotranspiration graph presents a detailed assessment of ET patterns across a specified geographic area, utilizing advanced remote sensing techniques, meteorological data, and modeling algorithms. It offers a comprehensive overview of ET rates, spatial distribution, and temporal variations, enabling stakeholders to make informed decisions regarding water management strategies, land use planning, and environmental conservation efforts. As water scarcity and climate variability continue to pose significant challenges, the ET map emerges as a crucial asset for informed decision-making and adaptive management strategies aimed at ensuring the sustainable use of water sources and the resilience of ecosystems in a changing climate context.

The actual ET data unit is in millimeters (mm) and is in the range from 2014 to the present. For Evapotranspiration analysis, TerraClimate data are used, which provides important inputs for ecological and hydrological studies at global scales that require high spatial resolution and time-varying data. All data have yearly temporal resolution and its unit is mm/year.

Table 9.5: Data Source

What is Evapotranspiration?	Evapotranspiration (ET) is a critical process in the hydrological cycle, encompassing the combined loss of water from the Earth's surface through evaporation and transpiration by plants and water bodies
What is an Evapotranspiration Graph?	Evapotranspiration Map Graph provides comprehensive data to analyze, visualize, and interpret ET data, providing valuable insights into regional water dynamics and ecosystem health.
What is a data source?	The Climate Engine team has developed important partnerships with NOAA's National Integrated Drought Information System (NIDIS), the Bureau of Land Management (BLM), the US Geological Survey (USGS), Google, the US Forest Service, NASA, the Navajo Nation, and more. These partnerships have been instrumental in bringing Earth Observations data into management operations.
How data are generated?	Datasets consisting of satellite observations like Landsat, climate reanalyses like ERA5, and decision-ready drought and rangeland vegetation datasets, Climate Engine tools put petabytes of cutting-edge data backed by Google Earth Engine cloud computing.
What does it provide?	This map provides data on the loss of water from the earth's surface.

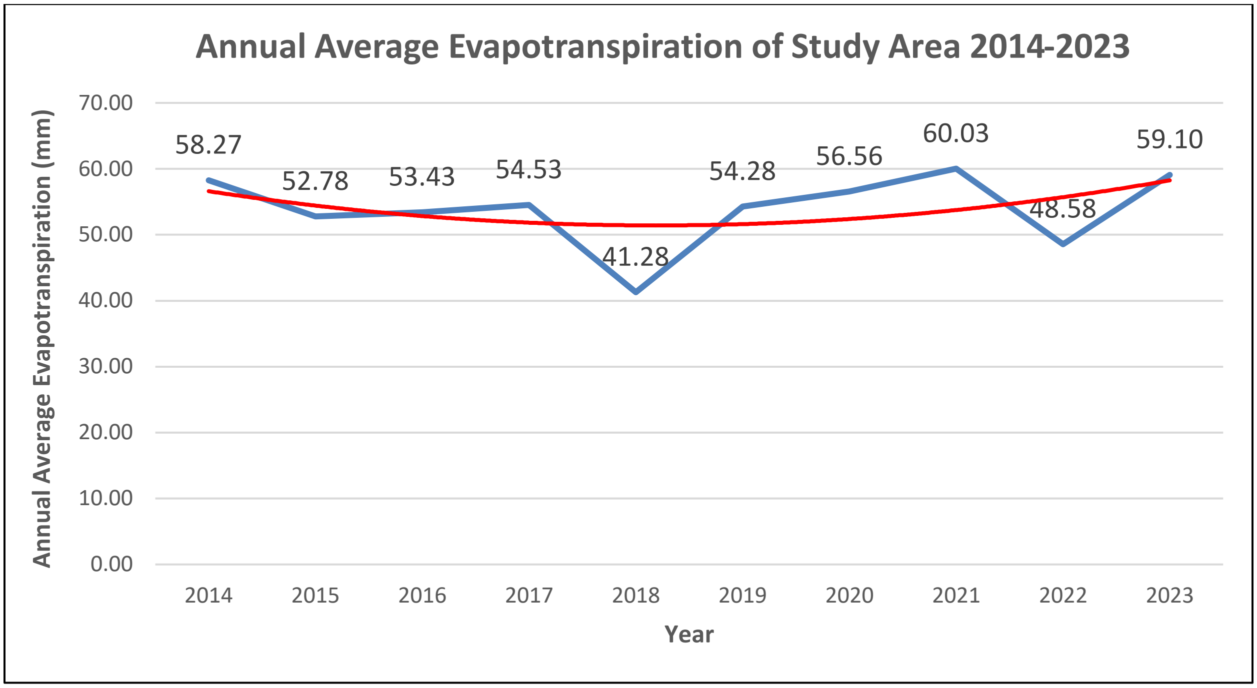


Figure 9.4: Annual Average Evapotranspiration

The above graph and data help in generating tangible information and technical insights to interpret and analyze the hydrological impact of the study area. Evapotranspiration value has been observed in increasing trend in the last 10 years. These data will be further incorporated into water credit quantification.

9.2.2 Infiltration

The rate of infiltration depends on various land cover surfaces and human activity (e.g., grazing, conservation) associated with a specific land unit. In this study, land cover will be the preferred term as it has a more direct bearing on the data required to determine the runoff coefficient.

The running coefficient refers to the water loss due to the soil properties and land cover Therefore, land cover for the study area is prepared based on a supervised classification technique utilizing Sentinel-2 Multi-spectral Imagery.

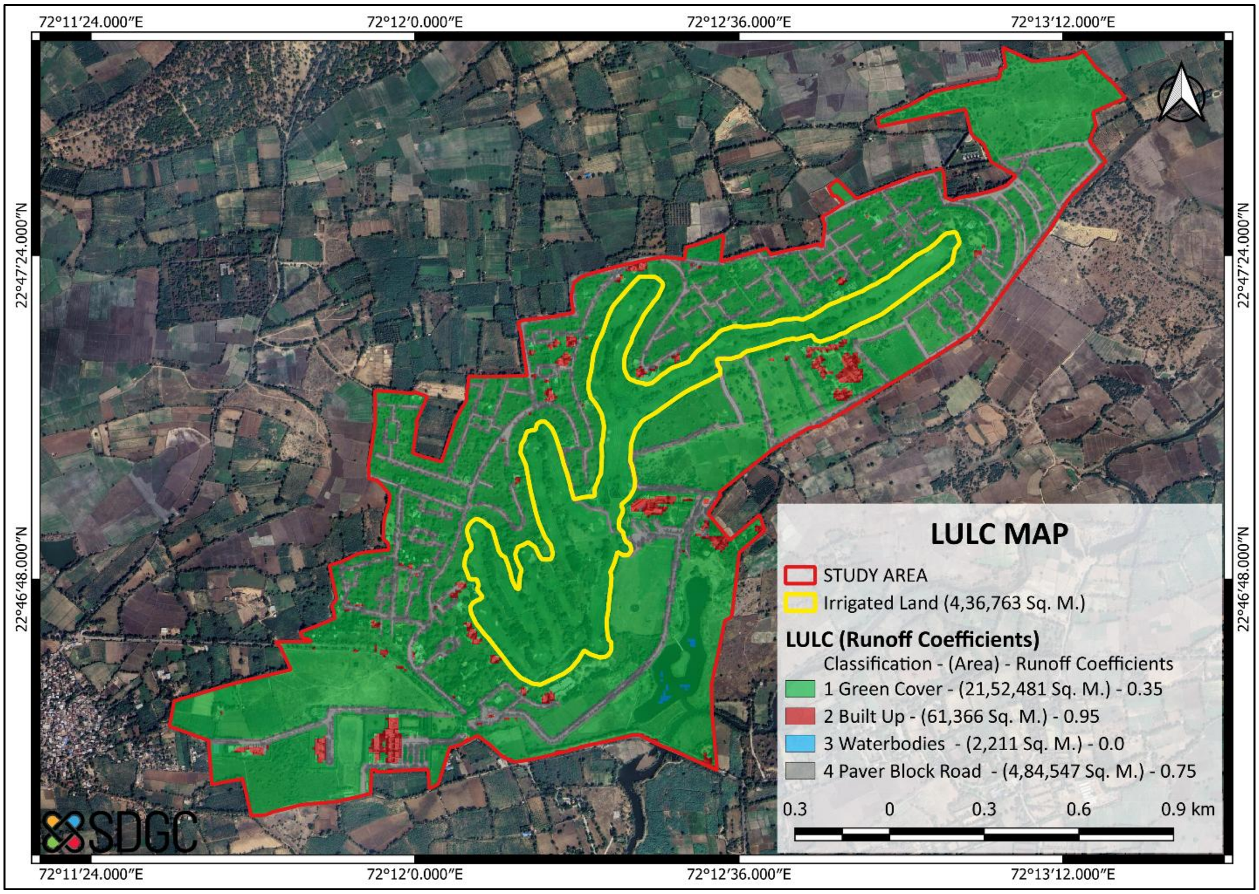


Figure 9.5: Land Cover Map

The following technical insights have been generated and interpreted to analyze the hydrological impact of the study area from the above map. Tangible data and information will be further incorporated into water credit quantification.

Table 9.6: Technical Insights

SN	TECHNICAL INSIGHTS
1	The study area is covered with irrigated land 4,36,763 SqMt.
2	This area is mostly covered with green cover/ vegetation/ tree cover/turf/paver block.
3	Infiltration coefficient reference page no. 53
3	The tentative water consumption for this land cover is approximately 3 Lit/ SqMt/Day.
4	Some of the areas are still bare land or shrubland patches.
5	The water bodies like ponds are in stable condition as presented towards the south of the study area.
6	There is the presence of a river flowing from northeast to south, near the site which is toward the east of the study area.

10 WATER CONSERVATION (How water conserved?)

The hydrological basin may or may not be the “system” in many places, however, that focuses on what is happening within the project boundary (e.g. aquifers, often exist in recharge and discharge basins that have complex relationships with what is happening on the surface with reservoirs like rivers and lakes).

This methodology understands its own water use, catchment context, and shared concerns in terms of water governance; water balance; Important Water-Related Areas; Water, Sanitation, and Hygiene (WASH), and then engages in meaningful actions that benefit people, the economy, and nature. In all project activities under this methodology, the end use of the water must either be consumption, utilization, recycling with gainful end use, groundwater recharge, or protection of freshwater-related ecosystems.

10.1 SURFACE WATER STORAGE - POND (Where water stays?)

Surface water storage (SWS) is the amount of freshwater stored in lakes, rivers, wetlands, and floodplains. It's a key component of the water cycle and land surface hydrology and is important for water resources management. The total volume of water held per unit area is called the surface storage capacity. Most reservoirs are built to increase water supplies, and sometimes for flood protection.

POND NUMBER	AREA (In Sq Meter)
P1	51257.66
P2	1370.59
P3	4019.45
P4 a	442.32
P4 b	1884.72
P4 c	1602.35
P4 d	1021.58
P5	4875.91
P6	1668.12
P7	1698.67
P8	921.1
P9	1730

Figure 10.1: Surface Water Storage Map

10.1.1 Geomorphology

Geomorphology is the scientific study of the origin and evolution of topographic and bathymetric created by physical, chemical and biological processes operating at or near the earth's surface. The morphological analysis concerns the annual water presence and transition processes due to hydrological impact.

Table 10.1: Data Source

What is a Geomorphology Map?	This map represents the surface landforms and terrain features of a particular area.
How are they created?	Through the interpretation of aerial photographs, satellite imagery, topographic maps, and ground truthing.
What do they provide?	Detailed information about the gradual changes in shape, composition, and arrangement of landforms such as mountains, valleys, plains, hills, rivers, and coastlines.
What is the application of this map?	Geography, geology, environmental science, urban planning, and engineering while understanding the morphological process and landform evolution of earth surfaces.
Water body (pond/ river)	Area containing water either freshwater, brackish or seawater which may include lakes, rivers, ponds, reservoirs, etc.
Fluvial origin older alluvial plain	Fluvial landforms are those landforms that are shaped and modified by running water is called as **fluvial origin landforms** and **alluvial plain** is a plain created by the deposition of sediment over a long period by one or more rivers coming from highland regions, from which alluvial soil forms.

The following technical insights have been generated and interpreted to analyze the hydrological impact of the study area from the below map. Tangible data and information will be further incorporated into water credit quantification.

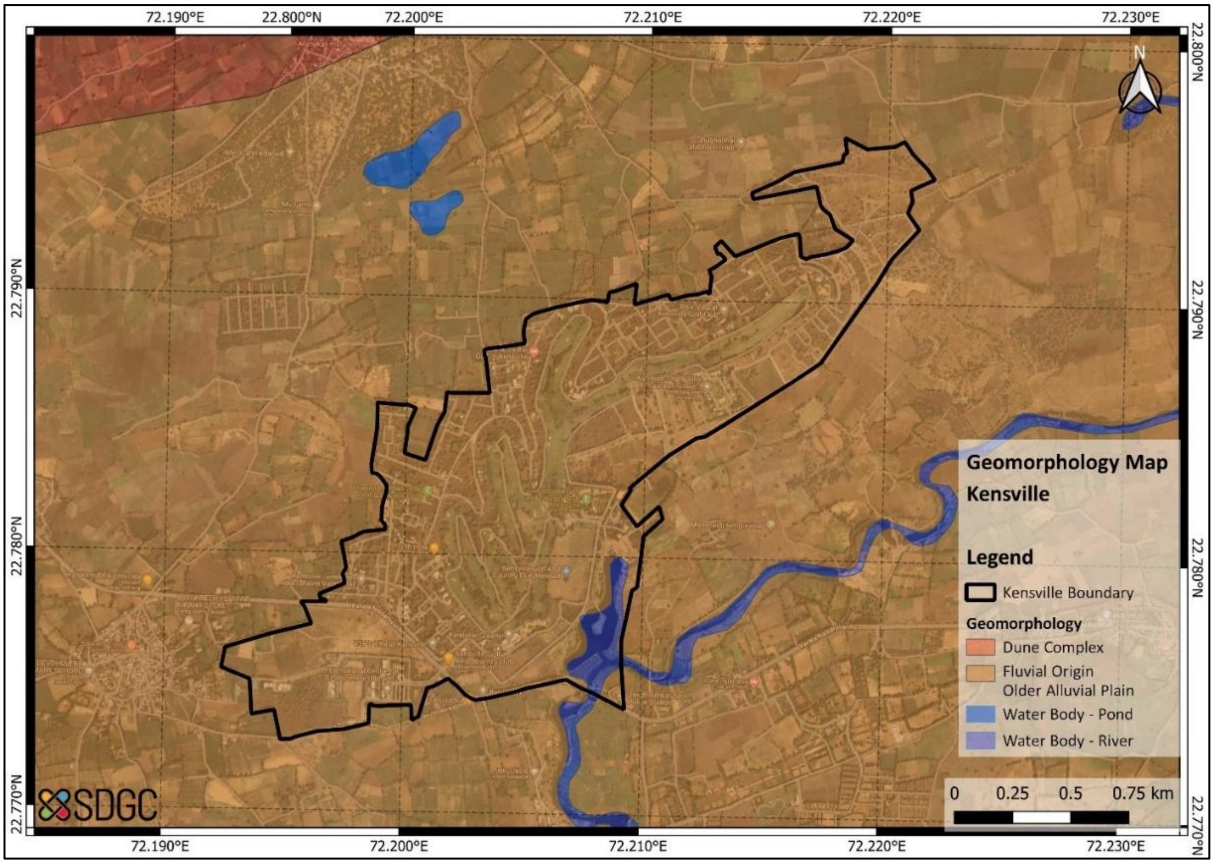


Figure 10.2: Geomorphology Map

Table 10.2: Technical Insights

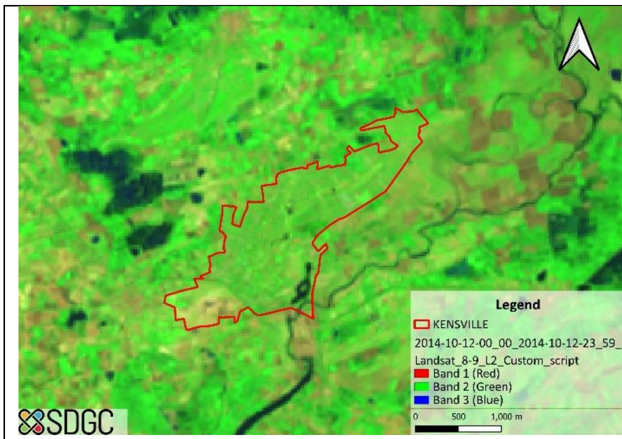
SN	TECHNICAL INSIGHTS
1	The geomorphology map represents the presence of topsoil/ landscape activities above the geological strata.
2	The geomorphology of the site is of Fluvial Origin Older Alluvial Plain.
3	Most of the land is depicted in the geomorphology as an older alluvial plain, indicating that most of the region has been deposited with silt, clay and sand by the river erosion and deposition action which is directly related to the infiltration properties of that particular soil.
4	This map provides data on the permanent water bodies around and within the study area.
5	Watermarks (P1) are mainly observed in the southwest part of the study area along the natural streams.
6	This information also corresponds to terrain-based stream & catchment delineation. In addition, the watermarks are also high in the pond/reservoir in the south of the study area.
7	Small ponds (P2/ P3/ P4a/ P4b/ P4c/ P4d/ P5/ P6/ P7/ P8 /P9) are not detected and represented in the maps since these ponds are seasonal permanent water bodies.

10.1.2 Timelapse study

The timelapse study is carried out by extracting relevant satellite images of the study area to calculate the morphological changes for the vintage period. The satellite image for October represents the rainwater conservation done during the rainy season, whereas May represents the gainful use of conserved water for irrigation purposes.

Landsat-8 Satellite images are sourced to establish water presence in ponds, as water absorbs short-wave infrared bands. Composite 3 bands the red band is B07, the Green band is B06 and the Blue band is B04, where composite vegetation is seen in shades of green, soils and built-up areas are in various shades of brown, and water appears black.

