Co-Treatment Feasibility (Septage with Sewage)– Dehradun, Uttarakhand

(ADB supported Banjarawala, Mothrawala and Raipur Sewerage projects)

10th JULY 2020

Prepared For
Uttarakhand Urban Sector Development Agency(UUSDA)

National Institute of Urban Affairs

SCBP
Sanitation Capacity Building Platform

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DISCLAIMER

This note is prepared based on a request from ADB and UUSDA, to explore the feasibility, design and potential of scientific Co-treatment of septage with sewage at their upcoming STPs in Dehradun, Uttarakhand, and the additional population coverage that will be benefitted from this intervention

THE FULL REPORT SHOULD BE REFERENCED AS FOLLOWS

NIUA (2020) “Co-Treatment Feasibility (Septage with Sewage)– Dehradun, Uttarakhand - ADB supported Banjarawala, Mothrawala and Raipur Sewerage projects

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Contents

Executive Summary 1

Purpose 3

Co-Treatment Design Criteria 4

Characteristics and flow of Sewage and Septage 5

Effects of Direct Mxing of Septage with Sewage 5

Requirement of Appropriate Co-treatment Infrastructure 5

- Septage receiving station 5
- Holding tanks- 5
- STP Dewatering unit - Centrifuge 5
- Sludge drying beds 5

Analysis of Availability of Loading of Septage, Vacuum Tankers Requirement and Dewatered Sludge Generation from Co-treatment 6

Infrastructure and Tentative Costing of the Facilities 6

Uncovered Population and Potential for Increased Reach 8

References 11

Annex 1: 11

Report findings for Co-Treatment at 9 STPs, a study by IIT-Roorkee and NIUA 11

Annexure 2: 14

Co Treatment Schematic for Septage-sewage at an STP 14

Annex 3: 15

Analysis of Availability of Septage loading, Tankers Required and Dewatered Sludge Generation from Co treatment 15

Annexure 4: 16

No. of households Rely on Onsite Sanitation system 16

LIST OF FIGURES

Figure 1: Sewerage zone map and proposed area of Dehradun city 11

Figure 2: Process flow diagram for Co-treatment 16

LIST OF TABLES

Table 1: Summary of Co-treatment units area and cost requirements 3

Table 2: Sludge and sewage characteristics: Average concentrations for Uttarakhand conditions 6

Table 3: STPs with designed period and flow rate in the respective STPs 6

Table 4: Quantity of sepatge can be co-treated, relative no. of vaccuum tankers required and dried sludge produce 8

Table 5: Units Size Requirement and Tentative Costing 9

Table 6: Strategies for Co-treatment of septage in 9 Ganga Towns, IIT-Roorkee-NIUA, 2019 14

Table 7: Households dependent on Onsite Sanitation 19

Executive summary

This note is prepared based on a request from ADB and UUSDA, to explore the feasibility, design and potential of scientific Co-treatment of septage with sewage at their upcoming STPs in Dehradun, Uttarakhand, and the additional population coverage that will be benefitted from this intervention. ADB is supporting new sewerage infrastructure development works for Banjarawala, Motharawala and Raipur areas in Dehradun city. The respective agencies are keen that septage management is included as critical components of the work, that will ensure inclusive and city-wide sanitation, for their investment.

NIUA has been supporting Septage Management for Uttarakhand through a primarily capacity development and technical assistance engagement in the state since 2019. This note is based on the following work done by NIUA:

- Study on Co-treatment Potential of 9 Ganga Towns. A study commissioned by Peyjal Nigam and NMCG, undertaken by IIT Roorkee and completed in partnership with NIUA (Nov 2019)
- Guidance Note on Designing of Co-treatment infrastructure for Septage and Sewage, at Kargi STP, Dehradun (NIUA, May 2020).

Recommendations

The IIT Roorkee-NIUA report analysed and recommended co-treatment of septage with sewage as a scientifically valid treatment option. The study highlights that a co-treatment facility should be constructed at STP for receiving septage instead of direct dumping of septage into main sewers. The study features adherence to a maximum loading norm for each STP, based on its operating potential and the incoming sludge strength, and the timings for co treatment, etc. *Annexure 1: Report findings for Co-treatment at 9 STPs.*

Based on the analysis of detailed project reports of Banjarawala, Mothrawala and Raipur and the methodology adopted in the IIT- Roorkee report, the following is recommended for the upcoming sewerage system of Dehradun under the ADB loan.

