UWR Rainwater Offset Unit Standard (UWR RoU Standard)

Concept & Design: Universal Water Registry
www.uwaterregistry.io

Project Concept Note & Monitoring Report (PCNMR)

Project Name: Water Credit Project by NSL Jay Mahesh Unit, Maharashtra, India
UWR RoU Scope: 2 & 5
Monitoring Period: 01/01/2014-31/12/2025
Crediting Period[1]: 2014-2025
UNDP Human Development Indicator[2]: 0.644

[1] Not applicable. RoUs can be claimed for the "Lifetime of the Project Activity as per UWR RoU standard version 8.1
[2] Value is applicable for India according to latest HDI 2023-24 https://hdr.undp.org/sites/default/files/2023-24_HDR/HDR23-24_Statistical_Annex_HDI_Table.xlsx.
This is below 0.9 as per requirement mentioned in methodology rainwater offset methodology standard version 8.1.

A.1 Location of Project Activity

State	Maharashtra
District	Beed
Block Basin/Sub Basin/Watershed	Please refer to http://cgwb.gov.in/watershed/basinsindia.html
Lat. & Longitude	19° 8'52.90"N & 76°16'6.59"E
Area Extent	185.94 acres (75.25 Ha)
No. of Villages/Towns	4; Pawarwadi, Adagaon, Nipani Takli and Shimpe Takli village

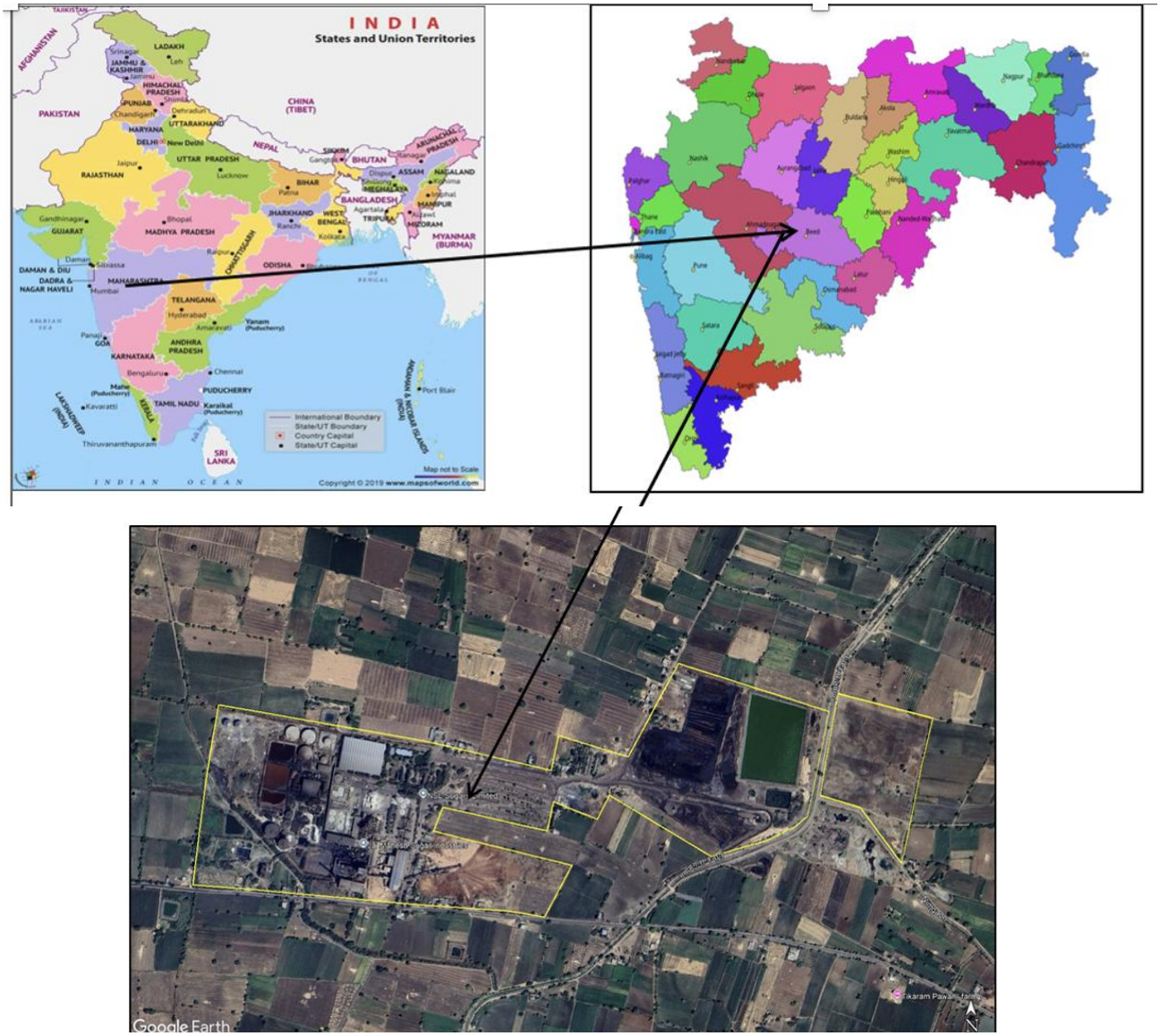
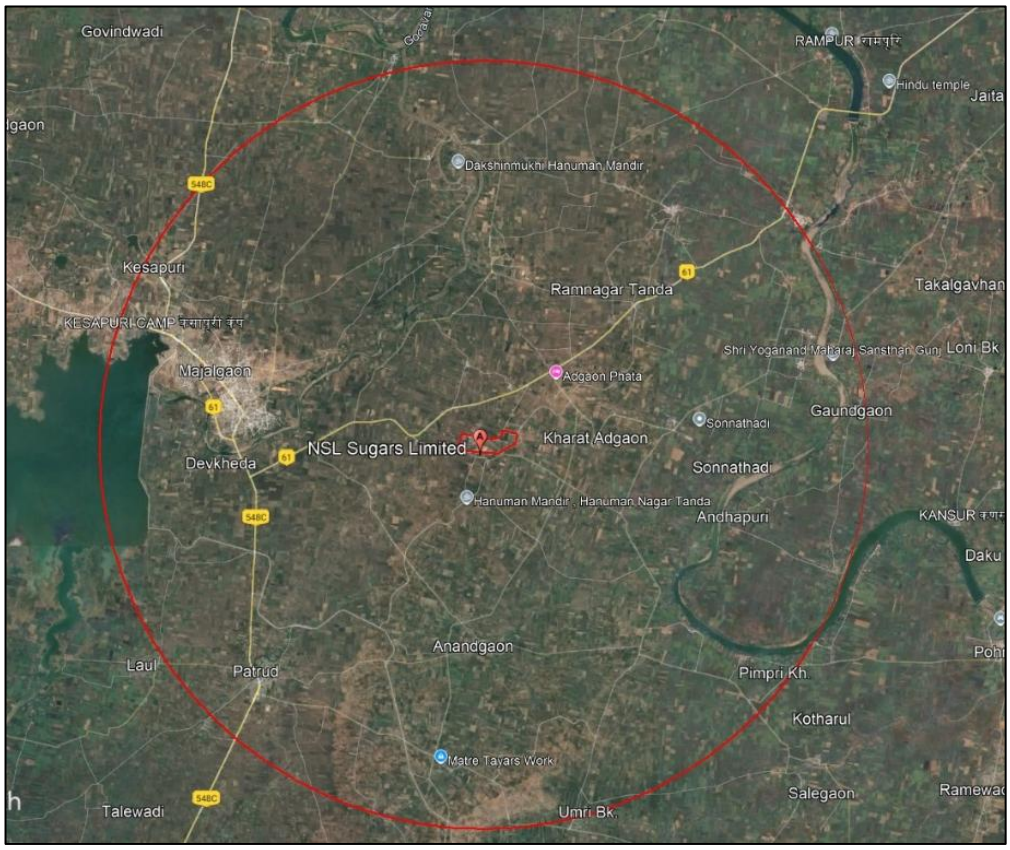


Figure 01: Location of NSL Sugars, Pawarwadi, Majalgaon Taluk, Beed District, Maharashtra, India



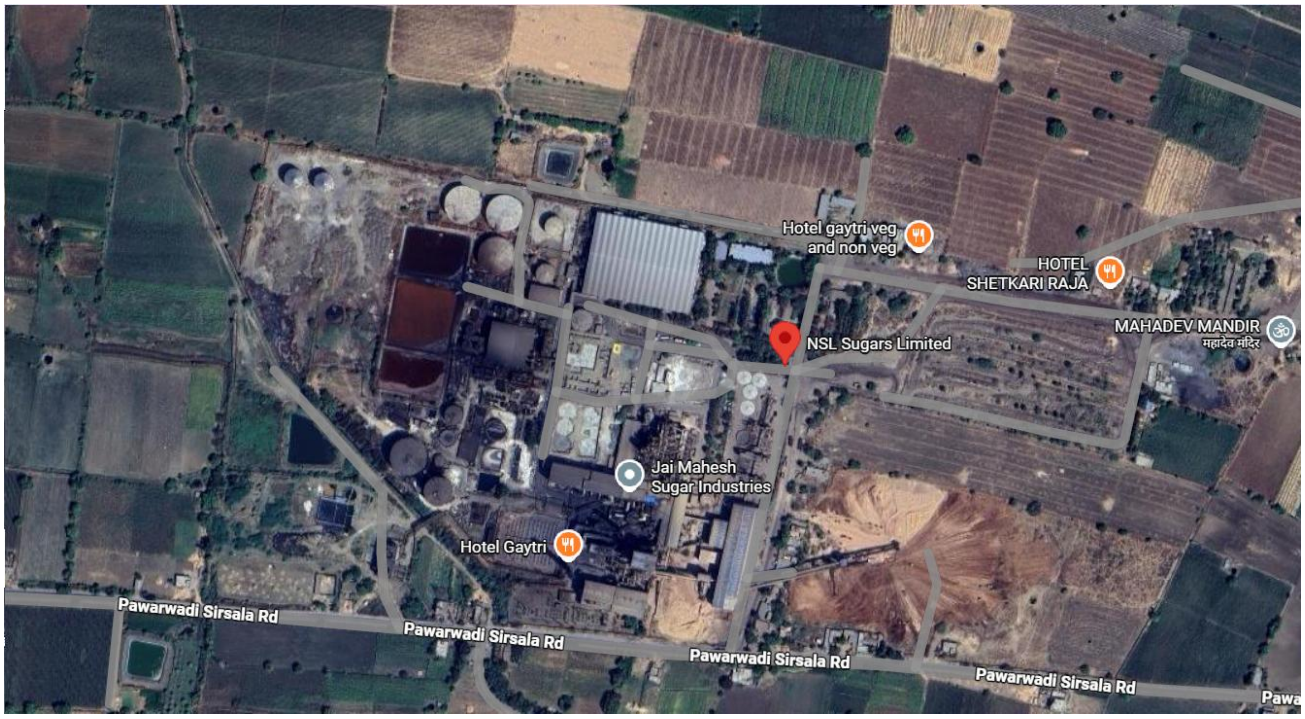


Figure 02: Google map and Aerial view of NSL Sugar Jay Mahesh Unit

A.2. Project owner information, key roles and responsibilities

The NSL Sugars Limited, is a Public Limited Company incorporated in the Companies Act 1956. It is an integrated Sugar, Distillery and Co-generation Plant. Initially, a sugar manufacturing and Co-gen Unit was established and commenced its production in 2004 and a molasses-based Distillery unit in 2007. The NSL is one of the most efficient sugar companies and the sugar arm of the NSL Group. NSL (Nuziveedu Seeds Limited) group foundation was led by Sri Venkata Ramaiah in 1973, and built upon by his son Sri M Prabhakar Rao, who has been leading the company since 1982. The company has evolved over the years with core expertise in research, marketing and supply chain to emerge as the largest seed company in India.

Name	Designation
Shri. M. Prabhakar Rao	Chairman of NSL Group
Sri KVVS Narayana Murthy	Unit Head of NSL Sugars Limited, Jay Mahesh

Roles and responsibilities are clearly documented here within the management plan including clear lines of accountability and reporting:-

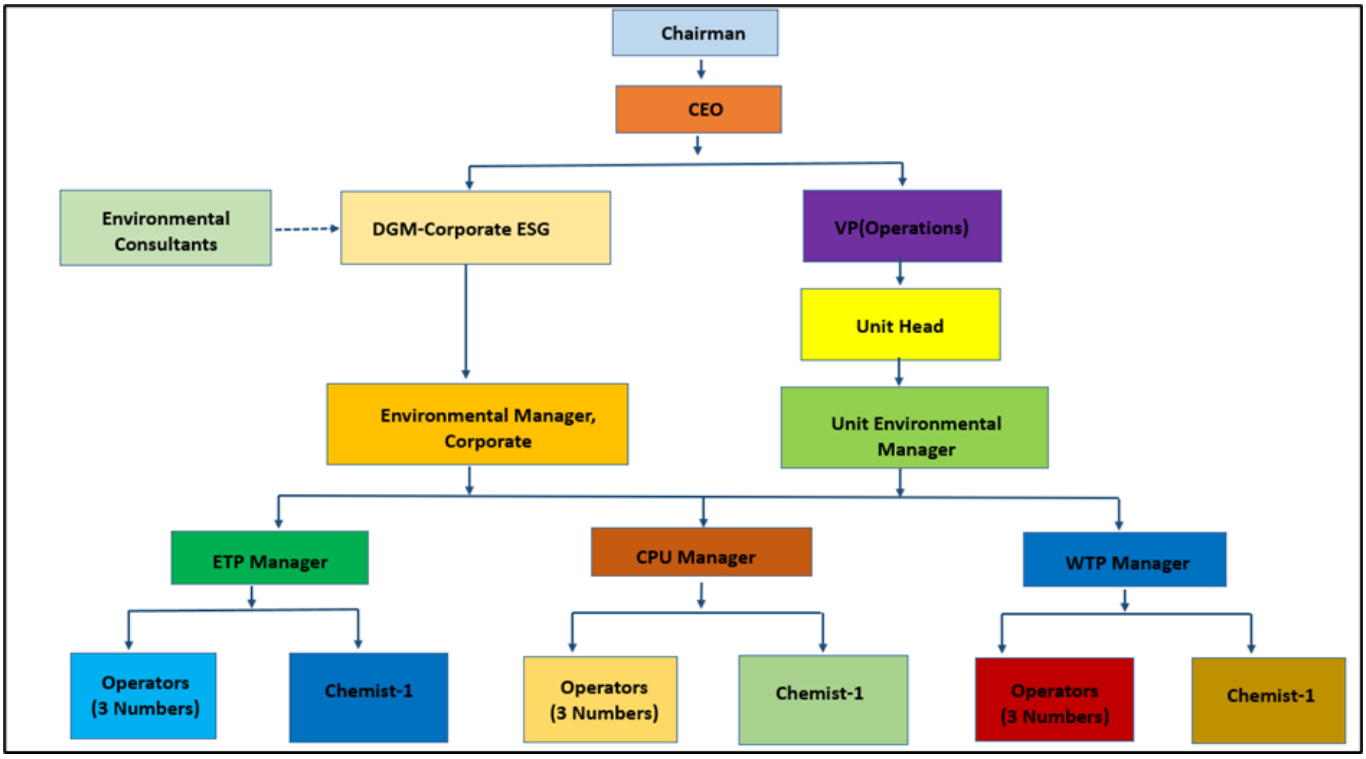


Figure 03: Environment Management Cell

S. No.	Designation	Responsibility
1	Chairman	• Strategic Oversight • Board Leadership • Compliance and risk management
2	CEO	• Allocate adequate resources, including budgets and personnel, to implement and maintain environmental initiatives. • Invest in technologies and infrastructure that support sustainable practices
3	DGM- Corporate ESG	Interact with regulatory authorities, local communities, and other stakeholders to address environmental concerns and promote sustainability initiatives.
4	VP (Operation)	Ensuring the alignment of environmental goals with operational objectives
5	Environmental Manager, Corporate	• Compliance Management • Environmental Monitoring and Reporting • Sustainability Initiatives • Training and Awareness • Incident management • Documentation and record keeping
6	Unit head	• Strategic Leadership • Compliance Oversight • Team management • Resource allocation • Policy Advocacy and Representation
7	Unit Environmental Manager	• Environmental Compliance • Develop strategies to mitigate adverse environmental impacts • Pollution Control • Resource management • Environmental Monitoring • Training and education
8	ETP Manager	• Resource management • Pollution Control • Effluent quality Monitoring • Training and education • To verify the data entered in log book regarding treated and untreated effluent quality
9	ETP chemist	• Effluent Analysis and Monitoring • Treatment Process Optimization
10	ETP Operators	Operation and Maintenance of ETP

11	CPU manager	• Pollution Control • To verify the data entered in log book regarding treated and untreated effluent quality • To verify the working efficiency of CPU
12	CPU Chemist	• Treated Effluent Analysis and Monitoring • Treatment Process Optimization
13	CPU operator	Operation and Maintenance of CPU
14	WTP Manager	Water quality analysis
15	WTP operator	Operation and Maintenance of WTP
16	WTP Chemist	• Water quality Analysis and Monitoring • Treatment Process Optimization
17	APC operator	Operation and Maintenance ESP
18	Supervisors	Development and Maintenance of Greenbelt and other general EMP of the industry

Table 01: Roles & responsibilities of Environment Management Cell at NSL Plant

The Project owner of NSL attest to the following:

(a) NSL Jay Mahesh Unit owns the water user rights for the area within the project's boundary,

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास
और गंगा संरक्षण विभाग
केन्द्रीय भूमि जल प्राधिकरण
Government of India
Ministry of Jal Shakti
Department of Water Resources,
River Development & Ganga Rejuvenation
Central Ground Water Authority

(भूजल निकासी हेतु अनापत्ति प्रमाण पत्र)

