Market Sounding Exercise for the First Stage of Desalination Plant at Tseung Kwan O (Plant capacity of 135 million litres per day)

Invitation to Respond

Water Supplies Department
Government of Hong Kong Special Administrative Region

~~February~~ April 2016

The Water Supplies Department (WSD) wishes to invite potential bidders, who may be interested in either Design and Build (D&B) or Design, Build and Operate (DBO), of the *First Stage of Desalination Plant at Tseung Kwan O* (the Project) to share their level of interest as well as corporate profile, experiences, expertise, and ideas on the Project.

1. The Market Sounding Exercise

1.1 Through the Marketing Sounding Exercise (MSE), we would like to understand potential bidders':

- Level of interest in the Project
- View regarding the proposed Project delivery arrangement of either D&B or DBO
- Capability to undertake the Project under either a D&B or a DBO approach
- Ideas on various aspects of Project implementation, including preferred delivery arrangement, optimal plant layout, employer's requirements, adoption of renewable energy and advanced desalination technology, etc. to meet the Project objectives of minimisation of footprint and maximisation of energy efficiency.
- WSD will consider the relevant information gained through the MSE with a view to optimising the Project implementation arrangement to both meet the Project objectives and suit good market practices.

1.2 This is not a pre-qualification exercise to shortlist or prequalify any potential bidders. All information, views, and ideas of the respondent will be kept confidential and will not be used for any future tender evaluation exercise. Access to such information will be restricted to authorised personnel, including consultants' staff, strictly on a need-to-know basis. Potential bidders who do not respond to the MSE will not be barred from the future tendering exercise.

1.3 All engineering contracting organisations having capability and experience in undertaking D&B or DBO delivery of municipal-scale seawater desalination plant are encouraged to participate in the MSE.

1.4 In responding to the MSE, a respondent shall be deemed to have agreed to all the terms of this invitation. Respondents should note that the Government of the Hong Kong Special Administrative Region will not be responsible for any costs and expenses that may be incurred in responding to the MSE.

1.5 Submission of any information, data, analysis, or plans/drawings in support of responses is welcome. In particular, any plan/drawing, engineering calculation, or financial estimate in support of particular viewpoint or statement would be useful to WSD in understanding and analysing the MSE responses.

1.6 Interested potential bidders are encouraged to respond, as far as practicable, to the market sounding questions listed in **Appendix 1**. Relevant views and suggestions in relation to topics not mentioned in this document are welcome insofar as they will enhance the value for money proposition of the Project.

1.7 Responses to the market sounding questions should be returned to us preferably before **30 April 2016**

Either by email to:

musa_hs_tsang@wsd.gov.hk

Or by post to:

Consultants Management Division
Water Supplies Department,
6/F Shatin Government Offices,
1 Sheung Wo Che Road
Shatin, New Territories
Hong Kong
(Attention: Miss Musa H.S. TSANG)

1.8 Responses to the questions may be returned in batches and ahead of the date nominated above to enable our early review and feedback. WSD will take stock of the suggestions and comments received through the MSE and fine tune the tender/contractual arrangements. Respondents may be invited, when needed, to attend meeting(s) with WSD together with WSD's consultants, Black & Veatch, to discuss any points made in their submitted responses.

1.9 The MSE will continue until a point in time prior to the commencement of the formal tender exercise. Views or recommendations returned after 30 April 2016, but before the commencement of the tender exercise, may be considered.

1. 10 Interested potential bidders or respondents may wish to check the Project website (http://www.tkodesal.hk) regularly for any updates of the MSE.

2. Project Overview

2.1 The Project objectives include:

- Consistent compliance with product water quality standards
- Minimum environmental, social, and land use impacts on existing and future neighbouring communities and developments
- Being able to operate reliably and cost-effectively for a wide range of water production outputs over extended periods
- Minimisation of footprint of the desalination plant
- Maximisation of energy efficiency
- Completion and commissioning of the desalination plant within target timeline
- Achieving asset durability, material integrity, and workmanship standards
- Reasonable flexibility in coping with changes in plant performance targets, product water quality standards, and regulatory requirements

- Compliance with relevant risk, quality, environmental, health, safety, and asset management requirements and standards
- Satisfactory transfer of technology and knowledge on the design, construction and operation & maintenance of the desalination plant to WSD

2.2 The Project will have a water production capacity of 135 million litres per day (MLD), which is the design capacity of the first stage of the desalination plant. It will also make provisions for future expansion to the ultimate capacity up to 270MLD. The Project comprises the following key components:

- Formation of the reserved site of about 10 hectares in TKO Area 137 to provide sufficient space for a desalination plant with an ultimate water production output at 270 MLD (the Site)
- Design and construction of the desalination plant and associated facilities, including the intake/outfall system and desalinated water pumping station
- Operation and maintenance of the desalination plant and the associated facilities for the designated operation period

2.3 Works will be carried out on the adjacent natural slope to mitigate the natural terrain hazards affecting the Site. Such slope mitigation works will be delivered using a traditional design-bid-build approach and is outside the scope of this MSE.

2.4 Product water produced by the desalination plant will be transferred via a fresh water main to the existing Tseung Kwan O Fresh Water Primary Service Reservoir (TKOFWPSR) and/or other existing fresh water service reservoirs. Detailed design of the fresh water main is being carried out by WSD Design Division and the main laying works will be arranged by WSD separately. This work package is also outside the scope of this MSE.

2.5 Preliminary Project design data are summarised in **Appendix 2-1**, **Appendix 2-2,** and **Appendix 2-3**, which contain the treated water quality objectives, seawater quality sampling data, and ground investigation results, respectively.

2.6 The Environmental Impact Assessment Report approved by the Environmental Protection Department (EPD) is available on line via:

http://www.epd.gov.hk/eia/register/report/eiareport/eia_2292015/Front%20Page.htm

Moreover, Environmental Permit has been issued by EPD. Details of the permit are available on line via: http://www.epd.gov.hk/eia/register/permit/latest/ep5032015.pdf

3. Proposed Procurement Model

3.1 WSD intends to procure the Project using a D&B or DBO approach. Specifically,

- The project delivery contractor will be responsible for design development, construction, testing and commissioning of the desalination plant.
- Under the D&B approach, the project delivery contractor will be responsible for operations and maintenance of the desalination plant for an *initial* operation period (duration of which will be determined by WSD). The project delivery contractor will hand the desalination plant back to WSD (or another party nominated by WSD) upon completion of the initial operation period.
- Under the DBO approach, the project delivery contractor will be responsible for operations and maintenance of the desalination plant for the Operation Period (duration of which to be determined by WSD). The project delivery contractor will hand the desalination plant back to WSD (or another party nominated by WSD) upon completion of the designated Operation Period.

- The detailed risk allocation and commercial arrangements, including payment mechanism, will be determined taking into account the MSE results.

3.2 WSD is expecting that the comments and suggestions received in the MSE will contribute to the development and fine-tuning of the procurement model.

4. Procurement Timeline

4.1 Subject to the progress on clearing of statutory requirements, it is aimed to commence prequalification by the end of 2016 with a short period (about 2 months) allowed for the submission of prequalification documents and to invite proposals from the prequalified tenderers in early 2017.

5. Capability of the Delivery Contractor

5.1 ~~Given the complex nature of the Project,~~ WSD expects the prime project delivery contractor ~~(which may be a single entity or a joint venture)~~ will have capability (i.e., project experiences, technical resources, and personnel) in (a) the design, construction, testing, commissioning, operations, and maintenance of municipal-scale seawater reverse osmosis desalination plants and (b) delivery of local construction works relevant to the scope of the Project. ~~both:~~

- ~~Design, construction, testing and commissioning, and/or operations, and maintenance of municipal-scale seawater reverse osmosis desalination plants~~
- ~~Design and construction of civil engineering works, including site formation, foundations, building structures, and marine works in Hong Kong~~

5.2 The prime project delivery contractor may be a single entity or a joint venture (JV). If a JV is to be formed, WSD would like to hear your view on what might be an appropriate composition of the JV to maximize value for money outcome. ~~Electrical, mechanical, and other~~ Other technical or engineering discipline consultants or contractors may be engaged by the prime project delivery contractor as subcontractors, if needed.

6. Enquiry

6.1 If you have any question, please feel free to contact Miss Musa Hiu-sum TSANG at email address musa_hs_tsang@wsd.gov.hk or telephone number (+852) 2634 3576.

7. Disclaimer

7.1 This document is for reference and for the purposes of collecting market information only.

7.2 This is not a prequalification process of tenderers. Potential bidders that have not responded to this MSE will not be barred from bidding for delivery of the Project.

7.3 This document does not constitute any offer or invitation/solicitation of any offer in connection with the Project described herein. Neither this document nor any activities in connection therewith shall create any legal obligations or liabilities in any way on the part of the WSD or the Government of Hong Kong Special Administrative Region. Neither this document nor anything contained herein shall form the basis of any contract or commitment whatsoever.

7.4 The WSD will under no circumstances be liable to any fees, costs, expenses, loss or damage whatsoever arising out of or in connection with this MSE. No information and material received from the respondents will be returned.

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Market Sounding Exercise Questions for Delivery of Stage 1 of Desalination Plant at Tseung Kwan O

(Plant capacity of 135 million litres per day)

PREAMBLE

Interested potential bidders are encouraged to respond to the market sounding questions listed below, as far as practicable, in relation to the delivery of *Stage 1 of Desalination Plant at Tseung Kwan O* (the Project). Responses to the questions should be returned preferably by 30 April 2016. Early responses in batches ahead of time are welcome to enable our early review and feedback.

WSD will keep the information received confidential. Access to the information will be restricted to authorised personnel, including the consultants' staff, strictly on a need-to-know basis. The information will not be used for any future tendering exercise.

1.0 LEVEL OF INTEREST AND CAPABILITY

1.1 Identification of the Respondent

Please provide:

1. Name, in both Chinese (if applicable) and English, of the respondent
2. Place and date of incorporation if the respondent is a corporation and the corresponding certified copy of the certificate of incorporation and any certificates of incorporation on change of name
3. Evidence showing the respondent's overseas business registration, if applicable

1.2 Organisational Information

Please provide:

1. Brief description of the history and business of the respondent, including company brochures as well as its business experience in Hong Kong and/or overseas (Note: If the respondent is a member, e.g., a subsidiary of a group of companies, provide also the same of the group)
2. Name of registered and beneficial immediate, intermediate, and ultimate shareholders of the respondent
3. Description of the respondent's experience and expertise in the design, construction, operation, or maintenance of seawater reverse osmosis desalination plants that are of similar nature and/or scale to this Project, if appropriate and preferably using the template shown in Appendix 1-1.
4. Description of the respondent's key personnel in the design, construction, operation or maintenance of seawater reverse osmosis desalination plants that are of similar nature and scale to this Project, if appropriate and preferably using the template shown in Appendix 1-2.

1.3 Participation

1. For a project such as this, in which of the following areas/roles would you be interested in participating?

    - Design – designer / engineer
    - Construction – main contractor
    - Construction – sub-contractor
    - Construction - supplier
    - Operation and Maintenance – operator
    - Operation and Maintenance - supplier

2. What other projects in the market will you be considering in the same timeframe that would be competing for resources and what is the impact on your ability / interest to participate in this Project?

3. If other projects would affect your ability / interest to participate, how will you determine which project to pursue? What would make this Project attractive?

4. Would your company be able to deliver a project of this size and nature by itself (under either a D&B or a DBO procurement mode)? Or, would you need to form a team / partnership?

5. What key personnel resources, in terms of area of expertise and length of experience, do you expect to be required to deliver this project?

6. Are there any other issues that are critical to your participation in this Project that you can foresee?

2.0 RESPONDENT'S VIEWS AND SUGGESTIONS

2.1 Project Scope and Works Packaging

WSD is considering procuring the desalination plant and associated facilities including the seawater intake and brine outfall systems under a D&B or DBO contract.

1. Do you have any views on this approach? If so, please elaborate on your suggestion and rationale.

2. What is your view if the seawater intake and outfall system is procured under a separate D&B contract and handed over to the DBO contractor to operate?

3. Is there any other alternative works packaging that you may think of would be preferable?

2.2 Desalination Plant Capacity

The first stage of the TKO Desalination Plant is currently planned to have a design capacity of 135 million litres per day (MLD), which is expandable to 270 MLD ultimately.

1. Do you see any savings in capital and/or operations & maintenance costs if the plant availability target for water production can be relaxed to exclude certain low frequency feed seawater quality scenarios (e.g., occurrence of red tides)? If so, please elaborate and provide supporting technical information (e.g., preliminary plant layout) to illustrate the concept.

2. Do you see any savings in capital and/or operations & maintenance costs if the design capacity of the desalination plant can be modified slightly to allow more flexibility in the configuration of process equipment and technologies? If so, please elaborate.

3. Given land availability, do you have any views, in the context of achieving optimal whole life cycle cost, on the proposal of integrating the provisions for future capacity expansion into the design of the Project (i.e., First stage of the TKO Desalination Plant) to achieve more cost-effectiveness of the plant? If yes, please elaborate.

2.3 Plant Footprint

It is desirable to minimise the footprint of the desalination plant. Use of compact technologies or multi-storey approach to plant layout could reduce the footprint of the overall desalination plant, but this could also increase energy consumption and maintenance efforts.

1. What is your approach with respect to optimising footprint with energy consumption and plant maintainability for these two operating scenarios: (1) water production capacity is to be made available all the time and (2) the plant may be operated at a lower availability (e.g. not less than 80% of the time)? Preliminary layouts of the plant for (1) and (2) are welcome to facilitate better understanding of your approach.

2. What is the optimal minimum footprint of the plant to achieve the design capacity of 135 MLD (expandable to 270 MLD) while keeping energy consumption and maintenance efforts at an optimum? A preliminary layout plan is welcome to illustrate your view.

2.4 Energy Efficiency

It is desirable to minimise energy consumption of the desalination plant, which will have benefits in terms of reduction of both greenhouse gas emissions and energy costs. Use of compact technologies or a multi-storey approach to plant layout could reduce the footprint of the overall desalination plant, but this could also increase energy consumption and maintenance efforts.

1. What is your approach with respect to optimising energy consumption with footprint reduction and plant maintainability?

2. What key performance indicators do you think should be included in the D&B or DBO contract to incentivise outperformance in this subject?

3. Will you consider use of renewable energy for the desalination plant? If not, why not? If yes, please elaborate and let us have your estimate on the potential net energy saving or contribution to the energy consumption of the plant.

2.5 Dealing with Possible Uncertainties

There may be uncertainties in the context of procurement/contract strategy:

- The uncertainty in the future water production rate or output pattern of the first stage of the TKO Desalination Plant; and

- The uncertainty in the timing for implementing the future stage of the TKO Desalination Plant (up to a capacity of 270 MLD)

1. Given these two uncertainties, what do you think would be appropriate measures (e.g., risk sharing mechanism, payment mechanism during the operation period, phasing of installation of RO modules/units, etc.) to maximise value-for-money to the WSD?

2. With reference to the preliminary design parameters given in **Appendix 2**, do you find any further design information required and/or any site investigation or survey data required in order to minimise the risks of project implementation?

2.6 Contract Form and Operations Period

It aims to achieve the most optimal whole-life-cycle cost (or total cost of asset ownership) solution to the Project.

1. Given the identified uncertainties, risks, and opportunities, what do you think would be an appropriate duration of the Operations Period for the DBO approach to maximise value-for-money to the WSD? What key considerations you think should be taken into account in determining the Operation Period? Please elaborate on your suggestion and rationale.

2. If a D&B approach is adopted, WSD intends that there will be a short initial operation period after commissioning of the plant, the primary purpose of which will be for the D&B contractor to prove the operational performance of the plant. What do you think would be an appropriate length of such initial operation period? Please elaborate on your suggestion and rationale.

3. There is at present an uncertainty in the timing for implementing Stage 2 of the desalination plant at TKO. To avoid interfacing issues and operational complexities, it is considered that only one single contractor would be responsible for expanding the plant (i.e., future Stag 2) and operating the Stage 1 plant facilities at the same time. To allow this, "no-fault termination" clause is being considered for incorporation into the DBO contract for Stage 1. This clause could be invoked by WSD during the Operation Period (say, for example, any point in time within 10 years after plant commissioning) at its discretion without the need to discuss the matter with the contractor. Do you have any comments on this arrangement?

4. What is your preference, a D&B contract, or a DBO contract? Please elaborate on your rationale and consideration.

5. Do you have any knowledge and experience in implementing NEC contract? If NEC contract form is adopted for the D&B or DBO contract, what is your view and suggestion?

2.7 Risk Allocation

1. Do you see any significant risks that you, as a DB/DBO contractor, would not be able to manage cost-efficiently?

2. What aspects do you consider preferable to be specified in the Employer's Requirements, specifications, and other contract provisions in order to minimise risks to the Project and hence overall cost to WSD?

3. What are the Employer's Requirements as well as mandatory requirements, which you consider should be best incorporated into the DB/DBO contract? Please elaborate your suggestion and rationale.

2.8 Statutory Requirements

As part of the feasibility study on the desalination plant (including the seawater intake and brine disposal facilities), a statutory Environmental Impact Assessment (EIA) report was prepared and approved by the Environmental Protection Department. The Environmental Permit (EP) granted for the construction and operation of the desalination plant stipulates certain detailed design submissions and other requirements on the environmental monitoring and audit programme.

Do you have any concern or views on the proposed location and preliminary design of the seawater intake and brine disposal facilities shown in the EIA report and EP?

2.9 Employer's Requirements

1. What aspects do you consider <u>not</u> preferable to be specified in the Employer's Requirement, specifications, or other contract provisions?

2. What role do you see the Tender Reference Design to be incorporated into the final Contract documentation?

2.10 Implementation Programme and Site Possession

The Site may be handed over to the DB/DBO contractor in phases. For example, it may only be possible to hand over *initially* a portion of site with a size of approximately 4 hectares (or smaller). This initial portion may only be available three months after Contract award, while the remaining site portion may be made available approximately 12 months (or longer) after Contract award.

1. What are your views on the phased handover arrangement and what is your approach to site mobilisation?

2. Under the current programme, the time allowed for the design and construction (detailed design, construction, testing, and commissioning) of the desalination plant is about 35 months (including an allowance for extensions of time due to inclement weather). What is your view on the length of the proposed design and construction period in the light of the likely site handover arrangements?

3. In your experience, what do you think would be appropriate lengths of time required for detailed design, procurement, construction, testing and commissioning, respectively of a desalination plant of similar capacity? What are your corresponding estimated durations for the Project? Please provide a preliminary programme of activities to facilitate better understanding of your view.

4. Do you see any potential issues that could cause delay to the commissioning of the desalination plant?

5. What is your approach to achieving the implementation programme as outlined above?

2.11 Promoting Innovations

1. What do you think would be the most effective means to drive innovation in the procurement process to maximise value-for-money outcome to the Government?

2. How can the first stage of the plant make provisions for facilitating research and development of desalination technologies and/or pilot testing of any advanced technologies? Do you have any knowledge or experiences on how this can be implemented?

3. Do you have any suggestion on any research & development aspects and/or advanced desalination technologies that can be put in place in the first stage of the desalination plant?

2.12 Incentives for Outperformance

1. What do you think would be the most effective means to incentivise outperformance by the DBO contractor to maximise value-for-money outcome to the Government in the procurement process and during construction and operation?

2. What key performance indicators do you think should be included in the D&B contract or DBO contract to incentivise outperformance in this subject?

2.13 Technology and Skill Transfer

WSD is looking for transfer of technology and skill with respect to operation, and maintenance of seawater reverse osmosis desalination facilities from experienced practitioners. What do you think would be the most effective way to make this happen?

3.0 CONCLUDING QUESTIONS

1. Based on the information provided above, how likely will you be participating in the Project (e.g. unlikely, likely, highly likely)? What are or will be the factors that influence your decision to participate?

2. Do you have other issues that you wish to comment on or make suggestions? If yes, what are they?

3. Are there any significant information gaps in, for example, the land or marine site investigations that you consider critical to sound risk management and hence realistic pricing and scheduling?

