MUNICIPAL CORPORATION OF GREATER MUMBAI

No. Ch.E/1419/ Coastal Road, date: 19/07/2021

Office of
Chief Engineer (Coastal Road),
3rd Floor, Engineering Hub building,
Dr E Moses Road, Worli,
Mumbai 400 018
Email: che.coastalroad@mcgm.gov.in

To,
Mr.Suresh Kumar Adapa
Scientist –D
Ministry of Environment, Forest & Climate Change,
Regional office (WCZ), Ground floor, East wing
New Secretariat Building, Civil Lines Nagpur – 440001
apccfcentral-ngp-mef@gov.in

Sub: Mumbai Coastal Road Project (South) from Princess Street Flyover to Worli end of BWSL

Ref:
1. MoEF&CC letter no. 19-74/2016-IA.III dated 11.05.2017
2. Ch.E/1000 (v) /Coastal Road Project date 08.06.2017
3. F. No. EC-427/RON/2017-NGP/1975 dated 27.06.2017
4. Ch.E/1237/Coastal Road Project date 03.10.2017
5. Ch.E/1357/Coastal Road Project date 25.10.2018
6. Ch.E/1901/Coastal Road Project date 28.05.2019
7. Ch.E/3222/Coastal Road Project date 29.06.2019
8. Ch.E/9246/Coastal Road Project date 4.02.2020
9. Ch.E/1092/Coastal Road Project date 17.08.2020
10. Ch.E/3250/Coastal Road Project date 22.01.2021

Sir,

With reference to above referred CRZ clearance dated 11.05.2017, the half yearly compliances report for the period of October 2020 to March 2021 is submitted herewith. The data sheets are attached herewith accompanying with the required information.

1. Present status of work:-

Work is divided into three Packages as mentioned below and present status of work is attached as Annexure 1.

Sr.No	Package	Description	Contractors	Date of Commencement
1	Package - I	Priyadarshani Park to Baroda Palace	M/s L&T Limited	13.10.2018
2	Package - II	Baroda Palace to Worli end of BWSL	M/s HCC-HDC	16.10.2018
3	Package -IV	Princess Street flyover to Priyadarshani Park	M/s L&T Limited	13.10.2018

2. Copies of Consent to Establish/Operate from MPCB:-
   Attached as Annexure 2.

3: The information in the enclosed data sheet :-
   The information in the Standard format is attached herewith

4. Copy of EIA/EMP report :-
   The EIA/EMP report including EMP prepared by DPR consultant is submitted to MoEF&CC while obtaining CRZ clearance. The salient features of EMP is attached as Annexure 3.

This information is submitted as a status of Compliance. Copy of the same is also sent through mail on email id apccfcentral-ngp-mef@gov.in .

Yours Faithfully,

19/07/2019

Vijay Nighot
Chief Engineer (Coastal Road)

M. C. G. M
Chief Engineer (Coastal Rd)

MUMBAI COASTAL ROAD PROJECT

ENVIRONMENTAL BI-ANNUAL COMPLIANCE REPORT

OCTOBER 2020 – MARCH 2021

MUNICIPAL CORPORATION GREATER MUMBAI

Monitoring the Implementation of Environmental Safeguards
Ministry of Environment, Forest & Climate Change
Regional Office (West Central Zone), Nagpur
Monitoring Report
Part -1
DATA SHEET (October 2020 to March 2021)

1.	Project Type: River-Valley / Mining / Industry / Thermal / Nuclear /Other (Specify)	Mumbai Coastal Road (South)
2.	Name of the Project	Mumbai Coastal Road (South) from Princes Street Flyover to Worli End of Bandra worli sea link. 1) Package I: Priyadarshini Park to Baroda Palace. 2) Package II: Baroda Palace to Worli End of BWSL. 3) Package IV: Princess Street Flyover to Priyadarshini Park.
3.	Clearance Letter (S) /OM No.&date	F. No. 19-74/2016-IA-III dated 11th May 2017
4.	Location a. District (S) b. State (S) c. Latitude (S) d. Longitude (S)	 Mumbai City Maharashtra
5.	Address for correspondence a. Address of concerned Project Chief Engineer (with Pin Code & Telephone / Telex/Fax Numbers) & address of Executive Project Engineer / Manager (with pin code/fax numbers)	Chief Engineer (Coastal Road), Municipal Engineering Hub Building, 3rd Floor, Dr. E. Moses Road, Worli Naka, Worli, Mumbai-400 018, Maharashtra, India. Telephone No. 022-24958211
6	Salient Features a. Of the project as per earlier CRZ Clearance.	Mumbai Coastal Road Project (South): As per CRZ clearance • Length-9.98 km • Length of Tunnel- 3.452 km 02 Tubes each having lanes 02+01 (emergency) • Number of Interchanges : 03 No's • Total Reclamation: 90 Ha. • Road : 4+4 lanes • Project Cost: Rs. 5303.00 Crs.
	b. As per amendment to CRZ Clearance.	Mumbai Coastal Road Project (South): As per CRZ clearance • Length-10.58 km • Length of Tunnel- 2.07 km 02 Tubes each having lanes 02+01 (emergency) • Number of Interchanges : 03 No's • Total Reclamation: 111 (96.51 + 14.49) Ha.

		• Road : 4+4 lanes • Project Cost: Rs. 8429.44 Crs.
	c. Of the Environment Management Plan	The Salient Features of Environment Management Plan submitted as Annexure 3 along with this data sheet
7.	Breakup of the Project Area a. Submergence Area Forest & Non-Forest b. Others	Not Applicable being Coastal Road Project
	a. Total plot Area	As submitted earlier
	b. Built – up Area (Including Road)	Not applicable since Coastal Road Project
	c. Open Space Available	Not Applicable since Coastal Project Road
	d. Green belt Area	Green Belt 70 Ha. Area
8.	Breakup of the Project affected population with enumeration of those losing houses / dwelling units & both dwelling units & agricultural land & landless laborers / artisan a. SC, ST/Adivasis b. Others (Please indicate whether these figures are based on any scientific and systematic survey carried out or only provisional figures, if a survey carried out gives details and years of survey).	Nil
9.	Financial details a. Project costs as originally planned & subsequent revised estimates and the year of price reference.	As per CRZ Clearance: Rs. 5303.00 Cr As per present Construction Cost : Rs. 8429.44 Crs. Project Cost : Rs. 12,721.59, Cr
	b. Allocation made for Environmental Management Plan with item wise & Year wise breakup.	April 2020 to March 2021 =Rs. 4.03 (Cr)
	c. Benefits Cost Ration / Internal rate of Return and the year of assessment.	Benefit Cost Ratio : 1.15 (2016-2017)
	d. Whether (C) includes the cost of Environmental Management as shown in the above	Yes
	e. Actual expenditure incurred on the Project so far	Rs. 1997.07.(Cr)
	f. Actual expenditure incurred on the Environmental Management Plan so far	Rs. 10.07 (Cr)

10.	Forest land Requirement a. The status of approval for diversion of forestland for non-forestry use. b. The status of clearing felling. c. The Status of compensatory afforestation program in the light of actual field experience.	NIL
11.	The status of clear felling in non-forest area (such as submergence area of reservoir, approach roads), if any with quantitative information.	NIL
12.	Status of Construction a. Date of Commencement (Actual and/or Planned)	1. Contractors for Package – I and Package IV-M/s L & T Limited . Date of Commencement – 13.10.2018. Construction Work is in progress 2. Contractors for Package – II- M/s HCC – HDC. Date of Commencement – 16.10.2018. Construction work is in progress
	b. Date of Completion (Actual and/or Planned)	15.10.2022 (Planned) and further extended upto 07.07.2023
13.	Reasons for the delay if the project is yet to start	Not applicable
14.	Date of site visits a. The dates on which the Project was monitored by Regional Office on previous occasions, if any b. Date of site visit for this monitoring Report	13.01.2021 to 14.01.2021 Nil
15.	Details of correspondence with project authorities for obtaining action plan /information on status of compliance to safeguard other than the routine letters for logistic support for site visit. (Monitoring report may obtain the details of all the letters issued so far but the later reports may cover only the letters issued subsequently)	1. Monitoring Report (EMP-Report) (April 2020 till September 2020) for three Packages are attached as Annexure 04. 2. MoEF&CC- CRZ Clearance compliance report & MCZMA – Compliance report attached as Annexure 05

Chief Engineer (Coastal Road) I/c
MCGM, Mumbai -18

06/04/2021
EE(3)

Annexure 01

Project Progress Report
October 2020 - March 2021

Mumbai Coastal Road Package - 01

Present Status of the Work Progress

				Oct-20 - Mar-21		Till date		
#	Description	Unit	Scope	Planned	Achieved	Planned % till 25th Mar 21	Achieved % till 25th Mar 21	% completion w.r.t cumulative plan
I. Bridges								
1A	GTI Works - Priority Boreholes	nos	329	-	-	94.5%	94.5%	94.5%
1B	GTI Works - Confirmatory Boreholes	nos	63	63	58	100.0%	92.1%	92.1%
1C	GTI Works - Monopile Construction	nos	92	80	68	87.0%	73.9%	73.9%
2	Test Pile	nos	14	2	2	100.0%	100.0%	100.0%
3	Temporary Jetty Construction- Foundation	Rm	317	157	157	100.0%	100.0%	100.0%
4	Amarsons Garden Interchange - Land Piling	nos	40.0	-	-	80.0%	80.0%	80.0%
5	Amarsons Garden Interchange - Land Pilecap	nos	10.0	4	4	80.0%	80.0%	80.0%
6	Amarsons Garden Interchange - Land Pier	nos	10.0	8	4	80.0%	40.0%	40.0%
7	Temporary Access Bridge - Haji Ali Interchange	Rmt	499.2	200	171	50.0%	44.2%	44.2%
8	Temporary Access Bridge - Amarsons Garden Interchange	Rmt	325.3	77	38	23.6%	11.8%	11.8%
9	Haji Ali Interchange - Land Piles	nos	308	181	143	58.8%	46.4%	46.4%

L & T CONSTRUCTION LTD. Sign MCRP. PKG.-1

Louis Berger Consulting Pvt. Ltd.

10	Haji Ali Interchange - Land Pilecap	nos	77	10	6	13.0%	7.8%	7.8%
11	Haji Ali Interchange - Land Pier	nos	77	5	1	6.5%	1.3%	1.3%
12	Temporary Access Bridge - Main Line Bridge	Rmt	374	211	163	56.4%	43.6%	43.6%
13	Main Bridge - Land Piles	nos	164	81	86	49.4%	52.4%	52.4%
14	Main Bridge - Land Pilecap	nos	41	11	4	26.8%	9.8%	9.8%
15	Box Culvert - Segment casting	Nos	408	112	12	27.5%	2.9%	2.9%
16	Pipe Culvert - Laying	nos	734	423	173	57.6%	23.6%	23.6%
II. Seawall & Reclamation								
1	Seawall Construction - Core Placement	Rmt	3,802	800	-	47.3%	37.5%	37.5%
2	Seawall Construction - Armour Placement - Stage 1	Rmt	3,802	219	184	37.5%	36.6%	36.6%
3	Reclamation - upto HWL (5.1 m CD)	Ha	60.3	21	21	87.6%	88.0%	88.0%
4	Reclamation - above HWL (upto 6.1 m CD)	Ha	60.3	15	16	44.8%	46.1%	46.1%
5	Reclamation - above HWL (upto 7.1 m CD)	Ha	60.3	9	9	14.1%	14.4%	14.4%
6	Geotextile & Bedding layer	Rmt	3,802	610	550	36.3%	37.3%	37.3%
7	Removal of Tetrapods & Revetment Rock	Rmt	2,296	2,296	1,913	100.0%	83.3%	83.3%
8	Stone Column Construction	Nos	31,900	18,229	17,676	57.1%	55.4%	55.4%

L&T CONSTRUCTION LTD. Sign MCRP. PKG.-1

Louis Berger Consulting Pvt. Ltd.

Mumbai Coastal Road Package - 02

S.NO.	ITEM DESCRIPTION	TOTAL SCOPE		Total Work progress in six months	Cumulative	Total work progress in percent %
		Unit	Qty		Quantity	
1	Geo technical Investigation	NOS	194	2	189	0.97
2	SEAWALL- QUARRY RUN	Cum	239020	20362	161629	0.68
3	Seawall - Bedding Layer	CUM	8110	1525	8040	0.99
4	Sea wall - Geotextile Layer	SQ.M	28096	4214	15294	0.54
5	Sea wall - Armour Layer	CUM	99258	31315	61799	0.62
6	Reclamation Works +1.92 MSL	CUM	530000	83758	389776	0.74
7	Selected Fill +6.00MSL	CUM	567573	132010	330487	0.58

Mumbai Coastal Road Package - 04

Physical Progress Status as on 31-03-2021

Description	Scope	Status
Bathymetry Survey	0.144 sq.km	Completed
Topographic Survey	44 Hectare	Completed
Hydro Graphical Survey	3.93 km	Scope finalization in progress
Existing Building Survey	3.93 km	Completed
Utilities Survey	3.93 km	Completed
Geotechnical Investigation	33 Nos	33 Nos Completed
Sea wall – Core Rock	685 RM	330 RM Completed
Sea wall – Armour Rock	685 RM	290 RM Completed
Secant Piling – Launching Shaft	547 Nos	547 Nos Completed
Secant Piling – Retrieval Shaft	186 Nos	186 Nos Completed
Secant Piling – Cut and Cover Tunnel – Priyadarshini Park	594 Nos	594 Nos Completed
Secant Piling – Ramp – Priyadarshini Park	464 Nos	464 Nos Completed
Secant Piling – Cut and Cover Tunnel – Chowpatty	2137 Nos	1421 Nos Completed
Secant Piling – Ramp – Chowpatty	1120 Nos	275 Nos Completed
Cantilever Promenade –Promenade Piles	52 Nos	41 Nos Completed
Cantilever Promenade –Promenade Pier cap	52 Nos	23 Nos Completed
RHS Tunnel drive	2072 Rm	160 Rm Completed
Cut & cover box	600 Rm	95 Rm Completed
Utility box	600 Rm	126 Rm Completed
Plastic Piles	114 Nos	114 Nos Completed

Mumbai Coastal Road Package - 04

Physical Progress Status as on 31-03-2021

Description	Scope	Status
Bathymetry Survey	0.144 sq.km	Completed
Topographic Survey	44 Hectare	Completed
Hydro Graphical Survey	3.93 km	Scope finalization in progress
Existing Building Survey	3.93 km	Completed
Utilities Survey	3.93 km	Completed
Geotechnical Investigation	33 Nos	33 Nos Completed
Sea wall – Core Rock	685 RM	330 RM Completed
Sea wall – Armour Rock	685 RM	290 RM Completed
Secant Piling – Launching Shaft	547 Nos	547 Nos Completed
Secant Piling – Retrieval Shaft	186 Nos	186 Nos Completed
Secant Piling – Cut and Cover Tunnel – Priyadarshini Park	594 Nos	594 Nos Completed
Secant Piling – Ramp – Priyadarshini Park	464 Nos	464 Nos Completed
Secant Piling – Cut and Cover Tunnel – Chowpatty	2137 Nos	1421 Nos Completed
Secant Piling – Ramp – Chowpatty	1120 Nos	275 Nos Completed
Cantilever Promenade –Promenade Piles	52 Nos	41 Nos Completed
Cantilever Promenade –Promenade Pier cap	52 Nos	23 Nos Completed
RHS Tunnel drive	2072 Rm	160 Rm Completed
Cut & cover box	600 Rm	95 Rm Completed
Utility box	600 Rm	126 Rm Completed
Plastic Piles	114 Nos	114 Nos Completed

ANNEXURE -2

CONSENT TO ESTABLISH/OPERATE FROM SPCB

Mumbai Coastal Road Project

Present Status of Consent to Establishment / Operate from MPCB

Sr. No	Name Temporary Construction Facility	Consent	Consent No	Date	Remarks
			MCRP-1		
1	Ready Mix Concrete	CTE	RO-Mumbai/2007001351	22/07/2020	Submitted in earlier compliance report
		CTE	RO-Mumbai/2011000656	11/11/2020	Copy enclosed
		CTO (Applied)	RO-Mumbai/0000107353	28/01/2021	Copy enclosed
2	Casting Yard	CTE	RO-Mumbai/2007001454	22/07/2020	Submitted in earlier compliance report
		CTO (Applied)	RO -Mumbai/0000108800	17/02/2021	Copy enclosed
3	Mobile Stone crusher plant	CTE	RO-Mumbai/0000110911	17/03/2021	Copy enclosed
			MCRP-2		
4	Ready Mix Concrete	CTE	SRO-MUMBAI/CONSENT/1901000695	10/01/2019	Submitted in earlier compliance report
		CTO	SRO-MUMBAI-I/CONSENT 2007001477	02/07/2020	
5	Casting Yard	CTE	RO-MUMBAI/2008000597	17/08/2020	Submitted in earlier compliance report
		CTO	SRO-MUMBAI-I/CONSENT 2012000933	21/12/2020	Copy enclosed
6	Mobile Crusher Plant	CTE	RO-MUMBAI/2101000553	13/01/2021	Copy enclosed
		CTO (Applied)	MPCB-CONSENT-0000110814	28/12/2021	Copy enclosed
			MCRP-4		
7	Casting Yard	CTE	SRO-MUMBAI-I/CONSENT 1904000649	15/04/2019	Submitted in earlier compliance report
		CTO	SRO-MUMBAI-I/CONSENT 2010000387	13/10/2020	Copy enclosed
8	Ready Mix Concrete	CTE	SRO-MUMBAI-I/CONSENT 1904000454	10/04/2019	Submitted in earlier compliance report
		CTO	SRO-MUMBAI-I/CONSENT 2103000398	05/03/2021	Copy enclosed
9	Mobile Crusher Plant	CTE	RO-MUMBAI I/2012001195	28/12/2020	Copy enclosed
		CTO (Applied)	MPCB-CONSENT-0000110814	16/03/2021	Copy enclosed

C-75

MUMBAI COASTAL PROJECT
PACKAGE-1

C-77

Maharashtra Pollution Control Board
5fd85907a11ad13abfaaec78

MAHARASHTRA POLLUTION CONTROL BOARD

Phone : 02225505028
Fax : 02225505926
Email : romumbai@mpcb.gov.in
Visit At : http://mpcb.gov.in

Regional Office, Mumbai,
Raikar Chambers, "A" Wing, 216, 2nd Floor,
Deonar Gaon Road, Near Jain Mandir,
Govandi (E), Mumbai-400088

Green/S.S.I Date: 11 /11/2020

Consent No: RO-MUMBAI/ 2011000656

Consent to Establish under Section 25 of the Water (Prevention & Control of Pollution) Act, 1974 & under Section 21 of the Air (Prevention & Control of Pollution) Act, 1981 and Authorization / Renewal of Authorization under Rule 5 of the Hazardous Wastes (Management, Handling & Transboundary Movement) Rules 2008

[To be referred as Water Act, Air Act and HW (M&H) Rules respectively].

CONSENT is hereby granted to

M/s. Larsen & Toubro Ltd.,
MCRP-Pkg-1, Tempo. Site Office Haji Ali,
Mumbai.

Located in the area declared under the provisions of the Water Act, Air act and Authorization under the provisions of HW (M&H) Rules and amendments thereto subject to the provisions of the Act and the Rules and the Orders that may be made further and subject to the following terms and conditions:

1. **The Consent to Establish is granted for a period up to Commissioning of the Project r 5 years whichever is earlier.**

2. **The Consent is valid for the manufacture of -**

Sr. No.	Product Name	Maximum Quantity	UOM
1	RMC	600	M3/D
	(Only for Captive purpose of Mumbai Coastal Road Project)		

3. **CONDITIONS UNDER WATER ACT:**

(i) The daily quantity of trade effluent from the factory shall not exceed **08.00 M³**.

(ii) The daily quantity of sewage effluent from the factory shall not exceed **03.20 M³**

(iii) **Trade Effluent Treatment :** The waste water generated from the source like batching plant, washing of transit mixture, floor washing, vehicle washing, two lever tyre washing area shall be collected through well designed drainage system in collection tank and shall provide comprehensive treatment system as is warranted to meet with disposal standards mentioned below.

Sr. No.	Parameter	Concentration	Limit
1	pH	between	5.5 to 9.0
2	BOD	Not to exceed	30 mg/l
3	COD	Not to exceed	150 mg/l
4	SS	Not to exceed	100 mg/l
5	O & G	Not to exceed	10 mg/l
6	TDS	Not to exceed	2100 mg/l

(iv) **Trade Effluent Disposal:** The treated effluent shall be reuse/recycle in the process, gardening/plantation and water sprinkling purpose only. There shall not be any discharge outside from the plant.

(iii) **Sewage Effluent Treatment:** The applicant shall provide comprehensive treatment system as is warranted with reference to influent quality and operate and maintain the same continuously so as to achieve the quality of treated effluent to the following standards.

(1)	Suspended Solids	Not to exceed	100 mg/L
(2)	BOD 3 days 27o C.	Not to exceed	100 mg/L

(iv) **Sewage Effluent Disposal:** The treated domestic effluent shall be soaked in a soak pit, which shall be got cleaned periodically. Overflow, if any, shall be used on land for gardening / plantation only.

(v) **Non-Hazardous Solid Wastes:**

Sr. No.	Type Of Waste	Quantity	UOM	Treatment & Disposal
1	Aggregates	—	MT/M	Either reused through recovery unit/Reclaiming system OR disposed off at designated approved site by local body, for derbies / construction waste

4. **The applicant shall comply with the provisions of the Water (Prevention & Control of Pollution) Cess Act, 1977 (to be referred as Cess Act) and amendment Rules, 2003 there under:**

The daily water consumption for the following categories is as under:

(i)	Domestic purpose	...	10.00 CMD
(ii)	Water gets Polluted & Pollutants are Biodegradable	...	120.00 CMD
(iii)	Water gets Polluted, Pollutants are not Biodegradable & Toxic	...	00.00 CMD
(iv)	Industrial Cooling, spraying in mine pits or boiler feed	...	00.00 CMD

5. **CONDITIONS UNDER AIR ACT:**

The applicant shall install a comprehensive control system consisting of control equipments as is warranted with reference to generation of emission and operate and maintain the same continuously so as to achieve the level of pollutants to the following standards:

1)	**Particulate Matter PM_{10}**	**Not to Exceed**	**100 µg/m³**
2)	**Particulate Matter $PM_{2.5}$**	**Not to Exceed**	**60 µg/m³**
3)	**SO2**	**Not to Exceed**	**80 µg/m³**
4)	**NOx**	**Not to Exceed**	**80 µg/m³**

Control Equipment:

Air Pollution Control:-

i) **In-house measures:-**

1. All material transfer points should be covered
2. The dust containment system shall be provided incorporating either of the following.

- Barricading all around the periphery of the plot boundary of height minimum 20 feet or 5 feet above free fall air emission area, whichever is higher with tin sheets. Same may extend above with netlon clothing whenever required
- Water sprinkling/Chemical dust stabilizing agent spraying system along the periphery inside the premises of RMC.

3. Internal work area shall be, cement concreted/Asphalted.
4. Daily cleaning / Removal of dust accumulation inside the plant (dry/wet) shall be carry out, with industrial vacuum cleaner.
5. Two level tyre washing facility shall be provided at entry and exit points, for transit mixture vehicle.

(ii) **Raw material Storage, Handling & Others:-**

1. Storage silos of cement & fly-ash shall be equipped with adequate capacity of dust Collection system such as multi- cyclone followed by bag house assembly.
2. Handling of Cement, sand, fly ash and aggregates shall be carried out with mechanical closed system only.
3. Manual operations shall be permitted only in a closed shed, equipped with dust control system at the loading point as well as roof top secondary dust control system.
4. All Conveyor belts of Sand, aggregate shall be covered with tin sheets and at transfer points dust collection system to be installed to avoid secondary fugitive emissions.
5. Mixing section of cement, aggregate & sand shall be equipped with adequate capacity dust collection system, such as multi-cyclone followed by bag house, so as to limit dust emissions.
6. Storage area of sand & aggregate shall be equipped with roof top water sprinkler system.
7. The air pollution control devices shall be operated regularly.
8. Alternative power supply system, should cover both the production and Air pollution control system.
9. Industry shall provide treatment facility industrial effluent.
10. Industry shall provide disposal facility for treated effluent.
11. Industry shall provide disposal facility for solid waste.
12. Industry shall provide proper exhaust system in the premises.

6. **CONDITIONS UNDER HAZARDOUS WASTE (MANAGEMENT, HANDLING & TRANSBOUNDRY MOVEMENT) RULES, 2008:**

(i) The Industry shall not generate any type of hazardous wastes.

7. **Noise Pollution control Measures:-**

The Industry shall comply with the provision under the Noise (Regulation and Control) Rule- 2000, to control noise pollution.

8. Industry shall comply with following additional conditions:

i. The applicant shall maintain good housekeeping and take adequate measures for control of pollution from all sources so as not to cause nuisance to surrounding area / inhabitants.

ii. The applicant shall bring minimum 33% of the available open land under green coverage/ tree plantation.

iii. Solid waste – The non hazardous solid waste arising in the factory premises, sweepings, etc., be disposed of scientifically so as not to cause any nuisance / pollution. The applicant shall take necessary permissions from civic authorities for disposal to dumping ground.

iv. The applicant shall provide for an alternate electric power source sufficient to operate all pollution control facilities installed by he applicant to maintain compliance with the terms and conditions of the consent. In the absence, the applicant shall stop, reduce or otherwise, control production to abide by terms & conditions of this consent regarding pollution levels.

v. The applicant shall not change or alter quantity, quality, the rate of discharge, temperature or the mode of the effluent / emissions or hazardous wastes or control equipments provided for without previous written permission of the Board.

vi. The applicant shall provide facility for collection of environmental samples and samples of trade and sewage effluents, air emissions and hazardous wastes to the Board staff at the terminal or designated points and shall pay to the Board for the services rendered in this behalf.

vii. **The applicant shall obtain Consent to Operate from Maharashtra Pollution Control Board before actual commencement of the Unit/ Activity.**

viii. The firm shall submit to this office, the 30th day of September every year, the Environmental Statement Report for the financial year ending 31st March in the prescribed Form-V as per the provisions of rule 14 of the Environment (Protection) (Second Amendment) Rules, 1992.

ix. An inspection book shall be opened and made available to the Board's officers during their visit to the applicant.

x. The applicant shall install a separate electric meter showing the consumption of energy for operation of domestic and industrial effluent treatment plants and air pollution control system. A register showing consumption of chemicals used for treatment shall be maintained.

xi. Separate drainage system shall be provided for collection of trade and sewage effluents. Terminal manholes shall be provided at the end of collection system with arrangement for measuring the flow. No effluent shall be admitted in the pipes / sewers down- stream of the terminal manholes. No effluent shall find its way other than in designed and provided collection System.

xii. Neither storm water nor discharge from other premises shall be allowed to mix with the effluents from the factory.

9. The consent is issued subject to direction issued by CPCB under section 18(1) (b) of Water (Prevention and Control of Pollution) Act, 1974, regarding classification of Industries dated 07th March 2016.

10. Operation of RMC plant shall be in day time only. The Day time is reckoned in between 6 a.m. and 6 p.m. i.e. from sun rise to sunset.

11. The Board may make the standards stringent for the RMC/batching plants located within Corporation areas.

12. Commercial plants shall install continuous ambient air quality monitoring station (CAAQMS) within the premises.

13. Captive plants shall carryout ambient air quality monitoring twice in a week for 24 hours.
14. The industry shall comply with the siting criteria as per RMC Notification dtd 16.10.2016.
15. The entire RMC Plant should be enclosed.
16. The Capital investment of the industry is Rs. 3161/- Lakhs.
17. Industry shall operate water sprinkling facility with fogging facility provided at raw material storage area.
18. Industry shall provide two level tyre washing facility at entry/exit points within 15 days period.
19. Industry shall provide Industrial vacuum cleaner for cleaning of internal roads/removal of dust within 7 days period.
20. Industry shall provide asphalted/concreted roads inside the plant premises within 1 month period.
21. Industry to submit BG's of Rs. 2/- Lakhs against compliance of consent conditions. The BG shall be valid upto 31.08.2021 which shall be submitted in favor of Regional Officer, Mumbai, within 7 days period.
22. This consent is issued without prejudice to the order issued by Hon'ble Supreme Court of India vide dtd 17.12.2019.
23. Industry to submit BG of Rs. 2,00,000/- against compliance of consent conditions. The BG shall be valid upto 31.01.2022 which shall be submitted in favor of Regional Officer, Mumbai, within 7 days period.
24. The Capital investment of the industry is Rs. 979/- Lacs
25. The Board reserve right to revoke, amend or suspend the consent granted.

For and on behalf of the
Maharashtra Pollution Control Board

(Dr. A. N. Harshvardhan)
Regional Officer, Mumbai

To,
M/s. Larsen & Toubro Ltd.,
MCRP-Pkg-1, Tempo. Site Office Haji Ali,
Mumbai.

Received Consent fee of:-

Sr. No.	Amount(Rs.)	Dr. No.	Date	Drawn On
1.	25,000/-	MPCB-DR-2431	22.10.2020	Citi Bank

Copy Submitted to:

1. Sub Regional Officer, Mumbai-I, M.P.C. Board, Mumbai

C-83

Maharashtra Pollution Control Board

महाराष्ट्र प्रदूषण नियंत्रण मंडळ

Application for Consent/ Authorisation

Sir,
I/We hereby apply for*

1. Consent to Establish/Operate/Renewal of consent under section 25 and 26 of the Water (Prevention & Control of Pollution) Act, 1974 as amended.

2. Consent to Establish/Operate/Renewal of consent under Section 21 of the Air (Prevention and Control of Pollution) Act, 1981, as amended.

3. Authorization/renewal of authorization under Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 in connection with my/our/existing/proposed/altered/ additional manufacturing/processing activity from the premises as per the details given below.

Consent Information

UAN No:
MPCB-CONSENT-0000107353

Application submitted on:
28-01-2021

Industry Information

Consent To:
Operate

IIN No.:

Submit to:
SRO - Mumbai I

Type of institution:
Industry

Industry Type:
G37 Ready mix cement concrete

Category:
Green

Scale:
S.S.I

EC Reqd.
No

EC Obtained
No

EC Ref. No.
-

Whether construction-buildup area is more than 20,000 sq.mtr.(Existing Expansion Unit)
No

General Information

1. Name, designation, office address with Telephone/Fax numbers, e-mail of the Applicant Occupier/Industry/Institution / Local Body.

Name
RAKESH SINGH SISODIA

Address
TOWER-B, TC-II, 1ST FLOOR,L&T GATE-5, POWAI,Mumbai City,Mumbai City

Designation
PROJECT DIRECTOR

Taluka
Mumbai City

Area
Parking Place, Amarsons Garden, Near Tata Tea Garden, AMARSONS GARDEN, AMARSONS GARDEN, MUMBAI CITY,

District
Mumbai city

Telephone
9870061308

Fax

Email
jadhavani@lntecc.com

Pan Number
AHFPS2369L

2. (a) Name and location of the industrial unit/premises for which the application is made (Give revenue Survey Number/Plot number name of Taluka and District, also telephone and fax number)

Industry name
Larsen & Toubro Ltd

Location of Unit
Mumbai Coastal Road Project PKG 1

Survey number/Plot Number
Amarson Garden

Taluka
Mumbai City

District
Mumbai city

(b) Details of the planning permission obtained from the local body/Town and Country Planning authority/Metropolitan Development authority/ designated Authority.

Planning permission

Planning Authority

Name of the local body under whose jurisdiction the unit is located and Name of the licence issuing authority

Name of Local Body

Name of the licence issuing authority

3. Names,addresses with Telephone and Fax Number of Managing Director / Managing Partner and officer responsible for matters connected with pollution control and/or Hazardous waste disposal.

Name of Managing Director
Rakesh Singh Sisodia

Telephone number
9870061308

Fax number
0

Officer responsible for day to day business
Rakesh Singh Sisodia

4. (a.) Are you registered Industrial unit ?

Yes

Registration number
L99999MH1946PLC004768

Date of registration
Oct 13, 2018

5. Gross capital investment of the unit without depreciation till the date of application (Cost of building, land, plant and machinery). (To be supported by an affidavit/undertaking on Rs.20/- stamp paper, annual report or certificate from a Chartered Accountant for proposed unit(s), give estimated figure)

Gross capital (in Lakh)	**** Verified***	**** Terms***	**** Consent Fee***
286.75	CA Certificate	1	15000.00

6. If the site is located near sea-shore/river bank/other water bodies/Highway, Indicate the crow fly distance and the name of the water body, if any.

Distance From	***Distance(Km)***	**** Name***
SH/NH	88.00	Mumbai-Pune Highway
River	23.00	Mithi
Human Habitation	0.20	--NA--
Religious Place	0.30	Maha Laxmi Temple
Historical Place	0.10	--NA--
Creek/Sea	0.10	Creek/Sea

6b. Enter Latitude and Longitude details of site

Latitude
0

Longitude
0

7. Does the location satisfy the Requirements Under relevant Central/State Govt. Notification such as Coastal Regulation Zone, Notification on Ecologically Fragile Area, Industrial Location policy, etc. If so, give details.

Location	Approved Industry Area	Sensitive Area	If Yes, Name Of Area	Industry Location with Reference to CRZ
	No	No		

8. If the site is situated in notified industrial estate,

		Details
(a) Whether effluent collection, treatment and disposal system has been provided by the authority.	No	
(b) Will the applicant utilize the system, if provided.	No	
(c) If not provided, details of proposed arrangement.		

9.

(a) Total plot area (in squear meter)	(b) Built up area and (in squear meter)	(c) Area available for the use of treated sewage/ trade effluent for gardening/irrigation. (in squear meter)
9855	4050	500

10. Month and year of commissioning of the Unit.

2021-02-20

11. Number of workers and office staff

Workers	staff	Hrs. of shift	Weekly off

12.

(a) Do you have a residential colony Within the premises in respect of Which the present application is Made ?	No

(b) If yes, please state population staying

Number of person staying	Water consumption	Sewage generation	Whether is STP provided?
			No

(c) Indicate its location and distance with reference to plant site.

Number of person staying	Water consumption

13. List of products and by-products Manufactured in tonnes/month, Kl/month or numbers/month with their types i.e.Dyes, drugs etc. (Give figures corresponding to maximum installed production capacity

Products Name and Quantity

Product Name	UOM	Product Name	Existing	Consented	Proposed Revision	Total	Remarks
RMC	m3/day	concrete	0	1200	0	1200	NA

Products Name and Quantity

Product Name	UOM	Quantity	Remarks
Spent wash/Concrete	m3/day	120	NA

14. List of raw materials and process chemicals with annual consumption corresponding to above stated production figures, in tonnes/month or kl/month or numbers/month.

Name of Raw Material	UOM	Quantity	Hazardous Waste	Hazardous Chemicals	Remarks

Cement	MT/M	6600	No	No	NA
Admixtures	MT/M	132	No	No	NA
Aggregates	MT/M	15000	No	No	NA
Sand	MT/M	15000	No	No	NA
Water	MT/M	3600	No	No	NA
Micro Silica	MT/M	3600	No	No	NA

15. Description of process of manufacture for each of the products showing input, output, quality and quantity of solid, liquid and gaseous wastes, if any from each unit process.

Part B : Waste Water aspects

16. Water consumption for different uses (m3/day)

Purpose	***Consumption***	***Effluent Generation***	***Treatment***	***Remarks***	***Disposal***	***Remarks***
Domestic Pourpose	10	8	Septic Tank & Soak Pit	Sedimentation tank	Recycle	NA
Water gets Polluted & Pollutants are Biodegradable	120	96	OTHERS	Sedimentation tank	Recycle	NA
Water gets Polluted,Pollutants are not Biodegradable & Toxic	0	0	--NA--	NA	--NA--	NA
Industrial Cooling,spraying in mine pits or boiler feed	0	0	--NA--	NA	--NA--	NA
Others	NA					

17. Source of water supply, Name of authority granting permission if applicable and quantity permitted.

Source of water supply ***Name of authority granting permission*** ***Qauntity permitted***

18. Quantity of waste water (effluent) generated (m3/day)

Domastic ***Boiler Blowdown*** ***Industrial*** ***Cooling water blowdown***

Process ***DM Plants/Softening*** ***Washing*** ***Tail race discharge from***

* 19. Water budget calculations accounting for difference between water consumption and effluent generated.

20. Present treatment of sewage/canteen effluent (Give sizes/capacities of treatment units).

Capacity of STP (m3/day)

Treatment unit ***Size (mxm)*** ***Retention time (hr)***

21. Present treatment of trade effluent (Give sizes/capacities of treatment units) (A schematic diagram of the treatment scheme with inlet/outlet characteristics of each unit operation/process is to be provided. Include details of residue Management system (ETP sludges)

Capacity of ETP (m3/day)

Treatment unit	Size (mxm)	Retention time (hr)

22.

(i) Are sewage and trade effluents mixed together?	No
If yes, state at which stage-Whether before, intermittently or after treatment.	

23. Capacity of treated effluent sump, Guard Pond if any.

Capacity of treated effluent sump (m3)	
Effluent sump/Guard pond details	No
If yes, state at which stage-Whether before, intermittently or after treatment.	No

24. Mode of disposal of treated effluent With respective quantity, m3/day

(i) into stream/river (name of river)	***(ii) into creek/estuary (name of Creek/estuary)***
(iii) into sea	***(iv) into drain/sewer (owner of sewer)***
(v) On land for irrigation on owned land/ase land. Specify cropped area.	***(vi) Connected to CETP***
(vii) Quantity of treated effluent reused/ recycled, m3/day Provide a location map of disposal arrangement indicating the outler(s) for sampling. Treated effluent reused / recycled (m3/day)	

25. (a) Quality of untreated/treated effluents (Specify pH and concentration of SS, BOD,COD and specific pollutants relevant to the industry. TDS to be reported for disposal on land or into stream/river.

Untreated Effluent

pH	NA	
SS (mg/l)	NA	
BOD (mg/l)	NA	
COD (mg/l)	NA	
TDS (mg/l)	NA	
Specific pollutant if any	***Name***	***Value***
1	0	0

Treated Effluent

pH	NA	
SS (mg/l)	NA	
BOD (mg/l)	NA	
COD (mg/l)	NA	
TDS (mg/l)	NA	
Specific pollutant if any	***Name***	***Value***
1	0	0

(b) Enclose a copy of the latest report of analysis from the laboratory approved by State Board/ Committee/Central Board/Central Government in the Ministry of Environment expected characteristics of the untreated/treated effluent

---

26. Fuel consumption

Fuel Type	***UOM***	***Fuel Consumption TPD/LKD***	***Calorific value***
Diesel	Ltr/Hr	42.6	10800
Ash content	***Sulphur content***	***Quantity***	***Other (specify)***
0.0	0.25	1	NA

---

27. (a) Details of stack (process & fuel stacks: D. G.)

(a) Stack number(s)	***(b) Stack attached to***	***(c) Capacity***	***(d) Fuel Type***
1	DG SET	AS PER NORMS	DIESEL
(e) Fuel quantiy (Kg/hr.)	***(f) Material of construction***	***(g) Shape (round/rectangular)***	***(h) Height, m (above ground level)***
42.6	MS	ROUND	6
(i) Diameter/Size, in meters	***(j) Gas quantity, Nm3/hr.***	***(k) Gas temperature °C***	***(l) Exit gas velocity, m/sec.***
0.3	2800	120	800
(m) Control equipment preceding the stack	***(n) Nature of pollutants likely to present in stack gases such as Cl2, Nox, Sox TPM etc.***	***(o) Emissions control system provided***	***(p) In case of D.G. Set power generation capacity in KVA***
AS PER CPCB	PM, SO2, NOx	AS PER CPCB	250

---

27. (B) Whether any release of odoriferous compounds such as Mercaptans, Phorate etc. Are coming out from any storages or process house.

---

28. Do you have adequate facility for collection of samples of emissions in the form of port holes, platform, ladder\etc. As per Central Board Publication "Emission regulations Part-III" (December, 1985)

Poart hole	No	***Details***	
Platform	No	***Details***	
Ladder	No	***Details***	

---

29. Quality of treated flue gas emissions and process emissions. Quantity of treated flue gas emissions and process emissions.

Sr. No	***Stack attached to***	***Parameter***	***Concentration mg/Nm3***	***flow (Nm3/hr)***
1				

(Specify concentration of criteria pollutants and industry/process-specific pollutants stack-wise. Enclose a copy of the latest report of analysis from the laboratory approved by State Board/Central Board/ Central Government in the Ministry of Environment & Forests. For proposed unit furnish expected characteristics of the emissions..

Part - D: Hazardous Waste aspect

---

30. Information about Hazardous Waste Management as defined in Hazardous Waste (Management & Handling) Rules, 1989 as amended in Jan..2000. Type/Category of Waste as per

Waste (Annually) Schedule I

Cat No	***Type***	***Qty***	***UOM***

5.1	5.1 Used or spent oil	40	Ltr/A
Max	***Method of collection*** MANUAL	***Method of reception*** MANUAL	***Method of storage*** BARREL
Method of transport Authorized Agency	***Method of treatment*** Authorized Agency	***Method of disposal*** Authorized Agency	

Waste (Annually) Schedule II

31. Details about use of hazardous waste

Name of hazardous waste/Spent chemical	***Quantity used/month***	***Party from whom purchased***	***Party to whom sold***

32.

a. Details about technical capability and equipments available with the applicant to handle the Hazardous Waste

b. Characteristics of hazardous waste(s) Specify concentration of relevant pollutants. Enclose a copy of the latest report of analysis from the laboratory approved by State Board/Central Board/Central Govt. in the ministry of Environment & Forests. For proposed units furnish expected characteristics

33.

Copy of format of manifest/record Keeping practiced by the applicant.

34.

Details of self-monitoring (source and environment system)

35.

Are you using any imported hazardous waste. If yes, give details.

36.

Copy of actual user Registration/certificate obtained from State Pollution Control Board/Ministry of Environment & Forests, Government of India, for use of hazardous waste.

37.

Present treatment of hazardous waste, if any (give type and capacity of treatment units)

38. Quantity of hazardous waste disposal

(i) Within factory

(ii) Outside the factory (specify location and enclose copies of agreement.)

(iii) Through sale (enclosed documentary proof and copies of agreement.)

(iv) Outside state/Union Territory, if yes particulars of (1 & 3) above.

(v) Other (Specify)

Part - E: Additional Information

39.

a. Do you have any proposals to upgrade the present system for treatment and disposal of effluent/emissions and/or hazardous waste.

b. If yes, give the details with time- schedule for the implementation and approximate expenditure to be incurred on it.

40.

Capital and recurring (O & M) expenditure on various aspect of environment protection such as effluent, emission, hazardous waste, solid waste, tree- plantation, monitoring, data acquisition etc. (give figures separately for items impiemented/to be implemented).

41.

To which of the pollution control equipment, separate meters for recording consumption of electric energy are installed ?

42.

Which of the pollution control items are connected to D.G. Set (captive power source) to ensure their running in the event of normal power failure

---

43. Nature, quantity and method of disposal of non- hazardous solid waste generated separately from the process of manufacture and waste treatment. (Give details of area/capacity available in applicant's land)

Type	*Quantity*	*UOM*	*Treatment*	*Disposal*	*Other Details*
Municipal Waste	12	Kg/Day	Locally	Local Body	NA
Spent Wash/Rejected Cubes	1.5	m3/day	Recycle/Reuse	Recycle/Reuse	NA

---

44. Hazardous Chemicals – Give details of Chemicals and quantities handled and Stored.

(i) Is the unit a Majot Accident Hazard unit as per Mfg.Storage Import Hazardous Chemicals Rules ?

(ii) Is the unit an isolated storage as defined under the MSIHC Rules ?

(iii) Indicate status of compliance of Rules 5,7,10,11,12.13 and 18 of the MSIHC Rules.

(iv) Has approval of site been obtained from the concerned authority?

(v) Has the unit prepared an off-site Emergency Plan? Is it updated ?

(vi) Has information on imports of Chemicals been provided to the concerned authority?

(vii) Does the unit possess a policy under the PLI Act?

---

45. Brief details of tree plantation/green belt development within applicant's premises (in hectors)

Open Space Availability	*Plantation Done On*	*Number of Trees Planted*
Square meter	Square meter(%)	

46.

Information of schemes for waste Minimization, resource recovery and recycling - implemented and to be implemented, separately.

NA

47.

(a) The applicant shall indicate whether Industry comes under Public Hearing, if so, the relevant documents such as EIA, EMP, Risk Analysis etc. shall be submitted, if so, the relevant documents enclosed shall be indicated accordingly.

(b) Any other additional information that the applicants desires to give

(c) Whether Environmental Statement submitted ? If submitted, give date of submission.

48.

I/We further declare that the information furnished above is correct to the best of my/our knowledge.

49.

I/We hereby submit that in case of any change from what is stated in this application in respect of raw materials, products, process of manufacture and treatment and/or disposal of effluent, emission, hazardous wastes etc. in quality and quantity; a fresh application for Consent/Authorization shall be made and until the grant of fresh Consent/Authorization no change shall be made.

50.

I/We undertake to furnish any other information within one month of its being called by the Board

Yours faithfully

Signature : RAKESH SINGH SISODIA
Name : RAKESH SINGH SISODIA
Designation : Project Director

Additional Information

Air Pollution

Sr No.	*Air Pollution Source*	*Pollutants*	*APCS Provided*	*Remark*
1	DG Set	PM, SO2,NOx	As per CPCB Standard	NA

Separate EM Provided	No	***Other Emission Sources***	NA
Measures Proposed	NA	***Foul Smell Coming Out***	No
Air Sampling Facility Details	NA		

D.G. Set Details

Description	*Capacity(KVA)*	*Remarks*
1 x 250 KVA	250	DG Will be used during power cut

Hazardous Waste Generation

Hazardous Waste	*Quantity*	*UOM*	*Treatment*	*Disposal*	*Other Details*
5.1 Used or spent oil	40	Ltr/A	Authorized Vendor	Through Authorized Vendor	NA

CHWTSDF Details

Member of CHWTSDF	*CHWTSDF Name*	*Remarks*

Cess Details

Cess Applicable	*Cess Paid*	*If Yes, UpTo*
No	No	Jan 1 1900 12:00:00:000AM

Legal Actions

Legal Action Taken	*Legal Record Of Company*	*Legal Action Details*	*Remarks*
No			

C-93

Maharashtra Pollution Control Board

महाराष्ट्र प्रदूषण नियंत्रण मंडळ

Application for Consent/ Authorisation

Sir,
I/We hereby apply for*

1. Consent to Establish/Operate/Renewal of consent under section 25 and 26 of the Water (Prevention & Control of Pollution) Act, 1974 as amended.

2. Consent to Establish/Operate/Renewal of consent under Section 21 of the Air (Prevention and Control of Pollution) Act, 1981, as amended.

3. Authorization/renewal of authorization under Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 in connection with my/our/existing/proposed/altered/ additional manufacturing/processing activity from the premises as per the details given below.

Consent Information

UAN No:
MPCB-CONSENT-0000108800

Application submitted on:
17-02-2021

Industry Information

Consent To:
Operate

IIN No.:

Submit to:
SRO - Mumbai I

Type of institution:
Industry

Industry Type:
G11 Cement products (without using asbestos / boiler / steam curing) like pipe,pillar, jafri, well ring, block/tiles etc.(should be done in closed covered shed to control fugitive emissions)

Category:
Green

Scale:
S.S.I

EC Reqd.
No

EC Obtained
No

EC Ref. No.
-

Whether construction-buildup area is more than 20,000 sq.mtr.(Existing Expansion Unit)
No

General Information

1. Name, designation, office address with Telephone/Fax numbers, e-mail of the Applicant Occupier/Industry/Institution / Local Body.

Name
RAKESH SINGH SISODIA

Address
TOWER-B, TC-II, 1ST FLOOR,L&T GATE-5, POWAI,Mumbai City,Mumbai City

Designation
PROJECT DIRECTOR

Taluka
Mumbai City

Area
Parking Place, Amarsons Garden, Near Tata Tea Garden, AMARSONS GARDEN, AMARSONS GARDEN, MUMBAI CITY,

District
Mumbai city

Telephone

Fax

9870061308

Email
jadhavani@lntecc.com

Pan Number
AHFPS2369L

---

2. (a) Name and location of the industrial unit/premises for which the application is made (Give revenue Survey Number/Plot number name of Taluka and District, also telephone and fax number)

Industry name
Larsen & Toubro

Location of Unit
MCRP-1, Amarson Garden, Near Breach Candy Hospital

Survey number/Plot Number
Amarson Garden

Taluka
Mumbai City

District
Mumbai city

(b) Details of the planning permission obtained from the local body/Town and Country Planning authority/Metropolitan Development authority/ designated Authority.

Planning permission

Planning Authority

Name of the local body under whose jurisdiction the unit is located and Name of the licence issuing authority

Name of Local Body

Name of the licence issuing authority

---

3. Names,addresses with Telephone and Fax Number of Managing Director / Managing Partner and officer responsible for matters connected with pollution control and/or Hazardous waste disposal.

Name of Managing Director
RAKESH SINGH SISODIA

Telephone number
9167061106

Fax number
0

Officer responsible for day to day business
7710009765

4. (a.) Are you registered Industrial unit ?

Yes

Registration number
L99999MH1946PLC004768

Date of registration
Feb 7, 1946

---

5. Gross capital investment of the unit without depreciation till the date of application (Cost of building, land, plant and machinery). (To be supported by an affidavit/undertaking on Rs.20/- stamp paper, annual report or certificate from a Chartered Accountant for proposed unit(s), give estimated figure)

Gross capital (in Lakh)	**** Verified***	**** Terms***	**** Consent Fee***
3161.00	CA Certificate	1	75000.00

---

6. If the site is located near sea-shore/river bank/other water bodies/Highway, indicate the crow fly distance and the name of the water body, if any.

Distance From	***Distance(Km)***	**** Name***
SH/NH	80.00	Mumbai-Pune Highway
River	20.00	Mithi
Human Habitation	25.00	MIDC
Religious Place	3.00	Maha Laxmi Temple
Historical Place	43.00	Belapur Fort
Creek/Sea	0.12	Creek/Sea

6b. Enter Latitude and Longitude details of site

Latitude
0

Longitude
0

7. Does the location satisfy the Requirements Under relevant Central/State Govt. Notification such as Coastal Regulation Zone. Notification on Ecologically Fragile Area, Industrial Location policy, etc. If so, give details.

Location	Approved Industry Area	Sensitive Area	If Yes, Name Of Area	Industry Location with Reference to CRZ
	No	No		

8. If the site is situated in notified industrial estate,

		Details
(a) Whether effluent collection, treatment and disposal system has been provided by the authority.	No	
(b) Will the applicant utilize the system, if provided.	No	
(c) If not provided, details of proposed arrangement.		

9.

(a) Total plot area (in squear meter)	(b) Built up area and (in squear meter)	(c) Area available for the use of treated sewage/ trade effluent for gardening/irrigation. (in squear meter)
51000	34926	10000

10. Month and year of commissioning of the Unit.

2021-03-18

11. Number of workers and office staff

Workers	staff	Hrs. of shift	Weekly off

12.

(a) Do you have a residential colony Within the premises in respect of Which the present application is Made ?	No

(b) If yes, please state population staying

Number of person staying	Water consumption	Sewage generation	Whether is STP provided?
			No

(c) Indicate its location and distance with reference to plant site.

Number of person staying	Water consumption

13. List of products and by-products Manufactured in tonnes/month, Kl/month or numbers/month with their types i.e.Dyes, drugs etc. (Give figures corresponding to maximum installed production capacity

Products Name and Quantity

Product Name	UOM	Product Name	Existing	Consented	Proposed Revision	Total	Remarks
Casting	m3/day	Casting Bridge Elements	0	180	0	180	NA

Products Name and Quantity

Product Name	UOM	Quantity	Remarks
NA	--NA--	0	NA

14. List of raw materials and process chemicals with annual consumption corresponding to above stated production figures, in tonnes/month or kl/month or numbers/month.

Name of Raw Material	UOM	Quantity	Hazardous Waste	Hazardous Chemicals	Remarks
Bee Wax	Kg/M	29104	No	No	NA
Curing Compound	Ltr/M	34925	No	No	NA
Shuttering Oil	Ltr/M	17462	No	No	NA
Ready Mix Concrete	m3/day	200	No	No	NA
Reinforcement	MT/M	40	No	No	NA

15. Description of process of manufacture for each of the products showing input, output, quality and quantity of solid, liquid and gaseous wastes, if any from each unit process.

Part B : Waste Water aspects

16. Water consumption for different uses (m3/day)

Purpose	Consumption	Effluent Generation	Treatment	Remarks	Disposal	Remarks
Domestic Pourpose	10	0	--NA--	NA	--NA--	NA
Water gets Polluted & Pollutants are Biodegradable	120	0	OTHERS	Sedimentation Tank	--NA--	NA
Water gets Polluted,Pollutants are not Biodegradable & Toxic	0	0	--NA--	NA	--NA--	NA
Industrial Cooling,spraying in mine pits or boiler feed	0	0	--NA--	NA	--NA--	NA
Others	NA					

17. Source of water supply. Name of authority granting permission if applicable and quantity permitted.

Source of water supply	Name of authority granting permission	Qauntity permitted

18. Quantity of waste water (effluent) generated (m3/day)

Domastic	**Boiler Blowdown**	**Industrial**	**Cooling water blowdown**
Process	**DM Plants/Softening**	**Washing**	**Tail race discharge from**

* 19. Water budget calculations accounting for difference between water consumption and effluent generated.

20. Present treatment of sewage/canteen effluent (Give sizes/capacities of treatment units).

Capacity of STP (m3/day)

Treatment unit	Size (mxm)	Retention time (hr)

21. Present treatment of trade effluent (Give sizes/capacities of treatment units) (A schematic diagram of the treatment scheme with inlet/outlet characteristics of each unit operation/process is to be provided. Include details of residue Management system (ETP sludges)

Capacity of ETP (m3/day)

Treatment unit	***Size (mxm)***	***Retention time (hr)***

22.

(i) Are sewage and trade effluents mixed together? No

If yes, state at which stage-Whether before, intermittently or after treatment.

23. Capacity of treated effluent sump, Guard Pond if any.

Capacity of treated effluent sump (m3)	
Effluent sump/Guard pond details	No
If yes, state at which stage-Whether before, intermittently or after treatment.	No

24. Mode of disposal of treated effluent With respective quantity, m3/day

(i) into stream/river (name of river)	***(ii) into creek/estuary (name of Creek/estuary)***
(iii) into sea	***(iv) into drain/sewer (owner of sewer)***
(v) On land for irrigation on owned land/ase land. Specify cropped area.	***(vi) Connected to CETP***
(vii) Quantity of treated effluent reused/ recycled, m3/day Provide a location map of disposal arrangement indicating the outler(s) for sampling.	
Treated effluent reused / recycled (m3/day)	

25. (a) Quality of untreated/treated effluents (Specify pH and concentration of SS, BOD,COD and specific pollutants relevant to the industry. TDS to be reported for disposal on land or into stream/river.

Untreated Effluent

pH	Min 6	
SS (mg/l)	Max 200	
BOD (mg/l)	Max 100	
COD (mg/l)	Max 250	
TDS (mg/l)	2000	
Specific pollutant if any	***Name***	***Value***
1	0	0

Treated Effluent

pH	min 6
SS (mg/l)	Less than 100
BOD (mg/l)	Less than 100
COD (mg/l)	Less than 250

TDS (mg/l)	2100

Specific pollutant if any	***Name***	***Value***
1	0	0

(b) Enclose a copy of the latest report of analysis from the laboratory approved by State Board/ Committee/Central Board/Central Government in the Ministry of Environment expected characteristics of the untreated/treated effluent

---

26. Fuel consumption

Fuel Type	***UOM***	***Fuel Consumption TPD/LKD***	***Calorific value***
Diesel	Kg/Hr	25	10800
Ash content	***Sulphur content***	***Quantity***	***Other (specify)***
0	0.2	1	0

---

27. (a) Details of stack (process & fuel stacks: D. G.)

(a) Stack number(s)	***(b) Stack attached to***	***(c) Capacity***	***(d) Fuel Type***
1	DG	NA	DIESEL
(e) Fuel quantiy (Kg/hr.)	***(f) Material of construction***	***(g) Shape (round/rectangular)***	***(h) Height, m (above ground level)***
25	MS	ROUND	3.5
(i) Diameter/Size, in meters	***(j) Gas quantity, Nm3/hr.***	***(k) Gas temperature °C***	***(l) Exit gas velocity, m/sec.***
0.3	300	NA	14
(m) Control equipment preceding the stack	***(n) Nature of pollutants likely to present in stack gases such as Cl2, Nox, Sox TPM etc.***	***(o) Emissions control system provided***	***(p) In case of D.G. Set power generation capacity in KVA***
NA	NOx. SOx	AS PER CPCB NORMS	250 Kva

---

27. (B) Whether any release of odoriferous compounds such as Mercaptans, Phorate etc. Are coming out from any storages or process house.

---

28. Do you have adequate facility for collection of samples of emissions in the form of port holes, platform, ladder\etc. As per Central Board Publication "Emission regulations Part-III" (December, 1985)

Poart hole	No	***Details***
Platform	No	***Details***
Ladder	No	***Details***

---

29. Quality of treated flue gas emissions and process emissions. Quantity of treated flue gas emissions and process emissions.

Sr. No	***Stack attached to***	***Parameter***	***Concentration mg/Nm3***	***flow (Nm3/hr)***
1				

(Specify concentration of criteria pollutants and industry/process-specific pollutants stack-wise. Enclose a copy of the latest report of analysis from the laboratory approved by State Board/Central Board/ Central Government in the Ministry of Environment & Forests. For proposed unit furnish expected characteristics of the emissions..

Part - D: Hazardous Waste aspect

C-99

30. Information about Hazardous Waste Management as defined in Hazardous Waste (Management & Handling) Rules, 1989 as amended in Jan.,2000. Type/Category of Waste as per

Waste (Annually) Schedule I

Cat No	***Type***	***Qty***	***UOM***
5.1	5.1 Used or spent oil	200	Ltr/M
Max	***Method of collection***	***Method of reception***	***Method of storage***
	Manual	Manual	Barrel
Method of transport	***Method of treatment***	***Method of disposal***	
Through Approved vendor	Through Approved vendor	Through Approved vendor	

Waste (Annually) Schedule II

31. Details about use of hazardous waste

Name of hazardous waste/Spent chemical	***Quantity used/month***	***Party from whom purchased***	***Party to whom sold***

32.

a. Details about technical capability and equipments available with the applicant to handle the Hazardous Waste

b. Characteristics of hazardous waste(s) Specify concentration of relevant pollutants. Enclose a copy of the latest report of analysis from the laboratory approved by State Board/Central Board/Central Govt. in the ministry of Environment & Forests. For proposed units furnish expected characteristics

---

33.

Copy of format of manifest/record Keeping practiced by the applicant.

34.

Details of self-monitoring (source and environment system)

35.

Are you using any imported hazardous waste. If yes, give details.

36.

Copy of actual user Registration/certificate obtained from State Pollution Control Board/Ministry of Environment & Forests, Government of India, for use of hazardous waste.

37.

Present treatment of hazardous waste, if any (give type and capacity of treatment units)

---

38. Quantity of hazardous waste disposal

(i) Within factory

(ii) Outside the factory (specify location and enclose copies of agreement.)

(iii) Through sale (enclosed documentary proof and copies of agreement.)

(iv) Outside state/Union Territory, if yes particulars of (1 & 3) above.

(v) Other (Specify)

Part - E: Additional information

39.

a. Do you have any proposals to upgrade the present system for treatment and disposal of effluent/emissions and/or hazardous waste.

b. If yes, give the details with time- schedule for the implementation and approximate expenditure to be incurred on it.

40.

Capital and recurring (O & M) expenditure on various aspect of environment protection such as effluent, emission, hazardous waste, solid waste, tree- plantation, monitoring, data acquisition etc. (give figures separately for items implemented/to be implemented).

41.

To which of the pollution control equipment, separate meters for recording consumption of electric energy are installed ?

42.

Which of the pollution control items are connected to D.G. Set (captive power source) to ensure their running in the event of normal power failure

43. Nature, quantity and method of disposal of non- hazardous solid waste generated separately from the process of manufacture and waste treatment. (Give details of area/capacity available in applicant's land)

Type	*Quantity*	*UOM*	*Treatment*	*Disposal*	*Other Details*
Reinforcement Steel	15	MT/M	NA	Sell	NA

44. Hazardous Chemicals – Give details of Chemicals and quantities handled and Stored.

(i) Is the unit a Majot Accident Hazard unit as per Mfg.Storage Import Hazardous Chemicals Rules ?

(ii) Is the unit an isolated storage as defined under the MSIHC Rules ?

(iii) Indicate status of compliance of Rules 5,7,10,11,12,13 and 18 of the MSIHC Rules.

(iv) Has approval of site been obtained from the concerned authority?

(v) Has the unit prepared an off-site Emergency Plan? Is it updated ?

(vi) Has information on imports of Chemicals been provided to the concerned authority?

(vii) Does the unit possess a policy under the PLI Act?

45. Brief details of tree plantation/green belt development within applicant's premises (in hectors)

Open Space Availability	*Plantation Done On*	*Number of Trees Planted*
Square meter	Square meter(%)	

46.

Information of schemes for waste Minimization, resource recovery and recycling - implemented and to be implemented, separately.

Reuse, Recycle

47.

(a) The applicant shall indicate whether Industry comes under Public Hearing, if so, the relevant documents such as EIA, EMP, Risk Analysis etc. shall be submitted, if so, the relevant documents enclosed shall be indicated accordingly.

(b) Any other additional information that the applicants desires to give

(c) Whether Environmental Statement submitted ? If submitted, give date of submission.

48.

I/We further declare that the information furnished above is correct to the best of my/our knowledge.

49.

I/We hereby submit that in case of any change from what is stated in this application in respect of raw materials, products, process of manufacture and treatment and/or disposal of effluent, emission, hazardous wastes etc. In quality and quantity; a fresh application for Consent/Authorization shall be made and until the grant of fresh Consent/Authorization no change shall be made.

50.

I/We undertake to furnish any other information within one month of its being called by the Board

---

Yours faithfully

Signature : RAKESH SINGH SISODIA
Name : RAKESH SINGH SISODIA
Designation : Project Director

Additional Information

Air Pollution

Sr No.	*Air Pollution Source*	*Pollutants*	*APCS Provided*	*Remark*
1	DG Set	PM, SO2,NOx	As per CPCB Standard	NA

Separate EM Provided	No	***Other Emission Sources***	NA
Measures Proposed	NA	***Foul Smell Coming Out***	No
Air Sampling Facility Details	NA		

D.G. Set Details

Description	*Capacity(KVA)*	*Remarks*
1 x 250 KVA	250	DG Will be used during power cut

Hazardous Waste Generation

Hazardous Waste	*Quantity*	*UOM*	*Treatment*	*Disposal*	*Other Details*
5.1 Used or spent oil	200	Ltr/M	Authorized Vendor	Through Authorized Vendor	NA

CHWTSDF Details

Member of CHWTSDF	*CHWTSDF Name*	*Remarks*

Cess Details

Cess Applicable	Cess Paid	If Yes, UpTo
No	No	Jan 1 1900 12:00:00:000AM

Legal Actions

Legal Action Taken	Legal Record Of Company	Legal Action Details	Remarks
No			

Maharashtra Pollution Control Board

महाराष्ट्र प्रदूषण नियंत्रण मंडळ

Application for Consent/ Authorisation

Sir,
I/We hereby apply for*

1. Consent to Establish/Operate/Renewal of consent under section 25 and 26 of the Water (Prevention & Control of Pollution) Act, 1974 as amended.

2. Consent to Establish/Operate/Renewal of consent under Section 21 of the Air (Prevention and Control of Pollution) Act, 1981, as amended.

3. Authorization/renewal of authorization under Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 in connection with my/our/existing/proposed/altered/ additional manufacturing/processing activity from the premises as per the details given below.

Consent Information

UAN No:
MPCB-CONSENT-0000110911

Application submitted on:
17-03-2021

Industry Information

Consent To:
Establish (New)

IIN No.:

Submit to:
SRO - Mumbai I

Type of Institution:
Industry

Industry Type:
O64 Stone crushers

Category:
Orange

Scale:
S.S.I

EC Reqd.
No

EC Obtained
No

EC Ref. No.
-

Whether construction-buildup area is more than 20,000 sq.mtr.(Existing Expansion Unit)
No

General Information

1. Name, designation, office address with Telephone/Fax numbers, e-mail of the Applicant Occupier/Industry/Institution / Local Body.

Name
RAKESH SINGH SISODIA

Address
TOWER-B, TC-II, 1ST FLOOR,L&T GATE-5, POWAI,Mumbai City,Mumbai City

Designation
PROJECT DIRECTOR

Taluka
Mumbai City

Area
Parking Place, Amarsons Garden, Near Tata Tea Garden, AMARSONS GARDEN, AMARSONS GARDEN, MUMBAI CITY,

District
Mumbai city

Telephone
9870061308

Fax

Email
jadhavani@lntecc.com

Pan Number
AHFPS2369L

2. (a) Name and location of the industrial unit/premises for which the application is made (Give revenue Survey Number/Plot number name of Taluka and District, also telephone and fax number)

Industry name
LARSEN & TOUBRO LTD

Location of Unit
MUMBAI COASTAL ROAD PROJECT PACKAGE-1, PROJECT SITE, AMARSONS GARDEN, MUMBAI

Survey number/Plot Number
MCRP-1

Taluka
NA

District
Mumbai city

(b) Details of the planning permission obtained from the local body/Town and Country Planning authority/Metropolitan Development authority/ designated Authority.

Planning permission
NA

Planning Authority
NA

Name of the local body under whose jurisdiction the unit is located and Name of the licence issuing authority

Name of Local Body
NA

Name of the licence issuing authority
NA

3. Names,addresses with Telephone and Fax Number of Managing Director / Managing Partner and officer responsible for matters connected with pollution control and/or Hazardous waste disposal.

Name of Managing Director
Rakesh Singh Sisodia

Telephone number
9167061106

Fax number

Officer responsible for day to day business
R Muthuraman

4. (a.) Are you registered Industrial unit ?
No

Registration number
L99999MH1946PLC004768

Date of registration
Feb 7, 1946

5. Gross capital investment of the unit without depreciation till the date of application (Cost of building, land, plant and machinery). (To be supported by an affidavit/undertaking on Rs.20/- stamp paper, annual report or certificate from a Chartered Accountant for proposed unit(s), give estimated figure)

Gross capital (in Lakh)	**** Verified***	**** Terms***	**** Consent Fee***
550.00	CA Certificate	1	25000.00

6. If the site is located near sea-shore/river bank/other water bodies/Highway, Indicate the crow fly distance and the name of the water body, if any.

Distance From	***Distance(Km)***	**** Name***
SH/NH	80.00	Mumbai-Pune Highway
River	20.00	Mithi
Human Habitation	25.00	MIDC
Religious Place	3.00	Maha Laxmi Temple
Historical Place	43.00	Belapur Fort
Creek/Sea	0.10	Creek/Sea

6b. Enter Latitude and Longitude details of site

Latitude
18.92552837205934

Longitude
70.51011258724817

C-105

7. Does the location satisfy the Requirements Under relevant Central/State Govt. Notification such as Coastal Regulation Zone. Notification on Ecologically Fragile Area, Industrial Location policy, etc. If so, give details.

Location	Approved Industry Area	Sensitive Area	If Yes, Name Of Area	Industry Location with Reference to CRZ
NA	No	No		

8. If the site is situated in notified industrial estate.

		Details
(a) Whether effluent collection, treatment and disposal system has been provided by the authority.	No	
(b) Will the applicant utilize the system, if provided.	No	
(c) If not provided, details of proposed arrangement.	NA	

9.

(a) Total plot area (in squear meter)	(b) Built up area and (in squear meter)	(c) Area available for the use of treated sewage/ trade effluent for gardening/irrigation. (in squear meter)
1400	1400	NA

10. Month and year of commissioning of the Unit.

2021-04-29

11. Number of workers and office staff

Workers	staff	Hrs. of shift	Weekly off
5	1	8	-----

12.

(a) Do you have a residential colony Within the premises in respect of Which the present application is Made ? No

(b) If yes, please state population staying

Number of person staying	Water consumption	Sewage generation	Whether is STP provided?
			No

(c) Indicate its location and distance with reference to plant site.

Number of person staying	Water consumption

13. List of products and by-products Manufactured in tonnes/month, Kl/month or numbers/month with their types i.e.Dyes, drugs etc. (Give figures corresponding to maximum installed production capacity

Products Name and Quantity

Product Name	UOM	Product Name	Existing	Consented	Proposed Revision	Total	Remarks
Stone Crushers	MT/Hr	CRUSHED STONE	250	250	0	250	

Products Name and Quantity

Product Name	UOM	Quantity	Remarks
NA	--NA--	0	

14. List of raw materials and process chemicals with annual consumption corresponding to above stated production figures, in tonnes/month or kl/month or numbers/month.

Name of Raw Material	UOM	Quantity	Hazardous Waste	Hazardous Chemicals	Remarks
STONE	MT/Hr	250	No	No	

15. Description of process of manufacture for each of the products showing input, output, quality and quantity of solid, liquid and gaseous wastes, if any from each unit process.

NA

Part B : Waste Water aspects

16. Water consumption for different uses (m3/day)

Purpose	Consumption	Effluent Generation	Treatment	Remarks	Disposal	Remarks
Domestic Pourpose	0	0	--NA--		--NA--	
Water gets Polluted & Pollutants are Biodegradable	0	0	--NA--		--NA--	
Water gets Polluted.Pollutants are not Biodegradable & Toxic	0	0	--NA--		--NA--	
Industrial Cooling,spraying in mine pits or boiler feed	0	0	--NA--		--NA--	
Others						

17. Source of water supply, Name of authority granting permission if applicable and quantity permitted.

Source of water supply	Name of authority granting permission	Qauntity permitted
NA	---	0

18. Quantity of waste water (effluent) generated (m3/day)

Domastic	Boiler Blowdown	Industrial	Cooling water blowdown
0	0	0	0
Process	**DM Plants/Softening**	**Washing**	**Tail race discharge from**
0	0	0	0

* 19. Water budget calculations accounting for difference between water consumption and effluent generated.

0

20. Present treatment of sewage/canteen effluent (Give sizes/capacities of treatment units).

Capacity of STP (m3/day)

0

Treatment unit	Size (mxm)	Retention time (hr)
0	0	0

21. Present treatment of trade effluent (Give sizes/capacities of treatment units) (A schematic diagram of the treatment scheme with inlet/outlet characteristics of each unit operation/process is to be provided. Include details of residue Management system (ETP sludges)

Capacity of ETP (m3/day)

0

Treatment unit	***Size (mxm)***	***Retention time (hr)***
0	0	0

22.

(i) Are sewage and trade effluents mixed together?	No
If yes, state at which stage-Whether before, intermittently or after treatment.	0

23. Capacity of treated effluent sump, Guard Pond if any.

Capacity of treated effluent sump (m3)	0
Effluent sump/Guard pond details	No
If yes, state at which stage-Whether before, intermittently or after treatment.	No

24. Mode of disposal of treated effluent With respective quantity, m3/day

(i) into stream/river (name of river)	NA	***(ii) into creek/estuary (name of Creek/estuary)***	NA
(iii) into sea	NA	***(iv) into drain/sewer (owner of sewer)***	NA
(v) On land for irrigation on owned land/ase land. Specify cropped area.	NA	***(vi) Connected to CETP***	NA
(vii) Quantity of treated effluent reused/ recycled, m3/day Provide a location map of disposal arrangement indicating the outler(s) for sampling. Treated effluent reused / recycled (m3/day)	0		

25. (a) Quality of untreated/treated effluents (Specify pH and concentration of SS, BOD,COD and specific pollutants relevant to the industry. TDS to be reported for disposal on land or into stream/river.

Untreated Effluent

pH	NA	
SS (mg/l)	NA	
BOD (mg/l)	NA	
COD (mg/l)	NA	
TDS (mg/l)	NA	
Specific pollutant if any	***Name***	***Value***
1		

Treated Effluent

pH	NA
SS (mg/l)	NA

BOD (mg/l)	NA
COD (mg/l)	NA
TDS (mg/l)	NA

Specific pollutant if any	***Name***	***Value***
1		

(b) Enclose a copy of the latest report of analysis from the laboratory approved by State Board/ Committee/Central Board/Central Government in the Ministry of Environment expected characteristics of the untreated/treated effluent

NA

---

26. Fuel consumption

Fuel Type	***UOM***	***Fuel Consumption TPD/LKD***	***Calorific value***
Diesel	Ltr/Hr	100	10800
Ash content	***Sulphur content***	***Quantity***	***Other (specify)***
0	0.02	1	

---

27. (a) Details of stack (process & fuel stacks: D. G.)

(a) Stack number(s)	***(b) Stack attached to***	***(c) Capacity***	***(d) Fuel Type***
NA	NA	NA	NA
(e) Fuel quantiy (Kg/hr.)	***(f) Material of construction***	***(g) Shape (round/rectangular)***	***(h) Height, m (above ground level)***
0	------	-----	------
(i) Diameter/Size, in meters	***(j) Gas quantity, Nm3/hr.***	***(k) Gas temperature °C***	***(l) Exit gas velocity, m/sec.***
----	0	-----	-----
(m) Control equipment preceding the stack	***(n) Nature of pollutants likely to present in stack gases such as Cl2, Nox, Sox TPM etc.***	***(o) Emissions control system provided***	***(p) In case of D.G. Set power generation capacity in KVA***
----	----	-----	-----

---

27. (B) Whether any release of odoriferous compounds such as Mercaptans, Phorate etc. Are coming out from any storages or process house.

NA

---

28. Do you have adequate facility for collection of samples of emissions in the form of port holes, platform, ladder\etc. As per Central Board Publication "Emission regulations Part-III" (December, 1985)

Poart hole	No	***Details***
Platform	No	***Details***
Ladder	No	***Details***

---

29. Quality of treated flue gas emissions and process emissions. Quantity of treated flue gas emissions and process emissions.

Sr. No	***Stack attached to***	***Parameter***	***Concentration mg/Nm3***	***flow (Nm3/hr)***
1	NA	NA	0	0

(Specify concentration of criteria pollutants and industry/process-specific pollutants stack-wise. Enclose a copy of the latest report of analysis from the laboratory approved by State Board/Central Board/ Central Government in the Ministry of Environment & Forests. For proposed unit furnish expected characteristics of the emissions..

NA

Part - D: Hazardous Waste aspect

30. Information about Hazardous Waste Management as defined in Hazardous Waste (Management & Handling) Rules, 1989 as amended in Jan.,2000. Type/Category of Waste as per

Waste (Annually) Schedule I

Cat No	***Type***	***Qty***	***UOM***
NA		0	--NA--
Max	***Method of collection***	***Method of reception***	***Method of storage***
	NA	NA	NA
Method of transport	***Method of treatment***	***Method of disposal***	
NA	NA	NA	

Waste (Annually) Schedule II

31. Details about use of hazardous waste

Name of hazardous waste/Spent chemical	***Quantity used/month***	***Party from whom purchased***	***Party to whom sold***
-----	0	----	----

32.

a. Details about technical capability and equipments available with the applicant to handle the Hazardous Waste

---

b. Characteristics of hazardous waste(s) Specify concentration of relevant pollutants. Enclose a copy of the latest report of analysis from the laboratory approved by State Board/Central Board/Central Govt. in the ministry of Environment & Forests. For proposed units furnish expected characteristics

---

33.

Copy of format of manifest/record Keeping practiced by the applicant.

34.

Details of self-monitoring (source and environment system)

35.

Are you using any imported hazardous waste. If yes, give details.

36.

Copy of actual user Registration/certificate obtained from State Pollution Control Board/Ministry of Environment & Forests, Government of India, for use of hazardous waste.

37.

Present treatment of hazardous waste, if any (give type and capacity of treatment units)

---

38. Quantity of hazardous waste disposal

(i) Within factory

0

(ii) Outside the factory (specify location and enclose copies of agreement.)

0

(iii) Through sale (enclosed documentary proof and copies of agreement.)

0

(iv) Outside state/Union Territory, if yes particulars of (1 & 3) above.

0

(v) Other (Specify)

0

Part - E: Additional information

39.

a. Do you have any proposals to upgrade the present system for treatment and disposal of effluent/emissions and/or hazardous waste.

NA

b. If yes, give the details with time- schedule for the implementation and approximate expenditure to be incurred on it.

NA

40.

Capital and recurring (O & M) expenditure on various aspect of environment protection such as effluent, emission, hazardous waste, solid waste, tree- plantation, monitoring, data acquisition etc. (give figures separately for items implemented/to be implemented).

NA

41.

To which of the pollution control equipment, separate meters for recording consumption of electric energy are installed ?

NA

42.

Which of the pollution control items are connected to D.G. Set (captive power source) to ensure their running in the event of normal power failure

NA

43. Nature, quantity and method of disposal of non- hazardous solid waste generated seperately from the process of manufacture and waste treatment. (Give details of area/capacity available in applicant's land)

Type	*Quantity*	*UOM*	*Treatment*	*Disposal*	*Other Details*
NA	0	--NA--	0	0	

44. Hazardous Chemicals - Give details of Chemicals and quantities handled and Stored.

(i) Is the unit a Majot Accident Hazard unit as per Mfg.Storage Import Hazardous Chemicals Rules ?

(ii) Is the unit an isolated storage as defined under the MSIHC Rules ?

(iii) Indicate status of compliance of Rules 5,7,10,11,12,13 and 18 of the MSIHC Rules.

(iv) Has approval of site been obtained from the concerned authority?

(v) Has the unit prepared an off-site Emergency Plan? Is it updated ?

(vi) Has information on imports of Chemicals been provided to the concerned authority?

(vii) Does the unit possess a policy under the PLI Act?

---

45. Brief details of tree plantation/green belt development within applicant's premises (in hectors)

Open Space Availability	***Plantation Done On***	***Number of Trees Planted***
0 Square meter	0 Square meter(0 %)	0

46.

Information of schemes for waste Minimization, resource recovery and recycling - implemented and to be implemented, separately.

NA

47.

(a) The applicant shall indicate whether Industry comes under Public Hearing, if so, the relevant documents such as EIA, EMP, Risk Analysis etc. shall be submitted, if so, the relevant documents enclosed shall be indicated accordingly.

0

(b) Any other additional information that the applicants desires to give

0

(c) Whether Environmental Statement submitted ? If submitted, give date of submission.

0

48.

I/We further declare that the information furnished above is correct to the best of my/our knowledge.

49.

I/We hereby submit that in case of any change from what is stated in this application in respect of raw materials, products, process of manufacture and treatment and/or disposal of effluent, emission, hazardous wastes etc. in quality and quantity; a fresh application for Consent/Authorization shall be made and until the grant of fresh Consent/Authorization no change shall be made.

50.

I/We undertake to furnish any other information within one month of its being called by the Board

Yours faithfully

Signature : Rakesh Singh Sisodia
Name : Rakesh Singh Sisodia
Designation : PROJECT DIRECTOR

Additional Information

Air Pollution

Sr No.	***Air Pollution Source***	***Pollutants***	***APCS Provided***	***Remark***

1	STONE CRUSHING	PM10 and PM2.5	NA	NA

Separate EM Provided	No	***Other Emission Sources***	NA
Measures Proposed	NA	***Foul Smell Coming Out***	No
Air Sampling Facility Details	NA		

D.G. Set Details

Description	***Capacity(KVA)***	***Remarks***
NA	0	NA

Hazardous Waste Generation

Hazardous Waste	***Quantity***	***UOM***	***Treatment***	***Disposal***	***Other Details***

CHWTSDF Details

Member of CHWTSDF	***CHWTSDF Name***	***Remarks***

Cess Details

Cess Applicable	***Cess Paid***	***If Yes, UpTo***
No	No	Jan 1 1900 12:00:00:000AM

Legal Actions

Legal Action Taken	***Legal Record Of Company***	***Legal Action Details***	***Remarks***
No			

MUMBAI COASTAL PROJECT
PACKAGE-2

C-115

MAHARASHTRA POLLUTION CONTROL BOARD

Phone : 022-24016239
Fax : 022-24015269
Email : Sromumbai1@mpcb.gov.in
Visit At : http://www.mpcb.gov.in

Kalpataru point, 1st floor, Sion Circle,
Opp. PVR Cinema, Sion (East),
Mumbai- 400 022

Green/S.S./

Consent No: SRO- MUMBAI-1 /CONSENT/2012000933 Date- 21.12.2020

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 / Renewal of Authorization under Rule 5 of the Hazardous Wastes (Management, Handling & Transboundry Movement) Rules 2008

[To be referred as Water Act, Air Act and HW (M&H) Rules respectively].

CONSENT is hereby granted to

**M/s. HCC – HDC JV ,
Mumbai Coastal Road Project Package - II , Worli ,
Address - HCC HDC JV Mumbai Coastal Road Project Package - II , Worli
Worli Seaface , Khan Abdul Gaffar Khan Road , Sea Face , Opposite Worli Dairy Worli
Mumbai – 400018.**

located in the area declared under the provisions of the Water Act, Air act and Authorization under the provisions of HW(M&H) Rules and amendments thereto subject to the provisions of the Act and the Rules and the Orders that may be made further and subject to the following terms and conditions:

1. **The Consent to Operate is granted up to: 31.12.2023.**

2. **The Consent is valid for the manufacture of –**

Sr. No.	Product Name	Maximum Quantity	UOM
1.	Casting Bridge Element s	200	M^3/ Day
	(Only for Captive Purpose Use of Mumbai Coastal Road Project)		

3. **CONDITIONS UNDER WATER ACT:**

(i) The daily quantity of trade effluent from the factory shall be **08.00 M^3.**
(ii) The daily quantity of sewage effluent from the factory shall not exceed **5.0 M^3.**
(iii) **Trade Effluent :**
Treatment: The waste water generated from sorce like batching plant , washing of transit mixture , floor washing , vehicle washing , two level tyre washing area

shall be collected through well designated system in collection tank and shall provide comprehensive treatment system as is warranted to meet with disposal Standards

The applicant shall provide , comprehensive treatment system consisting of primary / secondary or tertiary treatment as is warranted with reference to influent quality and operate and maintain the same continuously so as to achieve the quality of the treated effluent to the following standards-

(1)	Suspended Solids	Not to exceed	100 mg/l.
(2)	BOD 3 days 27o C.	Not to exceed	100 mg/l.
3)	pH	Not to exceed	Between 5.5 to 9.0
4)	BOD	Not to Exceed	30 mg/litre
5)	COD	Not to Exceed	150 Mg/liter
6)	SS	Not to Exceed	100 mg/liter
7)	Oil and grease	Not to Exceed	10 mg/liter
8)	TDS	Not to Exceed	2100 mg/liter

(iv) **Trade Effluent Disposal:** The treated effluent shall be 100 percent recycled /reuse into process again , gardening /plantation and water sprinkling purpose only . there shall not be any discharge outside from the plant .