Table 10.3: Timelapse Study



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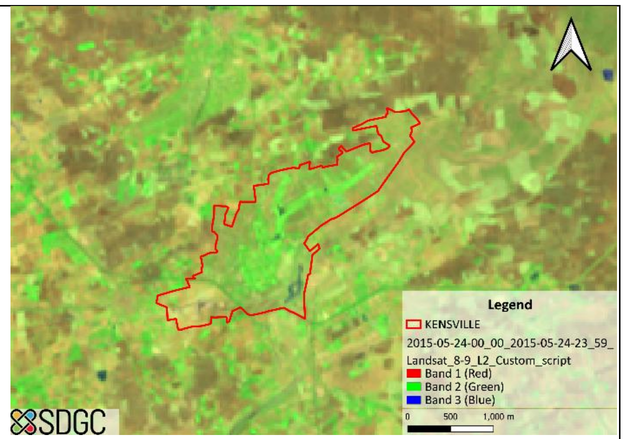
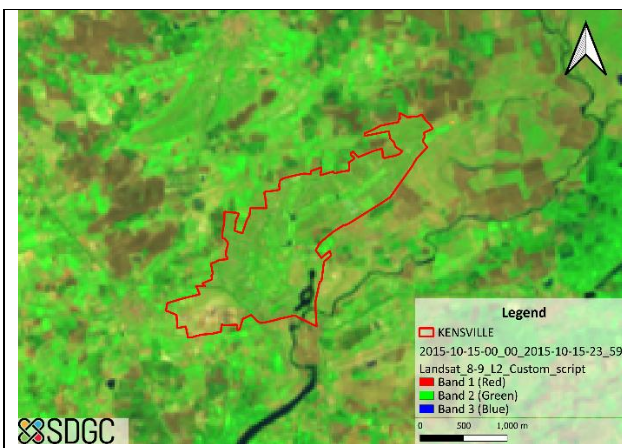


To May 2015



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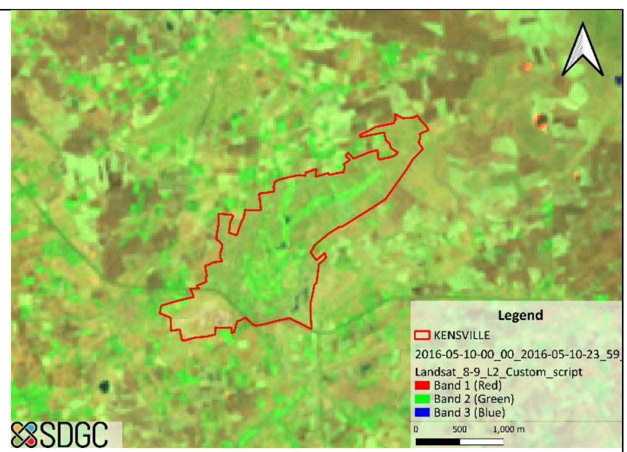
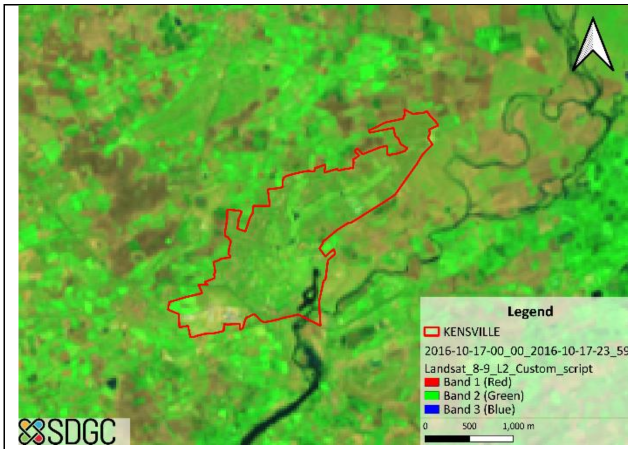


To May 2016



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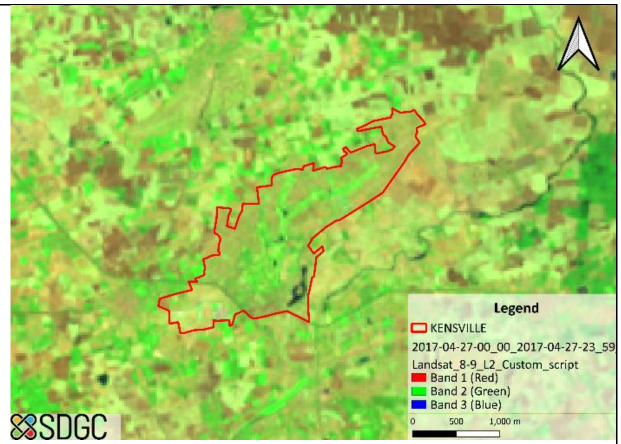
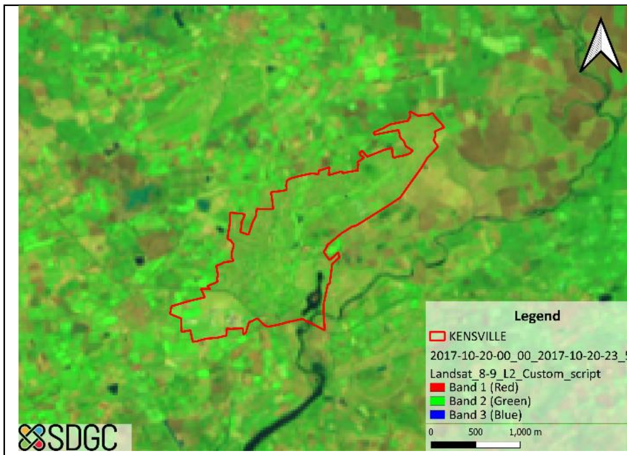


To May 2017



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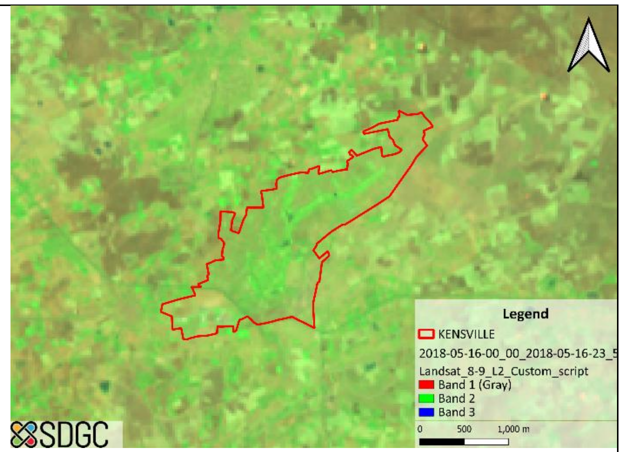
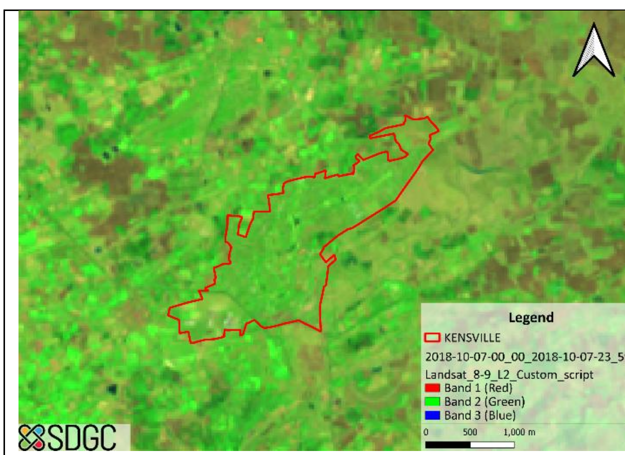


To May 2018



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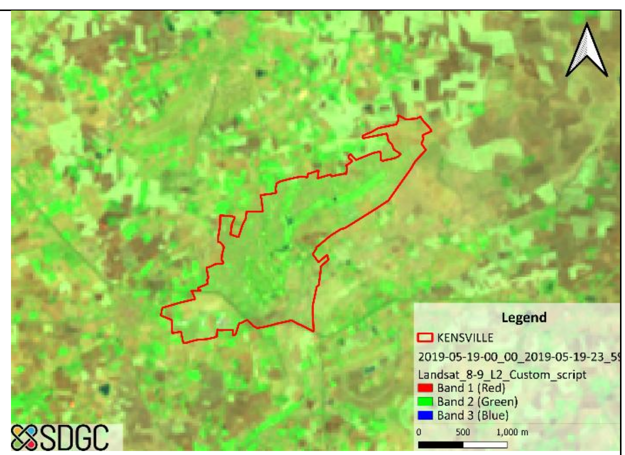

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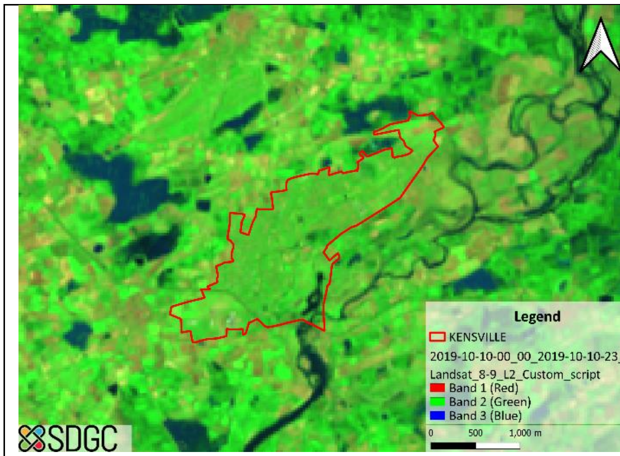

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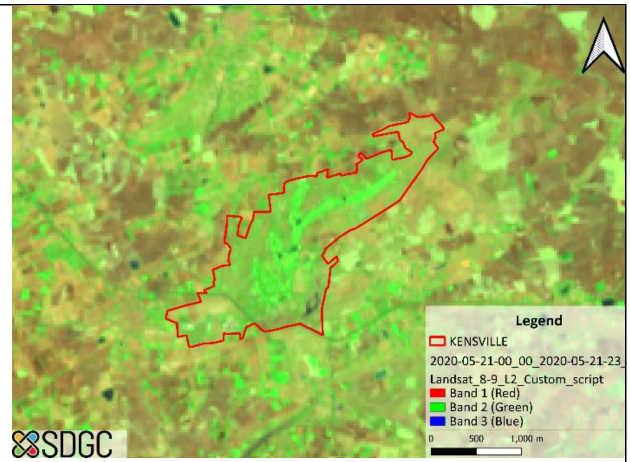
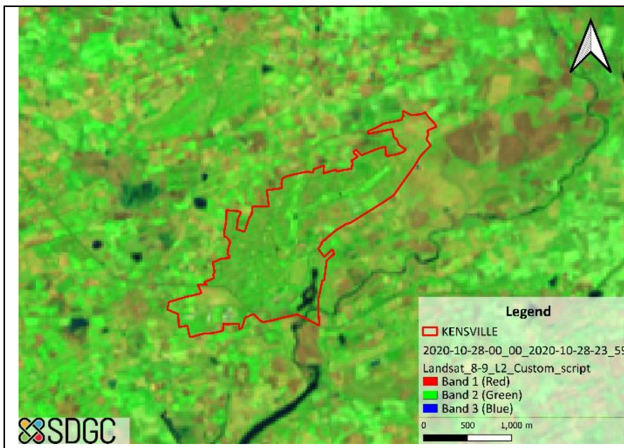


To May 2020



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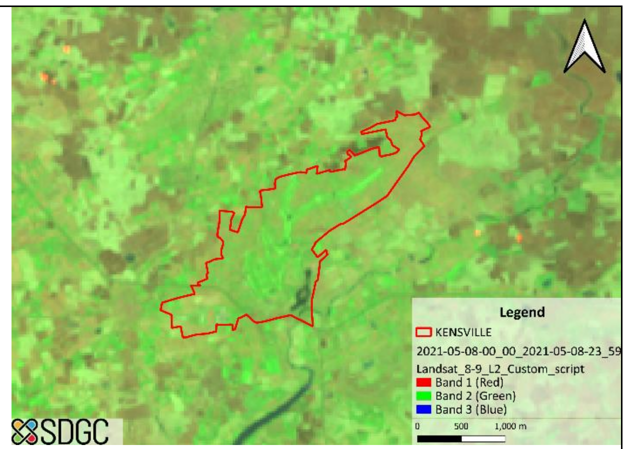
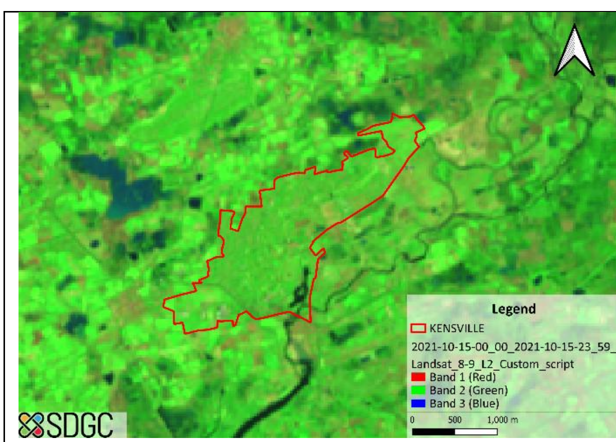


To May 2021



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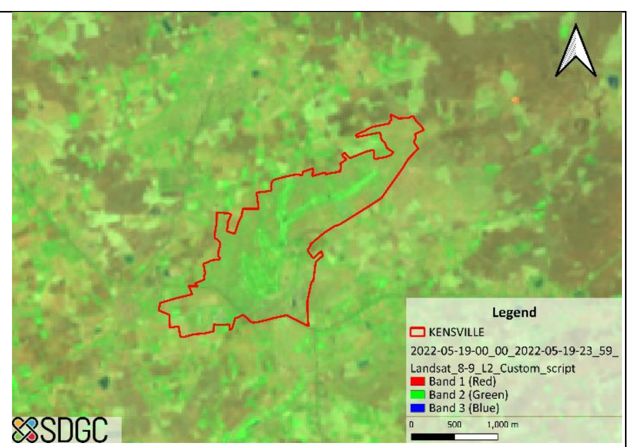
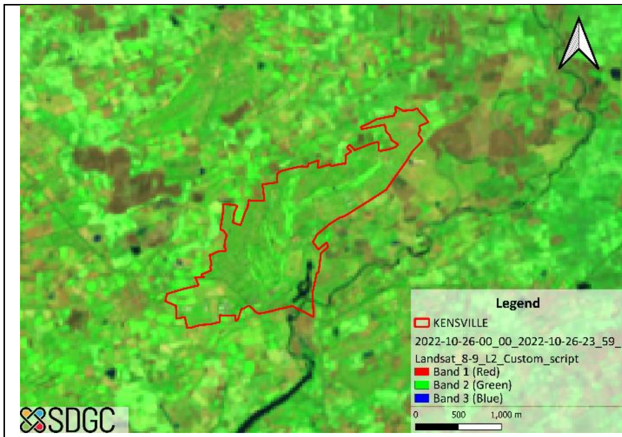


To May 2022



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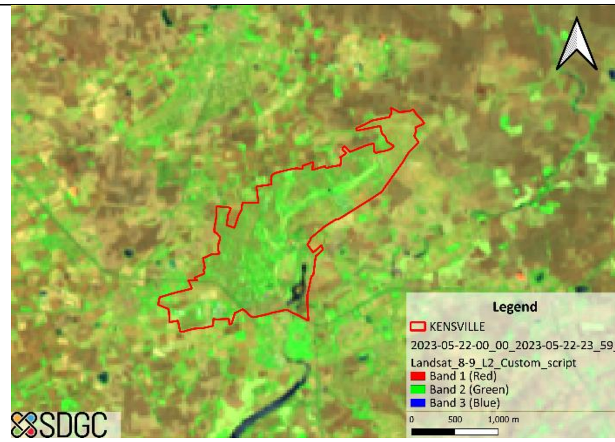

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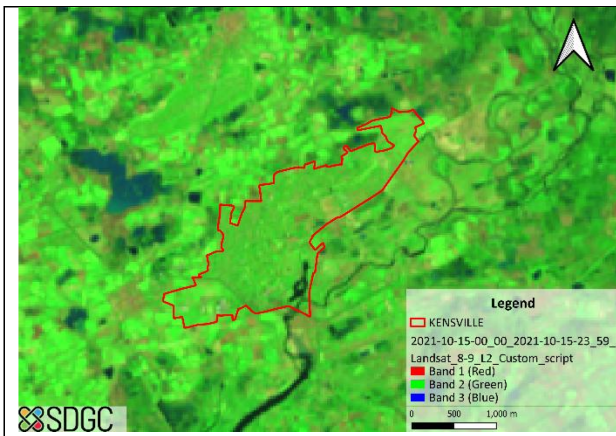

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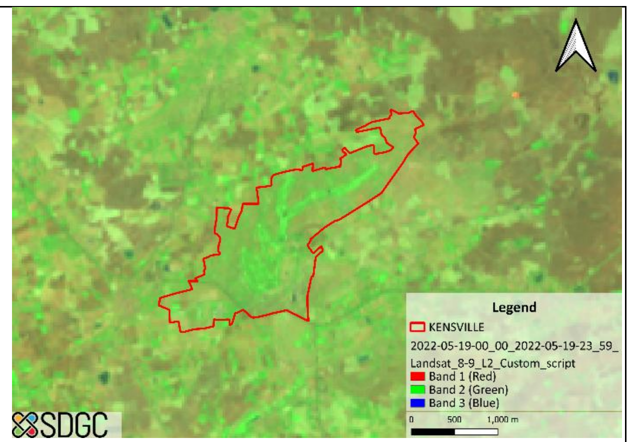

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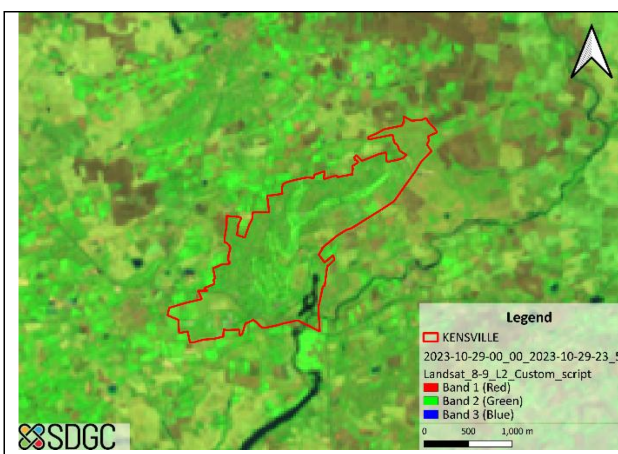

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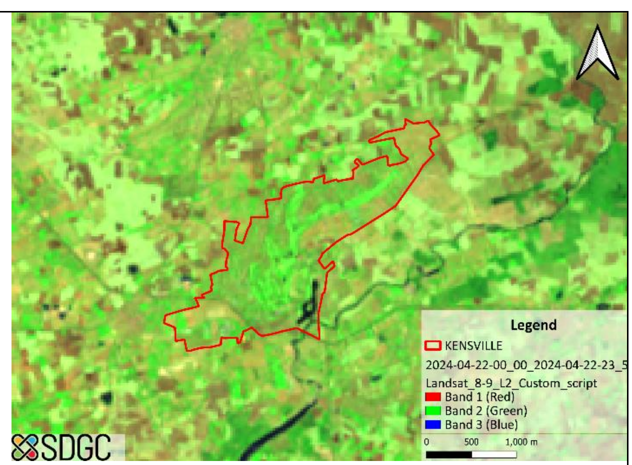


To May 2024

The following technical insights have been generated and interpreted to analyze the hydrological impact of the study area from the above map.

Table 10.4: Technical Insights

SN	TECHNICAL INSIGHTS
1	The above satellite images help to generate primary insights to establish the gainful use of the conserved rainwater in all ponds.
2	The P1, P3, P4, and P5 ponds are observed with full of rainwater by the end of the rainy season.
3	The rainwater conserved in these ponds is consumed for annual irrigation demand.
4	Therefore, these ponds are observed with partial / no rainwater before next year's rainy season begins.
5	Irrigated areas have been seen as healthy and green throughout the years since it has been maintained well to ensure international golf course standards intact for functional requirements.
6	Land use from the timelapse study refers to a well-maintained green patch, that is visible in the central part of the study area during pre-monsoon season.
7	This information will be used to calculate direct and dynamic water demand to quantify water credits against gainful use for a vintage period.

10.2 SURFACE WATER STORAGE (Where water stays?)

The study of the water conservation pattern at Club Mahindra Resort, Kensville, emphasizes wastewater generation and calculating water balance to manage the water footprint effectively. The wastewater generated is treated, stored, and reused for irrigation, promoting sustainability. The following assumptions help in defining the domestic water demand for the premises.

Table 10.5: Data Assumptions

SN	ASSUMPTIONS
1	Domestic use of water consists of various direct and indirect activities like drinking, cooking, housekeeping, etc.
2	Staff and workforce at the facility are excluded from water demand calculation.
3	It is assumed that the rooms are occupied fully during weekends and holidays. Therefore, the water footprint for that occupancy is accounted.
4	Domestic water consumption is assumed to be 105 Lit/ person/day as accounted as per CGWB guidelines for restaurants.
5	Flushing water consumption is assumed to be 60 Lit/ person/day as accounted as per CGWB guidelines for restaurants.
6	Drinking and Cooking water consumption is assumed to be 15 Lit/ person/day as accounted as per CGWB guidelines for restaurants.
7	The installed capacity of STP is 50KLD, however, it is assumed that it gets operated on 90% of the recovery coefficient after some conveyance losses of 10%.

10.3 GROUNDWATER STORAGE (Where water stays?)

The primary objective of the study is to investigate and understand subsoil formation by delineating sub-surface aquifer conditions and sub-surface layer information to know the depth of the potential water-bearing zone or potential groundwater recharge zone.

Water below the surface of the Earth is stored in pore spaces and fractures within rock or layers of sand and gravel (aquifers). In water sources management the term more specifically applies to water that can be extracted at a viable rate, quantity, and quality for human use (with or without treatment). Saline water or water contained in rocks of very low permeability is not conventionally considered groundwater.

