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Report No.: 0394/13/ED/0389A

Quarterly EM&A Report

September 2019 - November 2019

Client : China International Water & Electric Corporation

Project: Providing Sufficient Water Depth for Kwai Tsing Container Basin and its Approach Channel – CV/2013/04

Report No.: 0394/13/ED/0389A

Project Proponent:

Civil Engineering & Development Department
101 Princess Margaret Road,
Homantin,
Kowloon, Hong Kong.

Prepared by: Andy Choi

Reviewed by: Cyrus Lai

Certified by: ______________________
Colin Yung
Environmental Team Leader for
Fugro Technical Services Limited

Ref.: CEDDWKTBEM00_0_0394L.19

27 April 2020
By Post

Mott MacDonald Hong Kong Ltd.
3/F Mapletree Bay Point,
348 Kwun Tong Road
Kwun Tong, Kowloon

Attention: Mr. C M Howley

Dear Mr. Howley,

Re: Agreement No. CE 63/2008 (CE)
Dredging Works in Kwai Tsing Container Basin and its Approach Channel – Investigation, Design and Construction)

Contract No. CV/2013/04
Dredging Works in Kwai Tsing Container Basin and its Approach Channel
Verification of Quarterly EM&A Report for September 2019 to November 2019

Reference is made to the Environmental Team's submission of the Quarterly Environmental Monitoring & Audit Report for September 2019 to November 2019 (ET's Report No. 0394/13/ED/0389A) received by e-mail on 23 April 2019.

We write to verify the captioned report in accordance with Section 12.4 iii of EM&A Manual (AEIAR-156/2010).

Thank you very much for your kind attention and please do not hesitate to contact our Mr. Theo Chan or the undersigned should you have any queries.

Yours faithfully,
For and on behalf of
Ramboll Hong Kong Limited

Y H Hui
Independent Environmental Checker

Cc:	MMHK	Mr. Jason Chan	(by post and email)
	MateriaLab	Mr. Colin Yung	(by email)
	CIWE	Mr. K.O. Leung	(by email)

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EXECUTIVE SUMMARY

i. This is the eighteenth Quarterly Environmental Monitoring Audit (EM&A) Report – September 2019 – November 2019 for Contract No. CV/2013/04 – Dredging Works in Kwai Tsing and its Approach Channel (CE63/2008 – Providing Sufficient Water Depth for Kwai Tsing Container Basin and its Approach Channel). The dredging works commenced on 23 April 2014. This report presents the environmental monitoring and audit works conducted from 23 September 2019 to 22 November 2019.

ii. Construction Activities for the Reporting Period
During this reporting period, the principal work activities included:

September 2019	October 2019	November 2019
• Preparation Works of Dredging at Portion A / Zone 2B1, 2B2 and 2C1 in EP.	• Preparation Works of Dredging at Portion A / Zone 2B1, 2B2 and 2C1 in EP • Dredging at Portion A/ Zone 2B2 in EP	• Preparation Works of Dredging at Portion A / Zone 2B1, 2B2 and 2C1 in EP. • Dredging at Portion A/ Zone 2B2 in EP

iii. Water Quality Monitoring
Routine impact water quality monitoring at 7 designated monitoring stations namely C1A, C2A, G2, SR4, SR5, SR12, SR13 were conducted during the reporting period. Exceedances of NH3-N (in-situ & lab), UIA (in-situ & lab) ,TIN (in-situ & lab), Suspended solid and *E.coli* were recorded at various monitoring stations, detail of exceedance are summarized in **Table I and II**. However, investigation indicated these exceedances were not related to the Project works.

Table I Summary of Water Quality Exceedances – Routine Impact Monitoring (In-situ)

Station	Exceedance Level	DO (S&M)		DO (B)		Turbidity		NH_3-N		UIA		TIN		Total	
		E	F	E	F	E	F	E	F	E	F	E	F	E	F
SR4	Action	0	0	0	0	0	0	0	0	0	0	-	-	0	0
	Limit	0	0	0	0	0	0	0	0	12	14	-	-	12	14
SR5	Action	0	0	0	0	0	0	-	-	-	-	4	2	4	2
	Limit	0	0	0	0	0	0	-	-	-	-	13	15	13	15
SR12	Action	0	0	0	0	0	0	0	0	0	0	-	-	0	0
	Limit	0	0	0	0	0	0	1	1	15	15	-	-	16	16
SR13	Action	0	0	0	0	0	0	-	-	-	-	-	-	0	0
	Limit	0	0	0	0	0	0	-	-	-	-	-	-	0	0
Total	Action	0	0	0	0	0	0	0	0	0	0	4	2	6	
	Limit	0	0	0	0	0	0	1	1	27	29	13	15	86	

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Table II Summary of Water Quality Exceedances – Routine Impact Monitoring (Laboratory Analysis)

Station	Exceedance Level	Suspended Solids		BOD_5		*E. coli*		NH_3-N		UIA		Synthetic Detergent		TIN		Total	
		E	F	E	F	E	F	E	F	E	F	E	F	E	F	E	F
SR4	Action	0	0	0	0	0	0	0	0	0	0	0	0	-	-	0	0
	Limit	2	3	0	0	0	0	0	0	12	13	0	0	-	-	14	16
SR5	Action	1	1	-	-	-	-	-	-	-	-	-	-	4	2	5	3
	Limit	0	0	-	-	-	-	-	-	-	-	-	-	13	15	13	15
SR12	Action	0	0	0	0	0	0	0	0	0	0	0	0	-	-	0	0
	Limit	5	4	0	0	1	0	1	1	15	15	0	0	-	-	22	20
SR13	Action	0	0	-	-	-	-	-	-	-	-	-	-	-	-	0	0
	Limit	0	0	-	-	-	-	-	-	-	-	-	-	-	-	0	0
Total	Action	1	1	0	0	0	0	0	0	0	0	0	0	4	2	8	
	Limit	7	7	0	0	1	0	1	1	27	28	0	0	13	15	100	

Among the 7 monitoring stations, supplementary 24-hr water quality monitoring was also conducted at 4 of the stations, which are SR4, SR5, SR12 and SR13. No exceedance was recorded in the reporting period. Number of exceedances recorded in the reporting period at each impact station is summarized in **Table III**.

Table III Summary of the Exceedances Recorded in Reporting Quarter – 24-hr Monitoring

Station	Exceedance Level	Turbidity	DO	NH_3-N	Total
SR4	Action	0	0	0	0
	Limit	0	0	0	0
SR5	Action	0	0	-	0
	Limit	0	0	-	0
SR12	Action	0	0	0	0
	Limit	0	0	0	0
SR13	Action	0	0	-	0
	Limit	0	0	-	0
Total	Action	0	0	0	0
	Limit	0	0	0	0

iv. Waste Management

There was marine sediment Type 2 sediment (Confined Marine Disposal) disposed to East of Sha Chau Contaminated Mud Pit. No general refuse were disposed off site in the reporting month.

v. Non-Compliance, Complaints, Notifications of Summons and Successful Prosecutions

No complaint, notification of prosecutions or summons was received in the reporting period.

vi. Site Inspections and Audit

The Environmental Team conducted 13 site inspections in the reporting period. No particular observation was recorded in the reporting month except oil stain was found on the deck. The

Contractor was reminded to wash the desk regularly and ensure no leakage of oil into the sea. The waste shall be treated and disposed properly as chemical waste.

According to Contractor, no archaeological deposit was found during reporting period.

vii. Compliance with Specific EP conditions

Implementation of contractor's mitigation for dredging work and the associated dredging records were checked. It was concluded that the dredging is conducted orderly in compliance with the EP requirements on site mitigation measures in general.

viii. Construction Activities for the Coming Reporting Period

During the coming reporting period, the principal work activities included:

- Preparation Works of Dredging at Portion A / Zone 2B1, 2B2 and 2C1 in EP
- Dredging at Portion A / Zone 2B1, 2B2 and 2C1 in EP

Future Key Issues include:

- Regular inspection on silt curtain deployment
- Regular inspection on silt screen deployment
- Implementation of EM&A Programme
- Maintain dredging below allowable dredging rate in EP.
- Cleaning of excess material from the decks and exposed fittings of barges and dredgers before the vessel is moved.
- Barge loading shall be monitored to ensure material is not lost during transportation.
- Conditions in dumping permit shall be followed strictly.

According to information provided by the Contractor, the upcoming dredging works will only be carried out at sub-zone Z2B1, Z2B2 and Z2C1 will be approximately 5200 m^3 (in-situ volume) in total, which is far below than the dredging scale which was mentioned in the EP. Refer to Section 2.1.4 of the EM&A Manual, routine water quality monitoring stations at SR2 (Casam, Gazetted Beach) and SR3 (Approach, Gazetted Beach) were proposed to be removed as according to the Proposal of Scale down for the Water Quality Monitoring Stations during High Spots Removal at Sub-zone Z2B1, Z2B2 and Z2C1 (Ref.: 0394/13/ED/0370G). The proposal was justified by ET and verified by IEC, also no objection was received from other parties. The proposal was approved by EPD as per EPD's memo (Ref. (6) in Ax(1) to EP2/N3/C/57 Pt.10) dated 20 August 2019. The removal of the water quality monitoring at SR2 and SR3 will be effective from 23 August 2019.

1. INTRODUCTION

1.1 Background

1.1.1 The Project objective is to dredge approximately 4.0 million cubic metres of sediment from the seabed of Kwai Tsing Container Basin, as well as portions of Northern Fairway and Western Fairway, to provide sufficient depth of container basin and approach channel to Kwai Tsing Container Terminal (KTCT) for the safe navigation of Ultra Large Container Ships (ULCS).

1.1.2 The environmental monitoring and audit works of this Project is governed by Environmental Permit (EP) No. EP-426/2011/A, EM&A Manual (AEIAR-156/2010) and EM&A TIN (EPD Letter Ref: (34) in Ax(1) to EP2/N3/C/57Pt.7)).

1.1.3 The project proponent was the Civil Engineering & Development Department, HKSAR (CEDD). The Project General Layout is shown in **Figure 1**.

1.1.4 Mott MacDonald Hong Kong Ltd. (MMHK) was commissioned by CEDD as the Engineer for the Project. Ramboll Hong Kong Limited (RHK) was employed as the Independent Environmental Checker (IEC) in the Project.

1.1.5 China International Water & Electric Corporation Limited (CIWE) was appointed as the main contractor for the dredging works.

1.1.6 Fugro Technical Services Limited (FTS) was appointed as the Environmental Team (ET) to implement the Environmental Monitoring and Audit (EM&A) programme for the Project.

1.1.7 The construction phase of the Project under the EP was commenced on 23 April 2014.The impact EM&A programme of the Project commenced on 23 April 2014.

1.2 Purpose of the Report

1.2.1 This eighteenth Quarterly EM&A Report is prepared by FTS. This report presents a summary of the environmental monitoring and audit works, list of activities and mitigation measures proposed by the ET for the Project in 23 September 2019 to 22 November 2019.

1.3 Structure of the Report

1.3.1 The structure of this report is as follows:

Section 1: Introduction, including background, purpose and structure of the report

Section 2: Basic Project Information – summaries background and scope of the Contract, site description, project organization and contract details, construction programme, the construction works undertaken and the status of Environmental Permits/Licenses during the reporting period.

Section 3: Routine Impact Water Quality Monitoring – summaries the monitoring parameters, monitoring programmes, monitoring methodologies, monitoring frequency, monitoring locations, Action and Limit Levels, monitoring results and Event / Action Plans.

Section 4: 24-hr Water Quality Monitoring – summaries the monitoring parameters, monitoring programmes, monitoring methodologies, monitoring frequency, monitoring locations, Action and Limit Levels, monitoring results and Event / Action Plans.

Section 5: Environmental Site Inspection – summaries the audit findings of the weekly site inspections undertaken within the reporting period.

Section 6: Non-Compliance, Complaints, notifications of summons and Prosecution – summaries any environmental complaints, environmental summons and successful prosecutions within the reporting period.

Section 7: Conclusions and Recommendation

2. BASIC PROJECT INFORMATION

2.1 Project Organizations

2.1.1 The Project Organization structure is shown in **Appendix A**. The key personnel contact names and numbers are summarized in **Table 2.1**.

Table 2-1 Key Personnel Contact of the Contract

Party	Position	Name	Telephone	Fax
Engineer's Representative (MMHK)	Resident Engineer	Mr. Jason Chan	2585 8595	2827 1823
	Project Engineer	Ms. Sunny Zhao	2828 5908	2827 1823
Independent Environmental Checker (RHK)	Independent Environmental Checker	Mr. YH Hui	3465 2888	3465 2899
Contractor (CIWE)	Site Agent	Mr. KO Leung	2508 0983	2508 0987
Environmental Team (FTS)	Environmental Team Leader	Mr. Colin Yung	3565 4114	3565 4160

2.2 Construction Programme and Synopsis of Work

2.2.1 The construction phase of the Project under the EP commenced on 23 April 2014.

2.2.2 The construction programme of the Project is shown in **Appendix B**.

2.2.3 The environmental mitigation measures implementation schedule is presented in **Appendix F**.

2.3 Works undertaken during the quarter

During the reporting period, according to the Contractor, the principal work activities include:

September 2019	October 2019	November 2019
• Preparation Works of Dredging at Portion A / Zone 2B1, 2B2 and 2C1 in EP.	• Preparation Works of Dredging at Portion A / Zone 2B1, 2B2 and 2C1 in EP. • Dredging at Portion A/ Zone 2B2 in EP.	• Preparation Works of Dredging at Portion A / Zone 2B1, 2B2 and 2C1 in EP. • Dredging at Portion A/ Zone 2B2 in EP.

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3. EM&A REQUIREMENTS – ROUTINE IMPACT MONITORING

3.1 Monitoring Parameters

3.1.1 The monitoring parameters and frequency for both in-situ measurement and laboratory analysis are summarised in **Table 3.1**. Parameters for each monitoring station are specified in **Table 3.2**.

Table 3-1 **Monitoring Parameters and Frequency**

Parameters	Monitoring Frequency
In-situ Measurement Turbidity (in NTU), pH, Dissolved Oxygen (in mg/L and %), Temperature (in °C), Salinity (in ppt), [1]Ammonia-N (in mg/L-N and UIA); [2]TIN: Ammonia-N (in mg/L), Nitrite (in mg/L), Nitrate (in mg/L) Laboratory Analysis [1]Ammonia-N (in mg/L-N and UIA), Suspended Solids (SS), [3]BOD_5, [3]*E.coli*, [3]Synthetic Detergent; [2]TIN: Ammonia-N (in mg/L), Nitrite (in mg/L), Nitrate (in mg/L)	3 days per week, at mid-flood and mid-ebb tides (except [3]detergent which shall be taken one day per month, at mid-flood and mid-ebb) 36 hours interval was allowed between subsequent sets of measurement.

Notes:
1. Ammonia measurements and samples were taken at SR4, SR12, C1A, C2A only;
   UIA: In-situ unionized ammonia was calculated from in-situ measurement of NH_3-N, temperature, pH and salinity; Laboratory determined unionized ammonia was calculated from analysed NH_3-N from water samples and in-situ measurement of temperature, pH and salinity;
2. Total Inorganic Nitrogen (TIN) measurements and samples were taken at SR5, G2, C1A and C2A only;
3. BOD_5, *E.coli* and Synthetic Detergent samples were taken at SR4, SR12, C1A, C2A only.

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Table 3-2 **Water Quality Monitoring Parameters**

ID	In-situ Measurement							Laboratory Analysis					
	pH	Temperature	Salinity	Turbidity	Dissolved Oxygen / Dissolved Oxygen%	NH_3-N / UIA	TIN (NH_3-N, NO_2 & NO_3)	Suspended Solids	BOD_5	*E. coli*	NH_3-N / UIA	Synthetic Detergent	TIN (NH_3-N, NO_2 & NO_3)
SR4	O	O	O	O	O	O		O	O	O	O	O	
SR5	O	O	O	O	O		O	O					O
SR12	O	O	O	O	O	O		O	O	O	O	O	
SR13	O	O	O	O	O			O					
G2	O	O	O	O	O		O	O					O
C1A	O	O	O	O	O	O	O	O	O	O	O	O	O
C2A	O	O	O	O	O	O	O	O	O	O	O	O	O

Note:
1. UIA: In-situ unionized ammonia was calculated from in-situ measurement of NH_3-N, temperature, pH and salinity; laboratory determined unionized ammonia was calculated from analysed NH_3-N from water samples taken and in-situ measurement of temperature, pH and salinity.

3.2 Monitoring Locations

3.2.1 Referring to the Proposal for Temporary Suspension of Impact Water Quality Monitoring (0394_13_ED_0326F) which was submitted to EPD in August 2016 with no objection was received from EPD; removal of routine water quality monitoring stations at SR1 was effective on 24 December 2016.

3.2.2 Referring to the *Proposal on Removal of Some Water Quality Monitoring Stations After Resumption of Marine Construction Works (Dredging Works and Marine Works of the Northern Part of Kwai Tsing Container Basin Only)* (0394_13_ED_0332I) which has been submitted to EPD and relevant parties in December 2016 with no objection, removal of routine water quality monitoring stations at SR6, SR7, SR8, SR9, SR10 and SR11 was effective from 23 January 2017. Due to removal of some sensitive receivers in routine water quality monitoring, gradient stations G3, G5 and G6 were also be removed and gradient stations G1 and G4 replaced the previous control stations C1, C2 and C3 as C1A and C2A with reference to the approved proposal (0394_13_ED_0332I) which was effective from 23 January 2017.

3.2.3 Referring to the *Proposal of Scale down for the Water Quality Monitoring Stations during High Spots Removal at Sub-zone Z2B1, Z2B2 and Z2C1* (Ref.: 0394/13/ED/0370G), routine water quality monitoring stations at SR2 (Casam, Gazetted Beach) and SR3 (Approach, Gazetted Beach) were removed. The proposal was justified by ET and verified by IEC, also no objection was received from other parties. The proposal was approved by EPD as per EPD's memo (Ref. (6) in Ax(1) to EP2/N3/C/57 Pt.10) dated 20 August 2019. The removal of the water quality monitoring at SR2 and SR3 was effective from 23 August 2019.

3.2.4 Impact water quality monitoring was conducted at 7 locations, including 4 sensitive receivers (SR4, SR5, SR12 and SR13), 1 gradient station (G2) and 2 control stations (C1A and C2A). The locations of the stations are also shown in **Figure 2**.

3.3 Results and Observations

3.3.1 Impact water quality monitoring was conducted at all designated monitoring stations in the reporting quarter. Impact water quality monitoring results graphical presentations are provided in **Appendix D**.

3.3.2 During the monitoring period, some adverse weather conditions, including Rainstorm Warning Signals, Thunderstorm Warning and Tropical Cyclone Warning Signals were reported. Heavy marine traffic (not associated with the Project) was commonly observed nearby the Project site and its vicinity, that the propeller wash from vessels could lead to potential disturbance of seabed sediment and affect the water quality. The above conditions may affect monitoring results. Summary of weather condition is provided in **Appendix I**.

3.3.3 Exceedances were recorded for NH3-N (in-situ & lab), UIA (in-situ & lab), TIN (in-situ & lab), Suspended solid and *E. coli*. Number of exceedances recorded in the reporting quarter at each impact station is summarized in **Table 3-3 and 3-4**.

Table 3-3 Summary of Water Quality Exceedance (In-situ Measurement)

Station	Exceedance Level	DO (S&M)		DO (B)		Turbidity		NH_3-N		UIA		TIN		Total	
		E	F	E	F	E	F	E	F	E	F	E	F	E	F
SR4	Action	0	0	0	0	0	0	0	0	0	0	-	-	0	0
	Limit	0	0	0	0	0	0	0	0	12	14	-	-	12	14
SR5	Action	0	0	0	0	0	0	-	-	-	-	4	2	4	2
	Limit	0	0	0	0	0	0	-	-	-	-	13	15	13	15
SR12	Action	0	0	0	0	0	0	0	0	0	0	-	-	0	0
	Limit	0	0	0	0	0	0	1	1	15	15	-	-	16	16
SR13	Action	0	0	0	0	0	0	-	-	-	-	-	-	0	0
	Limit	0	0	0	0	0	0	-	-	-	-	-	-	0	0
Total	Action	0	0	0	0	0	0	0	0	0	0	4	2	6	
	Limit	0	0	0	0	0	0	1	1	27	29	13	15	86	

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Table 3-4 Summary of Water Quality Exceedance (Laboratory Analysis)

Station	Exceedance Level	Suspended Solids		BOD_5		*E. coli*		NH_3-N		UIA		Synthetic Detergent		TIN		Total	
		E	F	E	F	E	F	E	F	E	F	E	F	E	F	E	F
SR4	Action	0	0	0	0	0	0	0	0	0	0	0	0	-	-	0	0
	Limit	2	3	0	0	0	0	0	0	12	13	0	0	-	-	14	16
SR5	Action	1	1	-	-	-	-	-	-	-	-	-	-	4	2	5	3
	Limit	0	0	-	-	-	-	-	-	-	-	-	-	13	15	13	15
SR12	Action	0	0	0	0	0	0	0	0	0	0	0	0	-	-	0	0
	Limit	5	4	0	0	1	0	1	1	15	15	0	0	-	-	22	20
SR13	Action	0	0	-	-	-	-	-	-	-	-	-	-	-	-	0	0
	Limit	0	0	-	-	-	-	-	-	-	-	-	-	-	-	0	0
Total	Action	1	1	0	0	0	0	0	0	0	0	0	0	4	2	8	
	Limit	7	7	0	0	1	0	1	1	27	28	0	0	13	15	100	

3.3.4 During the reporting period, 2 LL exceedances for NH3-N (in-situ); 56 LL exceedances for UIA (in-situ); 6 AL and 28 LL exceedances for TIN (in-situ); 2 AL and 14 LL for Suspended Solids; 1 LL exceedance for E. coli; 2 LL exceedances for NH3-N (lab); 55 LL exceedances for UIA (lab); 6 AL and 28 LL exceedances for TIN (lab).

3.3.5 According to the investigations, the exceedances were considered caused by influences in the vicinity of the station or changes in ambient conditions and not related to the Project.

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4. EM&A REQUIREMENTS – 24-HR WATER QUALITY MONITORING

4.1 Monitoring Parameters

4.1.1 Dissolved oxygen, temperature and turbidity are recorded every 5 minutes, 24 hours a day 7 days a week during dredging works.

4.1.2 In-situ NH_3-N at WSD Flushing Water Intake is measured every 20 minutes, 24 hours a day 7 days a week during works.

4.1.3 The water quality parameters measured at particular locations are shown in **Table 4.1**.

Table 4-1 24-hr Water Quality Monitoring Parameters

ID	Description	Parameters				
		Temperature	Turbidity	DO (mg/L)	DO%	NH_3-N
SR4	Tsuen Wan, WSD Flushing Water Intake	O	O	O	O	O
SR5	Ma Wan, Fish Culture Zone	O	O	O	O	
SR12	Tsing Yi, WSD Flushing Water Intake	O	O	O	O	O
SR13	EMSD Cooling Water Intake for Kwai Chung Hospital	O	O	O	O	

4.2 Monitoring Locations

4.2.1 Referring to the *Proposal on Removal of Some Water Quality Monitoring Stations After Resumption of Marine Construction Works (Dredging Works and Marine Works of the Northern Part of Kwai Tsing Container Basin Only)* (0394_13_ED_0332I) which has been submitted to EPD and relevant parties in December 2016 with no objection, removal of 24 hour monitoring stations at SR9, SR10 and SR11 was effective from 23 January 2017. The setups of 24 hour monitoring stations at SR9, SR10 and SR11 were removed on 7 February 2017.

4.2.2 As shown in Table 4.1, the 24 hours water quality monitoring works are performed at SR4, SR5, SR12 and SR13.

4.2.3 Revisions on monitoring locations were proposed in previous submission (MateriaLab Report No. Ref: 0394/13/ED/0103 – WATER QUALITY MONITORING LOCATION) and were agreed among AFCD, EMSD, WSD and EPD.

4.3 Results and Observations

4.3.1 24-hr water quality monitoring was conducted at all designated monitoring stations in the reporting quarter. Monitoring result graphical presentations are provided in **Appendix E**.

4.3.2 During the reporting period, some adverse weather conditions, including Rainstorm Warning Signals, Thunderstorm Warning and Tropical Cyclone Warning Signals were reported. Heavy marine traffic (not associated with the Project) was commonly observed nearby the Project site and its vicinity, that the propeller wash from vessels could lead to potential disturbance of seabed sediment and affect the water quality. The above conditions may affect monitoring results. Furthermore, the fish culturing or other activities occurring on the fish rack may cause adverse impact on the receiving water. Summary of weather condition is provided in **Appendix I**.

4.3.3 Number of exceedances recorded in the reporting period at each impact station is summarized in Table 4.2.

Table 4-2 Summary of Water Quality Exceedance (24-hr Monitoring)

Station	Exceedance Level	Turbidity	DO	NH_3-N	Total
SR4	Action	0	0	0	0
	Limit	0	0	0	0
SR5	Action	0	0	-	0
	Limit	0	0	-	0
SR12	Action	0	0	0	0
	Limit	0	0	0	0
SR13	Action	0	0	-	0
	Limit	0	0	-	0
Total	Action	0	0	0	0
	Limit	0	0	0	0

4.3.4 No exceedance was recorded in the reporting quarter.

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5. ENVIRONMENTAL SITE INSPECTION AND AUDIT

5.1 Site Inspections

5.1.1 The Environmental Team conducted 13 site inspections in the reporting period. No particular observation was recorded in the reporting month except oil stain was found on the deck. The Contractor was reminded to wash the desk regularly and ensure no leakage of oil into the sea. The waste shall be treated and disposed properly as chemical waste.

5.1.2 According to Contractor, no archaeological deposit was found during reporting period.

5.2 Implementation Status of Environmental Mitigation Measures

5.2.1 A summary of the Implementation Schedule of Environmental Mitigation Measures (EMIS) is presented in **Appendix F**. Most of the necessary mitigation measures were implemented properly.

5.2.2 The mitigation measures recommended in the EIA report and required by the EP are considered effective in minimizing environmental impacts. The Contractor has implemented the recommended mitigation measures except those mitigation measures not applicable at this stage.

5.3 Summary of Action taken

5.3.1 The exceedances recorded were considered not related to the Project, follow-up actions are not required.

5.4 Advice on the Solid and Liquid Waste Management Status

5.4.1 According to the Contractor, no general refuse were disposed off site in the reporting period. Summary of waste flow table is detailed in **Appendix G**.

5.4.2 There was no inert or non-inert C&D material related to dredging works. The details can be referred to the **Table 5-1.**

Table 5-1 Waste Quantities of Dredging Works

Month	Marine Sediment Type	Quantity Generated in Reporting Period (m^3)	Cumulative-to Reporting Period (m^3)	Disposal / Dumping Ground
September 2019	Type 1 – Open Sea Disposal	0	1685700	NA
	Type 2 – Confined Marine Disposal	0	654430	NA
	Type 3 – Special Treatment / Disposal	0	1260	NA
October 2019	Type 1 – Open Sea Disposal	0	1685700	NA
	Type 2 – Confined Marine Disposal	900	655330	NA
	Type 3 – Special Treatment / Disposal	0	1260	NA
November 2019	Type 1 – Open Sea Disposal	0	1685700	NA
	Type 2 – Confined Marine Disposal	1350	656680	NA
	Type 3 – Special Treatment / Disposal	0	1260	NA

Note:
1. All the Type 3 (Cat. Hf) sediment dredging and disposal was completed on 18 May 2016.
2. No dredging work was carried out and no marine sediment was disposed in the reporting period.

5.5 Review of Action and Limit Level

5.5.1 Referring to the ER Letter ref. (CV/2013/04)/M45/400/1247 dated 19 March 2015, a Revised Baseline Water Quality Monitoring Test Methodology – Review of Action and Limit Levels has been submitted to EPD by ER in March 2015. The Action and Limit Level for the wet season (April – October) was effected and applied to the water quality monitoring data from 1 April 2015. The Action and Limit Level is given in **Appendix C**.

5.6 Quarterly Review of Constructional Impacts on Water Quality

5.6.1 The construction impact on water quality was assessed by comparing the quarterly mean values with the relevant ambient or baseline mean values. Results showed that the mean values of Ammonia (in-situ), TIN (in-situ), TSS and TIN (lab) at all clusters of monitoring stations were below the 1.3 x baseline value. Cluster stations with higher impact data are statistically compared to 1.3 x baseline levels or other relevant levels to assess the constructional impacts.

5.6.2 Quarterly means of cluster 1 stations (i.e. SR4 and SR12) of UIA (In-situ) (at mid flood) and UIA (lab) (at mid flood) are compared to their 1.3 x baseline data respectively. Result shows the quarterly mean of cluster 1 (i.e. SR4 and SR12) UIA (In-situ) (at mid flood) and UIA (lab) (at mid flood) is significantly larger than 1.3 x baseline level ($p<0.05$). They are further compared to the quarterly UIA levels at upstream control station (i.e. C2A (at mid flood)). Result shows UIA (in-situ) and UIA (lab) level of upstream control (i.e. C2A) is not significantly different from that of impact stations (i.e. SR4 and SR12), indicating the background UIA level is high and the contribution from the project is not significant.

5.6.3 Quarterly means of cluster 1 stations (i.e. SR4 and SR12) of Ammonia (lab) (at mid flood) are compared to their 1.3 x baseline data. Result shows the quarterly mean of Ammonia (lab) cluster 1 stations (i.e.SR4 and SR12) (at mid flood) is significantly larger than 1.3 x baseline level ($p<0.05$). Quarterly means of cluster 1 stations (i.e. SR4 and SR12) of Ammonia (lab) (at mid flood) are further compared to the quarterly upstream control level at C2A (at mid flood). Result shows ammonia level at the upstream control station (i.e. C2A) is significantly greater than that of impact stations (i.e. SR4 and SR12), indicating the background ammonia level is high and the contribution from the project is not significant.

5.6.4 Quarterly mean of cluster 1 stations (i.e. SR4 and SR12) of *E. coli* (at mid flood) is compared to their 1.3 x baseline data respectively. Result shows the quarterly mean of *E. coli* at cluster 1 stations (i.e. SR4 and SR12) (at mid flood) is significantly larger than 1.3 x baseline level ($p<0.05$). Quarterly means of cluster 1 stations (i.e. SR4 and SR12) of *E. coli* (at mid flood) are further compared to the quarterly upstream control level at C2A (at mid flood). Result shows *E. coli* at the upstream control station (i.e. C2A) is not significantly different from that of impact stations (i.e. SR4 and SR12), indicating the background *E. coli* is high and the contribution from the project is not significant.

5.6.5 Data from ebb tide for Ammonia (lab), UIA (in-situ and lab) and *E.coli* at cluster 1 stations (i.e. SR4 and SR12) were not further compared to their 1.3 x baseline data as SR4 and SR12 were situated at upstream position at ebb tide and not subject to project impact. Comparison between quarterly mean and 1.3 x baseline mean is given in Table 5.2, while the summary of key statistical analysis is provided in Table 5.3. Details of key statistical analysis results are provided in **Appendix H**.

5.6.6 As 24-hr monitoring is to supplement the routine WQM activities (EM&A Manual Section 2.1.10) and there is no baseline value and/or control / gradient value for a meaningful statistical analysis. Thus no statistical analysis was done for 24-hr monitoring. Also, statistical analysis was not performed for some parameters without exceedances (DO (S&M), DO (B), Turbidity, BOD5 and Synthetic Detergent) in the reporting quarter.

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Table 5-2 Comparison of Quarterly Mean to Baseline Mean

		Ammonia – In-situ						UIA – In-situ					
		Baseline	Baseline x 1.3	Average	Sep 2019 – Nov 2019	Average	Larger than Baseline x 1.3	Baseline	Baseline x 1.3	Average	Sep 2019 – Nov 2019	Average	Larger than Baseline x 1.3
Control (Flood)	C1A	NA	NA	NA	0.24	NA	NA	NA	NA	NA	0.020	NA	NA
	C2A				0.43						0.030		
Control (Ebb)	C1A	NA	NA	NA	0.24	NA	NA	NA	NA	NA	0.020	NA	NA
	C2A				0.45						0.030		
Gradient (Flood)	G2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gradient (Ebb)	G2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cluster 1 (Flood)	SR4	0.26	0.34	0.35	0.27	0.30	no	0.013	0.017	0.018	0.021	0.024	yes
	SR5	NA	NA		NA			NA	NA		NA		
	SR12	0.28	0.36		0.32			0.014	0.018		0.026		
Cluster 1 (Ebb)	SR4	0.25	0.33	0.34	0.26	0.29	no	0.007	0.009	0.009	0.022	0.025	yes
	SR5	NA	NA		NA			NA	NA		NA		
	SR12	0.27	0.35		0.31			0.007	0.009		0.027		
Cluster 3 (Flood)	SR13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cluster 3 (Ebb)	SR13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

1. NA: Not Applicable
   - Control and Gradient stations are compared on individual stations for reference, no clustering analysis was performed. Impact stations are compared in clusters of stations, or
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		TIN – In-situ						TSS					
		Baseline	Baseline x 1.3	Average	Sep 2019 – Nov 2019	Average	Larger than Baseline x 1.3	Baseline	Baseline x 1.3	Average	Sep 2019 – Nov 2019	Average	Larger than Baseline x 1.3
Control (Flood)	C1A	0.60	0.78	NA	0.47	NA	NA	7	10	NA	6	NA	NA
	C2A	0.69	0.90		0.58			8	10		6		
Control (Ebb)	C1A	0.57	0.74	NA	0.52	NA	NA	5	7	NA	6	NA	NA
	C2A	0.65	0.85		0.60			7	9		6		
Gradient (Flood)	G2	0.56	0.73	NA	0.47	NA	no	5	7	NA	6	NA	no
Gradient (Ebb)	G2	0.48	0.62	NA	0.51	NA	no	5	7	NA	6	NA	no
Cluster 1 (Flood)	SR4	NA	NA	0.64	NA	0.50	no	7	9	9.67	7	6.67	no
	SR5	0.49	0.64		0.50			6	8		6		
	SR12	NA	NA		NA			9	12		7		
Cluster 1 (Ebb)	SR4	NA	NA	0.68	NA	0.45	no	5	7	7.33	6	6.33	no
	SR5	0.52	0.68		0.45			5	6		6		
	SR12	NA	NA		NA			5	9		7		
Cluster 3 (Flood)	SR13	NA	NA	NA	NA	NA	NA	16	21	21.00	6	6.00	no
Cluster 3 (Ebb)	SR13	NA	NA	NA	NA	NA	NA	10	14	14.00	7	7.00	no

Notes:

1. NA: Not Applicable
   - Control and Gradient stations are compared on individual stations for reference, no clustering analysis was performed. Impact stations are compared in clusters of stations, or
   - Parameter is not monitored at the station.
2. With reference to Review of Action and Limit Levels (0394/13/ED/0175C), the baseline results of TIN (In-sit) in C1A, C2A, G2 and SR5 in dry season are multiplying the relevant wet/dry season ratio to obtain the wet season baseline values

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		Ammonia – Lab						UIA – Lab					
		Baseline	Baseline x 1.3	Average	Sep 2019 – Nov 2019	Average	Larger than Baseline x 1.3	Baseline	Baseline x 1.3	Average	Sep 2019 – Nov 2019	Average	Larger than Baseline x 1.3
Control (Flood)	C1A	NA	NA	NA	0.23	NA	NA	NA	NA	NA	0.020	NA	NA
	C2A	NA	NA		0.43			NA	NA		0.030		NA
Control (Ebb)	C1A	NA	NA	NA	0.23	NA	NA	NA	NA	NA	0.020	NA	NA
	C2A	NA	NA		0.45			NA	NA		0.030		NA
Gradient (Flood)	G2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gradient (Ebb)	G2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cluster 1 (Flood)	SR4	0.13	0.17	0.19	0.26	0.29	yes	0.006	0.008	0.009	0.020	0.023	yes
	SR5	NA	NA		NA			NA	NA		NA		
	SR12	0.15	0.20		0.31			0.007	0.009		0.025		
Cluster 1 (Ebb)	SR4	0.14	0.18	0.19	0.25	0.28	yes	0.007	0.009	0.009	0.021	0.024	yes
	SR5	NA	NA		NA			NA	NA		NA		
	SR12	0.15	0.20		0.30			0.007	0.009		0.026		
Cluster 3 (Flood)	SR13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cluster 3 (Ebb)	SR13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

1. NA: Not Applicable
   - Control and Gradient stations are compared on individual stations for reference, no clustering analysis was performed. Impact stations are compared in clusters of stations, or
   - Parameter is not monitored at the station.

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		TIN – Lab						*E. coli*					
		Baseline	Baseline x 1.3	Average	Sep 2019 – Nov 2019	Average	Larger than Baseline x 1.3	Baseline	Baseline x 1.3	Average	Sep 2019 – Nov 2019	Average	Larger than Baseline x 1.3
Control (Flood)	C1A	0.42	0.55	NA	0.45	NA	NA	NA	NA	NA	71	247	NA
	C2A	0.43	0.56		0.57			NA	NA		861		NA
Control (Ebb)	C1A	0.40	0.52	NA	0.45	NA	NA	NA	NA	NA	68	220	NA
	C2A	0.42	0.55		0.58			NA	NA		713		NA
Gradient (Flood)	G2	0.39	0.51	NA	0.45	NA	no	NA	NA	NA	NA	NA	NA
Gradient (Ebb)	G2	0.36	0.47	NA	0.44	NA	no	NA	NA	NA	NA	NA	NA
Cluster 1 (Flood)	SR4	NA	NA	0.48	NA	0.48	no	134	174	286	496	594	yes
	SR5	0.37	0.48		0.48			NA	NA		NA		
	SR12	NA	NA		NA			360	468		711		
Cluster 1 (Ebb)	SR4	NA	NA	0.46	NA	0.44	no	281	365	359	387	477	yes
	SR5	0.35	0.46		0.44			NA	NA		NA		
	SR12	NA	NA		NA			272	354		588		
Cluster 3 (Flood)	SR13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cluster 3 (Ebb)	SR13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

1. NA: Not Applicable
   - Control and Gradient stations are compared on individual stations for reference, no clustering analysis was performed. Impact stations are compared in clusters of stations, or
   - Parameter is not monitored at the station.

2. With reference to Review of Action and Limit Levels (0394/13/ED/0175C), the baseline results of TIN (lab) in C1A, C2A, G2 and SR5 in dry season are multiplying the relevant wet/dry season ratio to obtain the wet season baseline values

3. *E.coli* is calculated by taking geometric mean of the readings of monitoring data.

Table 5-3 Summary of Statistical Analysis

Parameter	Cluster	Compared against	Results and Conclusions
UIA (Insitu)	Cluster 1	Quarterly Mean at Impact Station (flood tide) against 1.3 x Baseline Level (flood tide) Quarterly Mean at Impact Station (flood tide) against Upstream Control (C2A) Mean (flood tide)	Quarterly mean at Impact Station (flood tide) is significantly higher than 1.3 x Baseline mean (flood tide) ($p<0.05$). Impact Mean (flood tide) is not significantly different than Upstream Control (C2A) Mean (flood tide) ($p>0.05$), indicating the project impact is not significant.
Ammonia (lab)	Cluster 1	Quarterly Mean at Impact Stations (flood tide) against 1.3 x Baseline Level (flood tide) Quarterly Mean at Impact Stations (flood tide) against Upstream Control (C2A) Mean (flood tide)	Quarterly mean at Impact Station (flood tide) is significantly higher than 1.3 x Baseline mean (flood tide) ($p<0.05$). Impact Mean (flood tide) is significantly smaller than Upstream Control (C2A) Mean (flood tide) ($p<0.05$), indicating the project impact is not significant.
UIA (lab)	Cluster 1	Quarterly Mean at Impact Stations (flood tide) against 1.3 x Baseline Level (flood tide) Quarterly Mean at Impact Stations (flood tide) against Upstream Control (C2A) Mean (flood tide)	Quarterly mean at Impact Station (flood tide) is significantly higher than 1.3 x Baseline mean (flood tide) ($p<0.05$). Impact Mean (flood tide) is significantly smaller than Upstream Control (C2A) Mean (flood tide) ($p<0.05$), indicating the project impact is not significant.
E. coli	Cluster 1	Quarterly Mean at Impact Stations (flood tide) against 1.3 x Baseline Level (flood tide) Quarterly Mean at Impact Stations (flood tide) against Upstream Control (C2A) Mean (flood tide)	Quarterly mean at Impact Station (flood tide) is significantly higher than 1.3 x Baseline mean (flood tide) ($p<0.05$). Impact Mean (flood tide) is not significantly different than Upstream Control (C2A) Mean (flood tide) ($p>0.05$), indicating the project impact is not significant.

5.6.7 Exceedance are considered to be due to change in ambient conditions or influences in the vicinity of the stations. Mitigation measures for dredging works were implemented in accordance with EP and EIA requirements.

6. NON-COMPLIANCE, COMPLAINTS, NOTIFICATION OF SUMMONS AND PROSECUTION

6.1.1 In this reporting period, no complaint, inspection notice, notification of summons or prosecution was received. Cumulative complaint log, summaries of complaints, notification of summons and successful prosecutions are presented in **Tables 6.1, 6.2 and 6.3**.

Table 6-1 Environmental Complaints Log

Complaint Log No.	Date of Receipt	Received From and Received By	Nature of Complaint	Date Investigated	Outcome	Date of Reply
Nil	-	-	-	-	-	-

Table 6-2 Cumulative Statistics on Complaints

Environmental Parameters	Cumulative No. Brought Forward	No. of Complaints This Period	Cumulative Project-to-Date
Air	0	0	0
Noise	0	0	0
Water	0	0	0
Waste	0	0	0
Total	0	0	0

Table 6-3 Cumulative Statistics on Successful Prosecutions

Environmental Parameters	Cumulative No. Brought Forward	No. of Prosecutions This Period	Cumulative Project-to-Date
Air	0	0	0
Noise	0	0	0
Water	0	0	0
Waste	0	0	0
Total	0	0	0

7. CONCLUSIONS

7.1.1 The dredging works was commenced on 23 April 2014. The EM&A programme was carried out in accordance with the EM&A Manual requirements. As per the EM&A Manual, water quality impact monitoring was conducted during the dredging works.

7.1.2 During the reporting period, exceedances were recorded for NH3-N (in-situ & lab), UIA (in-situ & lab), TIN (in-situ & lab) and *E. coli* in the routine impact monitoring. No exceedance was recorded in 24-hr monitoring. Investigation found that the exceedances were not project related and were considered caused by influences in the vicinity of the stations or change in ambient conditions.

7.1.3 13 environmental site inspections were carried out weekly in the reporting period.

7.1.4 No environmental complaint was received and followed up by Environmental Team in the reporting period.

7.1.5 No notification of summons and prosecution was received in the reporting period.

7.1.6 According to information provided by the Contractor, the upcoming dredging works will only be carried out at sub-zone Z2B1, Z2B2 and Z2C1 will be approximately 5200 m^3 (in-situ volume) in total, which is far below than the dredging scale which was mentioned in the EP. Refer to Section 2.1.4 of the EM&A Manual, routine water quality monitoring stations at SR2 (Casam, Gazetted Beach) and SR3 (Approach, Gazetted Beach) were proposed to be removed as according to the Proposal of Scale down for the Water Quality Monitoring Stations during High Spots Removal at Sub-zone Z2B1, Z2B2 and Z2C1 (Ref.: 0394/13/ED/0370G). The proposal was justified by ET and verified by IEC, also no objection was received from other parties. The proposal was approved by EPD as per EPD's memo (Ref. (6) in Ax(1) to EP2/N3/C/57 Pt.10) dated 20 August 2019. The removal of the water quality monitoring at SR2 and SR3 will be effective from 23 August 201 9.