4. Is there any other information that you consider critical to the Project but not provided in this MSE document?

5. Do you agree that we may contact you again if we have follow up questions?

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List of Relevant Past Projects

1. Experience in Design and Build Desalination Plant Project

Project Title	Brief Description (See Note 1)	Project Value (USD)	A. Contract Commencement date B. Contract Completion date (Original) C. Contract Completion date (Extended) D. Actual / Anticipated Completion date				Contract Duration (days)	Client/Main Contractor	Plant Capacity (Mld)	Capacity of Involvement (see Note 2)	Name of the Entity Involved in the Project (see Note 3)
			A (mm/yyyy)	**B** (mm/yyyy)	**C** (mm/yyyy)	**D** (mm/yyyy)					

2. Experience in Design-Build-Operate / Build-Operate-Transfer / Build-Own-Operate Desalination Plant Project

Project Title	Brief Description (See Note 1)	Contract Type (DBO / BOT / BOO)	Project Value (USD) (see Note 4)	A. Contract Commencement date B. Contract Completion date (Original) C. Contract Completion date (Extended) D. Actual / Anticipated Completion date				Operation Period (years)	Client/Main Contractor	Plant Capacity (Mld)	Capacity of Involvement (see Note 2)	Name of the Entity Involved in the Project (see Note 3)
				A (mm/yyyy)	**B** (mm/yyyy)	**C** (mm/yyyy)	**D** (mm/yyyy)					

3. Experience in the design and installation of electrical and mechanical works, reverse osmosis equipment or the like for desalination plant

Project Title	Brief Description (See Note 1)	Contract Type	Value of design work (USD)	Value of supply and installation work (USD)	A. Contract Commencement date B. Contract Completion date (Original) C. Contract Completion date (Extended) D. Actual / Anticipated Completion date				Contract Duration (days)	Client /Main Cont-ractor	Plant Capacity (Mld)	Capacity of Involve-ment (see Note 2)	Name of the Entity Involved in the Project (see Note 3)
					A (mm/yyyy)	**B** (mm/yyyy)	**C** (mm/yyyy)	**D** (mm/yyyy)					

4. Experience in the civil construction of water / wastewater treatment facilities

Project Title	Brief Description (See Note 1)	Contract Type	Value of civil construction work (USD)	A. Contract Commencement date B. Contract Completion date (Original) C. Contract Completion date (Extended) D. Actual / Anticipated Completion date				Contract Duration (days)	Client/Main Contractor	Capacity of Involvement (see Note 2)	Name of the Entity Involved in the Project (see Note 3)
				A (mm/yyyy)	**B** (mm/yyyy)	**C** (mm/yyyy)	**D** (mm/yyyy)				

Notes:

(1) Please state nature, scope and key features of the contract e.g Type of Plant / Equipment Involved and Location.

(2) Please state whether your company was the main contractor, subcontractor, supplier, or a joint venture participant (to state the % of participation by value of work in case of a joint venture).

(3) Please indicate if you were involved in the project under a different name such as in the case of a subsidiary, sister company or mother company.

(4) Please specify value of design and build and value of operation and maintenance for DBO Contract.

(5) Please provide separate sheets if more space is required.

(6) Please categorise the above details for Hong Kong Government contracts and other contracts in the Hong Kong and outside Hong Kong separately.

Experience of Key Personnel

1. Project Manager

Qualifications : _____
Length of post-qualification experience (years): _____

Project Title	Brief Description	Location	Project Value (USD)	Role	Key Responsibilities	Start of Involvement (mm/yyyy)	End of Involvement (mm/yyyy)	Duration (months)

2. Construction Manager (Civil works)

Qualifications: _____
Length of post-qualification experience (years): _____

Project Title	Brief Description	Location	Project Value (USD)	Role	Key Responsibilities	Start of Involvement (mm/yyyy)	End of Involvement (mm/yyyy)	Duration (months)

3. Construction Manager (E&M works including the installation of reverse osmosis equipment)

Qualifications: _____
Length of post-qualification experience (years): _____

Project Title	Brief Description	Location	Project Value (USD)	Role	Key Responsibilities	Start of Involvement (mm/yyyy)	End of Involvement (mm/yyyy)	Duration (months)

4. Design Manager (Civil Works)

Qualifications: _____
Length of post-qualification experience (years): _____

Project Title	Brief Description	Location	Project Value (USD)	Role	Key Responsibilities	Start of Involvement (mm/yyyy)	End of Involvement (mm/yyyy)	Duration (months)

5. Plant Design Manager (E&M works)

Qualifications: _____
Length of post-qualification experience (years): _____

Project Title	Brief Description	Location	Project Value (USD)	Role	Key Responsibilities	Start of Involvement (mm/yyyy)	End of Involvement (mm/yyyy)	Duration (months)

6. Operation Manager

Qualifications: _____
Length of post-qualification experience (years): _____

Project	Brief	Location	Project	Role	Key	Start of	End of	Duration

Title	Description		Value (USD)		Responsibilities	Involvement (mm/yyyy)	Involvement (mm/yyyy)	(months)

Notes:
(1) For qualification, please state the education e.g. degree and professional qualification e.g. Corporate member of professional institution, if applicable.
(2) Please use separate sheet if more space is required.
(3) Name of the key personnel is not required to be given.

Proposed Water Quality Objectives of Desalinated Water

Parameter	Unit	Design Goal
pH	pH unit	8.2-8.8
Alkalinity	mg/L as $CaCO_3$	19
Hardness	mg/L as $CaCO_3$	30
Colour	Hazen units	≤5
Turbidity	NTU	≤1.0 NTU, and ≤0.3 NTU in 95% of daily samples in any month (prior to pH adjustment)
Iron as Fe	mg/L	≤ 0.1
Manganese as Mn	mg/L	≤0.05
Aluminium as Al	mg/L	≤0.10
Free residual chlorine	mg/L	0.5 – 1.5
Fluoride as F	mg/L	±10% of nominal level (current 0.5 mg/L)
Taste and odour	TON	Unobjectionable
Total Coliforms & *E. coli*	no./100mL	Absent
Viruses	Log removal in %	4-log (99.99%) reduction or inactivation
Cryptosporidium oocysts (C)	Log removal in %	4-log (99.99%) reduction or inactivation
Giardia cysts (G)	Log removal in %	4-log (99.99%) reduction or inactivation
Boron	mg/L	≤1.0
Total Dissolved Solids	mg/L	≤250
Bromide	mg/L	≤0.2

Seawater Quality Monitoring Results

Sea Water Quality Monitoring Results

Water sampling was conducted from December 2013 to December 2014 at two sampling locations as shown in **Figure 1**.

- Sampling Location 1 is located approximately 50m away from the shoreline. The water depth is approximately 4m according to the marine navigation chart. Samples were collected at the middle of the water depth. The results of the water sampling at location 1 showing the maximum, minimum and average of all testing parameters are summarised in **Table 1**.

- Sampling Location 2 is located approximately 250m away from the shoreline. The water depth is approximately 11-12m. Samples were collected at three different levels i.e. surface – 2m below water surface, middle – middle of the water depth, bottom – 2m above seabed.

  The results of the water sampling at the surface, middle and the bottom at location 2 showing the maximum, minimum and average of all testing parameters are summarised in **Table 2**, **Table 3** and **Table 4** respectively.

Figure 1 Sampling Locations

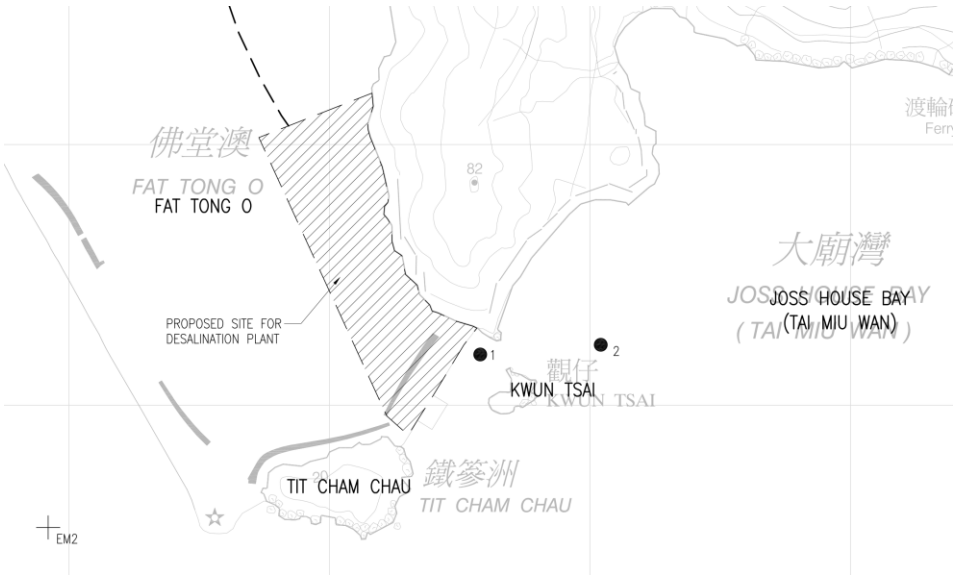


Table 1 Results Summary of the Water Sampling at Location 1 (middle depth)

	Max.	Average	Min.	Relevant Figure
Weekly Parameter – samples taken at 1 high tide event an 1 low tide event on one sampling day per week				
Electrical Conductivity (uS/cm)	54,600	48,934	38,500	Figure 2
Total Dissolved Solid (mg/l)	40,000	34,552	24,400	Figure 3
Suspended Solid (mg/l)	27	5	<2	Figure 4

	Max.	Average	Min.	Relevant Figure
Dissolved Organic Carbon (mg/l)	5	2	<2	Figure 5
Total Organic Carbon (mg/l)	5	2	<2	Figure 6
Chlorophyll a (ug/l)	30.5	4.2	0.3	Figure 7
Biweekly Parameter – samples taken at 1 high tide and 1 low tide event on one sampling day per every two weeks				
Settleable Solids (ml/l)	< 0.1			-
Turbidity (NTU)	18	3	<1	Figure 8
UV Absorption @254nm (Abs/cm)	< 0.1			-
Total Alkalinity as $CaCO_3$ (mg/l)	125	116	104	Figure 9
Sulphate as SO_4 (mg/l)	3520	2512	1340	Figure 10
Chloride (mg/l)	24000	17762	12000	Figure 11
Oil & Grease (mg/l)	< 5			-
Chemical Oxygen Demand (mg/l)	200	52	<25	Figure 12
Biochemical Oxygen Demand (mg/l)	2	2	<2	Figure 13
Boron (mg/l)	5.2	4.4	3.6	Figure 14
Calcium (mg/l)	449	393	302	Figure 15
Magnesium (mg/l)	1340	1177	844	Figure 16
Potassium (mg/l)	441	343	127	Figure 17
Sodium (mg/l)	10600	9479	7070	Figure 18
Monthly Parameter - samples taken at 1 high tide and 1 low tide event on one sampling day per month				
Ammonia (NH_4-N) (ug/l)	160	34	<5	Figure 19
Bromide (mg/l)	83.6	64.0	25.4	Figure 20
E.Coli (CFU/100ml)	380	22	ND	Figure 21
Total Coliforms (CFU/ 100ml)	770	49	ND	Figure 22
Bi-Monthly Parameter - samples taken at 1 high tide and 1 low tide event on one sampling day per every two months				
Total Cyanide (ug/l)	< 10			-
Fluoride (mg/l)	1.00	0.87	0.80	-
Silica (mg/l)	0.99	0.58	0.04	Figure 23
Nitrate - N (mg/l)	0.10	0.06	<0.01	Figure 24
Total Nitrogen - N (mg/l)	0.5	0.3	0.3	Figure 25
Total Phosphorus (mg/l)	0.02	0.01	<0.01	-
Manganese (mg/l)	0.02	0.01	<0.01	-
Strontium (ug/l)	8,940	7,092	4,110	Figure 26
Antimony(ug/l)	0.8	0.5	<0.5	Figure 27
Arsenic (ug/l)	2	2	1	-
Barium (ug/l)	10.7	8.6	4.0	Figure 28
Beryillium (ug/l)	< 0.5			-
Cadmium (ug/l)	0.7	0.2	<0.1	Figure 29
Chromium (ug/l)	2.0	0.5	<0.2	Figure 30
Copper (ug/l)	3.5	1.5	0.5	Figure 31
Lead (ug/l)	2.3	0.7	<0.2	Figure 32
Nickel (ug/l)	1.2	0.8	0.5	Figure 33
Selenium (ug/l)	< 10			-

	Max.	Average	Min.	Relevant Figure
Silver (ug/l)	< 0.1			-
Thallium (ug/l)	< 0.2			-
Vanadium (ug/l)	2	2	1	Figure 34
Zinc (ug/l)	17	7	2	Figure 35
Aluminum (mg/l)	0.11	0.05	<0.01	Figure 36
Iron (mg/l)	0.13	0.07	<0.05	Figure 37
Mercury (ug/l)	0.1	0.1	<0.1	-
Phenol (ug/l)	< 2			-
Benzene (ug/l)	< 0.5			-
Toluene (ug/l)	<0.5			-
Ethylbenzene (ug/l)	< 0.5			-
Xylenes - Total (ug/l)	< 20			-
Carbon Tetrachloride (ug/l)	< 0.5			-
Trichloroethene (ug/l)	< 0.5			-
Tetrachloroethene (ug/l)	< 0.5			-
Chloroform (ug/l)	< 0.5			-
Tributyltin (ug TBT /l)	< 0.015			-
Caesium-134 (Bq/l)	0.084	0.058	0.050	Figure 38
Tritium (Bq/l)	9.5	2.6	<2.0	Figure 39
Caesium-137 (Bq/l)	0.095	0.059	<0.050	Figure 40
Iodine-131 (Bq/l)	0.630	0.291	<0.100	Figure 41
Strontium-90 (Bq/l)	< 0.050			-

Table 2 Results Summary of the Water Sampling at Location 2 – Surface

	Max.	Average	Min.	Relevant Figure
Weekly Parameter – samples taken at 1 high tide event an 1 low tide event on one sampling day per week				
Electrical Conductivity (uS/cm)	54,500	49,170	42,300	Figure 2
Total Dissolved Solid (mg/l)	39,100	34,634	27,300	Figure 3
Suspended Solid (mg/l)	12	3	<2	Figure 4
Dissolved Organic Carbon (mg/l)	4	2	<2	Figure 5
Total Organic Carbon (mg/l)	7	2	<2	Figure 6
Chlorophyll a (ug/l)	37.6	6.5	0.2	Figure 7
Biweekly Parameter – samples taken at 1 high tide and 1 low tide event on one sampling day per every two weeks				
Settleable Solids (ml/l)	< 0.1			-
Turbidity (NTU)	4	2	<1	Figure 8
UV Absorption @254nm (Abs/cm)	< 0.1			-
Total Alkalinity as $CaCO_3$ (mg/l)	127	116	105	Figure 9
Sulphate as SO_4 (mg/l)	3200	2532	794	Figure 10
Chloride (mg/l)	21500	17810	12600	Figure 11
Oil & Grease (mg/l)	21	5	<5	-
Chemical Oxygen Demand (mg/l)	200	52	<25	Figure 12
Biochemical Oxygen Demand (mg/l)	3	2	<2	Figure 13
Boron (mg/l)	5.6	4.4	3.8	Figure 14
Calcium (mg/l)	468	397	318	Figure 15
Magnesium (mg/l)	1390	1196	904	Figure 16
Potassium (mg/l)	452	356	277	Figure 17
Sodium (mg/l)	10600	9528	7490	Figure 18
Monthly Parameter - samples taken at 1 high tide and 1 low tide event on one sampling day per month				
Ammonia (NH_4-N) (ug/l)	108	22	<5	Figure 19
Bromide (mg/l)	83.6	64.7	30.2	Figure 20
E.Coli (CFU/100ml)	220	30	ND	Figure 21
Total Coliforms (CFU/ 100ml)	620	57	ND	Figure 22
Bi-Monthly Parameter - samples taken at 1 high tide and 1 low tide event on one sampling day per every two months				
Total Cyanide (ug/l)	<10			-
Fluoride (mg/l)	1.00	0.88	0.80	-
Silica (mg/l)	0.84	0.42	<0.01	Figure 23
Nitrate - N (mg/l)	0.11	0.04	<0.01	Figure 24
Total Nitrogen - N (mg/l)	0.50	0.23	0.10	Figure 25
Total Phosphorus (mg/l)	0.02	0.01	<0.01	-
Manganese (mg/l)	0.02	0.01	<0.01	-

	Max.	Average	Min.	Relevant Figure
Strontium (ug/l)	9,200	7,742	6,860	Figure 26
Antimony(ug/l)	1.0	0.6	<0.5	Figure 27
Arsenic (ug/l)	2	2	2	-
Barium (ug/l)	9.5	8.4	6.8	Figure 28
Beryillium (ug/l)	< 0.5			-
Cadmium (ug/l)	0.1	0.1	<0.1	Figure 29
Chromium (ug/l)	0.5	0.3	<0.2	Figure 30
Copper (ug/l)	5.0	2.0	0.6	Figure 31
Lead (ug/l)	18.5	1.8	<0.2	Figure 32
Nickel (ug/l)	1.2	0.9	0.4	Figure 33
Selenium (ug/l)	<10.0			-
Silver (ug/l)	<0.1			-
Thallium (ug/l)	<0.2			-
Vanadium (ug/l)	3	2	1	Figure 34
Zinc (ug/l)	13	5	1	Figure 35
Aluminum (mg/l)	0.10	0.04	<0.01	Figure 36
Iron (mg/l)	0.13	0.06	<0.05	Figure 37
Mercury (ug/l)	<0.1			-
Phenol (ug/l)	< 2			-
Benzene (ug/l)	< 0.5			-
Toluene (ug/l)	<0.5			-
Ethylbenzene (ug/l)	< 0.5			-
Xylenes - Total (ug/l)	< 20			-
Carbon Tetrachloride (ug/l)	< 0.5			-
Trichloroethene (ug/l)	< 0.5			-
Tetrachloroethene (ug/l)	< 0.5			-
Chloroform (ug/l)	< 0.5			-
Tributyltin (ug TBT /l)	< 0.015			-
Caesium-134 (Bq/l)	0.100	0.054	<0.050	Figure 38
Tritium (Bq/l)	2.1	2.0	<2.0	Figure 39
Caesium-137 (Bq/l)	0.120	0.064	<0.050	Figure 40
Iodine-131 (Bq/l)	0.650	0.292	<0.100	Figure 41
Strontium-90 (Bq/l)	< 0.050			-

Table 3 Results Summary of the Water Sampling at Location 2 – Middle

	Max.	Average	Min.	Relevant Figure
Weekly Parameter- samples taken at 1 high tide and 1 low tide event on one sampling day per week				
Electrical Conductivity (uS/cm)	58,500	49,440	18,300	Figure 2
Total Dissolved Solid (mg/l)	40,300	35,093	29,700	Figure 3
Suspended Solid (mg/l)	15	4	<2	Figure 4
Dissolved Organic Carbon (mg/l)	6	2	<2	Figure 5
Total Organic Carbon (mg/l)	7	2	<2	Figure 6
Chlorophyll a (ug/l)	31.4	5.1	0.3	Figure 7
Biweekly Parameter – samples taken at 1 high tide and 1 low tide event on one sampling day per every two weeks				
Settleable Solids (ml/l)	< 0.1			-
Turbidity (NTU)	4	2	<1	Figure 8
UV Absorption @254nm (Abs/cm)	< 0.1			-
Total Alkalinity as $CaCO_3$ (mg/l)	125	115	20	Figure 9
Sulphate as SO_4 (mg/l)	3350	2553	920	Figure 10
Chloride (mg/l)	21600	18181	13200	Figure 11
Oil & Grease (mg/l)	< 5			-
Chemical Oxygen Demand (mg/l)	200	52	<25	Figure 12
Biochemical Oxygen Demand (mg/l)	2	2	<2	Figure 13
Boron (mg/l)	5.3	4.5	3.7	Figure 14
Calcium (mg/l)	479	399	289	Figure 15
Magnesium (mg/l)	1450	1201	980	Figure 16
Potassium (mg/l)	454	359	273	Figure 17
Sodium (mg/l)	10700	9623	7910	Figure 18
Monthly Parameter - samples taken at 1 high tide and 1 low tide event on one sampling day per month				
Ammonia (NH_4-N) (ug/l)	98	26	<5	Figure 19
Bromide (mg/l)	78.6	66.1	36.2	Figure 20
E.Coli (CFU/100ml)	360	26	ND	Figure 21
Total Coliforms (CFU/ 100ml)	440	48	ND	Figure 22
Bi-Monthly Parameter - samples taken at 1 high tide and 1 low tide event on one sampling day per every two months				
Total Cyanide (ug/l)	<10			-
Fluoride (mg/l)	0.90	0.88	0.80	-
Silica (mg/l)	1.25	0.51	0.05	Figure 23
Nitrate - N (mg/l)	0.15	0.05	0.02	Figure 24
Total Nitrogen - N (mg/l)	0.60	0.28	0.10	Figure 25
Total Phosphorus (mg/l)	0.03	0.01	<0.01	-
Manganese (mg/l)	0.02	0.01	<0.01	-
Strontium (ug/l)	8,960	7,693	6,910	Figure 26
Antimony(ug/l)	1.0	0.6	<0.5	Figure 27
Arsenic (ug/l)	2	2	2	-
Barium (ug/l)	10.2	8.0	6.2	Figure 28
Beryillium (ug/l)	< 0.5			-