NO OBJECTION CERTIFICATE (NOC) FOR GROUND WATER ABSTRACTION

Project Name:	Nsl Sugar Limited Unit Iii (jay Mahesh Sugar Industries Ltd)		
Project Address:	Gut No 85/86, Pawarwadi, Majalgaon		
Village:	Pawarwadi	Block:	Majalgaon
District:	Beed	State:	Maharashtra
Pin Code:			
Communication Address:	Nsl Sugar Ltd. Unit Iii (jay Mahesh Sugar Industries Ltd), Gut No85/86, Pawarwadi, Taluka Majalgaon, Majalgaon, Beed, Maharashtra - 431131		
Address of CGWB Regional Office :	Central Ground Water Board Central Region, N.s. Building, Civil Lines, Nagpur, Maharashtra - 440001		

1.	**NOC No.:**	CGWA/NOC/IND/REN/2/2025/10853	2.	**Date of Issuence**	20/02/2025
3.	Application No.:	21-4/1279/MH/IND/2017	4.	Category: (GWRE 2024)	Safe
5.	Project Status:	Existing Ground Water	6.	NOC Type:	Renewal
7.	**Valid from:**	27/12/2023	8.	**Valid up to:**	26/12/2026

9. Ground Water Abstraction Permitted:

Fresh Water		Saline Water		Dewatering		Total	
m³/day	m³/year	m³/day	m³/year	m³/day	m³/year	m³/day	m³/year
1000.00	365000.00					1000.00	365000.00

10. Details of ground water abstraction /Dewatering structures

	Total Existing No						Total Proposed No					
	DW	DCB	BW	TW	MP	MPu	DW	DCB	BW	TW	MP	MPu
Abstraction Structure*	2	0	2	0	0	0	0	0	0	0	0	0

*DW- Dug Well; DCB-Dug-cum-Bore Well; BW-Bore Well; TW-Tube Well; MP-Mine Pit;MPu-Mine Pumps

11.	Ground Water Abstraction/Restoration Charges paid (Rs.):	2190455.00
12.	Environment Compensation (if applicable) paid (Rs.):	0.00

13.	Number of Piezometers(Observation wells) to be constructed/ monitored & Monitoring mechanism.	No. of Piezometers	Monitoring Mechanism		
			Manual	DWLR**	DWLR With Telemetry
	**DWLR - Digital Water Level Recorder	2	0	1	1

(Compliance Conditions given overleaf)

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18/11, जामनगर हाउस, मानसिंह रोड, नई दिल्ली - 110011 / 18/11, Jamnagar House, Mansingh Road, New Delhi-110011
Phone: (011) 23383561 Fax: 23382051, 23386743
Website: cgwa-noc.gov.in

पानी बचाये – जीवन बचाये
SAVE WATER - SAVE LIFE

NOC for ground water extraction dated 20/02/2025

(b) NSL Jay Mahesh Unit holds an uncontested legal land title for the project area within the project's boundary

MAHARASHTRA POLLUTION CONTROL BOARD

Tel: 24010706/24010437
Fax: 24023516
Website: http://mpcb.gov.in
Email: cac-cell@mpcb.gov.in

Kalpataru Point, 2nd, 3rd and 4th floor, Opp. Cine Planet Cinema, Near Sion Circle, Sion (E), Mumbai-400022

No:- Format1.0/CAC/UAN No.MPCB-CONSENT-0000249091/CR/2510000627

Date: 08/10/2025

To,
M/s. NSL SugarsLtd, Unit-III, Jay Mahesh,
85 & 86, Pawarwadi,
Tal. - Majalgaon, Dist. - Beed.

LiFE Lifestyle for Environment

Your Service is Our Duty

Sub: **Renewal of consent to operate for 12000 TCD sugar cane crushing capacity and 33 MW Cogeneration unit**

Ref:
1. **Earlier consent to operate granted vide no. Format1.0/CAC/UAN No.MPCBCONSENT-0000210302/CR/2411000648 dated 12.11.2024**
2. **Minutes of 7th Consent Appraisal Committee Meeting held on 25.08.2025**

Your application No.MPCB-CONSENT-0000249091 Dated 31.05.2025

For: Grant of Consent to Renewal under Section 26 of the Water (Prevention & Control of Pollution) Act, 1974 & under Section 21 of the Air (Prevention & Control of Pollution) Act, 1981 and Authorization under Rule 6 and Rule 18(7) of the Hazardous & Other Wastes (Management & Transboundary Movement) Rules 2016 is considered and the consent is hereby granted subject to the following terms and conditions and as detailed in the schedule I, II, III & IV annexed to this order:

1. **The Consent to Renewal is granted upto: 31.07.2026**
2. **The capital investment of the industry is Rs.500.57 Crs. (As per C.A Certificate submitted by industry).**
3. **Consent is valid for the manufacture of:**

Sr No	Product	Maximum Quantity	UOM
1	White Sugar	1440	MT/Day
2	Bagasse	3360	M/Day
3	Molasses	564	MT/Day
4	Press Mud	300	MT/Day
5	Co-Generation Power	33	MW

4. **Conditions under Water (P&CP) Act, 1974 for discharge of effluent:**

Sr No	Description	Permitted in CMD	Standards to	Disposal
1.	Trade effluent	1065	As per Schedule -I	Partly recycle CMD & partly gardening CMD
2.	Domestic effluent	45	As per Schedule - I	On land for gardening

State Government Renewal dated 08/10/2025- Consent to Operate for Sugar Unit at NSL Jay Mahesh Unit

MAHARASHTRA POLLUTION CONTROL BOARD

Tel: 24010706/24010437
Fax: 24023516
Website: http://mpcb.gov.in
Email: cac-cell@mpcb.gov.in

Kalpataru Point, 2nd, 3rd and 4th floor, Opp. Cine Planet Cinema, Near Sion Circle, Sion (E), Mumbai-400022

RED/L.S.I (R60)/ Rev. RED/I.S./(44.1)
No:- Format1.0/CAC/UAN No.MPCB-CONSENT-0000249110/CR/2510000586

Date: 07/10/2025

To,
M/s. NSL Sugars Ltd.Unit III, Jay Mahesh,
85 & 86, Pawarwadi,
Tal. Majalgaon, Dist. Beed.

Your Service is Our Duty

Sub: Renewal of consent to operate for molasses bases distillery unit of capacity 500 KLPD

Ref:
1. Previous consent to operate granted vide no. Format1.0/CAC/UAN No.MPCBCONSENT-0000214299/CR/2411000647 dated 12/11/2024
2. Environment Clearance vide No. F.No. J-11011/26/2015-IA-II(I), dated 31.03.2022.
3. Minutes of 7th Consent Appraisal Committee Meeting held on 25.08.2025

Your application No.MPCB-CONSENT-0000249110 Dated 30.05.2025

For: Grant of Renewal of Consent to operate under Section 26 of the Water (Prevention & Control of Pollution) Act, 1974 & under Section 21 of the Air (Prevention & Control of Pollution) Act, 1981 and Authorization under Rule 6 of the Hazardous & Other Wastes (Management & Transboundary Movement) Rules 2016 is considered and the consent is hereby granted subject to the following terms and conditions and as detailed in the schedule I, II, III & IV annexed to this order:

1. **The consent to renewal is granted for a period up to 31/08/2026**
2. **The capital investment of the project is Rs.107.91 Crs. (As per C.A Certificate submitted by industry)**
3. **Consent is valid for the manufacture of:**

Sr No	Product	Maximum Quantity	UOM
Products			
1	Ethanol / ENA / Rectified Spirit(RS)	500	KL/D
2	Impure Spirit	1620	KL/A
3	Co-Generation Power Plant	30	MW
4	CO2 bottling plant	380	MT/Day
5	Potash derived from molasses	32.23	MT/Day
6	DDGS	240	MT/Day
7	CNG from Biogas	25	MT/Day

ENVIRONMENTAL CLEARANCE

PARIVESH

(Pro-Active and Responsive Facilitation by Interactive, and Virtuous Environment Single-Window Hub)

Government of India
Ministry of Environment, Forest and Climate Change
(Impact Assessment Division)

To,

The General Manager Unit Head
NSL SUGARS LIMITED, UNIT-III, JAY MAHESH
Pawarwadi village, Majalgaon Tq, Beed District, Maharashtra.,,BEED,Maharashtra-431131

Subject: Grant of Environmental Clearance (EC) to the proposed Project Activity under the provision of EIA Notification 2006-regarding

Sir/Madam,

This is in reference to your application for Environmental Clearance (EC) in respect of project submitted to the Ministry vide proposal number IA/MH/IND2/255527/2022 dated 14 Feb 2022. The particulars of the environmental clearance granted to the project are as below.

1.	**EC Identification No.**	**EC22A022MH171123**
2.	**File No.**	J-11011/26/2015-IA-II(I)
3.	**Project Type**	Expansion7
4.	**Category**	A
5.	**Project/Activity including Schedule No.**	5(g) Distilleries
6.	**Name of Project**	Expansion of Distillery Project from 150 KLPD to 500 KLPD (Ethanol) based on Syrup/ B heavy Molasses and Grain" at Pawarwadi Tal, Majalgaon Dist Beed, Maharashtra by M/s NSL sugars Ltd, Unit III, Jay Mahesh
7.	**Name of Company/Organization**	NSL SUGARS LIMITED, UNIT-III, JAY MAHESH
8.	**Location of Project**	Maharashtra
9.	**TOR Date**	N/A

The project details along with terms and conditions are appended herewith from page no 2 onwards.

Date: 31/03/2022

(e-signed)
A.K Pateshwary
Director
IA - (Industrial Projects - 2 sector)

Note: A valid environmental clearance shall be one that has EC identification number & E-Sign generated from PARIVESH.Please quote identification number in all future correspondence.

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Environmental Clearance for Distillery plant of Jay Mahesh Unit

F. No. J-11011/26/2015-IA.II (I)
Government of India
Ministry of Environment, Forest and Climate Change
(Impact Assessment Division)

Indira Paryavaran Bhawan
Aliganj, Jor Bagh Road,
New Delhi -110 003

Telefax: 011-24695365
E-mail: yogendra78@nic.in

Dated: 07th June, 2017

To,

The Vice President
(Shri S. Radhakrishnan)
M/s NSL Sugars Limited (Unit III)
Pawarwadi Village, Majalgaon
Beed District, Maharashtra

Sub: Expansion of Sugar Plant (7000 to 12000 TCD) and Molasses Based Distillery (100 KLPD) plant along with 3MW co-gen power (in addition to the existing 30MW co-gen power plant) in Pawarwadi Village, Majalgaon Taluka, Beed District, Maharashtra by M/s NSL Sugars Limited (Unit III)– Environmental Clearance– reg.

Ref: Online Proposal No. IA/MH/IND2/26637/2015 dated 05th October, 2016.

Sir,

This has reference to your online proposal no. IA/MH/IND2/26637/2015 dated 05th October, 2016 along with project documents including Form I, Terms of References, Pre-feasibility Report and EIA/EMP Report regarding the above mentioned project.

2. The Ministry of Environment, Forest and Climate Change has examined the application. It is noted that the proposal is for Expansion of Sugar Plant (7000 to 12000 TCD) and Molasses Based Distillery (100 KLPD) plant along with 3MW co-gen power (in addition to the existing 30MW co-gen power plant) in Pawarwadi Village, Majalgaon Taluka, Beed District, Maharashtra by M/s NSL Sugars Limited (Unit III). As per the information and documents submitted by the Project proponent (PP), the existing land area is 100 acres. No additional land is required for the present proposal. Greenbelt in 25 acres (about 16,000 plants) is developed in the plant premises and remaining 8 acres will be developed in the plant premises. The estimated cost for the proposed unimplemented units will be ₹ 110.0 crores. Total capital cost earmarked towards environmental pollution control measures is ₹ 440 Lakhs and the Recurring cost (operation & maintenance) will be about ₹ 25 Lakhs per annum. The project will provide employment to 50 persons as direct &100 persons as indirect after expansion. Industry proposes to allocate ₹ 275 Lakhs @ of 2.5 % towards Corporate Social Responsibility. It is reported that, there are no National park, wild life sanctuaries, Biosphere Reserves, Tiger/Elephant Reserves. Wildlife Corridors etc.

lies within 10 km distance. Sindaphana River & Godavari River are flowing at a distance of 3.1 Kms and 8.2 Kms in NW & SSE direction.

3. All molasses based distilleries are listed at S. N. 5(g) (i) of Schedule of EIA Notification under Category 'A' and are appraised at Central Level by Expert Appraisal Committee (EAC).

4. The project proposal was considered by the Expert Appraisal Committee (Industry – 2) in its 34th meeting held during 17th February, 2015 and recommended Terms of References (TORs) for the Project. The TOR has been issued by the Ministry vide letter dated 29th April, 2015.

5. The EAC (Industry-2) in its 16th meeting held during 8th - 9th December, 2016 and 21st meeting held during 27th – 29th March, 2017 has considered the proposal for environmental clearance (EC). The Project Proponent and the accredited consultant M/s Pioneer Enviro Laboratories & Consultants Pvt. Ltd., Hyderabad gave a detailed presentation on the salient features of the project and proposed environmental protection measures to be undertaken, as per the Terms of References (TORs).

6. It is reported that the unit has obtained Environmental Clearance for 12000 TCD sugar plant, 30 MW cogeneration power plant and 100 KLPD Molasses based distillery plant in Pawarwadi Village, Majalgaon Taluk, Beed District, Maharashtra vide order No. J-11011/1264/2007-IA.II (I) dated 30.04.2009 (in the name of M/s Jay Mahesh Sugar Industries Limited). The company is now operating 7000 TCD sugar plant and 30 MW co-gen power plant and the 100 KLPD distillery plant under erection stage. Environmental Clearance validity has been lapsed on 30.04.2014 and due to PP's mistake in interpretation of EC validity, the company was unable to apply for extension of validity before the EC validity tenure and PP has requested for issue of Environmental clearance for unimplemented unit. The unimplemented units comprise of 5000 TCD Sugar plant & 100 KLPD Molasses based Distillery plant. In addition, the company has also proposed to generate additional 3 MW power from Existing 2 X 20 TPH Boilers.

7. The proposed products and capacity are:

S. No.	Unit	Capacity				Operating Days
		As per EC No. J-11011 /1264/ 2007-IA II (I) dated 30.04.2009.	Implemen-ted Units	Proposed Capacity	Capacity after expansion	
1.	Sugar	12000 TCD	7000 TCD	5000 TCD	12000 TCD	180
2.	Co-gen Power plant	30 MW	30 MW	3MW	30+3 MW	330
3.	Distillery	100PD	-	100 PD	100 KLPD	270

8. Ambient air quality monitoring was carried out at 8 locations during 1st October, 2015 to 31st October, 2015 and the baseline data indicates the ranges of

Environmental Clearance for Sugar and Distillery plant of Jay Mahesh Unit which clearly declares the land occupied and details of project implementation and capacity

(c) NSL Jay Mahesh Unit holds all necessary permits to implement the project as project owner possess all necessary documents like Environmental Clearance from MoEF&CC and Consent to Operate for both the distillery and sugarcane processing units from State Pollution Control Board as attached above.

d) Project implementation Cost- The estimated project cost was referred as INR 110 crores

A.2.1 Project RoU Scope

PROJECT NAME	Water Credit Project by NSL Jay Mahesh Unit, Maharashtra, India
UWR Scope:	Scope-2 & 5
Date PCNMR Prepared	Current Version: 15/06/2026 Final Version: NA (will be considering during Verification)

A.3. Land use and Drainage Pattern

For Scope-5

Not Applicable, since this project activity involves:

a) Treating and reusing wastewater from distillery and sugar plant
b) Reusing condensate water from operation.

It doesn't include or harm any land-use practices and Drainage system as it is an industrial process designed with technical requirements and following the specified norms of local pollution control board.

For Scope-2

Land-use refers to the way in which the land has been used by humans and their habitat, usually with accent on the functional role of land for economic activities. It is the intended employment of management strategy placed on the land-cover type by human agents, and/or managers. Land-cover refers to the physical characteristics of earth's surface, captured in the distribution of vegetation, water, soil and other physical features of the land, including those created solely by human activities; for example - settlements. The land use and land cover are complex and largely continuous pattern and in order to understand its complexity, it is necessary to characterize them.

Land use land cover of the study area is derived through interpretation of satellite remote sensing image in digital environment using remote and GIS software Erdas Imagine (version 8.5). Satellite Image of the study area downloaded from U.S. Geological Survey web site USGS Earth Explorer (www.earthexplorer.usgs.gov) and a land use map was prepared. The satellite remote sensing, with its synoptic view and repetitively, is very helpful in order to cover large areas within a short time to characterize land use & land cover qualitatively and quantitatively.

Results and Discussion

Drainage pattern of the study area was developed using Survey of India (SOI) toposheet of the number 56 A/4.8. Toposheets were downloaded from Online maps Portal of Survey of India website (https://onlinemaps.surveyofindia.gov.in/).

Drainage system: On the regional scale, the study area forms a part of the gigantic Godavari river basin. Sindaphana River is the nearest river flowing through the area, which is a tributary of Godavari River. This river flows SW – NE at distance of about 4 km in northern direction from NSL Factory Premises. Sindphana River continues northwards and meets the Godavari River near Manjrath village. The drainage pattern thus developed clearly showed that most of the drainage flows towards **south-eastern** (**Figure 04**).

