Environmental Impact Assessment

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MLD: Greater Malé Waste-to-Energy Project – Waste to Energy Plant PART D

Prepared by Ministry of Environment of the Republic of Maldives for the Asian Development Bank.

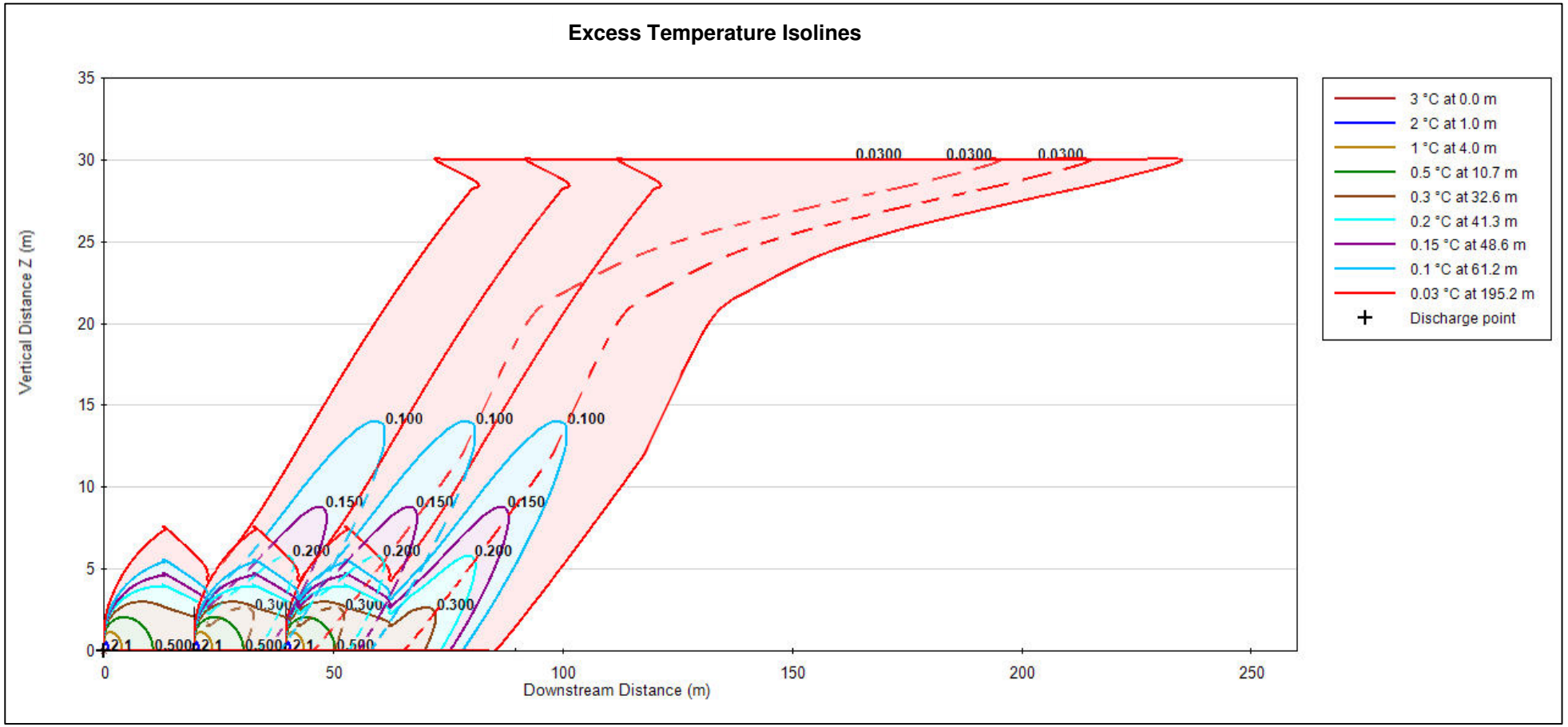

Figure 5.8: Interpreted Overall Results for Vertical Profile of Heat Plume for SW Monsoon – Spring Tide

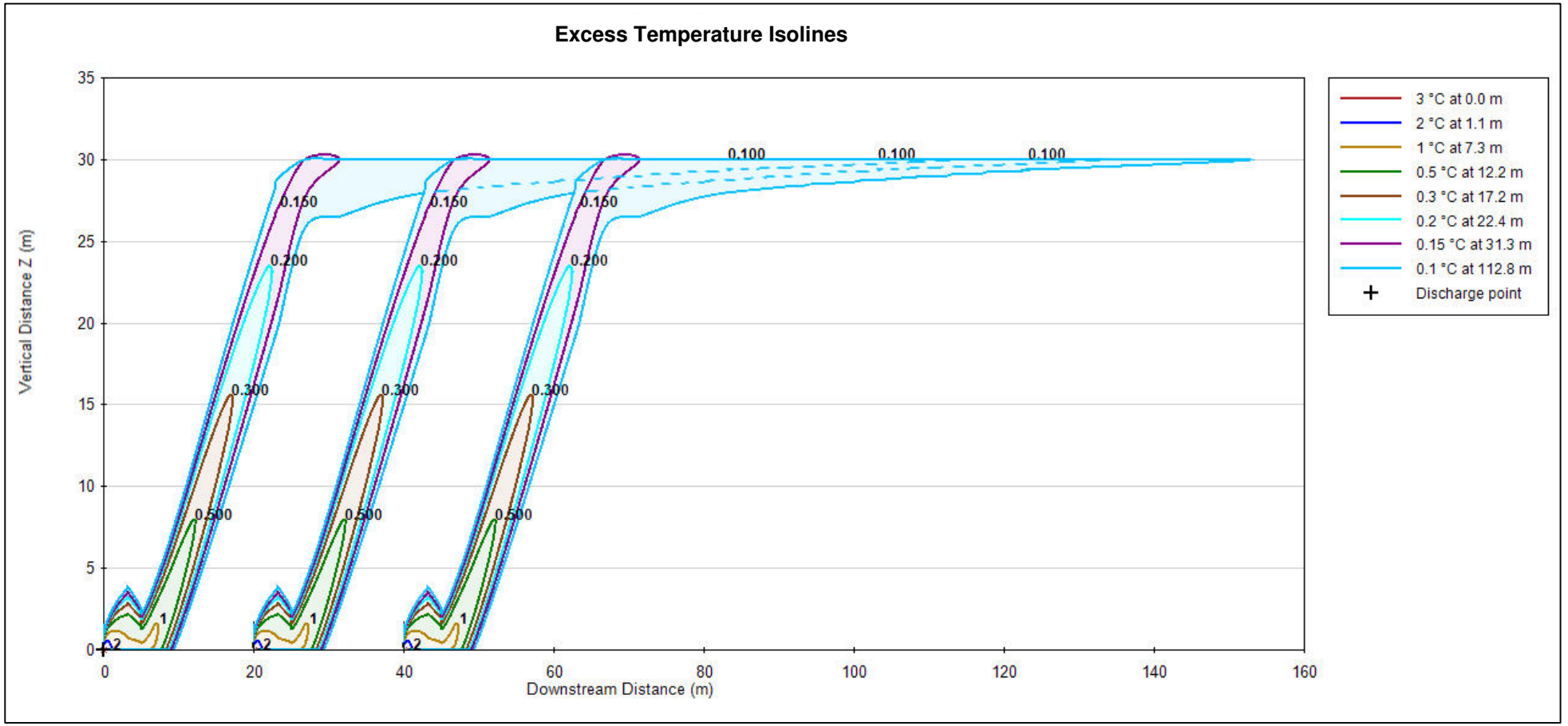

Figure 5.9: Interpreted Overall Results for Vertical Profile of Heat Plume for SW Monsoon – Neap Tide

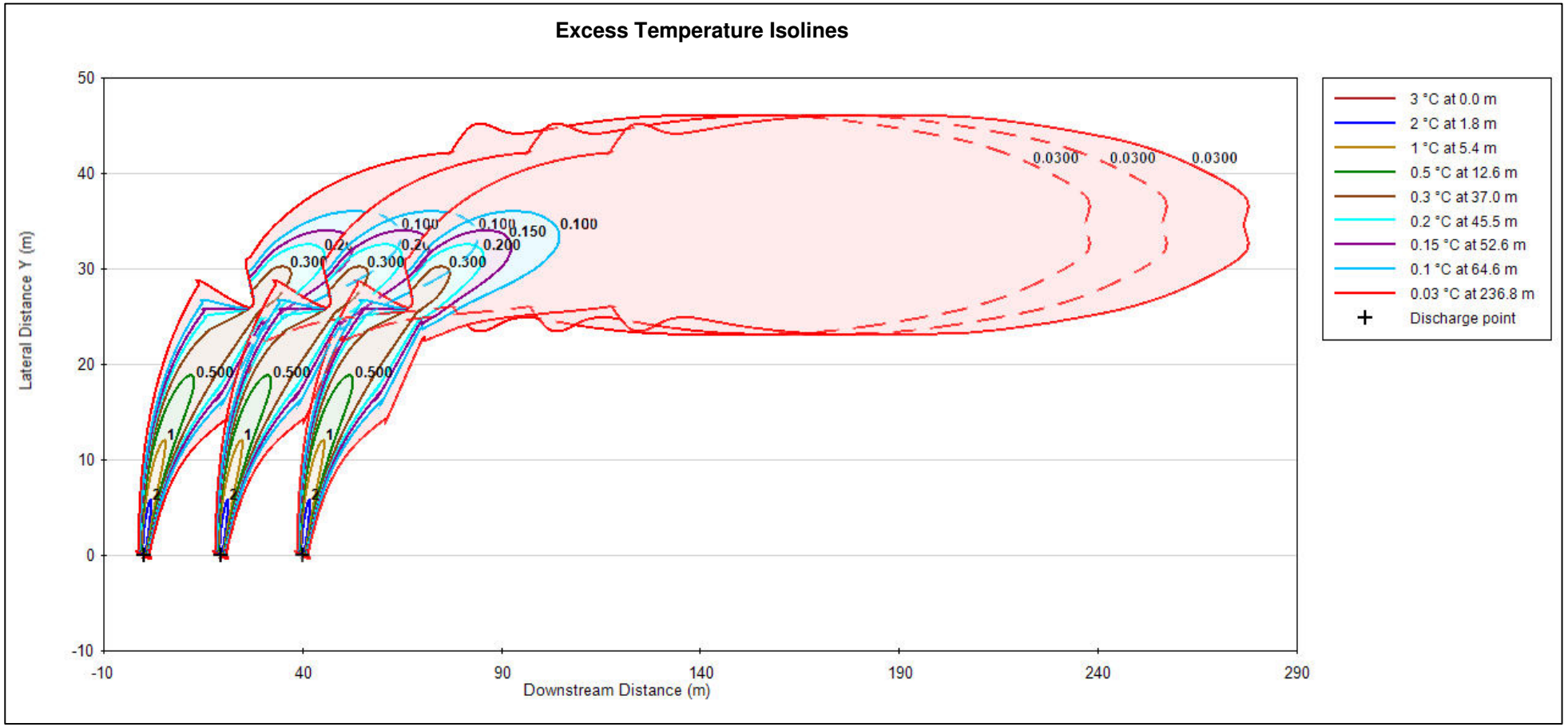

Figure 5.10: Interpreted Overall Results for Plan View of Heat Plume for NE Monsoon – Spring Tide

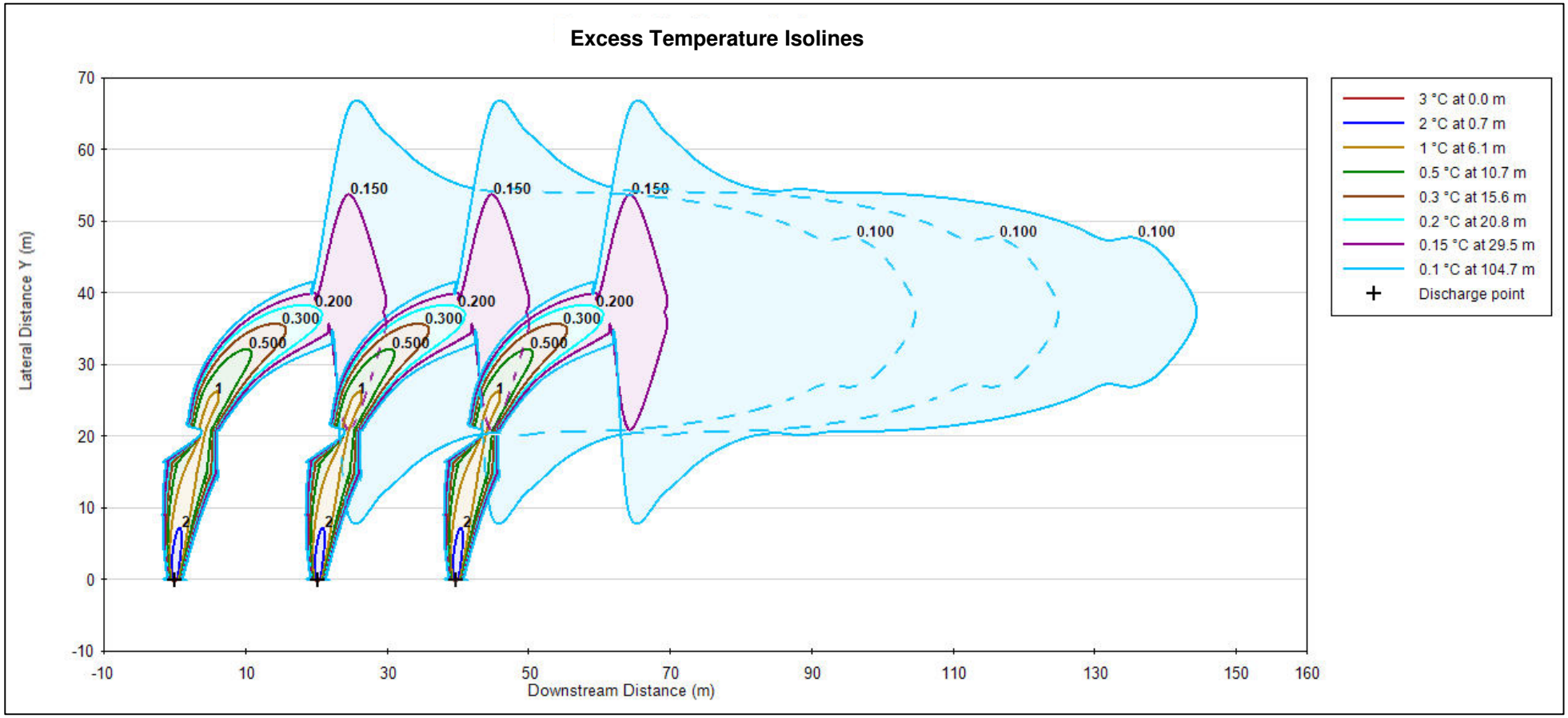

Figure 5.11: Interpreted Overall Results for Plan View of Heat Plume for NE Monsoon – Neap Tide

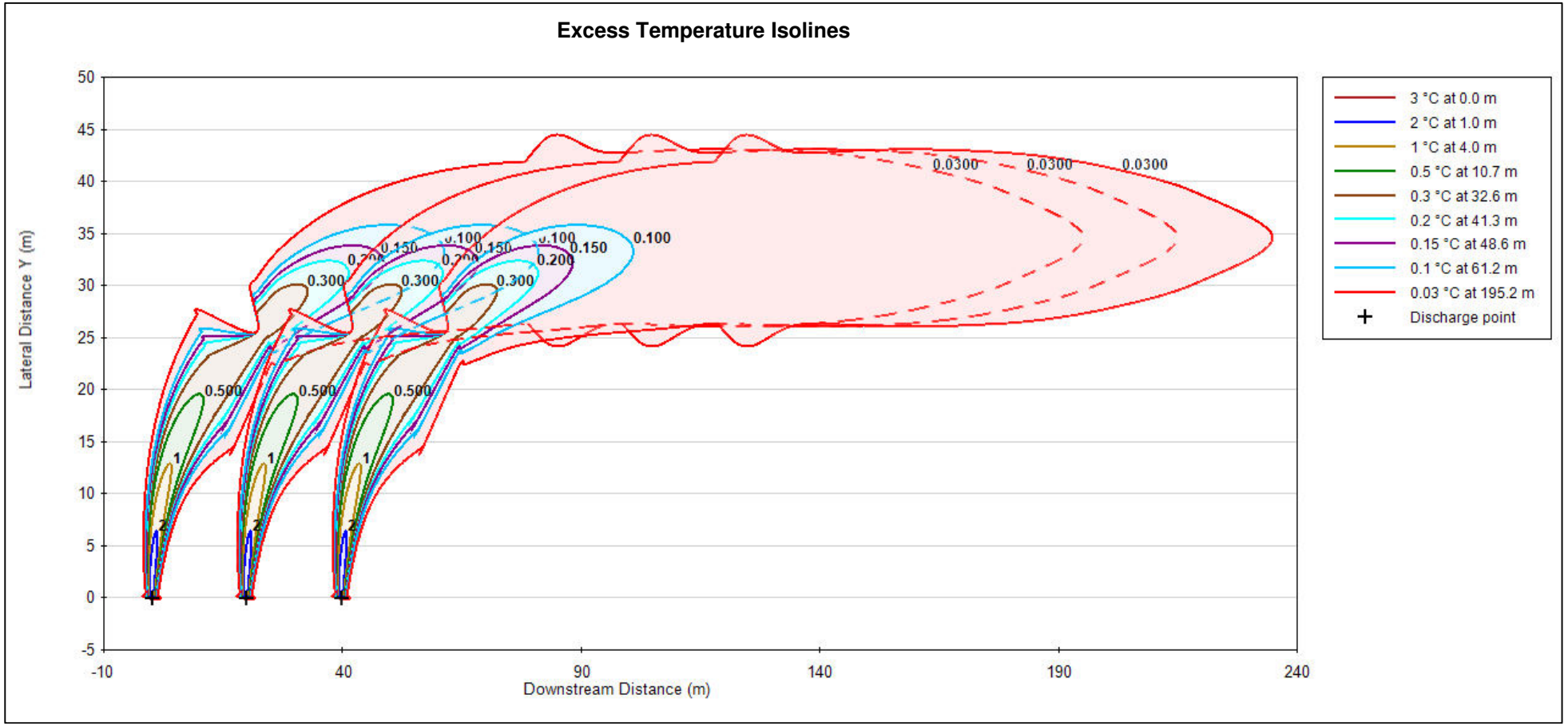

Figure 5.12: Interpreted Overall Results for Plan View of Heat Plume for SW Monsoon – Spring Tide

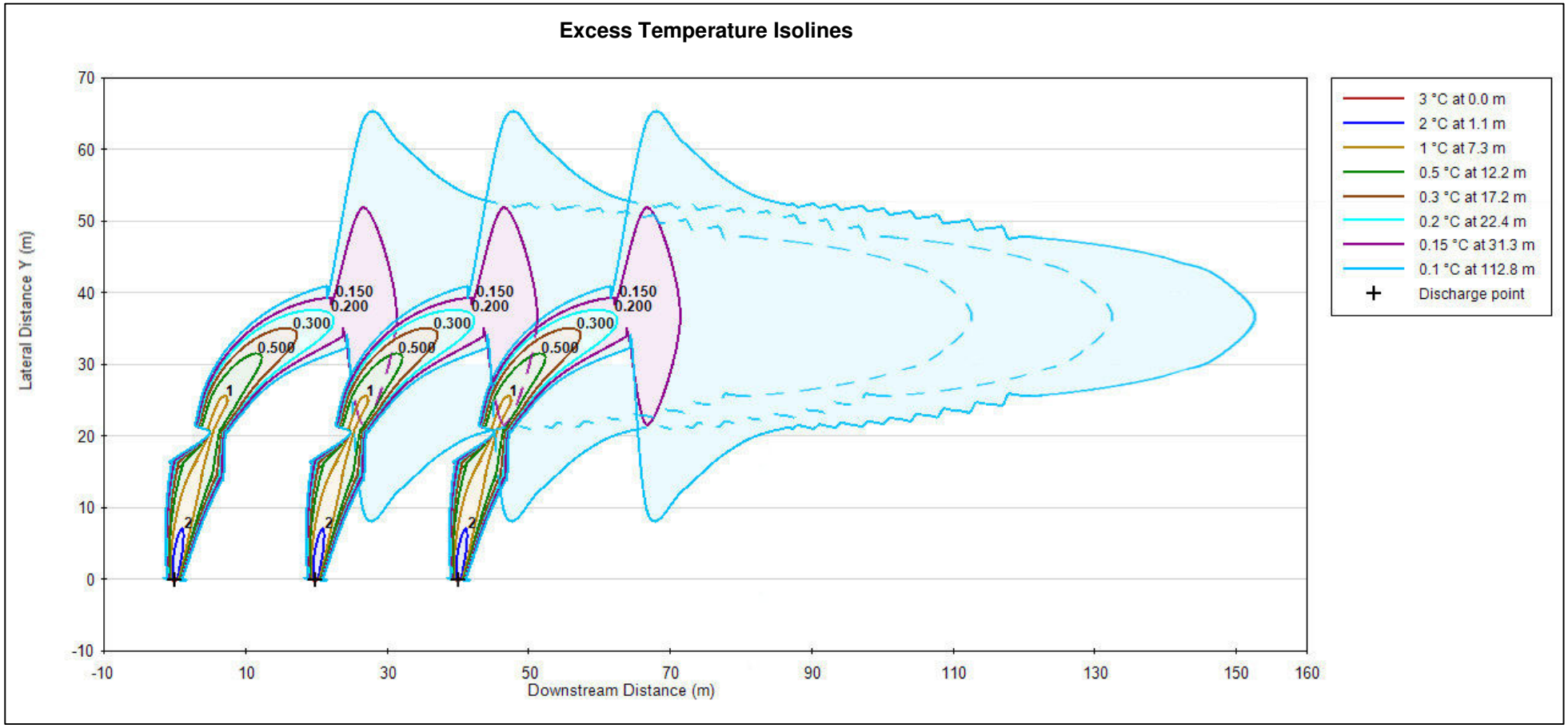

Figure 5.13: Interpreted Overall Results for Plan View of Heat Plume for SW Monsoon – Neap Tide

One Outfall instead of Three Outfalls

What would be the result, if all three outfall flows are combined together and discharged through one single outfall? Although this is not the real case, this system was also simulated in the near field model to compare the effect relative to the three single outfalls.