	Max.	Average	Min.	Relevant Figure
Cadmium (ug/l)	0.7	0.2	<0.1	Figure 29
Chromium (ug/l)	0.6	0.3	<0.2	Figure 30
Copper (ug/l)	10.8	3.5	1.0	Figure 31
Lead (ug/l)	35.5	3.7	<0.2	Figure 32
Nickel (ug/l)	2.2	0.9	0.5	Figure 33
Selenium (ug/l)	<10.0			-
Silver (ug/l)	<0.1			-
Thallium (ug/l)	<0.2			-
Vanadium (ug/l)	2	2	2	Figure 34
Zinc (ug/l)	33	9	3	Figure 35
Aluminum (mg/l)	0.13	0.04	<0.01	Figure 36
Iron (mg/l)	0.23	0.08	<0.05	Figure 37
Mercury (ug/l)	< 0.1			-
Phenol (ug/l)	< 2			-
Benzene (ug/l)	< 0.5			-
Toluene (ug/l)	<0.5			-
Ethylbenzene (ug/l)	< 0.5			-
Xylenes - Total (ug/l)	< 20			-
Carbon Tetrachloride (ug/l)	< 0.5			-
Trichloroethene (ug/l)	< 0.5			-
Tetrachloroethene (ug/l)	< 0.5			-
Chloroform (ug/l)	< 0.5			-
Tributyltin (ug TBT /l)	< 0.015			-
Caesium-134 (Bq/l)	0.086	0.053	<0.050	Figure 38
Tritium (Bq/l)	2.1	2.0	<2.0	Figure 39
Caesium-137 (Bq/l)	0.095	0.059	<0.050	Figure 40
Iodine-131 (Bq/l)	0.670	0.308	<0.070	Figure 41
Strontium-90 (Bq/l)	< 0.050			-

Table 4 Results Summary of the Water Sampling at Location 2 – Bottom

	Max.	Average	Min.	Relevant Figure
Weekly Parameter- samples taken at 1 high tide and 1 low tide event on one sampling day per week				
Electrical Conductivity (uS/cm)	54,900	50,338	45,200	Figure 2
Total Dissolved Solid (mg/l)	40,300	35,299	27,700	Figure 3
Suspended Solid (mg/l)	20	5	<2	Figure 4
Dissolved Organic Carbon (mg/l)	5	2	<2	Figure 5
Total Organic Carbon (mg/l)	6	2	<2	Figure 6
Chlorophyll a (ug/l)	22.6	3.1	0.2	Figure 7
Biweekly Parameter – samples taken at 1 high tide and 1 low tide event on one sampling day per every two weeks				
Settleable Solids (ml/l)	< 0.1			-
Turbidity (NTU)	6	3	<1	Figure 8
UV Absorption @254nm (Abs/cm)	< 0.1			-
Total Alkalinity as $CaCO_3$ (mg/l)	123	117	110	Figure 9
Sulphate as SO_4 (mg/l)	6300	2685	999	Figure 10
Chloride (mg/l)	22200	18344	13900	Figure 11
Oil & Grease (mg/l)	< 5			-
Chemical Oxygen Demand (mg/l)	200	52	<25	Figure 12
Biochemical Oxygen Demand (mg/l)	< 2			Figure 13
Boron (mg/l)	5.2	4.5	3.8	Figure 14
Calcium (mg/l)	512	410	324	Figure 15
Magnesium (mg/l)	1570	1236	996	Figure 16
Potassium (mg/l)	458	370	292	Figure 17
Sodium (mg/l)	10800	9823	6430	Figure 18
Monthly Parameter - samples taken at 1 high tide and 1 low tide event on one sampling day per month				
Ammonia (NH_4-N) (ug/l)	105	32	<5	Figure 19
Bromide (mg/l)	78.3	66.6	36.3	Figure 20
E.Coli (CFU/100ml)	91	15	ND	Figure 21
Total Coliforms (CFU/ 100ml)	170	33	ND	Figure 22
Bi-Monthly Parameter - samples taken at 1 high tide and 1 low tide event on one sampling day per every two months				
Total Cyanide (ug/l)	< 10			-
Fluoride (mg/l)	0.90	0.88	0.80	-
Silica (mg/l)	1.58	0.60	0.20	Figure 23
Nitrate - N (mg/l)	0.11	0.04	0.02	Figure 24
Total Nitrogen - N (mg/l)	0.40	0.23	<0.10	Figure 25
Total Phosphorus (mg/l)	0.05	0.02	0.01	-
Manganese (mg/l)	0.02	0.01	<0.01	-
Strontium (ug/l)	9,060	7,715	6,990	Figure 26
Antimony(ug/l)	0.8	0.6	<0.5	Figure 27
Arsenic (ug/l)	3	2	2	-

	Max.	Average	Min.	Relevant Figure
Barium (ug/l)	9.5	7.9	5.9	Figure 28
Beryillium (ug/l)	< 0.5			-
Cadmium (ug/l)	0.3	0.1	<0.1	Figure 29
Chromium (ug/l)	1.0	0.3	<0.2	Figure 30
Copper (ug/l)	21.6	3.8	1.1	Figure 31
Lead (ug/l)	25.7	3.6	<0.2	Figure 32
Nickel (ug/l)	1.2	0.8	0.5	Figure 33
Selenium (ug/l)	< 10			-
Silver (ug/l)	<0.1			-
Thallium (ug/l)	< 0.2			-
Vanadium (ug/l)	3	2	2	Figure 34
Zinc (ug/l)	39	13	2	Figure 35
Aluminum (mg/l)	0.24	0.07	<0.01	Figure 36
Iron (mg/l)	0.66	0.12	<0.05	Figure 37
Mercury (ug/l)	< 0.1			-
Phenol (ug/l)	< 2			-
Benzene (ug/l)	< 0.5			-
Toluene (ug/l)	<0.5			-
Ethylbenzene (ug/l)	< 0.5			-
Xylenes - Total (ug/l)	< 20			-
Carbon Tetrachloride (ug/l)	< 0.5			-
Trichloroethene (ug/l)	< 0.5			-
Tetrachloroethene (ug/l)	< 0.5			-
Chloroform (ug/l)	< 0.5			-
Tributyltin (ug TBT /l)	< 0.015			-
Caesium-134 (Bq/l)	0.081	0.053	<0.050	Figure 38
Tritium (Bq/l)	2.1	2.0	<2.0	Figure 39
Caesium-137 (Bq/l)	0.120	0.065	<0.050	Figure 40
Iodine-131 (Bq/l)	0.990	0.341	<0.070	Figure 41
Strontium-90 (Bq/l)	< 0.050			-

Seasonal Variations of Key Parameters at Location 2

The following are key source water quality parameters for the design of pre-treatment systems and RO system for a desalination plant with a submerged open intake:

- Turbidity and total suspended solids
- Total organic carbon (TOC)
- Algal cell loading measured as chlorophyll-a and algal cell counts
- Temperature and pH
- Salinity / Total dissolved solids (TDS)
- Individual salts that impact design and operation of the RO system (primarily chloride, bromide, and boron)

The sea water quality monitoring results at the surface, middle and bottom of Location 2 showing the key source water quality parameters are sorted seasonally and summarized in **Table 5** to **Table 7**.

Table 5 Sea Water Quality data Summary for Pre-treatment at Location 2 - Surface

Water Quality Parameter	Units	Dec 2013 – Feb 2014	Mar 14 – May 2014	June 2014 – Sept 2014	Oct 2014 – Dec 2014
pH (mean)	pH units	8.07	8.12	8.17	8.06
Temperature (range)	°C	15.5 – 19.9	15.7 – 26.4	24.5 – 29.9	20.8-29.7
Turbidity (range)	NTU	1.0 – 3.0	1.0 – 2.0	1.0 – 4.0	1.0 – 4.0
Suspended solids (range)	mg/L	2.0 – 4.0	2.0 – 8.0	2.0 – 11.0	2.0 – 12.0
Total dissolved solids (range)	mg/L	33,300 – 36,500	27,300 – 35,600	29,500 – 38,900	33,400-39,100
TOC (range)	mg/L	2.0 – 2.0	2.0 – 2.0	2.0 – 7.0	2.0-7.0
Oil and Grease (average)	mg/L	< 5	< 5	< 5	6.0
Chlorophyll-a	µg/L	0.2 – 9.2	0.3 – 25.6	0.8 – 37.6	0.8-12.4
Chloride (range)	mg/L	16,100 – 19,700	12,600 – 21,500	15,000 – 18,900	16,800-21,500
Boron (range)	mg/L	2.6 – 5.1	2.7 – 5.6	3.8 – 4.6	4.1-4.6
Bromide (range)	mg/L	64.1 – 68.4	61.5 – 70.3	59.5 – 70.0	59.9-83.6

Table 6 Sea Water Quality data Summary for Pre-treatment (Location 2 - Middle)

Water Quality Parameter	Units	Dec 2013 – Feb 2014	Mar 14 – May 2014	June 2014 – Sept 2014	Oct 2014 – Dec 2014
pH (mean)	pH units	8.11	8.09	8.00	8.19
Temperature (range)	°C	15.5 – 18.2	15.7 – 24.4	22.7 – 29.0	20.9-29.6
Turbidity (range)	NTU	1.0 – 4.0	1.0 – 3.0	1.0 – 4.0	1.0-3.0
Suspended solids (range)	mg/L	2.0 – 5.0	2.0 – 15.0	2.0 – 10.0	2.0 – 14.0
Total dissolved solids (range)	mg/L	31,400 – 36,200	33,300 – 35,500	29,800 – 39,700	33,500-40,300
TOC (range)	mg/L	< 2.0	2.0 – 3.0	2.0 – 4.0	2.0-7.0
Oil and Grease (average)	mg/L	< 5	< 5	< 5	< 5
Chlorophyll-a	µg/L	0.4 – 11.0	0.3 – 5.9	0.8 – 31.4	1.2-12.0
Chloride (range)	mg/L	15,700 – 18,500	13,200 – 21,600	15,900 – 20,000	17,200-20,900
Boron (range)	mg/L	2.6 – 5.0	2.8 – 5.3	4.0 – 5.0	3.8-5.1
Bromide (range)	mg/L	64.1 – 68.8	52.1 – 72.4	66.8 – 72.7	61.1-76.8

Table 7 Sea Water Quality data Summary for Pre-treatment at Location 2 - Bottom

Water Quality Parameter	Units	Dec 2013 – Feb 2014	Mar 14 – May 2014	June 2014 – Sept 2014	Oct 2014 – Dec 2014
pH (mean)	pH units	8.07	8.08	7.92	8.18
Temperature (range)	°C	15.4 – 19.5	15.7 – 24.2	22.2 – 28.9	20.9-29.7
Turbidity (range)	NTU	2.0 – 4.0	2.0 – 4.0	1.0 – 6.0	1.0-4.0
Suspended solids (range)	mg/L	2.0 – 6.0	2.0 – 8.0	2.0 – 19.0	2.0-20.0
Total dissolved solids (range)	mg/L	33,300 – 36,000	33,800 – 35,600	27,700 – 40,300	33,400-39,200
TOC (range)	mg/L	< 2.0	< 2.0	3.0 – 6.0	2.0-5.0
Oil and Grease (average)	mg/L	< 5	< 5	< 5	< 5
Chlorophyll-a	µg/L	0.4 – 10.0	0.4 – 18.6	0.6 – 22.0	1.1-9.0
Chloride (range)	mg/L	16,200 – 19,100	13,900 – 22,200	15,200 – 19,000	17,100-20,000
Boron (range)	mg/L	2.5 – 5.0	2.8 – 5.2	4.2 – 4.8	3.9-4.8
Bromide (range)	mg/L	65.9 – 66.7	62.1 – 74.3	68.2 – 77.9	58.9-78.3

Algae

High chlorophyll-a (>25µg/L) concentrations were recorded from May 2014 to September 2014. Subsequent algal species characterisation and respective concentration analysis were carried out immediately under the condition that chlorophyll-a concentration exceeds 25µg/L. **Table 8** provides a summary of the chlorophyll measurements along with sampling date and locations where high chlorophyll-a measurements were taken.

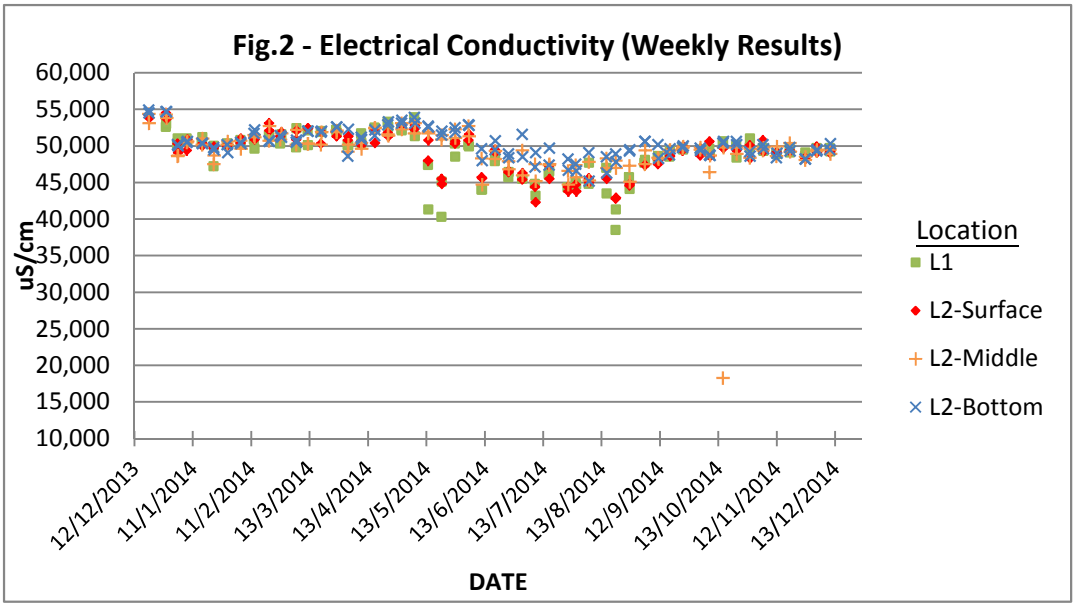
Table 8 High Chlorophyll-a Incidents

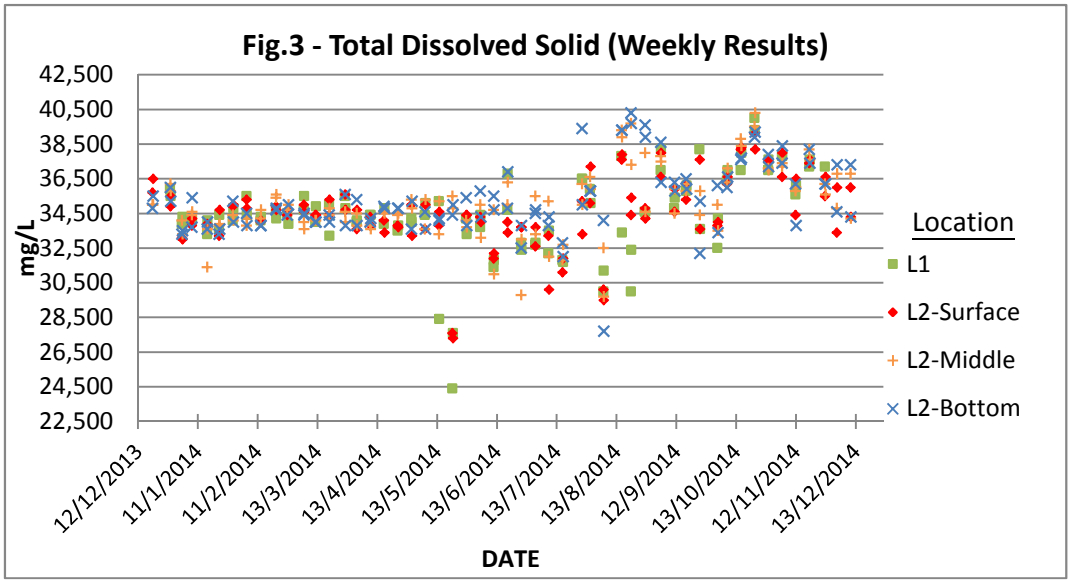
SAMPLING DATE	SAMPLING LOCATION	WATER DEPTH	CHLOROPHYLL-A (µg/L)	DOMINANT SPECIES	Cells/L
25 Jun 2014	L1	Middle	12.3	Chaetoceros curvisetus	996,000
				Chaetoceros lorenzianus	387,600
				Chaetoceros tortissimus	4,800
25 Jun 2014	L2	Surface	34.3	Chaetoceros curvisetus	1,915,200
				Chaetoceros lorenzianus	578,400
				Chaetoceros tortissimus	354,400
25 Jun 2014	L2	Middle	29.4	Chaetoceros curvisetus	3,276,000
				Chaetoceros lorenzianus	704,000
				Chaetoceros tortissimus/Bellerochea spp.	12,000
25 Jun 2014	L2	Bottom	22.0	Chaetoceros curvisetus	3,164,000
				Chaetoceros lorenzianus	432,000
				Chaetoceros tortissimus	242,000
9 Jul 2014	L2	Surface	27.8	Chaetoceros curvisetus	23,56,800
				Chaetoceros lorenzianus	1,415,700
				Chaetoceros tortissimus	1,171,800
16 Jul 2014	L2	Middle	27.4	Chaetoceros tortissimus	1,517,400
				Chaetoceros lorenzianus	925,200
				Leptocylindrus danicus	840,000
26 Jul 2014	L2	Surface	27.0	Leptocylindrus spp.	5,907,000
				Pseudo-nitzschia delicatissima	468,000
				Skeletonema costatum	219,000
26 Jul 2014	L2	Middle	36.2	Pseudo-nitzschia delicatissima	7,197,000
				Pseudo-nitzschia pungens	303,000
				Guinardia striata	285,000
30 Jul 2014	L1	Middle	30.5	Leptocylindrus spp.	3,252,000
				Pseudo-nitzschia delicatissima	291,000
				Guinardia striata	222,000
6 Aug 2014	L2	Middle	30.2	Leptocylindrus spp.	921,600
				Pseudo-nitzschia delicatissima	585,600
				Skeletonema costatum	446,400
6 Aug 2014	L2	Surface	37.6	Leptocylindrus spp.	2,311,200
				Skeletonema costatum	556,800
				Pseudo-nitzschia	552,000

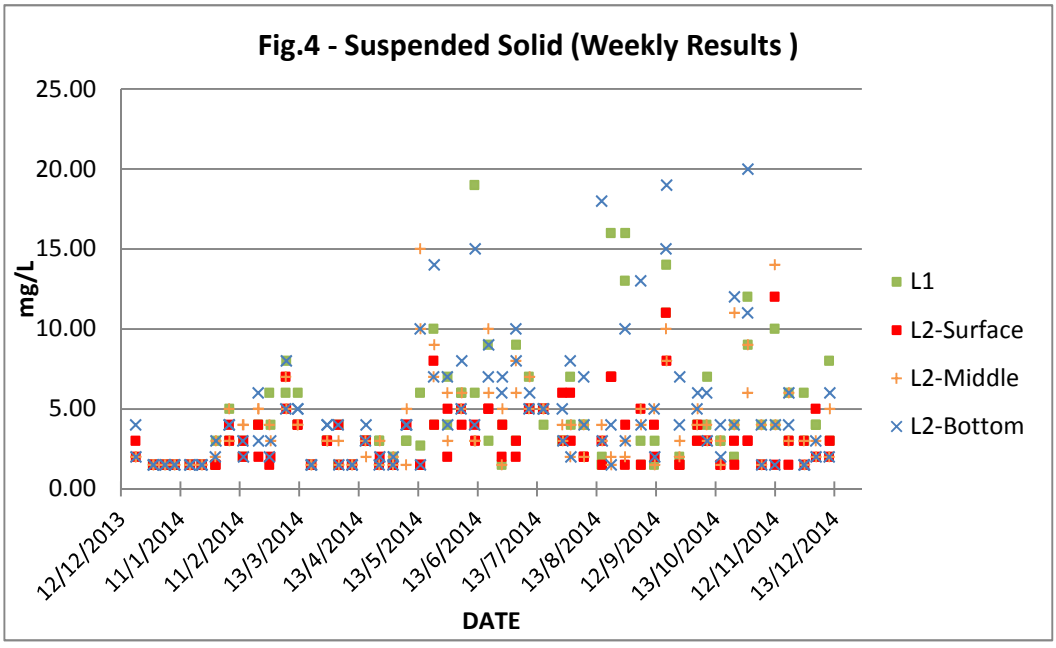
SAMPLING DATE	SAMPLING LOCATION	WATER DEPTH	CHLOROPHYLL-A (μg/L)	DOMINANT SPECIES	Cells/L
				delicatissima	
6 Aug 2014	L1	Middle	27.9	Leptocylindrus spp.	1,761,600
				Pseudo-nitzschia delicatissima	552,000
				Skeletonema costatum	441,600
27 Aug 2014	L2	Surface	26.1	Pseudo-nitzschia delicatissima	2,985,000
				Leptocylindrus spp.	1,701,000
				Skeletonema costatum	1,140,000
27 Aug 2014	L2	Surface	25.4	Chaetoceros lorenzianus	2,790,000
				Leptocylindrus spp.	2,784,000
				Pseudo-nitzschia delicatissima	153,000
4 Sept 2014	L2	Middle	31.4	Skeletonema costatum	3,270,000
				Pseudo-nitzschia delicatissima	153,000
				Chaetoceros curvisetus	150,000

In an event where chlorophyll-a exceeded 25 μg/L, algal species were identified and cell counts of the respective species were carried out. The speciation results suggested that most predominant species are diatoms, some of which are commonly found in Hong Kong waters, according to Agriculture, Fisheries and Conservation Department (AFCD)'s red tide database.