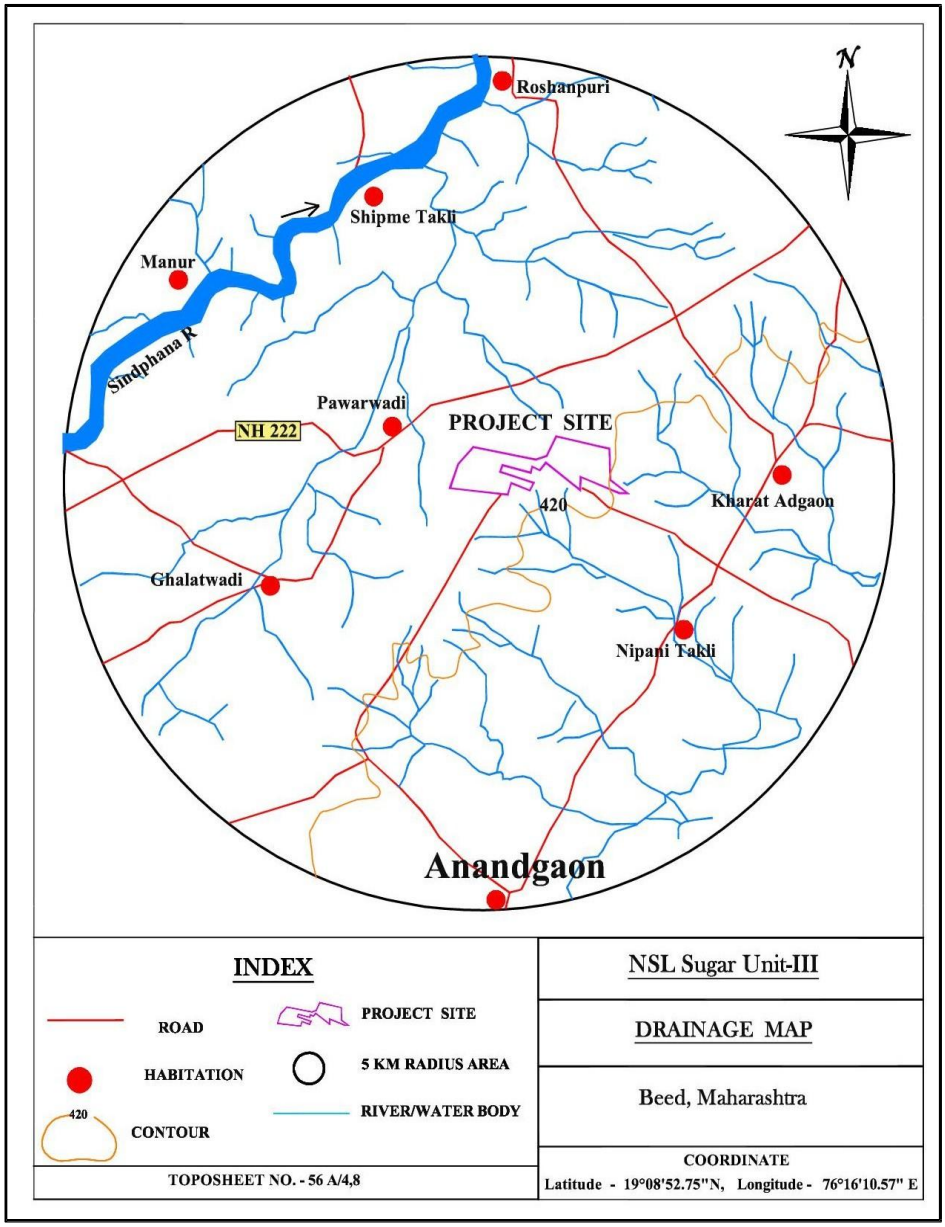


Figure 04: Drainage pattern of the project site in 5 km radius

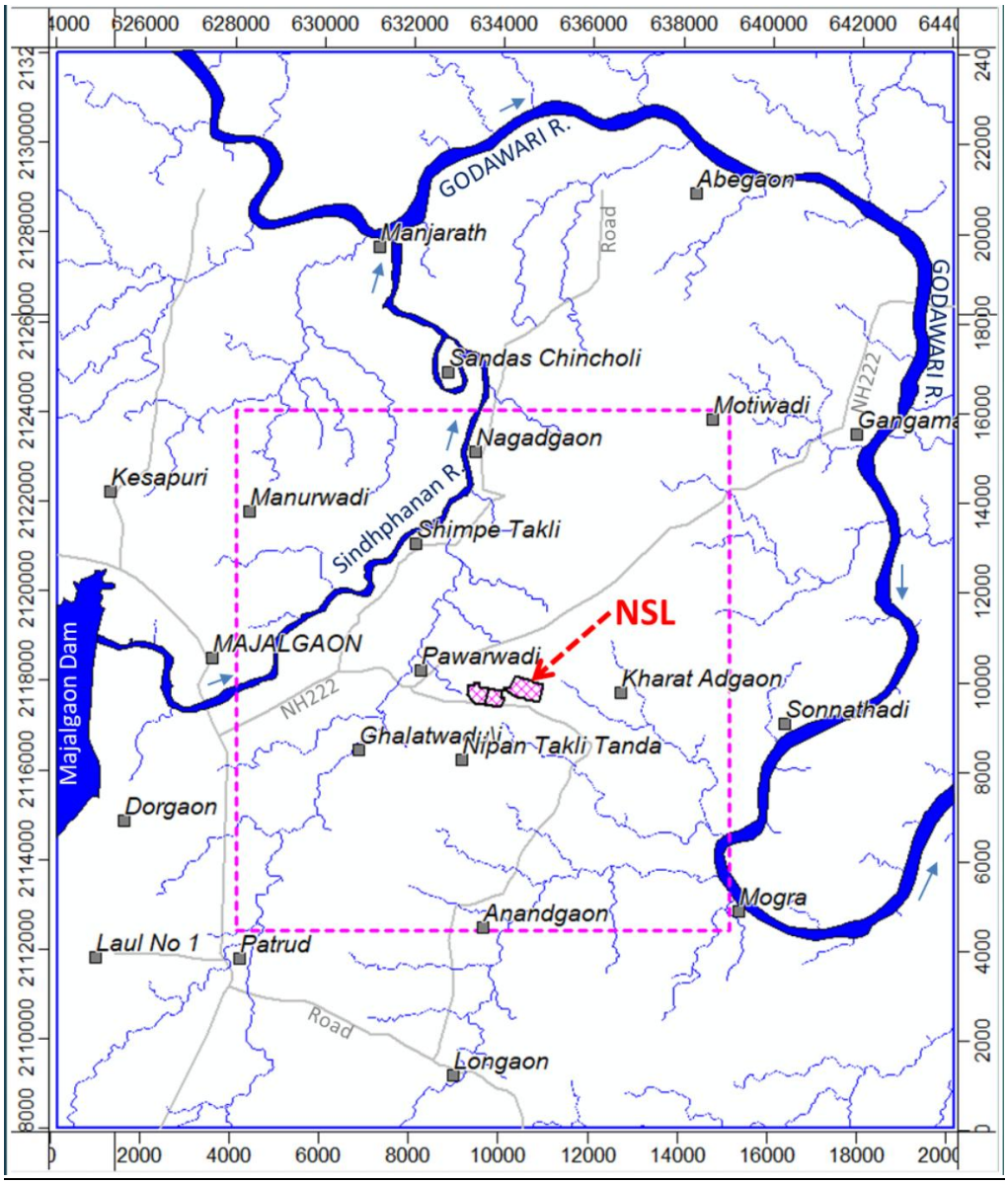


Figure 05: Drainage Map of the project site in 5 km radius

Seven different land use / land cover classes have been identified in the study area and the image was classified accordingly. **Table 02** shows the information about the extent of identified land use / land cover classes thus derived from the satellite image in the study area represented below in **Figure 06**.

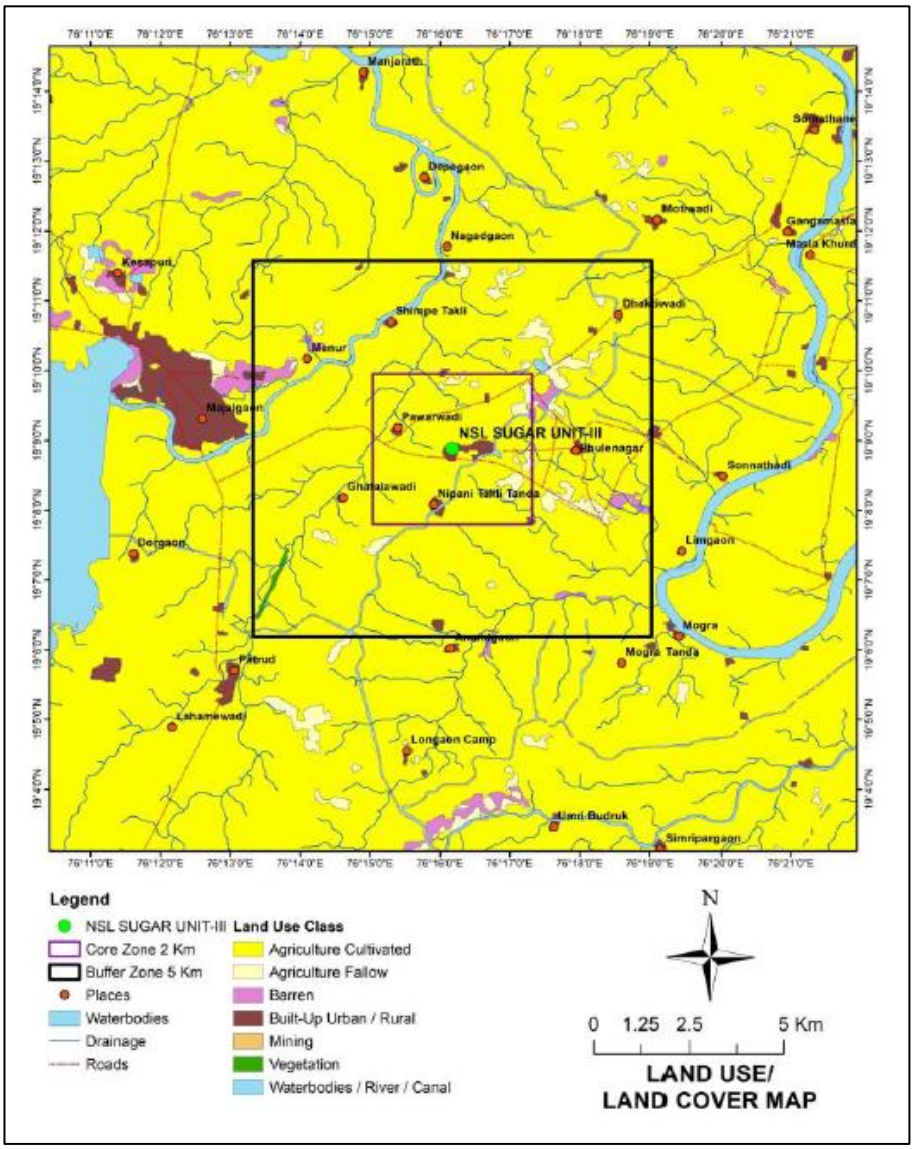


Figure 06: Land use and land cover classes map of the project site in 5 km radius

S. No.	Land use / Land cover classes	Area (%)
1	Water bodies/canal/river	1.81
2	Vegetation	0.21
3	Built-up Urban/Rural	1.13
4	Barren1	0.1
5	Mining	0.02
6	Agriculture Fallow	3.6
7	Agriculture Cultivated	91.56
Total		**100.0**

Table 02: Land use / land cover classes in 10 km area around the project site

There are **no reserved forests** in the study area. Vegetation of the study area is represented only by cultivated sparse trees (tree outside forests). Few third order drainage originate near the project site which joins river which is near the project site.

Since, the main river (**Sindhphana River**) is near to the project site, the possible impacts of the industry could be the wastes (both solid and liquid and organic as well as inorganic) generates in the premises of the industry if it goes into the drains and ultimately reaches the river. Hence, care must be taken to ensure the zero-discharge system is in place and also measures need to be taken to avoid the escape any possible leakage of chemicals/waste to the stream and reaching the river.

Geomorphology & Soil Type

The district can be broadly divided into 3 physiographic units namely; Lowland Beed, Highland Beed and Sina basin. Lowland Beed is the low lying northern part comprising a part of Godavari valley and is also known as Gangathari. It has a general elevation ranging from 400 meter above mean sea level (m amsl) in the east to 500 (m amsl) in the west with number of residual hills reaching upto 600 (m amsl). Highland Beed occupies the southern part forming a part of Balaghat Plateau. This dissected series of hills extending from west to east divides the district into two parts. Sina basin is low lying undulating area southwest and west of Highland Beed comprising almost whole of Ashti taluka.

It is interspersed with many low lying residual hills. The district is drained by Godavari, Manjra and Sina rivers and their tributaries. Godavari River flows from west to east along the northern boundary of the district. Manjra River starts from the mountains of Patoda taluka and flows west to east forming the southern boundary of the district. Sina River flows along the south-western boundary of the district.

In the district, rocky and thin layered soils are observed in major part of the district except on the banks of Godavari and Sindphana Rivers, where dark brown to black and clayey loamy to loamy soils are observed.

The nutrient levels in almost all the soils are low. The drainage head should be provided with small ponds so that leakages going into the drainage could be avoided. If these leakages going into the drain are not avoided, then agriculture in the study area may seriously affect due to the pollution of streams with organic and inorganic wastes from the industry.

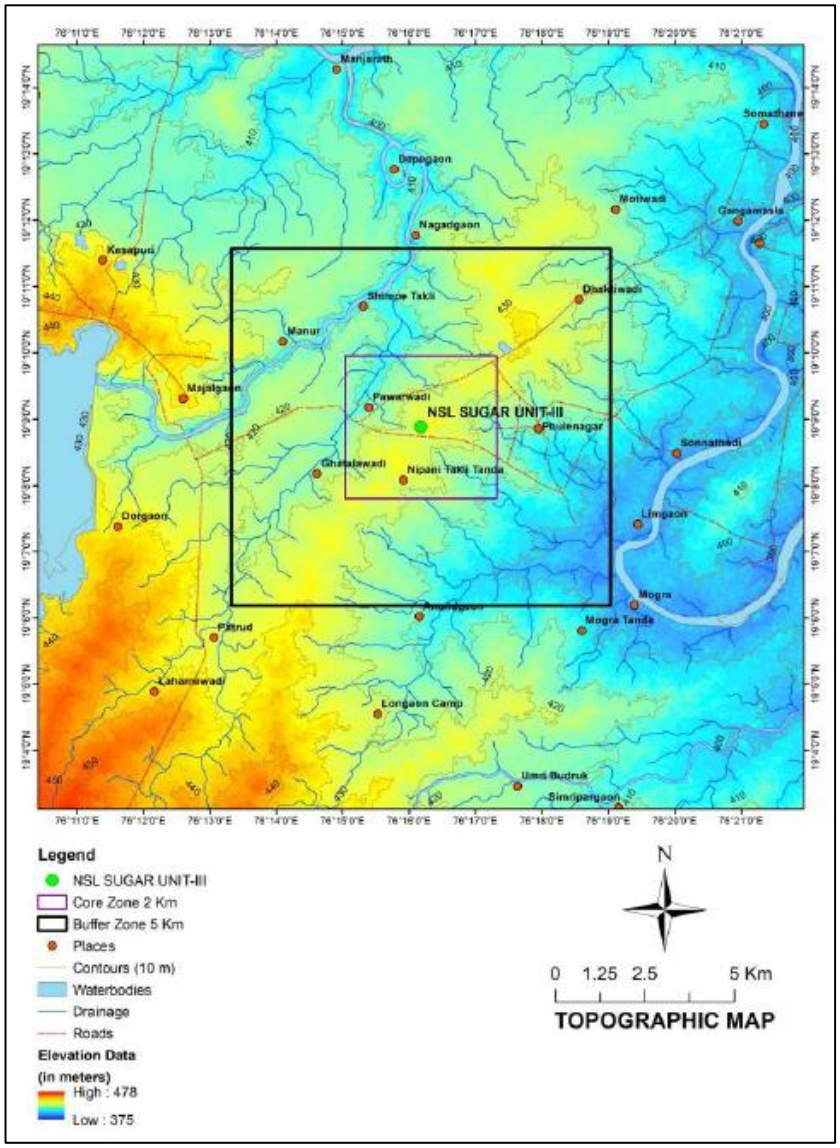


Figure 07: Topographic map of the project site in 5 km radius

The topography of the area is gently sloping, undulating pediplain. The topography varies between 375 and 440 m MSL. The lowest topographic elevation is found in the eastern and northern parts of the master model domain, while the highest elevation is found in the south-western part as shown in **Figure 07**.

A.4. Climate

For Scope-5

Not Applicable, since this project does not include any activity that is influenced by the climatic conditions of the area as it treats and reuses only the wastewater from the distillery and sugar plant without letting the water exposed to any climatic condition.

For Scope-2

Climate

The climate of this district is characterized by a hot summer and general dryness throughout the year except during the south-west monsoon season. The year may be divided into four seasons. The period from about the middle of November to the end of February constitutes the winter season. The summer season extends from March to June. This is followed by the south-west monsoon season which extends up to the end of September. The months of October and November constitute the post-monsoon season. The mean minimum temperature observed in the district is 12°C and mean maximum temperature is 42°C.

The maximum temperature varies between 44.8°C to 28.1°C and the minimum temperature varies from 13.09°C to 29.1°C. The monthly average temperatures of the area are presented in **Table 03**.

Month	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
January	22.71	20.93	22.15	20.98	22.31	21.59	25.76	19.50	22.43	24.67	23.70	23.05
February	23.96	25.11	27.76	25.78	25.32	25.51	25.99	20.36	23.99	26.53	25.80	25.58
March	27.00	27.55	29.89	28.96	29.87	29.84	27.77	27.55	27.09	27.90	31.15	29.35
April	31.71	32.13	34.62	33.62	32.98	34.46	31.59	30.15	31.34	32.45	34.70	32.85
May	33.21	34.70	35.16	35.75	35.68	36.42	34.12	33.51	36.40	34.22	37.00	32.40
June	34.77	33.17	32.80	32.58	32.61	34.61	29.82	30.30	35.67	33.66	34.65	30.21
July	30.68	32.41	29.05	30.66	29.39	28.31	28.38	26.68	29.20	26.85	29.75	28.63
August	28.95	28.88	29.64	29.85	29.62	27.97	27.83	25.86	28.71	26.70	29.05	27.79
September	27.11	29.12	27.65	29.83	28.64	25.68	27.74	25.19	27.94	27.36	28.10	27.60
October	27.63	28.92	26.55	28.36	28.08	25.19	27.33	26.10	26.35	26.50	31.95	31.45
November	24.37	25.85	22.47	23.64	25.05	24.49	22.80	24.02	24.16	25.72	25.78	24.70
December	20.91	23.49	21.65	22.27	21.92	22.82	20.29	23.60	24.89	23.73	28.17	25.20

Table 03: Average Monthly Temperatures of NSL Sugars Jay Mahesh Unit

Relative humidity, in general, is moderate to high throughout the year in the area. The average humidity is found to be lowest from April to May, ranging from 44.1% to 48.5%. The average humidity of the area starts rising from June to September ranging from 51.4% to 59.3%. Thereafter it starts rising with the commencement of Summer. In general, the humidity varies from a minimum of 44.1% during May to a maximum of 59.3% during September.

