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

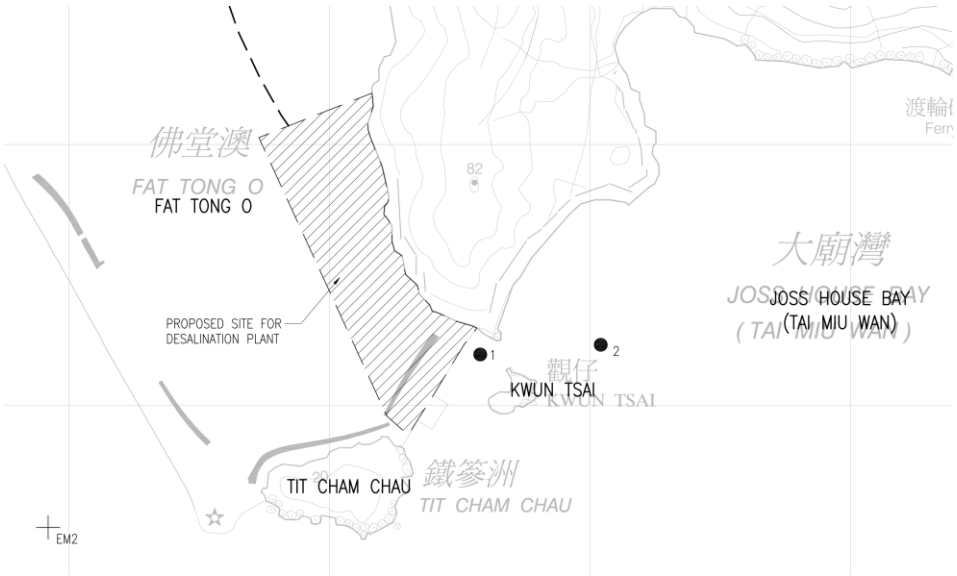

Table 1 Results Summary of the Water Sampling at Location 1 (middle depth)

	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.

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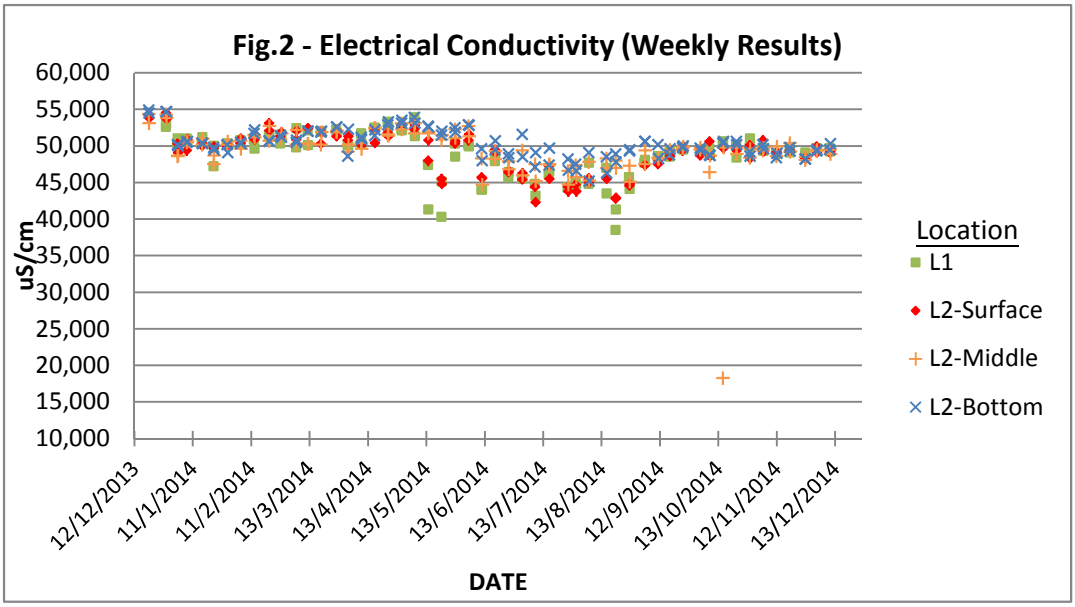