Same as the previous simulations, four scenarios, (i.e. two monsoon conditions and two tidal conditions) were also considered in this simulation. Accordingly, 3D views of heat plume dispersion for different scenarios are given in Figures 5.14 to 5.17 and plan views, elevations and graphs of excess temperature vs downstream distance are given in Annex B.

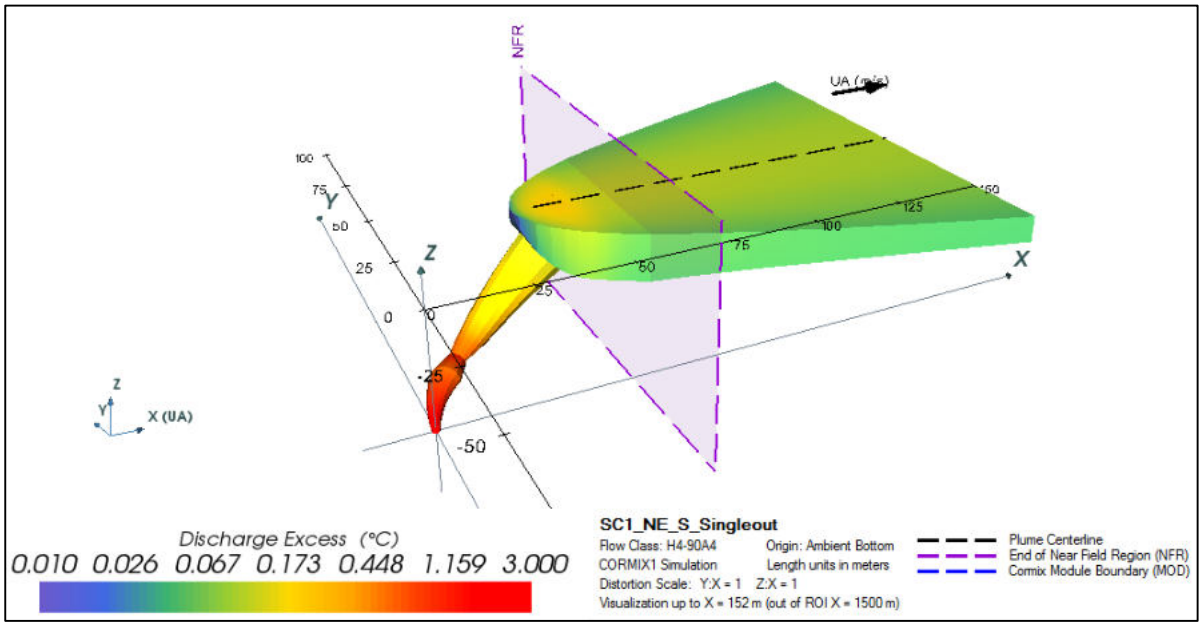

Figure 5.14: Effluent Discharged at Near-Field Region for Combined Single Outfall (NE Monsoon – Spring Tide)

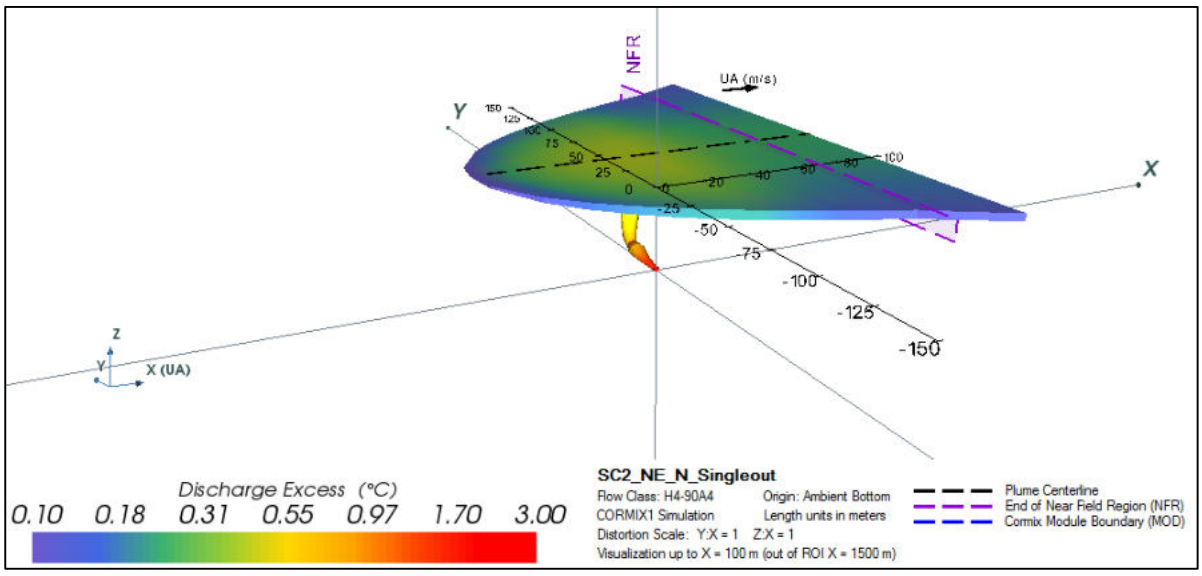

Figure 5.15: Effluent Discharged at Near-Field Region for Combined Single Outfall (NE Monsoon – Neap Tide)

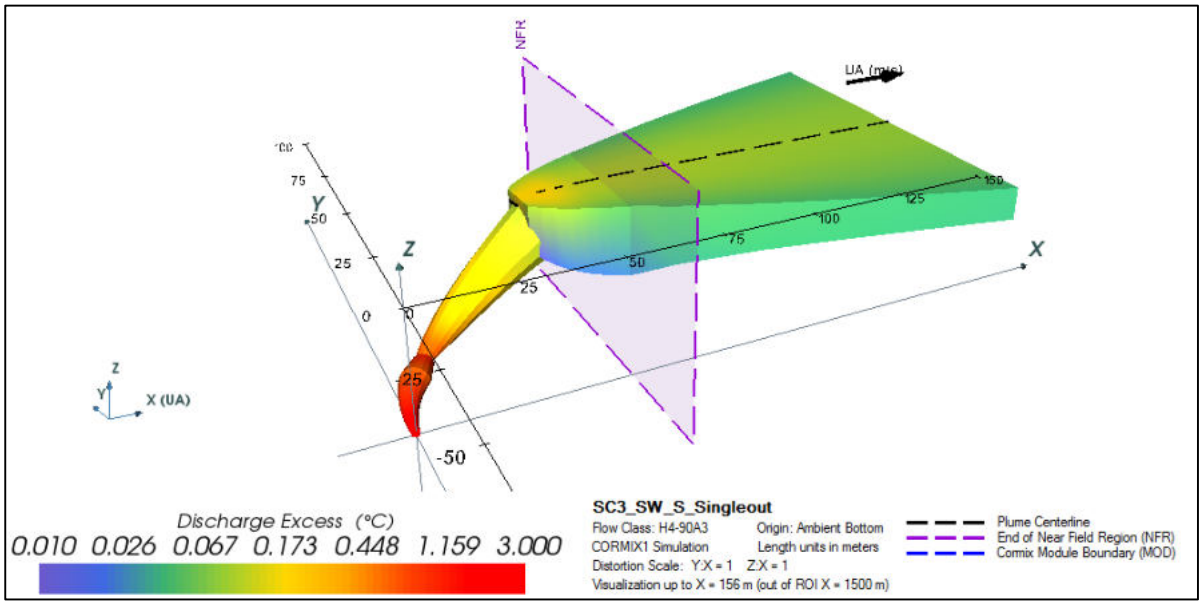

Figure 5.16: Effluent Discharged at Near-Field Region for Combined Single Outfall (SW Monsoon – Spring Tide)

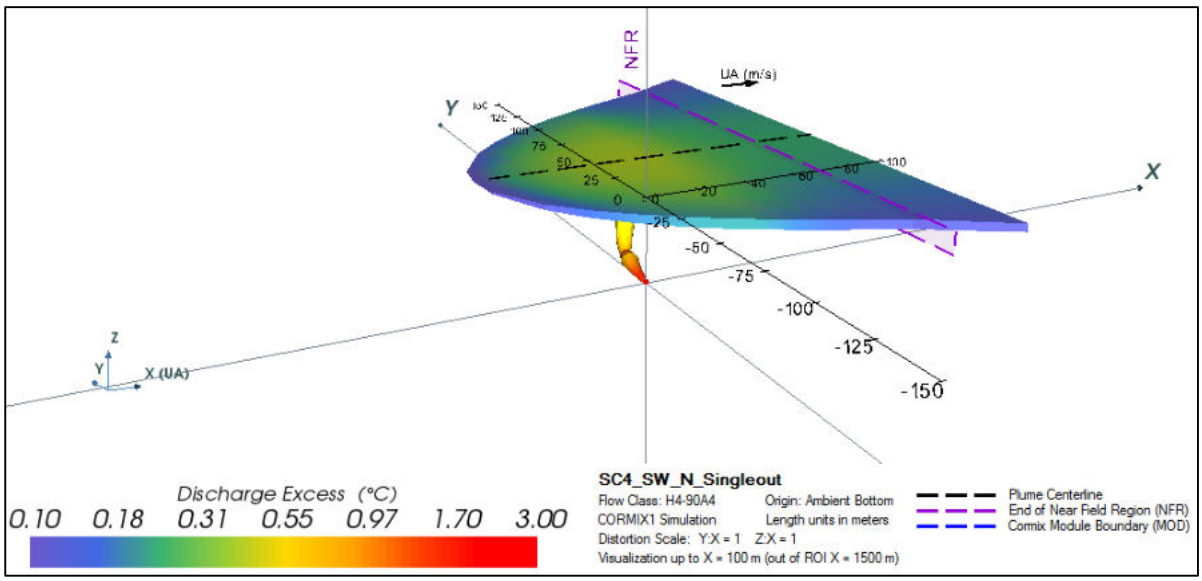

Figure 5.17: Effluent Discharged at Near-Field Region for Combined Single Outfall (SW Monsoon – Neap Tide)

The excess temperatures at the boundary of the near field were extracted from the model results for every scenario of combined single outfall case and they are presented in the table below.

Table 5.3: Excess Temperatures at Near Field Boundary for Combined Single Outfall

Sc. ID	Monsoon	Tide	Current Condition		Excess Temperature at Edge of Near Field (K)
			Speed (m/s)	Direction (Deg. N)	
NE_S	North-East	Spring	0.2	271	0.118
NE_N		Neap	0.1	280	0.244
SW_S	South-West	Spring	0.22	280	0.107
SW_N		Neap	0.1	277	0.240

5.3.4 Discussion

According to the results of the above scenarios, the excess temperature of 3K is decreased significantly down to 1K within the first meters for both the neap and spring tide conditions. As the outfalls release the hot water plume perpendicular to the shoreline, the excess temperature in the vertical direction and along the shoreline is uncritical (1K to 2K) in the direct vicinity of the outfall. Current speeds are high during spring tide which results in a higher initial dilution, i.e. in lower temperatures in the near field, but in a more extended mixing zone of the heat plume which yet reveals lower excess temperatures compared to the neap tide.

The interpretations of isolines overlaying to represent three single outfalls show that mixing of heat plume in near field region is very low for neap tide condition. According to the results of vertical profiles, the mixing takes place only after the excess temperature reduces to 0.1 K. However temperature isolines overlap for less than 0.5 K for spring tide condition, comparatively high current at outfall would be the reason for that mixing, but the plume reduces its temperature within a short distance and when it reaches the near field boundary the excess temperature reduces up to 0.03 K.

The results in Table 5.3 show that an increment of excess temperature at near field boundary for the combined one outfall case compared to the three outfall system. High flow rate would be the reason for this temperature increase.

5.4 Far Field Modelling

As discussed earlier two models were used to assess the dispersion pattern of the heat plume, one for the near field and one for the far field. The use of the semi-empirical length scale model, CORMIX, for the near field is described in Section 5.3.

As the turbulent plume travels further away from the discharge location, the jet characteristics become less important and three dimensional treatment of thermal dispersion is nearly changed

to two dimensional treatment. Then in order to simulate the current phenomena, it is possible to use two-dimensional models. MIKE 21 Hydrodynamic Model combine with Thermal Dispersion Tool has been used for hydrodynamic and thermal dispersion simulation in far field region.

5.4.1 Input Data

All input parameters used in local hydrodynamic model (as given in Chapter 4) were used for thermal dispersion modelling. Therefore two different monsoonal conditions (South-West and North-East) and two different tidal conditions (Spring and Neap) were taken into consideration in the simulation. In addition, heat plume discharge boundary for far-field simulation was established using the near-field model (CORMIX) results. The excess temperature was extracted in near field boundary from CORMIX model and given as an input data for MIKE 21 HD thermal dispersion model. Even though single outfall was simulated in the near field model, effect of all three outfalls were taken in to far field model. The excess temperature extracted for different scenarios are given in **Table 5.4**.

Table 5.4: Input Excess Temperature for Far-Field Model

Sc. ID	Monsoon	Tide	Current Condition		Input Excess Temperature for Far- Field Model (K)
			Speed (m/s)	Direction (Deg. N)	
NE_S	North-East	Spring	0.2	271	0.039
NE_N		Neap	0.1	280	0.114
SW_S	South-West	Spring	0.22	280	0.036
SW_N		Neap	0.1	277	0.112

5.4.2 Model Results and Discussion

Scenarios with neap tidal condition shows higher influence with their high input temperatures at near-field boundary and low current speed relative to the spring tide.

As an example Sc. ID: NE_N has been used for further discussion which resulted in the highest excess temperature at the near field boundary among considered four scenarios. Figure 5.18 and 5.19 show the temperature variation in 2D plain for this high influence scenario when current directed westward and eastward respectively. According to the results, 0.03K excess temperature transfer around 1km range from the discharge point for both cases. However 0.03K excess temperature is a very low temperature and negligible in coastal environment. Therefore thermal dispersion is very high even in a high influence scenario and it will be a very low effect to the coastal environment. Thermal dispersion plots for all scenarios are given in Annex C.

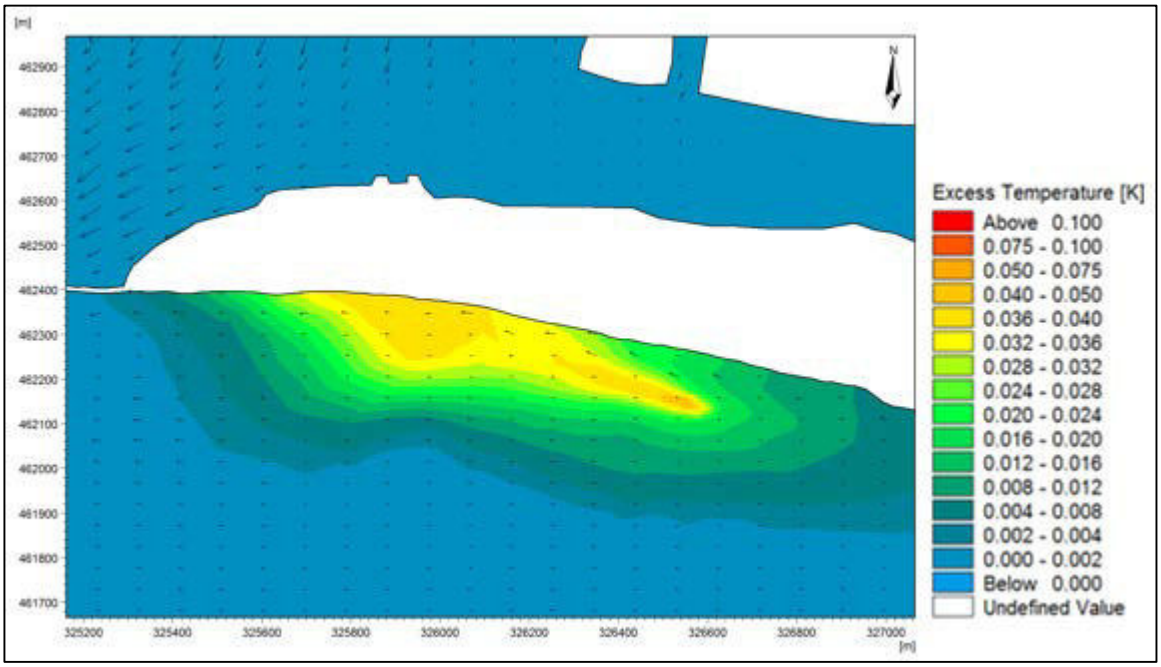

Figure 5.18: Thermal Dispersion towards West at Scenario NE_N

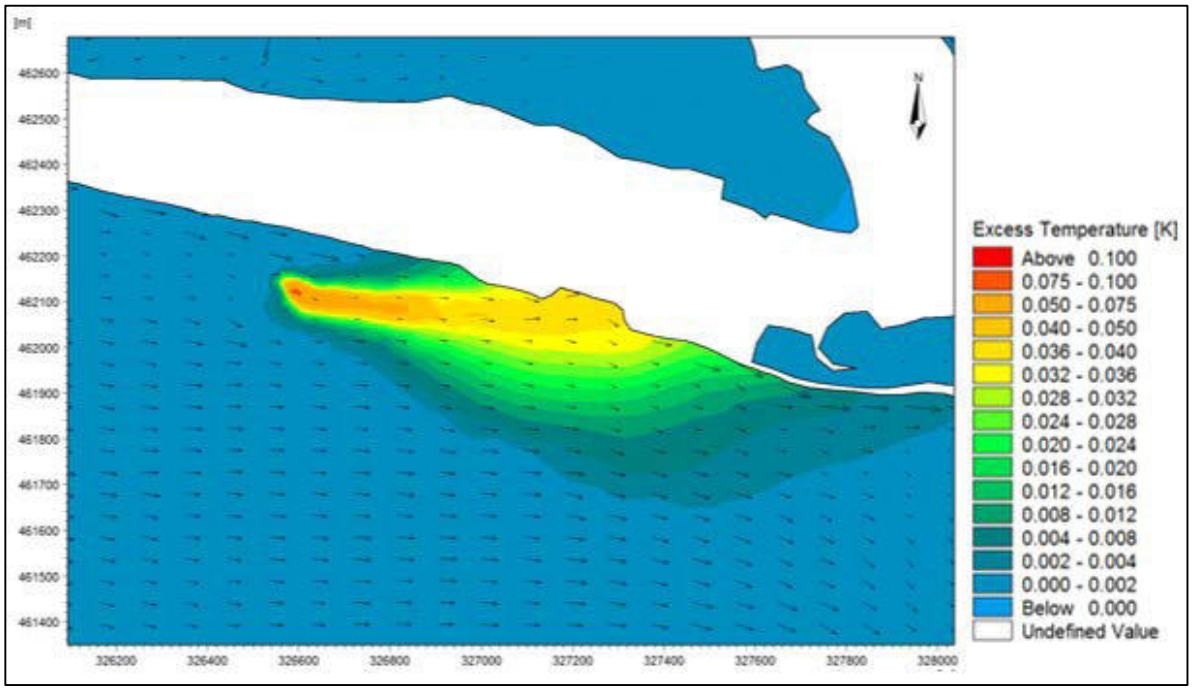

Figure 5.19: Thermal Dispersion towards East at Scenario NE_N

Temperatures at 10m and 20m depths next to the middle outfall (HWO2) location were extracted from far field model results. The locations and coordinates of the extracted points are given below.