- **Co-treatment of septage with sewage is possible** in all the 3 STPs and will entail the following:

Table 1: Summary of Co-treatment units area and cost requirements

Sl no.	STPs	Homogenisation tank	Sludge drying beds	Total tentative cost of new infrastructure
1	Mothrawala I and II combined	2 Tanks 75 KL each	8 beds Area 240 Sq.mts	Rs. 1 crore 6 lakhs
2	Raipur	2 Tanks 35 KL each	7 beds 142 Sq.mts	Rs. 47 lakhs
3	Banjaralwala	2 Beds 20 KL each	7 beds 70 Sq. mts	Rs. 34 lakhs

The area and cost requirements are indicative, to be used at bid stage of the procurement process. The cost estimated are for particular units only considering that other facilities requirement like approach road and chemical dosing (centrifuge), etc will be part of the sewage treatment facility

(STP). Design period for septage facility is taken for 15 years i.e. 2036 when the STP will be running at ~70% of its utilisation thus having spare capacity for septage treatment.

Uttarakhand State 'Protocols for Septage Management, 2017' developed by Uttarakhand Urban Development Department will need to be applied to ensure scheduled desludging of all onsite sanitation systems of the town, their safe conveyance and transportation to the STPs. The proposed Co-treatment method will provide a facility to the emptiers to discharge septage into the Septage receiving station which will have units like screens, grit removal, homogenisation tanks and the sludge drying beds. Ancillary requirements like Pumps will be needed to convey the septage from the homogenisation tank to the dewatering unit of STP and sludge drying beds.

- Inclusive city-wide sanitation coverage with co treatment

The spare capacity available in the STPs have the potential to handle septage of up to 92,500 population in Raipur STP and 50,000 population in Banjarawala STP till the year 2036,. However, Co-treatment facilities at STPs will immediately benefit households within the existing sewerage zones, who may take a few years to connect to the STPs.

However, there are more than 200,000 population (40, 000 HHs excluding HHs from existing 6 sewerage zones) within or nearby Dehradun MC area, who will remain dependent on the onsite sanitation systems, and may not get covered through this sewerage project in near future, can also be benefitted from this co-treatment facility. The septage generation is more than 80 KLD from these households for the current population and this will increase up-to 114 KLD by 2036. Hence, the proposed Co-treatment facility in Banjarawala and Raipur can cater up to 50% of septage generation of the city

Also, the proposed STPs in Banjarawala and Raipur are located near to the growth corridors or desludging demand areas which justifies the need of co-treatment infrastructure within STPs. More benefits can percolate to neighbouring towns and villages. This will contribute to the prevention of ground water contamination and pollution of the surface water bodies and rivers.

Since the DPRs for the ADB work are ready, it is recommended and agreed by UUSDA that co treatment infrastructure works will be incorporated into the bidding document and the same Operator who bids for running the STP will also operate the Co-treatment facility.

Purpose

A design guidance for Co-treatment of septage with sewage for the two upcoming STPs in Raipur and Banjarawala, Dehradun. The proposed Co-treatment design recommendations can be added in the bidding stage of the DPRs that are nearly ready by now and later can be upscaled for all STPs in the state. The note keeps an unbiased and technology neutral view for Co-treatment of septage with sewage at STP.

Co-treatment Design Criteria

Dehradun is an expanding town, the state capital of Uttarakhand. There are 8 STPs existing in the town. Yet, it is estimated that a significant proportion of households are dependent on septic tanks based sanitation systems that requires emptying of tanks on a regular basis. Septage needs to be treated either in Faecal Sludge Treatment Plants or Co-treated with Sewage at existing STPs.

To treat the septage with sewage at STP, a compatibility of the plant's spare capacity for the base year (2021) and intermediate year (2036) are checked for which the sewerage systems are designed. Design period for septage facility is taken for 15 years i.e. 2036 when the STP will be running a~70% of its utilisation thus having spare capacity for septage treatment. Although, the spare capacity estimated based on sewage inflow and incoming BOD-COD load anticipated in the respective ADB DPRs; it would be appropriate to design the Co-treatment facilities while the environmental process is designed for the respective STPs for the desired efficacy.

Characteristics and flow of Sewage and Septage

Based on the characteristics of septage analysed by IIT-Roorkee and inflow sewage in DPRs, an average concentration of BOD, COD and TSS parameters are assumed to check compatibility of co-treatment, see Annexure 1- table I, for more details on characteristics of septage in Dehradun. designed inflow of sewage in respective STPs during its base year and intermediate year, a compatibility check of Co-treatment of Septage with sewage is analysed for the upcoming STPs.

Table 2: Sludge and sewage characteristics : Average concentrations for Uttarakhand conditions

Sl. No.	Parameters	Septage	Inflow Sewage
(A)	BOD (mg/l)	20,000	250
(B)	COD (mg/l)	33,000	500
(C)	TSS (mg/l)	31,000	400

Source: DPR for inflow sewage

Given the higher strength of BOD, COD and TSS present in septage, as compared to sewage, the potential co- treatment of septage with sewage is determined based on the sewage inflow during STP's base year and intermediate year.