(v) **Sewage Effluent Treatment:** The applicant shall provide comprehensive treatment system as is warranted with reference to influent quality and operate and maintain the same continuously so as to achieve the quality of treated effluent to the following standards .

(1)	Suspended Solids	Not to exceed	100 mg/l.
(2)	BOD 3 days 27o C.	Not to exceed	100 mg/l.

(vi) **Sewage Effluent Disposal:** The treated domestic effluent shall be soaked in a soak pit, which shall be got cleaned periodically. Overflow, if any, shall be used on land for gardening / plantation only.

(vii) **Non-Hazardous Solid Wastes:**

Sr. No.	Type Of Waste	Quantity	UOM	Treatment & disposal
1	Aggregates	--	MT/M	Either reused through recovery unit / reclaiming system OR disposed off at designated approved site by local body , for debries /construction waste .

(viii) **Other Conditions:** Industry should monitor effluent quality regularly

C-117

4. **The applicant shall comply with the provisions of the Water (Prevention & Control of Pollution) Cess Act, 1977 (to be referred as Cess Act) and amendment Rules, 2003 there under**

The daily water consumption for the following categories is as under:

(i) Domestic purpose	10.00 CMD
(ii) Water gets Polluted & Pollutants are Biodegradable(Mixing) ...	00.0 CMD
(iii) Water gets Polluted. Pollutants are not Biodegradable & Toxic ...	0.00 CMD
(iv) Industrial Washing , Spraying of Vehicles , Water Sprinkling for dust suppressions	10.0 CMD

The applicant shall regularly submit to the Board the returns of water consumption in the prescribed form and pay the Cess as specified under Section 3 of the said Act.

4. **CONDITIONS UNDER AIR ACT :**

(i) The applicant shall install a comprehensive control system consisting of control equipments as is warranted with reference to generation of emission and operate and maintain the same continuously so as to achieve the level of pollutants to the following standards.

Particulate Matter PM 10	**Not to Exceed**	**100 µg/m³**
Particulate Matter PM 2.5	**Not to Exceed**	**60 µg/m³**
SO2	**Not to Exceed**	**80 ug/m3**
NOX	**Not to Exceed**	**80 ug/m3**

5. **Control Equipment:**

a) Air Pollution Control;

(i) In-house measures;

1. All material transfer points should be covered
2. The dust containment system shall be provided incorporating either of the following
   - Barricading all around the periphery of the plot boundary of height minimum 20 feet or 5 feet above free fall air emission area, whichever is higher with tin sheets. Same may extend above with netlon clothing whenever required
   - Water sprinkling/Chemical dust stabilizing agent spraying system along the periphery inside the premises of RMC.
3. Internal work area shall be, cement concreted/Asphalted.
4. Daily cleaning / Removal of dust accumulation inside the plant (dry/wet) shall be carry out, with industrial vacuum cleaner.
5. Two level tyre washing facility shall be provided at entry and exit points, for transit mixture vehicle.

6. Industry has to install fogger system, to suppress dust emissions inside RMC Premises.

(ii) Raw material storage & handling and others -

1. Storage silos of cement & fly-ash shall be equipped with adequate capacity of dust Collection system such as multi-cyclone followed by bag house assembly.
2. Handling of Cement, sand, fly ash and aggregates shall be carried out with mechanical closed system only.
3. Manual operations shall be permitted only in a closed shed, equipped with dust control system at the loading point as well as roof top secondary dust control system.
4. All Conveyor belts of Sand, aggregate shall be covered with tin sheets and at transfer points dust collection system to be installed to avoid secondary fugitive emissions.
5. Mixing section of cement, aggregate & sand shall be equipped with adequate capacity dust collection system, such as multi-cyclone followed by bag house, so as to limit dust emissions.
6. Storage area of sand & aggregate shall be equipped with roof top water sprinkler system.
7. The air pollution control devices shall be operated regularly.
8. Alternative power supply system should cover both the production and Air pollution control system.
9. Industry shall provide treatment facility industrial effluent.
10. Industry shall provide treatment facility for treated effluent.
11. Industry shall provide disposal facility for solid waste.
12. Industry shall provide proper exhaust system in the premises.

6.Standards for Air Emission

Ambient air quality at a distance of 10 mtr from source OR the plant Boundary, whichever is nearer, shall meet the following standards

Particulate Matter PM $_{10}$	**Not to Exceed**	**100 $\mu g/m^3$**
Particulate Matter PM $_{2.5}$	**Not to Exceed**	**60 $\mu g/m^3$**
SO2	**Not to Exceed**	**80 ug/m3**
NOX	**Not to Exceed**	**80 ug/m3**

7.Standards for Stack Emissions:

(i) The applicant shall observe the following fuel pattern:-

Sr. No.	Type Of Fuel	Quantity	UOM
1.	HSD	200	Lit/D

(ii) The applicant shall erect the chimney(s) of the following specifications:-

Sr. No.	Chimney Attached To	Height in mt
1.	D.G. Set (250 KVA)	3.0 (above roof)

(iii) The applicant shall provide ports in the chimney/(s) and facilities such as ladder, platform etc. for monitoring the air emissions and the same shall be open for inspection to/and for use of the Board's Staff. The chimney(s) vents attached to various sources of emission shall be designated by numbers such as S-1, S-2 etc. and these shall be painted/ displayed to facilitate identification.

(iv) The industry shall take adequate measures for control of noise levels from its own sources within the premises so as to maintain ambient air quality standard in respect of noise to less than 75 dB(A) during day time and 70 dB(A) during night time. Day time is reckoned in between 6 a.m. and 10 p.m. and night time is reckoned between 10 p.m. and 6 a.m.

(v) **Other Conditions:**

1) The industry should not cause any nuisance in surrounding area.

2) The industry should monitor stack emissions and ambient air quality regularly.

8.CONDITIONS UNDER HAZARDOUS WASTE (MANAGEMENT, HANDLING & TRANSBOUNDRY MOVEMENT) RULES, 2008:

(i) The industry shall handle hazardous wastes as specified below.

Sr. No.	Type Of Waste	Quantity	UOM	Disposal
NIL				

(ii) Treatment: - NIL

1. The authorization is hereby granted to operate a facility for collection, storage, transport & disposal of hazardous waste.
2. The industry should comply with the Hazardous Waste (M&H) Rules, 2003.

a. Whenever due to any accident or other unforeseen act or even, such emissions occur or is apprehended to occur in excess of standards laid down, such information shall be forthwith Reported to Board, concerned Police Station, office of Directorate of Health Services, Department of Explosives, Inspectorate of Factories and Local Body. In case of failure of pollution control equipment, the production process connected to it shall be stopped.

b. The unit has to display and maintain the data online outside the factory main gate in Marathi & English both on a 6'x4' display board in the manner and the report of the compliance along with photograph shall be submitted to this office & concerned Regional Office/ Sub Regional Office.

c. It shall be ensured that the Hazardous waste is handled, managed & disposed of strictly in accordance with the Hazardous Waste (Management & Handling) Rules, 1989 as amended on 2003 and shown & submitted to the Board as & when asked for.

- **Noise Pollution Control Measure-**
- The industry shall comply with the Provisions under the Noise (Regulation and Control) Rule – 2000, to control noise Pollution .

9.Industry shall comply with following additional conditions:

i. The applicant shall maintain good housekeeping and take adequate measures for control of pollution from all sources so as not to cause nuisance to surrounding area / inhabitants.

ii. Solid waste – The non hazardous solid waste arising in the factory premises, sweepings, etc., be disposed of scientifically so as not to cause any nuisance / pollution. The applicant shall take necessary permissions from civic authorities for disposal to dumping ground.

iii. The applicant shall provide for an alternate electric power source sufficient to operate all pollution control facilities installed by he applicant to maintain compliance with the terms and conditions of the consent. In the absence, the applicant shall stop, reduce or otherwise, control production to abide by terms & conditions of this consent regarding pollution levels.

iv. The applicant shall not change or alter quantity, quality, the rate of discharge, temperature or the mode of the effluent / emissions or hazardous wastes or control equipment's provided for without previous written permission of the Board.

v. The applicant shall provide facility for collection of environmental samples and samples of trade and sewage effluents, air emissions and hazardous wastes to the Board staff at the terminal or designated points and shall pay to the Board for the services rendered in this behalf.

vi. The applicant shall make an application for renewal of the consent at least 60 days before the date of the expiry of the consent.

vii. The firm shall submit to this office, the 30th day of September every year, the Environmental Statement Report for the financial year ending 31st March in the prescribed Form-V as pre the provisions of rule 14 of the Environment (Protection) (Second Amendment) Rules, 1992.

viii. As inspection book shall be opened and made available to the Board's officers during their visit to the applicant.

ix. The applicant shall install a separate electric meter showing the consumption of energy for operation of domestic and industrial effluent treatment plants and air pollution control system. A register showing consumption of chemicals used for treatment shall be maintained.

x. Separate drainage system shall be provided for collection of trade and sewage effluents. Terminal manholes shall be provided at the end of collection system with arrangement for measuring the flow. No effluent shall be admitted in the pipes / sewers down- stream of the terminal manholes. No effluent shall find its way other than in designed and provided collection System.

xi. Neither storm water nor discharge from other premises shall be allowed to mix with the effluents from the factory.

10. The consent is issued subject to direction issued by CPCB under section 18(1) (b) of Water (Prevention and Control of Pollution) Act, 1974.

C-121

Regarding classification of Industries dated 07th March 2016.

11. Operation of RMC Plant plant shall be in day time only. The Day time is reckoned in between 6 A.M. and 6 P.M. i.e from Sunrise to sunset.
12. The Board may make the standards stringent for the RMC / Batching plants located within Corporation areas.
13. Captive Plants shall carry out air quality monitoring twice in a week for 24 hours.
14. The industry shall comply with the siting criteria as per RMC Notification dtd. 16.10.2016
15. The Entire RMC plant should be enclosed.
16. The Capital investment of the industry is Rs. 2346.80 Lakhs
17. The consent should not be construed as any exemption from Obtaining necessary NOC from other govt. agencies as may deemed fit necessary.
18. This Consent is issued as per Permission of MCGM Chief Engineer Mumbai Coastal Road Vide Letter dtd. 28.9.2018
19. industry shall comply the al the conditions mentioned in the obtaining CRZ clearance on dated 11.5.2017.
20. The Board reserve right to revoke, amend or suspend the consent Granted.

For and on behalf of the
Maharashtra Pollution Control Board

(T.G. Yadav)
Sub Regional Officer, Mumbai-I

To,
M/s. HCC – HDC JV,
Mumbai Coastal Road Project Package - II, Worli,
Address - HCC HDC JV Mumbai Coastal Road Project Package - II, Worli Worli Seaface, Khan Abdul Gaffar Khan Road, Sea Face, Opposite Worli Dairy Worli Mumbai – 400018

Received Consent fee of –

Sr. No.	Amount(Rs.)	Bank Name	Transaction Type	Transaction Date & Approved Date
1	50,000/-	ICICI Dr No. - MPCB-DR-3080	Online Payment NEFT	02.12.2020

Copy Submitted to :-
1. Chief Account officer, MPCB, Sion, Mumbai-22.
2. Regional Officer, MPCB, Mumbai

C-123

MAHARASHTRA POLLUTION CONTROL BOARD

Phone : (022) - 24016239
Fax : (022)- 24015269
Email : romumbai@mpcb.gov.in
Phone : (022) - 24016239

Regional Office, Mumbai,
Kalpataru Point, 1st Floor, Sion Circle,
Sion (E), Mumbai- 400 022

Orange/S.S.I **Date: 13/01/2021**
Consent No: RO-MUMBAI/ 2101000553

Consent to Establish under Section 25 of the Water (Prevention & Control of Pollution) Act, 1974 & under Section 21 of the Air (Prevention & Control of Pollution) Act, 1981 and Authorization / Renewal of Authorization under Rule 5 of the Hazardous Wastes (Management, Handling & Transboundary Movement) Rules 2008

[To be referred as Water Act, Air Act and HW (M&H) Rules respectively].

CONSENT is hereby granted to

M/s. HCC HDC JV, Mumbai Coastal Road Project,
Package-II, Worli,
Sea- Face Khan Abdul Gaffar Khan Road,
Ward G- South, Opposite to Worli Dairy, Worli,
Mumbai 400 018.

Located in the area declared under the provisions of the Water Act, Air act and Authorization under the provisions of HW (M&H) Rules and amendments thereto subject to the provisions of the Act and the Rules and the Orders that may be made further and subject to the following terms and conditions:

1. **The Consent to Establish is granted for a period up to Commissioning of the Project r 5 years whichever is earlier.**

2. **The Consent is valid for the manufacture of -**

Sr. No.	Product Name	Maximum Quantity	UOM
1	Crushed Stone Metal	2000	MT/D
(Mobile Stone Crusher Only for Captive purpose of Mumbai Coastal Road Project)			

3. **CONDITIONS UNDER WATER ACT:**

(i) The daily quantity of trade effluent from the factory shall not exceed Nil M^3.
(ii) The daily quantity of sewage effluent from the factory shall not exceed **00.80 M^3**
(iii) **Trade Effluent Treatment:** Nil.
(iv) **Trade Effluent Disposal:** Nil.
(iii) **Sewage Effluent Treatment:** The applicant shall provide comprehensive treatment system as is warranted with reference to influent quality and operate and maintain the same continuously so as to achieve the quality of treated effluent to the following standards.

(1)	Suspended Solids	Not to exceed	100	mg/l.
(2)	BOD 3 days 27o C.	Not to exceed	100	mg/l.

(iv) **Sewage Effluent Disposal:** The treated domestic effluent shall be soaked in a soak pit, which shall be got cleaned periodically. Overflow, if any, shall be used on land for gardening / plantation only.

(v) **Non-Hazardous Solid Wastes:**

Sr. No.	Type Of Waste	Quantity	UOM	Treatment & Disposal
1	Nil	--	--	--

4. The applicant shall comply with the provisions of the Water (Prevention & Control of Pollution) Cess Act, 1977 (to be referred as Cess Act) and amendment Rules, 2003 there under:

The daily water consumption for the following categories is as under:

(i)	Domestic purpose	...	01.00 CMD
(ii)	Water gets Polluted & Pollutants are Biodegradable	...	00.00 CMD
(iii)	Water gets Polluted, Pollutants are not Biodegradable & Toxic	...	00.00 CMD
(iv)	Industrial Cooling, spraying in mine pits or boiler feed	...	00.00 CMD

5. CONDITIONS UNDER AIR ACT:

(i) The applicant shall install a comprehensive control system consisting of control equipments as is warranted with reference to generation of emission and operate and maintain the same continuously so as to achieve the level of pollutants to the following standards:

a) **Standards for Emission** (Ambient Air)

1.	$PM_{2.5}$	Not to exceed	60	$\mu g/NM^3$
2.	PM_{10}	Not to exceed	100	$\mu g/NM^3$
3.	SO_2	Not to exceed	80	$\mu g/NM^3$
4.	NO_X	Not to exceed	80	$\mu g/NM^3$

b) **Control Equipment:**

Air Pollution Control:-

1) Adequate capacity Air pollution control devices, Water sprinkler arrangement shall be provided for dust suppression.
2) Metallic approach road shall be provided in the work environment
3) Tin covered shed shall be provided at material handling/loading section.

c) In-house measures:-

1. All material transfer points should be covered
2. The dust containment system shall be provided incorporating either of the following.

- Barricading all around the periphery of the plot boundary of height minimum 20 feet or 5 feet above free fall air emission area, whichever is higher with tin sheets. Same may extend above with netlon clothing whenever required
- Water sprinkling/Chemical dust stabilizing agent spraying system along the periphery inside the premises.

3. Internal work area shall be, cement concreted/Asphalted.
4. Daily cleaning / Removal of dust accumulation inside the plant (dry/wet) shall be carry out, with industrial vacuum cleaner.

C-125

d) **Standards for Stack Emissions:**

1. SPM Not to exceed 150 µg/NM³

(ii) **The applicant shall observe the following fuel pattern:-**

Sr. No.	Type Of Fuel	Quantity	UOM
1.	Nil	–	–

(iii) **The applicant shall erect the chimney(s) of the following specifications:-**

Sr. No.	Chimney Attached To	Height in Mtrs.
1.	Nil	–

(iv) The applicant shall provide ports in the chimney/(s) and facilities such as ladder, platform etc. for monitoring the air emissions and the same shall be open for inspection to/and for use of the Board's Staff. The chimney(s) vents attached to various sources of emission shall be designated by numbers such as S-1, S-2, etc. and these shall be painted/ displayed to facilitate identification.

(v) The industry shall take adequate measures for control of noise levels from its own sources within the premises so as to maintain ambient air quality standard in respect of noise to less than 75 dB(A) during day time and 70 dB(A) during night time. Day time is reckoned in between 6 a.m. and 10 p.m. and night time is reckoned between 10 p.m. and 6 a.m.

(vi) **Other Conditions:**

1) The industry should not cause any nuisance in surrounding area.
2) The industry should monitor stack emissions and ambient air quality regularly

6. CONDITIONS UNDER HAZARDOUS WASTE (MANAGEMENT, HANDLING & TRANSBOUNDRY MOVEMENT) RULES, 2008:

(i) The Industry shall handle hazardous wastes as specified below.

Sr. No.	Type Of Waste	Quantity	UOM	Disposal
1.	The industry shall not generate any Hazardous waste			

(ii) **Treatment: Nil**

(iii) Whenever due to any accident or gas leakage or other unforeseen act or even, such emissions occur or is apprehended to occur in excess of standards laid down, such information shall be forthwith reported to Collector, Directorate of Industry, Safety and Health, Police Station, Fire Brigade, Directorate of Health services, Department of Explosives, Board and Local body and the production process should be stopped by taking all necessary safety measures.. The industry shall also monitor the emission and ensure that the emission do not cause any harm or nuisance in the surrounding. The industry should not restart the process without permission of the Board and other statutory organization as require under the law.

7. **Noise Pollution control Measures:-**
The Industry shall comply with the provision under the Noise (Regulation and Control) Rule- 2000, to control noise pollution.

8. **Industry shall comply with following additional conditions:**

i. The applicant shall maintain good housekeeping and take adequate measures for control of pollution from all sources so as not to cause nuisance to surrounding area / inhabitants.

ii. The applicant shall bring minimum 33% of the available open land under green coverage/ tree plantation.

iii. Solid waste – The non hazardous solid waste arising in the factory premises sweepings, etc., be disposed of scientifically so as not to cause any nuisance / pollution. The applicant shall take necessary permissions from civic authorities for disposal to dumping ground.

iv. The applicant shall provide for an alternate electric power source sufficient to operate all pollution control facilities installed by the applicant to maintain compliance with the terms and conditions of the consent. In the absence, the applicant shall stop, reduce or otherwise, control production to abide by terms & conditions of this consent regarding pollution levels.

v. The applicant shall not change or alter quantity, quality, the rate of discharge, temperature or the mode of the effluent / emissions or hazardous wastes or control equipments provided for without previous written permission of the Board.

vi. The applicant shall provide facility for collection of environmental samples and samples of trade and sewage effluents, air emissions and hazardous wastes to the Board staff at the terminal or designated points and shall pay to the Board for the services rendered in this behalf.

vii. **The applicant shall obtain Consent to Operate from Maharashtra Pollution Control Board before actual commencement of the Unit/ Activity.**

viii. The firm shall submit to this office, the 30th day of September every year, the Environmental Statement Report for the financial year ending 31st March in the prescribed Form-V as per the provisions of rule 14 of the Environment (Protection) (Second Amendment) Rules, 1992.

ix. As inspection book shall be opened and made available to the Board's officers during their visit to the applicant.

x. The applicant shall install a separate electric meter showing the consumption of energy for operation of domestic and industrial effluent treatment plants and air pollution control system. A register showing consumption of chemicals used for treatment shall be maintained.

xi. Separate drainage system shall be provided for collection of trade and sewage effluents. Terminal manholes shall be provided at the end of collection system with arrangement for measuring the flow. No effluent shall be admitted in the pipes / sewers down- stream of the terminal manholes. No effluent shall find its way other than in designed and provided collection System.

xii. Neither storm water nor discharge from other premises shall be allowed to mix with the effluents from the factory.

xiii. The authority shall not carry out any expansion of the without prior permission of the Board

xiv. The industry shall achieve the National Ambient Air Quality standards prescribed vide Government of India, Notification dt. 16.11.2009 as amended.

C-127

9. **Operation of stone crusher plant shall be in day time only. The Day time is reckoned in between 6 a.m. and 6 p.m. i.e. from sun rise to sunset.**

10. **Industry to submit BG's of Rs. 2/- Lakhs against compliance of consent conditions. The BG shall be valid upto 31.12.2021 which shall be submitted in favor of Regional Officer, Mumbai, within 7 days period.**

11. The Capital investment of the industry is Rs. 590./- Lacs

12. Board reserves right of revoke, suspend or amend the consent issued.

13. The consent should not be construed as any exemption from obtaining necessary NOC from other Govt. agencies as may deemed fit necessary

For and on behalf of the
Maharashtra Pollution Control Board

13/1/2021

(Dr. A. N. Harshvardhan)
Regional Officer, Mumbai

To,
M/s. HCC HDC JV, Mumbai Coastal Road Project,
Package-II, Worli,
Sea- Face Khan Abdul Gaffar Khan Road,
Ward G- South, Opposite to Worli Dairy, Worli,
Mumbai 400 018.

Received Consent fee of -

Sr. No.	Amount(Rs.)	Dr. No.	Date	Drawn On
1.	25,000/-	TXN2101000176	04.01.2021	--

Copy Submitted to;
1. Sub Regional Officer, Mumbai-I, M.P.C. Board, Mumbai

C-129

Maharashtra Pollution Control Board

महाराष्ट्र प्रदूषण नियंत्रण मंडळ

Application for Consent/ Authorisation

Sir,
I/We hereby apply for*

1. Consent to Establish/Operate/Renewal of consent under section 25 and 26 of the Water (Prevention & Control of Pollution) Act, 1974 as amended.

2. Consent to Establish/Operate/Renewal of consent under Section 21 of the Air (Prevention and Control of Pollution) Act, 1981, as amended.

3. Authorization/renewal of authorization under Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 in connection with my/our/existing/proposed/altered/ additional manufacturing/processing activity from the premises as per the details given below.

Consent Information

UAN No:
MPCB-CONSENT-0000105240

Application submitted on:
28-12-2020

Industry Information

Consent To:
Operate

IIN No.:

Submit to:
SRO - Mumbai I

Type of institution:
Industry

Industry Type:
O64 Stone crushers

Category:
Orange

Scale:
S.S.I

EC Reqd.
No

EC Obtained
No

EC Ref. No.
-

Whether construction-buildup area is more than 20,000 sq.mtr.(Existing Expansion Unit)
No

General Information

1. Name, designation, office address with Telephone/Fax numbers, e-mail of the Applicant Occupier/Industry/Institution / Local Body.

Name
SANJEEV JAIRATH

Address
HCC HDC JV MUMBAI COASTAL ROAD PROJECT PACKAGE II, WORLI SEA- FACE KHAN ABDUL GAFFAR KHAN ROAD, OPPO,Mumbai City

Designation
MANAGER- ADMINISTRATION

Taluka
SOUTH G

Area
OPPOSITE WORLI DAIRY, WORLI

District
Mumbai city

Telephone
9811710033

Fax

Email
sanjeev.jairath@hccindia.com

Pan Number
AIAPJ7568G

2. (a) Name and location of the industrial unit/premises for which the application is made (Give revenue Survey Number/Plot number name of Taluka and District, also telephone and fax number)

Industry name

HCC-HDC JV

Location of Unit

HCC HDC JV MUMBAI COASTAL ROAD PROJECT PACKAGE II, WORLI SEA- FACE KHAN ABDUL GAFFAR KHAN ROAD, Mumbai City Ward G- South, Opposite to Worli Dairy, Worli, Mumbai 400018

Survey number/Plot Number

Worli Sea-Face

Taluka

District

Mumbai city

(b) Details of the planning permission obtained from the local body/Town and Country Planning authority/Metropolitan Development authority/ designated Authority.

Planning permission

NA

Planning Authority

NA

Name of the local body under whose jurisdiction the unit is located and Name of the licence issuing authority

Name of Local Body

NA

Name of the licence issuing authority

NA

3. Names,addresses with Telephone and Fax Number of Managing Director / Managing Partner and officer responsible for matters connected with pollution control and/or Hazardous waste disposal.

Name of Managing Director

Mr. Aveek Panja

Telephone number

8657500900

Fax number

Officer responsible for day to day business

9819026595

4. (a.) Are you registered Industrial unit ?

No

Registration number

AB 282925

Date of registration

Sep 9, 2017

5. Gross capital investment of the unit without depreciation till the date of application (Cost of building, land, plant and machinery). (To be supported by an affidavit/undertaking on Rs.20/- stamp paper, annual report or certificate from a Chartered Accountant for proposed unit(s), give estimated figure)

Gross capital (in Lakh)	**** Verified***	**** Terms***	**** Consent Fee***
590.00	CA Certificate	1	25000.00

6. If the site is located near sea-shore/river bank/other water bodies/Highway, Indicate the crow fly distance and the name of the water body, if any.

Distance From	***Distance(Km)***	**** Name***
SH/NH	40.00	Mumbai-Pune Highway
River	10.00	Mithi
Human Habitation	20.00	MIDC
Religious Place	3.00	Maha Laxmi Temple
Historical Place	40.00	Belapur Fort
Creek/Sea	1.00	Creek/Sea

6b. Enter Latitude and Longitude details of site

Latitude

18.99922178

Longitude

72.81065772

C-139
C-131

7. Does the location satisfy the Requirements Under relevant Central/State Govt. Notification such as Coastal Regulation Zone. Notification on Ecologically Fragile Area, Industrial Location policy, etc. If so, give details.

Location	Approved Industry Area	Sensitive Area	If Yes, Name Of Area	Industry Location with Reference to CRZ
NA	No	No	NA	

8. If the site is situated in notified Industrial estate,

		Details
(a) Whether effluent collection, treatment and disposal system has been provided by the authority.	No	
(b) Will the applicant utilize the system, if provided.	No	
(c) If not provided, details of proposed arrangement.	NA	

9.

(a) Total plot area (in squear meter)	(b) Built up area and (in squear meter)	(c) Area available for the use of treated sewage/ trade effluent for gardening/irrigation. (in squear meter)
1400	1400	NA

10. Month and year of commissioning of the Unit.

2021-01-11

11. Number of workers and office staff

Workers	staff	Hrs. of shift	Weekly off
18	3	1	NA

12.

(a) Do you have a residential colony Within the premises in respect of Which the present application is Made ? No

(b) If yes, please state population staying

Number of person staying	Water consumption	Sewage generation	Whether is STP provided?
			No

(c) Indicate its location and distance with reference to plant site.

Number of person staying	Water consumption

13. List of products and by-products Manufactured in tonnes/month, Kl/month or numbers/month with their types i.e.Dyes, drugs etc. (Give figures corresponding to maximum installed production capacity

Products Name and Quantity

Product Name	UOM	Product Name	Existing	Consented	Proposed Revision	Total	Remarks
Stone Crushers	Ton/D	Crushed Stone	0	2000	0	2000	NA

Products Name and Quantity

Product Name	UOM	Quantity	Remarks
NA	--NA--	0	NA

14. List of raw materials and process chemicals with annual consumption corresponding to above stated production figures, in tonnes/month or kl/month or numbers/month.

Name of Raw Material	UOM	Quantity	Hazardous Waste	Hazardous Chemicals	Remarks
Stone	Ton/D	2000	No	No	NA

15. Description of process of manufacture for each of the products showing input, output, quality and quantity of solid, liquid and gaseous wastes, if any from each unit process.

NA

Part B : Waste Water aspects

16. Water consumption for different uses (m3/day)

Purpose	Consumption	Effluent Generation	Treatment	Remarks	Disposal	Remarks
Domestic Pourpose	0	0	--NA--		--NA--	
Water gets Polluted & Pollutants are Biodegradable	0	0	--NA--		--NA--	
Water gets Polluted,Pollutants are not Biodegradable & Toxic	0	0	--NA--		--NA--	
Industrial Cooling,spraying in mine pits or boiler feed	1	0	--NA--	USED FOR SPRINKLING PURPOSE	--NA--	
Others	0					

17. Source of water supply, Name of authority granting permission if applicable and quantity permitted.

Source of water supply	Name of authority granting permission	Qauntity permitted
NA	NA	0

18. Quantity of waste water (effluent) generated (m3/day)

Domastic	Boiler Blowdown	Industrial	Cooling water blowdown
0	0	0	0
Process	**DM Plants/Softening**	**Washing**	**Tail race discharge from**
0	0	0	0

* 19. Water budget calculations accounting for difference between water consumption and effluent generated.

0

20. Present treatment of sewage/canteen effluent (Give sizes/capacities of treatment units).

Capacity of STP (m3/day)

0

Treatment unit	Size (mxm)	Retention time (hr)
0	0	0

21. Present treatment of trade effluent (Give sizes/capacities of treatment units) (A schematic diagram of the treatment scheme with inlet/outlet characteristics of each unit operation/process is to be provided. Include details of residue Management system (ETP sludges)

Capacity of ETP (m3/day)

0

Treatment unit	***Size (mxm)***	***Retention time (hr)***
0	0	0

22.

(i) Are sewage and trade effluents mixed together?	No
If yes, state at which stage-Whether before, intermittently or after treatment.	NA

23. Capacity of treated effluent sump, Guard Pond if any.

Capacity of treated effluent sump (m3)	NA
Effluent sump/Guard pond details	No
If yes, state at which stage-Whether before, intermittently or after treatment.	No

24. Mode of disposal of treated effluent With respective quantity, m3/day

(i) into stream/river (name of river)	NA	***(ii) into creek/estuary (name of Creek/estuary)***	NA
(iii) into sea	NA	***(iv) into drain/sewer (owner of sewer)***	NA
(v) On land for irrigation on owned land/ase land. Specify cropped area.	NA	***(vi) Connected to CETP***	NA
(vii) Quantity of treated effluent reused/ recycled, m3/day Provide a location map of disposal arrangement indicating the outler(s) for sampling. Treated effluent reused / recycled (m3/day)	0		

25. (a) Quality of untreated/treated effluents (Specify pH and concentration of SS, BOD,COD and specific pollutants relevant to the industry. TDS to be reported for disposal on land or into stream/river.

Untreated Effluent

pH	NA	
SS (mg/l)	NA	
BOD (mg/l)	NA	
COD (mg/l)	NA	
TDS (mg/l)	NA	
Specific pollutant if any	***Name***	***Value***
1		

Treated Effluent

pH	NA
SS (mg/l)	NA

BOD (mg/l)	NA
COD (mg/l)	NA
TDS (mg/l)	NA

Specific pollutant if any	***Name***	***Value***
1		

(b) Enclose a copy of the latest report of analysis from the laboratory approved by State Board/ Committee/Central Board/Central Government in the Ministry of Environment expected characteristics of the untreated/treated effluent

NA

---

26. Fuel consumption

Fuel Type	***UOM***	***Fuel Consumption TPD/LKD***	***Calorific value***
Diesel	Lit/Day	1200	10800
Ash content	***Sulphur content***	***Quantity***	***Other (specify)***
0	0.02	1	

---

27. (a) Details of stack (process & fuel stacks: D. G.)

(a) Stack number(s)	***(b) Stack attached to***	***(c) Capacity***	***(d) Fuel Type***
NA	NA	NA	NA
(e) Fuel quantiy (Kg/hr.)	***(f) Material of construction***	***(g) Shape (round/rectangular)***	***(h) Height, m (above ground level)***
0	0	0	0
(i) Diameter/Size, in meters	***(j) Gas quantity, Nm3/hr.***	***(k) Gas temperature °C***	***(l) Exit gas velocity, m/sec.***
0	0	0	0
(m) Control equipment preceding the stack	***(n) Nature of pollutants likely to present in stack gases such as Cl2, Nox, Sox TPM etc.***	***(o) Emissions control system provided***	***(p) In case of D.G. Set power generation capacity in KVA***
0	0	0	0

---

27. (B) Whether any release of odoriferous compounds such as Mercaptans, Phorate etc. Are coming out from any storages or process house.

NA

---

28. Do you have adequate facility for collection of samples of emissions in the form of port holes, platform, ladder\etc. As per Central Board Publication "Emission regulations Part-III" (December, 1985)

Poart hole	No	***Details***
Platform	No	***Details***
Ladder	No	***Details***

---

29. Quality of treated flue gas emissions and process emissions. Quantity of treated flue gas emissions and process emissions.

Sr. No	***Stack attached to***	***Parameter***	***Concentration mg/Nm3***	***flow (Nm3/hr)***
1	NA	NA	0	0

(Specify concentration of criteria pollutants and industry/process-specific pollutants stack-wise. Enclose a copy of the latest report of analysis from the laboratory approved by State Board/Central Board/ Central Government in the Ministry of Environment & Forests. For proposed unit furnish expected characteristics of the emissions..

NA

Part - D: Hazardous Waste aspect

30. Information about Hazardous Waste Management as defined in Hazardous Waste (Management & Handling) Rules, 1989 as amended in Jan.,2000. Type/Category of Waste as per

Waste (Annually) Schedule I

Cat No	***Type***	***Qty***	***UOM***
NA		0	--NA--

Max	***Method of collection***	***Method of reception***	***Method of storage***
	NA	NA	NA

Method of transport	***Method of treatment***	***Method of disposal***
NA	NA	NA

Waste (Annually) Schedule II

31. Details about use of hazardous waste

Name of hazardous waste/Spent chemical	***Quantity used/month***	***Party from whom purchased***	***Party to whom sold***
Na	0	-	-

32.

a. Details about technical capability and equipments available with the applicant to handle the Hazardous Waste

-

b. Characteristics of hazardous waste(s) Specify concentration of relevant pollutants. Enclose a copy of the latest report of analysis from the laboratory approved by State Board/Central Board/Central Govt. in the ministry of Environment & Forests. For proposed units furnish expected characteristics

-

33.

Copy of format of manifest/record Keeping practiced by the applicant.

-

34.

Details of self-monitoring (source and environment system)

-

35.

Are you using any imported hazardous waste. If yes, give details.

-

36.

Copy of actual user Registration/certificate obtained from State Pollution Control Board/Ministry of Environment & Forests, Government of India, for use of hazardous waste.

-

37.

Present treatment of hazardous waste, if any (give type and capacity of treatment units)

-

38. Quantity of hazardous waste disposal

(i) Within factory

1

(ii) Outside the factory (specify location and enclose copies of agreement.)

0

(iii) Through sale (enclosed documentary proof and copies of agreement.)

0

(iv) Outside state/Union Territory, if yes particulars of (1 & 3) above.

0

(v) Other (Specify)

0

Part - E: Additional information

39.

a. Do you have any proposals to upgrade the present system for treatment and disposal of effluent/emissions and/or hazardous waste.

NA

b. If yes, give the details with time- schedule for the implementation and approximate expenditure to be incurred on it.

NA

40.

Capital and recurring (O & M) expenditure on various aspect of environment protection such as effluent, emission, hazardous waste, solid waste, tree- plantation, monitoring, data acquisition etc. (give figures separately for items implemented/to be implemented).

NA

41.

To which of the pollution control equipment, separate meters for recording consumption of electric energy are installed ?

NA

42.

Which of the pollution control items are connected to D.G. Set (captive power source) to ensure their running in the event of normal power failure

NA

---

43. Nature, quantity and method of disposal of non- hazardous solid waste generated separately from the process of manufacture and waste treatment. (Give details of area/capacity available in applicant's land)

Type	*Quantity*	*UOM*	*Treatment*	*Disposal*	*Other Details*
NA	0	--NA--	NA	NA	

---

44. Hazardous Chemicals - Give details of Chemicals and quantities handled and Stored.

(i) Is the unit a Majot Accident Hazard unit as per Mfg.Storage Import Hazardous Chemicals Rules ?

--

(ii) Is the unit an isolated storage as defined under the MSIHC Rules ?

--

(iii) Indicate status of compliance of Rules 5,7,10,11,12,13 and 18 of the MSIHC Rules.

..

(iv) Has approval of site been obtained from the concerned authority?

..

(v) Has the unit prepared an off-site Emergency Plan? Is it updated ?

..

(vi) Has information on imports of Chemicals been provided to the concerned authority?

..

(vii) Does the unit possess a policy under the PLI Act?

..

---

45. Brief details of tree plantation/green belt development within applicant's premises (in hectors)

Open Space Availability	***Plantation Done On***	***Number of Trees Planted***
0 Square meter	0 Square meter(0 %)	0

46.

Information of schemes for waste Minimization, resource recovery and recycling - implemented and to be implemented, separately.

NA

47.

(a) The applicant shall indicate whether Industry comes under Public Hearing, if so, the relevant documents such as EIA, EMP, Risk Analysis etc. shall be submitted, if so, the relevant documents enclosed shall be indicated accordingly.

0

(b) Any other additional information that the applicants desires to give

NA

(c) Whether Environmental Statement submitted ? If submitted, give date of submission.

NA

48.

I/We further declare that the information furnished above is correct to the best of my/our knowledge.

49.

I/We hereby submit that in case of any change from what is stated in this application in respect of raw materials, products, process of manufacture and
treatment and/or disposal of effluent, emission, hazardous wastes etc. In quality and quantity; a fresh application for Consent/Authorization shall be made and
until the grant of fresh Consent/Authorization no change shall be made.

50.

I/We undertake to furnish any other information within one month of its being called by the Board

---

Yours faithfully

Signature : SANJEEV JAIRATH
Name : SANJEEV JAIRATH
Designation : MANAGER- ADMINISTRATION

Additional Information

Air Pollution

Sr No.	***Air Pollution Source***	***Pollutants***	***APCS Provided***	***Remark***

1	Stone Crushing	PM10, PM2.5, SOx, NOx	NA	NA

Separate EM Provided	No	***Other Emission Sources***	NA
Measures Proposed	No	***Foul Smell Coming Out***	No
Air Sampling Facility Details	Will be Provided		

D.G. Set Details

Description	***Capacity(KVA)***	***Remarks***
NA	0	NA

Hazardous Waste Generation

Hazardous Waste	***Quantity***	***UOM***	***Treatment***	***Disposal***	***Other Details***

CHWTSDF Details

Member of CHWTSDF	***CHWTSDF Name***	***Remarks***

Cess Details

Cess Applicable	***Cess Paid***	***If Yes, UpTo***
No	No	Jan 1 1900 12:00:00:000AM

Legal Actions

Legal Action Taken	***Legal Record Of Company***	***Legal Action Details***	***Remarks***
No			

MUMBAI COASTAL PROJECT
PACKAGE-4

C-141

MAHARASHTRA POLLUTION CONTROL BOARD

Phone : 022-24015269
Fax : 022-24016239
Email : sromumbai1@mpcb.gov.in
Visit At : http://www.mpcb.gov.in

Kalpataru Point, First Floor,
Sion Circle, Sion (E),
Mumbai - 400088

Green/S.S.I

Consent No: SRO-MUMBAI I/CONSENT/2010003387 Date:15/10/2020.

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 / Renewal of Authorization under Rule 5 of the Hazardous Wastes (Management, Handling & Transboundry Movement) Rules 2008

[To be referred as Water Act, Air Act and HW (M&H) Rules respectively].

CONSENT is hereby granted to

M/s. Larsen And Toubro Limited, (Casting)
Mumbai Coastal Road Project Pkg 4
Nepean Sea Road, Next to Priyadarshani Park,
Malabar Hill, Mumbai-400006

located in the area declared under the provisions of the Water Act, Air act and Authorization under the provisions of HW(M&H) Rules and amendments thereto subject to the provisions of the Act and the Rules and the Orders that may be made further and subject to the following terms and conditions:

1. **The Consent to Operate is granted for a period up to: 31.10.2023.**

2. **The Consent is valid for the manufacture of –**

Sr. No.	Product Name	Maximum Quantity	UOM
1.	**Tunnel lining precast segment Casting purpose (Without using asbestos/boiler/steam curing like pipe, piller, Jafri, well ring, block/tiles etc.) should be done in closed covered shed to control fugitive emissions)**	**200**	**Nos./M**

3. **CONDITIONS UNDER WATER ACT:**

(i) The daily quantity of trade effluent from the factory shall not exceed **15.0 M³** .

(ii) The daily quantity of sewage effluent from the factory shall not exceed **5.0 M³**.

(iii) **Trade Effluent :**

Treatment: The applicant shall provide comprehensive treatment system consisting of primary / secondary or tertiary treatment as is warranted with reference to influent quality and operate and maintain the same continuously so as to achieve the quality of the treated effluent to the following standards:

Sr. No	Parameter	Limits	
1	pH	Between	5.5 to 9.0
2	BOD,3 Days 27 degree C	Not to exceed	100 mg/l.
3	COD	Not to exceed	250 mg/l.
4	Oil & Grease	Not to exceed	10 mg/l.
5	Suspended Solids	Not to exceed	100 mg/l.
21	TDS	Not to exceed	2100 mg/l.

(iv) **Trade Effluent Disposal:** The treated effluent is recycled into the process again.

(v) **Sewage Effluent Treatment:** The applicant shall provide comprehensive treatment system as is warranted with reference to influent quality and operate and maintain the same continuously so as to achieve the quality of treated effluent to the following standards.

(1)	Suspended Solids	Not to exceed	100	mg/l.
(2)	BOD 3 days 27o C.	Not to exceed	100	mg/l.

(vi) **Sewage Effluent Disposal:** The treated domestic effluent shall be soaked in a soak pit, which shall be got cleaned periodically. Overflow, if any, shall be used on land for gardening / plantation only.

(vii) **Non-Hazardous Solid Wastes:**

Sr. No.	Type Of Waste	Quantity	UOM	Treatment	Disposal
1	**Bentonite Muck**	**440**	M3/M	--	**Landfilling**

(viii) **Other Conditions:** Industry should monitor effluent quality regularly.

4. The applicant shall comply with the provisions of the Water (Prevention & Control of Pollution) Cess Act, 1977 (to be referred as Cess Act) and amendment Rules, 2003 there under

The daily water consumption for the following categories is as under:

(i) Domestic purpose ...	5.50 CMD
(ii) Water gets Polluted & Pollutants are Biodegradable(Mixing) ...	20.00 CMD
(iii) Water gets Polluted, Pollutants are not Biodegradable & Toxic ...	0.00 CMD
(iv) Industrial Washing, spraying in mine pits or boiler feed ...	0.00 CMD

4. CONDITIONS UNDER AIR ACT :

(i) The applicant shall install a comprehensive control system consisting of control equipment as is warranted with reference to generation of emission and operate and maintain the same continuously so as to achieve the level of pollutants to the following standards:

5. Control Equipment:

a) Air Pollution Control: Nil

6. Standards for Air Emission

Ambient air quality at a distance of 10 mtr from source OR the plant Boundary, whichever is nearer, shall meet the following standards

Particulate Matter PM_{10}	**Not to Exceed**	**100**	**$\mu g/m^3$**
Particulate Matter $PM_{2.5}$	**Not to Exceed**	**60**	**$\mu g/m^3$**

a. A proper routine and preventive maintenance procedure for DG set should be set and followed in consultation with the DG manufacturer which would help to prevent noise levels of DG set from deteriorating with use.

b. D.G. Set shall be operated only in case of power failure
c. The applicant should not cause any nuisance in the surrounding area due to operation of D.G. Set

7. **Standards for Stack Emissions:**

(i) **The applicant shall observe the following fuel pattern:-**

Sr. No.	Type Of Fuel	Quantity	UOM
	.....NA.....		

(ii) **The applicant shall erect the chimney(s) of the following specifications:-**

Sr. No.	Chimney Attached To	Height in mt
	.....NA.....	

(iii) The applicant shall provide ports in the chimney/(s) and facilities such as ladder, platform etc. for monitoring the air emissions and the same shall be open for inspection to/and for use of the Board's Staff. The chimney(s) vents attached to various sources of emission shall be designated by numbers such as S-1, S-2, etc. and these shall be painted/ displayed to facilitate identification.

(iv) The industry shall take adequate measures for control of noise levels from its own sources within the premises so as to maintain ambient air quality standard in respect of noise to less than 75 dB(A) during day time and 70 dB(A) during night time. Day time is reckoned in between 6 a.m. and 10 p.m. and night time is reckoned between 10 p.m. and 6 a.m.

(v) **Other Conditions:**

1) The industry should not cause any nuisance in surrounding area.
2) The industry should monitor stack emissions and ambient air quality regularly.

8. **CONDITIONS UNDER HAZARDOUS WASTE (MANAGEMENT, HANDLING & TRANSBOUNDRY MOVEMENT) RULES, 2008:**

(i) The Industry shall handle hazardous wastes as specified below.

Sr. No.	Type Of Waste	Quantity	UOM	Disposal
		NIL		

(ii) Treatment: - NIL

a. Whenever due to any accident or other unforeseen act or even, such emissions occur or is apprehended to occur in excess of standards laid down, such information shall be forthwith Reported to Board, concerned Police Station, office of Directorate of Health Services, Department of Explosives, Inspectorate of Factories and Local Body. In case of failure of pollution control equipment, the production process connected to it shall be stopped.

9. **Industry shall comply with following additional conditions:**

i. The applicant shall maintain good housekeeping and take adequate measures for control of pollution from all sources so as not to cause nuisance to surrounding area / inhabitants.

ii. Solid waste – The nonhazardous solid waste arising in the factory premises, sweepings, etc., be disposed of scientifically so as not to cause any nuisance /

pollution. The applicant shall take necessary permissions from civic authorities for disposal to dumping ground.

iii. The applicant shall provide for an alternate electric power source sufficient to operate all pollution control facilities installed by the applicant to maintain compliance with the terms and conditions of the consent. In the absence, the applicant shall stop, reduce or otherwise, control production to abide by terms & conditions of this consent regarding pollution levels.

iv. The applicant shall not change or alter quantity, quality, the rate of discharge, temperature or the mode of the effluent / emissions or hazardous wastes or control equipment provided for without previous written permission of the Board.

v. The applicant shall provide facility for collection of environmental samples and samples of trade and sewage effluents, air emissions and hazardous wastes to the Board staff at the terminal or designated points and shall pay to the Board for the services rendered in this behalf.

vi. The applicant shall make an application for renewal of the consent at least 60 days before the date of the expiry of the consent.

vii. The firm shall submit to this office, the 30th day of September every year, the Environmental Statement Report for the financial year ending 31st March in the prescribed Form-V as pre the provisions of rule 14 of the Environment (Protection) (Second Amendment) Rules, 1992.

viii. As inspection book shall be opened and made available to the Board's officers during their visit to the applicant.

ix. The applicant shall install a separate electric meter showing the consumption of energy for operation of domestic and industrial effluent treatment plants and air pollution control system. A register showing consumption of chemicals used for treatment shall be maintained.

x. Separate drainage system shall be provided for collection of trade and sewage Effluents. Terminal manholes shall be provided at the end of collection system with arrangement for measuring the flow. No effluent shall be admitted in the pipes / sewers down- stream of the terminal manholes. No effluent shall find its way other than in designed and provided collection System.

xi. Neither storm water nor discharge from other premises shall be allowed to mix with the effluents from the factory.

10. **The consent is issued subject to direction issued by CPCB under section 18(1) (b) of Water (Prevention and Control of Pollution) Act, 1974, regarding Classification of Industries dated 07th March 2016.**

11. **The Capital investment of the industry is Rs. 1825 Lakhs.**

12. **The Board reserve right to revoke, amend or suspend the consent granted.**

C-195

13. The consent is issued on the basis of NOC issued by MCGM vide No. Ch.E./1098/Costal Road dated 28/09/2018, for temporary activity.

For and on behalf of the
Maharashtra Pollution Control Board

(Tanaji Yadav)
Sub Regional Officer, Mumbai-I

To,
M/s. L&T Construction (Casting),
Mumbai Coastal Road Project Pkg 4
Nepean Sea Road, Next to Priyadarshani Park,
Malabar Hill, Mumbai-400006

Received Consent fee of –

Sr. No.	Amount(Rs.)	DD. No.	Date
1	50000/-	MPCB-DR-2016 City Bank	29.09.2020

Copy Submitted to:-
1. Chief Account officer, MPCB, Sion, Mumbai-22.,
2. Regional Officer, MPCB, Mumbai.

C-147

Maharashtra Pollution Control Board महाराष्ट्र प्रदूषण नियंत्रण मंडळ	Consent to Operate	Doc. No.: QMS.P06_F02 Revision No.: 00 Date: 05-03-2021

MAHARASHTRA POLLUTION CONTROL BOARD
Sub Regional Office Mumbai 1

Phone : (022)-24015269
Fax : (022)-24016239
Email : sromumbai1@mpcb.gov.in
Visit At : http://mpcb.gov.in

Kalpataru Point, 1 st Floor, Sion Circle, In front of Cine Planate Theater, Sion (East), Mumbai-400022

Green/S.S.I *Date:* 05.3.2021

Consent No: SRO-MUMBAI-I/CONSENT/ 2103000398

To,

M/s. Larsen & Tourbo Limited
Mumbai Coastal Road Project PKG 4,,
Nepean Sea Road Near PRIYA DARSHNI PARK
Malabar Hill Mumbai 400006

Sub:- Consent to Operate under Green/SSI Category.

Reference: 1. Application vide UAN No: MPCB-CONSENT- 0000107256

For 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 (M & T M) 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 Operate is valid up to **31/03/2024.**
2. Capital investment as per CA Certificate- Rs. 715.15 lakhs.
3. The Consent is valid for the manufacture of –

Sr. No.	Product Name	Maximum Quantity	UOM
1.	Ready Mix Concrete (Captive Purpose Only)	18000	M3/M.
(Only for Captive purpose of Mumbai Coastal Road Project package 4)			

Conditions under Water(P&CP),1974Actfordischargeof effluent:

Sr No	Description	Permitted (in CMD)	Standards to	Disposal Path
1.	Trade effluent	Nil	As per Schedule-I	Not applicable
2.	Domestic effluent	8.0	As per Schedule-I	On land for gardening

4. Conditions under Air(P&CP)Act,1981forairemissions:

(i) The applicant shall install a comprehensive control system consisting of control equipments as is warranted with reference to generation of emission and operate and maintain the same continuously so as to achieve the level of pollutants to the following standards

Control Equipment:

a) Air Pollution Control;

(i) In-house measures;

1. All material transfer points should be covered
2. The dust containment system shall be provided incorporating either of the following
   - Barricading all around the periphery of the plot boundary of height minimum 20 feet or 5 feet above free fall air emission area, whichever is higher with tin sheets. Same may extend above with netlon clothing whenever required
   - Water sprinkling/Chemical dust stabilizing agent spraying system along the periphery inside the premises of RMC.
3. Internal work area shall be, cement concreted/Asphalted.
4. Daily cleaning / Removal of dust accumulation inside the plant (dry/wet) shall be carry out, with industrial vacuum cleaner.
5. Two level tyre washing facility shall be provided at entry and exit points, for transit mixture vehicle.
6. Industry has to install fogger system, to suppress dust emissions inside RMC Premises.

(ii) Raw material storage & handling;

1. Storage silos of cement & fly-ash shall be equipped with adequate capacity of dust Collection system such as multi- cyclone followed by bag house assembly.
2. Handling of Cement, sand, fly ash and aggregates shall be carried out with mechanical closed system only.
3. Manual operations shall be permitted only in a closed shed, equipped with dust control system at the loading point as well as roof top secondary dust control system.
4. All Conveyor belts of Sand, aggregate shall be covered with tin sheets and at transfer points dust collection system to be installed to avoid secondary fugitive emissions.
5. Mixing section of cement, aggregate & sand shall be equipped with adequate capacity dust collection system, such as multi-cyclone followed by bag house, so as to limit dust emissions.
6. Storage area of sand & aggregate shall be equipped with roof top water sprinkler system.
7. The air pollution control devices shall be operated regularly.

5/3/2021

8. Alternative power supply system, should cover both the production and Air pollution control system.

- **.Standards for Air Emission**

Ambient air quality at a distance of 10 mtr from source OR the plant Boundary, whichever is nearer, shall meet the following standards

Particulate Matter PM $_{10}$	**Not to Exceed**	**100**	**µg/m^3**
Particulate Matter PM $_{2.5}$	**Not to Exceed**	**60**	**µg/m^3**

- **.Standards for Stack Emissions:**

(i) **The applicant shall observe the following fuel pattern:-**

Sr. No.	Type Of Fuel	Quantity	UOM
----------	NIL	----------	

(ii) **The applicant shall erect the chimney(s) of the following specifications:-**

Sr. No.	Chimney Attached To	Height in mt
----------	NIL	----------

(iii) The applicant shall provide ports in the chimney/(s) and facilities such as ladder, platform etc. for monitoring the air emissions and the same shall be open for inspection to/and for use of the Board's Staff. The chimney(s) vents attached to various sources of emission shall be designated by numbers such as S-1, S-2, etc. and these shall be painted/ displayed to facilitate identification.

(iv) The industry shall take adequate measures for control of noise levels from its own sources within the premises so as to maintain ambient air quality standard in respect of noise to less than 75 dB(A) during day time and 70 dB(A) during night time. Day time is reckoned in between 6 a.m. and 10 p.m. and night time is reckoned between 10 p.m. and 6 a.m.

(v) **Other Conditions:**

1) The industry should not cause any nuisance in surrounding area.

2) The industry should monitor stack emissions and ambient air quality regularly.

5. Non-Hazardous Wastes:

Sr No	Type of Waste	Quantity	UoM	Treatment	Disposal
1	—	—	—	—	—

6. Conditions under Hazardous &Other Wastes (M & T M) Rules 2016 for treatment and disposal of hazardous waste:

Sr No	Category No./ Type	Quantity	UoM	Treatment	Disposal
1	----------	NIL	----------		

7. The Board reserves the right to review, amend, suspend, revoke etc. this consent and the same shall be binding on the industry.

8. This consent should not be construed as exemption from obtaining necessary NOC/permission from any other Government authorities.
9. Industry shall strictly comply with the conditions laid down in Environment clearance granted by MoEFCC/Govt. of Maharashtra dtd. Not applicable
10. The consent is issued subject to direction issued by CPCB under section 18(1) (b) of Water (Prevention and Control of Pollution) Act, 1974, Regarding classification of Industries dated 07th March 2016.
11. Operation of RMC Plant shall be in day time only. The Day time is reckoned in between 6 A.M. and 6 P.M. i.e from Sunrise to sunset.
12. The applicant shall make an application for renewal of consent to operate 60 days prior to the date of expiry of the consent.
13. The Consent is issued on the basis of NOC issued by MCGM vide No. Ch.E/3931 /Coastal Road dated 16.2.2019.

Signature For and on behalf of the
Maharashtra Pollution Control Board

31/2021
(Tanaji Yadav)
Sub Regional Officer,Mumbai-I

Received Consent fee of –

Sr. No.	Amount (Rs.)	Transaction Type	DR No.	Bank Name	Approved Date
1.	Rs. 25000	RTGS	MPCB-DR-4054	Citi Bank	27.01.2021

Copy to:
1. Regional Officer, Mumbai, MPCB.
2. Chief Accounts Officer, MPCB, Mumbai.

SCHEDULE-I

Terms & conditions for compliance of Water Pollution Control:

1. Industrial effluent -**NIL** .
   (iii) **Trade Effluent :**
   Treatment: The applicant shall provide , comprehensive treatment system consisting of primary / secondary or tertiary treatment as is warranted with reference to influent quality and operate and maintain the same continuously so as to achieve the quality of the treated effluent to the following standards:
   (iv) **Trade Effluent Disposal:** The treated effluent shall be 100 percent recycle into process again .
2. Domestic water
   a. Details of the domestic water generation – 8.0 CMD
   Treatment – Septic tank and soak pit provided.
   (v) **Sewage Effluent Treatment:** The applicant shall provide comprehensive treatment system as is warranted with reference to influent quality and operate and maintain the same continuously so as to achieve the quality of treated effluent to the following standards.

   Sewage Effluent Disposal: The treated domestic effluent shall be soaked in a soak pit, which shall be got cleaned periodically. Overflow, if any, shall be used on land for gardening / plantation only.
   b. Treatment and parameters

(1)	Suspended Solids	Not to exceed	100	mg/l.
(2)	BOD 3 days 27o C.	Not to exceed	100	mg/l.

3. The Board reserves its rights to review plans, specifications or other data relating to plant setup for the treatment of waterworks for the purification thereof & the system for the disposal of sewage or trade effluent or in connection with the grant of any consent conditions. The Applicant shall obtain prior consent of the Board to take steps to establish the unit or establish any treatment and disposal system and or extension or addition thereto.
4. The industry shall ensure replacement of pollution control system or its parts after expiry of its expected life as defined by manufacturer so as to ensure the compliance of standards and safety of the operation thereof.
5. The Applicant shall comply with the provisions of the Water (Prevention & Control of Pollution) Act, 1974 and as amended, by installing water meters and other provisions as contained in the said act.

Sr. no.	Purpose for water consumed	Water consumption quantity (CMD)
1.	Industrial Cooling, spraying in mine pits or boiler feed	0.0
2.	Domestic purpose	10.0
3.	Processing whereby water gets polluted & pollutants are easily biodegradable	20.0
4.	Processing whereby water gets polluted & pollutants are not easily biodegradable and are toxic	0.0

5/2/2021

5.	Others: i) Gardening	0.0

Water used for Gardening should be treated effluent/sewage.

6. The Applicant shall provide Specific Water Pollution control system as per the conditions of EP Act, 1986 and rule made there under from time to time.

----0----

5/8/2021

SCHEDULE-II

Terms & conditions for compliance of Air Pollution Control:

1. As per your application, you have provided the Air pollution control (APC)system and also erected following stack (s) and to observe the following fuel pattern-

Sr. No.	Stack Attached To	APC System	Height in Mtrs	Type of Fuel	Quantity & UoM
NIL					

2. The applicant shall operate and maintain above mentioned air pollution control system, so as to achieve the level of pollutants to the following standards:

Particulate matter	Not to exceed	150 mg/Nm^3
SO_2 Process	Not to exceed	50 mg/Nm^3
NOx	NA	NA
Acid Mist	NA	NA
NH3	NA	NA

(As applicable)

3. The applicant shall provide specific Air Pollution control equipment's as per the conditions of EP Act, 1986 and rule made there under from time to time/Environmental Clearance/CREP guidelines.

4. The Applicant shall obtain necessary prior permission for providing additional control equipment with necessary specifications and operation thereof or alteration or replacement well before its life come to an end or erection of new pollution control equipment.

5. The Board reserves its rights to vary all or any of the condition in the consent, if due to any technological improvement or otherwise such variation (including the change of any control equipment, other in whole or in part is necessary).

5/3/2021

—0—

SCHEDULE-III

Details of Bank Guarantees:

Sr. No	Consent (C2E)	Amt of BG Imposed	Submission Period	Purpose of BG	Compliance Period	Validity Date
NA						

BG Forfeiture History

Srno	Consent (C2E)	Amount of BG imposed	Submission Period	Purpose of BG	Amount of BG Forfeiture	Reason of BG Forfeiture
NA						

BG Return details

Srno	Consent(C2E)	BG imposed	Purpose of BG	Amount of BG Returned
NA				

31/3/2021

—0—

SCHEDULE-IV

General Conditions:

1. The Energy source for lighting purpose shall preferably be LED based
2. The PP shall harvest rainwater from roof tops of the buildings and storm water drains to recharge the ground water and utilize the same for different industrial applications within the plant
3. Conditions for D.G. Set
    a. Noise from the D.G. Set should be controlled by providing an acoustic enclosure or by treating the room acoustically.
    b. Industry should provide acoustic enclosure for control of noise. The acoustic enclosure/ acoustic treatment of the room should be designed for minimum 25 dB (A) insertion loss or for meeting the ambient noise standards, whichever is on higher side. A suitable exhaust muffler with insertion loss of 25 dB (A) shall also be provided. The measurement of insertion loss will be done at different points at 0.5 meters from acoustic enclosure/room and then average.
    c. Industry should make efforts to bring down noise level due to DG set, outside industrial premises, within ambient noise requirements by proper sitting and control measures.
    d. Installation of DG Set must be strictly in compliance with recommendations of DG Set manufacturer.
    e. A proper routine and preventive maintenance procedure for DG set should be set and followed in consultation with the DG manufacturer which would help to prevent noise levels of DG set from deteriorating with use.
    f. D.G. Set shall be operated only in case of power failure.
    g. The applicant should not cause any nuisance in the surrounding area due to operation of D.G. Set.
    h. The applicant shall comply with the notification of MoEFCC, India on Environment (Protection) second Amendment Rules vide GSR 371(E) dated 17.05.2002 and its amendments regarding noise limit for generator sets run with diesel.
4. The applicant shall maintain good housekeeping.
5. The non-hazardous solid waste arising in the factory premises, sweepings, etc. be disposed of scientifically so as not to cause any nuisance / pollution. The applicant shall take necessary permissions from civic authorities for disposal of solid waste.
6. The applicant shall not change or alter the quantity, quality, the rate of discharge, temperature or the mode of the effluent/emissions or hazardous wastes or control equipments provided for without previous written permission of the Board. The industry will not carry out any activity, for which this consent has not been granted/without prior consent of the Board.
7. The industry shall ensure that fugitive emissions from the activity are controlled so as to maintain clean and safe environment in and around the factory premises.
8. The industry shall submit quarterly statement in respect of industries obligation towards consent and pollution control compliance's duly supported with documentary evidences (format can downloaded from MPCB official site).
9. The industry shall submit official e-mail address and any change will be duly informed to the MPCB.
10. The industry shall achieve the National Ambient Air Quality standards prescribed vide Government of India, Notification No. B-29016/20/90/PCI-L dated. 18.11.2009 as amended.
11. The Board reserves its rights to review plans, specifications or other data relating to plant setup for the treatment of waterworks for the purification thereof & the system for the

disposal of sewage or trade effluent or in connection with the grant of any consent conditions. The Applicant shall obtain prior consent of the Board to take steps to establish the unit or establish any treatment and disposal system or an extension or addition thereto.

12. The industry shall ensure replacement of pollution control system or its parts after expiry of its expected life as defined by manufacturer so as to ensure the compliance of standards and safety of the operation thereof.
13. The PP shall provide personal protection equipment as per norms of Factory Act
14. Industry should monitor effluent quality, stack emissions and ambient air quality monthly/quarterly.
15. Whenever due to any accident or other unforeseen act or even, such emissions occur or is apprehended to occur in excess of standards laid down, such information shall be forthwith Reported to Board, concerned Police Station, office of Directorate of Health Services, Department of Explosives, Inspectorate of Factories and Local Body. In case of failure of pollution control equipments, the production process connected to it shall be stopped.
16. The applicant shall provide an alternate electric power source sufficient to operate all pollution control facilities installed to maintain compliance with the terms and conditions of the consent. In the absence, the applicant shall stop, reduce or otherwise, control production to abide by terms and conditions of this consent.
17. The industry shall recycle/reprocess/reuse/recover Hazardous Waste as per the provision contain in the Hazardous and Other Wastes (M & TM) Rules 2016, which can be recycled /processed /reused /recovered and only waste which has to be incinerated shall go to incineration and waste which can be used for land filling and cannot be recycled/reprocessed etc. should go for that purpose, in order to reduce load on incineration and landfill site/environment.
18. An inspection book shall be opened and made available to the Board's officers during their visit to the applicant.
19. Industry shall strictly comply with the Water (P&CP) Act, 1974, Air (P&CP) Act, 1981 and Environmental Protection Act, 1986 and industry specific standard under EP Rules 1986 which are available on MPCB website (www.mpcb.gov.in).
20. Separate drainage system shall be provided for collection of trade and sewage effluents. Terminal manholes shall be provided at the end of the collection system with arrangement for measuring the flow. No effluent shall be admitted in the pipes/sewers downstream of the terminal manholes. No effluent shall find its way other than in designed and provided collection system.
21. Neither storm water nor discharge from other premises shall be allowed to mix with the effluents from the factory.
22. The industry should not cause any nuisance in surrounding area.
23. The industry shall take adequate measures for control of noise levels from its own sources within the premises so as to maintain ambient air quality standard in respect of noise to less than 75 dB (A) during day time and 70 dB (A) during night time. Day time is reckoned in between 6 a.m. and 10 p.m. and night time is reckoned between 10 p.m. and 6 a.m.
24. The industry shall create the Environmental Cell by appointing an Environmental Engineer, Chemist and Agriculture expert for looking after day to day activities related to Environment and irrigation field where treated effluent is used for irrigation.
25. The applicant shall provide ports in the chimney/(s) and facilities such as ladder, platform etc. for monitoring the air emissions and the same shall be open for inspection to/and for use of the Board's Staff. The chimney(s) vents attached to various sources of emission shall be designated by numbers such as S-1, S-2, etc. and these shall be painted/ displayed to facilitate identification.

9/2021

26. The industry should comply with the Hazardous and Other Wastes (M & TM) Rules, 2016 and submit the Annual Returns as per Rule 6(5) & 20(2) of Hazardous and Other Wastes (M & TM) Rules, 2016 for the preceding year April to March in Form-IV by 30th June of every year.
27. The applicant shall install a separate meter showing the consumption of energy for operation of domestic and industrial effluent treatment plants and air pollution control system. A register showing consumption of chemicals used for treatment shall be maintained.
28. The applicant shall bring minimum 33% of the available open land under green coverage/ plantation. The applicant shall submit a yearly statement by 30th September every year on available open plot area, number of trees surviving as on 31st March of the year and number of trees planted by September end.
29. The Board reserves its rights to review plans, specifications or other data relating to plant setup for the treatment of waterworks for the purification thereof & the system for the disposal of sewage or trade effluent or in connection with the grant of any consent conditions.
30. The firm shall submit to this office, the 30th day of September every year, the Environment Statement Report for the financial year ending 31st March in the prescribed FORM-V as per the provisions of Rule 14 of the Environment (Protection) (second Amendment) Rules, 1992.
31. The Applicant shall obtain necessary prior permission for providing additional control equipment with necessary specifications and operation thereof or alteration or replacement/alteration well before its life come to an end or erection of new pollution control equipment.
32. The Board reserves its rights to vary all or any of the condition in the consent, if due to any technological improvement or otherwise such variation (including the change of any control equipment, other in whole or in part is necessary).
33. The applicant shall provide facility for collection of environmental samples and samples of trade and sewage effluents, air emissions and hazardous waste to the Board staff at the terminal or designated points and shall pay to the Board for the services rendered in this behalf. Consumers or bulk consumers of electrical and electronic equipment listed in Schedule I shall ensure that e-waste generated by them is channelised through collection centre or dealer of authorised producer or dismantler or recycler or through the designated take back service provider of the producer to authorised dismantler orrecycler
34. Bulk consumers of electrical and electronic equipment listed in Schedule I shall maintain records of e-waste generated by them in Form-2 and make such records available for scrutiny by the concerned State Pollution ControlBoard
35. Consumers or bulk consumers of electrical and electronic equipment listed in Schedule I shall ensure that such end-of-life electrical and electronic equipment are not admixed with e-waste containing radioactive material as covered under the provisions of the Atomic Energy Act, 1962 (33 of 1962) and rules made thereunder;
36. Bulk consumers of electrical and electronic equipment listed in Schedule I shall file annual returns in Form-3, to the concerned State Pollution Control Board on or before the 30th day of June following the financial year to which that return relates. In caseof the bulk consumer with multiple offices in a State, one annual return combining information from all the offices shall be filed to the concerned State Pollution Control Board on or before the 30th day of June following the financial year to which that returnrelates.

5/3/2021

C-153

MAHARASHTRA POLLUTION CONTROL BOARD

Phone : (022) - 24016239
Fax : (022)- 24015269
Email : romumbai@mpcb.gov.in
Phone : (022) - 24016239

Regional Office, Mumbai,
Kalpataru Point, 1st Floor, Sion Circle,
Sion (E), Mumbai- 400 022

Orange/S.S.I

Date: 28/12/2020

Consent No: RO-MUMBAI/ 2012001195

Consent to Establish under Section 25 of the Water (Prevention & Control of Pollution) Act, 1974 & under Section 21 of the Air (Prevention & Control of Pollution) Act, 1981 and Authorization / Renewal of Authorization under Rule 5 of the Hazardous Wastes (Management, Handling & Transboundary Movement) Rules 2008

[To be referred as Water Act, Air Act and HW (M&H) Rules respectively].

.....

CONSENT is hereby granted to

M/s. Larsen & Toubro Ltd.,
Mumbai Coastal Road Project Package 4,
Project Site, Nepean Sea Road,
Near Priyadarshini Park, Mumbai.

Located in the area declared under the provisions of the Water Act, Air act and Authorization under the provisions of HW (M&H) Rules and amendments thereto subject to the provisions of the Act and the Rules and the Orders that may be made further and subject to the following terms and conditions:

1. **The Consent to Establish is granted for a period up to Commissioning of the Project r 5 years whichever is earlier,**

2. **The Consent is valid for the manufacture of -**

Sr. No.	Product Name	Maximum Quantity	UOM
1	Crushed Stone Metal	250	MT/Hr
	(Mobile Stone Crusher Only for Captive purpose of Mumbai Coastal Road Project)		

3. **CONDITIONS UNDER WATER ACT:**

(i) The daily quantity of trade effluent from the factory shall not exceed Nil M^3.

(ii) The daily quantity of sewage effluent from the factory shall not exceed 00.80 M^3.

(iii) **Trade Effluent Treatment:** Nil.

(iv) **Trade Effluent Disposal:** Nil.

(iii) **Sewage Effluent Treatment:** The applicant shall provide comprehensive treatment system as is warranted with reference to influent quality and operate and maintain the same continuously so as to achieve the quality of treated effluent to the following standards.

28/12/2020

Regional Office Mumbai

(1)	Suspended Solids	Not to exceed	100	mg/l.
(2)	BOD 3 days 27o C.	Not to exceed	100	mg/l.

(iv) **Sewage Effluent Disposal:** The treated domestic effluent shall be soaked in a soak pit, which shall be got cleaned periodically. Overflow, if any, shall be used on land for gardening / plantation only.

(v) **Non-Hazardous Solid Wastes:**

Sr. No.	Type Of Waste	Quantity	UOM	Treatment & Disposal
1	Nil	---	--	--

4. **The applicant shall comply with the provisions of the Water (Prevention & Control of Pollution) Cess Act, 1977 (to be referred as Cess Act) and amendment Rules, 2003 there under:**

The daily water consumption for the following categories is as under:

(i)	Domestic purpose	...	01.00 CMD
(ii)	Water gets Polluted & Pollutants are Biodegradable	...	00.00 CMD
(iii)	Water gets Polluted, Pollutants are not Biodegradable & Toxic	...	00.00 CMD
(iv)	Industrial Cooling, spraying in mine pits or boiler feed	...	00.00 CMD

5. **CONDITIONS UNDER AIR ACT:**

(i) The applicant shall install a comprehensive control system consisting of control equipments as is warranted with reference to generation of emission and operate and maintain the same continuously so as to achieve the level of pollutants to the following standards:

a) Standards for Emission (Ambient Air)

1.	$PM_{2.5}$	Not to exceed	60	$\mu g/NM^3$
2.	PM_{10}	Not to exceed	100	$\mu g/NM^3$
3.	SO_2	Not to exceed	80	$\mu g/NM^3$
4.	NO_X	Not to exceed	80	$\mu g/NM^3$

b) **Control Equipment:**

Air Pollution Control:-

1) Adequate capacity Air pollution control devices, Water sprinkler arrangement shall be provided for dust suppression.
2) Metallic approach road shall be provided in the work environment.
3) Tin covers/shed shall be provided at material handling/loading section.

c) **In-house measures:-**

1. All material transfer points should be covered.
2. The dust containment system shall be provided incorporating either of the following.

- Barricading all around the periphery of the plot boundary of height minimum 20 feet or 5 feet above free fall air emission area, whichever is higher with tin sheets. Same may extend above with netlon clothing whenever required.

- Water sprinkling/Chemical dust stabilizing agent spraying system along the periphery inside the premises.

3. Internal work area shall be, cement concreted/Asphalted.
4. Daily cleaning / Removal of dust accumulation inside the plant (dry/wet) shall be carry out, with industrial vacuum cleaner.

d) **Standards for Stack Emissions:**

1. SPM Not to exceed 150 µg/NM^3

(ii) **The applicant shall observe the following fuel pattern:-**

Sr. No.	Type Of Fuel	Quantity	UOM
1.	Nil	–	–

(iii) **The applicant shall erect the chimney(s) of the following specifications:-**

Sr. No.	Chimney Attached To	Height in Mtrs.
1.	Nil	–

(iv) The applicant shall provide ports in the chimney/(s) and facilities such as ladder, platform etc. for monitoring the air emissions and the same shall be open for inspection to/and for use of the Board's Staff. The chimney(s) vents attached to various sources of emission shall be designated by numbers such as S-1, S-2, etc. and these shall be painted/ displayed to facilitate identification.

(v) The industry shall take adequate measures for control of noise levels from its own sources within the premises so as to maintain ambient air quality standard in respect of noise to less than 75 dB(A) during day time and 70 dB(A) during night time. Day time is reckoned in between 6 a.m. and 10 p.m. and night time is reckoned between 10 p.m. and 6 a.m.

(vi) **Other Conditions:**

1) The industry should not cause any nuisance in surrounding area.
2) The industry should monitor stack emissions and ambient air quality regularly.

6. **CONDITIONS UNDER HAZARDOUS WASTE (MANAGEMENT, HANDLING & TRANSBOUNDRY MOVEMENT) RULES, 2008:**

(i) The industry shall handle hazardous wastes as specified below.

Sr. No.	Type Of Waste	Quantity	UOM	Disposal
1.	The industry shall not generate any Hazardous waste			

(ii) Treatment: Nil

Maharashtra Pollution Control Board

Maharashtra Pollution Control Board Regional Officer Mumbai

(iii) Whenever due to any accident or gas leakage or other unforeseen act or even, such emissions occur or is apprehended to occur in excess of standards laid down, such information shall be forthwith reported to Collector, Directorate of Industry, Safety and Health, Police Station, Fire Brigade, Directorate of Health services, Department of Explosives, Board and Local body and the production process should be stopped by taking all necessary safety measures. The industry shall also monitor the emission and ensure that the emission do not cause any harm or nuisance in the surrounding. The industry should not restart the process without permission of the Board and other statutory organization as require under the law.

7. **Noise Pollution control Measures:-**
The Industry shall comply with the provision under the Noise (Regulation and Control) Rule- 2000, to control noise pollution.

8. **Industry shall comply with following additional conditions:**

i. The applicant shall maintain good housekeeping and take adequate measures for control of pollution from all sources so as not to cause nuisance to surrounding area / inhabitants.

ii. The applicant shall bring minimum 33% of the available open land under green coverage/ tree plantation.

iii. Solid waste – The non hazardous solid waste arising in the factory premises, sweepings, etc., be disposed of scientifically so as not to cause any nuisance / pollution. The applicant shall take necessary permissions from civic authorities for disposal to dumping ground.

iv. The applicant shall provide for an alternate electric power source sufficient to operate all pollution control facilities installed by the applicant to maintain compliance with the terms and conditions of the consent. In the absence, the applicant shall stop, reduce or otherwise, control production to abide by terms & conditions of this consent regarding pollution levels.

v. The applicant shall not change or alter quantity, quality, the rate of discharge, temperature or the mode of the effluent / emissions or hazardous wastes or control equipments provided for without previous written permission of the Board.

vi. The applicant shall provide facility for collection of environmental samples and samples of trade and sewage effluents, air emissions and hazardous wastes to the Board staff at the terminal or designated points and shall pay to the Board for the services rendered in this behalf.

vii. **The applicant shall obtain Consent to Operate from Maharashtra Pollution Control Board before actual commencement of the Unit/ Activity.**

viii. The firm shall submit to this office, the 30th day of September every year, the Environmental Statement Report for the financial year ending 31st March in the prescribed Form V as pre the provisions of rule 14 of the Environment (Protection) (Second Amendment) Rules, 1992.

ix. An inspection book shall be opened and made available to the Board's officers during their visit to the applicant.

x. The applicant shall install a separate electric meter showing the consumption of energy for operation of domestic and industrial effluent treatment plants and air pollution control system. A register showing consumption of chemicals used for treatment shall be maintained.

xi. Separate drainage system shall be provided for collection of trade and sewage effluents. Terminal manholes shall be provided at the end of collection system with arrangement for measuring the flow. No effluent shall be admitted in the pipes / sewers down- stream of the terminal manholes. No effluent shall find its way other than in designed and provided collection System.

xii. Neither storm water nor discharge from other premises shall be allowed to mix with the effluents from the factory.

xiii. The authority shall not carry out any expansion of the without prior permission of the Board

xiv. The industry shall achieve the National Ambient Air Quality standards prescribed vide Government of India, Notification dt. 16.11.2009 as amended.

9. **Operation of stone crusher plant shall be in day time only. The Day time is reckoned in between 6 a.m. and 6 p.m. i.e. from sun rise to sunset.**

10. **Industry to submit BG's of Rs. 2/- Lakhs against compliance of consent conditions. The BG shall be valid upto 31.12.2021 which shall be submitted in favor of Regional Officer, Mumbai, within 7 days period.**

11. The Capital investment of the industry is Rs. 550/- Lacs.

12. Board reserves right of revoke, suspend or amend the consent issued.

13. The consent should not be construed as any exemption from obtaining necessary NOC from other Govt. agencies as may deemed it necessary

For and on behalf of the
Maharashtra Pollution Control Board

28/12/2020

(Dr. A. N. Harshvardhan)
Regional Officer, Mumbai

Maharashtra Pollution Control Board
Regional Officer Mumbai

To,
M/s. Larsen & Toubro Ltd.,
Mumbai Coastal Road Project Package-4,
Project Site, Nepean Sea Road,
Near Priyadarshini Park, Mumbai.

Received Consent fee of –

Sr. No.	Amount(Rs.)	Dr. No.	Date	Drawn On
1	25,000/-	MPCB-DR-3364	21.12.2020	Citi Bank

Copy Submitted to:
1. Sub Regional Officer, Mumbai-I, M.P.C. Board, Mumbai

C-165

Application for Consent/ Authorisation

Sir,
I/We hereby apply for*

1. Consent to Establish/Operate/Renewal of consent under section 25 and 26 of the Water (Prevention & Control of Pollution) Act, 1974 as amended.

2. Consent to Establish/Operate/Renewal of consent under Section 21 of the Air (Prevention and Control of Pollution) Act, 1981, as amended.

3. Authorization/renewal of authorization under Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 in connection with my/our/existing/proposed/altered/ additional manufacturing/processing activity from the premises as per the details given below.

Consent Information

UAN No:
MPCB-CONSENT-0000110814

Application submitted on:
16-03-2021

Industry Information

Consent To:
Operate

IIN No.:
RO-MUMBAI/2012001195

Submit to:
SRO - Mumbai I

Type of Institution:
Industry

Industry Type:
O64 Stone crushers

Category:
Orange

Scale:
S.S.I

EC Reqd.
No

EC Obtained
No

EC Ref. No.
-

Whether construction-buildup area is more than 20,000 sq.mtr.(Existing Expansion Unit)
No

General Information

Name, designation, office address with Telephone/Fax numbers, e-mail of the Applicant Occupier/Industry/Institution / Local Body.

Name
SANDEEP SINGH

Address
LARSEN AND TOUBRO LIMITED, BESIDES PRIYADARSHINI PARK,NAPEAN SEA ROAD,Mumbai City

Designation
Project Manager

Taluka
Malabar Hill

Area
Nepean Sea Road

District
Mumbai city

Telephone
8130891232

Fax

Email
sandeepsingh@lntecc.com

Pan Number
ARLPS4564K

2. (a) Name and location of the industrial unit/premises for which the application is made (Give revenue Survey Number/Plot number name of Taluka and District, also telephone and fax number)

Industry name
LARSEN & TOUBRO LTD

Location of Unit

Survey number/Plot Number

MUMBAI COASTAL ROAD PROJECT PACKAGE-4, PROJECT SITE, NEPEAN SEA ROAD, NEAR PRIYADARSHINI PARK, MUMBAI

MUMBAI COASTAL ROAD PROJECT PKG 4

Taluka
Malabar Hill

District
Mumbai city

(b) Details of the planning permission obtained from the local body/Town and Country Planning authority/Metropolitan Development authority/ designated Authority.

Planning permission
NA

Planning Authority
NA

Name of the local body under whose jurisdiction the unit is located and Name of the licence issuing authority

Name of Local Body
NA

Name of the licence issuing authority
NA

---

3. Names,addresses with Telephone and Fax Number of Managing Director / Managing Partner and officer responsible for matters connected with pollution control and/or Hazardous waste disposal.

Name of Managing Director
SANDEEP SINGH

Telephone number
9958899501

Fax number

Officer responsible for day to day business
SHIV SHANKAR VARMA

4. (a.) Are you registered Industrial unit ?

Yes

Registration number
4768

Date of registration
Feb 7, 1946

---

5. Gross capital investment of the unit without depreciation till the date of application (Cost of building, land, plant and machinery). (To be supported by an affidavit/undertaking on Rs.20/- stamp paper, annual report or certificate from a Chartered Accountant for proposed unit(s), give estimated figure)

Gross capital (in Lakh)	**** Verified***	**** Terms***	**** Consent Fee***
550.00	CA Certificate	1	25000.00

---

6. If the site is located near sea-shore/river bank/other water bodies/Highway, indicate the crow fly distance and the name of the water body, if any.

Distance From	***Distance(Km)***	**** Name***
SH/NH	87.80	Mumbai-Pune Highway
River	22.50	Mithi
Human Habitation	25.70	MIDC
Religious Place	5.00	Maha Laxmi Temple
Historical Place	41.90	Belapur Fort
Creek/Sea	0.15	Creek/Sea

6b. Enter Latitude and Longitude details of site

Latitude
18.96407475

Longitude
72.79999894

---

7. Does the location satisfy the Requirements Under relevant Central/State Govt. Notification such as Coastal Regulation Zone, Notification on Ecologically Fragile Area, Industrial Location policy, etc. If so, give details.

Location	***Approved Industry Area***	***Sensitive Area***	***If Yes, Name Of Area***	***Industry Location with Reference to CRZ***
NA	No	No		

---

8. If the site is situated in notified industrial estate,

		Details
(a) Whether effluent collection, treatment and disposal system has been provided by the authority.	No	
(b) Will the applicant utilize the system, if provided.	No	
(c) If not provided, details of proposed arrangement.	NA	

9.

(a) Total plot area (in squear meter)	*(b) Built up area and (in squear meter)*	*(c) Area available for the use of treated sewage/ trade effluent for gardening/irrigation. (in squear meter)*
1400	...	NA

10. Month and year of commissioning of the Unit.

2021-03-19

11. Number of workers and office staff

Workers	*staff*	*Hrs. of shift*	*Weekly off*
5	1	8	...

12.

(a) Do you have a residential colony Within the premises in respect of Which the present application is Made ?	No

(b) If yes, please state population staying

Number of person staying	*Water consumption*	*Sewage generation*	*Whether is STP provided?*
			No

(c) Indicate its location and distance with reference to plant site.