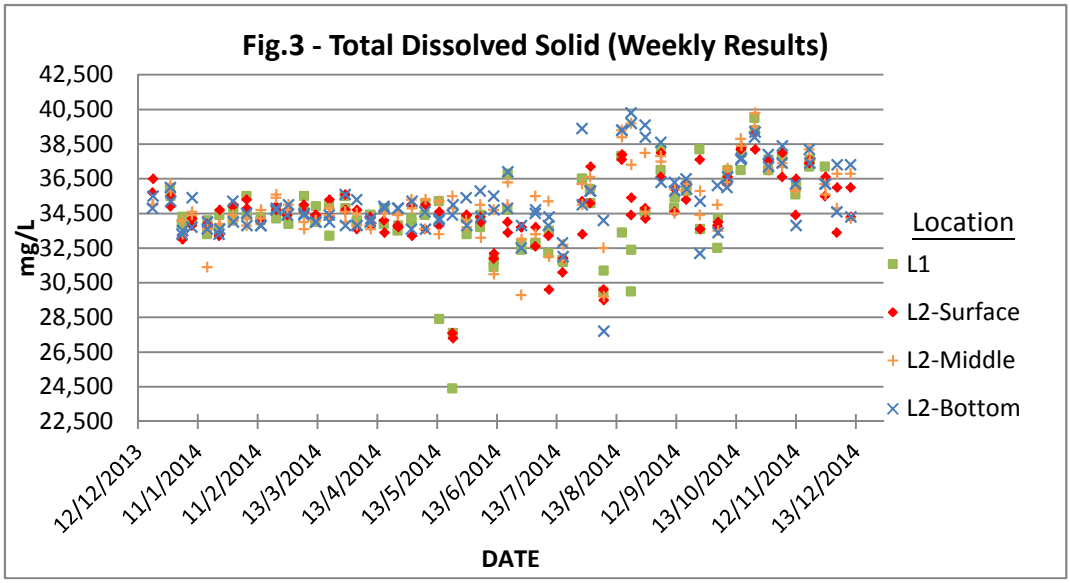

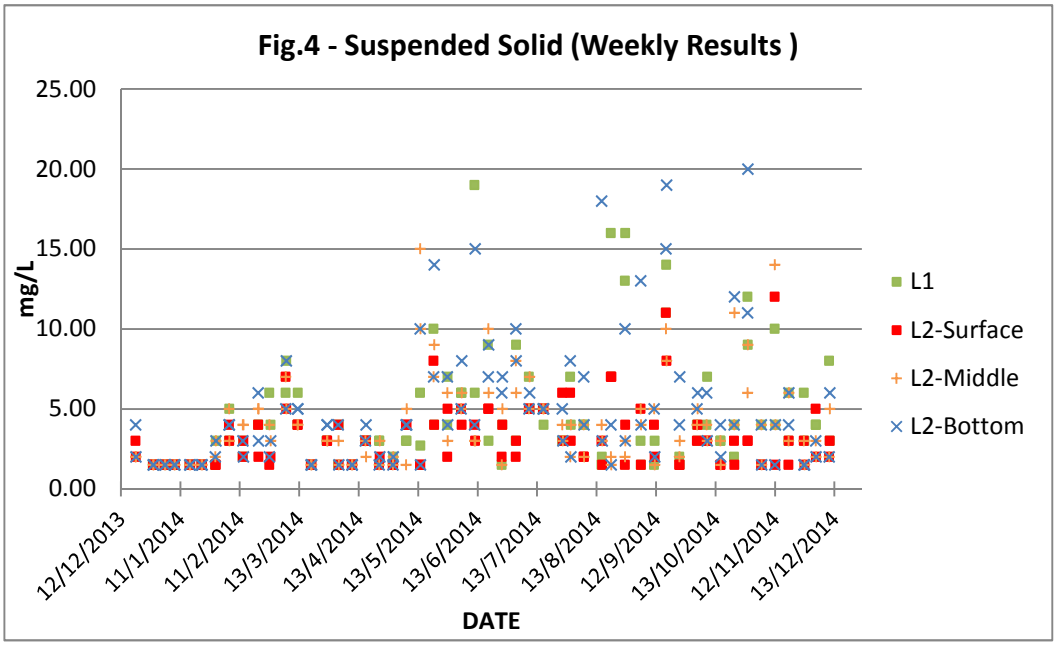

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