Table 3: STPs with designed period and flow rate in the respective STPs

Sl.no	Name of STP	Mothrawala I and II (combined)	Raipur	Banjarawala
(1)	Ultimate Capacity (MLD)	40	24.07	11
(2)	Actual flow	17	Yet to be constructed	Yet to be constructed
(3)	Population for initial period (2021)	The plant is up and running funded by ADB.	94963	37660
(4)	Population for intermediate period (2036)		149901	64787
(5)	Base sewage flow estimated by 2021 (MLD)		11	4.43
(6)	Intermediate Sewage flow by 2036 (MLD)		17.61	7.61

The Co-treatment of septage with sewage should be carried out in a planned manner with basic addition of infrastructure ensuring that the functionality of upcoming STP is not compromised.

Effects of Direct Mxing of Septage with Sewage

Direct mixing of septage with sewage requires excess aeration than designed for normal wastewater, as the flow rate wise mixing of septage with wastewater will be an insignificant effect but the strength of wastewater will increase drastically. For eg. A plant receiving flow rate of 14 MLD (14 MLD*250 mg/l BOD load =3500 kg/day) when 130 KLD of septage is directly mixed with sewage in sewage plant (0.13 MLD * 20,000 mg/l, BOD load =2600 kg/day) which add up to 6000 kg/day for just 14.13 MLD of flow. Hence, 70% increase in BOD load will demand relatively increase in oxygen requirement for digestion and will require extra running of aerators.

This practice will consume more electricity for treatment of relatively less volume of wastewater. Also, a highly skilled operator would be required to handle such variation in BOD load.

Requirement of Appropriate Co-treatment Infrastructure

Current system of dumping septage directly into trunk sewers can disrupt the STPs treatment potential. High strength of Septage with partially digested sludge and inert particles if directly fed into the sewer systems, may require more energy during aerobic treatment. To prevent indiscriminate discharge of septage and mixing with sewage, it is highly recommended to do a prior solid-liquid separation of septage which will remove the solids. And liquid portion with lesser BOD concentration can be easily treated with sewage.

- **Septage receiving station:** A vacuum tanker can discharge the septage into a receiving station which will comprise of coarse and fine Screens Septage after passing through screens will be homogenise in the homogenisation tank and thereafter will be dewatered at Centrifuge unit including DPWE dosing.
- **Holding tanks-Homogenisation tanks:** Septage emptied by tankers from various establishments have different characteristics and strength. These tanks will store septage 24- 48 hours and a homogenized septage will go into dewatering unit of STP. The HT should be installed in parallel with two units of suggested sizes.
- **STP Dewatering unit-Centrifuge:** As solid-liquid separation will be carried out through dewatering unit of the STP before mixing septage with incoming sewage. Therefore, the efficiency of Centrifuge to reduce COD and TSS concentration is taken at least 90% (Source: Metcalf and Eddy wastewater Engg).
- **Sludge drying beds:** The solid which will still have moisture content and pathogen can be further dried at Sludge drying beds. As the state enjoys temperate climate with high rainfall, it is suggested to construct covered dying beds, which shall allow sunlight and restrict rainwater onto the beds. The liquid/leachate generated from Centrifuge and Sludge drying bed can be treated with sewage by mixing at main pumping station, (Source: Co-treatment at Kargi STP Guidebook, 2020)

The leachate produced from the sludge drying beds and dewatering unit-Centrifuge would have 80- 90% reduced organic load (Metcalf and Eddy wastewater Engg). It should be mixed with incoming sewage to be treated at STP. *See Annexure 2: Co-treatment Schematic for Septage-sewage at an STP is presented.*

Analysis of Availability of Loading of Septage, Vacuum Tankers Requirement and Dewatered Sludge Generation from Co-treatment

Analysis of co-treatment of septage with sewage at the 3 STPs of Mothrawala (I and II), Raipur and Banjrawala, based on the co-treatment design, suggests the following septage volumes for co treatment. *See Annexure 3 for detailed analysis.*

Table 4: Quantity of sepatge can be co-treated, relative no. of vaccuum tankers required and dried sludge produce

STPs	Year	Mothrawala I and II (combined)	Banjarawala	Raipur
Septage (m^3/day) can be handled at STP (@ 31 kg/m^3 TSS concentration)	2021	148	75	38 ~40
	2036	82	37	19.6 ~20
Number of Vacuum Tankers (@4m^3 size)	2036	10	4	2
Dewatered sludge (septage) produced (m^3/day)	2021	15	7	4

These are conservative estimates, to ensure excess capacity is not built in one go. More co-treatment facilities can be added if required.