Number of person staying	*Water consumption*

13. List of products and by-products Manufactured in tonnes/month, Kl/month or numbers/month with their types i.e.Dyes, drugs etc. (Give figures corresponding to maximum installed production capacity

Products Name and Quantity

Product Name	*UOM*	*Product Name*	*Existing*	*Consented*	*Proposed Revision*	*Total*	*Remarks*
Stone Crushers	MT/Hr	CRUSHED STONE	0	250	0	250	NA

Products Name and Quantity

Product Name	*UOM*	*Quantity*	*Remarks*
NA	--NA--	0	

14. List of raw materials and process chemicals with annual consumption corresponding to above stated production figures, in tonnes/month or kl/month or numbers/month.

Name of Raw Material	*UOM*	*Quantity*	*Hazardous Waste*	*Hazardous Chemicals*	*Remarks*
STONE	MT/Hr	250	No	No	na

15. Description of process of manufacture for each of the products showing input, output, quality and quantity of solid, liquid and gaseous wastes, if any from each unit process.

NA

Part B : Waste Water aspects

16. Water consumption for different uses (m3/day)

Purpose	*Consumption*	*Effluent Generation*	*Treatment*	*Remarks*	*Disposal*	*Remarks*
Domestic Pourpose	...	0	--NA--		--NA--	no water used for process
Water gets Polluted & Pollutants are Biodegradable	...	0	--NA--		--NA--	
Water gets Polluted,Pollutants are not Biodegradable & Toxic	...	0	--NA--		--NA--	
Industrial Cooling,spraying in mine pits or boiler feed	1	0	--NA--	USED FOR SPRINKLING PURPOSE	--NA--	USED FOR SPRINKLING PURPOSE
Others						

17. Source of water supply, Name of authority granting permission if applicable and quantity permitted.

Source of water supply	*Name of authority granting permission*	*Qauntity permitted*
NA	...	0

18. Quantity of waste water (effluent) generated (m3/day)

Domastic	*Boiler Blowdown*	*Industrial*	*Cooling water blowdown*
0	0	0	0
Process	***DM Plants/Softening***	***Washing***	***Tail race discharge from***
0	0	0	0

* 19. Water budget calculations accounting for difference between water consumption and effluent generated.

0

20. Present treatment of sewage/canteen effluent (Give sizes/capacities of treatment units).

Capacity of STP (m3/day)

0

Treatment unit	*Size (mxm)*	*Retention time (hr)*
...	0	0

21. Present treatment of trade effluent (Give sizes/capacities of treatment units) (A schematic diagram of the treatment scheme with inlet/outlet characteristics of each unit operation/process is to be provided. Include details of residue Management system (ETP sludges)

Capacity of ETP (m3/day)

0

Treatment unit	*Size (mxm)*	*Retention time (hr)*
0	0	0

22.

(i) Are sewage and trade effluents mixed together?	No
If yes, state at which stage-Whether before, intermittently or after treatment.	NA

23. Capacity of treated effluent sump, Guard Pond if any.

Capacity of treated effluent sump (m3)	.....
Effluent sump/Guard pond details	No
If yes, state at which stage-Whether before, intermittently or after treatment.	No

24. Mode of disposal of treated effluent With respective quantity, m3/day

(i) into stream/river (name of river)	NA	***(ii) into creek/estuary (name of Creek/estuary)***	NA
(iii) into sea	NA	***(iv) into drain/sewer (owner of sewer)***	NA
(v) On land for irrigation on owned land/ase land. Specify cropped area.	NA	***(vi) Connected to CETP***	NA
(vii) Quantity of treated effluent reused/ recycled, m3/day Provide a location map of disposal arrangement indicating the outler(s) for sampling. Treated effluent reused / recycled (m3/day)	0		

25. (a) Quality of untreated/treated effluents (Specify pH and concentration of SS, BOD,COD and specific pollutants relevant to the industry. TDS to be reported for disposal on land or into stream/river.

Untreated Effluent

pH	NA	
SS (mg/l)	NA	
BOD (mg/l)	NA	
COD (mg/l)	NA	
TDS (mg/l)	NA	
Specific pollutant if any	***Name***	***Value***
1		

Treated Effluent

pH	NA	
SS (mg/l)	NA	
BOD (mg/l)	NA	
COD (mg/l)	NA	
TDS (mg/l)	NA	
Specific pollutant if any	***Name***	***Value***
1		

(b) Enclose a copy of the latest report of analysis from the laboratory approved by State Board/ Committee/Central Board/Central Government in the Ministry of Environment expected characteristics of the untreated/treated effluent

....

---

26. Fuel consumption

Fuel Type	***UOM***	***Fuel Consumption TPD/LKD***	***Calorific value***
Diesel	Ltr/Hr	100	10800
Ash content	***Sulphur content***	***Quantity***	***Other (specify)***
0	0.02	1	

---

27. (a) Details of stack (process & fuel stacks: D. G.)

(a) Stack number(s)	***(b) Stack attached to***	***(c) Capacity***	***(d) Fuel Type***
NA	NA	NA	NA
(e) Fuel quantiy (Kg/hr.)	***(f) Material of construction***	***(g) Shape (round/rectangular)***	***(h) Height, m (above ground level)***
0	....	...	....
(i) Diameter/Size, in meters	***(j) Gas quantity, Nm3/hr.***	***(k) Gas temperature °C***	***(l) Exit gas velocity, m/sec.***
....	0	....	....
(m) Control equipment preceding the stack	***(n) Nature of pollutants likely to present in stack gases such as Cl2, Nox, Sox TPM etc.***	***(o) Emissions control system provided***	***(p) In case of D.G. Set power generation capacity in KVA***
....	...	....	....

---

27. (B) Whether any release of odoriferous compounds such as Mercaptans, Phorate etc. Are coming out from any storages or process house.

NA

---

28. Do you have adequate facility for collection of samples of emissions in the form of port holes, platform, ladder\etc. As per Central Board Publication "Emission regulations Part-III" (December, 1985)

Poart hole	Yes	***Details***
Platform	Yes	***Details***
Ladder	Yes	***Details***

---

29. Quality of treated flue gas emissions and process emissions. Quantity of treated flue gas emissions and process emissions.

Sr. No	***Stack attached to***	***Parameter***	***Concentration mg/Nm3***	***flow (Nm3/hr)***
1	NA	NA	0	0

(Specify concentration of criteria pollutants and industry/process-specific pollutants stack-wise. Enclose a copy of the latest report of analysis from the laboratory approved by State Board/Central Board/ Central Government in the Ministry of Environment & Forests. For proposed unit furnish expected characteristics of the emissions..

NA

Part - D: Hazardous Waste aspect

30. Information about Hazardous Waste Management as defined in Hazardous Waste (Management & Handling) Rules, 1989 as amended in Jan.,2000. Type/Category of Waste as per

Waste (Annually) Schedule I

Cat No	***Type***	***Qty***	***UOM***
33.2	33.2 Contaminated cotton rags or other cleaning materials	15	Kg/M
Max	***Method of collection***	***Method of reception***	***Method of storage***
	Manual	Manual	Barrel
Method of transport	***Method of treatment***	***Method of disposal***	
Road	Na	Through approved vendor	

Waste (Annually) Schedule II

31. Details about use of hazardous waste

Name of hazardous waste/Spent chemical	***Quantity used/month***	***Party from whom purchased***	***Party to whom sold***
NA	0	....	....

32.

a. Details about technical capability and equipments available with the applicant to handle the Hazardous Waste

..

b. Characteristics of hazardous waste(s) Specify concentration of relevant pollutants. Enclose a copy of the latest report of analysis from the laboratory approved by State Board/Central Board/Central Govt. in the ministry of Environment & Forests. For proposed units furnish expected characteristics

....

33.

Copy of format of manifest/record Keeping practiced by the applicant.

....

34.

Details of self-monitoring (source and environment system)

...

35.

Are you using any imported hazardous waste. If yes, give details.

....

36.

Copy of actual user Registration/certificate obtained from State Pollution Control Board/Ministry of Environment & Forests, Government of India, for use of hazardous waste.

.....

37.

Present treatment of hazardous waste, if any (give type and capacity of treatment units)

....

---

38. Quantity of hazardous waste disposal

(i) Within factory

0

(ii) Outside the factory (specify location and enclose copies of agreement.)

0

(iii) Through sale (enclosed documentary proof and copies of agreement.)

0

(iv) Outside state/Union Territory, if yes particulars of (1 & 3) above.

0

(v) Other (Specify)

0

Part - E: Additional information

39.

a. Do you have any proposals to upgrade the present system for treatment and disposal of effluent/emissions and/or hazardous waste.

NA

b. If yes, give the details with time- schedule for the implementation and approximate expenditure to be incurred on it.

NA

40.

Capital and recurring (O & M) expenditure on various aspect of environment protection such as effluent, emission, hazardous waste, solid waste, tree- plantation, monitoring, data acquisition etc. (give figures separately for items implemented/to be implemented).

NA

41.

To which of the pollution control equipment, separate meters for recording consumption of electric energy are installed ?

NA

42.

Which of the pollution control items are connected to D.G. Set (captive power source) to ensure their running in the event of normal power failure

NA

---

43. Nature, quantity and method of disposal of non- hazardous solid waste generated separately from the process of manufacture and waste treatment. (Give details of area/capacity available in applicant's land)

Type	*Quantity*	*UOM*	*Treatment*	*Disposal*	*Other Details*
NA	0	--NA--	NA	NA	

---

44. Hazardous Chemicals - Give details of Chemicals and quantities handled and Stored.

(i) Is the unit a Majot Accident Hazard unit as per Mfg.Storage Import Hazardous Chemicals Rules ?

...

(ii) Is the unit an isolated storage as defined under the MSIHC Rules ?

....

(iii) Indicate status of compliance of Rules 5,7,10,11,12,13 and 18 of the MSIHC Rules.

....

(iv) Has approval of site been obtained from the concerned authority?

...

(v) Has the unit prepared an off-site Emergency Plan? Is it updated ?

....

(vi) Has information on imports of Chemicals been provided to the concerned authority?

....

(vii) Does the unit possess a policy under the PLI Act?

...

---

45. Brief details of tree plantation/green belt development within applicant's premises (in hectors)

Open Space Availability	***Plantation Done On***	***Number of Trees Planted***
0 Square meter	0 Square meter(0 %)	0

46.

Information of schemes for waste Minimization, resource recovery and recycling - implemented and to be implemented, separately.

NA

47.

(a) The applicant shall indicate whether Industry comes under Public Hearing, if so, the relevant documents such as EIA, EMP, Risk Analysis etc. shall be submitted, if so, the relevant documents enclosed shall be indicated accordingly.

0

(b) Any other additional information that the applicants desires to give

NA

(c) Whether Environmental Statement submitted ? If submitted, give date of submission.

NA

48.

I/We further declare that the information furnished above is correct to the best of my/our knowledge.

49.

I/We hereby submit that in case of any change from what is stated in this application in respect of raw materials, products, process of manufacture and treatment and/or disposal of effluent, emission, hazardous wastes etc. In quality and quantity; a fresh application for Consent/Authorization shall be made and until the grant of fresh Consent/Authorization no change shall be made.

I/We undertake to furnish any other information within one month of its being called by the Board

---

Yours faithfully

Signature : SANDEEP SINGH
Name : SANDEEP SINGH
Designation : PROJECT MANAGER

Additional Information

Air Pollution

Sr No.	***Air Pollution Source***	***Pollutants***	***APCS Provided***	***Remark***
1	STONE CRUSHING	PM10, PM2.5	water sprinkling	water sprinkling

---

Separate EM Provided	No	***Other Emission Sources***	NA
Measures Proposed	na	***Foul Smell Coming Out***	No
Air Sampling Facility Details	na		

D.G. Set Details

Description	*Capacity(KVA)*	*Remarks*
NA	0	NA

Hazardous Waste Generation

Hazardous Waste	*Quantity*	*UOM*	*Treatment*	*Disposal*	*Other Details*
33.2 Contaminated cotton rags or other cleaning materials	15	Kg/M	NA	through approved vendor	...

CHWTSDF Details

Member of CHWTSDF	*CHWTSDF Name*	*Remarks*

Cess Details

Cess Applicable	*Cess Paid*	*If Yes, UpTo*
No	No	Jan 1 1900 12:00:00:000AM

Legal Actions

Legal Action Taken	*Legal Record Of Company*	*Legal Action Details*	*Remarks*
No			

Annexure 3:

Salient Features of Site Environment Management Plan

Salient Features of Site Environment Management Plan for the Project

Project: Mumbai Coastal Road (South) from Princes Street Flyover to Worli End of Bandra Worli sea link.

MCGM has awarded all three Coastal Road Packages Civil Contracts to recognized International Contractors like L&T, HCC-HDC (JV) etc. with experienced International joint venture partners.

These contractors are having ISO 14001 (Environmental Management System) and OHSAS 18001 (Occupational Health and Safety Assessment Series) certifications prior to award of formal contract. (Certificate Photos for each package are attached in appendix).These steps will ensure almost all Environmental Related Compliances are compiled by these contractors. In addition to these following compliances are done or already in progress by all contractors regarding Environmental Compliances mentioned in Site specific Environment Plan as well as stipulated in Legal Requirements applicable to them

1) Preconstruction Air & Noise Monitoring is going on in sites to establish Base Line Air and Noise Monitoring Results. These results will establish Air Pollution Levels and Noise Levels on Coastal Road Project alignment before start of Actual Major Construction Activities. Actual Air and Noise Monitoring results during major Construction works will be compared with Preconstruction results and Standards mentioned legally by MOEF and CPCB. Consent to Establish are being taken by Contractors from MPCB to establish Casting Yard and Batching Plant.

2) For controlling dust on sites Contractors are doing Water Sprinkling on their sites during their work. Wheel Wash Facilities will also be provided at every Main Entrance and Exit of site where Vehicle Movement is there. Wastewater will be treated and will be used for Water Sprinkling and Wheel Washing. Maximum recycling and Reuse of Water will be done.

3) For Controlling Noise , following precautions are being taken on sites:
   a) Noise Barriers will be provided at all Critical Locations like Near Schools and Hospitals etc. At some locations, provision of Noise Barriers is under progress and started as per requirement. Please refer attached appendix for compliance photos.
   b) All Construction vehicles are provided with Noise Mufflers, Good Silencers on sites. Please refer pictures shown in attached appendix.
   c) All Construction sites barricaded by 2m X 2.5 m barricading boards in addition to Noise Barriers to Control Noise and demarcate site from General Public and Road users. Please refer picture shown in appendix. These boards are provided as per IRC SP 55 , Type IV (Board) .

d) All Contractors are using acoustically enclosed DG sets. Sample photos of DG sets are attached in appendix. Presently DG sets provided on site are between range of 62.5 KVa to 500 KVa.

e) Preventive Maintenance schedule for all construction Machinery at site are maintained. All construction machinery is having PUC certificates and they are with in limit. Preventive Maintenance of Machinery will also reduce noise from Machinery. Sample PUC certificate photo is shown in attached appendix.

f) All rotating parts of construction machineries will be provided with canopies and grills to control rotating parts noise during construction phase.

4) All Environmental Monitoring Data will be displayed on sites at conspicuous places like Casting Yard, all site offices and Entry and Exit of sites. This Environmental Monitoring date will contain, Air and Noise Monitoring Results for Month, Drinking Water Testing Results, Wastewater Monitoring Results.

5) Every Contractor is having dedicated Environmental Team as stipulated in contract. They have specially dedicated and Qualified Environmental Manager along with enough subordinates on sites.

6) All Environmental Monitoring is carried by third party Environmental Monitoring Agency approved by MoEF&CC and NABL. Details of agencies are attached in appendix.

7) Contractors have provided Bio Toilets on sites. Photos for the same are attached in appendix.

8) All Trucks are covered with Tarpaulin Sheets to avoid fall of soil/material on public Roads. Road cleaning will be done regularly to control dust on public roads.

9) **Compliances with evidence photos are attached in below**

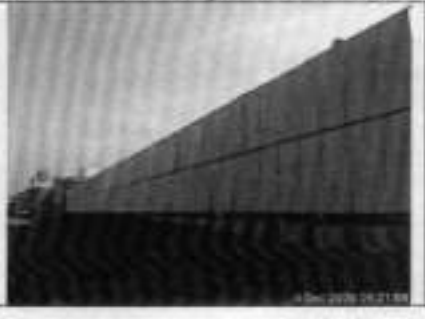
Mumbai Coastal Road Project Package -1

Compliance Status of Environmental Issues

S. No.	Description	Sample Photograph	Remarks
1.	L&T is ISO 14001 (Environmental Management System) and ISO 45001 (EHS Management) certified. M/s. DNV.GL is a third party certification agency and validity of certificate is until; • ISO 45001:2018 – 25 March 2022. • ISO 14001:2018 – 25 March 2022.	 	
2.	Preconstruction Air & Noise Monitoring is going on in sites to establish Base Line Air and Noise Monitoring Results. These results will establish Air Pollution Levels and Noise Levels on Coastal Road Project alignment before start of Actual Major Construction Activities. Actual Air and Noise Monitoring results during major Construction		Environment Monitoring is being carried out at site; 1. Ambient Air quality is being monitored at five locations on site, based on the activity. 2. Noise level is being monitored at five locations on site based on the activity.

L&T CONSTRUCTION LTD. Sign..... MCRP. PKG.-1

Louis Berger Consulting Pvt. Ltd.

	works will be compared with Preconstruction results and Standards mentioned legally by MOEF and CPCB.		
3.	For controlling Dust: 1. On-site Water Sprinkling is being carried out on regular basis. The frequency is defined as three times a day. 2. Load carrying vehicles are covered to control the spread of dust particles while transportation. 3. Wheel wash facility is provided. 4. Sedimentation tank (two chambered) will be provided to maximum recycling and Reuse of Water. 5. Green net is placed along the boundary to arrest dust.	  	
4.	For Controlling Noise, following precautions are being taken on sites:		
	1. Noise Barriers at all Critical Locations like Near Schools and Hospitals etc. will be provided.		Noise Barrier is erected along the Breach Candy Hospital.

L&T CONSTRUCTION LTD. Sign. MCRP. PKG.-1

Louis Berger Consulting Pvt. Ltd.

	2. All Construction vehicles are provided with Noise Mufflers, Good Silencers on sites.		
	3. All Construction sites barricaded by 2m X 2.5 m barricading boards at site in order to demarcate site from General Public and Road users.		As per IRC SP 55 type IV (Board).
	4. DG is provided with acoustic enclosures. Noise reduced up to 75 dB at 1m distance.		
	5. All rotating parts of construction machineries will be provided with canopies and grills to control rotating parts noise.	Presently no machines are placed with rotating part open, however, in future, it will be protected against entangled hazard.	
5.	The Environmental Monitoring Data is displayed on sites at conspicuous places like site & offices. This Environmental Monitoring date will contain, Air and Noise Monitoring Results.		
6.	All Environmental Monitoring is carried by third party Environmental Monitoring Agency approved by MoEF & CC and NABL.		M/s. Netel (India) Limited is MoEF & CC and NABL accredited lab. The copy of MoEF&CC is displayed.

L&T CONSTRUCTION LTD. Sign MCRP. PKG.-1

Louis Berger Consulting Pvt. Ltd.

7.	Bio-Toilets are provided at site.		

Mumbai Coastal Road Project Package -2

Compliance Status of Environmental Issues

S. No.	Description	Sample Photograph	Remarks
1.	HCC is ISO 14001 (Environmental Management System) and OHSAS 18001 certified. M/s. DNV.GL is a third party certification agency and validity of certificate is until; • ISO 14001:2015 – 19 March 2020. • BS OSHAS 18001:2007 – 19 March 2020.		
2.	Preconstruction Air & Noise Monitoring is going on in sites to establish Base Line Air and Noise Monitoring Results. These results will establish Air Pollution Levels and Noise Levels on Coastal Road Project alignment before start of Actual Major Construction Activities. Actual Air and Noise Monitoring results during major Construction works will be compared with Preconstruction results and Standards mentioned legally by MOEF and CPCB.		Environment Monitoring is being carried out at site; 1. Ambient Air quality is being monitored at 5 locations on site, based on the activity. 2. Noise level is being monitored at 5 locations on site based on the activity.

3.	For controlling Dust: 6. On-site Water Sprinkling is being carried out on regular basis. The frequency is defined as two times a day. 7. Load carrying vehicles are covered to control the spread of dust particles while transportation. 8. Wheel wash facility will be provided. 9. Sedimentation tank (two chambered) will be provided maximum recycling and Reuse of Water.		
4.	For Controlling Noise, following precautions are being taken on sites:		
5	Noise Barriers at all Critical Locations like Near Schools and Hospitals etc. will be provided.		
6	All Construction vehicles are provided with Noise Mufflers, Good Silencers on sites.		Vehicles are provided with mufflers and silencers and the same is given in reference
7	All Construction sites barricaded by 2m X 2.5 m barricading boards at site in order to demarcate site from General Public and Road users.		IRC SP 55 type IV (Board).

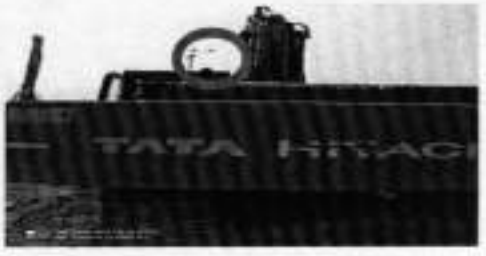
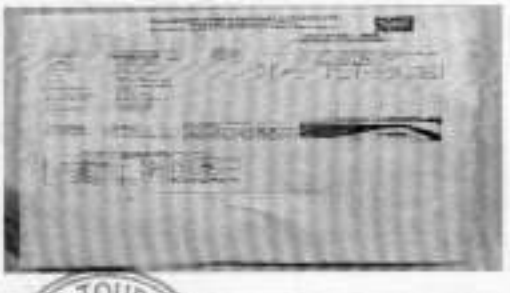
8	DG is provided with acoustic enclosures noise reduced upto 75 dB at 1m distance		DG set Provided in acoustic enclosure and the same is given in reference
9	Preventive Maintenance schedule for all construction Machinery at site are maintained. Copy of PUC certificate is provided herewith.		PUC certificate for the machineries operating in the site
10	All rotating parts of construction machineries will be provided with canopies and grills to control rotating parts noise.	Presently no machines are placed with rotating part open, however, in future, it will be protected against entangled hazard	
11	The Environmental Monitoring Data is displayed on sites at conspicuous places like site & offices. This Environmental Monitoring date will contain, Air and Noise Monitoring Results.	Noted, will be followed.	
12	All Environmental Monitoring is carried by third party Environmental Monitoring Agency approved by MoEF & CC and NABL.		M/s. Sky Lab Analytical Laboratory has be accredited by NABL/ MOEFCC and the same is given in reference
13	Bio Toilets are provided at site.		We have installed Bio Toilets

Mumbai Coastal Road Project Package-4

Compliance Status of Environmental Issues

S. No.	Description	Sample Photograph	Remarks
1	L&T is ISO 14001 (Environmental Management System) and ISO 45001 (Safety Standard) certified. M/s. DNV.GL is a third party certification agency and validity of certificate is until; • ISO 45001:2018 – 25 March 2022. • ISO 14001:2018 – 25 March 2022.	 	
2	Preconstruction Air & Noise Monitoring is going on in sites to establish Base Line Air and Noise Monitoring Results. These results will establish Air Pollution Levels and Noise Levels on Coastal Road Project alignment before start of Actual Major Construction Activities. Actual Air and Noise Monitoring results during major Construction works will be compared with Preconstruction results and Standards mentioned legally by MOEF and CPCB.	 	Environment Monitoring is being carried out at site; 1. Ambient Air quality is being monitored at two locations on site, based on the activity. 2. Noise level is being monitored at two locations on site based on the activity.
3	For controlling Dust: 1. On-site Water Sprinkling is being carried out on regular basis. The frequency is defined as once a day.		

	2. Road cleaning is being carried out on regular basis.		
	3. Load carrying vehicles are covered to control the spread of dust particles while transportation.		
	4. Wheel wash facility will be provided.		
	5. Sedimentation tank (two chambered) will be provided maximum recycling and Reuse of Water.		
	6. Noise barrier along the residential apartments also restrict the dust to mix in the outer environment.		
	7. Provision of enclosed shed for temporary construction facilities		
4	For Controlling Noise, following precautions are being taken on sites:		
	1. Noise Barriers at all Critical Locations like Near Schools and Hospitals etc. will be provided.		Noise barrier erection work is in progress.
	2. Provision of 6meter		

	height noise barrier shed for temporary construction facilities.		
	3. Use of enclosed noise barrier container during concrete pouring (High noise producing activity)		
	4. All Construction vehicles are provided with Noise Mufflers, Good Silencers on sites.		
	5. All Construction sites barricaded by 2m X 2.5 m barricading boards at site in order to demarcate site from General Public and Road users.		IRC SP 55 type IV (Board).
	6. DG is provided with acoustic enclosures noise reduced up to 75 dB at 1 m distance		
	7. Preventive Maintenance schedule for all construction Machinery/vehicle at site are maintained. Copy of PUC certificate is provided herewith.		
5	All rotating parts of		

	construction machineries will be provided with canopies and grills to control rotating parts noise.		
6	The Environmental Monitoring Data is displayed on sites at conspicuous places like site & offices. This Environmental Monitoring date will contain, Air and Noise Monitoring Results.		
7	All Environmental Monitoring is carried by third party Environmental Monitoring Agency approved by MoEF & CC and NABL.		M/s Horizon Service engaged for the environmental monitoring work. Company having MoEF & CC and NABL accredited lab facility.
8	Bio Toilets are provided at site.		

ANNEXURE-4

ENVIRONMENT MONITORING REPORT

(OCTOBER 2020 TO MARCH 2021)

Mumbai Coastal Road Project- Package -1

Ambient Air Quality Monitoring

Amarson Garden (AG)- PM 2.5

Date	Value	Std
03.10.2020	27.9	60
06.10.2020	33.1	60
20.10.2020	33.1	60
23.10.2020	24	60
30.10.2020	34.3	60
04.11.2020	26	60
10.11.2020	25.6	60
12.11.2020	35.2	60
18.11.2020	NA	60
20.11.2020	36.9	60
24.11.2020	36.9	60
27.11.2020	31.3	60
02.12.2020	32.6	60
04.12.2020	25.6	60
08.12.2020	32.1	60
11.12.2020	36.9	60
19.12.2020	35.6	60
22.12.2020	29.1	60
29.12.2020	29.5	60
02.01.2021	25.6	60
05.01.2021	28.2	60
08.01.2021	29.9	60

Date	Near Mahalakshmi temple	Tata Garden	Limit
12.01.2021	28.6	30.4	60
15.01.2021	26	26.9	60
19.01.2021	29.5	29.5	60
22.01.2021	32.6	31.7	60
27.01.2021	29.1	32.6	60
29.01.2021	34.3	29.1	60
02.02.2021	25.2	24.7	60
05.02.2021	36.5	28.2	60
09.02.2021	32.1	30.4	60
16.02.2021	28.6	34.7	60
19.02.2021	30.4	33.4	60
23.02.2021	31.7	34.3	60
26.02.2021	29.1	30.4	60
02.03.2021	30.4	28.6	60
05.03.2021	31.7	34.3	60
09.03.2021	25.6	31.3	60
12.03.2021	26.2	33.4	60
16.03.2021	35.2	32.6	60
19.03.2021	26.9	27.5	60

Amarson Garden (AG)- PM 10

Date	Value	Std
03.10.2020	62.3	100
06.10.2020	71.6	100
20.10.2020	71.8	100
23.10.2020	64.2	
30.10.2020	78.2	100
04.11.2020	71.8	100
10.11.2020	71.5	100
12.11.2020	78.2	100
18.11.2020	NA	100
20.11.2020	83.8	100
24.11.2020	85.7	100
27.11.2020	74.3	100
02.12.2020	85.1	100
04.12.2020	69.4	100
08.12.2020	74.8	100
11.12.2020	84.3	100
19.12.2020	83.1	100
22.12.2020	69.4	100
29.12.2020	67.1	100
02.01.2021	70.6	100
05.01.2021	72	100
08.01.2021	71.4	100

Date	Near Mahalakshmi temple	Tata Garden	Limit
12.01.2021	70.3	84.9	100
15.01.2021	68.3	68.6	100
19.01.2021	69.9	84.7	100
22.01.2021	76.2	81.3	100
27.01.2021	79.1	71.9	100
29.01.2021	83.4	80.9	100
02.02.2021	68.2	70.8	100
05.02.2021	85	80.8	100
09.02.2021	75	86.9	100
16.02.2021	71.3	80.9	100
19.02.2021	84	76.1	100
23.02.2021	72.3	79.7	100
26.02.2021	69.1	84.9	100
02.03.2021	74.2	79.9	100
05.03.2021	76.9	83.9	100
09.03.2021	67.7	74.8	100
12.03.2021	74.7	77.3	100
16.03.2021	78.8	78.9	100
19.03.2021	68.7	73.8	100

L&T CONSTRUCTION LTD. Sign MCRP, PKG.-1

Louis Berger Consulting Pvt. Ltd.

AECOM Asia Company Limited MUMBAI

Mumbai Coastal Road Project- Package -1

Ambient Air Quality Monitoring

Haji Ali (HA)- PM 2.5

Date	Value	Std
03.10.2020	24.8	60
06.10.2020	26.6	60
20.10.2020	26.6	60
23.10.2020	26.9	60
30.10.2020	29.5	60
04.11.2020	29.5	60
10.11.2020	38.6	60
18.11.2020	32.1	60
20.11.2020	33.9	60
24.11.2020	28.2	60
27.11.2020	37.3	60
02.12.2020	34.3	60
04.12.2020	33.9	60
08.12.2020	32.6	60
11.12.2020	25.2	60
15.12.2020	34.6	60
19.12.2020	29.5	60
29.12.2020	34.3	60
02.01.2021	31.3	60
05.01.2021	24.7	60
08.01.2021	32.1	60

Date	Slum Area	Weigh Bridge	Limit
12.01.2021	36	29.1	60
15.01.2021	30.4	26.9	60
19.01.2021	29.5	39.5	60
22.01.2021	30.4	34.3	60
27.01.2021	24.3	30.8	60
29.01.2021	26	28.6	60
02.02.2021	26.9	35.6	60
05.02.2021	28.6	39.5	60
09.02.2021	29.5	33	60
16.02.2021	29.9	25.6	60
19.02.2021	26.9	26	60
23.02.2021	32.6	26.9	60
26.02.2021	31.5	30.8	60
02.03.2021	26	29.9	60
05.03.2021	35.2	23.9	60
09.03.2021	31.3	30.8	60
12.03.2021	33.4	28.2	60
16.03.2021	26.9	30.8	60
19.03.2021	27.8	30.8	60

Haji Ali (HA)- PM 10

Date	Value	Std
03.10.2020	72.3	100
06.10.2020	76.6	100
20.10.2020	65	100
23.10.2020	69.5	100
30.10.2020	69.8	100
04.11.2020	79.6	100
10.11.2020	85.5	100
18.11.2020	86.8	100
20.11.2020	86.5	100
24.11.2020	67	100
27.11.2020	84.7	100
02.12.2020	85.7	100
04.12.2020	89	100
08.12.2020	79	100
11.12.2020	69.5	100
15.12.2020	86.3	100
19.12.2020	70.6	100
29.12.2020	76.3	100
02.01.2021	74.3	100
05.01.2021	70.8	100
08.01.2021	85	100

Date	Slum Area	Weigh Bridge	Limit
12.01.2021	83.5	83	100
15.01.2021	70.4	72.6	100
19.01.2021	78.1	87.7	100
22.01.2021	84.1	80.1	100
27.01.2021	67	81.2	100
29.01.2021	67.1	68.1	100
02.02.2021	70.9	82.8	100
05.02.2021	71.2	87.7	100
09.02.2021	68.2	82.1	100
16.02.2021	79.2	67.6	100
19.02.2021	71.1	72	100
23.02.2021	76.2	75.3	100
26.02.2021	72.2	76.6	100
02.03.2021	74.1	84.7	100
05.03.2021	85.4	68.2	100
09.03.2021	71.7	71.5	100
12.03.2021	76.4	76.3	100
16.03.2021	70.4	80.9	100
19.03.2021	75.6	74.1	100

L&T CONSTRUCTION LTD. Sign..... MCRP. PKG.-1

Louis Berger Consulting Pvt. Ltd.

Mumbai Coastal Road Project- Package -1

Ambient Air Quality Monitoring

Baroda Palace (BP)		
Date	PM-10	Std.
12.03.2021	81.6	100
16.03.2021	79.5	100
19.03.2021	81.2	100

Baroda Palace (BP)		
Date	PM-2.5	Std.
12.03.2021	36.9	60
16.03.2021	33	60
19.03.2021	34.3	60

Mumbai Coastal Road Project- Package -1

Ambient Noise Quality Monitoring

Amarson Garden- Leq-Day			
Date	Value		Limit
06.10.2020	67.4		75
20.10.2020	69.3		75
27.10.2020	70.8		75
04.11.2020	67.2		75
10.11.2020	72.2		75
18.11.2020	70.4		75
24.11.2020	72.5		75
02.12.2020	71.4		75
08.12.2020	69.9		75
15.12.2020	71.1		75
22.12.2020	72.9		75
29.12.2020	68.9		75
05.01.2021	68.8		75
Date	Tata Garden	Near Mahalakshmi	
12.01.2021	67.8		75
15.01.2021		69.3	75
19.01.2021	69.5		75
22.01.2021		70.5	75
27.01.2021	66.6		75
29.01.2021		67.9	75
02.02.2021	68.6		75
05.02.2021		70.4	75
09.02.2021	72.5		75
16.02.2021		63.1	75
19.02.2021	68.1		75
23.02.2021		69.1	75
26.02.2021	65.7		75
02.03.2021		67	75
05.03.2021	72.8		75
09.03.2021		70.3	75
12.03.2021	65.7		75
16.03.2021		69	75
19.03.2021	67		75

Amarson Garden- Leq-Night			
Date	Value		Limit
06.10.2020	65.1		70
20.10.2020	63.8		
27.10.2020	65.5		70
04.11.2020	63.1		70
10.11.2020	61.8		70
18.11.2020	66.6		70
24.11.2020	61		70
02.12.2020	65.6		70
08.12.2020	60.8		70
15.12.2020	67.6		70
22.12.2020	62.6		70
29.12.2020	68.5		70
05.01.2021	67.8		70
Date	Tata Garden	Near Mahalakshmi	
12.01.2021	68.6		70
15.01.2021		59.3	70
19.01.2021	67.2		70
22.01.2021		66.7	70
27.01.2021	61.7		70
29.01.2021		62.1	70
02.02.2021	62.1		70
05.02.2021		65.9	70
09.02.2021	66.1		70
16.02.2021		60.8	70
19.02.2021	62.1		70
23.02.2021		62.9	70
26.02.2021	60.2		70
02.03.2021		60	70
05.03.2021	63.7		70
09.03.2021		62.9	70
12.03.2021	62.9		70
16.03.2021		66.5	70
19.03.2021	65.2		70

L&T CONSTRUCTION LTD. Sign. MCRP. PKG.-1

Louis Berger Consulting Pvt. Ltd.

AECOM Asia Company Limited MUMBAI

Mumbai Coastal Road Project- Package -1							
Ambient Noise Quality Monitoring							
Haji Ali- Leq-Day					Haji Ali- Leq-Night		
Date	Value		Limit		Date	Value	Limit
06.10.2020	60.7		75		06.10.2020	58.3	70
20.10.2020	67.6		75		20.10.2020	66.2	70
27.10.2020	72.1		75		27.10.2020	67.4	70
04.11.2020	73.3		75		04.11.2020	65.8	70
10.11.2020	72		75		10.11.2020	65.9	70
18.11.2020	68.5		75		18.11.2020	66.3	70
24.11.2020	65.8		75		24.11.2020	62.3	70
02.12.2020	70.8		75		02.12.2020	64.2	70
08.12.2020	72.5		75		08.12.2020	67.8	70
15.12.2020	72.5		75		15.12.2020	67.9	70
22.12.2020	71.7		75		22.12.2020	66.2	70
29.12.2020	70.6		75		29.12.2020	65.3	70
05.01.2021	71.7		75		05.01.2021	67	70
Date	Slum	Weigh bridge			Date	Slum	Weigh bridge	
12.01.2021	70.6		75		12.01.2021	66.1		70
15.01.2021		67.1	75		15.01.2021		63.4	70
19.01.2021	68.8		75		19.01.2021	67		70
22.01.2021		71.6	75		22.01.2021		67.4	70
27.01.2021	71.8		75		27.01.2021	66.4		70
29.01.2021		67.2	75		29.01.2021		65.9	70
02.02.2021	67.5		75		02.02.2021	61.9		70
05.02.2021		62.9	75		05.02.2021		60.1	70
09.02.2021	69.7		75		09.02.2021	65.4		70
16.02.2021		70.9	75		16.02.2021		63	70
19.02.2021	71.4		75		19.02.2021	67.8		70
23.02.2021		71.9	75		23.02.2021		68.6	70
26.02.2021	70.2		75		26.02.2021	65.6		70
02.03.2021		70.1	75		02.03.2021		60.8	70
05.03.2021	64.9		75		05.03.2021	61.5		70
09.03.2021		67.5	75		09.03.2021		66.9	70
12.03.2021	68.8		75		12.03.2021	64		70
16.03.2021		69.3	75		16.03.2021		68.5	70
19.03.2021	70.9		75		19.03.2021	69.4		70

Baroda Palace		
Date	Day	Limit
12.03.2021	67.8	75
19.03.2021	71.1	75
Date	Night	Limit
12.03.2021	63.5	70
19.03.2021	66.3	70

L&T CONSTRUCTION LTD. Sign MCRP, PKG.-1

Louis Berger Consulting Pvt. Ltd.

Mumbai Coastal Road Project Package -II							
Ambient Air Quality Monitoring							
S.No	Date	Parameters (24 Hrs) & Unit	Result	NAAQS Limit	Parameters (24 Hrs) & Unit	Result	NAAQS Limit
Location: Gate No.1							
1	22-09-2020	PM 2.5 µg/m3	14.9	60	PM 10 µg/m3	33.1	100
2	25-09-2002		19.2	60		41.3	100
3	28-09-2020		23.6	60		48.2	100
4	05-10-2020		23.6	60		48.1	100
5	09-10-2020		27.1	60		57.2	100
6	12-10-2020		34.7	60		70.5	100
7	16-10-2020		31.1	60		60.8	100
8	19-10-2020		22.3	60		50.7	100
9	23-10-2020		28.8	60		54.1	100
10	26-10-2020		24.6	60		61.5	100
11	02-11-2020		38.5	60		75.1	100
12	09-11-2020		40.4	60		77.7	100
13	17-11-2020		42.7	60		86.5	100
14	20-11-2020		39.6	60		71.8	100
15	23-11-2020		46.4	60		89.8	100
16	27-11-2020		43.8	60		84.6	100
17	30-11-2020		41.8	60		84.4	100
18	04-12-2020		50.4	60		93.7	100
19	07-12-2020		49.3	60		92.6	100
20	11-12-2020		48.6	60		90.2	100
21	14-12-2020		52.3	60		94.4	100
22	18-12-2020		30.5	60		72.3	100
23	23.12.2020		44.5	60		89.4	100
24	28.12.2020		40.6	60		84.5	100
25	1.01.2021		44.6	60		92.5	100
26	4.01.2021		41.8	60		87.6	100
27	8.01.2021		48.3	60		93.5	100
28	11.01.2021		41.5	60		87.8	100
29	15.01.2021		40.6	60		78.3	100
30	18.01.2021		48.4	60		93.6	100
31	22.01.2021		38.1	60		87.5	100

Mumbai Coastal Road Project Package -II							
Ambient Air Quality Monitoring							
#	Date	Parameters (24 Hrs) & Unit	Result	NAAQS Limit	Parameters (24 Hrs) & Unit	Result	NAAQS Limit
Location: Gate No 4							
1	22-09-2020	PM 2.5 µg/m3	25.8	60	PM 10 µg/m3	54.7	100
2	25-09-2002		22.1	60		47.6	100
3	28-09-2020		18.6	60		40.4	100
4	05-10-2020		24.7	60		52.4	100
5	09-10-2020		28.5	60		59.3	100
6	12-10-2020		30.8	60		63.1	100
7	16-10-2020		26.2	60		54.5	100
8	19-10-2020		31.5	60		62.4	100
9	23-10-2020		33.4	60		69.3	100
10	26-10-2020		29.4	60		63.4	100
11	02-11-2020		28.6	60		58.3	100
12	09-11-2020		21.1	60		47	100
13	17-11-2020		27.7	60		64.8	100
14	20-11-2020		30.4	60		58.3	100
15	23-11-2020		34.6	60		72.8	100
16	27-11-2020		34.2	60		73.5	100
17	30-11-2020		37.2	60		82.8	100
18	04-12-2020		42.8	60		87.1	100
19	07-12-2020		43.6	60		86.4	100
20	11-12-2020		53.3	60		94.8	100
21	14-12-2020		34.3	60		74.6	100
22	18-12-2020		42.2	60		79.4	100
23	23.12.2020		46.6	60		90.4	100
24	28.12.2020		25.4	60		52.7	100
25	1.01.2021		28.6	60		63.5	100
26	4.01.2021		32.6	60		71.2	100
27	8.01.2021		40.7	60		83.6	100
28	11.01.2021		33.4	60		68.5	100
29	15.01.2021		31.4	60		74.6	100
30	18.01.2021		40.3	60		82.5	100
31	22.01.2021		46.5	60		86.4	100

Location	Month	Parameters	PM 2.5	PM 10
Main Gate 01 / Batching Plant /MB 21	February	µg/m3	27.3	58.7
		µg/m3	16.4	40.5
		µg/m3	46.5	91.5
		µg/m3	42.7	90.5
Main Gate 02- Crushing Unit /Admin Office/Store		µg/m3	52.8	97.5
		µg/m3	42.5	84.4
		µg/m3	53.6	97.7
		µg/m3	24.5	50.7
Main Gate 03 - Piling Work		µg/m3	30.7	62.5
		µg/m3	46.7	92.4
		µg/m3	24.5	52.6
		µg/m3	35.5	76.5
Main Gate 04 -Promenade		µg/m3	34.6	68.2
		µg/m3	38.4	80.5
		µg/m3	34.7	74.5
		µg/m3	43.5	89.7
Main Gate No.5 Garden Area		µg/m3	26.6	58.5

Location	Period	Parameters /unit	PM 10	PM 2.5
Main Gate 01	March	µg/m3	93.6	45.5
		µg/m3	68.8	32.7
		µg/m3	84.5	40.7
		µg/m3	93.7	47.5
		µg/m3	84.7	41.5
		µg/m3	92.7	45.5
		µg/m3	86.7	42.5
		µg/m3	85.4	41.2
Main Gate 02		µg/m3	64.8	32.5
		µg/m3	75.8	34.6
		µg/m3	85.3	40.6
		µg/m3	91.1	44.7
		µg/m3	87.4	42.6
		µg/m3	92.7	46.5
		µg/m3	95.7	50.5
		µg/m3	93.5	50.4
Main Gate 03		µg/m3	79.7	38.5
		µg/m3	89.6	43.5
		µg/m3	72.5	35.4

		µg/m3	65.6	32.4
		µg/m3	58.4	27.6
		µg/m3	64.4	32.3
		µg/m3	72.5	35.7
		µg/m3	55.4	33.3
		µg/m3	60.7	28.6
		µg/m3	84.5	42.7
		µg/m3	72.7	32.5
Main Gate 04		µg/m3	64.7	29.5
		µg/m3	54.6	26.5
		µg/m3	62.5	29.4
		µg/m3	69.7	34.8
		µg/m3	64.6	27.4
		µg/m3	87.7	42.6
		µg/m3	78.4	38.6
		µg/m3	82.3	39.4
Main Gate 05		µg/m3	73.8	34.6
		µg/m3	64.5	30.5
		µg/m3	59.4	27.7
		µg/m3	72.6	35.5
		µg/m3	71.5	32.1

Mumbai Coastal Road Project Package -II					
Ambient Air Quality Monitoring					
S. No	GATE No.1 - Leq-Day				
	Date	Value	Standard	Value	Standard
1	22-09-2020	60.4	75	57.4	70
2	25-09-2020	72.6	75	69.8	70
3	28-09-2020	72.9	75	67	70
4	05-10-2020	68.6	75	60.4	70
5	09-10-2020	51.9	75	47.3	70
6	12-10-2020	66.3	75	52.9	70
7	16-10-2020		75		70
8	19-10-2020	68.7	75	65.6	70
9	23-10-2020		75		70
10	26-10-2020	65.5	75	53.4	70
11	02-11-2020	68.9	75	62.5	70
12	09-11-2020	71.9	75	69.5	70
13	17-11-2020	73.7	75	62.5	70
14	23-11-2020	74.1	75	66.4	70
15	30-11-2020	64.3	75	59.7	70
16	07-12-2020	70.6	75	61.9	70
17	11-12-2020	73.7	75	65	70
18	14-12-2020	71.8	75	67.9	70
19	18-12-2020	61.9	75	54.1	70
20	23.12.2020	72.6	75	68.9	70
21	28.12.2020	72.8	75		70
22	1.01.2021	73.4	75	68.6	70
23	4.01.2021	73	75	69.2	70
24	8.01.2021	67.4	75	52.6	70
25	11.01.2021	67.2	75	63.8	70
26	15.01.2021	71.7	75	65.2	70
27	18.01.2021	70	75	63.6	70
28	22.01.2021	66.9	75	58.3	70

Location	Period	L_{eq} Day	L_{eq} Night
Main Gate 01	February	53.3	69.4
		79.8	68.9
		70.3	65.6
		62.5	52.8
Main Gate 02		73.6	68.4
		70.6	56.7
		70.6	56.7
		72.8	68.3

HCC-HDC JOINT VENTURE

MUMBAI COASTAL ROAD PROJECT

ACCIONA Infrastructure Company Limited

Main Gate 03		68.9	62.8
		66.3	60.6
		72.2	66.7
Main Gate 04		67.4	60.1
		69.1	62.9
		67.4	53.2
		70.9	54.9
		60.6	57.3
Main Gate 5		69.2	65.4

Location/Time	Period	Leq Day	Leq Night
Main Gate 01	March	73.6	66.8
		73.4	63.1
		71	65.6
		73.4	67.1
		73.4	67.1
		73.5	67.4
		69.9	61.5
		64.5	54.8
Main Gate 02		72	66.4
		71	67.1
		73.7	69.4
		66.1	60.8
		66.1	60.8
		74.7	65.5
		72.8	65.3
		71.4	66.5
Main Gate 03		70.2	64.9
		70.6	64.5
		74.7	61.5
		71.9	59.3
		71.9	59.3
		72.4	68.9
		70.9	63.8
		73.2	69.6
Main Gate 04		73.4	63.5
		67.2	60.3
		66.8	59.8
		64.6	57.7
		64.6	57.7
		67	64.9
		67.3	58
		66.3	55.6

C-201

Main Gate 5		64.1	58.6
		64.3	60.5
		70.2	67
		72.4	65.8
		72.4	65.8
		68.4	56
		68.9	64.2
		66.4	57

Mumbai Coastal Raod Project Package -4								
Ambient Air Quality Monitoring								
Sr.No	Parameters (24 Hrs) & Unit	Date	Result	NAAQS Limit	Parameters (24 Hrs) & Unit	Date	Result	NAAQS Limit
Location: Priyadarshini Park					Location: Priyadarshini Park			
1	PM 2.5 µg/m3	02.10.20	28.34	60	PM 10 µg/m3	02.10.20	58.47	100
2		07.10.20	20.64	60		07.10.20	42.89	100
3		09.10.20	16.44	60		09.10.20	35.81	100
4		14.10.20	25.91	60		14.10.20	53.61	100
5		16.10.20	28.33	60		16.10.20	59.78	100
6		20.10.20	22.12	60		20.10.20	45.67	100
7		22.10.20	27.66	60		22.10.20	51.69	100
8		27.10.20	31.08	60		27.10.20	...	100
9		29.10.20	26.51	60		29.10.20	57.34	100
10		02.11.20	28.73	60		02.11.20	60.18	100
11		04.11.20	24.19	60		04.11.20	52.13	100
12		09.11.20	36.49	60		09.11.20	73.15	100
13		10.11.20	32.01	60		10.11.20	64.28	100
14		19.11.20	30.13	60		19.11.20	62.58	100
15		21.11.20	34.32	60		21.11.20	69.76	100
16		25.11.20	35.46	60		25.11.20	73.25	100
17		27.11.20	32.01	60		27.11.20	67.43	100
18		02.12.20	42.1	60		02.12.20	79.65	100
19		04.12.20	36.5	60		04.12.20	72.01	100
20		09.12.20	36.49	60		09.12.20	70.85	100
21		11.12.20	38.19	60		11.12.20	75.32	100
22		16.12.20	40.12	60		16.12.20	79.85	100
23		18.12.20	37.49	60		18.12.20	72.31	100
24		22.12.20	45.99	60		22.12.20	85.10	100
25		24.12.20	42.11	60		24.12.20	79.37	100
26		28.12.20	36.82	60		28.12.20	75.34	100
27		30.12.20	33.41	60		30.12.20	68.73	100
28		06.01.21	33.17	60		06.01.21	69.78	100
29		08.01.21	35.2	60		08.01.21	73.18	100
30		14.01.21	41.25	60		14.01.21	79.86	100
31		16.01.21	34.61	60		16.01.21	70.84	100
32		20.01.21	36.49	60		20.01.21	72.36	100
33		21.01.21	42.13	60		21.01.21	88.67	100
34		27.01.21	46.39	60		27.01.21	88.57	100
35		29.01.21	34.52	60		29.01.21	72.41	100
36		01.02.21	40.89	60		01.02.21	78.64	100
37		03.02.21	30.18	60		03.02.21	62.79	100
38		10.02.21	31.66	60		10.02.21	62.48	100
39		12.02.21	42.51	60		12.02.21	80.96	100
40		17.02.21	45.91	60		17.02.21	78.69	100
41		19.02.21	49.66	60		19.02.21	75.94	100
42		24.02.21	38.64	60		24.02.21	70.36	100
43		26.02.21	48.96	60		26.02.21	86.45	100
44		03.03.21	42.51	60		03.03.21	79.86	100
45		05.03.21	45.28	60		05.03.21	96.38	100
46		10.03.21	35.62	60		10.03.21	72.36	100
47		12.03.21	46.49	60		12.03.21	92.31	100
48		17.03.21	40.27	60		17.03.21	79.68	100
49		19.03.21	41.25	60		19.03.21	80.43	100
50		24.03.21	45.17	60		24.03.21	86.69	100
51		26.03.21	47.85	60		26.03.21	90.11	100
52		31.03.21	46.85	60		31.03.21	95.34	100

Mumbai Coastal Raod Project Package-4								
Ambient Air Quality Monitoring								
Sr.No	Parameters (24 Hrs)	Date	Result	NAAQS Limit	Parameters (24	Date	Result	NAAQS Limit
Location		Girgaon Chowpatty			Location : Girgaon Chowpatty			
1		02.10.20	30.29	60		02.10.20	58.47	100
2		07.10.20	19.61	60		07.10.20	40.78	100
3		09.10.20	22.65	60		09.10.20	45.72	100
4		14.10.20	22.39	60		14.10.20	49.76	100
5		16.10.20	20.42	60		16.10.20	42.69	100
6		20.10.20	29.66	60		20.10.20	59.81	100
7		22.10.20	26.69	60		22.10.20	54.98	100
8		27.10.20	24.3	60		27.10.20	51.08	100
9		29.10.20	34.12	60		29.10.20	68.39	100
10		02.11.20	27.2	60		02.11.20	59.46	100
11		04.11.20	18.79	60		04.11.20	43.21	100
12		09.11.20	30.64	60		09.11.20	63.25	100
13		10.11.20	27.91	60		10.11.20	53.14	100
14		19.11.20	27.41	60		19.11.20	56.34	100
15		21.11.20	34.15	60		21.11.20	67.34	100
16		25.11.20	32.1	60		25.11.20	66.34	100
17		27.11.20	30.49	60		27.11.20	62.31	100
18		02.12.20	36.91	60		02.12.20	71.43	100
19		04.12.20	32.1	60		04.12.20	67.49	100
20		09.12.20	30.12	60		09.12.20	63.25	100
21		11.12.20	27.32	60		11.12.20	57.46	100
22		16.12.20	35.42	60		16.12.20	68.75	100
23		18.12.20	28.4	60		18.12.20	60.36	100
24		22.12.20	38.26	60		22.12.20	75.1	100
25		24.12.20	36.18	60		24.12.20	70.3	100
26	PM 2.5	28.12.20	64.42	60	PM 10	28.12.20	35.1	100
27	µg/m3	30.12.20	71.42	60	µg/m3	30.12.20	36.39	100
28		06.01.21	59.86	60		06.01.21	32.5	100
29		08.01.21	65.3	60		08.01.21	29.34	100
30		14.01.21	65.34	60		14.01.21	33.12	100
31		16.01.21	61.39	60		16.01.21	30.18	100
32		20.01.21	69.76	60		20.01.21	35.12	100
33		21.01.21	79.68	60		21.01.21	42.13	100
34		27.01.21	32.15	60		27.01.21	64.39	100
35		29.01.21	52.36	60		29.01.21	93.41	100
36		01.02.21	36.59	60		01.02.21	74.18	100
37		03.02.21	43.27	60		03.02.21	84.1	100
38		10.02.21	42.17	60		10.02.21	85.34	100
39		12.02.21	40.34	60		12.02.21	79.11	100
40		17.02.21	37.58	60		17.02.21	73.85	100
41		19.02.21	45.07	60		19.02.21	88.5	100
42		24.02.21	33.28	60		24.02.21	66.49	100
43		26.02.21	44.15	60		26.02.21	83.26	100
44		03.03.21	28.71	60		03.03.21	60.39	100
45		05.03.21	45.27	60		05.03.21	91.38	100
46		10.03.21	38.42	60		10.03.21	75.64	100
47		12.03.21	42.61	60		12.03.21	82.73	100
48		17.03.21	30.19	60		17.03.21	63.25	100
49		19.03.21	46.32	60		19.03.21	89.63	100
50		24.03.21	68.91	60		24.03.21	36.12	100
51		26.03.21	95.66	60		26.03.21	47.91	100
52		31.03.21	75.36	60		31.03.21	38.65	100

C-205

Mumbai Coastal Raod Project Package 4						
Ambient Noise Quality Monitoring						
Priyadarshini Park Project Area						
S. No	Near Temporary Construction Facility - Leq					
	Day			Night		
	Date	Value	Standard	Date	Value	Standard
1	02.10.20	70.0	75	02.10.20	53.19	70
2	09.10.20	70.2	75	09.10.20	53.43	70
3	16.10.20	72.1	75	16.10.20	56.19	70
4	22.10.20	74.0	75	22.10.20	56.38	70
4	29.10.20	70.54	75	29.10.20	62.26	70
5	04.11.20	66.29	75	04.11.20	52.36	70
6	10.11.20	69.7	75	10.11.20	57.56	70
7	19.11.20	70.77	75	19.11.20	62.78	70
8	25.11.20	69.19	75	25.11.20	60.86	70
9	02.12.20	69.22	75	02.12.20	57.47	70
10	10.12.20	70.83	75	10.12.20	60.4	70
12	16.12.20	68.73	75	16.12.20	59.82	70
14	22.12.20	70.56	75	22.12.20	58.13	70
16	28.12.20	73.26	75	28.12.20	62.87	70
17	06.01.21	73.82	75	06.01.21	65.31	70
18	14.01.21	69.33	75	14.01.21	64.06	70
19	20.01.21	67.34	75	20.01.21	57.35	70
20	27.01.21	65.69	75	27.01.21	59.56	70
21	01.02.21	61.07	75	01.02.21	54.75	70
22	10.02.21	66.64	75	10.02.21	65.62	70
23	17.02.21	76.15	75	17.02.21	76.2	70
24	24.02.21	66.63	75	24.02.21	65.82	70
25	03.03.21	66.38	75	03.03.21	59.86	70
26	10.03.21	68.17	75	10.03.21	66.2	70
27	17.03.21	67.65	75	17.03.21	64.4	70
28	24.03.21	67.68	75	24.03.21	64.78	70
29	31.03.21	66.65	75	31.03.21	65.43	70

S. No	Behind New Office/Weigh Bridge - Leq					
	Day			Night		
	Date	Value	Standard	Date	Value	Standard
1	04.11.20	47.43	75	04.11.20	44.67	70
2	10.11.20	45.29	75	10.11.20	41.61	70
3	19.11.20	45.19	75	19.11.20	41.36	70
4	10.02.21	71.49	75	10.02.21	64.36	70
4	17.02.21	68.22	75	17.02.21	67.39	70
5	24.02.21	66.56	75	24.02.21	65.5	70
6	03.03.21	75.4	75	03.03.21	70.68	70
7	10.03.21	75.9	75	10.03.21	71.02	70
8	17.03.21	61.91	75	17.03.21	59.19	70
9	24.03.21	63.33	75	24.03.21	61.4	70
10	31.03.21	61.99	75	31.03.21	62.0	70

Mumbai Coastal Raod Project Package 4						
Ambient Noise Quality Monitoring						
Girgaon Chowpatty						
S. No	Near Mafatlal Sweeming Pool - Leq-Day			Near Mafatlal Sweeming Pool - Leq-Night		
	Date	Value	Standard	Date	Value	Standard
1	02.11.20	72.44	75	02.11.20	63.75	70
2	09.11.20	74.62	75	09.11.20	65.75	70
3	21.11.20	75.68	75	21.11.20	70.25	70
4	12.02.21	67.25	75	12.02.21	61.95	70
4	19.02.21	67.95	75	19.02.21	64.64	70
5	26.02.21	66.58	75	26.02.21	62.03	70
6	05.03.21	75.02	75	05.03.21	68.51	70
7	12.03.21	71.1	75	12.03.21	63.94	70
8	19.03.21	67.51	75	19.03.21	64.00	70
9	26.03.21	66.88	75	26.03.21	65.89	70
S. No	Near Bal Bhavan/Police Chowki- Leq-Day			Near Bal Bhavan/Police Chowki- - Leq-Night		
	Date	Value	Standard	Date	Value	Standard
1	07.10.20	70.99	75	07.10.20	59.23	70
2	14.10.20	72.58	75	14.10.20	58.3	70
3	22.10.20	75.06	75	22.10.20	61.5	70
4	27.10.20	72.08	75	27.10.20	61.53	70
4	02.11.20	73.32	75	02.11.20	62.06	70
5	09.11.20	73.17	75	09.11.20	61.93	70
6	21.11.20	73.89	75	21.11.20	67.06	70
7	27.11.20	67.45	75	27.11.20	57.23	70
8	04.12.20	72.4	75	04.12.20	64.79	70
9	11.12.20	70.84	75	11.12.20	56.49	70
10	18.12.20	69.61	75	18.12.20	61.47	70
12	24.12.20	71.8	75	24.12.20	64.87	70
14	30.12.20	73.08	75	30.12.20	65.5	70
16	08.01.21	74.73	75	08.01.21	66.87	70
17	16.01.21	70.65	75	16.01.21	55.13	70
18	22.01.21	70.83	75	22.01.21	60.83	70
19	29.01.21	70.51	75	29.01.21	57.85	70
20	03.02.21	69.54	75	03.02.21	57.21	70
21	10.02.21	64.84	75	10.02.21	61.95	70
22	19.02.21	79.48	75	19.02.21	70.7	70
23	26.02.21	75.79	75	26.02.21	70.75	70
24	05.03.21	69.53	75	05.03.21	63.19	70
25	12.03.21	75.68	75	12.03.21	70.08	70
26	19.03.21	75.09	75	19.03.21	71.18	70
27	26.03.21	76.24	75	26.03.21	70.7	70

ANNEXURE-5

CRZ conditions compliance status

(October 2020 to March 2021)

MUNICIPAL CORPORATION OF GREATER MUMBAI

Compliances of the Specific and General Conditions Stipulated in CRZ Clearance Accorded by MoEF & CC for "Coastal Road (South) from Princess Street Flyover to Worli end of Sea Link in Mumbai by Municipal Corporation of Greater Mumbai"

A. Specific Conditions:

Sr. No.	Condition	Compliance
i	All the terms and conditions stipulated by the MCZMA in their letter No.CRZ 2016/CR 1/TC 4, dated 04th January, 2017, shall be strictly complied with and the status of implementation shall be submitted to all concerned agencies including regional office of the Ministry of Environment, Forest and Climate Change.	Details of compliances submitted to the Ministry on regular basis
ii	The project/activity shall be carried out strictly be in accordance with the provisions of CRZ Notification, 2011, and shall render the coastal ecology of the area including flora and fauna at its original state after completion of the project.	The work is being executed as per the provisions of CRZ Notification 2011 & the clearance granted
iii	The project proponent shall not undertake any blasting activities during night hours. Blasting activity (if any) shall be carried out strictly in conformity with applicable statutory requirements.	The Norms of Statutory Regulatory Authority are followed in Blasting activities.
iv	The project proponent shall ensure that during construction phase no adverse impact on tidal behaviour is attracted. It shall also be ensured that no human access/interventions in the CRZ area beyond the reclaimed land is made by preventing any access to the area.	Noted, during construction human access/interventions in the CRZ area beyond the reclaimed land is being controlled. National Institute of Oceanography (NIO) Dona Paula, Goa is engaged to assess the actual impact (in comparison with the projected impacts as stated in EIA) on shore morphology of adjacent areas during and after the construction of the coastal road. Copy of the Interim report 3 by NIO is submitted herewith.

Sr. No.	Condition	Compliance
v	Break up of 90 ha of land to be reclaimed shall be submitted with *six months* of receipt of the clearance to the regional office of the Ministry and to concerned agencies in the State Government along with justification thereof with a written undertaking that the reclaimed land shall not be used for any commercial or residential purpose.	The break up of reclamation land is submitted in previous compliances. Revised break up of reclamation as per approval of amendment of CRZ Clearance is as follows :- 1) Total Reclamation – 111 Ha. 2) Seawall protection – 14.49 Ha. 3) Road Carriageway – 14.88 Ha. 4) Median – 4.83 Ha. 5) Promenade – 11.66 Ha. 6) Open / Green – 70 Ha.
vi	The project proponent will ensure that open spaces created by reclamation as well as any ancillary facilities related to road maintenance are fully protected against encroachment, illegal parking, public events/processions of any kind, hawkers, religious structures, street vendors or any illegal occupants etc. Violation of this will amount to revocation of clearance. A clearly drafted prevention plan with necessary budget allocations shall be submitted to the concerned authority, including the regional office of the Ministry *within 30 days of receipt* of the clearance.	MCGM has issued circular in this regard. Copy of the same has been attached in previous submissions.

Sr. No.	Condition	Compliance
vii	The green spaces as proposed should be done in eco-friendly manner by developing it with open air nature information centre with novel concepts as open air butterfly garden, marine and coastal biodiversity display and dioramas, or botanical theme based information walkways as such that these spaces also carry educational value on environment to general public. *A specific allocation of Rs 10 crores shall be earmarked for the same.* A blue print of the same including timeline shall be developed within *six months* from the date of receipt of this clearance and submitted to regional office of the Ministry and implemented in a time bound manner.	Development of open air butterfly garden will be examined for feasibility. Marine and Coastal Biodiversity Display will be done through reputed Institution. Any other activity will be carried out as per MCGM's Policy, Rules & Regulations. The project already involves fund provision for landscaping, plantation and various green works on proposed reclaimed land wherein it is proposed to develop butterfly garden. This will be developed on reclaimed land after construction of super structure and reclamation to the design levels, as final activity.
viii	The project proponent shall provide alternative arrangement for Fish Drying beds with prior consultation with the fishing community, in the event, the project entails damages/destruction to the existing fish drying beds located in the project area. In addition, the project proponent shall ensure rehabilitation and resettlement of the fishermen communities in the event the project impacts existing livelihood pattern of these communities. Bridges with navigable spans will be provided by the project proponent as committed, so that there are no obstructions to fishing boats.	There are no Fish drying beds along proposed alignment of Mumbai Coastal Road (South). The issue of rehabilitation and resettlement of the fishermen communities does not arises since project does not entail damages /destruction to the existing fish drying beds. CMFRI is engaged for studying the impact on livelihood pattern of fishermen communities & they have submitted completion report of year long survey (May2019-May2020) in Oct. 2020. Copy enclosed herewith please and suitable policy for compensation to affected fishermen is being formulated accordingly. A Committee in this regard for compensation to fishermen is already formed. The office order copy has been submitted in previous compliances. At present navigational span of existing Bandra Worli Sea link is 29m. However, adequate navigational spans of 60m are proposed in Coastal Road for smooth maneuvering of fishermen boats.

Sr. No.	Condition	Compliance
ix	The project proponent shall develop a marine biodiversity conservation plan for the region from an institute which has expertise in the field of marine biodiversity of the region. The plan will be submitted to the Ministry within one year and implementation shall be monitored by the Ministry.	Marine biodiversity conservation plan for the region has been prepared by CSIR-National Institute of Oceanography, Versova , Mumbai and copy of the final report by NIO has been submitted in previous compliances. Monitoring activity of Marine Biodiversity is in progress by NIO.
x	The project proponent shall periodically carry out studies through the National Institute of Oceanography (NIO) during and after the construction of the coastal road to assess the actual impact (in comparison with the projected impacts as stated in EIA) on human habitations and shore morphology of adjacent areas and shall report its findings and mitigating steps taken every six months to the MCZMA, the State Pollution Control Board and the regional office of the Ministry.	National Institute of Oceanography (NIO) Dona Paula, Goa is engaged to assess the actual impact (in comparison with the projected impacts as stated in EIA) on shore morphology of adjacent areas during and after the construction of the coastal road. Copy of the Interim report 3 by NIO is submitted herewith.
xi	The project proponent shall ensure that noise barriers all along the coastal road on areas facing residential areas are erected and maintained.	Noise barriers all along the coastal road on areas facing residential areas are proposed to be provided as per IRC guidelines. During construction phase also noise barriers are provided wherever required.
xii	The project proponent shall deposit 2% of the total cost of the project for conservation of coastal and marine biodiversity, to the Mangrove Foundation of Maharashtra. Interest from the fund must be used exclusively to improve coastal and marine biodiversity of Mumbai and Thane region and as such be clearly earmarked in annual budget of the Foundation. The funds to be transferred on or before commencement of the construction work and a report in this regard to be forwarded to regional office of Ministry.	The total Cost of project was Rs.5303.00Cr at the time of CRZ clearance. Accordingly 2% cost of project Rs106.06cr was demanded by Mangrove Cell vide letter dated 10.6.2017. Now the construction cost of project has increased to Rs. 8429.44 crs + 4% physical contingency = Rs.8766.61crs from Rs5303.00 Crs. MCGM has deposited Rs.175.33 Crs in November 2020 to the Mangrove Foundation of Maharashtra.

Sr. No.	Condition	Compliance
xiii	In case tree cutting is unavoidable, three times the number of trees cut shall be planted along the ROW and its survival ensured.	The permission is obtained for tree cutting (140 nos) and transplantation (460 nos) The 36 trees has been cut in MCRP-1 at Haji Ali location and 30 nos trees are cut in MCRP-4. New plantation are done in the ratio of 1:3 of 297 trees at Worli reservoir and Bhandup Complex (Photos attached).
xiv	Adequate public access to the natural waterfront areas shall be provided and maintained free of cost by the project proponent without affecting road traffic.	Public access to the natural waterfront area is proposed to be provided at convenient locations.
xv	The proposed coastal road will be permanently toll free.	Noted.
xvi	The muck produced during tunnel digging should be tested for suitability for reclamation purpose prior to its use. A certificate in this regard from competent authority shall be submitted to the concerned authority in the State including the regional office of Ministry.	The tunnel muck quality tested in approved third party laboratory. Report attached as annexure -6 & is suitable for reclamation & is being used accordingly.
xvii	There shall be no disposal of solid or liquid wastes on the coastal area. Solid waste management shall be as per Solid Wastes Management Rules, 2016. A team comprising of members of the EAC and others with expertise in the subject may visit the project site periodically during the construction phase to supervise and suggest additional measures if desire.	Solid and Liquid Waste Disposal plan will be as per Site Environmental Plan.
xviii	A dedicated BRTS lane as stated by the project proponent must be maintained and will be used exclusively for public transport as well as medical and fire evacuation or other rescue operations. Under no circumstances this lane will be used for general, commercial or VIP transport.	Dedicated BRTS lane is proposed to be developed which will be utilized during medical as well as other emergencies including disasters.

Sr. No.	Condition	Compliance
xix	The project proponent shall ensue that the quality of the coastal road must be of high international standard and shall be rigorously maintained ensuring free of pot holes at all times. A severe fine will be levied on the project proponents if the quality of work is found/ reported compromised.	The international standards for measuring riding quality of road are "Roughness Indices". The care is taken in RFP documents as per IRC and high International standards to measure riding quality and construction is supervised as per the best standard procedures.

B. General Conditions:

Sr. No.	Condition	Compliance
i	Adequate provision for infrastructure facilities including water supply, fuel and sanitation must be ensured for construction workers during the construction phase of the project to avoid any damage to the environment.	The contractors have adhered.
ii	Full support shall be extended to the officers of this Ministry/Regional Office at Nagpur by the project proponent during inspection of the project for monitoring purposes by furnishing full details and action plan including action taken reports in respect of mitigation measures and other environmental protection activities.	Representative of MoEF&CC Regional Office, Nagpur, Mr. Suresh Kumar Adapa visited site on 13th -14th Jan. 2021. Full support has been extended for monitoring purposes by furnishing full details and action plan including action taken reports in respect of mitigation measures and other environmental protection activities.
iii	A six-Monthly monitoring report shall need to be submitted by the project proponents to the Regional Office of this Ministry at Nagpur regarding the implementation of the stipulated conditions.	Environmental Monitoring is being done. Reports are attached as Annexure 3.
iv	The Ministry of Environment, Forest &- Climate Change or any other competent authority may stipulate any additional conditions or modify the existing ones, if necessary in the interest of environment and the same shall be complied with.	Noted.

v	The Ministry reserves the right to revoke this clearance if any of the conditions stipulated are not complied with to the satisfaction of the Ministry.	Noted.
vi	In the event of a change in project profile or change in the implementation agency, a fresh reference shall be made to the Ministry.	Noted.
vii	The project proponents shall inform the Regional Office of the Ministry, the date of financial closure and final approval of the project by the concerned authorities and the date of start of land development work.	Being complied.
viii	A copy of the clearance letter shall be marked to concerned Panchayat/ local NGO, if any, from whom any suggestion/ representation has been made received while processing the proposal.	Complied and reported in earlier correspondence.
ix	A copy of the CRZ Clearance letter shall also be displayed on the website of the concerned State Pollution Control Board. The Clearance letter shall also be displayed at the Regional Office, District Industries centre and Collector's Office/Tehsildars Office for 30 days.	Complied and reported in earlier correspondence.

Other Conditions:

Sr. No.	Condition	Compliance
7.	The above stipulations would be enforced among others under the provisions of Water (Prevention and Control of Pollution) Act 1974, the Air (Prevention and Control of Pollution) Act 1981, the Environment (Protection) Act, 1986, the Public Liability (Insurance) Act, 1991 and EIA Notification 1994, including the amendments and rules made thereafter.	Noted.
8	All other statutory clearances such as the approvals for storage of diesel from Chief Controller of Explosives, Fire Department, Civil Aviation Department, and clearances under the Forest Conservation Act, 1980 and Wildlife (Protection) Act, 1972 etc. shall be obtained, as applicable by project proponents from the respective competent authorities.	The clearance under Wild life (Protection) Act, 1972, has been sought. Copy of the same alongwith the closure report of translocation of Corals by the expert of NIO, from HajiAli to Navy Nagar & Worli is attached herewith. The first monitoring report of same is also attached herewith.

9.	The project proponent shall advertise in at least two local Newspapers widely circulated in the region, one of which shall be in the vernacular language informing that the project has been accorded CRZ Clearance and copies of clearance letters are available with the State Pollution Control Board and may also be seen on the website of the Ministry of Environment, Forest & Climate Change at http://www.envfor.nic.in. The advertisement should be made within Seven days from the date of receipt of the Clearance letter and a copy of the same should be forwarded to the Regional office of this Ministry at Nagpur.	Complied and reported in earlier correspondence.
10.	This Clearance is subject to final order of the Hon'ble Supreme Court of India in the matter of Goa Foundation Vs. Union of India in Writ Petition (Civil) No.460 of 2004 as may be applicable to this project.	Noted.
11.	Any appeal against this clearance shall lie with the National Green Tribunal, if preferred, within a period of 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010.	Noted
12.	Status of compliance to the various stipulated environmental conditions and environmental safeguards will be uploaded by the project proponent on its website.	Noted
13.	A copy of the clearance letter shall be sent by the proponent to concerned Panchayat, Zilla Parishad/Municipal Corporation, Urban Local Body and the Local NGO, if any, from whom suggestions/representations, if any, were received while processing the proposal. The clearance letter shall also be put on the website of the company by the proponent.	Complied.
14.	The proponent shall upload the status of compliance of the stipulated EC conditions, including results of monitored data on their website and shall update the same periodically. It shall simultaneously be sent to the Regional Office of MoEF, the respective Zonal Office of CPCB and the SPCB.	Noted, will be complied.

15.	The project proponent shall also submit six monthly reports on the status of compliance of the stipulated EC conditions including results of monitored data (both in hard copies as well as by e-mail) to the respective Regional Office of MoEFCC, the respective Zonal Office of CPCB and the SPCB.	Report Submitted as follows • Ch.E/1000 (v) /Coastal Road Project date 08.06.2017 • Ch.E/1237/Coastal Road Project date 03.10.2017 • Ch.E/1357/Coastal Road Project date 25.10.2018 • Ch.E/1901/Coastal Road Project date 28.05.2019 • Ch.E/3222/Coastal Road Project date 29.06.2019 • Ch.E/9246/Coastal Road Project date 4.02.2020 • Ch.E/1092/Coastal Road Project date 17.08.2020 • Ch.E/3250/Coastal Road Project date 22.01.2021
16.	The environmental statement for each financial year ending 31st March in Form-V as is mandated to be submitted by the project proponent to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall also be put on the website of the company along with the status of compliance of EC conditions and shall also be sent to the respective Regional Offices of MoEFCC by e-mail.	Noted, being complied.

Chief Engineer (Coastal Road) I/c
MCGM

EE(2)

ANNEXURE-5.1

MCZMA Conditions Compliance Status

(October 2020 to March 2021)

Compliance Status against MCZMA Conditions as per Minutes of 114th meeting of Maharashtra Coastal Zone Management Authority held on 2nd and 3rd November, 2016

Sr. No	Conditions	Present Status
1	MCGM to ensure that proposed construction of coastal road is as per provisions of CRZ notification, 2011 (amended time to time)	All the construction work will be carried out as per the CRZ notification, 2019.
2	MCGM to ensure that all construction equipment are fully fitted with mufflers and exhaust silencers to contain the noise levels. Machinery used during construction should be properly maintained to minimize the air and noise emissions	The Environment Management Plan is in place. Noise control measures mentioned in the plan is in place as follows. 1. Well maintained construction equipments and vehicles used for the construction activities. Vehicle with valid PUC certificate is allowed to work at project area. 2. Equipment & Vehicle inspection done periodically. 3. Equipment's are with mufflers and exhaust silencers. 4. Noise barrier installation adjacent to residential apartment is under progress. 5. Ear muff/plug are provided to workmen working in noise prone areas. 6. Ambient air and noise monitoring carried out periodically.
3	MCGM as proposed, to set aside an amount of about 2% of the project cost towards mitigation measures; restoration & conservation of mangroves/birds/flora/fauna and mudflats restoration.	The fund for conservation of coastal and marine biodiversity of Rs. 175.33 Crores (includes amended project cost) has been deposited to the Mangrove Foundation of Maharashtra.
4	MCGM to ensure that no fishing activity is hampered during construction and operation phase of the project	Noted
5	MCGM to submit the impact of clearing of mangroves if any on surrounding low lying areas from flood. However post construction such areas should be restored with mangroves plantation if affected.	No mangrove in the project region
6	MCGM to obtain prior high court permission for clearing of mangrove, if any.	No mangrove in the project region
7	MCGM to undertake green belt development as suggested in the EMP	Noted, will be complied
8	For road safety, guidelines in respect of road signage, service roads, bus bays,	Noted and will be complied.

	inter-sections, pedestrians crossing etc. shall be strictly adhered to.	
9	Dust suppression measure during construction and operation phase	Following dust suppression measure are taken during construction phase, 1. Load carrying vehicles are covered to control the spread of dust particles while transportation.  2. Speed limit of vehicles are restricted to 10 KM/Hr at construction site.  3. Regular water sprinkling  4. Regular road cleaning.  5. Provision of wheel washing arrangement to clean vehicles wheel before leaving site to control mud on public road near the project site. 

		6. Provision of complete shed for temporary construction activities. 
10	MCGM to implement Green Belt Development plan	Noted
11	MCGM to implement all suggestions /recommendation given in the EIA, EMP, DMP studies for the project.	Noted
12	All other required permissions should be obtained before the commencement of the project	Noted. Will be obtained as applicable from competent authority.

L & T CONSTRUCTION LTD. Sign MCRP. PKG.-1

LARSEN & TOUBRO LTD. CRP. PKG.-1

HCC-MDC JOINT VENTURE

Louis Berger Consulting Pvt. Ltd.

MUMBAI COASTAL ROAD PROJECT PKG II

AECOM India Company Limited MUMBAI

YOOSHIN ENGINEERING CORPORATION (PMC) MCR (PKG-I)

ANNEXURE-6

TUNNEL MUCK QUALITY REPORT

(OCTOBER 2020 TO MARCH 2021)

Format No:SSA/TRF/GEN
Issue No:01, Issue Date:10-03-2018

SPECTRO®
SSA Labs Pvt Ltd
CIN:U74990DL2010PTC354497

TEST REPORT

Test Report Issued To:

LARSEN & TOUBRO LIMITED (MUMBAI COASTAL ROAD)
MUMBAI COASTAL ROAD PROJECT PACKAGE-04, DENA BANK (OPP).,
MSRDC COMPLEX, PRIYADHARSHINI PARK, NEPANSEA ROAD.,
MUMBAI, MAHARASHTRA - 400026,

Test Report No: M210122018/M210122018-10
Date of Issue: 03-Feb-2021

Sample Receipt Date: 22-Jan-2021
Date of Start of Testing: 22-Jan-2021
Date of Completion of Test: 02-Feb-2021

Customer Relationship Number 53890

Sample Description :
RECLAMATION FILL, SAMPLED FROM STP AREA (PDP), SOURCE-PDP SITE TUNNEL (TUNNEL EXCAVATAL MATERIAL)

Customer Reference No
MCR4/LNT/LL/SCM/00232 DT. 21/01/2021

Kind Attention : MR. SHRIKRISHNA KULKARNI
E-Mail: shrikrishna-kulkarni@lntecc.com **Contact No:** 9527281208

Sample Condition : GOOD
Sample Quantity (Approx) : - **Sample Size (Approx) :** -

SAMPLE NOT DRAWN BY OUR LABORATORY. THE RESULTS RELATE ONLY TO THE ITEMS TESTED

SPECTRO SSA LABS PVT. LTD.
Digitally signed by Yogesh Singh
Date: 2021.02.03 13:34:18 +05:30
Report Issued By

Authencity of report can be verified by mail at verification@spectrolab.in
This is a Digitally Signed Report and hence doesn't require Physical Signature

ID- M210122018-1

Chemical Analysis

Sr. No.	Test/Parameter	Result	Test Method
1	Organic matter % by mass	0.22	IS 2720-Part-22-1972 (RA-2015)

Analyst Signature

Digitally signed by DHANLESH BALKRISHNA RAUT
Date: 2021.02.03 13:34:17 +05:30

Authorised Signatory

C-227

TEST REPORT

ID-M210122018-1

Sl. No.	Tests	Results	Test Method
1	IS Sieve Size		IS:2720(Pt-4) - 1985
	(a) 100 mm	100	
	(b) 75 mm	100	
	(c) 19 mm	69.8	
	(d) 4.75 mm	44.0	
	(e) 425 micron	24.7	
	(f) 63 micron	8.8	
2	Impact Value,%	13.6	IS:2386(Pt4)1963
3	Water Absorption,% by mass	3.09	IS:2386(Pt-3- 1963
4	Soundness by $MgSo_4$,% (after 5 cycle)	2.82	IS:2386(Pt-5)1963
5	Density,(Kg/litre)	1.76	IS:2386(Pt-3)1963

-- End of Test Report --

Digitally signed by Yogesh Singh
Date: 2021.02.03 13:34:10 +05:30

Analyst Signature

Authorised Signatory

C-229

SPECTRO®
SSA Labs Pvt Ltd
CIN:U74990DL2010PTC354497

TEST REPORT

Test Report Issued To:

LARSEN & TOUBRO LIMITED (MUMBAI COASTAL ROAD)
MUMBAI COASTAL ROAD PROJECT PACKAGE-04, DENA BANK (OPP).,
MSRDC COMPLEX, PRIYADHARSHNI PARK, NEPANSEA ROAD.,
MUMBAI, MAHARASHTRA - 400026,

Test Report No: M210122018/M210122018-11
Date of Issue: 03-Feb-2021

Sample Receipt Date: 22-Jan-2021
Date of Start of Testing: 22-Jan-2021
Date of Completion of Test: 02-Feb-2021

Customer Relationship Number 53890

Sample Description :
RECLAMATION FILL, SAMPLED FROM STP AREA (PDP),
SOURCE-PDP SITE TUNNEL (TUNNEL EXCAVATAL MATERIAL)

Customer Reference No
MCR4/LNT/LL/SCM/00232 DT. 21/01/2021

Kind Attention : MR. SHRIKRISHNA KULKARNI
E-Mail: shrikrishna-kulkarni@lntecc.com **Contact No:** 9527281208

Sample Condition : GOOD
Sample Quantity (Approx) : - **Sample Size (Approx) :** -

SAMPLE NOT DRAWN BY OUR LABORATORY. THE RESULTS RELATE ONLY TO THE ITEMS TESTED

SPECTRO SSA LABS PVT. LTD.
Digitally signed by Yogesh Singh
Date: 2021.02.03 13:33:09 +05:30
Report Issued By

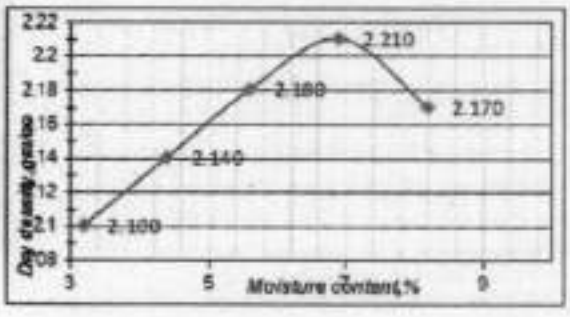
ULR-TC816321000000941F

Authencity of report can be verified by mail at verification@spectrolab.in

This is a Digitally Signed Report and hence doesn't require Physical Signature.