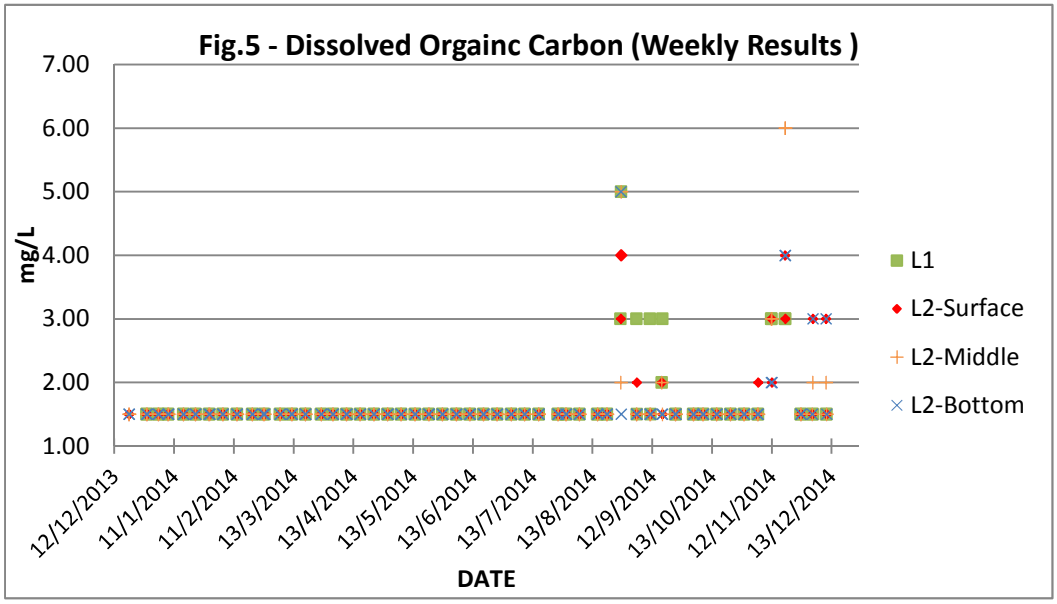

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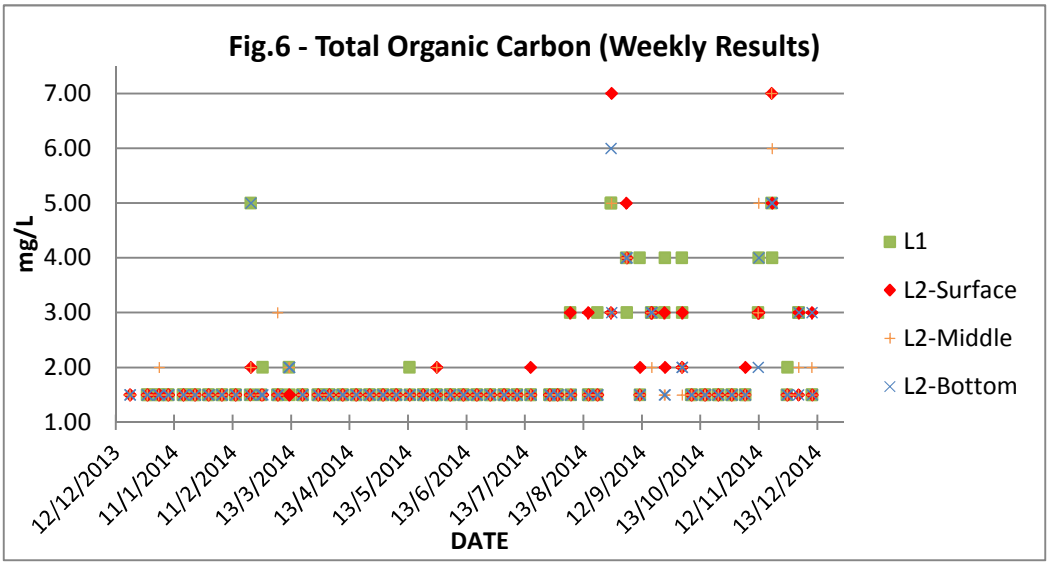