Infrastructure and Tentative Costing of the Facilities

The area required for the co-treatment facility and costing of the particular units are assessed below.

Table 5: Units Size Requirement and Tentative Costing

Sl.no	STPs	Mothrawala I and II (combined)	Raipur	Banjarawala
()	Capacity of Homogenisation tank (HT) (two tanks)	148 KL (75 KL each)	70 KL (35 KL each)	40 KL (20 KL each)
	Area required for Screen chamber + Rectangular HT* (Depth assumed 3m)	Screen=1.5 m^2 HT= 50 m^2	Screen=1.5 m^2 HT= 26 m^2	Screen=1.5 m^2 HT= 14 m^2
(2)	Sludge Drying beds required	No. of beds required = 8 Bed size = 7.5 *4 * 0.3	No. of beds required = 7 Bed size = 6 m * 3 m * 0.3 m	No. of beds required = 7 Bed size = 4 m * 2.0 m * 0.3 m
	Area required	240 m^2	142 m^2	70 m^2
Total cost (@500,000 INR per 10 KL capacity HT including Screen chambers and Pumps) (@500,000 INR per 10 KL capacity of SDB		HT Rs.74 lacs +(SDB=8beds*Rs.4Lacs) TOTAL Rs. 106 lacs	HT Rs.35 lacs +(SDB=6 beds*Rs. 2Lacs)= TOTAL Rs. 47 lacs	HT Rs. 27lacs +SDB Rs.7 lacs = TOTAL Rs. 34 Lacs

The HT can be constructed underground which will save space above ground level for any other facility.

Considerations :

These are tentative costs, actual costs will depend on the DPRs.

- The size of HT and SDBs are emphasized on the intermediate period. This would prevent from overdesigning of Co-treatment infrastructure.
- Given the fact, for safe management of septage in the city and continuous load of septage into STPs, scheduled desludging with an interval of 2-3 years emptying of all septic tanks in the city on a zone wise schedule, should be encouraged.
- The cost for Screen and homogenisation tank is referenced from a Co-treatment DPR for Bijnor (24 MLD STP).
- The Cost for unplanted sludge drying per 10 KL is taken from various DPRs from Rajasthan and Uttar Pradesh, the average cost of SDBs is taken 1.5 times more for estimation as the state is in hilly region and the covered SDBs are suggested.

Uncovered Population and Potential for Increased Reach

The population of Dehradun city (Dehradun Municipal Corporation) is 8,03,983 (2018) having 1,67,577 households. Considering the 30% decadal growth rate of the city, it is expected to increase to approx. 10.5 lakhs in 2021[1]. Dehradun is having 6 sewerage zones, namely, Kargi zone, Ripsana zone, Indra nagar zone, Vijay colony zone, Salawala zone and Doon vihar zone. Currently, these zones are partially served with sewerage network.

As per the Masterplan 2025 Dehradun, the population of the city will increase to almost 12 lakhs by 2025. The growth corridors will also add a considerable number to the increased population. Dehradun airport (currently domestic) is located 28 km south-east of the Dehradun city. It is getting upgraded to International airport and work is under process. This upgradation will attract big commercial establishments like Hotels, resorts nearby.