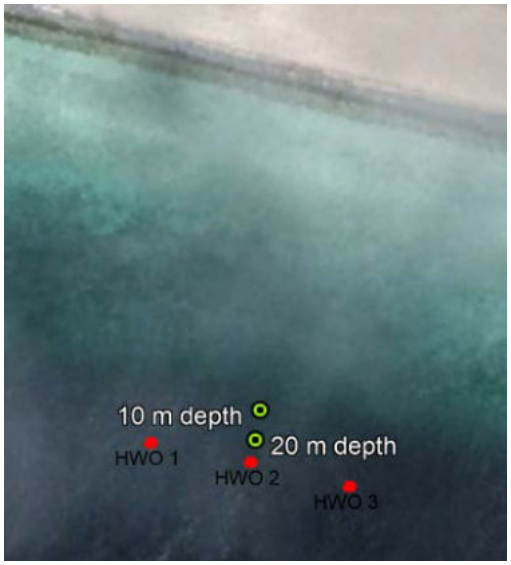

Table 5.5: Coordinates of Results Extracted Locations

Location	Coordinate	
	Lat	Long
10m Depth	4°10'47.56"N	73°26'15.58"E
20m Depth	4°10'47.37"N	73°26'15.55"E

Figure 5.20: Excess Temperature Extracted Locations

The maximum temperatures obtained through extracted results for different scenarios are given in Table 5.6. Even though extracted points are very close to the middle outfall (both points are located around within 10m distance from HWO2), excess temperature values are not significantly high. The maximum values are even less than the near field boundary excess temperatures for every scenario. Heat plume projections are directed to the seaward, but the extracted points are located at the other way, hence high temperatures would not transfer to the north side of outfalls. Therefore the direction of heat plume projections would be the reason for low maximum temperatures in the north side of the outfalls.

Table 5.6: Maximum Excess Temperatures at Extracted Points

Sc. ID	Monsoon	Tide	Maximum Excess Temperature (K)	
			10m Depth	20m Depth
NE_S	North-East	Spring	0.020	0.021
NE_N		Neap	0.036	0.038
SW_S	South-West	Spring	0.016	0.017
SW_N		Neap	0.065	0.073

6 SUMMARY AND CONCLUSION

- In order to find out thermal dispersion in coastal environment for outfall of hot water plume of a proposed incinerator at Thilafushi Island, a set of numerical model simulation was carried out for different monsoon and tidal conditions.
- Measured data as well as reliable predicted data were utilized as model inputs, and analysed them before applied to the model.
- MIKE 21 SW model was used to establish the wave condition at site for different monsoon periods (South-West and North-East) and MIKE 21 HD model was used to obtain the current condition at discharge location. Further both spring and neap tidal conditions were simulated separately; and about 0.2m/s and 0.1m/s average current speed were obtained at the discharge point for spring and neap tide respectively. Wave condition was not significantly affected on current condition at discharge point.
- Two modelling system were used thermal dispersion modelling, namely CORMIX model for **near-field** dispersion and MIKE 21 HD coupled with thermal dispersion tool for **far-field** dispersion.
- According to the near-field model results,
    - Excess temperatures at the near field boundary for the neap tidal conditions (around 0.11 K) were higher than for the spring tidal conditions (0.03 K)
    - A high temperature reduction was observed within a few meters from the released point.
    - Heat plume mixing of three outfalls shows the overlay interpretation for spring tidal condition, but it happens within a short distance from the release point and eventually, the excess temperature reduces up to 0.03 K at near field boundary.
    - Higher excess temperatures (0.11 to 0.24 K) at the near field boundary were observed in the combined single outfall case compared to the three separate outfalls system. The high flow rate would be the reason for that result.
- Results obtained from near-field model were used as input parameter for far-field model.
- Far-field model results represent the temperature spreading in 2D plain for different scenarios.
- According to far-field model results,
    - Same as the near-field model, scenarios with the neap tidal condition show some influence compared to the spring tidal situations.
    - High spreading of heat is also observed in the neap tidal condition but however spread excess temperature values are small and it would not significantly impact coastal environment.
    - Maximum excess temperatures extracted shoreward to the outfall are not significantly high. Even though extracted points are very close to the middle

outfall (both points are located around within 10m distance from HWO2), heat plume projections are directed to opposite way (towards deep sea). Therefore the direction of heat plume projections would be the reason for low maximum temperatures in the north side of the outfalls.

ANNEX A

Near Field Model Results

Plan Views & Elevations of Heat Plume and

Excess Temperature vs. Downstream Distance Graphs

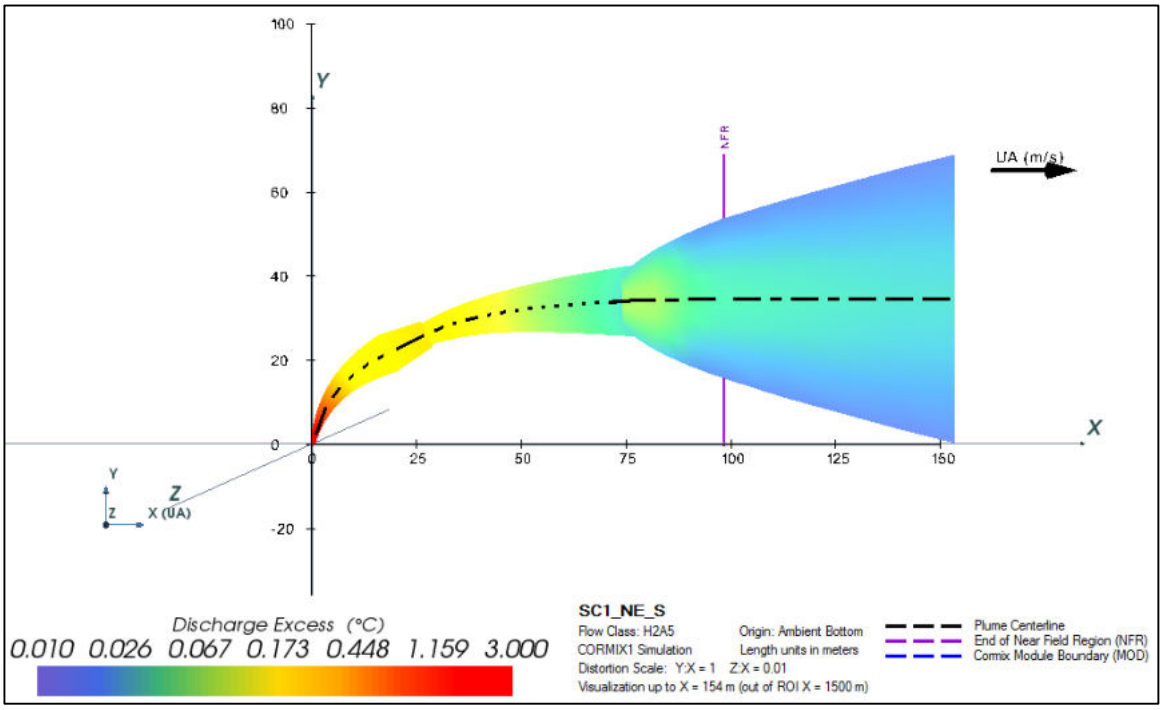

Figure A.1: Plan View - Effluent Discharged at Near-Field Region (NE Monsoon – Spring Tide)

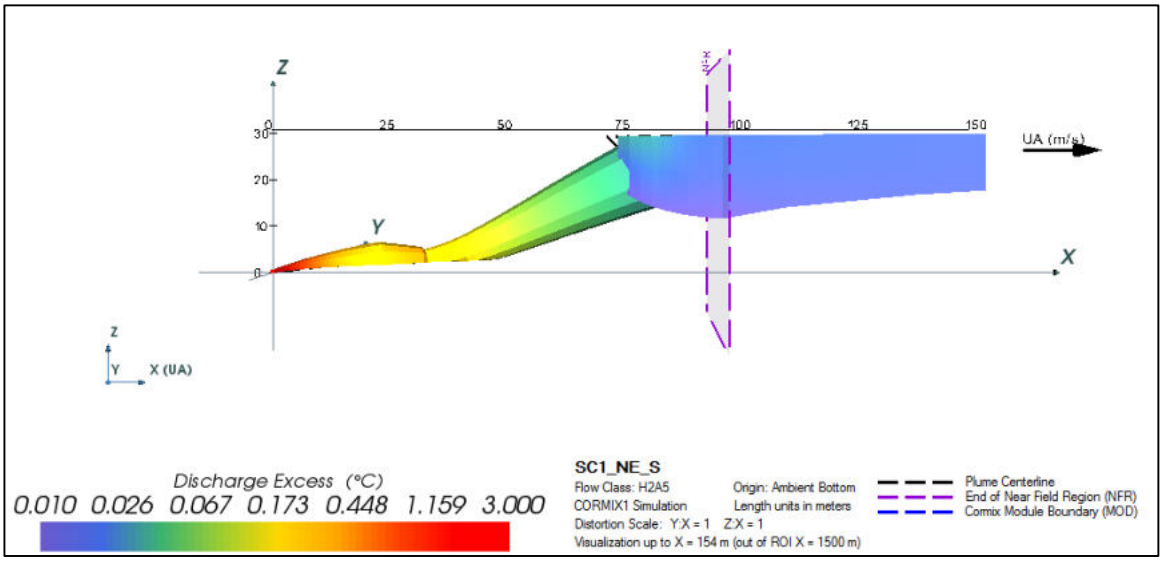

Figure A.2: Elevation - Effluent Discharged at Near-Field Region (NE Monsoon – Spring Tide)

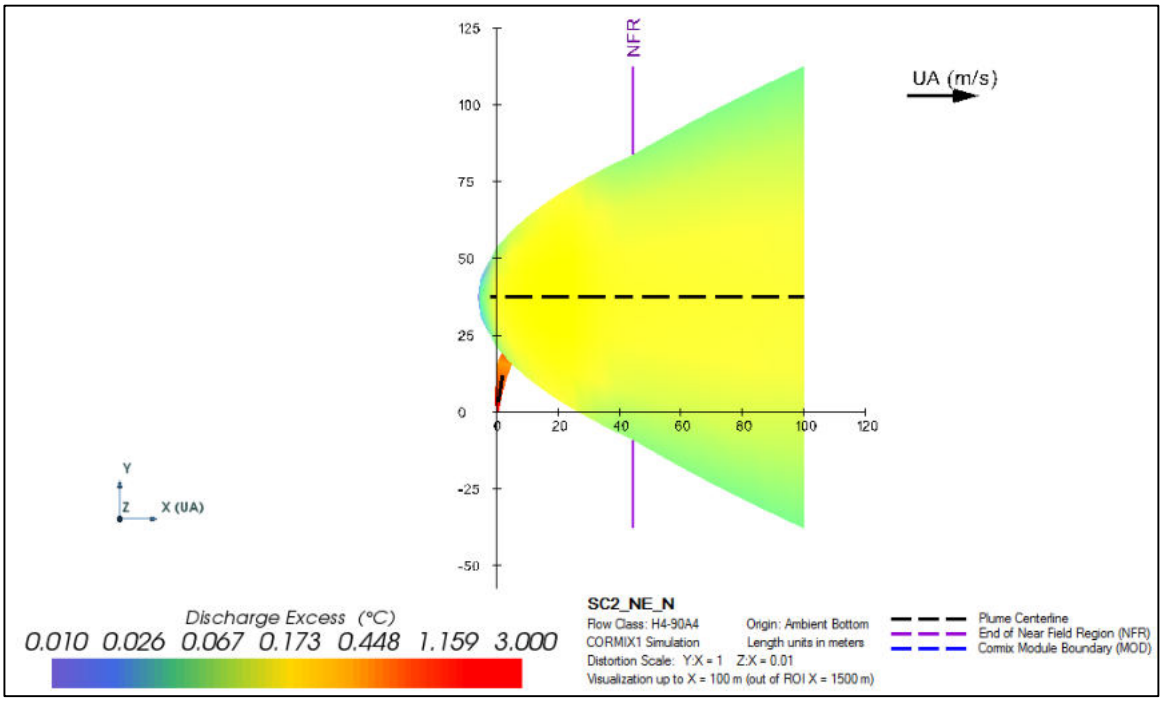

Figure A.3: Plan View - Effluent Discharged at Near-Field Region (NE Monsoon – Neap Tide)

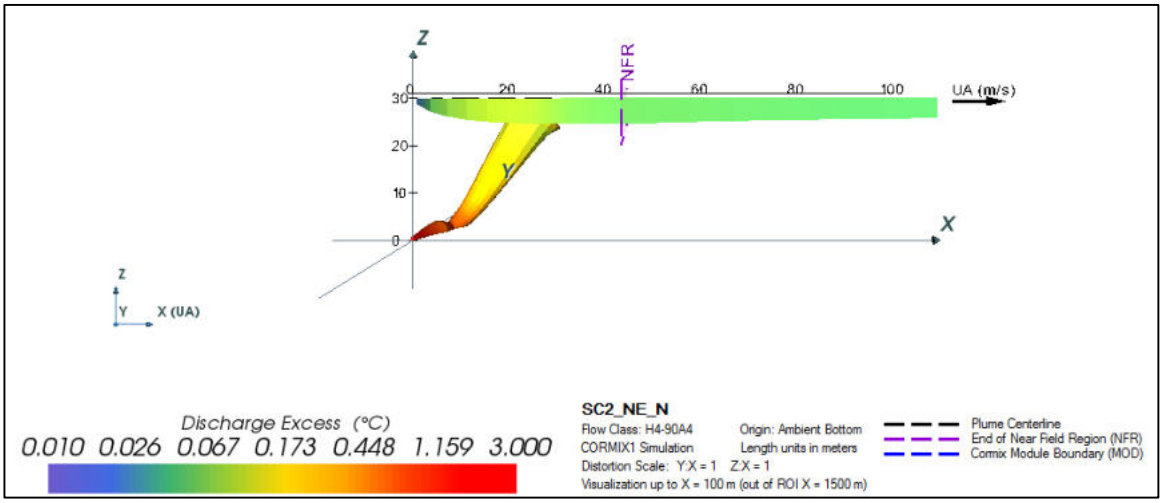

Figure A.4: Elevation - Effluent Discharged at Near-Field Region (NE Monsoon – Neap Tide)

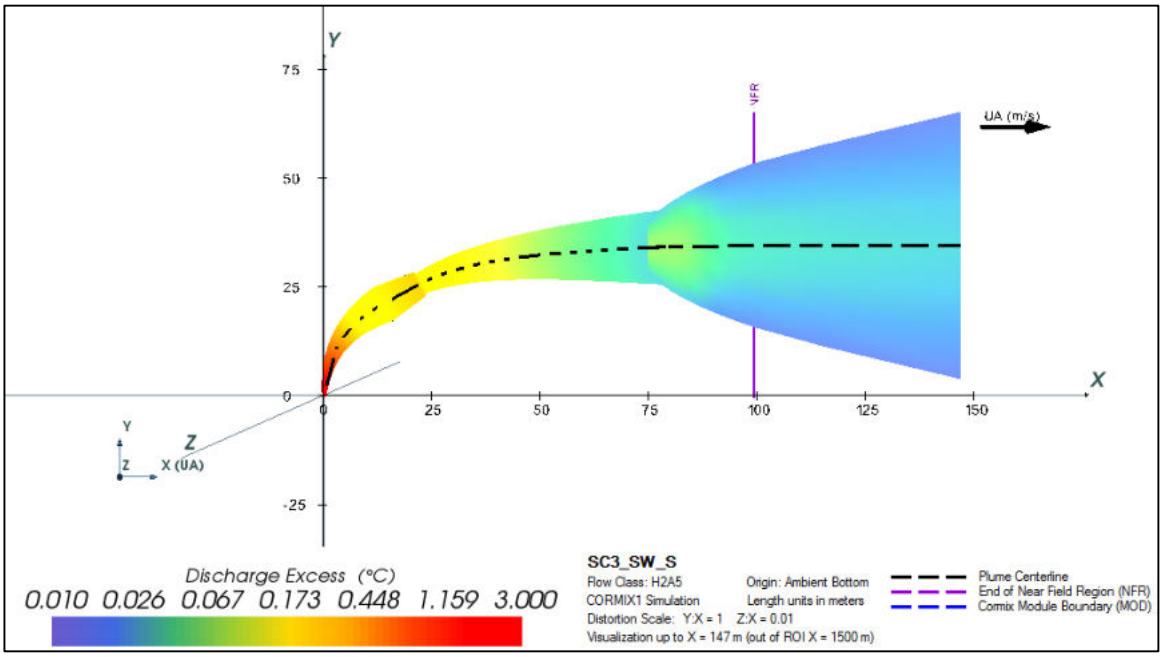

Figure A.5: Plan View - Effluent Discharged at Near-Field Region (SW Monsoon – Spring Tide)

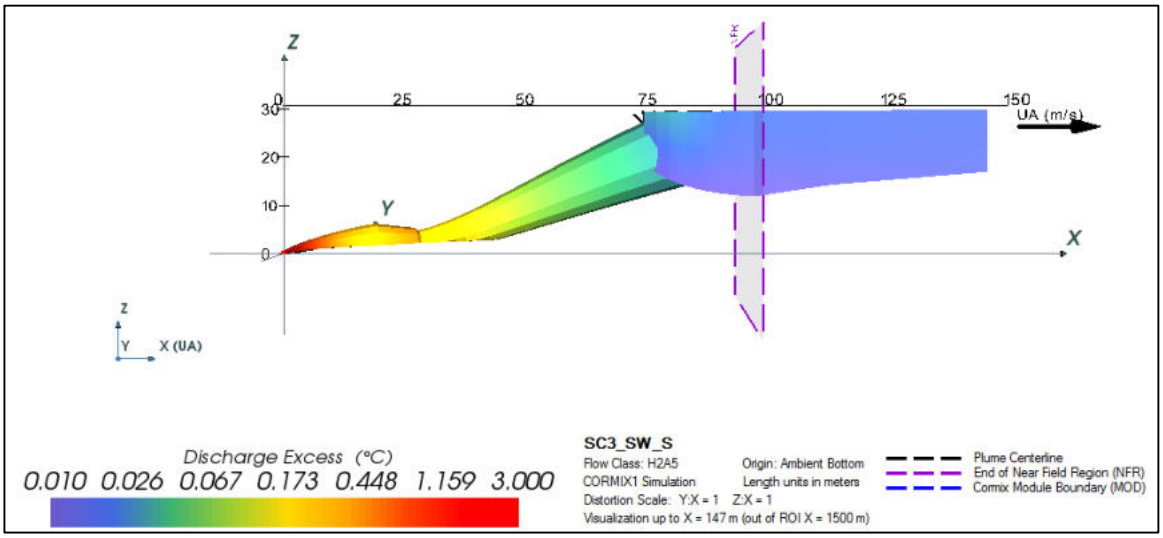

Figure A.6: Elevation - Effluent Discharged at Near-Field Region (SW Monsoon – Spring Tide)