ID-M210122018-1

Sl. No.	Tests	Results	Test Method
1	Heavy Weight Proctor Test		IS: 2720 (Pt.8)- 1983
	(a) Maximum Dry Density, gm/cc	2.21	
	(b) Optimum Moisture Content, %	6.9	
2	Atterberg's Limit, %		IS: 2720 (Pt-5) - 1985
	(a) Liquid limit	23.9	
	(b) Plastic Limit	NP	
	(c) Plastic index	NP	



Analyst Signature

ilac-MRA

Testing(TC-8163)

ULR-TC816321000000941F

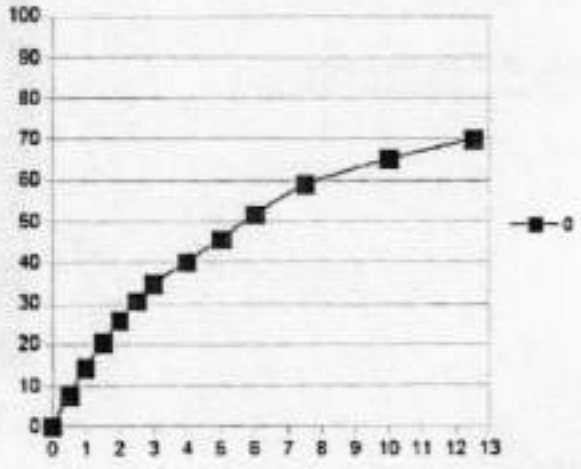
Digitally signed by Yogesh Singh
Date: 2021.02.03 13:32:00 +05:30

Authorised Signatory

C-231

ID-M210122018-I

Sl. No.	Tests / Parameters	Results	Test Method
3	California Bearing Ratio (Soaked), %		IS2720(pt-16) -1987
	(a) At 2.5 mm Penetration	43.66	
	(b) At 5.0 mm Penetration	43.34	



-- End of Test Report --

ULR-TC816321000000941F

Analyst Signature

Testing(TC-8163)

Digitally signed by Yogesh Singh
Date: 2021.02.03 13:33:06 +05:30

Authorised Signatory

SPECTRO®
Analytical Labs Limited
CIN:U74220DL1998PLC092698

TEST REPORT

Test Report Issued To:

LARSEN & TOUBRO LIMITED (MUMBAI COASTAL ROAD)
MUMBAI COASTAL ROAD PROJECT PACKAGE-04, DENA BANK (OPP),,
MSRDC COMPLEX, PRIYADHARSHINI PARK, NEPANSEA ROAD,,
MUMBAI, MAHARASHTRA - 400026,

Test Report No: M210122018/M210122018-20
Date of Issue: 11-Feb-2021

Sample Booking/Receipt Date: 22-Jan-2021
Date of Start of Testing: 03-Feb-2021
Date of Completion of Test: 11-Feb-2021

Customer Relationship Number	53890

Sample Description :
RECLAMATION FILL, SAMPLED FROM STP AREA (PDP), SOURCE-PDP SITE TUNNEL (TUNNEL EXCAVATAL MATERIAL)

Customer Reference No :
MCR4/LNT/LU/SCM/03232 DT. 21/01/2021

Kind Attention : MR. SHRIKRISHNA KULKARNI
E-Mail: shrikrishna-kulkarni@lntecc.com **Contact No:** 9527281208

Sample Condition : *GOOD*
Sample Quantity (Approx) : - **Sample Size (Approx) :** -

SAMPLE NOT DRAWN BY OUR LABORATORY. THE RESULTS RELATE ONLY TO THE ITEMS TESTED

SPECTRO ANALYTICAL LABS LTD
Digitally signed by Narender Goel
Date: 2021.02.11 11:13:48 +05:30

Report Issued by

Authenticity of report can be verified by mail at verification@spectrolab.in

This is a Digitally Signed Report and hence doesn't require Physical Signature

C-233

TEST REPORT

Report No. M210122018/M210122018-20

S.No.	Test Parameter	Observed Value	Test method
1.	**Drain Direct Share Test**		IS 2720 (Pt-13): 1985/R 2015
	Cohesion (C), Kg/cm^2	0.05	
	Angle of Friction (Φ), °	34	

-- End of Test Report --

Analyst Signature

Digitally signed by Narender Goel
Date: 2021.02.11 11:13:18 +05:30

Authorised Signatory

C-249

Mumbai Coastal Road Project (South)

New Plantation

MCRP Package-1 Worli

C-251

Mumbai Coastal Road Project (South)
New Plantation

MCRP Package-4 Bhandup Complex

Office of the Additional Principal Chief Conservator of Forests,
Mangrove Cell, Mumbai
302, Wakefield House, 3rd Floor, Ballard Estate, Above Britannia & Co. Restaurant,
Fort, Mumbai-400 001.
Ph: 022-2694984, 22694985, Email: ccfmmumbai@gmail.com / ccfmangrove@mahaforest.gov.in

Ot No. Desk-9/land/ 1159/2020-21
Kurla-400 024 Mumbai Dt- 21/12/2020

To:

Principal Chief Conservator of Forests (Wildlife)
Maharashtra State, Nagpur

Sub: Completion of Coral Translocation Work at Haji Ali and Worli that was getting affected by the proposed Coastal Road activities.

Ref: 01. Permit No. SPP-55/2020 dated 29th October 2020.
02. MCGM letter no.Ch.E/2565/Coastal Road Project Dtd. 09.12.2020.
03. DFO office letter no. Desk-9/ land / 1268/ 2020-21 dt.21/12/2020.

With reference to above cited Permit, the translocation of corals was carried out by MCGM. MCGM has successfully translocated the corals with help of the expert team from CSIR-NIO under the supervision of authorised Forest Officer of Mangrove Cell, RFO Central Mumbai and Marine Biologist from the Mangrove Foundation. The compliance report has been submitted by User agency i.e., MCGM.

The work has been carried out within the terms and conditions laid down by the Chief Wildlife Warden. The Compliance is as follows:

Condition no	Details of conditions	Compliance
8(1)	The permit holder shall write a report of his collection as may be required by the chef Wildlife Warden or authorized officer, *and* send a copy of such report to the Additional Principal Chief Conservator of Forest Department 'Mangrove Cell) Mumbai (Authorized Officer) of the area where hunting has taken piece.	User agency has submitted a report of CSIR-NIO. CSIR-NIO (Competent Authority and executioner) which is attached as Annexure I. MCGM has submitted that work of translocation corals has successfully completed with help of the expert team from CSIR-NIO under the supervision of authorised Forest Officer of Mangrove Cell, RFO Central Mumbai and Marine Biologist from the Mangrove Foundation.
8(2)	the permit holder Shall produce the entire *evidence* made by him for inspection, whenever required by the Chief Wildlife Warden or any other officer authorized by him for the purpose	User agency has submitted that whenever entire evidence required by Chief Wildlife Warden or any other authorised officer, photographic evidence will be produced vide letter no. ChE/2750/Coastal Road Road/dt.17.12.2020 The copy of letter is annexed as Annexure II.
8(3)	The permit holder shall not use any wild animal under this permit *for* any commercial purpose. Further, the permit holder shall not export his collection outside the State of Maharashtra, without the prior written permission from the Chief Wildlife Warden Or any officer authorized by him in this behalf.	User agency has submitted that they will be abiding by this condition.

8(4)	The permit holder shall submit report of hunting under this permit to the Authorized Officer The report shall include details of Inventory along with species including scientific name, number and sex of wild animals hunted, juvenile specimens hunted, location of hunting and number of wild animals released back to its natural habitat as well *as* details of any wild animal Inadvertently hunted by him during the period.	User agency has submitted that report of NIO to this office vide letter no. u/no Ch..E/2471/Coastal Road Project dt. 02.12.2020. The copy of NIO report is enclosed for further action.
8(5)	The permit holder shall surrender this permit to the Authorized Officer issuing this permit within 15 day of Its expiry or before leaving the area given In the *Permit,* whichever is earlier, along with the final reports containing the details as required in the quarterly report.	User agency has submitted that original copy of permit is already returned to this office; vide letter no.u/no Ch.E/ 2471/Coastal Road Project dt. 02.12.2020. The Original copy of permit is attached as Annexure III for further action.
8(6)	No person other than the permit holder or in Assistants engaged by the permit holder *can use* of this permit. The permit holder shall communicate names of his assistants at least three days in advance to the Authorized Officer, whose direction on dissociating any individual from use of this permit will be binding. The permit holder it prohibited from subletting, outsourcing or transferring this permit In any manner. This permit is not transferable by inheritance or any other means for similar nature	User agency has submitted that the condition is already complied.
8(7)	The permit holder shall abide by additional conditions If any appended to this permit, as deemed fit by the Ciller Wildlife Warden or Authorized Officer while issuing this permit. See annexure of this permit for additional conditions. Compliance: Noted and Complied.	User agency has submitted that they have noted and will be followed.
8(1)	The permit holder shall write a report of his collection as may be required by the chef Wildlife Warden or authorized officer, *and* send a copy of such report to the Additional Principal Chief Conservator of Forest Department 'Mangrove Cell) Mumbai (Authorized Officer) of the area where hunting has taken piece	DFO MMCU has submitted that MCGM has successfully translocated the corals with help of the NIO CSIR officials and authorised officer of Mangrove Cell. The copy of NIO CSIR report is attached for further action.
8(2)	the permit holder Shall produce the entire *evidence* made by him for inspection, whenever required by the Chief Wildlife Warden or any other officer authorized by him for the purpose	MCGM has submits that whenever entire evidence is required for inspection Chief Wildlife warden or any authorised officer, MCGM shall produce it vide its letter no.ChE/2750/Coastal Road/dt.17.12.2020.
8(3)	The permit holder shall not use any wild animal under this permit *for* any commercial purpose.	MCGM has submitted that MCGM will abide by this condition.

	Further, the permit holder shall not export his collection outside the State of Maharashtra, without the prior written permission from the Chief Wildlife Warden Or any officer authorized by him in this behalf.	
8(4)	The permit holder shall submit report of hunting under this permit to the Authorized Officer The report shall include details of Inventory along with species including scientific name, number and sex of wild animals hunted, juvenile specimens hunted, location of hunting and number of wild animals released back to its natural habitat as well *as* details of any wild animal Inadvertently hunted by him during the period.	MCGM has submitted that the process of translocation the corals has been successfully completed with help of the NIO CSIR's representatives and authorised officer of Mangrove Cell. The copy of NIO CSIR report is attached for further action
8(5)	The permit holder shall surrender this permit to the Authorized Officer issuing this permit within 15 day oflts expiry or before leaving the area given In the *Permit,* whichever is earlier, along with the final reports containing the details as required in the quarterly report.	This office has submitted the original copy permit vide letter which enclosed as **Annexure III.**
8(6)	No person other than the permit holder or in Assistants engaged by the permit holder *can use* of this permit. The permit holder shall communicate names of his assistants at least three days in advance to the Authorized Officer, whose direction on dissociating any individual from use of this permit will be binding. The permit holder it prohibited from subletting, outsourcing or transferring this permit In any manner. This permit is not transferable by inheritance or any other means for similar nature	The condition is compiled during translocation process.
8(7)	The permit holder shall abide by additional conditions If any appended to this permit, as Deemed fit by the Ciller Wildlife Warden or Authorized Officer while issuing this permit. See annexure of this permit for additional conditions.	Noted and will be complied
1	The Chief Engineer, Mumbai Coastal Road Project (MCRP) to strictly follow the directions of Hon'ble Supreme Court in respect of SLP No. 17471-17476/ 2019.	MCGM has followed the direction given by Supreme Court and if any direction in future will be followed.
2	The Chief Engineer, Mumbai Coastal Road Project (MCRP), Municipal Corporation of Greater Mumbai, to carry out collection & Translocation in the presence of the Additional Principal Chief Conservator of Forest (Mangrove Cell) Mumbai, or his representative of Forest Department and also in the presence of an expert from wildlife institute of India, Dehradun or National Institute of Oceanography.	MCGM has submitted that the process of translocate the corals has been successfully completed with help of the NIO CSIR's representatives and authorised officer of Mangrove Cell. The copy of NIO CSIR report is attached for further action.
3	The Chief Engineer, Mumbai Coastal Road Project (MCRP) Municipal Corporation of Greater Mumbai shall ensure adequate protection to the coral species during the entire process and also to monitor at the translocated site with respect to survival and growth.	MCGM has submitted that the process of translocation of corals was done with help of NIO experts and under supervision of Mangrove Cell.
4	No damage to be caused to other Wildlife and	MCGM has submitted that no damage was

	utmost care shall be exercised during the process.	found during the translocation process, vide letter no. ChE/2750/Coastal Road Road/dt.17.12.2020.
5	The completion report should be shared with both, the central Government and the State Government.	MCGM has submitted that the copy of report vide letter No. Ch.E/2471/Coastal Road dt. 02.12.2020. is forwarded to 01. The Deputy Inspector General of Forests (Wildlife) Gov. MoEF &CC wildlife Division and 02. Principal Chief Conservator of forests (Wildlife) and Chief Wildlife Warden Maharashtra State.
6	In case of any miss-happening during the process, that endangers or may endanger the safety of the corals, the central	MCGM has submitted that no damage was found during the translocation process, vide letter no. ChE/2750/Coastal Road Road/dt.17.12.2020

Here the point wise compliance report is submitted for information and further action.

(Virendra Tiwari) 21/12
Additional Principal Chief Conservator of Forests,
Mangrove Cell, Mumbai.

Copy to

1) Chief Engineer, (Coastal Road), for information & necessary action.
2) Divisional Forest Officer, Mumbai Mangrove Conservation Unit, for information & necessary action.

Annexure I

सी एस आई आर - राष्ट्रीय समुद्र विज्ञान संस्थान
(वैज्ञानिक एवं औद्योगिक अनुसंधान परिषद)
क्षेत्रीय केंद्र, लोखंडवाला रोड, चार बंगला, अंधेरी (प.), मुंबई - 400 053, भारत

CSIR - National Institute of Oceanography
(Council of Scientific & Industrial Research)
Regional Centre, Lokhandwala Road, Four Bungalows, Andheri (W), Mumbai - 400 053, India
EPBX : 91-22-26359605-08 (4 Lines), Fax : 91-22-26364627 / 26346875, e-mail : rcm@nio.org

No. NIO/M-2020/BEIPL(Corals-MCRP)/SSP3357//202

Date:25.11.2020

To,

Building Environment (India) Private Limited,
4th Floor, Plot No.2, Dakshina Building,
Sector 11, C.B.D Belapur, Navi Mumbai,
Maharashtra 400614

Sub: Translocation of corals at Haji Ali and Worli area to avoid their loss due to construction of Mumbai Coastal Road Project (South)

Ref: Your e-mail communication sub. Preliminary report on Coral Translocation for MCRP- South dt. 20-25 November 2020 in connection with your Letter No. BEIPL/E-ConcreteStudies/2020/02 and amendment letter dt. 23.11.2020.

Dear Sir,

With refer to our email communication mentioned above, we have sent you the draft interim report on "Translocation of corals at Haji Ali and Worli area under Mumbai Coastal Road Project (South)". Based on your email communication dt. 25.11.2020 there are no clarifications required on the report, so we are hereby submitting the final interim report for your consideration and do the needful.

Enclosed: Interim report as mentioned above

Thanking you

(Dr. Sabyasachi Sautya)

Forwarded for necessary action

Dr. C. Mohandass
(Scientist-in-Charge)

25/11/2020

Annexure I

Interim Report

On

TRANSLOCATION OF CORALS AT HAJI ALI AND WORLI AREA TO AVOID THEIR LOSS DUE TO CONSTRUCTION OF MUMBAI COASTAL ROAD PROJECT (SOUTH)

Sponsored By

Building Environment (India) Private Limited
C.B.D Belapur, Navi Mumbai
Maharashtra 400614

NOVEMBER 2020

सी.एस.आई.आर. – राष्ट्रीय समुद्र विज्ञान संस्थान
CSIR-NATIONAL INSTITUTE OF OCEANOGRAPHY
क्षेत्रीय केंद्र/ **REGIONAL CENTRE**
अंधेरी (प.) / **Andheri (W), मुंबई / Mumbai-400 053**
फोन/Tel : +91(0)22-26359605-08 : फक्स /Fax: +91(0)22-26364627
HQ- दोना पावला, गोवा / Dona Paula, Goa- 403004

M. C. G. M. Chief Engineer (Coastal Rd)

1. Background

MCGM has proposed a Coastal Road from Worli end of Bandra Worli Sealink to Princess flyover as a part of larger Coastal Road from Versova to Princess Flyover. The project work started after getting CRZ clearance in 2017. However, the marine biodiversity management plan was to be prepared for the project activity areas. Accordingly, MCGM engaged CSIR-NIO, an expert organisation on the subject. A rapid marine biodiversity survey was conducted in the project area and the surrounding area up to 10 km radius. The study concluded with coral mapping survey including the number and locations of coral colonies potentially affected by the reclamation part of the project, the data also includes species, size, and feasibility of coral colony translocation. This coral translocation plan is to report the findings from the coral mapping survey and proposed translocation works. Building Environment (India) Private Limited (BEIPL) is engaged as a consultant by MCGM through their contractors for various issues related to the environment for the Mumbai Coastal Road Project (MCRP- South). Considering the best practices in the industry, BEIPL planned to conduct a pilot study for protection and enhancement of biodiversity for the area closer to the MCRP- South). In this context, BEIPL contracted CSIR-NIO (WO NO. BEIPL/E-ConcreteStudies/2020/02) to conduct the study as mentioned above.

As per the scope of the project CSIR-NIO (WO NO. BEIPL/E-ConcreteStudies/2020/02) has prepared a plan for the translocation of corals and have submitted to MCGM through BEIPL for the execution of this plan. MCGM has applied for the permission of aforementioned work to Office of Principal Chief Conservator of Forest, Maharashtra State (letter No. Ch.E/1559 dt. 24/09/2020, application in prescribed format Form No-I, dt. 09/10/2020). Based on this application the permission from PCCF (HOFF), Maharashtra State has given on 'Permit to Hunt for Special Purpose' to translocate the coral (Scleractinians) species from Worli and Haji Ali [Ref No. Desk-22(8)/WL/Research/CR-29(20-21)/1605/20-21 dt.29/10/2020] as there is no legal provision for the coral translocation work.

2. Objectives

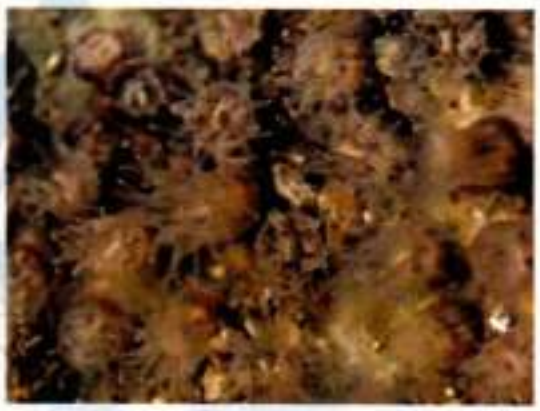
- The objectives of the survey are to record the species, number, locations, size and translocation feasibility of coral colonies within the area of the reclamation and in its vicinity.

- Identification of potential recipient sites on the nearby coastline to facilitate a translocation programme, and to formulate action plan at recommended translocation site, the translocation method, and a monitoring plan.

3. Baseline Corals distribution (donor site)

Based on the previous report submitted to MCGM in September 2019 and a further rapid short report on field visit organised on 22nd June 2020 (report submitted to BEIPL dt. 22.06.2020), the donor and recipient sites of corals which were found for translocation are shown in the Map 1. Total three species of Scleractinia coral, i.e., *Oulangia* sp., Rhizangiidae (unidentified species) and *Pseudosiderastrea tayami* (Fig. 1).

***Oulangia* sp.**



Rhizangiidae (unidentified species)

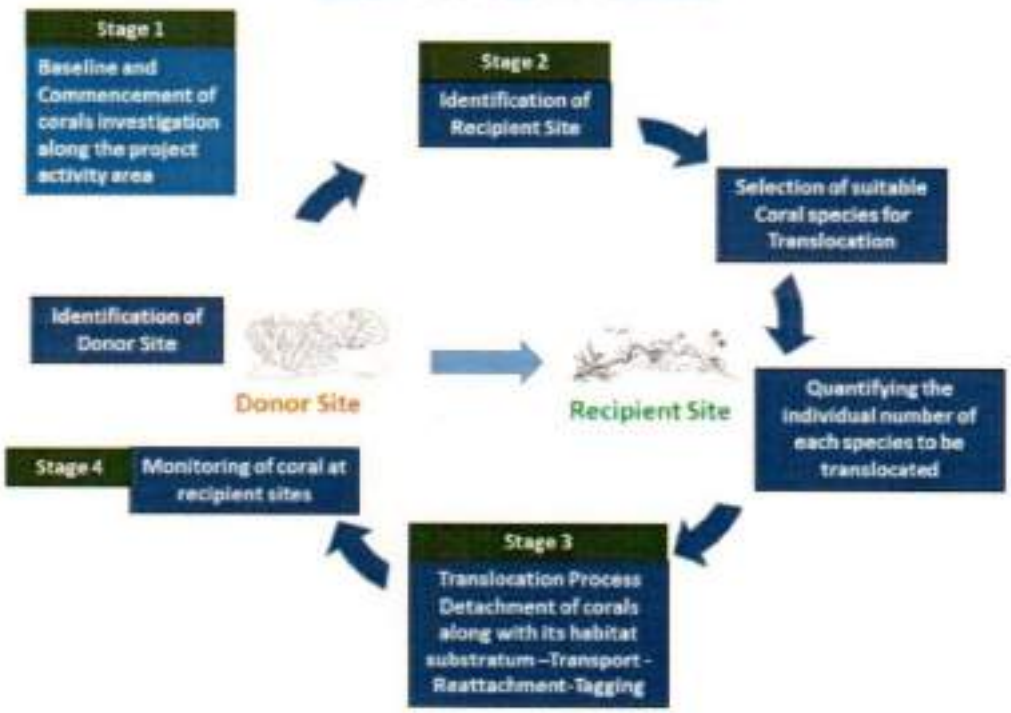
Pseudosiderastrea tayami

Figure 1. Three varieties of coral have been found in the study area are considered for translocation

Date of translocation: The coral translocation is being carried out during 12 – 17 November 2020 October as the tide was most appropriate for the translocation activity.

METHODOLOGY

Coral translocation has been established as an appropriate restoration technique particularly where coral habitat overlaps with the development footprint, and there are no alternative sites as far as the project is concerned. In the proposed project area, there are few locations recorded with coral colonies which were translocated to the previously decided area after examining the feasibility. Recipient site selection was made based several parameters viz; proximity of site to the donor site, adequate presence of the area devoid of coral cover and favourable substrate conducive for attachment of corals and environmental parameters. Tide ranged between 0 m to 0.2 m depth during low tide time at Worli area (subject to tidal variations throughout the year) while the depth at Haji Ali site for *Pseudosiderastrea tayami* colonies varied between 0.2 – 0.4 m (at tide pools during low tide). The overall procedure of the work is shown in the schemetic diagram below.



Schematic diagram shows the overall procedure engaged for the present study.

Translocation methods

Worli

At the donor site, coral colonies were carefully assessed for detachment with its exiting hard substratum (rock). The substratum of the coral colonies was cut by using AG7 angle grinder with diamond cutter blade, chisel and hammer without any disturbing the coral colony (Fig. 2). After this detachment of substratum, the intact coral colonies were kept submerged in the crates filled with seawater and were immediately carried them to the nearby recipient site. All the intact colonies were fixed on the rocky bed by using rapid setting cement at a similar tide level of the low tidal zone. Proper care has been taken to ensure that no particle of cement settled or touched the coral polyps. The distance about 130 m of recipient site was kept from the project activity area.

Cutting of substratum without any disturbing of corals at the donor site

Placed coral along with its substratum and fixed with rapid setting cement at the recipient site

Figure 2. Coral translocation method used at Worli

Haji Ali

Live corals were removed with the settled rocks/substratum from the project activity site. The attached colonies are grown as single or more on rocks/boulders which were tagged by acrylic rectangle sheets with an embossed number and fixed them by using super glue adhesive for documentation and further monitoring (Fig. 3). All removed corals were transported to the recipient site at an intertidal region of Navy Nagar, Colaba, Mumbai through a tempo with proper caring and monitoring. The corals were ensured to remain entirely submerged during their short journey to the selected recipient sites. It may be noted that the survival success of corals at the recipient site depends on many factors, and the percent success rate can vary significantly. Most important criteria are the resilience of species and their acclimatisation at

the recipient site. Reattachment or securing the substratum is a crucial process, wherein boulders with colonies were secured by cementing. The rocks/boulders represented with coral colonies were tagged and acquired GPS data for documenting and monitoring purposes.

Figure 3. Flow diagram shows the full process involved in coral colonies translocation during the present study.

Computation methods:

Each rock/substratum which contains coral colonies were photographed along with the tag and scale. The attached colonies are grown as single or more in numbers on a rock/substratum, which was considered for computation (Fig 4.). The live coral colonies were considered for computation only. The computation method for area coverage was performed by using the software ImageJ. There were also bleached colonies present within the same substratum, but not included them in the colony area computation.

Figure 4. Example of computation method used for area coverage [(A) and (B)] of coral colonies during the present study. (C) Live coral colonies were considered for area coverage computation only while bleached colonies are not included in the present study.

4. EXECUTION OF WORK

Environmental parameter did not show much variations between the donor (Worli and Haji Ali) and recipient sites (Worli and Navy Nagar) (Table 1). The wave action was higher at Worli area than Haji Ali, which is due to morphological differences in the intertidal region in both the region. The tide pool of Haji Ali is located at upper mid to high tidal zone with a depth range of about 0.2 to 0.4 m during low tide condition. The tide pool was found to be high suspended solids (SS), dissolved oxygen (DO) and Phenol (Table 2). The recipient site Navy Nagar tidal pools were recorded comparatively less SS than Haji Ali. Further other parameters showed about similar pattern between donor and recipient sites.

Worli:

Total 18 nos of colonies of Rhizangiidae (unidentified species) and five nos *Oulangia* sp have been found at the project activity area and translocated at low tide region about 110 m distance from the proposed project activity area. The area coverage of the total translocated coral colonies was about 2347.139 cm^2 (0.2347 m^2) where minimum area coverage was about 7.561 cm^2 and the maximum was about 444.32 cm^2. The current study area coverage was little smaller than the previous report (sampling in March 2019) which could be loss of few solitary corals from the colonies due to several factors such as wave action and exposure, changes in beach morphology over the period and other environmental parameters.

Haji Ali:

Total about 329 numbers of colonies of the coral *Pseudosiderastrea tayami* were found at donor site Haji Ali, and all of them were translocated to the recipient site at Navy Nagar, Colaba. The highest number of colonies was ten on a single substratum. These colonies were located about 194 nos of rocks/substratum. There were variations of area coverage (0.0000475 to 33.099 cm^2) in coral colonies at this area. The majority of area coverage occupied by the of small colonies (<5 cm^2) at this area. About 68% of colonies were <5 cm^2 of area coverage on its substratum while 22.5%, 6.7%, 1.6% and 1.2% were represented by the area range of 5-10 cm^2, 11-15 cm^2, 16-20 cm^2 and 21-33 cm^2 respectively (Fig. 5).

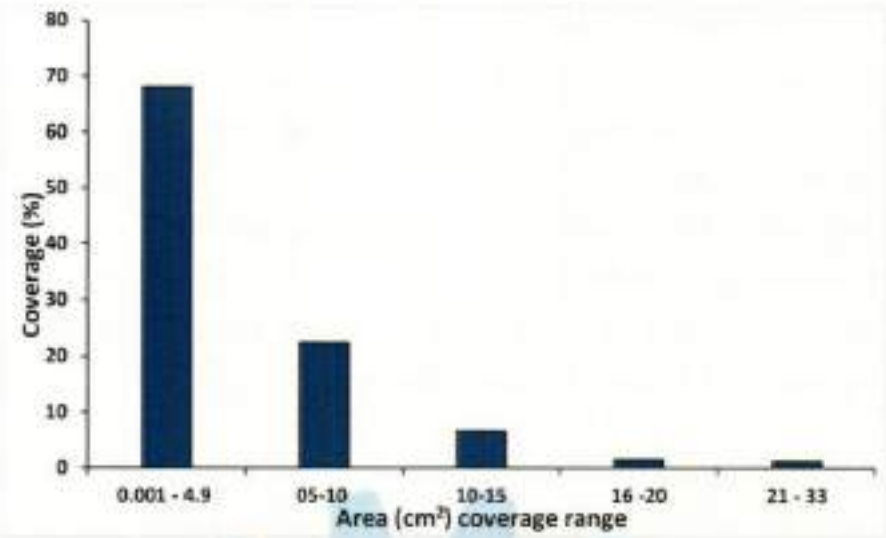


Figure 5. Area coverage (%) range of coral (*S. tayami*) colonies on the rock/substratum translocated from Haji Ali to Navy Nagar.

The area coverage of the total translocated coral colonies was about 1514.758 cm^2 (~ 0.15 m^2). The area of translocated coral colonies was increased (~0.04 m^2) during the present work with compare to the permission given for 0.11 m^2 by the office of PCCF, Maharashtra State (mentioned in the background section). As the baseline study was carried out during March 2019, which is almost 20 months back, could lead many differences like in visibility related to suspended solid, seasonal changes and its related environmental changes. The bleaching event also should be considered while we considered for area computation. As it was ensured that all colonies were translocated for conservation purpose, the differences of the area between permitted and translocated (0.04 m^2) may be considered.

5. MONITORING PLAN

It is planned for monitoring the corals after translocations at recipient sites. The monthly monitoring will be carried out up to the next one year. The monitoring will be carried out during the lowest tidal cycle of each month.

The parameters are described below for the monitoring plan.

Physico-chemical parameters:

Temperature, pH, Suspended solids, DO, BOD, TDS, Salinity, PHc, Phosphates, Nitrates, Nitrite, Ammonical Nitrogen, Sulphates, Chlorides

Biological parameters:

Monitoring the growth of translocated corals and new recruits along with other flora and fauna study will be carried out based on parameters such as benthic faunal population structure (meio, macro) and group diversity, megafaunal diversity, assessment of algae if any. These parameters will be monitored within the vicinity of translocated corals.

Map 1. The map showing the donor and recipient sites of translocated corals during the present study conducted in November 2020.

Table 1. Environmental data collected at donor and recipient site during the present study November 2020						
Place Name	pH	Salinity	Chloride (g/kg)	SS (mg/L)	DO (mg/L)	BOD (mg/L)
Worli (Donor site)	8.17	34.01	18.82	20.48	2.89	0.71
Worli (Recipient site)	8.11	34.26	18.97	39.88	3.06	0.72
Haji Ali (Donor site)	8.11	34.96	19.35	41.61	8.76	0.99
Navi nagar (Tide Pool 1)	8.17	33.21	18.38	13.44	4.06	0.98
Navi nagar (Tide Pool 2)	8.19	35.07	19.41	28.33	2.64	0.77
Place Name	NO_2^- (µmol/L)	NO_3^- (µmol/L)	NH_4^+ (µmol/L)	PO_4^{3-} (µmol/L)	Phenol (µg/L)	
Worli (Donor site)	1.92	11.06	2.18	4.14	183.4	
Worli (Recipient site)	1.53	13.67	3.48	4.79	204.5	
Haji Ali (Donor site)	0.55	8.72	1.69	3.28	178.1	
Navi nagar (Tide Pool 1)	0.64	12.33	1.43	1.77	196.8	
Navi nagar (Tide Pool 2)	0.35	9.73	1.71	2.30	138.7	

डॉ. सब्यसाची साउटया
Dr. Sabyasachi Sautya
वैज्ञानिक / Scientist
क्षेत्रीय केन्द्र / Regional Centre
सी.एस.आई.आर-राष्ट्रीय समुद्र विज्ञान संस्थान
CSIR-National Institute of Oceanography
मुंबई-४०० ०५३, भारत/Mumbai-400 053, India

buildingenvironment (India) Pvt. Ltd.

Dakshina Building, 401, 4th Floor , Plot No. 2, Sector - 11, Near Raigad Bhavan, C.B.D Belapur, Navi Mumbai - 400614.

Date: 01.12.2020

To,

1. Larsen & Toubro Limited - Package I.
Mumbai Coastal Road Project
Amarsons Garden, Bhulabhai Desai Road
Breach Candy, Cumballa Hills
Mumbai – 400 026

2. HCC – HDC Joint Venture - Package II
Worli Sea Face, Opp. Worli Diary,
Khan Abdul Gaffar Khan Road
Worli, Mumbai 400 018

Subject: Coral translocation at Haji Ali and Worli for Mumbai Coastal Road Project.

As per the permit received from Chief Wildlife Warden for translocation of corals at Haji Ali and Worli, the translocation was carried out between 12th to 17th November 2020. The activity was carried out by CSIR – NIO under my supervision. The project was also monitored by Mr. Harshal Karve, Marine Biologist from Mangrove foundation and Mr. Suresh Varak, Range Forest Officer, Mangrove Cell.

The said translocation work was also scrutinized by D.R.Patil, District Forest Officer and Mr. Magdum, Assistant Conservator of Forest. Representatives from MCGM, GC, PMC and DBC were also present.

As per my knowledge, the work has been completed and no additional corals were observed at site (Haji Ali and Worli) after the translocation process was completed. The interim report from NIO is attached with this letter.

Building Environment (India) Pvt. Ltd. Mumbai

Mr. Vivek Kulkarni
CEO,
Building Environment (India) Pvt. Ltd.

Annexure II

MUNICIPAL CORPORATION OF GREATER MUMBAI

No. Ch. E./2471 /Coastal Road Project Dtd. 02/12/2020

अपर प्रधान मुख्य वनसंरक्षक, वाईल्डलाईफ झोन, मुंबई यांचे कार्यालय
आवक- 1548
दिनांक- 2/12/2020
मुख्य लेखापाल अपर प्रधान मुख्य वनसंरक्षक

Office of
Chief Engineer (Coastal Road)
Worli Eng. Hub Building,
3rd Floor, Dr. E Moses Road,
Worli Naka, Mumbai 400 018.
Email: che.coastalroad@mcgm.gov.in

To,
The Additional Principal Chief Conservator of Forests (Mangrove Cell) Mumbai
Room No. 302, 3rd Floor,
Wekfield House,
Near Britannia Restaurant,
Ballard Estate Mumbai 400 001

Sub: Permission under section -12(bb) of WLPA,1972 for Translocation of Corals at Haji Ali and Worli area to avoid their loss due to construction of MCRP (South)

Ref: Desk-22(8)/WL/Research/CR-29(20-21)/1605/20-21 dated 29.10.2020

Sir,

In respect of above referred permit issued by Principal Chief Conservator of Forest (Wildlife) and Chief Wildlife Warden, Maharashtra state, it is to state that the translocation of Corals have been executed by the experts from National Institute of Oceanography (NIO) in the presence of representatives of Additional Principal Chief Conservator of Forests (Mangrove Cell) Mumbai during 12.11.2020 to 17.11.2020. The report in this respect prepared by NIO is submitted herewith. The copy of forwarding letter of NIO is also enclosed alongwith report. The original permit referred above in reference is also enclosed herewith please.

Thanking you for the co-operation.

Yours faithfully,
02/12/2020
(Vijay Nighot)
Chief Engineer (Coastal Road)

ACC:
1. Report on translocation of Corals
2. Original Permit as refereed above

M. C. G. M. Chief Engineer (Coastal Rd)

Land Important

Annexure III

प्रधान मुख्य वन संरक्षक (वन बल प्रमुख), महाराष्ट्र राज्य यांचे कार्यालय
Office of the Principal Chief Conservator of Forests (HOFF), Maharashtra State
वन भवन, रामगिरी रोड, सिविल लाइन्स, नागपूर ४४०००१ Van Bhavan Ramgiri Road, Civil Lines, Nagpur 440001
प्रधान मुख्य वन संरक्षक (वन्यजीव), महाराष्ट्र राज्य Principal Chief Conservator of Forests (Wildlife), Maharashtra State
pccfwlngp@mahaforest.gov.in; फोन Phone: 0712-2549563; फैक्स Fax: 0712-2553018; वेबसाइट: www.mahaforest.gov.in

Sub:- Seeking permission under Section-12(bb) of WLPA, 1972 for Translocation of Corals at Haji Ali and Worli area to avoid their loss due to construction of Mumbai Coastal Road Project (South)-Reg.

No: Desk-22(8)/WL/Research/CR-29 (20-21)/ **1605**/20-21
Nagpur dated: **29th October, 2020**

To,
Shri Vijay Nighot,
Chief Engineer, Mumbai Coastal Road Project (MCRP),
Municipal Corporation of Greater Mumbai,
3rd Floor, Engineering Hub Building,
Dr. E. Moses Road, Worli Naka, Mumbai-400 018.

Ref:-
1. The Chief Engineer, Coastal Road Project, Worli, Mumbai letter No. Ch.E/1559 dated 24/09/2020 application in prescribed format Form No.-I, dated 09th Oct., 2020.
2. The Deputy Inspector General of Forests (Wildlife) MoEF&CC, GoI, Wildlife Division letter F.No.1-53/2020 WL dated 28th October, 2020.

With reference to your application dated 09th Oct., 2020 referred above, please find enclosed herewith a 'Permit to Hunt for Special Purpose'. This permit is for scientific management project involves capture/hunting, Collection and Translocation of Corals species Order: (*Scleractinians*) from the area under alignment and outside alignment area i.e. 0.251 Sq.m. in Worli area & 0.11 Sq.m. in Haji Ali area to suitable nearby sites to avoid their loss due to construction of Mumbai Coastal Road Project, Maharashtra.

The capture/hunting Corals species should be done in a manner causing least disturbance and should be released in their natural habitat after collection.

The enclosed permit is valid for period from **29th October 2020 to 31st December, 2020** and does not allow any activity in any protected area (National park, Wildlife Sanctuary or Conservation area). Kindly ensure that the conditions stated in the permits are strictly adhered to by every person associated with this project. Please acknowledge receipt of the permit.

Encl:- As above

(M.K. Rao) 29/10/20
Principal Chief Conservator of Forests (Wildlife)
and
Chief Wildlife Warden
Maharashtra State

Copy Submitted/Forwarded to :-

1. The Principal Secretary (Forests) Revenue & Forest Department, Mantralaya, Mumbai-32
2. The Deputy Inspector General of Forests (Wildlife) GoI, MoEF&CC, Wildlife Division, 6th Floor, Indira Paryavaran Bhawan, Jor Bagh Road, New Delhi 110 003.
3. The Additional Principal Chief Conservator of Forests (Mangrove Cell) Mumbai.
4. The Director, Wildlife Institute of India, Dehradun.

New Folder permission to capture and radio-collar 2 Tigers Unred Karhandle and Pandharkawada Forest Division

बृहन्मुंबई महानगरपालिका
प्रमुख अभियंता / कि.र.प्र.

02 NOV 2020

04P
प्र.अ./2121 कि.र.प्र.

1. Exe. Engineer (Coastal Road) 01/02/03
2. A. O. (Coastal Road)

For n/a and compliance.

02/11/2020
Ch. Engineer (Coastal Road) I/c

EE (CR) 01/02/03

2.11.2020
AE (CR) 01/02/03/04/05

SE (CR) 01/02/03/04/05

FORM - II

[See Rule 9(6)]

PERMIT TO HUNT FOR SPECIAL PURPOSE

(Not Transferable)

Permit No. SPP-55/2020 dated 29th October, 2020 (See letter No. D-22(8)/WL/Research /CR-29/ (20-21)/1605 /20-21 dated 29th October, 2020)

Subject to the provisions of the Wildlife (Protection) Act, 1972 and the Maharashtra Wildlife (Protection) Rules, 2014 this permit is hereby granted to: -

1 Name of the permit holder : Shri Vijay Nighot, Chief Engineer, Mumbai Coastal Road Project (MCRP)

2 Name of contact person in case of Institution/Organization : Shri Vijay Nighot, Chief Engineer, Mumbai Coastal Road Project (MCRP),

3 Postal Address :Taluka and District, Pin code : Municipal Corporation of Greater Mumbai, 3rd Floor, Engineering Hub Building, Dr. E. Moses Road, Worli Naka, Mumbai-400 018

4 For period from : **29/10/2020 to 31/12/2020** (not exceeding one year) to hunt/collect the wild animals given in the table for the following special purpose.

(b) Scientific Management : Under the scientific management project involving Collection and Translocation of Corals species Order: (*Scleractinians*) from the area under alignment and outside alignment area i.e. 0.251 Sq.m. in Worli area & 0.11 Sq.m. in Haji Ali area to suitable nearby sites to avoid their loss due to construction of Mumbai Coastal Road Project, Maharashtra. The details are as follows:

Sr. No	Common name of species	Scientific name of species	Schedule of the Act	Number and sex (include young ones)	Location	Forest Range	Forest Division	Number to be released in natural habitat
1	2	3	4	5	6	7	8	9
1.	*Scleractinians* Corals	Order-*Scleractinians*	Sch.-I Part IV-A	Eighteen colonies (0.251 Sq.m spread in Worli area & 0.11 Sq.m spread in Haji Ali area)	Haji Ali & Worli Mumbai in Maharashtra	As per column No.6	As per column No.6	All 18 Colonies shall be translocated to the nearby suitable sites of Coastal area.

5. Species and Number of juvenile (young) specimens permitted to be hunted: None:

6. The wild animals will be released back in natural habitat **on the same day of its hunting.**
7. The permit holder has paid fee of Rs. 8857/- (Rupees Eight Thousand Eight Hundred Fifty Seven only) vide DD No. 113321 Axis Bank, Nagpur Branch, dated 12/10/2020.

8. The conditions under which this permit is issued are as under :-

1. The permit holder shall submit a report of his collection as may be required by the Chief Wildlife Warden or authorized officer, and send a copy of such report to the Additional Principal Chief Conservator of Forests (Mangrove Cell) Mumbai (Authorised Officer) of the area where hunting has taken place.
2. The permit holder shall produce the entire evidence made by him for inspection, whenever required by the Chief Wildlife Warden or any other officer authorized by him for the purpose.
3. The permit holder shall not use any wild animal under this permit for any commercial purpose. Further, the permit holder shall not export his collection outside the State of Maharashtra, without the prior written permission from the Chief Wildlife Warden or any officer authorized by him in this behalf.
4. The permit holder shall submit report of hunting under this permit to the Authorized Officer. The report shall include details of inventory along with species (including scientific name), number and sex of wild animals hunted, juvenile specimens hunted, location of hunting and number of wild animals released back to its natural habitat as well as details of any wild animal inadvertently hunted by him during the period.
5. The permit holder shall surrender this permit to the Authorized Officer issuing this permit within 15 days of its expiry or before leaving the area given in the Permit, whichever is earlier, along with the final reports containing the details as required in the quarterly report.
6. No person other than the permit holder or his assistants engaged by the permit holder can use of this permit. The permit holder shall communicate names of his assistants at least three days in advance to the Authorized Officer, whose direction on dissociating any individual from use of this permit shall be binding. The permit holder is prohibited from subletting, outsourcing or transferring this permit in any manner. This permit is not transferable by inheritance or any other means of similar nature.
7. The permit holder shall abide by additional conditions, if any appended to this permit, as deemed fit by the Chief Wildlife Warden or Authorized Officer while issuing this permit.
   See annexure-I of this permit for additional conditions.

The Government of India, Ministry of Environment, Forest and Climate Change has given due approval vide letter F.No.1-53/2020 WL dated 28th October, 2020.

Enclosure :- Annexure-I

Place :- Nagpur
Dated :- 29th October, 2020

29/10/20

(M.K. Rao)
Principal Chief Conservator of Forests (Wildlife)
and
Chief Wildlife Warden
Maharashtra State

प्रधान मुख्य वन संरक्षक (वन बल प्रमुख), महाराष्ट्र राज्य यांचे कार्यालय
Office of the Principal Chief Conservator of Forests (HOFF), Maharashtra State
वन भवन, रामगिरी रोड, सिविल लाइन्स, नागपूर ४४०००१ Van Bhavan Ramgiri Road, Civil Lines, Nagpur 440001

ANNEXURE-I TO PERMIT TO HUNT FOR SPECIAL PURPOSE

Permit No. SPP-55/2020 dated 29th October, 2020 (See letter No. D-22(8)/Research/WL/CR-29/(20-21) /**1605** /dated 29th October, 2020)

Permit to hunt/collection and translocation purpose under the scientific management project involving Collection and Translocation of Corals species Order: (*Scleractinians*) from the area under alignment and outside alignment area i.e. 0.251 Sq.m. in Worli area & 0.11 Sq.m. in Haji Ali area to suitable nearby sites to avoid their loss due to construction of Mumbai Coastal Road Project, Maharashtra. Corals

Additional conditions with reference to item no. 8 (7) of the permit are as follows:

1. The Chief Engineer, Mumbai Coastal Road Project (MCRP) to strictly follow the directions of Hon'ble Supreme Court in respect of SLP No. 17471-17476/2019.
2. The Chief Engineer, Mumbai Coastal Road Project (MCRP), Municipal Corporation of Greater Mumbai, to carry out collection and translocation in the presence of the Additional Principal Chief Conservator of Forests (Mangrove Cell) Mumbai, or his representative of Forest Department and also in the presence of an expert from Wildlife Institute of India, Dehradun or National Institute of Oceanography (NIO).
3. The Chief Engineer, Mumbai Coastal Road Project (MCRP), Municipal Corporation of Greater Mumbai shall ensure adequate protection to the coral species during the entire process and also to monitor at the translocated site with respect to survival and growth.
4. No damage to be caused to other wildlife and utmost care shall be exercised during the process.
5. The completion report should be shared with both, the central government and the State Government.
6. In case of any mis-happening during the process, that endangers or may endanger the safety of the corals, the central government or the Chief Wildlife Warden, Maharashtra State may review/revoke the permission given.

The permit holder shall promptly share information generated by activities carried out under this permit.

Nagpur
Dated :- **29th October, 2020**

29/10/20

(M.K. Rao)
Principal Chief Conservator of Forests (Wildlife)
and
Chief Wildlife Warden
Maharashtra State

Annexure IV

MUNICIPAL CORPORATION OF GREATER MUMBAI

No. Ch. E./2750 /Coastal Road Project Dtd. 17/12/2020

Office of Chief Engineer (Coastal Road)
Worli Eng. Hub Building,
3rd Floor, Dr. E Moses Road,
Worli Naka, Mumbai 400 018.
Email: che.coastalroad@mcgm.gov.in

अपर प्रधान मुख्य वनसंरक्षक, वनविकास दल, मुंबई यांचे कार्यालय
आवक - 1772
दिनांक - 18/12/2020
मुख्य लेखापाल अपर प्रधान मुख्य वनसंरक्षक

To,
The Additional Principal Chief Conservator of Forests (Mangrove Cell) Mumbai
Room No. 302, 3rd Floor,
Wekfield House,
Near Britannia Restaurant,
Ballard Estate Mumbai 400 001

Sub: Permission under section -12(bb) of WLPA,1972 for Translocation of Corals at Haji Ali and Worli area to avoid their loss due to construction of MCRP (South)
Completion of Coral Translocation Work at Haji Ali and Worli that was getting affected by the proposed Coastal Road activities

Ref: 1.Permit No. SPP-55/2020 dated 29th October 2020
Desk-22(8)/WL/Research/CR-29(20-21)/1605/20-21 dated 29.10.2020
2. Ch.E/2471/Coastal Road Project dated 02.12.2020
3. Ch.E/2565/Coastal Road Project dated 09.12.2020

Dear Sir,

With reference to above subject and in continuation with the report submitted u/no. Ch.E/2565/Coastal Road Project dated 09.12.2020, as discussed on 17.12.2020; the details in this regard are as given below.

The work of coral translocation has been successfully completed by MCGM on 17.11.2020 through the CSIR-NIO agency and in the presence of authorized officers of Mangrove cell. No damage was found cause to other wildlife during translocation process. The photographic evidence is maintained and can be made available whenever required for inspection of the Chief Wildlife Warden or any authorized officer. MCGM has followed the directions given by Hon'ble Supreme Court.

Thanking you for the co-operation.

Yours faithfully,
17/12/2020
(Vijay Nighot)
Chief Engineer (Coastal Road)

Land
Immediate
18/12

2087

MUNICIPAL CORPORATION OF GREATER MUMBAI
No. Ch. E./ 2565 /Coastal Road Project Dtd. 09/12/2020

अपर प्रधान मुख्य वनसंरक्षक, कांदळवन कक्ष, मुंबई यांचे कार्यालय
आवक - 1671
दिनांक - 9/12/2020
मुख्य लेखाधिकारी अपर प्रधान मुख्य वनसंरक्षक

Office of Chief Engineer (Coastal Road)
Worli Eng. Hub Building,
3rd Floor, Dr. E Moses Road,
Worli Naka, Mumbai 400 018.
Email: che.coastalroad@mcgm.gov.in

To,
The Additional Principal Chief Conservator of Forests (Mangrove Cell) Mumbai
Room No. 302, 3rd Floor,
Wekfield House,
Near Britannia Restaurant,
Ballard Estate Mumbai 400 001

Sub: Permission under section -12(bb) of WLPA,1972 for Translocation of Corals at Haji Ali and Worli area to avoid their loss due to construction of MCRP (South)
Completion of Coral Translocation Work at Haji Ali and Worli that was getting affected by the proposed Coastal Road activities

Ref: 1.Permit No. SPP-55/2020 dated 29th October 2020
Desk-22(8)/WL/Research/CR-29(20-21)/1605/20-21 dated 29.10.2020
2. Ch.E/2471/Coastal Road Project dated 02.12.2020

Land

Dear Sir,

As reported vide this office referred letter dated 02.12.2020, the translocation of Corals have been executed by the experts from National Institute of Oceanography (NIO) in the presence of representatives of Additional Principal Chief Conservator of Forests (Mangrove Cell) Mumbai during 12.11.2020 to 17.11.2020. The work of translocation of Corals is completed by 17.11.2020. Since the wok has been completed under the presence of APCCF, Mumbai staff and the report of NIO was submitted alongwith original permit there was no other specific report to be submitted. However, as required the condition wise compliance is submitted as under:

Condition No.	Conditions	Compliance
8 (1)	The permit holder shall submit a report of his collection as may be required by the Chief Wildlife Warden or authorized officer, *and* send a copy of such report to the Additional Principal Chief Conservator of Forest (Mangrove Cell) Mumbai (Authorised Officer) of the area where hunting has taken place.	A report prepared by NIO has been submitted vide letter u/no. Ch.E/2471/Coastal Road Project dated 02.12.2020.
8 (2)	The permit holder shall produce the entire	The work has been executed in

M.C.G.M. Chief Engineer (Coastal Rd)

P.T.O

	evidence made by him for inspection, whenever required by the Chief Wildlife Warden or any other officer authorised by him for the purpose.	presence of representatives of APCCF, Mumbai. Whenever required by the Chief Wildlife Warden or any other authorised officer, photographic evidence will be produced. Few photographs are attached herewith.
8 (3)	The permit holder shall not use any wild animal under this permit *for* any commercial purpose. Further, the permit holder shall not export his collection outside the State of Maharashtra, without the prior written permission from the Chief Wildlife Warden Or any officer authorized by him in this behalf.	Complied
8 (4)	The permit holder shall submit report of hunting under this permit to the Authorized Officer The report shall include details of Inventory along with species including scientific name, number and sex of wild animals hunted, juvenile specimens hunted, location of hunting and number of wild animals released back to its natural habitat as well *as* details of any wild animal Inadvertently hunted by him during the period.	The report of NIO has been submitted vide letter u/no. Ch.E/2471/Coastal Road Project dated 02.12.2020.
8(5)	The permit holder shall surrender this permit to the Authorized Officer issuing this permit within 15 day of Its expiry or before leaving the area given In the *Permit,* whichever is earlier, along with the final reports containing the details as required in the quarterly report.	The permit is already returned to the APCCF, Mangrove Cell vide letter u/no. Ch.E/2471/Coastal Road Project dated 02.12.2020.
8(6)	No person other than the permit holder or in Assistants engaged by the permit holder *can use* of this permit. The permit holder shall communicate names of his assistants at least three days in advance to the Authorized Officer, whose direction on dissociating any individual from use of this permit will be binding. The permit holder it prohibited from subletting, outscurcing or transferring this permit In any manner. This permit is not transferable by inheritance Or any other means for similar nature	Complied.
8(7)	The permit holder shall abide by additional	Done as under:

M. C. G. M. * Chief Engineer (Coastal Rd)

	conditions If any appended to this permit, as deemed fit by the Ciller Wildlife Warden or Authorised Officer while issuing this permit. See annexure-I of this permit for additional conditions.	
Additional Conditions as mentioned in 8(7)		
1	The Chief Engineer, Mumbai Coastal Road Project (MCRP) to strictly follow the directions of Honourable Supreme Court in respect of SLP No. 17471-17476/2019.	Followed.
2	The Chief Engineer, Mumbai Coastal Road Project (MCRP), Municipal Corporation of Greater Mumbai, to Carry Out collection & Translocation in the presence of the Additional Principal Chief Conservator of Forests (Mangrove Cell) Mumbai, or his representative of Forest Department and also in the presence of an expert from Wildlife Institute of India, Dehradun or National Institute of Oceanography	Complied.
3	The Chief Engineer, Mumbai Coastal Road Project (MCRP), Municipal Corporation of Greater Mumbai shall ensure adequate protection to the coral species during the entire process and also to monitor at the translocated site with respect to survival and growth.	Complied through consultants and NIO in presence of representatives of APCCF, Mangrove Cell, Mumbai.
4	No damage to be caused to other wildlife and utmost care shall be exercised during the process.	Complied through consultants and NIO in presence of representatives of APCCF, Mangrove Cell, Mumbai.
5	The completion report should be shared with both, the central government and the State Government.	Noted. The copy of report vide letter no. Ch.E/2471/Coastal Road Project dated 02.12.2020 is forwarded to 1. The Deputy Inspector General of Forests (Wildlife) Gov, MoEF&CC, Wildlife Division, and 2. Principal Chief Conservator of Forests (Wildlife) and Chief Wildlife Warden Maharashtra State
6	In case of any mis-happening during the process, that endangers or may endanger the safety of the corals, the central	Noted. The work has been executed by designated agencies in presence of representatives of

M. C. G. M. * Chief Engineer (Coastal Rd) *

P.T.O

	government or the Chief Wildlife Warden, Maharashtra State may review/revoke the permission given.	APCCF, Mangrove Cell, Mumbai.

Thanking you for the co-operation.

Yours faithfully,

09/12/2020

(Vijay Nighot)

Chief Engineer (Coastal Road)

M. C. G. M. Chief Engineer (Coastal Rd)

MUNICIPAL CORPORATION OF GREATER MUMBAI

No. Ch. E./ 2471 /Coastal Road Project Dtd. 02/12/2020

Office of
Chief Engineer (Coastal Road)
Worli Eng. Hub Building,
3rd Floor, Dr. E Moses Road,
Worli Naka, Mumbai 400 018.
Email: che.coastalroad@mcgm.gov.in

To,
The Additional Principal Chief Conservator of Forests (Mangrove Cell) Mumbai
Room No. 302, 3rd Floor,
Wekfield House,
Near Britannia Restaurant,
Ballard Estate Mumbai 400 001

Sub: Permission under section -12(bb) of WLPA,1972 for Translocation of Corals at Haji Ali and Worli area to avoid their loss due to construction of MCRP (South)

Ref: Desk-22(8)/WL/Research/CR-29(20-21)/1605/20-21 dated 29.10.2020

Sir,

In respect of above referred permit issued by Principal Chief Conservator of Forest (Wildlife) and Chief Wildlife Warden, Maharashtra state, it is to state that the translocation of Corals have been executed by the experts from National Institute of Oceanography (NIO) in the presence of representatives of Additional Principal Chief Conservator of Forests (Mangrove Cell) Mumbai during 12.11.2020 to 17.11.2020. The report in this respect prepared by NIO is submitted herewith. The copy of forwarding letter of NIO is also enclosed alongwith report. The original permit referred above in reference is also enclosed herewith please.

Thanking you for the co-operation.

Yours faithfully,

02/12/2020

(Vijay Nighot)
Chief Engineer (Coastal Road)

ACC:
1. Report on translocation of Corals
2. Original Permit as refereed above

02/12/20

2/12/2020
EE CR03

P.T.O

CC
Divisional Forest Officer,
Mumbai Mangrove Conservation Unit
68-B Kamgar Nagar, Near Tilaknagar Station,
Kurla (E) -400024

For information and doing further needful in the matter please.

(Vijay Nighot)
Chief Engineer (Coastal Road)

ACC: Report on translocation of Corals

CC
The Deputy Inspector General of Forests (Wildlife) Got,
MoEF&CC, Wildlife Division,
6 " Floor, Indira Paryavaran Bhawan,
Jor Bagh Road, New Delhi 110 003

For information please.

(Vijay Nighot)
Chief Engineer (Coastal Road)

ACC: Report on translocation of Corals

CC
Principal Chief Conservator of Forests (Wildlife) and
Chief Wildlife Warden Maharashtra State
Van Bhavan, Ramgiri Road, Civil Lines, Nagpur 440001

For information please.

(Vijay Nighot)
Chief Engineer (Coastal Road)

ACC: Report on translocation of Corals

CC to

1. DMC (SE)
2. AMC (ES)

Madam,

Submitted for information Please.

Chief Engineer (Coastal Road)

Picture_ 1 Corals Tagging at Haji Ali by NIO scientist

Picture_ 2 Corals Tagged by NIO Scientist at Haji Ali

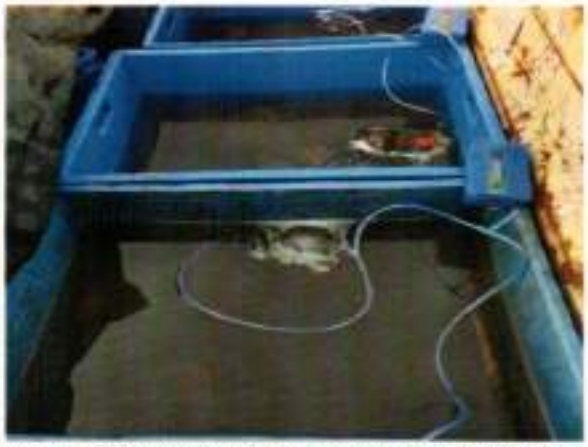
Picture_ 3 Coral Measurements taken by scientist -NIO at Haji Ali

Picture_ 4 NIO-Team (Scientist) taking measurements of Corals at Hai Ali

Picture_ 5 Taking Corals to Camper for translocation at Navy Nagar from Haji Ali by DBC labor

Picture_ 6 Unloading of Corals at Navy Nagar by DBC labor.

Picture_ 7 Aeration & water quality check by experts while transportation.



Picture_ 8 Aeration & water quality check by experts while transportation in vehicle

Picture_ 9 Representatives of NIO, DFO, APCCF and MCGM at Navy Nagar for Translocation

Picture_ 10 Placement of Corals (tagged) at Tide Pool-1 (Navy Nagar) by NIO scientist

Picture_ 11 Manual Placement of Corals (tagged) at Tide Pool (Navy Nagar) by Scientist -NIO

Picture_ 12 Placement of Corals (tagged) at Tide Pool-2- Navy Nagar by NIO scientist

Picture_ 13 Placement of Corals at Navy Nagar by the experts.

CORAL TRANSLOCATION WORKS
12TH TO 15TH Nov 2020

Picture _ 1 Corals Cutting at Worli by Experts of NIO

Picture_ 1 Corals Measurements taken by scientist -NIO team

Picture_ 3 Corals Tagging at Worli Sea Face

Picture_ 4 Coral stored in crates for Transportation to under Bandra Worli Sea Link

Picture_ 5 Coral Transportation to designated location

Picture_ 6 Placement of Coral on Rock (Fixing)

Picture_7 Coral Translocation witnessed by Deputy Conservator of Forests Smt. Somraj Neenu and the representatives of MCGM by NIO Team at Worli

Picture_ 8 Translocated corals with tags at under Bandra Worli Sea Link

Picture_ 9 Representative of APCCF DFO Mr. Patil and Mr. Harshal Karve Verifying the translocated corals at Under Bandra Worli Sea Link

Picture_10 Site Inspection by Deputy Conservator of Forests Smt. Somraj Neenu along with the representatives of MCGM with NIO Team

MUNICIPAL CORPORATION OF GREATER MUMBAI

No. Ch.E/2 [illegible]/ Coastal Road, dtd 04.11.2020

Office of Chief Engineer (Coastal Road),
3rd Floor, Worli Engg. Hub,
Dr E Moses Road, Worli,
Mumbai 400 018.
Email: che.coastalroad@mcgm.gov.in

To,
The Divisional Forest Officer(Mumbai Mangroves Conservation Unit),
Kamgaar Nagar,
Kurla (East) Mumbai 400024.

Subject :- Translocation Of Corals in the alignment of Mumbai Coastal Road Project (South), Mumbai.

Reference :- Permit No. SPP-55/2020 dated 29th October , 2020.

Sir,

In respect of above reference this is to inform you that the Translocation of Corals will be carried out through the contractors of this office.

The Translocation will be done by NIO along with Consultants and Experts of the Contractor. The Translocation will be carried out during the period from 13.11.2020 to 18.11.2020. The Consultants representative Shri Vivek kulkarni (Mb No.- 9820349517) will coordinate with your office in this respect.

You are requested to remain present during the Translocation Process and extend your cooperation.

Yours faithfully,

04/11/2020

Chief Engineer
O/C (Coastal Road Project)

04/11/2020
EE(CR)

CC To :-
APCCF (Mangrove Cell) Mumbai.

For information please.

लिपीक
विभागीय वन अधिकारी
मुं. का. सं. ध., मुंबई

5/11/2020

5/11/2020.
लिपीक
अपर प्रधान मुख्य वनसंरक्षक (मैंग्रोव्ह),
कोंकणभवन ठाणे मुंबई.

Yours faithfully,

04/11/2020

Chief Engineer
(Coastal Road Project)

04/11/2020
EE(CR)

O/C 04/11/20
EE(CR)

C-297

LARSEN & TOUBRO

Larsen & Toubro Limited
L&T Construction
Heavy Civil Infrastruture
Mount Poonamallee Road, Manapakkam
P. B. No. 979, Chennai - 600 089, INDIA
CIN No-L99999MH1946PLC004768

Ref No.: MCR1/L&T/271/LL/102267
Date: 28-May 2021

The Chief Engineer (Coastal Road),
Municipal Corporation of Greater Mumbai
Third Floor, Engineering Hub Building
Dr. E Moses Road, Near Worli Naka, Worli
Mumbai- 400018, Maharashtra, India

Kind Attention: Shri. Vijay S Nighot

Project: Mumbai Coastal Road Project (South) Package I: "Design and Construction Contract For Road, Bridges, Interchanges, Including Reclamation and Associated Works (Priyadharshini Park to Baroda Palace)"

Contract No: AM133386 dated 26th October 2018

Subject: **1st quarterly interim report on "Translocation of corals at Haji Ali and Worli area to avoid their loss due to construction of Mumbai Coastal Road Project,".**

Dear Sir,

Please find enclosed 1st quarterly interim report on **"Translocation of corals at Haji Ali and Worli area to avoid their loss due to construction of Mumbai Coastal Road Project,"** for your reference and record

Assuring Employer/Engineer of Contractor's best services at all times.

Best Regards,
For **Larsen & Toubro Limited**

Rakesh Singh Sisodia
Project Manager

Enclosures: Interim quarterly report – Translocation of corals (70.Pages)

Copy to:
1. **The Project Manager,** AECOM Asia Company Ltd., General Consultant, MCRP-1
2. **The Project Manager**, Louis Berger Consulting Pvt Ltd., PMC, MCRP-1

Registered Office:
L&T House, N.M.Marg ,
Ballard Estate, Mumbai - 400 001,

Site Office:
Mumbai Coastal Road Project Package-1
Amarsons Garden, Mumbai-400026.

बृहन्मुंबई महानगरपालिका
प्रमुख अभियंता / कि.र.प्र.

3 1 MAY 2021

प्र.अ./ 599 कि.र.प्र. (B)

1. Exe. Engineer (Coastal Road) 01/02/03
2. A. O. (Coastal Road)

EE(CR) 01/02/03 to note. Original report to EE02.

For info pl.

01/06/2021

Ch. Engineer (Coastal Road) I/c

01/06 EE(CR)01 01/6 EE(CR)03

EE (CR) 01/02/03

AE (CR) 01/02/03/04/05

& Secret. Archana

SE ~~(CR) 01/02/03/04/05~~

For further info pl.

01/06/2021 EE(CR)02.

C-299

सी एस आई आर - राष्ट्रीय समुद्र विज्ञान संस्थान
(वैज्ञानिक एवं औद्योगिक अनुसंधान परिषद)
क्षेत्रीय केंद्र, लोखंडवाला रोड, चार बंगला, अंधेरी (प.), मुंबई - 400 053, भारत

CSIR - National Institute of Oceanography
(Council of Scientific & Industrial Research)
Regional Centre, Lokhandwala Road, Four Bungalows, Andheri (W), Mumbai - 400 053, India
EPBX : 91-22-26359605-08 (4 Lines), Fax : 91-22-26364627 / 26346875, e-mail : rcm@nio.org

No. NIO/M-2020/BEIPL(Corals-MCRP)/SSP3357/ 1501

Date:21.04.2021

To,

Building Environment (India) Private Limited,
4th Floor, Plot No.2, Dakshina Building,
Sector 11, C.B.D Belapur, Navi Mumbai,
Maharashtra 400614

Sub: 1st quarterly Interim report on "Translocation of corals at Haji Ali and Worli area to avoid their loss due to construction of Mumbai Coastal Road Project (South)"

Ref: Your WO. No. BEIPL/E-ConcreteStudies/2020/02 dt.18.03.2020

Dear Sir,

We have sent you the draft 1st quarterly interim report on "Translocation of corals at Haji Ali and Worli area under Mumbai Coastal Road Project (South)". Based on your communication there are no clarifications required on the report, so we are hereby submitting the final 1st quarterly interim report for your consideration and do the needful.

Enclosed: Interim report as mentioned above

Thanking you

(Dr. Sabyasachi Sautya)

Forwarded for necessary action

21/4/2021

Dr. C. Mohandass
(Scientist-in-Charge)

Interim Report

On

TRANSLOCATION OF CORALS AT HAJI ALI AND WORLI AREA TO AVOID THEIR LOSS DUE TO CONSTRUCTION OF MUMBAI COASTAL ROAD PROJECT (SOUTH)

Sponsored By
Building Environment (India) Private Limited
C.B.D Belapur, Navi Mumbai
Maharashtra 400614

MARCH 2021

सी.एस.आई.आर. – राष्ट्रीय समुद्र विज्ञान संस्थान
CSIR-NATIONAL INSTITUTE OF OCEANOGRAPHY
क्षेत्रीय केंद्र/ REGIONAL CENTRE
अंधेरी (प.) / Andheri (W), मुंबई / Mumbai-400 053
फ़ोन/Tel : +91(0)22-26359605-08 : फ़ैक्स /Fax: +91(0)22-26364627
HQ- दोना पावला, गोवा / Dona Paula, Goa- 403004

C-303

(SSP3357)

Interim Report

On

TRANSLOCATION OF CORALS AT HAJI ALI AND WORLI AREA TO AVOID THEIR LOSS DUE TO CONSTRUCTION OF MUMBAI COASTAL ROAD PROJECT (SOUTH)

Project Leader

Dr. Sabyasachi Sautya

Associate Project Leaders

Dr. C. Mohandass

Dr. Mandar Nanajkar

Dr. Umesh K. Pradhan

MARCH 2021

सी.एस.आई.आर. – राष्ट्रीय समुद्र विज्ञान संस्थान

CSIR-NATIONAL INSTITUTE OF OCEANOGRAPHY

क्षेत्रीय केंद्र/ **REGIONAL CENTRE**

अंधेरी (प.) / **Andheri (W), मुंबई / Mumbai-400 053**

फोन/Tel : +91(0)22-26359605-08 : फैक्स /Fax: +91(0)22-26364627

HQ- दोना पावला, गोवा / Dona Paula, Goa- 403004

Contents

List of Tables

List of Figures

List of Plates

1. Background

MCGM has proposed a Coastal Road from Worli end of Bandra Worli Sealink to Princess flyover as a part of larger Coastal Road from Versova to Princess Flyover. The project work started after getting CRZ clearance in 2017. However, the marine biodiversity management plan was to be prepared for the project activity areas. Accordingly, MCGM engaged CSIR-NIO, an expert organisation on the subject. A rapid marine biodiversity survey was conducted in the project area and its surrounding, covering the area up to 10 km radius. The study concluded with coral mapping survey including the number and locations of coral colonies potentially affected by the reclamation part of the project, the data also includes species, size, and feasibility of coral colony translocation. This coral translocation plan is to report the findings from the coral mapping survey and proposed translocation works. Building Environment (India) Private Limited (BEIPL) is engaged as a consultant by MCGM through their contractors for various issues related to the environment for the Mumbai Coastal Road Project (MCRP- South). Considering the best practices in the industry, BEIPL planned to conduct a pilot study for protection and enhancement of biodiversity for the area closer to the MCRP- South). In this context, BEIPL approached CSIR-NIO (WO NO. BEIPL/E-ConcreteStudies/2020/02) to conduct the study as mentioned above.

As per the scope of the project CSIR-NIO (WO NO. BEIPL/E-ConcreteStudies/2020/02) has prepared a plan for the translocation of corals and submitted to MCGM through BEIPL for the execution of this plan. MCGM has applied for the permission of aforementioned work to Office of Principal Chief Conservator of Forest, Maharashtra State (letter No. Ch.E/1559 dt. 24/09/2020, application in prescribed format Form No-I, dt. 09/10/2020). Based on this application the permission was given from PCCF (HOFF), Maharashtra State 'Permit to Hunt for Special Purpose' to translocate the coral (Scleractinians) species from Worli and Haji Ali [Ref No. Desk-22(8)/WL/Research/CR-29(20-21)/1605/20-21 dt.29/10/2020] as there is no legal provision for the coral translocation work.

1.1. Objectives

The objectives of the survey are to record the species, number, locations, size and translocation feasibility of coral colonies within the area of the reclamation and in its vicinity.

Identification of potential recipient sites on the nearby coastline to facilitate a translocation programme, and to formulate action plan at recommended translocation site, the translocation method, and a monitoring plan.

1.2. Baseline studies on Corals distribution (donor site)

Based on the previous report submitted to MCGM in September 2019 and a rapid field visit conducted on 22nd June 2020 (report submitted to BEIPL dt. 22.06.2020), the corals which were found in the donor and recipient sites shown in the Map 1. Total three species of Scleractinia coral, i.e., *Oulangia* sp., Rhizangiidae (unidentified species) and *Pseudosiderastrea tayami* (Figure 1).

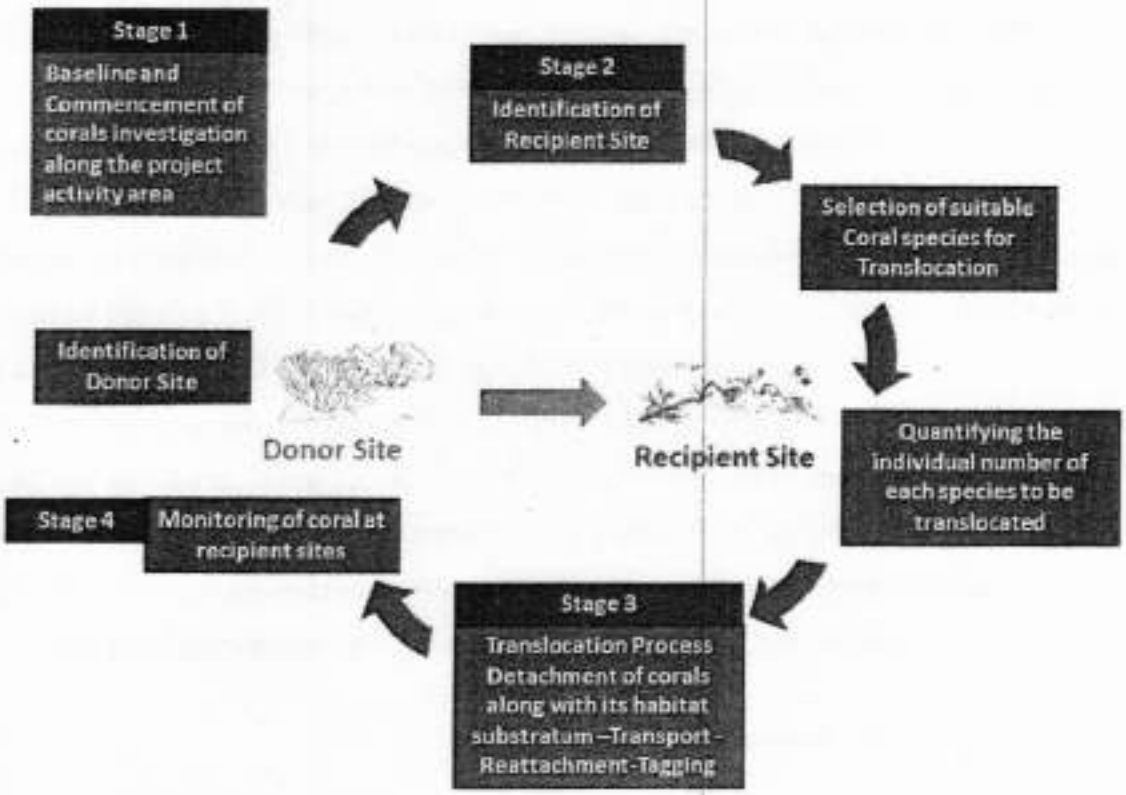
Date of translocation: The coral translocation is being carried out during 12 – 17 November 2020 as the tide was most appropriate for the translocation activity.

Monitoring date: 13-15, December, 2020; 11-13 January, 2021; 9-11 February, 2021

2. Methodology

2.1. Coral translocation

Coral translocation has been established as an appropriate restoration technique particularly where coral habitat overlaps with the development footprint, and there are no alternative sites as far as the project is concerned. In the proposed project area, there are few locations recorded with coral colonies which were translocated to the previously decided area after examining the feasibility. Recipient site selection was made based several parameters viz; proximity of site to the donor site, adequate presence of the area devoid of coral cover and favourable substrate conducive for attachment of corals and environmental parameters. Tide ranged between 0 m to 0.2 m depth during low tide time at Worli area (subject to tidal variations throughout the year) while the depth at Haji Ali site for *Pseudosiderastrea tayami* colonies varied between 0.2 – 0.4 m (at tide pools during low tide). The overall procedure of the work is shown in the schemetic diagram below.



Schematic diagram shows the overall procedure engaged for the present study

2.2. Translocation methods

2.2.1. Type 1 at Worli site

At the donor site, coral colonies were carefully assessed for detachment with its exiting hard substratum (rock). The substratum of the coral colonies was cut by using AG7 angle grinder with diamond cutter blade, chisel and hammer without any disturbing the coral colony (Figure 2). After this detachment of substratum, the intact coral colonies were kept submerged in the crates filled with seawater and were immediately carried them to the nearby recipient site. All the intact colonies were fixed on the rocky bed by using rapid setting cement at a similar tide level of the low tidal zone. Proper care has been taken to ensure that no particle of cement settled or touched the coral polyps. The distance about 130 m of recipient site was kept from the project activity area.

2.2.2. Type 2 at Haji Ali site

Live corals were removed with the settled rocks/substratum from the project activity site. The attached colonies are grown as single or more on rocks/boulders which were tagged by acrylic rectangle sheets with an embossed number and fixed them by using super glue adhesive for documentation and further monitoring (Figure 3). All removed corals were transported to the recipient site at an intertidal region of Navy Nagar, Colaba, Mumbai through a tempo with proper caring and monitoring. The corals were ensured to remain entirely submerged during their short journey to the selected recipient sites. It may be noted that the survival success of corals at the recipient site depends on many factors, and the percent success rate can vary significantly. Most important criteria are the resilience of species and their acclimatisation at the recipient site. Reattachment or securing the substratum is a crucial process, wherein boulders with colonies were secured by cementing. The rocks/boulders represented with coral colonies were tagged and acquired GPS data for documenting and monitoring purposes.

2.3. Computation methods

Each rock/substratum which contains coral colonies were photographed along with the tag and scale. The attached colonies are grown as single or more in numbers on a rock/substratum, which was considered for computation (Figure 4). The live coral colonies were considered for computation only. The computation method for area coverage was performed by using the

software ImageJ. There were also bleached colonies present within the same substratum, but not included them in the colony area computation.

2.4. Coral monitoring

2.5. Chemistry

2.6. Biodiversity within adjacent area

2.6.1. Benthic fauna

In both the intertidal areas of recipient sites, three numbers of core or similar area coverage of algae mixed with rocky sediments have been scratched to collect meiofaunal samples from the rocky outcrops and surrounding areas. Three replicates were collected per station and transferred to plastic sediment containers. After which, relaxation, staining and fixation were carried out using 7% of Magnesium Chloride ($MgCl_2$), 1% Rose bengal stain and 5% Formaldehyde respectively. The samples were homogenized and stored for further analysis. For macrofauna quadrants (total area coverage 0.25 m^2) have been placed to collect the samples at the intertidal region of the study area. The sediment/algae/scrapped materials from rocky substratum were sieved through a 500 µm mesh sieve and animals retained were preserved in 7% buffered formaldehyde and Rose Bengal. In the laboratory, samples were sieved through a mesh size of 500 µm putting top and 63 µm below. Decantation and extraction of meiofauna were done by gently stirring the sample and decanting upper aliquot, at least 4-5 times. The investigation of suctorian ciliates attached with meiofauna and macrofauna samples were carried out under stereo (SMZ745 Nikon, S8APO Leica). After shorting out the suctorians, all samples were picked up and transferred to a slide and mounted with cover glass and DPX for permanent slide. All photographs were taken using stereo microscope (Nikon SMZ18 attached DS-Ri2 Camera and zoom used 200x) and upright brightfield compound microscope (Nikon Ei attached Digital sight 1000 Camera and objective used 10x – 100x).

2.6.2. Biomass estimation

For estimation of meiofaunal biomass, less abundant faunal groups were entirely picked out onto slides, wherever the abundance of the faunal group is high, 100 individuals per group per core were randomly picked out for biomass estimation. The length-width measurements were then used to determine the biomass of the organisms following the formulae given by Nozais

et al. (2005). Biomass of 10 groups (viz., Nematoda, Ostracoda, Kinorhyncha, Polychaeta, Oligochaeta, mites, Nauplii, Tardigrada, Turbellaria) were computed. The total population of macrofauna was estimated as a number of animals in $1m^2$ areas and biomass on wet weight basis. The biomass was estimated by using microbalance and denoted gram per sq. meter.

3. Execution of work

3.1. Environmental conditions

3.1.1. Translocation event: Donor vs recipient sites (November 2020)

Environmental parameter did not show much variations between the donor (Worli and Haji Ali) and recipient sites (Worli and Navy Nagar) (Table 1). The wave action was higher at Worli area than Haji Ali, which is due to morphological differences in the intertidal region in both the region. The tide pool of Haji Ali is located at upper mid to high tidal zone with a depth range of about 0.2 to 0.4 m during low tide condition. The tide pool was found to be high suspended solids (SS), dissolved oxygen (DO) and Phenol (Table 1). The recipient site Navy Nagar tidal pools were recorded comparatively less SS than Haji Ali. Further other parameters showed about similar pattern between donor and recipient sites.

3.1.2. Monthly variation (recipient sites)

3.1.2.1. Temperature

The temperature varied markly between the months (Figure 7). The higesst temperature (29.5 °C) were recorded at Worli in the month of November 2020. Whereas, the lowest temperature (26.0 °C) were recorded at TP-1 and TP-2 in the month of December 2020. The month of November 2020 was found with high temperature compared to other months at each site.

3.1.2.2. pH

The pH was found to be lowest in the month of November 2020 with respect to other months (Figure 7). The February was found with highest pH (8.6) at worli and TP1 sites. While the highest pH (8.2) at TP-2 was reported in the months of December 2020 and January 2021.

3.1.2.3. Salanity

The salinity ranged from 33.2-35.4 ppt during the study period. The salinity was reported lowest (33.2 ppt) at TP1 during the month of November 2020 (Figure 7). The highest salinity was observed in TP-2 in the month of February 2021 followed by Novemver 2020 at same site.

3.1.2.4. Turbidity

The turbidity was ranged from 3.4-17.5 during the study period (Figure 7). The the highest turbidity was recored at Worli in the month of December 2020 followed by TP-2 in February 2021. However, the lowest turbidity was recorded in the same month at TP-2 site.

3.1.2.5. Suspended solids (SS)

The suspended solid was varied from 12.3-127.9 mg/L during the study period. The highest was reported at Worli followed by TP-1 in the month of December 2020 and January 2021 respectively (Figure 7). The lowest was observed mainly in the month of November 2020 except TP-2, where SS did not varied much compared to Worli and TP1 and ranged between 12.3-53.9 mg/L.

3.1.2.6. Dissolved Oxygen (DO)

The dissolved oxygen was found high at navy nagar sites than worli except at TP-2 in Novmber 2020 (Figure 7). The DO was ranged from 2.9-6.1 mg/L during the study period. The highest DO was recorded at TP-2 in the month of January 2021.

3.1.2.7. Biochemical oxygen demand (BOD)

The biochemical oxygen demand was ranged from 0.6-4.0 mg/L during the study period (Figure 7). Overall, the lowest BOD were observed at Wolri and TP-1 comparing all the sites and months. The lowest was reported at Worli during December 2020 followed by TP-2 in November 2020. The highest was reported at TP-2 in the month of Decembe 2020 and January 2021.

3.1.2.8. Nitrite (NO_2^-)

The nitrite was found lowest at Worli in the month of January 2021 and February 2021, and TP-1 in February 2021 (Figure 8). The highest was recored at wolri in the month of November 2020.

3.1.2.9. Nitrate (NO_3^-)

The nitrate was range from 3.1-17.4 µmol/L during the study period (Figure 8). The nitrate showed similer trend at Worli and TP-1, where January 2021 and February 2021 were reported low concentration of nitrate. Whereas, The nitrate has increased in the month of February 2021 at TP-2.

3.1.2.10. Ammonia (NH_4^+)

The ammonia was ranged from 1.1-4.0 µmol/L during the study period (Figure 8). The January 2021 and February 2021 were found with highest concentration of ammonia at all the sites. The lowest was observed at TP-1 dunring December 2020 and highest was reporded at Worli in the month of January 2021.

3.1.2.11. Phosphate (PO_4^{3-})

The phosphate was varied greatly during the stuidy period and ranged between 1.4-4.1 µmol/L (Figure 8). The high values were reported from the Worli during November 2020 and December 2020. Whereas, lowest values were reported at TP-1 and TP-2 during February 2021 and Janurary 2021 respectively.

3.1.2.12. Polyaromatic Hyndrocarbon (PHc)

The PHc was ranged from 09-2.4 µg/L during the study period (Figure 8). The lowest valucs were reported from te Worli site and highest values were reported from Navy nagar sites in all the months.