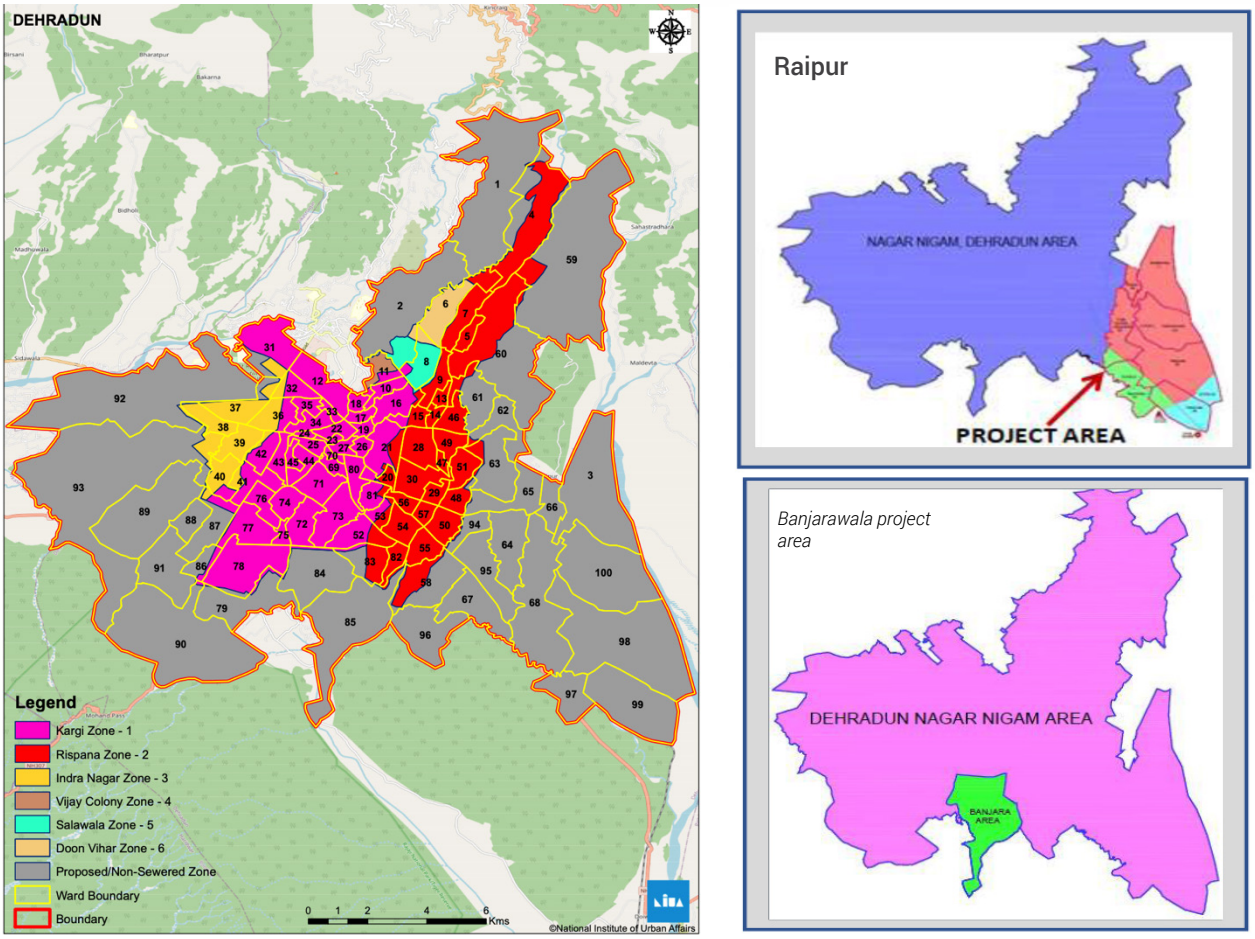
Currently, 25-30 cesspool trucks are providing desludging services in Dehradun MC area and nearby small municipal bodies and village panchayats. Expansion of the city as per the master plan 2025 and scheduled desludging of onsite sanitation systems will increase the demand for cesspool vehicles in the city and ultimately the demand for co-treatment facility at STPs will emerge.

Under the Uttarakhand Urban Development Project, three zones (Kargi, Banjarawala and Raipur) have been demarcated and proposed to improve and develop sanitation services in Dehradun. Kargi zone already have a 68 MLD STP with partially connected to sewerage network across the Kargi zone. There are 27,043 domestic/non-domestic sewerage connections with Kargi chowk STP sewer lines. Settlements that are not connected to the sewer lines are dependent on cesspool vehicles to empty their onsite sanitation systems.

Other two STPs i.e. Banjarawala and Raipur are proposed and expected to be implemented by next 3-4 years. The current population of these two zones are 24,360 with 8,404 HHs and 96,234 with 27,386 HHs respectively. By the time both proposed STPs in Banjarawala and Raipur zones are functional, the current population will increase and the population in growth corridors (as per the master plan 2025) will also add into the future population increasing it to almost 25%.

[1] *Master Plan 2025 Dehradun*

Figure 1: Sewerage zone map and proposed area of Dehradun city



As illustrated in the above map, Kargi zone, Banjwarawala zone and Raipur zone are the three areas that has proposed sewerage work. Based on the current and proposed sewerage zoning, following wards will emerge as potential areas that are dependent on co-treatment because of partial presence or completely absence of existing Waste Water conveyance and treatment infrastructure within Dehradun MC boundaries:

Proposed Raipur zone includes 13 wards (ward no. 63, 64, 65, 66, 67, 68, 94, 95, 97, 98, 99, 100 and 3). The total population considered for this project is 96,963 with 19393 HHs. Although, the sewerage system is designed for 96,963 population (base year) but only 18993 HHs connections will be provided under 'Household Sewer Connection package'. The remaining households i.e. 400 may take some time to be connected to sewer, meanwhile, can be served with co-treatment facility.