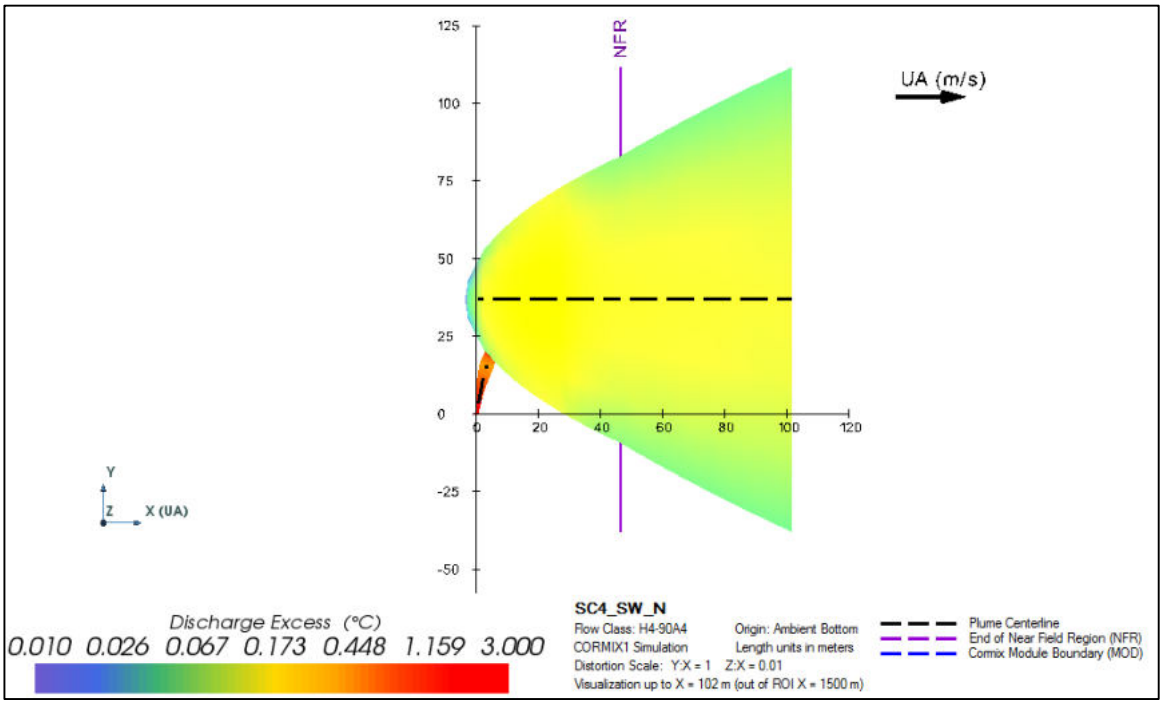

Figure A.7: Plan View - Effluent Discharged at Near-Field Region (SW Monsoon – Neap Tide)

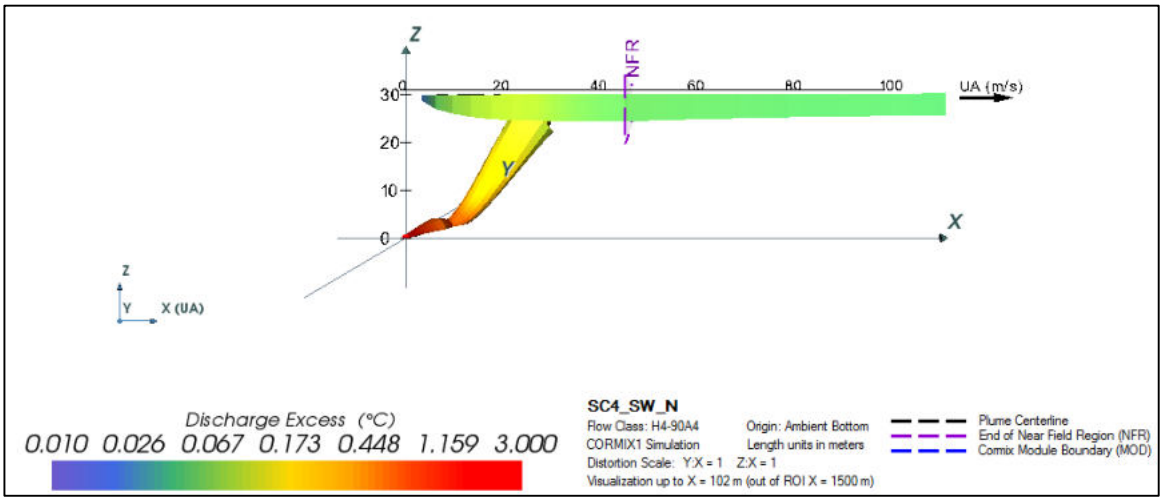

Figure A.8: Elevation - Effluent Discharged at Near-Field Region (SW Monsoon – Neap Tide)

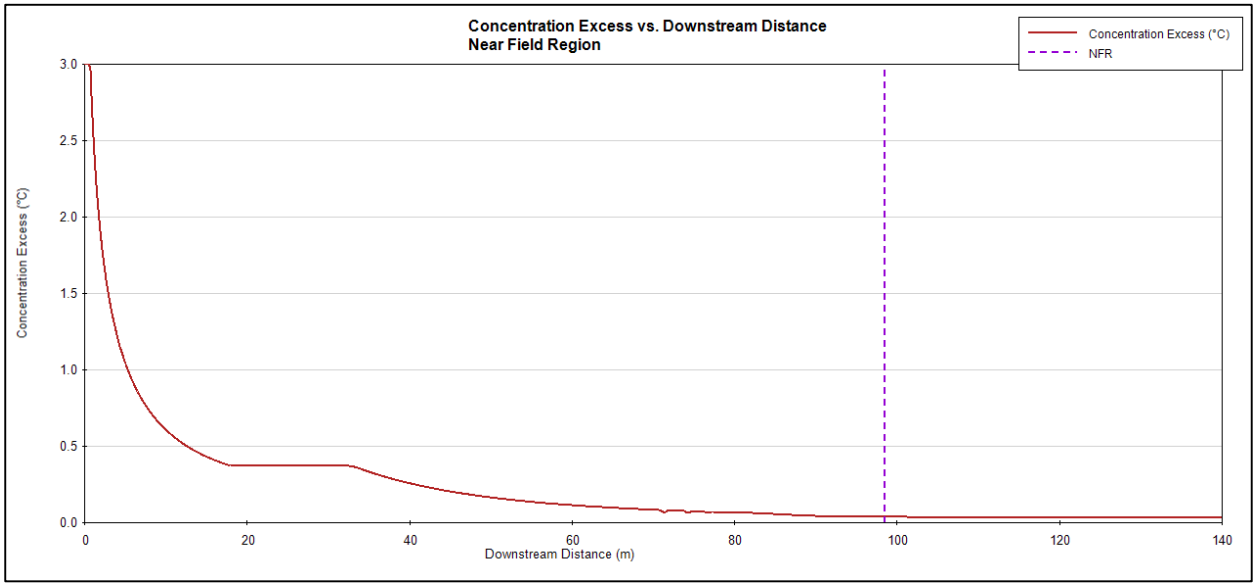

Figure A.9: Excess Temperature vs Downstream Distance (NE Monsoon – Spring Tide)

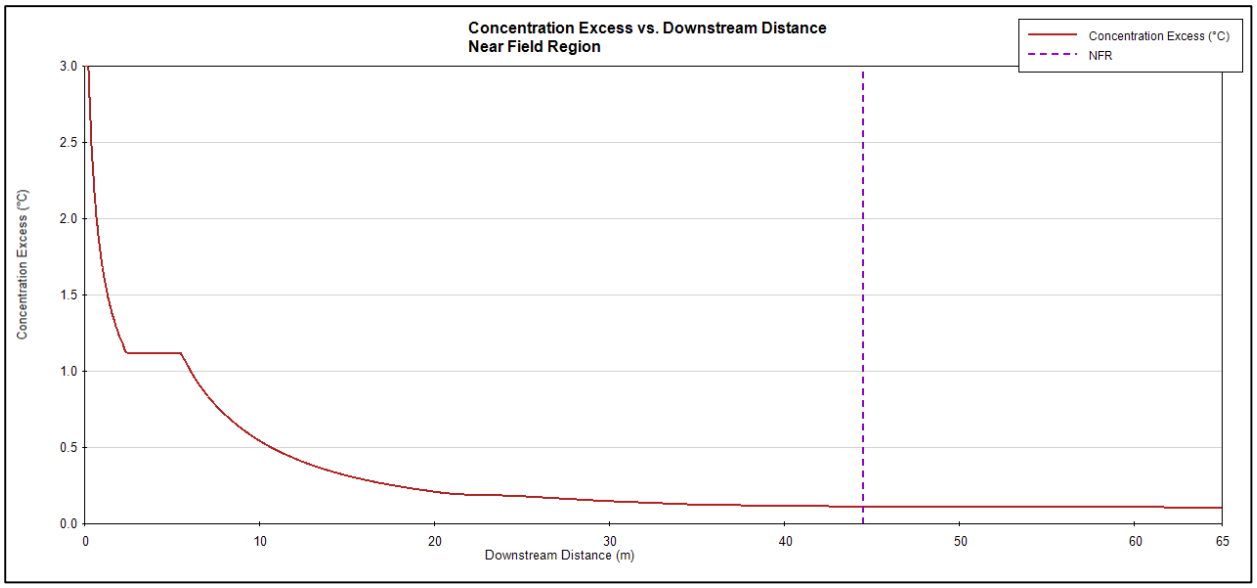

Figure A.10: Excess Temperature vs Downstream Distance (NE Monsoon – Neap Tide)

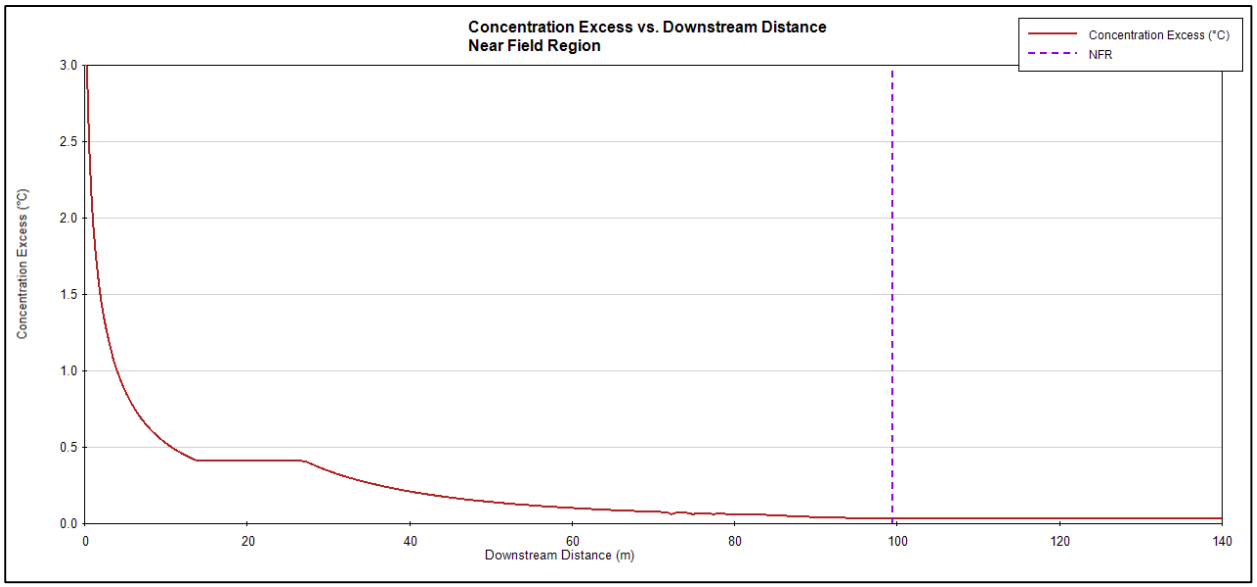

Figure A.11: Excess Temperature vs Downstream Distance (SW Monsoon – Spring Tide)

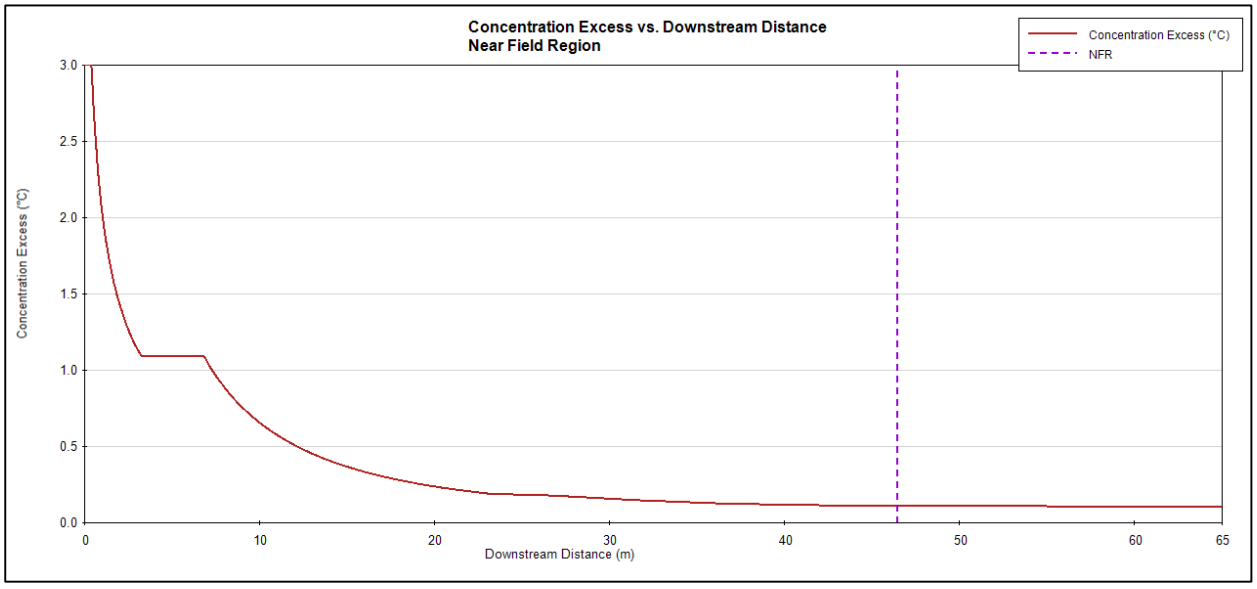

Figure A.12: Excess Temperature vs Downstream Distance (SW Monsoon – Neap Tide)

ANNEX B

Near Field Model Results for Combined Single Outfall

Plan Views & Elevations of Heat Plume and

Excess Temperature vs. Downstream Distance Graphs

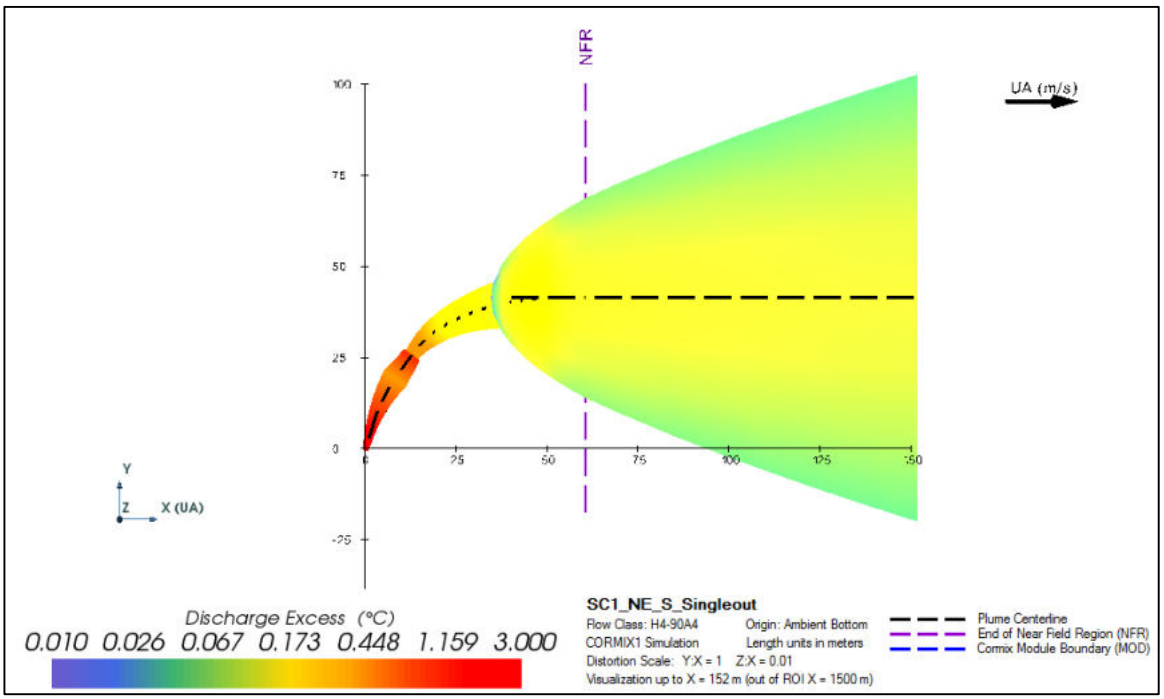

Figure B.1: Plan View - Effluent Discharged at Near-Field Region for Combine Single Outfall (NE Monsoon – Spring Tide)

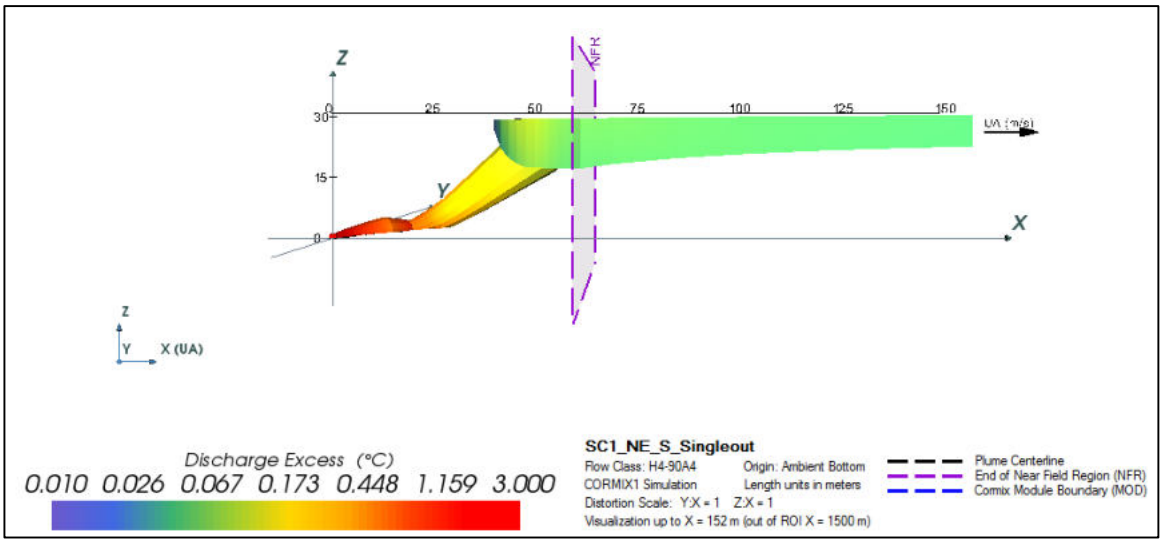

Figure B.2: Elevation - Effluent Discharged at Near-Field Region for Combine Single Outfall (NE Monsoon – Spring Tide)