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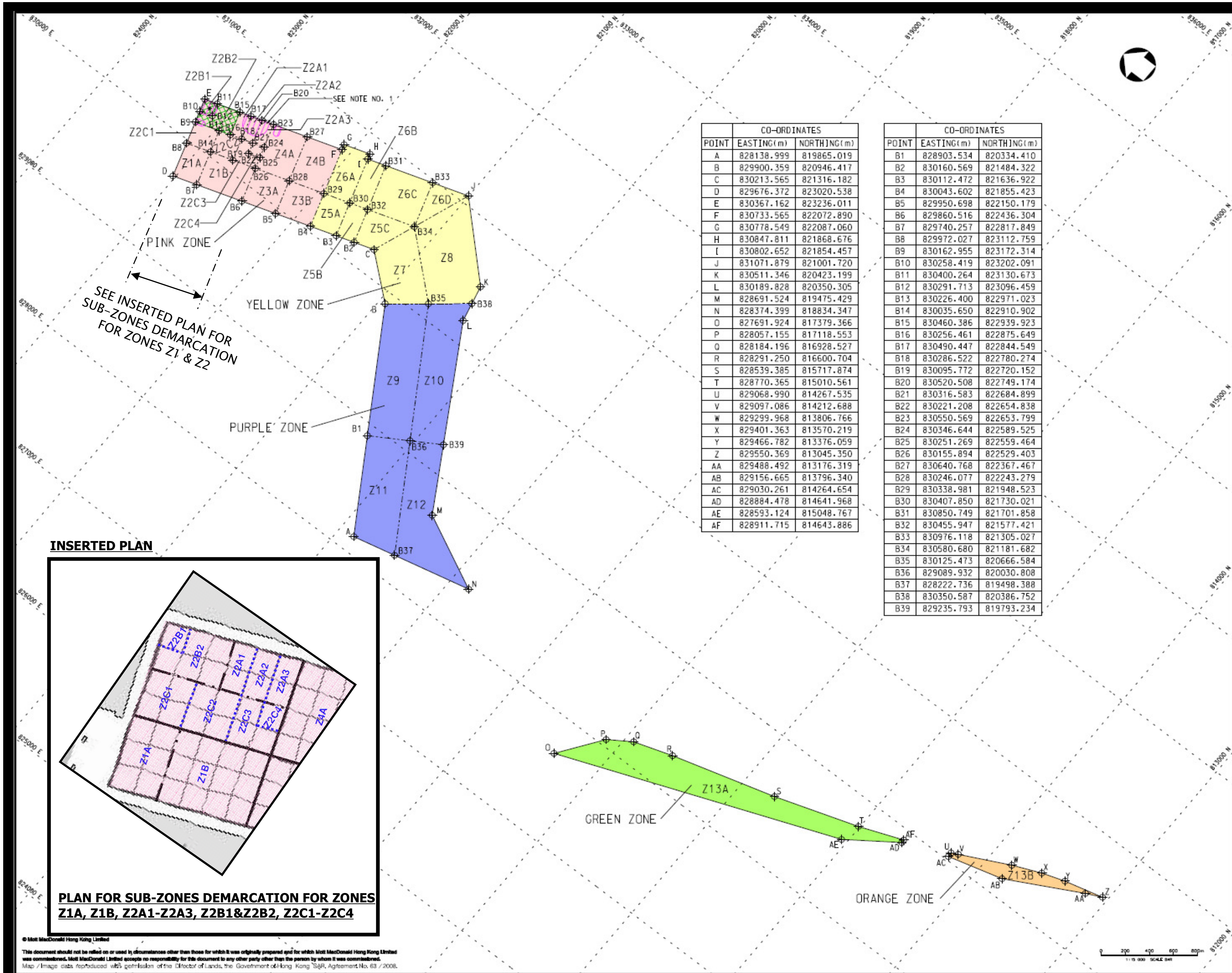
Report No.: 0394/13/ED/0389A

Figure 1

Project General Layout



	CO-ORDINATES	
POINT	EASTING(m)	NORTHING(m)
A	828138.999	819865.019
B	829900.359	820946.417
C	830213.565	821316.182
D	829676.372	823020.538
E	830367.162	823236.011
F	830733.565	822072.890
G	830778.549	822087.060
H	830847.811	821868.676
I	830802.652	821854.457
J	831071.879	821001.720
K	830511.346	820423.199
L	830189.828	820350.305
M	828691.524	819475.429
N	828374.399	818834.347
O	827691.924	817379.366
P	828057.155	817118.553
Q	828184.196	816928.527
R	828291.250	816600.704
S	828539.385	815717.874
T	828770.365	815010.561
U	829068.990	814267.535
V	829097.086	814212.688
W	829299.968	813806.766
X	829401.363	813570.219
Y	829466.782	813376.059
Z	829550.369	813045.350
AA	829488.492	813176.319
AB	829156.665	813796.340
AC	829030.261	814264.654
AD	828884.478	814641.968
AE	828593.124	815048.767
AF	828911.715	814643.886

	CO-ORDINATES	
POINT	EASTING(m)	NORTHING(m)
B1	828903.534	820334.410
B2	830160.569	821484.322
B3	830112.472	821636.922
B4	830043.602	821855.423
B5	829950.698	822150.179
B6	829860.516	822436.304
B7	829740.257	822817.849
B8	829972.027	823112.759
B9	830162.955	823172.314
B10	830258.419	823202.091
B11	830400.264	823130.673
B12	830291.713	823096.459
B13	830226.400	822971.023
B14	830035.650	822910.902
B15	830460.386	822939.923
B16	830256.461	822875.649
B17	830490.447	822844.549
B18	830286.522	822780.274
B19	830095.772	822720.152
B20	830520.508	822749.174
B21	830316.583	822684.899
B22	830221.208	822654.838
B23	830550.569	822653.799
B24	830346.644	822589.525
B25	830251.269	822559.464
B26	830155.894	822529.403
B27	830640.768	822367.467
B28	830246.077	822243.279
B29	830338.981	821948.523
B30	830407.850	821730.021
B31	830850.749	821701.858
B32	830455.947	821577.421
B33	830976.118	821305.027
B34	830580.680	821181.682
B35	830125.473	820666.584
B36	829089.932	820030.808
B37	828222.736	819498.388
B38	830350.587	820386.752
B39	829235.793	819793.234

LEGEND:

PROPOSED DREDGING AREA

ZONAL BOUNDARIES

DREDGING HOT SPOT AND BUFER AREA

HARDER MATERIAL (SEE NOTE NO.1)

HOT SPOT WITH HIGHER NH_3-N LEVEL

NOTE:

1. HARDER MATERIAL TO BE REMOVED BY CUTTER SUCTION DREDGER.

Project Title: Providing Sufficient Water Depth for Kwai Tsing Container Basin and its Approach Channel

Figure 2: Zones and Sub-zone of Dredging Plan Layout (Extracted from Figure 2 of Justification for the Proposed Demarcation of the Dredging Zones)

Environmental Permit No.:

EP-426/2011/A

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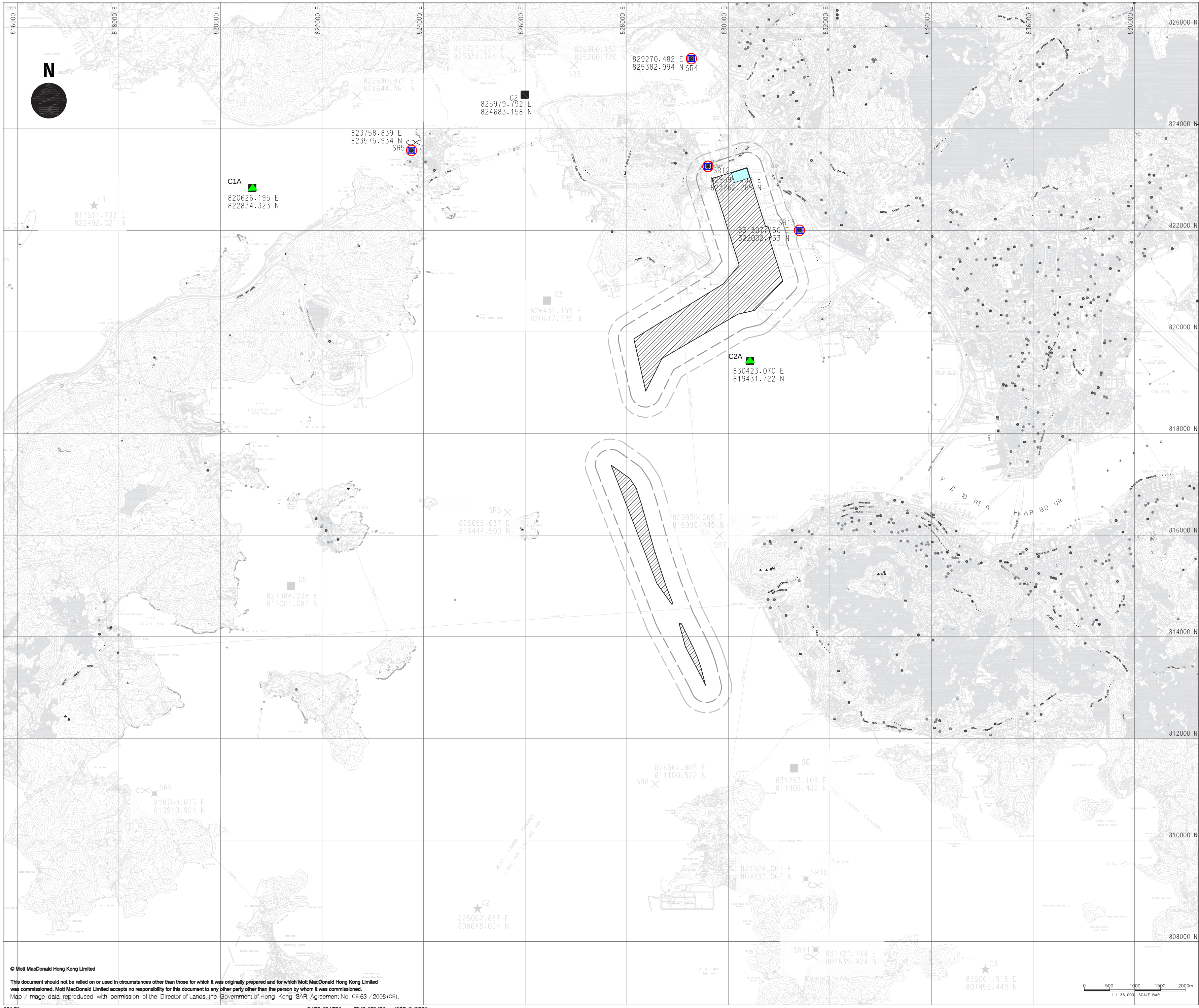
Figure 2

Locations of Water Quality Monitoring Stations



NOTES:
1. ALL COORDINATES ARE IN HONG KONG METRIC GRID (1980).
2. THE CONTRACTOR SHALL REFER TO RELEVANT SECTION(S) AND APPENDICES OF THE PARTICULAR SPECIFICATION REGARDING THE WATER QUALITY MONITORING.

LEGEND:
- SITE BOUNDARY UNDER EP-426/2011A
- CURRENT SCOPE OF DREDGING WORK BOUNDARY
- ROUTINE IMPACT MONITORING STATION
- 24 HOUR MONITORING STATION
- CONTROL STATION
- GRADIENT STATION

Client
THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION CIVIL ENGINEERING AND DEVELOPMENT DEPARTMENT

Project
CONTRACT NO. : CV/2013/04
DREDGING WORKS IN KWAI TSING CONTAINER BASIN AND ITS APPROACH CHANNEL

Title
PROVISIONAL LOCATION OF WATER QUALITY MONITORING STATIONS

Scale at A1	Status	Rev
1:35000	TEN	2

$FILE$ DATE: $DATE$ TIME: $TIME$ USER: $USER$

Figure 2 - Location of Water Quality Monitoring Stations

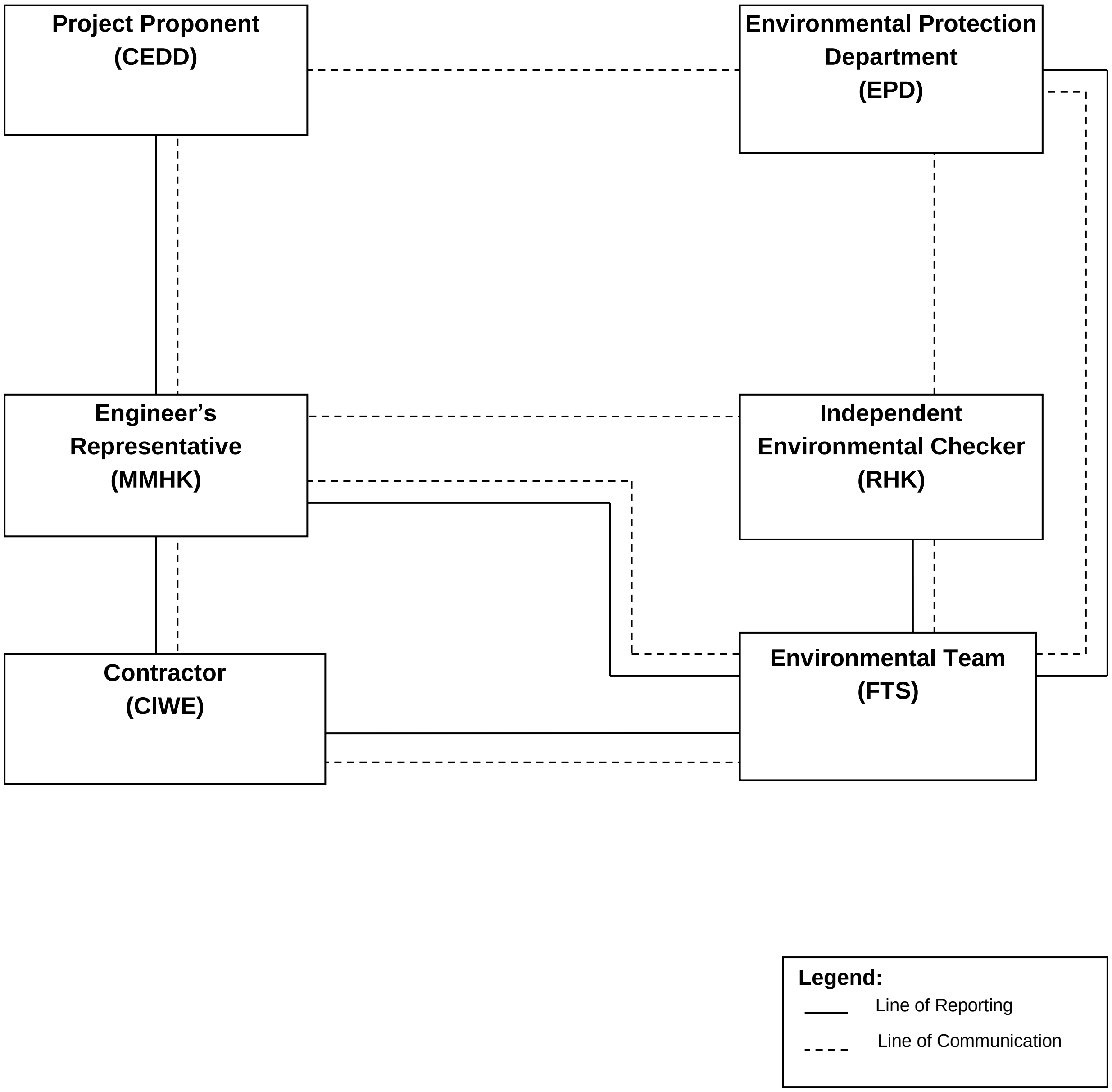
Fugro Development Centre,
5 Lok Yi Street, Tai Lam,
Tuen Mun, N.T.,
Hong Kong.

Tel : +852 2450 8233
Fax : +852 2450 6138
E-mail : matlab@fugro.com
Website : www.fugro.com

Report No.: 0394/13/ED/0389A

Appendix A

Project Organization Chart


Project Proponent
(CEDD)
Environmental Protection
Department
(EPD)
Engineer's
Representative
(MMHK)
Independent
Environmental Checker
(RHK)
Contractor
(CIWE)
Environmental Team
(FTS)
Legend:
Line of Reporting
Line of Communication

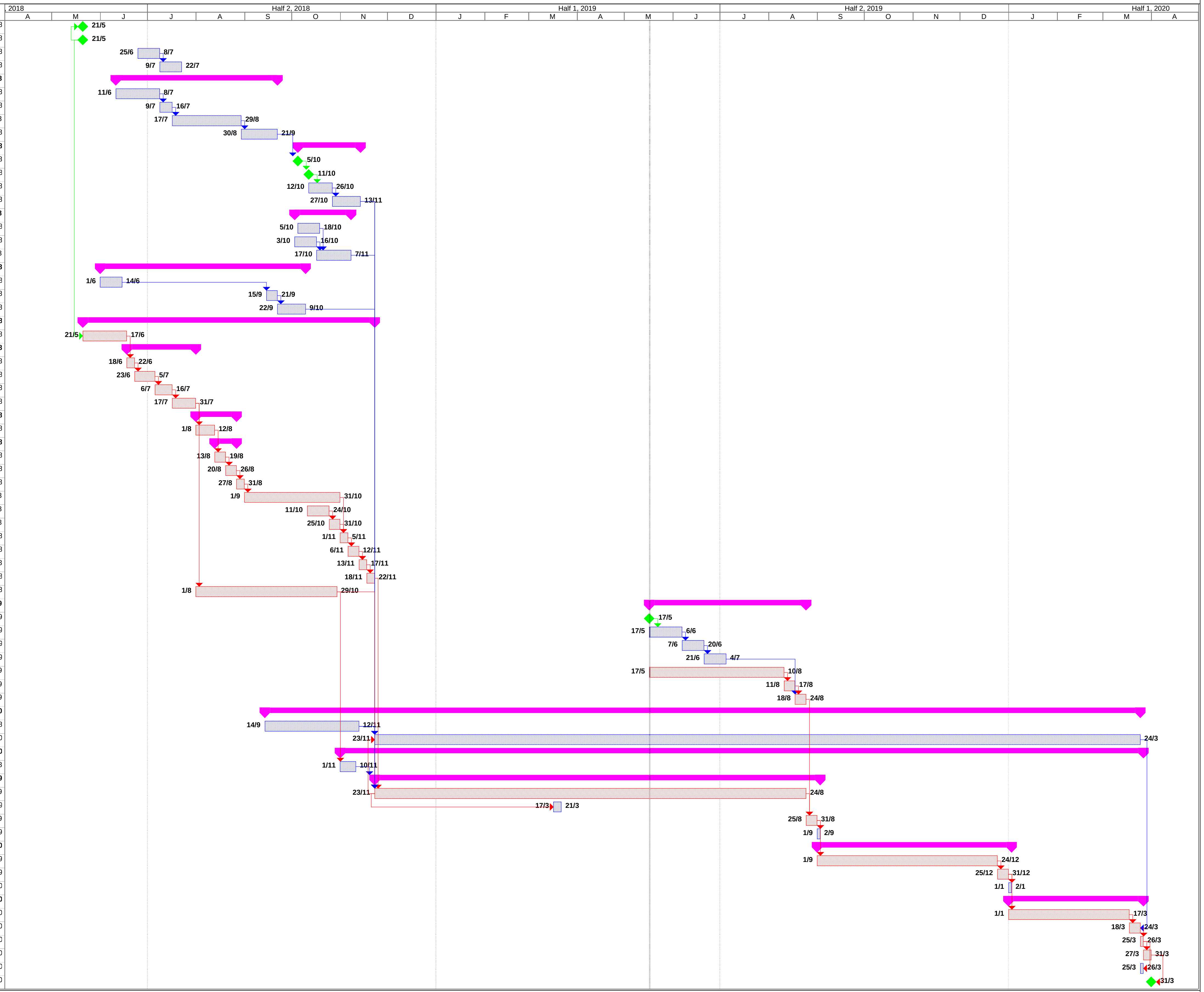
Appendix B

Construction Programme

Contract No. CV/2013/04
Dredging Works in Kwai Tsing Container Basin and its Approach Channel
Updated Programme for Rock Excavation Works outside Berth KC5

Date: 17 May 2019

ID	Task Name	Duration	Start	Finish
1	**Commencement Date**	0 days	Mon 21/5/18	Mon 21/5/18
2	Works reviewed and agreed between CEDD and CIWE	0 days	Mon 21/5/18	Mon 21/5/18
3	Notification of works to EPD, MD and relevant stakeholders by CEDD	14 days	Mon 25/6/18	Sun 8/7/18
4	Comments/no objection to works from EPD, MD and relevant stakeholders	14 days	Mon 9/7/18	Sun 22/7/18
5	**Method Statement**	**103 days**	**Mon 11/6/18**	**Fri 21/9/18**
6	Preparation	28 days	Mon 11/6/18	Sun 8/7/18
7	First submission	8 days	Mon 9/7/18	Mon 16/7/18
8	Comments from MMHK	44 days	Tue 17/7/18	Wed 29/8/18
9	Second submission	23 days	Thu 30/8/18	Fri 21/9/18
10	**Marine Department Notice**	**40 days**	**Fri 5/10/18**	**Tue 13/11/18**
11	Notification of MTMLG Meeting	0 days	Fri 5/10/18	Fri 5/10/18
12	MTMLG Meeting	0 days	Thu 11/10/18	Thu 11/10/18
13	Preparation and submission of MDN application	15 days	Fri 12/10/18	Fri 26/10/18
14	Approval	18 days	Sat 27/10/18	Tue 13/11/18
15	**Marine Dumping Permit**	**36 days**	**Wed 3/10/18**	**Wed 7/11/18**
16	Disposal ground allocated by CEDD	14 days	Fri 5/10/18	Thu 18/10/18
17	Preparation and submission	14 days	Wed 3/10/18	Tue 16/10/18
18	Approval	22 days	Wed 17/10/18	Wed 7/11/18
19	**Construction Noise Permit**	**131 days**	**Fri 1/6/18**	**Tue 9/10/18**
20	Noise Assessmet	14 days	Fri 1/6/18	Thu 14/6/18
21	Preparation and submission	7 days	Sat 15/9/18	Fri 21/9/18
22	Approval	18 days	Sat 22/9/18	Tue 9/10/18
23	**Drilling Barge**	**186 days**	**Mon 21/5/18**	**Thu 22/11/18**
24	Design of modification works	28 days	Mon 21/5/18	Sun 17/6/18
25	**Application for MD's approval of modification works**	**44 days**	**Mon 18/6/18**	**Tue 31/7/18**
26	First submission	5 days	Mon 18/6/18	Fri 22/6/18
27	Comments from MD	13 days	Sat 23/6/18	Thu 5/7/18
28	Second submission	11 days	Fri 6/7/18	Mon 16/7/18
29	Approval	15 days	Tue 17/7/18	Tue 31/7/18
30	**Reschedule of modification works due to requiements imposed by MD**	**26 days**	**Wed 1/8/18**	**Sun 26/8/18**
31	Preliminary revised design for modification works	12 days	Wed 1/8/18	Sun 12/8/18
32	**Rearrangement of dockyard for modification works**	**14 days**	**Mon 13/8/18**	**Sun 26/8/18**
33	Liaison with dockyard in Mainland China for modification works	7 days	Mon 13/8/18	Sun 19/8/18
34	Reservation of dockyard for modification works	7 days	Mon 20/8/18	Sun 26/8/18
35	Mobillization of barge to dockyard in Mainland China	5 days	Mon 27/8/18	Fri 31/8/18
36	Modification of flat top barge with 2 nos. drilling rigs added	61 days	Sat 1/9/18	Wed 31/10/18
37	Plan Approval of modification works	14 days	Thu 11/10/18	Wed 24/10/18
38	Survey/Inspection of modification works	7 days	Thu 25/10/18	Wed 31/10/18
39	Brage returnung to Hong Kong	5 days	Thu 1/11/18	Mon 5/11/18
40	Installation of drilling rigs, air compressors and gensets	7 days	Tue 6/11/18	Mon 12/11/18
41	Testing of lifting appliances and gears	5 days	Tue 13/11/18	Sat 17/11/18
42	Operating Licence issued by MD	5 days	Sun 18/11/18	Thu 22/11/18
43	Work Permit approved by Mainland China	90 days	Wed 1/8/18	Mon 29/10/18
44	**Dredger**	**100 days**	**Fri 17/5/19**	**Sat 24/8/19**
45	AIP application	0 days	Fri 17/5/19	Fri 17/5/19
46	AIP approved by MD	21 days	Fri 17/5/19	Thu 6/6/19
47	Modification works	14 days	Fri 7/6/19	Thu 20/6/19
48	Inspection and testing	14 days	Fri 21/6/19	Thu 4/7/19
49	Export Permit	86 days	Fri 17/5/19	Sat 10/8/19
50	Mobilzation to Hong Kong	7 days	Sun 11/8/19	Sat 17/8/19
51	Operating licence issued by MD	7 days	Sun 18/8/19	Sat 24/8/19
52	**Water Quality Monitoring Works**	**558 days**	**Fri 14/9/18**	**Tue 24/3/20**
53	Reinstallation of equipment	60 days	Fri 14/9/18	Mon 12/11/18
54	Monitoring works	488 days	Fri 23/11/18	Tue 24/3/20
55	**Site Works (Subject to working period provided by MTL)**	**512 days**	**Thu 1/11/18**	**Thu 26/3/20**
56	Survey grid plan for drilling works	10 days	Thu 1/11/18	Sat 10/11/18
57	**Drilling works**	**284 days**	**Fri 23/11/18**	**Mon 2/9/19**
58	Drilling works including trial drilling	275 days	Fri 23/11/18	Sat 24/8/19
59	Removal of broken rock material	5 days	Sun 17/3/19	Thu 21/3/19
60	Further removal of broken rock material	7 days	Sun 25/8/19	Sat 31/8/19
61	Interim hydrographic survey	2 days	Sun 1/9/19	Mon 2/9/19
62	**Removal of high spots**	**124 days**	**Sun 1/9/19**	**Thu 2/1/20**
63	Drilling works	115 days	Sun 1/9/19	Tue 24/12/19
64	Removal of broken rock material	7 days	Wed 25/12/19	Tue 31/12/19
65	Interim hydrographic survey	2 days	Wed 1/1/20	Thu 2/1/20
66	**Removal of remaining high spots**	**86 days**	**Wed 1/1/20**	**Thu 26/3/20**
67	Drilling works	77 days	Wed 1/1/20	Tue 17/3/20
68	Removal of broken rock material	7 days	Wed 18/3/20	Tue 24/3/20
69	Final hydrographic survey	2 days	Wed 25/3/20	Thu 26/3/20
70	Handover	5 days	Fri 27/3/20	Tue 31/3/20
71	Hydrographic Survey by CEDD, MD	2 days	Wed 25/3/20	Thu 26/3/20
72	**Completion Date**	0 days	Tue 31/3/20	Tue 31/3/20



China International Water & Electric Corp.

Task | Critical Task | Milestone | Summary

Appendix C

Action and Limit Levels

Action and Limit Levels for Routine Water Quality Monitoring (Dry Season)

Monitoring Station	DO (mg/L) Surface & Middle		DO (mg/L) Bottom		Turbidity (NTU) Depth-Averaged		Suspended Solids (mg/L) Depth-averaged		BOD5(mg/L) Depth-averaged		E.coli (CFU /100mL) Depth-averaged		NH3-N (mg/L) Depth-averaged		UIA (mg/L) Depth-averaged		Synthetic Detergent as MBAS (mg/L) Depth-averaged		TIN (mg/L) Depth Averaged	
	AL	**LL**	**AL**	**LL**	**AL**	**LL**	**AL**	**LL**	**AL**	**LL**	**AL**	**LL**	**AL**	**LL**	**AL**	**LL**	**AL**	**LL**	**AL**	**LL**
Seawater Intake																				
SR4 SR12	2	2	2	2	<10	<10	<10	<10	<10	<10	<20,000	<20,000	<1	<1	0.021	0.021	<5	<5	NA	NA
Fish Culture Zone																				
SR5	5.45	5.39[#]	5.43	5.27[+]	6.7 or 120%C*	10.1 or 130%C^	12 or 120%C*	19 or 130%C^	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.36	0.39
Gazetted Beach																				
SR2 SR3	5.45	5.39[#]	5.43	5.27[+]	6.7 or 120%C*	10.1 or 130%C^	12 or 120%C*	19 or 130%C^	NA	NA	NA	NA	0.21 or 120%C*	0.24 or 130%C^	0.021	0.021	NA	NA	NA	NA
EMSD Cooling Water Intake																				
SR13	5.31	5.22[#]	5.29	5.12[+]	13.1 or 120%C*	15.7 or 130%C^	23 or 120%C*	38 or 130%C^	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Note:
* Or 120% of upstream control station at the same tide of the day
^ Or 130% of upstream control station at the same tide of the day
# According to EM&A Manual, LL of DO (surface & middle) is 5 mg/L or 1 percentile of baseline data in FCZ; 4 mg/L or 1 percentile of baseline data in other impact monitoring stations.
+ According to EM&A Manual, LL of DO (bottom) is 2 mg/L or 1 percentile of baseline data
For DO measurement, non-compliance occurs when monitoring result is lower than the limits;
For TIN, UIA, NH_3-N, SS, BOD_5, E.coli, synthetic detergent and turbidity, non-compliance of water quality results when monitoring results is higher than the limits;
AL/LL of TIN and NH_3-N are determined from laboratory results for better accuracy and reliability. These AL/LL will be applied to both laboratory and in-situ measurements at impact stage.
Dry Season: November to March

Action and Limit Levels for Routine Water Quality Monitoring (Wet Season)

Monitoring Station	DO (mg/L) Surface & Middle		DO (mg/L) Bottom		Turbidity (NTU) Depth-Averaged		Suspended Solids (mg/L) Depth-averaged		BOD5 (mg/L) Depth- averaged		E.coli (CFU /100mL) Depth-averaged		NH3-N (mg/L) Depth-averaged		UIA (mg/L) Depth-averaged		Synthetic Detergent as MBAS (mg/L) Depth-averaged		TIN (mg/L) Depth Averaged	
	AL	LL	AL	LL	AL	LL	AL	LL	AL	LL	AL	LL	AL	LL	AL	LL	AL	LL	AL	LL
Seawater Intake																				
SR4 SR12	2	2	2	2	<10	<10	<10	<10	<10	<10	<20,000	<20,000	<1	<1	0.021	0.021	<5	<5	NA	NA
Fish Culture Zone																				
SR5	5.00#	5.00#	4.11	4.04+	10.8 or 120%C*	15.0 or 130%C^	12 or 120%C*	19 or 130%C^	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.45	0.50
Gazetted Beach																				
SR2 SR3	4.68	4.62#	4.11	4.04+	10.8 or 120%C*	15.0 or 130%C^	12 or 120%C*	19 or 130%C^	NA	NA	NA	NA	0.21 or 120%C*	0.24 or 130%C^	0.021	0.021	NA	NA	NA	NA
EMSD Cooling Water Intake																				
SR13	4.24	4.17#	3.70	3.58+	13.1 or 120%C*	15.7 or 130%C^	23 or 120%C*	38 or 130%C^	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Note:
* Or 120% of upstream control station at the same tide of the day
^ Or 130% of upstream control station at the same tide of the day
# According to EM&A Manual, LL of DO (surface & middle) is 5 mg/L or 1 percentile of baseline data in FCZ; 4 mg/L or 1 percentile of baseline data in other impact monitoring stations. (5%ile & 1 %ile determined from wet season baseline data for cluster 1 (4.68mg/L & 4.62mg/L) and cluster 2 (5.00mg/L & 4.82mg/L) are 5mg/L or below, thus 5mg/L was adopted as the AL & LL for the SR in FCZ)
+ According to EM&A Manual, LL of DO (bottom) is 2 mg/L or 1 percentile of baseline data
Referring to the ER Letter ref. (CV/2013/04)/M45/400/1247 dated 19 March 2015, a Revised Baseline Water Quality Monitoring Test Methodology – Review of Action and Limit Levels has been submitted to EPD by ER in March 2015. The Action and Limit Level for the wet season (April – October) was effected and applied to the water quality monitoring data from 1 April 2015.
For DO measurement, non-compliance occurs when monitoring result is lower than the limits;
For TIN, UIA, NH_3-N, SS, BOD_5, E.coli, synthetic detergent and turbidity, non-compliance of water quality results when monitoring results is higher than the limits;
AL/LL of TIN and NH_3-N are determined from laboratory results for better accuracy and reliability. These AL/LL will be applied to both laboratory and in-situ measurements at impact stage.
Wet season: April to October

Action and Limit Levels for 24-hr Water Quality Monitoring (Dry Season)

Monitoring Station	DO (mg/L) Surface		Turbidity (NTU) Surface		Ammonia-N (mg/L) Surface	
	AL	LL	AL	LL	AL	LL
WSD Seawater Intake						
SR4	2	2	<10	<10	<1	<1
SR12						
Fish Culture Zone						
SR5	5.46	5.39	6.0	7.9	NA	NA
EMSD Cooling Water Intake						
SR13	5.28	5.22	11.9	13.3	NA	NA

Note: According to EM&A Manual, LL of DO (surface & middle) is 5 mg/L or 1 percentile of baseline data in FCZ**;** 4 mg/L or 1 percentile of baseline data in other impact monitoring stations.

Dry Season: November to March.

Action and Limit Levels for 24-hr Water Quality Monitoring (Wet Season)

Monitoring Station	DO (mg/L) Surface		Turbidity (NTU) Surface		Ammonia-N (mg/L) Surface	
	AL	LL	AL	LL	AL	LL
WSD Seawater Intake						
SR4	2	2	<10	<10	<1	<1
SR12						
Fish Culture Zone						
SR5	5.24	5.13	9.7	14.4	NA	NA
EMSD Cooling Water Intake						
SR13	4.23	4.17	11.9	13.3	NA	NA

Note: # According to EM&A Manual, LL of DO (surface & middle) is 5 mg/L or 1 percentile of baseline data in FCZ; 4 mg/L or 1 percentile of baseline data in other impact monitoring stations. (1 %ile determined from wet season baseline data for cluster 2 (4.78mg/L) is below 5mg/L, thus 5mg/L was adopted as the DO (surface) LL for the SR in FCZ in cluster 2 stations)

Referring to the ER Letter ref. (CV/2013/04)/M45/400/1247 dated 19 March 2015, a Revised Baseline Water Quality Monitoring Test Methodology – Review of Action and Limit Levels has been submitted to EPD by ER in March 2015. The Action and Limit Level for the wet season (April – October) was effected and applied to the water quality monitoring data from 1 April 2015.

Wet Season: April to October

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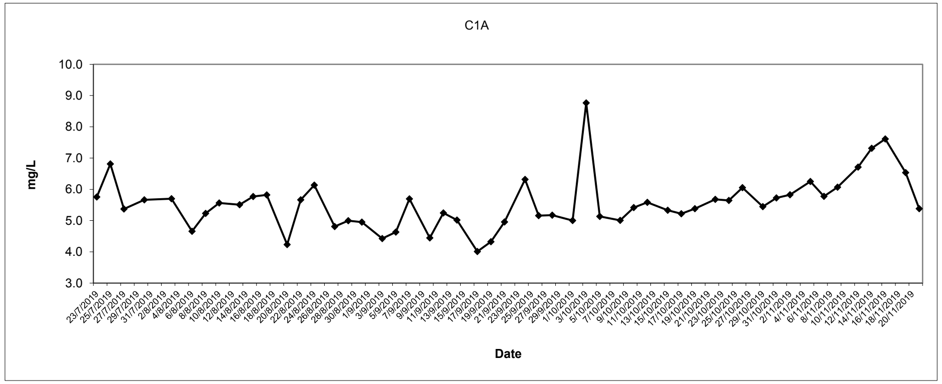
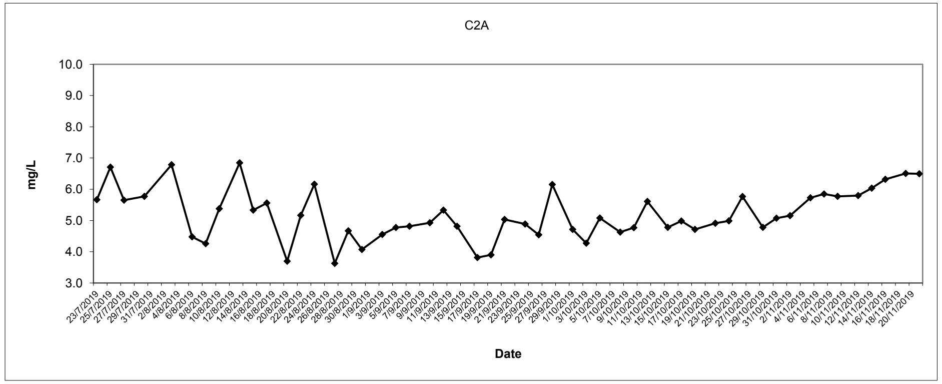
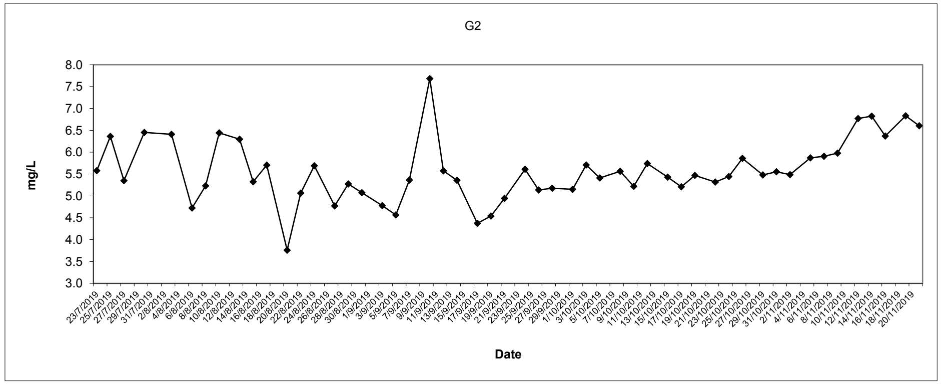
Appendix D

Graphical Presentation – Routine Impact Monitoring Results

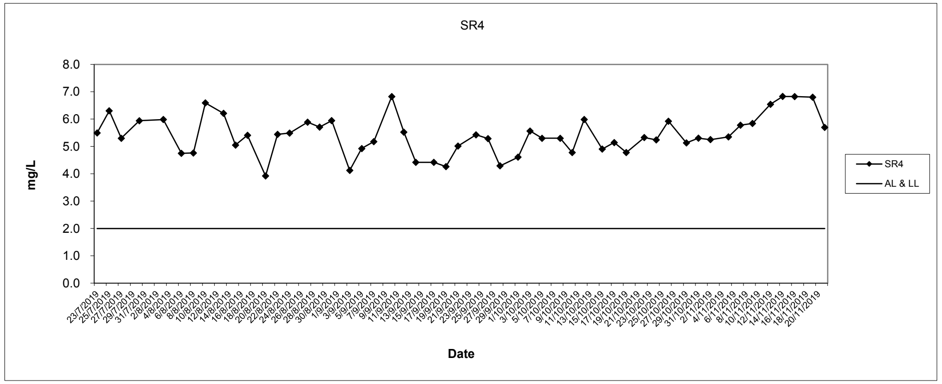
Dissolved Oxygen (Surface and Middle) at Mid-Flood Tide

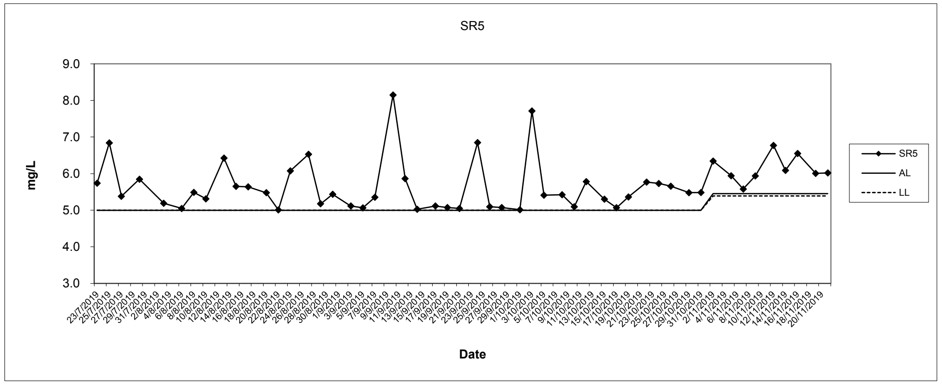


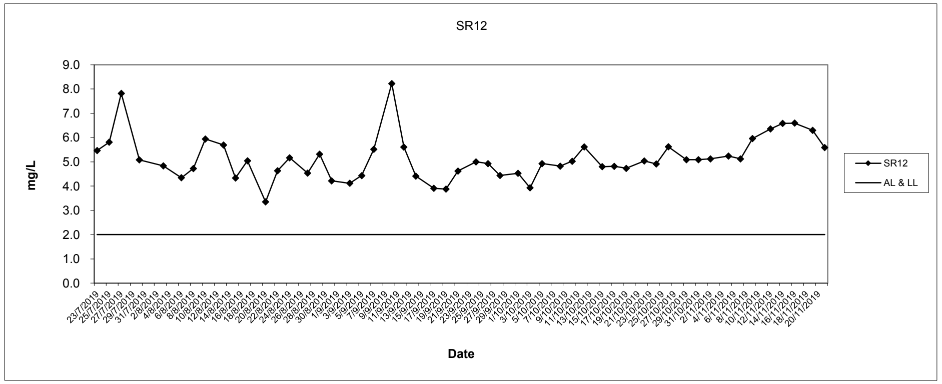




Dissolved Oxygen (Surface and Middle) at Mid-Flood Tide

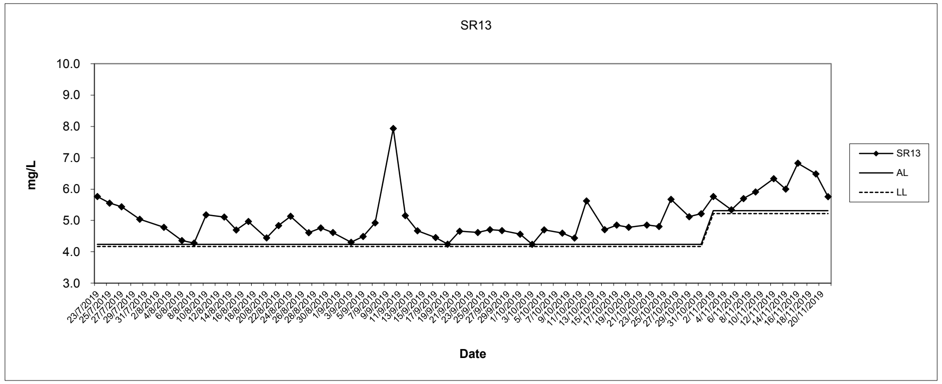




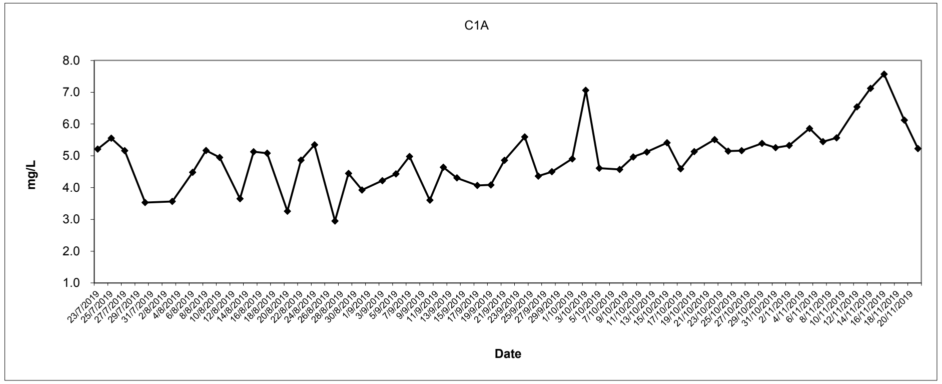


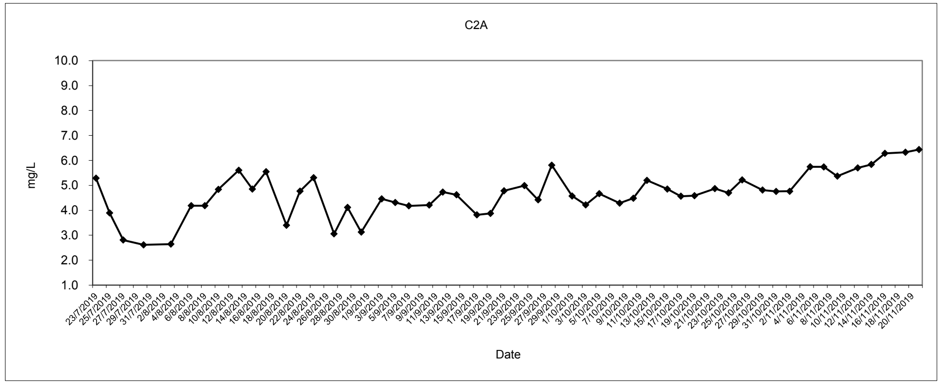
Providing Sufficient Water Depth for Kwai Tsing Container Basin and its Approach Channel