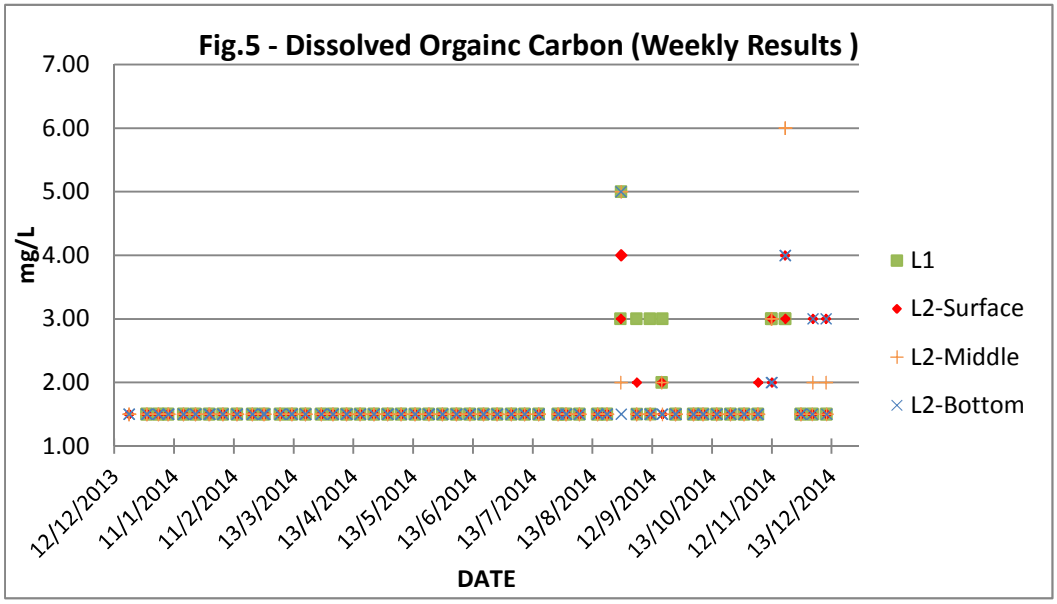
****







Remarks: minimum values shown in Fig.4 are indicative.



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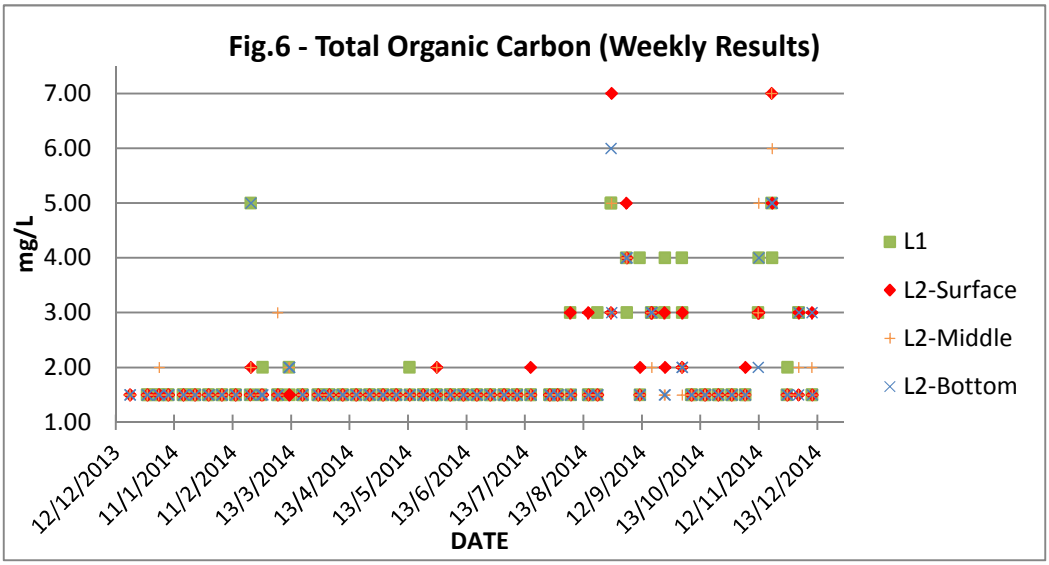

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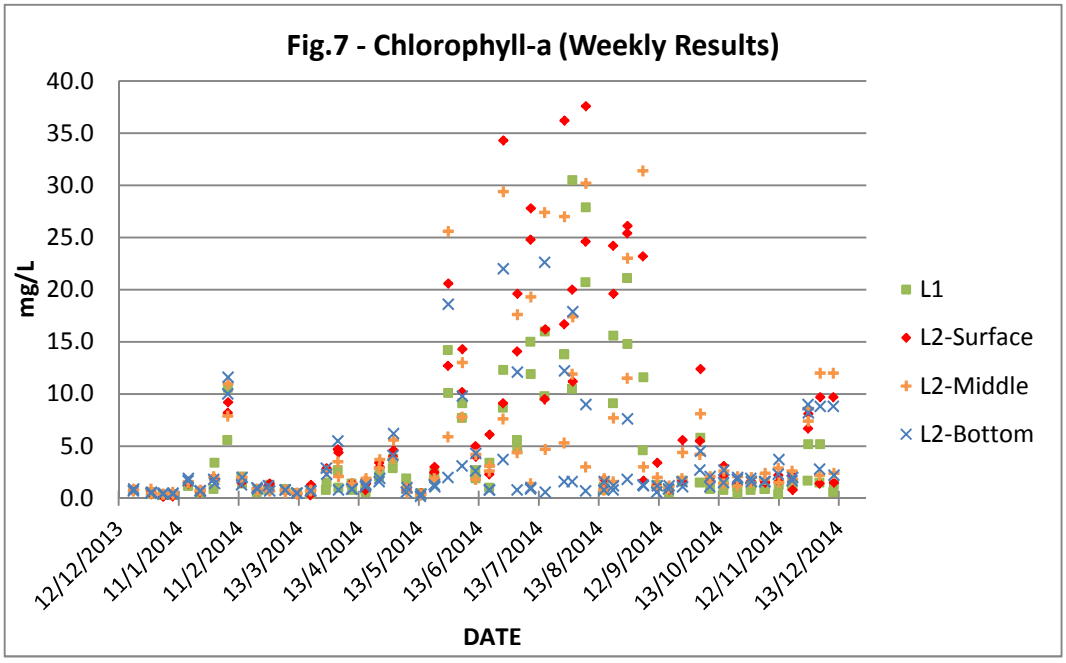

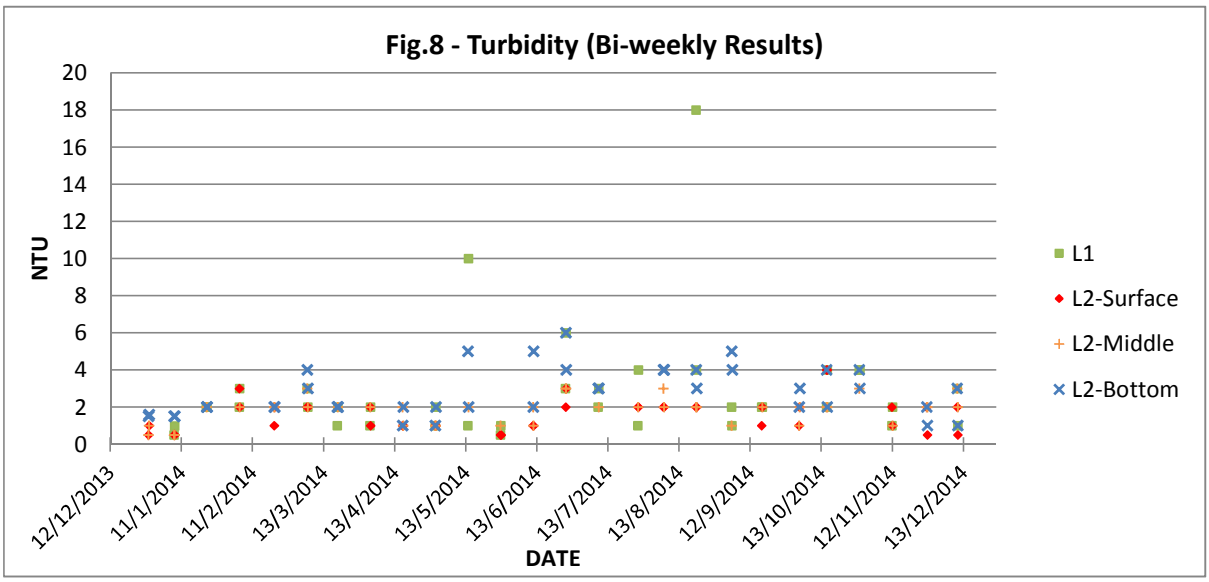

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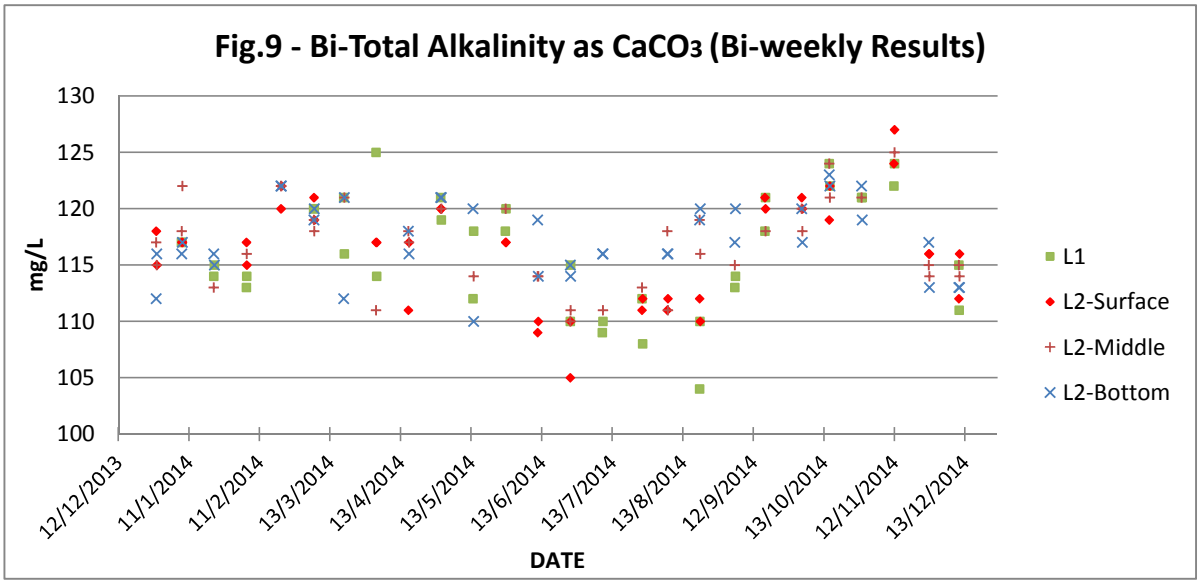

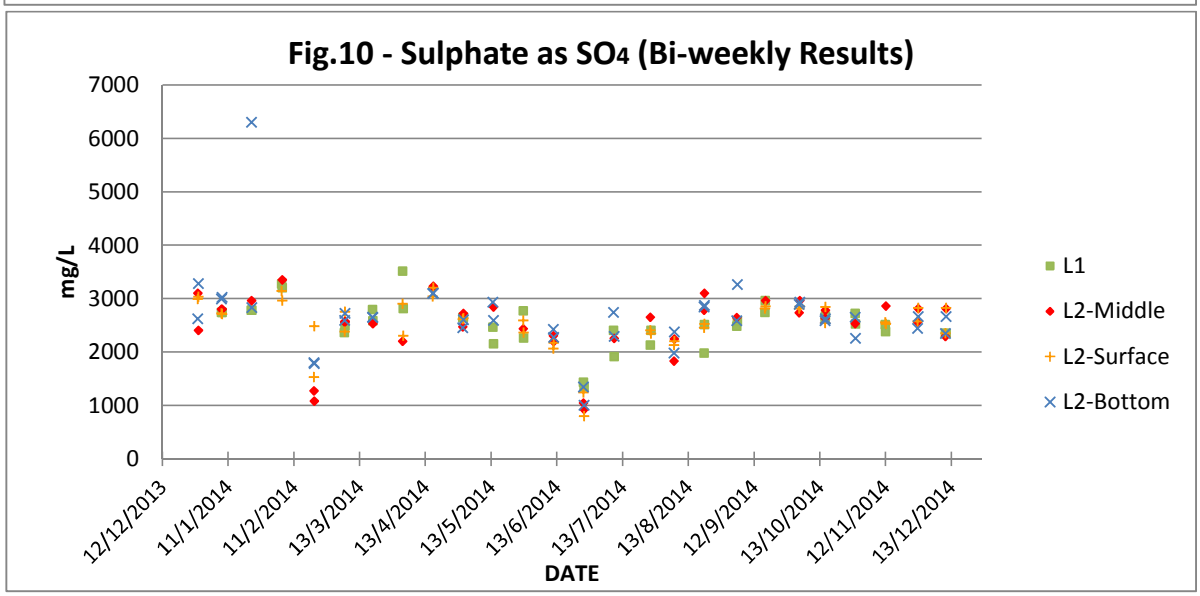

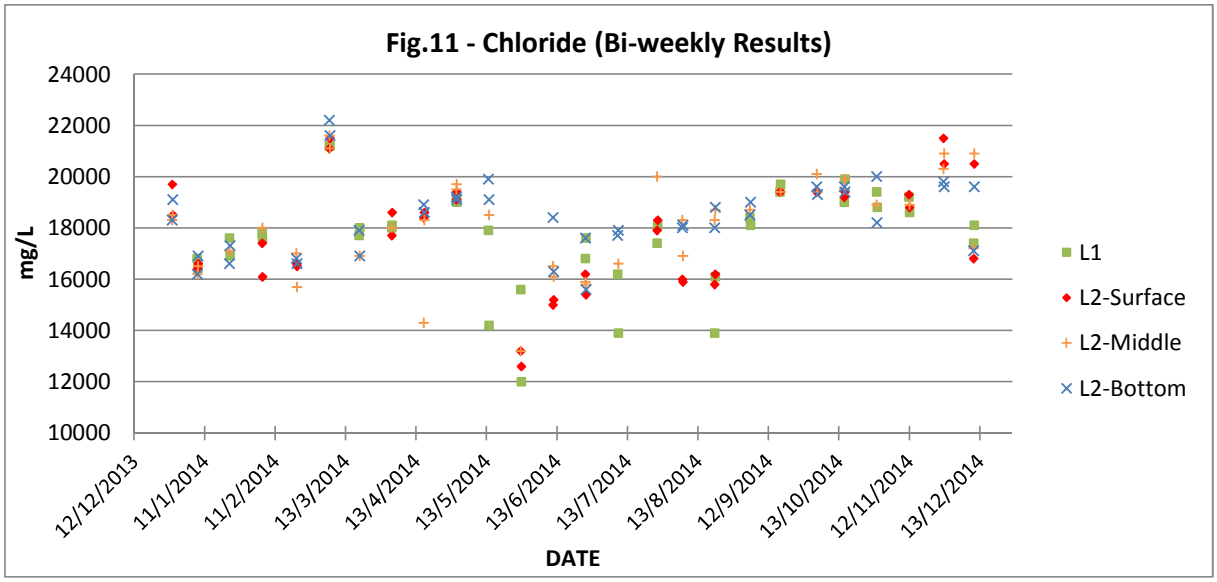

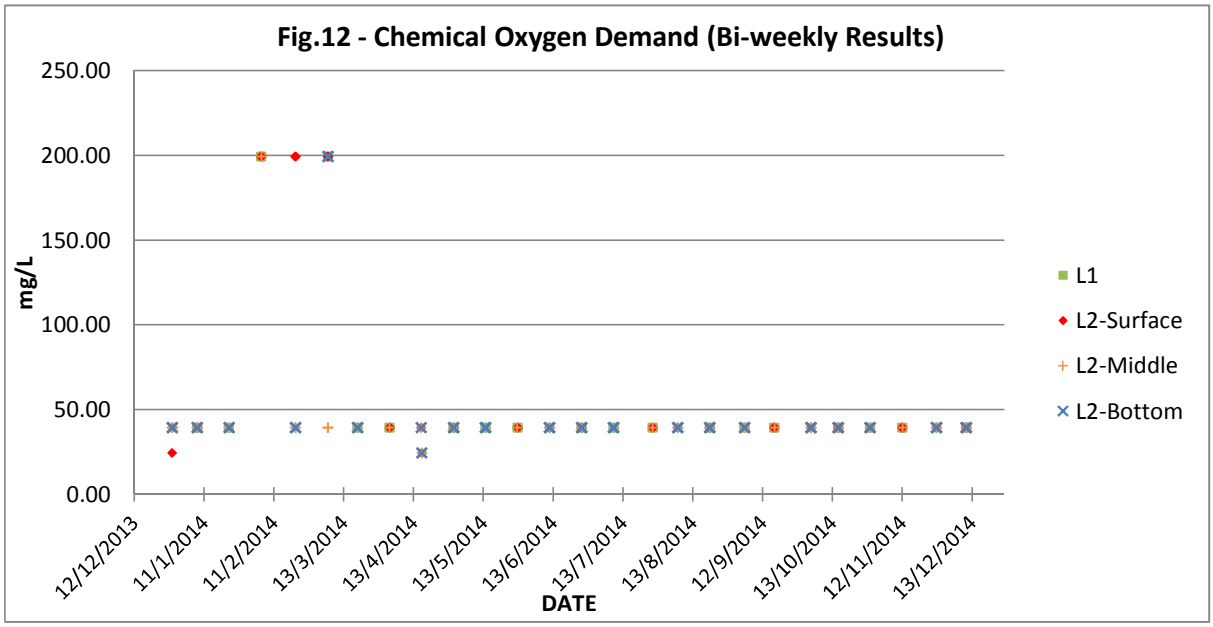

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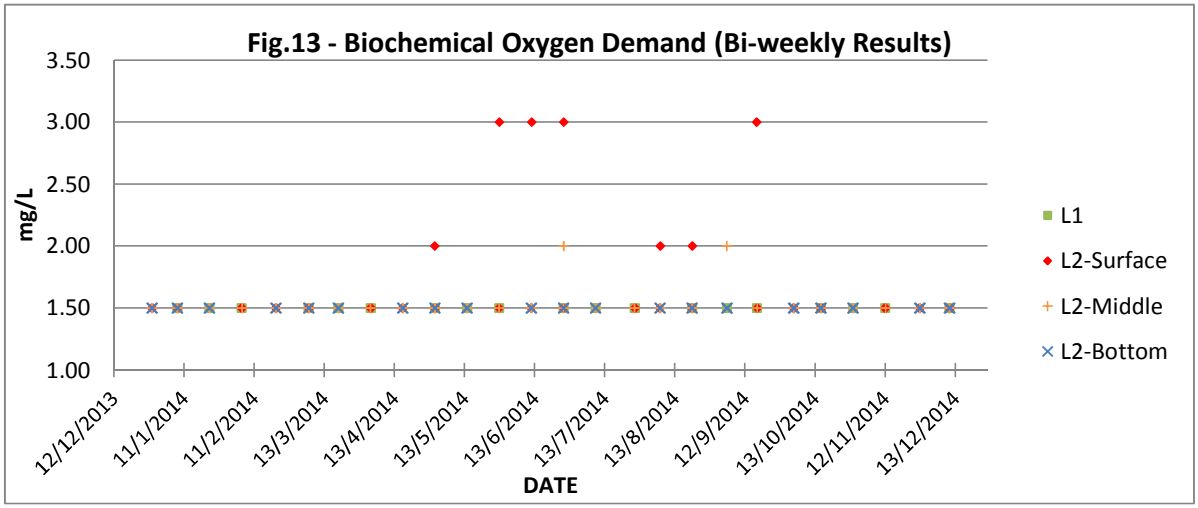


Remarks: minimum values shown in Fig.13 are indicative.