The Resistivity survey and Geomagnetic survey are required carried out for delineating sub-surface aquifer conditions and subsurface layer information for groundwater beyond 10/30m. Generally, dry, and compact formations indicate high resistivity, water-bearing formations indicate medium resistivity, whereas saline (high TDS) formations indicate low resistivity. Permeable (bigger grain size) formations indicate comparatively higher resistivity than silt/clay/high TDS formations.

Specified investigation methodology will help in computing groundwater sources and strengthen the groundwater potential conditions of the study area.

The major confined and unconfined aquifer systems are formed by sand/ kankars, which causes a higher intake rate. The movement of groundwater is controlled primarily by the porosity and permeability of aquifer material. The aquifer recharge potential of any area depends upon three major factors rainfall, runoff, and aquifer acceptives. Hydrogeology of an area deals with the following parameters.

SN	PARAMETERS
1	Average rainfall and probable run-off
2	Vegetative and land use cover for run-off estimation.
3	Subsoil absorption potential
4	Aquifer geometry
5	Aquifer material
6	Impact of Aquifer material on water quality
7	Seasonal fluctuation of water level
8	Study of surrounding water bodies

The following map is generated showing resistivity and geomagnetic study location to create a cross-section of the sub-surface layer up to 200m/400m/600m.

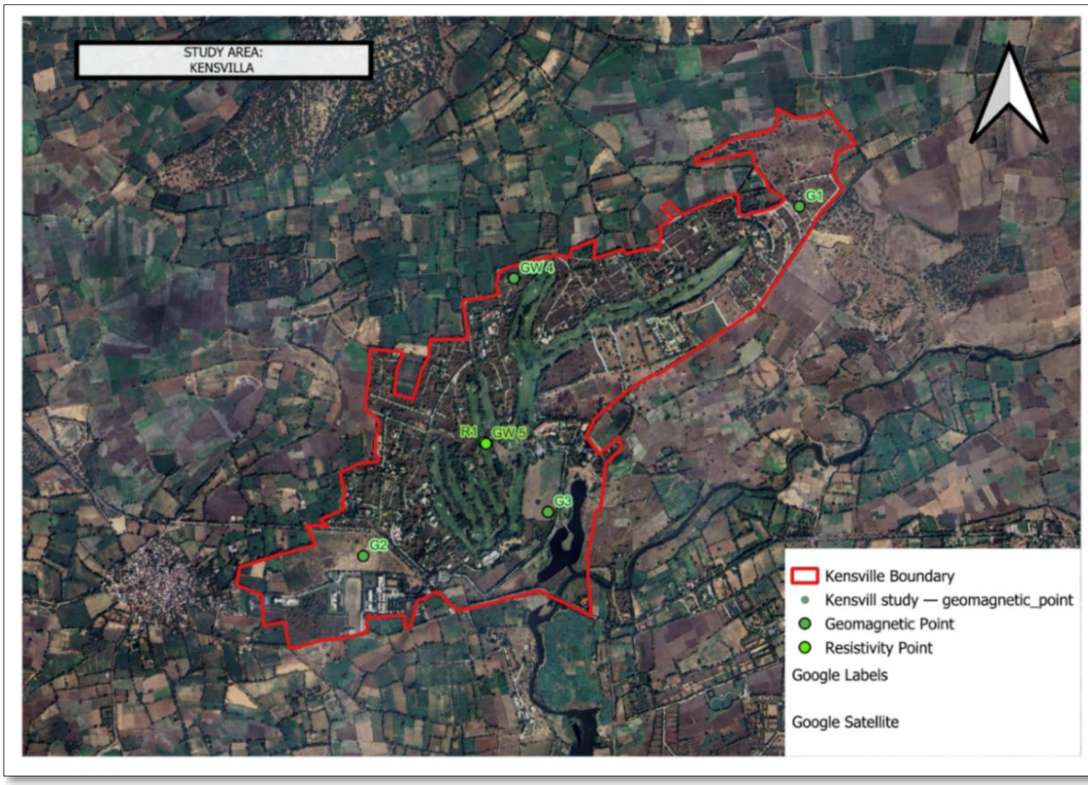


Figure 10.3: Survey Location Map

10.3.1 Resistivity Survey

It is recommended to conduct a resistivity survey to visualize sub-surface conditions being used commonly, where it gives clues and not the confirmation of geological conditions. The vertical electrical resistivity sounding survey technique is used to study the vertical (depth-wise) variations of subsurface resistivity. The current is injected into the ground using two metal stakes called current electrodes (A and B).

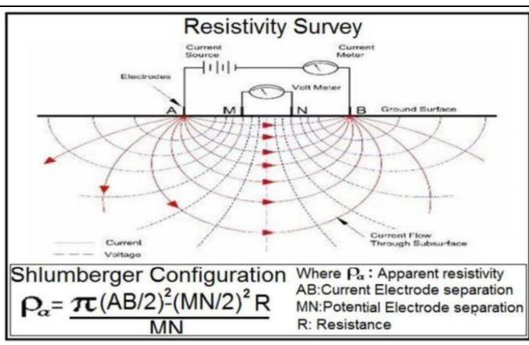


Figure 10.4: Resistivity Survey Instrument

Potential response due to current within the ground is observed using the second pair of potential electrodes placed in line between them. The spacing between two current electrodes is increased progressively, enabling deeper penetration of current & measurement of an increasing volume of the sub-surface, which reveals depth-wise variation in resistivity. Apparent resistivity is calculated by multiplying the geometrical configuration factor with measured resistance readings (from the instrument) as mentioned below.

Table 10.6: Resistivity Survey

R1.	**Location of Site**	**1st Resistivity study location is duly marked at located site**	
1.	Site Photograph		
2.	Village/Taluka/ District	Bavla/Ahmedabad	
3.	Topography	Plain	
4.	Geology of Area	Topsoil followed by recent to sub recent Alluvium formations	
GEOHYDROLOGICAL DETAILS			
5.	Exp. S.W.L. (m)	60.0 To 66.0 m	
6.	Exp. P.W.L. (m)	120.0 To .130.0 m	
7.	Exp. Draw Down (m)	60.0 To 64.0 m	
8.	Intake rate	12000 - 15000 LPH	
9.	Exp. Total Dissolved Solids	1000 ppm - 1200 ppm	
10.	Exp. Total Depth (m)	MIN.213.0mts to MAX 228.0 mts	
GEOHYDROLOGICAL DETAILS			
SN	**Resistivity (ohm-mt.)**	**Formation**	**b.g.l.(m)**
11.	02 ohms. M	Unconfined Aquifer	000 – 014
12.	03 ohms. M	Fine-grained silty-type clay	014 – 048
13.	05 ohms. M	Find grained sand mix calc. Kankars	048 – 102
14.	14 ohm. M	Sand mix type with clay	102 – 186
15.	22 ohm. M	Sand mix type	186 – 228
1ST Zone - 180 - 213 mts (Fresh)			

CONCLUSION & RECOMMENDATIONS		
16.	Type of rig to be deployed	DR
17.	Feasibility depth suggested for t/well	MIN 213.0 mts to MAX 243.0 mts
18.	Dimension of the bore	400 mm X 150mm X MIN 213.0 mts to MAX 228.0 mts
19.	Pump design	NA
20.	Intake rate	10,000 to 12,000 LPH
21.	Purpose of Survey	Development of Rainwater Harvesting Structures
Results are submitted based on field data and field surveys and little variation in results (either on the higher or lower side by 25%) is expected.		

10.3.2 Geomagnetic Survey

The magnetic survey is the method which is a passive electromagnetic (EM) exploration method that measures orthogonal components of electric and magnetic fields on the earth's surface; the source field is naturally generated by the variations in the earth's magnetic field, which provides a wide and continuous spectrum of EM field waves. These fields induce current into the earth, which is measured at the surface and contains information about subsurface resistivity structure.

TESLA 6 channel groundwater detector is designed on a frequency amplification sequence working on magnetotellurics 4/6 channel detection method. The system is powered for deeper depth penetration and noise reduction by utilizing the effect of different channels to decrease the noise data which may affect the actual results in a groundwater survey. The system is powered to penetrate and capture data to a depth of 400/ 600 meters in favorable geological conditions.

Data are recorded from different channels and multiple sets, the recorder data are of set frequencies which are transmitted via transmitting channels and recorded via receiving channels depending on the depth to be interpreted, the recorded data are further processed to form of curve graph and the differences from the curve graph is further processed to form interpreted virtual section of the subsurface lithological structure.

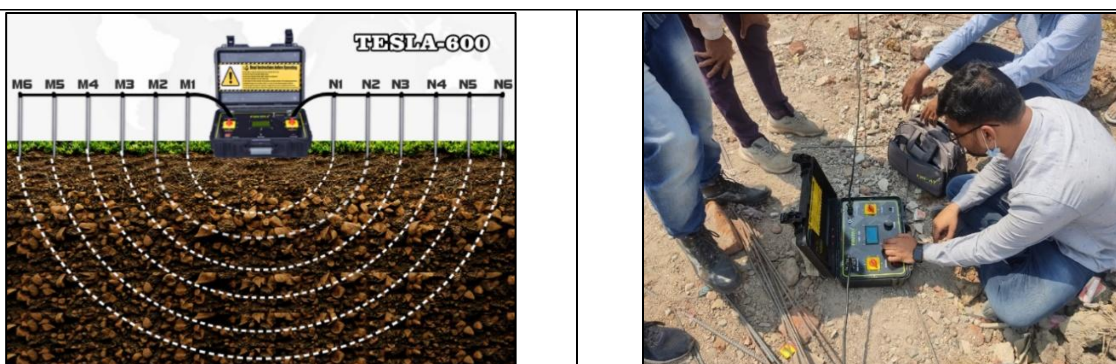
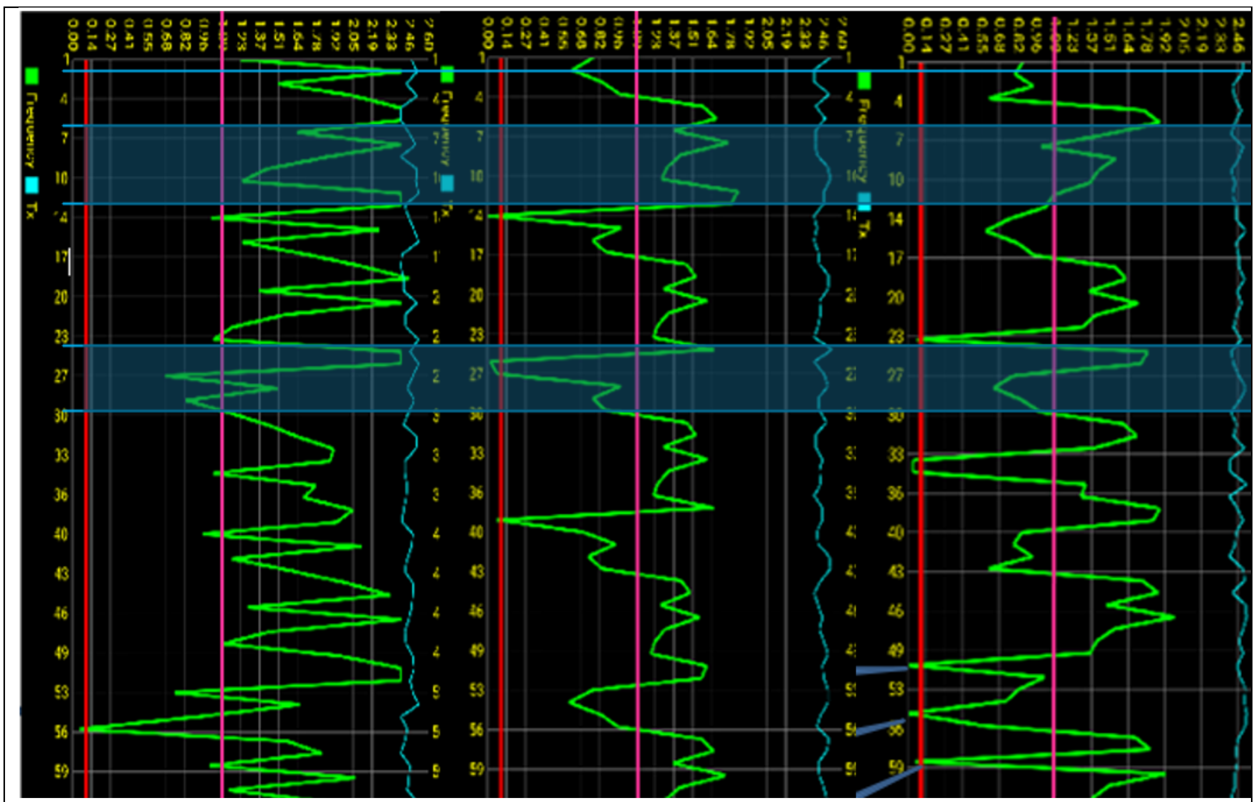


Figure 10.5: Geomagnetic Survey Instrument

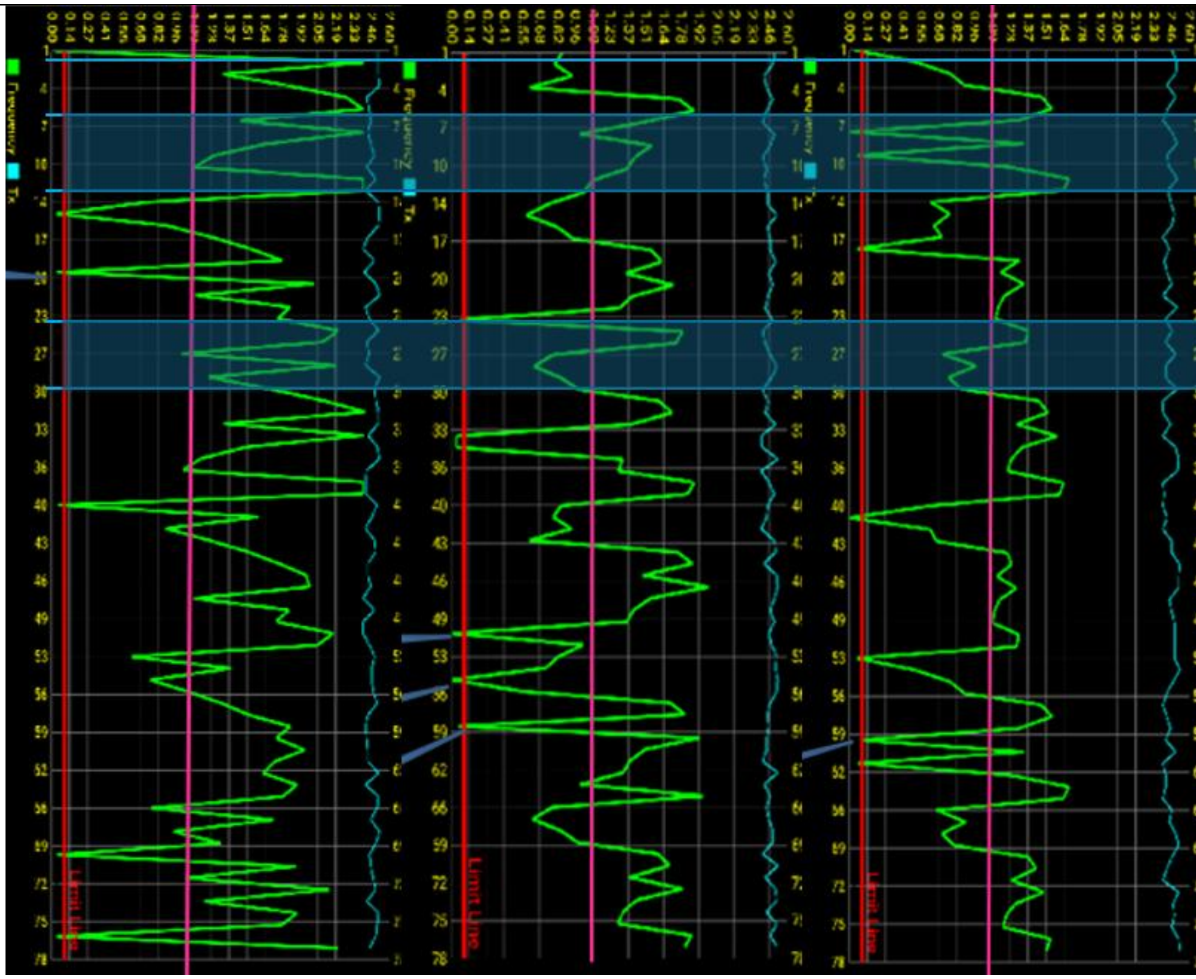
A geophysical magnetic investigation has been carried out to know the depth of the potential water-bearing zone or potential groundwater recharge zone.

Reports generated are based on frequencies transmitted, frequencies received and differences in frequency levels at each stage, and the geological fault should be monitored as per borehole data, Geomorphology, and hydrogeological conditions of a particular site selection. Instruments calibrations are up to the mark and can be suitable for favorable geological conditions cent- per cent results cannot be assured in groundwater surveys as per geological changes and frequency differences based on the earth's temperature, magnetic field, and gravity differences.

Porosity defines the total percentage of voids available in an aquifer and Permeability defines how much water can pass through the aquifer. Both depend upon the aquifer material, its grain size, and its composition. Interpretation is done to find out porosity factors for various soil materials. Dry porosity is measured on rocks without any water or fluid in their pores, whereas wet porosity is measured on saturated cores. Based on the transmitted and received frequency for each layer final factor is derived. Each layer has a depth of 7.69m and each value of factor represents different types of material as mentioned in the legend. Based on this interpretation, a layer map or lithology of the specific location is created as mentioned below.



GW1	GW5	GW3



GW2	GW5	GW4

Figure 10.6: Geomagnetic Survey Graph

Table 10.7: Technical Insights

SN	TECHNICAL INSIGHTS
1	The first aquifer is ranging between C6 (48mt) to C14 (102mt) – A1
2	The second aquifer is ranging between C4 (186mt) to C30 (228mt) – A2
3	Based on the survey and inventory data results, it reflects that A1 has saturated and saline properties.
4	A2 around GW2 point has no potential recharge zone.
5	A1 has saline water, which may increase water filtration/ treatment costs.
6	The total depth of recharging wells ranges from 213 to 228 meters.
7	The recharge capacity of A2 is estimated to be 10,000 LPH to 12,000 LPH.

10.4 Recharge Aspects

The recharge aspects for the study area are divided into two different components, surface water recharge and groundwater recharge.

10.4.1 Surfacewater Recharge Potential

The study area has a large open water pond that is designed and excavated to store rainwater to fulfill annual irrigation water demand. The recharge potential/aspects are not taken into account, since all water bodies are lined at the bottom to prevent water infiltration.

Moreover, the surface water infiltration takes place while conveyance on different ground surfaces with specified runoff coefficients as presented in the Land Cover Map of Chapter 10.2. The infiltration takes place up to 14 meters into the topsoil, the same can be extracted by constructing dug wells or nearby springs. The same is not taken into the water credit calculations consideration since the infiltration in topsoil is a natural process.

The annual rainwater availability is calculated by subtracting surface infiltration to arrive at available rainwater for conservation. The same is represented below with detailed calculations.