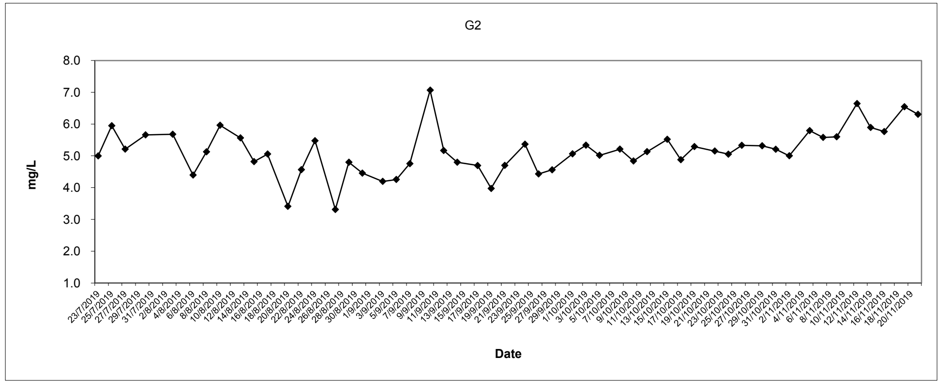
Dissolved Oxygen (Surface and Middle) at Mid-Flood Tide



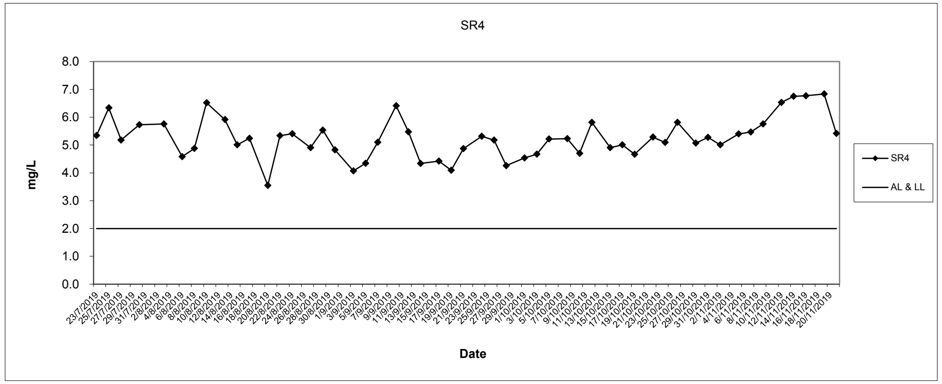
Dissolved Oxygen (Bottom) at Mid-Flood Tide



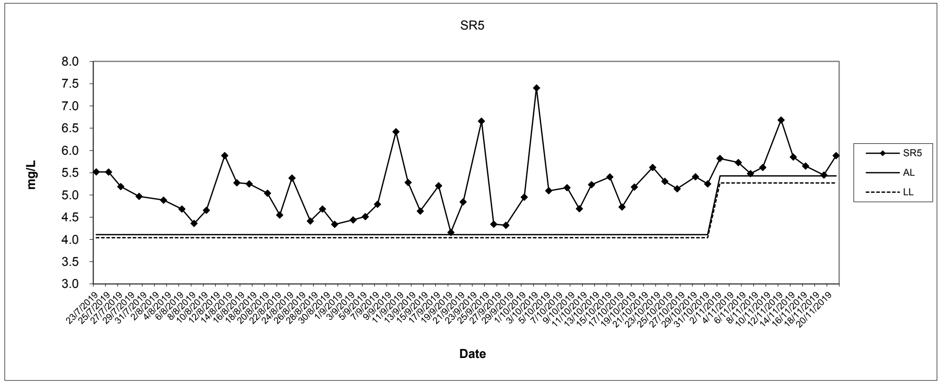


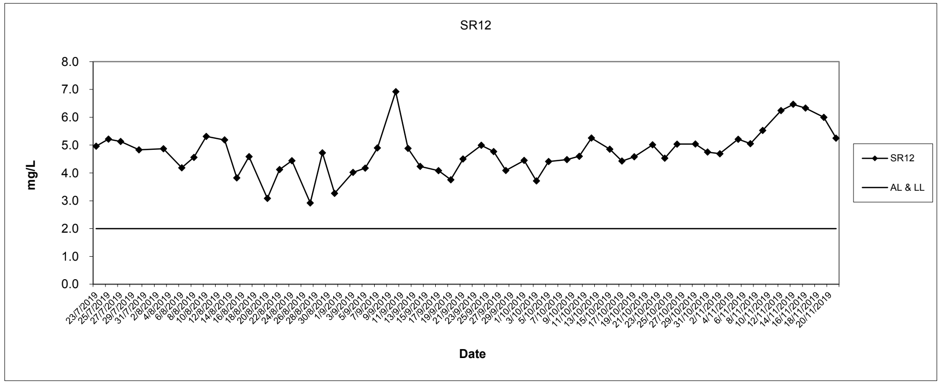


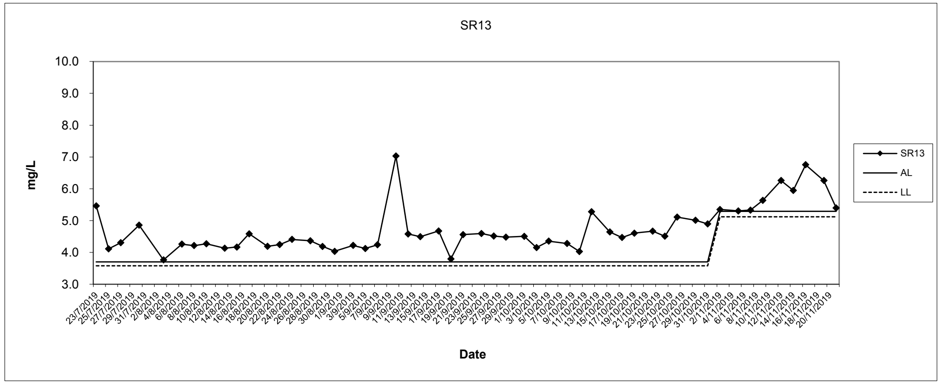
Dissolved Oxygen (Bottom) at Mid-Flood Tide



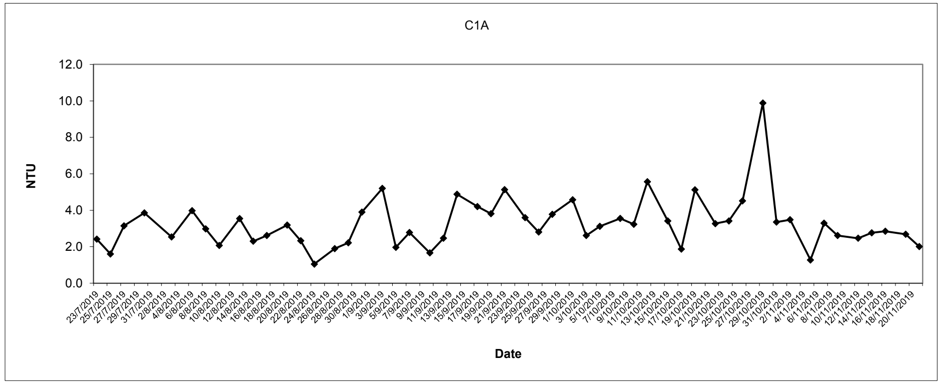
Dissolved Oxygen (Bottom) at Mid-Flood Tide

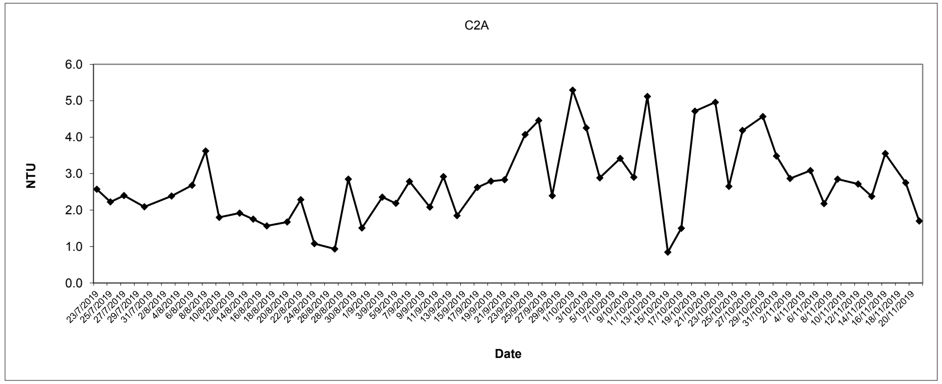


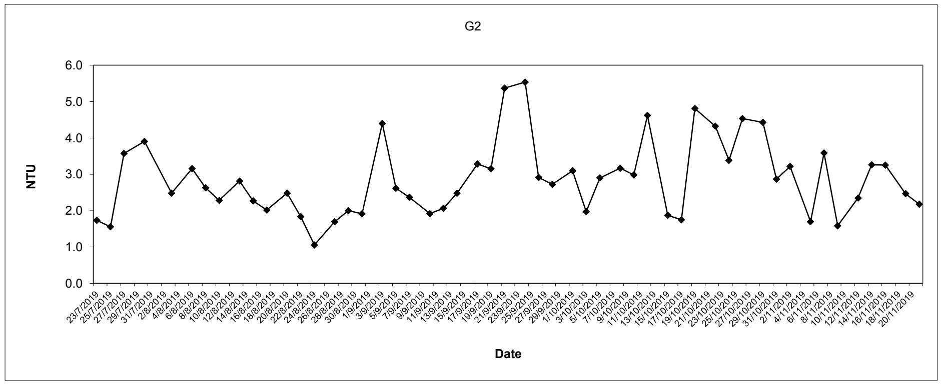




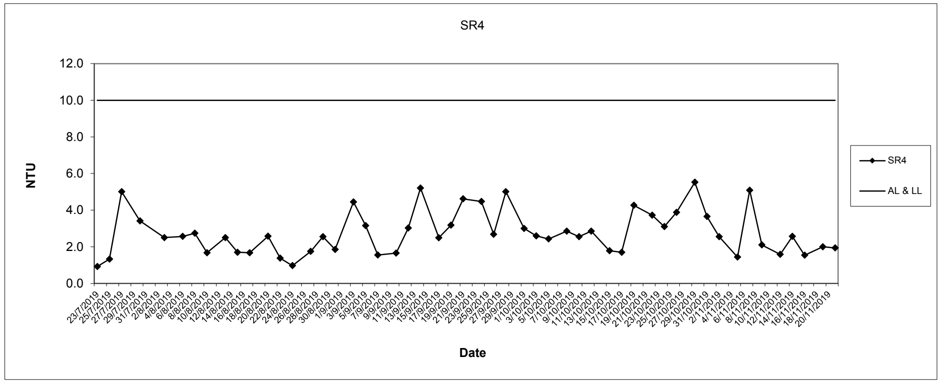
Turbidity (Depth average) at Mid-Flood Tide

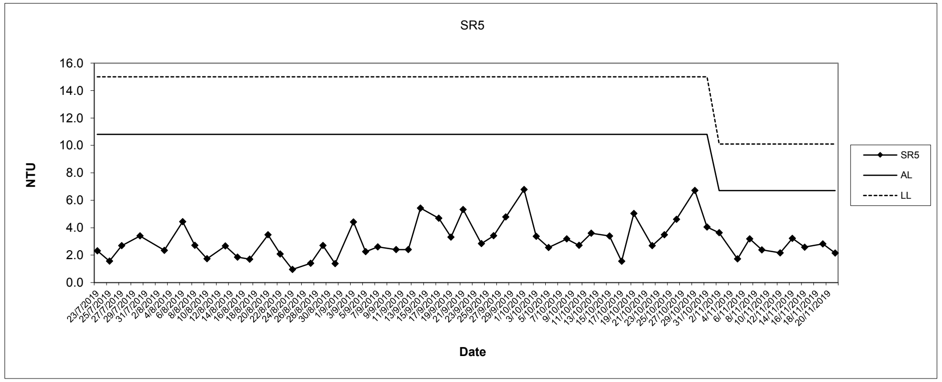


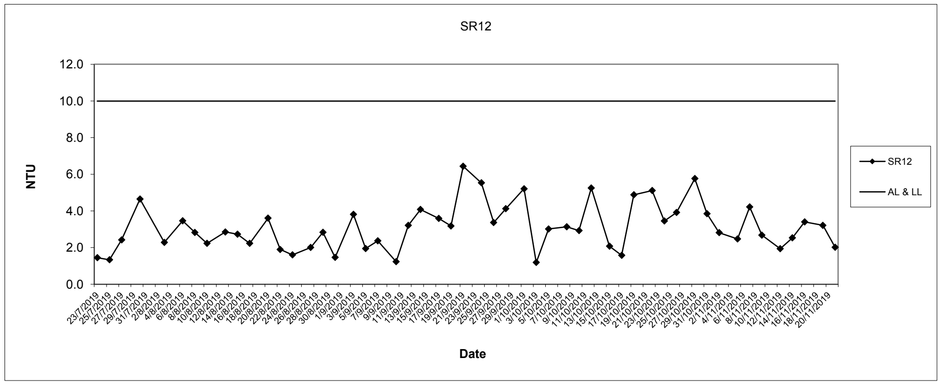




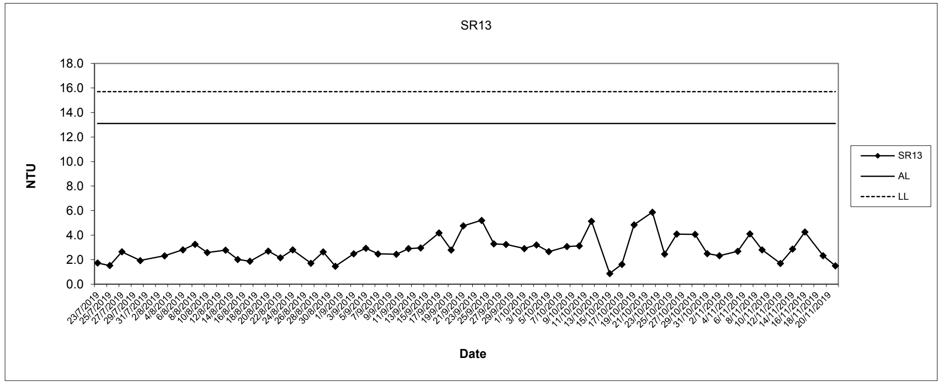
Turbidity (Depth average) at Mid-Flood Tide



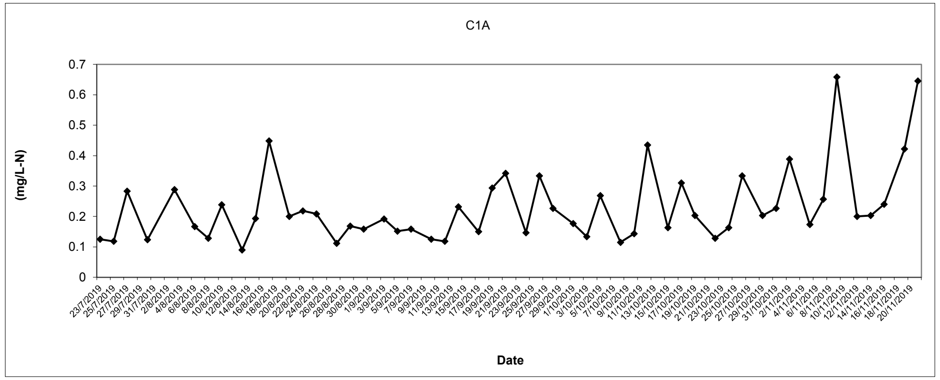


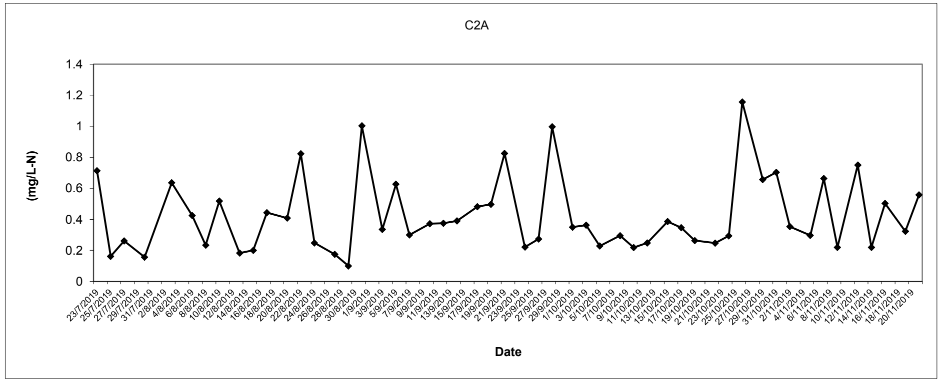


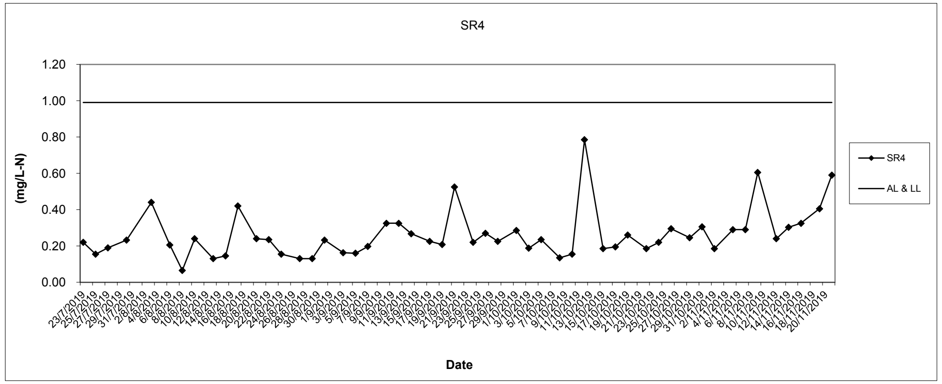
Turbidity (Depth average) at Mid-Flood Tide



In-situ Ammonia (Depth average) at Mid-Flood Tide

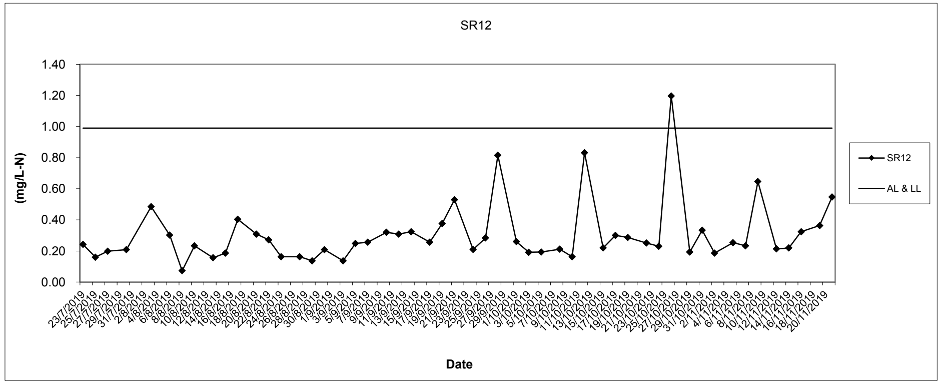




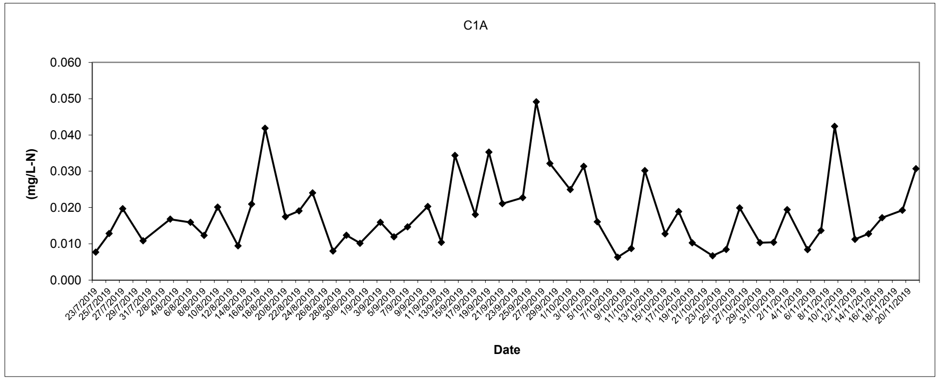


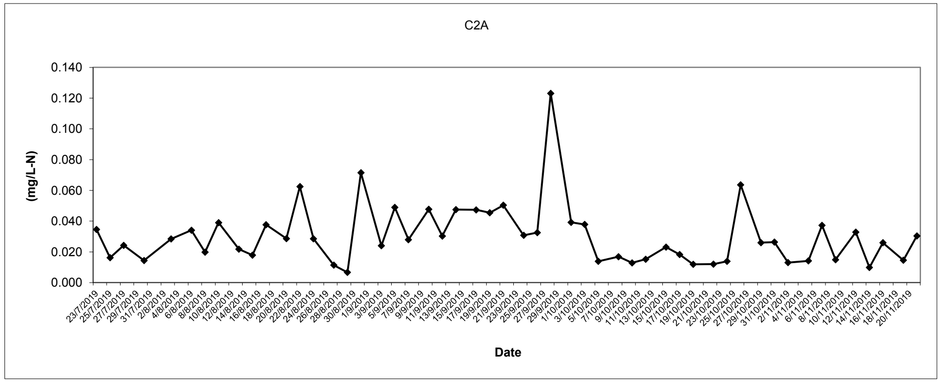
Providing Sufficient Water Depth for Kwai Tsing Container Basin and its Approach Channel

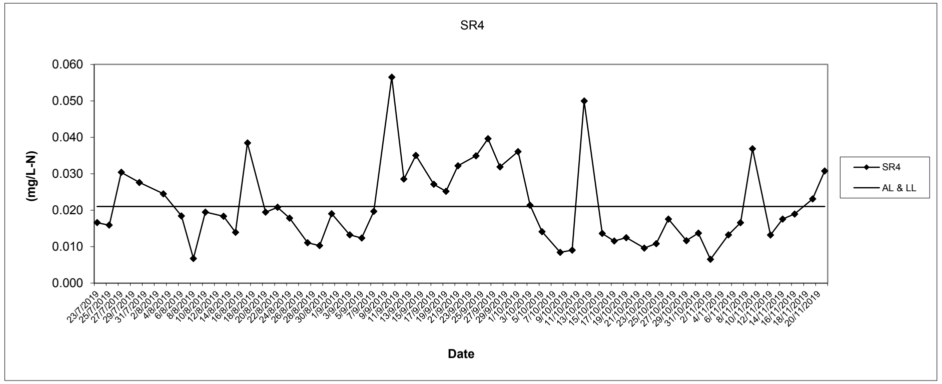
In-situ Ammonia (Depth average) at Mid-Flood Tide



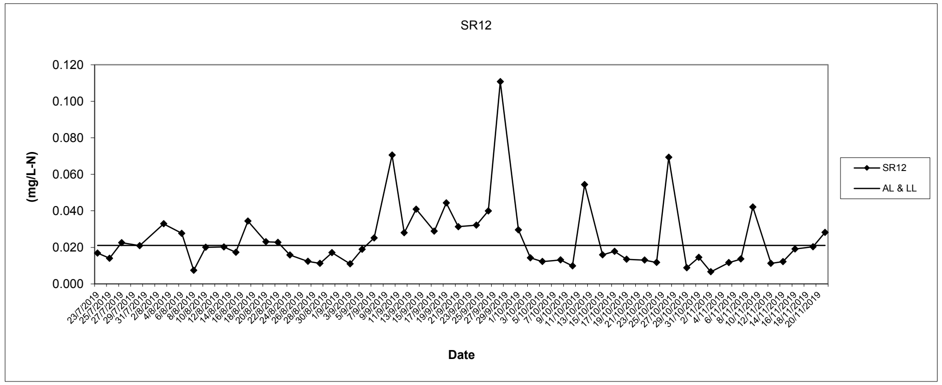
In-situ UIA (Depth average) at Mid-Flood Tide



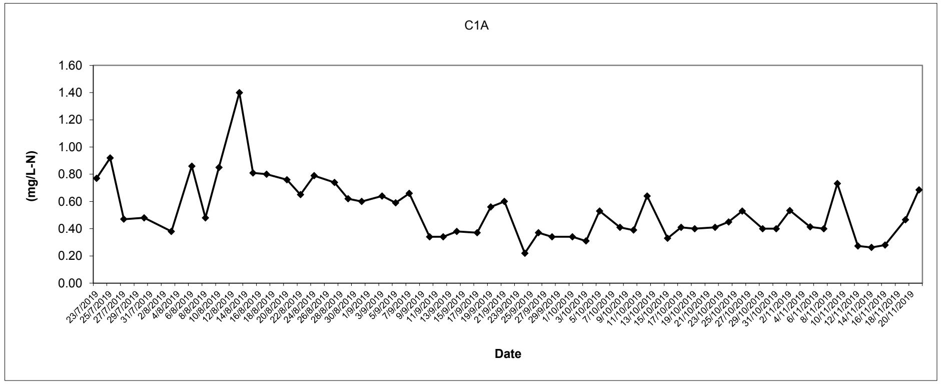


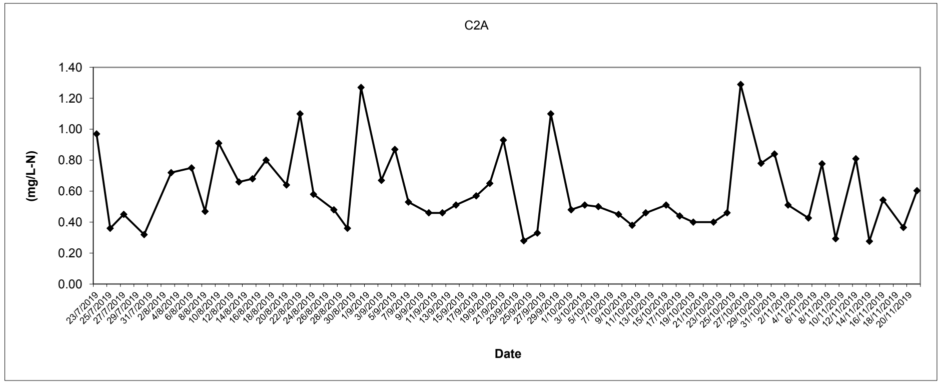


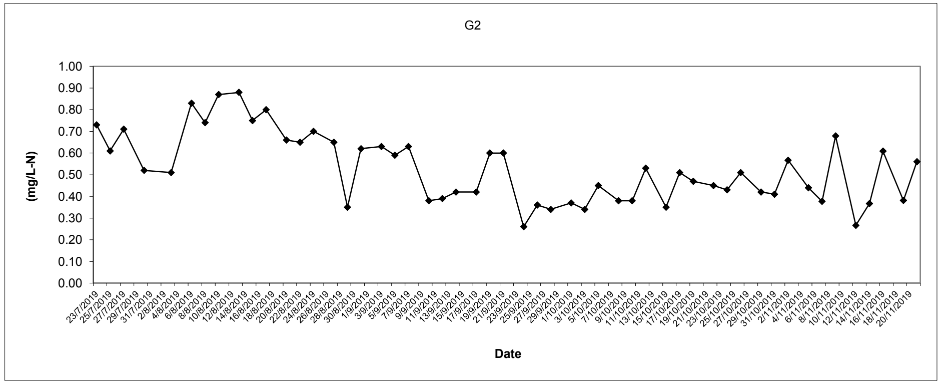
In-situ UIA (Depth average) at Mid-Flood Tide



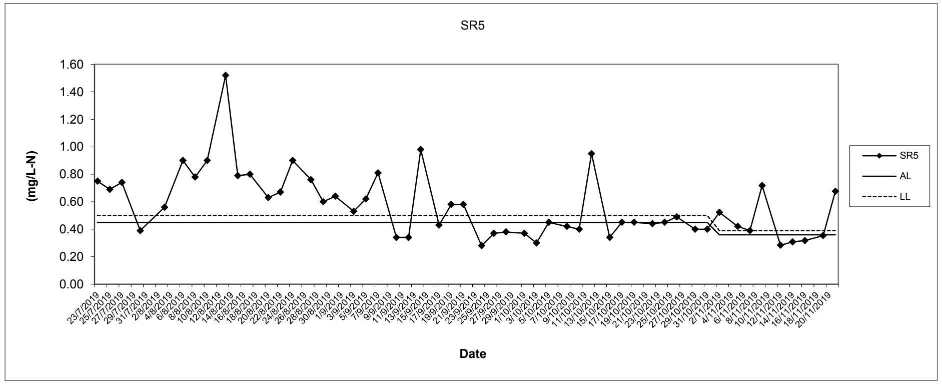
In-situ TIN (Depth average) at Mid-Flood Tide



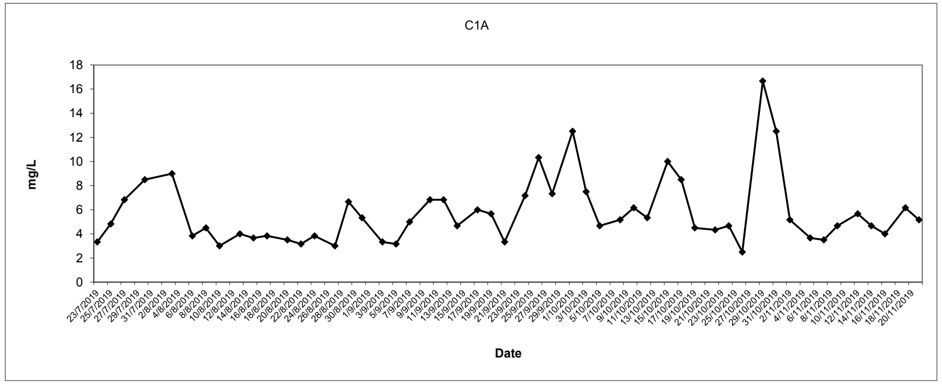


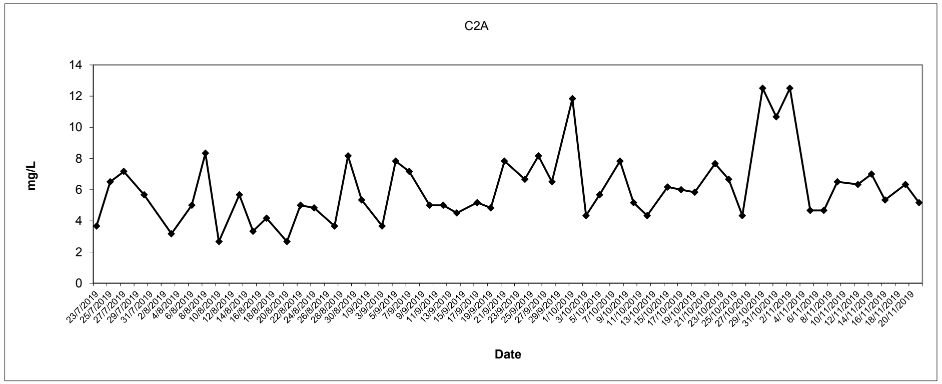


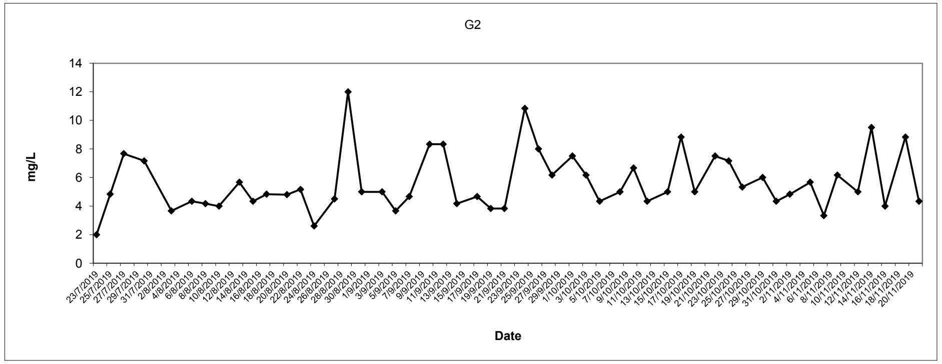
In-situ TIN (Depth average) at Mid-Flood Tide



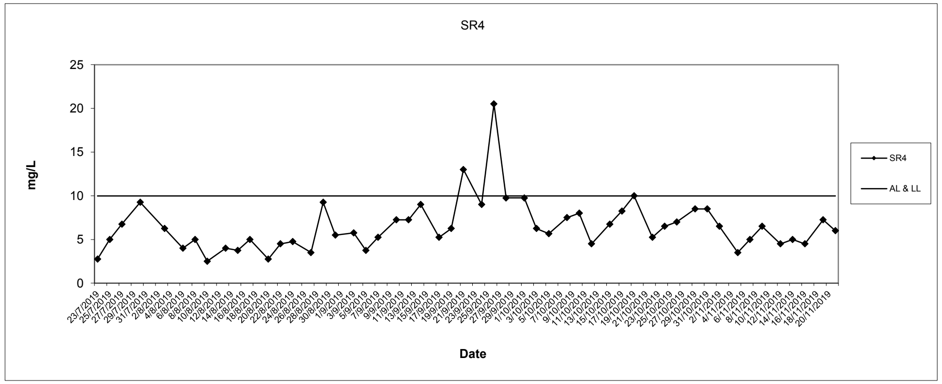
Total Suspended Solids (Depth average) at Mid-Flood Tide

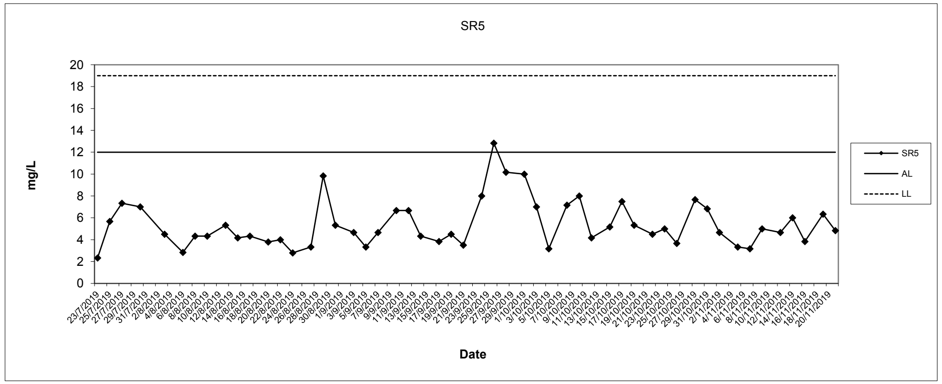


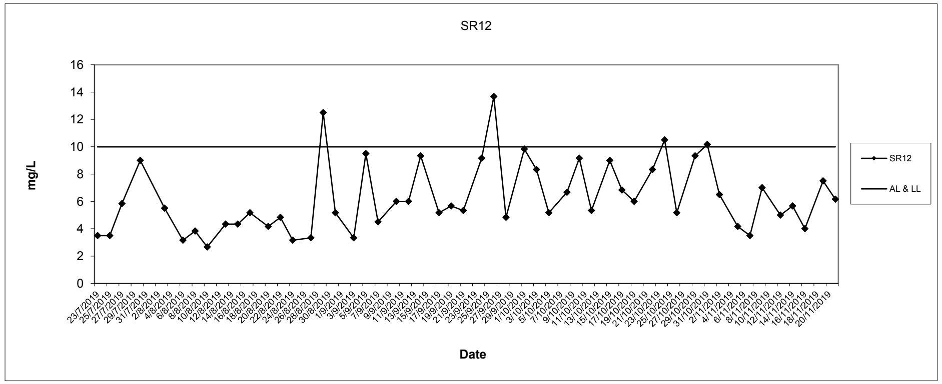




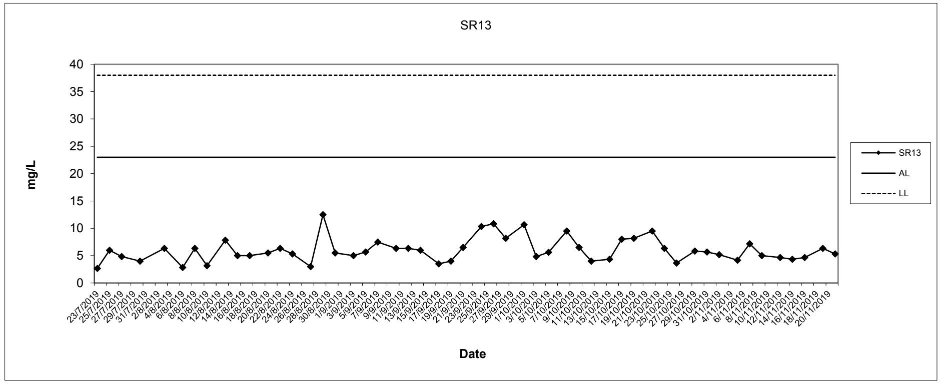
Total Suspended Solids (Depth average) at Mid-Flood Tide



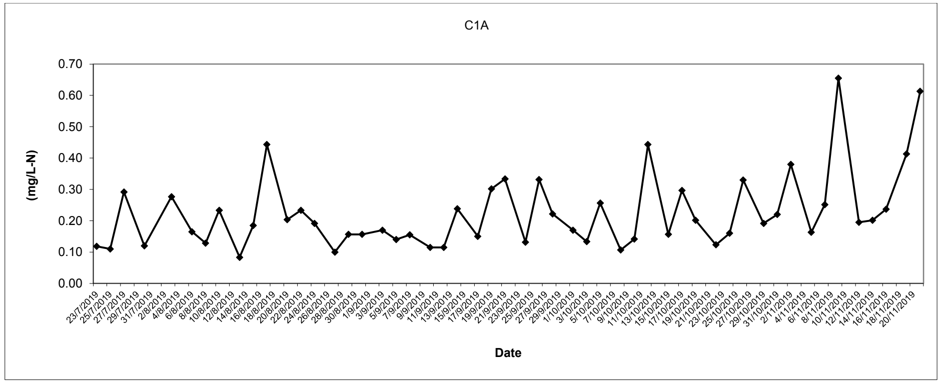


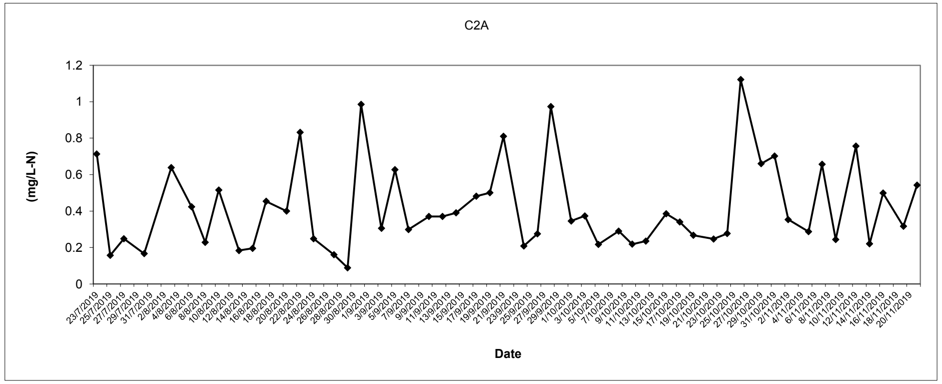


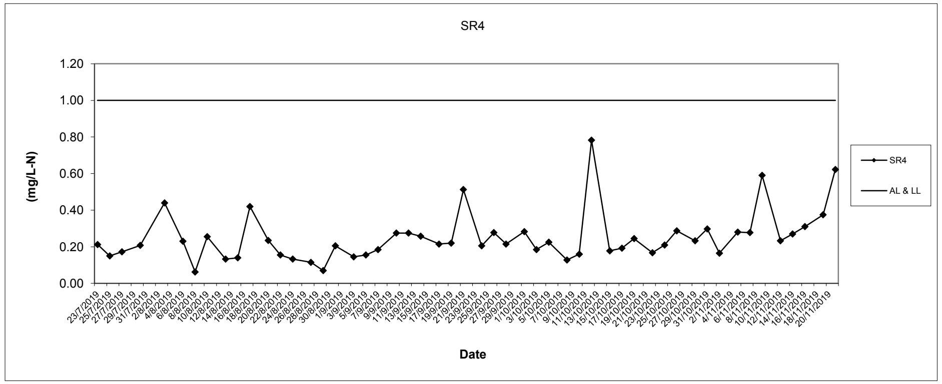
Total Suspended Solids (Depth average) at Mid-Flood Tide



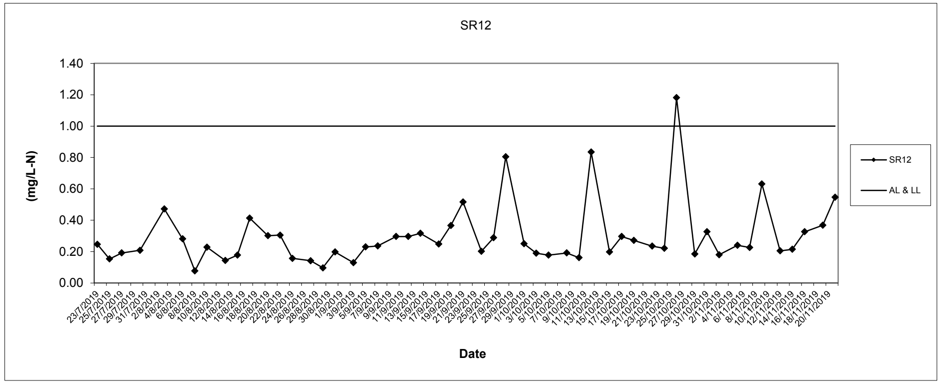
Ammonia Nitrogen (Depth average) at Mid-Flood Tide