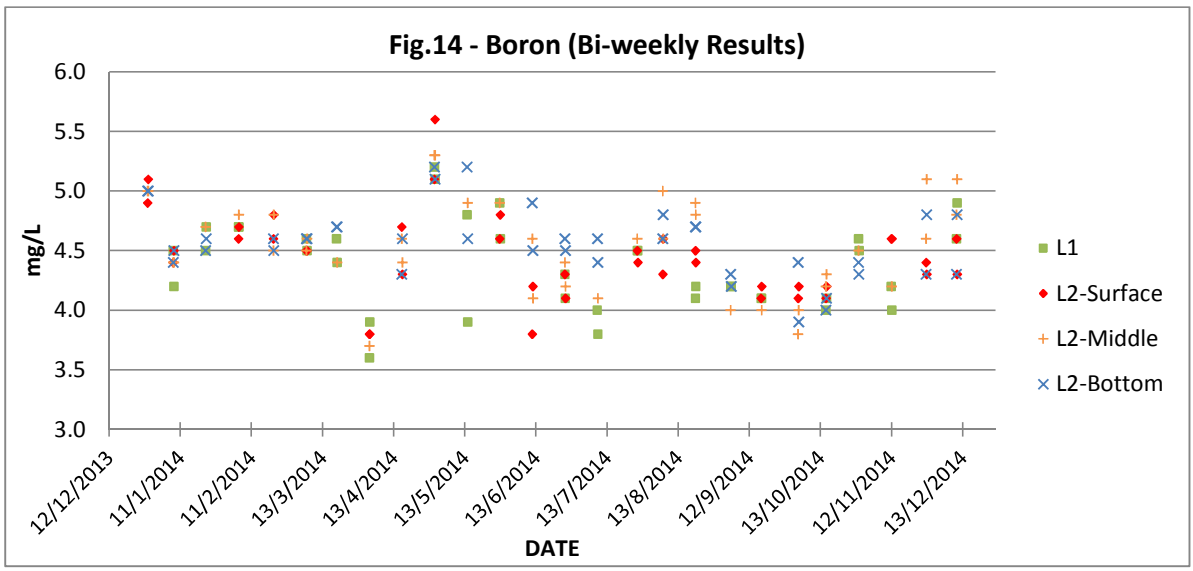


Fig.14 - Boron (Bi-weekly Results)
6.0
5.5
5.0
4.5
4.0
3.5
3.0
mg/L
12/12/2013
11/1/2014
11/2/2014
13/3/2014
13/4/2014
13/5/2014
13/6/2014
13/7/2014
13/8/2014
12/9/2014
13/10/2014
12/11/2014
13/12/2014
DATE
L1
L2-Surface
L2-Middle
L2-Bottom

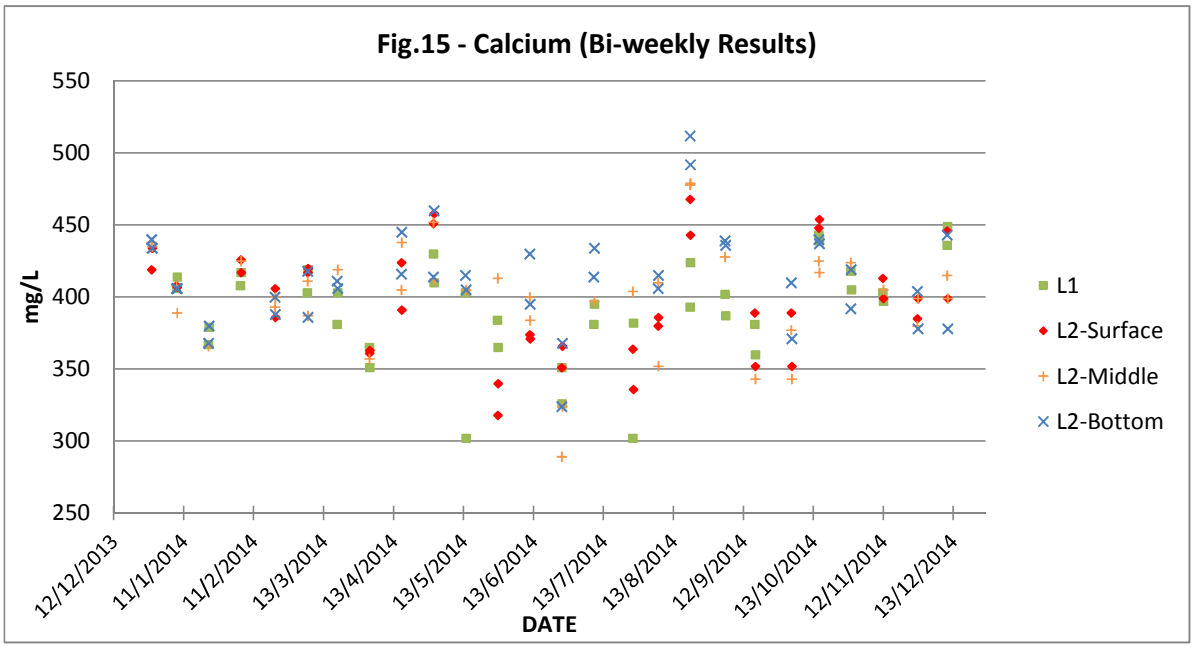


Fig.15 - Calcium (Bi-weekly Results)
550
500
450
400
350
300
250
mg/L
12/12/2013
11/1/2014
11/2/2014
13/3/2014
13/4/2014
13/5/2014
13/6/2014
13/7/2014
13/8/2014
12/9/2014
13/10/2014
12/11/2014
13/12/2014
DATE
L1
L2-Surface
L2-Middle
L2-Bottom

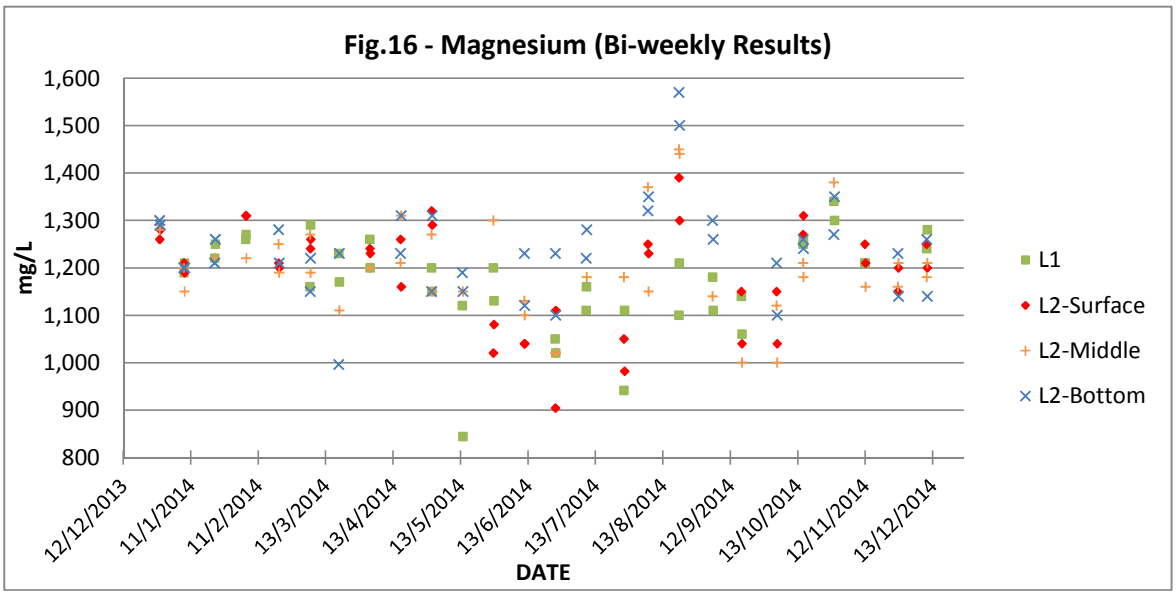


Fig.16 - Magnesium (Bi-weekly Results)
1,600
1,500
1,400
1,300
1,200
1,100
1,000
900
800
mg/L
12/12/2013
11/1/2014
11/2/2014
13/3/2014
13/4/2014
13/5/2014
13/6/2014
13/7/2014
13/8/2014
12/9/2014
13/10/2014
12/11/2014
13/12/2014
DATE
L1
L2-Surface
L2-Middle
L2-Bottom

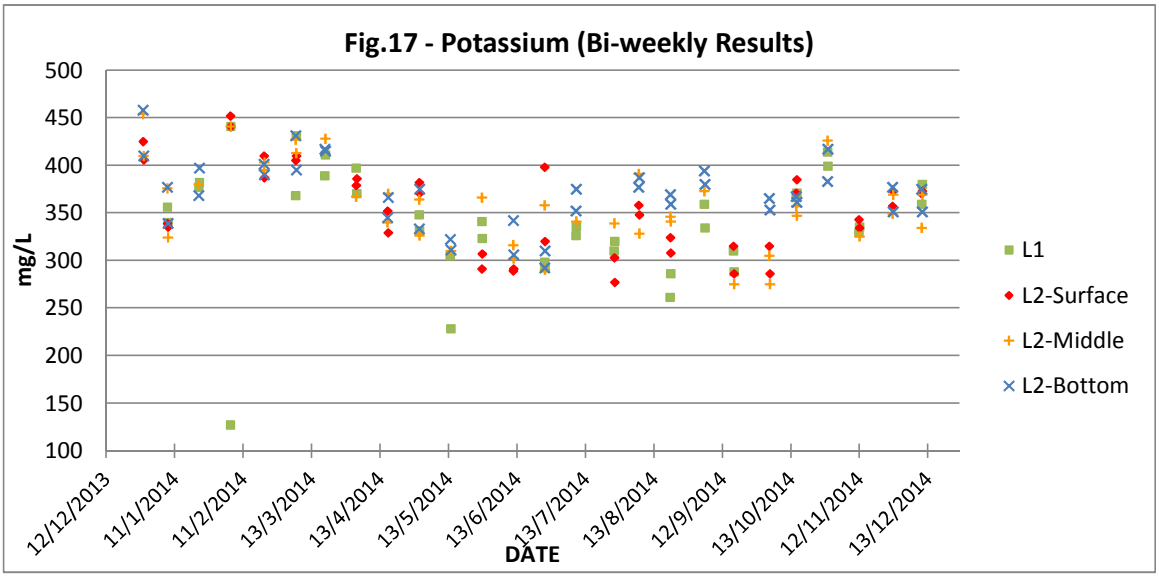


Fig.17 - Potassium (Bi-weekly Results)
500
450
400
350
300
250
200
150
100
mg/L
12/12/2013
11/1/2014
11/2/2014
13/3/2014
13/4/2014
13/5/2014
13/6/2014
13/7/2014
13/8/2014
12/9/2014
13/10/2014
12/11/2014
13/12/2014
DATE
L1
L2-Surface
L2-Middle
L2-Bottom

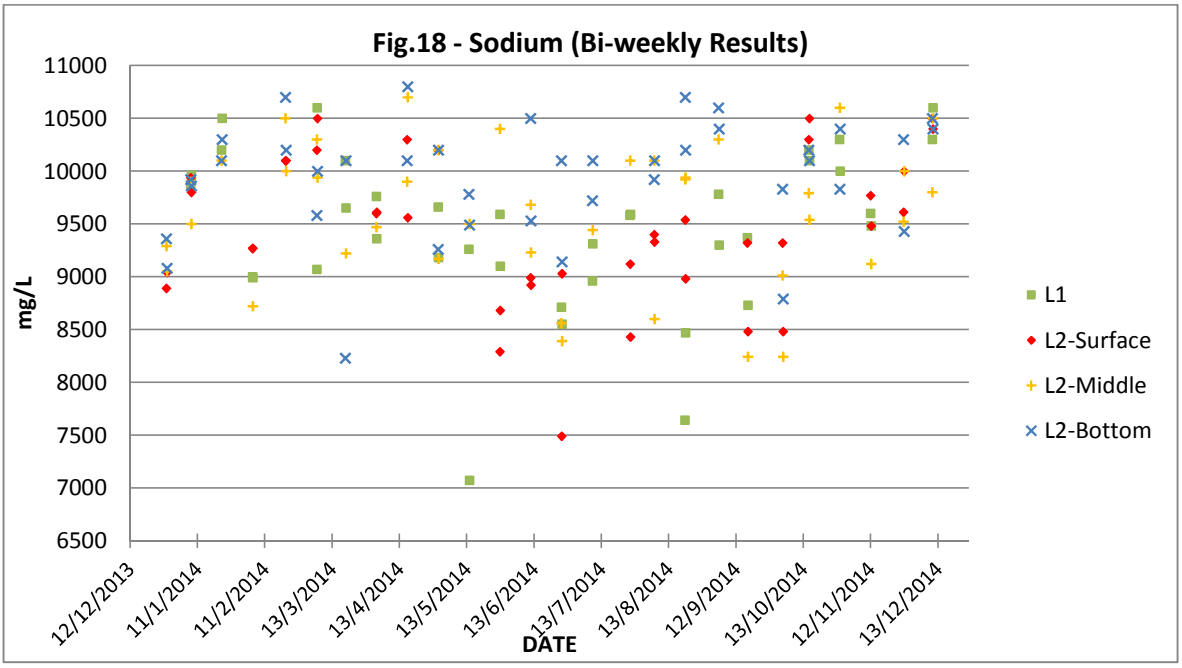
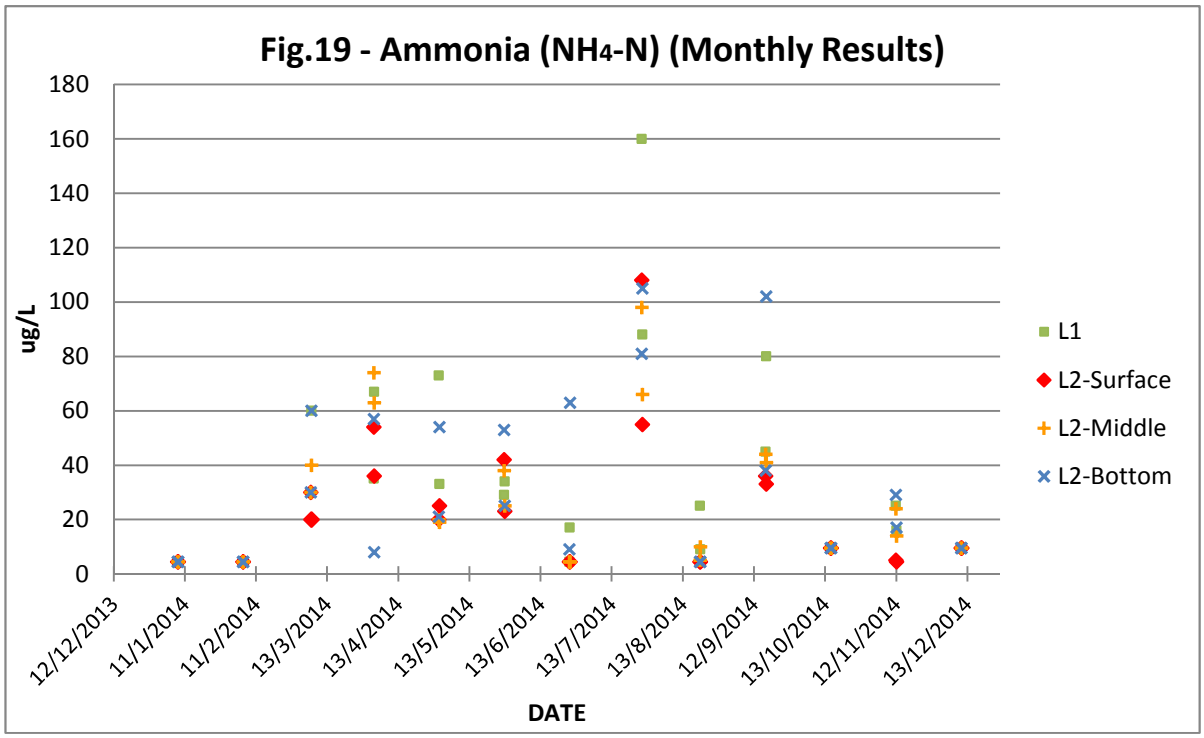
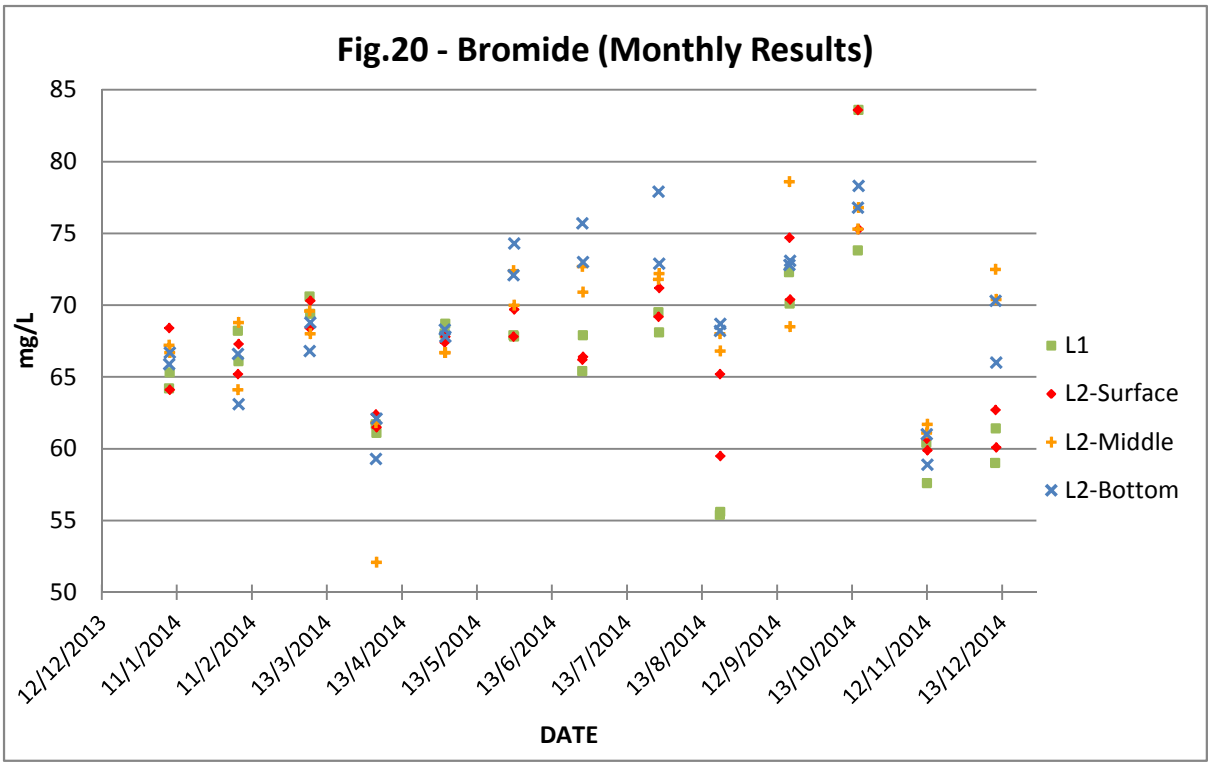


Fig.18 - Sodium (Bi-weekly Results)
11000
10500
10000
9500
9000
8500
8000
7500
7000
6500
mg/L
12/12/2013
11/1/2014
11/2/2014
13/3/2014
13/4/2014
13/5/2014
13/6/2014
13/7/2014
13/8/2014
12/9/2014
13/10/2014
12/11/2014
13/12/2014
DATE
L1
L2-Surface
L2-Middle
L2-Bottom



Remarks: minimum values shown in Fig.19 are indicative.