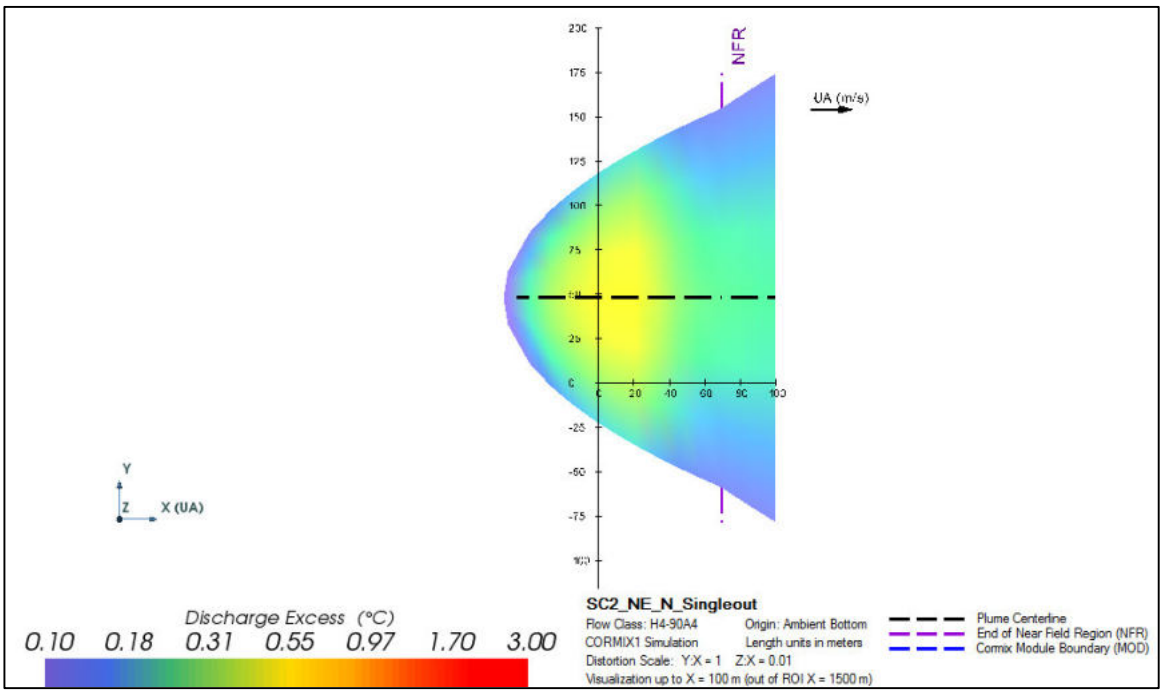

Figure B.3: Plan View - Effluent Discharged at Near-Field Region for Combine Single Outfall (NE Monsoon – Neap Tide)

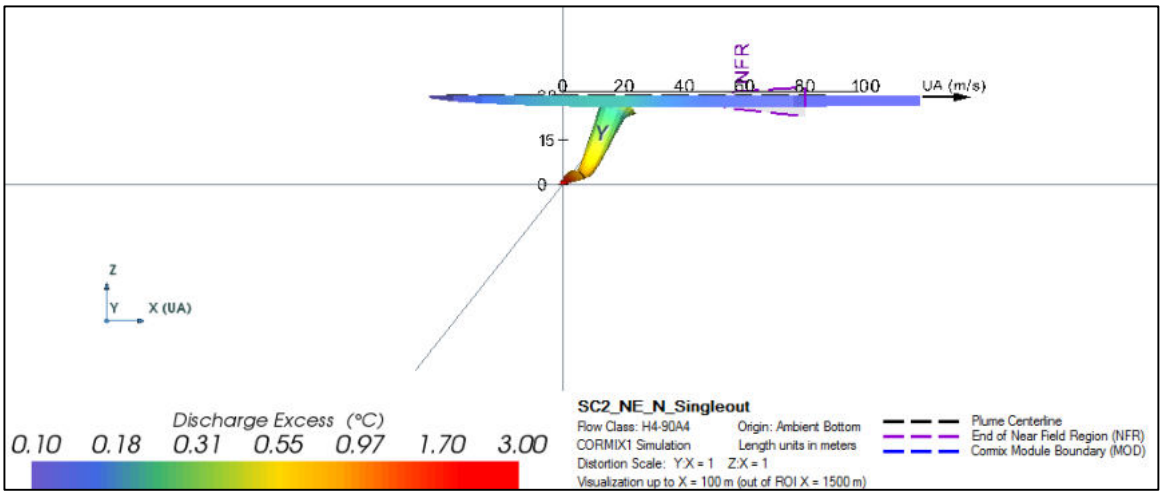

Figure B.4: Elevation - Effluent Discharged at Near-Field Region for Combine Single Outfall (NE Monsoon – Neap Tide)

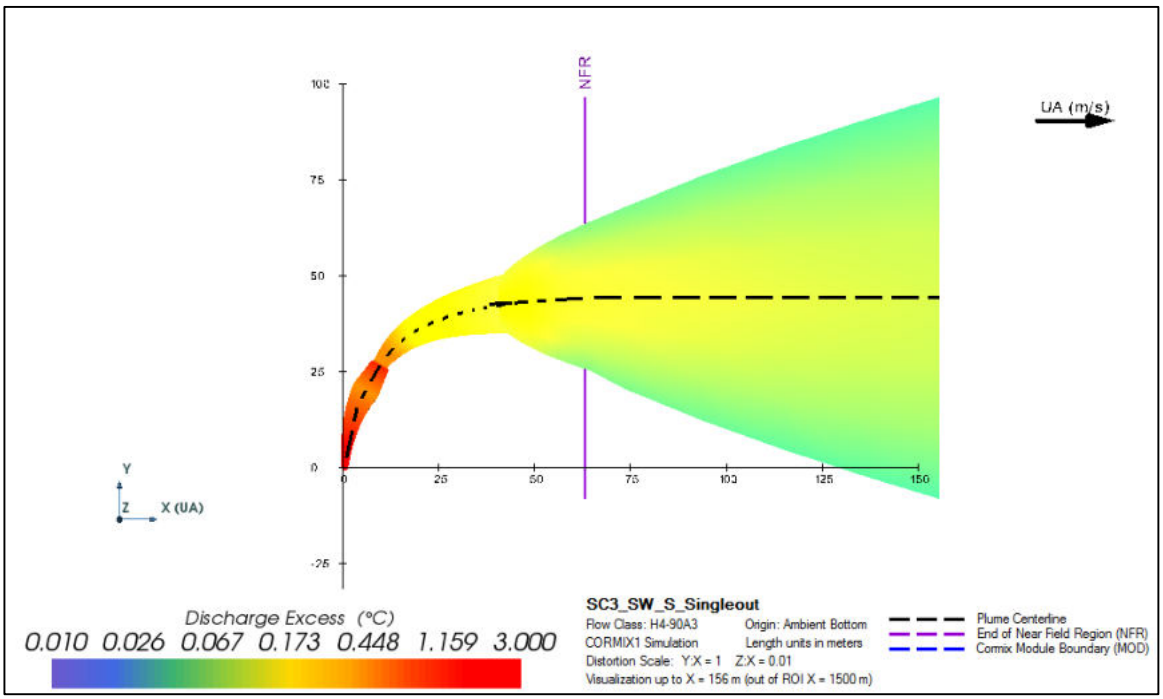

Figure B.5: Plan View - Effluent Discharged at Near-Field Region for Combine Single Outfall (SW Monsoon – Spring Tide)

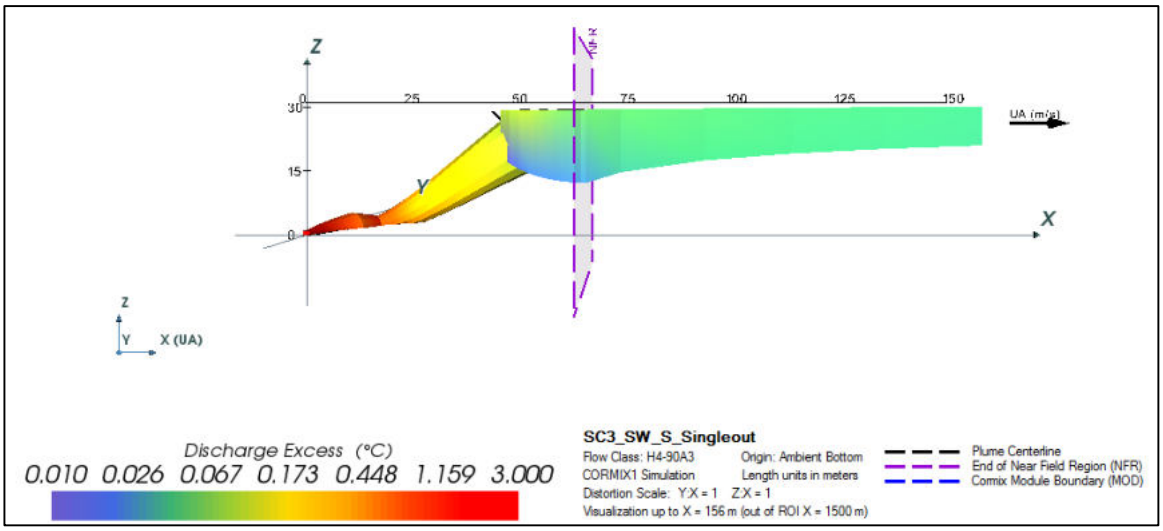

Figure B.6: Elevation - Effluent Discharged at Near-Field Region for Combine Single Outfall (SW Monsoon – Spring Tide)

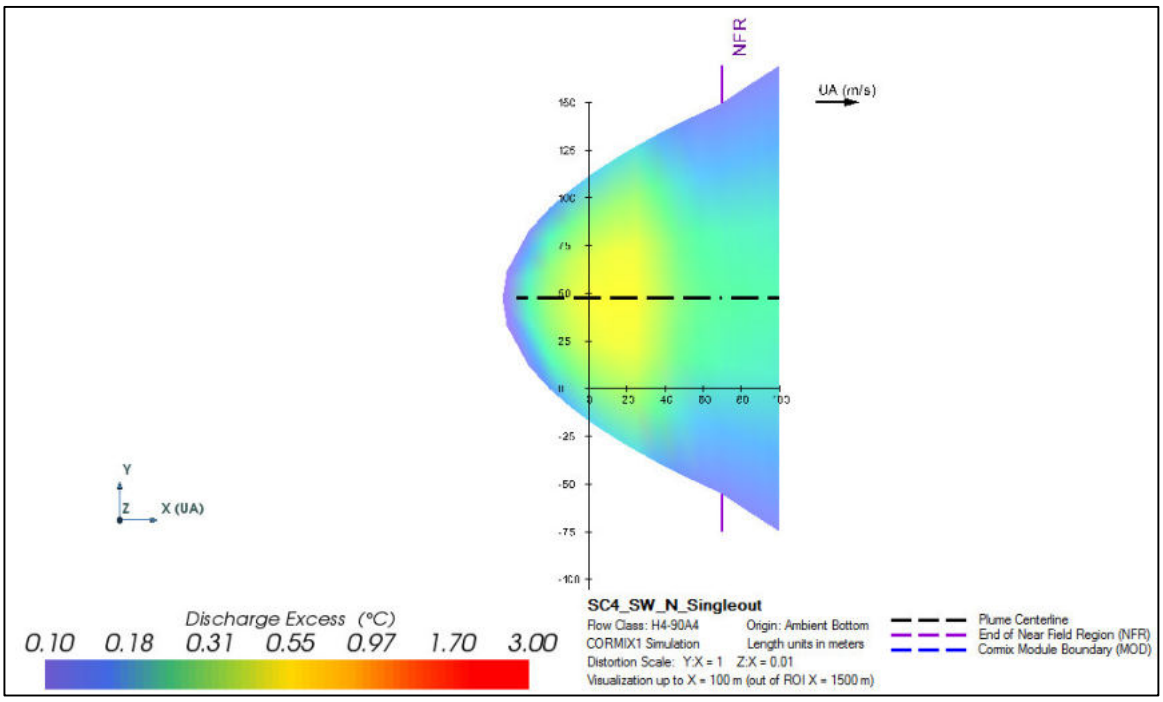

Figure B.7: Plan View - Effluent Discharged at Near-Field Region for Combine Single Outfall (SW Monsoon – Neap Tide)

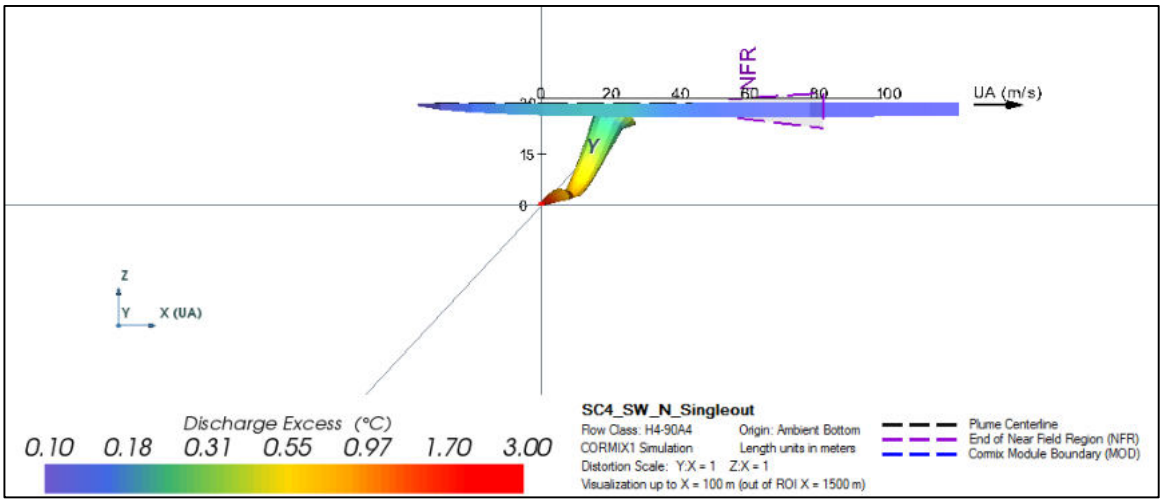

Figure B.8: Elevation - Effluent Discharged at Near-Field Region for Combine Single Outfall (SW Monsoon – Neap Tide)

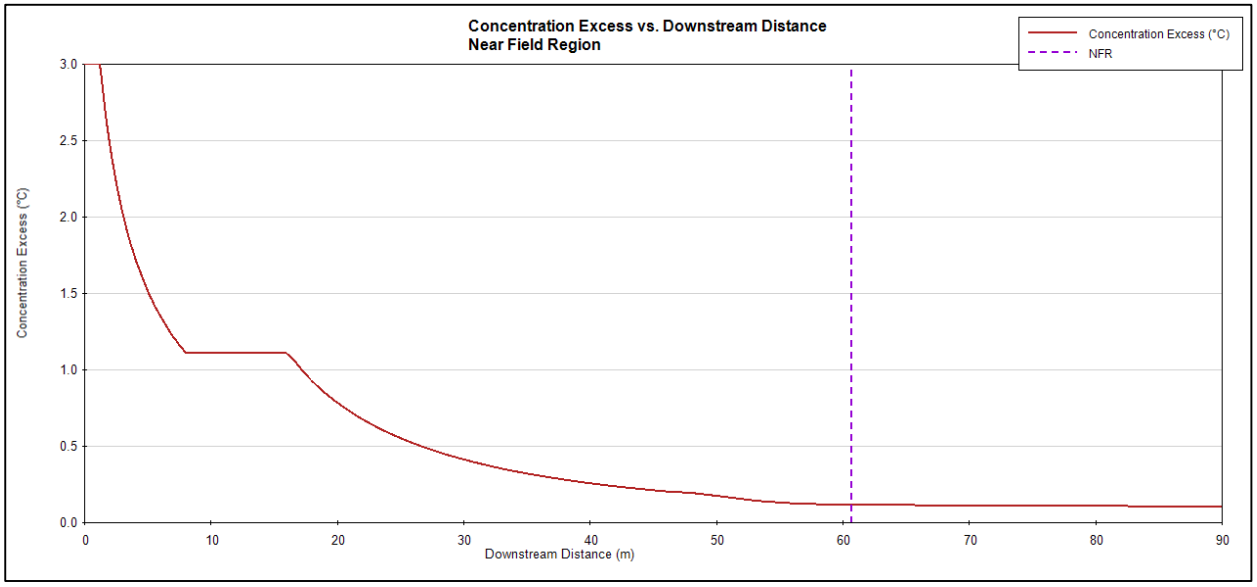

Figure B.9: Excess Temperature vs Downstream Distance for Combine Single Outfall (NE Monsoon – Spring Tide)

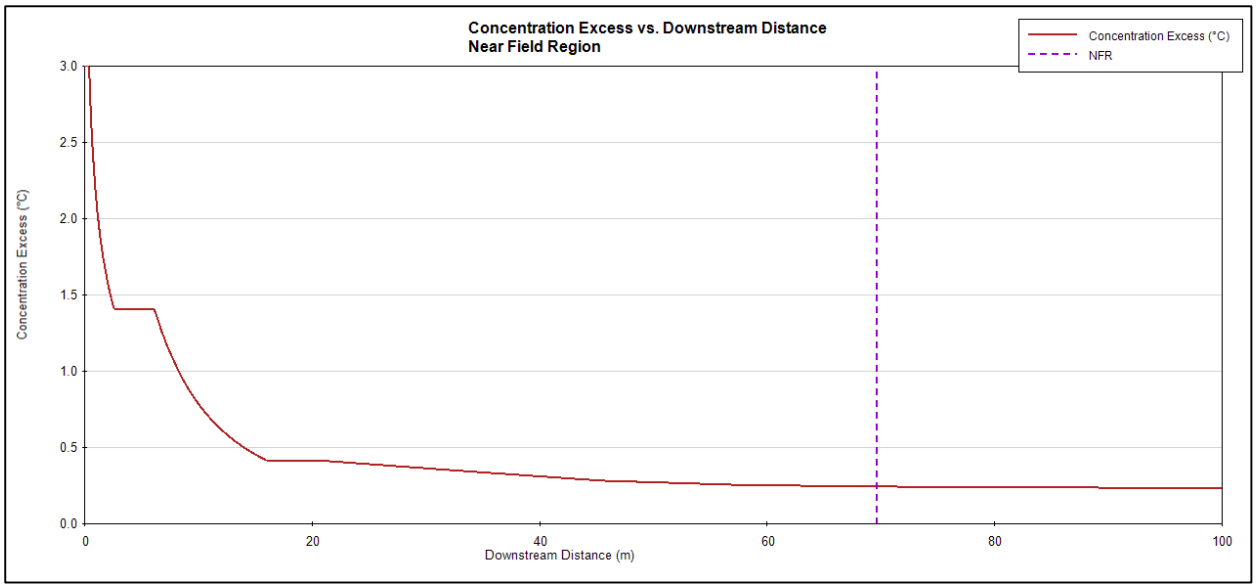

Figure B.10: Excess Temperature vs Downstream Distance for Combine Single Outfall (NE Monsoon – Neap Tide)

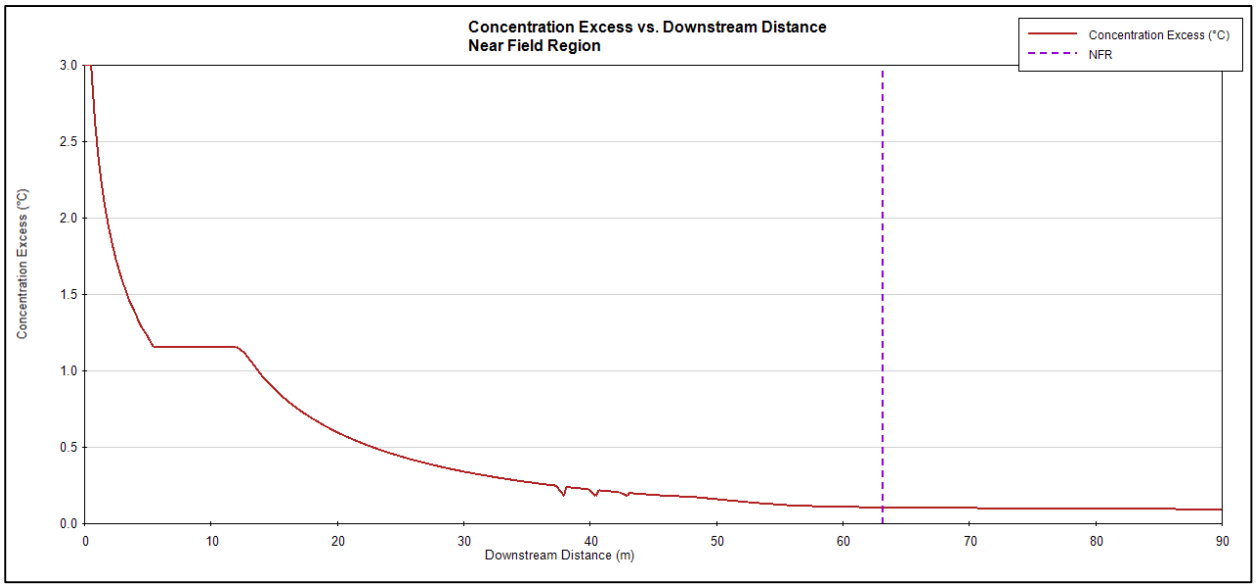

Figure B.11: Excess Temperature vs Downstream Distance for Combine Single Outfall (SW Monsoon – Spring Tide)