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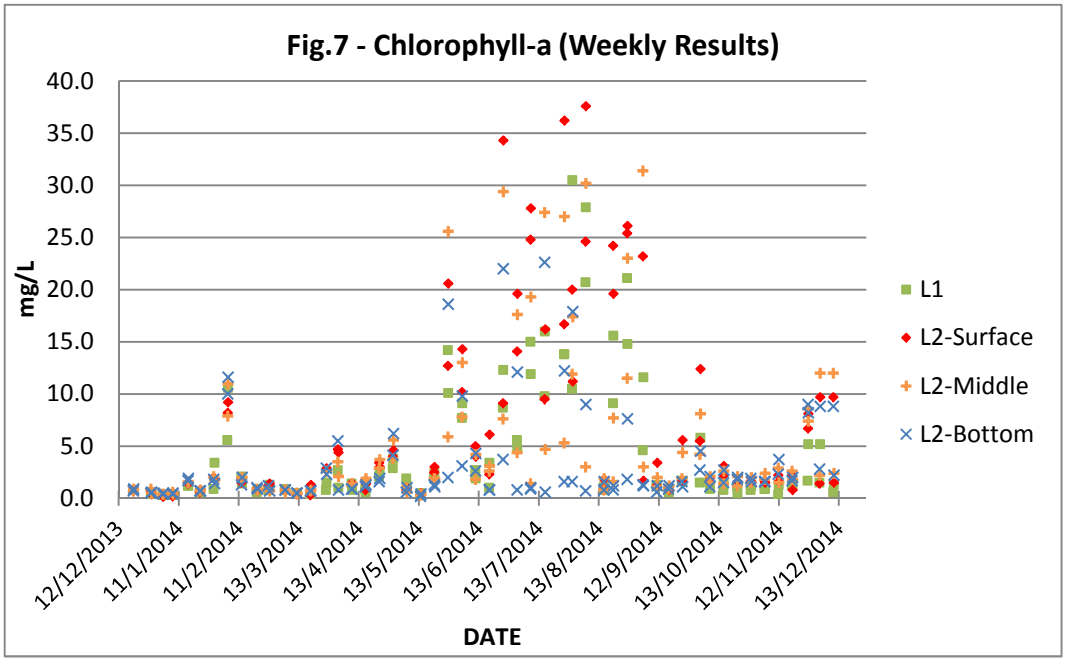