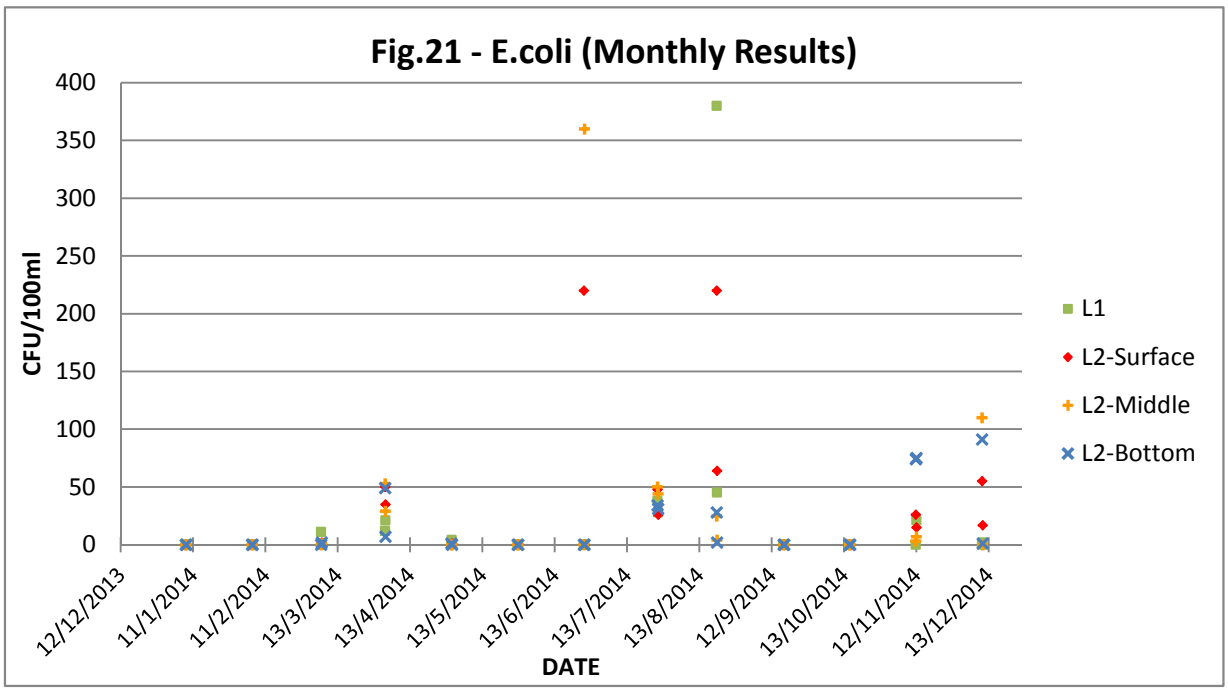


Fig.21 - E.coli (Monthly Results)
CFU/100ml
400
350
300
250
200
150
100
50
0
12/12/2013
11/1/2014
11/2/2014
13/3/2014
13/4/2014
13/5/2014
13/6/2014
13/7/2014
13/8/2014
12/9/2014
13/10/2014
12/11/2014
13/12/2014
DATE
L1
L2-Surface
L2-Middle
L2-Bottom

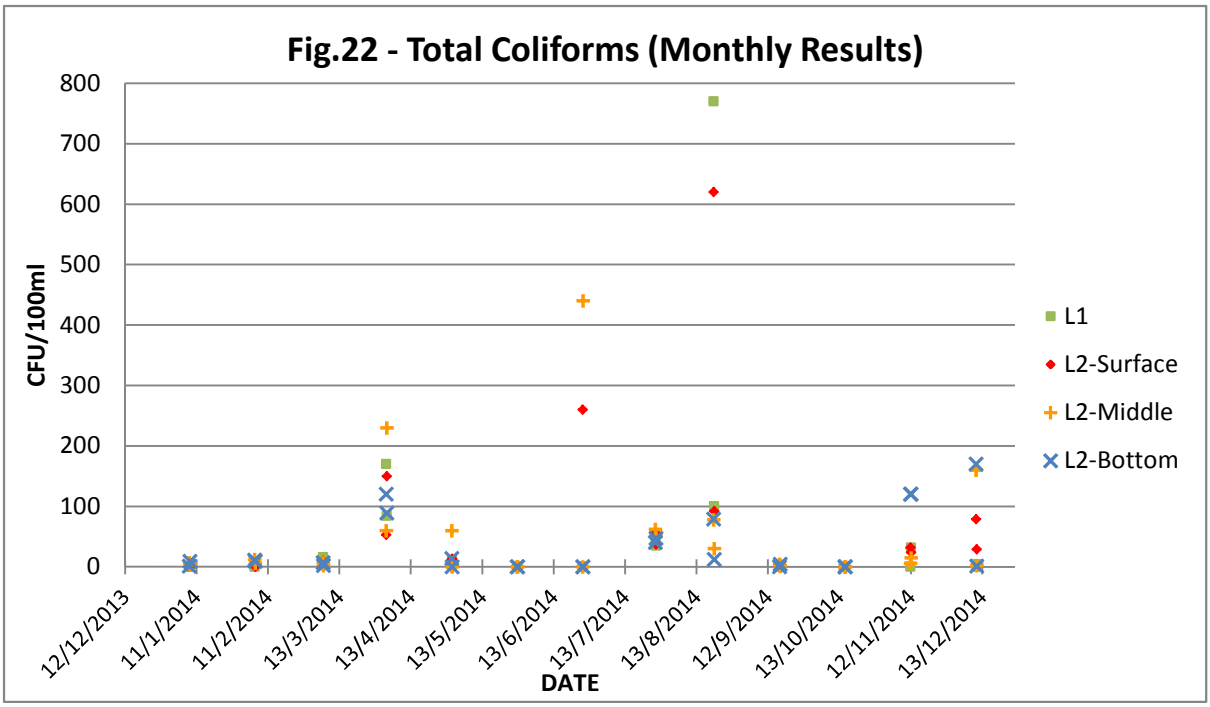
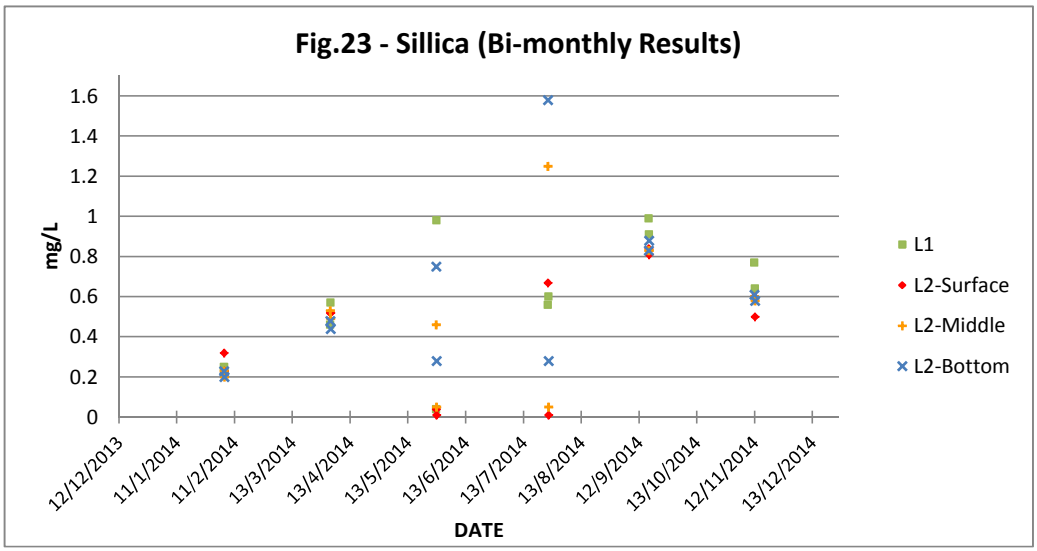
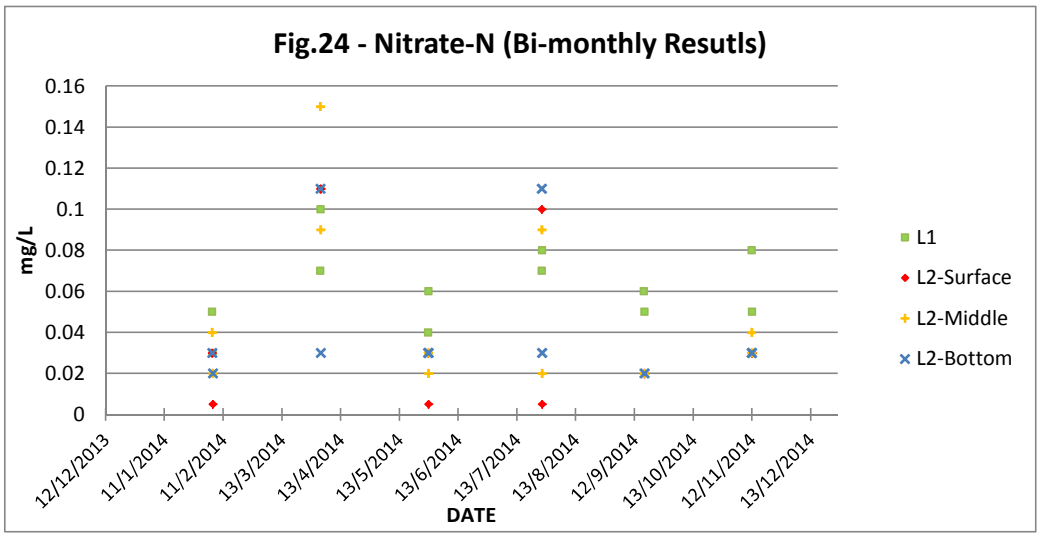
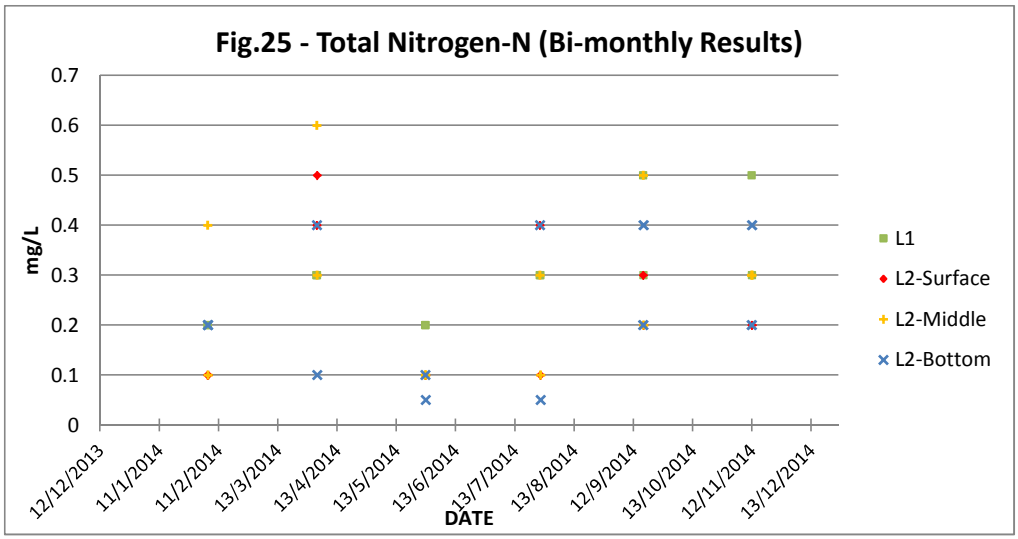


Fig.22 - Total Coliforms (Monthly Results)
CFU/100ml
800
700
600
500
400
300
200
100
0
12/12/2013
11/1/2014
11/2/2014
13/3/2014
13/4/2014
13/5/2014
13/6/2014
13/7/2014
13/8/2014
12/9/2014
13/10/2014
12/11/2014
13/12/2014
DATE
L1
L2-Surface
L2-Middle
L2-Bottom

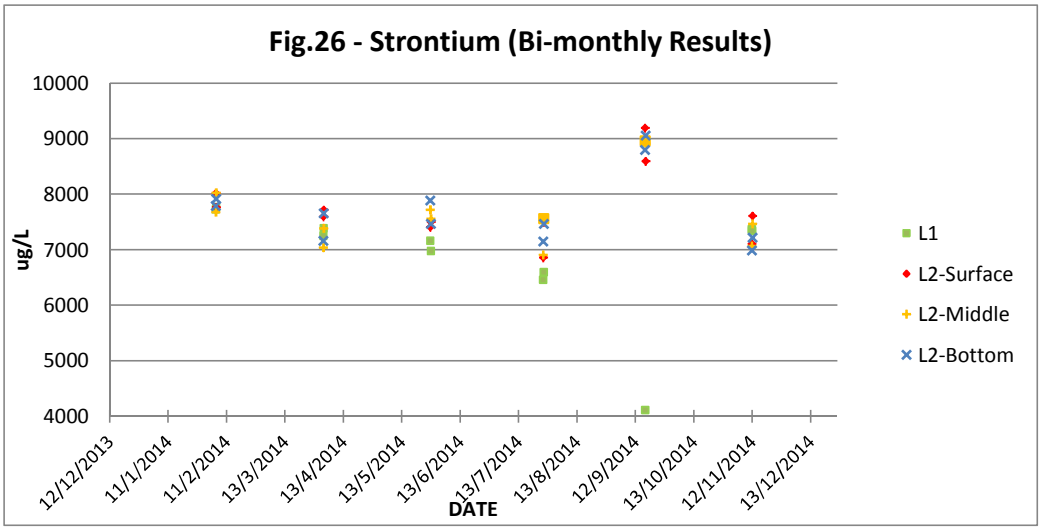


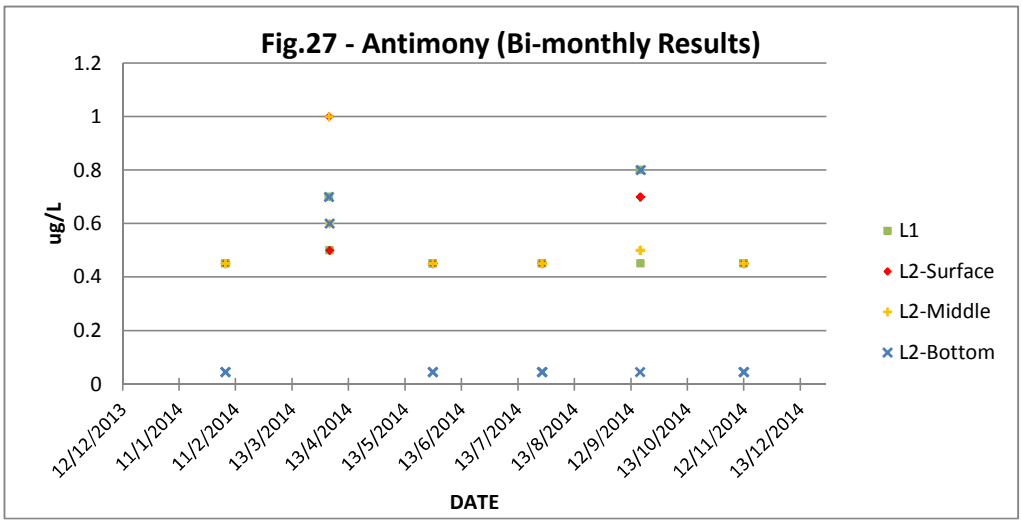


Remarks: minimum values shown in Fig.24 are indicative.

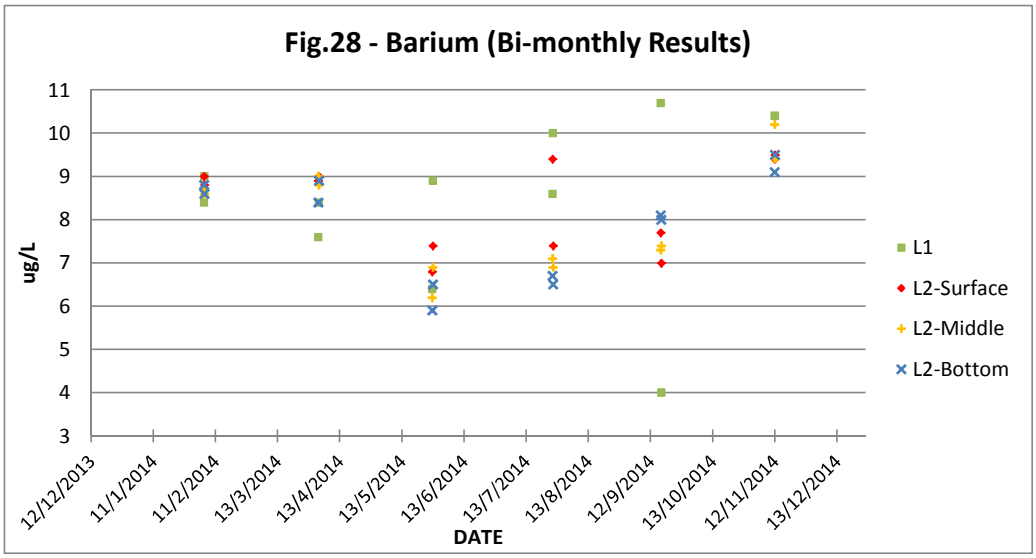


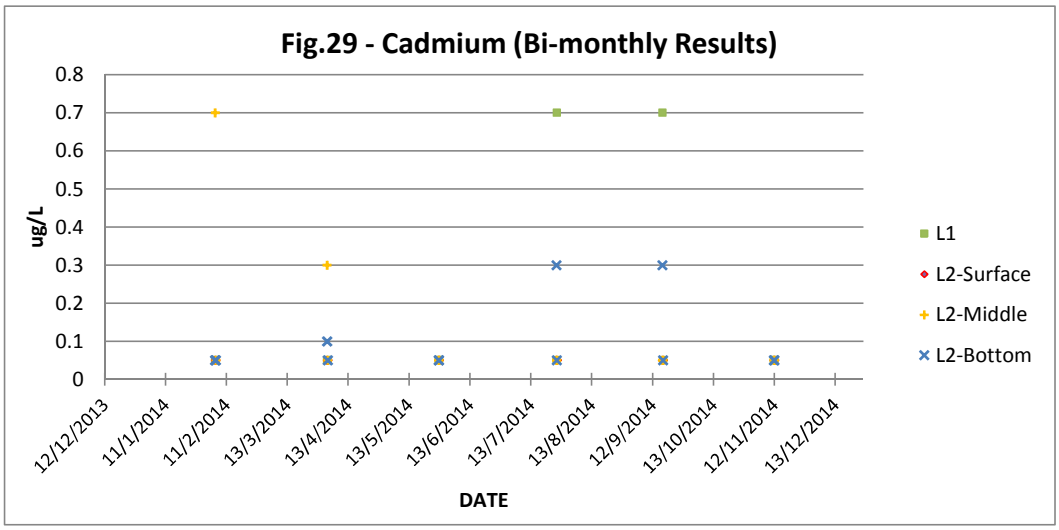
Remarks: minimum values shown in Fig.25 are indicative.