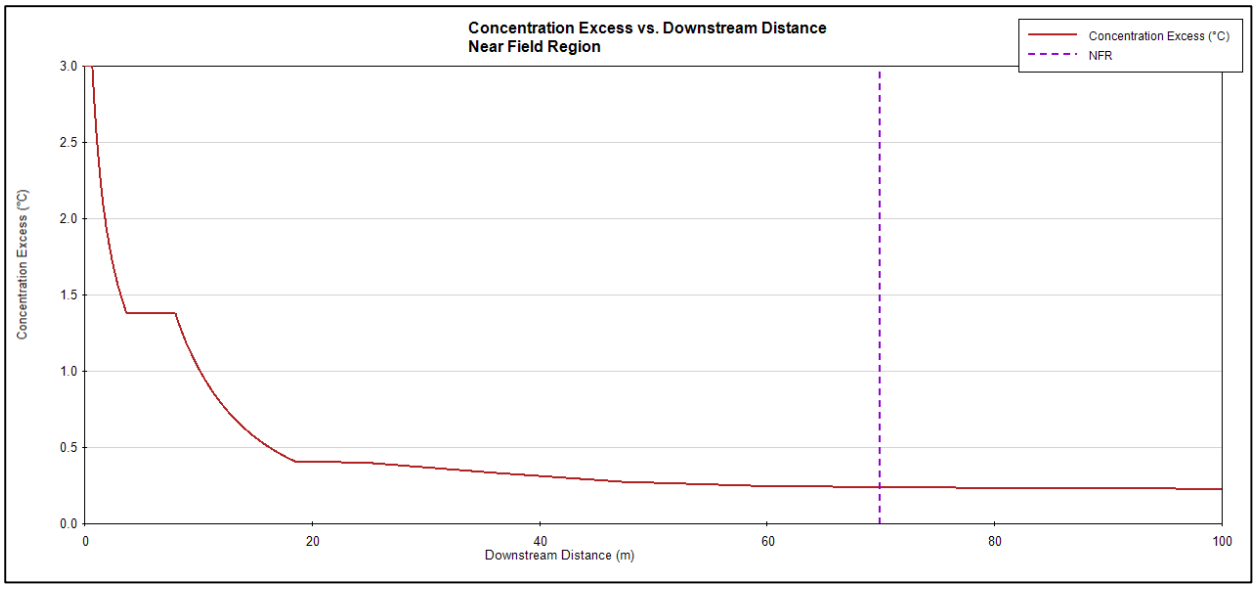

Figure B.12: Excess Temperature vs Downstream Distance for Combine Single Outfall (SW Monsoon – Neap Tide)

ANNEX C

Heat Dispersion in Far Field (MIKE 21 HD)

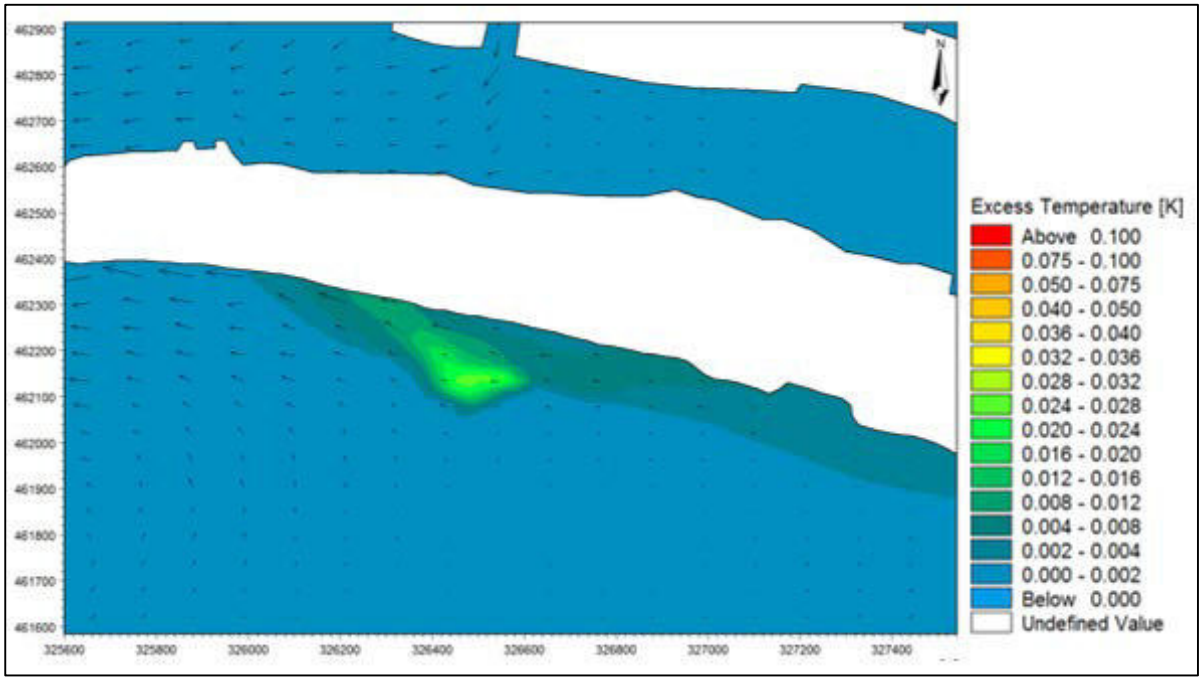

Figure C.1: Thermal Dispersion towards West (NE Monsoon – Spring Tide)

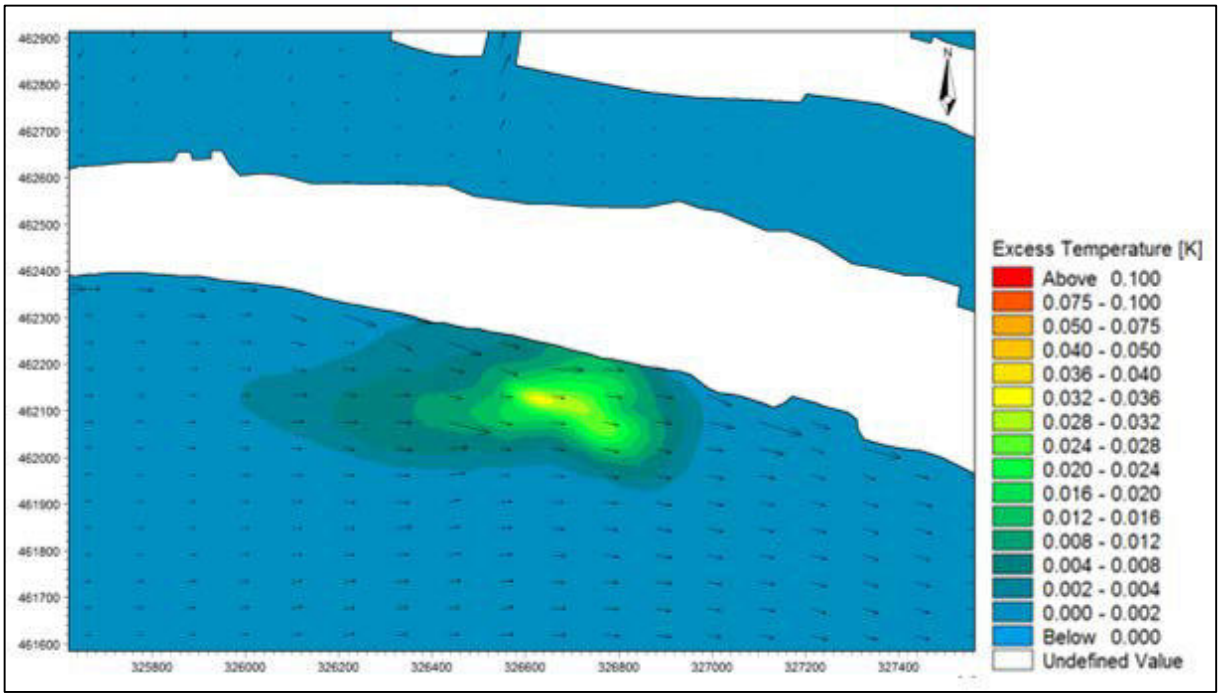

Figure C.2: Thermal Dispersion towards East (NE Monsoon – Spring Tide)

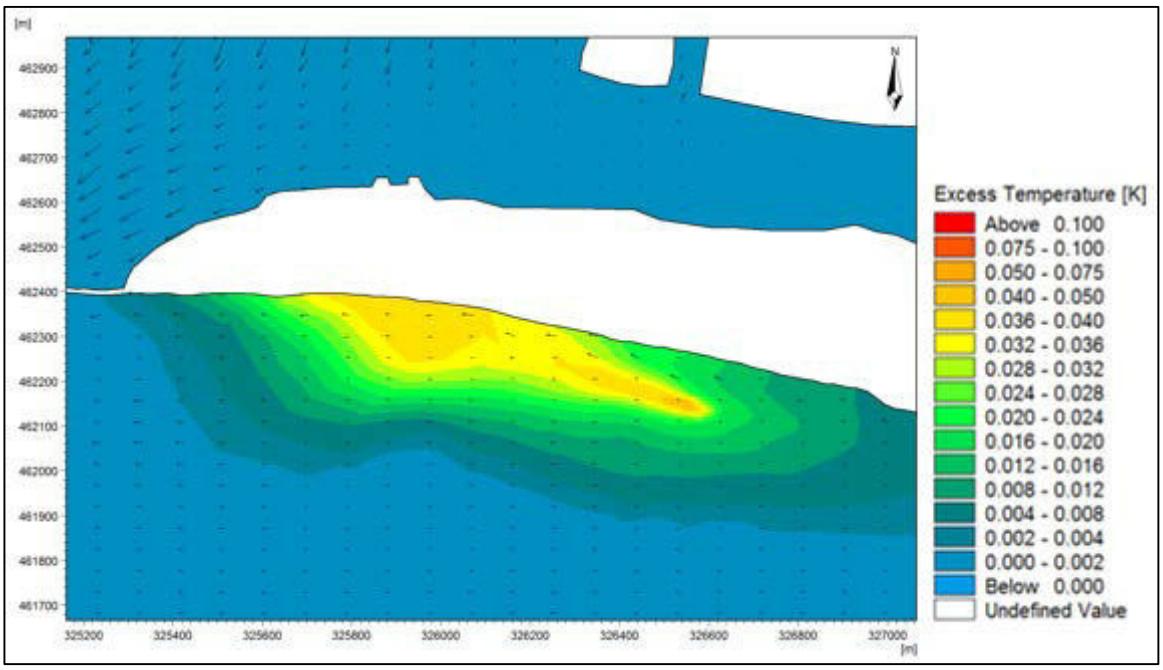

Figure C.3: Thermal Dispersion towards West (NE Monsoon – Neap Tide)

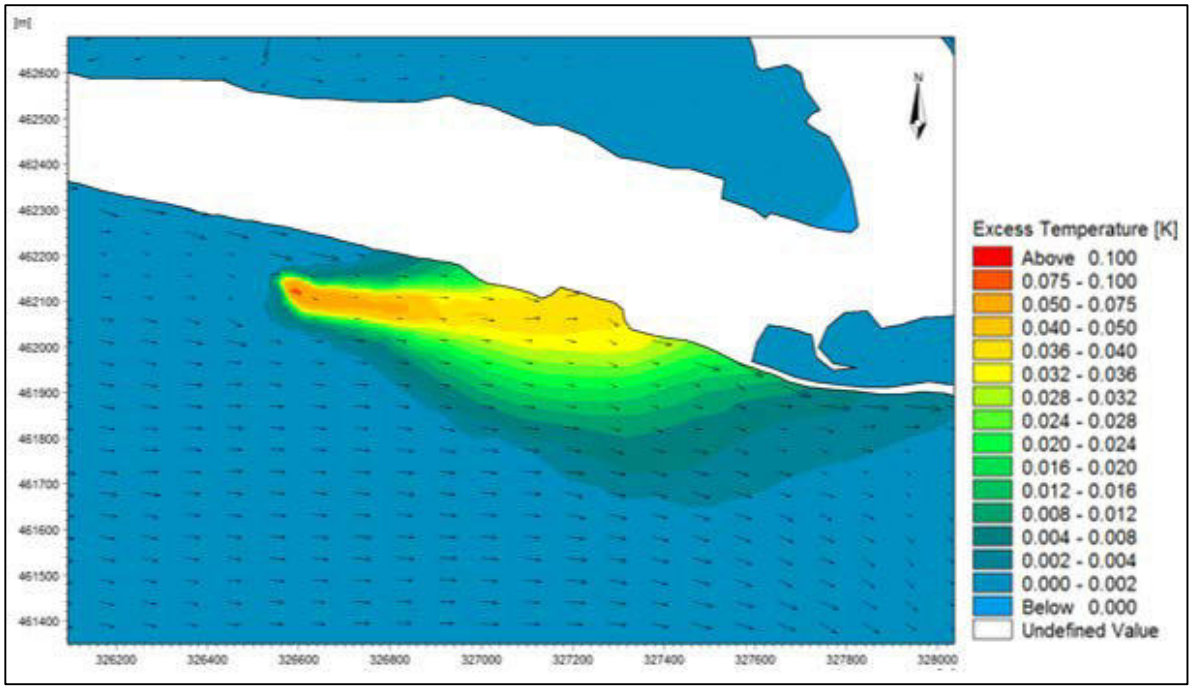

Figure C.4: Thermal Dispersion towards East (NE Monsoon – Neap Tide)

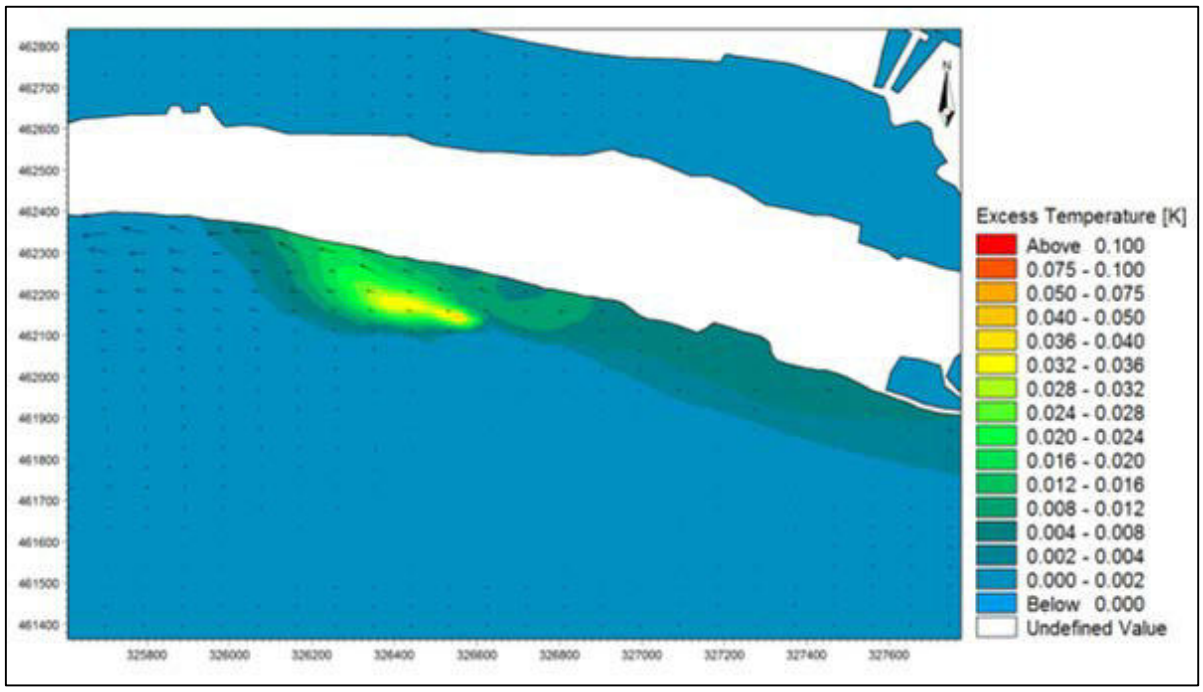

Figure C.5: Thermal Dispersion towards West (SW Monsoon – Spring Tide)

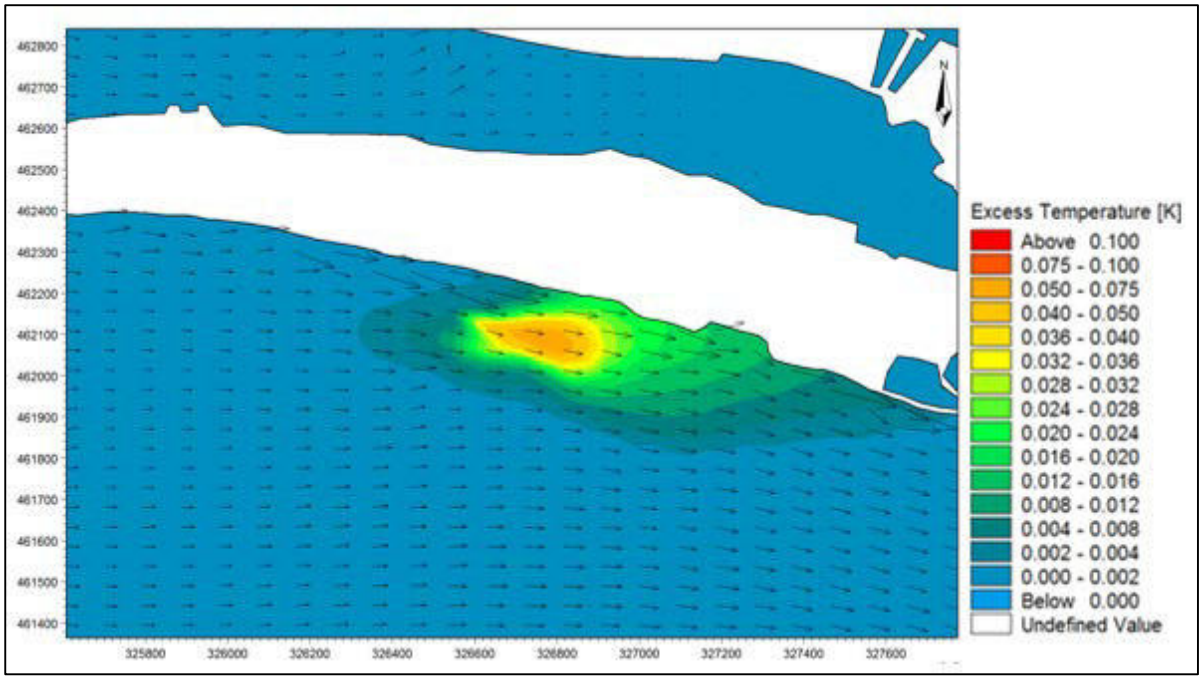

Figure C.6: Thermal Dispersion towards East (SW Monsoon – Spring Tide)