Proposed Banjarawala zone includes 3 wards (ward no. 83, 84 and 85). The total population of the proposed zone is 37,660 with 7532 households. Although, the sewerage system is designed for 37,660 population (base year) but only 6314 HHs connections will be provided under 'Household Sewer Connection package'. The remaining households i.e. 1218 may take some time to be connected to sewer, meanwhile, can be served with co-treatment facility.

In Raipur, it is proposed under this project to provide onsite sanitation to 1181 HHs (2021) and 1833 HHs (2036) and in Banjarawala 814 (2021) and 1408 (2036) HHs. These are houses which are

not technically feasible to connect with the proposed sewers because the proposed sewers will have to be laid much deeper in many stretches.

Ward no. 1, 2, 59, 60, 61, 62, 96, 79, 90, 86, 91, 87, 88, 89, 93 and 92. The population of all these wards is 1,23,131 with 27,130 households. These wards are neither covered under the existing sewerage zoning plan nor under the proposed sewerage plan in Banjarawala and Raipur.

Apart from the Dehradun MC boundaries, there are 79 village boards under Dehradun sub-district and one large municipal body i.e. Doiwala municipal council (12,302 Households) which is currently getting cesspool vehicles service from Dehradun on demand basis.

Overall, it can be analyzed from above data that there are approx. more than 40, 000 HHs (excluding the six-sewerage zones) within or nearby Dehradun MC area, which will remain dependent on the onsite sanitation systems like septic tanks, pit latrines etc.. Also, the proposed STPs in Banjarawala and Raipur are located near to the growth corridors or desludging demand areas which justifies the need of co-treatment infrastructure within STPs.

The septage generation is more than 80 KLD from these households for the current population and this will increase up-to 114 KLD by 2036. Hence, the proposed Co-treatment facility in Banjarawala and Raipur can cater up to 50% of septage generation of the city, See table 7 for detailed analysis.

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- NIUA (2019) Co-Treatment of Septage at STPs of Ganga Towns in Uttarakhand
- DPRs of Raipur and Banjarawala
- Environmental process design of Kargi STP

Annex 1:
Report findings for Co-Treatment at 9 STPs, a Study by IIT-Roorkee and NIUA

The State Program Management Group (SPMG), Uttarakhand had commissioned IIT Roorkee to explore the co treatment potential of septage and sewage in nine STPs of the state (primarily Ganga towns). The report carried detailed study of potential for co-treatment of septage with sewage Uttarakhand state.

City	Sampling location	pH	Alkalinity (mg/L)	O&G (mg/L)	COD (mg/L)	BOD (mg/L)	TSS (mg/L)	VSS (mg/L)	NH_3-N (mg/L)	TKN (mg/L)	TN (mg/L)	T-P (mg/L)
Dehradun	1. Niranjanpur	11.7	524	2310	45050	28381	7081	4310	98	112	113	310
	2. Brahmaputra	12.9	714	4309	27010	17016	31011	27001	115	122	123	620
	3. Triveni, Bihar	10.6	534	5101	45745	19117	63710	55010	171	189	190	410
	4. Dehaj	9.9	419	5310	21425	15414	27109	21014	141	159	160	437
	5.Bengali Kothi	11.7	721	5219	26575	21134	28101	19017	121	135	136	508

Table 6: Strategies for Co-treatment of septage in 9 Ganga Towns, IIT-Roorkee-NIUA, 2019

S. No.	Name of STP	Capacity (MLD)	Technology	Date of Monitoring & Sampling	Actual Flow (MLD)	Septage addition m^3/d (Tankers/d)	Septage Addition (Timings)	Septage Storage Facility
1	Jagjeetpur, Haridwar	27	Primary Clarifier + SBR	6-7th June 2019	21.8	49.5 (16.w5 Tankers/day)	23:00–10:00 AM	Yes
2	Sarai, Haridwar	18	SBR	6-7th June 2019	15.8	54 (18 tankers/day)	19:00 to 7 :00 am	Yes
3	Kankhal, Haridwar	18	Conventional Activated Sludge	6-7th June 2019	19.1	30 (10 Tankers/day)	23:00 – 09:00 AM	Yes
4	Mothorowala, Dehradun	20	SBR	19-20 June 2019	9.52	48 (16 tankers/day)	13:00 to 21:00	Yes
5	Indira Nagar, Dehradun	5.0	SBR	8-9 July 2019	8.4	9 (3 tankers/ day)	1:00 am - 10:00 am	Yes
6	Kargi, Dehradun	68	SBR	14-15 June 2019	17.6	336 (112 tankers/day)	16:00 – 8:00 am	Yes
7	Tehri	5.0	Extended Aeration	1-7th July 2019	2.28	28.5 (9.5 tankers/day)	6:00 am – 1:00 am	No
8	Tapovan, Rishikesh	3.5	SBR	13-14th August 2019	0.62	30 (10 tankers/day)	Anytime (24 h)	No