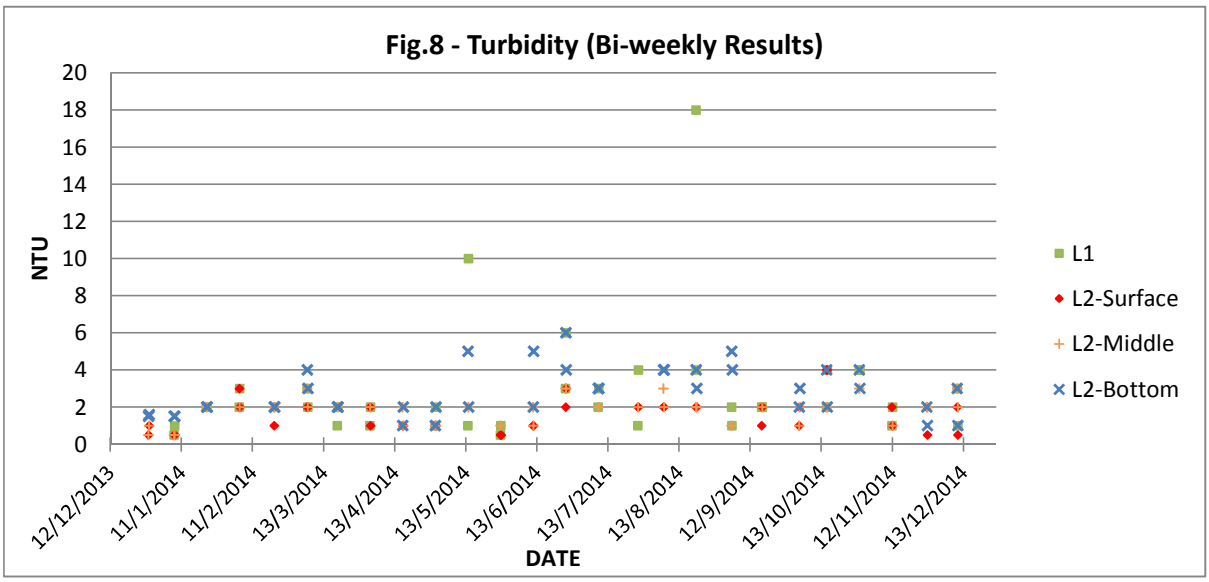

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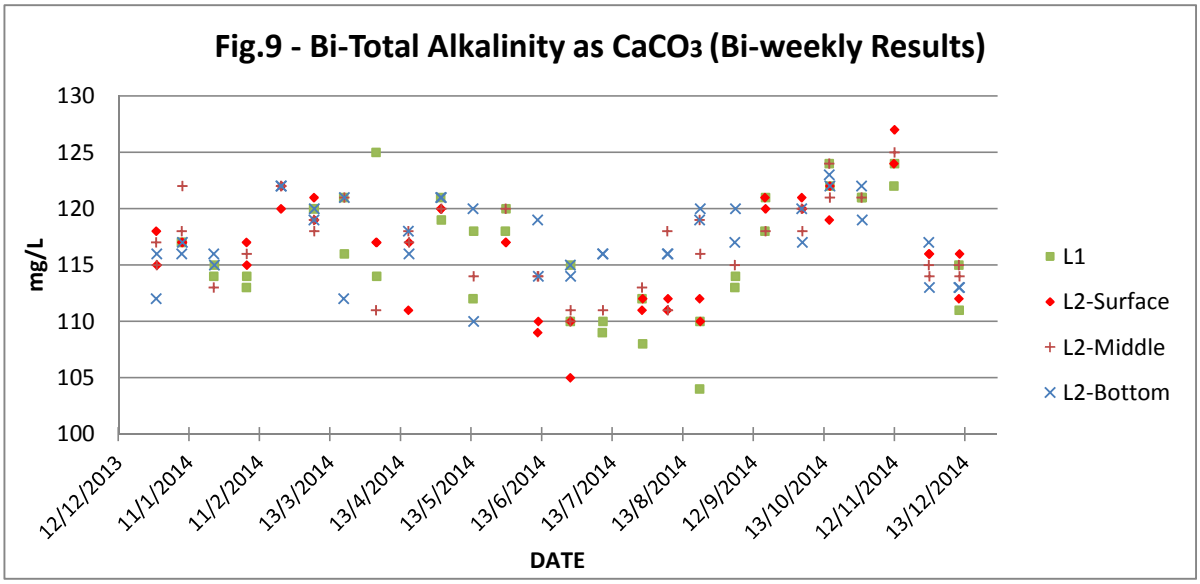