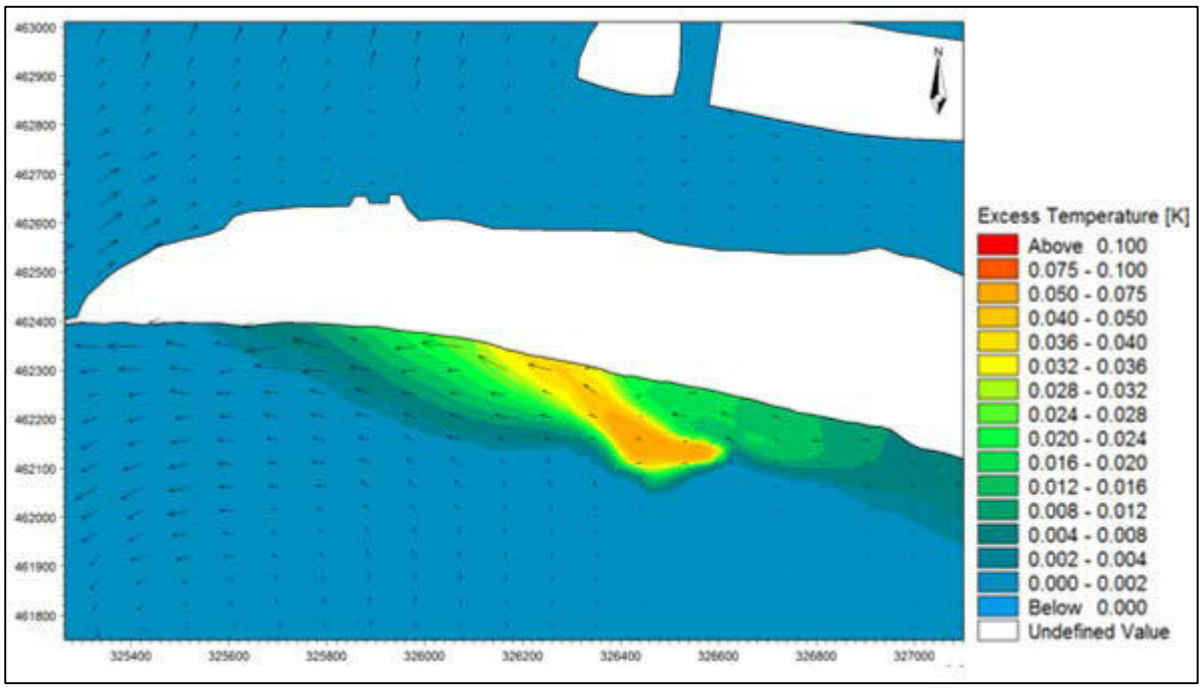

Figure C.7: Thermal Dispersion towards West (SW Monsoon – Neap Tide)

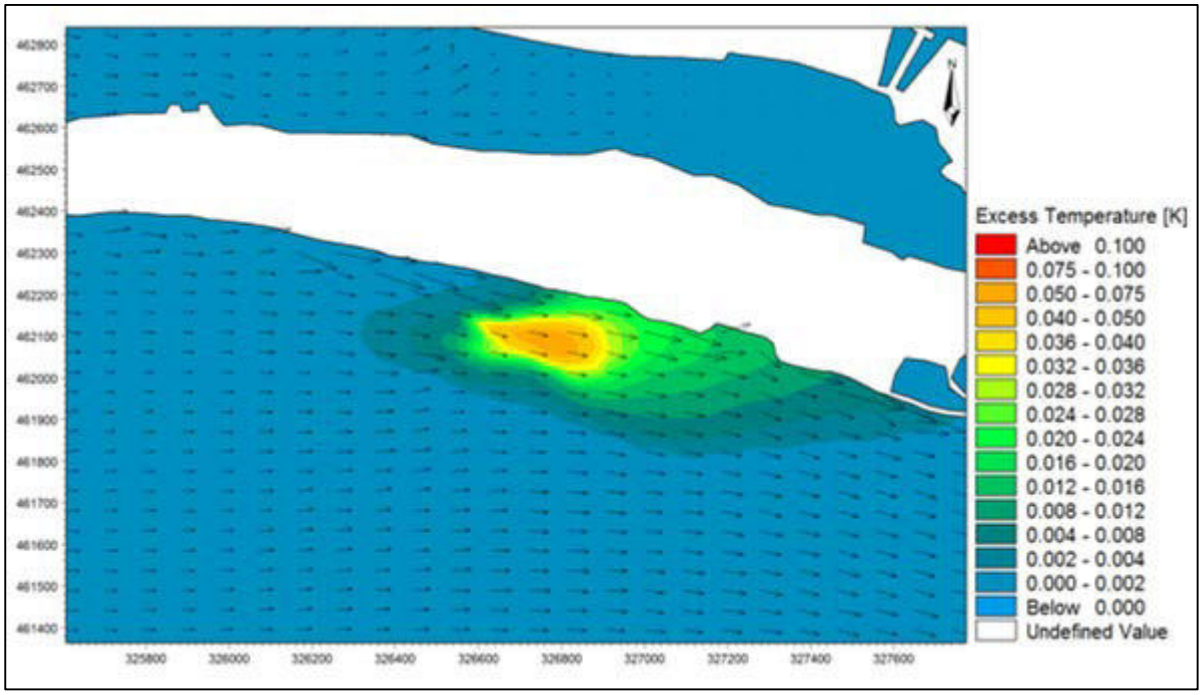

Figure C.8: Thermal Dispersion towards East (SW Monsoon – Neap Tide)

Environmental and Social Impact Assessment for the Regional Solid Waste Management Facility (RSWMF) Thilafushi

Noise Level Measurement

Prepared by: Abdul Aleem (EIA P03/2019)

23rd September 2019

Noise Level Measurement

Noise level was measured to establish baseline at five locations: NQ1, NQ2, NQ3, NQ4 and NQ5 by Water Solutions on 25th August 2019 using hand held sound level meter at Thilafushi. Ambient noise levels were measured during the day time from 10:00 am to 12:00 pm and during the night from 10:00 pm to 12:00 pm at 5 locations (see map). The day time was considered as 7:00 a.m. to 10:00 p.m, while the night time was considered as 10:00 p.m. to 7:00am.

Station Name	Station Coordinates	Monitoring rationale
NQ1 *(Thilafushi)*	4°10'26.4 N 73°28'59.9 E	The station was selected as it represents a major industrial location of the island and is also located close to the harbour. The location lies north of the proposed facility on the opposite side of the lagoon.
NQ2 *(Thilafushi)*	4°10'56.6 N 73°26'53.3 E	The station was selected as it represents a major industrial location of the island. The location lies east of the proposed facility on the opposite side of the lagoon. The location has various industrial activities in its proximity
NQ3 *(Thilafushi)*	4°10'58.3 N 73°26'09.6 E	This station was selected as it is located near the boundary of the proposed WTE facility.
NQ4 *(Thilafushi)*	4°10'57.3 N 73°25'59.4 E	This station was selected as it is located west of proposed WTE facility. The area has less development and less activity during the day time.
NQ5 *(Thilafushi)*	4°10'57.3 N 73°26'14.4 E	This station was selected as it is located at the proposed WTE facility.

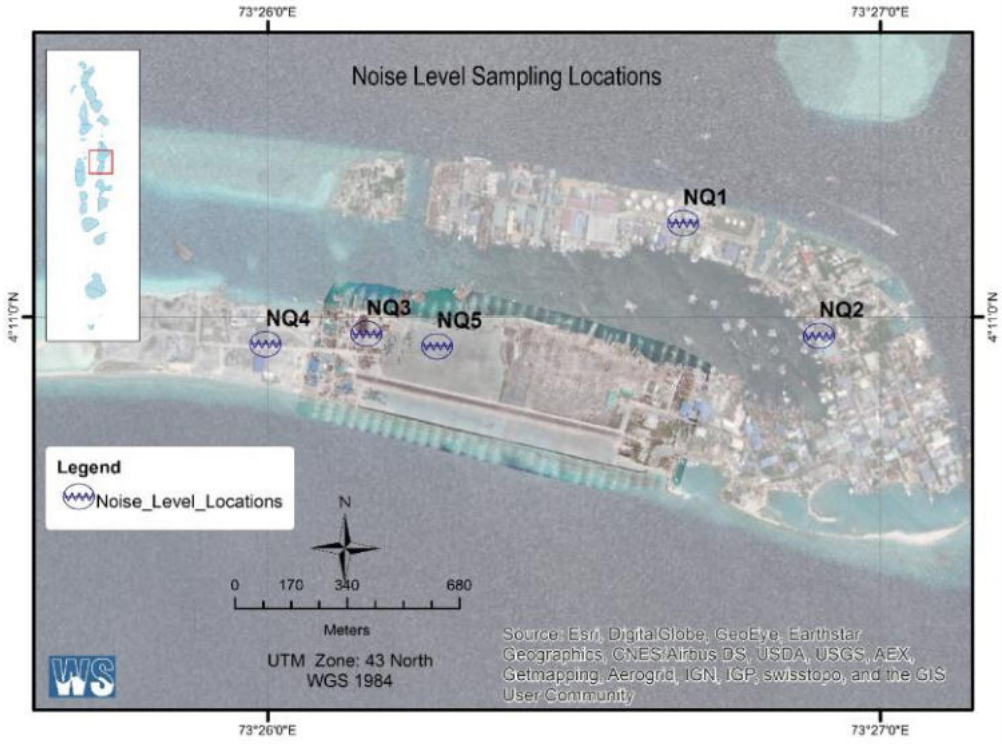

Figure: Locations where noise was monitored for the baseline assessment.

Table: Summary of Noise Quality Results for Thilafushi

S. No	Locations	Noise Level dB (A) Day Time	Noise Level dB (A) Night Time
NQ1	Thilafushi	65.1	53.7
NQ2	Thilafushi	64.2	51.8
NQ3	Thilafushi	56.3	50.0
NQ4	Thilafushi	56.0	48.9
NQ5	Thilafushi	54.6	49.0

The ambient noise levels were moderate to high considering the international standards. The higher background noise can be attributed to the roar from the sea, windy conditions and closely packed industrial areas and movement of boats. Thilafushi was quitter during the night as there are no activity on the island.

Environmental and Social Impact Assessment for the Regional Solid Waste Management Facility (RSWMF) Thilafushi

Noise Level Measurement (Additional Measurements)

Prepared by: Abdul Aleem (EIA P03/2019)

24th October 2019

Noise Level Measurement

Additional Noise level was measured at two locations: NQ3 and NQ4 by Water Solutions on 6th and 7th October 2019 using hand held sound level meter at Thilafushi. Ambient noise levels were measured every hour for 24 hours at each locations.

Station Name	Station Coordinates	Monitoring rationale
NQ3 *(Thilafushi)*	4°10'58.3 N 73°26'09.6 E	This station was selected as it is located near the boundary of the proposed WTE facility.
NQ4 *(Thilafushi)*	4°10'57.3 N 73°25'59.4 E	This station was selected as it is located west of proposed WTE facility. The area has less development and less activity during the day time.

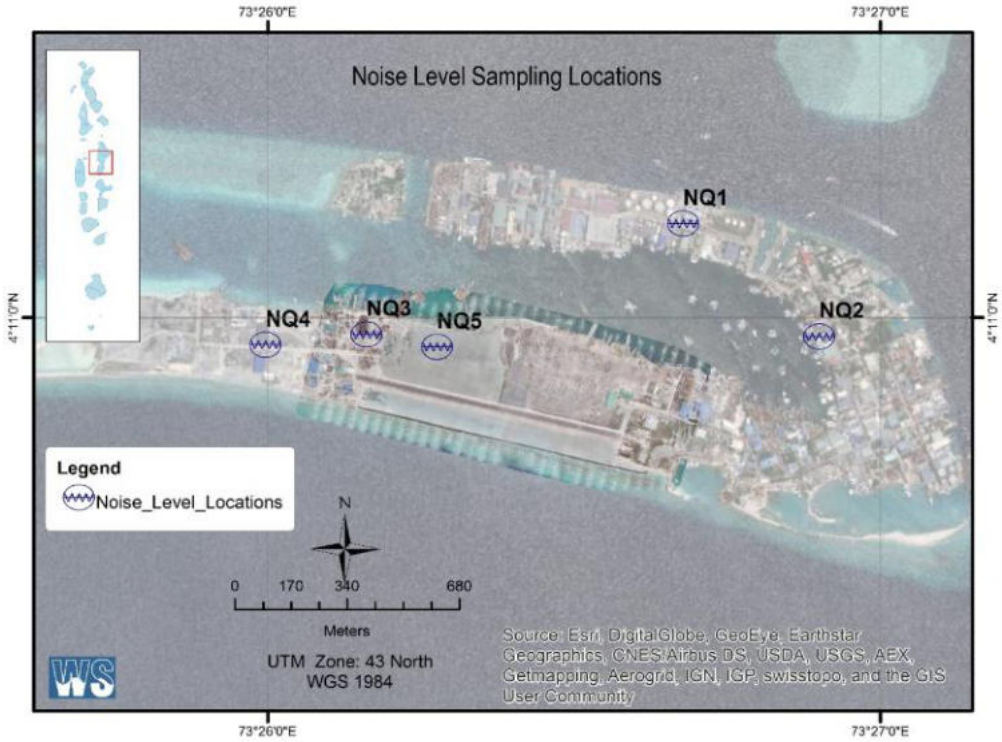

Figure: Locations where noise was monitored for the baseline assessment.

Table: Noise Measurement Results for Thilafushi

		Noise Level dB (A)	
Date	**Time**	**NQ3**	**NQ4**
6/10/2019	7:00	50.1	52.4
6/10/2019	8:00	54.4	54.3
6/10/2019	9:00	55.7	56.2
6/10/2019	10:00	56.5	56.8
6/10/2019	11:00	57.1	55.4
6/10/2019	12:00	56.8	57.4
6/10/2019	13:00	57.4	56.4
6/10/2019	14:00	57.3	55.9
6/10/2019	15:00	56.7	55.4
6/10/2019	16:00	56.8	56.1
6/10/2019	17:00	51.3	54.3
6/10/2019	18:00	49.4	49.4
6/10/2019	19:00	50.1	48.9
6/10/2019	20:00	49.6	48.6
6/10/2019	21:00	49.3	48.3
6/10/2019	22:00	50.1	48.5
6/10/2019	23:00	50.3	48.3
7/10/2019	0:00	50.1	48.1
7/10/2019	1:00	50.1	48.1
7/10/2019	2:00	50.3	48.3
7/10/2019	3:00	50.8	47.8
7/10/2019	4:00	50.2	48
7/10/2019	5:00	49.5	49.1
7/10/2019	6:00	49.8	49.3

The ambient noise levels were low considering the international standards. The background noise can be attributed to the roar from the sea, windy conditions areas and movement of boats. Thilafushi was quitter during the night as there are no activity on the island.

TEST REPORT

Report No: **(7419)080-0561A(S)** May 16, 2019

Attn: Mr. Nashfa Nashidh

Customer:	Water Solutions (Pvt) Ltd
Address :	MA. Faseri, 1st Floor, Ameenee Magu, Male, Maldives
Date of Sample Received:	Apr 03, 2019
Date of Testing Started:	Apr 03, 2019
Date of Report Modified:	May 16, 2019
Date of Testing Completed:	May 16, 2019
Sample Description:	**Sample Received as:** Approximately 500ml x 3 Nos. of Water sample contained in two sealed plastic bottles & one glass bottle respectively **Sample Identified by the Client as:** Ground Water Thilafushi GW 1
Sample Drawn By BVCPS	NO

Photo of the Samples Submitted

Bureau Veritas Consumer Products Services Lanka (Pvt) Ltd.

No. 570, Galle Road, Katubedda, Moratuwa, Sri Lanka
Tel: (9411) 2350111-115 (dedicated lines), Fax: (9411) 112622198 & 199
Email: bvcps.lanka@lk.bureauveritas.com

TEST REPORT

TEST RESULTS

No.	Parameters	Results	LOQ	Unit	Test Method
1	Turbidity*	1.3	-	NTU	APHA 23rd ed: 2017: 2130 B
2	pH at 25ºC*	7.3	-	-	APHA 23rd ed: 2017 :4500H$^+$
3	Iron (as Fe)*	0.4	-	mg/l	APHA 23rd ed: 2017: 3125 B
4	Manganese (as Mn)	0.02	-	mg/l	APHA 23rd ed: 2017: 3125 B
5	Arsenic (as As)	ND	0.001	mg/l	APHA 23rd ed: 2017: 3125 B
6	Total Dissolved Solids*	794	-	mg/l	APHA 23rd ed: 2017: 2540 C
7	Electrical Conductivity at 25ºC*	1.39	-	mS/cm	APHA 23rd ed: 2017; 2510 B
8	Cadmium (as Cd)*	ND	0.0001	mg/l	APHA 23rd ed: 2017: 3125 B
9	Lead (as Pb)*	ND	0.001	mg/l	
10	Mercury (as Hg)	ND	0.00005	mg/l	
11	**Polynuclear Aromatic Hydrocarbons***				
a	Naphthalene	ND	1.0	µg/l	CPSD –AN-00576
b	Acenaphthylene	ND	1.0	µg/l	CPSD –AN-00576
c	Acenaphthene	ND	1.0	µg/l	CPSD –AN-00576
d	Fluorene	ND	1.0	µg/l	CPSD –AN-00576
e	Phenanthrene	ND	1.0	µg/l	CPSD –AN-00576
f	Anthracene	ND	1.0	µg/l	CPSD –AN-00576
g	Fluoranthene	ND	1.0	µg/l	CPSD –AN-00576
h	Pyrene	ND	1.0	µg/l	CPSD –AN-00576
i	Benzo[a]anthracene	ND	1.0	µg/l	CPSD –AN-00576
j	Chrysene	ND	1.0	µg/l	CPSD –AN-00576
k	Benzo[a]pyrene	ND	1.0	µg/l	CPSD –AN-00576
l	Benzo[e]pyrene	ND	1.0	µg/l	CPSD –AN-00576
m	Indeno[1,2,3-cd]pyrene	ND	1.0	µg/l	CPSD –AN-00576
n	Dibenzo[a,h]anthracene	ND	1.0	µg/l	CPSD –AN-00576
o	Benzo[g,h,i]perylene	ND	1.0	µg/l	CPSD –AN-00576
p	Benzo[b]fluoranthene	ND	1.0	µg/l	CPSD –AN-00576
q	Benzo[j]fluoranthene	ND	1.0	µg/l	CPSD –AN-00576
r	Benzo[k]fluoranthene	ND	1.0	µg/l	CPSD –AN-00576

TEST REPORT

(*)Indicates- ISO 17025: 2005 accredited test.

Remark:
The test report (7419)080-0561A has been replaced with the test report (7419)080-0561A(S) in order to add test results of Heavy metals.

NOTE:
APHA: American Public Health Association,
SLS: Sri Lanka Standard, ND: Not Detected,
LOQ: Limit of Quantification, mg/l: milligrams per liter,
ºC :Celcius, NTU: Nephelometric Turbidity Units,
mS/cm : milliSiemens per centimeter.

Contact Information for this report (Technical and General Inquiries and Feedback)

GENERAL INQUIRIES:		
IROSHA UDUGAMPALA	TEL: +94 768 229 528	E-MAIL: Irosha.Udugampala@lk.bureauveritas.com
TECHNICAL INQUIRIES:		
ROHITHA GUNARATHNA	TEL: +94 774 151 768	E-MAIL: rohitha.gunarathna@lk.bureauveritas.com
FEED BACK:		
KUMUDINI RATHNAYAKE	TEL: +94 768 229 455	E-MAIL: kumudinie.rathnayake@lk.bureauveritas.com

REVIEWED BY: SHYAMIKA WICKRAMASINGHE

BUREAU VERITAS CONSUMER PRODUCTS SERVICES LANKA (PVT) LTD.

AUTHORIZED SIGNATORY

ROHITHA GUNARATHNA

MANAGER-
ANALYTICAL LABORATORY

TEST REPORT

CPS CONDITIONS OF SERVICE

The party that submits a completed service request form to Company or signs a quotation issued by the Company for its performance of services ("**Services**") is the "**Client**" under these Conditions of Service. The entity within the Bureau Veritas Consumer Products Services division accepting the service request form and issuing the Report documenting the results of those Services is the "**Company**" under these Conditions of Service. Company and Client are, together, the "**Parties**" and each is a "**Party**". A request for Services constitutes a legally binding agreement on both Parties when such a request is accepted by the Company ("**Agreement**") under the following terms and conditions (collectively, "**Conditions**"):

1. Services. (a) The completion of the Services shall be evidenced by the Company's issuing to Client a written report setting forth the results of the Services based upon the properly accepted request, applicable protocols, written information, and where applicable, the product sample provided by Client to Company ("**Report**"). Company may delegate/assign the performance of all or a portion of the Services to an affiliate of Company or to an agent or subcontractor. Client shall provide to Company on a timely basis, all documents and information necessary to enable Company to properly perform the Services. Company may, in its sole discretion, dispose of product samples furnished to Company for the Services that were not destroyed in the course of performance of the Services. **(b)** Client represents and warrants to Company that (i) each product sample is not submitted in violation of a third party's intellectual property rights; (ii) Client will not use and rely upon Company's Report for any product whose properties differ from the sample(s) upon which the Report is based; and (iii) any goods subject to inspection will be completely prepared for the type of inspection booked for the specified date, and **(c)** Client accepts sole responsibility and liability for the accuracy of documents submitted to government or other regulatory bodies, including certificates of compliance required under the US Consumer Product Safety Improvement Act and EU requirements under REACH regulations. Client's responsibility and liability for accuracy shall apply even where Company has provided assistance to Client in preparation of such documentation.