Variation of relative humidity is presented is given in **Table 04**.

Month	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Avg
January	49.8	45.5	46.3	57.5	58.5	51.6	61.8	59.1	51.4	56.9	54.7	51.9	53.7
February	50.0	34.5	38.5	51.4	56.9	50.4	60.4	58.3	49.6	51.9	54.9	52.1	50.7
March	50.2	45.7	35.8	47.2	52.0	38.1	59.3	52.2	44.3	56.1	51.6	50.1	48.5
April	48.2	36.8	33.3	37.2	48.0	36.8	47.9	48.9	48.3	54.5	54.2	49.6	45.3
May	47.9	29.7	26.5	38.9	46.2	33.1	42.6	53.9	46.2	52.6	55.8	55.7	44.1
June	49.5	42.1	45.0	53.8	52.0	40.9	59.8	54.4	52.4	55.4	57.6	53.3	51.4
July	52.5	42.9	59.7	60.7	56.7	52.0	61.6	58.4	41.7	61.9	59.2	58.4	55.5
August	54.7	57.5	55.2	60.9	60.1	53.2	57.6	56.9	52.2	57.1	57.2	55.2	56.5
September	54.9	56.6	66.4	60.1	55.2	66.9	61.4	62.8	56.8	54.1	58.5	58.4	59.3
October	49.7	52.7	55.6	57.4	49.0	60.9	59.1	56.3	56.6	54.0	53.8	52.8	54.8
November	49.2	52.6	52.3	52.6	50.7	53.6	48.9	51.3	53.5	53.4	49.6	48.8	51.4
December	46.7	47.3	62.4	63.6	53.9	63.1	54.4	48.6	59.6	53.3	50.2	51.2	54.5

Table 04: Average Monthly Relative Humidity (%) of NSL Sugars Jay Mahesh Unit

A.5. Rainfall

For Scope-5

Not Applicable, since this project does not involve any usage of rainfall data.

For Scope-2

(a) Average annual rainfall: 1055.83 mm

(b) Temperature: The average temperatures of the area during the monsoon period vary from 27.6°C to 29.1°C.

The project activity area gets the benefit of South West monsoon rainfall. The NSL Plant is collecting the daily rainfall data from a **rain gauge station** established in their Plant premises. The average per year rainfall from 2014 to 2025 (12 Years) of the station is 1055.83 mm. The maximum rainfall of 3786.4 mm was received in 2020 and a minimum 579 mm during the year 2018.

The monthly rainfall data of NSL Sugars from 2014 to 2025 is presented in **Table 05** below:

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Rainfall (mm)
2014	0	5	169	3	0	59	87	204	57	13	2	8	**607**

2015	1	3	35	30	1	126	27	213	194	6	8	0	**644**
2016	0	1	0	0	1	223	272	65	500	82	0	0	**1144**
2017	0	0	0	0	0	132	75	182	153	84	0	0	**626**
2018	0	0	0	0	1	144	193	234	7	0	0	0	**579**
2019	0	0	0	2	0	129	144	180	352	294	54	0	**1155**
2020	0	0	12	0	0	311.8	3077.9	102.3	211.2	71.2	0	0	**3786.4**
2021	0	22	26.3	0	51.6	231.9	212.6	162.4	489.9	52.6	0	0	**1249.3**
2022	0	0	0	0	0	173.2	248.8	72.8	210.1	145.3	0	0	**850.2**
2023	0	0	2	52	9	66	190.2	13.8	170.6	0	34.4	1.1	**539.1**
2024	0	0	0	67.5	16.3	236.6	192.7	78.1	171.5	0	0	0	**762.7**
2025	0	0	0	4	117.2	31.5	127.9	240.1	150.3	54.2	2	0	**727.2**
Average Rainfall (mm)	**0.08**	**2.58**	**20.36**	**13.21**	**16.43**	**155.33**	**404.01**	**145.63**	**222.22**	**66.86**	**8.37**	**0.76**	**1055.83**

Table 05: Monthly Rainfall Data of NSL Sugars Jay Mahesh Unit (2014 to 2025)

In general, the rainfall for 12 years from 2014 to 2025 is showing a rising trend. The year 2018 and successive three years followed by 2021 being good rainfall years, general rainfall is showing a rising trend.

A.6. Ground Water

For Scope-5

Not Applicable, since this scope of project does not include any activity that uses the ground water.

For Scope-2

Monitoring of ground water levels at pre-specified locations with respect to time provides basic idea of changes in ground water regime due to various stresses acting on the ground water system. Seasonal fluctuations in ground water level are indicator of changes in input and output to ground water reserves. Water level is the manifestation of the resultant changes in space and time. The long-term decline in ground water level points towards excess withdrawal with respect to recharge. The major part of the district is constituted by a sequence of basaltic lava flows (Deccan Trap) and alluvium occupies a small portion. The alluvium consisting of clay, Silt, Sand and Gravel occur along the course of major rivers. The thickness of alluvium varies up to few meters. The alluvium lies directly over the Basaltic lava flows. Groundwater occurrence and movement in the area is influenced by its rock formations. The Groundwater potential of the area depends upon porosity and permeability (both primary and secondary) of rock formations. The entire district is underlain by the Basaltic lava flows of upper Cretaceous to lower Eocene age. The shallow Alluvial formation of Recent age occurs as narrow stretch along the major rivers flowing in the area, but it does not play much important role from ground water point of view.

Hard Rock Area

i) Deccan Trap Basalt

The Deccan Trap includes several flows of Basalt which are supposed to have extruded from fissure volcanoes. Ground water in Deccan Trap Basalt occurs mostly in the upper weathered and fractured parts down to 20-25 m depth. At places potential zones are encountered at deeper levels in the form of fractures and inter-flow zones. The upper weathered and fractured parts form phreatic aquifer and ground water occurs under water table (unconfined) conditions. This aquifer is tapped by mainly dug

wells in the depth range of 3.00 to 29.60 m bgl and their yield ranges between 5700 and 72900 lph. At deeper levels, the ground water occurs under semi-confined conditions. These are tapped by Dug-cum-Borewell (DCB) ranging in depth from 11 to 50 m bgl.

The confined aquifers in Basalt are encountered at depth of more than 40 to 50 m and are tapped by borewells ranging in depth from 40 to 100 m bgl. Borewells drilled down to 70 m depth, tapping weathered and vesicular basalt are found to yield 500 to 3000 lph. As per Ground Water Exploration data deeper potential aquifers below 100 m bgl have been observed in Gevrai and Ashti talukas.

Soft Rock Area

ii) Alluvium

Alluvial deposits occur in long narrow basin along Godavari and Sindphana rivers. About a 10% area of the district is occupied by Alluvium. It consists of sand, gravels and boulders with intercalations of clays and silt. The beds of sand and gravels are discontinuous and lenticular and pinch out laterally within short distance. Ground water occurs under phreatic and semi-confined conditions in inter granular pore spaces of gravel and sand. This aquifer is tapped mainly by dug-wells ranging in depth 5 to 25 m bgl with 2 to 3 m diameter and the yield varies from 100 to 250 m^3/day.

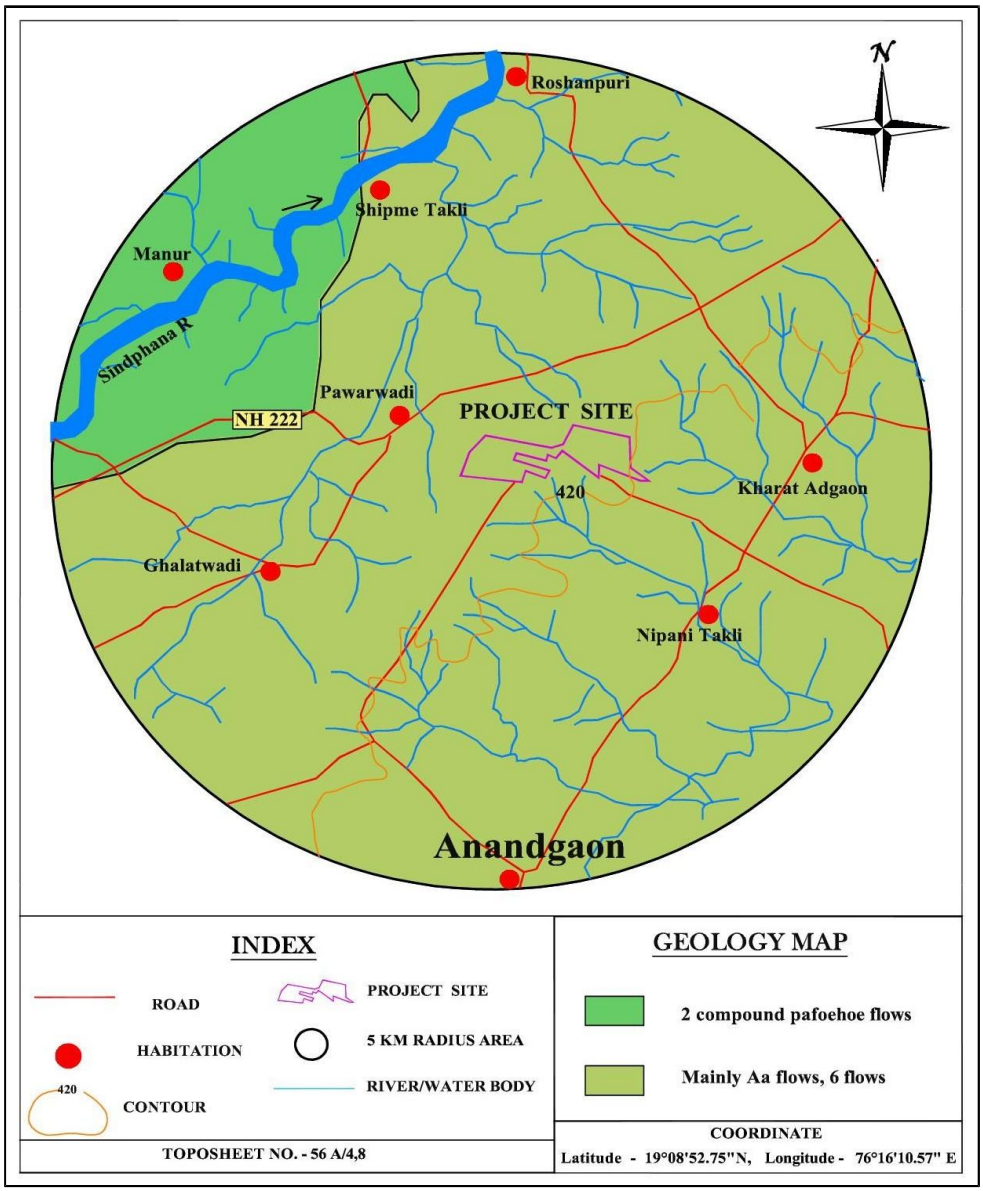


Figure 08: Geological Map of the Project Area

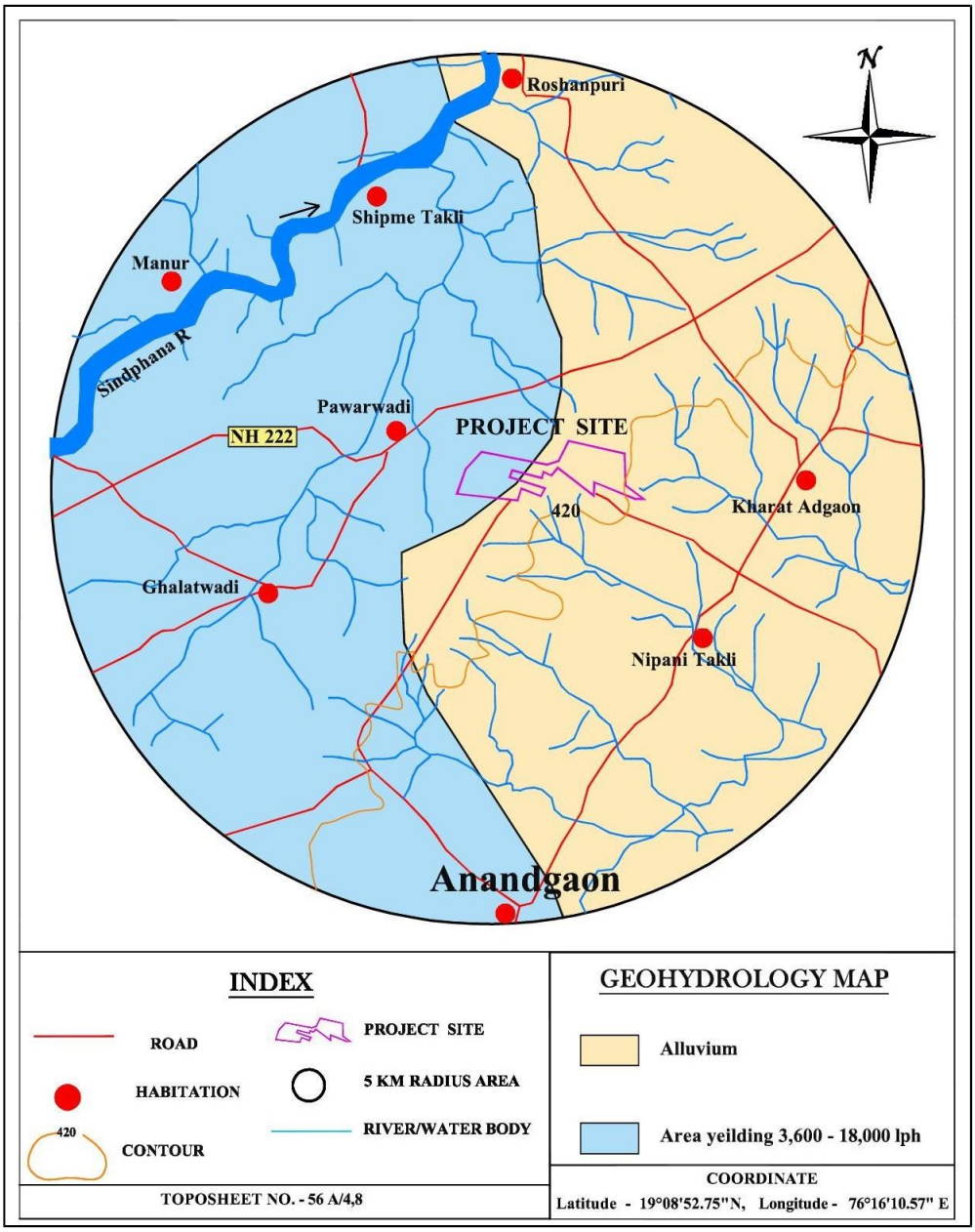


Figure 09: Hydro-geological Map of the Project Area

Groundwater occurs under unconfined to semi-confined conditions within these formations. Typically, groundwater is found under phreatic conditions in the moderately weathered basalt and under unconfined conditions within the fissured and fractured zones at greater depths. The area is underlain by both porous and fissured formations, which constitute the primary aquifer systems, comprising unconsolidated to semi-consolidated rock masses.

Major Aquifer Systems

Basalt formations constitutes the principal aquifers in the district. Based on the ground water exploration carried out in the district.

The aquifer units found in each of the formation are given below:

- **Alluvium**: The alluvium in the district is found as very shallow sandy horizons along the rivers. Its depth is generally within 10m with thickness of granular zone varying from 5 to 8 m. The water levels are generally between 5 and 10 m.
- **Basalt**: The basaltic aquifer can be categorised into two parts,

    - **Aquifer I:** The Aquifer-I in Basalt formation occurs as weathered/fractured basalt with thickness varying from 18 to 34 m. The yield of the wells in this aquifer is up to 100 m3/day.
    - **Aquifer II:** Aquifer-II in Basalt formation is observed in the depth range of 38 to 195.60 mbgl with water levels of 3.11 to 100 mbgl and thickness of fractured zone varying from 0.5 to 10 m. The aquifer-II is exploited mainly by borewells and yield of the aquifer generally varies up to 2.5 lps

Plant is located in a watershed draining directly to the Godavari River, and groundwater flow is directed towards the Godavari River. The variation in water table is relatively gradual compared to the NW side of the NSL area, which is also part of the Sindphana watershed, where the water table gradient is very steep. The overall groundwater flow direction is towards the Sindphana and Godavari River.

The ground water level data available for different locations at various time intervals has been analysed for the study area to understand the regional as well as local ground water regime scenario.

In entire Beed district, the Deccan Trap Basalt of Upper Cretaceous to Lower Eocene age is the major rock formation.

The major part of the district is covered by Basaltic flows commonly known as Deccan Traps of Upper Cretaceous-Lower Eocene age. Alluvial deposits of Recent to Sub Recent age are observed along the river courses of Godavari and Sindphana.