3.1.2.13. Phenol

The Phenol was renged from 55.3-143.5 µg/L during the study period (Figure 8). The lowest values were reported from the TP-1 and TP-1 than the Worli ste. The highest phenol was reported from TP-1 in the month of November 2020. Whereas, lowest was reported from TP-2 in the month February 2021.

3.2. Execution of Coral Translocation

3.2.1. Worli site

Total 18 nos of colonies of Rhizangiidae (unidentified species) and five nos Oulangia sp have been found at the project activity area and translocated at low tide region about 110 m distance from the proposed project activity area. The area coverage of the total translocated coral colonies was about 2347.139 cm^2 (0.2347 m^2) where minimum area coverage was about 7.561 cm^2, and the maximum was about 444.32 cm^2. The current study area coverage was little smaller than the previous report (sampling in March 2019) which could be loss of few solitary corals from the colonies due to several factors such as wave action and exposure, changes in beach morphology over the period and other environmental parameters.

3.2.2. Haji Ali site

Total about 329 numbers of colonies of the coral *Pseudosiderastrea tayami* were found at donor site Haji Ali, and all of them were translocated to the recipient site at Navy Nagar, Colaba. The highest number of colonies was ten on a single substratum. These colonies were located about 194 nos of rocks/substratum. There were variations of area coverage (0.0000475 to 33.099 c^m) in coral colonies at this area. The majority of area coverage occupied by the of small colonics (<5 cm^2) at this area. About 68% of colonies were <5 cm^2 of area coverage on its substratum while 22.5%, 6.7%, 1.6% and 1.2% were represented by the area range of 5-10 cm^2, 11-15 cm^2, 16-20 cm^2 and 21-33 cm^2 respectively (Figure 5).

The area coverage of the total translocated coral colonies was about 1514.758 cm^2 (~ 0.15 m^2). The area of translocated coral colonies was increased (~0.04 m^2) during the present work with compare to the permission given for 0.11 m^2 by the office of PCCF, Maharashtra State (mentioned in the background section). As the baseline study was carried out during March 2019, which is almost 20 months back, could lead many differences like in visibility related to suspended solid, seasonal changes and its related environmental changes. The bleaching event also should be considered while we considered for area computation. As it was ensured that all colonies were translocated for conservation purpose, the differences of the area between permitted and translocated (0.04 m^2) may be considered.

3.3. Monitoring of corals

After translocating of the corals from the donor site at Worli and Haji Ali to recipient sites Worli and Navy-nagar respectively, the monthly monitoring is continuing to observe the coral

health and survival. The environmental condition of the recipient sites are described in the above section 3.1. The survival rate at Navy-nagar site was 100% during the last visit in February, 2021. Translocated corals (*Pseudosiderastrea tayami*) at Navy-nagar tide pools are adopted and well-adjusted the condition and appearing all in healthy conditions (Plate 1-5). The healthy conditions can be identified by their ability to algal removal and cleaning mechanism from the polyps. Corals recipient site at Worli also found with similar species of translocated Rhizangiidae about 2 - 6 colonies (size ranged 26-134 cm^2/colony) within 10m LIT. Translocated corals at Worli also well-adjusted the condition and 100% survival with healthy was observed in December 2020 after one month of translocation. The survival rate at Worli was about 100% during December 2020 and January 2021 and about 2% bleaching of polyps among the colonies were observed during February 2021. The monitoring of corals are continuing in every month and will carried out till October 2021.

3.4. Prevaling benthic fauna

The ocean is full of weired and wonderful creatures. 71% of the earth surface cover with ocean. It plays a vital role for both living and nonliving resources. The marine environment is categorised into two regions namely pelagic and benthic region. The pelagic region refers to the total water mass or water column. The benthic region associated with sediment i.e rocks, stones, gravel, sand, mud that make up the sea floor from the high water mark to the deepest abysses of the open ocean. Based on their size difference, the benthic organisms are divided into microbenthos(<63μm), meiobenthos((>63 - <500 μm), macrobenthos(>500 μm). Based on the habitat, two major groups are known namely soft bottom benthos and hard bottom benthos. The soft bottom benthos are generally found on soft substrates like sand and mud present, and the soft bottom communities have higher proportions of infaunal species composition. The hard bottom benthos refers to the organisms, which are found in rocky shores. The majority of hard bottom benthos are represented by firmly attached forms of the rocky substratum. Rocky shores are ecologically important because of the most extensive habitat exposed to eroding waves. The rocky intertidal habitat or Tide pools are shallow pools of sea water found on rocky beaches, between high and low tide. It filled with an amazing sea life such as snails, barnacles, mussels, anemones, urchins, sea stars, crustaceans, seaweed, and small fish.

Benthic community provides many ecosystem services that help to maintain good water and sediment quality. Filter feeder remove the particles from the water column, which improve water clarity. Macro fauna are act as a bioindicator providing a more accurate understanding of changing environmental condition. Due to their sedentary habitat, benthic assemblages are most affected by ecological changes and respond quickly to habitat disturbance. Hence they are useful in assessing the impact of anthropogenic perturbations on environmental quality.

3.4.1. Meiofauna

The term meiobenthos was coined by Molly F. Mare in 1942. Meiobenthos are benthic metazoan assemblage distinguished from macrobenthos due to their small size. They are also known as meiofauna. The meiofauna are characterized by their size ranging from 63µm to 500µm. Meiofauna consists of approx. 30 taxa of the invertebrates. The distribution of meiofauna is influenced by environmental conditions (chemical and physical) like temperature, salinity, sediment texture, dissolved oxygen and food availability. They are ubiquitous in the world oceans, and are widely studied for ecological purposes due to their effective response to even minute environmental perturbations. Their small size and short life cycles make them efficient tools for environmental monitoring.

The present study describes the distribution pattern of meiofauna along the two-different intertidal location with hard substratum and different structure complexity. The detailed meiofaunal assemblage is described in Table 2 and Table 3.

3.4.1.1. Worli

3.4.1.1.1. November 2020

The meiofaunal density, biomass and group diversity illustrated temporal variation (Figure 9). The meiofaunal density was found to range between 76 to 149 ind. 10 cm^{-2} with mean meiofaunal density 107 ind. 10 cm^{-2} during November. The meiofaunal biomass was ranging between 84.38 to 246.72 µg 10 cm^{-2} with a mean meiofaunal biomass of 188.71 µg 10 cm^{-2}. The meiofaunal composition comprised of 10 taxa: nematode, polychaete, copepod, tanaid, mite, nauplius, kinorhynch, cnidaria, echinoderm and bivalve. Harpacticoid copepods were found to be dominant taxa (Figure 10).

3.4.1.1.2. December 2020

In December the meiofaunal density varied between 610 to 1540 ind.10 cm^{-2} with mean density 1117 ind.10 cm^{-2}. The maximum meiofaunal biomass recorded was 9060.98 µg 10 cm^{-2} and the least was 4301.90 µg 10 cm^{-2} with an average 6226.28 µg 10 cm^{-2}. The meiofaunal composition consist of 20 taxa that includes, copepod, nematode, amphipod, nauplii, polycheate, foraminifera, bryozoa, kinorhynch, oligochaete, insects, gastropod, cnidaria, turbellaria, tanaid, isopod, mite, bivalve, ostracod, echinoderm and cumacea. Copepod was found to be the dominant taxa contributing about 45 % of the total meiofaunal density followed by nematode (43%) (Figure 10).

3.4.1.1.3. January 2021

The maximum meiofaunal density recorded was 660 ind. 10 cm^{-2} and the least was 393 ind. 10 cm^{-2} in January 2021 with an average 521 ind. 10 cm^{-2}. While the meiofaunal biomass ranged between 2014.86 to 3133.87 µg 10 cm^{-2} with an average meiofaunal biomass of 2640.24 µg 10 cm^{-2}. The meiofaunal composition was as follows: copepod, nematode, tanaid, polycheate, amphipod, nauplii, isopod, foraminifera, cumacea, gastropod, insect, Sipuncula. Copepod was found to be the most dominant taxa followed by nematode and tanaid (Figure 10).

3.4.1.1.4. February 2021

During February 2021, the maximum meiofaunal density observed was 1523 ind. 10 cm^{-2} with minimum 521 ind. 10 cm^{-2} with an average meiofaunal density of 956 ind. 10 cm^{-2}. Thw maximum meiofaunal biomass recorded was 3700.40 µg 10 cm^{-2} with an average 8379.09 µg 10 cm^{-2}. The meiofaunal composition includes 15 taxa comprising of copepod, nematode, nauplii, polycheate, foraminifera, amphipod, sipuncula, oligoheate, ostracod, cumacea, isopod, tanaid, bryozoa, kinorhynch and turbellaria. Copepod was found to be the most dominant taxa followed by nematode (Figure 10).

Overall, the meiofaunal density ranged between 76 to 1540 ind. 10 cm^{-2} with an average 675 ind. 10 cm^{-2} at Worli. The lowest mean meiofaunal density was recorded during the month of November 107 ind. 10 cm^{-2}, whereas the meiofaunal density was maximum during December (Figure 9). The meiofaunal biomass distribution varied from the meiofaunal density. The least meiofaunal biomass was found in November i.e 188.71 10 cm^{-2}, whereas the maximum

biomass was observed during February. This could be due to variation in contribution and composition of taxa.

The meiofaunal diversity show temporal variation. The maximum number of taxa was recorded in December (20 taxa). The diversity index of equitability: Shannon waiver and Pileou's evenness was found to be maximum in January. (Figure 11).

3.4.1.2. Navy nagar (Tide pool-1)

3.4.1.2.1. November 2020

The meiofaunal density, biomass and diversity illustrated temporal variation. The meiofaunal density was found to range between 245 to 577 ind. 10 cm^{-2} with mean meiofaunal density 443 ind. 10 cm^{-2} during November. The meiofaunal biomass was ranging between 588.42 to 1154.93 µg 10 cm^{-2} with a mean meiofaunal biomass of 965.98 µg 10 cm^{-2}. The meiofaunal composition comprised of 7 taxa: copepod nematode, polychaeta, foraminifera, mite, amphipod and ostracod. Copepod were found to be dominant taxa followed by nematode and polychaeta (Figure 12).

3.4.1.2.2. December 2020

The meiofaunal density varied between 929 to 3149 ind. 10 cm^{-2} with mean meiofaunal density 1922 ind. 10 cm^{-2} during December 2020. The maximum meiofaunal biomass recorded was 2274.95 µg 10 cm^{-2} and the least was 1004.05 µg 10 cm^{-2} with an average 1844.56 µg 10 cm^{-2}. The meiofaunal composition consist of 15 taxa that includes nematode, copepod, polychaete, nauplii, foraminifera, ostracod, sipuncula, oligochaete, amphipod, isopod, kinorhynch, turbellaria, cumacea, bivalve, cladocera, and mite. Nematode was found to be the dominant taxa contributing 66 % of the total meiofaunal density followed by copepod (18%) (Figure 12).

3.4.1.2.3. January 2021

The maximum meiofaunal density recorded was 1674 ind. 10 cm^{-2} and the least was 527 ind. 10 cm^{-2} in January with an average 1169 ind. 10 cm^{-2}. While the meiofaunal biomass ranged between 1997.21 to 13545.39 µg 10 cm^{-2} with an average meiofaunal biomass of 7951.16 µg 10 cm^{-2}. The meiofaunal composition was as follows: nematode, copepod, polychaete, nauplii,

isopod, foraminifera, tanaid, amphipod, ostracod, cumacea, kinorhynch, and bivalve. Nematode was found to be the most dominant taxa followed by copepod (Figure 12).

3.4.1.2.4. February 2021

In February, the maximum meiofaunal density observed was 2694 ind. 10 cm^{-2} with minimum 1762 ind. 10 cm^{-2} with an average meiofaunal density of 2274 ind. 10 cm^{-2}. The maximum meiofaunal biomass recorded was 24629.07 µg 10 cm^{-2} with an average 19104.18 µg 10 cm^{-2}. The meiofaunal composition includes 13 taxa comprising of copepod, nematode, amphipod, polychaete, tanaid, isopod, nauplii, cumacea, ostracod, oligochaete, foraminifera, sipuncula, and kinorhynch. Copepod was found to be the most dominant taxa followed by nematode (Figure 12).

3.4.1.3. Navy-nagar (Tide pool-2)

3.4.1.3.1. November 2020

The meiofaunal density was found to range between 280 to 534 ind. 10 cm^{-2} with mean meiofaunal density 382 ind. 10 cm^{-2} during November 2020. The meiofaunal biomass was ranging between 3038.78 to 7913.15 µg 10 cm^{-2} with a mean meiofaunal biomass of 5871.15 µg 10 cm^{-2}. The meiofaunal composition comprised of 7 taxa: copepod, polychaete, nematode, mite, ostracoda, amphipoda, and cumacea. Copepod were found to be dominant taxa (Figure 13).

3.4.1.3.2. December 2020

In December 2020 the meiofaunal density varied between 2975 to 4535 ind. 10 cm^{-2} with mean meiofaunal density 3644 ind. 10 cm^{-2}. The maximum meiofaunal biomass recorded was 26633.64 µg 10 cm^{-2} and the least was 5375.94 µg 10 cm^{-2} with an average 16045.99 µg 10 cm^{-2}. The meiofaunal composition consist of 15 taxa that includes, nematode, copepod, polychaete, nauplius, ostracoda, foraminifera, cumacea, isopoda, sipuncula, amphipod, tanaid and gastropod. Nematode was found to be the dominant taxa contributing 70 % of the total meiofaunal density followed by copepod (17%) (Figure 13).

3.4.1.3.3. January 2021

The maximum meiofaunal density recorded was 2381 ind. 10 cm^{-2} and the least was 960 ind. 10 cm^{-2} in January with an average 1596 ind. 10 cm^{-2}. While the meiofaunal biomass ranged between 4387.15 to 14080.76 µg 10 cm^{-2} with an average meiofaunal biomass of 9213.06 µg 10 cm^{-2}. The meiofaunal composition was as follows: copepod, nematode, nauplii, isopod, polychaete, ostracoda, cumacea, foraminifera, amphipod, tanaid, and gastropod. Copepod was found to be the most dominant taxa followed by nematode (Figure 13).

3.4.1.3.4. February 2021

During February, the maximum meiofaunal density observed was 2212 ind. 10 cm^{-2} with minimum 1735 ind. 10 cm^{-2} with an average meiofaunal density of 956 ind. 10 cm^{-2}. The maximum meiofaunal biomass recorded was 17102.22 µg 10 cm^{-2} with an average 12083.15 µg 10 cm^{-2}. The meiofaunal composition includes taxa comprising of copepod, nematode, isopod, amphipod, cumacea, nauplii, polychaete, tanaid, oligochaete, ostracod, sipuncula, foraminifera, and kinorhynch. Copepod was found to be the most dominant taxa followed by nematode (Figure 13).

The meiofaunal diversity varied between the 2 tide pools of Navy-nagar. The maximum number of taxa was recorded in December in both the locations 18 and 16 taxa each at NN1 and NN2 respectively. The diversity index of equitability: Shannon waiver and Pileou's evenness was found to be maximum in February at both the locations of Navy-nagar (Figure 14).

It was observed that the meiofaunal density at Worli was found to be low compared to Navy-nagar (Figure 9). This could be due to structural complexity in both the area. The substratum at Worli is basaltic huge rock bed covered with mussels, while the Navy-nagar substratum is mixture of small boulders, basaltic rocks and with sand deposited through sedimentation between the boulders. This may be also due too presence of algal film at the site which provides shelter from predation and food availability.

Meiofauna play an important role in the trophic chain, which shows necessity to know the contribution of meiofauna to the next trophic level. The biomass here describes the standing stock of meiobenthic community. The mean meiofauna biomass variation among the sites differed than the density in December 2020. The maximum biomass was observed at NN 2

(16045.99 ± 10629.09 µg 10 cm^{-2}) while the minimum was found NN1 (1844.56 ± 727.98 µg 10 cm^{-2}) in Navy nagar (Table 2). Although in December there was presence of algal film in Navy nagar. The variation between the NN1 and NN2 biomass could be due to composition of meiofaunal taxa. This illustrates variation in biomass rather than density. All through in February the mean meiofaunal density illustrated similar distribution pattern maximum at Navy nagar NN2 and minimum at Worli.

The meiofaunal composition of the present study represents 22 taxa: nematode, copepod, polychaete, nauplii, isopod, amphipod tanaid, cumacea, foraminifera, ostracod, oligochaete, sipuncula, mite, kinorhynch bryozoan, gastropod, turbellarian, bivalve, cnidaria, echinoderm, insects and cladocera (showing in decreasing contribution pattern) (Table 3). Hard substratum is reported to be dominated by two major phyla nematode and crustaceans (specifically harpacticoid copepod). The dominant taxa recorded above 1% of the total meiofaunal abundance are nematode (44%), copepod (34%), polychaete (7%), nauplii (5%), isopoda (3%), amphipod (3%) tanaid (1%), cumacea (1%) and others were the sum of taxa recorded below 1% of total meiofaunal abundance. The distribution pattern of others is depicted in Figure 15. The photographs of the meiofauna were represented in Plate 6and Plate 7.

The present study illustrate in Dec 2020 maximum diversity was observed at both the sites. The contribution of crustaceans was maximum at Worli. It was observed that the nematode contribution was more compared to copepod and other crustaceans at Navy nagar during Dec'20 which signifies that the algal film cover was decaying which give rise to nematode abundance. While the algal film cover in February reduced the nematode density, and gave rise to crustacean density. These illustrated maximum contribution of isopod, amphipod, tanaid and cumacea were in Feb'21. Algae are recorded to recruit crustaceans like harpacticoid copepod, amphipod, cumacea, isopod and tanaid. Due to which meiofaunal biomass variation can be recorded. Although ostracods were found to be maximum at Navy nagar compared to Worli. The temporal change in the meiofaunal assemblage may even be influenced by physical and chemical environmental factors and substratum complexity.

3.4.2. Macrofauna

Macrofauna is also known as macrobenthos. Annelid worms, bivalves, gastropods, crustaceans are the most commonly encountered macrofauna in the tide pool area of the rocky shore. In

present study, macrofauna were studied from 3 intertidal area (one from Worli site and 2 tide pool from Navy-nagar site) along the Mumbai coast. The Table 4 summarizes the macrofaunal parameters from the recipient site of translocated coral area in Mumbai during Nov 20 - Feb 21.

The macrobenthic standing stock in terms of biomass and population was impressive and also varied greatly in the study region. Region and zonation wise intertidal macrofaunal community have been represented in the above mentioned Table 4.

The biomass of macrobenthic fauna ranged from 0.0544 to 140.69 g/m^2 with an average 15.59 g/m^2. The population of macrobenthic fauna ranged from 112 to 13888 no./m^2 with an average 4716 no./m^2. Overall, 26 faunal groups were observed in the study region and varied from 2 to 17 nos./quadrant (Table 4). The macrobenthic standing stock was lowest in term of biomass and population at Navy-nagar . Highest biomass and population were observed at Worli (42.948 g/m^2) and Worli (10248 no./m^2) respectively. Population was found to be higher at Worli in Nov'20 and Dec'20 while in Jan'21 and Feb'21 NN TP-2 found to be higher (Figure 16). The photographs of the macrofauna were represented in Plate 8 to Plate 20.

3.4.2.1. Worli

3.4.2.1.1. November 2020

The macrobenthic standing stock varied in terms of biomass from 0.80 to 140.69 g/m^2 and population from 272 to 1376 no./m^2. An average biomass and population was 36.861 g/m2 and 756 no./m^2 respectively. In total, 11 groups were observed. Whereas, Faunal diversity of macrobenthos varied from 4 to 7 nos. with an average of 5 nos. per quadrate. The dominant faunal group was Amphipoda (46.03%) followed by Polychaeta (43.38%), Polyplacophora (3.17%), Pelecypoda (2.11%), Brachyura (1.58%), Caridean shrimp (1.05%), Sponge (0.53%), Pycnogonid (0.53%), Ophiuroida (0.53%), Fish larvae (0.53%), Cumacea (0.53%) (Figure 17).

3.4.2.1.2. December 2020

The macrobenthic standing stock varied in terms of biomass from 6.05 to 70.77 g/m^2 and population from 3552 to 13888 no./m^2. Overall, an average biomass and population was 42.95 g/m^2 and 10248 no./m^2 respectively. Faunal diversity of macrobenthos varied from 11 to 14

nos. with an average of 12 nos. per quadrate. In total, 26 faunal groups were observed. Amphopoda (58.98%) was dominant and followed by Polychaeta (32.16%), Brachyura (1.56%), Caridean shrimp (1.41%), Tanaidacea (1.21%), Nematoda(1.17%), Polyplacophora(1.01%), oligochaeta(0.51%), Sipuncula(0.43%), Cumacea(0.39), Pelecypoda(0.35%), Isopoda and ostracoda (0.2%), Anumora and Sponge(0.12%), Copepoda and Gastropoda(0.08%) and Fish larvae and turbellaria(0.04%) (Figure 17).

3.4.2.1.3. January 2021

The macrobenthic standing stock varied in terms of biomass from 5.2 to 23.53 g/m^2 and population from 1840 to 10096 no./m^2. An average biomass and population was 15.033 g/m^2 and 5160 no./m^2 respectively. In total, 19 groups were observed. Whereas, Faunal diversity of macrobenthos varied from 10 to 13 nos. with an average of 12 nos. per quadrate. The dominant faunal group was Amphipoda (76.12%) followed by Polychaeta (11.87%), Tanaidacea (5.5%),Copepoda (1.24), Caridean shrimp (1.01%), Brachyura (0.8%), Anumora, Isopoda, Nematda, Nemertea and Sipuncula (0.54%), Polyplacophora and turbellaria (0.47%), Cumacea(0.16%), Sea anemone and Pelecypoda(0.08) (Figure 17).

3.4.2.1.4. February 2021

The macrobenthic standing stock varied in terms of biomass from 10.53 to 86.74 g/m^2 and population from 3696 to 5504 no./m^2. An average biomass and population was 37.03 g/m^2 and 4700 no./m^2 respectively. In total, 18 groups were observed. Whereas, Faunal diversity of macrobenthos varied from 10 to 14 nos. with an average of 12 nos. per quadrate. The dominant faunal group was Amphipoda (70.02%) followed by Polychaeta (16.31%), turbellaria(3.21%), Copepoda (2.64%), Anumora (1.48%), Brachyura (0.8%), Polyplacophora (0.99%), Nemertea (0.82%), Nematoda (0.66%), Isopoda (0.49%), Sponge (0.41%), Sipuncula, Pelecypoda and Gastropoda (0.33%), Oigochaeta(0.25%), Caridean shrimp and Cumacea (0.16%), Sea anemone and (0.08%) (Figure 17).

3.4.2.2. Navy-nagar (Tide pool-1)

3.4.2.2.1. November 2020

The macrobenthic standing stock varied in terms of biomass from 0.04 to 18.42 g/m^2 and population from 224 to 608 no./m2. An average biomass and population was 5.29 g/m^2 and 460 no./m^2 respectively. In total, 7 groups were observed. Whereas, Faunal diversity of macrobenthos varied from 3 to 4 nos. with an average of 3 nos. per quadrate. The dominant faunal group was Polychaeta (78.26%) followed by Amphipoda (8.69%), Tanaidaceae (5.22%), Copepoda (3.48%), Isopoda (2.61%),Brachyura (0.9%), Caridean shrimp (0.9%) (Figure 18).

3.4.2.2.2. December 2020

The macrobenthic standing stock varied in terms of biomass from 5.4 to 36.51 g/m^2 and population from 3424 to 8752 no./m^2. Overall, an average biomass and population was 24.14 g/m^2 and 5516 no./m^2 respectively. Faunal diversity of macrobenthos varied from 7 to 12 nos. with an average of 10 nos. per quadrate, In total, 17 faunal groups were observed. Polychaeta (52.36%) was dominant and followed by Amphipoda (28.14%), Tanaidacea (5.44%), Cumacea (4.28%), Nematoda (2.83%) , Brachyura (2.03%), Polyplacophora (1.16%), Ostracoda (1.09%), Isopoda (0.73%), Copepoda (0.65%), Caridean shrimp and gastropoda (0.36%), Sipuncula (0.22%), Nemertea (0.15%), Ophiuroidae,Pelecypoda and sponge (0.07%) (Figure 18).

3.4.2.2.3. January 2021

The macrobenthic standing stock varied in terms of biomass from 1.76 to 16.62 g/m^2 and population from 2976 to 5760 no./m^2. Overall, an average biomass and population was 6.62 g/m2 and 4752 no./m^2 respectively. Faunal diversity of macrobenthos varied from 10 to 14 nos. with an average of 11 nos. per quadrate, In total, 17 faunal groups were observed. Polychaeta (40.57%) was dominant and followed by Amphipoda (17.26%), Isopoda (16.25%), Tanaidacea (7.15%), Cumacea (6.06%), Nematoda (4.63%), Copepoda (2.69%), Caridean shrimp (2.61%), Ostracoda (1.43%), Brachyura (0.42%), Pelecypoda (0.34%), Nemertea (0.25%), Anumora, Sea anemone, Pycnogonida, Sponge and Turbellaria (0.08%) (Figure 18).

3.4.2.2.4. February 2021

The macrobenthic standing stock varied in terms of biomass from 2.42 to 4.62 g/m^2 and population from 6128 to 7344 no./m^2. Overall, an average biomass and population was 3.52

g/m^2 and 6540 no./m^2 respectively. Faunal diversity of macrobenthos varied from 9 to 12 nos. with an average of 10 nos. per quadrate, In total, 16 faunal groups were observed. Polychaeta (26.85%) was dominant and followed by Amphipoda (24.28%), Isopoda (24.22%), Tanaidacea (9.72%), Cumacea (8.75%), Copepoda(3%), Nematoda (1.59%), Ostracoda (0.67%), Sipuncula(0.31%), Sea anemone, Nemertea, Pelecypoda (0.12%), Anumora, Caridean shrimp, Polyplacophora and sponge (0.06%) (Figure 18).

3.4.2.3. Navy-nagar (Tide pool-2)

3.4.2.3.1. November 2020

The macrobenthic standing stock varied in terms of biomass from 0.50 to 14.27 g/m^2 and population from 112 to 304 no./m^2. Overall, an average biomass and population was 3.99 g/m^2 and 196 no./m^2 respectively. Faunal diversity of macrobenthos varied from 2 to 3 nos. with an average of 2 nos. per quadrate, In total, 3 faunal groups were observed.. Polychaeta (48.98%), Amphipoda (46.94%), was dominant and followed by Nematoda (2.04%), Brachyura (2.04%) (Figure 19).

3.4.2.3.2. December 2020

The macrobenthic standing stock varied in terms of biomass from 1.7 to 4.04 g/m^2 and population from 3408 to 5856 no./m^2. Overall, an average biomass and population was 3.261 g/m^2 and 4620 no./m^2 respectively. Faunal diversity of macrobenthos varied from 8 to 13 nos. with an average of 10 nos. per quadrate, In total, 15 faunal groups were observed. Polychaeta (43.38%) was dominant and followed by Nematoda (20.52%), Copepoda (10.3%), Cumacea (8.4%), Isopoda (4.94%), Amphipoda and Tanaidacea (4.07%), Ostracoda (2.94%), Brachyura (0.52%), Sea anemone(0.43%),Pycnogonida (0.17%), Gastropoda larvae, Holothuroidae, and Pelecypoda (0.09) (Figure 19).

3.4.2.3.3. January 2021

The macrobenthic standing stock varied in terms of biomass from 1.82 to 5.47 g/m^2 and population from 3296 to 8304 no./m^2. Overall, an average biomass and population was 4.31 g/m^2 and 5752 no./m^2 respectively. Faunal diversity of macrobenthos varied from 9 to 17 nos. with an average of 10 nos. per quadrate, In total, 19 faunal groups were observed. Polychaeta

(40.26%) was dominant and followed by Isopoda (21.07%), Nematoda (12.93%), Amphipoda(8.07%) Cumacea (7.65%), Tanaidacea (4.31%), Copepoda (3.06%), and Ostracoda (0.90%), Sipuncula(0.35%), Fish larvae and Oligochaete (0.28%), Gastropoda, Gastropoda larvae, Nemertea, Polyplacophora (0.14%) Brachyura, Pelecypoda, Pycnogonida, Sponge(0.07%) (Figure 19).

3.4.2.3.4. February 2021

The macrobenthic standing stock varied in terms of biomass from 1.99 to 5.4 g/m^2 and population from 4144 to 14304 no./m^2. Overall, an average biomass and population was 4.18 g/m^2 and 7888 no./m^2 respectively. Faunal diversity of macrobenthos varied from 10 to 11 nos. with an average of 10 nos. per quadrate, In total, 16 faunal groups were observed. Polychaeta (38.29%) was dominant and followed by Isopoda (26.22%), Cumacea (14%), Amphipoda(12.27%), Tanaidacea (3.9%), Ostracoda (1.67%), Copepoda (1.62%), Nematoda (0.96%), Pycnogonida, and Sipuncula(0.25%), Nemertea(0.2%), Brachyura and Pelecypoda (0.10%), Caridean shrimp, Sea anemone and Oligochaeta(0.05%) (Figure 19).

Table 1. Environmental data collected at donor and recipient site during the present study in November 2020.

Site	pH	Salinity (ppt)	Chloride (g/kg)	SS (mg/L)	DO (mg/L)	BOD (mg/L)
Worli (Donor site)	8.17	34.01	18.82	20.48	2.89	0.71
Worli (Recipient site)	8.11	34.26	18.97	39.88	3.06	0.72
Haji Ali (Donor site)	8.11	34.96	19.35	41.61	8.76	0.99
Navi nagar (Tide Pool 1)	8.17	33.21	18.38	13.44	4.06	0.98
Navi nagar (Tide Pool 2)	8.19	35.07	19.41	28.33	2.64	0.77

Site	NO_2^- (µmol/L)	NO_3^- (µmol/L)	NH_4^+ (µmol/L)	PO_4^{3-} (µmol/L)	Phenol (µg/L)
Worli (Donor site)	1.92	11.06	2.18	4.14	183.4
Worli (Recipient site)	1.53	13.67	3.48	4.79	204.5
Haji Ali (Donor site)	0.55	8.72	1.69	3.28	178.1
Navi nagar (Tide Pool 1)	0.64	12.33	1.43	1.77	196.8
Navi nagar (Tide Pool 2)	0.35	9.73	1.71	2.30	138.7

Table 2. Range and average of meiofauna at recipient sites along Mumbai coast during November 2020 to February 2021.

Location	Month Year	Density (ind. 10 cm^{-2})			Biomass (µg 10 cm^{-2})			Taxon (no.)		
		Min	Max	Av.	Min	Max	Av.	Min	Max	Av.
Worli (W1)	Nov 20	76	149	107	84.38	246.72	188.71	4	10	6
	Dec 20	610	1540	1117	4301.90	9060.98	6226.28	13	15	14
	Jan 21	393	660	521	2014.86	3133.87	2640.24	8	11	9
	Feb 21	521	1523	956	3700.40	8372.98	8379.09	11	14	12
Overall		76	1540	675	84	9061	4359	4	15	10
Navy nagar (TP-1)	Nov 20	245	577	433	588.42	1154.93	965.98	5	7	6
	Dec 20	929	3149	1922	1004.05	2274.95	1844.56	11	13	12
	Jan 21	527	1674	1169	1997.21	13545.39	7951.16	10	11	11
	Feb 21	1762	2694	2274	6501.85	24629.07	19104.18	12	13	12
Overall		245	3149	1450	588	24629	7466	5	13	10
Navy nagar (TP-2)	Nov 20	280	534	382	3038.78	7913.15	5871.15	4	6	5
	Dec 20	2975	4535	3644	5375.94	26633.64	16045.99	10	12	11
	Jan 21	960	2381	1596	4387.15	14080.76	9213.06	9	10	10
	Feb 21	1735	2212	2017	4932.60	17102.22	12083.15	11	12	12
Overall		280	4535	1910	3039	26634	10803	4	12	10

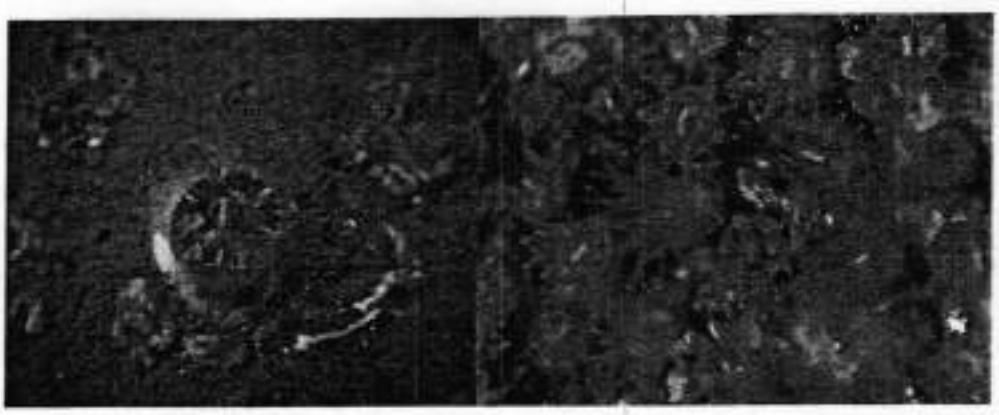
Table 3. Composition (%) of meiofauna at recipient sites along Mumbai coast during November 2020 to February 2021.

Station	Worli (R1)				Navy nagar (TP-1)				Navy nagar (TP-1)				Total
	Nov 20	Dec 20	Jan 21	Feb 21	Nov 20	Dec 20	Jan 21	Feb 21	Nov 20	Dec 20	Jan 21	Feb 21	
Nematoda	74.89	24.51	20.52	43.35	66.25	69.83	17.85	49.76	33.94	29.75	32.18	18.16	44.40
Copepoda	6.61	47.28	54.51	44.74	18.93	17.35	46.92	26.76	41.37	47.76	43.61	41.18	33.54
Polychaeta	8.81	20.59	20.89	1.99	6.14	8.08	8.88	10.01	3.99	4.09	4.71	3.49	6.55
Nauplius	1.33	0.00	0.00	2.75	5.13	3.41	6.52	5.85	9.31	11.79	2.28	4.49	4.72
Isopoda	0.00	0.00	0.00	0.08	0.27	0.08	2.08	3.43	4.70	0.20	3.28	15.33	3.22
Amphipoda	0.00	0.87	0.37	3.08	0.32	0.05	7.25	0.73	0.44	1.97	7.03	7.63	2.69
Tanaidacea	3.52	0.00	0.00	0.08	0.00	0.04	9.06	0.93	0.15	0.15	3.65	3.49	1.37
Cumacea	0.00	0.00	0.12	0.04	0.07	0.22	0.09	0.20	2.16	0.20	1.85	4.49	1.13
Foraminifera	0.00	5.01	0.00	1.48	0.76	0.38	1.09	1.61	1.12	2.27	0.29	0.16	0.87
Ostracoda	0.00	0.22	0.86	0.04	0.59	0.43	0.00	0.57	2.72	0.39	0.39	0.51	0.65
Oligochaeta	0.00	0.00	0.00	0.34	0.56	0.00	0.00	0.00	0.00	0.54	0.35	0.70	0.26
Sipuncula	0.00	0.00	0.00	0.00	0.59	0.06	0.09	0.00	0.00	0.69	0.25	0.35	0.21
Mite	2.64	1.53	2.72	0.08	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.14
Kinorhyncha	0.44	0.00	0.00	0.59	0.15	0.01	0.00	0.12	0.00	0.05	0.12	0.02	0.10
Bryozoa	0.00	0.00	0.00	0.68	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.05
Gastropoda	0.00	0.00	0.00	0.17	0.00	0.03	0.09	0.00	0.09	0.00	0.00	0.00	0.03
Turbellaria	0.00	0.00	0.00	0.08	0.15	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.03
Bivalvia	0.88	0.00	0.00	0.08	0.05	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.02
Cnidaria	0.44	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Echinodermata	0.44	0.00	0.00	0.04	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Insecta	0.00	0.00	0.00	0.17	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.01
Cladocera	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

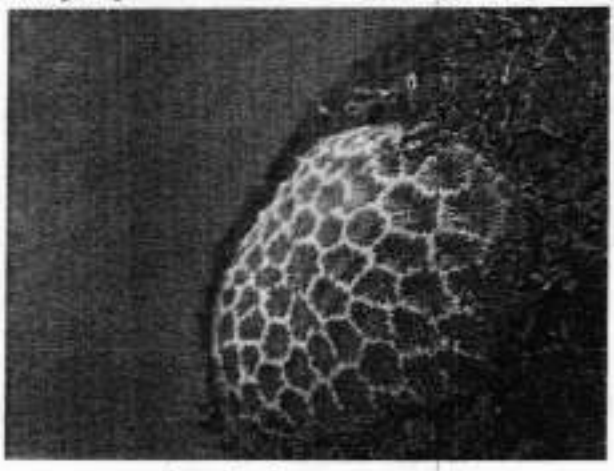
C-337

Table 4. Range and average of macrofauna at recipient sites along Mumbai coast during November 2020 to February 2021.

Month	Region	Biomass (g/m^2, Wet weight)			Population ($no./m^2$)			Faunal groups (no.)		
		Min.	Max.	Av.	Min.	Max.	Average	Min.	Max.	Av.
Nov 2020	Worli	0.8006	140.69	36.861	272	1376	756	4	7	5
	NN(TP-1)	0.4891	18.426	5.2862	224	608	460	3	4	3.25
	NN(TP-2)	0.0544	14.266	3.986	112	304	196	2	3	2.5
Dec 2020	Worli	6.0502	70.768	42.948	3552	13888	10248	11	14	12.5
	NN(TP-1)	5.3997	36.511	24.144	3424	8752	5516	7	12	10.5
	NN(TP-2)	1.6802	4.0462	3.261	3408	5856	4620	8	13	10
Jan 2021	Worli	5.2006	23.532	15.033	1840	10096	5160	10	13	11.75
	NN(TP-1)	1.7648	16.622	6.6194	2976	5760	4752	10	14	11.5
	NN(TP-2)	1.8181	5.4715	4.3105	3296	8304	5752	9	17	11.25
Feb 2021	Worli	10.53	86.743	37.031	3696	5504	4700	10	14	12.25
	NN(TP-1)	2.4163	4.6235	3.5197	6128	7344	6540	9	12	10.25
	NN(TP-2)	1.9933	5.3848	4.1802	4144	14304	7888	10	11	10.25



Oulangia sp. Rhizangiidae (unidentified species)



Pseudosiderastrea tayami

Figure 1. Three varieties of coral have been found in the study area are considered for translocation

Cutting of substratum without any disturbing of corals at the donor site

Placed coral along with its substratum and fixed with rapid setting cement at the recipient site

Figure 2. Coral translocation method used at Worli.

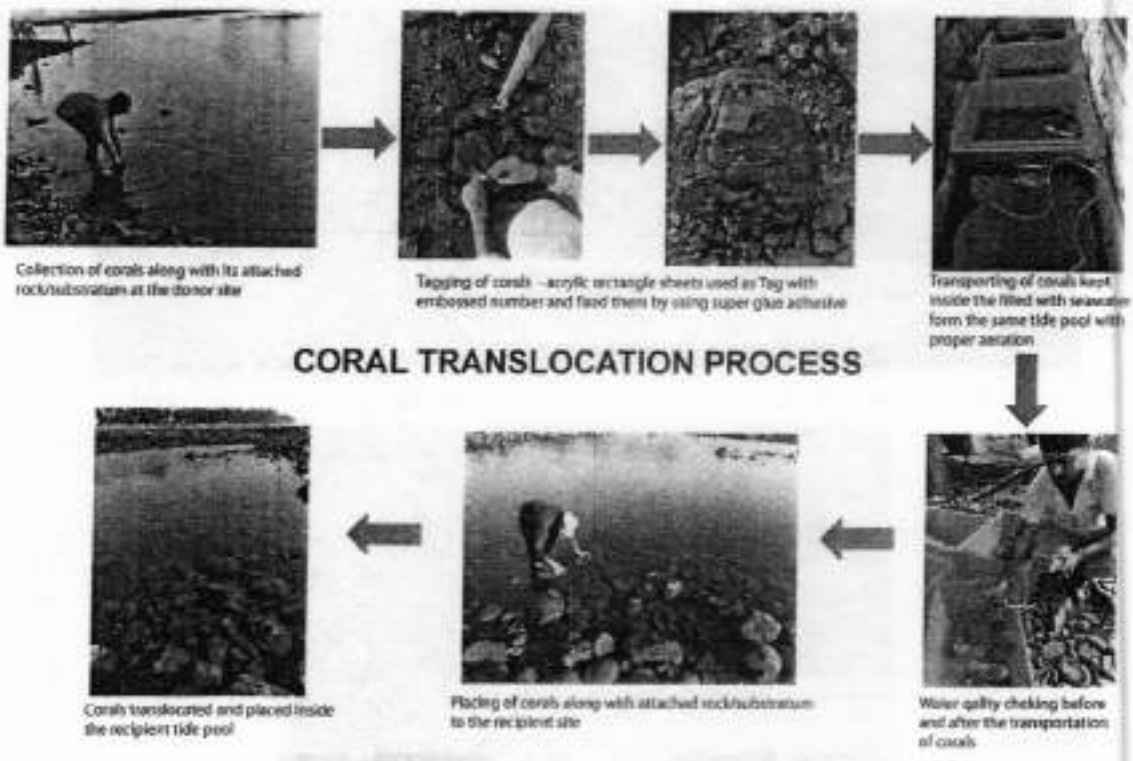


Figure 3. Flow diagram shows the full process involved in coral colonies translocation during the present study.

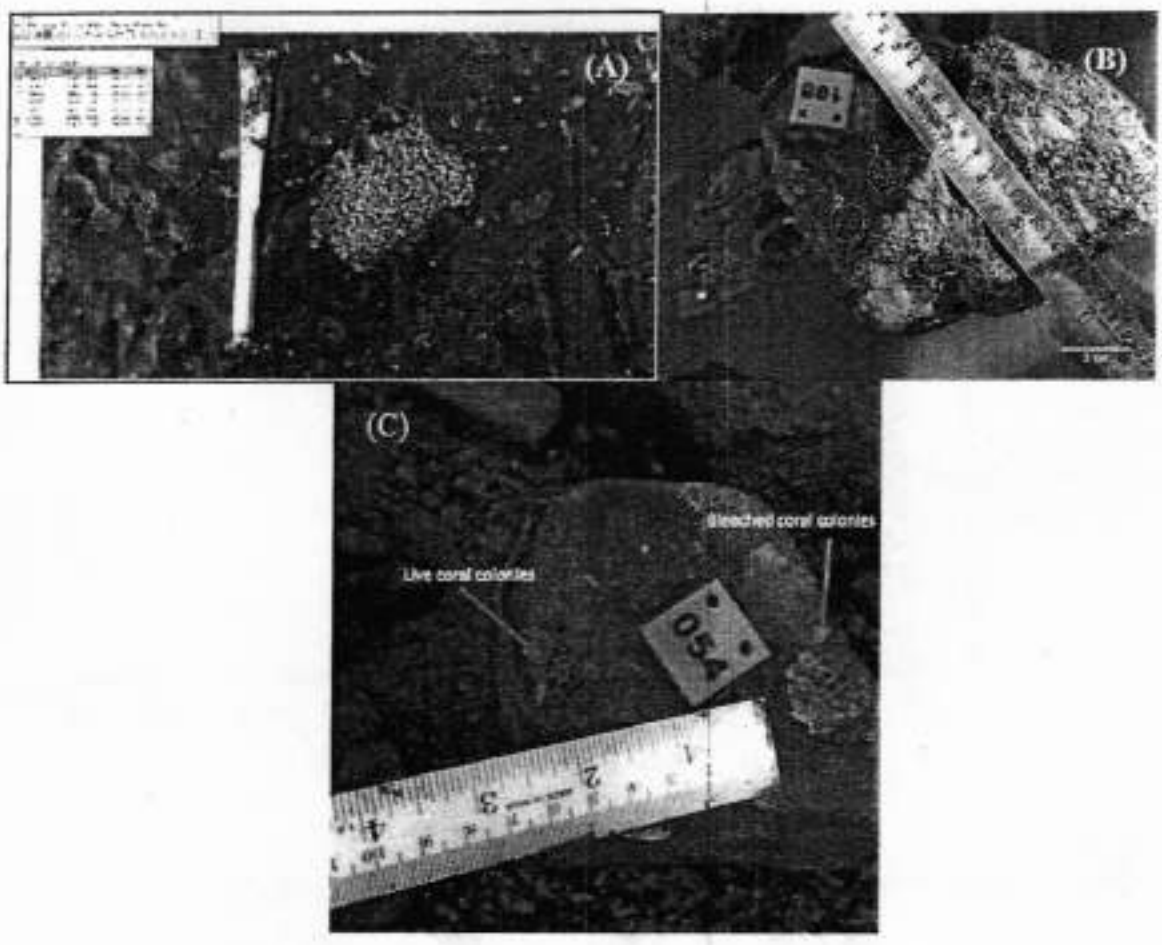


Figure 4. Example of computation method used for area coverage [(A) and (B)] of coral colonies during the present study. (C) Live coral colonies were considered for area coverage computation only while bleached colonies are not included in the present study.

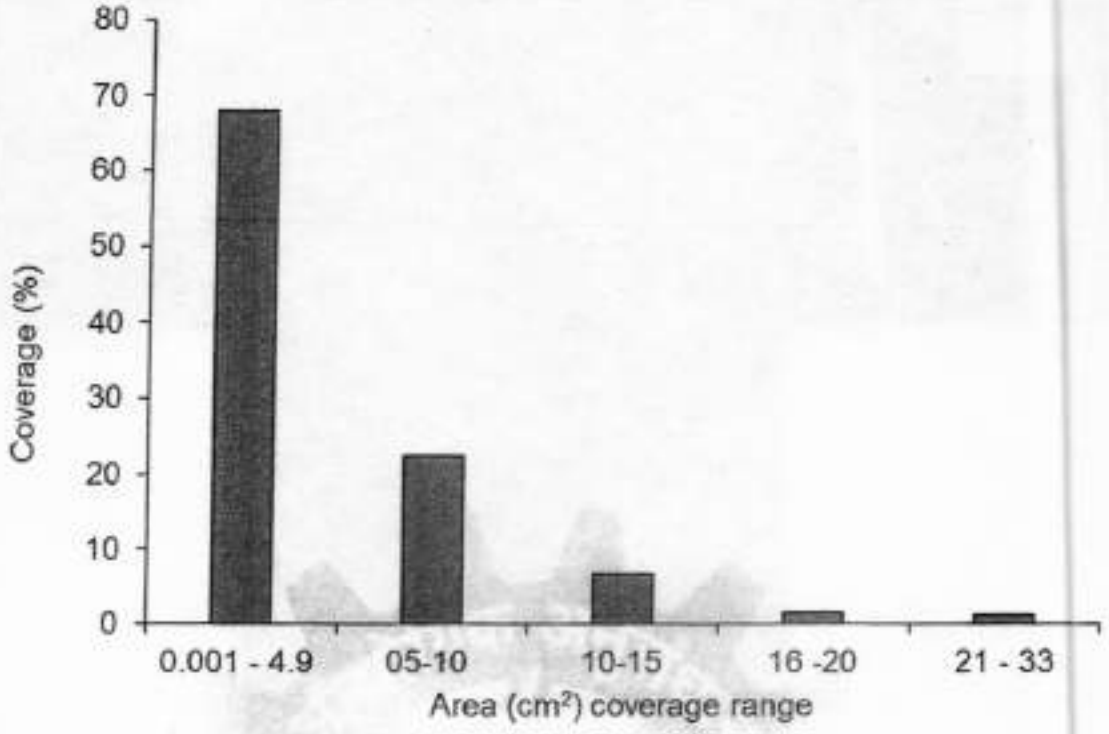


Figure 5. Area coverage (%) range of coral (P. tayami) colonies on the rock/substratum translocated from Haji Ali to Navy nagar.

Figure 6. The map showing the donor and recipient sites of translocated corals during the present study conducted in November 2020.

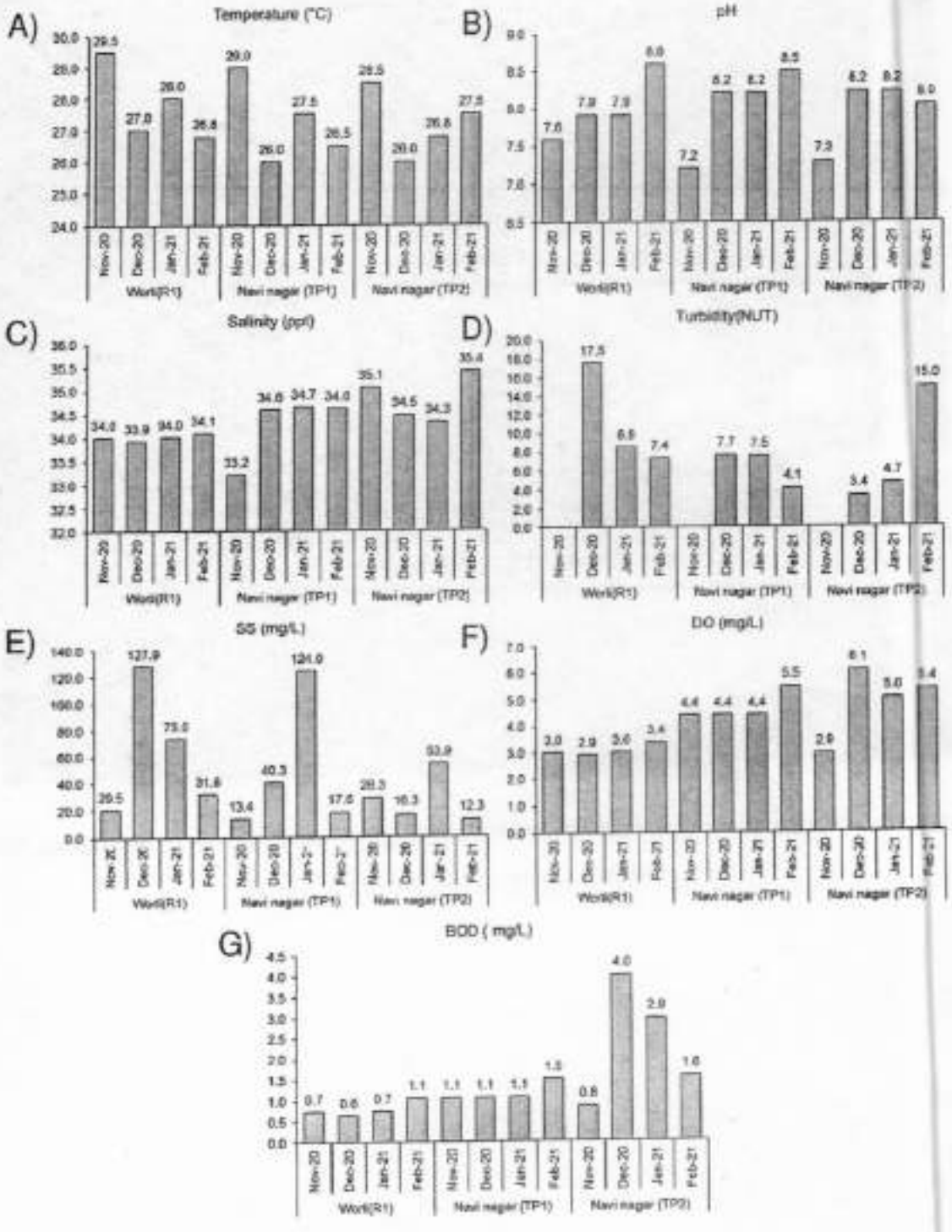


Figure 7. Spatio-temporal variation of environmental parameters along the recipient intertidal sites during the study period. A) Temperature; B) pH; C) Salinity; D) Turbidity; E) Suspended solid (SS); F) Dissolved Oxygen (DO); G) Biochemical Oxygen Demand (BOD).

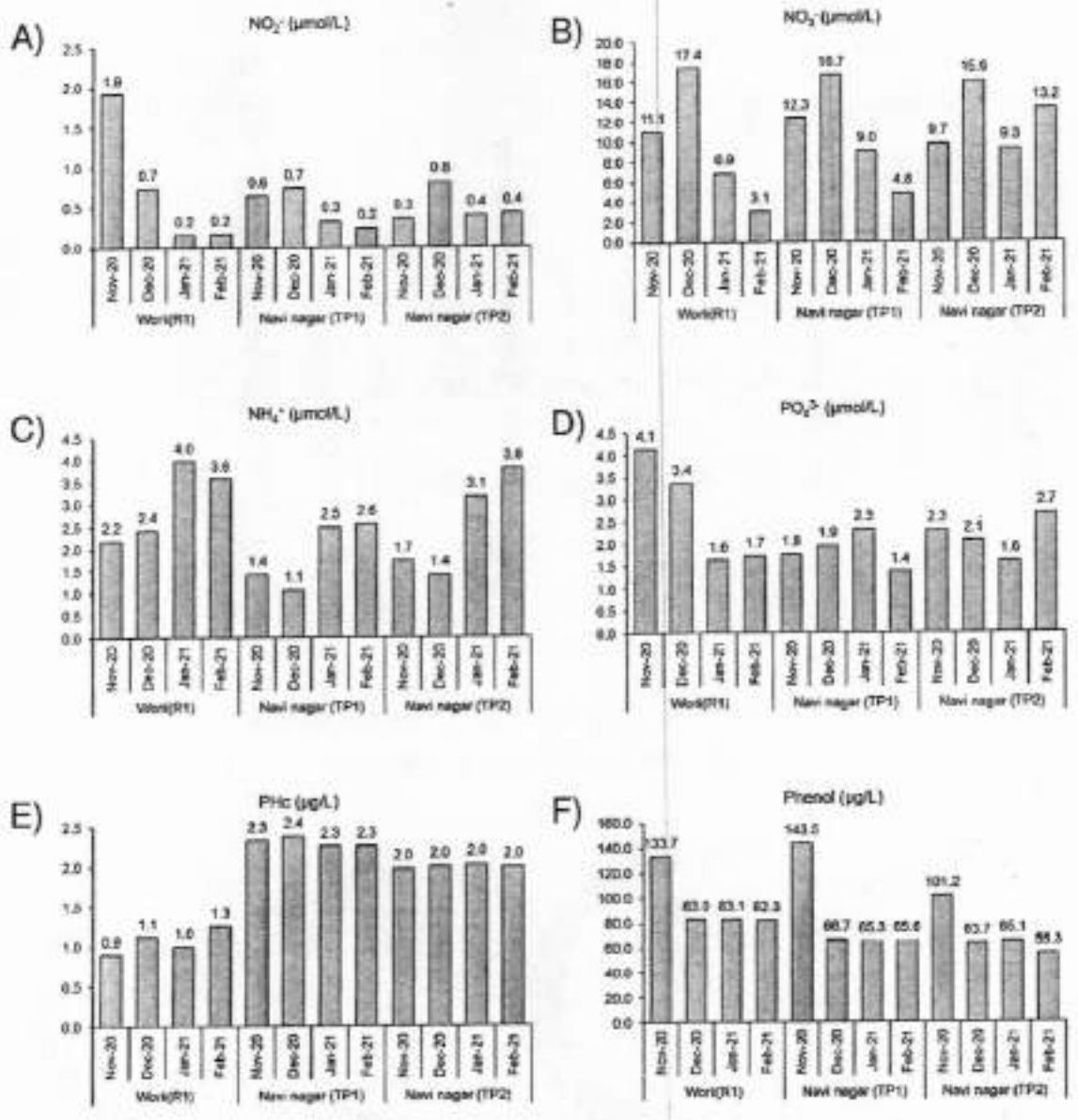


Figure 8. Spatio-temporal variation of nutrient parameters, polyaromatic hydrocarbon and Phenol along the recipient intertidal sites during the study period. A) Nitrite; B) Nitrate; C) Ammonia; D) Phosphate; E) polyaromatic hydrocarbon (PHc); F) Phenol.

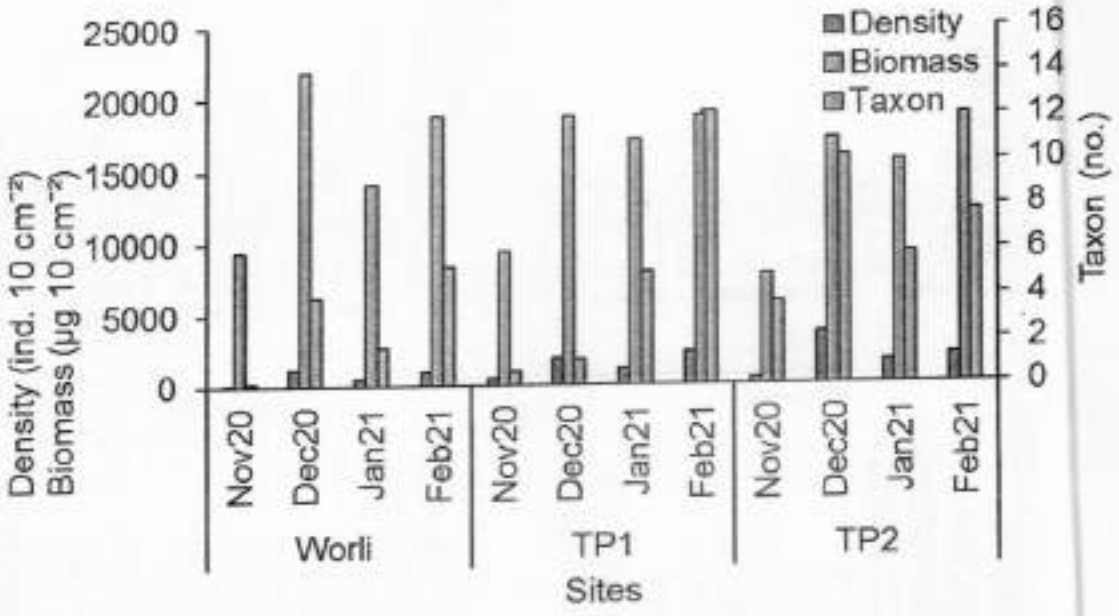


Figure 9. Spatio-temporal distribution of meiofaunal density, biomass and taxa number of coral recipient sites along Mumbai.

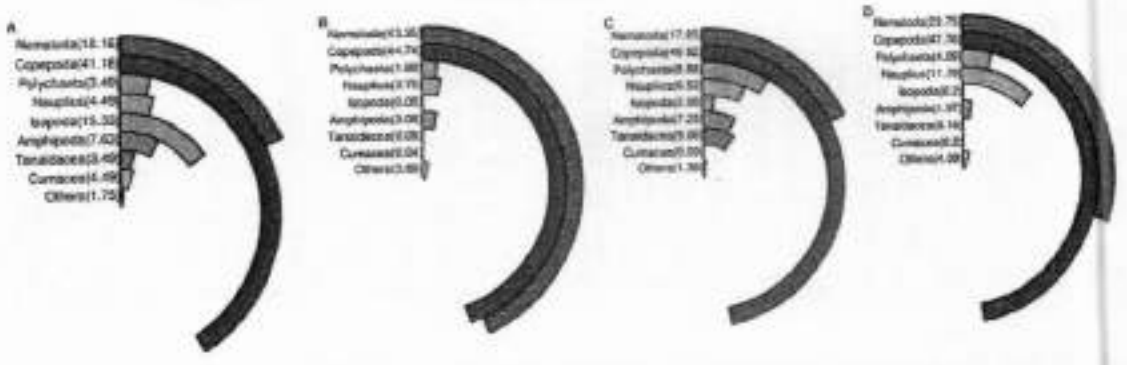


Figure 10. Percentage contribution of major dominating taxa (above 1% of total meiofaunal density) showing temporal variation.at Worli. A) November 2020; B) December 2020; C) January 2021; D) February 2021.

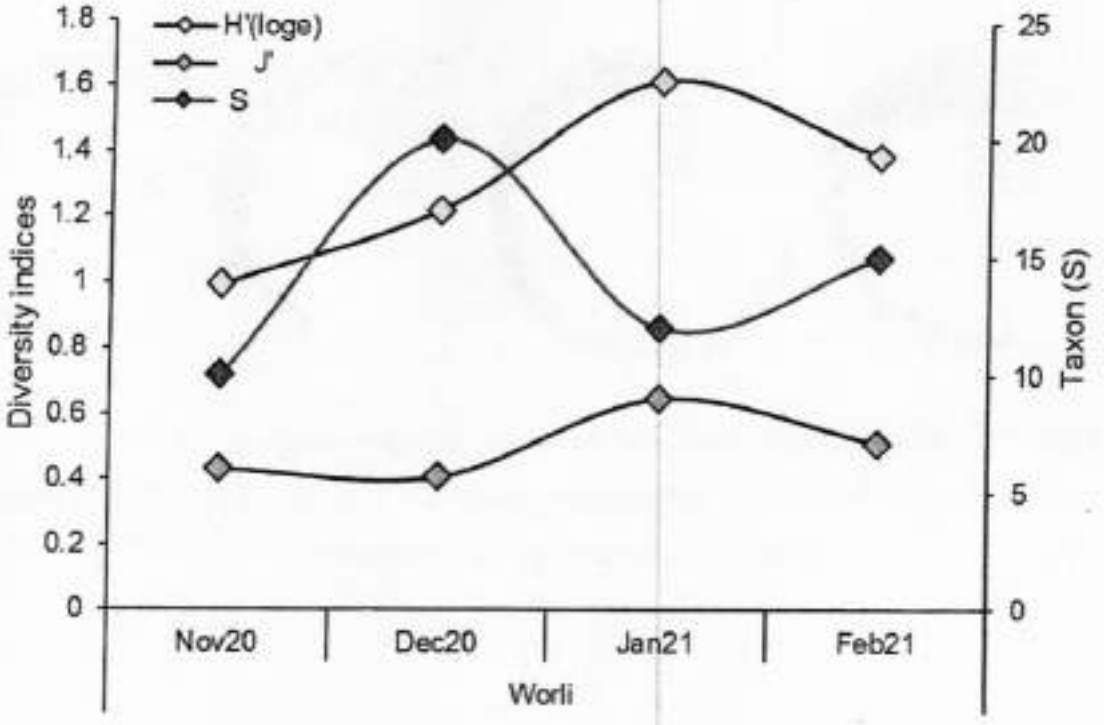


Figure 11. Distribution pattern of diversity indices based on meiofauna showing temporal variation at Worli.

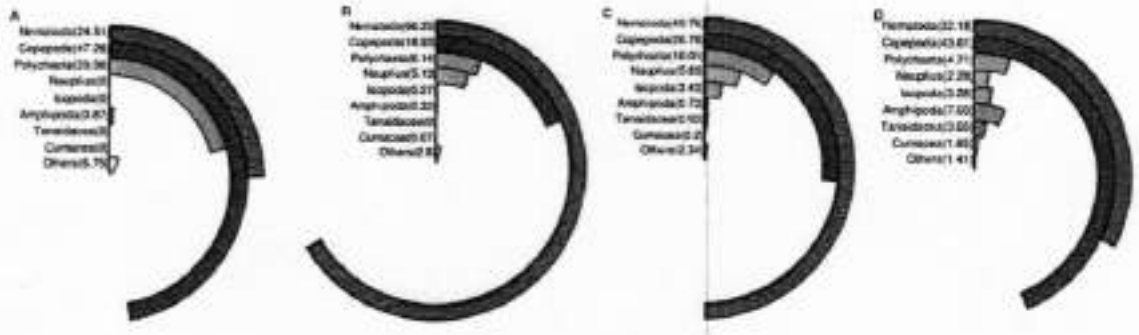


Figure 12. Percentage contribution of major dominating taxa (above 1% of total meiofaunal density) showing temporal variation.at Navy nagar TP-1. A) November 2020; B) December 2020; C) January 2021; D) February 2021.

Figure 13. Percentage contribution of major dominating taxa (above 1% of total meiofaunal density) showing temporal variation.at Navy nagar TP-2. A) November 2020; B) December 2020; C) January 2021; D) February 2021.

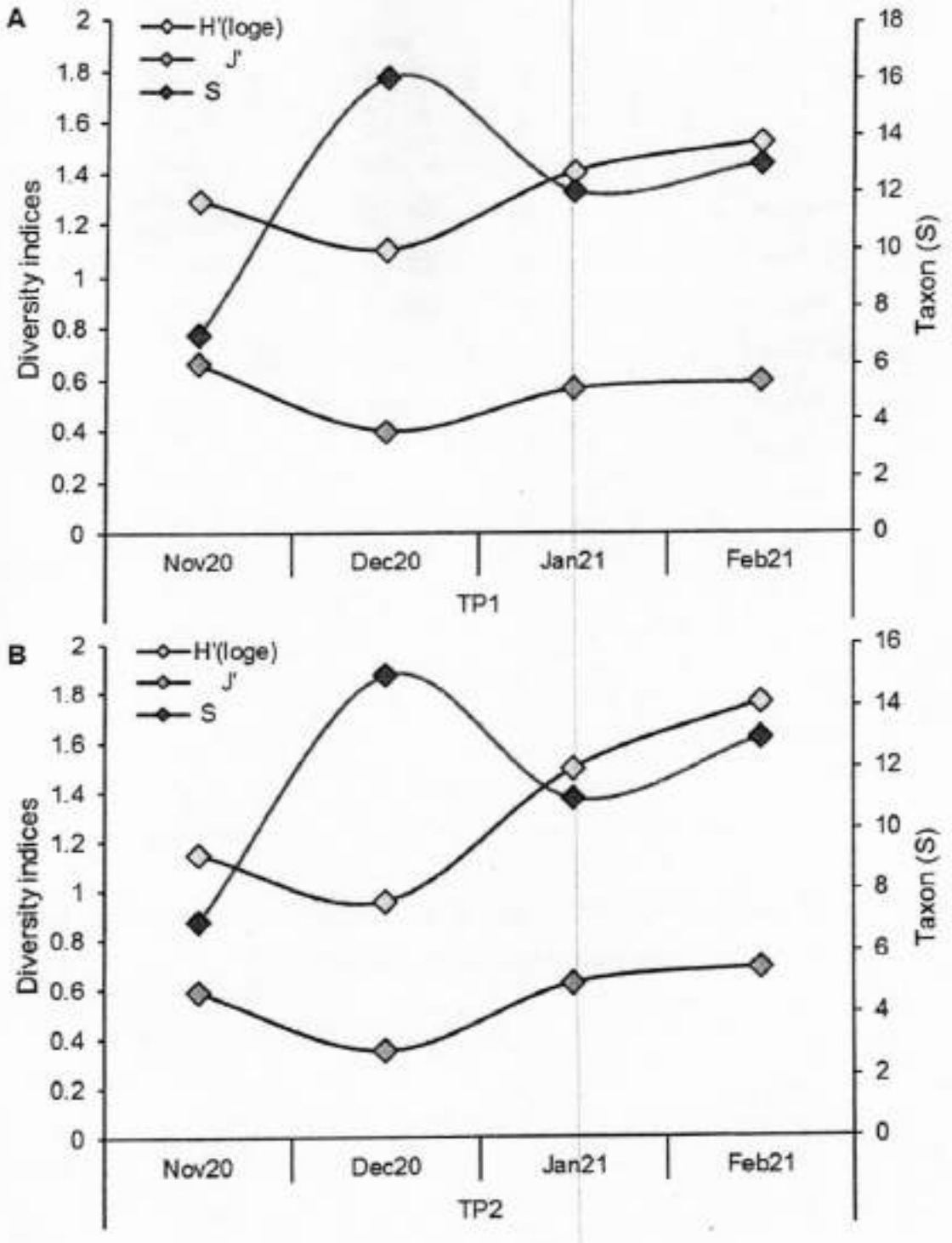


Figure 14. Distribution pattern of diversity based on meiofauna showing temporal variation at Navy nagar. A) TP-1; B) TP-2.

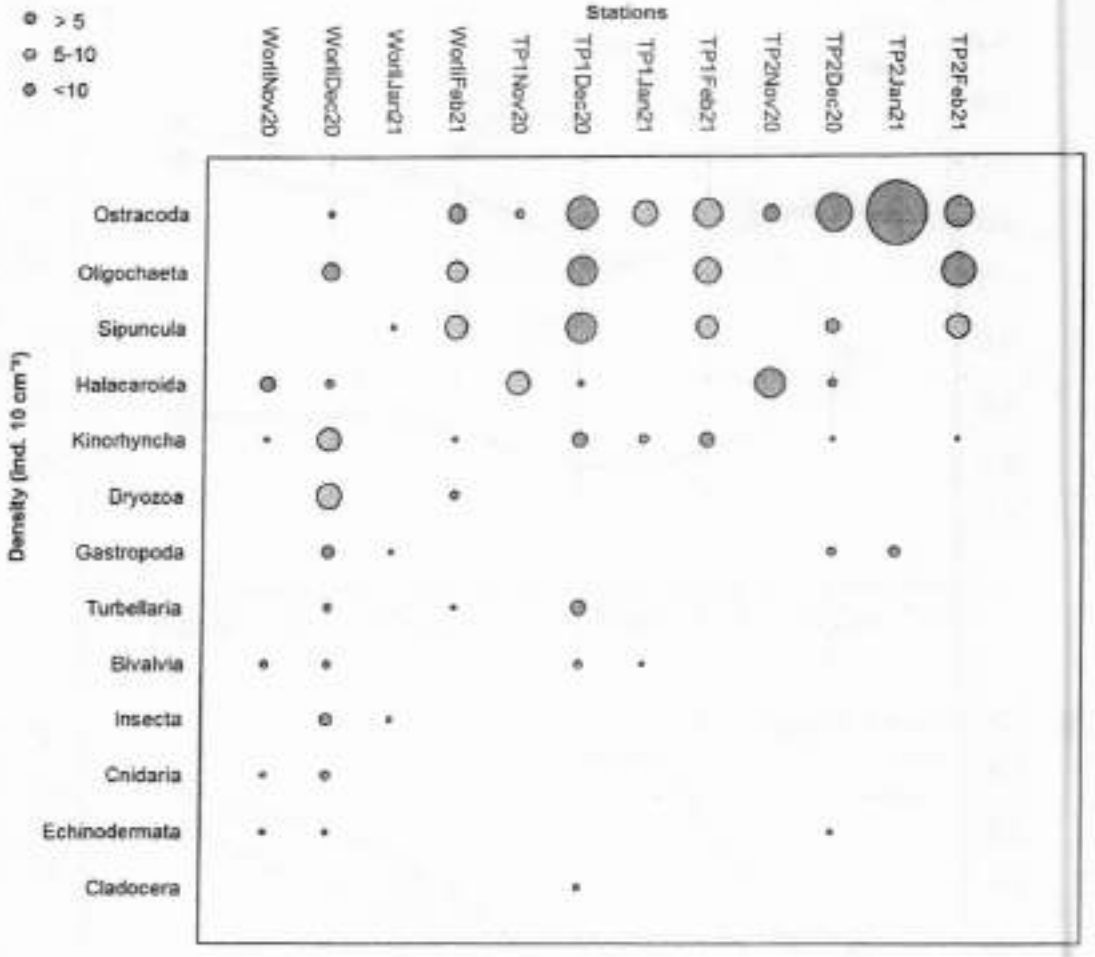


Figure 15. Contribution of meiofaunal taxa (below 1% of total meiofaunal density) showing temporal variation along the study area.

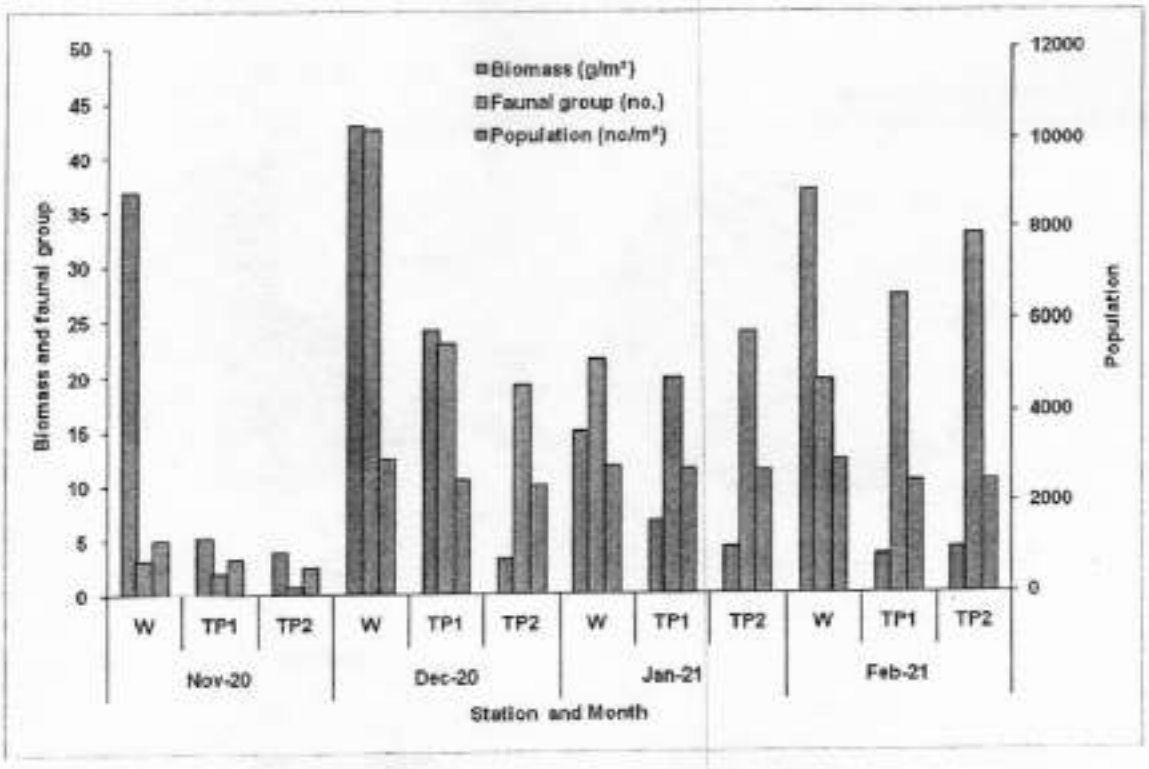


Figure 16. Spatio-temporal variation of macrobenthic parameters of coral recipient sites along Mumbai.

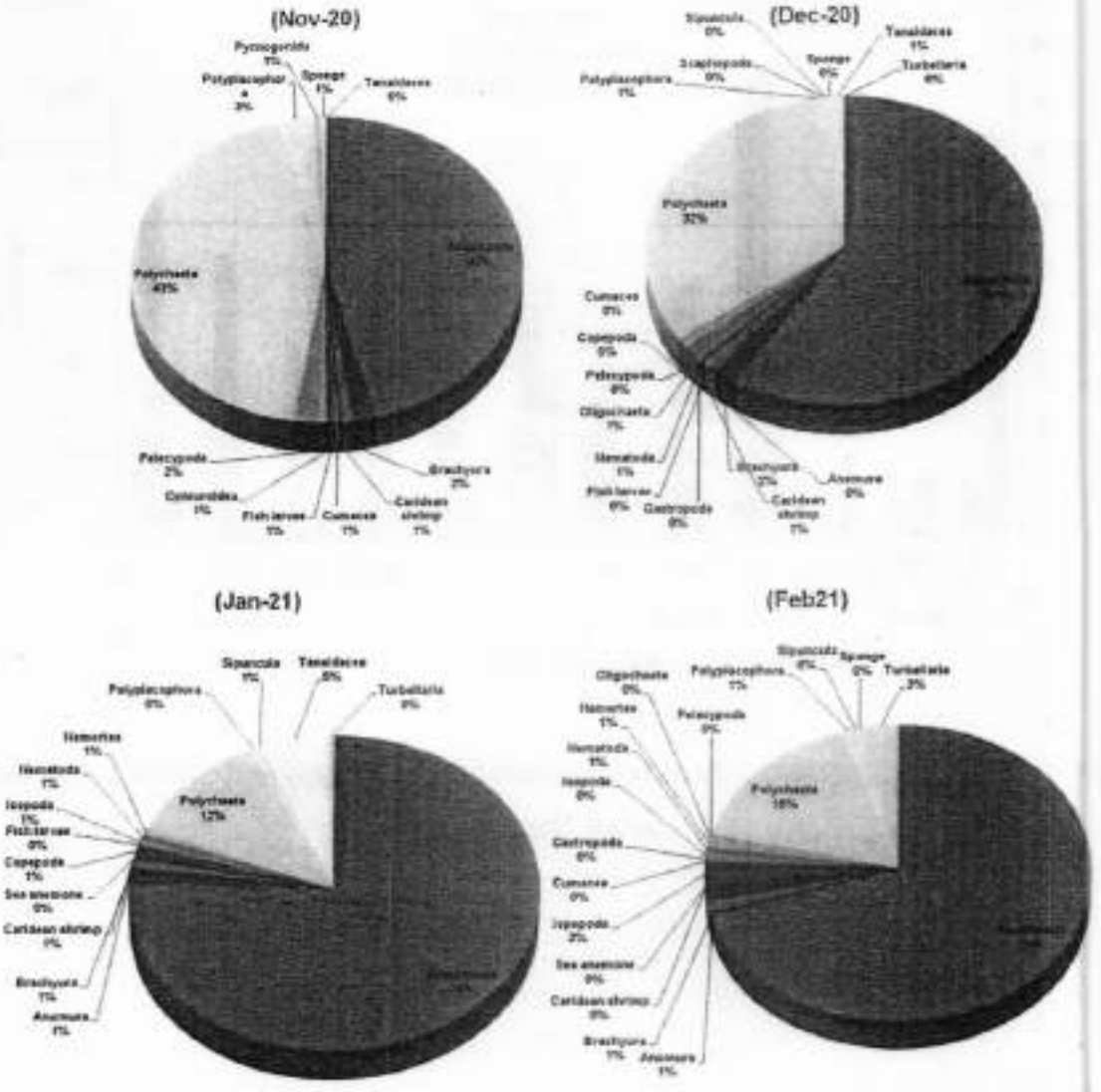


Figure 17. Macrobenthic percentage composition and temporal variation at intertidal transect of Worli.

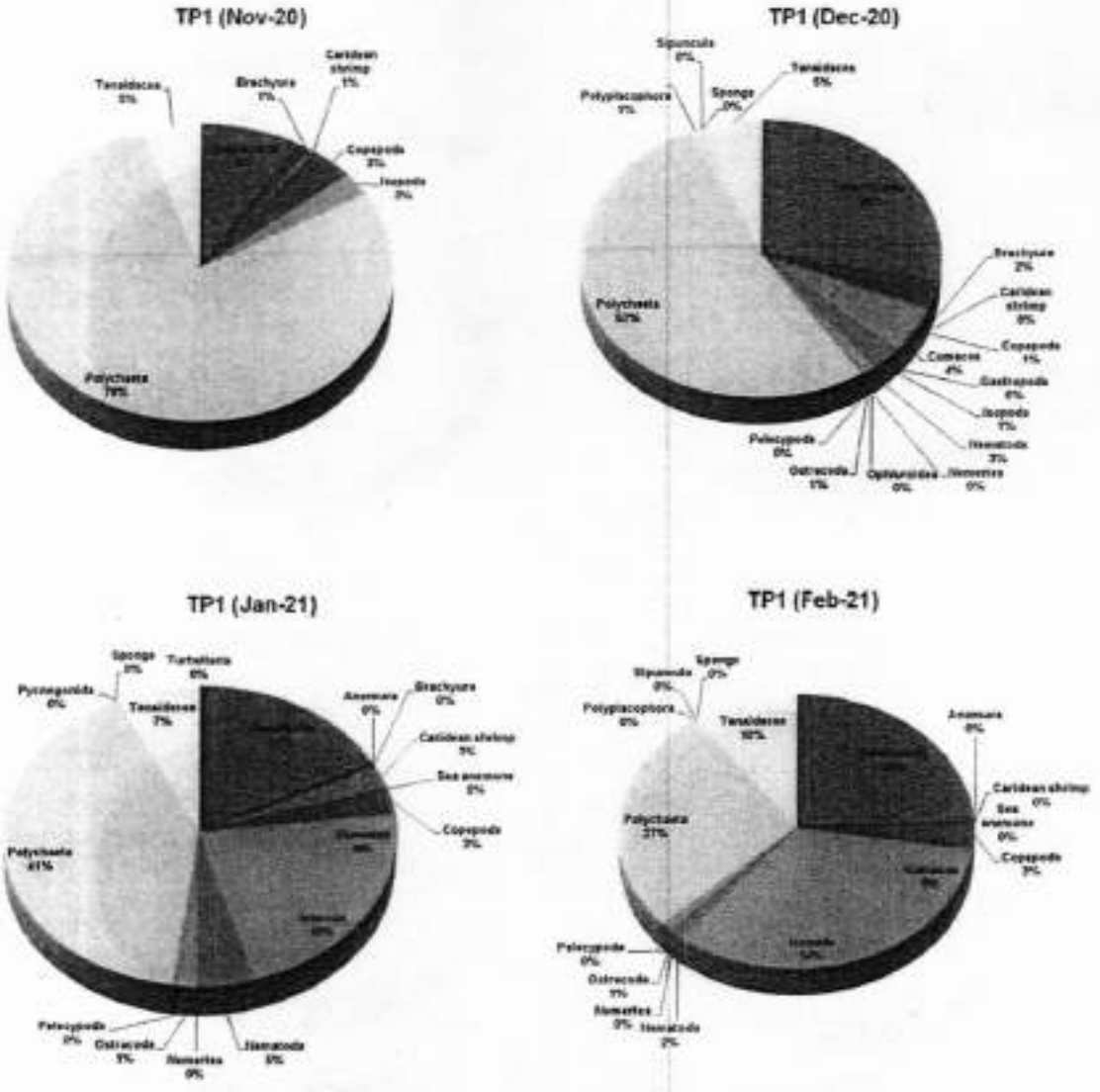


Figure 18. Macrobenthic percentage composition and temporal variation at intertidal transect of Navy nagar (TP-1).