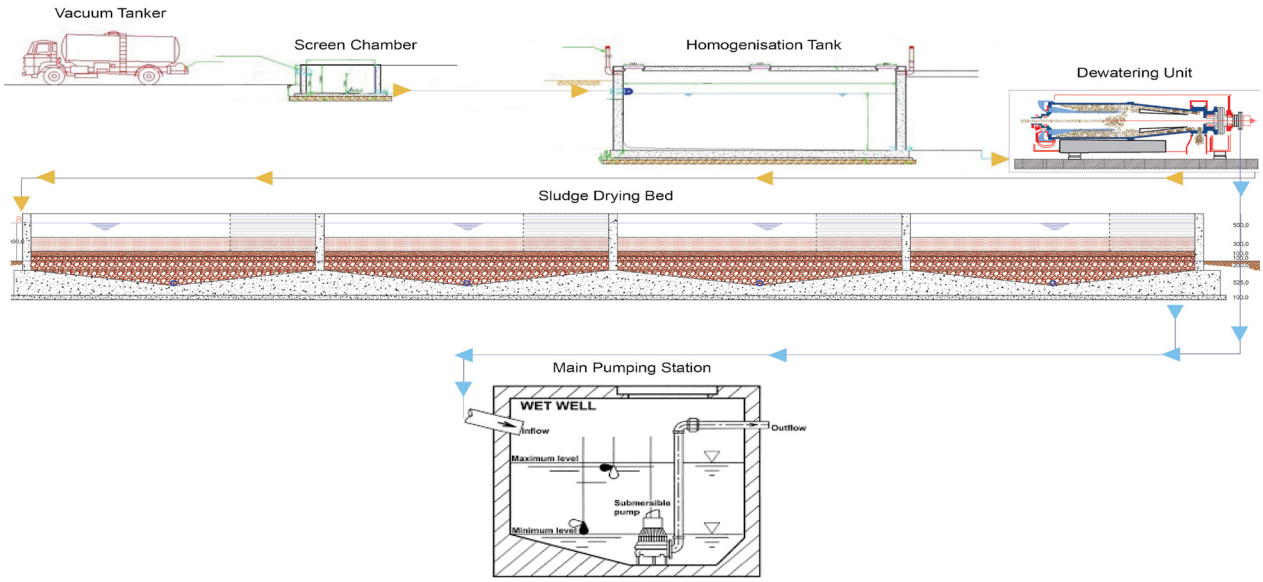
Source: IIT-Roorkee and NIUA 2019

Loading and disposing criteria adapted from the IIT report and Co-treatment guidebook for Kargi STP

- The incoming FSS tested by IIT -Roorkee presents a high solids concentration of ~31 kg/m3 the STP should receive FSS at a separate receiving station and storage facility which should include a coarse screen followed by fine screen and a grit chamber units
- Septage should be stored in a tank for homogenisation of the incoming Faecal sludge and septage, preferably underground tanks should be constructed; the size of stabilisation tank is determined based on the capacity of centrifuge and its associated sump well.
- Stored sludge in the stabilisation tank should be dewatered at Centrifuge unit of the STP. Liquid extracted from the centrifuge process should be conveyed into Main Pumping Station of the STP, for co treatment with incoming sewage at the SBR system.
- Solids cakes produced from Septage dewatering by Centrifuge may not need any further drying. But it is preferred that it should be further sun dried on sludge drying beds for 3-5 days. Co-composting with organic waste is recommended for killing remaining pathogens and use for agricultural purpose as manure.

Annexure 2:
Co Treatment Schematic for Septage-sewage at an STP

Figure 2: Process flow diagram for Co-treatment



(Source: Co-treatment guidebook for Kargi STP, 2020)

Annex 3:
Analysis of Availability of Septage loading, Tankers Required and Dewatered Sludge Generation from Co treatment