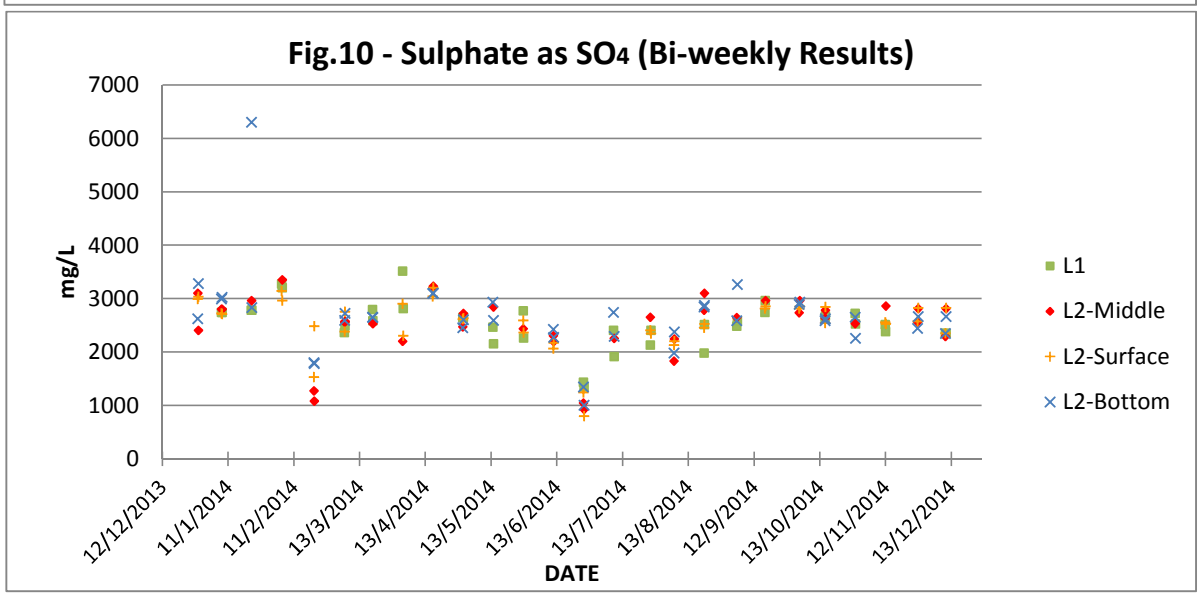

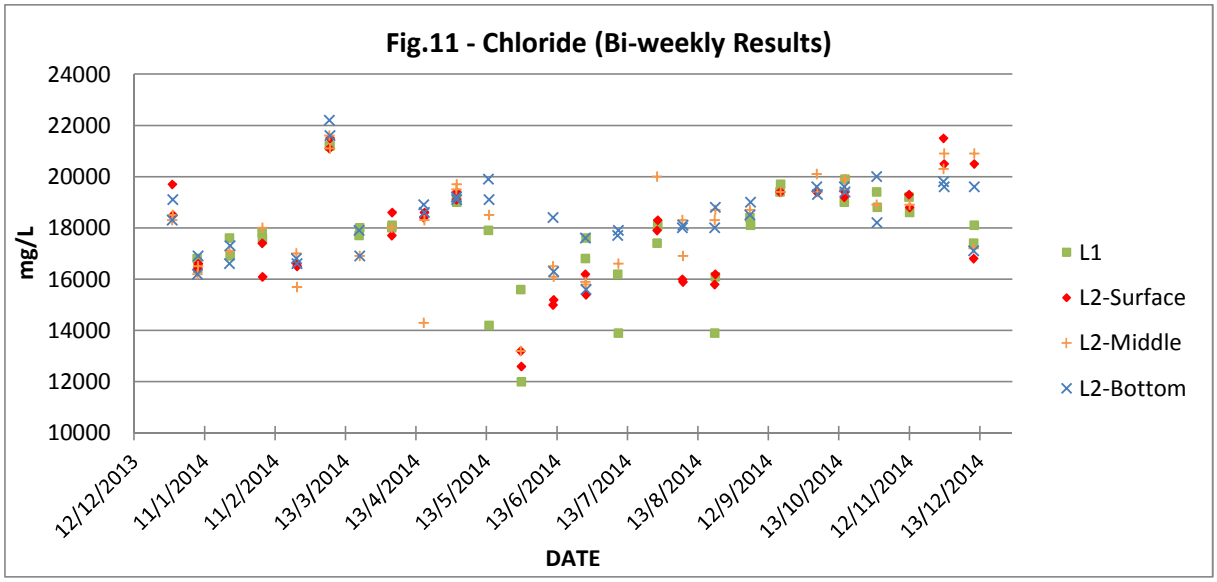

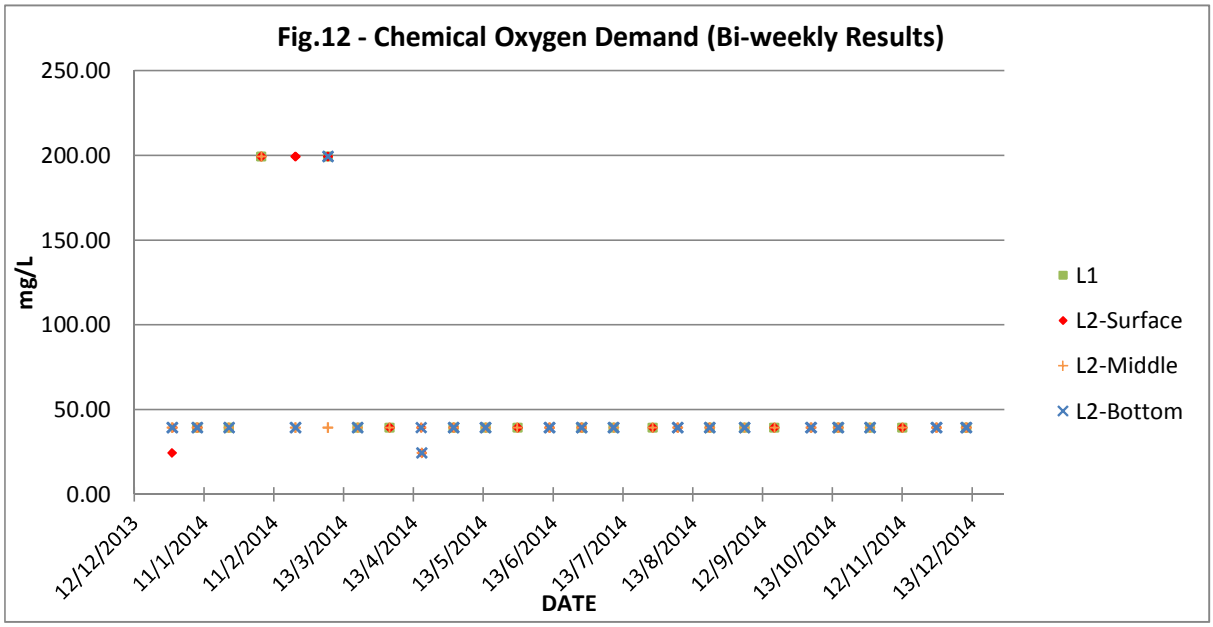

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