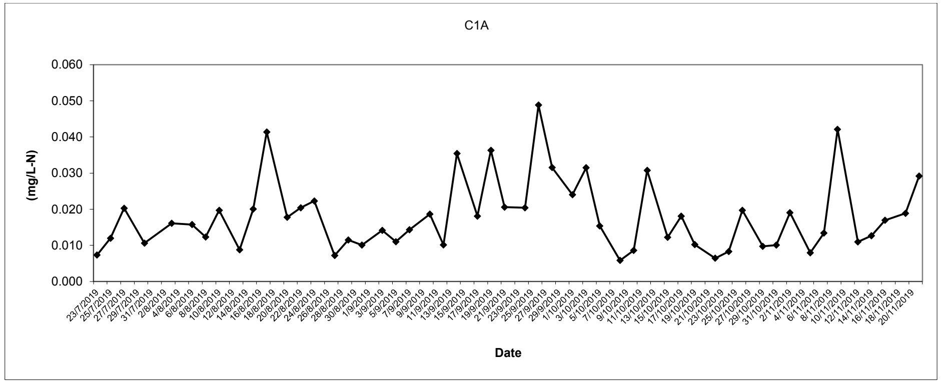


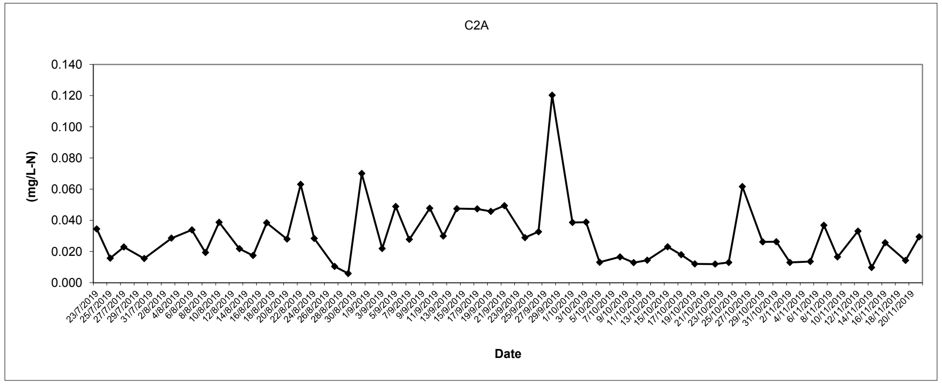


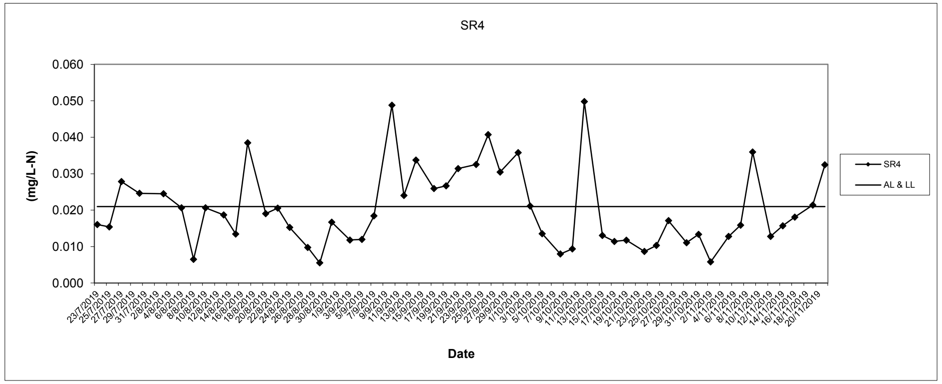
Ammonia Nitrogen (Depth average) at Mid-Flood Tide



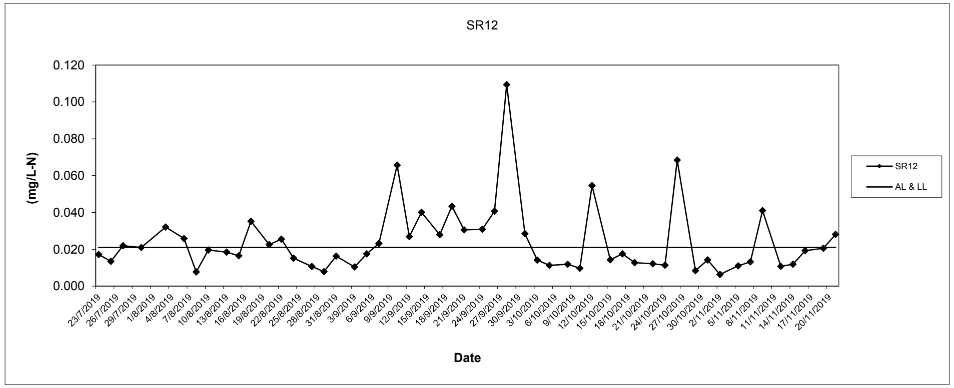
Laboratory Analysis UIA (Depth average) at Mid-Flood Tide





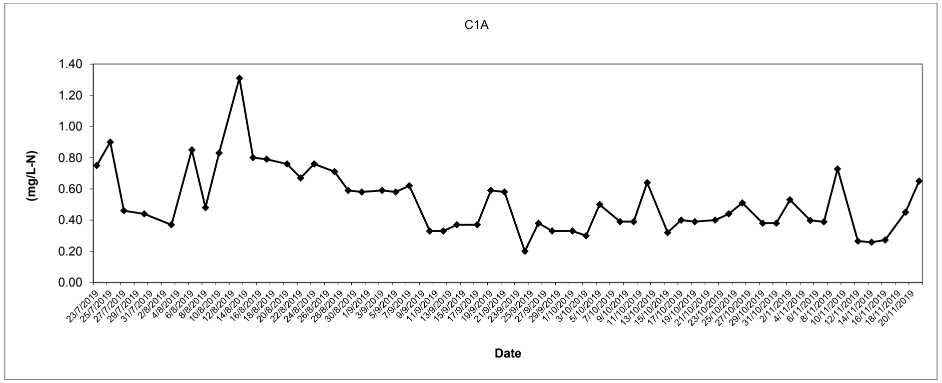


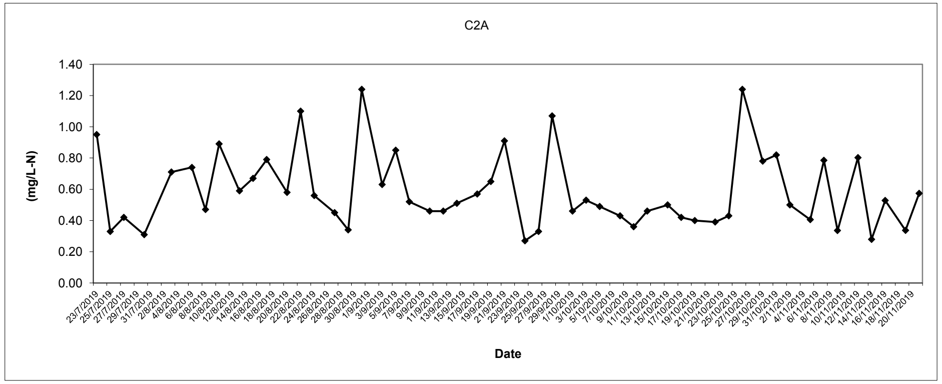
Laboratory Analysis UIA (Depth average) at Mid-Flood Tide

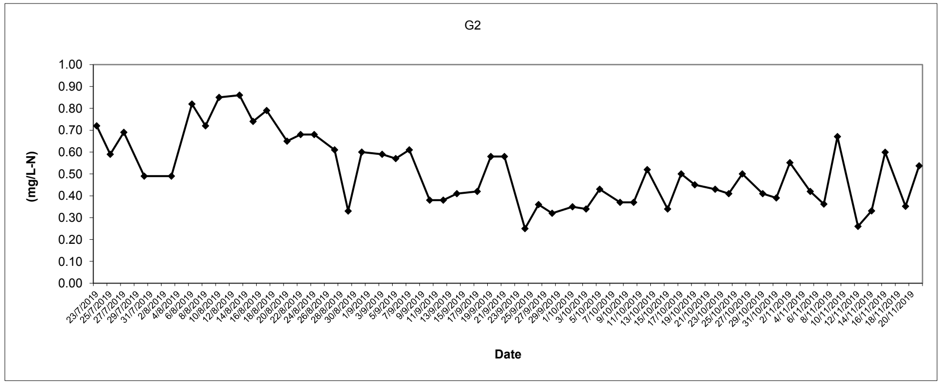


Providing Sufficient Water Depth for Kwai Tsing Container Basin and its Approach Channel

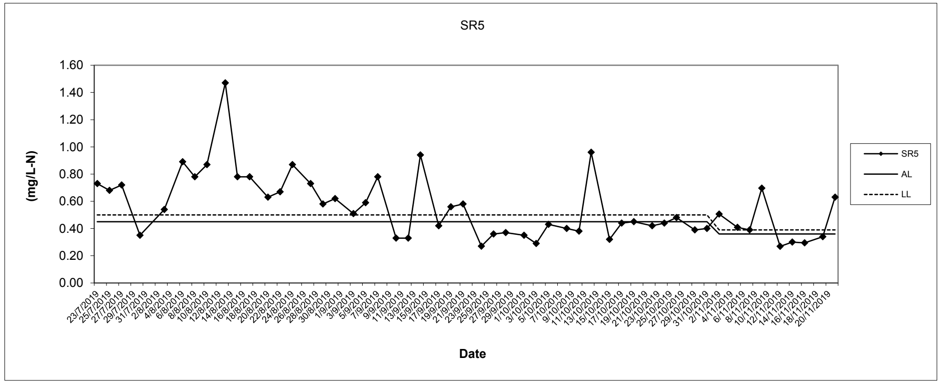
Laboratory Analysis TIN (Depth average) at Mid-Flood Tide





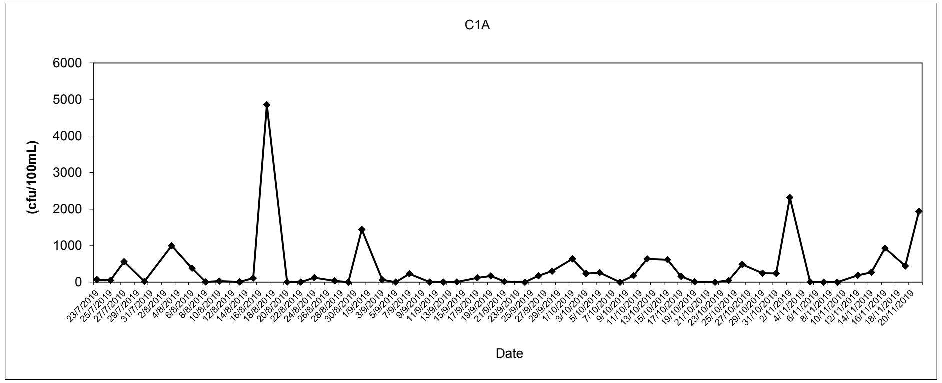


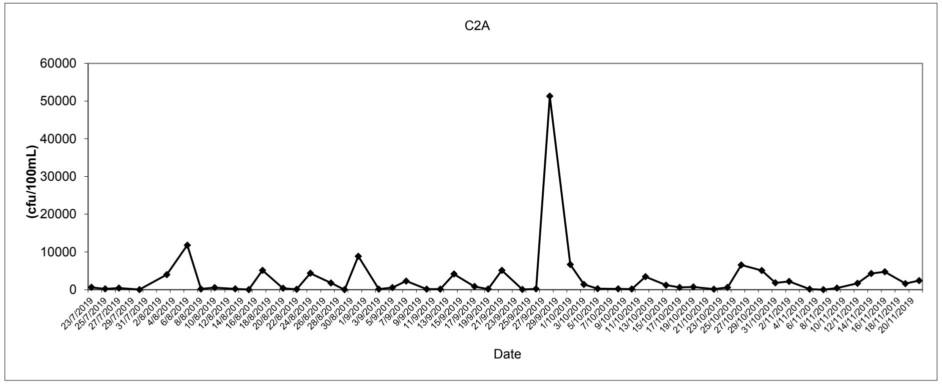
Laboratory Analysis TIN (Depth average) at Mid-Flood Tide

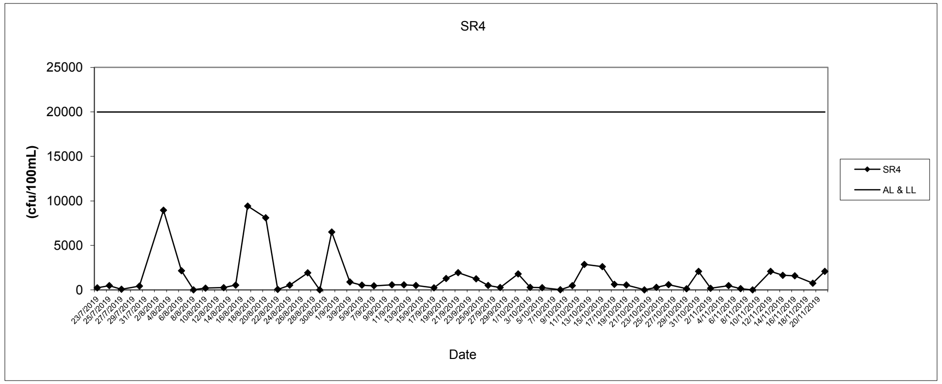


Providing Sufficient Water Depth for Kwai Tsing Container Basin and its Approach Channel

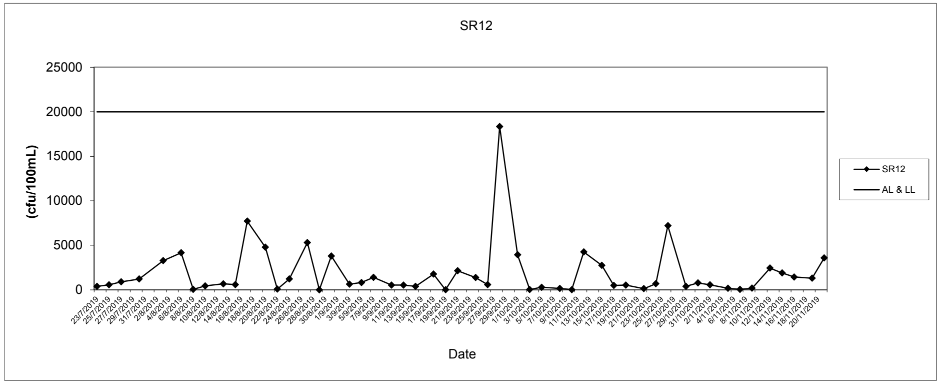
***E.coli* (Depth average) at Mid-Flood Tide**



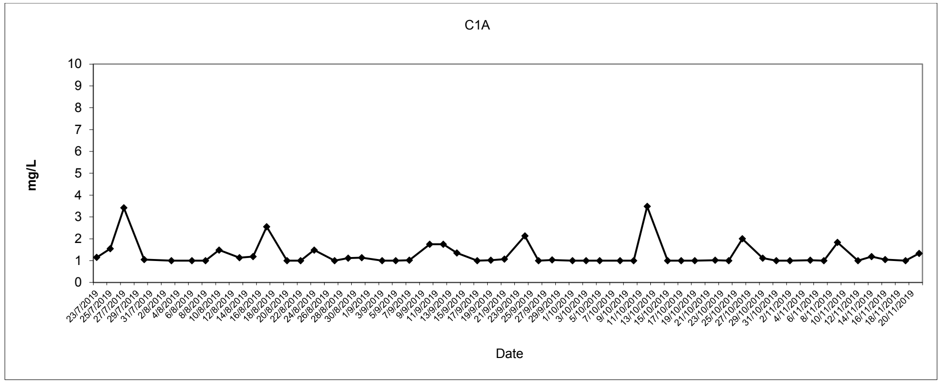


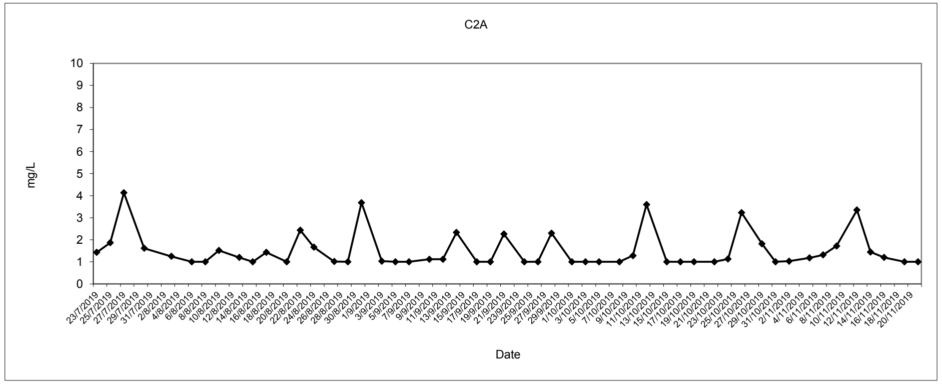


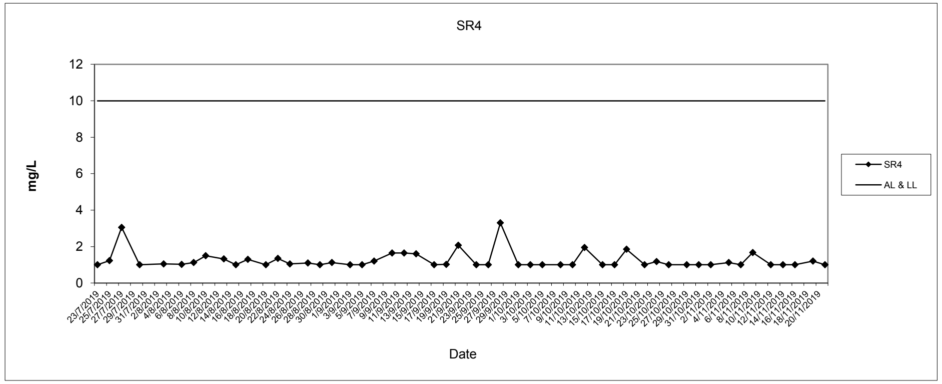
***E.coli* (Depth average) at Mid-Flood Tide**



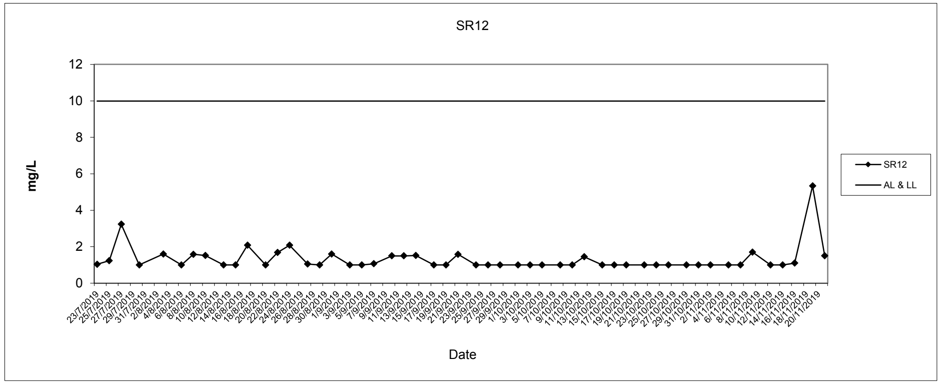
BOD_5 (Depth average) at Mid-Flood Tide





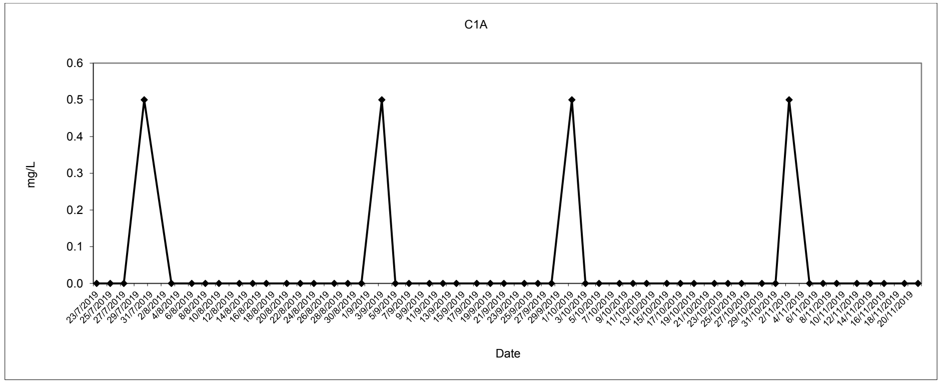


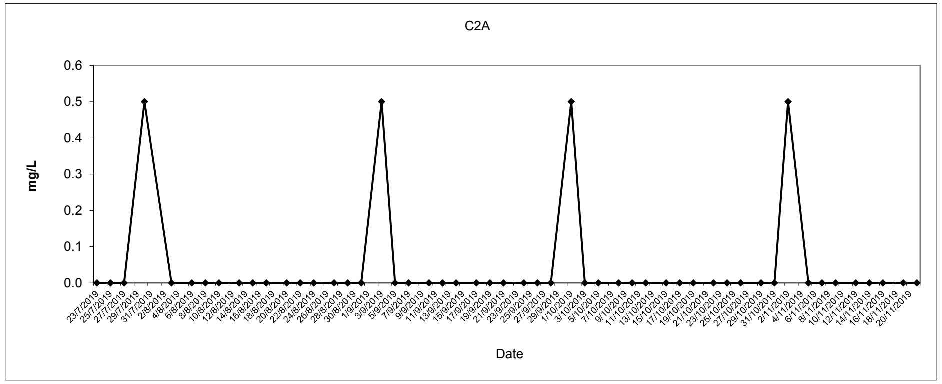
BOD_5 (Depth average) at Mid-Flood Tide

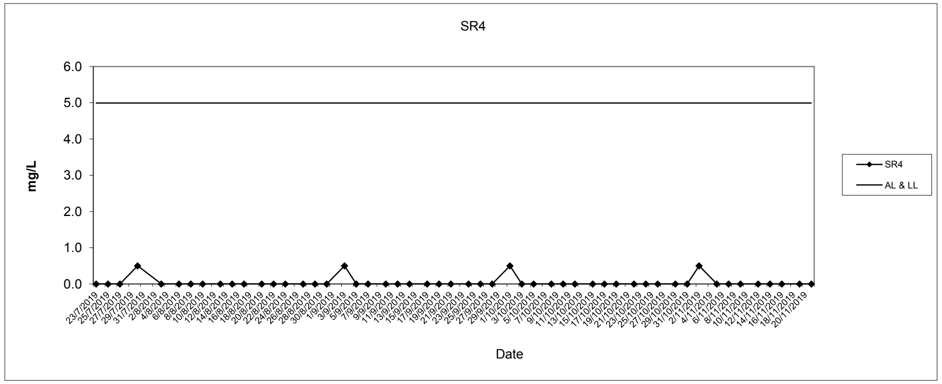


Providing Sufficient Water Depth for Kwai Tsing Container Basin and its Approach Channel

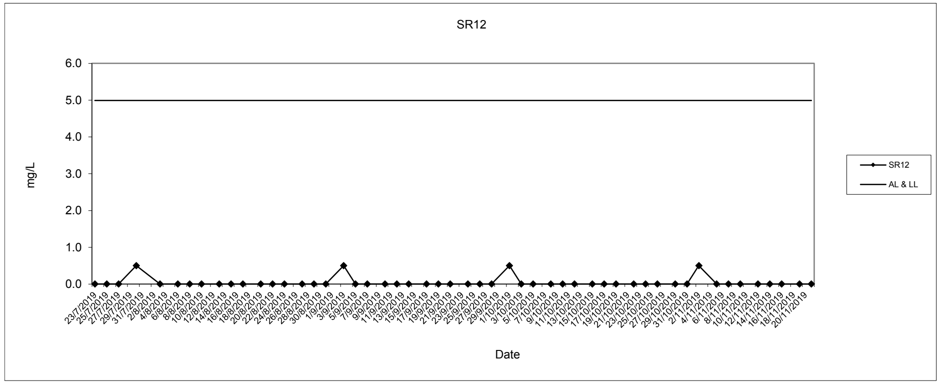
Synthetic Detergent (Depth average) at Mid-Flood Tide





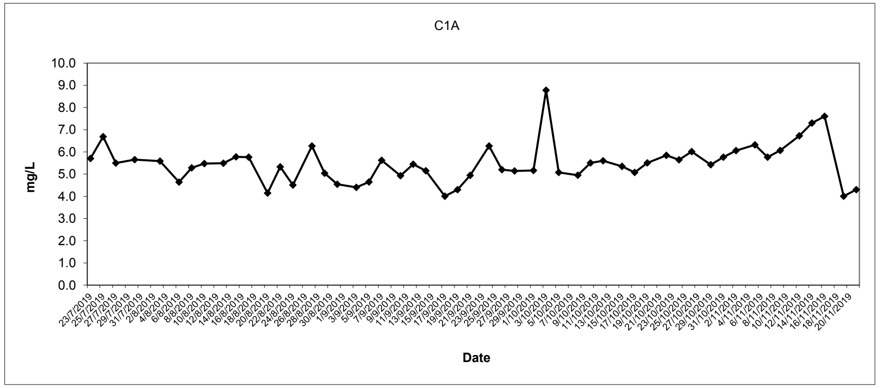


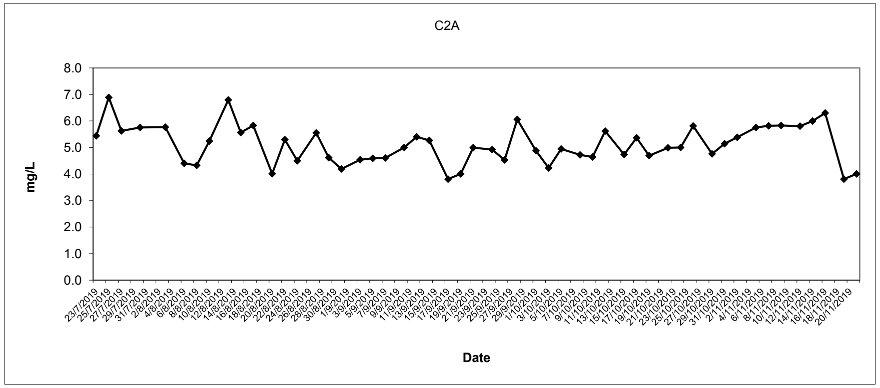
Synthetic Detergent (Depth average) at Mid-Flood Tide

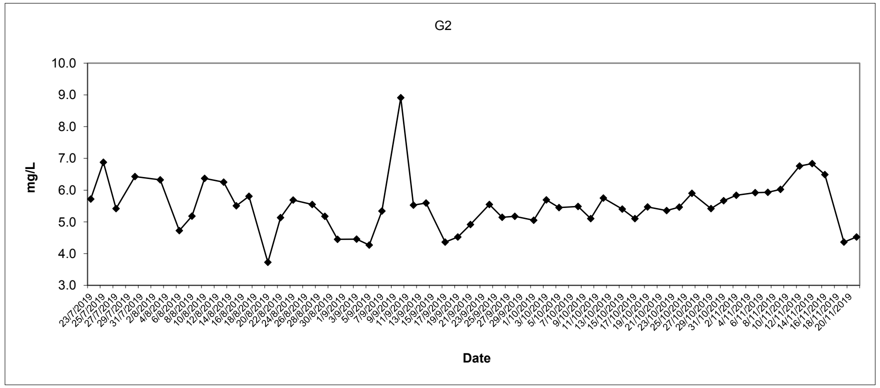


Providing Sufficient Water Depth for Kwai Tsing Container Basin and its Approach Channel

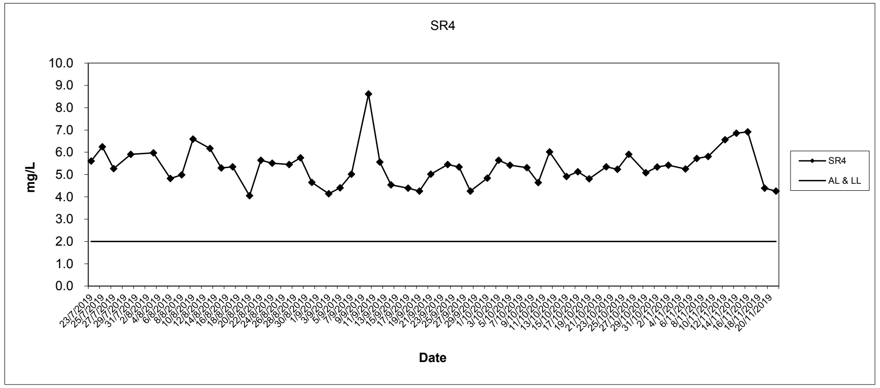
Dissolved Oxygen (Surface and Middle) at Mid-Ebb Tide

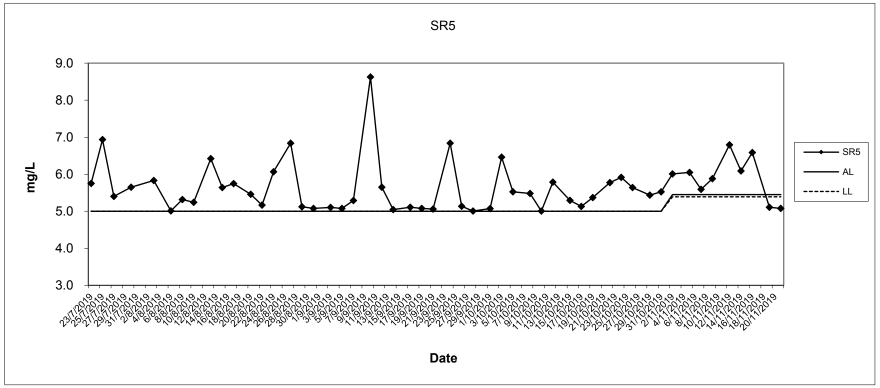


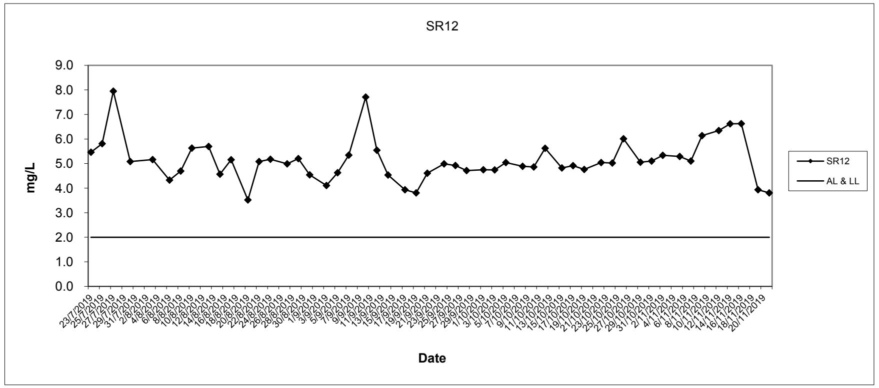




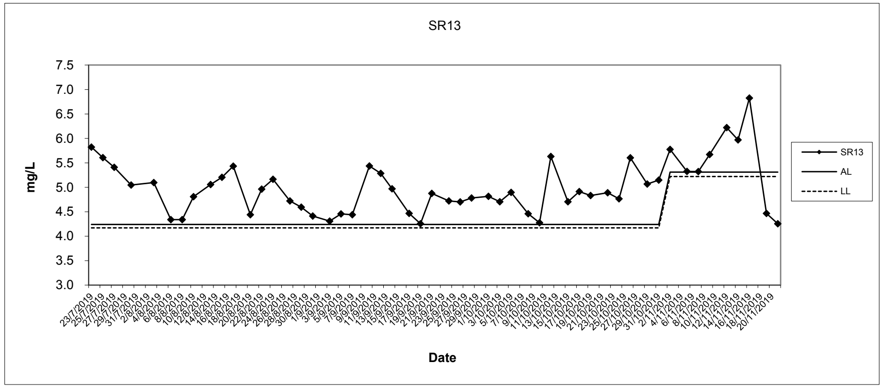
Dissolved Oxygen (Surface and Middle) at Mid-Ebb Tide



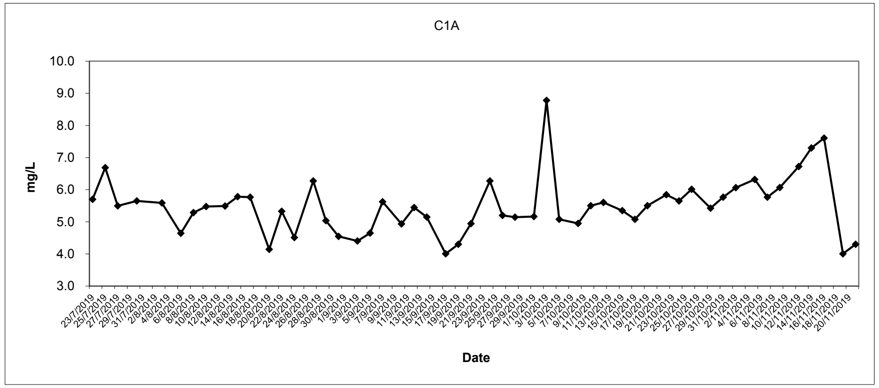


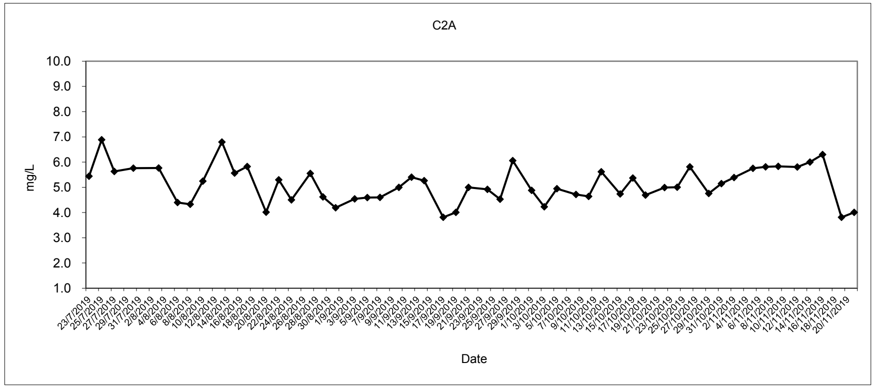


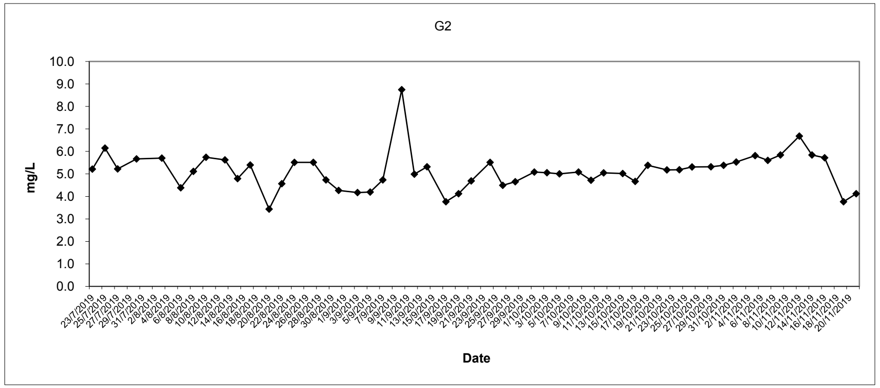
Dissolved Oxygen (Surface and Middle) at Mid-Ebb Tide



Dissolved Oxygen (Bottom) at Mid-Ebb Tide

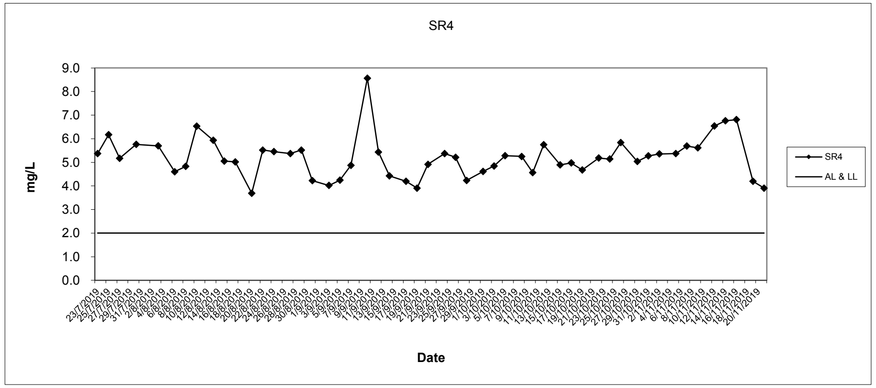


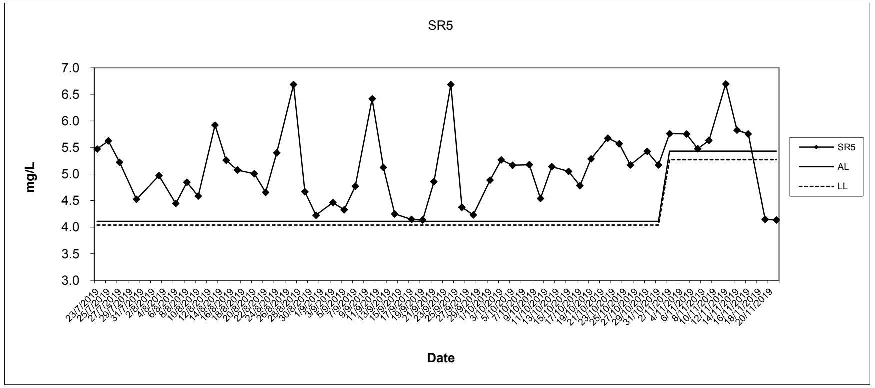


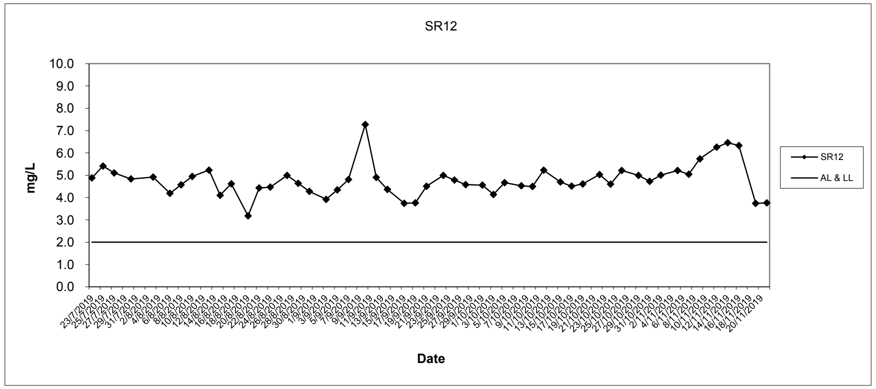


Providing Sufficient Water Depth for Kwai Tsing Container Basin and its Approach Channel

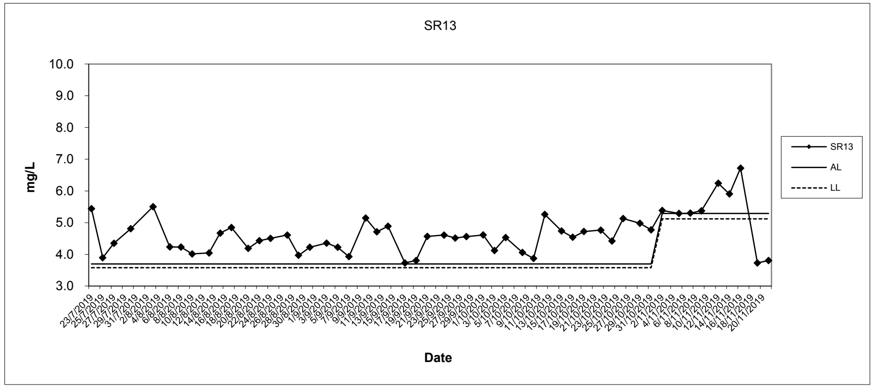
Dissolved Oxygen (Bottom) at Mid-Ebb Tide



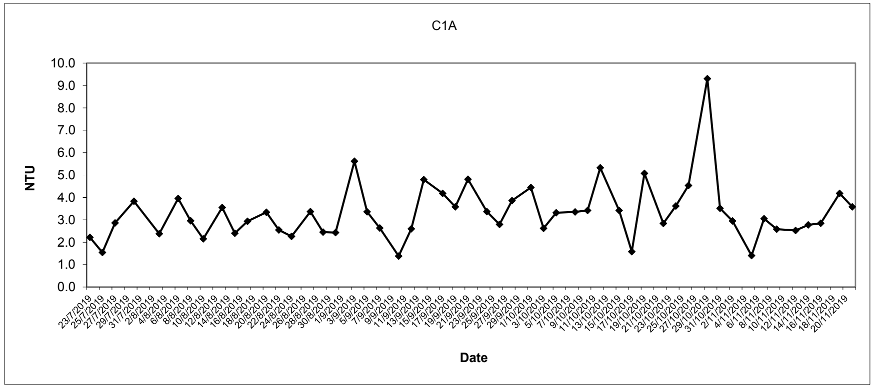


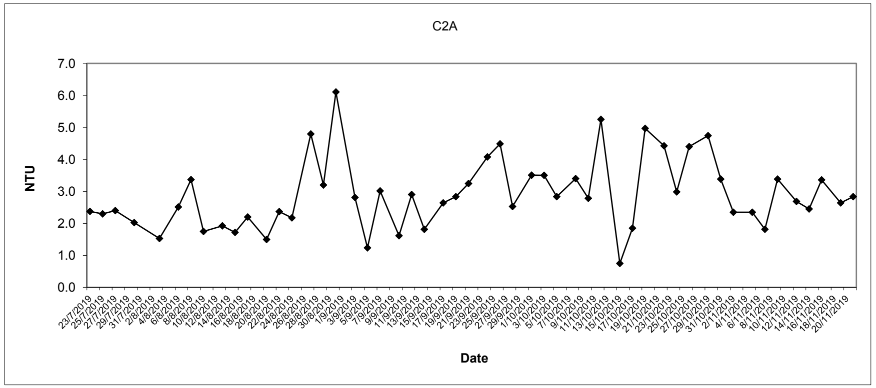


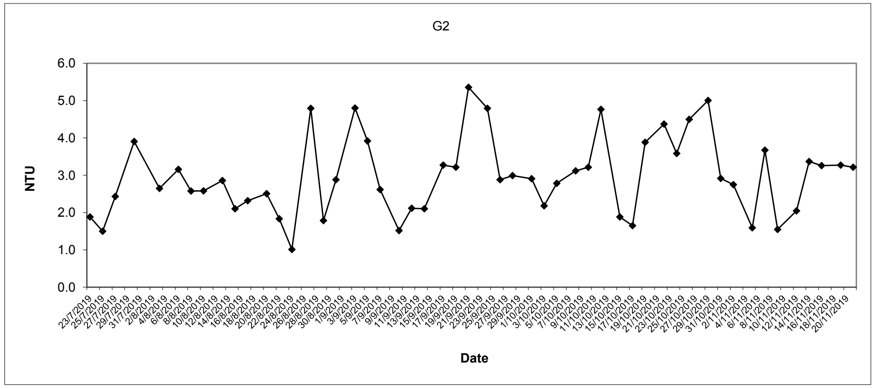
Dissolved Oxygen (Bottom) at Mid-Ebb Tide