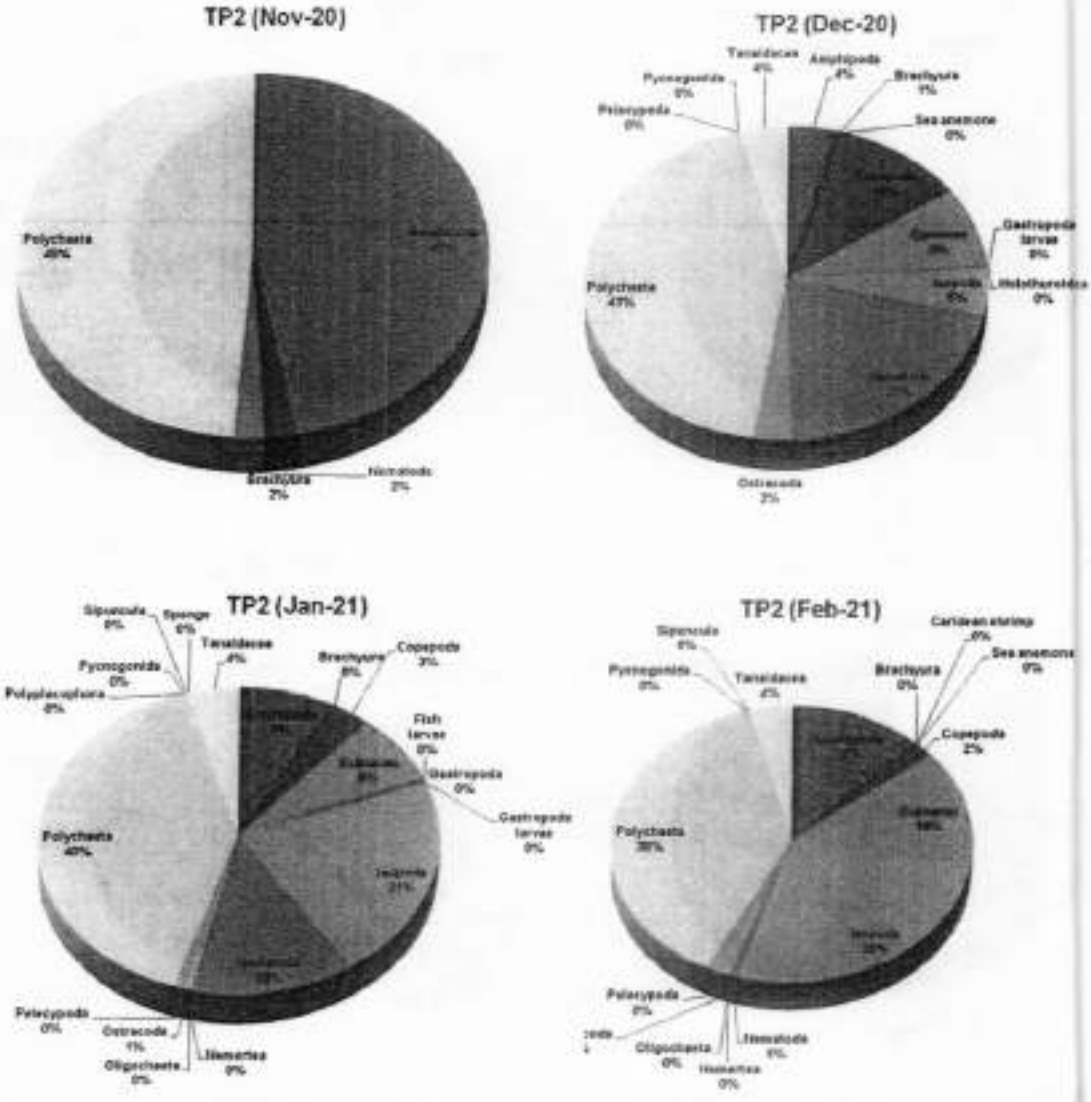


Figure 19. Macrobenthic percentage composition and temporal variation at intertidal transect of Navy nagar (TP-2).

Coral Plates

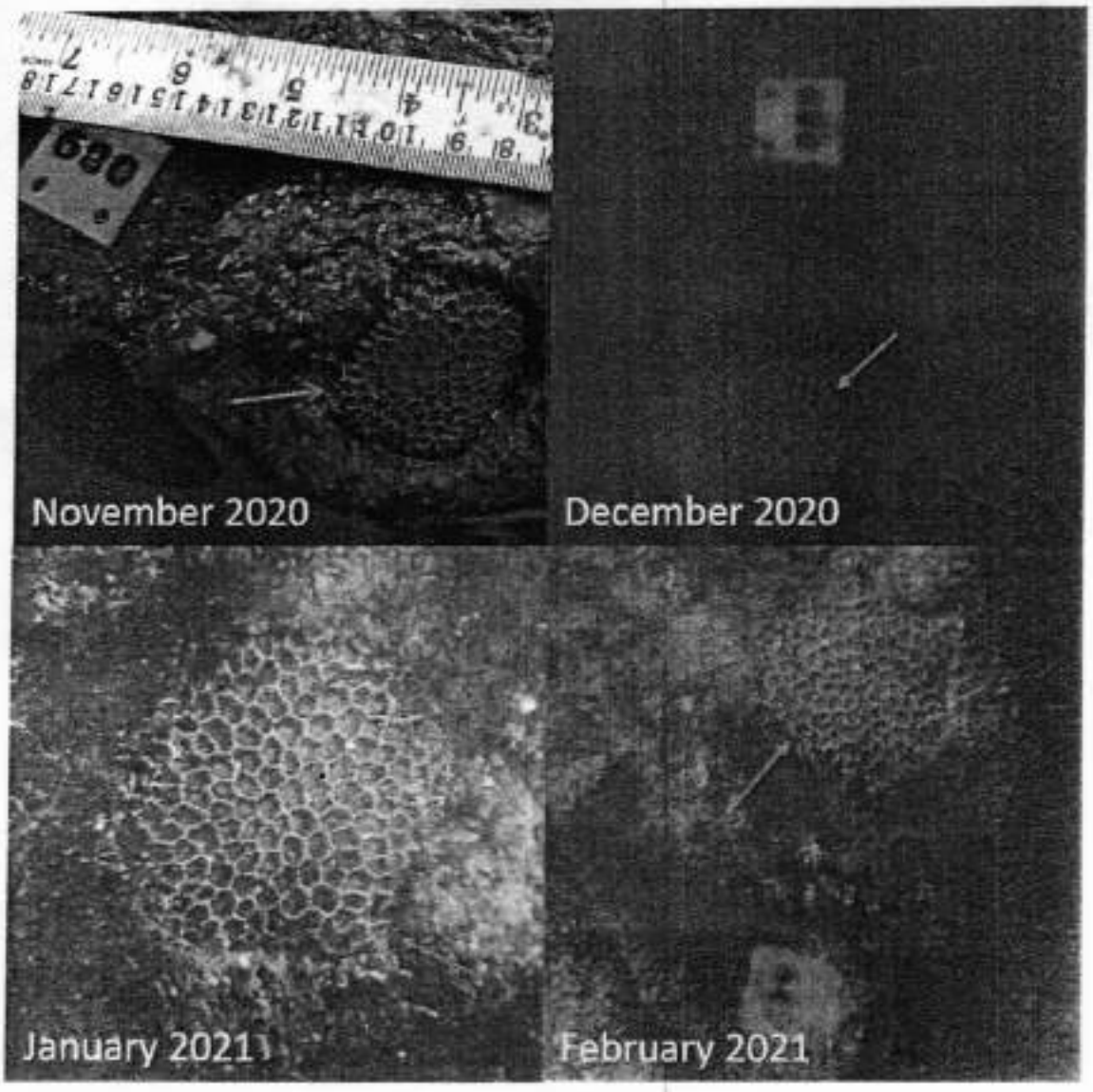


Plate 1. Monthly observation of translocated corals P. tayami (Tag no. 089) at recipient sites.

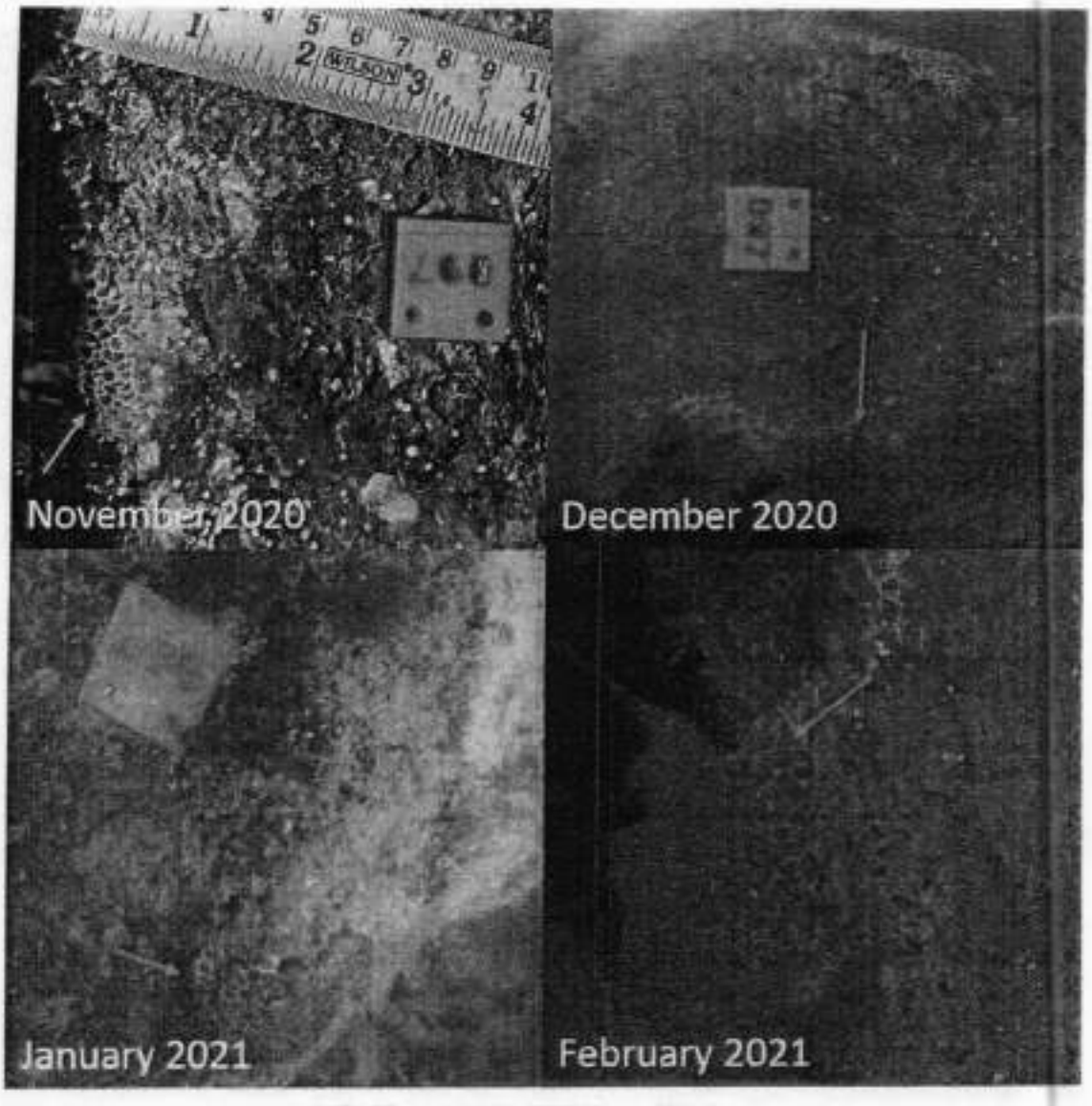


Plate 2. Monthly observation of translocated corals P. tayami (Tag no. 097) at recipient sites.

Plate 3. Monthly observation of translocated corals P. tayami (Tag no. 098) at recipient sites.

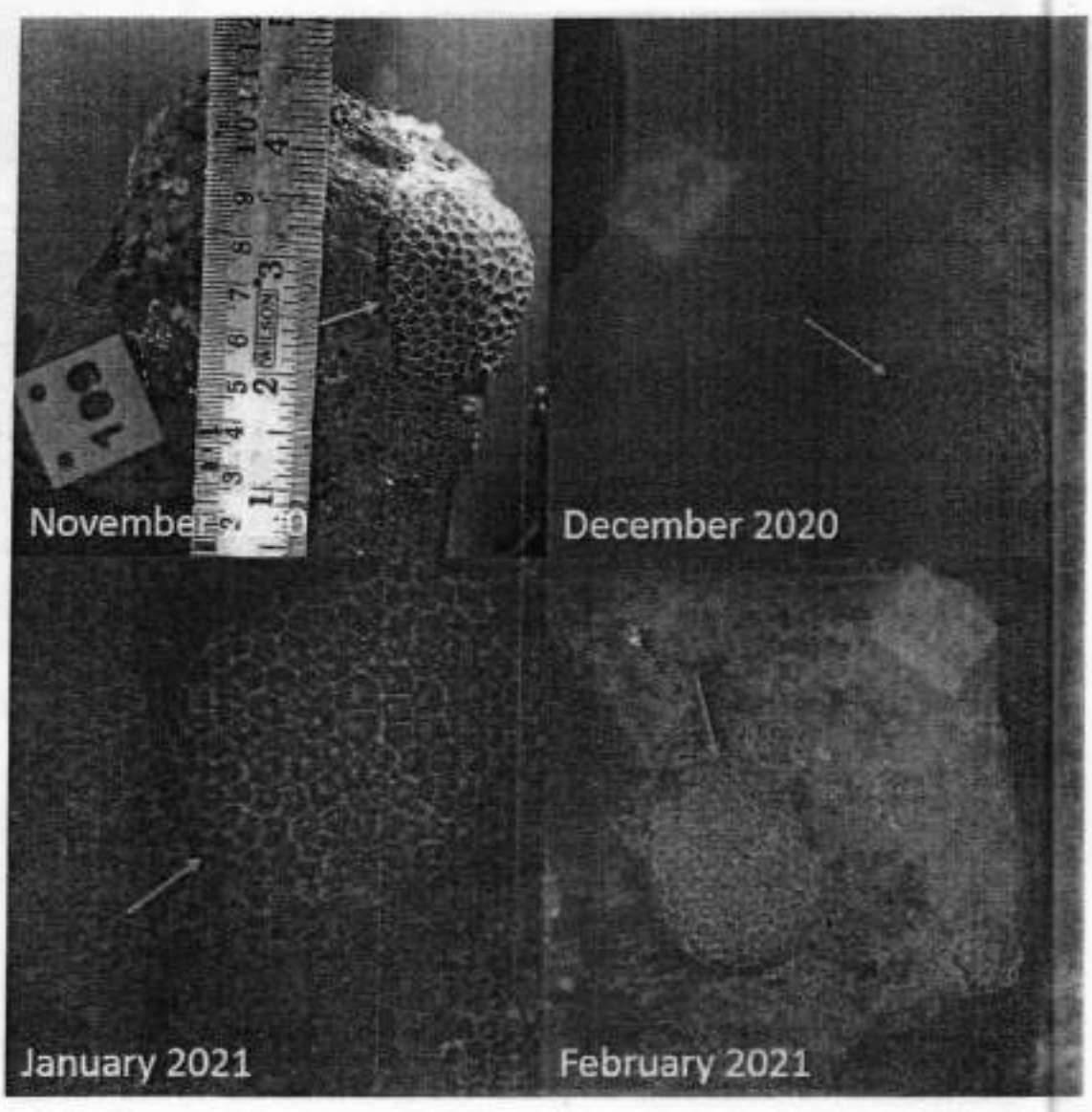


Plate 4. Monthly observation of translocated corals P. tayami (Tag no. 109) at recipient sites.

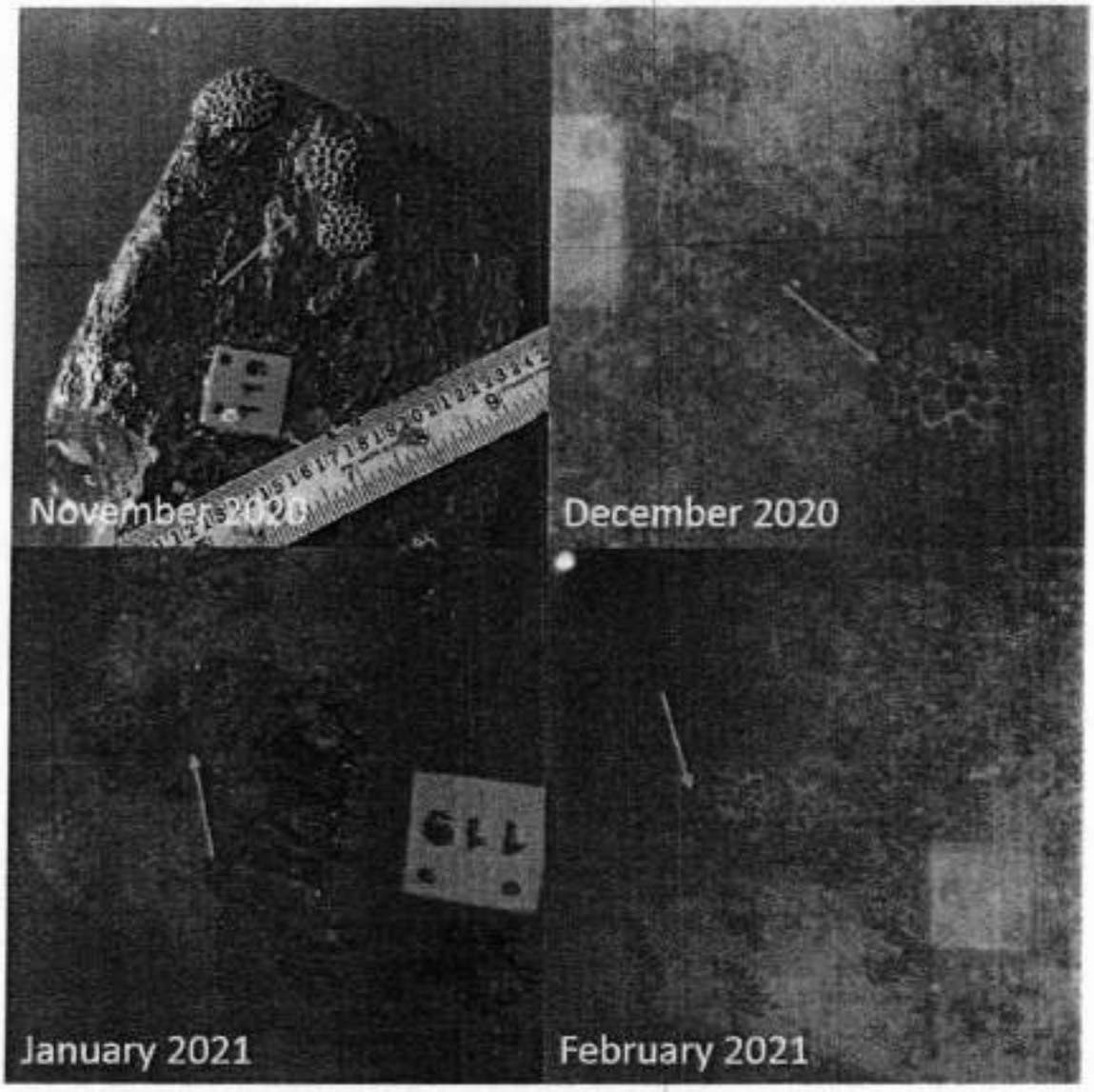


Plate 5. Monthly observation of translocated corals P. tayami (Tag no. 119) at recipient sites.

Meiofauna Plates

Worli

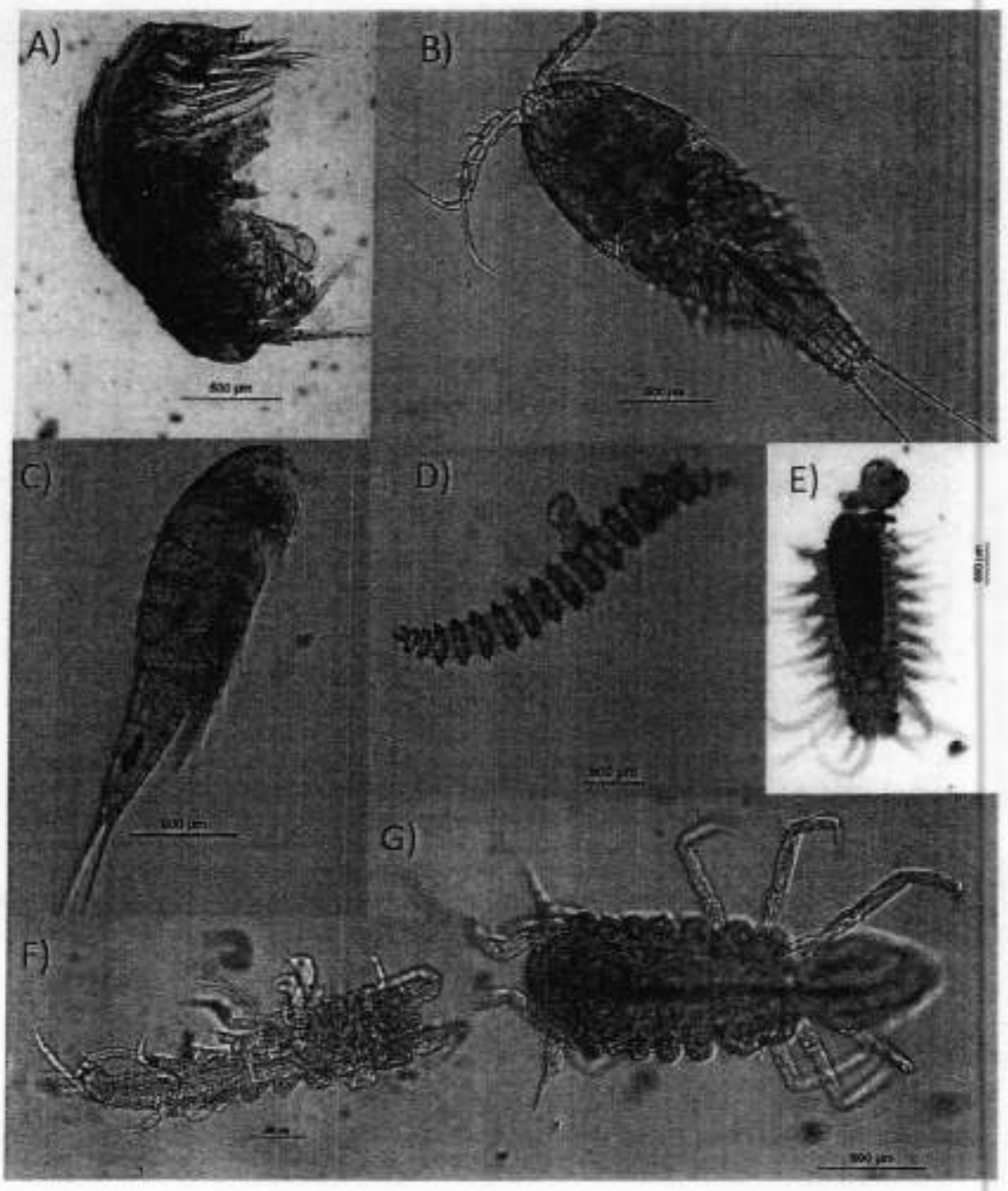


Plate 6. (A) Amphipoda; (B, C) Copepoda; (C) Nematoda; (E) Polychaeta; (F) Tanaidaceae; (G) Isopoda.

Navy Nagar

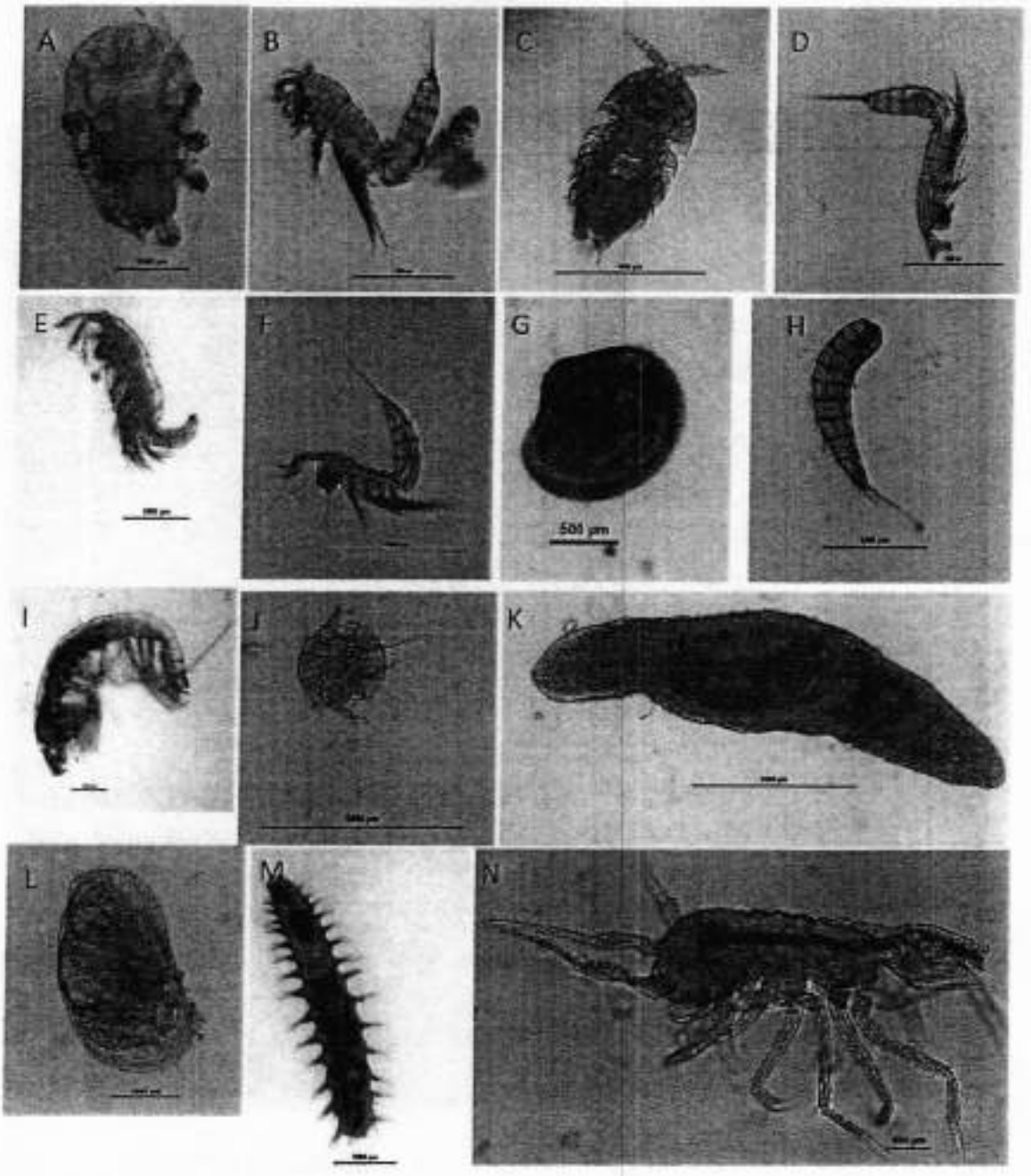


Plate 7. (A) Mite; (B-F) Copepoda; (G) Bivalvia; (H) Kinorhyncha; (I) Amphipoda; (J) Nauplii; (K) Turbellaria; (L) Ostracoda; (M) Polychaeta; (N) Isopoda.

Macrofauna Plates

Worli

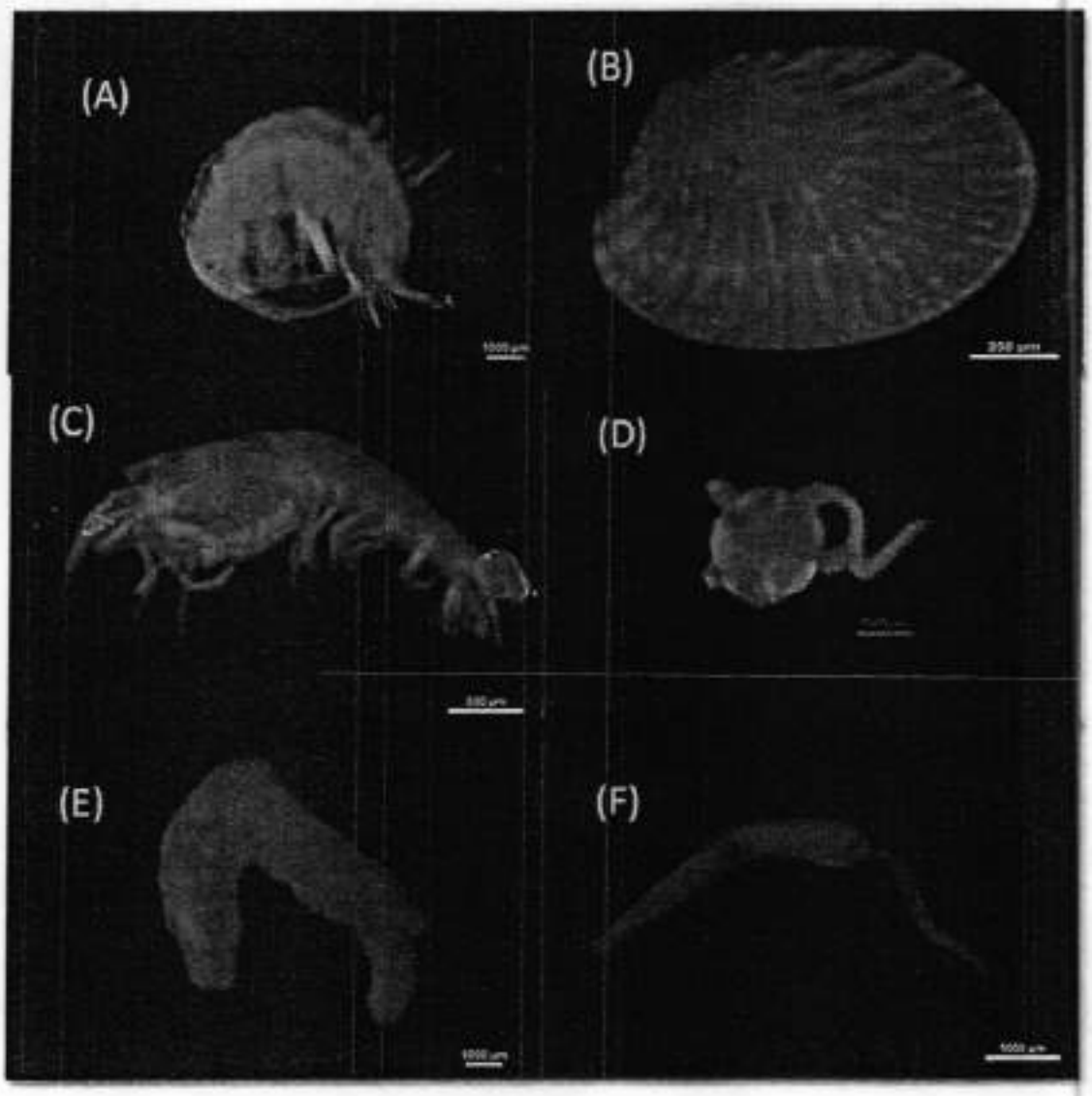


Plate 8. (A) Amphipoda; (B)Bivalvia; (C) Alpheidae; (D) Ophiuroidea; (E) Sponge; (F) Sipuncula.

Worli

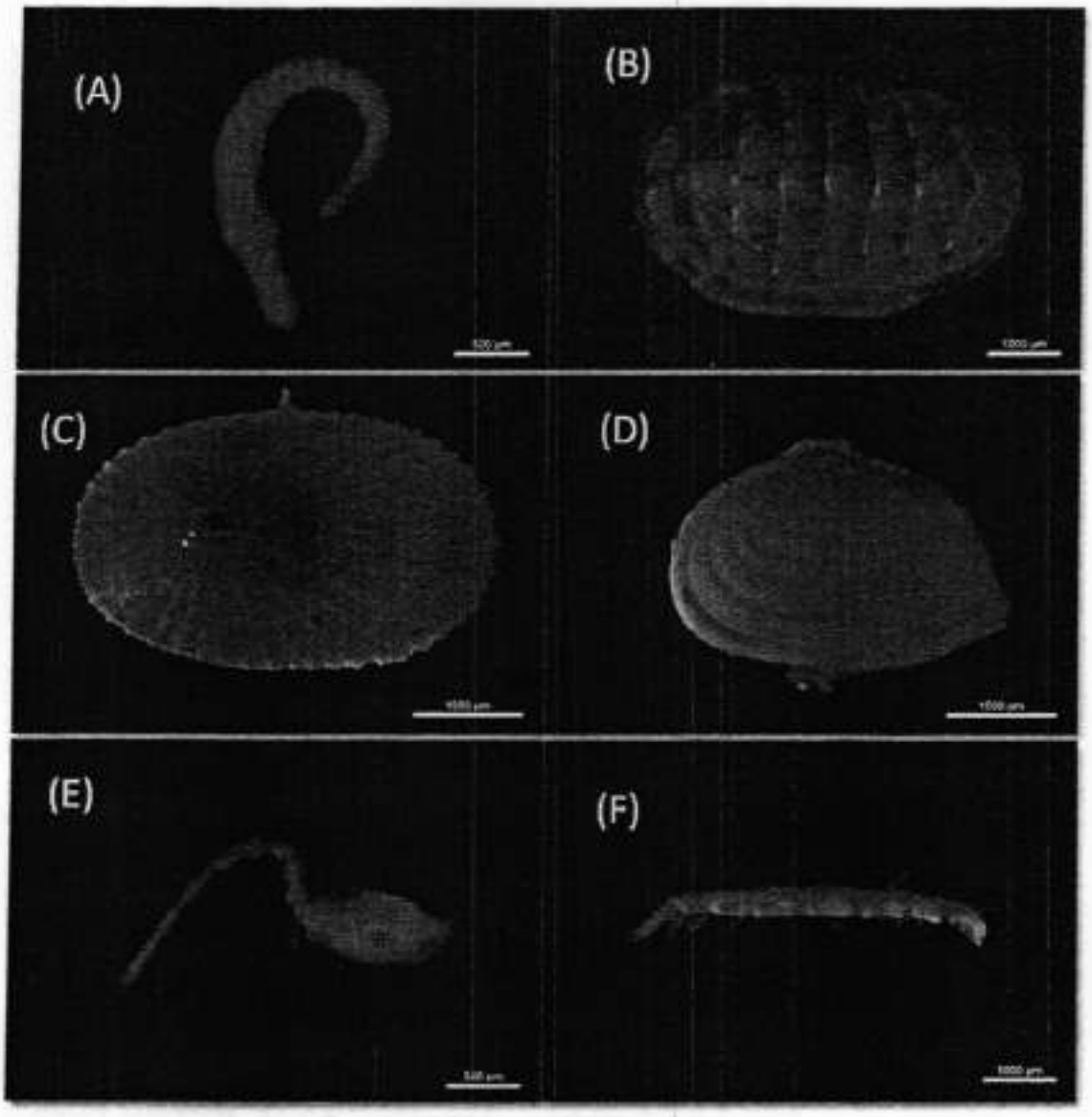


Plate 9. (A) Nemertea; (B)Chiton; (C) Limpet; (D) Bivalvia; (E) Cumacea; (F) Isopoda.

Worli

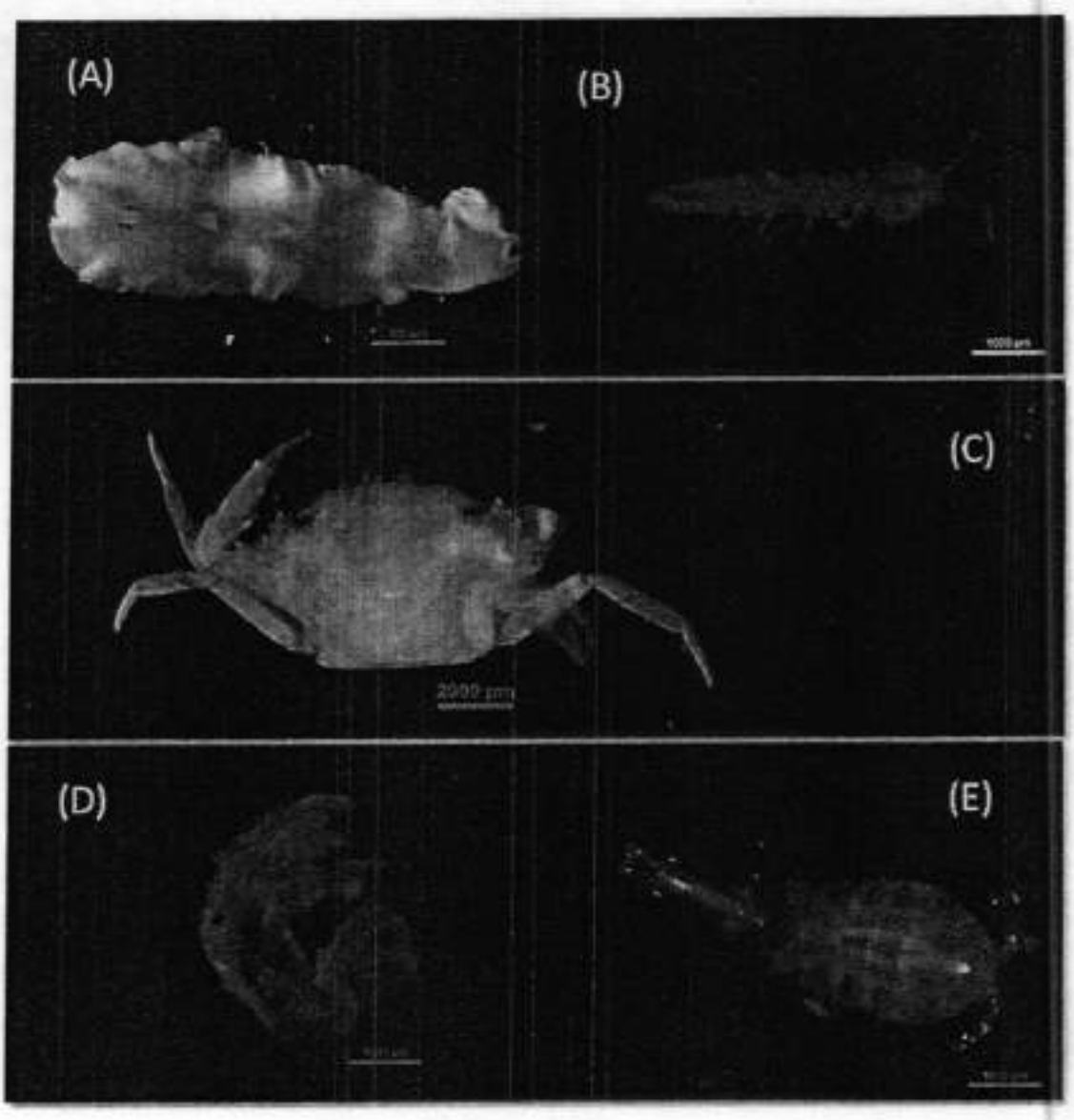


Plate 10. (A) Turbellaria; (B) Tanaidaceae; (C) Brachyura; (D) Anomura; (E) Copepoda.

Worli

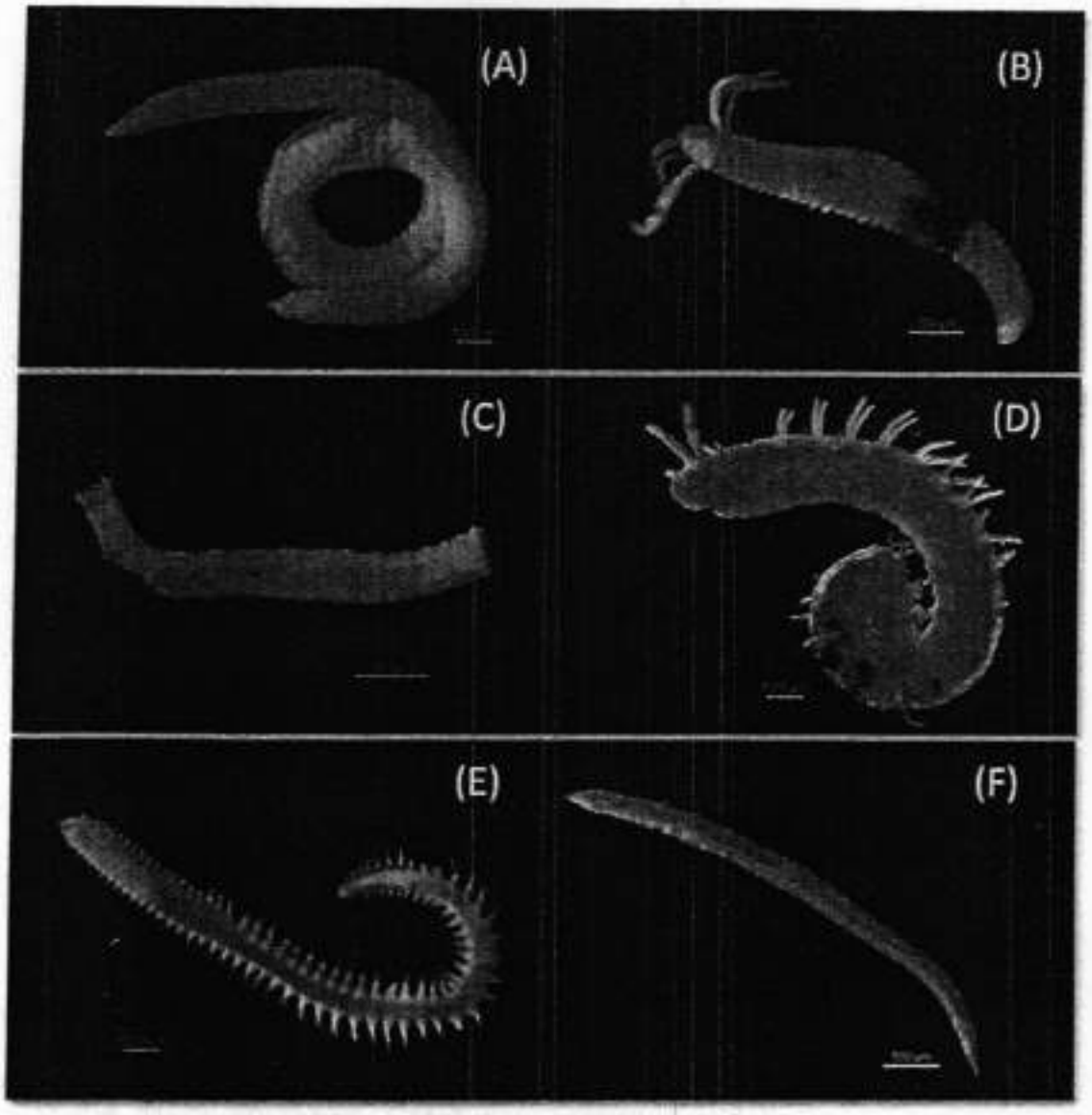


Plate 11. Polychaeta families. (A, B) Cirratulidae; (C) Maldanidae; (D) Eunicidae; (E) Nephtyidae; (F) Opheliidae.

Worli

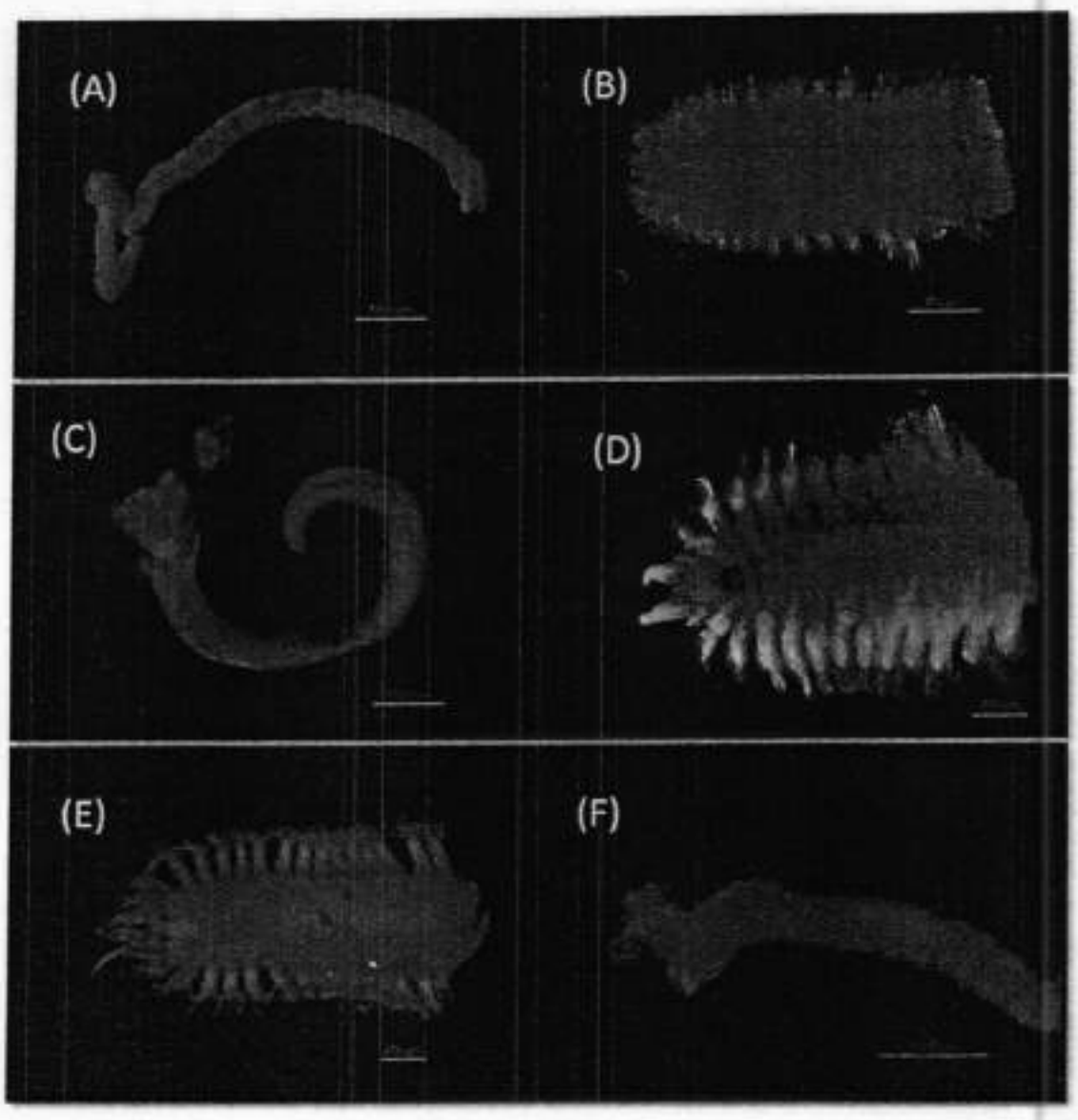


Plate 12. Polychaeta families. (A) Capitellidae; (B) Chrysopetalidae; (C) Serpulidae; (D) Polynoidae; (E) Sigalionidae; (F) Terebellidae.

Worli

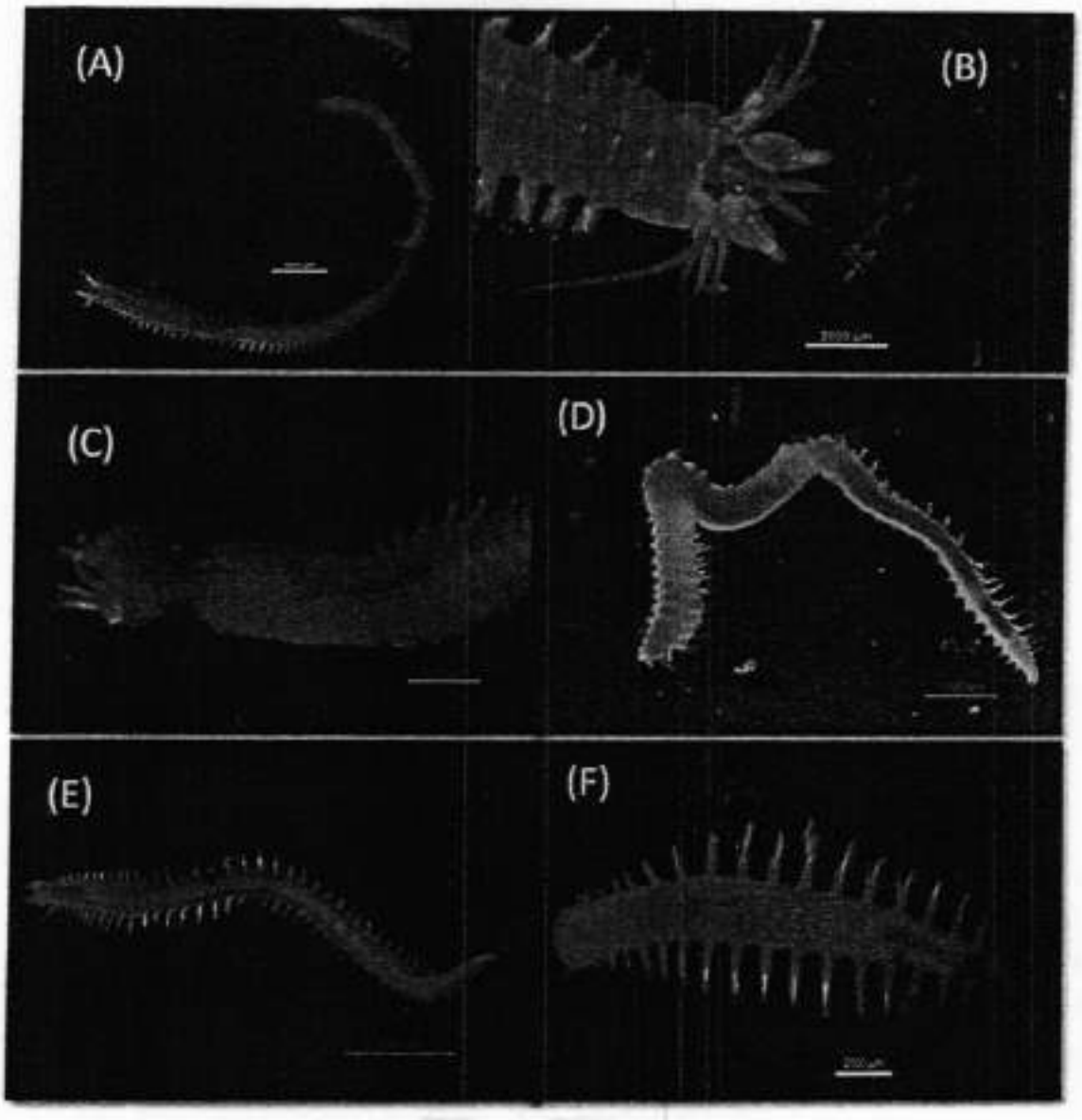


Plate 13. Polychaeta families. (A, B) Nereidae; (C) Pectinariidae; (D) Spionidae; (E) Syllidae; (F) Phyllodocidae.

Navy nagar (TP-1)

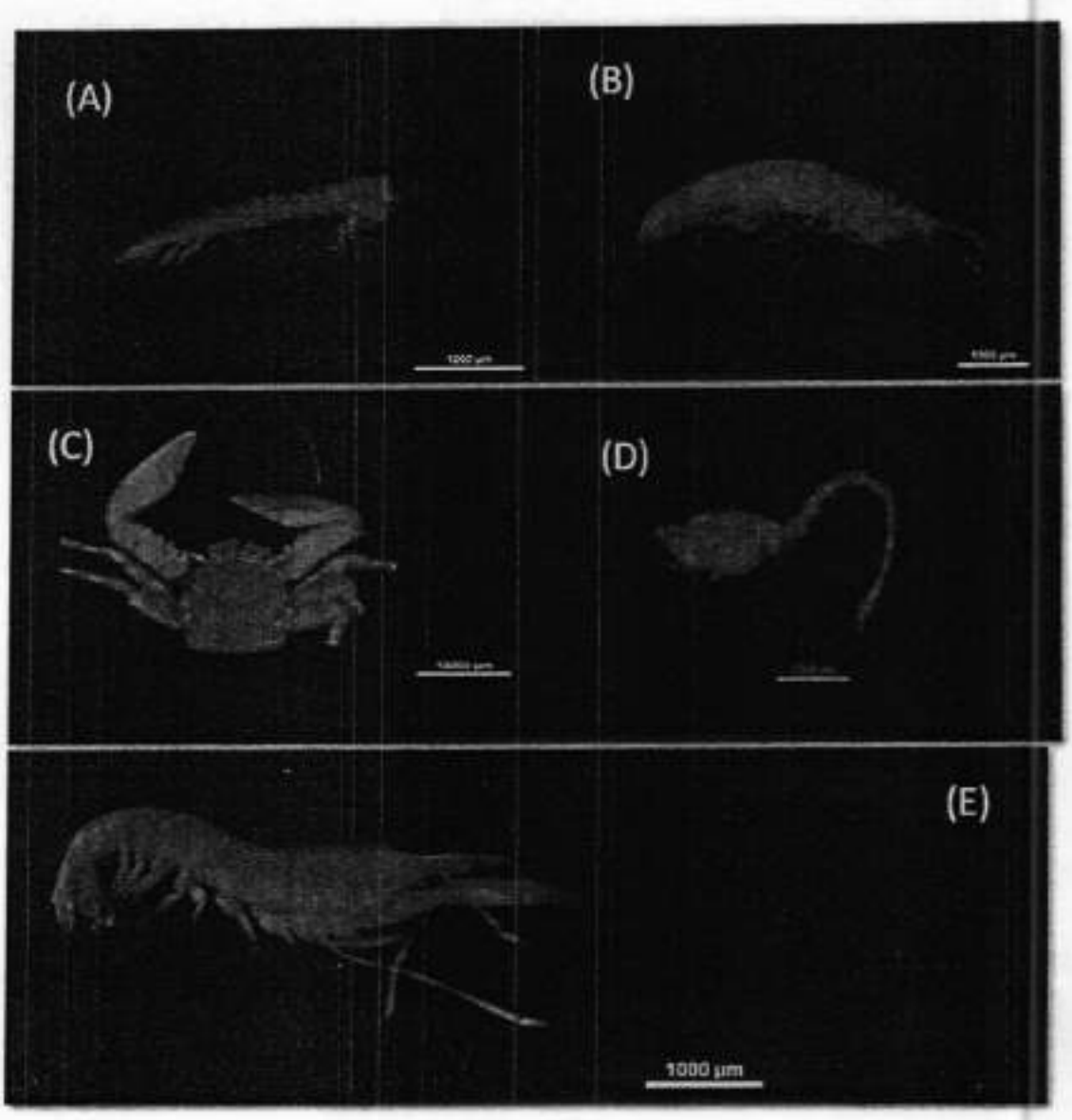


Plate 14. (A) Amphipoda; (B) Isopoda, (C) Brachyura; (D) Cumacea; (E) Alpheidae.

Navy nagar (TP-1)

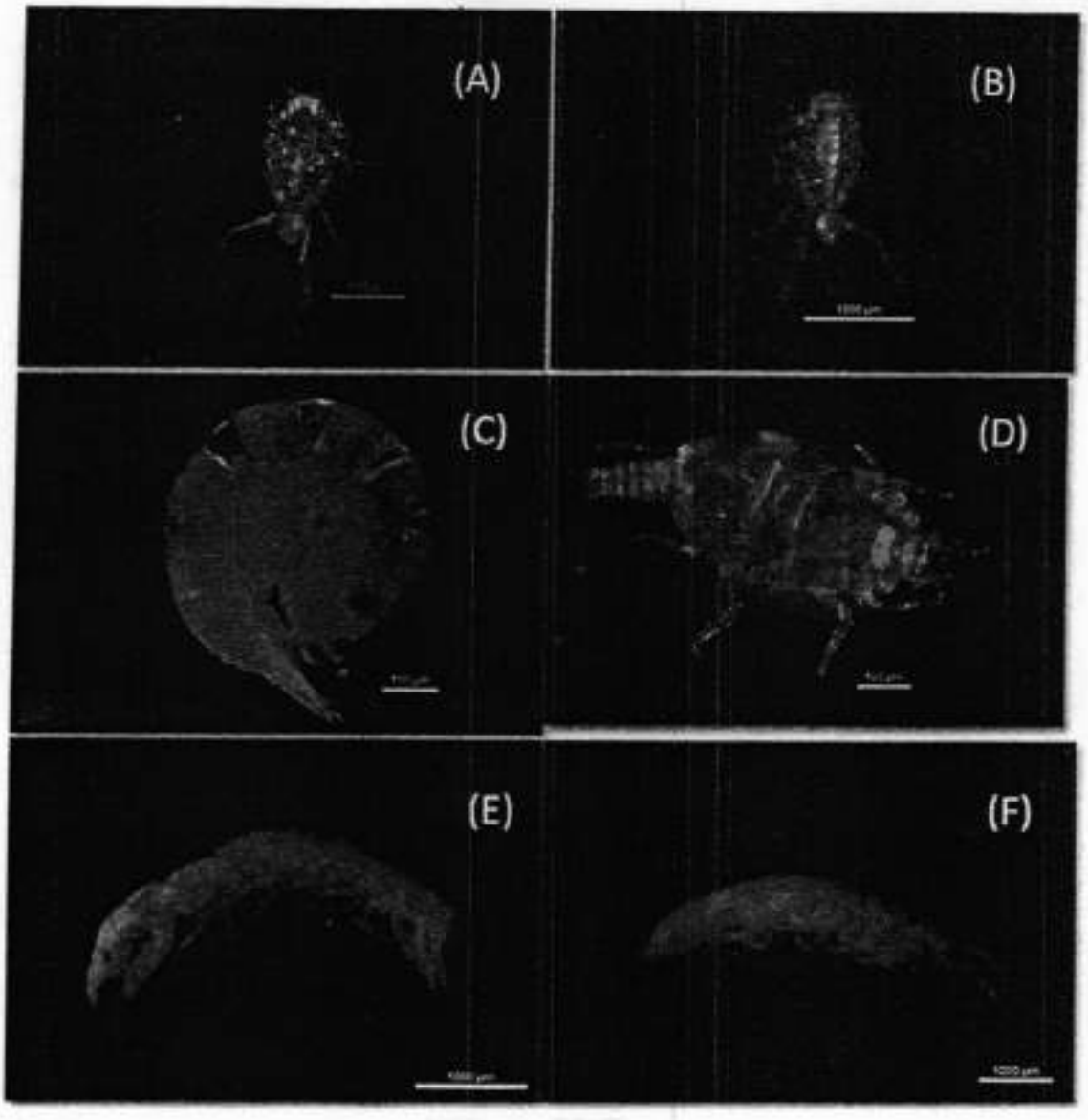


Plate 15. Types of Isopoda observed during present study (Nov2020 - Feb2020).

Navy nagar (TP-1)

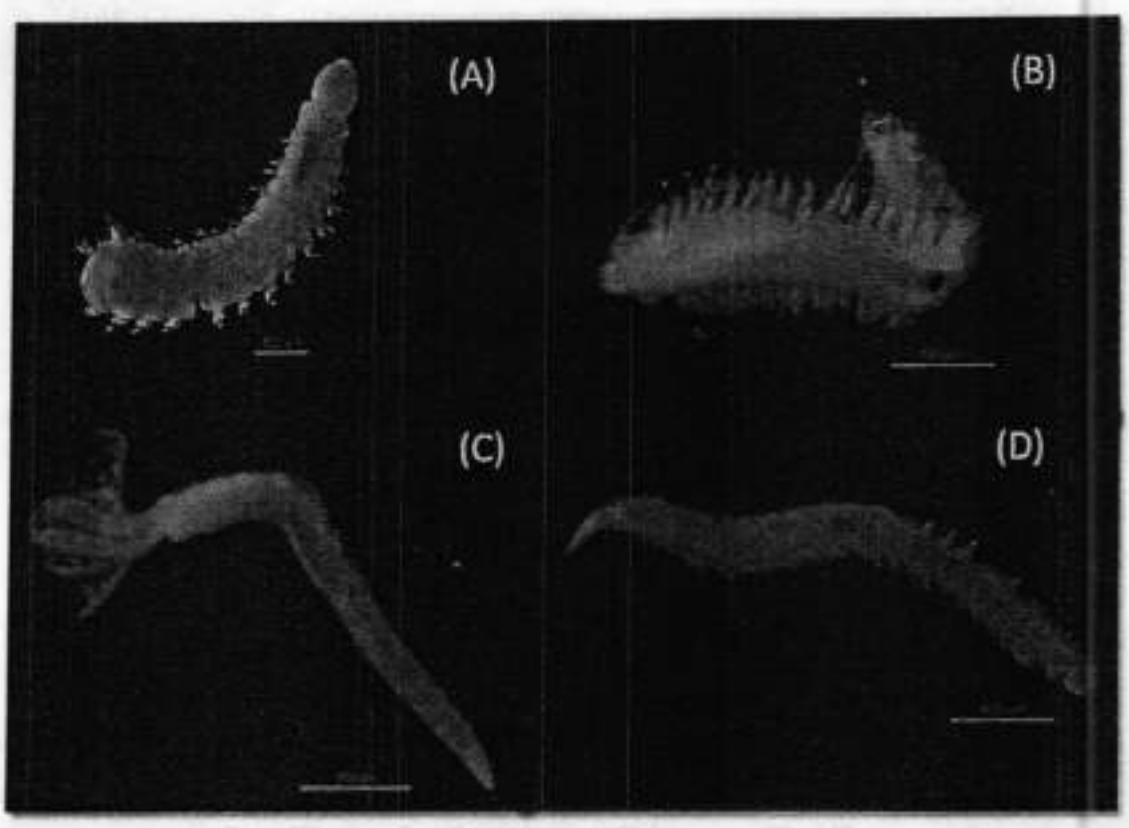


Plate 16. Polychaeta families. (A) Arabellidae; (B) Dorvilleidae; (C) Sabellidae; (D) Glyceridae.

C-341

Navy nagar (TP-1)

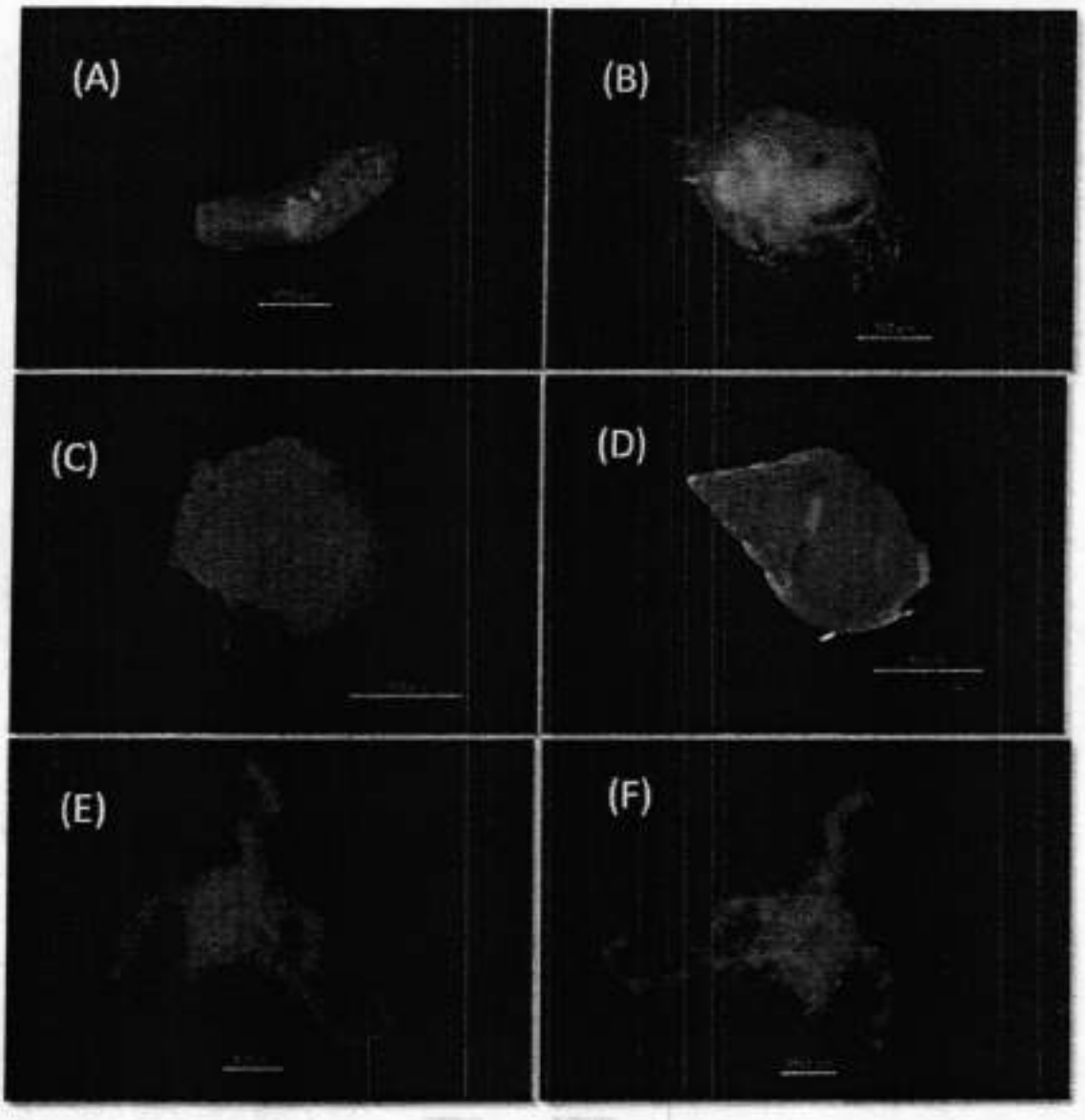


Plate 17. (A) Sea anemone; (B) Ostracoda; (C) Veliger larva; (D) Gastropoda; (E, F) Ophiuroidae.

Navy nagar (TP-2)

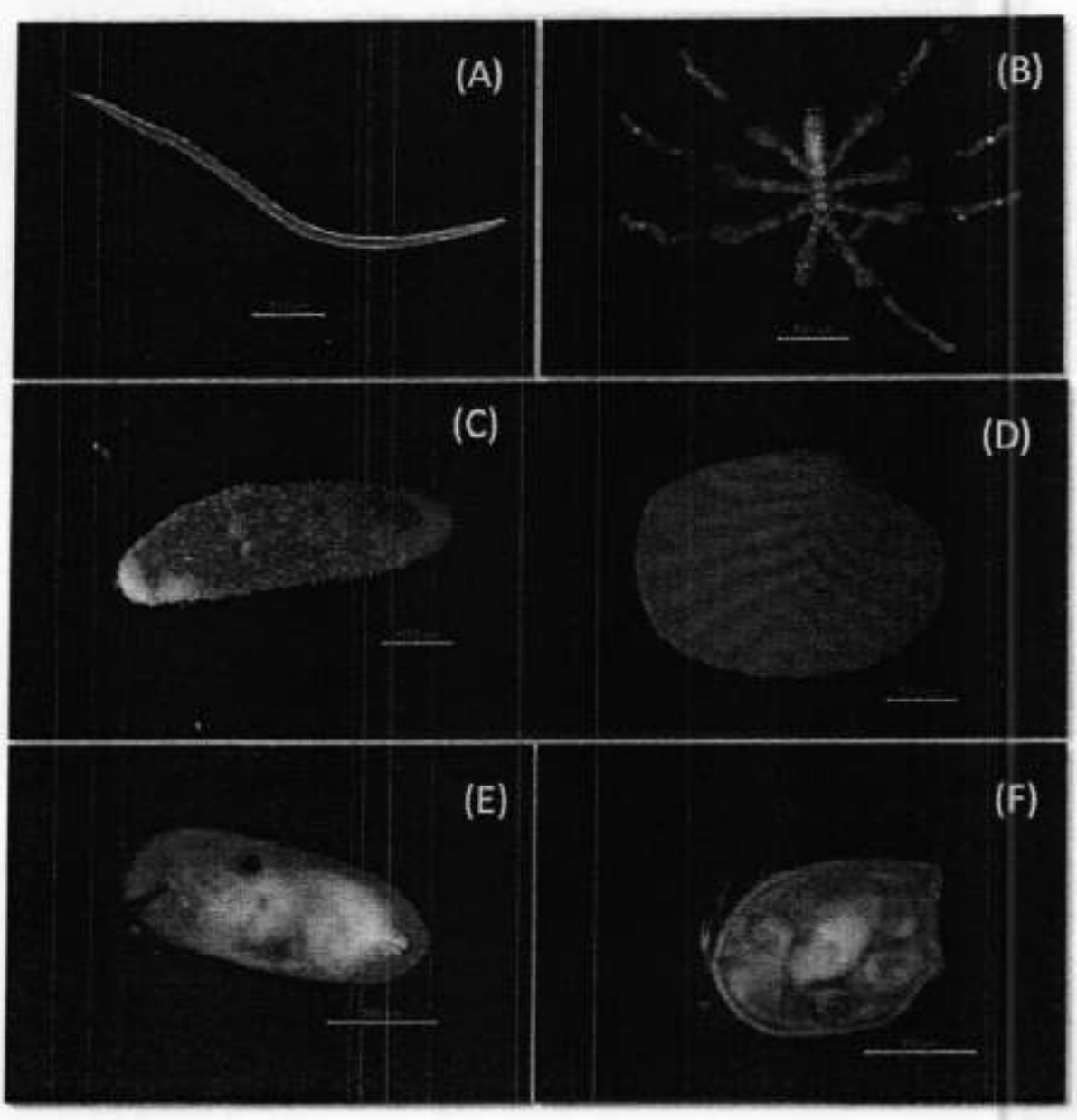


Plate 18. (A) Nematoda; (B) Pycnogonida; (C) Holothuroidea; (D) Bivalvia; (E,F) Ostracoda.

Navy nagar (TP-2)

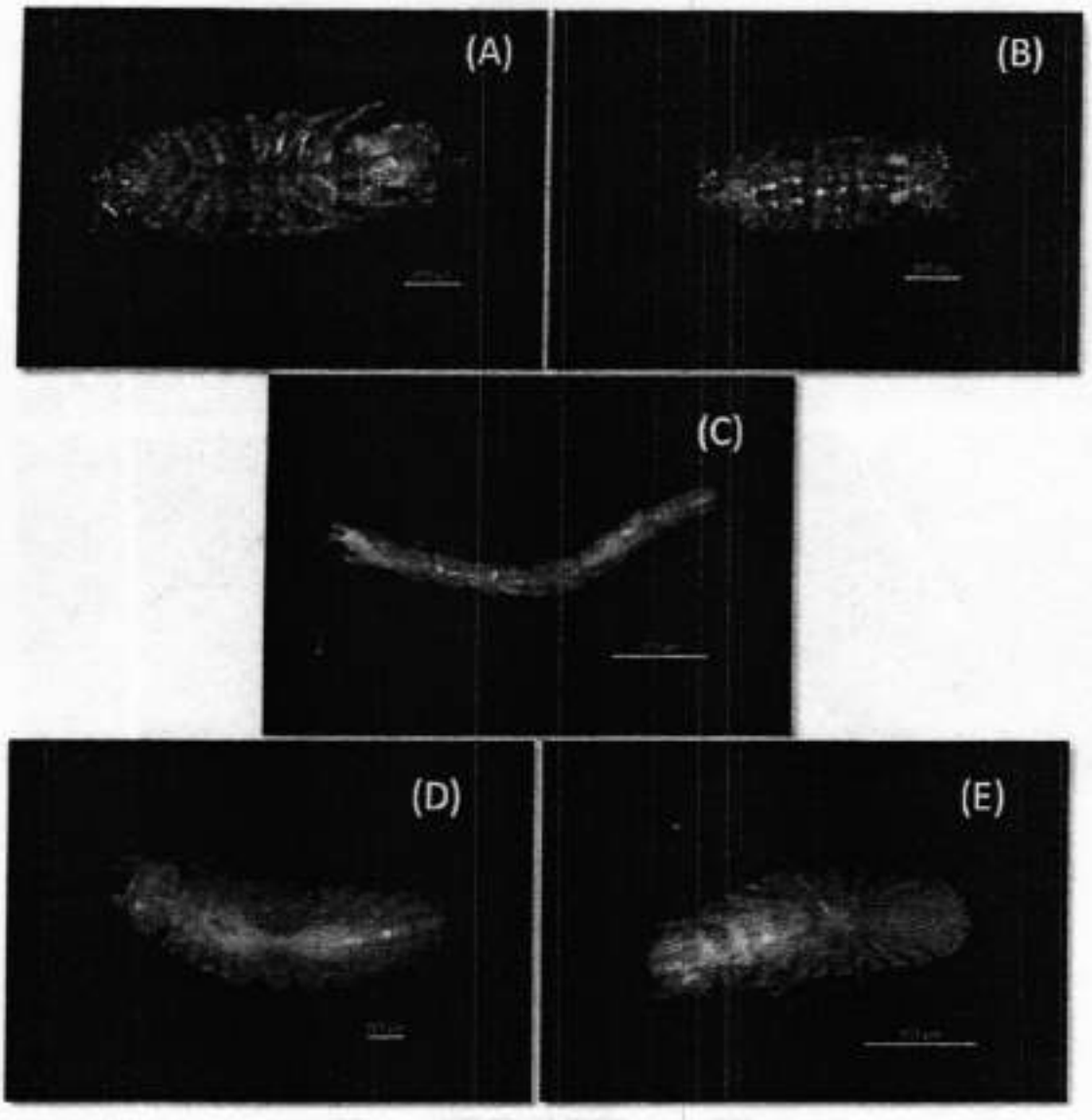


Plate 19. Types of Isopoda observed during present study at TP-2 (Nov2020 - Feb2020).

Navy nagar (TP-2)

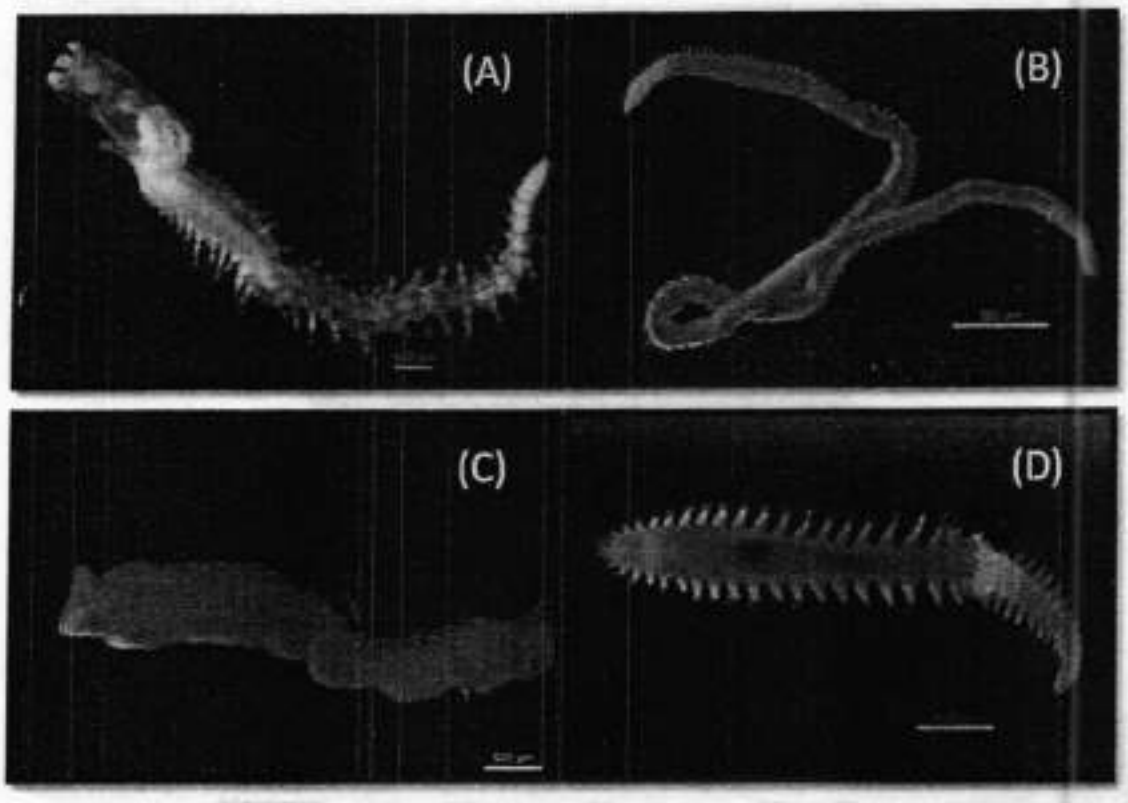


Plate 20. Polychaeta families. (A) Glyceridae; (B) Orbiinidae; (C) Chaetopteridae; (D) Nephtyidae.

C-377

DISTRIBUTION RESTRICTED

Investigations on impact of Phase 1 Coastal Road project on waves, water levels, and seawater quality

Sponsored by

Municipal Corporation Greater Mumbai (MCGM)
Mumbai

Interim Report - 3

February 2021

सीएसआईआर – राष्ट्रीयसमुद्रविज्ञानसंस्थान
CSIR-NATIONAL INSTITUTE OF OCEANOGRAPHY
(वैज्ञानिकतथाऔद्योगिकअनुसंधानपरिषद)
(COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH)
दोनापावला, गोवाभारत / DONA PAULA, GOA - 403004 India
फ़ोन/Tel : 91(0)832-2450450/ 2450327
फैक्स /Fax: 91(0)832-2450602
इ-मेल/e-mail : ocean@nio.org
http:// www.nio.org

C-379

CONTENTS

PROJECT TEAM

Dr. Jaya Kumar Seelam	Project Leader (HQ)
Dr. Soniya Sukumaran	Project Leader (RC Mumbai)
Dr. C. Mohandass	Scientist-in-Charge (RC Mumbai)
Dr. R. Mani Murali	
Dr. Haridevi C. K.	
Dr. Umesh Pradhan	
Dr. P.S. Rakesh	
Dr. Abhay Fulke	
Dr. Sabyasachi Sautya	
Mr. Jai Singh	
Mr. Narayan Satelkar	
Mr. Satej Pawar	
Ms. Jisna M. J.	
Ms. Hurmine Ridha	
Mr. Vivek M. A.	
Ms. Aparna M. T.	
Mr. Saurabh Lonkar	
Mr. Balaram Sahu	
Ms. Deepika Jagadale	
Mr. Vinayak Yerudkar	

LIST OF TABLES

LIST OF FIGURES

1. STUDIES CONDUCTED

Measurements of waves, currents and tides are planned to be carried out by deploying integrated coastal met-ocean buoys that can measure wave parameters, current parameters along with coastal winds. Two coastal met-ocean buoys were procured, tested and are ready for deployment. The nationwide lockdown and further southwest monsoon of 2020 hampered deployment. The deployment of these buoys were planned in October 2020 after withdrawal of monsoon and availability of boats for deployment is restored. However, due to unforeseen situation in procuring boat services, the deployment was delayed till January 2021. A tender for the deployment services is ready to be floated on 10th February 2021 (Tender Reference Number: NIO/Boat Hire/OED/Mumbai/2021; Tender ID: 2021_CSIR_69791_1 dt. 10/2/2021) and the deployment is likely to be done before end of March 2021.

This report includes the results on the water quality studies carried out in the nearshore waters of Mumbai extending from Rajiv Gandhi Sea Link in the north to Nariman Point in the south. About thirteen locations positioned in a grid like manner covering the coastal waters at different distances (1km, 3km, and 8km) from the area of development were sampled. The field observations were made from 05.03.2020 to 08.03.2020 and the results are presented. Apart from the water quality studies, shoreline changes from satellite imageries over the period of 2019-2021 is included.

1.1 Sampling locations

A total of 13 subtidal stations were selected for the assessment of marine environment of the western Mumbai coast as illustrated in Figure 1.1.1. The total area covered by these sampling stations works out to be ~ 80 km^2. The geographical positions of the sampling stations, sampling depths and their distance from the coastline are given in the Table 1.1.1.

Table 1.1.1: Geographical co-ordinates of sampled locations in the coastal waters off Mumbai with sampling depth and distance from the coastline.

Station Code	Latitude	Longitude	Station Depth(m)	Distance from coastline (km)
1	19°0'56.72"N	72°48'23.14"E	9.0	1.0
2	18°59'9.21"N	72°47'55.79"E	5.5	
3	18°57'16.52"N	72°47'17.21"E	9.0	
4	18°56'25.73"N	72°48'11.91"E	9.0	
5	18°55'34.92"N	72°47'49.36"E	6.0	
6	19°01'7.45"N	72°47'0.07"E	12.0	3.0
7	18°59'17.14"N	72°46'48.20"E	11.0	
8	18°57'27.28"N	72°45'58.35"E	12.0	
9	18°55'38.61"N	72°46'1.80"E	15.0	
10	19° 1'30.10"N	72°44'10.09"E	14.0	8.0
11	18°59'34.92"N	72°43'56.93"E	18.0	
12	18°57'44.34"N	72°43'1.72"E	19.0	
13	18°55'35.94"N	72°43'11.67"E	16.0	

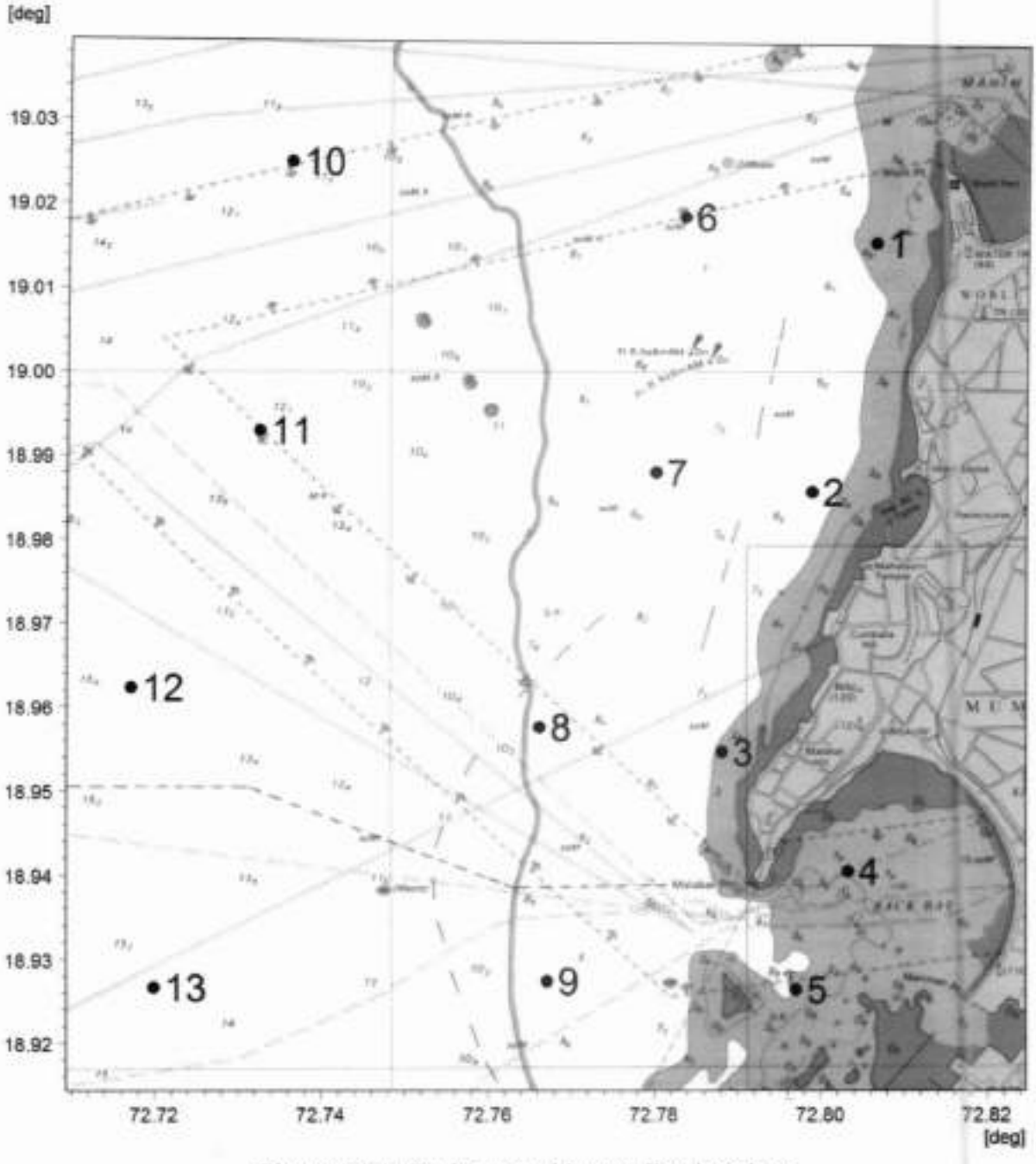


Figure 1.1.1: Study area with sampling locations

1.2 Sampling frequency

Water samples were collected during high tide (HT) and low tide (LT) at stations within 1 km distance from coastline (herein after referred as 1 km zone) in order to check the variability in water quality parameters with respect to tidal conditions. The stations at 3 km and 8 km distance from coastline were sampled twice and the average values of water quality parameters measured at these locations were reported. Water, sediment and selected biological characteristics were assessed at all stations. Subtidal sediments were collected in quadruplicate at each station.