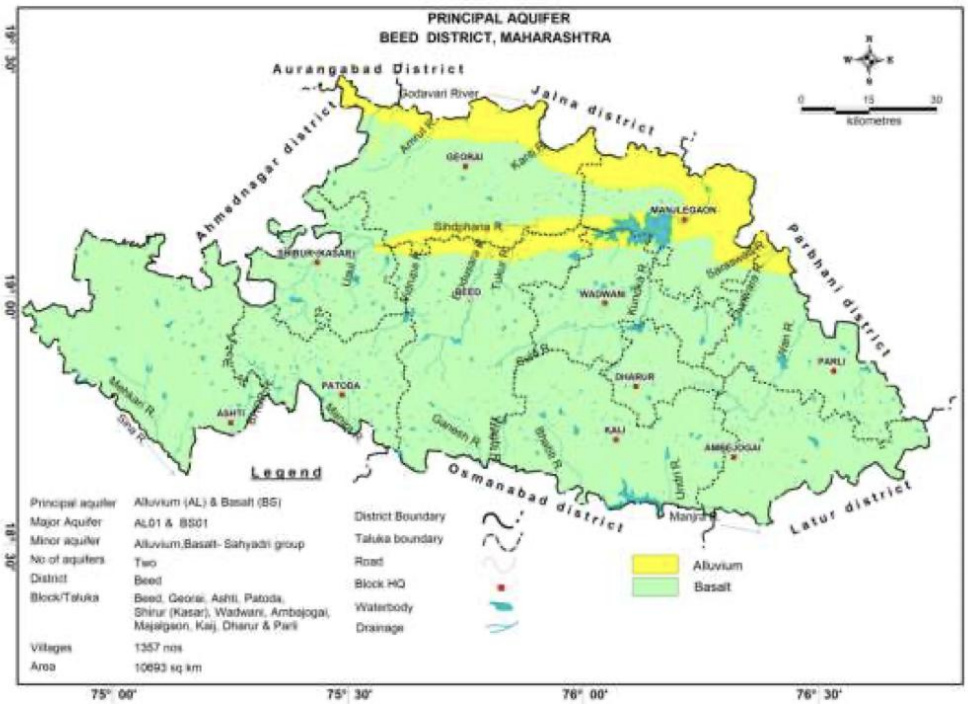


Figure 10: Major Aquifer system available according to CGWB of Maharashtra

A.7. Alternate methods

For Scope-5

a) Common Practices for Wastewater Treatment in Sugar and Distillery Industries:
   - Anaerobic Digestion: Used to treat high-strength effluent like spent wash, reducing COD/BOD and generating biogas.
   - Multiple Effect Evaporation (MEE): Concentrates spent wash to reduce volume, preparing it for further treatment.
   - Bio-composting: Combines treated spent wash with press mud to produce organic fertilizer.
   - Zero Liquid Discharge (ZLD): Integrates MEE, crystallization, and reverse osmosis to recover water and prevent discharge.
   - Irrigation Use: Treated effluent is diluted and applied in agriculture under controlled conditions.
   - Incineration: Concentrated spent wash is burned for energy recovery in distillery operations.

b) Common Practices for Condensate water in Sugar and Distillery Industries:
   - It is generally used in the process back after treatment.
   - In some distilleries especially molasses-based units, condensate can be reused for diluting molasses in the fermentation section.

These methods align with regulatory norms and support resource recovery and sustainability.

Industries face challenges such as high capital and operational costs, land scarcity for methods like bio-composting, and skilled workforce shortages. Managing spent wash with high COD/BOD, odour control, seasonal effluent variations, and strict regulatory compliance adds complexity. Additionally, handling byproducts and ensuring sustainable water reuse remain significant concerns. Hence implementing these methods in industry improves the water security.

For Scope-2

As per the study and data available of the NSL project it is clear that the project owner is trying to collect and conserve the rainwater for reuse in the plant activity to avoid any runoff and wastage of water. The hydrological structures and conservation measures are developed in such a way that the runoff generated within the plant will be collected and stored to meet a part of the water requirement of the Plant.

As it was determined from each zone and land use hydrological characteristics, the runoff is the major component which is being affected by various factors. The following are the factors which are affecting different hydrological characteristics:

Storm Characteristics	Nature of Storm
	Seasonal Storms
	Intensity
	Duration
	Areal extent (Distribution)
	Antecedent Precipitation
	The direction of Storm Movement
	Temperature
	Humidity
	Wind velocity

Meteorological Characteristics	Pressure Variation
	Size
	Shape
	Slope (Average land slope & Stream slope)
	Altitude (Elevation)
Catchment Characteristics	Topography
	Geology
	Land use/vegetation
	Orientation
	Type of drainage network
	Proximity to Ocean and mountains
	Ranges
	Depressions
	Pits and Ponds
Storage Characteristics	Steams and channels
	Upstream tanks/ponds
	Flood plains and swamps
	Ground water storage in pervious deposits

Based on the above characteristics it is found that in general, low-intensity storms over longer spells contribute to the ground water storage and produces relative less runoff. On the other hand, high-intensity storm or smaller catchment areas increases the runoff since the losses like infiltration and evaporation are less. However, if there is a succession of storms the runoff will increase due to the initial wetness of the soil, and antecedent rainfall and most of the area is well developed into buildings for Plant activities and paved ones. As usual, the rain during the summer will produce less runoff and during the winter will produce more runoff.

The development of these catchment areas and measures to prevent run-off will save water and result is less runoff in the area.

A.8. Design Specifications

For Scope-5

A) Sugar Effluent Treatment Plant (ETP) is designed to treat wastewater generated from leakages and spillage of juice and syrup and molasses in different sections of the industry. Leakage occurs at pipe joints and pump glands. The periodical washing of floor also contributes pollution load in the wastewater. Wastewater is also generated due to the cleaning of equipment such as mills, evaporators, pans, juice heaters, etc. The effluent thus generated is having COD and BOD that needs to be treated before using it for agricultural purposes.

ETP is having following 12 steps of treatment processes:

1. Grit Chamber
2. Screen Chamber
3. Oil & Grease Collection Tank
4. Lime Mixing Tank
5. Equalization Tank
6. Primary Clarifier
7. Buffer Tank
8. UASB Digester

9. Aeration Tank
10. Secondary Clarifier
11. Disposal Tank
12. Sludge Drying Bed

Details of treatment unit:

S. No.	Name of the unit	Dimensions	Volume, m^3	Units
1	Grit Chamber	2.5 m x 1.5 m x 2.4 m	7.2	1
2	Screen Chamber	2.5 m x 1.5 m x 2.4 m	9	1
3	Oil & Grease collection Tank	2 m x 1.5 m x 2.4 m	7.2	1
4	Lime Mixing (MS) Tank	1 m x 1 m x 1 m	1	1
5	Equalization Tank	18 m x 18 m x 2.2 m	713	1
6	Primary Clarifier	8 dia X 2.5 h	125	1
7	Buffer tank	31.1 m x 6.5 m x 2 m	404	1
8	UASB Digester	17.3 dia X 6 h	1400	1
9	Aeration Tank	15 m X 12 m X 4 m	720	1
10	Secondary Clarifier	15 dia X 1.8 h	114	1
11	Disposal Tank	9.5 m X 4.5 m X 2.5 m	77	1
12	Sludge Drying Bed	-	-	1

Table 06: Major ETP tank list of NSL Sugars Jay Mahesh Unit

Figure 11: ETP plant at NSL Jay Mahesh Unit

Physio-Chemical process:

1) **Grit Chamber:**
   Effluent from sugar factory collection gutter firstly enters into grit chamber where solid particles from inlet effluent are settled down.

2) **Screen Chamber:**
   Screen chamber has been provided to accommodate the screen. The screen will remove the suspended particles like bagasse, cotton waste, etc. coming from the sugar unit.

3) **Oil & Grease Collection Tank:**
   In this chamber mechanical O & G skimmer is installed for mechanical removal of free & floating oil and grease, which otherwise would affect the performance of anaerobic biological treatment. The trap is provided with oil removal mechanism.
   Collected Oil & grease is mixed with boiler feed bagasse & burn into boiler.

4) **Lime Mixing Tank:**
   After O& G next chamber MS tank with stirrer is installed for lime mixing. Milk lime is continuously mixed with effluent or adjustment of pH to neutral.

5) **Equalization Tank:**
   An Equalization Tank is used to overcome the problem caused in influent wastewater flow and characteristics of waste water. Float mixers are provided for mixing for enhanced biological treatment and improve chemical feed control.

Equalization Tank

6) **Primary Clarifier:**
   A primary Clarifier in the form of circular tank shall be provided for settlement of aerated effluent from the equalization tank. The tank shall be provided with centrally driven fixed bridge type clarifier mechanism.

7) Buffer Tank:

In this tank complex organics in the waste water is subjected to hydrolysis. The hydrolysed effluent shall be pumped to anaerobic treatment in UASBR reactor.

Buffer Tank

8) UASB Reactor:

Up flow Anaerobic sludge blanket reactor (UASB Reactor) consist mainly feed distribution network at the bottom, sludge blanket approximately mid height of reactor and the gas, liquid, solid separator (GLSS) at the top of the reactor.

In this type of treatment effluent is treated anaerobically in air tight RCC tank. The reactor consists of three zones viz. Influent distribution zone, Reaction zone, Gas solid liquid separation zone.

Influent Distribution zone: The raw wastewater enters into the digester at the bottom through influent distribution zone. A sophisticatedly designed piping network is provided for uniform distribution of the effluent in the tank. The effluent then travels upward in the reactor.

Reaction zone: In the reaction zone the anaerobic bacteria are maintained on the surface of the PVC media. The organic matter in the wastewater comes in contact with the bacterial population and is degraded anaerobically to methane rich biogas, the end product of anaerobic digestion. The process of conversion of organic matter into the biogas is a two-stage process. In the first stage the organic matter in the raw effluent is converted in to the volatile acids by acid forming bacteria. In the second stage the acid produced in the first stage are converted in to methane by another group of bacteria i.e. methane formers. In anaerobic digester process both the stages are completed in single reactor. The biogas so produced is bubbled through the effluent and is separated out in the third section i.e. Gas collection zone. The suspended solids are also separated to prevent escape of solids from the reactor.

Gas collection zone: In gas collection zone the biogas generated will be collected and the same will be conveyed to flare stack where it is flared continuously. The treated effluent overflows through a launder and will take to a secondary treatment.

UASB Tank

9) Aeration Tank:

The secondary treatment consists of aeration basin and secondary clarifier. Raw effluent after anaerobic treatment will be conveyed by gravity into the aeration basins for biological treatment of organic matter. BOD will take place in aeration basin. The aeration basin will be oxygenated using diffused aerators and will effectively bio-degrade the organic matter to the required BOD level of purity.

The bacteria grow by using organic content in the raw effluent and the dissolved oxygen available. Due to constant aeration, continuous mixing take place. The bacterial growth increases to a certain extent. The bacterial reaction is carried out into two stages, for maximizing the BOD removal efficiency. Air supply is given through diffused aeration, to maintain MLSS concentration in aeration tank. The effluent from aeration basin passed through secondary clarifier, where sludge settled and supernatant overflow to treated water tank.

Aeration Tank

10) Secondary Clarifier:

A secondary Clarifier in the form of circular tank shall be provided for settlement of fully aerated effluent from the extended aeration tank. The tank shall be provided with centrally driven fixed bridge type clarifier mechanism. Part of the settled sludge at the bottom of the settling tank will be pumped to the EAT and part of it will be discharged on sludge drying beds as per operational requirement. This sludge being fully mineralized is suitable for sun drying on sand drying beds.

11) Disposal Tank:

This tank is provided to store the treated effluent before pumping to the green belt development area or sugar cane irrigation.

12) Sludge drying Beds:

In the activated sludge process system the sludge is sufficiently mineralized and does not need any further treatment before dewatering and disposal. Sand filtration drying beds will be provided, where sludge will be dewatered by filtration through sand bed and sun drying of the dewatered sludge is scraped & may be used as manure

List of Equipment:

S. No.	Name of the equipment	Capacity, m^3/hr
1.	Equalisation Tank Handling Pump • Make:- SPX • Model No.:- CN-65-125G6S2L1 • RPM:- 2880 • Qty:-02 Nos	Cap: 100 m^3/hr

2.	Buffer Tank Handling Pump • Make:- SPX • Model No: CN-65-125G6S2L • RPM:- 2880 • Qty:- 02 Nos	Cap: 100 m^3/hr
3.	Aeration Tank Blower Motor • Make: SMW/ Root Blower • RPM- 1160 • Pressure: 0.45 m^3/H • Qty:- 02 Nos	Cap: 1100 m^3/hr
4.	Disposal Tank Handling Pump • Make:-SINTEX • Model No: UMHC-65/32 • RPM: 1450 • Qty:- 02 Nos	Cap: 70 m3/hr

Table 07: Major List of Equipment used in ETP of NSL Sugars Jay Mahesh Unit

Details	Flow m3/day	PH	COD mg/lit.	BOD mg/lit.	TSS mg/lit.	O &G mg/lit.	TDS mg/lit.
Characteristics of combined effluent.	650	4-11	7000	3500	550	60	2300
Percentage reduction in O & G traps.	-	-				90%	
Characteristics of effluent after O & G.	650	4-11	7000	3500	550	06	2300
Percentage reduction in primary clarifier			05	05	70%	-	-
Characteristics of effluent after primary clarifier.	650	7-8	6650	3325	165	06	2300
Percentage reduction in UASBR			85	75	10	15	15
Characteristics of effluent after UASBR.	650	7-8	997	831	148.5	05	1955
Percentage reduction in Aeration Tank.			80	90			
Characteristics of effluent after aeration tank.	650	7-8	199	83	148.5	5	1955
Percentage reduction in secondary Clarifier.			5	5	70		
Characteristics of effluent after secondary clarifier	650	7-8	189	78.8	33.6	5	1995

Table 08: Shows the Tentative Percentage reduction across each stage of Treatment

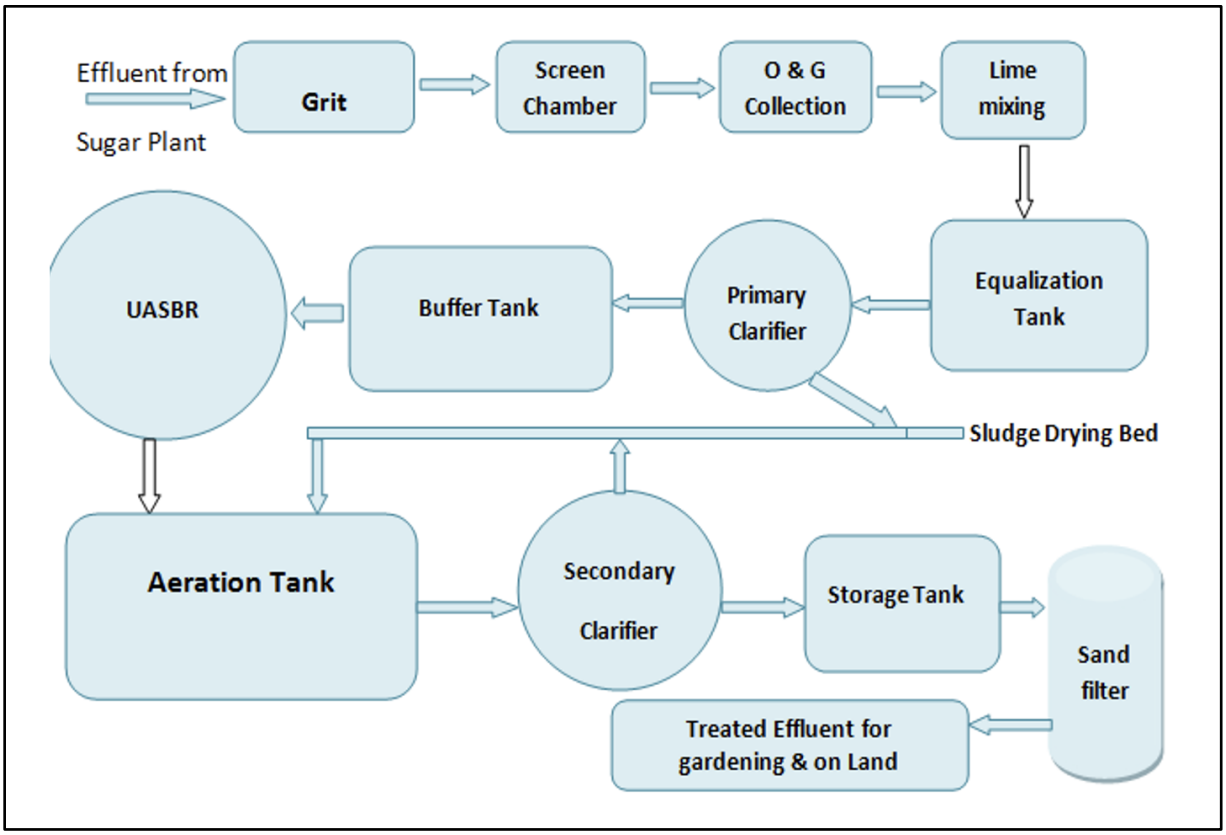


Figure 12: Showing the process flow of STP plant in NSL Sugar Jay Mahesh Unit

B) Sugar Condensate Plant: is designed to captures process vapours from evaporators and pans, converting them into purified, reusable water. This drastically reduces fresh water consumption and helps achieve Zero Liquid Discharge (ZLD) when integrated with the distillery.

The major impurity contents of sugar factory condensate are trace organics and more particularly the Ammonical Nitrogen which can prove detrimental for reuse applications.

The treatment scheme for condensate polishing unit involves the utilization of biological mode, specially developed to treat not only trace organics, but basically the Ammonical nitrogen. The treatment scheme therefore comprises of an Aerobic – Anaerobic approach.