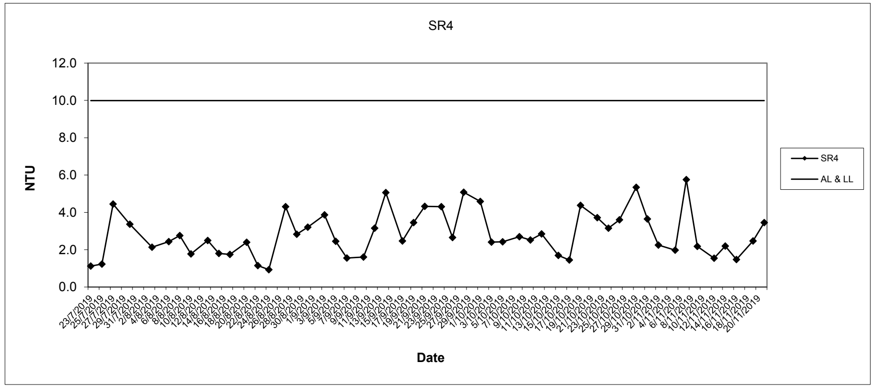
Turbidity (Depth average) at Mid-Ebb Tide

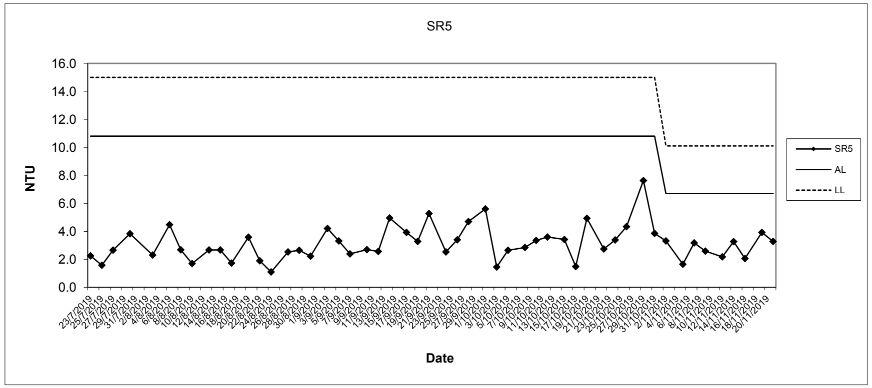


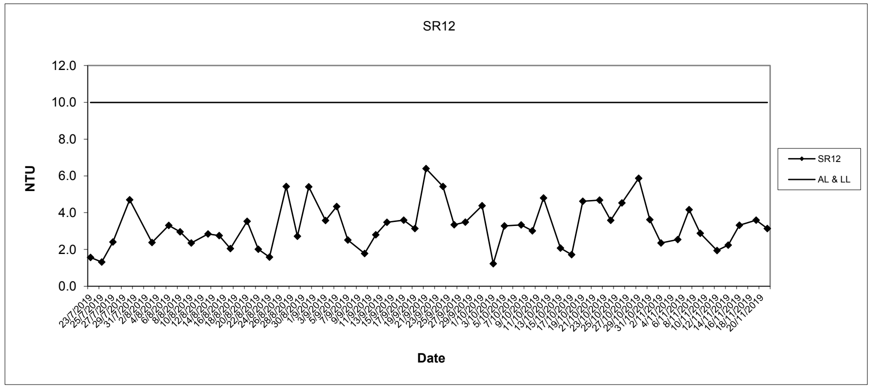




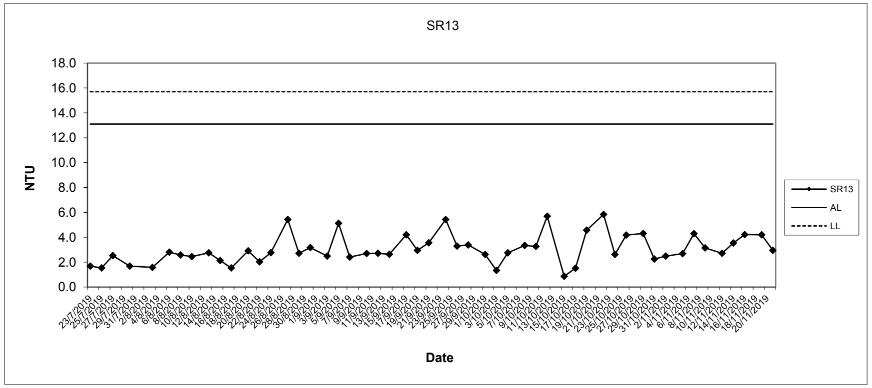
Turbidity (Depth average) at Mid-Ebb Tide



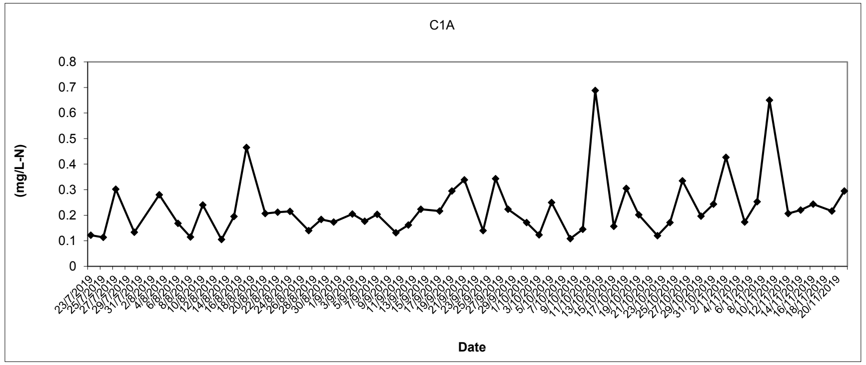


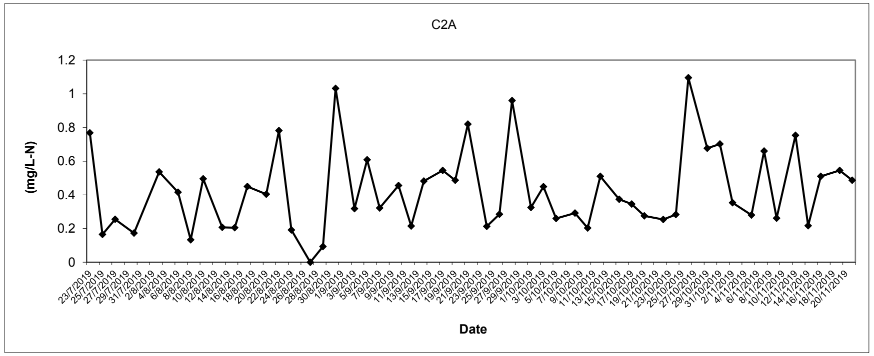


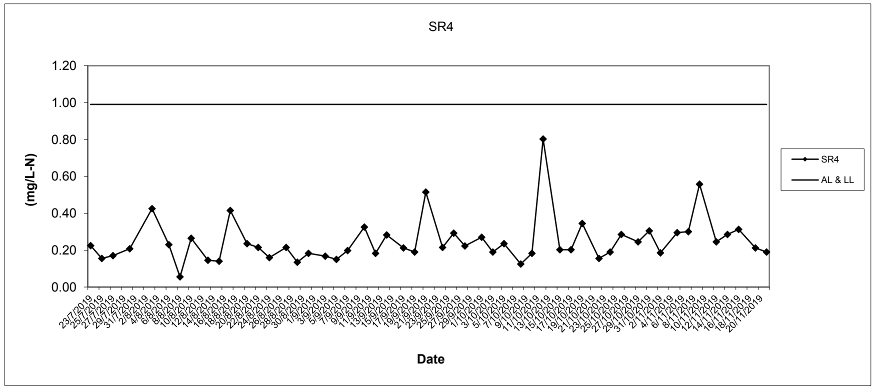
Turbidity (Depth average) at Mid-Ebb Tide



In-situ Ammonia (Depth average) at Mid-Ebb Tide

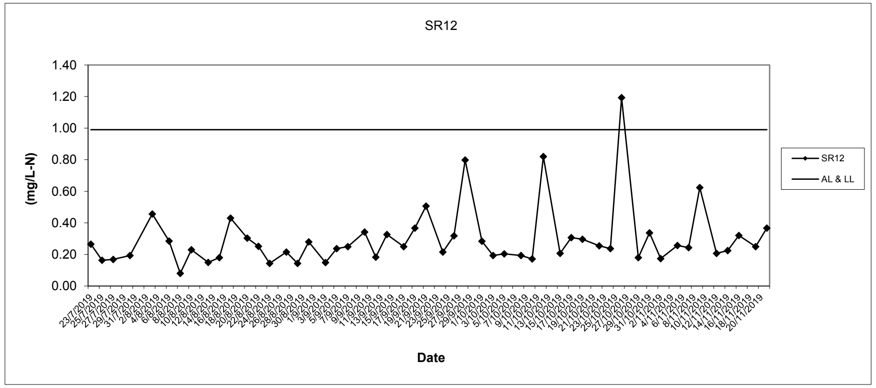






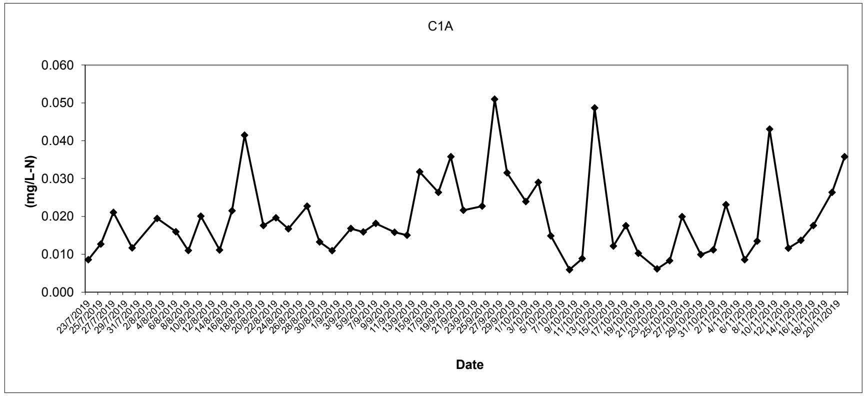
Providing Sufficient Water Depth for Kwai Tsing Container Basin and its Approach Channel

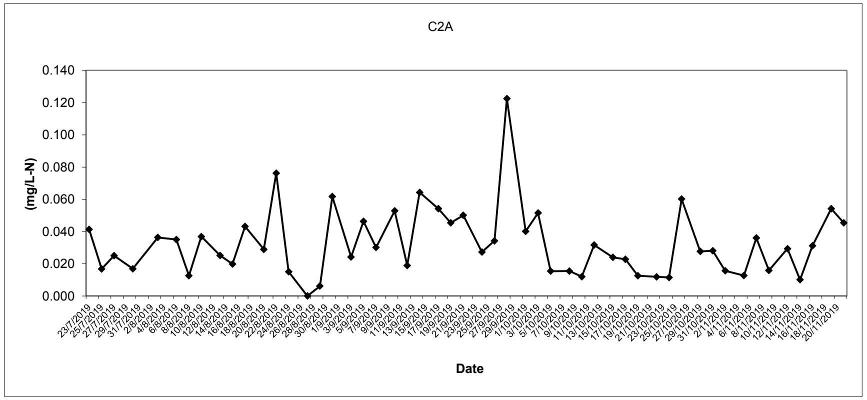
In-situ Ammonia (Depth average) at Mid-Ebb Tide

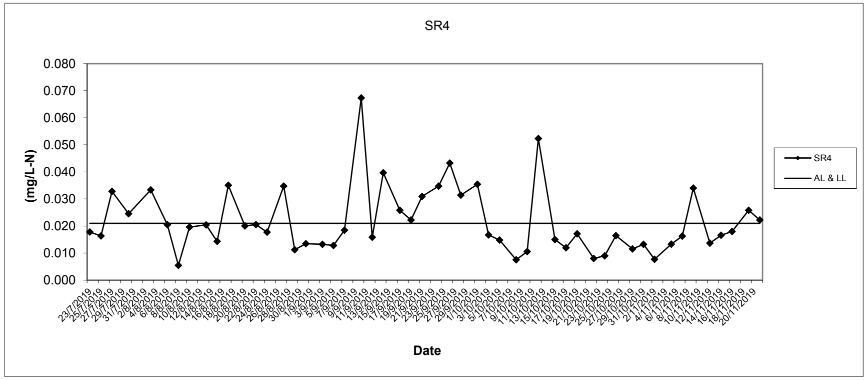


Providing Sufficient Water Depth for Kwai Tsing Container Basin and its Approach Channel

In-situ UIA (Depth average) at Mid-Ebb Tide

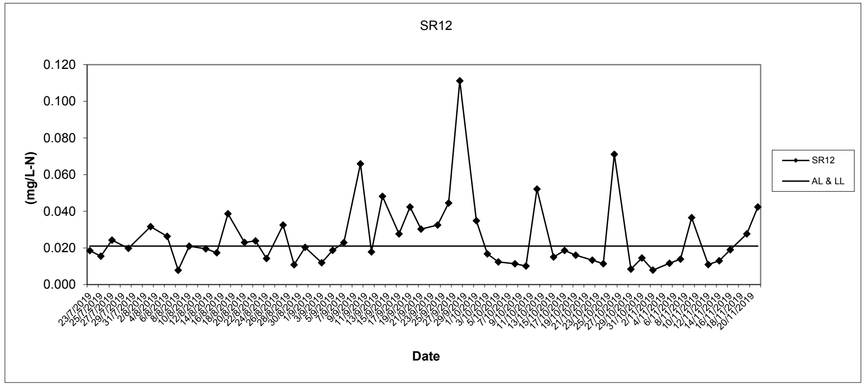




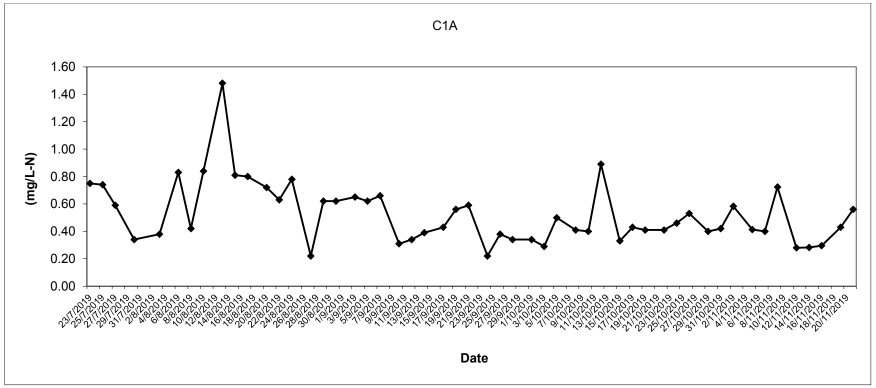


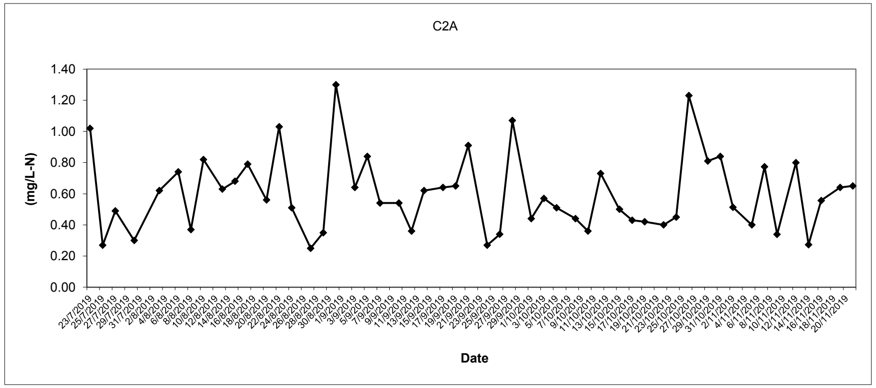
Providing Sufficient Water Depth for Kwai Tsing Container Basin and its Approach Channel

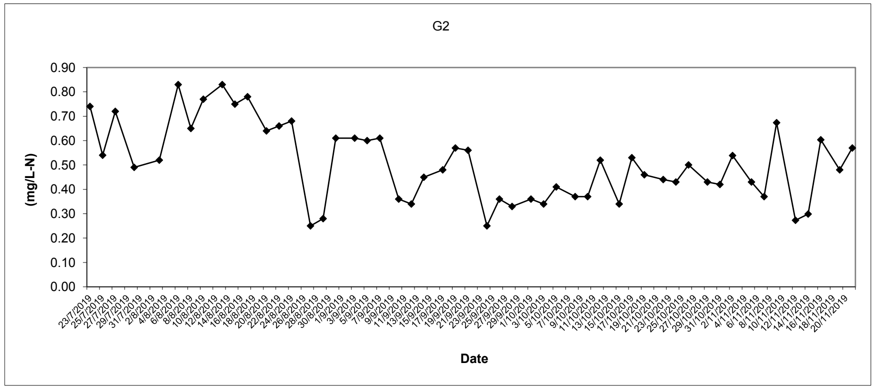
In-situ UIA (Depth average) at Mid-Ebb Tide



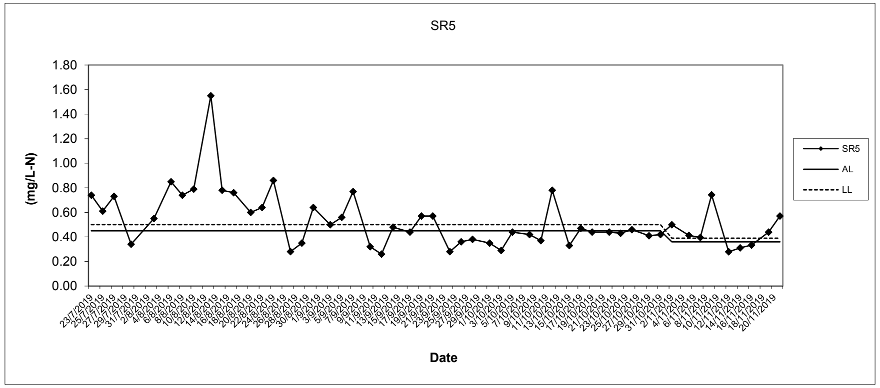
In-situ TIN (Depth average) at Mid-Ebb Tide



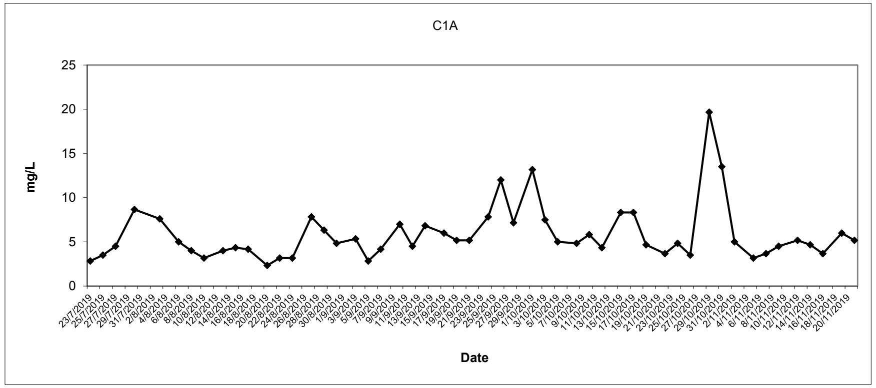


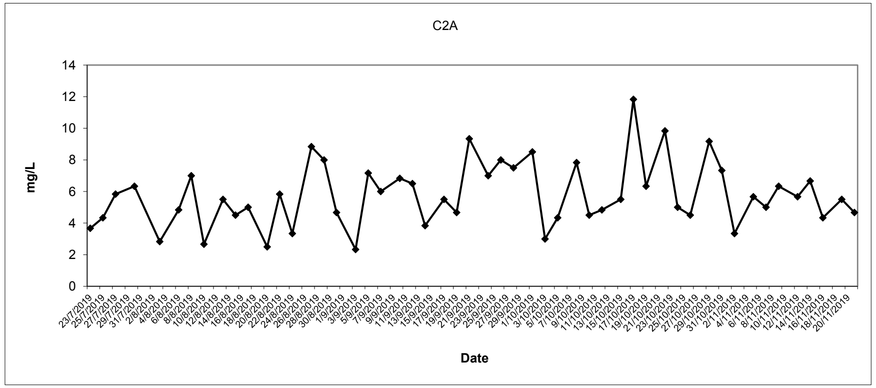


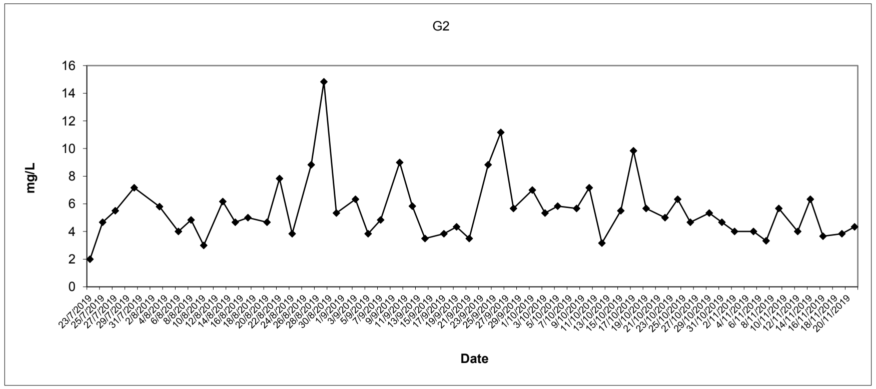
In-situ TIN (Depth average) at Mid-Ebb Tide



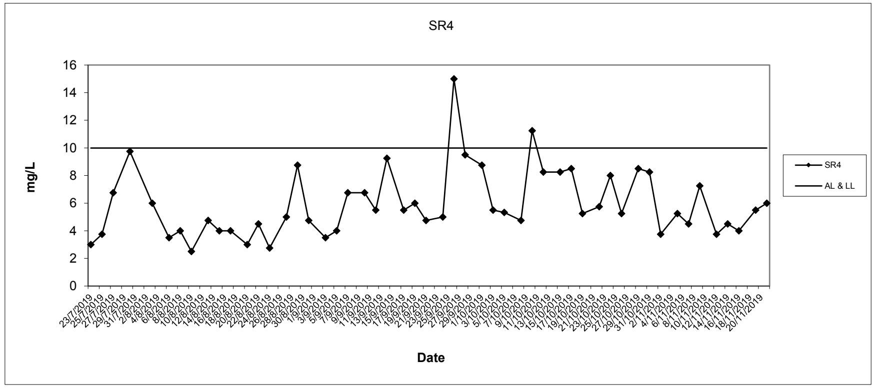
Total Suspended Solids (Depth average) at Mid-Ebb Tide

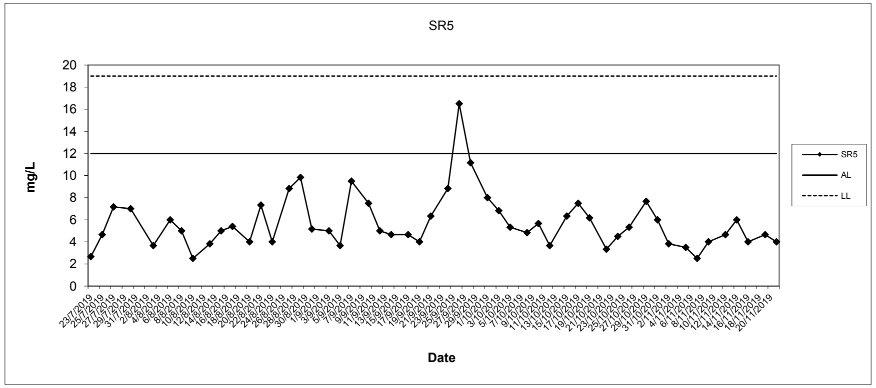


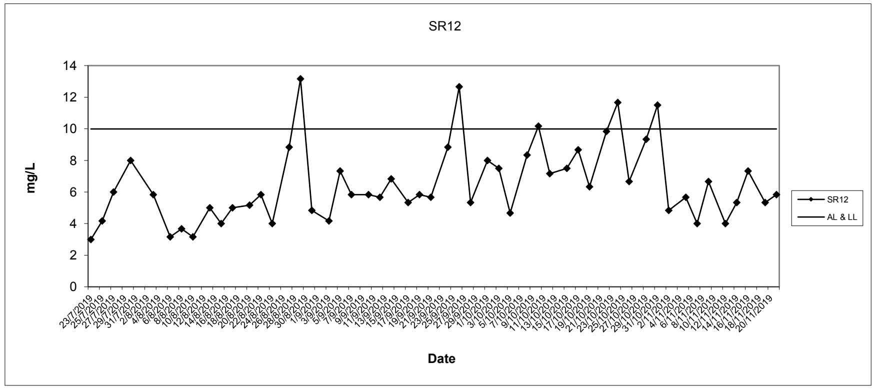




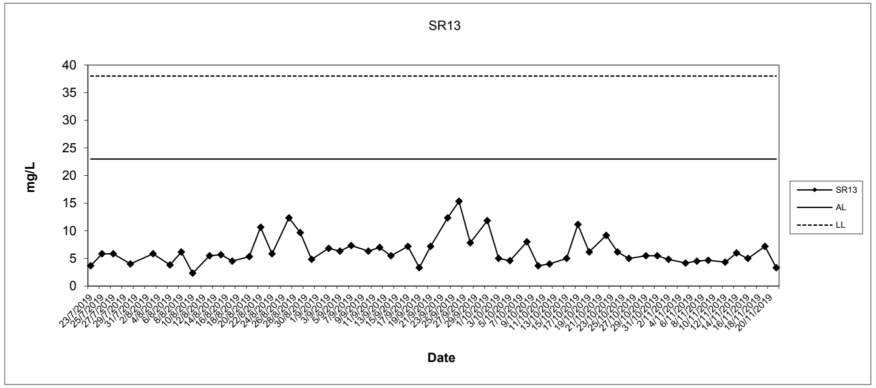
Total Suspended Solids (Depth average) at Mid-Ebb Tide



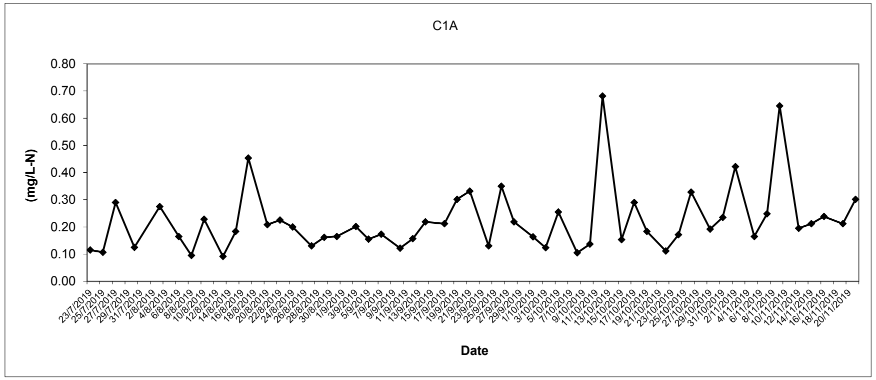


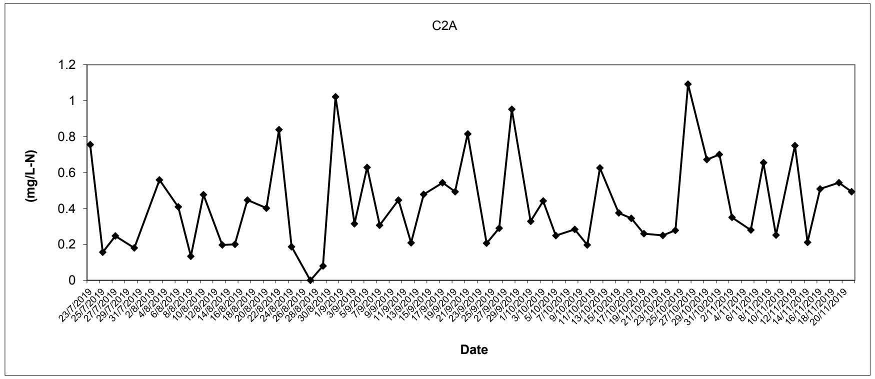


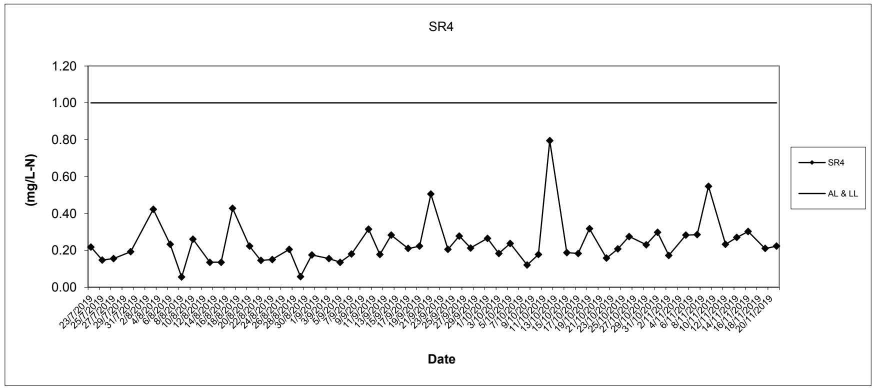
Total Suspended Solids (Depth average) at Mid-Ebb Tide



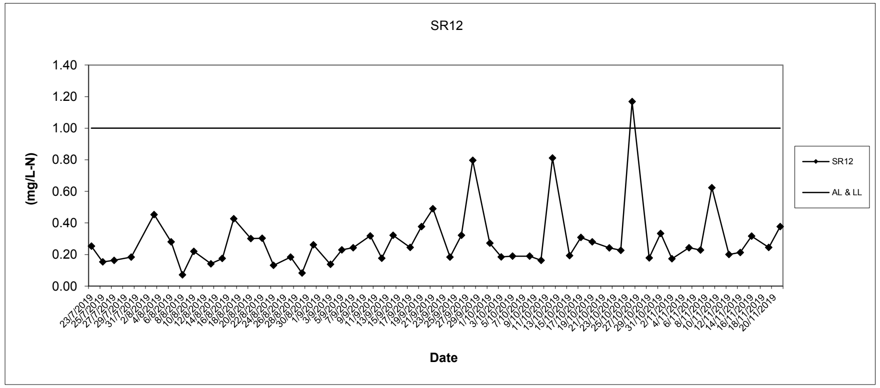
Ammonia Nitrogen (Depth average) at Mid-Ebb Tide





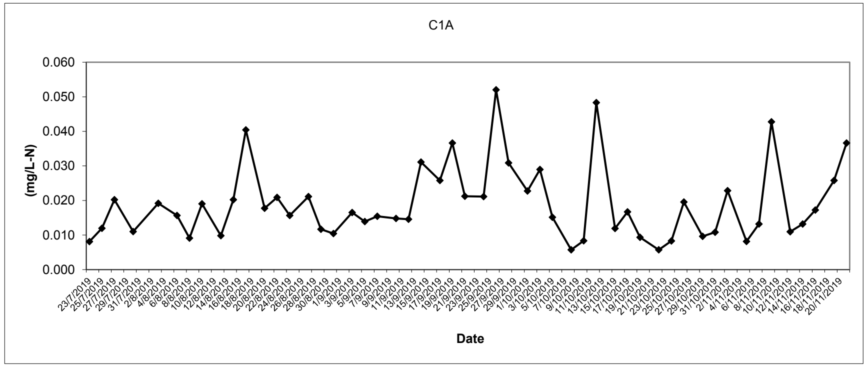


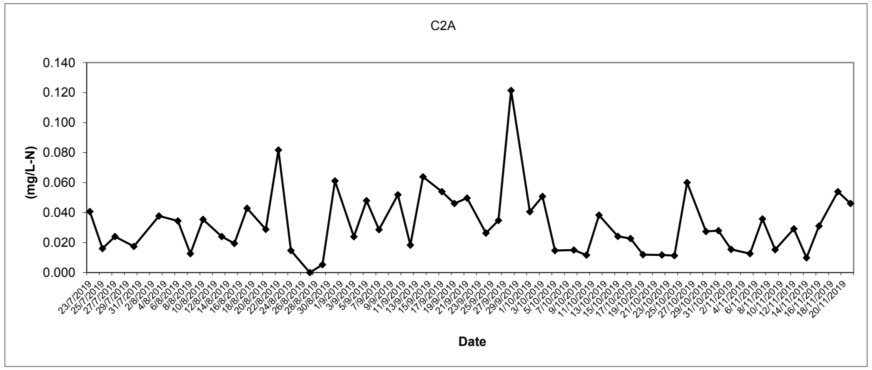
Ammonia Nitrogen (Depth average) at Mid-Ebb Tide

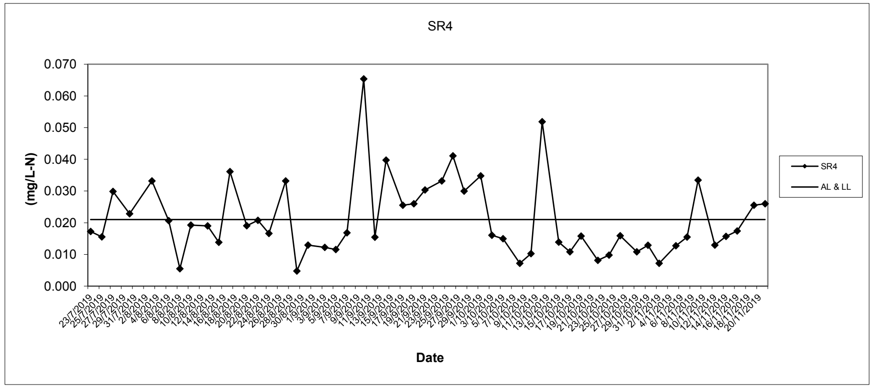


Providing Sufficient Water Depth for Kwai Tsing Container Basin and its Approach Channel

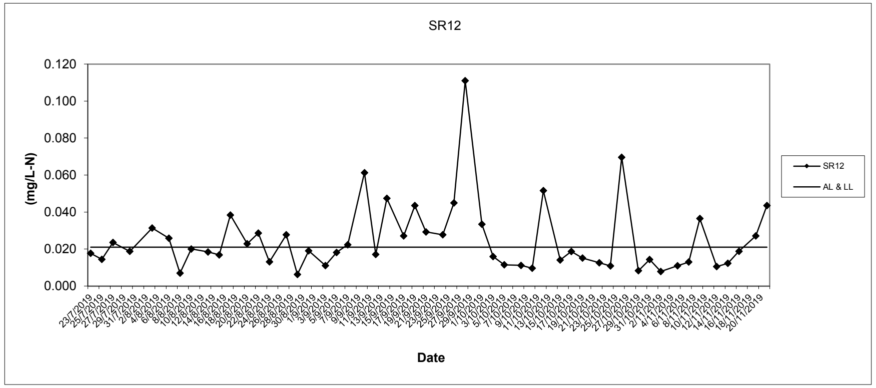
Laboratory Analysis UIA (Depth average) at Mid-Ebb Tide



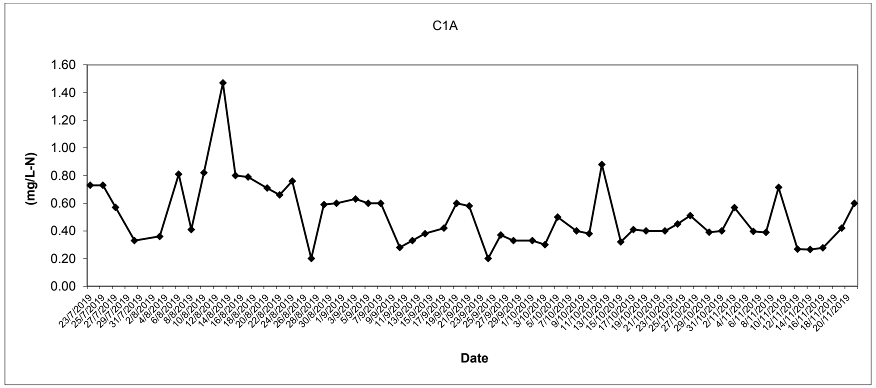


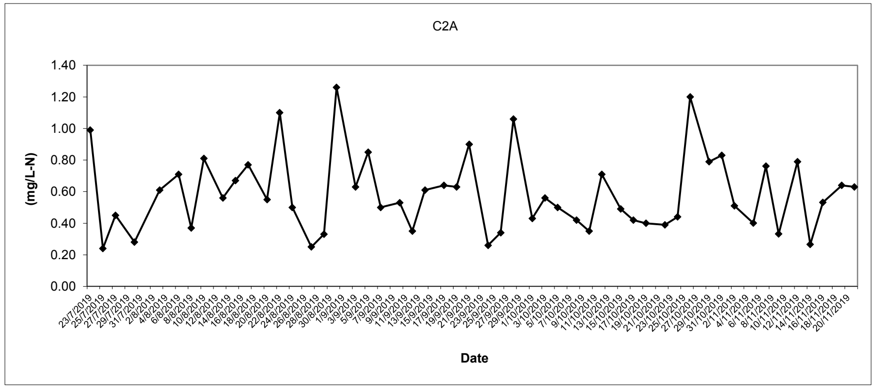


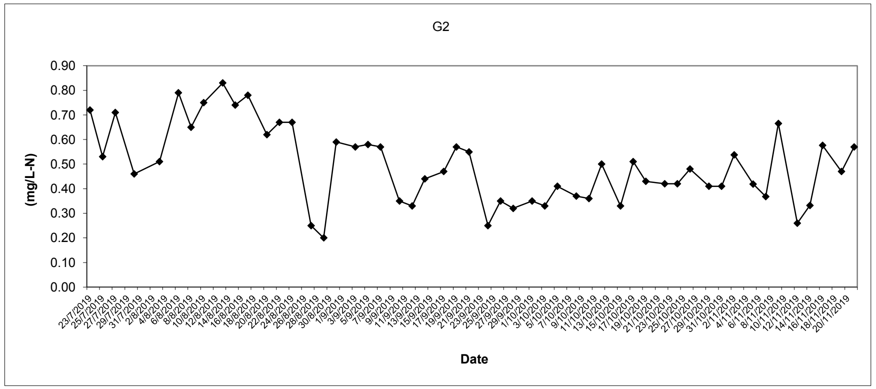
Laboratory Analysis UIA (Depth average) at Mid-Ebb Tide



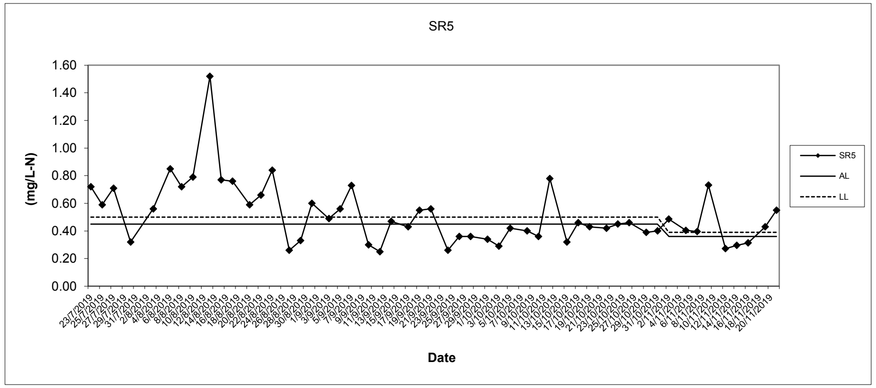
Laboratory Analysis TIN (Depth average) at Mid-Ebb Tide



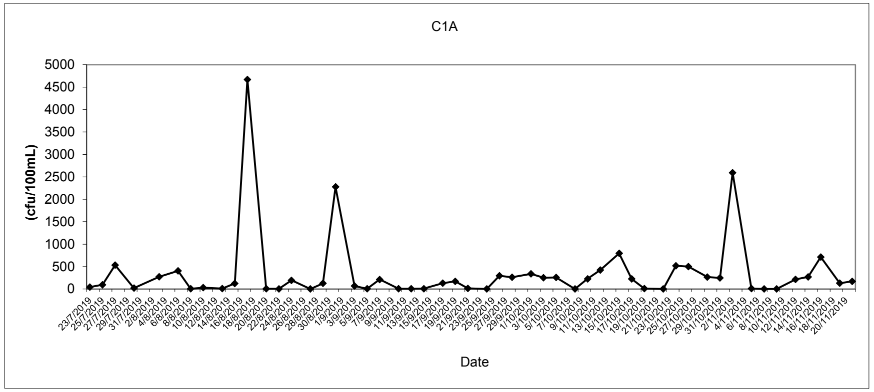


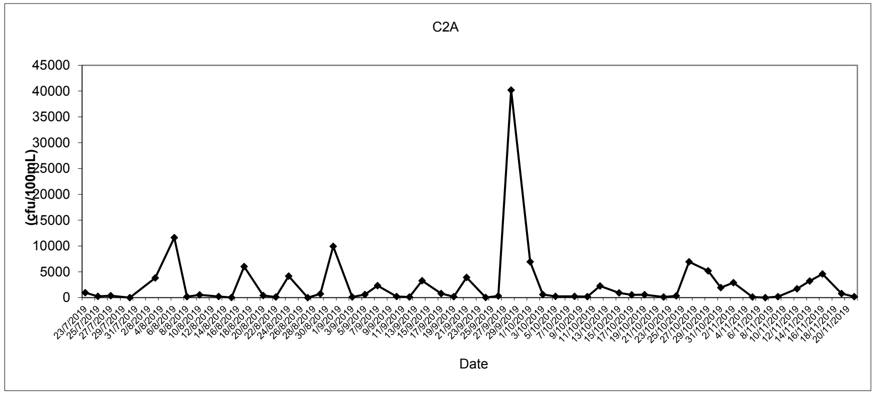


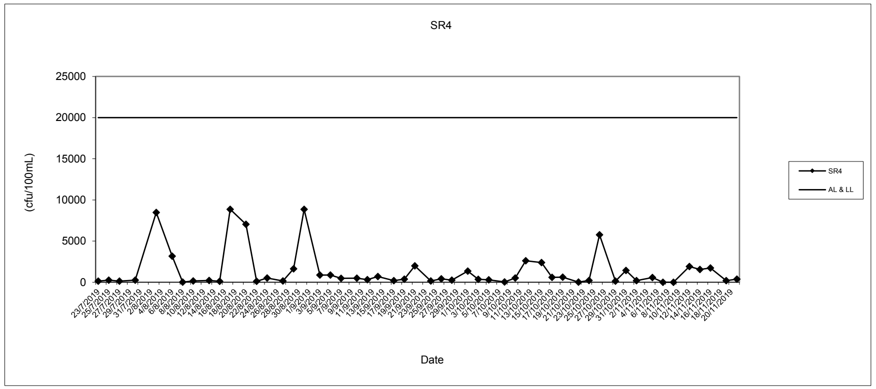
Laboratory Analysis TIN (Depth average) at Mid-Ebb Tide