1.3 Water quality parameters

1.3.1 Sampling procedure

Surface and bottom water samples were collected using Niskin samplers for chemical analyses. Water samples at 1 m below the surface were also collected for the estimation of PHc.

1.3.2 Methods of analyses

Majority of the water quality parameters were analysed within 24 h of collection in the laboratory of CSIR-NIO, RC Mumbai. Concentrations of dissolved inorganic nutrients were determined by colorimetric method using a UV-visible spectrophotometer (Model:Shimadzu 1240). The concentrations of petroleum hydrocarbon (PHc) in water and sediment were determined by solvent extraction technique, thereafter measured in a Spectrofluorophotometer (Model: Shimadzu RF-5301 PC).

i) Temperature: Temperature was measured immediately after sample collection using the centigrade mercury thermometer with a graduation of 0–50 °C (Precision ±0.05).

ii) pH: pH of water sample was measured onboard using a portable pH meter (Eutech Tutor) with an accuracy of 0.1 pH units. The instrument was first calibrated with standard pH buffers of pH 7.0 and pH 9.0 and then the measurements were made.

iii) Salinity: Salinity was measured using AUTOSAL salinometer. The instrument was standardized with IAPSO standard sea water (OSIL, UK).

iv) Total Suspended Solids (TSS): Total Suspended solids of a known volume of water sample were measured by filtration using filtration pump (Aspirator Vacuum) (Preston and Summers, 1997). Seawater samples were filtered through pre-weighed membrane filter papers (diameter47 mm; nominal pore size, 0.45 µm; Make: Millipore) using Vacuum Pump(Make: Millipore). The filter papers were then dried (45°C) and weighed again. TSS was calculated from the difference of initial and final weights of the filter paper and expressed as mg/l.

(v) Turbidity: Turbidity was determined by nephalometric method using a turbidity meter (Model: Orion AQ4500; Make: Thermo Scientific). The instrument was calibrated with known standards before taking the sample readings.

(vi) Chloride (Cl^-): Chloride content was measured using an AUTOSAL salinometer (Make: GUILDLINE Instruments Ltd., Canada). The instrument was calibrated with standard seawater obtained from International Association for the Physical Sciences of the Oceans (IAPSO; Make: OSIL, UK).

vii) Dissolved Oxygen (DO) and Biochemical Oxygen demand (BOD): DO concentration in seawater was estimated by Winkler's method. A known volume of seawater sample was first fixed onboard by adding the Winkler's reagents A (manganous chloride) and B(alkaline

potassium iodide) immediately after collection. The precipitate so formed was then decomposed with 50% Hydrochloric Acid (HCl) and the released iodine was titrated against $Na_2S_2O_3$. End point of titration was determined using starch indicator. Concentrations of DO are expressed in mg/l. Samples for the determination of Biochemical Oxygen Demand (BOD_3) were collected in triplicate. The DO concentration was determined first using one of the triplicate samples according to the Winkler's method. The remaining bottles were incubated in BOD incubator for 3 days at 27 °C. DO concentration in these samples were determined by Winkler's method after fixing the samples immediately on completion of 3 days incubation period. The difference in the DO concentrations on the 1st and 3rd day yielded the measure of BOD_3 and expressed in mg/l. BOD of the samples having DO <0.3 mg/l was analysed by seeded method.

viii) Phosphate-Phosphorous (PO_4^{3-}-P): Dissolved reactive phosphate was measured by the method of Murphy & Riley (1962), modified by Grasshoff et al., 1999, in which the samples were made to react with acidified molybdate reagent and reduced using ascorbic acid. The absorbance of the resultant blue complex was measured at 882 nm using Shimadzu UV mini 1240 spectrophotometer. The instrument performance was evaluated using international seawater standard for nutrient (OSIL, UK)

ix) Nitrite-Nitrogen (NO_2^--N): Nitrite was determined by the method of Grasshoff et al., 1999wherein the nitrite in the samples was measured after diazotizing it with sulfanilamide and coupling with N (1-Naphthy)-ethylene diamine dihydrochloride. The absorbance of the resultant azo dye was measured at 543 nm using a Shimadzu UV mini 1240 spectrophotometer.

x) Nitrate-Nitrogen (NO_3^--N): Nitrate in the samples was first reduced to nitrite by passing each through an amalgamated cadmium reduction column and the resultant nitrite was determined as above. The measured absorbance was due to the initial nitrite in the sample and the nitrite obtained after the reduction of nitrate. Necessary correction was therefore made for any nitrite initially present in the sample.

xi) Ammonia-Nitrogen (NH_4^+-N): Ammonia-nitrogen was determined by the Indophenol blue method based on the principle that in a moderately alkaline medium, ammonia was allowed to react with hypochlorite in the presence of catalytic amounts of nitroprusside to form indophenol blue. The formation of monochloramine requires a pH between 8 and 11.5. The resultant blue complex was measured at 630 nm by spectrophotometer.

xii) Sulphate (SO_4^{2-}): Sulphate was analyzed using gravimetric method by precipitating with barium chloride as described in Grasshoff,1983.

xiii) Petroleum Hydrocarbons (PHc): Dissolved petroleum hydrocarbons (PHc) were extracted from seawater with n-hexane and quantified by using Shimadzu RF-5301PC spectrofluorophotometer with excitation at 310 nm and emission at 360 nm (Ehrhardt, M.

1983). Reference material used for quantifying hydrocarbons was the Saudi Arabia mixed (SAM) crude oil.

1.4 Sediment quality parameters

1.4.1 Sampling procedure

Subtidal surfacial bed sediment from all locations was collected by a van Veen grab of 0.04 m^2 area in quadruplicate. The sample after retrieval was transferred to a polyethylene bag and preserved for further analysis.

1.4.2 Methods of analyses

i) Texture: Dried sediment (25 g) mixed with deionised water and 10 ml sodium hexametaphosphate (6.2 g/l) was sieved through 63 µm sieve to retain sand and the passed material was dispersed in deionised water (1 l). The fractions (20 ml) collected at 20 and 10 cm depths immediately and after 2 h 30 min were considered as silt and clay, respectively. Collected sediment fractions were dried separately and weighed. Different fractions of sediment are expressed as percentage (%).

ii) Metals: Sediment was brought into solution by treatment with conc. HF-$HClO_4$-HNO_3-HCl and the metals were estimated on an ICP-OES (PerkinElmer). Mercury was estimated by flameless AAS technique (FIMS-400, PerkinElmer) after digesting the sediment with aquaregia. Accuracy of methods was ascertained by simultaneous analysis of PACS-2 and BCSS-2, certified reference material (CRM, NRC-Canada) for trace metals and mercury in sediment.

iii) PHc: Sediment after refluxing with KOH-methanol mixture was extracted with hexane. After removal of excess hexane, the residue was subjected to clean-up procedure by silica gel column chromatography. The hydrocarbon content was then estimated by measuring the fluorescence as described under water quality analysis for PHc.

iv) C_{org}: Percentage (%) of C_{org} in the dry sediment was determined by oxidising organic matter in the sample by chromic acid and estimating excess chromic acid by titrating against ferrous ammonium sulphate with ferroin as an indicator.

v) Total Phosphorus: Digested samples for metal analysis were used for estimating total phosphorus in the sediment. The method used was similar to that described under water quality analysis for PO_4^{3-}-P.

1.5 Flora and fauna

1.5.1 Sampling procedure

For microbiological analyses, surface water samples were collected using the Niskin water sampler into sterilised PP bottles at each sampling location in the coastal waters of Mumbai. Small portions of the sediment samples obtained by van-Veen grab from all the sampling locations were aseptically transferred into fresh polythene bags with a sterile spatula before disturbing the sediment samples for other analyses. Immediately after

collections, both water and sediment samples were stored in ice in an insulated icebox. They were transported to an adequately clean room (microbiology laboratory) for microbiological analysis. Samples were stored in ice until they were processed for enumeration of various groups of bacteria.

Polyethylene bucket and Niskin sampler respectively, were used for sampling surface and near bottom waters for the estimation of phytoplankton pigments and population. Samples for enumeration of phytoplankton cell count were fixed in Lugol's iodine and a few drops of 3% buffered formaldehyde. Mesozooplankton samples were collected by oblique hauls using Heron Tranter net (mesh size 0.20 mm, mouth area 0.25 m^2) attached with a calibrated flow meter. All collections were of 5 min duration. Samples were preserved in 5% buffered formaldehyde. Sediment samples for subtidal macrobenthos were collected using a van Veen grab of 0.04 m^2 area. Samples were preserved in 5% buffered formaldehyde- Rose Bengal.

1.5.2 Methods of analyses

Microbiology

To detect the presence of faecal contamination in seawater certain microbial indicators such as Faecal indicator bacteria (FIBs) were used. These FIBs are part of normal intestinal flora. The two important bacteria that form the indicator system are *Escherichia coli* and faecal *Streptococci.* As detection of every pathogenic bacterium from water is a tedious and expensive task, detection of indicator bacteria offers a faster approach. Bacteriological analyses for present study included the enumeration of total viable counts (TVC), total coliforms (TC), faecal coliforms (FC), *Escherichia coli* like organisms (ECLO) and *Streptococcus faecalis* like Organism (SFLO).

a) Total Viable Counts (TVC)

Water Samples: 0.5 ml of the water sample was added to 4.5 ml of autoclaved sea water in order to get a dilution of 10^{-1}, after vigorous shaking by hand for 30 seconds, 0.1ml of the sample was spread plated on to full strength Zobell marine agar plates and incubated for 24-48hours.

Sediment Samples: 1 gm of the sediment sample was suspended in 99 ml of autoclaved seawater. The suspension was vortexed for two minutes. The sediment was then allowed to settle, and serial dilutions were carried out by serially transferring 0.5 ml of the sample to 4.5 ml autoclaved seawater, serial dilutions were carried out up to 10^{-3}. Then 0.1 ml of the sample was spread plated onto full strength Zobell marine agar and incubated for 24-48hours.

b) Indicator Bacterial Groups

Samples were analyzed by plating for Total Viable Counts(TVC), Tota Coliform (TC), *Escherichia coli* like organisms (ECLO), Faecal Coliform (FC), *Streptococcus faecalis* like Organism (SFLO). Colonies of TC,ECLO, FCLO and SFLO were counted separately. The media employed for growth of bacteria were as follows:

Sr. No.	Parameter	Growth medium (Agar)
1	Total Viable Count	Marine Agar
2	Total Coliform	Mac-Conkey's Agar
3	Fecal Coliforms	m-FC Agar
4	*Escherichia coli* like organisms (ECLO)	M7HRFC Agar
5	*Streptococcus faecalis* like organisms (SFLO)	M-Enterococcus Agar

ii) Phytoplankton pigments

Water samples for phytoplankton analysis were collected using Niskin water samplers (5 L capacity) from two depths (surface and near bottom). The samples were analysed for phytoplankton cell counts, composition and biomass (Chlorophyll *a* and Phaeophytin) as per the JGOFS Protocols (UNESCO, 1994).

***a)* Phytoplankton Biomass (Chlorophyll *a* and Phaeophytin):** For the estimation of the concentrations of chlorophyll *a* (Chl *a)* and phaeophytin (Phaeo), a known volume of water sample (500 ml) was filtered through Whatman GF/F Glass fibre filter paper (47 mm diameter; nominal pore size, 0.7 µm) and extracted in 90% acetone overnight at 5 °C. The extracts were used for the estimation of fluorescence before and after acidification using Turner Designs Fluorometer following Parsons *et al.* (1984). The fluorescence values were converted to chlorophyll *a* and phaeophytin using appropriate calibration factors.

***b)* Phytoplankton Abundance and Composition:** For phytoplankton cell counts, a known volume of water was transferred to a plastic bottle (500 ml) and preserved in Lugol's iodine and formalin. The fixed and preserved samples were transported to laboratory for identification and counting. The supernatant water was removed without disturbing sedimented particles and the final volume was made to 10 ml. One ml of this was counted using Sedgewick Rafter counting chamber, under inverted microscope. Total cells were counted and organisms were identified using standard manuals of diatoms, dinoflagellates and blue green algae. The counts are expressed as cells per litre basis for comparison. For taxonomic identification, a research microscope (Olympus, Japan, 400x) was used and the identification was carried out according to available literature (Subrahmanyam, 1946; UNESCO, 1978, Tomas et al., 1997).

iii) Zooplankton parameters

Zooplankton samples were collected from surface waters by horizontally towing a Heron-Tranter net (mesh size, 200 µm) attached with a calibrated digital flow meter (General Oceanics, USA) at the mouth to record the value of water. After the haul (5 minutes), the net was carefully washed with seawater and the samples were collected in a plastic bottle. The samples were then preserved in 4% buffered formalin prepared in seawater for further analysis in the laboratory. Zooplankton biomass was estimated by displacement volume method and expressed as ml/100m^3 (ICES, Zooplankton Methodology, 2000) and the concentrated samples were diluted to an aliquot of 6.25% using a Folson plankton splitter and

were then examined under the stereoscopic binocular microscope (Leica, Germany) for numerical counts and group identification.

iv) Macrobenthos

Sediment samples for macrofauna were washed through a 500 µm mesh sieve with copious amount of seawater. After sieving, the fauna (live animals) were carefully separated and together with residual sediment, if any, the samples were fixed in 5% buffered formalin solution with Rose Bengal stain. All samples were labelled and stored for further examination. In the laboratory, the sediments were washed again under tap water and the materials were preserved in 5% buffered formaldehyde containing Rose Bengal stain. For qualitative enumeration, each sample was examined under a binocular microscope. The organisms were separated into different taxonomic groups for further identification. All taxa were identified to their species level to the extent possible with the help of standard taxonomic references and available expertise. Macrofaunal abundance was expressed as ind./m^2. Macrofaunal biomass was determined by taking weight measurements on an electronic balance and was expressed as g/m^2 wet weight. From the grab, sub-samples for meiofauna were collected using an acrylic core (Ø = 2.5 cm; 10 cm long) for meiobenthic study. Sediment length of the core was measured. The samples from the core were *in toto* transferred to polythene containers, labelled and preserved in 5% neutral formalin mixed with Rose Bengal for further examination. In the laboratory, the meiobenthic sediments were passed through 300 µm and 63 µm sieves and organisms retained on finer mesh sieve were considered as meiofauna. All the meiobenthic organisms were counted and identified up to group level under a stereo-zoom microscope. The density counts of meiofauna were converted to ind./10 cm^2.

1.6 Data presentation

In order to identify changes, if any, in the ecology of the marine segment off Mumbai due to the ongoing construction works for the coastal road project, the data of the stations were clubbed as per their distance from the coast as presented below and compared. The present data (March 2020) is compared with March 2019 and December 2019 to understand the seasonal variations.

Distance from coastline (km)	Stations
1 km	1-5
3 km	6-9
8 km	10-13

References

Ehrhardt M. 1983. Determination of petroleum residues dissolved and/or finely dispersed in surface seawater. Chapter 12 Methods of seawater analysis (Second, revised and extended edition) edited by Grashoff K., Kremling K and Ehrhardt M.

ICES 2000. Harris R., Wiebe P., Len, J., Skjoldal H R and Huntley M E. (Eds.), Zooplankton

Methodology Manual, Academic Press, London, 684 pp.

Murphy J and Riley J P. 1962.A modified single solution method for the determination of phosphate in natural waters.AnalyticaChimicaActa, 27, 31-36.

Parsons T R., Malta Y and Lalli M. 1984.A Manual of Chemical and Biological Methods for Seawater Analyses.Pergamon Press, New York.

Preston S D and Summers R M. 1997. Estimation of nutrient and suspended-sediment loads in the Patuxent river basin, Maryland, water years 1986-90: U.S. Geological Survey Water-Resources Investigations Report 96-4175, 69 p.

Tomas, C. R (Ed.). (1997). Identifying marine phytoplankton. California: Academic Press.

UNESCO. 1978. A monograph on oceanographic methodology–Phytoplankton manual, S. Sournia(ed.) Paris, 337 p.

UNESCO. 1994. Protocols for joint global ocean flux study. S. Sournia (ed.) Paris, 337 p.

UNESCO. 1994. Protocols for joint global ocean flux study.

USEPA. 1986. Method 9065: Phenolics (Spectrophotometric, Manual 4-AAP with Distillation). Part of Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, 7 pp, 214 K.

2. PREVAILING ENVIRONMENT

2.1 Water quality

2.1.1 Temperature

Water temperature generally regulates distribution, composition and activity of living organisms in aquatic environment. It regulates metabolism, survival ability and reproduction efficiency in major aquatic animal. In general, the water temperature varies with prevalent air temperature in shallow coastal areas. During March 2020, air temperature around the study area was ranged at 25.0-29.5°C (av.26.7°C). Limits of water temperature closely followed the air temperature, with values ranging between 24.5-29.0°C (av. 26.2°C) (Table 2.1.1). The average limits of water temperature in surface (26.2°C) and bottom (26°C) water column were roughly similar during March 2020. The average water temperature limits were comparable around 1 km, 3 km and 8 km zones, with a unit degree higher in the 1 km zone, thus indicating limited spatial variability. Such variation could be related with air temperature variation and with the diurnal change in temperature. The zone wise comparison of average air and water temperatures during March 2019, December 2019 and March 2020 are presented in Figure 2.1.1.

Overall the water temperature around the study area during March 2020 was lower than those recorded during March 2019 and much lower when compared with December 2019. Furthermore, similar trend was also reflected in air temperature, which indicated that the relative variation in water temperature in the study area was in line with short-term diurnal variation. The water temperature in this study did not exceed 35°C (considered as threshold limit for tropical aquatic species), therefore unlikely to have any significant impact on aquatic organisms.

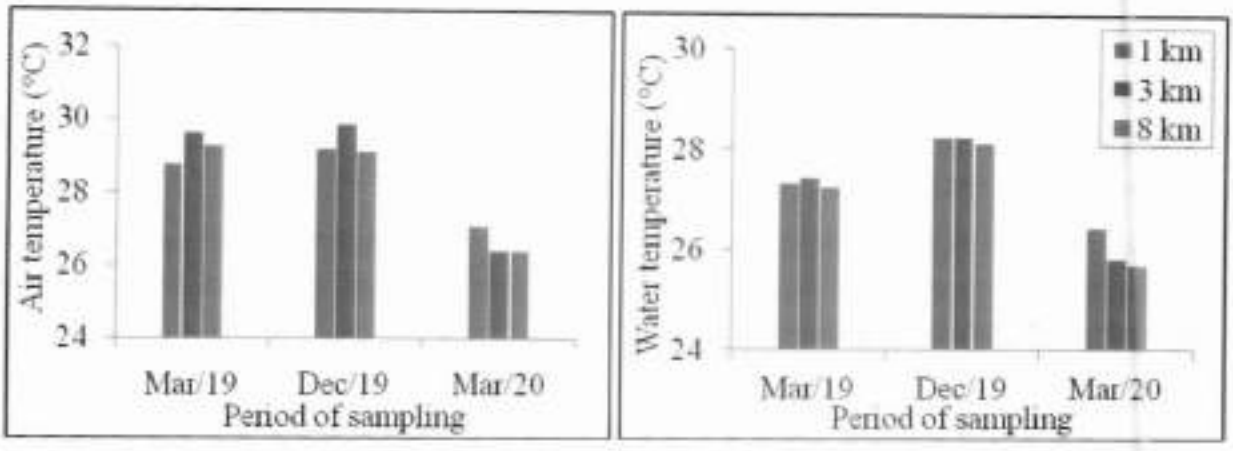


Figure 2.1.1: Air temperature (left) and water temperature (right) variation in the coastal waters off Mumbai during different sampling periods.

2.1.2 pH

Seawater pH is mainly regulated by carbonate system (CO_2, HCO_3^- and CO_3^{2-}), salt content and borate alkalinity. In general, seawater pH varies between 7.8 and 8.3, but due to increased HCO_3^- ions in industrial era, pH can broadly vary between 7.9 and 9.0. In shallow and biologically active tropical coastal water, diurnal pH can vary between 7.3 and 9.5, conducive to the photosynthesis process. Mixing of freshwater in nearshore environment during monsoon and release of low pH water from anthropogenic activities mainly affect the buffering capacity, which cause reduction of pH (below 8.0). A pH range of 5 to 9 is not directly harmful to aquatic life but the rapid change in pH can turn common pollutants more toxic in marine waters. The range of pH around the study area during March 2020 was between 8.1 and 8.9 (av. 8.5), with similar surface and bottom water pH limits (i.e. 8.5). The pH variation between surface and bottom water was not significant indicative towards a well-mixed water column during March 2020 (Tables 2.1.1). The comparison of average pH during the three different sampling periods is presented in Figure 2.1.2.

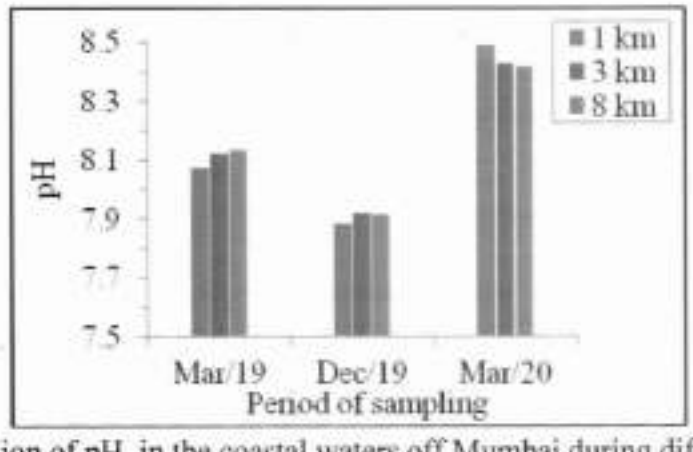


Figure 2.1.2: Variation of pH in the coastal waters off Mumbai during different sampling periods.

The average limits of pH in all the three zones were nearly similar, indicative of limited spatial variation of pH around the study area during March 2020. However, when compared with the pH of March 2019, the values of pH were roughly higher up to +0.5 in all the three zones. This could be related with the diurnal change in pH in the study area.

2.1.3 Salinity

Seawater salinity levels are dependent upon the balance between evaporation and precipitation averages at 35.5 psu. Salinity is an important ecological factor for the organisms that live in marine water. The organisms are acclimatized to a certain range of salinity, however, large variation in the salinity levels can result in adoption and/or dominance of selected organisms in the lower order, while higher order organisms may migrate. In coastal and nearshore waters, abrupt changes in salinity are generally caused during high saline effluent discharges from the anthropogenic activities. Sudden changes in salinity may cause high mortality of biota including fish due to salinity shock.

The range of salinity during March 2020 was 34.7–35.7 psu (av. 35.4 psu), with surface and bottom ranges as 34.7–35.7 psu, 35.0–35.6 psu, respectively (Table 2.1.1). There was not much variation noticed in the average limits of salinity between surface (35.4 psu) and bottom (35.4 psu) during the sampling period. The average salinity at high tide (35.3 psu) and low tide (35.2 psu) were nearly similar during March 2020. The temporal and spatial variations in average salinity values are represented in Figure 2.1.3.

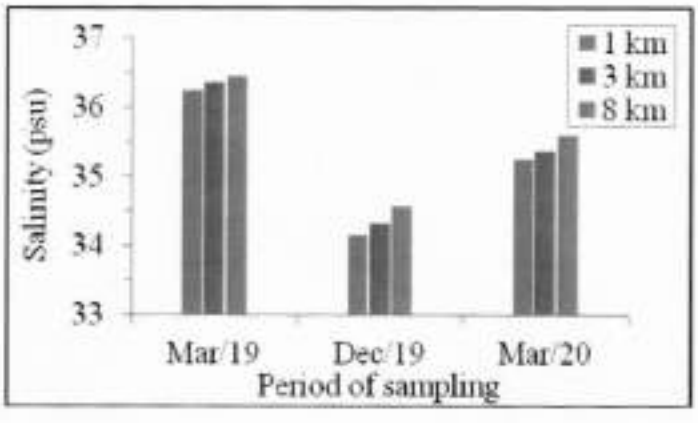


Figure 2.1.3: Variation of salinity in the coastal waters off Mumbai during different sampling periods.

The average salinity values roughly increased from towards 8 km zone impacted by the marine waters. The change in salinity during all the campaigns of this study do not indicate any abrupt change and indicate natural variation.

2.1.4 Suspended Solids (SS)

Suspended Solids (SS) are mainly made up of inorganic and organic materials from hinterland soils, degraded and fresh residues of plant, plankton and algae etc. float in the water column and eventually sink into sediment due to effects of physicochemical properties of seawater. They contribute to turbidity of seawater and higher concentrations of SS can

affect health of the aquatic animals and submerged vegetation by reducing the photosynthesis. The reduced rates of photosynthesis cause less dissolved oxygen production by the plants. In case of complete blockage of light by turbidity, the photosynthesis by bottom dwelling plants will cease; therefore they die and start to degrade. The bacteria act up on the degrading plant by using up the dissolved oxygen. SS in the water column also adversely affects certain sensitive populations through mortality, reducing growth rate and resistance to diseases, preventing proper development of fish eggs and larvae, modifying natural movement and migration and reducing abundance of available food. SS settling on the bed can damage the benthic invertebrate population, block spawning etc.

The SS was ranged at 5.2–42.9 mg/l (av. 20.8 mg/l) during March 2020, with surface and bottom averages being 16.6 mg/l and 24.9 mg/l, respectively (Table 2.1.1). The values of SS varied within a narrow range during high and low tides, ranging 17.2–30.8 mg/l in surface and 13.2–42.9 mg/l in bottom waters. The average SS values of the three zones during different periods are presented in Figure 2.1.4.

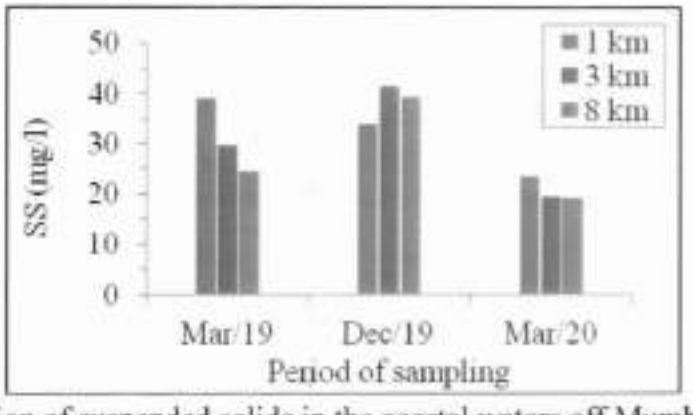


Figure 2.1.4: Variation of suspended solids in the coastal waters off Mumbai during different sampling periods.

The average SS values remained higher at1 km zone and lower at 8 km zone during March 2019 as well as March 2020. This is indicative of settling of SS in marine water. The SS limits found in all the three zones of March 2020 were lower than that of December 2019, which could be related with dominance of low-turbid waters during pre-monsoon as compared to that during post monsoon period in the coastal regions off Mumbai.

2.1.5 Turbidity

Turbidity of water relates to optical clearness and is affected by contents of dissolved matter and SS present in it. In general, turbidity has direct relationship with SS in water. However, some deviations may occur as SS includes silt, sediment, non-settleable solids, bacteria, clay, algae and settleable solids, whereas turbidity may be the contribution of these plus dyes, coloured dissolved organic matter and humic acids excluding settle able solids. Measurement of turbidity is one of key parameter in deciding the quality of water as high turbidity can harm fish and other aquatic life by reducing food supplies, degrading spawning beds, and affecting gill function.

Turbidity was ranged at 1.0–50.7 NTU (av. 9.4 NTU) during March 2020, with surface and bottom ranges at 1.0–34.7 NTU and 2.2–50.7 NTU, respectively (Tables 2.1.1-

2.1.13). Like SS, average values of turbidity varied within a narrow range during high and low tides, averaging 5.4 and 13.4 NTU respectively during March 2020. The average limits of turbidity at different zones during different sampling campaigns are presented in Figure 2.1.5.

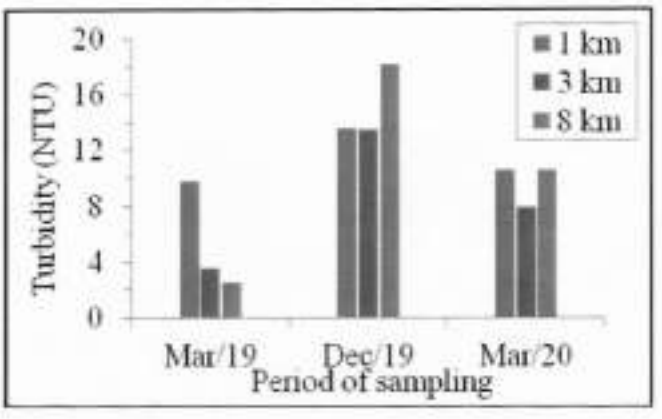


Figure 2.1.5: Variation of turbidity in the coastal waters off Mumbai during different sampling periods.

The above figure indicated lower turbidity during the premonsoon (March) period as compared to the postmonsoon (December) across different depth zones.

2.1.6 Chloride (Cl^-)

The Chloride, in the form Cl^- ion, is one of the major inorganic anions or negative ions in saltwater. Seawater (salinity 35 ppt) has natural Cl^- concentration of 19400 mg/l or 19.4 µg/kg. Natural spikes in chloride concentration can occur during summer and/or "low-flow" periods, when the evaporation exceeds precipitation. The Cl^- in the environment can come from sodium chloride (NaCl) or from other chloride salts such as potassium chloride (KCl), calcium chloride ($CaCl_2$) and magnesium chloride ($MgCl_2$) and anthropogenic factors such as road salt and due to contamination by the sewage.

Concentration of Cl^- ranged at 19.2–19.7µg/kg (av. 19.6 µg/kg) during March 2020. The average Cl^-concentration in surface (19.5µg/kg) and bottom water (19.6 µg/kg) were nearly similar and close to 19.4 µg/kg, which shows no natural addition of Cl^-in the region (Table 2.1.1). There was no significant variation in Cl^- among all the three zones of the study. Comparative average values of chloride during the three sampling are presented in Figure 2.1.6.

As compared to the Cl^- values of December 2019, the Cl^- values in March 2019 and 2020 were higher at all the three zones. This is relative to seasonal change in salinity in the study area.

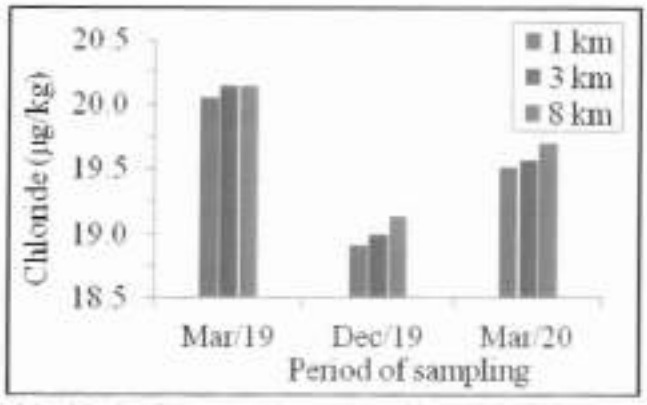


Figure 2.1.6: Variation of chloride in the coastal waters off Mumbai during different sampling periods.

2.1.7 Dissolved Oxygen (DO) and biochemical oxygen demand (BOD)

DO is an important parameter of water quality and its concentration in water highlights the ability of a water body to support aquatic life. The sources of DO in aquatic environments such as bay, near-shore and offshore are combining due to photosynthesis, atmosphere exchange and addition of oxygen-rich water by river runoff. Consumption of DO during heterotrophic oxidation of oxidizable organic matter and respiration by aquatic flora and fauna gives rise to biochemical oxygen demand (BOD). It is difficult to attain the threshold limit of DO for aquatic life, since environmental conditions, waste loading and natural levels of DO vary considerably and the existent composite aquatic life has variable demand for DO depending on their composition, age, activity, nutritional status etc. However, it has been observed that below 3 mg/l concentration of DO, good and diversified aquatic life may not sustain since feeding of many organisms is stopped and their growth is retarded at low DO levels. Embryonic and larval stage of aquatic life are especially vulnerable to reduced oxygen conditions and may result in retarded development and even partial mortality. It is considered that the level should not fall below 4 mg/l consistently for a longer period of time.

The range of DO during March 2020 was 2.7–11.6 mg/l (av. 6.5 mg/l), with comparable surface (7.1 mg/l) and bottom water (6 mg/l) averages (Table 2.1). The high and low tide averages of DO at 1 km zone were 8.6 mg/l and 7.0 mg/l, respectively during March 2020. Consumption of DO during heterotrophic degradation of oxidizable organic matter creates oxygen demand referred as BOD, measured after incubation of DO samples for 3 days at 27°Csoon after the collection. Presence of sufficient DO through replenishment keeps this demand low. However, input of oxidizable organic matter often cause enhancement of BOD, which is the indicator of unfavourable conditions for the aquatic life. The BOD was ranged at 1.2–6.6 mg/l (av. 3.7 mg/l) during March 2020, with surface and bottom water averages of 3.7 mg/l and 3.6 mg/l, respectively (Table 2.1). The high low tide averages of BOD at 1 km zone were 4.2 mg/l and4.5 mg/l, respectively during March 2020. The zonal average values of DO and BOD during different periods are presented in Figure 2.1.7.

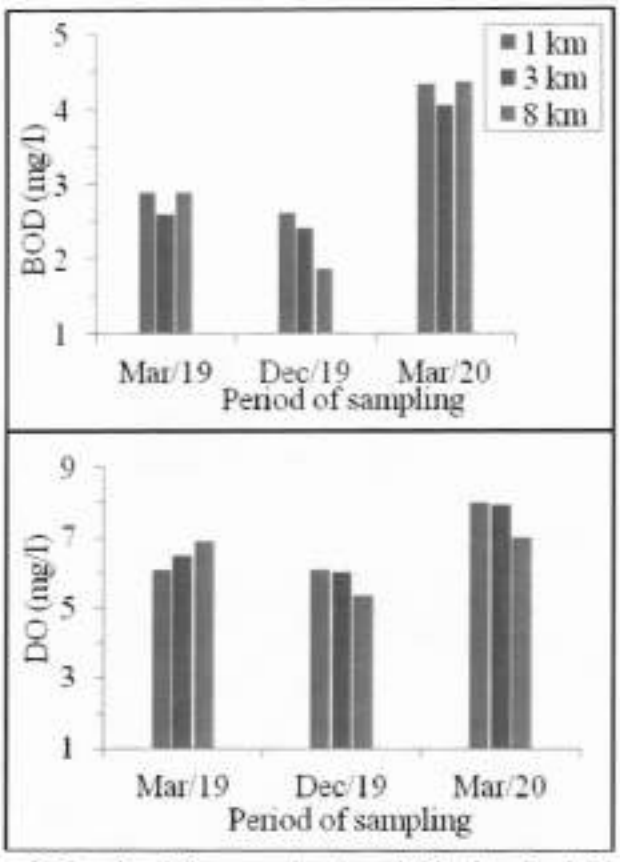


Figure 2.1.7: Variation of Dissolved Oxygen (top) and Biochemical Oxygen Demand (bottom) in the coastal waters off Mumbai during different sampling periods.

The average DO levels were higher during March 2020 as compared to the other monitoring periods. On an average, DO limits remained >5 mg/l throughout, which indicated that in the study area a well oxygenated water column prevailed for the healthy aquatic life. During March 2020, average BOD limits around all the three sampling zones were more or less similar and higher as compared to other two sampling months as displayed in the above figure. The BOD of >4 mg/l associated with fairly high DO (>7mg/l) observed in the northern transect, could be related with efficient biochemical oxidation by the heterotrophs present in those water or could be due to localized impact of sewage, which were absent in other regions.

2.1.8 Nutrients

The nutrients such as forms of phosphate, nitrogen and silicon, along with trace metals are used by phytoplankton during primary productivity. Amongst these, nitrogen and phosphorus occur in estuarine and coastal water mainly in forms of nitrate (NO_3^-; oxidation state +5) and ammonium (NH_4^+; oxidation state -3) along with other compounds. The dominant forms of nitrogen that exist in seawater are nitrate (NO_3^--N), nitrite (NO_2^--N) and ammonium (NH_4^+-N). NH_4^+-N is produced during the oxidation of organic matter, which is later oxidized to produce NO_3^--N via NO_2^--N, in the presence of sufficient quantities of DO in the environment. NO_2^--N is an intermediate product of oxidation of NH_4^+-N and reduction of NO_3^--N and is thermodynamically unstable. Nitrogen cycle involving elementary dissolved nitrogen; oxides: NO_3^-, NO_2^- and reduced forms: NH_4^+, play a significant role in

sustaining life within the aquatic environment. NO_3^--N is the end product of oxidation and most stable form at pH 7. The principal source of nitrogen in marine environment is fixation of atmospheric N_2. NO_2^- occurs in seawater as an intermediate product of NO_3^- reduction in microbial processes i.e. denitrification at low oxygen level at which NO_2^- is further transformed into N_2 under anoxic conditions. Inorganic phosphorus occurs most often as the phosphate (PO_4^{3-}-P). Though these nutrients are essential for life support in the aquatic environment, their enrichment in nearshore regions may hamper the coastal nutrient status and in extreme cases it can lead to eutrophication. Collectively, the compounds of phosphate, nitrogen and silicon are prime nutrients used for primary productivity. However, occurrence of high levels of these nutrients in creek and near-shore regions may hamper the coastal nutrient status and in extreme cases it can lead to eutrophication.

(i) Phosphate (PO_4^{3-}-P)

Phosphate is an essential nutrient required for plant nutrition. Anthropogenic sources of phosphates in coastal marine environment include domestic sewage, detergents, effluents from agro-based and fertilizer industries, agricultural runoff, organic detritus such as leaves, cattle waste etc. The range of phosphate around the study area during March 2020 was 0.04−1.7 µmol/l (av. 0.6 µmol/l), with surface and bottom averages of 0.5 and 0.7 µmol/l respectively (Table 2.1.1). The higher value (1.7 µmol/l) observed at nearshore region in the North, also associated with high BOD could be related with localized discharge. The average limits of phosphate during high and low tides were almost similar i.e. 0.7µmol/l during March 2020. The average PO_4^{3-}-P values at different zones during the three sampling periods are presented in Figure 2.1.8 (*i*)

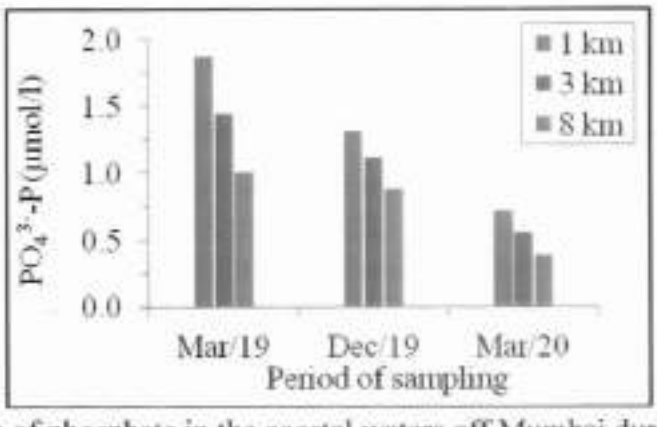


Figure 2.1.8(*i*): Variation of phosphate in the coastal waters off Mumbai during different sampling periods.

A decreasing trend in the average concentrations of phosphate from 1 km to 8 km zone was observed during all three sampling periods indicating distinct spatial variability. On an average, the phosphate limits at all the three zones during March 2020 were lower than that in March 2019, indicating temporal variation and/or short term changes, which is apparently not significant.

(ii) Nitrate (NO_3^--N)

The nitrate range during March 2020 was 0.1−8.4 µmol/l (av. 2.8 µmol/l). The average limits of nitrate in surface and bottom were2.3 and 3.3 µmol/l, respectively (Table 2.1.1). The average limits of nitrate during high and low tides were 3.8 and 3.5 µmol/l, respectively during March 2020.

(iii) Nitrite (NO_2^--N)

The range of NO_2^--N was between 0.001 and 2.6 µmol/l (av. 0.6 µmol/l), with surface and bottom limits having ranges of 0.001−2.1 and 0.1−2.6 µmol/l respectively (Table 2.1.1). The average limits of NO_2^--N during high and low tides were 0.7 µmol/land 0.6 µmol/l, respectively in March 2020. The average values of NO_2^--N of all three zones during the three sampling periods are presented in Figure 2.1.8 (*ii*) and (*iii*).

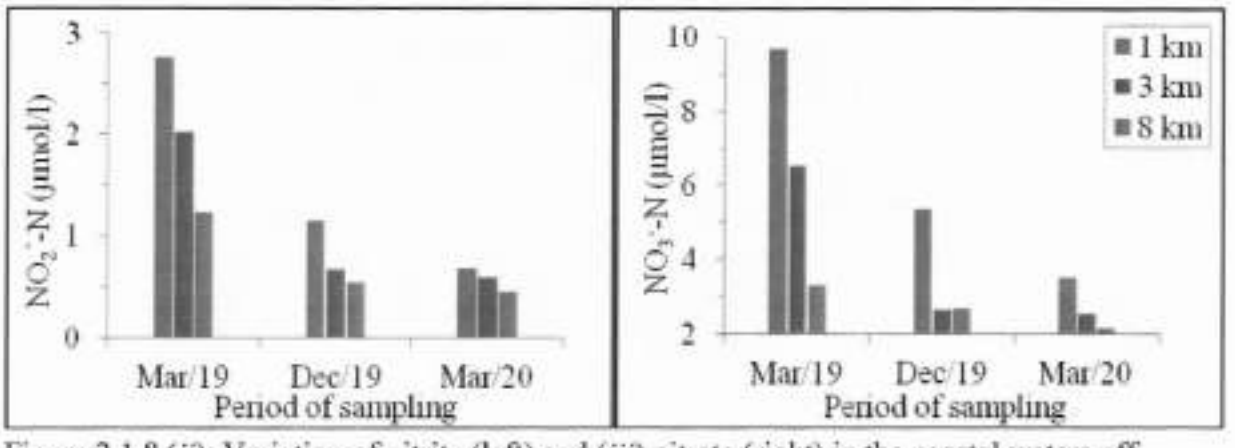


Figure 2.1.8 (*ii*): Variation of nitrite (left) and (*iii*) nitrate (right) in the coastal waters off Mumbai during different study periods.

As presented in the figure, the average concentrations of nitrite and nitrate decreased from 1 km to 8 km zone in this study. Both nitrite and nitrate concentrations were lower as compared to the previous campaigns during March 2020. The process of decrease of nitrite as well as nitrate in coastal waters are often relevant to the building of organic molecules with processes such as nitrate assimilation as well as nitrate reduction.

(iv) Ammonium (NH_4^+-N)

The ammonium is unstable in natural surface waters, therefore further oxidized to nitrate via nitrite. The concentration of ammonium in surface and bottom water column were ranged at 0.3-4.7 µmol/l and 0.5-8.1µmol/l respectively, whereas the ammonium concentration varied between 0.3-8.1 µmol/l (av. 1.7 µmol/l) during March 2020 (Table 2.1.1). The average limits of ammonium during high and low tides were 2.0 µmol/l and 2.1 µmol/l, respectively during March 2020. The average NH_4^+-N values at different zones during the three sampling periods are presented in Figure 2.1.8 (*iv*).

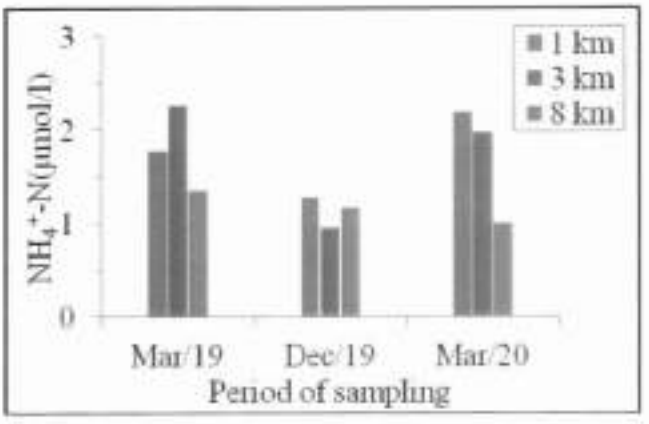


Figure 2.1.8 (*iv*): Variation of Ammonium in the coastal waters off Mumbai during different periods.

As shown in the figure, the mean values of ammonium indicated a decreasing trend from 1 km to 8 km zone during March 2020. The average limits during this period were similar to the results of March 2019.

Overall, the nitrogenous component such as nitrate and nitrite were lower during the sampling period, which indicated their limitation. The spatial variability of nitrate was significant, with higher limits in nearshore waters. There was no substantial enrichment of these nutrients found during the campaigns. Overall, higher levels of DO in all the three zones associated with lower BOD suggests a natural nutrient variability in the region.

(v) Sulphate (SO_4^{2-})

Sulphate (SO_4^{2-}) is one of the conservative elements, which co-varies with chlorinity in seawater with a constant ratio of SO_4^{2-}: Cl is 0.14 (Morris and Riley 1966). The principal source of sulphur in coastal marine environment could be from sea salt during rain and continental and anthropogenic sources (Kroopnick, 1977). The SO_4^{2-}: Cl ratio may vary with the addition or removal of SO_4^{2}. Hence, the addition of SO_4^{2-} rich substance can enhance the concentration of SO_4^{2-} and thereby the SO_4^{2-}: Cl ratio. Furthermore, reduction due to removal or dilution of SO_4^{2-} salts can cause decrease of SO_4^{2-} : Cl ratio. The range of sulphate during March 2020 was 2.0–2.9 g/kg (av. 2.4 g/kg). On an average there was no significant variation in sulphate values between surface and bottom water column during the sampling campaign. The average limits of sulphate in surface and bottom waters ranged between 2.0-2.9 g/kg and 2.1-2.7 g/kg respectively during March 2020. The zonal average SO_4^{2-} values during the different sampling periods are presented in Figure 2.1.9 (a).

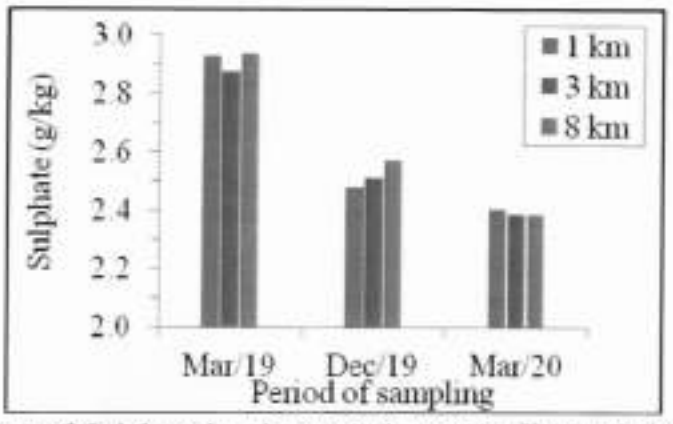


Figure 2.1.9 (a) : Variation of Sulphate in the coastal waters off Mumbai during different periods.

There was no significant variation in average sulphate levels among all the sampled zones during March 2020. Likewise, the SO_4^{2-}: Cl ratio varied within a very narrow range in surface as well as bottom water samples i.e. between 0.13 and 0.15. From the Figure 2.1.9 (b) it was evident that the average SO_4^{2-}: Cl at all the stations were nearly identical and, in the range observed for the natural seawater. The SO_4^{2-} vs. Cl plot for all data collected during March 2019, December 2019 and March 2020 around off Mumbai waters are presented below:

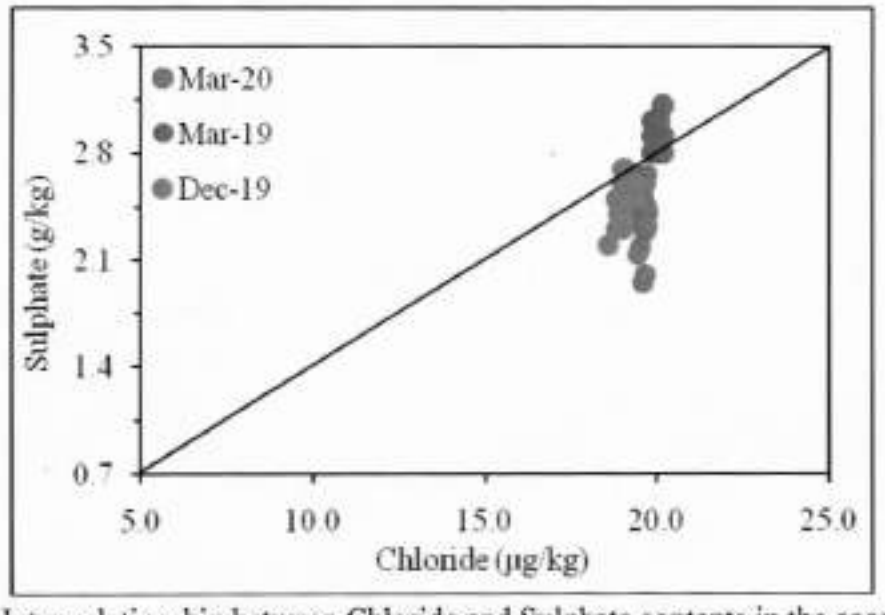


Figure 2.1.9 (b): Inter-relationship between Chloride and Sulphate contents in the coastal waters off Mumbai during different periods.

The results indicated that all the data points (2 σ sv.) are in line with the average SO_4^{2-} : Cl^- ratio of sea water (i.e. 0.14; Morris and Riley 1966). Few of the observations indicated higher or lower SO_4^{2-}: Cl ratio, which may be due to natural variation of Cl in water samples. The Cl enrichment in nearshore and coastal areas are normal, however, the processes such as sulphate reduction is ruled out as indicated by fairly normal DO values. Therefore, it appears that there was no accumulation or removal of sulphate in the study area.

2.1.9 Petroleum hydrocarbon (PHc)

Naturally occurring hydrocarbons in aquatic environment are in trace amounts of simple forms produced by microbes. PHc derived from crude oil and its products are added to marine environment by anthropogenic activities namely production of crude oil and its products, their transport, ship traffic, etc. Prominent land-based sources are domestic and industrial effluents, atmospheric fallout of fuel combustion products, condensed vapors etc. PHc can cause severe damage to the aquatic life when there are sudden discharges in large quantities during accidents such as tanker collision, pipeline rupture, fire etc. Samples for PHc were collected 1m below the surface water. The concentration of PHc measured during March 2020 around off Mumbai was ranged at 1.7–3.7 µg/l (av. 2.8 µg/l) (Table 2.1.1). The comparative averages of PHc during March and December 2019 for all three zones are presented in Figure 2.1.10.

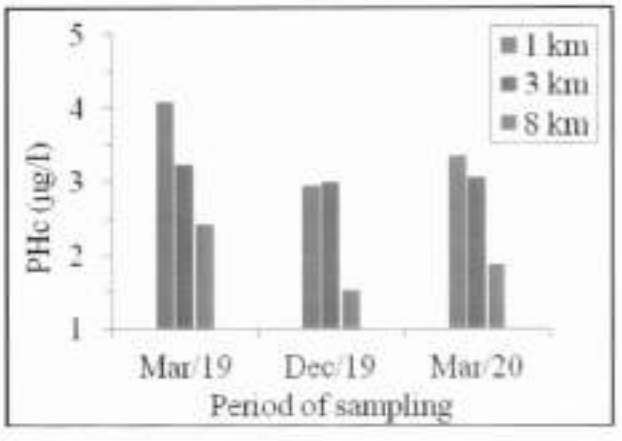


Figure 2.1.10: Variation of PHc variation in the coastal waters off Mumbai during different periods.

As presented in Table 2.1.1, the average values of PHc decreased from 1 km zone towards 8 km zone during the study period, indicating minimal contamination due to petroleum compounds in the 8 km zone off Mumbai. As displayed in the above figure, the average limits of PHc were comparable with previous studies around the same region.

2.2 Sediment quality

The sedimentary bed in coastal aquatic systems act as an eventual sink of SS, which often carries significant amount of chemical substance (metals, organic carbon and pollutants) from the source region via water column. The pollutants removed through adsorption are attached to the SS. In several instances, it is observed that even close to a location of effluent release, the metal content in receiving water often decreases to a normal value making assessment of contamination through analysis of water, a difficult task.

The concentrations of metals, organic carbon (C_{org}) and pollutants increase over a period of time at the sediment-water interface dependent upon the balance between their receiving fluxes, accumulation and removal rates. Moreover, the accumulation of metals, C_{org} and pollutants in sediments over a period of time can substantially indicate the quality of sediment. A good quality sediment substratum is essential for a sustainable healthy benthic

ecosystem. The data on metals, PHc, phosphorous and C_{org} in the sediment samples collected during March 2020 are presented in Table 2.2.1.

2.2.1 Texture

The textural characteristics of bed sediment around the study region during March 2020 showed compositional change in clay, silt and sand fractions, but mainly dominated by the silty fraction. The average percentage of silt was higher at all the three zones. There was no significant difference in the relative composition of grain size fraction in sediment during all the sampling campaigns as indicated in Figure 2.2.1.

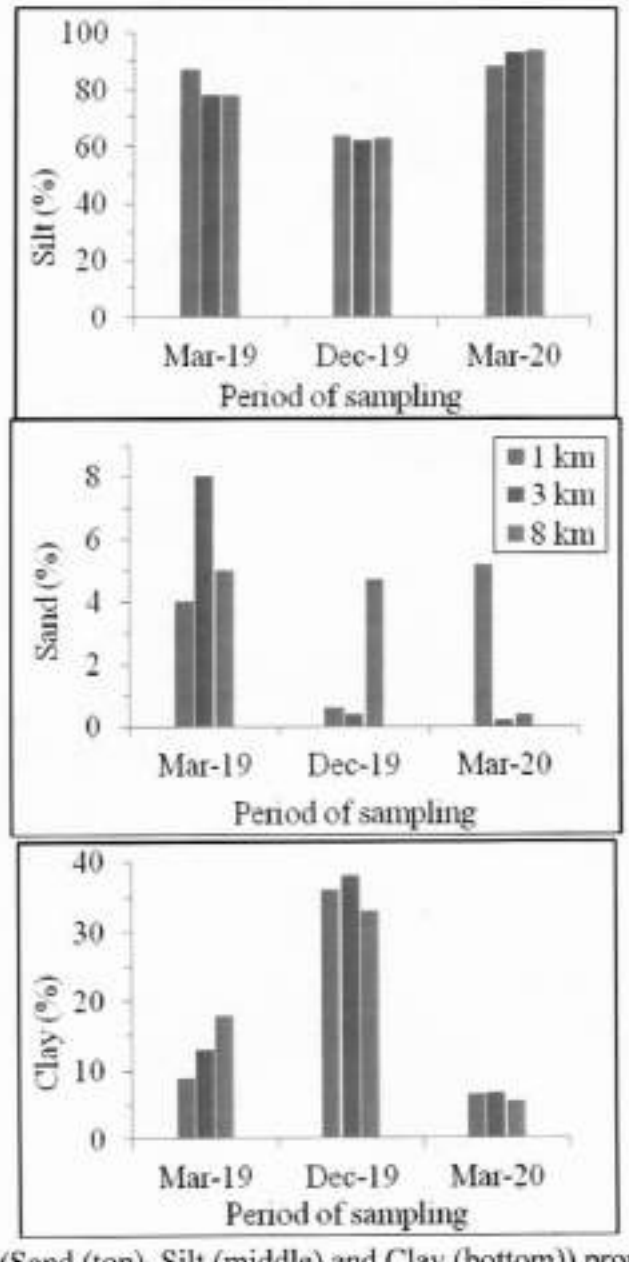
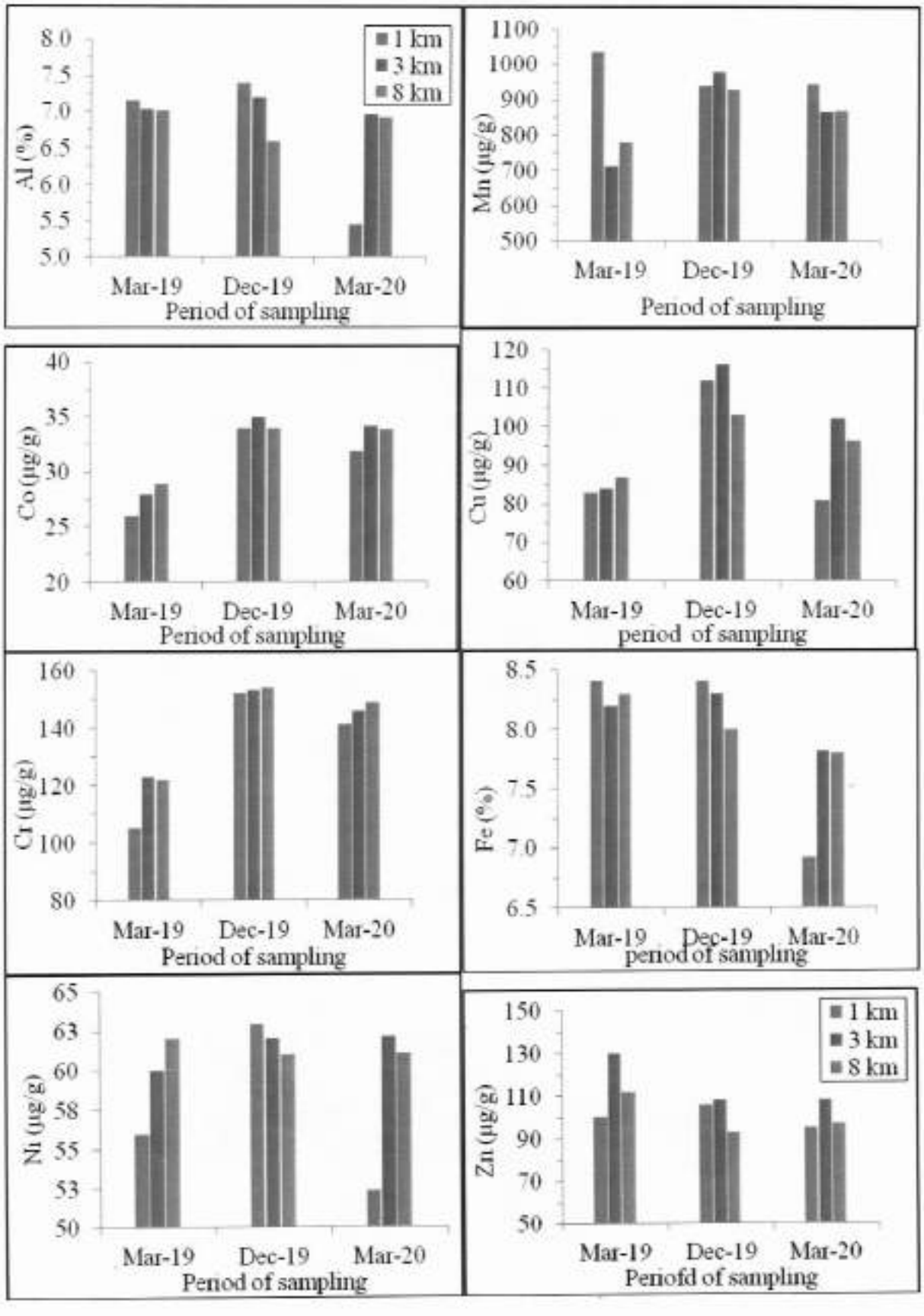


Figure 2.2.1: Texture (Sand (top), Silt (middle) and Clay (bottom)) properties of the coastal sediments off Mumbai during different sampling periods.

2.2.2 Metals

Bed sediments in uncontaminated areas has lithogenic metal concentrations, which are derived from rocks and soils encountered. However, these levels can get altered when the coastal waters receive discharges of anthropogenic effluents. The forms of metals in sediment namely hydroxides, sulfides, carbonates associated with organic substances entering through aqueous phase are influenced by several factors that determine their residence time in thermo-dynamically metastable phase. They are enriched as detrital minerals, chemically absorbed and complexed, co-precipitated, flocculated eventually settled in sediment. The variation of metal content largely depends upon the texture of bed sediment. Studies have demonstrated that marine sediments from industrialized coastal areas are greatly contaminated by metals; therefore, the evaluation of metal distribution in surface sediments is useful to assess the pollution in the marine environment. The results of metal content in sediments from the subtidal regions off Mumbai during March and December 2019 are presented in Table 2.2.1. The average contents of different metals in three different zones during the three sampling periods are presented below.

Results indicated the metals contents along the dispersal pathways e.g. from 1 km to 8 km zone off Mumbai did not follow any significant trend. Exceptions were Al, Fe, Ni and Cu, which showed a marked decrease at 1 km zone during March 2020. Variations in lithogenic fraction of metals in sediment across the eastern Arabian Sea are often commonly noticed due to various factors such as, variable inputs of SS through land drainage, littoral transport, and continental sediment movement during tidal epochs etc. The variations in the concentration of trace metals could also be due to changing levels of Al and Fe, which generally influence the concentration of trace metals. The average levels indicated nearly similar values during March 2020 as compared to other two sampling campaigns. However, Hg showed lower contents during March 2020. The average concentration of metal can fluctuate spatially dependant up on their source and abundance in the grain sized fraction of sediment deposited in the area. Their efficient transport can bring forth change in the concentration more significantly as compared to their utilization in dynamic coastal environment such as Mumbai.



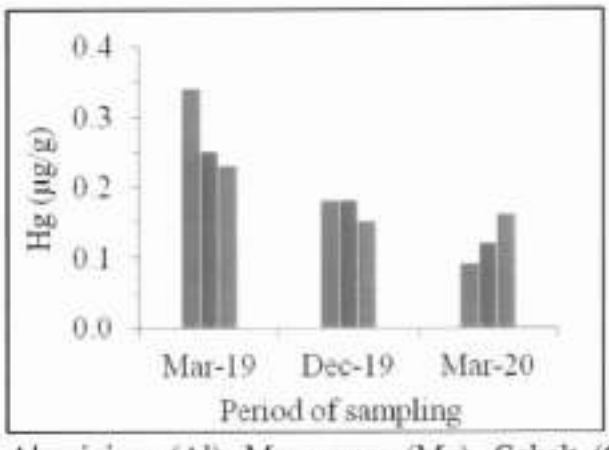


Figure 2.2.2: Variation in Aluminium (Al), Manganese (Mn), Cobalt (Co), Copper (Cu), Chromium (Cr), Iron (Fe) , Nickel (Ni), Zinc (Zn), Mercury (Hg) in the coastal sediments off Mumbai during different sampling periods.

2.2.3 Petroleum hydrocarbon (PHc)

The concentration of PHc in sediments off Mumbai is a vital parameter in the context of operations and activities such as operational fishing boats, ships and barges. The petroleum residue left after their release into water either due to transportation activity or major oil spillage adsorbed by SS, thereby eventually deposited on the sediment. Hence, PHc levels in sediment serves as a useful indicator of cumulative effect of oil contamination. The average concentration of PHc in sediments from different zone is presented below. The PHc in sediments ranged from 0.0 to 1.0 µg/g during March 2020in the study area (Table 2.2.1). The zone wise averages of PHc in sediments during both sampling periods are presented in Figure 2.2.3.

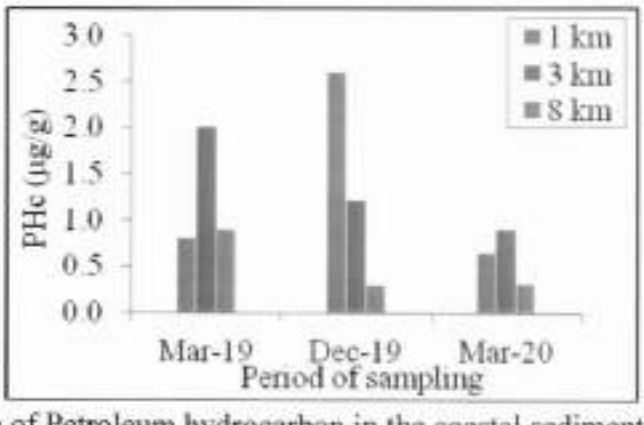


Figure 2.2.3:Variation of Petroleum hydrocarbon in the coastal sediments off Mumbai during different sampling periods.

There was no significant trend of PHc variation observed in sediment during March 2020, with more or less lower values observed during March 2020 as compared to the other two campaigns, which is indicated in the above figure. The average PHc limits were relatively lower at the 1 km and 8 km zones as compared to 3 km zone during March 2019 and March 2020. Overall the PHc levels found in the 8 km zone area were low, which therefore did not indicate any major contamination due to petroleum compounds upto off shore.

2.2.4 Organic carbon (C_{org})

Organic matter in nearshore and coastal sediments are mainly sourced from terrestrial runoff. Anthropogenic organic matter inputs can be reflected through abnormal increase in C_{org}, which can disturb the ecosystem. C_{org} present in the bed sediments are utilized by benthic organisms to a large extent. A fraction is also decomposed in the presence of DO by heterotrophic microorganisms. Hence, DO in sediment-interstitial water is continuously consumed and anoxic conditions develop if the organic matter is more than that can be oxidized through oxygen as an oxidant. Such anoxic conditions are harmful to benthic fauna. The average contents of C_{org} in the subtidal sediments from all the three zones of this study are presented in Figure 2.2.4.

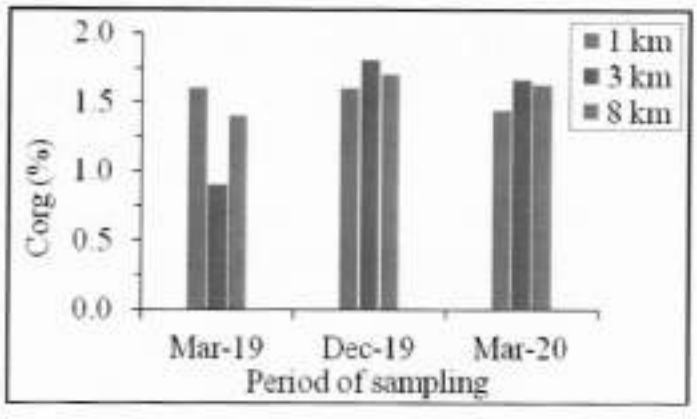


Figure 2.2.4:Variation of Organic Carbon in sediments in the coastal waters off Mumbai during different sampling periods.

The average content of C_{org} did not vary significantly from 1 km zone towards 8 km zone, which may be due to their similar source or origin. On an average, the limits of C_{org} in all the three zones were comparable with the limits found during the previous campaigns. The contents of C_{org} varied negatively with sand in the sediments during this study. The contents of C_{org} often corresponds to their nature and origin, however the content itself may not represent with any specific source but when compared alongside of other parameters such as total nitrogen content and the isotopic signatures, the potential C_{org} sources can be identified.

2.2.5 Total Phosphorus (P)

Lithogenic phosphorus in nearshore marine sediments mostly derived from the geological sources through river, while, the anthropogenic phosphorus is the result of sewage and industrial discharges, agricultural runoff etc. The phosphorous in sediments ranged between 887-1324 µg/g during March 2020. The average contents of sedimentary P in all the three zones of this study are presented in Figure 2.2.5.

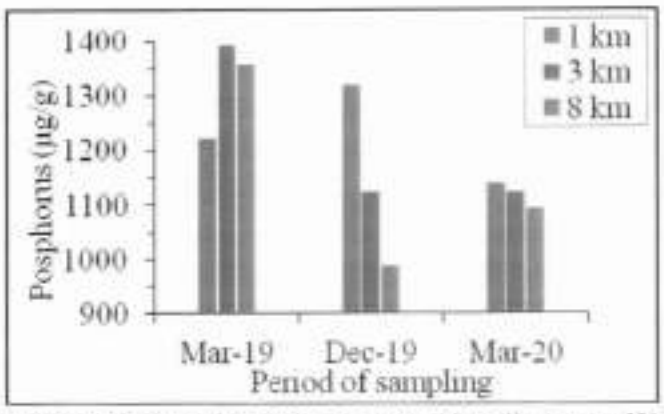


Figure 2.2.5:Variation of Total Phosphorus in the coastal sediments off Mumbai during different sampling periods.

The average contents of sedimentary P around all the three zones off Mumbai region did not vary significantly during March 2020. The average content of sedimentary P during March 2020 showed decreasing pattern from 1 km to 8 km zone and similar to the pattern of December 2019 as shown in the figure. This is indicative of the addition of P to the nearshore region.

In summary, it was considered that the sedimentary parameters such as texture, metals, PHc, C_{org}, and P in the subtidal sediments around off Mumbai varied widely within the region, but hardly indicated any abrupt rise in values as compared to the previous monitoring results across the same region. Also, clear seasonal trends with less spatial variability are seen for geo-chemical elements such as C_{org}, certain metal, P, etc.

References

1. Kroopnick, P. 1977. The SO_4: Cl Ratio in Oceanic Rainwater. Pacific Science 31, 91-100.
2. Morris, A.W. and Riley, P. 1966. Bromide / chlorinity and sulphate chlorinity ratio in sea water. Deep Sea Research 13, 699-705.

Table 2.1.1: Water quality at stations in the coastal waters off Mumbai during March 2020

Station	Level	1			2			3			4	5		
Parameter		Min	Max	Av.	Min	Max	Av.	Min.	Max	Av.	Av.*	Min	Max	Av.
Temperature (°C)	S	24.5	26.0	25.3	26.5	28.5	27.5	25.0	27.0	26.0	29.0	25.5	27.5	26.5
	B	24.5	25.5	25.0	26.0	27.5	26.8	24.5	26.5	25.5	28.5	26.5	27.0	26.8
	(AT)	(25.0)	(26.0)	(25.5)	(27.0)	(29.5)	(28.3)	(26.0)	(27.5)	(26.8)	(29.5)	(25.0)	(28.0)	(26.5)
pH	S	8.1	8.1	8.1	8.6	8.9	8.8	8.2	8.3	8.3	8.9	8.6	8.7	8.7
	B	8.1	8.1	8.1	8.7	8.9	8.8	8.2	8.3	8.3	8.8	8.6	8.7	8.7
SS (mg/l)	S	17.2	18.1	17.6	5.2	20.1	12.6	6.4	30.8	18.6	19.8	20.5	21.9	21.2
	B	42.5	42.9	42.7	16.7	40.7	28.7	28.9	37.9	33.4	13.2	19.2	23.0	21.1
Turbidity (NTU)	S	12.5	15.4	14.0	1.1	2.4	1.7	3.8	34.7	19.2	3.1	3.4	4.2	3.8
	B	16.0	25.2	20.6	4.4	21.8	13.1	8.5	21.0	14.8	3.4	4.1	5.1	4.6
Salinity (psu)	S	34.7	35.1	34.9	34.9	35.4	35.2	35.3	35.4	35.4	35.4	35.3	35.3	35.3
	B	35.0	35.4	35.2	35.1	35.4	35.3	35.5	35.5	35.5	35.3	35.2	35.3	35.3
DO (mg/l)	S	7.5	3.3	2.7	10.3	9.9	5.0	10.8	8.3	4.8	11.6	9.3	7.8	4.3
	B	6.8	6.0	3.2	7.9	7.7	3.9	8.7	7.7	4.1	8.2	5.9	5.9	3.0
BOD (mg/l)	S	3.4	2.8	1.6	5.9	4.3	2.6	6.2	3.9	2.5	6.6	5.6	3.7	2.3
	B	2.8	2.1	1.2	5.0	4.4	2.4	3.8	3.0	1.7	5.1	4.9	4.3	2.3
PO_4^{3-}-P (µmol/l)	S	0.9	1.7	1.3	0.6	0.9	0.8	0.0	0.1	0.0	0.1	0.5	1.0	0.8
	B	1.3	1.5	1.4	0.6	0.7	0.6	0.1	0.1	0.1	0.6	1.0	1.2	1.1
NO_3^--N (µmol/l)	S	0.2	0.8	0.5	2.7	5.8	4.3	0.5	0.6	0.5	1.7	7.5	7.6	7.6
	B	3.0	3.6	3.3	2.8	5.9	4.4	0.4	0.8	0.6	4.6	6.4	8.4	7.4
NO_2^--N (µmol/l)	S	0.7	1.0	0.9	0.1	0.2	0.2	0.1	0.1	0.1	0.0	0.5	2.1	1.3
	B	0.3	1.1	0.7	0.1	0.3	0.2	0.1	0.2	0.2	0.6	2.0	2.6	2.3
NH_4^+-N (µmol/l)	S	3.7	4.7	4.2	0.6	1.9	1.3	1.0	1.1	1.0	0.8	0.9	1.4	1.2
	B	6.0	8.1	7.0	1.3	2.2	1.7	0.8	1.0	0.9	0.6	1.7	1.7	1.7
PHc (µg/l)	1m	3.7	3.7	3.7	3.2	3.2	3.2	3.4	3.4	3.4	2.8	3.3	3.4	3.4
Sulphate (g/kg)	S	2.5	2.9	2.7	2.5	2.5	2.5	2.4	2.4	2.4	2.0	2.4	2.4	2.4
	B	2.3	2.5	2.4	2.5	2.7	2.6	2.2	2.3	2.3	2.4	2.1	2.3	2.2
Chloride (µg/kg)	S	19.2	19.4	19.3	19.3	19.6	19.5	19.5	19.6	19.6	19.6	19.5	19.5	19.5
	B	19.4	19.6	19.5	19.4	19.6	19.5	19.7	19.7	19.7	19.5	19.5	19.5	19.5

Continue....

Station / Parameter	Level	6 Av.*	7 Av.*	8 Av.*	9 Av.*	10 Av.*	11 Av.*	12 Av.*	13 Av.*
Temperature (°C)	S	25.5	25.5	26.0	26.0	25.5	26.0	25.5	26.0
	B	25.5	26.0	25.5	26.5	25.0	25.0	26.0	26.5
	(AT)	(26.0)	(26.5)	(26.0)	(27.0)	(26.0)	(27.5)	(25.0)	(27.0)
pH	S	8.1	8.7	8.2	8.8	8.1	8.5	8.3	8.8
	B	8.1	8.6	8.2	8.8	8.1	8.6	8.2	8.8
SS (mg/l)	S	9.6	7.9	21.6	21.9	15.7	14.9	17.9	16.7
	B	29.8	38.0	8.7	19.1	20.0	30.1	21.0	19.1
Turbidity (NTU)	S	5.2	1.8	5.8	1.0	5.2	2.1	4.8	3.0
	B	21.7	16.3	7.6	3.5	50.7	3.9	12.4	2.2
Salinity (psu)	S	34.9	35.2	35.6	35.3	35.6	35.7	35.6	35.6
	B	35.4	35.5	35.6	35.5	35.6	35.6	35.6	35.6
DO (mg/l)	S	7.7	10.7	7.4	8.4	7.2	7.7	7.0	7.6
	B	6.7	5.9	7.3	9.2	7.4	5.8	6.5	6.8
BOD (mg/l)	S	2.3	4.8	2.8	6.5	3.7	4.4	3.4	4.9
	B	3.3	3.9	3.4	5.4	4.0	4.8	4.2	5.4
PO_4^{3-}-P (µmol/l)	S	1.0	0.3	0.1	0.3	0.2	0.7	0.1	0.5
	B	0.8	1.1	0.1	0.9	0.6	0.8	0.1	0.3
NO_3^--N (µmol/l)	S	0.6	3.9	0.3	2.3	1.0	3.7	0.6	3.0
	B	2.2	4.4	0.1	6.8	1.3	4.2	1.2	2.5
NO_2^--N (µmol/l)	S	0.6	0.7	0.1	0.8	0.1	0.1	0.6	0.9
	B	0.4	0.9	0.2	1.1	0.2	0.5	0.5	0.8
NH_4^+-N (µmol/l)	S	3.1	0.3	0.8	1.2	0.6	0.7	1.6	1.1
	B	6.6	0.9	0.7	2.2	0.8	0.9	1.9	0.5
PHc (µg/l)	Im	3.0	3.0	3.1	3.1	2.1	1.7	1.9	1.8
Sulphate (g/kg)	S	2.5	2.1	2.3	2.3	2.3	2.4	2.3	2.0
	B	2.5	2.4	2.4	2.5	2.7	2.6	2.3	2.5
Chloride (µg/kg)	S	19.3	19.5	19.7	19.5	19.7	19.7	19.7	19.7
	B	19.6	19.7	19.7	19.7	19.7	19.7	19.7	19.7

*average of two readings; AT: air temperature

Table 2.2.1 : Sediment quality in the coastal waters off Mumbai during March 2020.

Station	Sand (%)	Silt (%)	Clay (%)	Al (%)	Cr (µg/g)	Mn (µg/g)	Fe (%)	Co (µg/g)	Cu (µg/g)	Ni (µg/g)	Zn (µg/g)	Hg (µg/g)	C_{org} (%)	P (µg/g)	PHc* (µg/g)
1	1.0	91.0	8.0	7.2	145.2	1047.0	7.7	33.9	104.4	62.3	115.4	0.07	2.7	1226	1.0
2	0.1	96.4	3.6	7.2	147.9	906.9	7.9	33.6	103.8	63.2	110.7	0.11	1.7	1129	0.7
3	10.2	84.2	5.6	6.6	152.5	909.6	7.4	33.1	95.2	58.8	94.1	0.13	1.7	1128	0.8
4	85.3	7.5	7.1	4.4	200.2	1153.0	8.5	44.5	70.4	57.2	110.8	0.11	0.5	1324	0.4
5	84.8	7.0	8.2	1.9	60.3	707.4	3.1	14.5	30.6	20.5	43.6	0.05	0.7	887	0.3
6	0.2	92.5	7.3	7.1	146.5	893.7	7.9	34.0	108.7	63.2	117.3	0.13	2.0	1177	0.4
7	0.1	91.2	8.7	7.0	146.3	894.9	7.8	33.1	106.7	62.7	116.2	0.17	1.9	1170	0.0
8	0.3	94.1	5.6	7.1	148.4	819.0	8.0	34.9	98.6	63.3	100.5	0.10	1.5	1091	2.6
9	0.2	94.6	5.2	6.7	141.9	865.2	7.6	34.7	93.7	59.5	97.5	0.09	1.4	1053	0.6
10	0.0	93.6	6.4	7.1	147.6	862.5	7.8	33.8	99.5	62.1	100.7	0.13	1.5	1063	0.2
11	0.2	94.5	5.4	7.0	145.7	916.5	7.8	33.5	105.3	61.1	103.3	0.09	1.8	1098	0.1
12	0.2	95.8	4.0	7.2	152.9	851.5	8.2	35.3	96.8	63.8	99.5	0.12	1.7	1176	0.9
13	1.2	92.0	6.7	6.3	149.2	850.4	7.4	33.2	83.9	57.5	84.8	0.32	1.5	1045	0.1

*On Wet weight basis

2.3 Biological characteristics

Evaluation of the biological components of an ecosystem is integral to any environmental monitoring study as the consequences of any fluctuation in physico-chemical parameters is eventually on the biotic components. The important natural factors which influence fauna in coastal areas are tides, currents, freshwater flow, water quality and sediment characteristics. Faunal components in coastal waters are highly diverse inhabiting a variety of ecosystems. The basic process in an aquatic ecosystem is the production of organic carbon by photosynthesis. The anthropogenic stress may cause the communities to exhibit low biomass and high metabolism. In addition, due to depressed functions of less tolerant predators, there may be also a significant increase of dead organic matter deposited in sediments of ecosystems modified under stress. Depending upon the type, strength and extent of a stress factor, the ecosystem will react to either re-establish the previous equilibrium or establish a new one, or it may remain in prolonged disequilibrium.

Important biological parameters which are considered for assessment in the present study are bacterial counts; phytoplankton pigments, cell counts and generic diversity; zooplankton biomass, density and group diversity; macrobenthic and meiobenthic biomass, density and group diversity. The first three reflect the productivity of water column at the primary and the secondary levels. Benthic organisms being sedentary animals associated with the seabed, provide information regarding the integrated effects of stress, if any, and hence are good indicators of early warning of potential damage. A collective evaluation of all the above components is a reliable approach to predict the state of equilibrium of aquatic life of coastal area off the study area. The results are given in Tables 2.3.1- 2.3.24.

2.3.1 Microbial studies

Microbial ecology is on the forefront of developing and applying a new generation of indicators of environmental stress and ecological change. The roles played by marine microorganisms are profound in the overall normal functioning, stability and continuance of the marine ecological processes. Despite their small size marine micro-organisms are far more important as they are linked to water column and sediment (benthic) processes. Marine microorganisms occupy the base of the food web, and form food for protozoa, invertebrate larvae and many large zooplankton and regenerate dissolved nutrients for marine photosynthesis and formation of newer organic biomass. Bacteria are major links to many biological and non-biological events in the oceans. In order to bring into focus the importance of marine bacteria at base of the food web, an assessment of their abundance and distribution are essential. The microbial diversity of coastal waters can be influenced by anthropogenic activities also besides oceanic processes.

Coliform bacteria such as *Escherichia coli* and Faecal streptococci (Genus: *Streptococcus*) are the two most important groups of non-pathogenic bacteria found in sewage.

Because of number of problems associated with the determination of populations of individual pathogens, non-pathogenic bacteria (such as coliforms) are used as indicators of water pollution. Untreated domestic waste-water has about 3 million coliforms/100 ml. Because pathogens originate from the same source, the presence of high numbers of coliforms indicates potential danger. Bacteriological analyses for present study included the enumeration of total viable bacterial counts (TVC) and coliforms at 13 stations in the coastal waters off Mumbai. Total Viable Counts (TVC), Total Coliform (TC), Faecal Coliforms (FC), *Escherichia coli* like organisms (ECLO) and *Streptococcus faecalis* like Organism (SFLO) were studied. The microbiological results for water and sediments are given in Tables 2.3.1-2.3.2.

a) Water

The average TVC count at different stations was in the range of 10 x 10^3 –1200 x 10^3 CFU/ml during March 2020 (Table 2.3.1). The comparative average values of TVC at the three zones during March 2019, December 2019 and March 2020 are presented in Figure 2.3.1.