Table 10.8: Surface water Potential

SN	ACTIVITIES	Plot Area (SqMt)	Annual rainfall (In Meter)	Infiltration Runoff Coefficient	Annual Available Rainwater (In Cu Meter)	Annual Available Rainwater for Conservation (In CuMt)
(a)	(b)	(c)	(d)	(e)	(f)	(g)
1	**SURFACE WATER POTENTIAL**					
a	2014					974,138
	Cemented / Tiled Roof	61,366	0.829	0.950	48,329	
	Turf, Average (1 – 3% slope)	2,152,481	0.829	0.350	624,542	
	Open-grid Concrete Pavement	484,547	0.829	0.750	301,267	
	Water bodies	2,211	0.829	0.000	0	
b	2015					412,452
	Cemented / Tiled Roof	61,366	0.351	0.950	20,462	
	Turf, Average (1 – 3% slope)	2,152,481	0.351	0.350	264,432	
	Open-grid Concrete Pavement	484,547	0.351	0.750	127,557	
	Water bodies	2,211	0.351	0.000	0	

c	2016					453,579
	Cemented / Tiled Roof	61,366	0.386	0.950	22,503	
	Turf, Average (1 – 3% slope)	2,152,481	0.386	0.350	290,800	
	Open-grid Concrete Pavement	484,547	0.386	0.750	140,276	
	Water bodies	2,211	0.386	0.000	0	

d	2017					343,122
	Cemented / Tiled Roof	61,366	0.292	0.950	17,023	
	Turf, Average (1 – 3% slope)	2,152,481	0.292	0.350	219,984	
	Open-grid Concrete Pavement	484,547	0.292	0.750	106,116	
	Water bodies	2,211	0.292	0.000	0	

e	2018					613,390
	Cemented / Tiled Roof	61,366	0.522	0.950	30,431	
	Turf, Average (1 – 3% slope)	2,152,481	0.522	0.350	393,258	
	Open-grid Concrete Pavement	484,547	0.522	0.750	189,700	
	Water bodies	2,211	0.522	0.000	0	

f	2019					1,098,696
	Cemented / Tiled Roof	61,366	0.935	0.950	54,508	
	Turf, Average (1 – 3% slope)	2,152,481	0.935	0.350	704,399	
	Open-grid Concrete Pavement	484,547	0.935	0.750	339,789	
	Water bodies	2,211	0.935	0.000	0	

g	2020					968,263
	Cemented / Tiled Roof	61,366	0.824	0.950	48,037	
	Turf, Average (1 – 3% slope)	2,152,481	0.824	0.350	620,776	
	Open-grid Concrete Pavement	484,547	0.824	0.750	299,450	
	Water bodies	2,211	0.824	0.000	0	

h	2021					883,657
	Cemented / Tiled Roof	61,366	0.752	0.950	43,840	
	Turf, Average (1 – 3% slope)	2,152,481	0.752	0.350	566,533	
	Open-grid Concrete Pavement	484,547	0.752	0.750	273,285	
	Water bodies	2,211	0.752	0.000	0	

j	2022					741,473
	Cemented / Tiled Roof	61,366	0.631	0.950	36,786	
	Turf, Average (1 – 3% slope)	2,152,481	0.631	0.350	475,375	
	Open-grid Concrete Pavement	484,547	0.631	0.750	229,312	
	Water bodies	2,211	0.631	0.000	0	

k	2023					473,556
	Cemented / Tiled Roof	61,366	0.403	0.950	23,494	
	Turf, Average (1 – 3% slope)	2,152,481	0.403	0.350	303,607	
	Open-grid Concrete Pavement	484,547	0.403	0.750	146,454	
	Water bodies	2,211	0.403	0.000	0	
	TOTAL WATER DEMAND FROM 2014 TO 2023					**6,962,327**

10.4.2 Groundwater Recharge Potential

The study area has an aquifer (A2) having a functional depth of 42mt (228mt – 186mt). The aquifer A2 is made of soil material as sand in maximum proportion, having an average of 14-15% voids to hold the water. The groundwater recharge aspect is estimated at 10,000LPH to 12,000LPH in the A2 aquifer. It is observed from the resistivity study that, the zone around GW2 has no recharge potential as represented in the map.

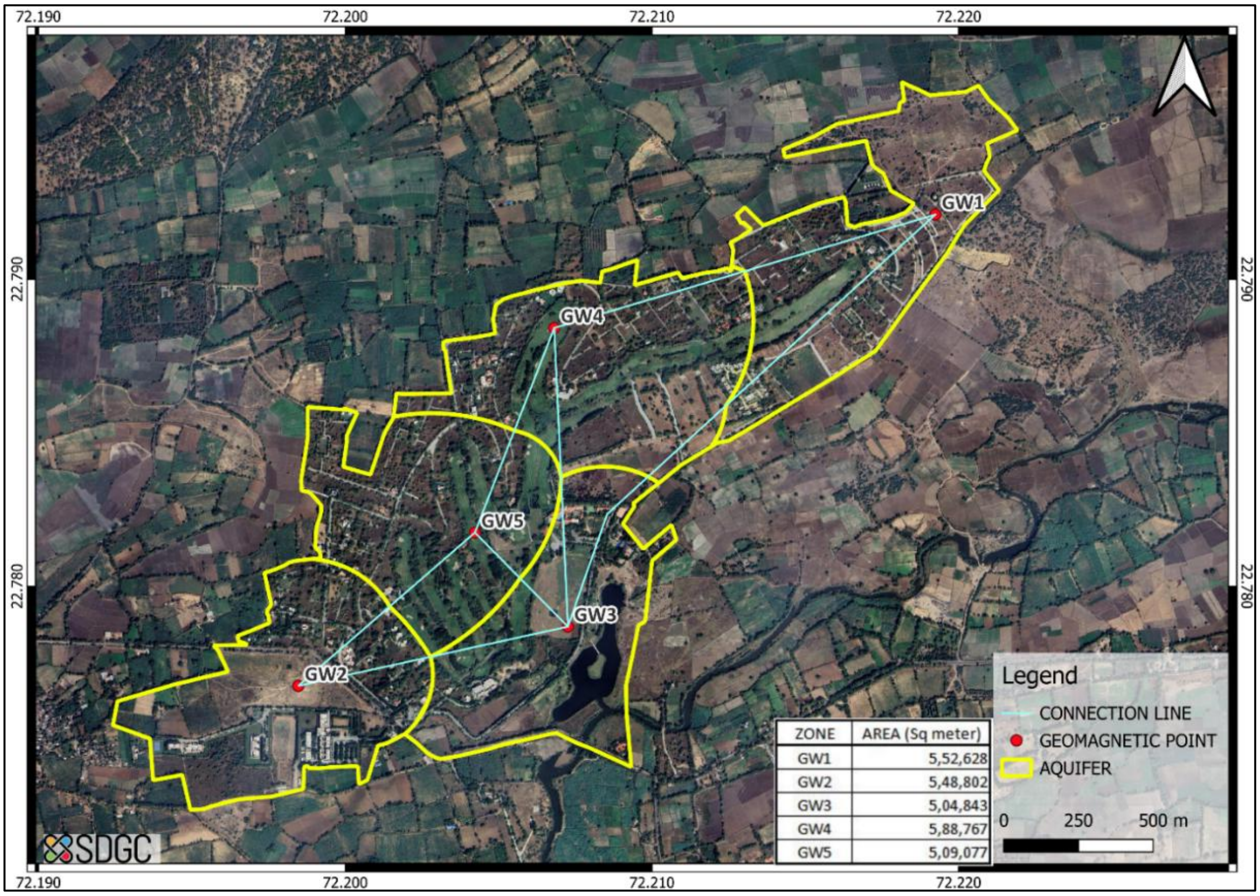


Figure 10.7: Recharge Zone Map

Table 10.9: Groundwater Recharge Potential

SN	ACTIVITIES	Area of Aquifer A2 (SqMt)	Height of Aquife A2 (In Meter)	Volume of Aquifer A2 (Cumt)	Percentage of Voids for soil Material (Sand)	Groundwater Recharge Potential (In CuMt)	Remark
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(j)
1	GROUNDWATER RECHARGE POTENTIAL	2,155,315	42	90,523,230	14%	12,673,252	The specific yield value of geological formation in the zone are estimated from GEC 97 CGWB Cluase no. 5.9.

11 WATER BALANCE (Available Water for gainful use)

The existing annual water balance is prepared to understand water demand, water consumption, and expected water losses in the study area. This will be used to define the gross water footprint and recharge potential of the study area to implement water sustainability initiatives.

11.1 WATER DEMAND

Water Demand describes the total amount of water required from its source/ alternate source (Groundwater in aquifer + Surface water storage + Recycled water) to be used. Water demand could be assessed based on potential water requirements. The following assumptions have been made while calculating raw water demand for the premises.

Table 11.1: Data Assumptions

SN	ASSUMPTIONS
1	The premises are functional for 365 days continuously.
2	Irrigated area is 4, 36, 763 Sqmt. Please refer to chapter no 10.2 for reference.
3	The number of rainy days can be referred to in chapter 8.
4	Domestic use of water consists of various direct and indirect activities like hand washing, face washing, housekeeping, sewer cleaning, road cleaning, car washing and other related activities.
5	Direct domestic use is marginal in proportion to overall water demand due to higher numbers of floating occupancy.
6	Irrigation water consumption is calculated for the dry season only.
7	Landscaping/ horticulture water demand is calculated as 3 Lit/sqm/ day.
8	Landscaping/ horticulture water demand is not calculated for rainy days and subsequent days, assuming there is no water demand during rain.

Table 11.2: Water Demand for Landscaping

SN	ACTIVITIES	Surface Area	Irrigation water demand Lit/ SqMt/ Day	Total Irrigation water demand Lit/ Day	Non Rainy Days	Water demand Lit/ Day/ Non-rainy days	Annual Water demand CuMt	Remark
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(j)
1	LANDSCAPE SURFACE AREA							
	2014 - 15	4,36,763	3	13,10,289	305	39,96,38,145	3,99,638	It is assumed that irrigation is not required in landscape areas on rainy days. Also, it is assumed that irrigation may be skipped on the very next day of rain due to in-air humidity and in-land moisture in the earth. (Ref - Chapter 8.4 - Number of rainy days)
	2015 - 16	4,36,763	3	13,10,289	322	42,19,13,058	4,21,913	
	2016 - 17	4,36,763	3	13,10,289	298	39,04,66,122	3,90,466	
	2017 - 18	4,36,763	3	13,10,289	291	38,12,94,099	3,81,294	
	2018 - 19	4,36,763	3	13,10,289	307	40,22,58,723	4,02,259	
	2019 - 20	4,36,763	3	13,10,289	277	36,29,50,053	3,62,950	
	2020 - 21	4,36,763	3	13,10,289	274	35,90,19,186	3,59,019	
	2021 - 22	4,36,763	3	13,10,289	299	39,17,76,411	3,91,776	
	2022 - 23	4,36,763	3	13,10,289	259	33,93,64,851	3,39,365	
	2023 -24	4,36,763	3	13,10,289	259	33,93,64,851	3,39,365	
	TOTAL WATER DEMAND FROM 2014 TO 2023						37,88,045	

11.2 CAPACITY CALCULATION - POND

Rainwater conservation is a simple strategy by which rainfall is collected, stored, and recharged for future usage. Rainwater from natural or artificially created catchment areas is collected, stored, and recharged through the use of artificially engineered systems(e.g. rooftops, compounds, rocky surfaces, hill slopes or artificially repaired impervious/semi-pervious land surfaces). The collected rainwater from surfaces may be filtered, stored, and utilized in different ways or directly used.

The capacity calculation is done by carrying out a physical site survey. All water reservoirs/ ponds have been surveyed to obtain the relative elevations to arrive at cross-sectional and longitudinal measurements to determine the volume of water storage. The physical site survey was done on 3rd June 2024 to register the actual elevation level of the pond to create the base map. The invert levels at outflow locations are measured to calculate the storage capacity of each pond as per the following images.

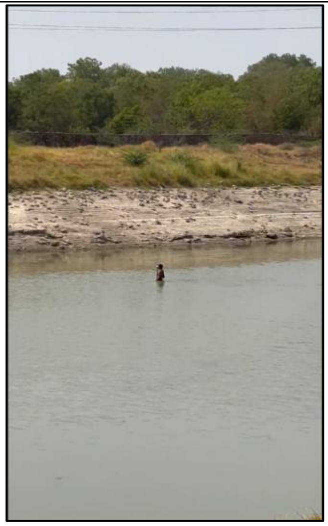
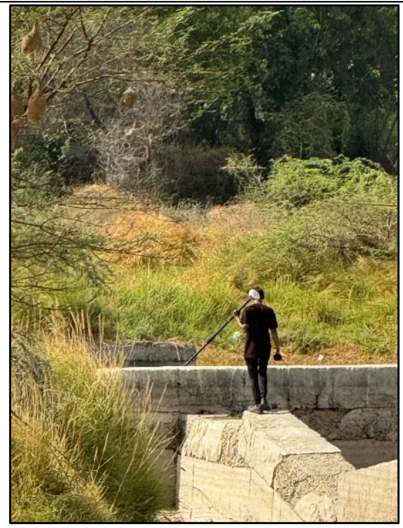
		
Site Survey by Level Instruments	Bathymetric Survey	Check Dam level at the Outflow location

Figure 11.1: Site Survey

Table 11.3: Pond Volume Calculation Methodology

SN	POND VOLUME CALCULATIONS METHODOLOGY
1	A Bathymetric Survey is carried out to determine the pond's depth by using a DGPS (Differential Global Positioning System) supported machine.
2	Contours are the output of the Bathymetric Survey.
3	DEM (Digital Elevation Model) has been generated from this output by using remote sensing and GIS techniques.
3	The maximum water storage of the pond is calculated considering the reduced level (RL) on the top of the check dam as the outlet location.
4	Contours at 0.5 meters (vertical intervals) are used to calculate the volume of the pond.
5	The formula for volume calculations, $V = \left(\frac{(A1+A2)}{2}\right) \times (c1 - c2)$ Where, V – Volume of the pond A1 –Area of Top Contour A2–Area of Bottom Contour $c1$ –Top Contour $c2$ –Bottom Contour

11.2.1 POND 1

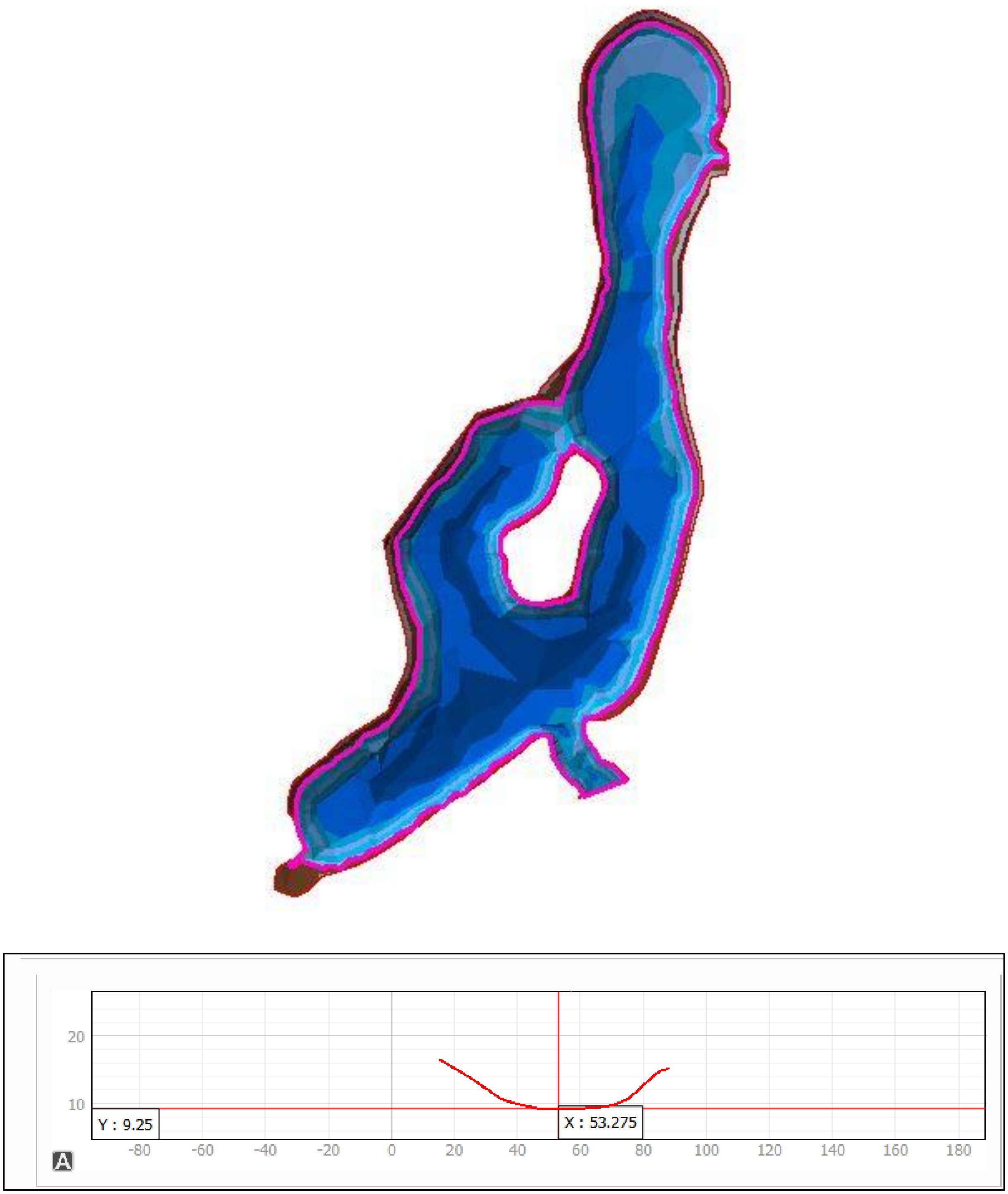


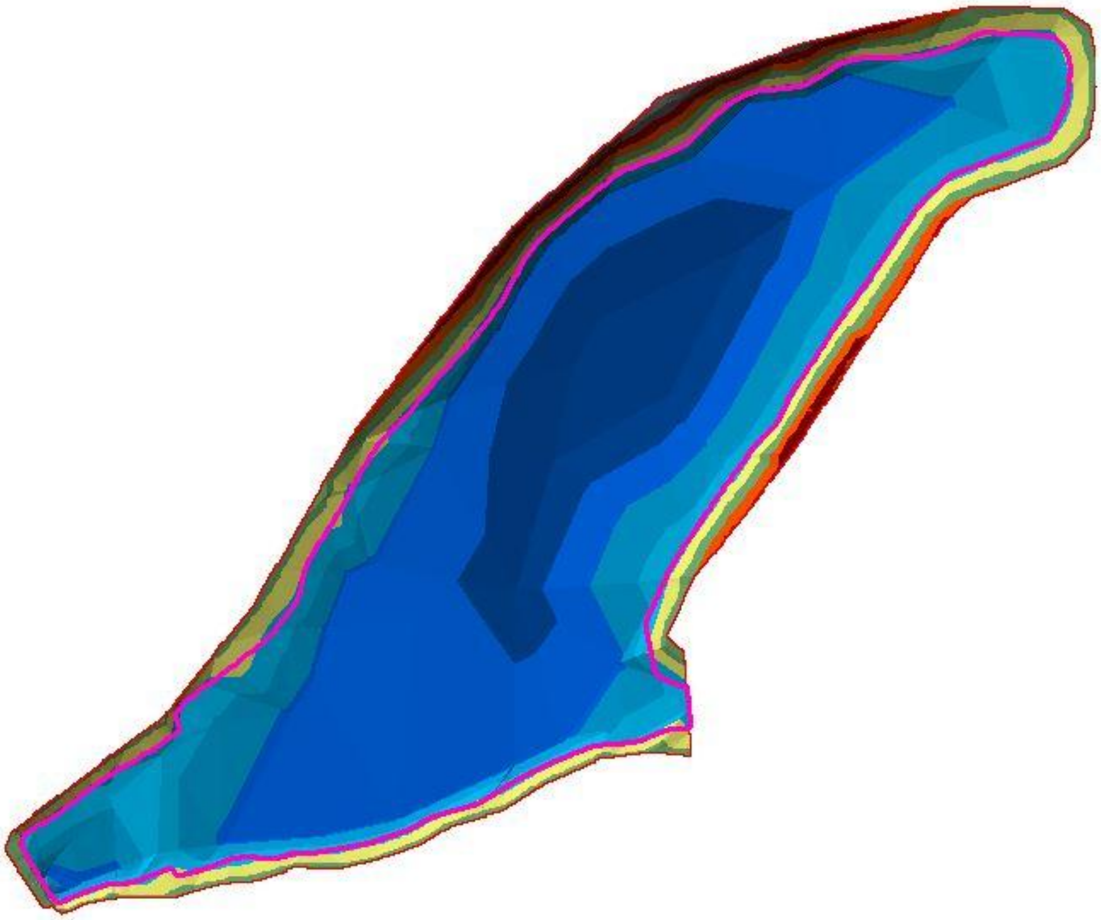
Figure 11.2: POND 1- DEM plan & cross-section

Table 11.4: POND 1- Voume Calculation

POND 1							
SN	CONTOUR NUMBER	TOP CONTOUR (Mt)	BOTTOM CONTOUR (Mt)	DIFEERENCE (Mt)	TOP AREA (Sq.Mt)	BOTTOM AREA (Sq.Mt)	VOLUME (Cu.Mt)
1	1	14.75	14.50	0.25	40,888	42,592	10,435
2	2	14.50	14.00	0.50	42,592	38,744	20,334
3	3	14.00	13.50	0.50	38,744	36,404	18,787
4	4	13.50	13.00	0.50	36,404	34,072	17,619
5	5	13.00	12.50	0.50	34,072	33,564	16,909
6	6	12.50	12.00	0.50	33,564	29,547	15,778
7	7	12.00	11.50	0.50	29,547	26,225	13,943
8	8	11.50	11.00	0.50	26,225	22,622	12,212
9	9	11.00	10.50	0.50	22,622	14,358	9,245
10	10	10.50	10.00	0.50	14,358	5,530	4,972
11	11	10.00	9.50	0.50	5,530	478	1,502
12	12	9.50	9.25	0.25	478	101	72
							141,808

Note: Contour 1 – 14.75 m is registered physically at the site as the top level of the check dam.