2. Report. (a) The Report shall (i) constitute the sole deliverable for the Services, (ii) relate solely to the facts and circumstances as observed and recorded by Company at the time of performance of the Services within the limits of written information and instructions received from Client; Company shall have no obligation to update the Report after its issuance. Where the Services include testing or inspection: (i) the Report will set forth the findings of Company solely with respect to the product samples identified therein and (ii) the results set forth in the Report are not to be construed as indicative or representative of the quality or characteristics of the lot from which a product sample was taken for Company's performance of Services. **(b)** The Report is issued solely by Company, is intended for the exclusive use of Client and its affiliates and, except as required by a regulatory body, shall not be published, used for advertising purposes, copied or replicated for distribution or publicly disclosed without Company's prior written consent. Company is not responsible for any third party's interpretation of the Report. **(c)** Client shall not request a Report for purposes of litigation, nor shall it list Company, its affiliates or employees as an expert in any proceeding without Company's prior written consent. If Client anticipates producing or otherwise using the Report in any legal proceedings, it shall so notify Company prior to submitting the Report in such proceeding.

3. Representations and Warranties. (a) Company undertakes due care and ordinary skill in the performance of its Services. **(b)** Client agrees that Company is neither an insurer nor a guarantor and does not take the place of Client or the third parties that it retains, including designers, manufacturers, agents, buyers, distributors, and transportation or shipping companies; Company disclaims all liability in such capacities. Client understands that, if it seeks to protect itself from claims of loss, damage or injury, it should obtain appropriate insurance. **(c)** Company does not warrant or guarantee Client's products, and Company's Report does not represent a warranty of merchantability, a warranty of fitness for a particular purpose, or any other warranty or guarantee.

4. Payment. Payment in full shall be due 30 days after the date of invoice, failing which Company may revoke any credit extended to Client. Client shall reimburse Company for (i) interest on overdue amounts from the due date until paid at an interest rate of 1.5% per month and (ii) any other costs Company incurs in collecting past due amounts, including court, attorneys and collection agencies' fees.

5. Intellectual Property. The names, service marks, trademarks and copyrights of Company and its affiliates (collectively, the "**Marks**") are and remain the sole property of Company and shall not be used by Client. Client shall not contest the validity of the Marks or take any action that might impair the value or goodwill associated with the Marks or the image or reputation of Company or its affiliates. Client understands that any information or samples submitted to Company is a license for Company to use the same in the performance of Services.

6. Relationship. (a) Nothing herein creates a partnership, agency or joint venture between the Parties. **(b)** The failure to require strict observance or performance of any provision of these Conditions shall not be construed to be a waiver of a Party's right to later require strict observance and performance of the same. If any provision of these Conditions is held to be invalid or unenforceable, such invalidity shall not invalidate the remainder of the Conditions. **(c)** For a period of two years after the commencement of this Agreement, Client shall not directly or indirectly try to solicit for employment any of Company's employees.

7. INDEMNITY. CLIENT SHALL HOLD HARMLESS AND INDEMNIFY COMPANY, ITS AFFILIATES AND THEIR RESPECTIVE DIRECTORS, OFFICERS, EMPLOYEES, AGENTS AND SUBCONTRACTORS AGAINST ALL THIRD-PARTY CLAIMS FOR LOSS, DAMAGE, INJURY, DEATH, OR EXPENSE OF WHATEVER NATURE, INCLUDING BUT NOT LIMITED TO CLAIMS ARISING FROM OR RELATING TO (I) THE PERFORMANCE OF ANY SERVICES BY COMPANY, (II) THE SALE, RESALE, MANUFACTURE, DISTRIBUTION OR USE OF ANY OF CLIENT'S GOODS OR (III) BREACH OF CLIENT'S OBLIGATIONS OR WARRANTIES HEREIN.

8. LIMITATIONS OF LIABILITY. (A) COMPANY SHALL NOT BE LIABLE FOR ANY INDIRECT, CONSEQUENTIAL OR SPECIAL LOSS IN CONNECTION WITH THE REPORT, THE PRODUCT FOR WHICH SERVICES WERE PERFORMED, OR THE SERVICES PROVIDED BY COMPANY HEREUNDER. COMPANY SHALL NOT BE LIABLE FOR ANY LOSS OR DAMAGE WHATSOEVER RESULTING FROM ANY DELAY IN THE PERFORMANCE OF ITS OBLIGATIONS HEREUNDER OR FROM THE FAILURE OF COMPANY TO PROVIDE ITS SERVICES WITHIN ANY TIME PERIOD FOR COMPLETION ESTIMATED BY COMPANY, REGARDLESS OF THE CAUSE OF THE DELAY OR FAILURE. **(B)** THE ENTIRE FINANCIAL AND LEGAL LIABILITY OF COMPANY IN RESPECT OF ANY CLAIM FOR LOSS, INDEMNITY, CONTRIBUTION OR DAMAGE OF WHATEVER NATURE OR HOWSOEVER ARISING, SHALL NOT EXCEED AN AMOUNT EQUAL TO FIVE (5) TIMES THE AMOUNT OF FEES PAID TO COMPANY FOR THE SPECIFIC SERVICES WHICH GAVE RISE TO SUCH CLAIM.

9. Force Majeure. If any event of force majeure or any event outside the control of Company occurs, Company may immediately cancel or suspend its performance hereunder without incurring any liability whatsoever to Client.

10. Governing Law. These Conditions shall be governed by the laws of the country as follows: for Services performed in (i) the Americas: the laws of New York, (ii) Asia Pacific, South Asia, Middle East and Africa: the laws of Hong Kong (except for China where PRC laws govern), and (iii) Europe: the laws of England.

11. Dispute Resolution. (a) If Client desires to assert a claim relating to the Services, it must submit the same to Company in writing setting forth with particularity the basis for such claim within 90 days from discovery of the claim and not more than six months after the date of issuance of the Report. Client waives any and all claims without limitation that it does not submit within such time periods. **(b)** If a dispute arises under this Agreement, the Parties shall first attempt good faith negotiations, failing which, the Parties (i) agree that the courts of the country of governing law shall have exclusive jurisdiction to settle any such dispute related to this Agreement and (ii) irrevocably waive their right to trial by jury in any such action or proceeding.

12. These Conditions, the applicable order form and/or quotation and the Report represent the entire understanding of the Parties on the subject matter hereof, and no modification is binding unless in writing. Any of Client's terms and conditions attached to, enclosed with or referred to in any order form, purchase order or other document shall not apply.

END OF THE REPORT.

TEST REPORT

Report No: **(7419)080-0561D(S)** May 16, 2019

Attn: Mr. Nashfa Nashidh

Customer:	Water Solutions (Pvt) Ltd
Address :	MA. Faseri, 1st Floor, Ameenee Magu, Male, Maldives
Date of Sample Received:	Apr 03, 2019
Date of Testing Started:	Apr 03, 2019
Date of Report Modified:	May 16, 2019
Date of Testing Completed:	May 16, 2019
Sample Description:	**Sample Received as:** Approximately 500ml x 3 Nos. of Water sample contained in two sealed plastic bottles & one glass bottle respectively **Sample Identified by the Client as:** Ground Water Thilafushi GW 4
Sample Drawn By BVCPS	NO

Photo of the Samples Submitted

Bureau Veritas Consumer Products Services Lanka (Pvt) Ltd.

No. 570, Galle Road, Katubedda, Moratuwa, Sri Lanka
Tel: (9411) 2350111-115 (dedicated lines), Fax: (9411) 112622198 & 199
Email: bvcps.lanka@lk.bureauveritas.com

TEST REPORT

Report No: **(7419)080-0561D(S)** May 16, 2019

TEST RESULTS

No.	Parameters	Results	LOQ	Unit	Test Method
1	Turbidity*	0.4	-	NTU	APHA 23rd ed: 2017: 2130 B
2	pH at 25ºC*	8.0	-	-	APHA 23rd ed: 2017 :4500H$^+$
3	Iron (as Fe)*	ND	0.001	mg/l	APHA 23rd ed: 2017: 3125 B
4	Manganese (as Mn)	ND	0.001	mg/l	APHA 23rd ed: 2017: 3125 B
5	Arsenic (as As)	ND	0.001	mg/l	APHA 23rd ed: 2017: 3125 B
6	Total Dissolved Solids*	1003	-	mg/l	APHA 23rd ed: 2017: 2540 C
7	Electrical Conductivity at 25ºC*	1.87	-	mS/cm	APHA 23rd ed: 2017; 2510 B
8	Cadmium (as Cd)*	ND	0.0001	mg/l	APHA 23rd ed: 2017: 3125 B
9	Lead (as Pb)*	ND	0.001	mg/l	
10	Mercury (as Hg)	ND	0.00005	mg/l	
11	**Polynuclear Aromatic Hydrocarbons***				
a	Naphthalene	ND	1.0	µg/l	CPSD –AN-00576
b	Acenaphthylene	ND	1.0	µg/l	CPSD –AN-00576
c	Acenaphthene	ND	1.0	µg/l	CPSD –AN-00576
d	Fluorene	ND	1.0	µg/l	CPSD –AN-00576
e	Phenanthrene	ND	1.0	µg/l	CPSD –AN-00576
f	Anthracene	ND	1.0	µg/l	CPSD –AN-00576
g	Fluoranthene	ND	1.0	µg/l	CPSD –AN-00576
h	Pyrene	ND	1.0	µg/l	CPSD –AN-00576
i	Benzo[a]anthracene	ND	1.0	µg/l	CPSD –AN-00576
j	Chrysene	ND	1.0	µg/l	CPSD –AN-00576
k	Benzo[a]pyrene	ND	1.0	µg/l	CPSD –AN-00576
l	Benzo[e]pyrene	ND	1.0	µg/l	CPSD –AN-00576
m	Indeno[1,2,3-cd]pyrene	ND	1.0	µg/l	CPSD –AN-00576
n	Dibenzo[a,h]anthracene	ND	1.0	µg/l	CPSD –AN-00576
o	Benzo[g,h,i]perylene	ND	1.0	µg/l	CPSD –AN-00576
p	Benzo[b]fluoranthene	ND	1.0	µg/l	CPSD –AN-00576
q	Benzo[j]fluoranthene	ND	1.0	µg/l	CPSD –AN-00576
r	Benzo[k]fluoranthene	ND	1.0	µg/l	CPSD –AN-00576

TEST REPORT

(*)Indicates- ISO 17025 :2005 accredited test.

Remark:
The test report (7419)080-0561D has been replaced with the test report (7419)080-0561D(S) in order to add test results of Heavy metals.

NOTE:
APHA: American Public Health Association,
SLS: Sri Lanka Standard, ND: Not Detected,
LOQ: Limit of Quantification, mg/l: milligrams per liter,
ºC :Celcius, NTU: Nephelometric Turbidity Units,
mS/cm : milliSiemens per centimeter.

Contact Information for this report (Technical and General Inquiries and Feedback)

GENERAL INQUIRIES:		
IROSHA UDUGAMPALA	TEL: +94 768 229 528	E-MAIL: Irosha.Udugampala@lk.bureauveritas.com
TECHNICAL INQUIRIES:		
ROHITHA GUNARATHNA	TEL: +94 774 151 768	E-MAIL: rohitha.gunarathna@lk.bureauveritas.com
FEED BACK:		
KUMUDINI RATHNAYAKE	TEL: +94 768 229 455	E-MAIL: kumudinie.rathnayake@lk.bureauveritas.com

REVIEWED BY: SHYAMIKA WICKRAMASINGHE

BUREAU VERITAS CONSUMER PRODUCTS SERVICES LANKA (PVT) LTD.

AUTHORIZED SIGNATORY

ROHITHA GUNARATHNA

MANAGER-
ANALYTICAL LABORATORY

TEST REPORT

CPS CONDITIONS OF SERVICE

The party that submits a completed service request form to Company or signs a quotation issued by the Company for its performance of services ("**Services**") is the "**Client**" under these Conditions of Service. The entity within the Bureau Veritas Consumer Products Services division accepting the service request form and issuing the Report documenting the results of those Services is the "**Company**" under these Conditions of Service. Company and Client are, together, the "**Parties**" and each is a "**Party**". A request for Services constitutes a legally binding agreement on both Parties when such a request is accepted by the Company ("**Agreement**") under the following terms and conditions (collectively, "**Conditions**"):

1. Services. (a) The completion of the Services shall be evidenced by the Company's issuing to Client a written report setting forth the results of the Services based upon the properly accepted request, applicable protocols, written information, and where applicable, the product sample provided by Client to Company ("**Report**"). Company may delegate/assign the performance of all or a portion of the Services to an affiliate of Company or to an agent or subcontractor. Client shall provide to Company on a timely basis, all documents and information necessary to enable Company to properly perform the Services. Company may, in its sole discretion, dispose of product samples furnished to Company for the Services that were not destroyed in the course of performance of the Services. **(b)** Client represents and warrants to Company that (i) each product sample is not submitted in violation of a third party's intellectual property rights; (ii) Client will not use and rely upon Company's Report for any product whose properties differ from the sample(s) upon which the Report is based; and (iii) any goods subject to inspection will be completely prepared for the type of inspection booked for the specified date, and **(c)** Client accepts sole responsibility and liability for the accuracy of documents submitted to government or other regulatory bodies, including certificates of compliance required under the US Consumer Product Safety Improvement Act and EU requirements under REACH regulations. Client's responsibility and liability for accuracy shall apply even where Company has provided assistance to Client in preparation of such documentation.

2. Report. (a) The Report shall (i) constitute the sole deliverable for the Services, (ii) relate solely to the facts and circumstances as observed and recorded by Company at the time of performance of the Services within the limits of written information and instructions received from Client; Company shall have no obligation to update the Report after its issuance. Where the Services include testing or inspection: (i) the Report will set forth the findings of Company solely with respect to the product samples identified therein and (ii) the results set forth in the Report are not to be construed as indicative or representative of the quality or characteristics of the lot from which a product sample was taken for Company's performance of Services. **(b)** The Report is issued solely by Company, is intended for the exclusive use of Client and its affiliates and, except as required by a regulatory body, shall not be published, used for advertising purposes, copied or replicated for distribution or publicly disclosed without Company's prior written consent. Company is not responsible for any third party's interpretation of the Report. **(c)** Client shall not request a Report for purposes of litigation, nor shall it list Company, its affiliates or employees as an expert in any proceeding without Company's prior written consent. If Client anticipates producing or otherwise using the Report in any legal proceedings, it shall so notify Company prior to submitting the Report in such proceeding.

3. Representations and Warranties. (a) Company undertakes due care and ordinary skill in the performance of its Services. **(b)** Client agrees that Company is neither an insurer nor a guarantor and does not take the place of Client or the third parties that it retains, including designers, manufacturers, agents, buyers, distributors, and transportation or shipping companies; Company disclaims all liability in such capacities. Client understands that, if it seeks to protect itself from claims of loss, damage or injury, it should obtain appropriate insurance. **(c)** Company does not warrant or guarantee Client's products, and Company's Report does not represent a warranty of merchantability, a warranty of fitness for a particular purpose, or any other warranty or guarantee.

4. Payment. Payment in full shall be due 30 days after the date of invoice, failing which Company may revoke any credit extended to Client. Client shall reimburse Company for (i) interest on overdue amounts from the due date until paid at an interest rate of 1.5% per month and (ii) any other costs Company incurs in collecting past due amounts, including court, attorneys and collection agencies' fees.

5. Intellectual Property. The names, service marks, trademarks and copyrights of Company and its affiliates (collectively, the "**Marks**") are and remain the sole property of Company and shall not be used by Client. Client shall not contest the validity of the Marks or take any action that might impair the value or goodwill associated with the Marks or the image or reputation of Company or its affiliates. Client understands that any information or samples submitted to Company is a license for Company to use the same in the performance of Services.

6. Relationship. (a) Nothing herein creates a partnership, agency or joint venture between the Parties. **(b)** The failure to require strict observance or performance of any provision of these Conditions shall not be construed to be a waiver of a Party's right to later require strict observance and performance of the same. If any provision of these Conditions is held to be invalid or unenforceable, such invalidity shall not invalidate the remainder of the Conditions. **(c)** For a period of two years after the commencement of this Agreement, Client shall not directly or indirectly try to solicit for employment any of Company's employees.

7. INDEMNITY. CLIENT SHALL HOLD HARMLESS AND INDEMNIFY COMPANY, ITS AFFILIATES AND THEIR RESPECTIVE DIRECTORS, OFFICERS, EMPLOYEES, AGENTS AND SUBCONTRACTORS AGAINST ALL THIRD-PARTY CLAIMS FOR LOSS, DAMAGE, INJURY, DEATH, OR EXPENSE OF WHATEVER NATURE, INCLUDING BUT NOT LIMITED TO CLAIMS ARISING FROM OR RELATING TO (I) THE PERFORMANCE OF ANY SERVICES BY COMPANY, (II) THE SALE, RESALE, MANUFACTURE, DISTRIBUTION OR USE OF ANY OF CLIENT'S GOODS OR (III) BREACH OF CLIENT'S OBLIGATIONS OR WARRANTIES HEREIN.

8. LIMITATIONS OF LIABILITY. (A) COMPANY SHALL NOT BE LIABLE FOR ANY INDIRECT, CONSEQUENTIAL OR SPECIAL LOSS IN CONNECTION WITH THE REPORT, THE PRODUCT FOR WHICH SERVICES WERE PERFORMED, OR THE SERVICES PROVIDED BY COMPANY HEREUNDER. COMPANY SHALL NOT BE LIABLE FOR ANY LOSS OR DAMAGE WHATSOEVER RESULTING FROM ANY DELAY IN THE PERFORMANCE OF ITS OBLIGATIONS HEREUNDER OR FROM THE FAILURE OF COMPANY TO PROVIDE ITS SERVICES WITHIN ANY TIME PERIOD FOR COMPLETION ESTIMATED BY COMPANY, REGARDLESS OF THE CAUSE OF THE DELAY OR FAILURE. **(B)** THE ENTIRE FINANCIAL AND LEGAL LIABILITY OF COMPANY IN RESPECT OF ANY CLAIM FOR LOSS, INDEMNITY, CONTRIBUTION OR DAMAGE OF WHATEVER NATURE OR HOWSOEVER ARISING, SHALL NOT EXCEED AN AMOUNT EQUAL TO FIVE (5) TIMES THE AMOUNT OF FEES PAID TO COMPANY FOR THE SPECIFIC SERVICES WHICH GAVE RISE TO SUCH CLAIM.

9. Force Majeure. If any event of force majeure or any event outside the control of Company occurs, Company may immediately cancel or suspend its performance hereunder without incurring any liability whatsoever to Client.

10. Governing Law. These Conditions shall be governed by the laws of the country as follows: for Services performed in (i) the Americas: the laws of New York, (ii) Asia Pacific, South Asia, Middle East and Africa: the laws of Hong Kong (except for China where PRC laws govern), and (iii) Europe: the laws of England.

11. Dispute Resolution. (a) If Client desires to assert a claim relating to the Services, it must submit the same to Company in writing setting forth with particularity the basis for such claim within 90 days from discovery of the claim and not more than six months after the date of issuance of the Report. Client waives any and all claims without limitation that it does not submit within such time periods. **(b)** If a dispute arises under this Agreement, the Parties shall first attempt good faith negotiations, failing which, the Parties (i) agree that the courts of the country of governing law shall have exclusive jurisdiction to settle any such dispute related to this Agreement and (ii) irrevocably waive their right to trial by jury in any such action or proceeding.

12. These Conditions, the applicable order form and/or quotation and the Report represent the entire understanding of the Parties on the subject matter hereof, and no modification is binding unless in writing. Any of Client's terms and conditions attached to, enclosed with or referred to in any order form, purchase order or other document shall not apply.

END OF THE REPORT.