Sl no.	Name of STP		Mothrawala I and II	Raipur	Banjarawala
(1)	Sewage load 2021 (Kg) (Sewage Concentration*Flow rate)	BOD	4250	2750	1107
		COD	8500	5500	2215
		TSS	7650	4400	1772
(2)	Sewage load 2036 (Kg)	BOD	Estimations are done based on ultimate capacity designed and current flow rate	4402	1902
		COD		8805	3805
		TSS		7044	3044
(3)	Ultimate Load designed (kg)	BOD	10000	6000	2750
		COD	20000	12000	5500
		TSS	16000	9600	4400
(4)	Spare capacity available (in terms of COD only) (Kg)	(i) 2021 ((3)-(1))	11500	6500	3285
		(ii) 2036 ((3)-(2))		3195	1695
(5)	Septage flow (m^3) can be handled after Solid-liquid separation	2021 ((B)-(B*0.90)* X m^3)=4(i)	3484	1969	995
		2036	1742 (assuming 50%)	968	513
(6)	Sewage sludge produced (kg/day) – i.e. Centrifuge capacity Flow (m^3/day) x 2.25% x 8kg/m^3)	(i)Ultimate designed	1000 (1000*8=8000 kg/day)	540 (540*8=4320 kg/day)	247.5 (247.5*8=1980 kg/day)
		(ii)2021	425(425*8=3400 kg/day)	247.5 (247.5*8=1980 kg/day)	99.7 (99.7 *8= 797.6 kg/day)
		(iii)2036	680 (680*8=5440 kg/day)	396 (396*8=3168 kg/day)	171.2 (171.2 * 8 = 1369.8 kg/day)
(7)	Actual capacity available to entertain Septage (kg/day)	2021 6 (i)- 6(ii)	4600	2340	1182
		2036 6(i)-6(iii)	2560	1152	610.2
(8)	Septage (m^3/day) can be handled at STP @ 31 kg/m^3 TSS conc.	2021 (7)/TSS Conc.)	148	75	38 ~40
		2036 (7)/TSS Conc.)	82	37	19.6 ~20
(9)	No. of vacuum tankers @4m^3	2036	10	4	2
(10)	Solid (septage) produced after dewatering (m^3/day)	2021	15	7	4
		2036	8	3.5	2

The table above highlights the feasibility of Septage co treatment in the 3 STPs, in terms of the base flow potential gap of sewage flowing into these STPs.

Assumptions taken

- Centrifuge capacity is designed based on 2.25% sewage sludge is produced of sewage (Source: Kargi Environmental process design-SBR technology)
- Solid concentration of sewage sludge into centrifuge = 8 kg/m3 Source: Kargi Environmental process design-SBR technology)
- Solid concentration of septage (TSS conc.) = 33 kg/ m3
- Truck capacity 4m3.
- COD loading per truck = 33000mg/l COD*4 m3= 130 kg/truck
- One truck can do maximum two emptying per day
- No. of working days = 300 days
- Septage generation 120 litres/capita/annum (adapted from IS 2470)

Annex 4:
No. of households Rely on Onsite Sanitation system

These households will remain relied on onsite sanitation systems until any sewerage projects are proposed for thsese areas. Hence, these areas can provided with Septage management including Co-treatment of Septage with sewage at Dehradun STPs. The table above highlights the feasibility of Septage co treatment in the 3 STPs, in terms of the base flow potential gap of sewage flowing into these STPs.

Table 7: Households dependent on Onsite Sanitation

Area name	Description	No .of households
Doiwala municipal council	79 village boards under Dehradun sub-district and Doiwala Municipal council	12,302
Ward no. 1, 2, 59, 60, 61, 62, 96, 79, 90, 86, 91, 87, 88, 89, 93 and 92	No proposal for sewerage yet	27130
Raipur	These are houses which are not technically feasible to connect with the proposed sewers	1181
Banjarawala		814
No. of households (2021)		41427
Septage generation - 2021 (KLD)		82
No. of households (2036) @ 25% decadal growth rate		56961
Septage generation - 2036 (KLD)		114

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NIUA is a premier national institute for research, capacity building and dissemination of knowledge in the urban sector, including sanitation. Established in 1976, it is the apex research body for the Ministry of Housing and Urban Affairs (MoHUA), Government of India. NIUA is also the strategic partner of the MoHUA in capacity building for providing single window services to the MoHUA/states/ULBs. The Institute includes amongst its present and former clients Housing and Urban Development Corporation, Niti Ayog, City and Industrial Development Corporation of Maharashtra, USAID, World Bank, Asian Development Bank, GIZ, UNICEF, UNEP, UNOPS, Cities Alliance, Bill & Melinda Gates Foundation, Rockefeller Foundation, Global Green Growth

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Sanitation Capacity Building Platform (SCBP) is an initiative of the National Institute of Urban Affairs(NIUA) for addressing urban sanitation challenges in India. The 3 year programme(starting 2016) is supported by a Gates Foundation grant. It is aimed at promoting decentralised urban sanitation solutions for septage and waste water management. The Platform is an organic and growing collaboration of universities, training centres, resource centres, non-governmental organizations, consultants and experts. The Platform currently has on board CEPT University, CDD Society and BORDA, ASCI, AIILSG, UMC, ESF, CSE, WaterAid, CPR, iDECK, CSTEP and WASHi. The Platform works in close collaboration with the National Faecal Sludge and Septage Management Alliance(NFSSMA).

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