Although, the characteristics of condensate are fairly uniform with reference to period, it is desirable to provide some cushion for minor variations in the form of equalization tank. This also serves as a part of composite and complex biological system specially developed as the treatment scheme. The condensate is subjected to aerobic and anaerobic biological modes selectively to cater for and treat the two main impurities. Care is taken to optimize the treatment structures as well as the energy inputs, thereby minimizing the capital as well as working expenditures

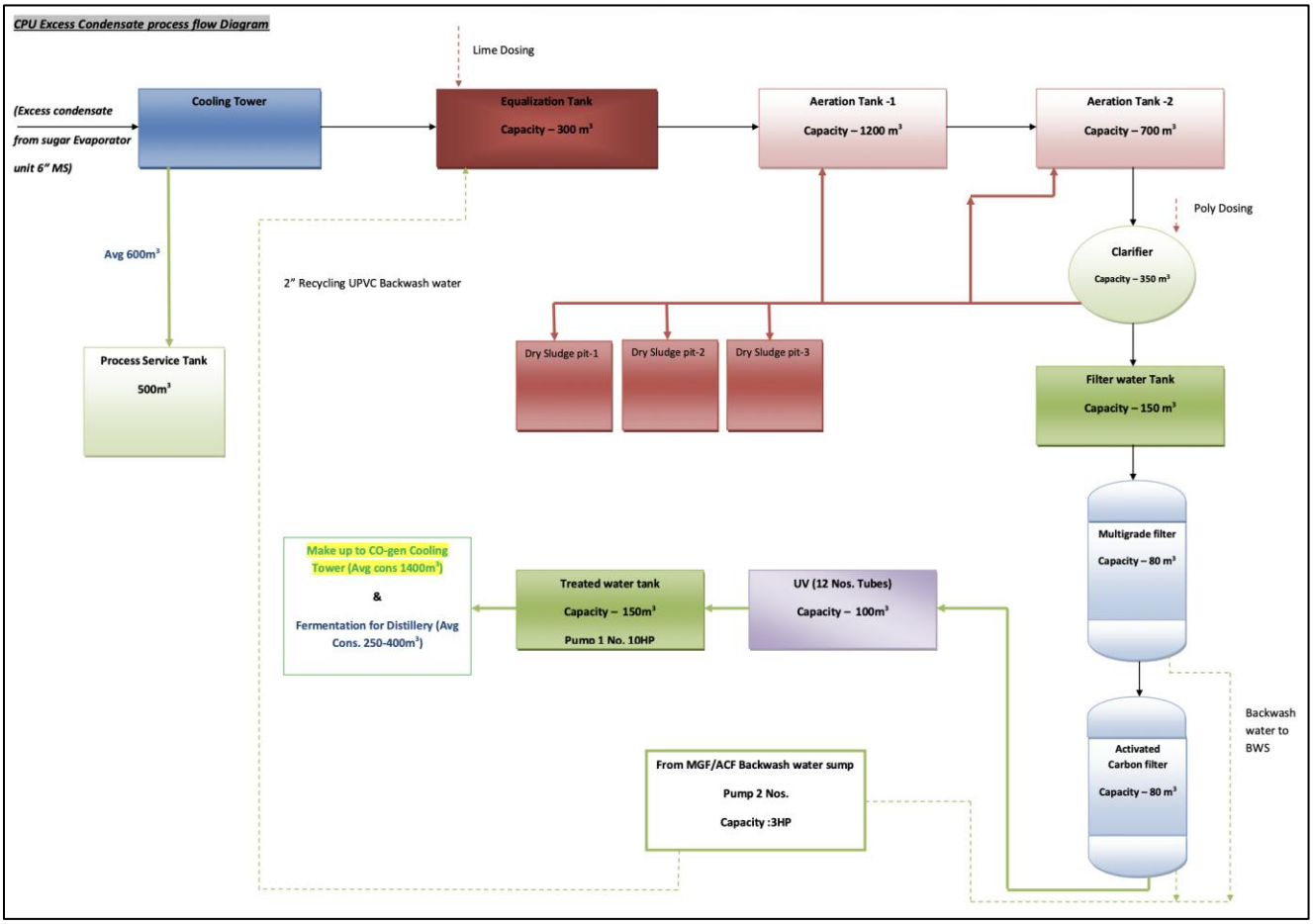


Figure 13: Showing the process flow of Sugar Condensate Recycling plant in NSL Sugar Jay Mahesh Unit

1) **Excess Condensate from Sugar Evaporator Unit**

Excess condensate generated from the sugar evaporator contains traces of sugars and organic impurities that prevent its direct reuse. The condensate is collected and routed to the Condensate Polishing Unit (CPU) for treatment and recovery.

2) **FRP Cooling Tower**

The condensate is first cooled in the **FRP Cooling Tower** to achieve a suitable temperature for biological treatment. Cooling improves process efficiency and protects the microbial population in the downstream aeration tanks. A portion of the cooled water is also supplied to the **Process Service Tank** for plant utility requirements.

3) **Equalization Tank (300 m^3)**

The cooled condensate is collected in the **Equalization Tank**, where flow and pollutant concentrations are equalized to provide a consistent feed to the treatment system. **Lime dosing** is carried out for pH correction, while recycled filter backwash water is also returned to this tank for treatment.

4) **Aeration Tank – 1 (1,200 m^3)**

The equalized wastewater enters **Aeration Tank-1**, where air is continuously supplied to support aerobic microorganisms. These microorganisms degrade dissolved organic matter, resulting in substantial reduction of BOD and COD.

5) **Aeration Tank – 2 (700 m^3)**

The partially treated water flows to **Aeration Tank-2** for further biological oxidation. The additional retention time enhances treatment efficiency and ensures complete stabilization of the wastewater before clarification.

6) **Secondary Clarifier (350 m^3)**

The biologically treated water enters the **Secondary Clarifier**, where suspended biomass settles under gravity. **Poly dosing** improves sludge settling, while clarified water flows for tertiary treatment and excess sludge is withdrawn for drying.

7) **Dry Sludge Pits**

Excess biological sludge is transferred to **Dry Sludge Pits**, where moisture is removed through natural drainage and evaporation. The dried sludge is easier to handle and can be safely disposed of or utilized as manure, subject to regulatory compliance.

8) Filter Water Tank (150 m^3)

Clarified water is collected in the Filter Water Tank, which serves as an intermediate storage reservoir before tertiary filtration. It ensures a continuous and balanced supply of water to the filtration units.

9) Multigrade Filter (80 m^3)

Water passes through the Multigrade Filter to remove suspended solids, turbidity, and fine particulate matter. This improves water clarity and prepares it for final polishing.

10) Activated Carbon Filter (80 m^3)

The filtered water is further polished in the Activated Carbon Filter, where residual colour, odour, and dissolved organic compounds are removed through adsorption. This significantly enhances the overall water quality.

11) UV Disinfection System (100 m^3)

The filtered water is disinfected using the UV System, which effectively inactivates microorganisms without the use of chemicals. This ensures safe and high-quality water for industrial reuse.

12) Treated Water Tank (150 m^3)

The disinfected water is stored in the Treated Water Tank**,** which provides buffer storage and ensures a continuous supply of treated water. The stored water is pumped to various process applications as required.

13) Reuse of Treated Water

The treated condensate is reused as make-up water for the Co-generation Cooling Tower (approximately 1,400 m^3/day) and for the Distillery Fermentation Process (approximately 250–400 m^3/day**).** This reduces freshwater consumption and supports sustainable water management.

14) Backwash Water Recycling

Backwash water generated from the MGF and ACF is collected in the backwash water sump and pumped back to the Equalization Tank for retreatment. This internal recycling minimizes water losses and maximizes overall water recovery within the plant.

For Scope-2

Plant Area Assessment for Rainwater Harvesting

The topography, climate, soil, land use and hydrogeological conditions are important factors controlling the suitability of an area for ground water recharge. The prevalent topography, soil and land use conditions determine the extent of infiltration, whereas the hydrogeological conditions govern the occurrence of potential

aquifer systems and their suitability for artificial recharge. The Layout Plan of NSL Sugars Jay Mahesh Unit Is presented in **Figure 14**.

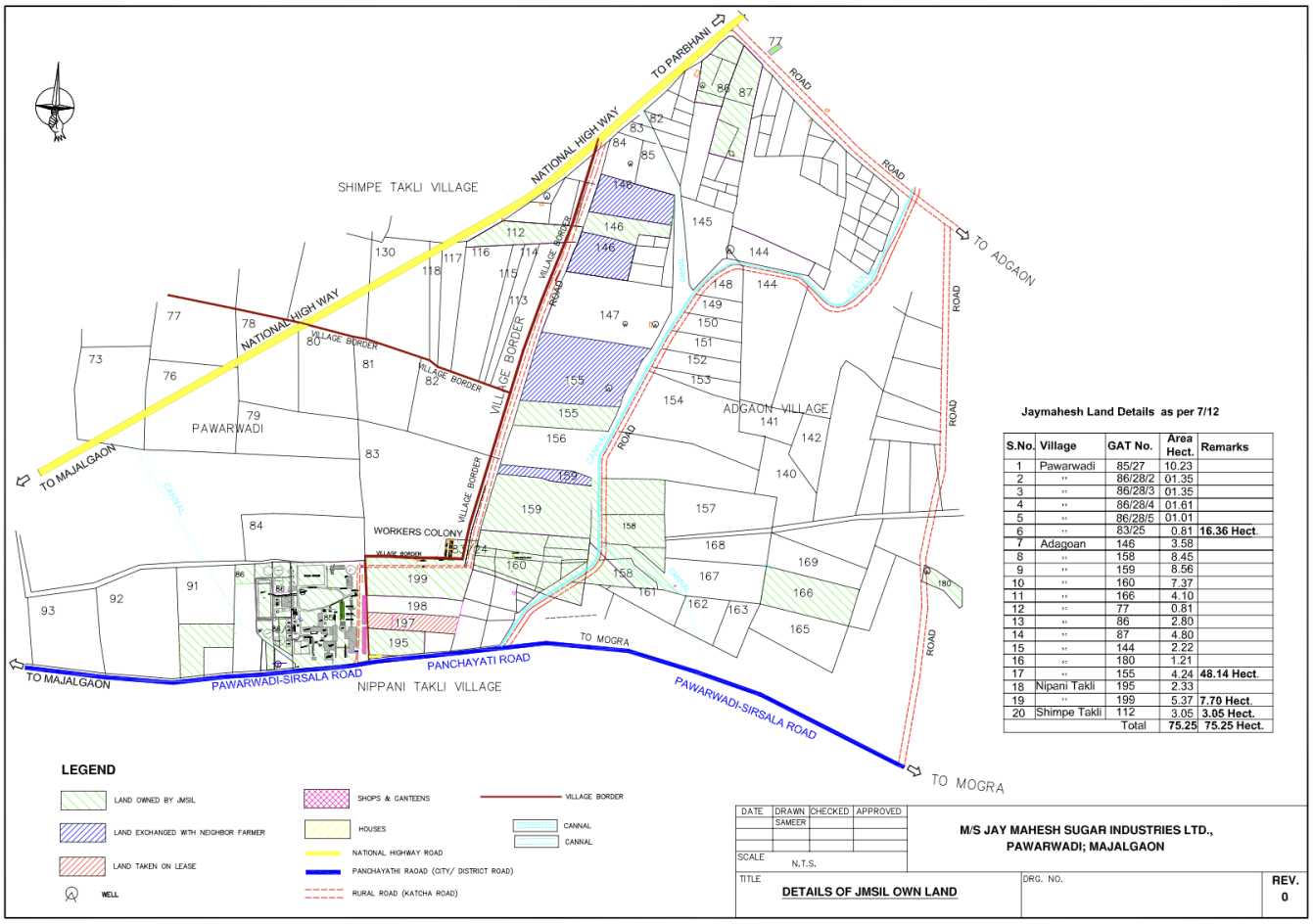


Figure 14: Layout plan of NSL Sugar Jay Mahesh Unit

Out of the total plot area of about 185.25 acres (749,672 m²) of the NSL Sugars Jay Mahesh Unit, different land-use surfaces have been identified and quantified separately for assessment of rainwater harvesting potential. The total area comprises roof area, road/paved area, green belt area and open area used for irrigation purposes. The roof area of the plant and associated buildings accounts for about 3.43 acres (138,74 m²), while the road and paved surfaces occupy around 38.63 acres (156,322 m²). These surfaces are expected to contribute significant runoff during rainfall events and are considered suitable for rainwater collection and harvesting.

Similarly, the green belt area covers about 47.06 acres (190,457 m²), contributing towards groundwater recharge through infiltration and environmental improvement within the premises. In addition, a large open area of about 96.13 acres (389,019 m²) is available for irrigation and natural percolation purposes.

Thus, the total plot area of about 185.25 acres (749,672 m²) has been taken into consideration for evaluating the overall rainwater harvesting potential, stormwater management and groundwater recharge within the Maharashtra Unit premises.

S.No.	Particulars	Area in m^2	Area in Acre
1	Roof	13874	3.43
2	Road/Paved area	156322	38.63
3	Green Belt area	190457	47.06
4	Open Area	389019	96.13
Total Plot Area		**749672**	**185.25**

Table 09: Details of the land use Surfaces in NSL Sugars Jay Mahesh Unit

Topography of Plant Layout:

The topography of the area around the Jay Mahesh Unit of NSL Sugars at Pawarwadi Village, Majalgaon Taluk, Beed District, is generally characterized by gently sloping to moderately undulating terrain forming part of the Deccan Plateau region. The area mainly consists of basaltic geological formations with predominantly black cotton soil and scattered rocky surfaces. The regional terrain exhibits gradual slopes with well-developed natural drainage patterns typical of the semi-arid Marathwada region.

The topographic elevation in the Beed region generally varies between about 375 m and 640 m above Mean Sea Level (MSL), while the broader district terrain ranges from approximately 364 m to 893 m MSL depending upon local hill ranges and plateau formations. The Balaghat hill range located towards the south and south-western side contributes to relatively higher elevations, whereas the northern and eastern parts consist of comparatively lower and gently sloping plains.

The drainage pattern in the study area is mainly dendritic in nature with seasonal streams and natural runoff channels carrying stormwater during the monsoon period. The general surface slope facilitates runoff towards the local drainage courses and river systems associated with the Bindusara, Sindphana and Godavari river basins. The undulating terrain and natural drainage characteristics support surface runoff movement and groundwater recharge through infiltration in open and green belt areas within the project premises.

On the other hand, because of this overland flow through different puddles, pits and pot holes joins in the low-lying areas are formed as depression areas. Such depression areas have been selected and utilized for water harvesting structures and recharge measures.

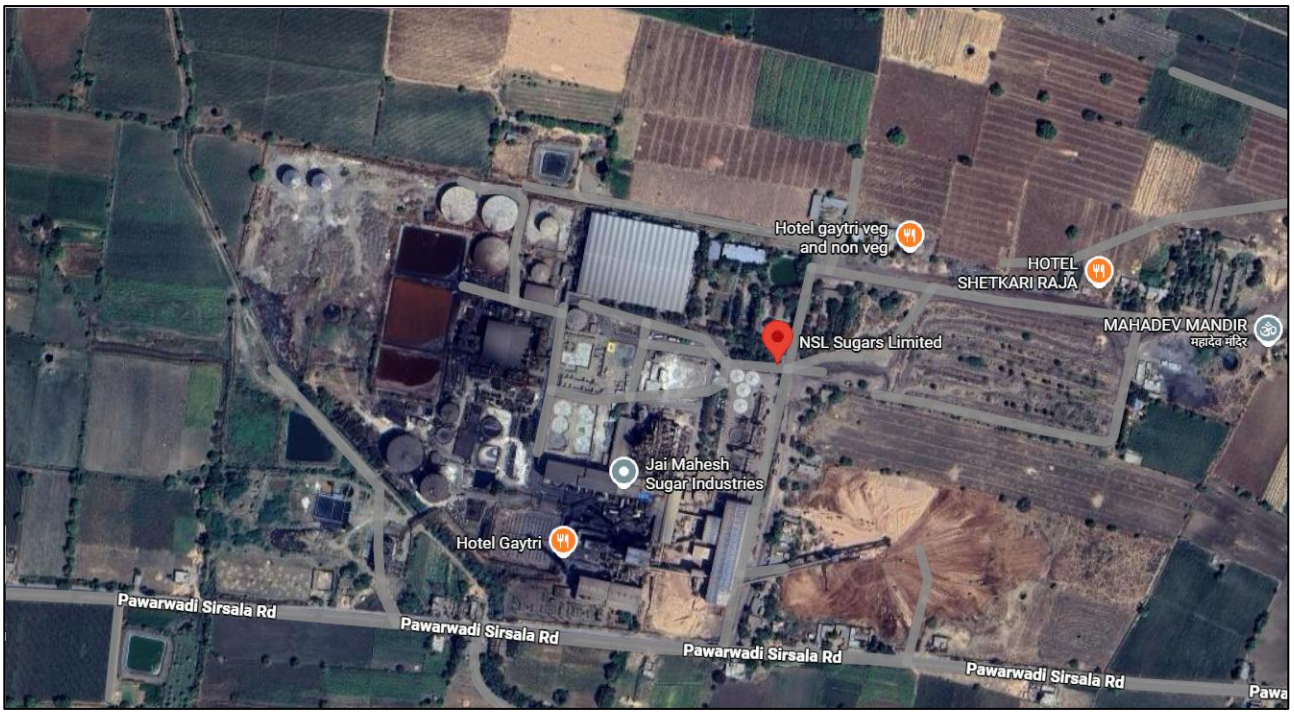


Figure 15: Jay Mahesh Plant site satellite image taken from Google Earth

Assessment of the Existing Strom water drains

Well-designed storm water systems are existing in the plant premises to make way for the runoff created due to rainfall, especially in Plant area. All the drains have been assessed based on the topography data provided by project owner and from the existing storm water drains, for which the carrying capacity of storm water generated in the plant premises is also analysed. In general, found that all the existing storm water drains have appropriate slopes for carrying runoff generated to the average rainfall of the area.

The existing layout of the storm water drains in the premises is shown in Figure below. It is also observed that some of the drains are being used for both the purpose of storm water and the processed waste water of various processes and which are not having enough storm water carrying capacity.

Separate arrangements for processed waste water need to be planned so that there is no interference between storm water and processes water drains. The separation of storm water from processed water drains is of utmost importance to avoid contamination of the storm water. Based on the observations majority of storm water drains are well laid and for further connection to the rainwater collection tanks, new drains are proposed, to properly divert the storm water to the proposed rain water harvesting structures. The proposed drains, are to be executed in continuation to the existing and corresponding storm water drains/suitable pipes to their volumetric dimensions and appropriate slope for easy carrying of storm water.