11.2.2 POND 2



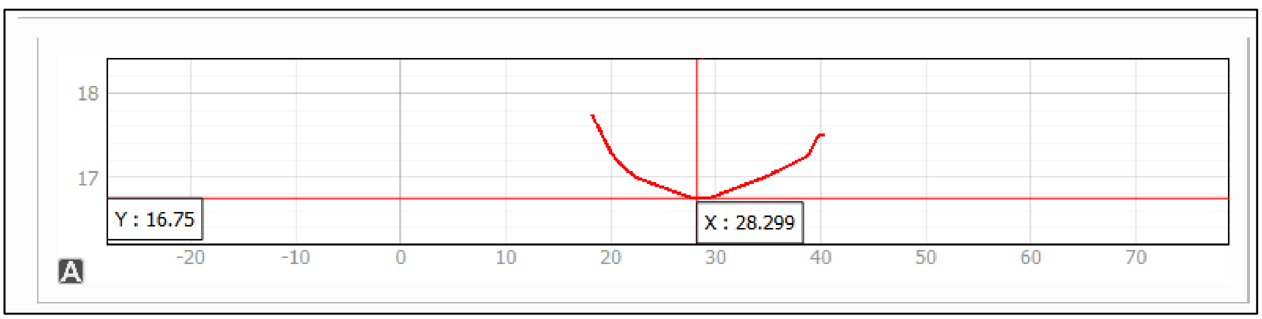


Figure 11.3: POND 2- DEM plan & cross-section

Table 11.5: POND 2- Voume Calculation

POND 2							
SN	CONTOUR NUMBER	TOP CONTOUR (Mt)	BOTTOM CONTOUR (Mt)	DIFEERENCE (Mt)	TOP AREA (Sq.Mt)	BOTTOM AREA (Sq.Mt)	VOLUME (Cu.Mt)
1	1	17.25	16.75	0.5	984.00	72.00	264.00
							264.00

11.2.3 POND 3

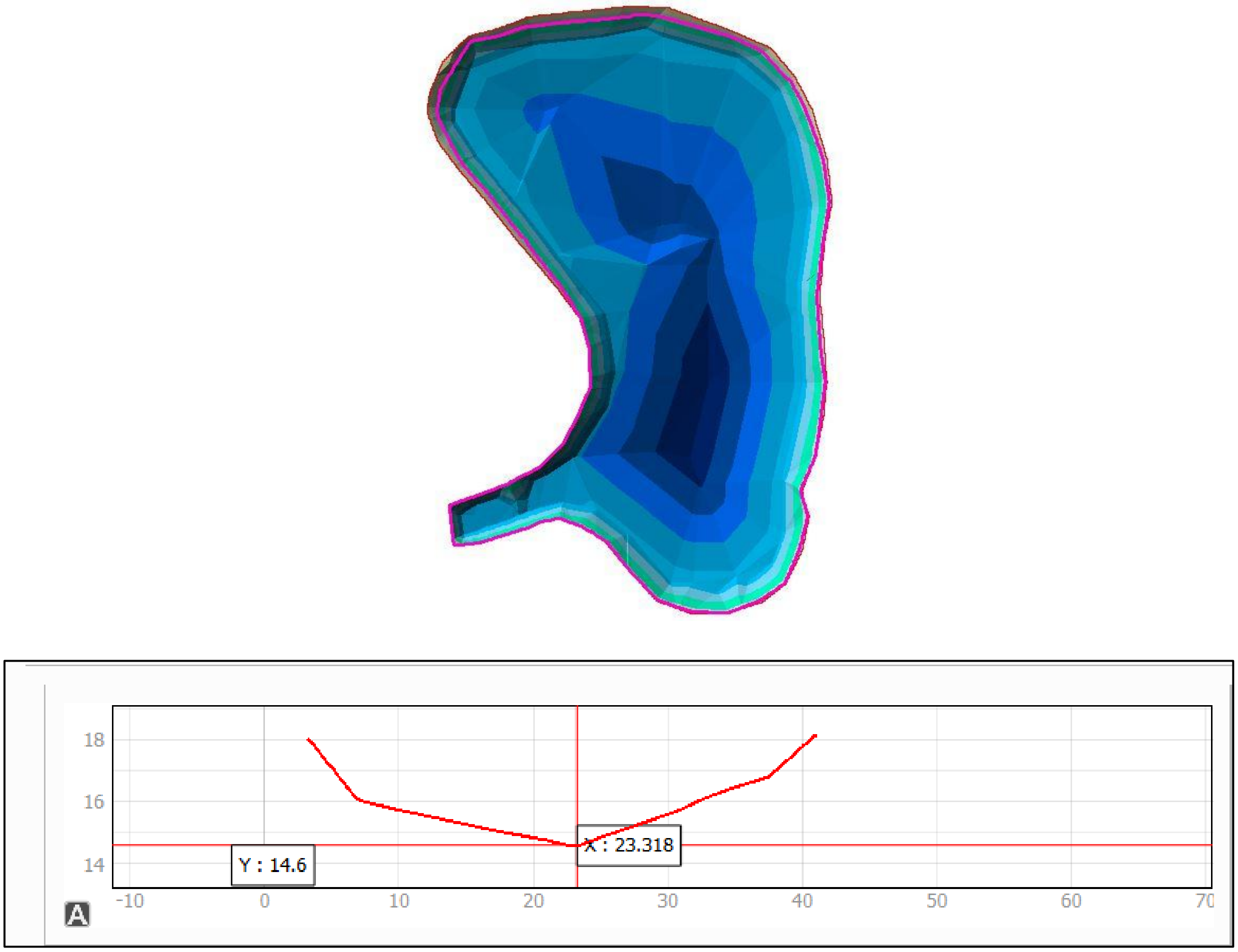
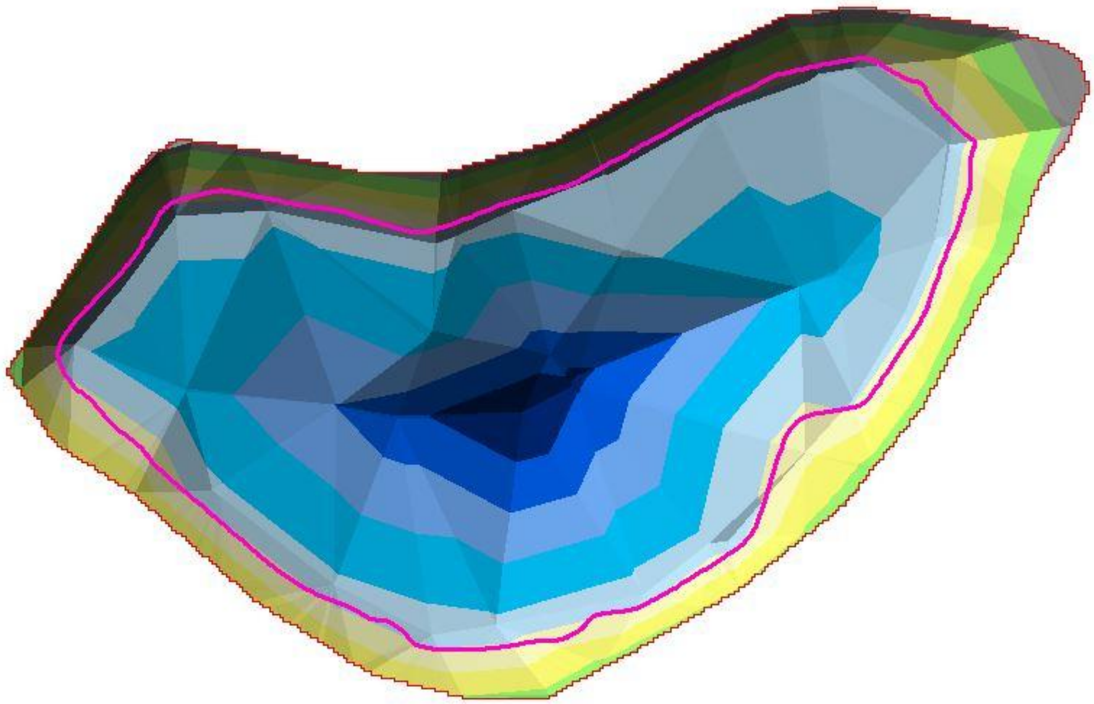


Figure 11.4: POND 3- DEM plan & cross-section

Table 11.6: POND 3- Voume Calculation

POND 3							
SN	CONTOUR NUMBER	TOP CONTOUR (Mt)	BOTTOM CONTOUR (Mt)	DIFEERENCE (Mt)	TOP AREA (Sq.Mt)	BOTTOM AREA (Sq.Mt)	VOLUME (Cu.Mt)
1	1	18.20	18.00	0.20	3,736	3,788	752
2	2	18.00	17.50	0.50	3,788	3,516	1,826
3	3	17.50	17.00	0.50	3,516	3,248	1,691
4	4	17.00	16.50	0.50	3,248	2,583	1,458
5	5	16.50	16.00	0.50	2,583	1,436	1,005
6	6	16.00	15.50	0.50	1,436	591	507
7	7	15.50	15.00	0.50	591	169	190
8	8	15.00	14.60	0.40	169	12	36
							7,465

11.2.4 POND 4a



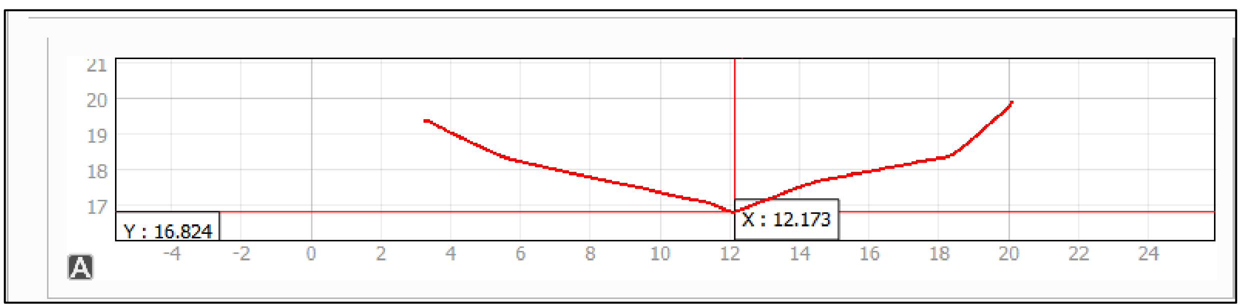
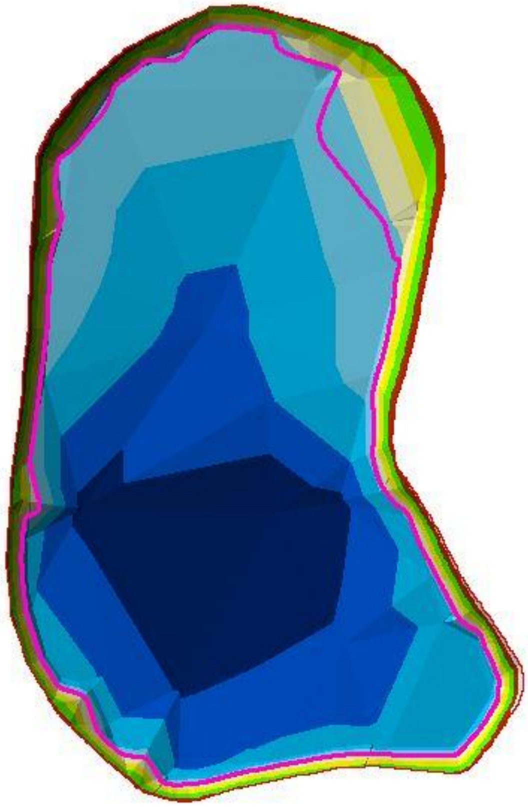


Figure 11.5: POND 4a- DEM plan & cross-section

Table 11.7: POND 4a- Voume Calculation

POND 4a							
SN	CONTOUR NUMBER	TOP CONTOUR (Mt)	BOTTOM CONTOUR (Mt)	DIFEERENCE (Mt)	TOP AREA (Sq.Mt)	BOTTOM AREA (Sq.Mt)	VOLUME (Cu.Mt)
1	1	18.60	18.50	0.10	311	265	29
2	2	18.50	18.00	0.50	265	117	95
3	3	18.00	17.50	0.50	117	31	37
4	4	17.50	17.00	0.50	31	2	8
5	5	17.00	16.80	0.20	2	1	0
							169

11.2.5 POND 4b



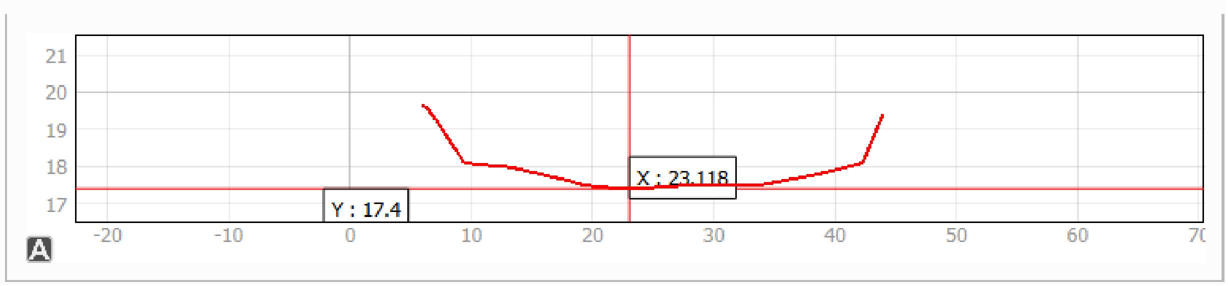
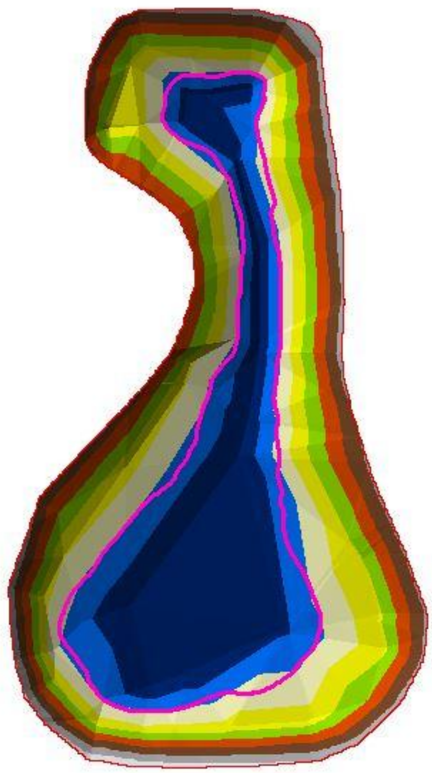


Figure 11.6: POND 4b- DEM plan & cross-section

Table 11.8: POND 4b- Voume Calculation

POND 4b							
SN	CONTOUR NUMBER	TOP CONTOUR (Mt)	BOTTOM CONTOUR (Mt)	DIFEERENCE (Mt)	TOP AREA (Sq.Mt)	BOTTOM AREA (Sq.Mt)	VOLUME (Cu.Mt)
1	1	18.40	18.00	0.40	1,518	798	463
2	2	18.00	17.50	0.50	798	89	222
3	3	17.50	17.4	0.10	89	2	5
							690

11.2.6 POND 4c



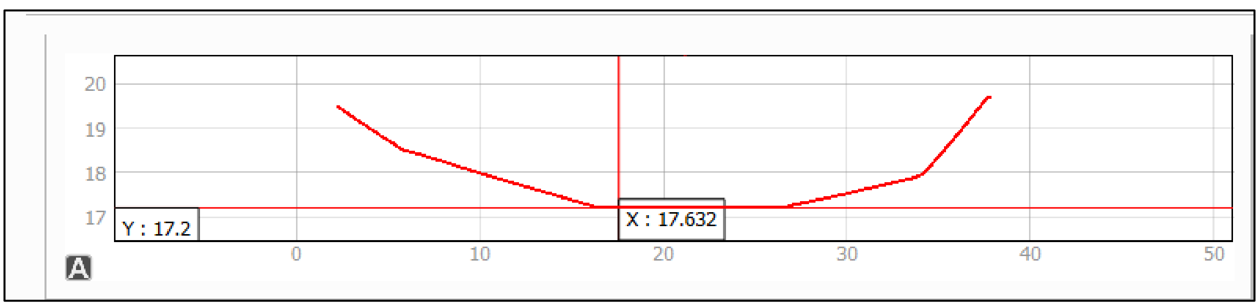
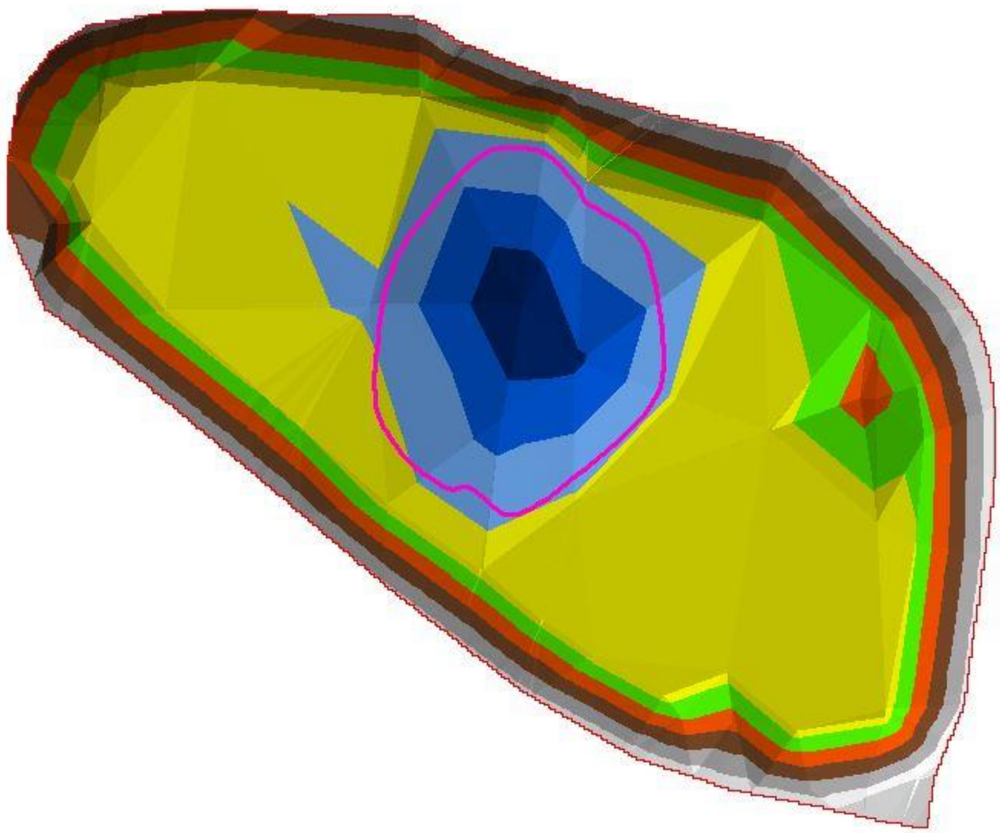