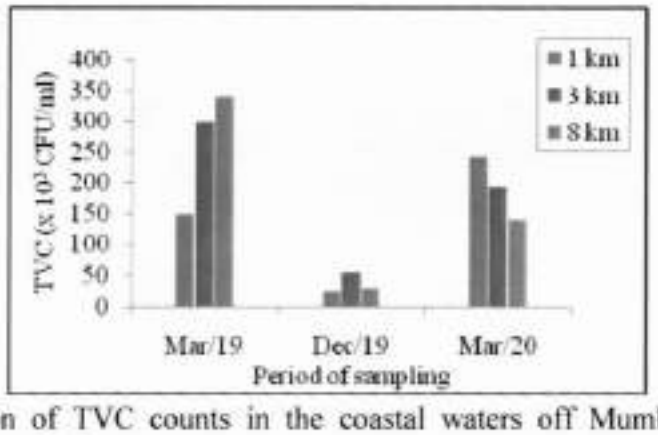


Figure 2.3.1: Variation of TVC counts in the coastal waters off Mumbai during different sampling periods.

The TVC during March 2020 showed a decreasing trend towards offshore which was an opposite trend compared to other sampling periods (March 2019 & December 2019). During March 2019, TVC showed an increasing trend towards offshore. In December 2019, the counts at 1 km and 8 km zones were comparable (Figure 2.3.1). TVC were particularly high at 1 km zone during March 2020 whereas during March 2019 the counts were found to be higher at 8 km zone and during December 2019 higher counts were observed at 3 km zone (Figure 2.3.1). Seasonal differences in TVC were evident as the values were distinctly higher during both the March periods as compared to December.

b) Sediment

The average TVC counts in the sediments off Mumbai ranged from 10 x 10^4 to 2280 x 10^4 CFU/g during March 2020 (Table 2.3.2). The comparative TVC in coastal sediments of the three zones during March 2019, December 2019 and March 2020 are presented in Figure 2.3.2.

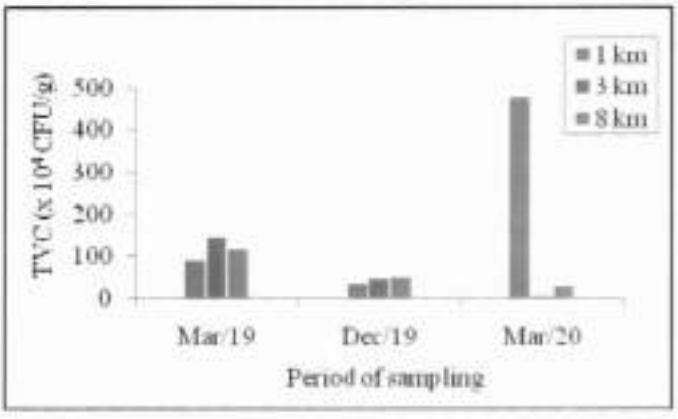


Figure 2.3.2: Variation of TVC counts in the sediments off Mumbai during different sampling periods.

The average TVC counts in sediments were higher at 1 km zone during March 2020 compared to two other sampling periods. In March 2019, the TVC count was higher at 3 km zone. The average TVC counts during December 2019 were found to be 2-3 folds lower at all the three transects compared to that of March 2019. The average TVC count at 1 km zone in March 2020 was found to be 10-12 times higher compared to that of December 2019 (Figure 2.3.2).

Table 2.3.1: Microbial counts in the coastal waters (CFU/ml) off Mumbai during March 2020

Type of Bacteria	1		2		3		4	5		6	7	8	9	10	11	12	13
	1 km									3 km				8 km			
Tide	Ebb	Fld	Ebb	Fld	Ebb	Fld	Ebb	Fld	Ebb	Fld	Spot	Spot	Spot	Spot	Spot	Spot	Spot
TVC $x10^3$	-	850	-	1200	10	-	110	90	50	660	-	-	110	520	-	-	40

Table 2.3.2: Microbial counts in sediments (CFU/g) in the coastal waters off Mumbai during March 2020

Type of bacteria	1	2	3	4	5	6	7	8	9	10	11	12	13
	1 km					3 km				8 km			
TVC $x10^4$	10	2280	10	10	80	-	-	-	20	60	-	40	10

2.3.2 Phytoplankton

Phytoplankton are a variety of microscopic plants passively drifting in natural waters and mostly confined to the illuminated zone. In an ecosystem these organisms constitute primary producers forming the first link in the food chain by synthesizing organic carbon using inorganic nutrients, carbon dioxide and sunlight in the marine environment. Because of their short life cycles, phytoplankton responds quickly to environmental changes. Hence their standing crop in terms of biomass, cell counts and species composition are more likely to indicate the quality of the water mass in which they are found. A normal ecosystem with a natural balance between different trophic levels viz. primary, secondary and tertiary productions gets disturbed and imbalanced of its food chain due to anthropogenic pollutants. Generally, phytoplankton standing crop is studied in terms of biomass by estimating chlorophyll *a* and primary productivity and in terms of population by counting total number of cells and their generic composition. When under stress or at the end of their life cycle, chlorophyll in phytoplankton decomposes with phaeophytin as one of the major products. The range and average of phytoplankton in coastal waters off Mumbai during March 2020 are given in Tables 2.3.3-2.3.5.

a. Phytoplankton biomass

The phytoplankton pigment chlorophyll *a* in the study region ranged between 0.2-13.7 mg/m^3 (av.5.4 mg/m^3) during March 2020 (Table 2.3.3). During the study period the variability of chlorophyll *a* in the surface and bottom waters was not significant. The chlorophyll *a* in surface water ranged at 0.7-13.7 mg/m^3 (av. 5.9 mg/m^3) and bottom waters 0.2-13.1 mg/m^3 (av. 4.9 mg/m^3) respectively. The concentration of Phaeophytin in the study region ranged between 0.1-3.5 mg/m^3 (av. 0.9 mg/m^3). Phaeophytin in the surface water ranged at 0.1-1.7 mg/m^3 (av.0.5 mg/m^3) and in bottom water it ranged between 0.1-3.5 mg/m^3 (av. 1.2 mg/m^3) during the study period (Table 2.3.3). The average values of chlorophyll *a* across the three zones during March 2019, December 2019 and March 2020 are presented in Figure 2.3.3.

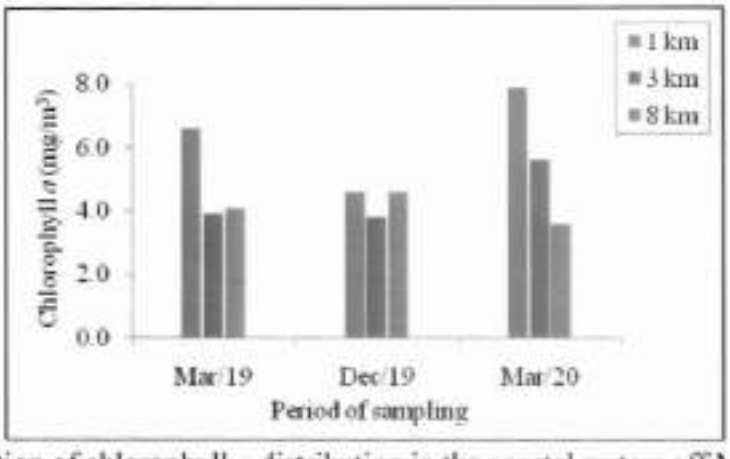


Figure 2.3.3: Variation of chlorophyll *a* distribution in the coastal waters off Mumbai during different sampling periods.

The above figure revealed that chlorophyll *a* was found to be relatively higher during March 2020 at the 1 km zone compared to the other two sampling periods (March & December 2019). The enhanced concentration of chlorophyll *a* at 1 km zone (March 2020) could be probably because the area received nutrients from the nearby terrestrial zones. On the other hand, chlorophyll *a* during December 2019 were comparable at 1 km and 8 km zones. The lower chlorophyll *a* concentration at 1 km zone in December 2019 compared to the two other sampling periods could be attributed to the seasonal variation, additionally it could also be due to the difference in phytoplankton taxa. During March 2019 and 2020, the chlorophyll values were highest at the I km zone (Figure 2.3.3). The chlorophyll *a*: phaeophytin ratio which indicates the health of the phytoplankton cells revealed that the cells were not under any kind stress as the ratio was >1 at all stations (Table 2.3.3).

Impact of tidal variation on chlorophyll *a* was also studied along the 1 km stretch of coastal waters of Mumbai (Figure 2.3.4). The tidal variation in chlorophyll *a* showed that station 2 had high chlorophyll *a* during full ebb (F.Ebb) and full flood (F.Fld) during March 2020. Tidal variability was least at station 5 during all the three observations (Figure 2.3.4). Comparison of March 2019 and March 2020 indicated an inter-annual variability in the contribution of chlorophyll *a*. Enhanced chlorophyll *a* during F.Fld could be probably due to the contribution from coastal waters and during F.Ebb period could be due to re-suspension.

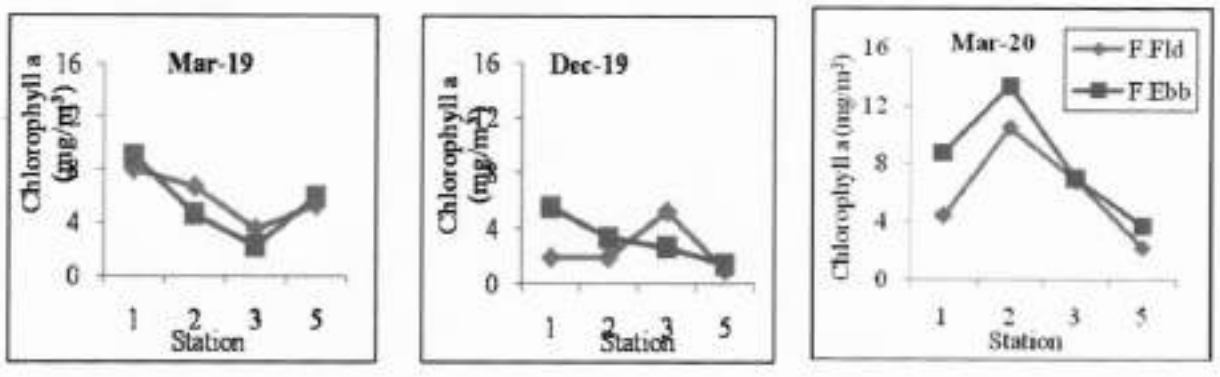


Figure 2.3.4: Tidal variation in the chlorophyll *a* distribution in the coastal waters off Mumbai during different sampling periods.

Phytoplankton cell count (population) and total genera from 1 to 8 km stretch were studied during March 2020 (Table 2.3.4). During March 2020 phytoplankton cell count in the study region varied within range of 70.5-1200 x 10^3 cells/ l (av. 401.6x 10^3 cells/ l). Phytoplankton cell count in surface and bottom water ranged at 70.5-811.2 x 10^3 cells/ l (av.400.9 x 10^3 cells/ l) and 70.5-1200 x 10^3 cells/ l (av. 402.3 x 10^3 cells/ l) respectively in March 2020 (Table 2.3.4). The average phytoplankton count of the three zones during March 2019, December 2019 and March 2020 are presented in Figure 2.3.5.

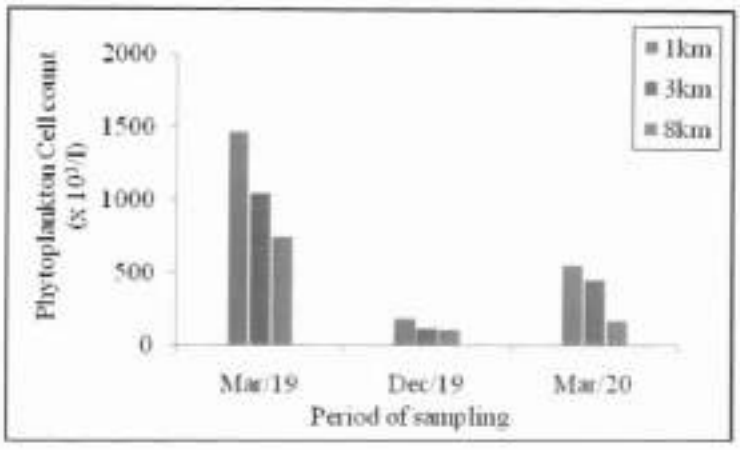


Figure 2.3.5: Variation of phytoplankton cell count distribution in the coastal waters off Mumbai during different sampling periods.

The above figure indicated that the phytoplankton cell count was higher during March 2019 compared to December 2019 and March 2020. A seasonal trend was observed with the December values being lower than that recorded during March. The cell densities were found to be 2 to 10 fold lower during December 2019 and March 2020 compared to March 2019.A decreasing trend in phytoplankton cell count was observed towards the offshore region during all the three observation periods (Figure. 2.3.5). The impact of tidal variation on phytoplankton cell count was studied along the 1 km stretch of coastal waters of Mumbai (Figure. 2.3.6).

The tidal variation in phytoplankton cell count indicated that station 1 was with high cell count during F.Ebb during March 2019, while during December 2019 and March 2020 impact of tidal variability on phytoplankton cell count was minimal (Figure 2.3.6).

Phytoplankton genera (no) in the study region varied considerably in the range of 9-29 (av. 17) during March 2020. Phytoplankton genera (no) in surface and bottom waters were ranged at 9-29 (av.19) and 9-25 (av.15) respectively during the study period (Table 2.3.4). The highest number of genera was recorded at 3 km zone during March 2020 (Figure 2.3.7). Similarly an increment in genera number were observed during the present sampling period (81 no) as compared to March 2019 (46 no) and December 2019 (61 no).

During March 2020 the major class of phytoplankton observed were diatoms followed by dinoflagellates, similar to March 2019 and December 2019. The abundance of phytoplankton species was in the order of: *Chaetoceros curvisetus* >*Chaetoceros decipiens* >*Skeletonema costatum* >*Chaetoceros lorenzianus* >*Gymnodinium catenatum*. Among the diatoms, *Chaetoceros curvisetus*, *Chaetoceros danicus*, *Pseudo-nitzschia australis* and among the dinoflagellates *Gymnodinium catenatum* and *Gyrodinium spirale* were observed in all the three zones during March 2020 (Table 2.3.5). The comparative account of phytoplankton genera during March 2019, December 2019 and March 2020 is presented in Figure 2.3.7.

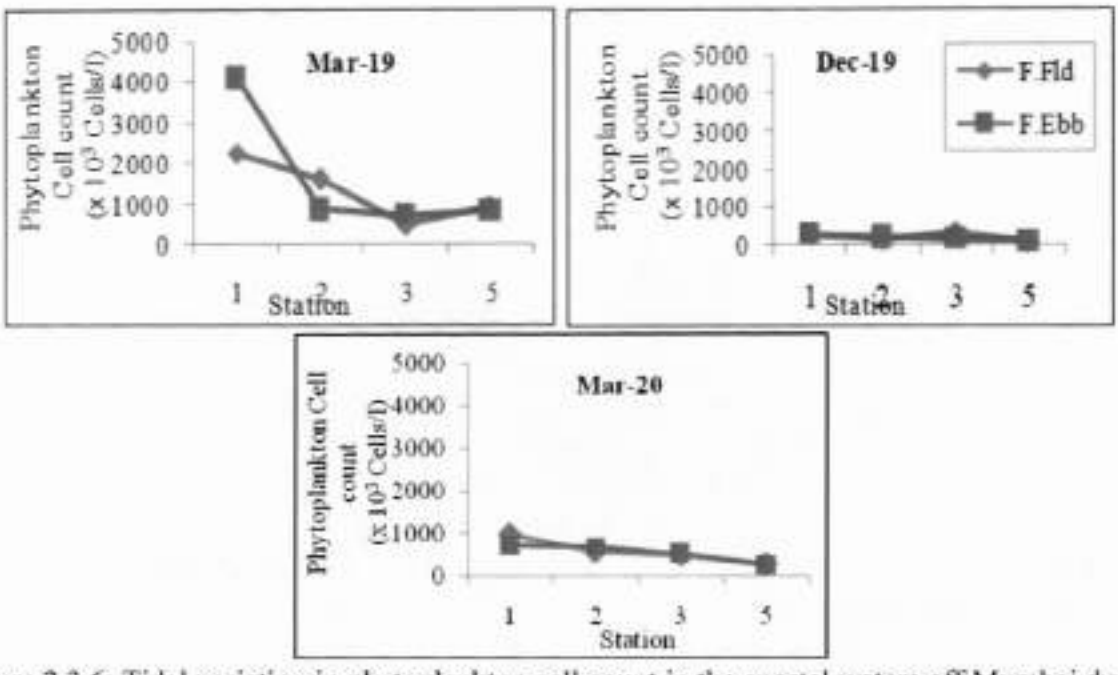


Figure 2.3.6: Tidal variation in phytoplankton cell count in the coastal waters off Mumbai during different sampling periods.

The generic diversity was always higher at 3 km zone during March 2019, December 2019 and March 2020 (Figure 2.3.7). Present generic diversity was higher at the 1 and 3 km zones. The Shannon-Wiener diversity index was calculated for the sampling periods (March 2019, December 2019 & March 2020) and is presented in Figure 2.3.8.

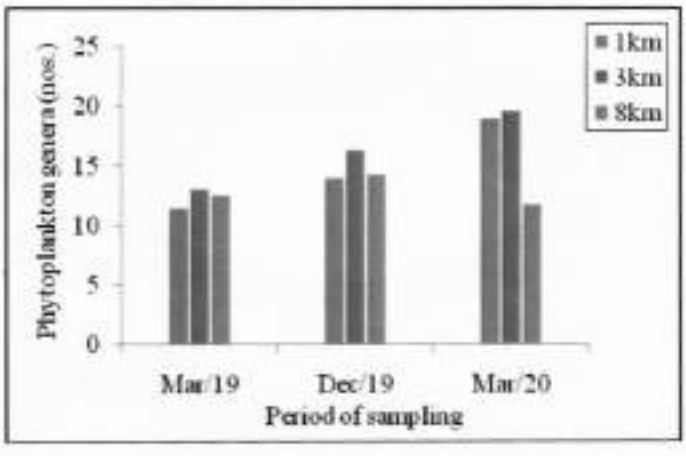


Figure 2.3.7: Variation of phytoplankton total genera distribution in the coastal waters off Mumbai during different sampling periods.

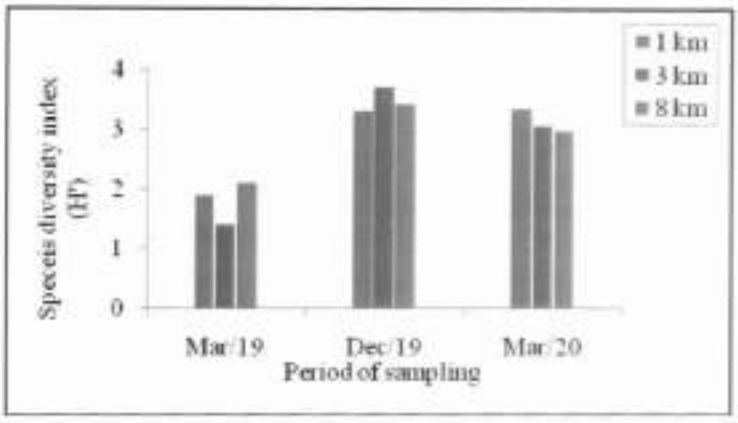


Figure 2.3.8: Variation in phytoplankton species diversity index in the coastal waters off Mumbai during different sampling periods.

The phytoplankton H' were higher during December 2019 and March 2020 indicating balanced phytoplankton populations during that period. The diversity index, H' was almost comparable between the zones during the sampling periods of December 2019 and March 2020. The H' were relatively higher during December 2019 at 3 km zone as compared to the observations during March 2019 and March 2020 (Figure 2.3.8).

Shannon-Wiener diversity index can be used as a proxy for ecosystem modification under eutrophication or pollution stress. Shannon Wiener index as a pollution index suggests the following scale: 0–1 for high pollution (poor), 1–2 for moderate pollution (bad), 2–3 for marginal pollution (moderate), and 3–4 for incipient pollution (good) (Balloch et al., 1976). From the below table it is understood that the study region showed pollution index between poor and moderate condition during the March 2019. In December 2019 and March 2020 the system recovered and maintained moderate to good condition.

Stations	Distance	Diversity index		
		March 2019	December 2019	March 2020
1	1 Km	Bad	Good	Moderate
2		Bad	Good	Good
3		Bad	Good	Moderate
4		Poor	Moderate	Moderate
5		Poor	Moderate	Moderate
6	3 Km	Bad	Good	Moderate
7		Bad	Good	Moderate
8		Bad	Good	Moderate
9		Poor	Good	Good
10	8 Km	Bad	Moderate	Moderate
11		Bad	Good	Moderate
12		Bad	Good	Moderate
13		Moderate	Moderate	Moderate

Pollution Index: 0-1 (Poor); 1-2 (Bad); 2-3 (Moderate) and 3-4 (Good)

69.2 % of the stations indicated bad condition during March 2019 while in December 2019 the system recovered and more than 50% of the study region remained in good condition. During March 2020, 84.6 % stations were in moderate category.

Status	March 2019	December 2019	March 2020
Poor	23.1	-	-
Bad	69.2	-	-
Moderate	7.7	30.8	84.6
Good	-	69.2	15.4

Reference

Balloch, D., Davies, C. E., & Jones, F. H. (1976). Biological assessment of water quality in three British rivers: the north Esk (Scotland), the Ivel (England) and the Taff (Wales). Water Pollution Control, 75, 92–114.

Table 2.3.3: Range and average (parenthesis) of phytopigments in the coastal waters off Mumbai during March 2020

Station	Distance (km)	Chlorophyll *a*				Phaeophytin				Ratio			
		S		B		S		B		S		B	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
1	1 km	7.3-8.1 (7.7)		1.6-9.4 (5.5)		0.7-1.7 (1.2)		2.2-3.5 (2.8)		4.6-10.1 (7.4)		0.4-4.4 (2.4)	
2		9.8-13.7 (11.8)		11.3-13.1 (12.2)		0.6-0.8 (0.7)		1.3-1.7 (1.5)		15.5-17.2 (16.3)		6.5-10.2 (8.4)	
3		7.5-10.1 (8.8)		3.7-6.1 (4.9)		0.5-1.4 (1.0)		1.1-2.4 (1.8)		7.0-13.9 (10.5)		1.5-5.5 (3.5)	
4		7.9-8.0 (8.0)		8.0-8.0 (8.0)		0.3-0.3 (0.3)		2.4-3.5 (3.0)		26.7-29.2 (27.9)		2.3-3.3 (2.8)	
5		2.2-4.8 (3.5)		2.2-2.6 (2.4)		0.3-0.8 (0.6)		0.9-0.9 (0.9)		2.6-17.7 (10.2)		2.4-2.9 (2.6)	
6	3 km	5.9-5.9 (5.9)		6.2-6.4 (6.3)		0.6-0.6 (0.6)		2.1-2.4 (2.2)		9.2-10.3 (9.7)		2.7-2.9 (2.8)	
7		7.7-7.4 (7.3)		8.4-8.5 (8.4)		0.5-0.6 (0.5)		1.1-1.3 (1.2)		12.8-13.9 (13.4)		6.3-7.6 (7.0)	
8		0.8-0.9 (0.9)		0.2-0.4 (0.3)		0.2-0.3 (0.2)		0.1-0.2 (0.1)		3.2-4.5 (3.9)		2.2-4.8 (3.5)	
9		8.3-8.4 (8.3)		1.3-1.5 (1.4)		0.6-0.6 (0.6)		0.5-0.5 (0.5)		13.5-14.5 (14.0)		2.8-3.0 (2.9)	
10	8 km	3.8-3.9 (3.8)		4.1-4.3 (4.2)		0.3-0.4 (0.3)		0.8-1.0 (0.9)		9.6-13.4 (11.5)		4.2-5.0 (4.6)	
11		4.4-4.8 (4.6)		4.7-5.2 (5.0)		0.3-0.3 (0.3)		0.3-0.5 (0.4)		13.8-17.1 (15.4)		8.9-15.9 (12.4)	
12		5.0-5.3 (5.2)		4.0-4.3 (4.1)		0.3-0.6 (0.5)		0.6-0.8 (0.7)		7.9-16.2 (12.0)		5.0-7.5 (6.2)	
13		0.7-0.8 (0.7)		0.5-0.6 (0.5)		0.1-0.1 (0.1)		0.1-0.1 (0.1)		9.0-9.5 (9.3)		6.0-9.2 (7.6)	

Table 2.3.4: Distribution of phytoplankton population (cell count) and genera in the coastal waters off Mumbai during March 2020

Station	Distance (km)	Time & Tide	Cell count (no x 10^3 Cells/ l)		Total genera (no.)	
			S	B	S	B
1	1 km	1030 F.Fld	772.0	1200.0	28	18
		1640 F.Ebb	614.0	829.0	26	22
2		0845 F.Fld	690.0	491.0	21	25
		1500 F.Ebb	811.2	581.0	21	19
3		1000 F.Fld	593.0	415.0	28	22
		1605 F.Ebb	498.0	551.0	26	24
4		1130 Fld-Ebb	476.0	476.0	16	11
5		0700 F.Fld	246.0	327.0	12	14
		1400 F.Ebb	255.0	309.0	13	9
6	3 km	1307 Fld-Ebb	429.0	426.0	21	16
7		0718 Ebb-Fld	642.5	678.0	29	17
8		1100 Fld-Ebb	422.0	405.5	19	20
9		1005 Fld-Ebb	335.0	230.5	21	14
10	8 km	1115 Fld-Ebb	326.9	300.5	18	14
11		1007 Fld-Ebb	186.0	208.5	16	11
12		0800 Ebb-Fld	84.5	70.5	9	9
13		0835 Fld-Ebb	70.5	82.5	10	9

Table 2.3.5: Composition (%) of phytoplankton population in the coastal waters off Mumbai during March 2020

Species name	1	2	3	4	5	6	7	8	9	10	11	12	13	Av.
	1 km					3 km				8 km				
Diatoms														
Asterionellopsis glacialis				0.4	0.1		0.1							<0.1
Aulacoseira grannulata	0.1													<0.1
Bacteriastrum delicatula	<0.1	<0.1						0.1						<0.1
Bacteriastrum hyalinum	1.0	0.3					<0.1		0.3					0.1
Bacteriastrum varians		0.4												<0.1
Chaetoceros curvisetus	42.4	18.3	34.4	24.1	27.7	36.0	26.4	35.9	25.4	39.7	16.6	16.1	32.4	28.9
Chaetoceros danicus	1.0	0.7	0.6	0.2	0.3	1.1	0.8	0.8	1.1	0.4	0.9	0.6	2.6	0.9
Chaetoceros decipiens			26.2	17.1	15.4	8.3	20.3	27.0	18.7	8.2	31.9	34.5	38.9	19.0
Chaetoceros lorenzianus	22.0	29.8	8.7	10.9	4.6	16.8	11.2	10.9	13.1	15.2	25.6	21.3		14.6
Corethron hystrix	<0.1													<0.1
Cylindrotheca closterium	0.2	0.2	0.1						0.1					<0.1
Dactyliosolen fragilissmus	1.2	0.6	1.1	0.5			0.1	0.1						0.3
Ditylum brightwelli	<0.1		<0.1				<0.1							<0.1
Ditylum sol	<0.1		0.1		0.1				0.1	0.1				<0.1
Eucampia zodiacus	0.1	0.2	0.1	0.3			1.1				0.5			0.2
Guinardia flaccida			0.3											<0.1
Guinardia striata	0.4	0.7	0.3	1.3	0.2	0.8	0.2	0.4	0.4	1.3	0.6			0.5
Gyrosigma sp.	0.1		0.1	0.1										<0.1
Lauderia annulata	0.2	0.5	1.6	0.6	0.5	1.0	1.1	0.7	1.0	1.5	0.8			0.7
Leptocylindrus danicus	0.1		0.4	0.4				0.1						0.1
Melosira sp.		0.5												<0.1
Meuniera membranacea										0.2				<0.1
Navicula sp.								0.1						<0.1
Navicula transitans	0.1						0.1							<0.1
Nitzschia longissima							0.2	1.7	0.1	0.6	1.4	2.9	4.9	0.9
Nitzschia sp.														<0.1
Noctiluca cinaillans	0.7	0.1			0.1	0.8	0.1		0.1					0.1

Species name	1	2	3	4	5	6	7	8	9	10	11	12	13	Av.
	1 km					3 km				8 km				
Odontella mobiliensis							<0.1			0.1		0.3	0.3	0.1
Odontellas lnensis								0.1						<0.1
Odontella sp.			0.1											<0.1
Planktoniella sol	0.1		<0.1				0.1	0.1			0.1			<0.1
Pleurosigma angulatum		<0.1												<0.1
Pleurosigma directum		0.1	<0.1	0.2	0.2		0.5	0.1		0.1		1.0	1.6	0.3
Pleurosigma elongatum		0.2				0.1								<0.1
Pleurosigma normanii			0.1		0.1	0.4	0.1	0.4	0.3	0.5		1.0	0.3	0.2
Podolampas palmipes	0.2						<0.1				0.1			<0.1
Proboscia sp.	<0.1	0.1	0.1			0.1	<0.1	0.1						<0.1
Pseudo-nitzschia australis	4.2	5.5	1.2	3.6	0.4	2.8	1.4	2.4	4.3	2.3	2.9	10.3	1.0	3.3
Pseudo-nitzschia delicatissima	0.6	0.1	0.8	8.8	0.2	0.9	0.2			0.2				0.9
Pseudo-nitzschia pungens	1.0													0.1
Rhizosolenias etigera	1.1	0.7	0.1	0.4		0.5	0.4	0.3	0.2		0.1	1.0		0.4
Rhizosolenias tyliformis	0.4													<0.1
Skeletonema costatum	16.8	9.7	9.7	25.5	37.1	22.2	21.6	13.4	15.5	21.7	11.5	3.9		16.1
Skeletonema tropicum		10.8	5.4				7.8		8.1	1.8				2.6
Stephanopyxis sp.		2.0	1.3		2.6	0.8	1.1	1.1	0.5	1.0	1.0			0.9
Streptotheca sp.	0.3	<0.1							0.1					<0.1
Surirella sp.										0.1				<0.1
Thalassionema nitzschioides		1.0	0.2	2.4	6.1	0.8		0.4	0.5	0.1	0.5			0.9
Thalassionema sp.						0.1	0.6	0.4						0.1
Thalassiosira sp.	1.2	1.3	<0.1		0.2	0.1	0.1	0.1	0.1	0.2	0.1	1.0	0.7	0.4
Thalassiothrix frauenfeldii	0.2			0.1										<0.1
Thalassiothrix longissima		0.3	0.1		0.2	0.1				0.5				0.1
Thalassiothrix nitzschioides	0.3		0.2	0.3		0.4	0.3	0.4	0.2		0.1			0.2
Trachyneis sp.		<0.1												<0.1

Species name	1	2	3	4	5	6	7	8	9	10	11	12	13	Av.
	1 km					3 km				8 km				
Triceratium dubium											0.1			<0.1
Tropidoneis sp.		<0.1	<0.1		0.1									<0.1
Dinoflagellates														
Alexandrium sp.	0.6	0.2	0.2		0.1	0.1	0.3	0.4	0.3	0.1	0.3			0.2
Brachydinium sp.									0.1		0.1			<0.1
Ceratium carriense										0.1				<0.1
Ceratium furca	0.5	0.1	0.2		0.1	0.4	0.2	1.0	0.8	0.3	1.1	2.6	0.7	0.6
Ceratium fuscus			0.1					0.1						<0.1
Ceratium gibbernum											0.1			<0.1
Ceratium triops			0.2											
Dinophysis acuminata	0.1	0.1	0.2	0.2	0.5	0.9	0.3	0.1	0.2	0.1				0.2
Dinophysis caudata			<0.1											<0.1
Dinophysis miles											0.1		0.3	<0.1
Gymnodinium breve						0.1	<0.1		0.1					<0.1
Gymnodinium catenatum	0.2	8.4	2.4	1.7	0.4	1.3	1.9	0.6	5.8	2.3	2.0	1.6	11.1	3.1
Gyrodinium spirale	0.8	1.2	0.4	0.2	1.0	1.1	0.4	0.2	1.0	0.4	0.8	1.9	2.6	0.9
Oxytoxum sp.	<0.1													<0.1
Prorocentrum gracile	0.9	1.7	0.6	0.2	1.6	1.3	0.5	0.4	0.9	0.7			1.0	0.8
Prorocentrum lima	0.1													<0.1
Prorocentrum micans	<0.1	0.1	0.7	0.2	<0.1									0.1
Protoperidinium brevipes	0.1													<0.1
Protoperidinium depressum	0.3	1.7	0.2	0.3	0.4	0.4	0.3	0.1	0.4	0.6	0.1		0.7	0.4
Protoperidinium divergens			0.2			0.2		0.1						<0.1
Protoperidinium oceanicum		0.4									0.1			<0.1
Protoperidinium pellucidum			0.1											<0.1
Protoperidinium pentagonum			0.1			0.1		0.1						<0.1
Scrippsiella trochoidea	0.2	1.7	0.2	0.3		0.1	0.1		0.4		0.1		1.0	0.3
Silicoflagellates														
Dictyocha sp.	<0.1													<0.1
Protoperidinium oceanicum		0.4									0.1			<0.1

Species name	1	2	3	4	5	6	7	8	9	10	11	12	13	Av.
	1 km					3 km				8 km				
Protoperidinium pellucidum			0.1											<0.1
Protoperidinium pentagonum			0.1			0.1		0.1						<0.1

2.3.3 Zooplankton

Zooplankton (Greek: Zoon, animal; planktos, wandering) are myriads of diverse floating and drifting animals with limited power of locomotion. Zooplankton includes arrays of organisms, varying in size from the microscopic protozoans of a few microns to some jelly organisms with tentacles, several meters long. Majority of them are microscopic, unicellular or multicellular forms with size ranging from a few microns to a millimetre or more. In addition to size variations, there are differences in morphological features and taxonomic position. Zooplankton by virtue of its food value to higher animals forms a vital link between phytoplankton and fish and hence is an indicator of fish productivity of a marine area. The zooplankton plays an important role to study the faunal bio-diversity of aquatic ecosystems. They include representatives of almost every taxon of the animal kingdom and occur in the pelagic environment either as adults (holoplankton) or eggs and larvae (meroplankton). The planktonic forms with calcareous or siliceous shells or tests contribute to the bottom sediments. The zooplankton are more varied as compared to phytoplankton, their variability in any aquatic ecosystem is influenced mainly by patchiness, diurnal vertical migration and seasons. Environmental factors play a major role in the zooplankton distribution patterns and species composition in the marine ecosystem. Their abundance are not only associated with changes in food supply (phytoplankton crop)but also with a combined effect exerted by hydrographic conditions and pollution stress.

Mesozooplankton standing stock varied widely in terms of biomass (3.7-74.7 ml/100m^3, av. 24.2 ml/100m^3)and population (26.8-1088.9 x10^3/100m^3, av.255.6 ml/100m^3) during March 2020 (Table 2.3.6). The average zooplankton biomass of the zones during all the three sampling periods is given in Figure 2.3.9.

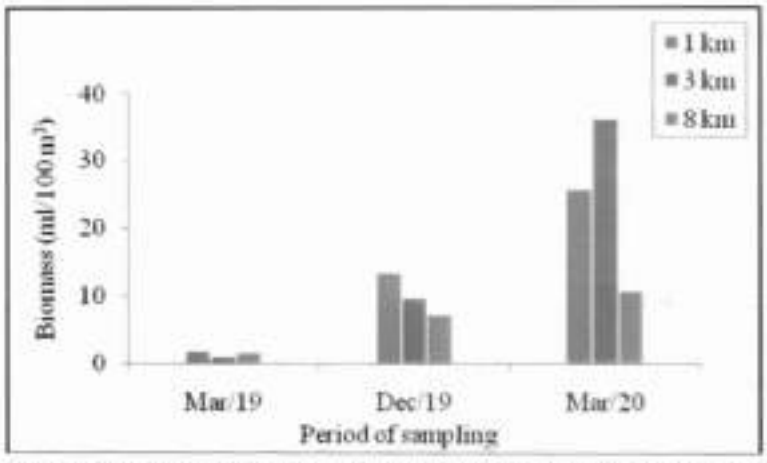


Figure 2.3.9: Variation in mesozooplankton biomass distribution in the coastal waters off Mumbai during different sampling periods.

The biomass distribution study revealed that zooplankton parameters were higher during March 2020 when compared to March 2019 and December 2019 observations. There was 8-10 fold increase in biomass distribution at 3 km zone during the present study period. The biomass distribution showed a significant variation over the sampling periods. The mesozooplankton

population averages for the three zones during March 2019, December 2019 and March 2020 are given in Figure 2.3.10.

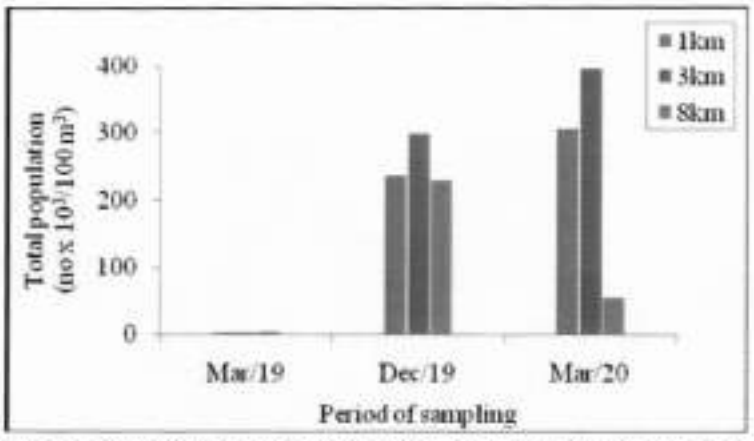


Figure 2.3.10: Variation in mesozooplankton total abundance distribution in the coastal waters off Mumbai during different sampling periods.

Mesozooplankton population also followed the same trend as that of biomass with very less contribution during March 2019. The higher population distribution was observed at 3 km zone in March 2020 (Figure 2.3.10). During December 2019 and March 2020, the population was noticed to be higher at the 3 km zone. Total zooplankton groups ranged at 11-20 (av.16) during March 2020 (Table 2.3.6). The percentage composition of mesozooplankton composition revealed that copepod dominated throughout the study region during March 2020 (Table 2.3.7). Similarly copepods were the dominant groups present in the study region during March 2019 and December 2019. The mesozooplankton group dominance was in the order of copepod (90.7%)>lamellibranchs (5.1%)>cladocerans (1.3%) >appendicularians (0.8%) during March 2020 (Table2.3.7).The mesozooplankton group diversity for the three zones during March 2019, December 2019 and March 2020 are given in Figure 2.3.11.

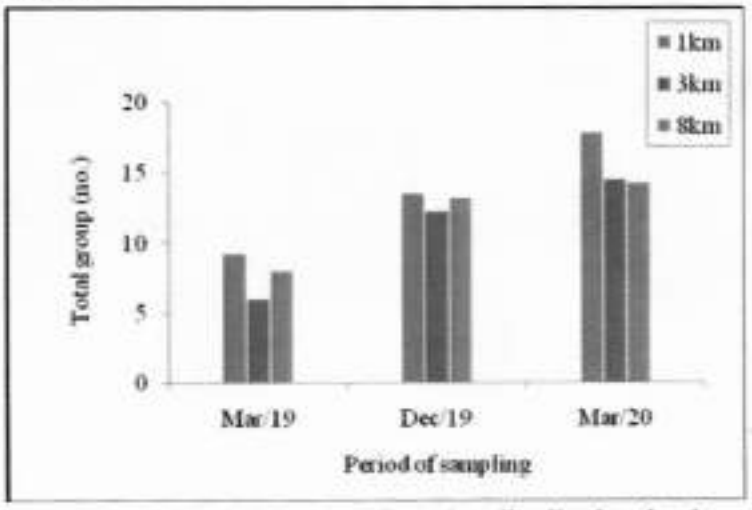


Figure 2.3.11: Variation in mesozooplankton group diversity distribution in the coastal waters off Mumbai during different sampling periods.

The mesozooplankton group diversity was higher during March 2020 mirroring the trends indicated by zooplankton biomass and abundance. Intrazonal differences in group diversity were minor. The impact of tidal variation on mesozooplankton biomass, population and group distribution was investigated in the 1 km zone stations during March 2019 (Figure 2.3.12).

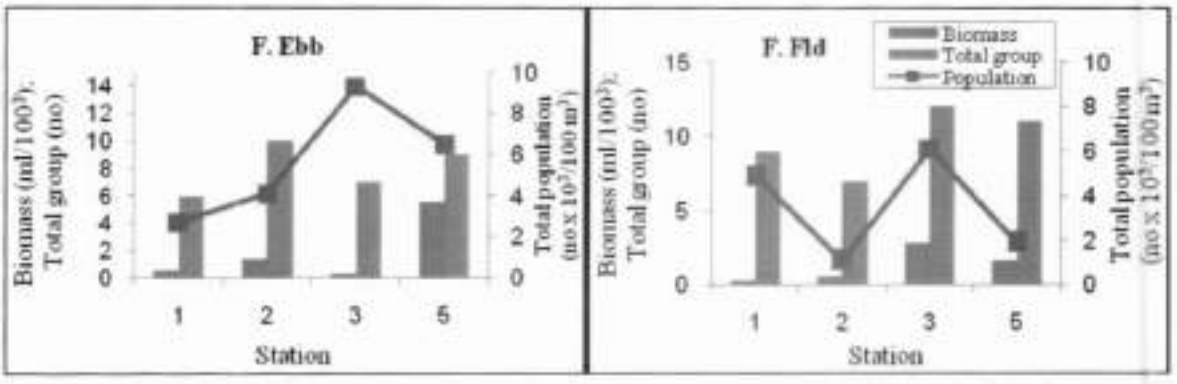


Figure 2.3.12: Tidal variation of mesozooplanktonin the coastal waters off Mumbai duringMarch 2019

The total number of zooplankton groups remained almost the same with minor variation during the F.Ebb and F.Fld periods. There was a change in contribution to biomass and population from F.Ebb to F.Fld period. Among the tidal stations, station 3 showed higher population during the F.Ebb and F.Fld period and higher biomass at station 5 during F.Ebb period (Figure 2.3.12).The tidal biomass, population and total groups during December 2019 are depicted in Figure 2.3.13.

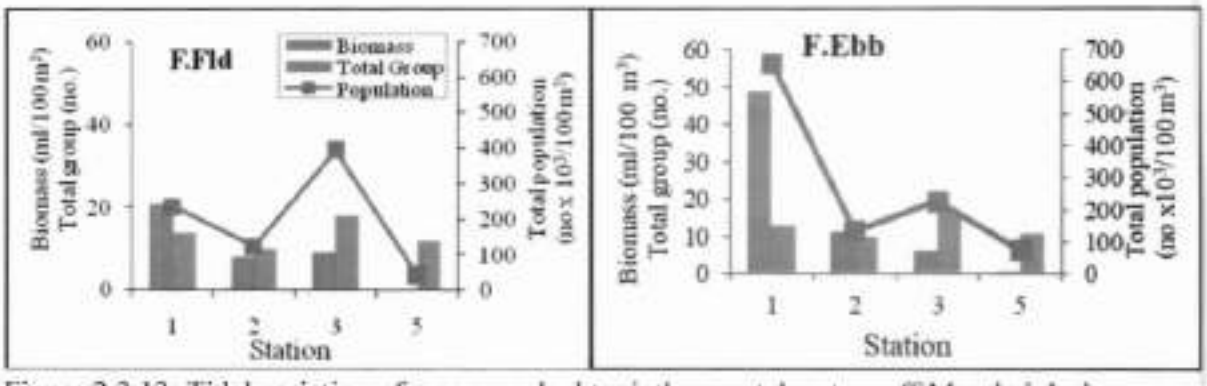


Figure 2.3.13: Tidal variation of mesozooplanktoninthe coastal waters off Mumbai during December 2019.

Station 1 recorded the highest biomass and population during F.Ebb period otherwise the biomass and population were more or less the same during F.Ebb and F.Fld. The total groups during the sampling period were almost similar (Figure 2.3.13). The tidal biomass, population and total groups during March 2020 are depicted in Figure 2.3.14.

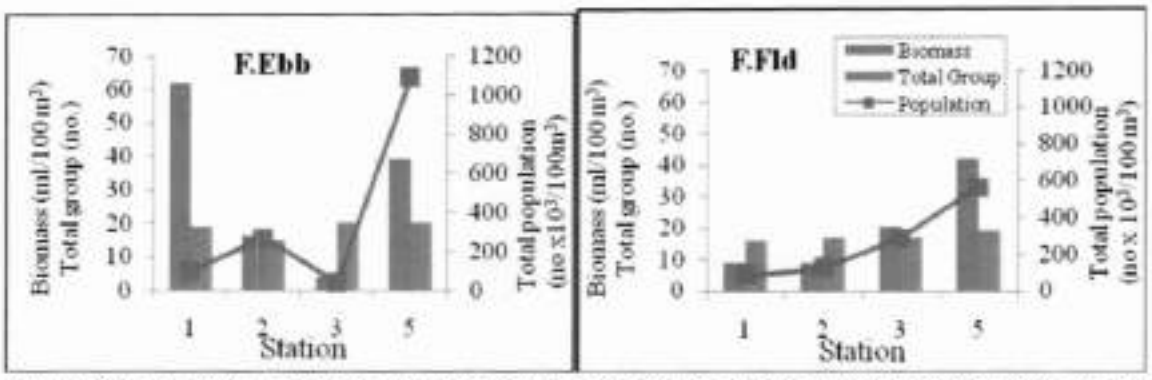


Figure 2.3.14: Tidal variation of mesozooplankton in the coastal waters off Mumbai during March 2020.

The highest biomass was observed at station 1 and highest population at station 5 during F.Ebb period. The biomass and population were more or less same during F.Fld period. The total zooplankton groups remained almost similar during F.Ebb and F.Fld period. Major changes in contribution of biomass and population were observed from F.Ebb to F.Fld period (Figure 2.3.14), though without any specific trend.

Table 2.3.6: Range and average (parenthesis) of mesozooplankton in the coastal waters off Mumbai during March 2020

Station (Date)	Distance (km)	Biomass (ml/100m^3)	Population (nox10^3/100m^3)	Total Groups (no)	Major groups (%)
1 (08/03/2020)	1 km	9.0-62.1 (35.5)	81.1-92.6 (86.9)	16-19 (18)	Copepods (88.3), Ostracods (3.1), Lamellibranchs (2.8), *Lucifer* sp. (1.0), Ctenophores (0.9), Gastropods (0.8), Decapod larvae (0.6), Siphonophores (0.5), Medusae (0.5), Fish eggs (0.5), Fish larvae (0.3), Foraminiferans (0.2), Appendicularians (0.1), Cladocerans (0.1), Polychaetes (0.1), Others (0.1).
2 (06/03/2020)		8.9-16.0 (12.5)	122.5-266.7 (194.6)	15-17 (16)	Copepods (93.3), Appendicularians (2.1), Ostracods (1.6), Lamellibranchs (1.5), Chaetognaths (0.4), Polychaetes (0.3), Cladocerans (0.2), Gastropods (0.2), Fish larvae (0.2), Decapod larvae (0.1), Others (0.1).
3 (07/03/2020)		3.9-20.2 (12.1)	37.9-287.0 (162.4)	17-20 (19)	Copepods (88.7), Cladocerans(6.4), Decapod larvae (1.3), Appendicularians (1.1), Fish eggs (1.0), Siphonophores (0.5), Chaetognaths (0.4), Lamellibranchs (0.1), Fish larvae (0.1), Polychaetes (0.1), Ctenophores (0.1), Others (0.1).
4 (05/03/2020)		17.2-36.9 (27.1)	154.8-351.4 (253.1)	15-17 (16)	Copepods(94.5), Fish eggs (4.0), Ostracods (0.3), Polychaetes (0.3), Appendicularians (0.2), Decapod larvae (0.2),

	1 km				Siphonophores (0.1), Foraminiferans (0.1), Lamellibranchs (0.1), Others (0.1).
5 (05/03/2020)		39.1-41.9 (40.5)	563.5-1088.9 (826.2)	19-20 (20)	Copepods (78.2), Lamellibranchs (19.5), Decapod larvae (0.7), Fish larvae (0.4), Chaetognaths (0.3), Gastropods (0.3), *Lucifer* sp. (0.2), Ostracods (0.2), Polychaetes (0.2), Others (0.1).
6 (08/03/2020)	3 km	7.0-14.9 (11.0)	235.4-270.1 (252.8)	15-15 (15)	Copepods (97.4) Cladocerans (1.1) Appendicularians(0.9) Decapod larvae (0.3) Siphonophores (0.1) Gastropods(0.1) Fish larvae (0.1) Lamellibranchs (0.1) Others (0.1).
7 (06/03/2020)		17.6-43.6 (30.6)	344.0-689.9 (516.9)	15-15 (15)	Copepods (97.2), Appendicularians(1.1), Cladocerans (1.0), Gastropods (0.4), Lamellibranchs (0.1), Decapod larvae (0.1), Others (0.1).
8 (07/03/2020)		27.3-28.9 (28.1)	172.5-178.8 (175.7)	14-15 (15)	Copepods (96.8), Appendicularians (1.3), Siphonophores (0.9), Cladocerans (0.4), Chaetognaths (0.4), Others (0.1).
9 (05/03/2020)		73.7-74.7 (74.2)	633.0-637.5 (635.3)	13-13 (13)	Copepods (94.9), Cladocerans (3.0), Appendicularians (1.4), Siphonophores (0.5), Lamellibranchs (0.1), Others (0.1).
10 (08/03/2020)		3.7-4.6 (4.15)	84.0-87.8 (85.9)	11-12 (12)	Copepods (96.3) Cladocerans (1.4) Appendicularians (1.1) Fish eggs (0.6) Lamellibranchs (0.4) Gastropods (0.1) Chaetognaths (0.1)

					Decapod larvae (0.1), Others (0.1).
11 (06/03/2020)	**8 km**	13.3-19.1 (16.2)	38.0-57.8 (47.9)	16-16 (16)	Copepods (93.9) Cladocerans (1.8) Appendicularians (1.4) Foraminiferans (0.5) Chaetognaths (0.4) Lamellibranchs (0.3) Fish larvae (0.3) Fish eggs (0.3) Decapod larvae (0.3) Siphonophores (0.3) *Lucifer* sp. (0.2) Gastropods (0.1) Polychaetes (0.1) Ctenophores (0.1) Medusae (0.1) Others (0.1).
12 (07/03/2020)		10.1-12.6 (11.35)	26.8-35.6 (31.2)	15-15 (15)	Copepods (86.2) Cladocerans (3.4) Decapod larvae (2.9) Appendicularians (2.2) Chaetognaths (2.0) *Lucifer* sp.(1.2) Amphipods (0.7) Gastropods (0.4) Lamellibranchs (0.4) Polychaetes (0.1) Siphonophores (0.1) Medusae (0.1) Fish larvae (0.1), Others (0.1).
13 (05/03/2020)		10.7-10.7 (10.7)	48.5-59.1 (53.8)	14-14 (14)	Copepods (92.5), Cladocerans (4.3), Lamellibranchs (0.5), Gastropods (0.4), Siphonophores (0.4), Decapod larvae (0.4), Chaetognaths (0.4), Fish eggs (0.4), Fish larvae (0.4), *Lucifer* sp.(0.1), Medusae (0.1), Others (0.1).

Table 2.3.7: Composition (%) of mesozooplankton in the coastal waters off Mumbai during March 2020

Faunal Groups	1	2	3	4	5	6	7	8	9	10	11	12	13	Av
	1 km					3 km				8 km				
Foraminiferans	0.2	-	<0.1	0.1	<0.1	-	-	-	-	-	0.5	-	-	<0.1
Siphonophores	0.5	<0.1	0.5	0.1	<0.1	0.1	<0.1	0.8	0.5	<0.1	0.3	0.1	0.4	0.2
Medusae	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	0.1	0.1	0.1	<0.1
Ctenophores	0.9	<0.1	0.1	-	-	<0.1	<0.1	<0.1	-	-	0.1	<0.1	<0.1	<0.1
Chaetognaths	<0.1	0.4	0.4	<0.1	0.3	<0.1	<0.1	0.4	<0.1	0.1	0.4	2.0	0.4	0.2
Polychaetes	0.1	0.3	0.1	0.3	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	<0.1	0.1
Cladocerans	0.1	0.2	6.4	<0.1	<0.1	1.1	1.0	0.5	3.0	1.4	1.8	3.4	4.3	1.3
Ostracods	3.1	1.6	<0.1	0.3	0.2	-	-	-	-	-	-	-	-	0.3
Copepods	88.3	93.3	88.7	94.5	78.2	97.4	97.2	97.0	94.9	96.3	93.9	86.2	92.5	90.7
Amphipods	<0.1	-	<0.1	-	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.7	<0.1	<0.1
Mysids	-	<0.1	<0.1	<0.1	-	-	-	-	-	-	-	-	-	<0.1
Lucifer sp.	1.0	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	-	-	0.2	1.2	0.1	0.1
Decapod larvae	0.6	0.1	1.3	0.2	0.7	0.3	0.1	<0.1	0.1	0.1	0.3	2.9	0.4	0.3
Stomatopods	-	-	<0.1	-	<0.1	-	-	-	-	-	-	-	-	<0.1
Heteropods	<0.1	<0.1	-	<0.1	<0.1	-	-	-	-	-	-	-	-	<0.1
Gastropods	0.8	0.2	<0.1	<0.1	0.3	0.1	0.4	<0.1	<0.1	0.1	0.1	0.4	0.4	0.2
Lamellibranchs	2.8	1.5	0.2	0.1	19.5	0.1	0.1	<0.1	0.1	0.4	0.3	0.4	0.5	5.1
Appendicularians	0.1	2.1	1.1	0.2	<0.1	0.9	1.1	1.2	1.4	1.1	1.4	2.2	<0.1	0.8
Salpids	-	-	<0.1	-	-	-	-	-	-	-	-	-	-	<0.1
Fish eggs	0.5	<0.1	1.0	4.0	<0.1	<0.1	<0.1	<0.1	<0.1	0.6	0.3	<0.1	0.4	0.4
Fish larvae	0.3	0.2	0.1	<0.1	0.4	0.1	<0.1	<0.1	<0.1	<0.1	0.3	0.1	0.4	0.1
Marine insects	<0.1	<0.1	<0.1	-	<0.1	-	-	<0.1	-	-	<0.1	-	-	<0.1

2.3.4 Macrobenthos

Benthic communities are comprised of complex assemblages of fauna living in association with sea-floor sediments that play a central role in marine ecosystem functioning. They assimilate substantial quantities of organic matter settling on the seafloor, which are transferred to benthic and pelagic food webs. They are also important sources of food for demersal fishes and shellfish; and regions with high benthic production are also known to support commercial fishery sources. Changes in benthic community structure can be the harbinger for associated food web alterations. Depending upon their size, benthic animals are divided into three categories, microfauna, meiofauna and macrofauna. Benthic community responses to environmental perturbations are useful in assessing the impact of anthropogenic impact on water quality.

Macrobenthic organisms have been regarded as the best indicators of environmental changes caused by pollution, because of their constant presence, relatively long life span, sluggish habits and tolerance to differential stress.Limited mobility of benthic fauna makes them exposed to physical, chemical and ecological disturbances. Areas subject to stress, both anthropogenic as well as human, will result in a shift in benthic assemblages. Undisturbed systems are often dominated by K-selected species (large body, long lifespan, slow-growing) while r-selected species characterised by small body size, short lifespan, fast growth represent a disturbed community. Macrobenthic organisms which are considered for the present study are species with body size larger than 0.5 mm.

On the other hand, the meiofauna (species with body size <500 µm and >63 µm) are an important component of marine benthic community with vital roles in benthic energetics. They have an ecological significance in the testing of hypotheses and indices. The number and biomass of meiofauna can vary to a great extent, according to season, latitude, water depth etc. Certain taxa are restricted to particular sediment type. There is great degree of variation in the vertical distribution of meiofauna. Generally the density decreases with increasing depth in the sediment.

a) Macrobenthos

The macrofaunal standing stock in terms of population and biomass at subtidal stations varied from 25 to 55400 no/m^2 (av.3301 no/m^2) and from 0.01 to 222.7 g/m^2 (av.11.2 g/m^2) (wet wt.) during March 2020(Table 2.3.8). The comparative averages of macrobenthic biomass, population and groups at the three zones during the sampling periods are given in Figure 2.3.15-2.3.17.

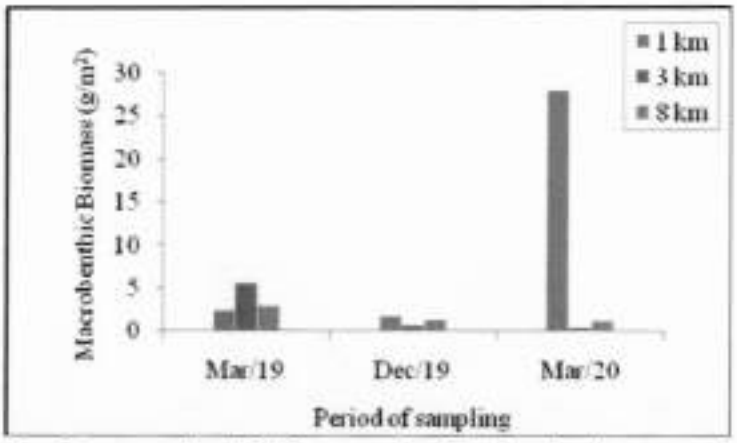


Figure 2.3.15: Variation in macrobenthicbiomass distribution in the coastal waters off Mumbai during different sampling periods.

The above figure revealed that the macrobenthic biomass distribution was observed to be higher at 1 km zone during March 2020. Intra-annual variability in macrobenthic biomass was observed with 12 fold increase in biomass during March 2020 compared to March 2019 at 1 km stretch.

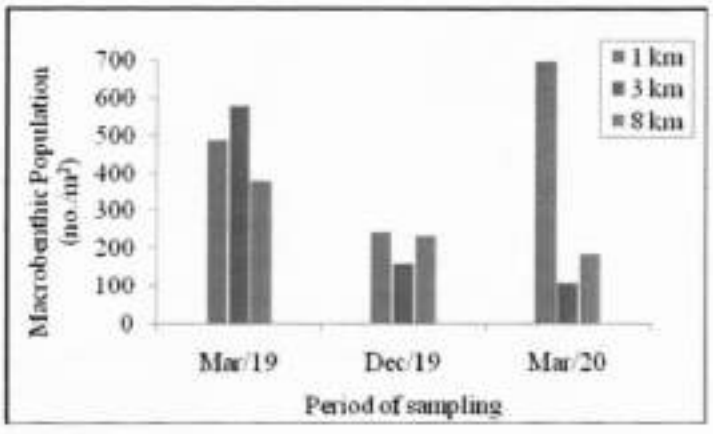


Figure 2.3.16: Variation in macrobenthic population distribution in the coastal waters off Mumbai during different sampling periods.

The macrobenthic population was observed to be higher at 1 km zone during March 2020. During March 2019 the population was higher at the 3 km zone (Figure 2.3.16). Variations in macrobenthic abundance indicated lower values at the 3 and 8 km zones during March 2020.

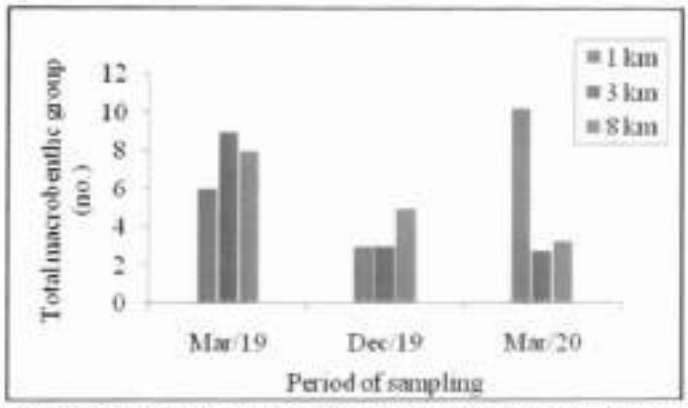


Figure 2.3.17: Variation of macrobenthic group distribution in the coastal waters off Mumbai during different sampling periods.

The macrobenthic total group was observed to be higher at 1 km zone during March 2020. In March 2019, the total groups were observed to be higher at 3 km zone in the study region. The distribution of macrobenthic groups did not show any particular pattern and presented an irregular distribution (Figure 2.3.17).

The subtidal macrobenthic community during March 2020 was dominated by Phylum Arthropoda (90%) followed by Phylum Annelida (9.2%)(Table2.3.9). A total of 66 macrobenthic taxa were identified in the study area during March 2020 (Table 2.3.9). Earlier, a total of 50 and 43 macrobenthic taxa were identified during March 2019 and December 2019. Tanaidaceans were the most dominant at stations 4 and 5 during the present study period. *Cossuracoasta, Capitella capitata* and*Ampeliscabrevicornis*were other dominant species observed during the sampling period. *Cossuracoasta*was present at all the three zones.

The various statistical parameters of macrobenthic community status during March 2020 are given in Table 2.3.10. The macrobenthic species diversity index (*H'*) ranged from 0.6 to 4.2 during the sampling period. The evenness index indicated that the macrobenthic assemblages were well balanced without any dominance of opportunistic species. The comparative ecological quality status of the stations during the three sampling periods are presented below.

Ecological Quality status				
Station	**Distance (km)**	**March 2019**	**December 2019**	**March 2020**
1	**1 km**	-	Poor	Moderate
2		-	Good	Poor
3		Moderate	Good	Good
4		Good	-	High
5		-	Bad	Bad
6	**3 km**	Good	Poor	Moderate
7		Good	Poor	Moderate
8		Good	Moderate	Good
9		-	Moderate	Moderate
10	**8 km**	Good	Good	Moderate
11		High	Moderate	Moderate
12		Moderate	Moderate	Poor
13		Good	Good	Poor

Shannon-Weiner index of macrobenthos indicated that the benthic ecological quality status of the study area ranged between moderate to high during April 2019, bad to good during December 2019 and bad to high during March 2020. During March 2020, 46% of stations fell in moderate category.

	March 2019	**December 2019**	**March 2020**
High	11.1	-	7.7
Good	66.6	33.3	15.4
Moderate	22.2	33.3	46.1
Poor	-	25	23.1
Bad	-	8.3	7.7

Table 2.3.8:Range and average (parenthesis) of subtidal macrobenthos in the coastal waters off Mumbai during March 2020

Station	Distance (km)	Biomass (wet wt.; g/m^2)	Population (no./m^2)	Faunal Group (no.)	Major Group
1	1 km	0.01 – 0.5 (0.3)	25 - 100 (81)	1 - 4 (3)	Decapod larvae, Fish larvae, *Cossura coasta*
2		0.1 - 0.7 (0.3)	50 – 75 (62)	1 - 3 (2)	*Cossura coasta*
3		0.5 – 5.1 (2.0)	75 – 300 (150)	2 - 8 (4)	*Aglaophamus dibranchis*, *Sthenelais* sp., *Paraprionospio patiens*, Maldanidae
4		2.6 - 6.1 (3.9)	1675 - 4450 (3081)	19 - 28 (24)	Tanaids, *Capitella capitata*
5		62.7 – 222.7 (133.2)	20475 - 55400 (38388)	12 – 23 (18)	Tanaids
6	3 km	0.1 – 2.4 (1.0)	75 – 425 (181)	2 – 5 (3)	*Cossura coasta*, *Prionospio* sp., *Aonides oxycephala*
7		0.02 – 0.3 (0.2)	25 – 175 (112)	1– 4 (3)	*Cossura coasta*, *Aglaophamus dibranchis*, *Magelona cincta*
8		0.1– 1.1 (0.4)	25 – 150 (75)	2 – 5 (3)	*Paraprionospio patiens*, *Levinsenia gracilis*
9		0.01 – 0.2 (0.1)	25 – 75 (44)	1 – 3 (2)	Phoronids
10	8 km	0.3 – 8.9 (2.8)	50 – 125 (81)	2 – 4 (3)	*Cossura coasta*, Tanaids, *Paraonis* sp.
11		0.1 – 0.5 (0.3)	75 – 175 (119)	3 - 4 (3)	*Cossura coasta*, *Capitella capitata*, *Ninoe* sp., *Paraonis* sp.
12		0.1 - 3.9 (1.1)	25 - 50 (43)	1 - 2 (1)	*Ninoe* sp., *Cossura coasta*, Pelecypods
13		0.3.- 0.9 (0.6)	100 - 700 (500)	3 - 8 (6)	*Cossura coasta*

Table 2.3.9: Composition (%) of subtidal macrobenthos in the coastal waters off Mumbai during March 2020.

Faunal Groups	1	2	3	4	5	6	7	8	9	10	11	12	13	Av.
	1 km					3 km				8 km				
Phylum Sipuncula														
Sipunculids				0.4	0.1		5.6			7.7				0.25
Phylum Phoronida														
Phoronids		10				3.5		8.3	15					0.06
Phylum Mollusca														
Bivalvia														0.01
Gastropods				0.2	0.02									0.01
Pelecypods	7.4				0.24							14		0.28
Phylum Nemertea				0.4										
Nemerteans				0.4										0.03
Phylum Annelida														
Aglaophamus dibranchis	7.4	10	16.7	0.6	0.02		11				5.3		5	0.26
Aglaophamus sp.														0.00
Aonides oxycephala				3.9	0.05	17.3								0.39
Aonides sp.				2	0.31	6.9								0.45
Aphelochaeta filiformis									14				1.3	0.03
Aricidia sp.				0.6				8.3						0.06
Capitella capitata				18.3	0.02			8.3			15.9		1.3	1.40
Caulleriella acicula			4		0.02									0.01
Caulleriella sp.				0.2										0.03
Chone filicaudata				0.2	1.13									0.13
Cirratulus sp.				2						7.7				0.16
Cossura coasta	16	61	8.8	0.2		31.1	44.6	8.3		23	42	14	67.5	1.39
Euchone sp.				2.2	1.03									1.08
Eunice indica					0.03									0.03
Glycera longipinnis					0.02									0.01
Glycera natalensis				0.4	0.33	6.9								0.35
Glycera sp.													1.3	0.01
Isolda pulchella			4	0.2										0.03
Leocrates sp.						6.9				7.7				0.04
Levinsenia gracilis				1				16.7	14					0.12
Lumbrinereis meteorana													7.5	0.09
Magelona cincta	7.4		4	4.5	0.02		11	8.3						0.41
Maldanidae (gen. sp.)			12.8	1									1.3	0.13
Mediomastus sp.	7.4	10		0.4		6.9			14				1.3	0.12
Ninoe sp.		10	4	0.2	0.02			8.3	14	7.7	15.9	72	6.3	0.29
Notomastus sp.				0.2										0.01
Orbinia sp.					0.02									0.01
Ophiodromus sp.					0.02									0.01
Paraonis sp.										15.3	10.5			0.06

Table 2.3.9: contd. (2)

Faunal Groups	1	2	3	4	5	6	7	8	9	10	11	12	13	Av.
	1 km					3 km				8 km				
Paraprionospio pinnata			12.8	3	0.1		5.6	16.7						0.40
Phyllodoce capensis					0.08									0.07
Phyllodoce malmgreni					0.02									0.01
Poecilochaetus serpens				2.4	0.05									0.22
Prionospio sp.				0.6		20.7							1.3	0.15
Pygospio sp.														0.04
Scoloplos uniramus				0.2	0.02									0.03
Sigambra parva			4	1				8.3	14				2.5	0.14
Spio sp.				0.4	0.02									0.04
Sternaspis scutata				7.9										0.57
Sthenelais sp.			16.7	3.2			5.6				5.3		2.5	0.35
Syllis sp.				0.2			5.6							0.03
Terebellides stroemi				0.6	0.02									0.06
Phylum Arthropoda														
Ampelisca aequicornis				0.2	0.1									0.10
Ampelisca brevicornis	7.4			0.2	1.84		5.6							1.69
Ampelisca sp.				0.4	0.07									0.09
Cheiriphotis sp.				0.2										0.71
Cheiriphotis trifurcata					0.03									0.03
Maera othonis				2										0.15
Maera sp.				3.7	0.8								1.3	0.99
Metaprotella problematica				1.4										0.10
Paracaprella sp.				1										0.07
Cumaceans			4	3.2	0.49									0.69
Copepods				0.4										0.03
Decapod larvae				1				8.3						0.14
Brachyurans				0.2	0.07									0.07
Tanaids				23.1	93.01		5.6		14	23				84.9
Penacids			4	0.4							5.3			0.06
Isopods				1	0.1									0.16

Table 2.3.9: contd. (2)

Faunal Groups	1	2	3	4	5	6	7	8	9	10	11	12	13	Av.
	1 km					3 km				8 km				
Phylum Echinodermata														
Ophiuroids			4	0.4	0.05									0.09
Phylum Chordata														
Fish larvae										7.7				0.04

Table 2.3.10: Diversity indices of macrobenthic community in the coastal waters off Mumbai during March 2020

Station	*S*	*N*	*d*	*J'*	*H'(log$_2$)*
1	8	81	1.59	0.92	2.76
2	5	62	0.97	0.75	1.74
3	13	149	2.40	0.92	3.42
4	48	3087	5.85	0.75	4.17
5	36	38388	3.32	0.12	0.62
6	8	183	1.34	0.89	2.67
7	9	112	1.70	0.82	2.60
8	10	74	2.09	0.97	3.23
9	7	42	1.61	1.00	2.81
10	8	81	1.59	0.93	2.80
11	7	119	1.26	0.84	2.37
12	3	43	0.53	0.72	1.13
13	13	500	1.93	0.52	1.94

b) Meiobenthos

The meiofaunal population and biomass varied from 42 to 984 µg/10 cm^2 (av. 302.6 µg/10 cm^2) and from 61 to 4593 no/10 cm^2 (av. 607 no/10 cm^2) (wet wt.) during March 2020 (Table 2.3.11). Faunal group diversity (no) in the study region ranged from 4-13 (av.6). The average meiobenthic parameter values for the three zones during the three sampling periods are presented in Figure 2.3.18 - 2.3.20.

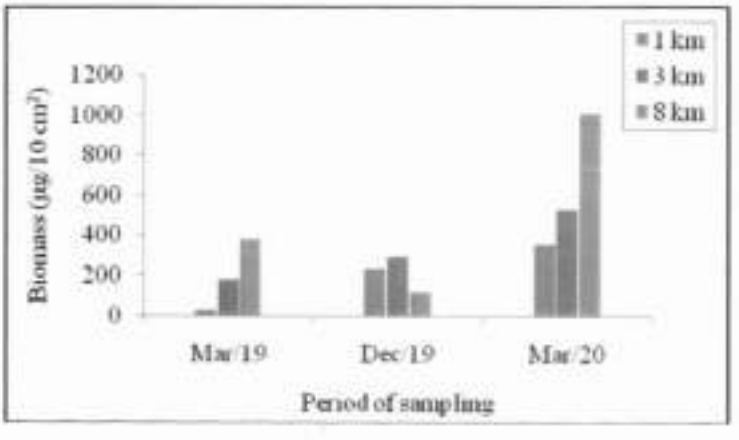


Figure 2.3.18: Variation in meiobenthic biomass distribution in the coastal waters off Mumbai during different sampling periods.

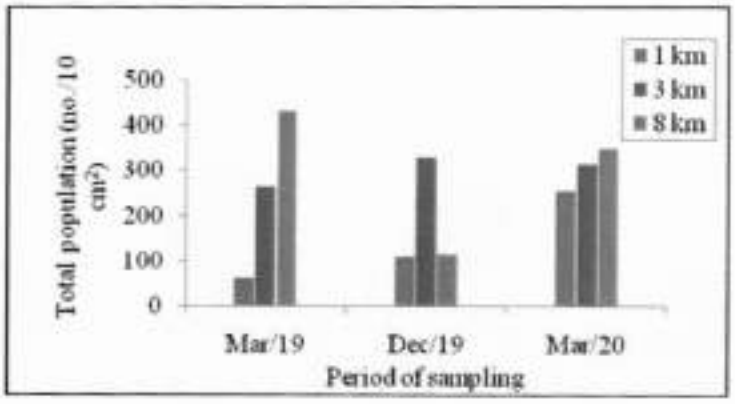


Figure 2.3.19: Variation of meiobenthic population distribution in the coastal waters off Mumbai during different sampling periods.

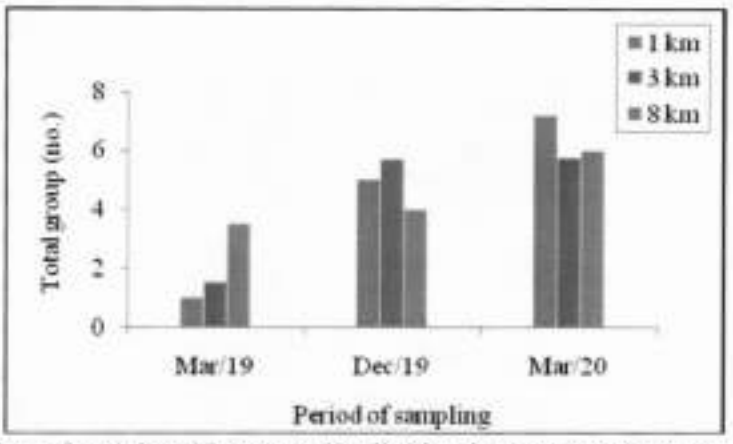


Figure 2.3.20: Variation of meiobenthic group distribution in the coastal waters off Mumbai during different sampling periods.

The stations which were 8 km away from the shoreline recorded maximum biomass and population whereas total group was found to be higher at 1 km zone during March 2020 (Figure 2.3.18-2.3.20). The percentage composition of meiobenthic community indicated that the study region was dominated by nematodes followed by hydrozoa polyp and foraminifera during March 2020. During March 2019 and December 2019 also it was observed that nematodes were the dominant community. Groups like nemertina, fish egg, polychaeta, tanaidacea, echiura and copepod were also encountered (Table 2.3.12).

Table 2.3.11: Range and average (parenthesis) of subtidal meiobenthos in the coastal waters off Mumbai during March 2020

Station	Distance (km)	Biomass (µg/10 cm^2)	Population (no./10 cm^2)	Faunal Group (no.)
1	1 km	191-330 (227)	177-375 (252)	4-6 (5)
2		61-135 (88)	142-198 (167)	4-7 (5)
3		189-454 (278)	156-467 (267)	8-9 (8)
4		451-586 (500)	120-545 (311)	7-9 (8)
5		321-1267 (647)	177-375 (283)	7-13 (10)
6	3 km	64-242 (181)	205-361 (257)	5-8 (6)
7		72-277 (188)	120-389 (236)	4-9 (6)
8		84-1409 (855)	42-984 (467)	5-8 (6)
9		184-1354 (881)	205-396 (295)	4-5 (5)
10	8 km	320-1354 (899)	234-453 (363)	6-6 (6)
11		168-877 (414)	304-453 (363)	5-6 (6)
12		388-835 (577)	234-340 (274)	5-7 (6)
13		326-4593 (2150)	134-743 (399)	6-7 (6)

Table 2.3.12: Composition (%) of subtidal meiobenthos in the coastal waters off Mumbai during March 2020

Groups	1	2	3	4	5	6	7	8	9	10	11	12	13	Av.
	1 km					3 km				8 km				
Nematoda	29.91	21.13	52.21	37.88	15.83	42.20	48.00	65.15	19.20	37.01	40.91	35.34	17.75	35.58
Hydrozoa polyp	48.60	54.93	17.70	27.27	1.67	37.61	32.00	6.57	36.80	25.97	35.71	25.86	2.37	27.16
Foraminifera	14.02	5.63	10.62	10.61	0.00	5.50	7.00	19.70	38.40	29.22	13.64	25.86	71.60	19.37
Nemertina	4.67	8.45	6.19	5.30	3.33	5.50	3.00	1.01	2.40	3.25	5.84	6.90	4.14	4.62
Fish egg	1.87	7.04	3.54	2.27	2.50	3.67	2.00	1.52	1.60	2.60	2.60	3.45	0.59	2.71
Polychaeta	0.00	0.00	0.00	9.85	16.67	2.75	1.00	1.52	0.00	0.00	0.00	0.00	0.59	2.49
Tanaidacea	0.00	0.00	0.00	0.00	22.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.73
Echiura	0.00	0.00	0.00	0.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.54
Copepoda	0.00	1.41	2.65	3.03	3.33	1.83	1.00	3.54	0.00	0.00	0.00	0.00	0.00	1.29
Ostracoda	0.00	0.00	0.00	1.52	6.67	0.00	0.00	0.51	1.60	1.95	0.00	0.86	1.78	1.14
Insecta	0.93	0.00	0.88	0.00	0.00	0.92	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.52
Bivalvia	0.00	0.00	0.00	0.00	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.86	1.18	0.41
Halacaroida	0.00	1.41	1.77	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32
Nauplius	0.00	0.00	2.65	0.76	0.00	0.00	0.00	0.51	0.00	0.00	0.00	0.00	0.00	0.30
Sipuncula	0.00	0.00	1.77	0.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19
Turbellaria	0.00	0.00	0.00	0.00	0.83	0.00	1.00	0.00	0.00	0.00	0.65	0.00	0.00	0.19
Amphipoda	0.00	0.00	0.00	0.00	1.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
Oligochaeta	0.00	0.00	0.00	0.76	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12
Ophiuroid	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.00	0.07
Cumacea	0.00	0.00	0.00	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
Cnidaria	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.65	0.00	0.00	0.05

3 SHORELINE CHANGE ANALYSIS

The Sentinel-2A images for the month of January with similar tides were used for extracting the shorelines for the years 2019, 2020 and 2021. The shorelines highlight the changes in the coastline due to the undergoing land reclamation process. It is observed that most of the reclamation works carried outafter January 2019. Shoreline has shifted towards sea approximately 100m near upper Worli, 300m in Cumballa hill and 150m near breach candy in January 2020 satellite image. These were the initial changes observed, but the recent shoreline from January 2021 shows a massive reclamationin the sea. The land reclaimed is0.16 Sq.km in upper Worli, 0.12 Sq.km in Haji Ali and 0.40 Sq.km in Cumballa Hill regions (Figure 3.1). This analysis shows the progress of reclamation in Mumbai coast and the status of coastline in other areas. It is also observed that there are no significant shoreline changes observed other than the reclamation areas.

Figure 2.3.20: Shoreline of the Mumbai coast in 2019,2020 and 2021

4 CONCLUSIONS

Prediction of impacts of an activity on aquatic environmental quality is often achieved by comparing the results of monitoring with the results obtained prior to the commencement of the activity (pre-project). Environmental monitoring and ecological status assessment were carried out in the coastal zone between Rajiv Gandhi Sea Link in the north to Nariman Point in the south, by sampling at 13 locations positioned in a grid like manner covering the coastal waters at different distances (1km, 3 km, 8 km) from the area of development. Based on one-time observations during March 2019, December 2019 and March 2020, which respectively corresponds to the pre monsoon, post monsoon and pre monsoon seasons, the following conclusions are drawn.

i. The trend of variation in water temperature closely followedthat of air temperature variation at the1km, 3km and 8km zones. The values remained lower than 35°C, which is considered as threshold limit for most tropical aquatic species. The variation in water temperature was not affected by any anthropogenic activities and more relative to short-term diurnal variation in the study region.
ii. There was no significant variation in pH averaged at 1km, 3km and 8km zones during all the campaigns. Variation in pH was increased by 0.5 units between March 2019 and March 2020, which is not significant considering the hydrodynamics in coastal water. The decrease of pH during December as compared to March is indicated seasonal shifts in pH owing to low pH water prevalent during post monsoon.. During all the sampling periods, the ranges of pH range did not exceed 9, which indicated no direct effect on aquatic life.
iii. The increasing trend of variation in salinity from 1km towards 8km was not statistically significant, however, it can be indicative towards influence of marine water at the distant stations. The variation in salinity between March 2019 and March 2020 is relevant with short term changes owing to dynamics of coastal water. Relatively lower salinity in December as compared to March is indicated influence of low salinity water during post monsoon. Overall, there was no record of sudden rise in salinityduring the study period, which can affect the biological organisms.
iv. There was no distinctive variation in SS recorded among 1km, 3km and 8km zones during the study periods. On an average, the SS values during all the three campaigns were lower than 45 mg/l, close to the standard limit found in coastal waters of Arabian Sea. Likewise, the turbidity showed lower values during the March campaigns owing to seasonal change. The average limits of turbidity were lower than 20 NTU, which is low when compared to standard limits of turbidity generally found in the coastal waters of Arabian Sea. The turbidity in the study area therefore, did not indicate any abrupt increase due to construction activities.
v. Throughout all the campaigns, average DO limits were higher than 5 mg/l, at 1km, 3km and 8km zones, which indicated that well oxygenated water column prevailed for the healthy aquatic life. The DO generally decreases either due to intense organic matter oxidation or mixing with low oxygen waters. In the former case, BOD rises with a decline in DO. However, during March 2020, higher BOD limits (>3 mg/l) observed were associated with fairly high DO (>6 mg/l), which is indicative of short-term or localized impact of sewage that could raise the BOD, which was absent in March 2019 and December 2019.

vi. Inorganic nutrients such as nitrite, nitrate and phosphate were comparatively lower during March 2020, which is indicative towards their biological constraint during pre-monsoon, which favours DO in the study area. There was no significant enrichment of nutrients due to any anthropogenic activities during the study period. The ratio of sulphate to chloride indicates no significant enrichment of these ions due to construction activities.

vii. The average limits of PHc in water as well as in the sediment collected from the study area indicated no significant contamination by oil compounds, which can affect the biological organisms.

viii. The sedimentary metal contents at the 1km, 3km and 8km zones were not significantly enriched during the study campaigns and were mainly related with variation due to littoral transport and/or continental sediment movement. The average concentration of metal can fluctuate along the longitudinal gradient due to differences in source and abundance in the grainsized fraction of sediment deposited in the area. However, such variation was not found during the study period. Similarly, the organic carbon content, which is often associated with metal oxides remain less variable during the campaign. This is indicative of limited source variability of sediment and/or no significant anthropogenic addition of metals into sediment.

ix. Seasonal differences in Total Viable Counts of bacteria were evident as the values were distinctly higher during both the March periods as compared to December.

x. The enhanced concentration of chlorophyll *a* at 1 km zone (March 2020) could be probably because the area received nutrients from the nearby terrestrial zones. The major class of phytoplankton observed were diatoms followed by dinoflagellates.

xi. Shannon-Wiener diversity index (H') can be used as a proxy for ecosystem modification under eutrophication or pollution stress. H' of phytoplankton were higher during December 2019 and March 2020 indicating balanced phytoplankton populations during that period. Shannon Wiener index of phytoplankton as a pollution index suggested poor and moderate conditions during March 2019. During December 2019 and March 2020 the study area indicated moderate to good condition.

xii. Zooplankton parameters were higher during March 2020 when compared to March 2019 and December 2019 observations, indicating the absence of impact of anthropogenic activities on them.

xiii. Shannon-Weiner index of macrobenthos indicated that the benthic ecological quality status of the study area ranged between moderate to high during March 2019, bad to good during December 2019 and bad to high during March 2020. During March 2020, 46% of stations fell in moderate category.

xiv. Apart from the reclamation regions, no significant changes in the shoreline is observed during the study period.

The above conclusions will need to be further substantiated with future data for more cohesive understanding of the changes in the coastal marine water quality, its influencing factors and shoreline changes.

x-x-x-End of this report-x-x-x