Rainwater Collection Tank installed at site

Rainwater channel Pipes installed at site

Rainwater Collection system installed at site

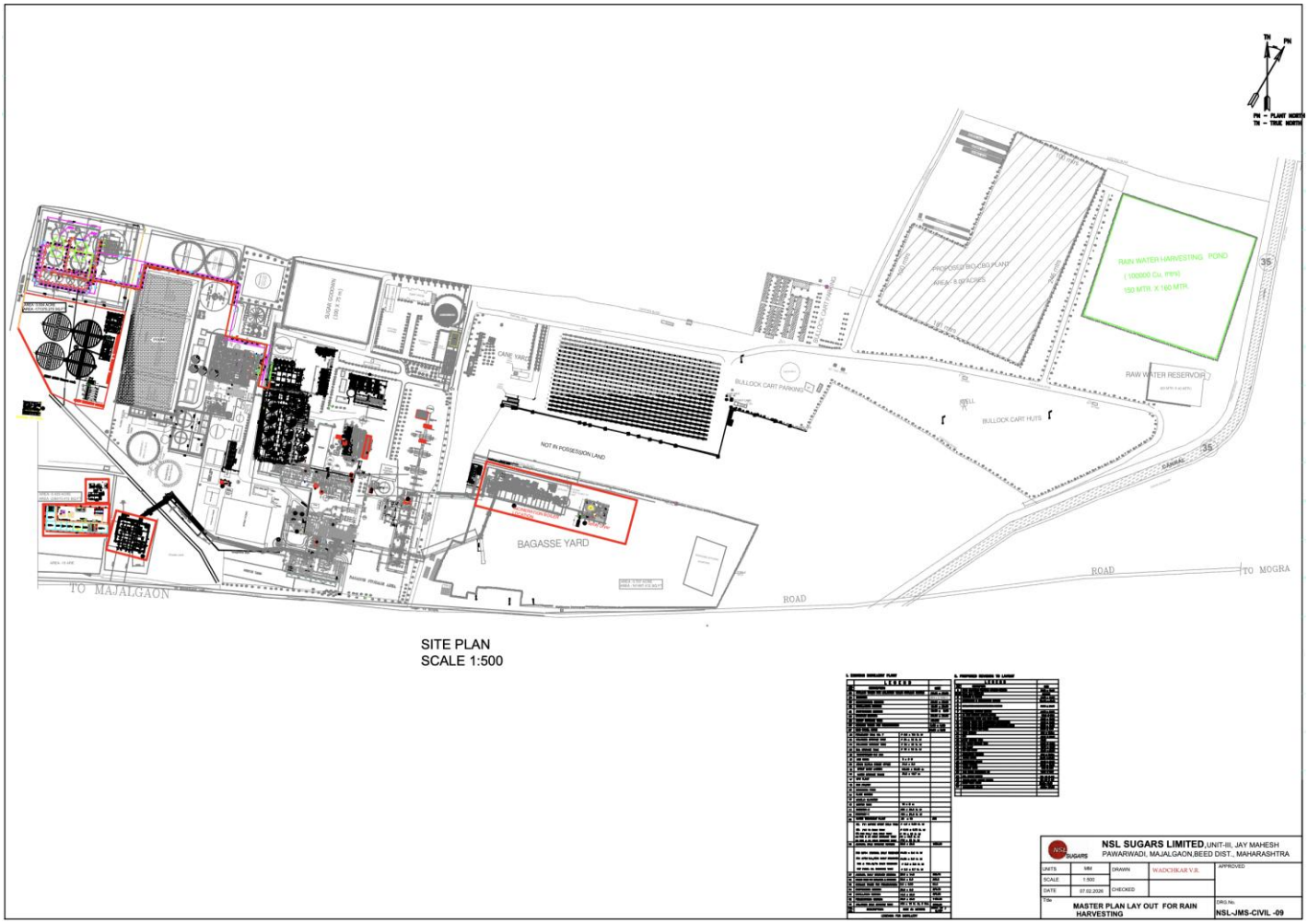


Figure 16:Plant Layout for Rainwater Harvesting at NSL Jay Mahesh Unit

1. **Design Consideration of Rainwater Harvesting & Recharge Measures**

   The design considerations are made in the planning and design of rainwater harvesting for storage and recharge based on the plant layout, contour map, stormwater system, catchment areas, soil conditions, hydrology and hydrogeological behaviour of the area. This entire work is carried out in detail during hydrogeological and engineering studies to know the characteristics and parameters for the actual assessment of rainwater conservation and recharge. At the same time, a study was also focused on the location of the rainwater harvesting for storage and aquifer recharge measures.

2. **Optimum Utilization of the Rainwater**

   The hydrogeological and geophysical studies carried out in and around plant premises show that the geological formation (granite gneisses and schists) is highly weathered and fractured till conducive for storage as well as recharge to groundwater. A major part of the runoff generated is considered for storage to utilize for various needs. However, one circular recharge pit is suggested to augment the existing and production bore well as desired by the Authorities. To make harvested water silt free and to reduce the velocity of the flow in the drains at each structure, Gutters, Desilting Chambers and Diversion chambers have been suggested.

3. Desilting Chamber

The proposed recharge measures are planned with gutters and de-silting chambers to reduce the entering of silt materials into structures. Since the stormwater is likely to contain dust and silt materials gathered from the roofs and paved areas, it is essential to remove them to the maximum extent to avoid the possibility of silting drains, and channels and lastly the recharge structure proper. The desilting chambers also help to reduce the turbidity in the stormwater. De-silting chambers, locating before the main recharge structure will not clog the filter media and maintain the efficiency of the main recharge structure proposed around the bore well.

The desilting chamber and gutters together will facilitate to entry silt free water into rainwater harvesting structures like storage tanks or ponds. As per the quantity of silt load carried by the stormwater, desilting chambers are suggested in required locations where the possibility of more silt generation, to send silt-free water into recharge structures. The volumetric dimensions and different structural components such as the gutters involved are given in the drawing.

4. Diversion Chamber

A vital part of any Rain Harvesting system is the "First Flush" diversion drain/channel to capture and isolate the most contaminated rainwater from roof and ground surface in special diversion chambers. This first flush water can automatically be released into wastewater drains or ETP for any other deemed fit to use. The First Flush diversion protects rainwater quality by minimizing the volume of suspended and dissolved fine particles and turbidity of water that gathered during the non-monsoon period over the roofs and on the ground that end up in the water being harvested. This is something like a pre-storage treatment to clean the rainwater runoff as much as possible before it enters the storage tank/recharge pit. This helps to reduce organic matter collecting in the tank, and reduces the amount of treatment needed after storage. This first flush of water has been found to contain the most amount of dust, silt and dry leaves from the roof as well as ground surfaces.

To divert the first flush, (i.e. initial rainwater runoff generated is generally loaded with most contaminants from the entire Plant area to let off into wastewater channels), a chamber needs to be constructed in such a way that the runoff generated during the initial one or two showers of rain to let off and divert into waste drains by stopping the rainwater going into the rainwater harvesting pond/structure by arranging stoppage M S plate. After the first flush is once or twice done, the M S Plate is to be arranged against the waste water drain letting the water into the harvesting structure.

5. Rainwater Harvesting Tank and Pond

There is RCC tanks in the Plant which can accommodate the rainwater runoff. However, it is not sufficient to accommodate the entire runoff generated for a high rainfall intensity. In view of excess runoff, it is suggested to divert the excess runoff water into the open ponds inside the plant premises.

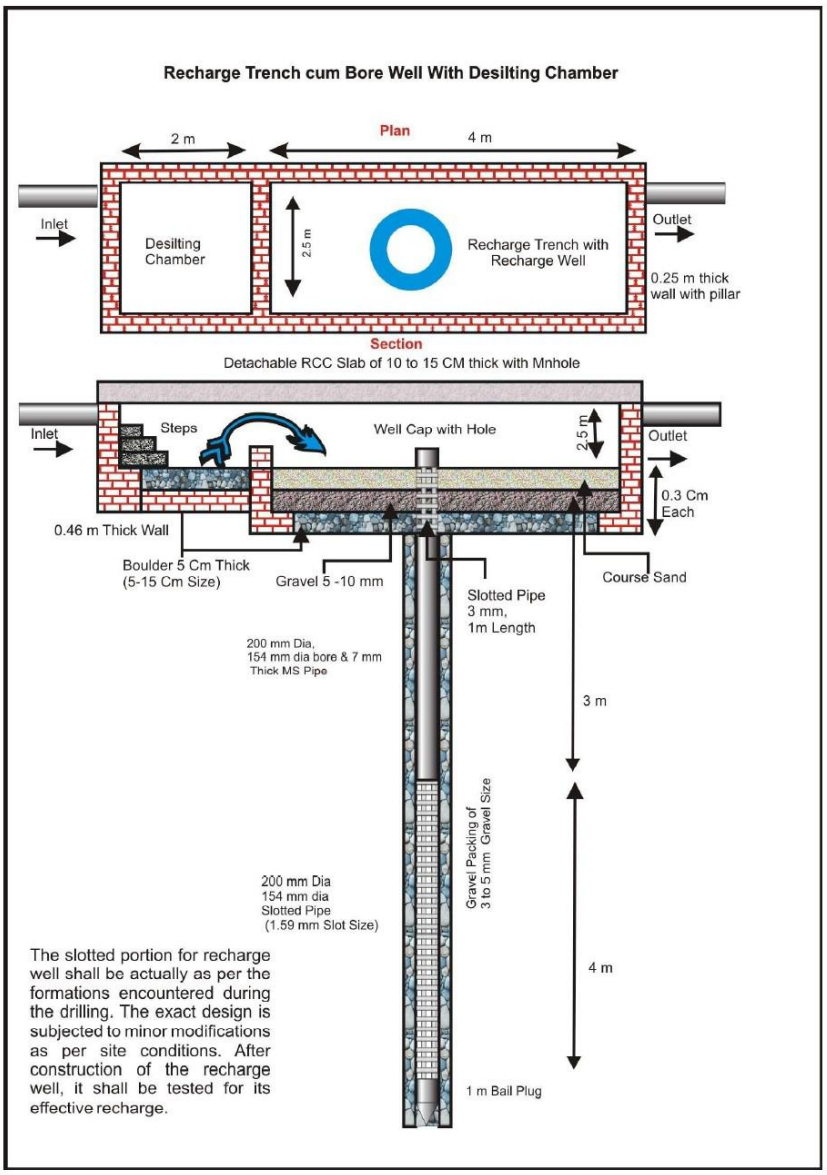


Figure 17: Proposed Recharge Structure through Injection well

6. Maintenance And Management Measures of Proposed Rainwater Harvesting Structures

The maintenance of rainwater harvesting structures is as important as the construction. Periodic maintenance of rainwater harvesting structures is essential because of silting, chemical precipitation and accumulation of organic matter hence the success of artificial recharge schemes and related developmental activities primarily depend on periodic maintenance. To ensure maintenance and management of the proposed structures, the following suggestions should be strictly adhered to increase the effectiveness, efficiency and life of the structure

- As these are all permanent structures, there will not be any shortcomings, except watch and ward. Therefore, Scheduled visits to the structures by an assigned person should be there for any defectiveness and shortcomings to attend immediately.

- The structures that are proposed should be used for the purpose that is meant and should not be used for any other purpose.
- Cleaning and removal of the silt, suspended particles organic matter from the water body before the onset of monsoon every year.
- All the structures should have outlets to flow the excess water out in case of heavy and unusual rainfalls as the structures are designed for maximum hourly intensity of 3.4 cm/hour or 34mm/hour.
- All the structures should be protected by arranging fences around them and covering with appropriate material to avoid any untoward incidents and accidents.
- Frequent disinfection should be done with chlorine to reduce biological activity and near the walls of the recharge structures.
- Care should be taken such that the silt or suspended particles load should not increase in the structures.
- If any damage (either it is minor or major) immediate action needs to be taken to renovate and improve the performance of the structure.
- The water in the existing bore should be collected at least twice a year during pre- and post-monsoon periods to see the changes in the chemical quality of groundwater.
- Overall, the entire structure and its allied components should be taken care of

Sr. No.	Structure	Location	Co-ordinate	Status
1.	Roof-top rainwater harvesting	Back Side of Sugar Godown	N 19° 8' 57.6" E 76° 16' 06.7"	Existing
2.	Ground Water Recharge Through Recharge injection Well	Beside Store Building	N 19° 8' 51.65" E 76° 16' 07.70"	Existing
3.	Ground Water Recharge Through Recharge Well	Sugar House	N 19° 8' 50.49" E 76° 16' 06.03"	Existing
4.	Ground Water Recharge Through Recharge injection Well	4.5 Turbine Back Side	N 19° 8' 46.58" E 76° 16' 08.42"	Existing
5.	Ground Water Recharge Through Recharge injection Well	Left side of Control Room	N 19° 8' 50.99" E 76° 16' 10.65"	Existing

Table 10: Rainwater Harvesting/Artificial Recharge Structure with coordinate.

Roof-Top Rainwater Harvesting

S. No.	Description	Total Area (m^2)
1	PEB Sugar Godown (roof)	7605
2	Mill House	1900
3	Workshop	399
4	TG Building (4.5 MW)	360
5	TG Building (30 MW)	915
6	Sugar House & Boiling House	1837
7	Store Building (roof)	858
Total		**138,74**

Table 11: Rainwater Harvesting – Rooftop Details

A.9. Implementation Benefits to Water Security

For Scope-5- Key Benefits:

a) Ensures regulatory compliance by effectively reducing Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), Total Suspended Solids (TSS), and other pollutants in wastewater before discharge or reuse.
b) Protects water resources and ecosystems by preventing contamination of surface water, groundwater, and surrounding soil through effective wastewater treatment and management.
c) Promotes circular economy practices through resource recovery, including treated water reuse, hot condensate recovery, biogas generation, and bio-compost production.
d) Reduces freshwater consumption by maximizing the reuse of treated effluent and recovered condensate water, thereby minimizing dependence on groundwater and external water sources.
e) Enhances water security and climate resilience by ensuring sustainable water availability and reducing operational risks associated with water scarcity.
f) Optimizes water and energy efficiency through water recycling, process optimization, and recovery of thermal energy from hot condensate, resulting in reduced energy consumption and operating costs.
g) Minimizes the overall environmental footprint by reducing wastewater generation, pollutant discharge, freshwater abstraction, and associated greenhouse gas emissions.
h) Improves operational efficiency and cost savings by lowering water procurement costs, reducing wastewater treatment and disposal expenses, and enhancing resource utilization.
i) Strengthens Environmental, Social, and Governance performance by demonstrating responsible water stewardship, sustainable resource management, and alignment with corporate sustainability objectives.
j) Supports long-term sustainable industrial growth by integrating efficient water management practices, ensuring regulatory compliance, conserving natural resources, and contributing to the achievement of sustainability goals and relevant Sustainable Development Goals (SDGs).

For Scope-2 Key Benefits:

a) Maximizes rainwater utilization by harvesting and storing rainfall within the plant premises, reducing the loss of a valuable natural resource.
b) Reduces surface runoff and minimizes the loss of rainwater while preventing waterlogging and localized flooding during heavy rainfall events.
c) Enhances groundwater recharge, contributing to improved groundwater availability and long-term water security.
d) Reduces dependence on external water sources and minimizes stress on groundwater aquifers through sustainable water resource management.
e) Strengthens resilience to water scarcity and climate variability by ensuring reliable water availability during lean seasons and drought conditions.
f) Improves groundwater and nearby surface water quality through natural filtration, recharge, and reduced pollutant transport.

g) Prevents soil erosion and enhances soil moisture, supporting greenbelt development, vegetation growth, and improved land productivity.
h) Promotes biodiversity conservation by maintaining ecological balance and supporting healthy terrestrial and aquatic ecosystems within the project area.
i) Improves catchment and stormwater management by facilitating efficient collection, storage, and utilization of rainwater resources.
j) Supports long-term environmental sustainability by promoting integrated water resource management, climate resilience, regulatory compliance, and responsible water stewardship

A9.1 Objectives vs Outcomes

For Scope-5

Objective: The project aims to promote sustainable water resource management by treating and reusing wastewater generated from sugar and distillery operations, along with recovering and utilizing hot condensate water. The objective is to minimize freshwater withdrawal, reduce pollutant discharge, improve energy efficiency, enhance compliance with environmental regulations, and mitigate adverse impacts on surrounding ecosystems and communities through efficient water and waste management practices.

Outcome: The project has successfully established a circular water management approach wherein high-strength effluents are effectively treated and reused, resulting in substantial reductions in COD, BOD, and other contaminants before discharge. Reuse of treated wastewater and hot condensate has significantly reduced freshwater consumption and overall effluent generation while improving energy efficiency by utilizing the thermal energy available in condensate streams. The project has enhanced environmental performance, minimized odour and nuisance in the surrounding areas, reduced risks of soil and water contamination, and ensured compliance with applicable environmental standards. Collectively, these interventions have contributed to improved ecosystem health, sustainable water use, and a lower environmental footprint of the sugar and distillery operations.

For Scope-2

Objective: The project aims to conserve and sustainably utilize rainwater through the implementation of a scientifically designed rainwater harvesting system comprising multiple catchment areas. The objective is to augment groundwater resources, reduce stormwater runoff, improve water quality, strengthen water security, and enhance ecological balance by promoting efficient capture, storage, and recharge of rainwater.

Outcome: The project has effectively captured and utilized monsoon runoff, thereby enhancing groundwater recharge and improving the availability of water during lean periods. Reduced surface runoff has minimized soil erosion, waterlogging, and the risk of inundation in nearby areas, while also preventing pollutants from entering surrounding water bodies. The recharge process has contributed to improved groundwater quality through natural filtration and dilution mechanisms, supporting sustainable water availability and reducing dependence on external water sources. Increased soil moisture and improved catchment management have strengthened vegetation cover and ecological health, thereby supporting biodiversity and maintaining the overall environmental balance of the project area.

A9.2 Interventions by Project Owner / Proponent / Seller

For Scope-5

Interventions by Project Owner for ETP plant:

1. **Regular Monitoring and Maintenance:** Ensuring continuous monitoring of wastewater quality, system performance, and compliance with environmental standards through automated systems and regular inspections.
2. **Resource Recovery:** Implementing systems to recover biogas, treated water, or compost from the effluent treatment process, which adds value and reduces overall operational costs.
3. **Training and Skill Development**: Conducting regular training sessions for staff to ensure efficient operation and maintenance of the ETP, improving both performance and compliance with regulations.
4. **Compliance with Regulatory Standards**: Regularly updating the ETP to comply with evolving environmental regulations and local pollution control board requirements, ensuring sustainable operations.
5. **Public Awareness and Engagement:** Collaborating with local communities to raise awareness about the importance of ETP and its benefits for environmental protection and public health.
6. **Optimization of Chemical Usage:** Implementing strategies to optimize the use of chemicals in the treatment process, reducing operational costs and minimizing chemical waste.
7. **Zero Liquid Discharge (ZLD) Implementation:** Working towards a ZLD approach to ensure that no wastewater is discharged into the environment, promoting water reuse and reducing environmental impact.