Figure 11.7: POND 4c- DEM plan & cross-section

Table 11.9: POND 4c- Voume Calculation

POND 4c							
SN	CONTOUR NUMBER	TOP CONTOUR (Mt)	BOTTOM CONTOUR (Mt)	DIFEERENCE (Mt)	TOP AREA (Sq.Mt)	BOTTOM AREA (Sq.Mt)	VOLUME (Cu.Mt)
1	1	17.80	17.50	0.30	516	272	118
2	2	17.50	17.20	0.30	272	109	57
							175

11.2.7 POND 4d



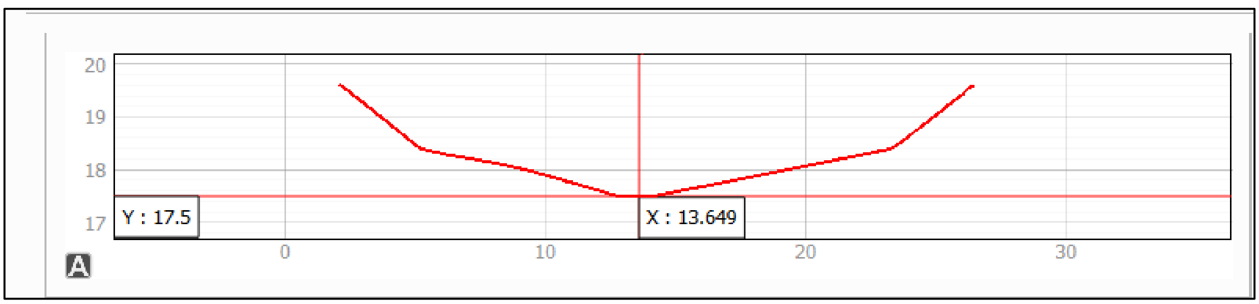


Figure 11.8: POND 4d- DEM plan & cross-section

Table 11.10: POND 4d- Voume Calculation

POND 4d							
SN	CONTOUR NUMBER	TOP CONTOUR (Mt)	BOTTOM CONTOUR (Mt)	DIFEERENCE (Mt)	TOP AREA (Sq.Mt)	BOTTOM AREA (Sq.Mt)	VOLUME (Cu.Mt)
1	1	18.20	18.00	0.20	141	53	19
2	2	18.00	17.50	0.50	53	5	15
							34

11.2.8 POND 5

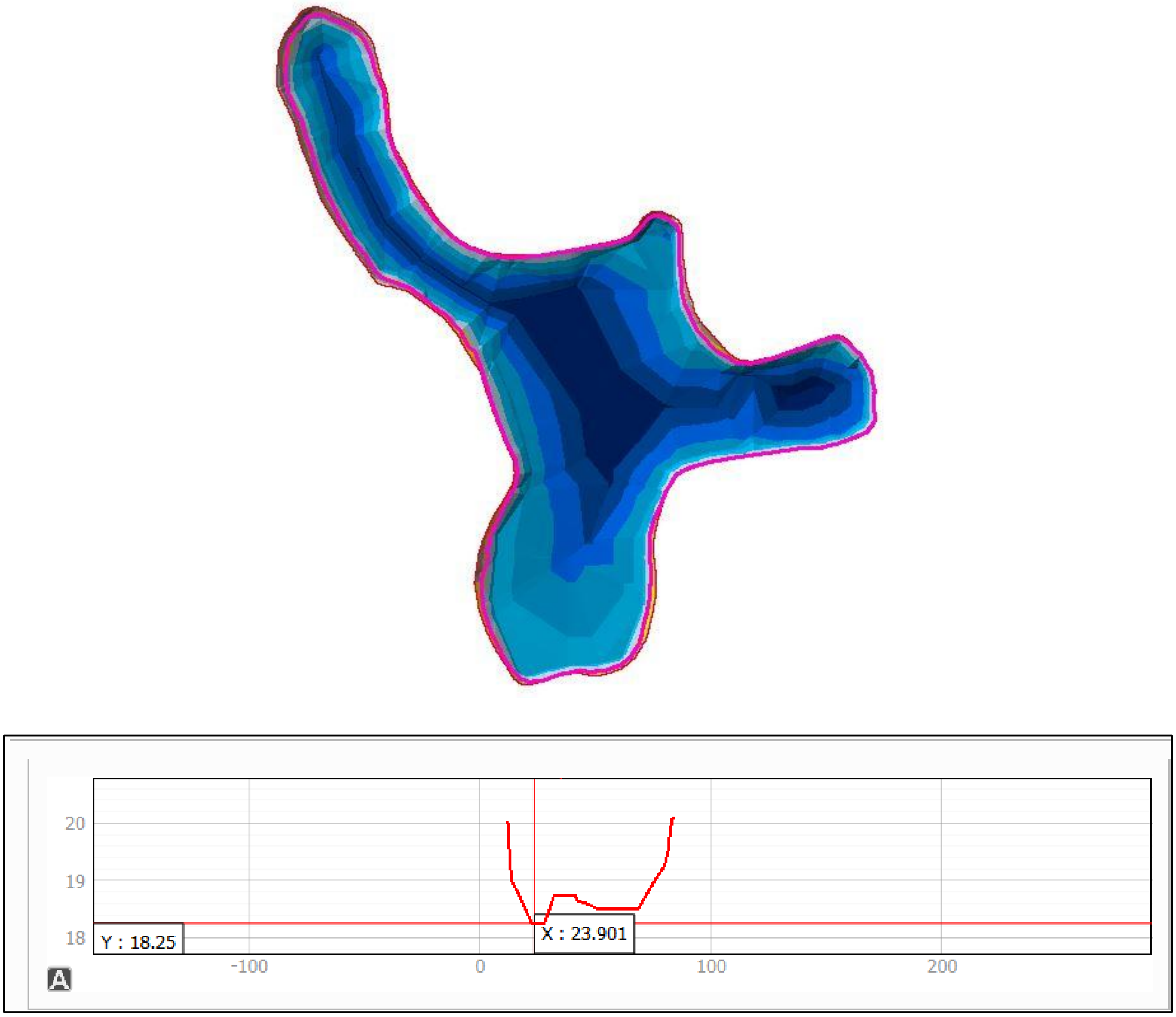
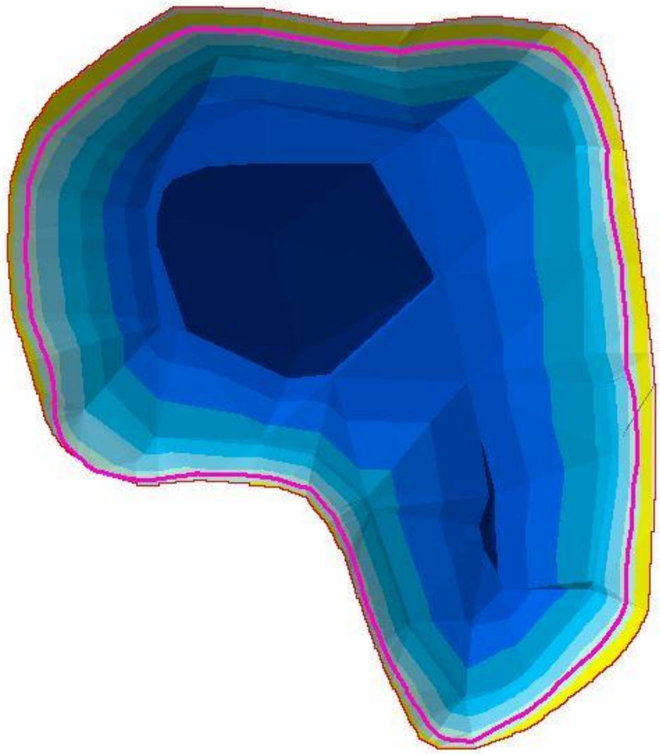


Figure 11.9: POND 5- DEM plan & cross-section

Table 11.11: POND 5- Voume Calculation

POND 5							
SN	CONTOUR NUMBER	TOP CONTOUR (Mt)	BOTTOM CONTOUR (Mt)	DIFEERENCE (Mt)	TOP AREA (Sq.Mt)	BOTTOM AREA (Sq.Mt)	VOLUME (Cu.Mt)
1	1	20.00	19.50	0.50	4,553	3,654	2,052
2	2	19.50	19.00	0.50	3,654	2,097	1,438
3	3	19.00	18.50	0.50	2,097	489	647
4	4	18.50	18.25	0.25	489	3	62
							4,198

11.2.9 POND 6



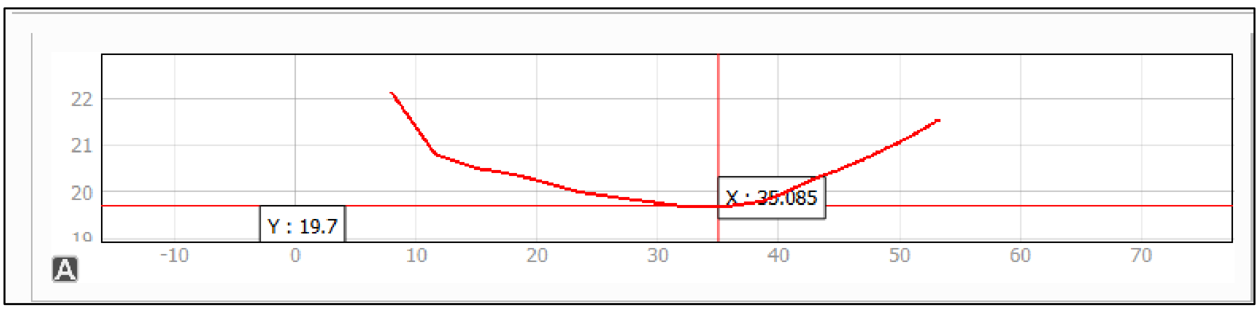
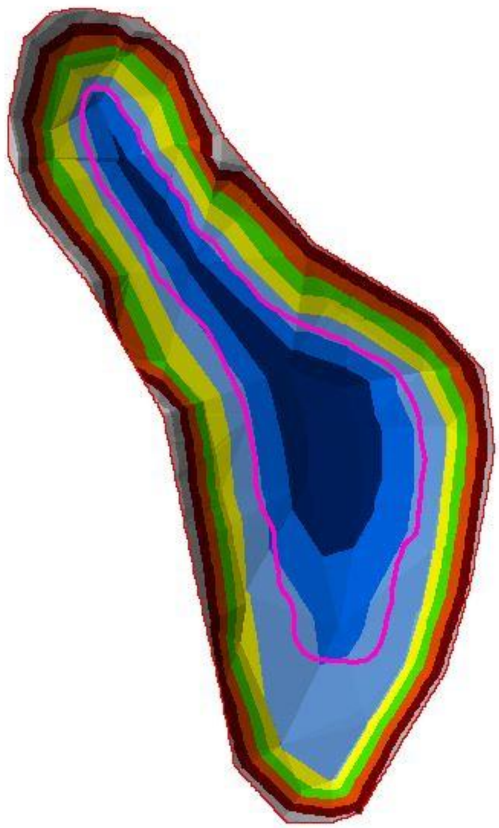


Figure 11.10: POND 6- DEM plan & cross-section

Table 11.12: POND 6- Voume Calculation

POND 6							
SN	**CONTOUR NUMBER**	**TOP CONTOUR (Mt)**	**BOTTOM CONTOUR (Mt)**	**DIFEERENCE (Mt)**	**TOP AREA (Sq.Mt)**	**BOTTOM AREA (Sq.Mt)**	**VOLUME (Cu.Mt)**
1	1	21.50	21.00	0.50	1,475	1,175	663
2	2	21.00	20.50	0.50	1,175	780	489
3	3	20.50	20.00	0.50	780	298	270
4	4	20.00	19.70	0.30	298	32	49
							1,470

11.2.10 POND 7



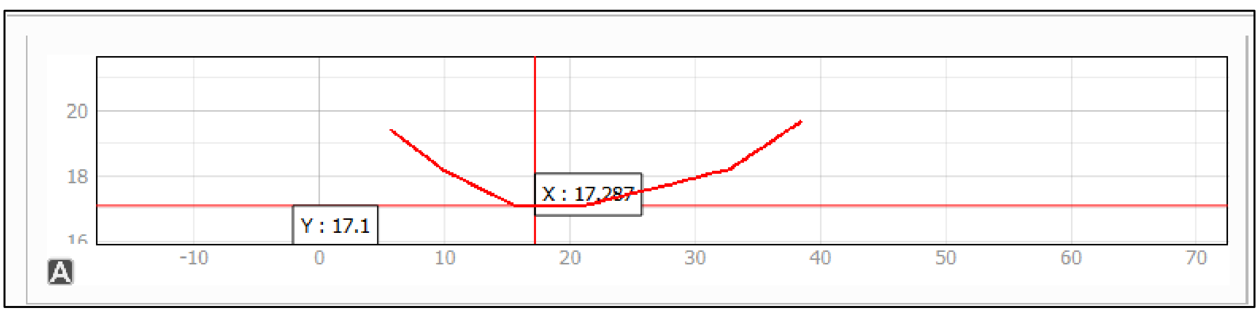
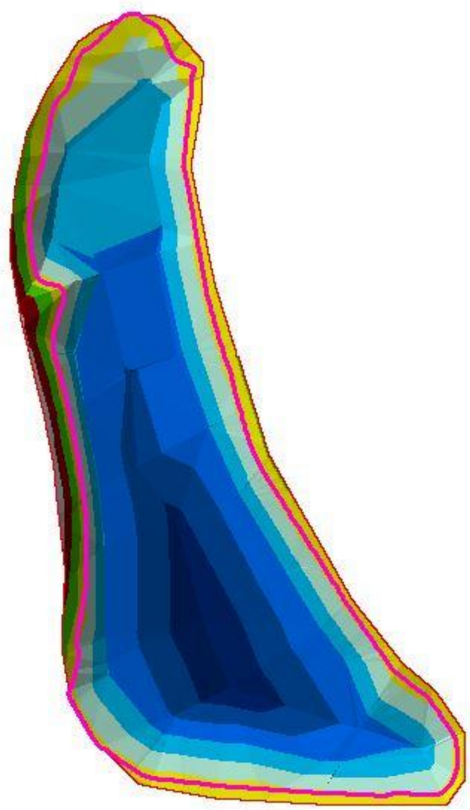


Figure 11.11: POND 7- DEM plan & cross-section

Table 11.13:POND 7- Voume Calculation

POND 7							
SN	CONTOUR NUMBER	TOP CONTOUR (Mt)	BOTTOM CONTOUR (Mt)	DIFEERENCE (Mt)	TOP AREA (Sq.Mt)	BOTTOM AREA (Sq.Mt)	VOLUME (Cu.Mt)
1	1	17.80	17.50	0.30	526	211	110
2	2	17.50	17.10	0.40	211	24	47
							157

11.2.11 POND 8



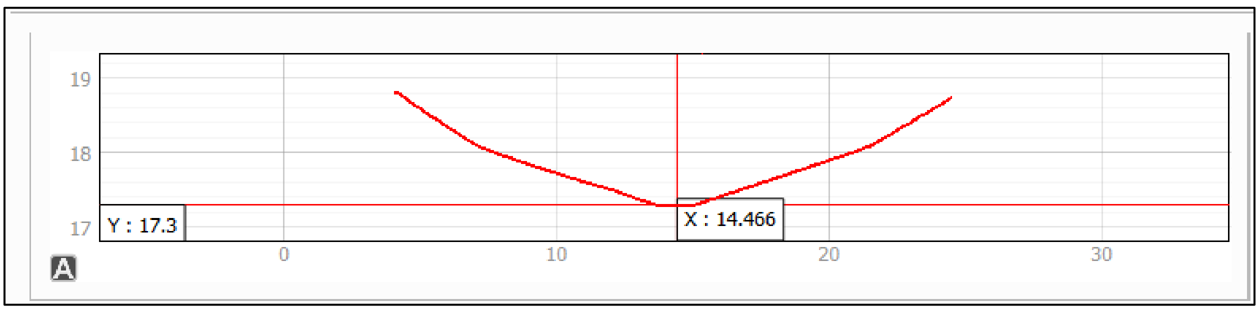


Figure 11.12: POND 8- DEM plan & cross-section

Table 11.14: POND 8- Voume Calculation

POND 8							
SN	CONTOUR NUMBER	TOP CONTOUR (Mt)	BOTTOM CONTOUR (Mt)	DIFEERENCE (Mt)	TOP AREA (Sq.Mt)	BOTTOM AREA (Sq.Mt)	VOLUME (Cu.Mt)
1	1	18.70	18.50	0.20	779	635	141
2	2	18.50	18.00	0.50	635	298	233
3	3	18.00	17.50	0.50	298	42	85
4	4	17.50	17.30	0.20	42	6	5
							464

11.2.12 POND 9

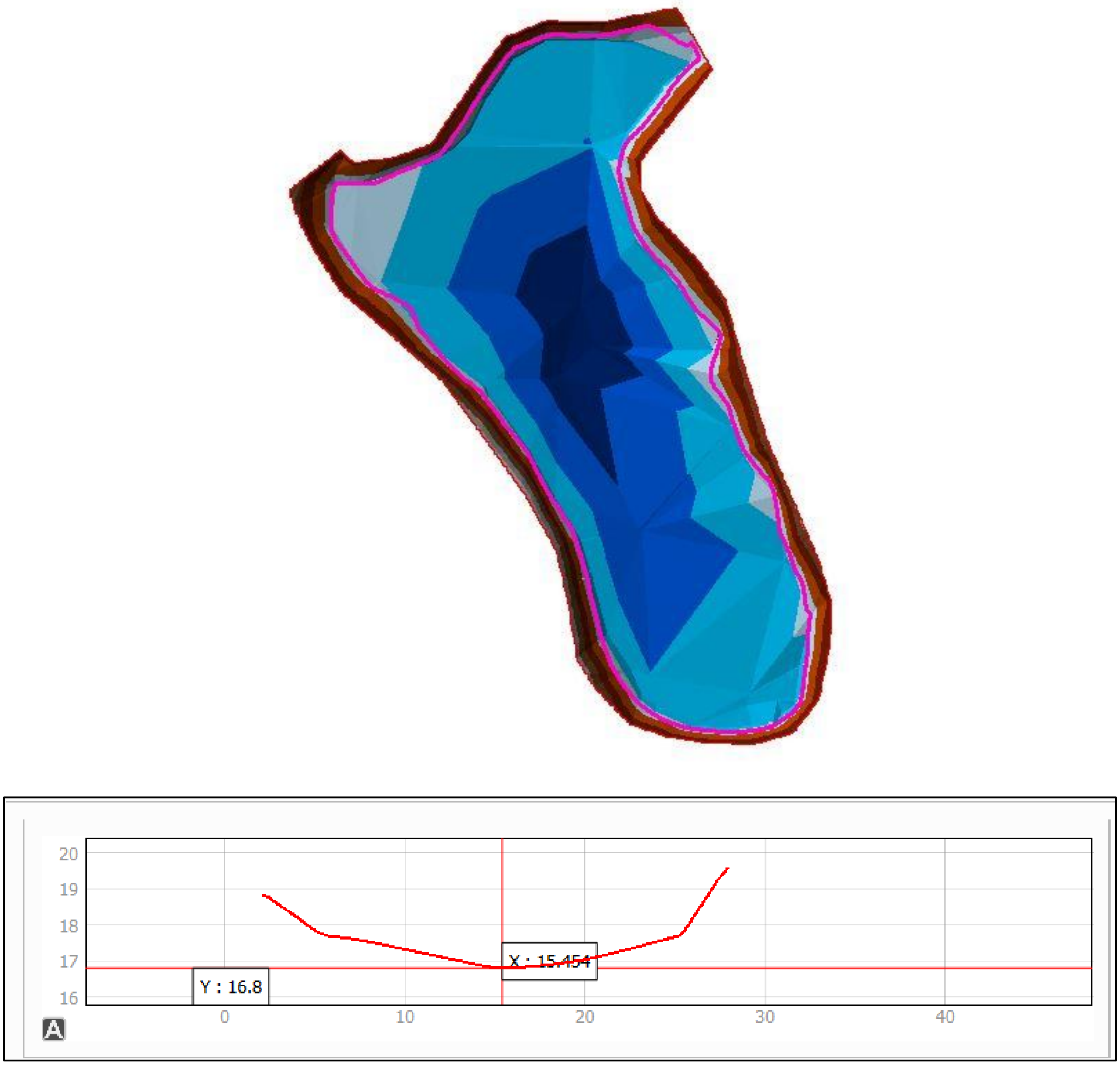


Figure 11.13: POND 9- DEM plan & cross-section

Table 11.15: POND 9- Voume Calculation

POND 9							
SN	CONTOUR NUMBER	TOP CONTOUR (Mt)	BOTTOM CONTOUR (Mt)	DIFEERENCE (Mt)	TOP AREA (Sq.Mt)	BOTTOM AREA (Sq.Mt)	VOLUME (Cu.Mt)
1	1	17.90	17.50	0.40	1,337	578	383
2	2	17.50	17.00	0.50	578	98	169
3	3	17.00	16.80	0.20	98	12	11
							563

Table 11.16: Cumulative Rainwater Storage

Activities	Water Availability	
	Volume of Pond (Cu Meter)	Cumulative Rainwater Storage (Cu Meter)
(b)	(e)	(f)
RAINWATER STORAGE CAPACITY		
POND 1	141,808	141,808
POND 2	264	142,072
POND 3	7,075	149,147
POND 4a	169	149,316
POND 4b	690	150,006
POND 4c	175	150,181
POND 4d	34	150,215
POND 5	4,198	154,413
POND 6	1,470	155,883
POND 7	157	156,040
POND 8	464	156,504
POND 9	563	**157,067**
Total Pond Storage from 2014 to 2023		

11.3 CAPACITY CALCULATION -STP

The STP plays a vital role in water conservation and eco-friendly waste management. The STP is a critical infrastructure for managing sewage and promoting sustainable water usage. Treating and reusing wastewater minimizes environmental impact, supports resource conservation, and ensures a healthier ecosystem. Proper design, operation, and maintenance are essential for maximizing its efficiency and benefits.