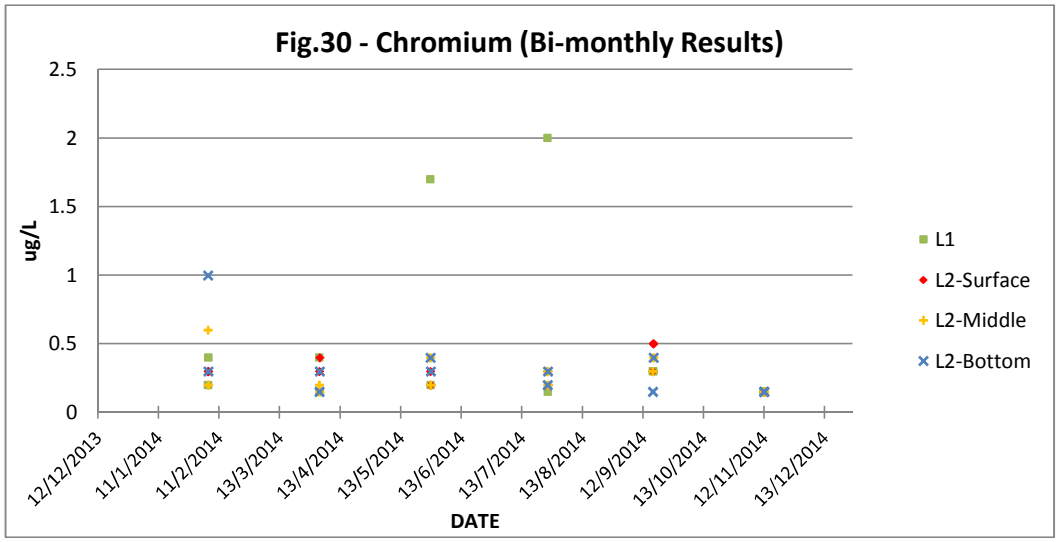


Remarks: minimum values shown in Fig.27 are indicative.





Remarks: minimum values shown in Fig.29 are indicative.



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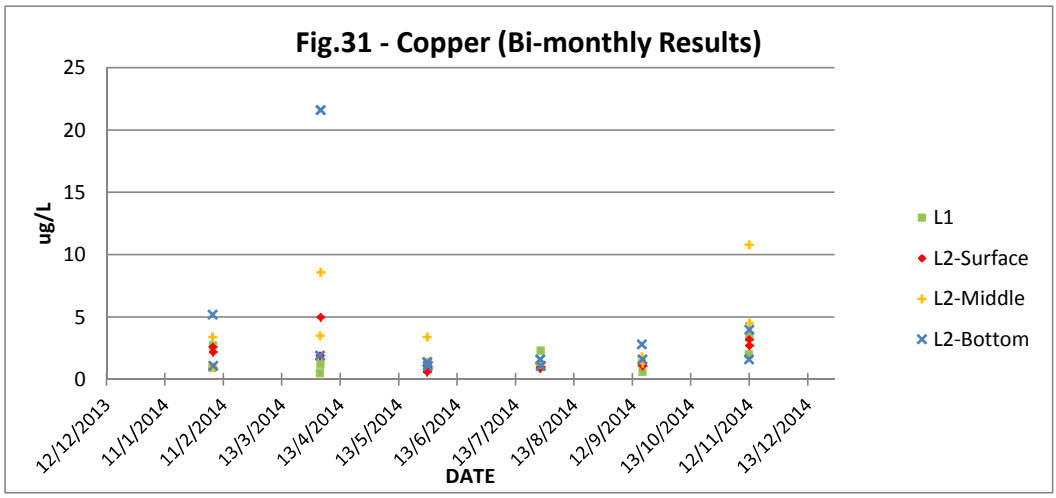

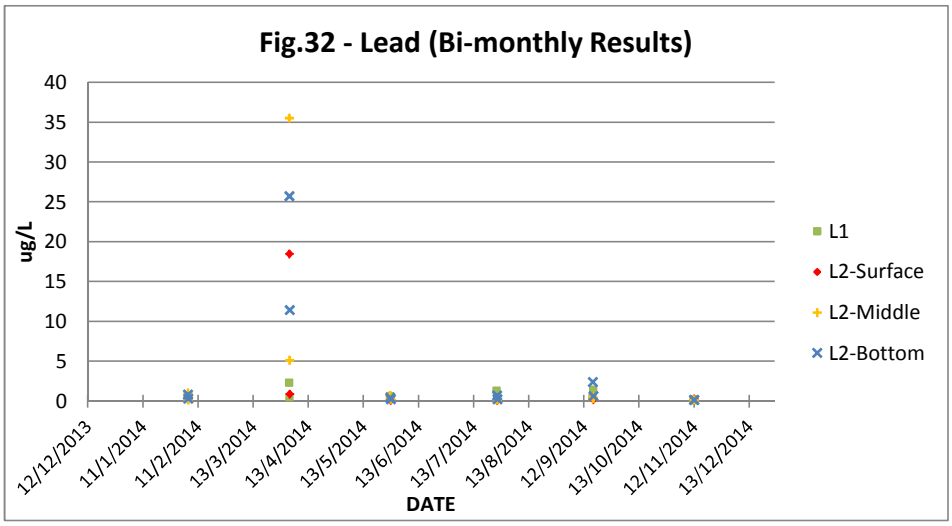

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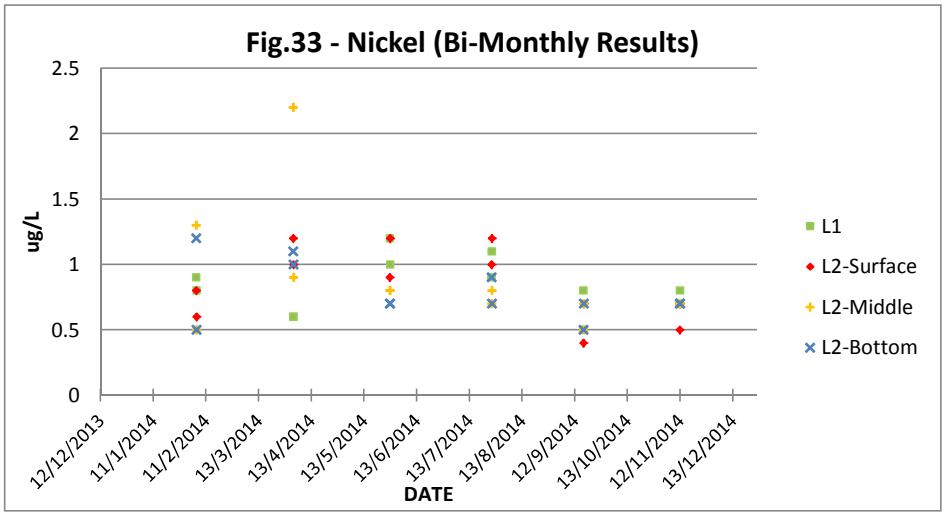

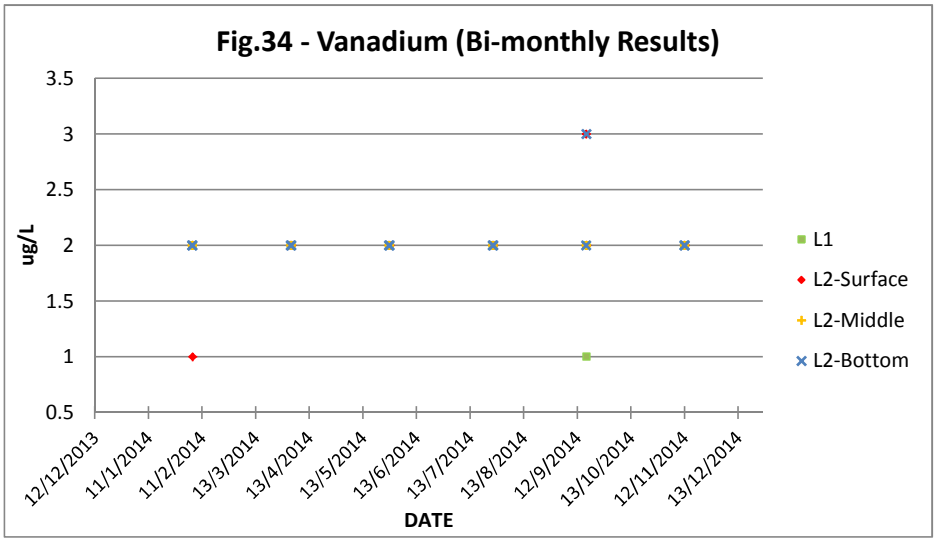

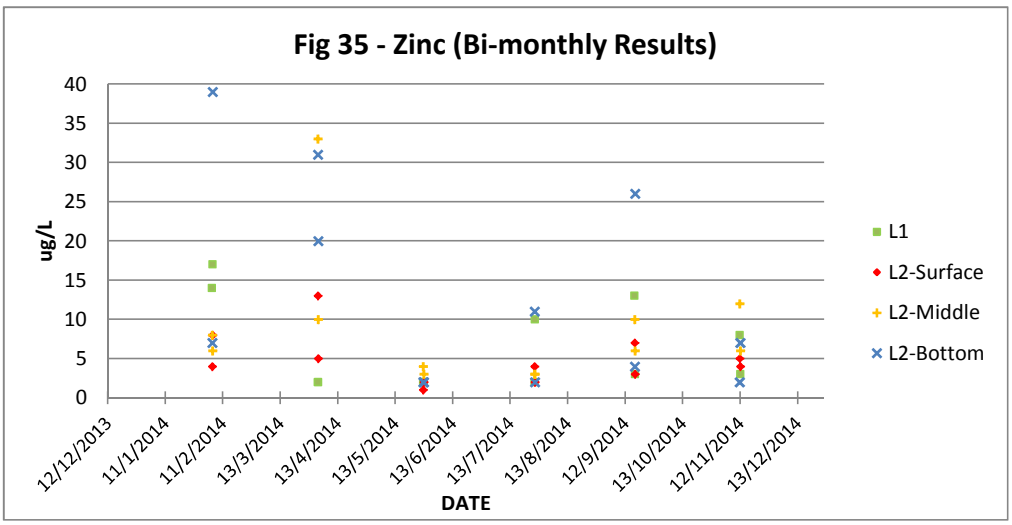

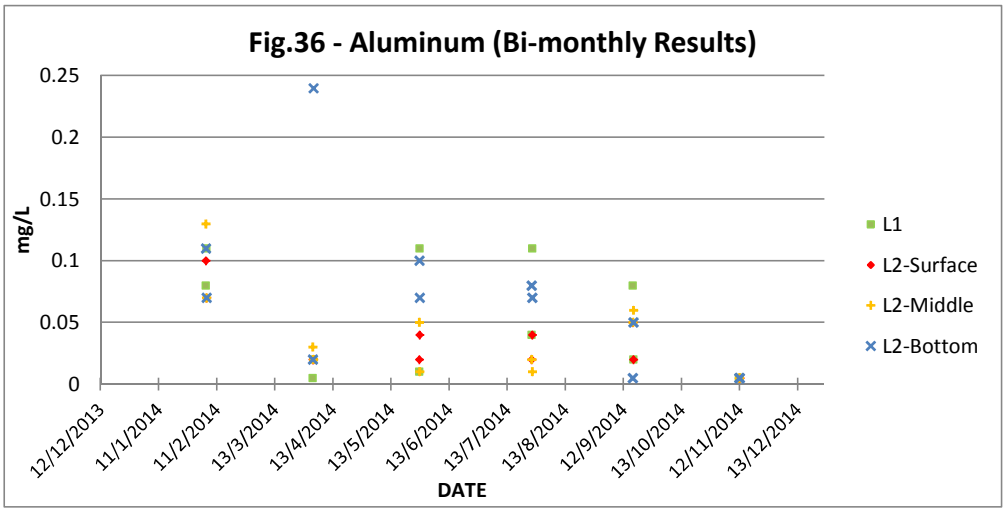

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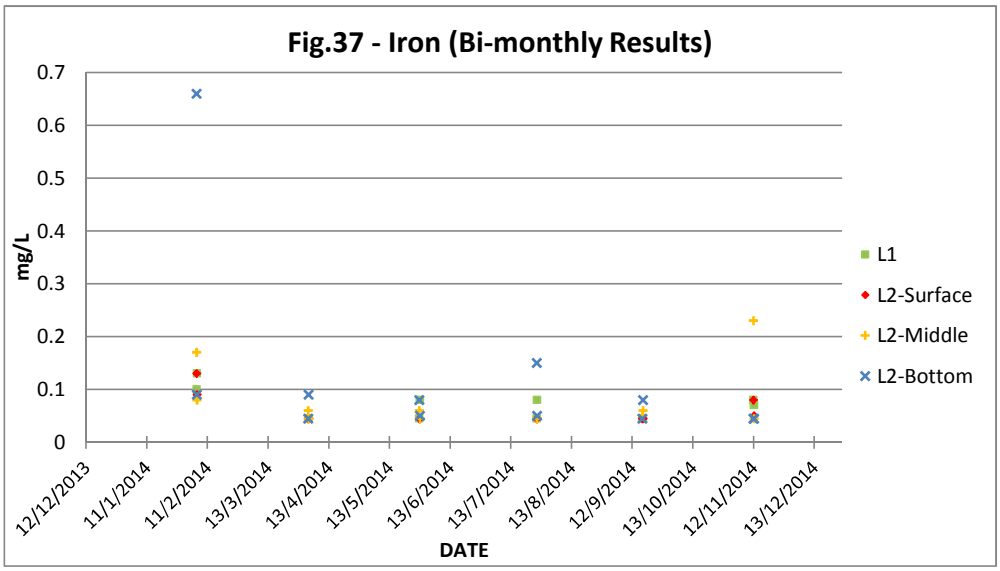

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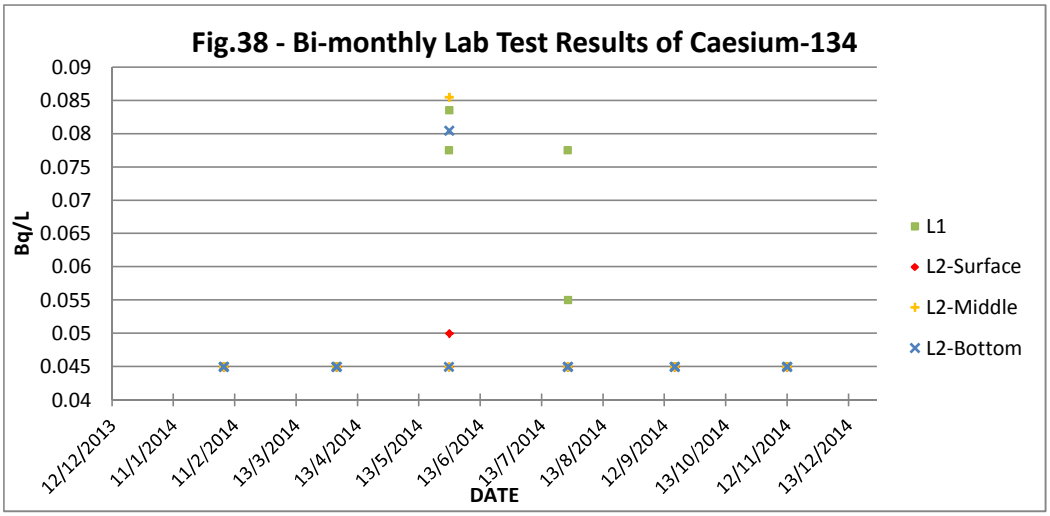

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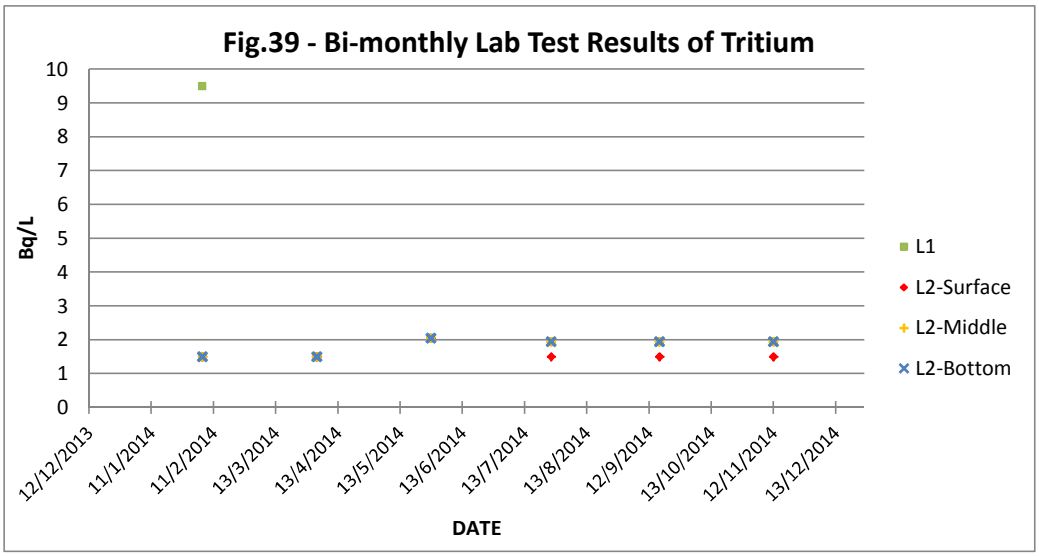

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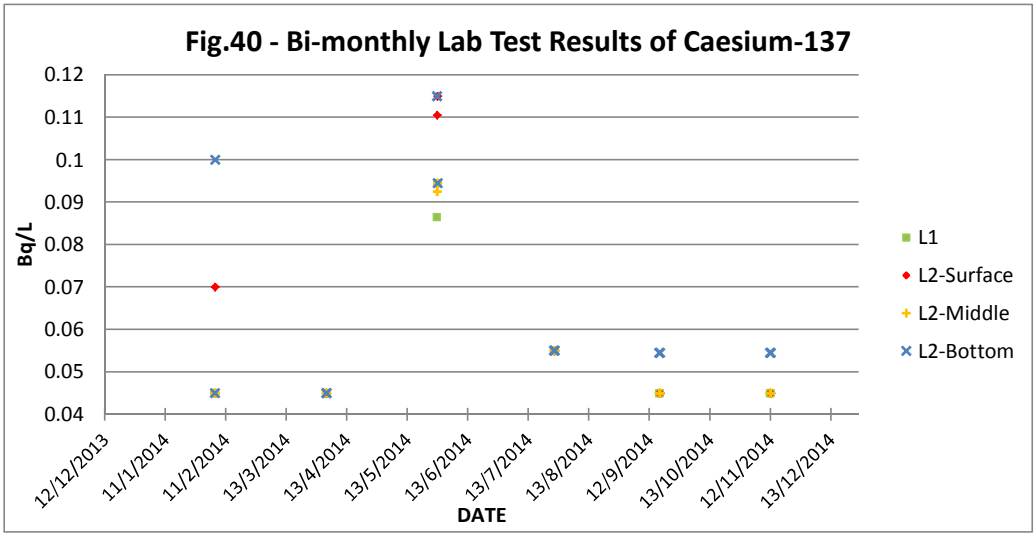