Interventions by Project Owner for Use of Condensate water in plant:

1. **Infrastructure Upgrade:** Installed piping and storage systems to collect and transport hot condensate from process areas.
2. **Heat Recovery Systems:** Integrated heat exchangers to utilize thermal energy from hot condensate in preheating operations.
3. **Water Reuse Integration:** Modified existing processes to allow direct reuse of hot condensate as boiler feed water or for cleaning.
4. **Monitoring Systems:** Implemented flow meters and temperature sensors to monitor condensate recovery and reuse efficiency.
5. **Training & SOPs:** Conducted staff training and developed standard operating procedures for effective condensate management.
6. **Sustainability Alignment:** Ensured alignment of interventions with corporate water conservation and sustainability goals

For Scope-2

NSL Group identified huge potential and decided to take up the rainwater harvesting in project as discussed in above sections to conserve and store the rainwater and avoid the storm runoff.

1. **Installation of RWH Structures:** Project owners establish dedicated rainwater harvesting systems, such as recharge wells, ponds, and surface collection tanks, to capture and store rainwater during the monsoon season.
2. **Catchment Area Development:** They improve and maintain catchment areas, including roofs, paved surfaces, and surrounding land, to maximize rainwater collection potential.
3. **Filtration and Pre-treatment Systems:** Installing filtration units and first flush diverters to ensure clean and safe water storage, preventing contamination from debris or pollutants.
4. **Groundwater Recharge:** Implementing systems like recharge wells or pits to direct harvested rainwater into the ground, replenishing local aquifers and improving groundwater levels.
5. **Water Quality Monitoring:** Regular testing of stored rainwater to ensure its quality is suitable for reuse in plant operations or irrigation, meeting health and environmental standards.
6. **Reuse of Harvested Rainwater:** The harvested water is utilized for various plant needs, such as cooling systems, irrigation, cleaning, or non-potable uses, reducing dependence on external water sources.
7. **Monitoring and Optimization:** Using digital tools and sensors to monitor rainfall patterns, water levels, and system efficiency, enabling timely interventions and optimization of water collection.
8. **Sustainability Initiatives:** Aligning the rainwater harvesting strategy with broader sustainability goals, such as reducing the plant's water footprint, conserving local water resources, and supporting the community's water needs.

These interventions help to conserve water, reduce dependency on external sources, and promote sustainable water management within the sugar and distillery industry.

A.10. Feasibility Evaluation

For Scope-5

The installed ETP and condensate water recovery system by the project owner are robust and effectively handle variations in wastewater effluent. Prior to project implementation, a feasibility study was conducted in accordance with Karnataka State Pollution Control Board guidelines.

For Scope-2

The rainwater harvesting system installed by the project owner is robust and capable of managing heavy rainfall events. The catchment areas are well-graded to ensure efficient runoff collection, and the storage infrastructure is of high quality.

A.11. Ecological Aspects & Sustainable Development Goals (SDGs):

For Scope-5

This project demonstrates sustainable management and efficient utilization of water resources by treating and reusing ETP effluent and condensate water, thereby reducing dependence on groundwater extraction and conserving millions of litres of freshwater for distillery operations. The project also minimizes ecological impacts by preventing inundation of inhabited areas, reducing the risk of waterlogging and associated vector-borne diseases, and safeguarding groundwater quality through effective effluent

treatment and the use of impervious infrastructure that prevents seepage and soil contamination. The initiative serves as a model for sustainable captive water management across water-intensive industries.

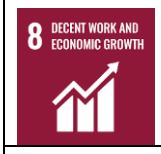
The ETP effectively treats the distillery effluent, and the use of impervious machinery within the ETP area further safeguards against potential leakage and contamination of surrounding soil.

For Scope-2

Rainwater harvesting is an environmentally sustainable practice that conserves water, enhances groundwater recharge, and supports ecosystem preservation. Its key ecological benefits include:

- Replenishes aquifers and reduces dependence on borewells and other groundwater sources, promoting sustainable water availability.
- Reduces surface runoff, thereby preventing soil erosion, inundation of inhabited areas, and waterlogging that can lead to vector-borne diseases.
- Improves groundwater and surface water quality by minimizing the entry of pollutants into water bodies.
- Supports aquatic ecosystems, biodiversity conservation, and the development of water-sensitive urban environments with minimal ecological disturbance.

SDGs Impacted- Linkage of the project activities with SDGs:

SDG 6 	Clean Water and Sanitation – Enhances water availability, quality, and accessibility through harvesting, recharge, or conservation.
SDG 8 	Decent Work and Economic Growth – Generates local employment during project implementation and maintenance.
SDG 12 	Responsible Consumption and Production – Promotes sustainable use and management of natural resources.
SDG 13- 	Climate Action – Contributes to climate resilience and adaptation by reducing water stress and improving local hydrological balance.
SDG 15 	Life on Land – Supports ecosystem restoration, soil moisture retention, and biodiversity through improved water balance.

A.12. Recharge Aspects:

For Scope-5

Not Applicable, since this aspect does not lead to any recharging and storing facility for a long time for the water recycled.

For Scope-2

For the rainwater harvesting systems (RWH) indirectly contribute to recharging the bore wells within the project area and reduce the storm water flow in the area. Soak pits near the catchment zones effectively filter the rainwater runoff before it enters the recharge areas. Consequently, the bore wells in the region are filled with water during the non-monsoon season, indicating successful groundwater recharge. Plans have been proposed to reduce any mixing of storm water and rainwater conserved and saved to ensure good quality of water.

A.12.1 Solving for Recharge

For Scope-5

Water Budget Component	Typical Estimated Uncertainty (%)	Description
Surface Inflow	NA	NA
Precipitation	NA	NA
Surface Outflow	NA	NA
Evapotranspiration	NA	NA
Change in Storage	NA	NA
Deep Percolation	NA	NA

For Scope-2

Recharge = Rainfall + Surface Inflow – Evapotranspiration – Surface Outflow – Change in Storage

Evapotranspiration & Other Data: https://datameet-pune.github.io/open-water-data/docs/open-water-data-paper.pdf (or available under Documents Section- Water Data Guide)

Water Budget Component	Typical Estimated Uncertainty (%)	Description
Surface Inflow	1%	Typical range of accuracy from meters to minimum delivery accuracy requirements of delivery and diversion measurement devices.
Precipitation	2%	Typical range of accuracy from field-level rain gauges to extrapolation of local weather station data

Surface Outflow	1%	Typical range of accuracy from meters to estimated outflow relationships
Evapotranspiration	10%[3]	Clemmens and Burt, 1997; typical accuracy based on free water surface evaporation coefficient.
Change in Storage	5%	Estimated accuracy of change in storage calculation based on field scale water budget calibration to observed water levels.
Deep Percolation	5%	Typical range of calculated accuracy from field-scale water budget results (fields ranging from 56 to 125 acres)
Total	**25%**	

A.13. Quantification Tools

The following tools are recommended to be used to estimate the quantity of RoUs in the absence of tamperproof flow meters or systems that accurately quantify the volume in litres or m^3 of water being harvested or conserved by the project activity.

For Scope-5

The baseline scenario is the situation where, unutilized water is not conserved/treated/recycled and water is extracted from multiple bore wells within the project boundary which would have depleted the local groundwater resources (aquifers), in the absence of the project activity, the water for distillery process, gardening and other plant facilities usage would have been extracted from the ground water which have been avoided with the ETP implementation and reuse of condensate water installed within the project boundary.

Hence, the quantity of RoUs estimated as: *"the net quantity of treated wastewater that is gainfully used post treatment."*

Option -2 as per Rainwater Offset Standard version 8.1 is used and stated as:

Harvested/Recycled unutilized water or Volume of sea water utilized (m3) = Quantity of treated or recycled water in liters treated or harvested or volume of the artificial holding tank ($1m^3$ = 1000 liters).

The net quantity of treated water used is measured via flow meters installed at the site.

Further, as per *Rainwater Offset Standard version 8.1* a Conservative Approach: *The UWR RoU Verifier is recommended to apply a **10-50%** uncertainty factor related to degree of uncertainty to the final quantity*

[3] Since the harvested rainwater is utilized immediately and not stored for extended periods, and the flow distance within the project area is minimal, the potential for evaporation losses is significantly reduced. Therefore, a lower evaporation factor has been considered for the calculation than recommended.

of RoUs calculated for vintage years 2014-2021. However, a more conservative approach to uncertainty may be selected by the RoU Verifier as per its discretion.

An uncertainty factor of 0.5% has been considered for the entire monitoring period from 01/01/2014 to 31/12/2025 for Scope 5 project. This factor reflects the high accuracy of the water flow measurements, which are obtained through calibrated flow meters with a standard accuracy of 0.5%. As these meters operate with minimal scope for manual intervention, the measurement process is free from human error and ensures consistent reliability throughout the monitoring period. Accordingly, the uncertainty factor has been derived based on this, representing a realistic and technically justified estimation.

The Sugar ETP and CPU Unit data for the treated water and ROUs generated[4] is represented in the **Table-12** below:

Year	Water treated in Sugar CPU Unit (m^3)	Water treated in Sugar STP Unit (m^3)	Water treated in distillery CPU Unit (m^3)
2014	99937	38604	0
2015	143797	54066	0
2016	59850	35080	0
2017	76473	1155	0
2018	126620	61624	0
2019	106319	38589	0
2020	85628	38285	0
2021	175556	75529	3771
2022	224119	83796	48322
2023	177429	70047	80376
2024	172750	72346	40613
2025	117239	46538	14796
ROUs	**1565717**	**615659**	**187878**
Total ROUs	**2369254**		
Final ROUs after uncertainty factor of 0.5%	**2357408**		

Table 12: Total RoUs for Scope-5 of NSL Sugar Jay Mahesh Unit

[4] For the calculations, please refer ER Sheet

For Scope-2

The baseline scenario is the situation where, unutilized water is not harvested into a well/aquifer/sub-surface structure/above-ground storage tank/collection chamber, in the absence of the project activity, the water for gardening and other plant facilities usage would have been extracted from the ground water which have been avoided with the rainwater harvesting method installed within the project boundary.

Hence, the quantity of RoUs is estimated as: *"the net quantity of rainwater harvested that is gainfully used in some other plant activity"*

Option -1 as per Rainwater Offset Standard is stated as:

Harvested/Recycled unutilized water or Volume of water utilized (m3) = Area of Catchment/Roof/Collection Zone (m2) X Amount of rainfall (mm) X Runoff coefficient*Uncertainty Factor (1-0.25 = 0.75)

Further, as per *Rainwater Offset Standard version 8.1* a Conservative Approach: *The UWR RoU Verifier is recommended to apply a **10-50%** uncertainty factor related to degree of uncertainty to the final quantity of RoUs calculated for vintage years 2014-2021. However, a more conservative approach to uncertainty may be selected by the RoU Verifier as per its discretion.*

An uncertainty factor of 25% (0.75) has been considered for the entire monitoring period from 01/01/2014 to 31/12/2025 for Scope 2 project as per recharge aspect discussed in above section.

Water Harvesting Potential

Water harvesting potential of any catchment area is to be calculated under this methodology for each given year that the RoU is being claimed. The total amount of water that is received from rainfall over an area is called the rainwater legacy of that area. The amount that can be effectively harvested is called the water harvesting potential.

Assessment of Annual Rainwater Harvesting Potential (ARHP)

- Availability of source water is one of the basic prerequisites for taking up any rainwater harvesting and aquifer recharge scheme.
- The source of water available for aquifer recharge in the present case is only the rainfall-runoff which otherwise goes waste into local drains.
- A realistic assessment and quantification of the source water will help in designing the storage and recharge capacity of the RWH structures.
- The estimation of rainfall-runoff is made to quantify the water available for recharge, after all, losses.
- This estimated runoff will be used for the assessment of the size of the recharge structures.
- Though there are various methods to estimate the runoff, rational method is generally used as it is one of the most common and popularly used for small areas.
- The rational method is the sensible approach to determining the yield of a catchment by assuming the runoff coefficient.

- The **runoff coefficient** for various surfaces as per CGWB.
- Hence, based on each land use, its areas have been determined along with the corresponding runoff coefficient.
- The runoff coefficients established by CGWB[5], based on the field experiments are being used for the computation of rain water harvesting potential as listed in **Table 13**.
- Knowing the areas, runoff coefficient and average annual rainfall, the runoff from each land use has been determined. In this manner, all the land use, and open areas have been considered and cumulative runoff has been determined.
- The run-off coefficients for a different surface type are given in Table13.

Different Surfaces	Runoff Coefficient (K)	Runoff Coefficient (K) used
Roof conventional (Flat)	0.7 to 0.8	0.7
Road surface	0.8-0.9	0.8
Concrete/Kota Paving	0.6 to 0.7	0.6
Green Belt	0.1	0.1
Brick Paving	0.7	0.7
Parks and Farms	0.05- 0.3	0.3

Table 13: Details of Runoff Coefficient (CGWB) and in line with the recommended Runoff Coefficient (K) by UWR ROU latest Standard

The following is the rational formula adopted to determine the yield of the catchment byconsidering the above runoff coefficient:

Annual rainwater harvesting potential is given by $V = K \times I \times A$

Where, V=Volume of water that can be harvested annually in litres.

K = Runoff coefficient

I = Annual rainfall in (mm)

A = Catchment area in (m^2

Based on the above method and using the land use pattern, estimated the Annual Rain Water Harvesting Potential (ARHP) for different areas. In this calculation of ARHP, the Average Annual Rainfall considered is **1055.83 mm[6].** The table indicates that there is a tremendous scope to harvest the rain water to the tune of **285,622,623.66 (l) liters** within plant premises as indicated in **Table 14.**

[5] http://cgwa-noc.gov.in/LandingPage/index.htm

[6] Please refer ER Sheet for calculation

Type of Surface	Area Type	Gross Available Area in m^2	Quantity of Runoff = V = K × I× A
Landuse		**A**	**V (l)**
Roofs	Flat-RCC, Asbestos	13,874	10,253,961.24
Road/Paved area	Concrete	1,56,322	13,2038,940.52
Green Belt	Green Belt	1,90,457	20,108,926.20
Open Area	Park	3,89,019	12,322,0795.70
Total		**7,49,672**	**285,622,623.66**

Table 14: Details of Annual Rain Water Harvesting Potential for Jay Mahesh Unit

Quantification

The formula for calculation for harvesting potential or volume of water received or runoff produced or harvesting capacity is given as:-

Harvesting potential or Volume of water utilized (m^3) = Area of Catchment/Roof/Collection Zone (m^2) X Amount of rainfall (m) X Runoff coefficient

Year	Runoff Generated in all Catchments				Total Harvested water- m^3 (RoUs)	Total ROUs after applying Uncertainty factor of 0.75 (RoUs)
	Roofs	Road	Green Belt	Open Area		
2014	5895.06	75909.96	11560.74	70840.36	164206	123155
2015	6254.40	80537.09	12265.43	75158.47	174215	130662
2016	11110.30	143065.89	21788.28	133511.32	309476	232107
2017	6079.59	78286.06	11922.61	73057.77	169346	127010
2018	5623.13	72408.35	11027.46	67572.60	156632	117474
2019	11217.13	144441.53	21997.78	134795.08	312452	234339
2020	36772.76	473518.10	72114.64	441894.46	1024300	768225
2021	12132.95	156234.46	23793.79	145800.43	337962	253471
2022	8256.97	106323.97	16192.65	99223.19	229997	172498
2023	5235.63	67418.55	10267.54	62916.04	145838	109378
2024	7407.19	95381.43	14526.16	89011.44	206326	154745
2025	7062.42	90941.89	13850.03	84868.39	196723	147542
Total	**123048**	**1584467**	**241307**	**1478650**	**3427471**	**2570604**

Table 15: Total RoUs generated for Scope-2 of NSL Sugars Jay Mahesh Unit

Final ROUs from Both Scopes (Scope 2 & Scope 5) are as follows:

Final Vintage wise RoUs Calculation					
Year	**Water treated in CPU Unit (m^3)**	**Water treated in ETP Unit (m^3)**	**Water treated in distillery CPU Unit (m^3)**	**Total Harvested water- m^3 (RoUs)**	**Vintage wise ROU achieved**
	Scope-5			**Scope 2**	
2014	99437	38411	0	123155	261003
2015	143078	53796	0	130662	327535
2016	59551	34905	0	232107	326562
2017	76091	1149	0	127010	204249
2018	125987	61316	0	117474	304776
2019	105787	38396	0	234339	378522
2020	85200	38094	0	768225	891518
2021	174678	75151	3752	253471	507053
2022	222998	83377	48080	172498	526953
2023	176542	69697	79974	109378	435591
2024	171886	71984	40410	154745	439025
2025	116653	46305	14722	147542	325222
Total	**1557888**	**612581**	**186939**	**2570604**	**4928011**
Final ROU achieved in current period	**4928011**				

Table 16: Vintage wise Total RoUs from Scope 2 and Scope-5 of NSL Sugars Jay Mahesh Unit

	Total RoUs generated with Uncertainty factor	**Total RoUs generated without Uncertainty factor**
Total RoUs Generated from Jay Mahesh Unit	**4,928,011**	**5796725**
Annual RoUs Generated from Jay Mahesh Unit	**410,668**	**483,060**

A.14. UWR Rainwater Offset Do No Net Harm Principles

W.r.t Scope-5

The project activity accomplishes the following:

- Implementation of project activity prevents the release of wastewater directly into nearby river Godavari which is the crucial step towards greener economy.
- The project activity does not harm any person or environment and it helps in improving the water quality of the area.
- The by-products are also used as fertilizers by the farmers in nearby areas.
- This creates awareness among the employees and local people to practice such things on their level.

W.r.t Scope-2

The project activity accomplishes the following:

- Increases the sustainable water yield in areas where over development has depleted the aquifer and water level in surrounding areas.
- The catchments areas are built to collect the rainwater from going into storm drains or sewers and utilise in the facility for different purposes in future.
- This creates awareness among the employees and local people to practice such things on their level

A.15. Scaling Projects-Lessons Learned-Restarting Projects

W.r.t Scope-5

No Scope of extension observed as of now, by Project owner.

W.r.t Scope-2

No Major Scope of extension observed as of now. Although there is a proposed recharge rainwater injection well at the site and to make harvested water silt free and to reduce the velocity of the flow in the drains at each structure, Gutters, Desilting Chambers and Diversion chambers have been suggested for future by project owner.