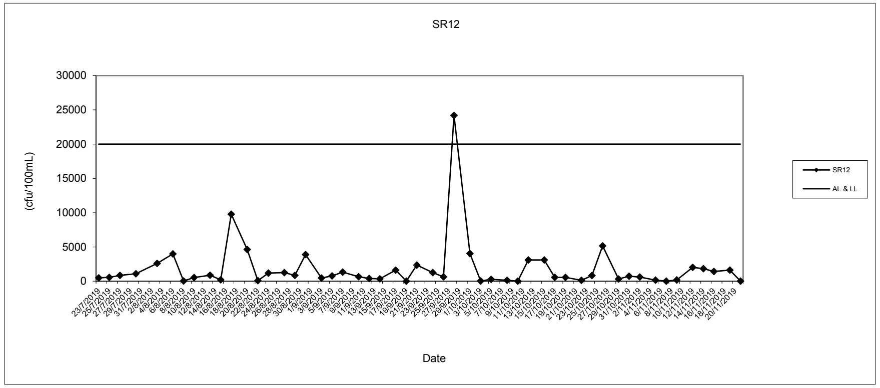
E.coli (Depth average) at Mid-Ebb Tide



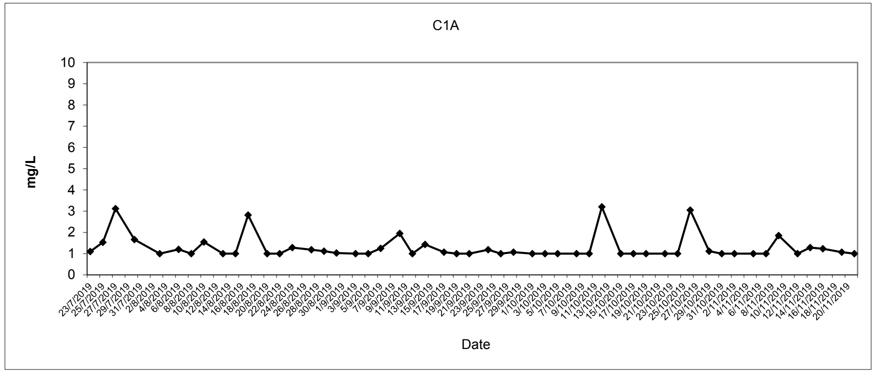


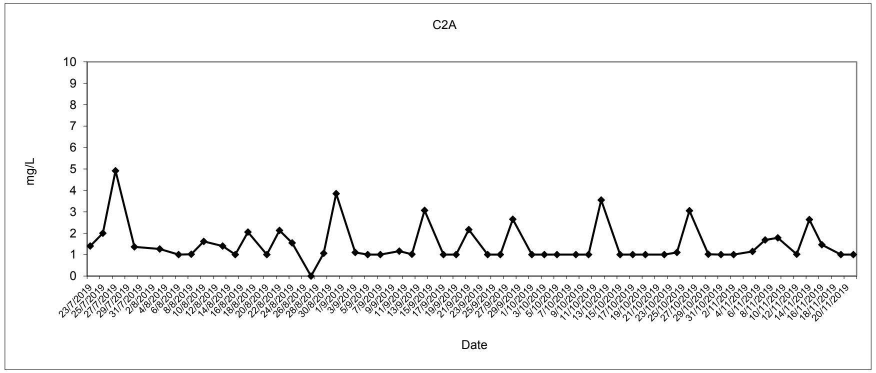


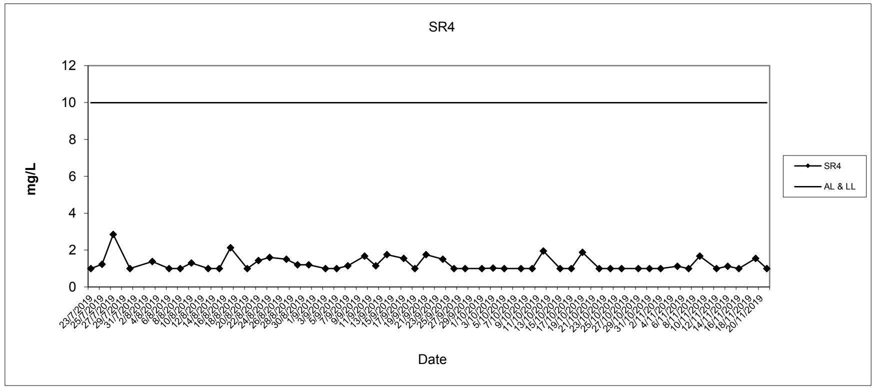
E.coli (Depth average) at Mid-Ebb Tide



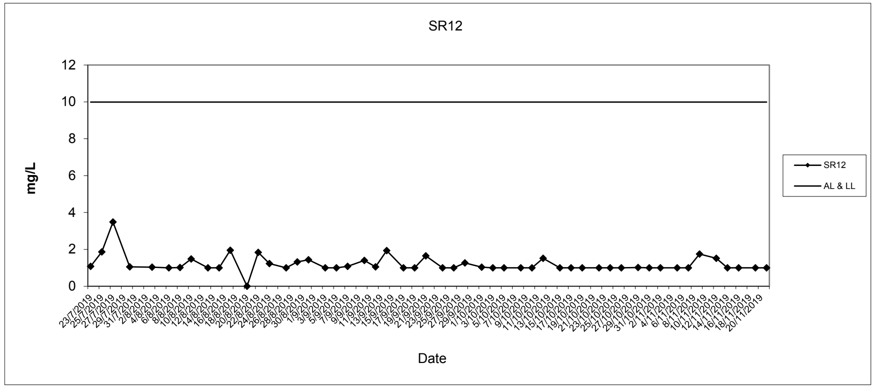
BOD$_5$ (Depth average) at Mid-Ebb Tide



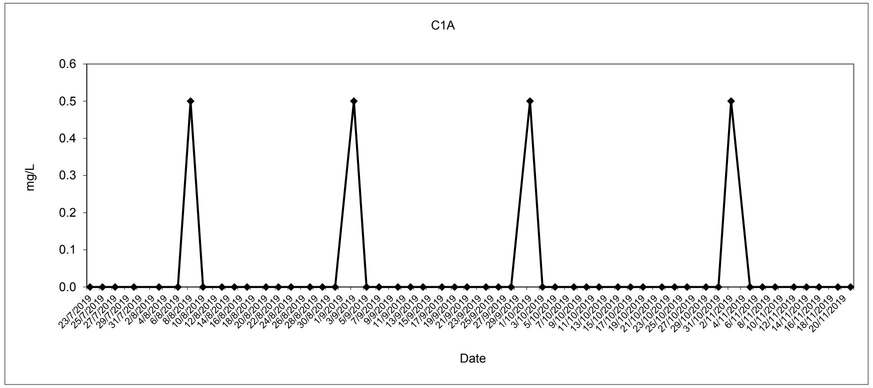


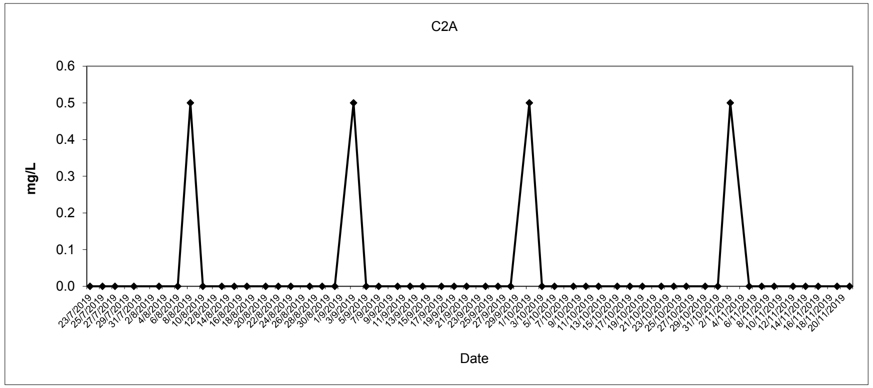


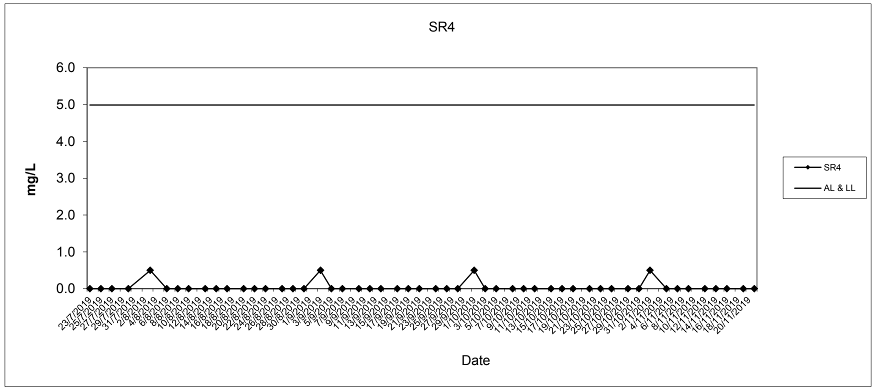
BOD$_5$ (Depth average) at Mid-Ebb Tide



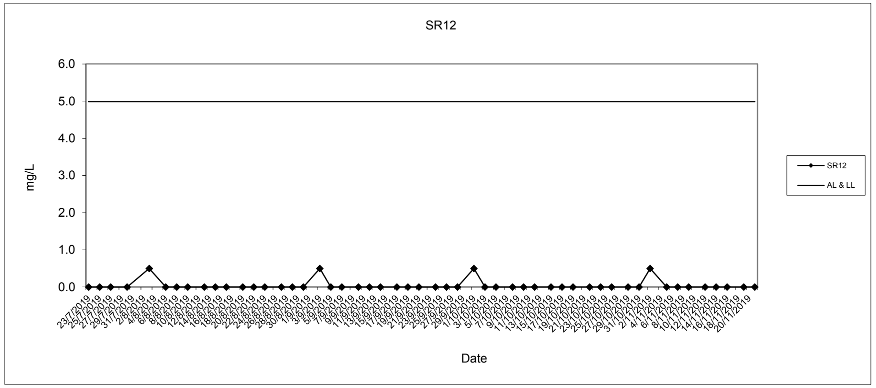
Synthetic Detergent (Depth average) at Mid-Ebb Tide







Synthetic Detergent (Depth average) at Mid-Ebb Tide



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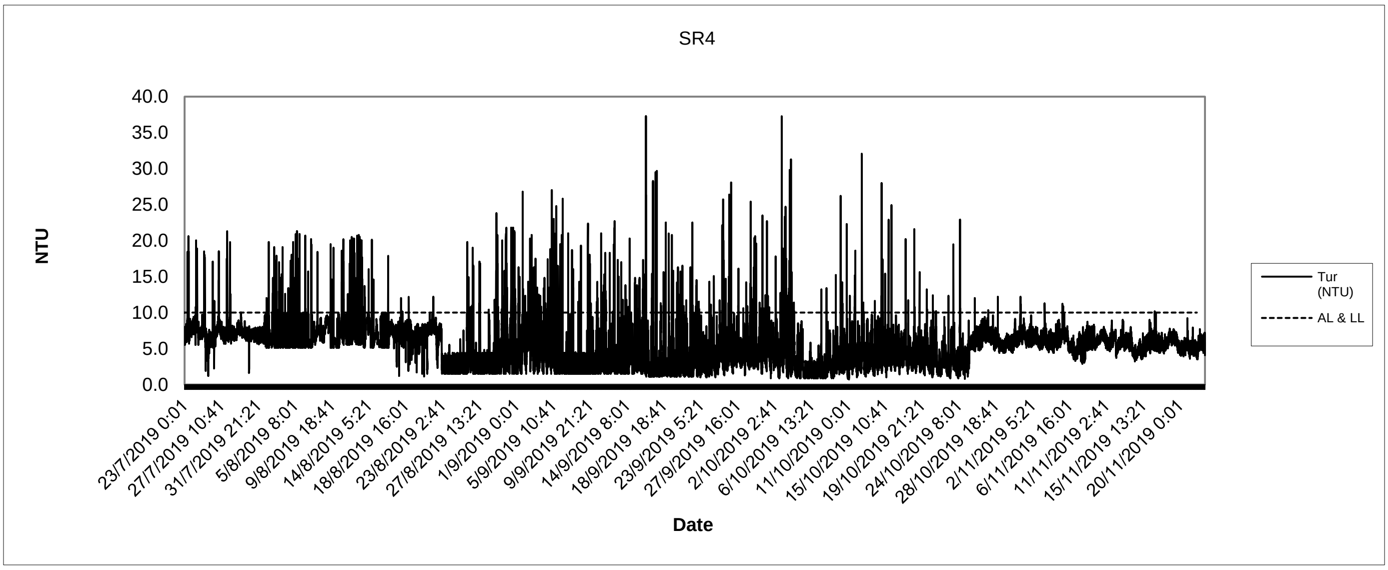
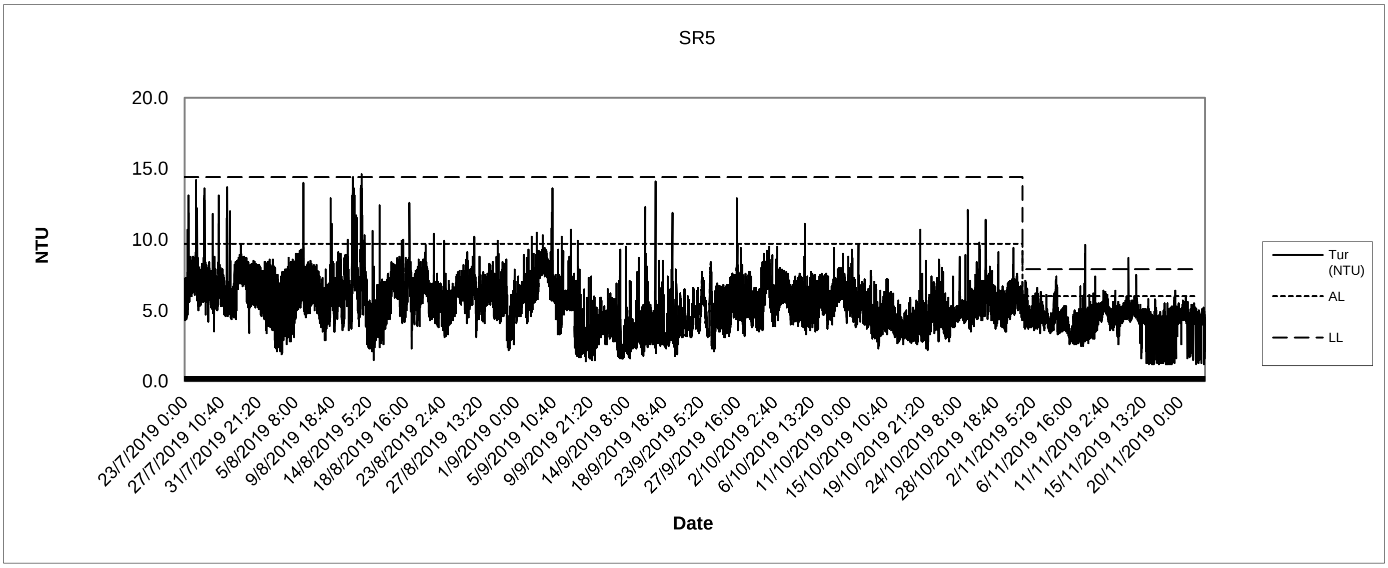
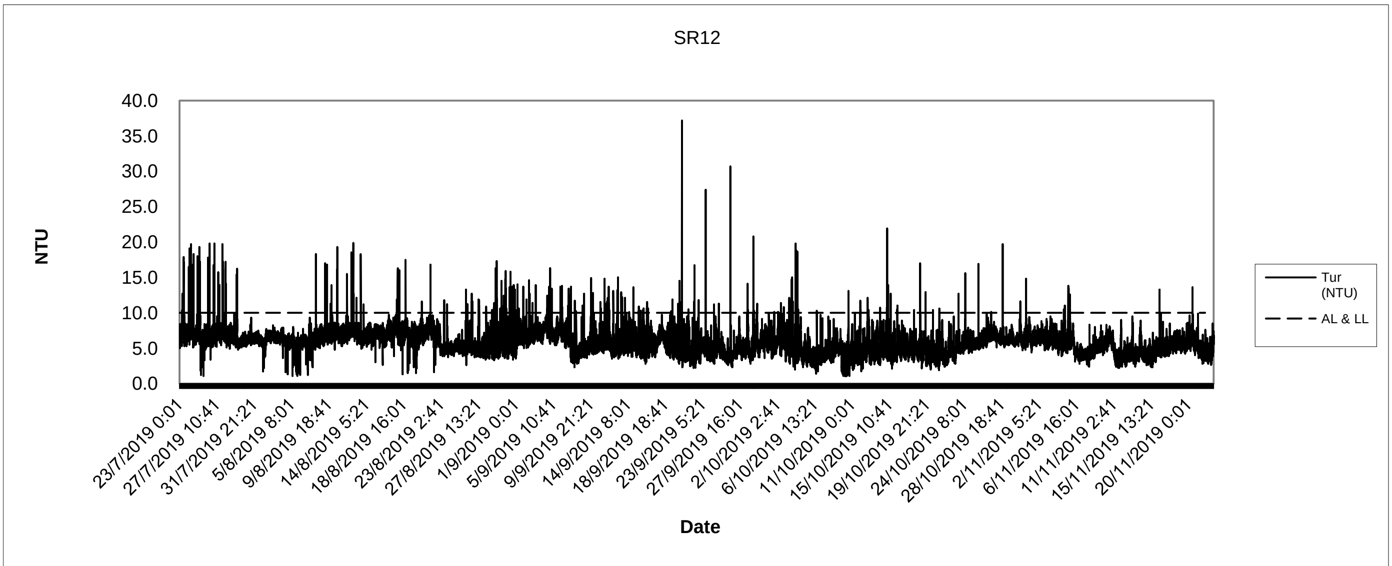
Appendix E

Graphical Presentation – 24-hr Monitoring Results

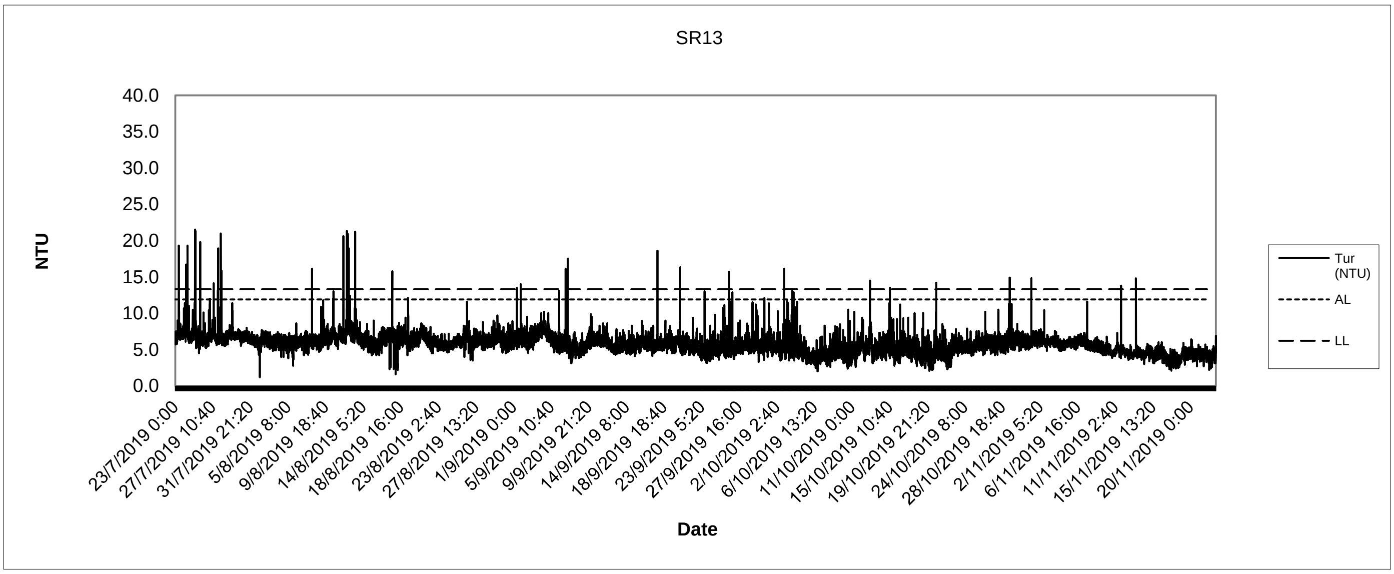
Turbidity
24-hr Water Quality Monitoring



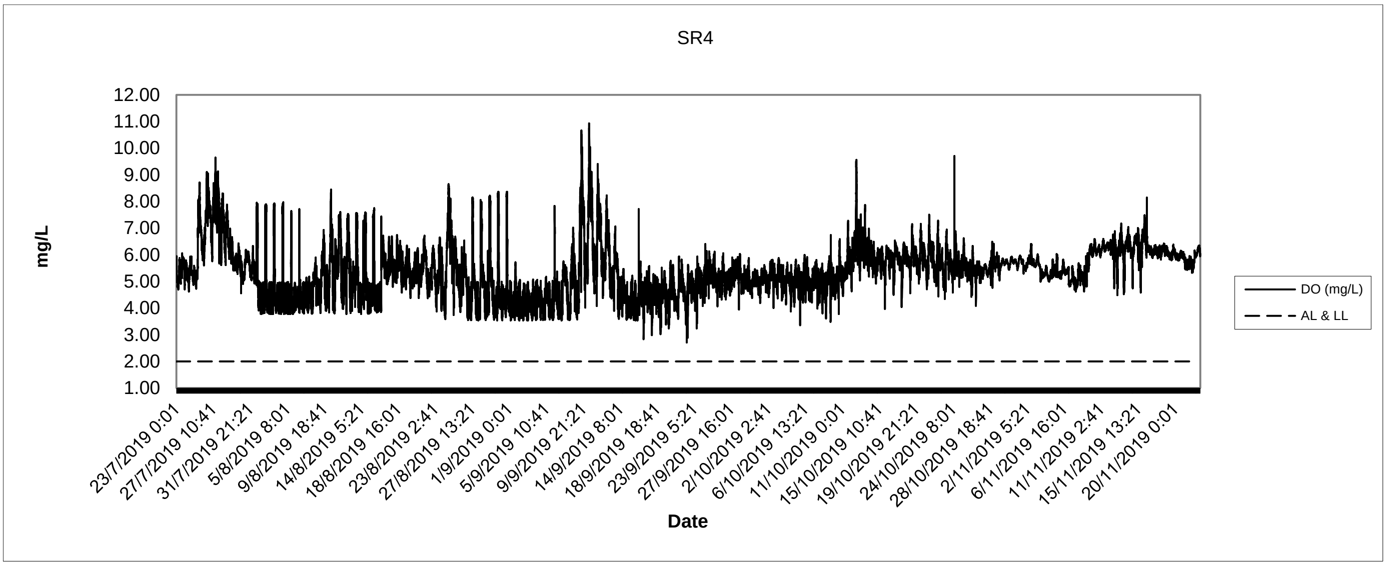


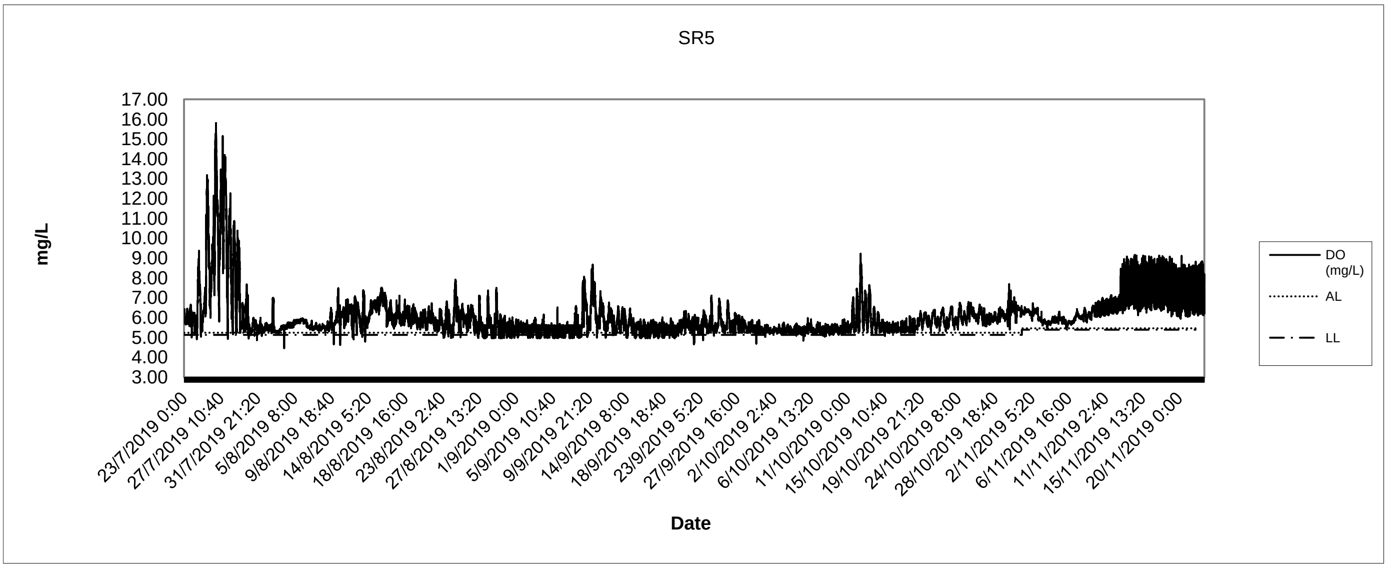


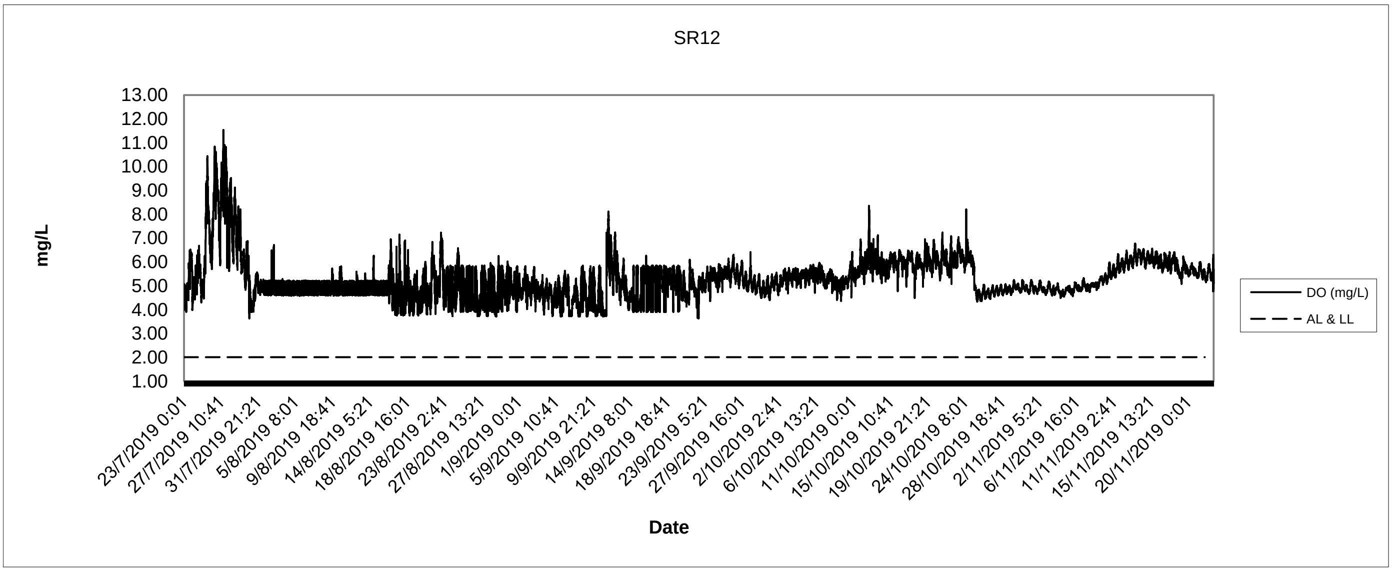
Turbidity
24-hr Water Quality Monitoring



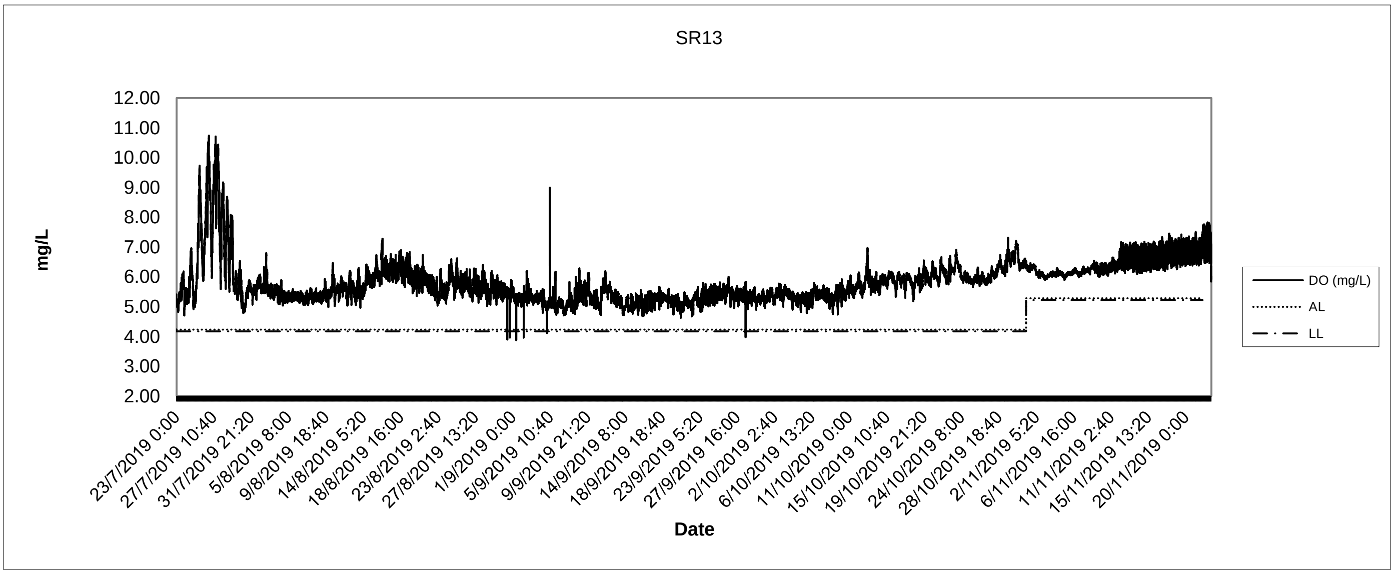
Dissolved Oxygen
24-hr Water Quality Monitoring



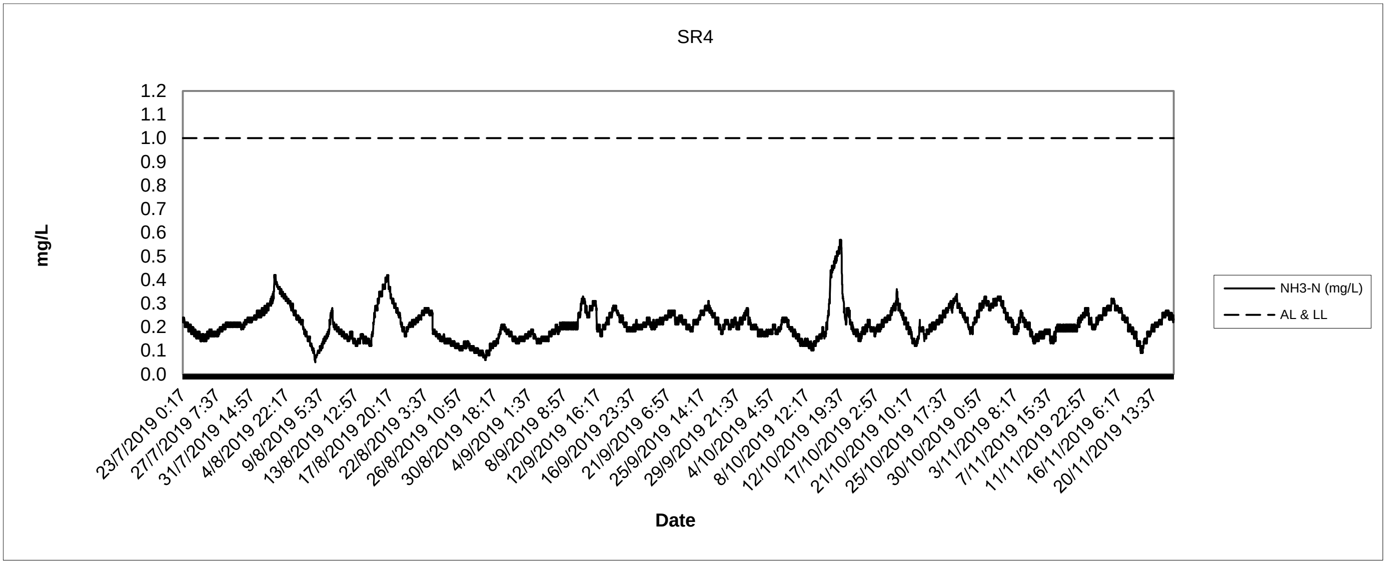


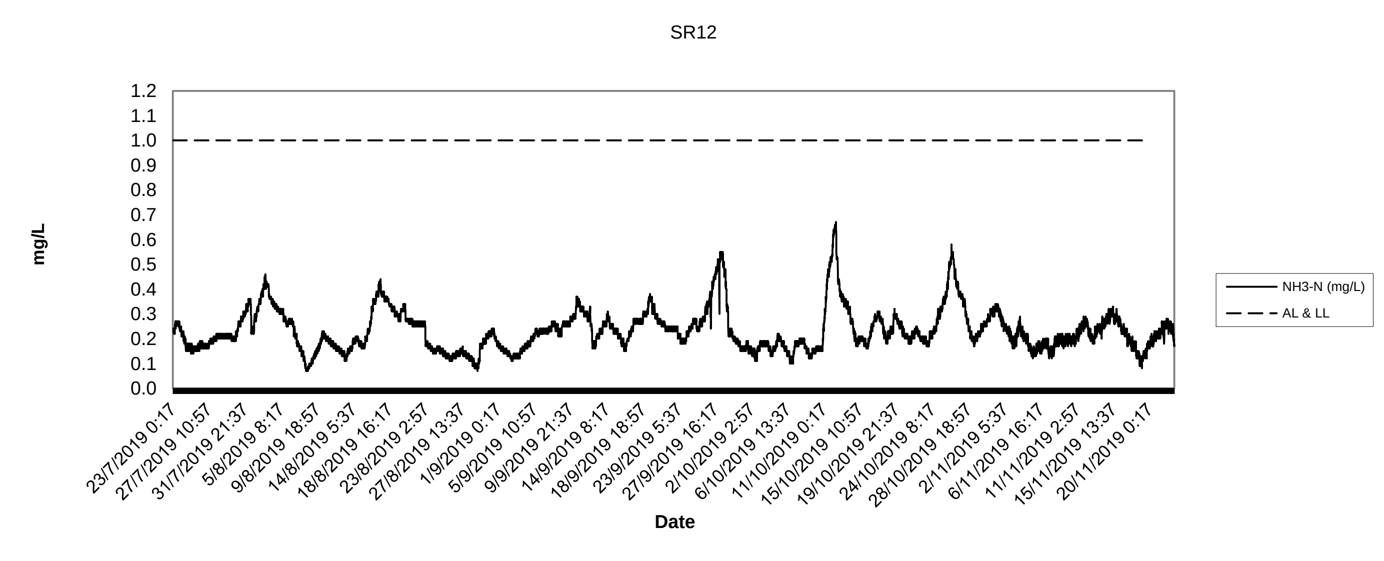


Dissolved Oxygen
24-hr Water Quality Monitoring



Ammonia-N
24-hr Water Quality Monitoring





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Report No.: 0394/13/ED/0389A

Appendix F

Environmental Mitigation Implementation Schedule

EIA Ref	EM&A Ref	No.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concerns to Address	Who to implement the measure	Location of the measure	When to implement the measure?	Implementation Status
		A	Water Quality					
3.8	2.9		<u>Use of Silt Screens</u>	Minimize the effect of potential increase in SS levels at the seawater intakes	Contractor	WSD8, WSD9 and EMSD1	Construction Phase	
		A1	Silt Screens shall be installed at the flushing water intakes WSRs WSD1, WSD8~~, WSD9~~ and EMSD1 to minimise the effect of potential increase in SS levels at the seawater intakes.					Implemented
3.8	2.9		<u>Use of Silt Curtains</u>	Minimize the release of suspended soil from the dredging area	Contractor	Construction Work Sites	Construction Phase	
		A2	To minimize the potential SS impact from dredging, deployment of silt curtains around the grab dredgers is recommended; and Before commencement of dredging works, the holder of the Environmental Permit shall submit detailed proposal of the design and arrangement of the frame type silt curtain to EPD for approval.					Implemented
3.10	2.9	A3	Water Quality Monitoring Program	Perform water quality monitoring at sensitive receivers during construction phase	ET	Monitoring Locations as stated in Table 2.1 of the EM&A Manual	Construction Phase	
			Water quality monitoring shall be carried out in accordance with Section 2 of the Environmental Monitoring and Audit (EM&A) Manual. Event and Action Plan (EAP) for water quality shall be followed in case of any exceedance in action and limit level.					Implemented
3.8 (EP Ref 3)	-		Dredging Operation	Minimize potential adverse effect as a result of dredging activities	Contractor	Construction Work Sites	Construction Phase	
		A4	Only two types of dredgers are allowed for this Project: (a) grab dredger with closed grab, and (b) ~~cutter suction dredger~~ spud pole grab dredger.					Implemented
		A5	The speed of any construction vessels shall not exceed 10 knots when passing through the area of the Project.					Implemented
		A6	No more than ~~three~~ two grab dredgers with closed grab ~~(or one cutter suction dredger with two closed grab dredgers)~~ shall be operated within the Project Area at any one time for the Project.					Implemented
		A7	Only one closed grab dredger ~~or one cutter suction dredger~~ shall be operated in Zone 2B and during which no other closed grab dredger shall be allowed in other zones within the Project Area.					Implemented
		A8	No more than one grab dredger with closed ~~grab (or one cutter suction dredger)~~ shall be operated within each of the five main zones at any one time for the ~~Project in which the cutter suction dredger shall only be operated in Zones 2 and 4 with maximum dredging rate of 700 m³ in 30 minutes in any given hour (max. 8,400 m³/day, based on a 12-hour operation per day)~~.					Implemented
		A9	The maximum dredging rate for closed grab dredger at Rambler Channel – Zones 1 to 2 (subzones Z1A, Z1B, Z2A, Z2B and Z2C) shall follow the Dredging Plan for the Hotspot, as shown in EP-426/2011/A.					Implemented
		A10	The maximum dredging rate for closed grab dredger at Rambler Channel – Zones 3 to 4 (subzones Z3A to Z4B) shall not exceed 1,600 m³ per day during dry season or 3,440 m³ per day during wet season as shown in EP-426/2011/A.					NA – No work in such area
		A11	The maximum dredging rate for closed grab dredger at Rambler Channel – Zones 5 to 6 (subzones Z5A, Z5B and Z6A) shall not exceed 4,000 m³ per day during both dry and wet seasons as shown in EP-426/2011/A.					NA – No work in such area

EIA Ref	EM&A Ref	No.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concerns to Address	Who to implement the measure	Location of the measure	When to implement the measure?	Implementation Status
		A12	The maximum dredging rate for closed grab dredger at Rambler Channel – Zones 5 to 8 (subzones Z5C, Z6B, Z6C, Z6D, Z7 and Z8) shall not exceed 4,000 m^3 per day during both dry and wet seasons as shown in EP-426/2011/A.					NA – No work in such area
		A13	The maximum dredging rate for closed grab dredger at Northern Fairway – Zones 9 to 12 shall not exceed 4,000 m^3 per day during both dry and wet seasons as shown in EP-426/2011/A.					NA – No work in such area
		A14	The maximum dredging rate for closed grab dredger at Western Fairway – Zone 13A shall not exceed 4,000 m^3 per day during both dry and wet seasons as shown in EP-426/2011/A.					NA – No work in such area
		A15	The maximum dredging rate for closed grab dredger at Western Fairway – Zone 13B shall not exceed 4,000 m^3 per day during both dry and wet seasons as shown in EP-426/2011/A.					NA – No dredging was carried out
		A16	~~The dredging pump of cutter suction dredger shall be operated during cutting to reduce the sediment loss to water body.~~					NA-no CSD employed
		A17	Project dredging works within Zone 1 to 6 (including sub-zones) of the Container Basin shall not be carried out at the same time with Terminal Operator's maintenance dredging activities.					NA-No Terminal Operator's maintenance dredging carried out
		A18	~~Cutter suction dredger is only to be deployed for the removal of harder material during daytime only (07:00 to 19:00) in Zone 2 (including subzones) of the Container Basin.~~					NA-no CSD employed
		A19	In case of rainstorm warning in effect during dredging works, the dredged material on barge shall be covered properly before transportation to disposal site.					Implemented
		A20	In case of exceedance of SS and NH3-N at the Tsing Yi WSD flushing intake due to dredging operation is evidenced, the Contractor shall propose mitigation measures not limited to reducing dredging rate. If exceedance persists, the Contractor shall propose not to undertake dredging operation in close proximity to the Tsing Yi flushing water intake during flood tide. The Contractor shall liaise with the ETL, IEC, ER, EPD and WSD for the proposed mitigation measures.					NA-no exceedance due to dredging operation
		A21	If further mitigation measures are required due to continuous exceedance of SS and NH_3-N, consideration shall then be given to dredge only on the state of the tide which would avoid migration of SS towards the WSD and EMSD intakes.					NA-no exceedance due to dredging operation
		A22	Dredging sub-zone Z2B where high NH_3-N in sediment is found shall be isolated with dredging works to be carried out towards the end of construction programme.					Implemented
		A23	Administrative control in terms of dredging rate adjustment in controlling the release of contaminants shall be employed as mitigation measures.					Implemented
		A24	Field trials shall be carried out to propose the most effective dredging process and rate to control the release of ammoniacal nitrogen and UIA into the water column and achieve compliance at the WSD1 seawater intake (NH_3-N) and at the beaches for UIA.					Implemented