The physical site survey was done on 30th November 2024, to know STP unit type and its capacity to treat the wastewater. Water conservation by treatment of the sewage water is represented below as per the predefined assumption and water consumption pattern.

 Sewage Water Collection Tank	 Barscreen Chamber
 Equalization Tank	 Bio Reactor / Aeration Tank

 Settling Tank	 UNDERGROUND DISINFECTION TANK including 1 no.of multi-grade sand filter, 1 no.of activated carbon filter and 2 nos. of non membrane blower
 Water meter at STP outlet to know the amount of water treated	 Installed Fixtures Flowrate Verification

Figure 11.14: Site Survey - Club Mahindra Kensville

11.3.1 Raw Water Demand

Water is a very important source to be used judiciously to ensure the long-term operation and performance of the facility, it is important to define operational philosophy while maintaining the water usage limit against water availability.

Occupancy details, plumbing fixtures, and sanitary fixtures have been obtained to calculate raw water demand. The table below shows technical information on the installed fixtures, including flow rates, which have been used to calculate the facility's water demand.

Table 11.17: Fixtures Installed at Club Mahindra Kensville

SN	CATALOG NO	PRODUCT IMAGE	FLOW RATE (Lit/ Min/)	REMARK
1	K-16027 SINGLE BASIN MIXTURE		8.0	BASIN INSTALLED IN EACH GUEST ROOM
2	BASIN (SINK) MIXTURE (FOR KITCHEN)		7.5	SINK INSTALLED IN KITCHEN
3	K-12925IN-CP (HEALTH FAUCET)		11.7	HEALTH FAUCET INSTALLED IN EACH GUEST ROOM
4	KOHLER-2686 CONCEALED CISTERN (FOR DUAL FLUSHING)		6.0	FOR FULL FLUSH APPLICATION FOR TOILET
5	KOHLER-2686 CONCEALED CISTERN (FOR DUAL FLUSHING)		3.0	FOR HALF FLUSH APPLICATION FOR TOILET
6	K-10879 BATH TUB MIXTURE		15.0	ASSUMED

Raw water demand is calculated for the water footprint that is accounted for directing water consumption required for the operation and maintenance of the facility. Water consumption data is projected for domestic use consisting of various direct and indirect activities like bathing, hand washing, face washing, housekeeping, and other human consumptions/ activities.

Table 11.18: Total Water Demand at Club Mahindra - Kensville

Sr. No.	Description	Occupancy (nos)	Frequency (nos)	Duration (min)	Flow (lit/min)	Total Water Demand (lit)/Day
1	Master Toilet					
	Bathtub Mixture	144	2	5	15	21600
	WC / Flush Tank (Full Flush)	144	2	1	6	1728
	WC / Flush Tank (Half Flush)	144	6	0.5	3	1296
	Hand Faucet	144	2	1	11.7	3369.6
	Basin Mixture	144	5	2.5	8	14400
2	Kitchen					
	Mono Sink Mixture	1	5	5	7.5	187.5
	Total (Lit)					**42581**
3	**Add 20% contingency for floating occupancy + Housekeeping**					**8516**
	Total Water Demand (lit/person/ day)					**355**

Table 11.19: Water Demand Calculation for STP

SN	Activities	Number of Rooms	Occupancy (Days)	Occupancy (Heads)	Total Occupancy (heads)	Lit/ day / person	Lit/year	CuMt/ year	Peak Water Demand CuMt/ Day	Remark
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	1. The flow for all fixtures and faucets has been checked at the site as installed. 2. A separate calculation sheet is prepared to define the frequency of use based on the activities to be performed. 3. Drinking is considered as per CGWA Guidelines. Annexure I, Table - Page No. 49-50.
1	Floating Occupancy (Guest)	72	120	2	**17280**	**370**	63,93,600	**6394**	**53.28**	
	Domestic				17280	355	6134400	6134	51.12	
	Drinking				17280	15	259200	259	2.16	
	TOTAL WATER DEMAND							**6,394**	**53.28**	

11.3.2 Total STP Recovered Treated Water

Table 11.20: Total STP Recovered Treated Water

SN	Activities	Demand (CuMt/Day)	Consumption (CuMt/Day)	Losses (CuMt/ Day)	Balance (CuMt/Day)	TO STP (CuMt/Day)	Occupancy (Days)	Volume (CuMt/Year)	STP Recovery Coefficient	Recovered Treated Water for reuse (KLD)
	(a)	(b)	(c)	(d)	(e) = (b-(c+d))	(f)	(g)	(h) = (f*g)	(i)	(j) = (h*i)
1	**2015 - 2016**	**53.28**	**2.16**	**2.56**	**48.56**	**48.56**	70	3399	90%	**3060**
	Domestic	51.12	0.00	2.56	48.56	48.56				
	Drinking and Cooking	2.16	2.16	0.00	0.00	0.00				
2	**2016 - 2017**	**53.28**	**2.16**	**2.56**	**48.56**	**48.56**	120	5828	90%	**5245**
	Domestic	51.12	0.00	2.56	48.56	48.56				
	Drinking and Cooking	2.16	2.16	0.00	0.00	0.00				
3	**2017 - 2018**	**53.28**	**2.16**	**2.56**	**48.56**	**48.56**	120	5828	90%	**5245**
	Domestic	51.12	0.00	2.56	48.56	**49**				
	Drinking and Cooking	2.16	2.16	0.00	0.00	0.00				

4	**2018 - 2019**	**53.28**	**2.16**	**2.56**	**48.56**	**48.56**	120	5828	90%	**5245**
	Domestic	51.12	0.00	2.56	48.56	48.56				
	Drinking and Cooking	2.16	2.16	0.00	0.00	0.00				
5	**2019 - 2020**	**53.28**	**2.16**	**2.56**	**48.56**	**48.56**	120	5828	90%	**5245**
	Domestic	51.12	0.00	2.56	48.56	48.56				
	Drinking and Cooking	2.16	2.16	0.00	0.00	0.00				
6	**2020 - 2021**	**53.28**	**2.16**	**2.56**	**48.56**	**48.56**	120	5828	90%	**5245**
	Domestic	51.12	0.00	2.56	48.56	48.56				
	Drinking and Cooking	2.16	2.16	0.00	0.00	0.00				
7	**2021 - 2022**	**53.28**	**2.16**	**2.56**	**48.56**	**48.56**	120	5828	90%	**5245**
	Domestic	51.12	0.00	2.56	48.56	48.56				
	Drinking and Cooking	2.16	2.16	0.00	0.00	0.00				
8	**2022 - 2023**	**53.28**	**2.16**	**2.56**	**48.56**	**48.56**	120	5828	90%	**5245**
	Domestic	51.12	0.00	2.56	48.56	48.56				
	Drinking and Cooking	2.16	2.16	0.00	0.00	0.00				
9	**2023 - 2024**	**53.28**	**2.16**	**2.56**	**48.56**	**48.56**	120	5828	90%	**5245**
	Domestic	51.12	0.00	2.56	48.56	48.56				
	Drinking and Cooking	2.16	2.16	0.00	0.00	0.00				
Total STP Recovered Treated Water for Gainful use from 2015 to 2023										**45,019**

11.4 WATER BALANCE CALCULATION

Yearly water balance datasets are calculated to derive a site's water security potential using a water balance model that incorporates reference evapotranspiration, precipitation, temperature, and interpolated plant extractable soil water capacity.

RoUs serve as an important tool in rebalancing the region's water dynamics through all efforts to harvest and conserve rainwater, methods that recycle and/or reuse wastewater, and projects that convert an unutilized water source into usable water. The establishment of RoUs leads to a water-secure environment.

All projects using this methodology will be required to maintain a ratio of 1m3 of unutilized water recharged/conserved/recycled to be eligible to generate 1 RoU Rainwater offset credits = 1 RoU = 1000 liters of rainwater/unutilized water captured or recycled/reused/restored from systems (freshwater ecosystems included) and measures undertaken by individuals and entities per year. The following assumptions were made while calculating the raw water demand for the premises.

1. Please refer to chapter no 12.2 for reference.
2. Average evapotranspiration data can be referred to in chapter 10.1.
3. Available water storage volume is derived to calculate annual and comprehensive RoU. The same is mentioned in the below table.

Table 11.21: Total Water Credits Vintage Year (2014 – 2023)

SN	Activities	Pond storage	Surface Area	Evapotranspiration	Water loss	Water Conservation Pond	Water Conservation STP	RoU	Remark
		Cu Meter	Sq Mt	Mt / Year	CuMt/ Year	CuMt/ Year	CuMt/ Year	Unit	
1	2014 - 15	1,57,067	56,981	0.058	3,320	1,53,747	0	1,53,747	1000 Lit of unutilized rainwater - 1 RoU as per UWR guidleines.
2	2015 - 16	1,57,067	56,981	0.053	3,007	1,54,060	3,060	1,57,120	
3	2016 - 17	1,57,067	56,981	0.053	3,044	1,54,023	5,245	1,59,268	
4	2017 - 18	1,57,067	56,981	0.055	3,107	1,53,960	5,245	1,59,205	
5	2018 - 19	1,57,067	56,981	0.041	2,352	1,54,715	5,245	1,59,960	
6	2019 - 20	1,57,067	56,981	0.054	3,093	1,53,974	5,245	1,59,219	
7	2020 - 21	1,57,067	56,981	0.057	3,223	1,53,844	5,245	1,59,089	
8	2021 - 22	1,57,067	56,981	0.060	3,421	1,53,647	5,245	1,58,892	
9	2022 - 23	1,57,067	56,981	0.049	2,768	1,54,299	5,245	1,59,544	
10	2023 -24	1,57,067	56,981	0.059	3,368	1,53,700	5,245	1,58,945	
Total Water Vintage Credits (2014 - 2023)						**15,39,968**	**45,020**	**15,84,988**	
Considering Correction Factor 2%						**15,09,168**	**44,120**	**15,53,288**	
Total Water Vintage Credits (2014 - 2023)						**15,09,168**	**44,120**	**15,53,288**	

12 WATER CREDITS

The Universal Water Registry (UWR) Standard and Platform aims to introduce better waternomics with the next-generation voluntary rainwater offset projects that are far more efficient, faster, cheaper, de-centralized in transfer, and convenient for every small green projects involved in rainwater or unutilized water capture and/or groundwater recharge. UWR Standard allows for early action projects and the ability to monetize rainwater credits from the vintage year 2014 onwards. Similar to the carbon vintage year concept, RoUs can be classified as the year in which the conservation, recharge, or recycling of water took place and quantified for the monitoring period from June 01, 2014 to October 30.

RoUs, serve as an important tool in rebalancing the water dynamics of the region by incentivizing and monetizing all efforts to harvest and conserve rainwater. The established RoUs represented below that is leading to a water-rich environment.

12.1 WATER CREDITS

Table 12.1: Total RoU Generation for Vintage Year (2014 – 2023)

Year (June 01, 2014 onwards)	RoUs (1 RoU = 1000 litres)/Year*
01/ 06/ 2014 to 31/ 05/2015	1,53,747
01/ 06/ 2015 to 31/ 05/2016	1,57,120
01/ 06/ 2016 to 31/ 05/2017	1,59,268
01/ 06/ 2017 to 31/ 05/2018	1,59,205
01/ 06/ 2018 to 31/ 05/2019	1,59,960
01/ 06/ 2019 to 31/ 05/ 2020	1,59,219
01/ 06/ 2020 to 31/ 05/2021	1,59,089
01/ 06/ 2021 to 31/ 05/2022	1,58,892
01/ 06/ 2022 to 31/ 05/2023	1,59,544
01/ 06/ 2023 to 31/ 03/2024	1,58,945
Total RoU	15,84,988
Correction Factor	2%
Total RoU	**15,53,288**

13 IMPLEMENTATION BENEFITS

13.1 Pond

KENSVILLE ponds are only observed as the primary water source for the premises and they cater to all irrigation water needs. Hence the PP needs to carry out preventive maintenance of these ponds to ensure water security since it's the only reliable and fully useable water source of the premises. These artificial storage address the following issues

1. Harvesting of surplus monsoon runoff into the surface reservoir which otherwise was going un-utilised outside the watershed/ basin and to sea.
2. Fulfilling irrigation requirements by storing rainwater runoff which would have gone to the sea thereby preserving the groundwater security of the region and local geography.
3. Meeting substantial irrigation water requirements of the site with rainwater conservation for the vintage period.
4. Reduction of reliance on surface water from the major and minor irrigation canals that are primarily constructed to cater to surrounding farmlands.
5. Ensuring drawable groundwater availability and water security to the local agricultural farms and communities by harnessing and conserving rainwater.
6. Moreover, these ponds are freshwater ecosystems that support a variety of plants and animals and contribute to the environment in many ways.
7. Ponds provide habitats for many species, including amphibians, insects, fish, and birds to enhance biodiversity.
8. Ponds filter out sediments and can act as drinking water sources for wildlife.
9. Prevent water logging on roads and other parts of premises.
10. Serve as alternatives to enhance the sustainable yield in areas where overdevelopment has depleted the aquifer.
11. Reduces soil erosion.
12. Serves to conserve and store excess surface water for future requirements, since these requirements often change within a season or a period.
13. Ponds function as rainwater holding storage that can be connected with artificial rainwater harvesting to recharge surface water in groundwater by replenishing continuous water flow during the rainy season.

13.2 STP

The STP unit at Club Mahindra is a primary wastewater treatment plan for the resort, which treats the wastewater to make gainful use. When operating and maintaining a Sewage Treatment Plant (STP), certain preventive measures should be considered to ensure its efficiency, longevity, and environmental compliance. Here are the key preventive measures:

1. Contributing to water conservation and sustainable resource management aligns with global and local sustainability initiatives.

2. STP treats wastewater to remove harmful pollutants, ensuring that only clean, treated water can be reused for non-potable purposes such as irrigation, landscaping, etc.
3. Proper wastewater treatment prevents excessive groundwater use, which is crucial for regions relying on underground aquifers.

4. Reusing treated wastewater reduces the dependency on freshwater sources, lowering water procurement costs.

14 ALTERNATE WATER CONSERVATION METHODS

There is an urgent need for the management of water sources for sustainable development, where groundwater should be protected and reserved. Creating awareness amongst communities and industries regarding the conjunctive use of surface water and groundwater through the judicious use of water and the adoption of effective techniques has become important.

A planned water conservation strategy needs to be deployed to discharge and the withdrawal of water, that can be used during the lean period. Resorting to artificial recharge practices by diverting surplus runoff during the monsoon into ponds, percolation tanks, spreading basins abandoned dug wells, etc could be an alternative rainwater conservation method, that could be taken up through appropriate techniques. That may be implemented depending upon the suitable hydrogeological conditions to explore other scopes as mentioned in the UWR guidelines.

Following suitable hydraulic structure's feasibility can be checked for the study area as an alternative to the project activity.

14.1 Recharge Wells

Table 14.1: Recharge Wells

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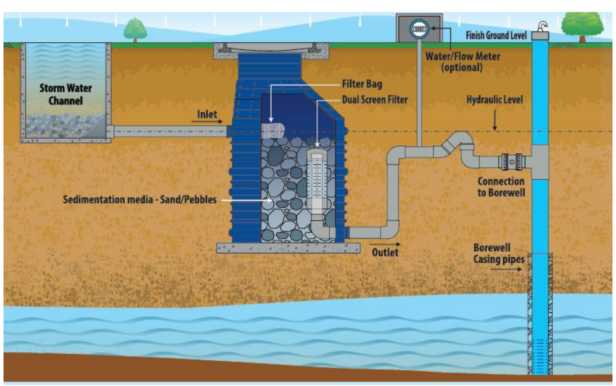

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Recharge wells are also known as infusion wells. This is being used to promote their products and concepts, however, the working fundamentals for both are the same.

Presently, surface rainwater runoff or rooftop rainwater gets diverted to a deeper aquifer (A1) through the reverse borehole through the conventional rainwater harvesting structure. Such structure could be planned in study area at various location.

Alternatively, the smart rainwater harvesting structure integrated with an ultrasonic water meter could be installed to recharge the deeper aquifer (A1) to bring groundwater balance. The number of such wells must neutralize groundwater extraction.
</td>
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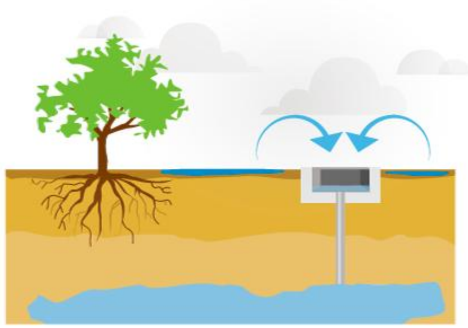
14.2 Dugwells

Table 14.2: Dugwells

	The working fundamentals of Dug wells are very similar to percolation wells, however, these wells are larger compared to percolation wells. Dug wells are normally seen in the vicinity of farms and situated downstream of the natural water path. The primary function of this well is to collect the rainwater to prevent the surrounding farmland from flooding. Moreover, these wells fulfill the yearly irrigation water demand of the farm. Interesting to know that percolated water keeps the soil in moist condition throughout the year and it reduces water demand substantially. Dug wells integrated with recharge wells replenish groundwater aquifer to fulfill water demand and keep the production borewell in working condition for a longer time while improving the quality of groundwater.

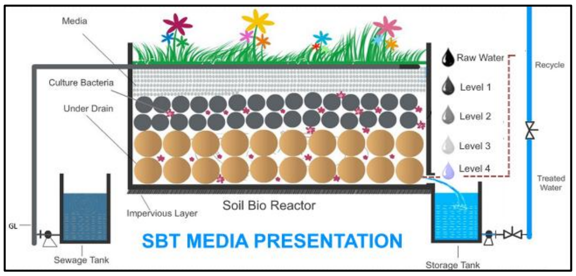
14.3 Bhungroo

Table 14.3: Bhungroo

	Bhungroo is an innovative and sustainable agricultural technology developed to combat water scarcity in arid regions. It involves a groundwater recharge system that captures and stores rainwater during the monsoon season. This stored water is then channeled into the ground, recharging unconfined aquifers and preventing waterlogging during heavy rains. Bhungroo not only conserves water but also supports year-round irrigation, enabling farmers to cultivate crops in dry seasons. This technology empowers rural communities, particularly women, by enhancing agricultural productivity, reducing dependency on erratic rainfall, and promoting climate resilience. Bhungroo represents a crucial solution for addressing water scarcity and ensuring food security in vulnerable regions.