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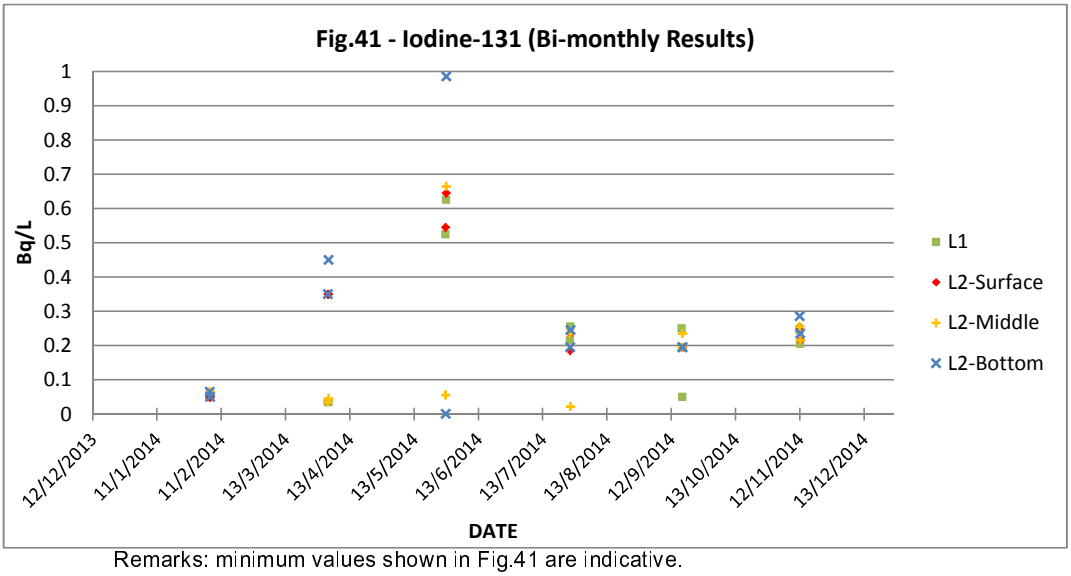
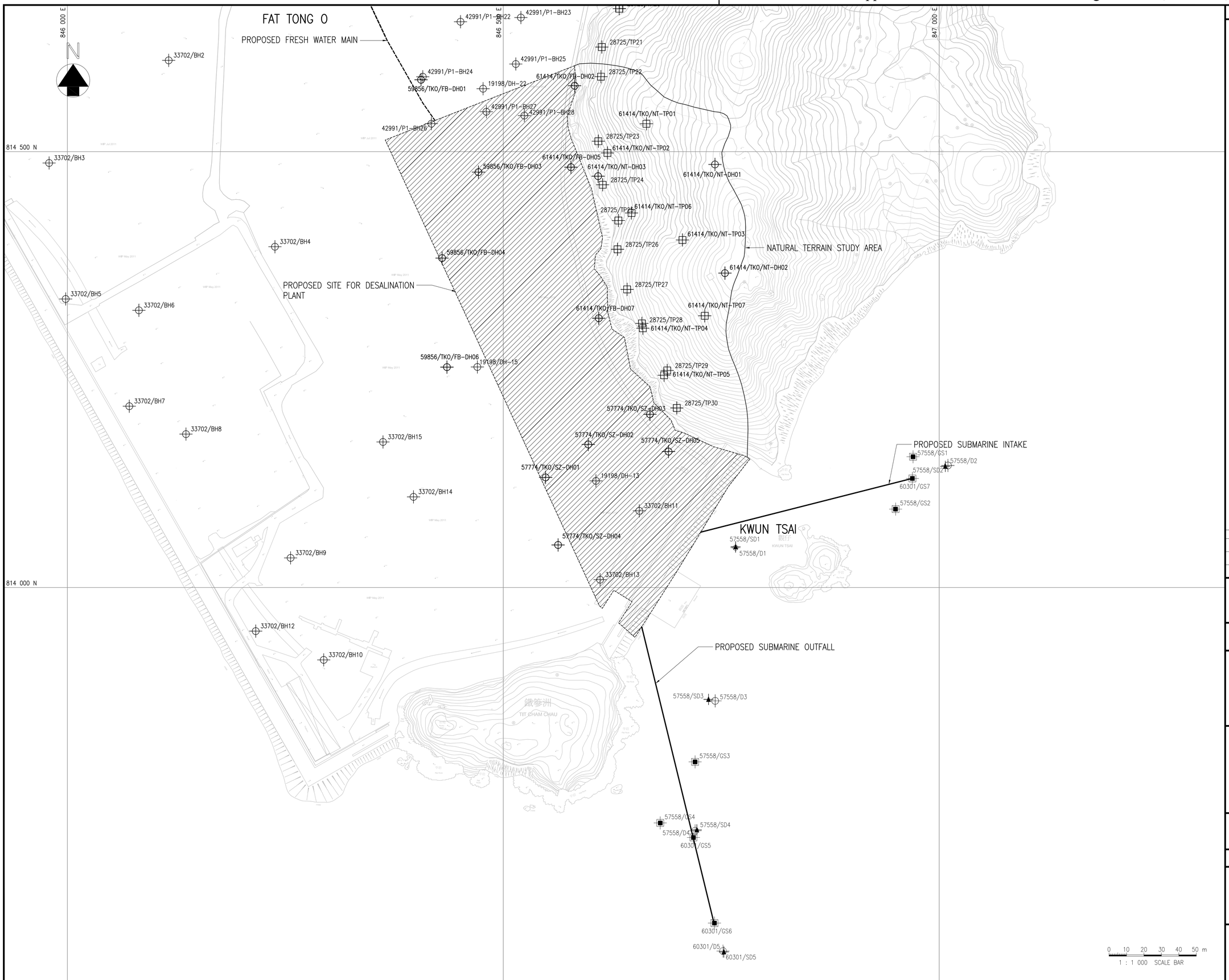


Remarks: minimum values shown in Fig.41 are indicative.



MAP NOS. 12SW11D, 12SW12C, 12SW16B, 12SW16D, 12SW17A, 12SW17C

LEGEND:

- EXISTING DRILLHOLE
- EXISTING TRIAL PIT
- EXISTING GRAB SAMPLE
- EXISTING VIBROCORE

Revision	Date	Description			Initial
	Designed	Checked	Drawn	Checked	
Initial	YLC	CKH	SZ	WLS	
Date	11/15	11/15	11/15	11/15	

Approved

Agreement No.
CE 8/2015 (WS)

Contract Title
FIRST STAGE OF DESALINATION PLANT AT TSEUNG KWAN O – INVESTIGATION, DESIGN AND CONSTRUCTION

Drawing Title
EXISTING GROUND INVESTIGATION

Drawing No.
190495/B/DSR/00-10009

Revision
–

Scale
A1 1 : 2000
A3 1 : 4000

水務署
Water Supplies Department

BLACK & VEATCH HONG KONG LIMITED
博威工程顧問有限公司

Appendix 2-3

Summary of Existing Ground Investigation Results

Location	Report No.	GI Station No.	Sample	Easting	Northing	Ground Level (mPD)	Depth of Strata Encountered (mPD)																														Remarks
							Fill			Colluvium			Marine Sand			Marine (Clay/Silt)			Beach Deposit			Alluvium (Clay/Silt)			Alluvium (Sand/Gravel)			Marine (Clay/Silt) 2			CDt			HDt			MDt or above			
TKO Area 137	57774	TKO/SZ-DH01	Drillhole	846548.53	814126.32	16.44	16.44	-	(17.36)	-	-	-	-	-	-	-	-	-	-	-	-	(17.36)	-	(22.86)	-	-	-	-	-	-	-	-	-	(22.86)	-	(23.84)	(23.84)	-	(29.26)	-
		TKO/SZ-DH02	Drillhole	846597.48	814164.13	13.82	13.82	-	(12.78)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(12.78)	-	(19.80)	(19.80)	-	(24.01)	(24.01)	-	(31.38)	-
		TKO/SZ-DH03	Drillhole	846668.22	814198.72	5.27	5.27	-	(5.33)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(5.33)	-	(6.84)	(6.84)	-	(12.88)	-
		TKO/SZ-DH04	Drillhole	846562.83	814048.84	15.28	15.28	-	(10.34)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(10.34)	-	(11.00)	(11.00)	-	(18.83)	-
		TKO/SZ-DH05	Drillhole	846689.54	814155.99	5.38	5.38	-	(9.12)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(9.12)	-	(9.92)	-	-	-	(9.12)	-	(16.19)	-
	59856	TKO/FB-DH01	Drillhole	846362.04	814513.80	26.50	26.50	-	(16.90)	-	-	-	-	-	-	(16.90)	-	(24.90)	-	-	-	(24.90)	-	(42.00)	-	-	-	-	-	-	(42.00)	-	(59.05)	-	-	-	(59.05)	-	(65.00)	-
		TKO/FB-DH03	Drillhole	846471.51	814476.53	26.77	26.77	-	(21.73)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(21.73)	-	(22.53)	-	-	-	(22.53)	-	(27.77)	-
		TKO/FB-DH04	Drillhole	846429.78	814377.90	28.45	28.45	-	(27.55)	-	-	-	-	-	-	-	-	-	-	-	-	(27.55)	-	(33.05)	-	-	-	-	-	(33.05)	-	(59.05)	(59.05)	-	(60.25)	(60.25)	-	(66.62)	-
		TKO/FB-DH06	Drillhole	846435.34	814252.83	35.96	35.96	-	(26.04)	-	-	-	-	-	-	-	-	-	-	-	-	(26.04)	-	(35.04)	-	-	-	-	-	(35.04)	-	(52.44)	(52.44)	-	(55.07)	(55.07)	-	(60.40)	-
	61414	TKO/FB-DH02	Drillhole	846581.83	814575.61	5.40	5.40	-	1.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.22		(9.11)	-
		TKO/FB-DH05	Drillhole	846577.62	814482.20	5.45	5.45		(0.85)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(0.85)	-	(3.85)	(3.85)	-	(5.10)	(5.10)	-	(16.08)	-
		TKO/FB-DH07	Drillhole	846609.49	814308.92	5.91	5.91	-	(0.29)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(0.29)	-	(4.59)	(4.59)	-	(12.62)	(12.62)	-	(22.94)	-
	19198	19198/DH13	Drillhole	846606.29	814122.36	(10.86)	-	-	-	-	-	-	(12.36)	-	(13.86)	(10.86)	-	(12.36)	-	-	-	-	-	-	-	-	-	-	-	(13.86)	-	(21.86)	-	-	-	-	-	-	-
		19198/DH15	Drillhole	846470.26	814253.01	(9.39)	-	-	-	-	-	-	-	-	-	(9.39)	-	(26.39)	-	-	-	-	-	-	-	-	-	-	-	(26.39)	-	(33.39)	-	-	-	-	-	-	-
		19198/DH22	Drillhole	846476.80	814572.20	(8.20)	-	-	-	-	-	-	-	-	-	(8.20)	-	(22.85)	-	-	-	-	-	-	-	-	-	-	-	(22.85)	-	(30.85)	-	-	-	-	-	-	-
	33702	33702/BH2	Drillhole	846116.17	814604.71	7.18	7.18	-	(7.80)	-	-	-	-	-	-	(7.80)	-	(35.67)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		33702/BH4	Drillhole	846238.05	814390.94	12.75	12.75		(10.43)	-	-	-	(10.43)	-	(13.50)	(13.50)	-	(34.00)	(34.00)	-	(37.00)	(37.00)	-	(42.66)	(42.66)	-	(42.91)	(42.91)	-	(51.10)	-	-	-	-	-	-	-	-	-	-
		33702/BH6	Drillhole	846082.39	814318.20	5.33	5.33	-	(11.97)	-	-	-	-	-	-	(11.97)	-	(50.22)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		33702/BH7	Drillhole	846071.07	814208.28	4.92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		33702/BH8	Drillhole	846136.34	814176.25	4.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		33702/BH11	Drillhole	846656.24	814088.25	5.67	5.67	-	(7.04)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(7.04)	-	(8.05)	-	-	-	(8.05)	-	(12.85)	-	-	-	(12.85)	-	(15.58)	-
		33702/BH13	Drillhole	846611.20	814008.97	5.56	5.56	-	(3.44)	-	-	-	(3.44)	-	(5.94)	-	-	-	-	-	-	-	-	-	(5.94)	-	(6.44)	-	-	-	(6.44)	-	(9.34)	(9.34)	-	(10.44)	(10.44)	-	(15.93)	-
		33702/BH14	Drillhole	846396.73	814103.58	26.68	26.68	-	(13.52)	-	-	-	-	-	-	(13.52)	-	(34.62)	-	-	-	-	-	-	(34.62)	-	(35.62)	-	-	-	-	-	-	-	-	-	(35.12)	-	(36.52)	-
	42991	42991/P1-BH22	Drillhole	846460.90	814649.03	27.00	27.00	-	(14.50)	(26.96)		(28.00)	-	-	-	(14.50)	-	(22.50)	-	-	-	(22.50)	-	(26.96)	-	-	-	-	-	-	(28.00)	-	(30.76)	(30.76)	-	(36.08)	(36.08)	-	(40.26)	-
		42991/P1-BH23	Drillhole	846520.16	814653.84	26.83	26.83	-	(6.17)	(17.17)		(18.17)	(6.17)	-	(13.67)	(13.67)	-	(17.17)	-	-	-	-	-	-	-	-	-	-	-	-	(18.17)	-	(31.07)	(31.07)	-	(35.17)	(35.17)	-	(38.27)	-
		42991/P1-BH24	Drillhole	846407.64	814585.92	32.65	32.65	-	(15.13)	(32.85)		(33.85)	-	-	-	(15.13)	-	(26.25)	-	-	-	(26.25)	-	(32.85)	-	-	-	-	-	-	(33.85)	-	(53.85)	(53.85)	-	(58.30)	(58.30)	-	(59.31)	-
		42991/P1-BH25	Drillhole	846514.33	814600.53	27.54	27.54	-	(10.96)	(19.96)		(24.46)	(10.96)	-	(13.48)	(13.48)	-	(19.96)	-	-	-	-	-	-	-	-	-	-	-	-	(24.46)	-	(35.24)	(35.24)	-	(36.07)	(36.07)	-	(39.13)	-
		42991/P1-BH26	Drillhole	846417.52	814532.09	32.60	32.60	-	(12.40)	(29.30)		(30.20)	(12.40)	-	(13.00)	(13.00)	-	(24.40)	-	-	-	(24.40)	-	(29.30)	-	-	-	-	-	-	(30.20)	-	(38.40)	(38.40)	-	(42.80)	(42.80)	-	(48.29)	-
		42991/P1-BH27	Drillhole	846480.58	814545.79	27.55	27.55	-	(8.45)	-	-	-	(8.45)	-	(14.45)	(14.45)	-	(22.45)	-	-	-	(22.45)	-	(25.15)	-	-	-	-	-	-	(25.15)	-	(29.55)	(29.55)	-	(32.17)	(32.17)	-	(35.10)	-
		42991/P1-BH28	Drillhole	846524.16	814541.40	21.13	21.13	-	(7.57)	-	-	-	(7.57)	-	(11.87)	(11.87)	-	(15.68)	-	-	-	-	-	-	-	-	-	-	-	-	(15.68)	-	(24.87)	(24.87)	-	(27.79)	(27.79)	-	(31.43)	-
Natural Terrain	28725	28725/BH8	Drillhole	846642.72	814682.44	15.64	-	-	-	15.64	-	14.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14.14	-	7.64	7.64	-	4.49	4.49	-	(0.76)	-
		28725/BH9	Drillhole	846613.41	814571.74	28.19	-	-	-	28.19	-	26.99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26.99	-	24.67	24.67	-	10.29	-
		28725/BH10	Drillhole	846643.79	814401.61	29.46	-	-	-	29.46	-	25.54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25.54	-	21.56	21.56	-	20.98	20.98	-	17.69	-
		28725/BH11	Drillhole	846668.68	814313.63	42.84	-	-	-	42.84	-	38.34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38.34	-	33.34	33.34	-	31.34	31.34	-	27.99	-
		28725/TP20	Trial Pit	846633.13	814664.31	17.79	17.79	-	17.49	17.49	-	16.99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16.99	-	15.99	15.99	-	15.39	-	-	-	-
		28725/TP21	Trial Pit	846613.37	814620.47	22.09	22.09	-	21.94	21.94	-	20.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		28725/TP22	Trial Pit	846612.22	814585.55	24.27	24.27	-	23.97	23.97	-	22.97	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		28725/TP23	Trial Pit	846608.86	814512.01	18.27	18.27	-	18.07	18.07	-	16.47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		28725/TP24	Trial Pit	846613.84	814462.06	13.29	13.29	-	12.99	12.99	-	12.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		28725/TP25	Trial Pit	8466331.82	814421.44	20.30	20.30	-	20.10	20.10	-	18.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		28725/TP26	Trial Pit	846631.10	814388.11	24.63	24.63	-	24.43	24.43	-	23.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23.33	-	21.43	-	-	-	-	-	-	-
		28725/TP27	Trial Pit	846642.05	814341.93	33.17	33.17	-	32.97	32.97	-	32.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		28725/TP28	Trial Pit	846659.26	814303.15	35.31	35.31	-	35.16	35.16	-	34.61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34.61	-	33.71	33.71	-	33.11	-	-	-	-
		28725/TP29	Trial Pit	846687.80	814248.82	31.02	31.02	-	30.87	30.87	-	30.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30.52	-	29.97	-	-	-	-	-	-	-
		28725/TP30	Trial Pit	846699.27	814205.88	16.30	16.30	-	16.15	16.15	-	15.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15.70	-	13.60	-	-	-	-
	61414	TKO/NT-DH01	Drillhole	846742.78	814485.34	68.65	-	-	-	68.85	-	66.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	66.45	-	53.65	-	-	-	-	-	-	-
		TKO/NT-DH02	Drillhole	846754.22	814360.66	78.98	-	-	-	78.98	-	78.48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	78.48	-	63.98	-	-	-	-	-	-	-
		TKO/NT-DH03	Drillhole	846608.74	814471.87	10.53	-	-	-	10.53	-	8.98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.98	-	7.08	7.08	-	(3.24)	-
		TKO/NT-TP01	Trial Pit	846664.17	814531.98	47.04	-	-	-	47.04	-	46.64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	46.64	-	44.44	-	-	-	-	-	-	-
		TKO/NT-TP02	Trial Pit	846619.46	814498.51	19.54	-	-	-	19.54	-	18.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		TKO/NT-TP03	Trial Pit	846705.51	814398.69	54.43	-	-	-	54.43	-	53.83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	53.83	-	51.23	-	-	-	-	-	-	-
		TKO/NT-TP04	Trial Pit	846660.07	814297.46	34.27	-	-	-	34.27	-	33.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33.07	-	32.73	-
		TKO/NT-TP05	Trial Pit	846684.45	814243.52	27.37	-	-	-	27.37	-	26.57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26.57	-	26.07	-	-	-	-	-	-	-
		TKO/NT-TP06	Trial Pit	846647.07	814429.67	26.07	-	-	-	26.07	-	24.57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		TKO/NT-TP07	Trial Pit	846731.08	814311.71	63.10	-	-	-	63.10	-	62.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	62.50	-	60.80	-	-	-	-	-	-	-
Marine	57558	D1	Drillhole	846766.33	814045.60	(2.35)	-	-	-	-	-	-	(2.35)	-	(3.35)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(3.35)	-	(8.95)	-	-	-	(8.95)	-	(24.33)	-
		D2	Drillhole	847010.00	814140.00	(11.05)	-	-	-	-	-	-	(25.05)	-	(27.77)	(11.05)	-	(25.05)	-	-	-	-	-	-	-	-	-	-	-	(27.77)	-	(46.25)	(46.25)	-	(47.35)	(47.35)	-	(63.43)	-
		D3	Drillhole	846743.00	813870.00	(8.80)	-	-	-	-	-	-	(8.80)	-	(13.30)	-	-	-	-	-	-	-	(13.30)	-	(15.05)	-	-	-	(15.05)	-	(18.36)	-	-	-	(18.36)	-	(34.39)	-
		D4	Drillhole	846720.00	813721.00	(14.75)	-	-	-	-	-	-	(14.75)	-	(18.55)	-	-	-	-	-	-	-	(18.55)	-	(19.19)	-	-	-	-	-	-	-	-	-	(19.19)	-	(34.44)	-
		SD1	Vibrocore	846766.50	814046.70	(2.85)	-	-	-	-	-	-	(2.45)	-	(2.85)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(2.85)	-
		SD2	Vibrocore	847007.00	814139.00	(23.10)	-	-	-	-	-	-	-	-	-	(11.20)	-	(23.10)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(23.10)	-
		SD3	Vibrocore	846735.40	813871.70	(7.85)	-	-	-	-	-	-	(7.15)	-	(7.85)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(7.85)	-
		SD4	Vibrocore	846722.00	813722.00	(17.00)	-	-	-	-	-	-	(15.00)	-	(17.00)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(17.00)	-
		GS1	Grab sample	846970.00	814150.00	(9.20)	-	-	-	-	-	-	(9.20)	-	(9.30)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(9.30)	-
		GS2	Grab sample	846950.00	814090.00	(9.50)	-	-	-	-	-	-	(9.50)	-	(9.60)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(9.60)	-
		GS3	Grab sample	846720.00	813800.00	(10.50)	-	-	-	-	-	-	(10.50)	-	(10.60)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(10.60)	-
		GS4	Grab sample	846680.00	813730.00	(10.70)	-	-	-	-	-	-	(10.70)	-	(10.80)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(10.80)	-
	60301	D5	Drillhole	846752.00	813583.00	(13.35)	-	-	-	-	-	-	-	-	-	(13.35)	-	(27.35)	-	-	-	(27.35)	-	(33.45)	(33.45)	-	(35.48)	-	-	-	-	-	-	(35.48)		(38.74)	(38.74)	-	(55.03)	-
		SD5	Vibrocore	846753.00	813582.00	(14.15)	-	-	-	-	-	-	-	-	-	(14.15)	-	(26.15)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		GS5	Grab sample	846718.10	813713.30	(13.41)	-	-	-	-	-	-	(13.41)	-	(13.51)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		GS6	Grab sample	846742.20	813615.10	(13.63)	-	-	-	-	-	-	(13.63)	-	(13.73)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		GS7	Grab sample	846969.30	814125.10	(13.29)	-	-	-	-	-	-	(13.29)	-	(13.29)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(10.80)	-

Remarks:

CD	Completed Decomposed
HD	Highly Decomposed
MD	Moderately Decomposed
t	fine ash crystal TUFF