EIA Ref	EM&A Ref	No.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concerns to Address	Who to implement the measure	Location of the measure	When to implement the measure?	Implementation Status
			Capital dredging works in dredging sub-zone Z2B (Figure 1.2h refers) should not therefore be carried out until the proposed method and rate are confirmed.					
		A25	Detailed dredging plan shall be prepared providing details of individual dredging subzones and dredging rate taking into account of the field trial results.					Implemented
3.8	-		Other Good Site Practices for Dredging	Minimize potential adverse effect as a result of dredging activities	Contractor	Construction Work Sites	Construction Phase	
		A26	All vessels should be sized so that adequate clearance is maintained between vessels and the seabed in all tide conditions, to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash.					Implemented
		A27	The speed of all Contractor's vessels should be controlled within the works area to prevent propeller wash from stirring up the seabed sediments.					Implemented
		A28	All barges / dredgers used should be fitted with tight fitting seals to their bottom openings to prevent leakage of material.					Implemented
		A29	Construction activities should not cause foam, oil, grease, scum, litter or other objectionable matter to be present on the water within the site or dumping grounds.					Implemented
		A30	No overflow of dredged mud should be allowed. Barges or hopper should not be filled to a level that will cause the overflow of materials or polluted water during loading or transportation.					Implemented
		B	**Waste Management**					
			<u>Good Site Practices</u>	Minimize potential adverse effect arising from the handling of dredged material	Contractor	Construction Work Sites (General)	Construction Phase	
4.5	3.3	B1	Obtain the profile of different sediment categories and careful planning of sediment removal.					Implemented
		B2	Nomination of an approved person, such as a site manager, to be responsible for good site practices, arrangements for collection and effective disposal to an appropriate facility, of all wastes generated at the site.					Implemented
		B3	Training of site personnel in proper waste management and chemical handling procedures.					Implemented
		B4	Provision of sufficient waste disposal points and regular collection of waste.					Implemented
		B5	Well planned delivery programme for offsite disposal such that adverse environmental impact from transporting sediment material is not anticipated.					Implemented
		B6	Use well maintained PME on site.					Implemented
			<u>General Refuse</u>	Minimize the adverse effect arising from the handling of site general refuse	Contractor	Construction Work Sites (General)	Construction Phase	
4.5	3.3	B7	General refuse should be stored in enclosed bins. A reputable waste collector should be employed by the contractor to remove general refuse from the site.					Implemented
			<u>Chemical Waste</u>	Minimize the adverse effect arising from the handling of site chemical waste	Contractor	Construction Work Site	Construction Phase	
4.5	3.3	B8	If chemical wastes are produced at the construction site, the Contractor shall be required to register with the EPD as a chemical waste producer and to follow the guidelines stated in the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes. Good quality containers compatible with the chemical wastes shall be used, and incompatible chemicals should be stored separately. Appropriate labels shall be securely attached on each chemical waste container indicating the corresponding					Partially Implemented

EIA Ref	EM& A Ref	No.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concerns to Address	Who to implement the measure	Location of the measure	When to implement the measure?	Implementation Status
			chemical characteristics of the chemical waste, such as explosive, flammable, oxidizing, irritant, toxic, harmful, corrosive, etc. The Contractor shall use a licensed collector to transport and dispose of the chemical wastes, to either the approved Chemical Waste Treatment Centre, or another licensed facility, in accordance with the Waste Disposal (Chemical Waste) (General) Regulation.					
4.5	3.3		Marine Dredged Sediment	Control of transportation and disposal of dredged material in a manner to minimize potential impacts on water quality	Contractor	Construction Work Site	Construction Phase	
		B9	Control of transportation and disposal of dredged material in a manner to minimize potential impacts on water quality.					Implemented
		B10	Bottom opening of barges will be fitted with tight fitting seals to prevent leakage of material. Excess material shall be cleaned from the decks and exposed fittings of barges and dredgers before the vessel is moved.					Implemented
		B11	Monitoring of the barge loading shall be conducted to ensure that loss of material does not take place during transportation. Transport barges or vessels shall be equipped with automatic self-monitoring devices as specified by the EPD.					Implemented
		B12	Barges or hopper barges shall not be filled to a level that would cause the overflow of materials or sediment laden water during loading or transportation.					Implemented
		B13	Sediment Quality Report shall be prepared and submit to EPD under DASO.					Implemented
		B14	If disposal of Type 3 sediment is identified, agreement with EPD shall be reached regarding the treatment of sediment before disposal.					NA – no type 3 material disposed
		B15	Project works shall not be carried out before obtaining confirmation from MFC on disposal option.					Implemented
		B16	Follow strictly all conditions stipulated in the dumping permit.					Implemented
		C	**Marine Ecology**	Review and assess the potential adverse effect on marine ecology	Contractor	Construction Work Sites	Construction Phase	
5.7	4.1	C1	Water quality monitoring results shall be reviewed from time to time to assess if there were any impact to marine ecology due to dredging operation.					Implemented
		D	**Fisheries**	Review and assess the potential adverse effect on fisheries	Contractor	Construction Work Sites	Construction Phase	
6.7	5.1	D1	Water quality monitoring results shall be reviewed from time to time to assess if there were any impact to fisheries due to dredging operation.					Implemented
		E	**Hazard to Life**		Contractor	Construction Work Sites (General)	Construction Phase	
7.8.2	6.2	E1	Sound communication channel shall be established with the oil companies, Marine Department, and Fire Services Department for effective notification and emergency evacuation in case of accidents.					Implemented
		E2	Proper safety and emergency training shall be given to the relevant operation staff at the dredging site. Emergency plans and procedures should be prepared and drills should be performed periodically.					Implemented
		F	**Landscape Visual and Glare**	Minimize landscape and visual impacts during construction phase	Contractor	Construction activities' area	Throughout design, construction phase	
8.9 Table 8-3 & 8-6	7.2	F1	Visa shields to the lights of dredgers shall be provided.					Implemented
		F2	The light source shall not point directly to any VSRs.					Implemented
		F3	Lights shall be switched off if they are not in use.					Implemented
		G	**Cultural Heritage**		Contractor		During	

EIA Ref	EM&A Ref	No.	Recommended Mitigation Measures	Objectives of the Recommended Measures & Main Concerns to Address	Who to implement the measure	Location of the measure	When to implement the measure?	Implementation Status
9.5	8		Monitoring Brief	Minimize potential marine archaeological impact during dredging activities		Locations of the 20 unidentified sonar contacts and masked areas	Construction works	
		G1	A monitoring brief shall be conducted during the dredging. It shall only be required during dredging at the locations of the 20 unidentified sonar contacts and masked areas and does not need to cover all of the dredging activities. Dredging staff should be briefed about the possibility of locating archaeological objects and a marine archaeologist shall be available to monitor the dredged spoil and provide advice. If material indicative of archaeological remains is retrieved, the AMO should be contacted as soon as possible.					NA- no archaeological deposit was found during reporting period.
		H	**Noise**					
10.8	9		Good Site Practices	Control and minimize the generation of undue noise nuisance	Contractor	Construction Work Sites (Along the alignment of dredging	Construction Phase	
		H1	Only well-maintained plant shall be operated on-site and plant should be serviced regularly during the construction program.					Implemented
		H2	Machines and plant that may be in intermittent use should be shut down between works periods or should be throttled down to a minimum.					Implemented
		H3	Plant known to emit noise strongly in one direction should, wherever possible, be orientated so that the noise is directed away from nearby NSRs.					Implemented
		H4	If dredging is to be carried out during restricted hours, work locations close to NSRs shall be avoided.					Implemented
		I	**Construction Dust**					
11.7	10		Dust Control	Good site practice to control dust and odour impact to the nearby sensitive receivers	Contractor	Construction Work Sites (General)	Construction Phase	
		I1	Requirements of the Air Pollution Control (Construction Dust) Regulation, where relevant, shall be adhered to during the construction period.					Implemented
			Odour		Contractor	Construction Work Sites (General)	Construction Phase	
		I2	To minimize potential odour emissions, if dredged sediment is anticipated to be placed on barge for more than a day the load shall be properly covered as far as practicable to minimise the exposed area and potential odour.					NA-no work in such condition
		I3	If dredged sediment is found to be malodorous it shall be removed from site as soon as possible within one hour after the barge being filled up.					NA-no work in such condition

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Report No.: 0394/13/ED/0389A

Appendix G

Waste Generation in Reporting Period

Name of Department : Civil Engineering and Development Department
Contract No. : CV/2013/04

Monthly Summary Waste Flow Table for _2019__ (year)

Year	Actual Quantities of Inert C&D Materials Generated Monthly					Actual Quantities of C&D Wastes Generated Monthly				
2019	Total Quantity Generated	Broken Concrete (see Note 3)	Reused in the Contract	Reused in other Projects	Disposed as Public Fill	Metals	Paper/cardboard packaging	Plastics (see Note 2)	Chemical Waste	Others, e.g. general refuse
	(in '000 m^3)	(in '000 m^3)	(in '000 m^3)	(in '000 m^3)	(in '000 m^3)	(in '000 kg)	(in '000 kg)	(in '000 kg)	(in '000 kg)	(in '000 m^3)
Jan	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
Feb	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
Mar	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
Apr	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
May	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
Jun	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
Jul	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
Aug	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
Sep	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
Oct	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
Nov	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
Dec										
Total	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil

Notes:

(1) The waste flow table shall also include C&D materials that are specified in the Contract to be imported for use at the Site.

(2) Plastics refer to plastic bottles/containers, plastic sheets/foam from packaging material.

(3) Broken concrete for recycling into aggregates

Yearly Summary Waste Flow Table

Year	Estimated Annual Quantities of Inert C&D Materials (in '000m^3)										Estimated Annual of C&D Wastes									
	Total Quantity Generated		Broken Concrete (see Note 3)		Reused in the Contract		Reused in other Projects		Disposed as Public Fill		Metals		Paper/cardboard packaging		Plastics (see Note 2)		Chemical Waste		Others, e.g. general refuse	
	(a)		(b)		(c)		(d)		(a-b-c-d)		(in '000 kg)		(in '000 kg)		(in '000 kg)		(in '000 kg)		(in '000 m^3)	
	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.
2013	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	0.003	0.01
2014	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	0.2	0.16
2015	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	13	14.4	0.2	0.12
2016	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	17	Nil	0.2	0.12
2017	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	10	Nil	0.15	0.12
2018	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2020																				
2021																				
Grand Total	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	40	14.4	0.753	0.53

Notes:

(1) The waste flow table shall also include C&D materials that are specified in the Contract to be imported for use at the Site.

(2) Plastics refer to plastic bottles/containers, plastic sheets/foam from packaging material

(3) Broken concrete for recycling into aggregates.

Monthly Summary of Sediment Disposal (2019)

Marine Sediment Type	Type 1 – Open Sea Disposal	Type 2 – Confined Marine Disposal	Type 3 – Special Treatment / Disposal
Month	Quantity (m^3)	Quantity (m^3)	Quantity (m^3)
2014			
Jan-Dec	549,430	99,660	nil
2015			
Jan-Dec	938,560	372,370	nil
2016			
Jan-Dec	195,860	153,250	1,260
2017			
Jan-Dec	1,850	28,550	nil
2018			
Jan-Dec	nil	nil	nil
2019			
January	nil	nil	nil
February	nil	nil	nil
March	nil	600	nil
April	nil	nil	nil
May	nil	nil	nil
June	nil	nil	nil
July	nil	nil	nil
August	nil	nil	nil
September	nil	nil	nil
October	nil	900	nil
November	nil	1350	nil
Total	1,685,700	656,680	1,260

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Appendix H

Quarterly Assessment of Construction Impact

Cluster 1 UIA (in-situ)
1.3 x Baseline vs Impact

1.3 x Baseline UIA (in-situ) (mg/L)			
SR4	4/1/2014	Mid-Flood	0.003
SR4	7/1/2014	Mid-Flood	0.004
SR4	9/1/2014	Mid-Flood	0.006
SR4	11/1/2014	Mid-Flood	0.004
SR4	14/1/2014	Mid-Flood	0.005
SR4	16/1/2014	Mid-Flood	0.005
SR4	18/1/2014	Mid-Flood	0.002
SR4	21/1/2014	Mid-Flood	0.005
SR4	23/1/2014	Mid-Flood	0.010
SR4	25/1/2014	Mid-Flood	0.018
SR4	27/1/2014	Mid-Flood	0.012
SR4	29/1/2014	Mid-Flood	0.025
SR12	4/1/2014	Mid-Flood	0.003
SR12	7/1/2014	Mid-Flood	0.004
SR12	9/1/2014	Mid-Flood	0.006
SR12	11/1/2014	Mid-Flood	0.003
SR12	14/1/2014	Mid-Flood	0.004
SR12	16/1/2014	Mid-Flood	0.006
SR12	18/1/2014	Mid-Flood	0.003
SR12	21/1/2014	Mid-Flood	0.017
SR12	23/1/2014	Mid-Flood	0.010
SR12	25/1/2014	Mid-Flood	0.012
SR12	27/1/2014	Mid-Flood	0.016
SR12	29/1/2014	Mid-Flood	0.027

Impact UIA (in-situ) (mg/L)							
SR4	24/8/2019	Mid-Flood	0.018	SR12	24/8/2019	Mid-Flood	0.016
SR4	27/8/2019	Mid-Flood	0.011	SR12	27/8/2019	Mid-Flood	0.012
SR4	29/8/2019	Mid-Flood	0.010	SR12	29/8/2019	Mid-Flood	0.011
SR4	31/8/2019	Mid-Flood	0.019	SR12	31/8/2019	Mid-Flood	0.017
SR4	3/9/2019	Mid-Flood	0.013	SR12	3/9/2019	Mid-Flood	0.011
SR4	5/9/2019	Mid-Flood	0.012	SR12	5/9/2019	Mid-Flood	0.019
SR4	7/9/2019	Mid-Flood	0.020	SR12	7/9/2019	Mid-Flood	0.025
SR4	10/9/2019	Mid-Flood	0.056	SR12	10/9/2019	Mid-Flood	0.071
SR4	12/9/2019	Mid-Flood	0.029	SR12	12/9/2019	Mid-Flood	0.028
SR4	14/9/2019	Mid-Flood	0.035	SR12	14/9/2019	Mid-Flood	0.041
SR4	17/9/2019	Mid-Flood	0.027	SR12	17/9/2019	Mid-Flood	0.029
SR4	19/9/2019	Mid-Flood	0.025	SR12	19/9/2019	Mid-Flood	0.044
SR4	21/9/2019	Mid-Flood	0.032	SR12	21/9/2019	Mid-Flood	0.031
SR4	24/9/2019	Mid-Flood	0.035	SR12	24/9/2019	Mid-Flood	0.032
SR4	26/9/2019	Mid-Flood	0.040	SR12	26/9/2019	Mid-Flood	0.040
SR4	28/9/2019	Mid-Flood	0.032	SR12	28/9/2019	Mid-Flood	0.111
SR4	1/10/2019	Mid-Flood	0.036	SR12	1/10/2019	Mid-Flood	0.030
SR4	3/10/2019	Mid-Flood	0.021	SR12	3/10/2019	Mid-Flood	0.014
SR4	5/10/2019	Mid-Flood	0.014	SR12	5/10/2019	Mid-Flood	0.012
SR4	8/10/2019	Mid-Flood	0.008	SR12	8/10/2019	Mid-Flood	0.013
SR4	10/10/2019	Mid-Flood	0.009	SR12	10/10/2019	Mid-Flood	0.010
SR4	12/10/2019	Mid-Flood	0.050	SR12	12/10/2019	Mid-Flood	0.054
SR4	15/10/2019	Mid-Flood	0.014	SR12	15/10/2019	Mid-Flood	0.016
SR4	17/10/2019	Mid-Flood	0.012	SR12	17/10/2019	Mid-Flood	0.018
SR4	19/10/2019	Mid-Flood	0.012	SR12	19/10/2019	Mid-Flood	0.013
SR4	22/10/2019	Mid-Flood	0.010	SR12	22/10/2019	Mid-Flood	0.013
SR4	24/10/2019	Mid-Flood	0.011	SR12	24/10/2019	Mid-Flood	0.012
SR4	26/10/2019	Mid-Flood	0.018	SR12	26/10/2019	Mid-Flood	0.069
SR4	29/10/2019	Mid-Flood	0.012	SR12	29/10/2019	Mid-Flood	0.009
SR4	31/10/2019	Mid-Flood	0.014	SR12	31/10/2019	Mid-Flood	0.014
SR4	2/11/2019	Mid-Flood	0.007	SR12	2/11/2019	Mid-Flood	0.007
SR4	5/11/2019	Mid-Flood	0.013	SR12	5/11/2019	Mid-Flood	0.012
SR4	7/11/2019	Mid-Flood	0.017	SR12	7/11/2019	Mid-Flood	0.014
SR4	9/11/2019	Mid-Flood	0.037	SR12	9/11/2019	Mid-Flood	0.042
SR4	12/11/2019	Mid-Flood	0.013	SR12	12/11/2019	Mid-Flood	0.011
SR4	14/11/2019	Mid-Flood	0.018	SR12	14/11/2019	Mid-Flood	0.012
SR4	16/11/2019	Mid-Flood	0.019	SR12	16/11/2019	Mid-Flood	0.019
SR4	19/11/2019	Mid-Flood	0.023	SR12	19/11/2019	Mid-Flood	0.020
SR4	21/11/2019	Mid-Flood	0.031	SR12	21/11/2019	Mid-Flood	0.028

Cluster 1 UIA (in-situ)
1.3 x Baseline vs Impact

1.3 x Baseline UIA (in-situ)		Impact UIA (in-situ)	
Raw Statistics		Raw Statistics	
Number of Valid Observations	24	Number of Valid Observations	78
Number of Distinct Observations	24	Number of Distinct Observations	78
Minimum	0.00473	Minimum	0.00653
Maximum	0.0443	Maximum	0.111
Mean of Raw Data	0.0174	Mean of Raw Data	0.0235
Standard Deviation of Raw Data	0.0129	Standard Deviation of Raw Data	0.0172
Kstar	1.838	Kstar	2.678
Mean of Log Transformed Data	-4.309	Mean of Log Transformed Data	-3.942
Standard Deviation of Log Transformed Data	0.736	Standard Deviation of Log Transformed Data	0.592
Normal Distribution Test Results		Normal Distribution Test Results	
Correlation Coefficient R	0.918	Correlation Coefficient R	0.868
Shapiro Wilk Test Statistic	0.829	Approximate Shapiro Wilk Test Statistic	0.772
Shapiro Wilk Critical (0.95) Value	0.916	Approximate Shapiro Wilk P Value	0
Approximate Shapiro Wilk P Value	6.26E-04	Lilliefors Test Statistic	0.192
Lilliefors Test Statistic	0.263	Lilliefors Critical (0.95) Value	0.1
Lilliefors Critical (0.95) Value	0.177	Data not Normal at (0.05) Significance Level	
Data not Normal at (0.05) Significance Level			

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Impact UIA (in-situ)
Background Data: Baseline UIA (in-situ) x 1.3

Raw Statistics

	Site	Background
Number of Valid Observations	78	24
Number of Distinct Observations	78	24
Minimum	0.00653	0.00473
Maximum	0.111	0.0443
Mean	0.0235	0.0174
Median	0.0176	0.00987
SD	0.0172	0.0129
SE of Mean	1.95E-03	2.63E-03

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	4330
WMW Test U-Stat	2.465
WMW Critical Value (0.050)	1.645
P-Value	6.85E-03

Conclusion with Alpha = 0.05
Reject H0, Conclude Site > Background
P-Value < alpha (0.05)

Cluster 1 UIA (in-situ)
1.3 x Baseline vs Impact

Upstream Control UIA (in-situ) (mg/L)					Impact UIA (in-situ) (mg/L)							
C2A	23/5/2019	Mid-Flood	0.021		SR4	24/8/2019	Mid-Flood	0.018	SR12	24/8/2019	Mid-Flood	0.016
C2A	25/5/2019	Mid-Flood	0.082		SR4	27/8/2019	Mid-Flood	0.011	SR12	27/8/2019	Mid-Flood	0.012
C2A	28/5/2019	Mid-Flood	0.012		SR4	29/8/2019	Mid-Flood	0.010	SR12	29/8/2019	Mid-Flood	0.011
C2A	30/5/2019	Mid-Flood	0.016		SR4	31/8/2019	Mid-Flood	0.019	SR12	31/8/2019	Mid-Flood	0.017
C2A	1/6/2019	Mid-Flood	0.025		SR4	3/9/2019	Mid-Flood	0.013	SR12	3/9/2019	Mid-Flood	0.011
C2A	4/6/2019	Mid-Flood	0.023		SR4	5/9/2019	Mid-Flood	0.012	SR12	5/9/2019	Mid-Flood	0.019
C2A	6/6/2019	Mid-Flood	0.037		SR4	7/9/2019	Mid-Flood	0.020	SR12	7/9/2019	Mid-Flood	0.025
C2A	8/6/2019	Mid-Flood	0.008		SR4	10/9/2019	Mid-Flood	0.056	SR12	10/9/2019	Mid-Flood	0.071
C2A	11/6/2019	Mid-Flood	0.017		SR4	12/9/2019	Mid-Flood	0.029	SR12	12/9/2019	Mid-Flood	0.028
C2A	13/6/2019	Mid-Flood	0.027		SR4	14/9/2019	Mid-Flood	0.035	SR12	14/9/2019	Mid-Flood	0.041
C2A	15/6/2019	Mid-Flood	0.020		SR4	17/9/2019	Mid-Flood	0.027	SR12	17/9/2019	Mid-Flood	0.029
C2A	18/6/2019	Mid-Flood	0.017		SR4	19/9/2019	Mid-Flood	0.025	SR12	19/9/2019	Mid-Flood	0.044
C2A	20/6/2019	Mid-Flood	0.026		SR4	21/9/2019	Mid-Flood	0.032	SR12	21/9/2019	Mid-Flood	0.031
C2A	22/6/2019	Mid-Flood	0.063		SR4	24/9/2019	Mid-Flood	0.035	SR12	24/9/2019	Mid-Flood	0.032
C2A	25/6/2019	Mid-Flood	0.014		SR4	26/9/2019	Mid-Flood	0.040	SR12	26/9/2019	Mid-Flood	0.040
C2A	27/6/2019	Mid-Flood	0.012		SR4	28/9/2019	Mid-Flood	0.032	SR12	28/9/2019	Mid-Flood	0.111
C2A	29/6/2019	Mid-Flood	0.009		SR4	1/10/2019	Mid-Flood	0.036	SR12	1/10/2019	Mid-Flood	0.030
C2A	2/7/2019	Mid-Flood	0.017		SR4	3/10/2019	Mid-Flood	0.021	SR12	3/10/2019	Mid-Flood	0.014
C2A	4/7/2019	Mid-Flood	0.018		SR4	5/10/2019	Mid-Flood	0.014	SR12	5/10/2019	Mid-Flood	0.012
C2A	6/7/2019	Mid-Flood	0.014		SR4	8/10/2019	Mid-Flood	0.008	SR12	8/10/2019	Mid-Flood	0.013
C2A	9/7/2019	Mid-Flood	0.014		SR4	10/10/2019	Mid-Flood	0.009	SR12	10/10/2019	Mid-Flood	0.010
C2A	11/7/2019	Mid-Flood	0.014		SR4	12/10/2019	Mid-Flood	0.050	SR12	12/10/2019	Mid-Flood	0.054
C2A	13/7/2019	Mid-Flood	0.015		SR4	15/10/2019	Mid-Flood	0.014	SR12	15/10/2019	Mid-Flood	0.016
C2A	16/7/2019	Mid-Flood	0.015		SR4	17/10/2019	Mid-Flood	0.012	SR12	17/10/2019	Mid-Flood	0.018
C2A	18/7/2019	Mid-Flood	0.027		SR4	19/10/2019	Mid-Flood	0.012	SR12	19/10/2019	Mid-Flood	0.013
C2A	20/7/2019	Mid-Flood	0.062		SR4	22/10/2019	Mid-Flood	0.010	SR12	22/10/2019	Mid-Flood	0.013
C2A	23/7/2019	Mid-Flood	0.035		SR4	24/10/2019	Mid-Flood	0.011	SR12	24/10/2019	Mid-Flood	0.012
C2A	25/7/2019	Mid-Flood	0.016		SR4	26/10/2019	Mid-Flood	0.018	SR12	26/10/2019	Mid-Flood	0.069
C2A	27/7/2019	Mid-Flood	0.023		SR4	29/10/2019	Mid-Flood	0.012	SR12	29/10/2019	Mid-Flood	0.009
C2A	30/7/2019	Mid-Flood	0.015		SR4	31/10/2019	Mid-Flood	0.014	SR12	31/10/2019	Mid-Flood	0.014
C2A	3/8/2019	Mid-Flood	0.029		SR4	2/11/2019	Mid-Flood	0.007	SR12	2/11/2019	Mid-Flood	0.007
C2A	6/8/2019	Mid-Flood	0.034		SR4	5/11/2019	Mid-Flood	0.013	SR12	5/11/2019	Mid-Flood	0.012
C2A	8/8/2019	Mid-Flood	0.019		SR4	7/11/2019	Mid-Flood	0.017	SR12	7/11/2019	Mid-Flood	0.014
C2A	10/8/2019	Mid-Flood	0.039		SR4	9/11/2019	Mid-Flood	0.037	SR12	9/11/2019	Mid-Flood	0.042
C2A	13/8/2019	Mid-Flood	0.022		SR4	12/11/2019	Mid-Flood	0.013	SR12	12/11/2019	Mid-Flood	0.011
C2A	15/8/2019	Mid-Flood	0.017		SR4	14/11/2019	Mid-Flood	0.018	SR12	14/11/2019	Mid-Flood	0.012
C2A	17/8/2019	Mid-Flood	0.038		SR4	16/11/2019	Mid-Flood	0.019	SR12	16/11/2019	Mid-Flood	0.019
C2A	20/8/2019	Mid-Flood	0.028		SR4	19/11/2019	Mid-Flood	0.023	SR12	19/11/2019	Mid-Flood	0.020
C2A	22/8/2019	Mid-Flood	0.063		SR4	21/11/2019	Mid-Flood	0.031	SR12	21/11/2019	Mid-Flood	0.028

Cluster 1 UIA (in-situ)
1.3 x Baseline vs Impact

Upstream Control UIA (in-situ)		Impact UIA (in-situ)	
Raw Statistics		Raw Statistics	
Number of Valid Observations	39	Number of Valid Observations	78
Number of Distinct Observations	26	Number of Distinct Observations	78
Minimum	0.008	Minimum	0.00653
Maximum	0.082	Maximum	0.111
Mean of Raw Data	0.0257	Mean of Raw Data	0.0235
Standard Deviation of Raw Data	0.0166	Standard Deviation of Raw Data	0.0172
Kstar	3.154	Kstar	2.678
Mean of Log Transformed Data	-3.815	Mean of Log Transformed Data	-3.942
Standard Deviation of Log Transformed Data	0.537	Standard Deviation of Log Transformed Data	0.592
Normal Distribution Test Results		Normal Distribution Test Results	
Correlation Coefficient R	0.883	Correlation Coefficient R	0.868
Shapiro Wilk Test Statistic	0.785	Approximate Shapiro Wilk Test Statistic	0.772
Shapiro Wilk Critical (0.95) Value	0.939	Approximate Shapiro Wilk P Value	0
Approximate Shapiro Wilk P Value	4.07E-07	Lilliefors Test Statistic	0.192
Lilliefors Test Statistic	0.191	Lilliefors Critical (0.95) Value	0.1
Lilliefors Critical (0.95) Value	0.14	Data not Normal at (0.05) Significance Level	
Data not Normal at (0.05) Significance Level			

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Site Mean/Median <= Background Mean/Median (Form 1)
Alternative Hypothesis	Site Mean/Median > Background Mean/Median

Area of Concern Data: Impact UIA (in-situ)
Background Data: Upstream Control UIA (in-situ)

Raw Statistics

	Site	Background
Number of Valid Observations	78	39
Number of Distinct Observations	78	26
Minimum	0.00653	0.008
Maximum	0.111	0.082
Mean	0.0235	0.0257
Median	0.0176	0.02
SD	0.0172	0.0166
SE of Mean	1.95E-03	0.00265

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background

Site Rank Sum W-Stat	4362
WMW Test U-Stat	-1.391
WMW Critical Value (0.050)	1.645
P-Value	9.18E-01

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Site <= Background
P-Value < alpha (0.05)

ProUCL Version 4.0 (Version 4.00.04)

Cluster 1 NH3-N (lab)
Upstream Control vs Impact

1.3 x Baseline NH3-N (lab) (mg/L)			
SR4	4/1/2014	Mid-Flood	0.10
SR4	7/1/2014	Mid-Flood	0.11
SR4	9/1/2014	Mid-Flood	0.21
SR4	11/1/2014	Mid-Flood	0.19
SR4	14/1/2014	Mid-Flood	0.14
SR4	16/1/2014	Mid-Flood	0.12
SR4	18/1/2014	Mid-Flood	0.04
SR4	21/1/2014	Mid-Flood	0.06
SR4	23/1/2014	Mid-Flood	0.20
SR4	25/1/2014	Mid-Flood	0.16
SR4	27/1/2014	Mid-Flood	0.10
SR4	29/1/2014	Mid-Flood	0.15
SR12	4/1/2014	Mid-Flood	0.10
SR12	7/1/2014	Mid-Flood	0.12
SR12	9/1/2014	Mid-Flood	0.20
SR12	11/1/2014	Mid-Flood	0.12
SR12	14/1/2014	Mid-Flood	0.13
SR12	16/1/2014	Mid-Flood	0.13
SR12	18/1/2014	Mid-Flood	0.07
SR12	21/1/2014	Mid-Flood	0.21
SR12	23/1/2014	Mid-Flood	0.21
SR12	25/1/2014	Mid-Flood	0.17
SR12	27/1/2014	Mid-Flood	0.13
SR12	29/1/2014	Mid-Flood	0.18

Impact NH3-N (lab) (mg/L)							
SR4	24/8/2019	Mid-Flood	0.16	SR12	24/8/2019	Mid-Flood	0.16
SR4	27/8/2019	Mid-Flood	0.13	SR12	27/8/2019	Mid-Flood	0.14
SR4	29/8/2019	Mid-Flood	0.13	SR12	29/8/2019	Mid-Flood	0.10
SR4	31/8/2019	Mid-Flood	0.23	SR12	31/8/2019	Mid-Flood	0.20
SR4	3/9/2019	Mid-Flood	0.16	SR12	3/9/2019	Mid-Flood	0.13
SR4	5/9/2019	Mid-Flood	0.16	SR12	5/9/2019	Mid-Flood	0.23
SR4	7/9/2019	Mid-Flood	0.20	SR12	7/9/2019	Mid-Flood	0.24
SR4	10/9/2019	Mid-Flood	0.33	SR12	10/9/2019	Mid-Flood	0.30
SR4	12/9/2019	Mid-Flood	0.33	SR12	12/9/2019	Mid-Flood	0.30
SR4	14/9/2019	Mid-Flood	0.27	SR12	14/9/2019	Mid-Flood	0.32
SR4	17/9/2019	Mid-Flood	0.23	SR12	17/9/2019	Mid-Flood	0.25
SR4	19/9/2019	Mid-Flood	0.21	SR12	19/9/2019	Mid-Flood	0.37
SR4	21/9/2019	Mid-Flood	0.53	SR12	21/9/2019	Mid-Flood	0.52
SR4	24/9/2019	Mid-Flood	0.22	SR12	24/9/2019	Mid-Flood	0.20
SR4	26/9/2019	Mid-Flood	0.27	SR12	26/9/2019	Mid-Flood	0.29
SR4	28/9/2019	Mid-Flood	0.23	SR12	28/9/2019	Mid-Flood	0.81
SR4	1/10/2019	Mid-Flood	0.29	SR12	1/10/2019	Mid-Flood	0.25
SR4	3/10/2019	Mid-Flood	0.19	SR12	3/10/2019	Mid-Flood	0.19
SR4	5/10/2019	Mid-Flood	0.24	SR12	5/10/2019	Mid-Flood	0.18
SR4	8/10/2019	Mid-Flood	0.14	SR12	8/10/2019	Mid-Flood	0.19
SR4	10/10/2019	Mid-Flood	0.16	SR12	10/10/2019	Mid-Flood	0.16
SR4	12/10/2019	Mid-Flood	0.79	SR12	12/10/2019	Mid-Flood	0.84
SR4	15/10/2019	Mid-Flood	0.19	SR12	15/10/2019	Mid-Flood	0.20
SR4	17/10/2019	Mid-Flood	0.20	SR12	17/10/2019	Mid-Flood	0.30
SR4	19/10/2019	Mid-Flood	0.26	SR12	19/10/2019	Mid-Flood	0.27
SR4	22/10/2019	Mid-Flood	0.19	SR12	22/10/2019	Mid-Flood	0.24
SR4	24/10/2019	Mid-Flood	0.22	SR12	24/10/2019	Mid-Flood	0.22
SR4	26/10/2019	Mid-Flood	0.30	SR12	26/10/2019	Mid-Flood	1.18
SR4	29/10/2019	Mid-Flood	0.25	SR12	29/10/2019	Mid-Flood	0.19
SR4	31/10/2019	Mid-Flood	0.31	SR12	31/10/2019	Mid-Flood	0.33
SR4	2/11/2019	Mid-Flood	0.19	SR12	2/11/2019	Mid-Flood	0.18
SR4	5/11/2019	Mid-Flood	0.29	SR12	5/11/2019	Mid-Flood	0.24
SR4	7/11/2019	Mid-Flood	0.29	SR12	7/11/2019	Mid-Flood	0.23
SR4	9/11/2019	Mid-Flood	0.61	SR12	9/11/2019	Mid-Flood	0.63
SR4	12/11/2019	Mid-Flood	0.24	SR12	12/11/2019	Mid-Flood	0.21
SR4	14/11/2019	Mid-Flood	0.30	SR12	14/11/2019	Mid-Flood	0.22
SR4	16/11/2019	Mid-Flood	0.33	SR12	16/11/2019	Mid-Flood	0.33
SR4	19/11/2019	Mid-Flood	0.41	SR12	19/11/2019	Mid-Flood	0.37
SR4	21/11/2019	Mid-Flood	0.59	SR12	21/11/2019	Mid-Flood	0.55

Cluster 1 NH3-N (lab)
Upstream Control vs Impact

Baseline NH3-N (lab) x 1.3		Impact NH3-N (lab)	
Raw Statistics		Raw Statistics	
Number of Valid Observations	24	Number of Valid Observations	78
Number of Distinct Observations	21	Number of Distinct Observations	69
Minimum	0.0488	Minimum	0.07
Maximum	0.275	Maximum	1.182
Mean of Raw Data	0.18	Mean of Raw Data	0.286
Standard Deviation of Raw Data	0.065	Standard Deviation of Raw Data	0.186
Kstar	5.717	Kstar	3.611
Mean of Log Transformed Data	-1.794	Mean of Log Transformed Data	-1.389
Standard Deviation of Log Transformed Data	0.437	Standard Deviation of Log Transformed Data	0.497
Normal Distribution Test Results		Normal Distribution Test Results	
Correlation Coefficient R	0.985	Correlation Coefficient R	0.841
Shapiro Wilk Test Statistic	0.958	Approximate Shapiro Wilk Test Statistic	0.727
Shapiro Wilk Critical (0.95) Value	0.916	Approximate Shapiro Wilk P Value	0
Approximate Shapiro Wilk P Value	0.406	Lilliefors Test Statistic	0.258
Lilliefors Test Statistic	0.11	Lilliefors Critical (0.95) Value	0.1
Lilliefors Critical (0.95) Value	0.181	Data not Normal at (0.05) Significance Level	
Data appear Normal at (0.05) Significance Level			

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options	
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Impact NH3-N (lab)
Background Data: Baseline NH3-N (lab) x 1.3

Raw Statistics

	Site	Background
Number of Valid Observations	78	24
Number of Distinct Observations	69	21
Minimum	0.07	0.0488
Maximum	1.182	0.275
Mean	0.286	0.18
Median	0.233	0.173
SD	0.186	0.065
SE of Mean	0.021	0.0133

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	4447
WMW Test U-Stat	3.388
WMW Critical Value (0.050)	1.645
P-Value	3.52E-04

Conclusion with Alpha = 0.05
Reject H0, Conclude Site > Background
P-Value < alpha (0.05)

Cluster 1 NH3-N (lab)
Upstream Control vs Impact

Upstream Control NH3-N (lab) (mg/L)			
C2A	24/8/2019	Mid-Flood	0.25
C2A	27/8/2019	Mid-Flood	0.16
C2A	29/8/2019	Mid-Flood	0.09
C2A	31/8/2019	Mid-Flood	0.99
C2A	3/9/2019	Mid-Flood	0.31
C2A	5/9/2019	Mid-Flood	0.63
C2A	7/9/2019	Mid-Flood	0.30
C2A	10/9/2019	Mid-Flood	0.37
C2A	12/9/2019	Mid-Flood	0.37
C2A	14/9/2019	Mid-Flood	0.39
C2A	17/9/2019	Mid-Flood	0.48
C2A	19/9/2019	Mid-Flood	0.50
C2A	21/9/2019	Mid-Flood	0.81
C2A	24/9/2019	Mid-Flood	0.21
C2A	26/9/2019	Mid-Flood	0.28
C2A	28/9/2019	Mid-Flood	0.97
C2A	1/10/2019	Mid-Flood	0.35
C2A	3/10/2019	Mid-Flood	0.37
C2A	5/10/2019	Mid-Flood	0.22
C2A	8/10/2019	Mid-Flood	0.29
C2A	10/10/2019	Mid-Flood	0.22
C2A	12/10/2019	Mid-Flood	0.24
C2A	15/10/2019	Mid-Flood	0.39
C2A	17/10/2019	Mid-Flood	0.34
C2A	19/10/2019	Mid-Flood	0.27
C2A	22/10/2019	Mid-Flood	0.25
C2A	24/10/2019	Mid-Flood	0.28
C2A	26/10/2019	Mid-Flood	1.12
C2A	29/10/2019	Mid-Flood	0.66
C2A	31/10/2019	Mid-Flood	0.70
C2A	2/11/2019	Mid-Flood	0.35
C2A	5/11/2019	Mid-Flood	0.29
C2A	7/11/2019	Mid-Flood	0.66
C2A	9/11/2019	Mid-Flood	0.24
C2A	12/11/2019	Mid-Flood	0.76
C2A	14/11/2019	Mid-Flood	0.22
C2A	16/11/2019	Mid-Flood	0.50
C2A	19/11/2019	Mid-Flood	0.32
C2A	21/11/2019	Mid-Flood	0.54

Impact NH3-N (lab) (mg/L)							
SR4	24/8/2019	Mid-Flood	0.13	SR12	24/8/2019	Mid-Flood	0.16
SR4	27/8/2019	Mid-Flood	0.12	SR12	27/8/2019	Mid-Flood	0.14
SR4	29/8/2019	Mid-Flood	0.07	SR12	29/8/2019	Mid-Flood	0.10
SR4	31/8/2019	Mid-Flood	0.21	SR12	31/8/2019	Mid-Flood	0.20
SR4	3/9/2019	Mid-Flood	0.15	SR12	3/9/2019	Mid-Flood	0.13
SR4	5/9/2019	Mid-Flood	0.16	SR12	5/9/2019	Mid-Flood	0.23
SR4	7/9/2019	Mid-Flood	0.19	SR12	7/9/2019	Mid-Flood	0.24
SR4	10/9/2019	Mid-Flood	0.28	SR12	10/9/2019	Mid-Flood	0.30
SR4	12/9/2019	Mid-Flood	0.28	SR12	12/9/2019	Mid-Flood	0.30
SR4	14/9/2019	Mid-Flood	0.26	SR12	14/9/2019	Mid-Flood	0.32
SR4	17/9/2019	Mid-Flood	0.22	SR12	17/9/2019	Mid-Flood	0.25
SR4	19/9/2019	Mid-Flood	0.22	SR12	19/9/2019	Mid-Flood	0.37
SR4	21/9/2019	Mid-Flood	0.51	SR12	21/9/2019	Mid-Flood	0.52
SR4	24/9/2019	Mid-Flood	0.21	SR12	24/9/2019	Mid-Flood	0.20
SR4	26/9/2019	Mid-Flood	0.28	SR12	26/9/2019	Mid-Flood	0.29
SR4	28/9/2019	Mid-Flood	0.22	SR12	28/9/2019	Mid-Flood	0.81
SR4	1/10/2019	Mid-Flood	0.28	SR12	1/10/2019	Mid-Flood	0.25
SR4	3/10/2019	Mid-Flood	0.19	SR12	3/10/2019	Mid-Flood	0.19
SR4	5/10/2019	Mid-Flood	0.23	SR12	5/10/2019	Mid-Flood	0.18
SR4	8/10/2019	Mid-Flood	0.13	SR12	8/10/2019	Mid-Flood	0.19
SR4	10/10/2019	Mid-Flood	0.16	SR12	10/10/2019	Mid-Flood	0.16
SR4	12/10/2019	Mid-Flood	0.78	SR12	12/10/2019	Mid-Flood	0.84
SR4	15/10/2019	Mid-Flood	0.18	SR12	15/10/2019	Mid-Flood	0.20
SR4	17/10/2019	Mid-Flood	0.19	SR12	17/10/2019	Mid-Flood	0.30
SR4	19/10/2019	Mid-Flood	0.25	SR12	19/10/2019	Mid-Flood	0.27
SR4	22/10/2019	Mid-Flood	0.17	SR12	22/10/2019	Mid-Flood	0.24
SR4	24/10/2019	Mid-Flood	0.21	SR12	24/10/2019	Mid-Flood	0.22
SR4	26/10/2019	Mid-Flood	0.29	SR12	26/10/2019	Mid-Flood	1.18
SR4	29/10/2019	Mid-Flood	0.23	SR12	29/10/2019	Mid-Flood	0.19
SR4	31/10/2019	Mid-Flood	0.30	SR12	31/10/2019	Mid-Flood	0.33
SR4	2/11/2019	Mid-Flood	0.17	SR12	2/11/2019	Mid-Flood	0.18
SR4	5/11/2019	Mid-Flood	0.28	SR12	5/11/2019	Mid-Flood	0.24
SR4	7/11/2019	Mid-Flood	0.28	SR12	7/11/2019	Mid-Flood	0.23
SR4	9/11/2019	Mid-Flood	0.59	SR12	9/11/2019	Mid-Flood	0.63
SR4	12/11/2019	Mid-Flood	0.23	SR12	12/11/2019	Mid-Flood	0.21
SR4	14/11/2019	Mid-Flood	0.27	SR12	14/11/2019	Mid-Flood	0.22
SR4	16/11/2019	Mid-Flood	0.31	SR12	16/11/2019	Mid-Flood	0.33
SR4	19/11/2019	Mid-Flood	0.38	SR12	19/11/2019	Mid-Flood	0.37
SR4	21/11/2019	Mid-Flood	0.62	SR12	21/11/2019	Mid-Flood	0.55

Cluster 1 NH_3-N (lab)
Upstream Control vs Impact

Upstream Control NH3-N (lab)		Impact NH3-N (lab)	
Raw Statistics		Raw Statistics	
Number of Valid Observations	39	Number of Valid Observations	78
Number of Distinct Observations	38	Number of Distinct Observations	69
Minimum	0.0883	Minimum	0.07
Maximum	1.122	Maximum	1.182
Mean of Raw Data	0.427	Mean of Raw Data	0.286
Standard Deviation of Raw Data	0.245	Standard Deviation of Raw Data	0.186
Kstar	3.365	Kstar	3.611
Mean of Log Transformed Data	-0.996	Mean of Log Transformed Data	-1.389
Standard Deviation of Log Transformed Data	0.542	Standard Deviation of Log Transformed Data	0.497
Normal Distribution Test Results		Normal Distribution Test Results	
Correlation Coefficient R	0.93	Correlation Coefficient R	0.841
Shapiro Wilk Test Statistic	0.862	Approximate Shapiro Wilk Test Statistic	0.727
Shapiro Wilk Critical (0.95) Value	0.939	Approximate Shapiro Wilk P Value	0
Approximate Shapiro Wilk P Value	9.95E-05	Lilliefors Test Statistic	0.258
Lilliefors Test Statistic	0.226	Lilliefors Critical (0.95) Value	0.1
Lilliefors Critical (0.95) Value	0.142	Data not Normal at (0.05) Significance Level	
Data not Normal at (0.05) Significance Level			