14.4 Soil BioTechnology

Table 14.4: Soil Bio-Technology

	SBT (alternative to Sewage Treatment Plant) systems are practically maintenance-free, do not produce biosolids or foul odors, and consume minimal energy. They achieve river-quality water and enhance the surrounding aesthetic with greenery. Their operation is straightforward, cost-effective, and energy-efficient. SBT systems typically begin with an underdrain layer, followed by a media layer that supports culture and bioindicator plants. Water first flows through the additive layer and then through the media layer. The process can operate as either a single-stage or multi-stage system, depending on the desired water quality. Recirculation can be implemented for additional polishing if needed.

15 FEASIBILITY EVALUATION

Alternative conservation methods have been evaluated to check the feasibility of investigating various hydrological and hydrogeological conditions based on historical rainfall patterns.

15.1 Recharge well

1. Recharge wells are feasible to implement at the KENSVILLE.
2. The KENSVILLE and surrounding region have two aquifer systems.
3. First aquifer A1 is tapped at 48 meters (approx. 150 ft) and the quality observed is saline.
4. Recharging rainwater in this A1 aquifer is feasible but less effective. There will be fewer cavities in the aquifer since no significant water is being extracted in the surrounding region. KENSVILLE is extractive water for domestic use from the A1 aquifer if needed.
5. Dilusion of saline saline water will be a long process. Overflowing and excess rainwater can be diverted to the A1 aquifer as prospects.
6. Second aquifer A2 is tapped at 186 meters (approx. 600 ft) and the quality of water is fresh.
7. Surrounding region and farmland extractive extensive water from this aquifer for irrigation purposes.
8. Therefore, there would be huge cavities in the A2 aquifer compared to the A1 aquifer. Groundwater recharge in the A2 aquifer will be more effective.
9. Pumping cost from the A2 aquifer will be much higher than the A1 aquifer, however, the water treatment cost of the A1 aquifer will be extensively higher than the A2 aquifer.

15.2 Dug wells

1. Dug wells are feasible to implement at the KENSVILLE.
2. Dug wells will have perforated side walls and recharge well within.
3. Unconfined aquifer (topsoil) is identified up to 14 meters (50 ft).
4. Dug wells integrated with recharge wells are the best possible technique for KENSVILLE.
5. Dugwells function as an intermediate water holding structure and water gets recharged at the aquifer's recharge capacity.
6. Overflowing rainwater can be further stored in the dug wells and used for misc activities as may be required.
7. Retained rainwater in the topsoil may get diverted towards the dug well slowly and keep the wells functional even in the dry season.

15.3 Bhungroo

1. Bhungroo is the cost-effective solution to recharge groundwater into unconfined aquifers.
2. Application of this option is applied where there is a huge possibility of water logging.
3. Such a system works effectively, where surface infiltration is either not effective or negligible (having soil properties with a higher portion of lay and silt)
4. Many such units may be implemented with the decentralized, where surface runoff gets artificially recharged into topsoil.
5. This option may not be suitable for KENSVILLE since the whole site is well-graded and profiled to allow surface water flow to nearby drain outlets. The site is well-designed to prevent water logging.

15.4 Soil BioTechnology

1. Soil Bio-Technology (SBT) is a green technology with green chemistry
2. SBT is a feasible option for KENSVILLE as it is based on green technology for wastewater recycling.
3. In SBT, tertiary treatment is not required, and there is no maintenance needed during the breakdown period; it can practically operate under zero loading.
4. There is no generation of secondary biosolids, no chemical use, and zero liquid discharge compliance.
5. Low operating cost compared to operating technologies like conventional Sewage Treatment Plants.

16 INTERVENTIONS BY PROJECT OWNER/ PROPONENT/ SELLER

The revenue from the sale of the water credits from this project activity for the 2014 and 2023 vintage years under the UWR RoU program will enable the PP to finance and set up further action for water security within the KENSVILLE campus and surrounding region.

1. An annual water audit is required to identify the gap between water demand and water conservation.
2. The water audit will help in creating future possibilities to generate more water credits under other scopes as may be applicable.
3. There is still an opportunity to reduce the gap between water conservation and water consumption quantity.
4. Rainwater harvesting can be further planned within the campus to recharge the A2 aquifer for effective and early rejuvenation of the depleted aquifer system.
5. Qualitative water test results to be analyzed for their gainful utilization to plan rainwater harvesting in the A1 aquifer system.
6. Dugwells integrated with recharge wells distributed in two different aquifer systems may be explored to implement rainwater conservation efforts optimally.
7. The maintenance of the checkdam is to be ensured by scheduling a pre-monsoon activity list.
8. The water audit can be done by installation of a water meter in the inlet header of the STP unit and outlet header of the Treated water tank to know the wastewater generation and recycled water for gainful use.
9. Soil BioTechnology (SBT) can be further planned within the campus as a sustainable, eco-friendly, and efficient alternative for wastewater treatment.

17 UWR RAINWATER OFFSET DO NO NET HARM PRINCIPLES

The approach to mining water credits from projects addresses the **"Do No Harm or Negative Impact"** sustainability test. None of the information or elements of this project being mined on the UWR platform has any negative development impacts i.e. community or environment.

This PCNMR lays down the entire philosophy, methodology, implementation and future proposal of the functional model for the KENSVILLE as envisaged and operated by the PP. During project operations since 2007, there has not been a single case of adverse impact on the local flora, fauna, water security, or local human geography. On the contrary, the project has ensured several tangible and intangible direct and indirect benefits to the local geographical area by addressing several of the UNSDGs.

We support projects that contribute to UNSDGs encompassing environmental, social, and governance standards (ESG) as a key basis for eligibility on the UWR platform while accepting quality green water credit projects from a predefined list of activities. All our water conservation and groundwater recharge projects, either by individual or collective actions, benefit people, the economy, and nature. While this program and standard is aimed at all unutilized water conservation and recharge efforts (with or without treatment) worldwide, its genesis lies in Bharat and hence, the protocol keeps projects established within Bharat in mind as the basis of development and standardization of water offset or credits.

18 ECOLOGICAL ASPECTS

Sustainable Development Goals are part of a transformative agenda adopted by Bharat and which came into effect after the Sustainable Development Summit in 2015. At the core of this national agenda for 2030 is the principle of universality: 'Leave No One Behind'. Development in all its dimensions must include all people, everywhere, and should be built through the participation of everyone. This comprehensive agenda recognizes that it is no longer sufficient just to focus on economic growth but on fairer and more equal societies, and a safer and more prosperous planet.

Ecological aspects protect the planet and the biodiversity of the utilized areas as habitats, maintaining ecosystem services provided by various participants of the given ecosystems. An ecosystem contains functional aspects for its maintenance, biogeochemical cycles, energy flow, nutrient cycle, ecological succession, ecological pyramid, food web, and food chain.

The Sustainable Development Goals (SDGs) are a set of 5 goals that are a call to action to end poverty and inequality, protect the planet, and ensure that all people enjoy health, justice, and prosperity through the KENSVILLE project. These are precise outcomes against the pre-defined objective for the project.

18.1 CLEAN WATER AND SANITATION

UNSDG that is directly addressed	UNSDG indicator	How does the PP intervention with the project address the UNSDG
6 CLEAN WATER AND SANITATION	Ensure availability and sustainable management of water and sanitation for all.	Interventions of this project have fulfilled its irrigation requirements by storing surface rainwater runoff which would have gone to the sea thereby preserving the groundwater security of the region and local geography thus ensuring drawable groundwater availability and water security to the local agricultural farms and communities by harnessing and conserving rainwater.

18.2 INDUSTRY, INNOVATION AND INFRASTRUCTURE

UNSDG that is directly addressed	UNSDG indicator	How does the PP intervention with the project address the UNSDG
	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	The Project has met more than 50% of the irrigation water demand of the campus with rainwater conservation since 2007. The intervention by the PP through this project is a hallmark of resilient and sustainable infrastructure which has stood the test of time since 2007 in its industry segment i.e. sports infrastructure.

18.3 SUSTAINABLE CITIES AND COMMUNITIES

UNSDG that is directly addressed	UNSDG indicator	How does the PP intervention with the project address the UNSDG
	Make cities and human settlements inclusive, safe, resilient and sustainable	The Project is catering to a community primarily for sports and recreational use, where members can avail of the benefits of facilities throughout the year. The outcomes of this project activity are enumerated above and are testimony to the fact that the project has created a sports infrastructure community that is sustainable in all dimensions of the term.

18.4 RESPONSIBLE CONSUMPTION AND PRODUCTION

UNSDG that is directly addressed	UNSDG indicator	How does the PP intervention with the project address the UNSDG
	Ensure sustainable consumption and production patterns	The primary resource dependency of KENSVILLE is water for upkeep and maintenance for efficient use. More than 50% of its water demand being met by rainwater conservation, the project ensures a highly judicious, safe, sustainable and prudent utilization/ consumption of this highly valuable and finite resource.

18.5 CLIMATE ACTION

UNSDG that is directly addressed	UNSDG indicator	How does the PP intervention with the project address the UNSDG
	Take urgent action to combat climate change and its impacts	The primary drivers to combat climate change as outlined by thousands of peer-reviewed research papers over the years are carbon footprint reduction, water footprint reduction, and responsible waste management. The project addresses one of these 3 drivers positively i.e. water footprint reduction with sustainable water management practices as enumerated in this PCNMR.

19 SCALING PROJECTS – LESSONS LEARNED – RESTARTING PROJECTS

The KENSVILLE golf course has already been declared a signature golf course, where regular local, national, and international level golf tournaments are successfully played. The golf course is a full 18-hole course and there is no potential scaling up required of the golf course.

The project is fully functional and meeting its objectives partially when it comes to water security. This model of water conservation can be easily replicated elsewhere at various other golf courses in the country or anywhere in the world. The PP is also committed to implementing this project model in any future site development whether it be a resort, sporting infrastructure or residential/ commercial space.

It is important to list lessons learned from this project that can be applied in future projects, restarting the new project as well as enhancing the existing system.

1. Statutory compliance is the prerequisite for enhancing the existing water management system before scaling up the project.
2. The new project must be conceptualized with a sustainability design approach while complementing the design phase, development phase, construction phase and operational phase of the program.
3. The operational phase must be supported by the dashboard monitoring system by creating monitoring indicators to generate authentic data to support the verification process.
4. The construction phase must be supported by the Integrated Management Information System (IMIS), Real-time dashboard, and Geo-tagging assets will be updated periodically as the project progresses.
5. It is important to generate a large data bank to prepare water budgeting of the premises while planning the horizontal/ vertical growth.
6. The option of raising the level of check dams at the outlet location may be explored to increase the water storage capacity of the pond while safeguarding facilities/ structures on the upstream part of the pond.
7. By incorporating low-flow fixtures, can reduce the total water demand that will prevent the excessive use of groundwater.
8. Introducing water meters as a primary header and secondary header will be used as a powerful tool to quantify and initiate water conservation efforts for promoting environmental sustainability.

20 ABBREVIATIONS

1. **Safe area:** Area categorized as SAFE from the groundwater resources point of view, based on the latest groundwater resources assessment carried out jointly by CGWB and State groundwater organizations. Details are available on the websites of NOCAP and CGWB.

2. **Semi-critical area**: Area categorized as SEMI-CRITICAL from the groundwater resources point of view, based on the latest groundwater resources assessment carried out jointly by CGWB and State groundwater organizations. Details are available on the websites of NOCAP and CGWB.

3. **Critical area**: Area categorized as CRITICAL from the groundwater resources point of view, based on the latest groundwater resources assessment carried out jointly by CGWB and State groundwater organizations. Details are available on the websites of NOCAP and CGWB.

4. **Over-exploited area:** Area categorized as OVER-EXPLOITED from the groundwater resources point of view, based on the latest groundwater resources assessment carried out jointly by CGWB and State groundwater organizations. Details are available on the websites of NOCAP and CGWB.

5. **Aquifer:** Geological formation capable of storing and transmitting groundwater.

6. **Deeper Aquifer:** In areas having multiple aquifer systems, the aquifer(s) occur below the uppermost aquifer.

7. **Well:** Any structure used for the extraction of groundwater, including open wells, dug wells, bore wells, dug-cum-bore wells, tube wells, filter points, collector wells, infiltration galleries, recharge wells, or any of their combinations or variations.

8. **Government Agency:** Maybe a Central or State Government body.

9. **Illegal Ground Water Abstraction Structure:** Any energized abstraction structure viz. dug well, tube, borewell used to withdraw groundwater without a valid No Objection Certificate from Central Ground Water Authority.

10. **Rainwater Harvesting:** The technique or system of collection and storage of rainwater, at the micro watershed scale, including rooftop harvesting, for future use or recharge of groundwater.

11. **Ground Water Draft:** Quantum of groundwater withdrawal.

12. **Saline Water:** Water having salinity above 2500 µsiemens/cm at 250C.

13. **Water Table Intersection**: Intersection of the water table on excavating the overlying material due to mining or other activities.

14. **Drinking and domestic use**: Besides drinking & domestic use of households, this category will cover drinking requirements of industries not requiring water for the industrial process; drinking,

washing, cleaning use, etc. in the case of hospitals, hotels, malls & multiplexes, institutions, offices, banquet halls, fire stations, metro stations, railway stations, airports, seaports, stadia, etc.

15. **Sewage Treatment Plant (STP)**: is a process of purification of Sewage water and reusing for Gardening, Agricultural, and other general Purpose.
16. **Recycle/Reuse**: Using treated wastewater for various purposes/ putting water to multiple uses.
17. **Groundwater:** Water, which exists below the surface in the zone of saturation and can be extracted through wells or any other means or emerges as springs and base flow in streams and rivers.
18. **Bgl:** Below Ground Level.
19. **BCM:** Billion cubic meters.
20. **Groundwater Abstraction structure:** Structure used to withdraw groundwater like bore well/tube well / dug well/dug cum bore well/tunnel well.
21. **Observation well or Piezometer**: A bore well/tube well is used only for measuring the water level/piezometric head and to take water samples periodically but is not used for groundwater abstraction.
22. **Water Audit**: A method of quantifying water use in simple or complex systems to reduce water usage and often to save money on otherwise unnecessary water use.
23. **Groundwater pollution:** If the concentration of any parameter in groundwater exceeds the maximum permissible limit for drinking water prescribed by the Bureau of Indian Standards.
24. **Cooperative Group Housing Societies/ Builder flats**: A Housing Society is formed by house owners within a residential complex. The housing society formed must be formally registered with the registrar of co-operatives.
25. **KLD** – Kilo Liter per day
26. **ECGW –** Environmental compensation for drawing illegal groundwater.
27. **ECGWR –** Environmental compensation rates for drawing illegal groundwater.
28. **VES** – Vertical Electrical Sounding
29. **SWL** – Static Water Level
30. **PWL** – Pumping Water Level

31. **DD** – Draw Down

32. **LPM** – Liters Per Minute

33. **ppm** – Parts Per million

34. **TDS** – Total Dissolved Solids

35. **GPS** – Global Positioning System

36. **Aquifer Recharge** - defined as the process of water being added to a groundwater system comprised of a geological structure or formation, or part thereof, permanently, or intermittently permeated with water or capable of transmitting water. Water introduced or recharged into an aquifer becomes 'groundwater.'

37. **Aquifer storage and recovery (ASR)** - injection of water into a well for storage and recovery from the same well.

38. **Aquifer storage transfer and recovery (ASTR)** - injection of water into a well for storage and recovery from a different well, generally to provide additional water treatment.

39. **Aquitard**- A geological layer that has low permeability and confines or separates aquifers.

40. **Artificial recharge (AR)** —intentional banking and treatment of water in aquifers.

41. **Artificial recharge and recovery (ARR)** —recharge to and recovery of water from an aquifer; that is, both artificial recharge of the aquifer and recovery of the water for subsequent use.

42. **Augmentation pond**—water body designed to supply water to river systems at defined rates during particular times.

43. **Bank filtration**—extraction of groundwater from a well or caisson near or under a river or lake to induce infiltration from the surface water body, thereby improving and making more consistent the quality of water recovered.

44. **Conjunctive use**—combining the use of both surface and groundwater to minimize the undesirable physical, environmental, and economic effects of each solution.

45. **Dry well**—synonymous with vadose zone well.

46. **Infiltration basin**—synonymous with recharge basin.

47. **Managed (or management of) aquifer recharge (MAR)**—intentional banking and treatment of water in aquifers (synonymous with AR). MUS may be considered a subset of MAR.

48. **Recharge basin (or pond)**—a surface facility, often a large pond, used to increase the infiltration of surface water into a groundwater basin; basins require the presence of permeable soils or sediments at or near the land surface and an unconfined aquifer beneath. Recharge well—a well used to directly recharge water to either a confined or an unconfined aquifer.

49. **Surface spreading**—recharging water at the surface through recharge basins, ponds, pits, trenches, constructed wetlands, or other systems.

50. **Spreading basin**—synonymous with recharge basin.

51. **Underground storage and recovery (USR)** —similar to MUS; any type of project whose purpose is the artificial recharge, underground storage, and recovery of project water.

52. **Vadose zone well**—a well constructed in the interval between the land surface and the top of the static water level and designed to optimize the infiltration of water.

53. **Borehole**: A vertical below-ground installation to abstract groundwater. It is drilled (or bored) and lined with metal or plastic tubes to keep it open, and to protect against surface/near surface pollution.

54. **Beneficial use:** A use of the environment or any element or segment of the environment which (a) is conducive to public benefit, welfare, safety, health, or aesthetic enjoyment and which requires protection from the effects of waste discharges, emissions or deposits or of the emission of noise or (b) is declared in India's environment protection policy to be a beneficial use.

55. **Catchment:** The geographical zone in which water is captured, flows through and eventually discharges at one or more points. The concept includes both surface water catchment and groundwater catchment.

56. **A surface water catchment** is defined by the area of land from which all precipitation received flows through a sequence of streams and rivers towards a single river mouth, as a tributary to a larger river, or the sea.

57. A **groundwater catchment** is defined by the geological structure of an aquifer and groundwater flow paths. It is replenished by water that infiltrates from the surface. It has vertical thickness (from a few meters to 100s meters) as well as area. Depending on local conditions, surface and groundwater catchments may be physically separate or interconnected.

58. **Catchment of origin** - refers to a catchment, distinct from the site’s catchment(s), where a product or service is manufactured or sourced. It may be anywhere from an adjacent catchment to the other side of the world. Alternative terms are watershed, basin and river basin.

59. **Consumption** - references in the WF industry currently refer to it as the loss of water from the available ground–surface water body in a catchment area, which happens when water

evaporates, is incorporated into a product or is transported to another catchment area or the sea.

60. **Contaminated water body**: A water body that receives (or has received) untreated sewage, effluent discharge and/or industrial waste, and/or is defined as 'heavily polluted' or "unfit for human consumption" by the authorities.

61. **Effluent**: Water or wastewater discharged from a site after being used. It is a more specific term than discharge (ie., not including drainage or runoff). The quality of effluent may range from good to polluted, depending on its origin, its use, and the treatments applied.

62. **Embedded/virtual water**: Water that was used in the production or creation of an item, but not contained within it. For a crop, it is the water it needs to grow (irrigated or rain-fed), taken up by its roots and lost via transpiration, and is usually hundreds of times more than the water physically retained within the crop. It may also include water used to wash, process and transport it. Alternative terms are 'virtual water' and 'water footprint'.

63. **Freshwater**: Freshwater plays a fundamental role in support of the environment, society and the economy. Ecosystems such as wetlands, rivers, aquifers and lakes are indispensable for life on Earth.

64. **Rain Water Offset Unit or Credit (RoU)** is a volumetric measure of water harvested or conserved through project activities on UWR and expressed as m3 or 1000 liters of water per year.

65. **Groundwater**: Water below the surface of the Earth stored in pore spaces and fractures within rock or layers of sand and gravel (aquifers). In water resources management the term more specifically applies to water that can be extracted at a viable rate, quantity and quality for human use (with or without treatment).

66. **Injection well** A well that admits water into an aquifer, either by pumping or under gravity.

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22 DISCLAIMER

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