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options	
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Impact NH3-N (lab)
Background Data: Upstream Control NH3-N (lab)

Raw Statistics

	Site	Background
Number of Valid Observations	78	39
Number of Distinct Observations	69	38
Minimum	0.07	0.0883
Maximum	1.182	1.122
Mean	0.286	0.427
Median	0.233	0.345
SD	0.186	0.245
SE of Mean	0.021	0.0392

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	3885
WMW Test U-Stat	-4.149
WMW Critical Value (0.050)	1.645
P-Value	1.67E-05

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Site <= Background
P-Value < alpha (0.05)

Cluster 1 UIA (lab)
1.3 x Baseline vs Impact

1.3 x Baseline UIA (lab) (mg/L)			
SR4	4/1/2014	Mid-Flood	0.003
SR4	7/1/2014	Mid-Flood	0.004
SR4	9/1/2014	Mid-Flood	0.006
SR4	11/1/2014	Mid-Flood	0.004
SR4	14/1/2014	Mid-Flood	0.005
SR4	16/1/2014	Mid-Flood	0.005
SR4	18/1/2014	Mid-Flood	0.002
SR4	21/1/2014	Mid-Flood	0.005
SR4	23/1/2014	Mid-Flood	0.010
SR4	25/1/2014	Mid-Flood	0.018
SR4	27/1/2014	Mid-Flood	0.012
SR4	29/1/2014	Mid-Flood	0.025
SR12	4/1/2014	Mid-Flood	0.003
SR12	7/1/2014	Mid-Flood	0.004
SR12	9/1/2014	Mid-Flood	0.006
SR12	11/1/2014	Mid-Flood	0.003
SR12	14/1/2014	Mid-Flood	0.004
SR12	16/1/2014	Mid-Flood	0.006
SR12	18/1/2014	Mid-Flood	0.003
SR12	21/1/2014	Mid-Flood	0.017
SR12	23/1/2014	Mid-Flood	0.010
SR12	25/1/2014	Mid-Flood	0.012
SR12	27/1/2014	Mid-Flood	0.016
SR12	29/1/2014	Mid-Flood	0.027

Impact UIA (lab) (mg/L)							
SR4	24/8/2019	Mid-Flood	0.015	SR12	24/8/2019	Mid-Flood	0.015
SR4	27/8/2019	Mid-Flood	0.010	SR12	27/8/2019	Mid-Flood	0.011
SR4	29/8/2019	Mid-Flood	0.006	SR12	29/8/2019	Mid-Flood	0.008
SR4	31/8/2019	Mid-Flood	0.017	SR12	31/8/2019	Mid-Flood	0.016
SR4	3/9/2019	Mid-Flood	0.012	SR12	3/9/2019	Mid-Flood	0.010
SR4	5/9/2019	Mid-Flood	0.012	SR12	5/9/2019	Mid-Flood	0.018
SR4	7/9/2019	Mid-Flood	0.018	SR12	7/9/2019	Mid-Flood	0.023
SR4	10/9/2019	Mid-Flood	0.049	SR12	10/9/2019	Mid-Flood	0.066
SR4	12/9/2019	Mid-Flood	0.024	SR12	12/9/2019	Mid-Flood	0.027
SR4	14/9/2019	Mid-Flood	0.034	SR12	14/9/2019	Mid-Flood	0.040
SR4	17/9/2019	Mid-Flood	0.026	SR12	17/9/2019	Mid-Flood	0.028
SR4	19/9/2019	Mid-Flood	0.027	SR12	19/9/2019	Mid-Flood	0.043
SR4	21/9/2019	Mid-Flood	0.031	SR12	21/9/2019	Mid-Flood	0.031
SR4	24/9/2019	Mid-Flood	0.033	SR12	24/9/2019	Mid-Flood	0.031
SR4	26/9/2019	Mid-Flood	0.041	SR12	26/9/2019	Mid-Flood	0.041
SR4	28/9/2019	Mid-Flood	0.030	SR12	28/9/2019	Mid-Flood	0.109
SR4	1/10/2019	Mid-Flood	0.036	SR12	1/10/2019	Mid-Flood	0.028
SR4	3/10/2019	Mid-Flood	0.021	SR12	3/10/2019	Mid-Flood	0.014
SR4	5/10/2019	Mid-Flood	0.014	SR12	5/10/2019	Mid-Flood	0.011
SR4	8/10/2019	Mid-Flood	0.008	SR12	8/10/2019	Mid-Flood	0.012
SR4	10/10/2019	Mid-Flood	0.009	SR12	10/10/2019	Mid-Flood	0.010
SR4	12/10/2019	Mid-Flood	0.050	SR12	12/10/2019	Mid-Flood	0.055
SR4	15/10/2019	Mid-Flood	0.013	SR12	15/10/2019	Mid-Flood	0.014
SR4	17/10/2019	Mid-Flood	0.011	SR12	17/10/2019	Mid-Flood	0.018
SR4	19/10/2019	Mid-Flood	0.012	SR12	19/10/2019	Mid-Flood	0.013
SR4	22/10/2019	Mid-Flood	0.009	SR12	22/10/2019	Mid-Flood	0.012
SR4	24/10/2019	Mid-Flood	0.010	SR12	24/10/2019	Mid-Flood	0.011
SR4	26/10/2019	Mid-Flood	0.017	SR12	26/10/2019	Mid-Flood	0.068
SR4	29/10/2019	Mid-Flood	0.011	SR12	29/10/2019	Mid-Flood	0.008
SR4	31/10/2019	Mid-Flood	0.013	SR12	31/10/2019	Mid-Flood	0.014
SR4	2/11/2019	Mid-Flood	0.006	SR12	2/11/2019	Mid-Flood	0.006
SR4	5/11/2019	Mid-Flood	0.013	SR12	5/11/2019	Mid-Flood	0.011
SR4	7/11/2019	Mid-Flood	0.016	SR12	7/11/2019	Mid-Flood	0.013
SR4	9/11/2019	Mid-Flood	0.036	SR12	9/11/2019	Mid-Flood	0.041
SR4	12/11/2019	Mid-Flood	0.013	SR12	12/11/2019	Mid-Flood	0.011
SR4	14/11/2019	Mid-Flood	0.016	SR12	14/11/2019	Mid-Flood	0.012
SR4	16/11/2019	Mid-Flood	0.018	SR12	16/11/2019	Mid-Flood	0.019
SR4	19/11/2019	Mid-Flood	0.021	SR12	19/11/2019	Mid-Flood	0.021
SR4	21/11/2019	Mid-Flood	0.032	SR12	21/11/2019	Mid-Flood	0.028

Cluster 1 UIA (lab)
1.3 x Baseline vs Impact

1.3 x Baseline UIA (lab)		Impact UIA (lab)	
Raw Statistics		Raw Statistics	
Number of Valid Observations	24	Number of Valid Observations	78
Number of Distinct Observations	24	Number of Distinct Observations	78
Minimum	0.00172	Minimum	0.00553
Maximum	0.0268	Maximum	0.109
Mean of Raw Data	0.00881	Mean of Raw Data	0.0225
Standard Deviation of Raw Data	0.0071	Standard Deviation of Raw Data	0.0169
Kstar	1.743	Kstar	2.5
Mean of Log Transformed Data	-5.008	Mean of Log Transformed Data	-3.998
Standard Deviation of Log Transformed Data	0.746	Standard Deviation of Log Transformed Data	0.619
Normal Distribution Test Results		Normal Distribution Test Results	
Correlation Coefficient R	0.903	Correlation Coefficient R	0.871
Shapiro Wilk Test Statistic	0.811	Approximate Shapiro Wilk Test Statistic	0.779
Shapiro Wilk Critical (0.95) Value	0.916	Approximate Shapiro Wilk P Value	1.11E-16
Approximate Shapiro Wilk P Value	2.73E-04	Lilliefors Test Statistic	0.186
Lilliefors Test Statistic	0.288	Lilliefors Critical (0.95) Value	0.1
Lilliefors Critical (0.95) Value	0.177	Data not Normal at (0.05) Significance Level	
Data not Normal at (0.05) Significance Level			

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Impact UIA (lab)
Background Data: Baseline UIA (lab) x 1.3

Raw Statistics

	Site	Background
Number of Valid Observations	78	24
Number of Distinct Observations	78	24
Minimum	0.00553	0.00172
Maximum	0.109	0.0268
Mean	0.0225	0.00881
Median	0.0161	0.00556
SD	0.0169	0.0071
SE of Mean	1.92E-03	1.45E-03

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	4647
WMW Test U-Stat	4.966
WMW Critical Value (0.050)	1.645
P-Value	3.42E-07

Conclusion with Alpha = 0.05
Reject H0, Conclude Site > Background
P-Value < alpha (0.05)

Cluster 1 UIA (lab)
1.3 x Baseline vs Impact

Upstream Control UIA (lab) (mg/L)			
C2A	23/5/2019	Mid-Flood	0.021
C2A	25/5/2019	Mid-Flood	0.082
C2A	28/5/2019	Mid-Flood	0.012
C2A	30/5/2019	Mid-Flood	0.016
C2A	1/6/2019	Mid-Flood	0.025
C2A	4/6/2019	Mid-Flood	0.023
C2A	6/6/2019	Mid-Flood	0.037
C2A	8/6/2019	Mid-Flood	0.008
C2A	11/6/2019	Mid-Flood	0.017
C2A	13/6/2019	Mid-Flood	0.027
C2A	15/6/2019	Mid-Flood	0.020
C2A	18/6/2019	Mid-Flood	0.017
C2A	20/6/2019	Mid-Flood	0.026
C2A	22/6/2019	Mid-Flood	0.063
C2A	25/6/2019	Mid-Flood	0.014
C2A	27/6/2019	Mid-Flood	0.012
C2A	29/6/2019	Mid-Flood	0.009
C2A	2/7/2019	Mid-Flood	0.017
C2A	4/7/2019	Mid-Flood	0.018
C2A	6/7/2019	Mid-Flood	0.014
C2A	9/7/2019	Mid-Flood	0.014
C2A	11/7/2019	Mid-Flood	0.014
C2A	13/7/2019	Mid-Flood	0.015
C2A	16/7/2019	Mid-Flood	0.015
C2A	18/7/2019	Mid-Flood	0.027
C2A	20/7/2019	Mid-Flood	0.062
C2A	23/7/2019	Mid-Flood	0.035
C2A	25/7/2019	Mid-Flood	0.016
C2A	27/7/2019	Mid-Flood	0.023
C2A	30/7/2019	Mid-Flood	0.015
C2A	3/8/2019	Mid-Flood	0.029
C2A	6/8/2019	Mid-Flood	0.034
C2A	8/8/2019	Mid-Flood	0.019
C2A	10/8/2019	Mid-Flood	0.039
C2A	13/8/2019	Mid-Flood	0.022
C2A	15/8/2019	Mid-Flood	0.017
C2A	17/8/2019	Mid-Flood	0.038
C2A	20/8/2019	Mid-Flood	0.028
C2A	22/8/2019	Mid-Flood	0.063

Impact UIA (lab) (mg/L)							
SR4	24/8/2019	Mid-Flood	0.015	SR12	5/11/2019	Mid-Flood	0.011
SR4	27/8/2019	Mid-Flood	0.010	SR12	7/11/2019	Mid-Flood	0.013
SR4	29/8/2019	Mid-Flood	0.006	SR12	9/11/2019	Mid-Flood	0.041
SR4	31/8/2019	Mid-Flood	0.017	SR12	12/11/2019	Mid-Flood	0.011
SR4	3/9/2019	Mid-Flood	0.012	SR12	14/11/2019	Mid-Flood	0.012
SR4	5/9/2019	Mid-Flood	0.012	SR12	16/11/2019	Mid-Flood	0.019
SR4	7/9/2019	Mid-Flood	0.018	SR12	19/11/2019	Mid-Flood	0.021
SR4	10/9/2019	Mid-Flood	0.049	SR12	21/11/2019	Mid-Flood	0.028
SR4	12/9/2019	Mid-Flood	0.024	SR12	24/8/2019	Mid-Flood	0.015
SR4	14/9/2019	Mid-Flood	0.034	SR12	27/8/2019	Mid-Flood	0.011
SR4	17/9/2019	Mid-Flood	0.026	SR12	29/8/2019	Mid-Flood	0.008
SR4	19/9/2019	Mid-Flood	0.027	SR12	31/8/2019	Mid-Flood	0.016
SR4	21/9/2019	Mid-Flood	0.031	SR12	3/9/2019	Mid-Flood	0.010
SR4	24/9/2019	Mid-Flood	0.033	SR12	5/9/2019	Mid-Flood	0.018
SR4	26/9/2019	Mid-Flood	0.041	SR12	7/9/2019	Mid-Flood	0.023
SR4	28/9/2019	Mid-Flood	0.030	SR12	10/9/2019	Mid-Flood	0.066
SR4	1/10/2019	Mid-Flood	0.036	SR12	12/9/2019	Mid-Flood	0.027
SR4	3/10/2019	Mid-Flood	0.021	SR12	14/9/2019	Mid-Flood	0.040
SR4	5/10/2019	Mid-Flood	0.014	SR12	17/9/2019	Mid-Flood	0.028
SR4	8/10/2019	Mid-Flood	0.008	SR12	19/9/2019	Mid-Flood	0.043
SR4	10/10/2019	Mid-Flood	0.009	SR12	21/9/2019	Mid-Flood	0.031
SR4	12/10/2019	Mid-Flood	0.050	SR12	24/9/2019	Mid-Flood	0.031
SR4	15/10/2019	Mid-Flood	0.013	SR12	26/9/2019	Mid-Flood	0.041
SR4	17/10/2019	Mid-Flood	0.011	SR12	28/9/2019	Mid-Flood	0.109
SR4	19/10/2019	Mid-Flood	0.012	SR12	1/10/2019	Mid-Flood	0.028
SR4	22/10/2019	Mid-Flood	0.009	SR12	3/10/2019	Mid-Flood	0.014
SR4	24/10/2019	Mid-Flood	0.010	SR12	5/10/2019	Mid-Flood	0.011
SR4	26/10/2019	Mid-Flood	0.017	SR12	8/10/2019	Mid-Flood	0.012
SR4	29/10/2019	Mid-Flood	0.011	SR12	10/10/2019	Mid-Flood	0.010
SR4	31/10/2019	Mid-Flood	0.013	SR12	12/10/2019	Mid-Flood	0.055
SR4	2/11/2019	Mid-Flood	0.006	SR12	15/10/2019	Mid-Flood	0.014
SR4	5/11/2019	Mid-Flood	0.013	SR12	17/10/2019	Mid-Flood	0.018
SR4	7/11/2019	Mid-Flood	0.016	SR12	19/10/2019	Mid-Flood	0.013
SR4	9/11/2019	Mid-Flood	0.036	SR12	22/10/2019	Mid-Flood	0.012
SR4	12/11/2019	Mid-Flood	0.013	SR12	24/10/2019	Mid-Flood	0.011
SR4	14/11/2019	Mid-Flood	0.016	SR12	26/10/2019	Mid-Flood	0.068
SR4	16/11/2019	Mid-Flood	0.018	SR12	29/10/2019	Mid-Flood	0.008
SR4	19/11/2019	Mid-Flood	0.021	SR12	31/10/2019	Mid-Flood	0.014
SR4	21/11/2019	Mid-Flood	0.032	SR12	2/11/2019	Mid-Flood	0.006

Cluster 1 UIA (lab)
1.3 x Baseline vs Impact

Upstream Control UIA (lab)		Impact UIA (lab)	
Raw Statistics		Raw Statistics	
Number of Valid Observations	39	Number of Valid Observations	78
Number of Distinct Observations	26	Number of Distinct Observations	78
Minimum	0.008	Minimum	0.00553
Maximum	0.082	Maximum	0.109
Mean of Raw Data	0.0257	Mean of Raw Data	0.0225
Standard Deviation of Raw Data	0.0166	Standard Deviation of Raw Data	0.0169
Kstar	3.154	Kstar	2.5
Mean of Log Transformed Data	-3.815	Mean of Log Transformed Data	-3.998
Standard Deviation of Log Transformed Data	0.537	Standard Deviation of Log Transformed Data	0.619
Normal Distribution Test Results		Normal Distribution Test Results	
Correlation Coefficient R	0.883	Correlation Coefficient R	0.871
Shapiro Wilk Test Statistic	0.785	Approximate Shapiro Wilk Test Statistic	0.779
Shapiro Wilk Critical (0.95) Value	0.939	Approximate Shapiro Wilk P Value	1.11E-16
Approximate Shapiro Wilk P Value	4.07E-07	Lilliefors Test Statistic	0.186
Lilliefors Test Statistic	0.191	Lilliefors Critical (0.95) Value	0.1
Lilliefors Critical (0.95) Value	0.14	Data not Normal at (0.05) Significance Level	
Data not Normal at (0.05) Significance Level			

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Site Mean/Median <= Background Mean/Median (Form 1)
Alternative Hypothesis	Site Mean/Median > Background Mean/Median

Area of Concern Data: Impact UIA (lab)
Background Data: Upstream Control UIA (lab)

Raw Statistics

	Site	Background
Number of Valid Observations	78	39
Number of Distinct Observations	78	26
Minimum	0.00553	0.008
Maximum	0.109	0.082
Mean	0.0225	0.0257
Median	0.0161	0.02
SD	0.0169	0.0166
SE of Mean	1.92E-03	0.00265

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background

Site Rank Sum W-Stat	4291
WMW Test U-Stat	-1.801
WMW Critical Value (0.050)	1.645
P-Value	9.64E-01

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Site <= Background
P-Value < alpha (0.05)

Cluster 1 E. coli
1.3 x Baseline vs Impact

1.3 x Baseline *E. coli* (cfu/ 100mL)			
SR4	4/1/2014	Mid-Flood	374
SR4	7/1/2014	Mid-Flood	302
SR4	9/1/2014	Mid-Flood	448
SR4	11/1/2014	Mid-Flood	96
SR4	14/1/2014	Mid-Flood	272
SR4	16/1/2014	Mid-Flood	419
SR4	18/1/2014	Mid-Flood	322
SR4	21/1/2014	Mid-Flood	325
SR4	23/1/2014	Mid-Flood	178
SR4	25/1/2014	Mid-Flood	52
SR4	27/1/2014	Mid-Flood	30
SR4	29/1/2014	Mid-Flood	47
SR12	4/1/2014	Mid-Flood	1488
SR12	7/1/2014	Mid-Flood	951
SR12	9/1/2014	Mid-Flood	619
SR12	11/1/2014	Mid-Flood	264
SR12	14/1/2014	Mid-Flood	319
SR12	16/1/2014	Mid-Flood	422
SR12	18/1/2014	Mid-Flood	757
SR12	21/1/2014	Mid-Flood	329
SR12	23/1/2014	Mid-Flood	340
SR12	25/1/2014	Mid-Flood	206
SR12	27/1/2014	Mid-Flood	312
SR12	29/1/2014	Mid-Flood	653

Impact *E. coli* (cfu/ 100mL)							
SR4	24/8/2019	Mid-Flood	526	SR12	24/8/2019	Mid-Flood	1211
SR4	27/8/2019	Mid-Flood	1924	SR12	27/8/2019	Mid-Flood	5300
SR4	31/8/2019	Mid-Flood	6502	SR12	31/8/2019	Mid-Flood	3787
SR4	3/9/2019	Mid-Flood	892	SR12	3/9/2019	Mid-Flood	627
SR4	5/9/2019	Mid-Flood	527	SR12	5/9/2019	Mid-Flood	812
SR4	7/9/2019	Mid-Flood	458	SR12	7/9/2019	Mid-Flood	1396
SR4	10/9/2019	Mid-Flood	564	SR12	10/9/2019	Mid-Flood	525
SR4	12/9/2019	Mid-Flood	564	SR12	12/9/2019	Mid-Flood	525
SR4	14/9/2019	Mid-Flood	506	SR12	14/9/2019	Mid-Flood	379
SR4	17/9/2019	Mid-Flood	237	SR12	17/9/2019	Mid-Flood	1762
SR4	19/9/2019	Mid-Flood	1274	SR12	19/9/2019	Mid-Flood	14
SR4	21/9/2019	Mid-Flood	1938	SR12	21/9/2019	Mid-Flood	2133
SR4	24/9/2019	Mid-Flood	1245	SR12	24/9/2019	Mid-Flood	1384
SR4	26/9/2019	Mid-Flood	503	SR12	26/9/2019	Mid-Flood	580
SR4	28/9/2019	Mid-Flood	264	SR12	28/9/2019	Mid-Flood	18334
SR4	1/10/2019	Mid-Flood	1791	SR12	1/10/2019	Mid-Flood	3928
SR4	3/10/2019	Mid-Flood	293	SR12	3/10/2019	Mid-Flood	29
SR4	5/10/2019	Mid-Flood	248	SR12	5/10/2019	Mid-Flood	283
SR4	8/10/2019	Mid-Flood	19	SR12	8/10/2019	Mid-Flood	151
SR4	10/10/2019	Mid-Flood	480	SR12	10/10/2019	Mid-Flood	19
SR4	12/10/2019	Mid-Flood	2863	SR12	12/10/2019	Mid-Flood	4252
SR4	15/10/2019	Mid-Flood	2616	SR12	15/10/2019	Mid-Flood	2749
SR4	17/10/2019	Mid-Flood	616	SR12	17/10/2019	Mid-Flood	497
SR4	19/10/2019	Mid-Flood	551	SR12	19/10/2019	Mid-Flood	533
SR4	22/10/2019	Mid-Flood	9	SR12	22/10/2019	Mid-Flood	131
SR4	24/10/2019	Mid-Flood	282	SR12	24/10/2019	Mid-Flood	682
SR4	26/10/2019	Mid-Flood	587	SR12	26/10/2019	Mid-Flood	7201
SR4	29/10/2019	Mid-Flood	132	SR12	29/10/2019	Mid-Flood	380
SR4	31/10/2019	Mid-Flood	2085	SR12	31/10/2019	Mid-Flood	783
SR4	2/11/2019	Mid-Flood	182	SR12	2/11/2019	Mid-Flood	559
SR4	5/11/2019	Mid-Flood	483	SR12	5/11/2019	Mid-Flood	176
SR4	7/11/2019	Mid-Flood	140	SR12	7/11/2019	Mid-Flood	55
SR4	9/11/2019	Mid-Flood	1	SR12	9/11/2019	Mid-Flood	182
SR4	12/11/2019	Mid-Flood	2081	SR12	12/11/2019	Mid-Flood	2435
SR4	14/11/2019	Mid-Flood	1640	SR12	14/11/2019	Mid-Flood	1900
SR4	16/11/2019	Mid-Flood	1584	SR12	16/11/2019	Mid-Flood	1435
SR4	19/11/2019	Mid-Flood	753	SR12	19/11/2019	Mid-Flood	1309
SR4	21/11/2019	Mid-Flood	2087	SR12	21/11/2019	Mid-Flood	3584

Cluster 1 E. coli
1.3 x Baseline vs Impact

1.3 x Baseline *E. coli*		Impact *E. coli*	
Raw Statistics		Raw Statistics	
Number of Valid Observations	24	Number of Valid Observations	76
Number of Distinct Observations	24	Number of Distinct Observations	74
Minimum	30.18	Minimum	1
Maximum	1488	Maximum	18334
Geometric Mean of Raw Data	286	Geometric Mean of Raw Data	594
Standard Deviation of Raw Data	321.1	Standard Deviation of Raw Data	2439
Kstar	1.48	Kstar	0.655
Mean of Log Transformed Data	5.653	Mean of Log Transformed Data	6.387
Standard Deviation of Log Transformed Data	0.929	Standard Deviation of Log Transformed Data	1.633
Normal Distribution Test Results		Normal Distribution Test Results	
Correlation Coefficient R	0.896	Correlation Coefficient R	0.711
Shapiro Wilk Test Statistic	0.818	Approximate Shapiro Wilk Test Statistic	0.548
Shapiro Wilk Critical (0.95) Value	0.916	Approximate Shapiro Wilk P Value	0
Approximate Shapiro Wilk P Value	3.79E-04	Lilliefors Test Statistic	0.274
Lilliefors Test Statistic	0.228	Lilliefors Critical (0.95) Value	0.102
Lilliefors Critical (0.95) Value	0.181	Data not Normal at (0.05) Significance Level	
Data not Normal at (0.05) Significance Level			

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Impact *E. coli*
Background Data: 1.3 x Baseline *E. coli*

Raw Statistics

	Site	Background
Number of Valid Observations	76	24
Number of Distinct Observations	74	24
Minimum	1	30.18
Maximum	18334	1488
Geometric Mean	594	286
Median	583.2	323.8
SD	2439	321.1
SE of Mean	279.7	65.54

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	4217
WMW Test U-Stat	3.055
WMW Critical Value (0.050)	1.645
P-Value	1.13E-03

Conclusion with Alpha = 0.05
Reject H0, Conclude Site > Background
P-Value < alpha (0.05)

Cluster 1 E. coli
1.3 x Baseline vs Impact

Upstream Control *E. coli* (cfu/ 100mL)			
C2A	24/8/2019	Mid-Flood	4347
C2A	27/8/2019	Mid-Flood	1772
C2A	31/8/2019	Mid-Flood	8854
C2A	3/9/2019	Mid-Flood	127
C2A	5/9/2019	Mid-Flood	545
C2A	7/9/2019	Mid-Flood	2287
C2A	10/9/2019	Mid-Flood	124
C2A	12/9/2019	Mid-Flood	124
C2A	14/9/2019	Mid-Flood	4138
C2A	17/9/2019	Mid-Flood	830
C2A	19/9/2019	Mid-Flood	162
C2A	21/9/2019	Mid-Flood	5106
C2A	24/9/2019	Mid-Flood	28
C2A	26/9/2019	Mid-Flood	225
C2A	28/9/2019	Mid-Flood	51311
C2A	1/10/2019	Mid-Flood	6662
C2A	3/10/2019	Mid-Flood	1394
C2A	5/10/2019	Mid-Flood	247
C2A	8/10/2019	Mid-Flood	197
C2A	10/10/2019	Mid-Flood	162
C2A	12/10/2019	Mid-Flood	3430
C2A	15/10/2019	Mid-Flood	1195
C2A	17/10/2019	Mid-Flood	609
C2A	19/10/2019	Mid-Flood	708
C2A	22/10/2019	Mid-Flood	126
C2A	24/9/2019	Mid-Flood	28
C2A	26/9/2019	Mid-Flood	225
C2A	28/9/2019	Mid-Flood	51311
C2A	1/10/2019	Mid-Flood	6662
C2A	3/10/2019	Mid-Flood	1394
C2A	5/10/2019	Mid-Flood	247
C2A	8/10/2019	Mid-Flood	197
C2A	10/10/2019	Mid-Flood	162
C2A	12/10/2019	Mid-Flood	3430
C2A	12/10/2019	Mid-Flood	3430
C2A	15/10/2019	Mid-Flood	1195
C2A	17/10/2019	Mid-Flood	609
C2A	19/10/2019	Mid-Flood	708

Impact *E. coli* (cfu/ 100mL)							
SR4	24/8/2019	Mid-Flood	526	SR12	24/8/2019	Mid-Flood	1211
SR4	27/8/2019	Mid-Flood	1924	SR12	27/8/2019	Mid-Flood	5300
SR4	31/8/2019	Mid-Flood	6502	SR12	31/8/2019	Mid-Flood	3787
SR4	3/9/2019	Mid-Flood	892	SR12	3/9/2019	Mid-Flood	627
SR4	5/9/2019	Mid-Flood	527	SR12	5/9/2019	Mid-Flood	812
SR4	7/9/2019	Mid-Flood	458	SR12	7/9/2019	Mid-Flood	1396
SR4	10/9/2019	Mid-Flood	564	SR12	10/9/2019	Mid-Flood	525
SR4	12/9/2019	Mid-Flood	564	SR12	12/9/2019	Mid-Flood	525
SR4	14/9/2019	Mid-Flood	506	SR12	14/9/2019	Mid-Flood	379
SR4	17/9/2019	Mid-Flood	237	SR12	17/9/2019	Mid-Flood	1762
SR4	19/9/2019	Mid-Flood	1274	SR12	19/9/2019	Mid-Flood	14
SR4	21/9/2019	Mid-Flood	1938	SR12	21/9/2019	Mid-Flood	2133
SR4	24/9/2019	Mid-Flood	1245	SR12	24/9/2019	Mid-Flood	1384
SR4	26/9/2019	Mid-Flood	503	SR12	26/9/2019	Mid-Flood	580
SR4	28/9/2019	Mid-Flood	264	SR12	28/9/2019	Mid-Flood	18334
SR4	1/10/2019	Mid-Flood	1791	SR12	1/10/2019	Mid-Flood	3928
SR4	3/10/2019	Mid-Flood	293	SR12	3/10/2019	Mid-Flood	29
SR4	5/10/2019	Mid-Flood	248	SR12	5/10/2019	Mid-Flood	283
SR4	8/10/2019	Mid-Flood	19	SR12	8/10/2019	Mid-Flood	151
SR4	10/10/2019	Mid-Flood	480	SR12	10/10/2019	Mid-Flood	19
SR4	12/10/2019	Mid-Flood	2863	SR12	12/10/2019	Mid-Flood	4252
SR4	15/10/2019	Mid-Flood	2616	SR12	15/10/2019	Mid-Flood	2749
SR4	17/10/2019	Mid-Flood	616	SR12	17/10/2019	Mid-Flood	497
SR4	19/10/2019	Mid-Flood	551	SR12	19/10/2019	Mid-Flood	533
SR4	22/10/2019	Mid-Flood	9	SR12	22/10/2019	Mid-Flood	131
SR4	24/10/2019	Mid-Flood	282	SR12	24/10/2019	Mid-Flood	682
SR4	26/10/2019	Mid-Flood	587	SR12	26/10/2019	Mid-Flood	7201
SR4	29/10/2019	Mid-Flood	132	SR12	29/10/2019	Mid-Flood	380
SR4	31/10/2019	Mid-Flood	2085	SR12	31/10/2019	Mid-Flood	783
SR4	2/11/2019	Mid-Flood	182	SR12	2/11/2019	Mid-Flood	559
SR4	5/11/2019	Mid-Flood	483	SR12	5/11/2019	Mid-Flood	176
SR4	7/11/2019	Mid-Flood	140	SR12	7/11/2019	Mid-Flood	55
SR4	9/11/2019	Mid-Flood	1	SR12	9/11/2019	Mid-Flood	182
SR4	12/11/2019	Mid-Flood	2081	SR12	12/11/2019	Mid-Flood	2435
SR4	14/11/2019	Mid-Flood	1640	SR12	14/11/2019	Mid-Flood	1900
SR4	16/11/2019	Mid-Flood	1584	SR12	16/11/2019	Mid-Flood	1435
SR4	19/11/2019	Mid-Flood	753	SR12	19/11/2019	Mid-Flood	1309
SR4	21/11/2019	Mid-Flood	2087	SR12	21/11/2019	Mid-Flood	3584

Cluster 1 E. coli
1.3 x Baseline vs Impact

Upstream Control *E. coli*		Impact *E. coli*	
Raw Statistics		Raw Statistics	
Number of Valid Observations	38	Number of Valid Observations	76
Number of Distinct Observations	25	Number of Distinct Observations	72
Minimum	28	Minimum	1
Maximum	51311	Maximum	18334
Geometric Mean of Raw Data	247	Geometric Mean of Raw Data	594
Standard Deviation of Raw Data	11435	Standard Deviation of Raw Data	2439
Kstar	0.381	Kstar	0.655
Mean of Log Transformed Data	6.699	Mean of Log Transformed Data	6.387
Standard Deviation of Log Transformed Data	1.812	Standard Deviation of Log Transformed Data	1.632
Normal Distribution Test Results		Normal Distribution Test Results	
Correlation Coefficient R	0.602	Correlation Coefficient R	0.711
Shapiro Wilk Test Statistic	0.383	Approximate Shapiro Wilk Test Statistic	0.548
Shapiro Wilk Critical (0.95) Value	0.938	Approximate Shapiro Wilk P Value	0
Approximate Shapiro Wilk P Value	8.88E-16	Lilliefors Test Statistic	0.274
Lilliefors Test Statistic	0.354	Lilliefors Critical (0.95) Value	0.102
Lilliefors Critical (0.95) Value	0.142	Data not Normal at (0.05) Significance Level	
Data not Normal at (0.05) Significance Level			

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options	
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Site Mean/Median <= Background Mean/Median (Form 1)
Alternative Hypothesis	Site Mean/Median > Background Mean/Median

Area of Concern Data: Impact *E. coli*
Background Data: Upstream Control *E. coli*

Raw Statistics

	Site	Background
Number of Valid Observations	76	38
Number of Distinct Observations	72	25
Minimum	1	28
Maximum	18334	51311
Geometric Mean	594	247
Median	583.5	708.3
SD	2439	11435
SE of Mean	279.7	1855

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC = Mean/Median of Background

Site Rank Sum W-Stat	4309
Standardized WMW U-Stat	-0.37
Mean (U)	1444
SD(U) - Adj ties	1.66E+02
Approximate U-Stat Critical Value	1.645
P-Value (Adjusted for Ties)	0.644

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Site <= Background
P-Value >= alpha (0.05)

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Appendix I

Weather Conditions and Red Tide Occurrences for the Reporting Period

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Report No.: 0394/13/ED/0389A

Date	Air Temperature			Mean Relative Humidity (%)	Total Rainfall (mm)
	Maximum (deg. C)	Mean (deg. C)	Minimum (deg. C)		
August 2019					
23	31.4	29.4	28.2	80	0.7
24	33.9	30.9	27.7	75	0
25	32.6	27.2	25.1	89	88.4
26	28.7	25.7	22.9	95	178.3
27	31.4	28.6	26.9	88	2.9
28	33.8	29.9	27.2	77	0
29	30.7	29	27.8	83	5.9
30	30.1	27.7	25	86	8.5
31	30.3	26.9	25	91	43.7
September 2019					
1	31	28.2	26.2	82	8.5
2	28.1	26.9	25.2	90	38.4
3	30.9	28.4	26.2	80	12.9
4	28.3	26.8	25.5	91	62.2
5	29.3	27.2	25.4	88	31.8
6	32.4	28.9	26.8	79	0.2
7	33.3	29.8	27.5	79	0.4
8	33	30	28	80	0.4
9	33.3	30	28.3	78	0
10	33.3	30.1	28.2	76	0
11	33.3	30.2	28.4	73	Trace
12	33.5	30.3	28.3	73	0
13	33	30.1	28.7	77	Trace
14	32.3	29.8	28.4	78	Trace
15	32.2	29.2	25.9	76	11
16	32.3	29.3	26.3	76	4.3
17	31.8	29.2	27.9	76	2.1
18	32	28.8	25.8	79	18
19	32.4	28	24.9	74	8.7
20	32.6	29	26.2	52	0
21	32.5	29.2	26.5	42	0
22	31.3	28.3	25.9	40	0

Source: Hong Kong Observatory

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Report No.: 0394/13/ED/0389A

Date	Air Temperature			Mean Relative Humidity (%)	Total Rainfall (mm)
	Maximum (deg. C)	Mean (deg. C)	Minimum (deg. C)		
September 2019					
23	30.7	27.7	25.4	57	0
24	30.3	27.5	26.3	70	0
25	30.8	27.3	25.7	71	Trace
26	30.8	27.5	25.5	71	0
27	30.6	27.6	25.7	72	Trace
28	32.2	28.2	25.9	71	0
29	31.7	28.7	26.6	75	0
30	33.4	30.1	27.2	64	0
October 2019					
1	33.2	30.3	28.4	59	0
2	32.1	29.5	27.9	71	0
3	31.8	29	27.4	67	0
4	31.3	28.6	26.9	70	0
5	32.3	29.1	26.8	69	0
6	29.1	26.3	23.1	81	46.8
7	28.3	26.3	23.2	86	17.9
8	30.4	27.7	25.3	79	4.9
9	29.8	27.8	26.7	75	Trace
10	30.3	27.9	26.6	76	0
11	31.1	28.5	26.3	75	0
12	31.5	28.6	27.4	78	0.3
13	30.8	27.2	24.5	84	13.6
14	28.9	25.8	24.2	86	52.1
15	29.7	26	23.1	74	10.4
16	28.9	25.5	23.2	67	0
17	29.7	26.2	23.9	70	0
18	29	26.5	24.7	70	Trace
19	29.6	26.2	24.2	72	0
20	28.3	25.4	23.4	76	3.5
21	28.8	25.3	23.5	72	0
22	28	25	23.4	68	0

Source: Hong Kong Observatory

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Report No.: 0394/13/ED/0389A

Date	Air Temperature			Mean Relative Humidity (%)	Total Rainfall (mm)
	Maximum (deg. C)	Mean (deg. C)	Minimum (deg. C)		
October 2019					
23	28.7	25.5	23.5	71	0
24	29.5	26.2	24.5	71	0
25	28.3	25.8	24.3	75	0
26	28.3	25.9	24.7	75	Trace
27	29.0	25.7	24.0	76	Trace
28	29.0	25.2	22.4	77	Trace
29	24.7	22.7	20.3	65	0
30	26.4	24.0	21.5	60	0
31	27.2	24.8	23.2	68	0
November 2019					
1	29.3	25.7	24.0	73	0
2	28.2	25.3	23.9	74	0
3	28.8	25.7	23.8	74	0
4	28.6	25.0	22.8	56	0
5	27.4	23.9	21.6	56	0
6	26.5	23.8	22.3	69	0
7	26.9	23.8	21.4	56	0
8	26.8	23.3	20.8	51	0
9	26.0	22.7	20.4	62	0
10	26.7	22.7	20.6	70	0
11	26.8	23.1	20.9	72	0
12	25.2	23.3	22.3	78	0
13	26.8	24.1	22.3	75	0
14	25.9	23.0	21.1	64	0
15	25.7	22.8	21.5	70	0
16	25.6	22.5	21.5	76	0
17	26.5	23.4	21.4	79	0
18	28.4	24.3	20.6	69	0
19	22.7	20.5	17.9	63	0
20	24.0	21.1	19.4	66	0
21	25.2	21.7	19.2	66	Trace
22	26.3	22.3	19.6	66	0

Source: Hong Kong Observatory

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Rainstorm Warning Signals

Color	Start Time		End Time		Duration
	hh mm	dd/mon/yyyy	hh mm	dd/mon/yyyy	hh mm
Amber	0:50	25-Aug-19	2:40	25-Aug-19	01 50
Amber	11:30	25-Aug-19	14:45	25-Aug-19	03 15
Amber	23:55	25-Aug-19	0:40	26-Aug-19	00 45
Red	0:40	26-Aug-19	3:25	26-Aug-19	02 45
Amber	3:25	26-Aug-19	5:00	26-Aug-19	01 35
Amber	12:25	2-Sep-19	14:00	2-Sep-19	01 35
Amber	23:00	6-Oct-19	0:30	7-Oct-19	01 30
Amber	3:15	14-Oct-19	10:00	14-Oct-19	06 45

Source: Hong Kong Observatory

Thunderstorm Warning

Start Time		End Time		Duration
hh mm	dd/mon/yyyy	hh mm	dd/mon/yyyy	hh mm
7:00	23-Aug-19	14:30	23-Aug-19	07 30
15:20	23-Aug-19	17:00	23-Aug-19	01 40
23:55	24-Aug-19	2:45	25-Aug-19	02 50
10:55	25-Aug-19	15:00	25-Aug-19	04 05
21:40	25-Aug-19	15:30	26-Aug-19	17 50
0:50	27-Aug-19	2:00	27-Aug-19	01 10
3:15	29-Aug-19	7:30	29-Aug-19	04 15
10:55	29-Aug-19	16:30	29-Aug-19	05 35
5:35	30-Aug-19	10:30	30-Aug-19	04 55
1:30	31-Aug-19	6:00	31-Aug-19	04 30
14:55	31-Aug-19	19:45	31-Aug-19	04 50
9:45	1-Sep-19	10:45	1-Sep-19	01 00
13:45	1-Sep-19	21:00	1-Sep-19	07 15
23:20	1-Sep-19	3:00	2-Sep-19	03 40
4:35	2-Sep-19	19:30	2-Sep-19	14 55
20:25	2-Sep-19	22:30	2-Sep-19	02 05
5:47	3-Sep-19	7:15	3-Sep-19	01 28
22:55	3-Sep-19	19:00	4-Sep-19	20 05

Source: Hong Kong Observatory

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Start Time		End Time		Duration
hh mm	dd/mon/yyyy	hh mm	dd/mon/yyyy	hh mm
2:15	5-Sep-19	7:00	5-Sep-19	04 45
15:35	7-Sep-19	17:20	7-Sep-19	01 45
13:30	8-Sep-19	15:00	8-Sep-19	01 30
13:50	9-Sep-19	15:00	9-Sep-19	01 10
14:05	14-Sep-19	15:45	14-Sep-19	01 40
17:55	14-Sep-19	19:00	14-Sep-19	01 05
21:10	14-Sep-19	23:00	14-Sep-19	01 50
5:25	15-Sep-19	9:30	15-Sep-19	04 05
1:15	16-Sep-19	7:00	16-Sep-19	05 45
17:25	16-Sep-19	18:45	16-Sep-19	01 20
2:45	17-Sep-19	3:45	17-Sep-19	01 00
13:05	17-Sep-19	20:00	17-Sep-19	06 55
20:30	18-Sep-19	3:00	19-Sep-19	06 30

Source: Hong Kong Observatory

Thunderstorm Warning

Start Time		End Time		Duration
hh mm	dd/mon/yyyy	hh mm	dd/mon/yyyy	hh mm
0:20	6-Oct-19	4:30	6-Oct-19	04 10
13:30	6-Oct-19	17:00	6-Oct-19	03 30
20:15	6-Oct-19	1:20	7-Oct-19	05 05
2:35	7-Oct-19	9:30	7-Oct-19	06 55
12:55	12-Oct-19	17:15	12-Oct-19	04 20
2:25	13-Oct-19	7:30	13-Oct-19	05 05
18:00	13-Oct-19	11:30	14-Oct-19	17 30

Source: Hong Kong Observatory

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Tropical Cyclone Warning Signals

Intensity	Name	Signal	Start Time		End Time		Duration
			hh mm	dd/mon/yyyy	hh mm	dd/mon/yyyy	hh mm
Severe Tropical Storm	BAILU	1	14:40	24-Aug-19	19:20	25-Aug-19	28 40
Tropical Storm	PODUL	1	14:40	28-Aug-19	12:20	29-Aug-19	21 40
Tropical Depression	KAJIKI	1	8:40	1-Sep-19	16:20	1-Sep-19	07 40
Tropical Depression	KAJIKI	3	16:20	1-Sep-19	10:40	2-Sep-19	18 20
Tropical Depression	KAJIKI	1	10:40	2-Sep-19	9:20	3-Sep-19	22 40

Source: Hong Kong Observatory

Strong Monsoon Signals

Direction	Start Time		End Time		Duration
	hh mm	dd/mon/yyyy	hh mm	dd/mon/yyyy	hh mm
North	9:05	21-Sep-19	12:00	21-Sep-19	02 55
North	5:30	22-Sep-19	13:30	22-Sep-19	08 00
East	14:00	6-Oct-19	14:15	7-Oct-19	24 15
East	4:10	15-Oct-19	11:40	16-Oct-19	31 30

Source: Hong Kong Observatory