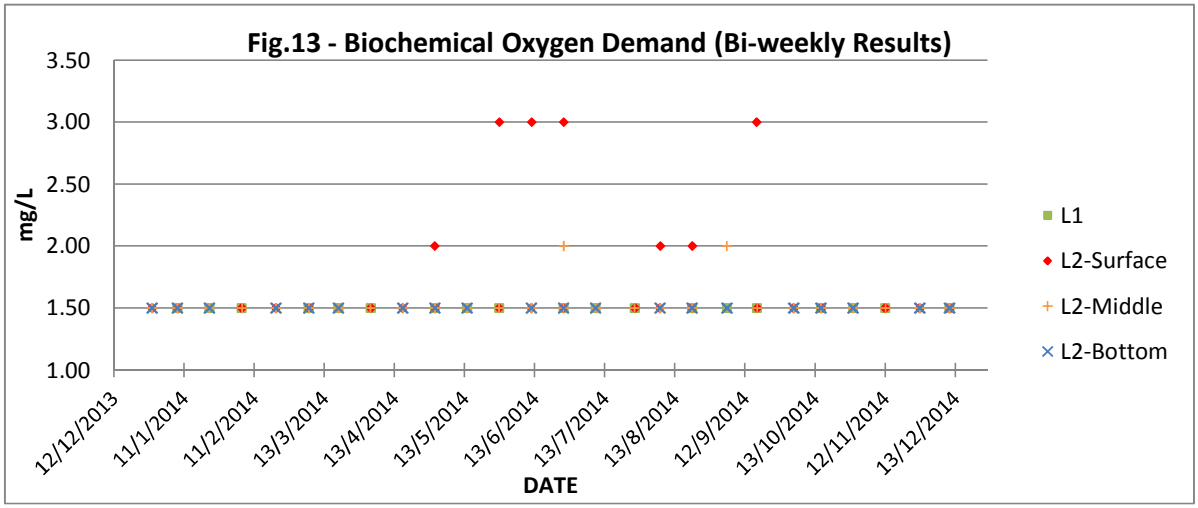

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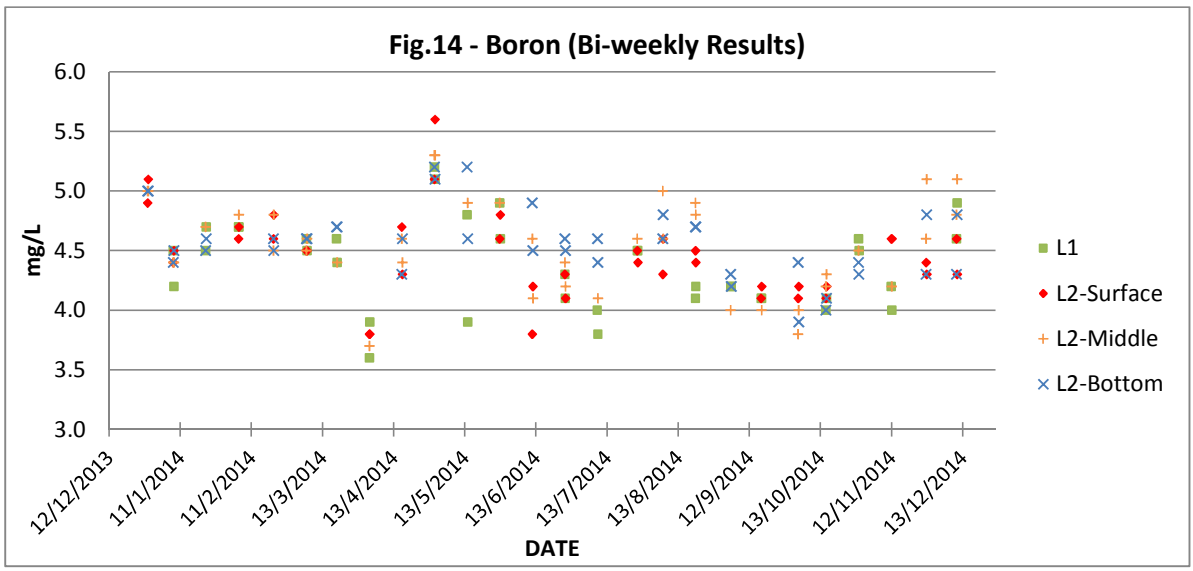


Fig.14 - Boron (Bi-weekly Results)
6.0
5.5
5.0
4.5
4.0
3.5
3.0
mg/L
12/12/2013
11/1/2014
11/2/2014
13/3/2014
13/4/2014
13/5/2014
13/6/2014
13/7/2014
13/8/2014
12/9/2014
13/10/2014
12/11/2014
13/12/2014
DATE
L1
L2-Surface
L2-Middle
L2-Bottom

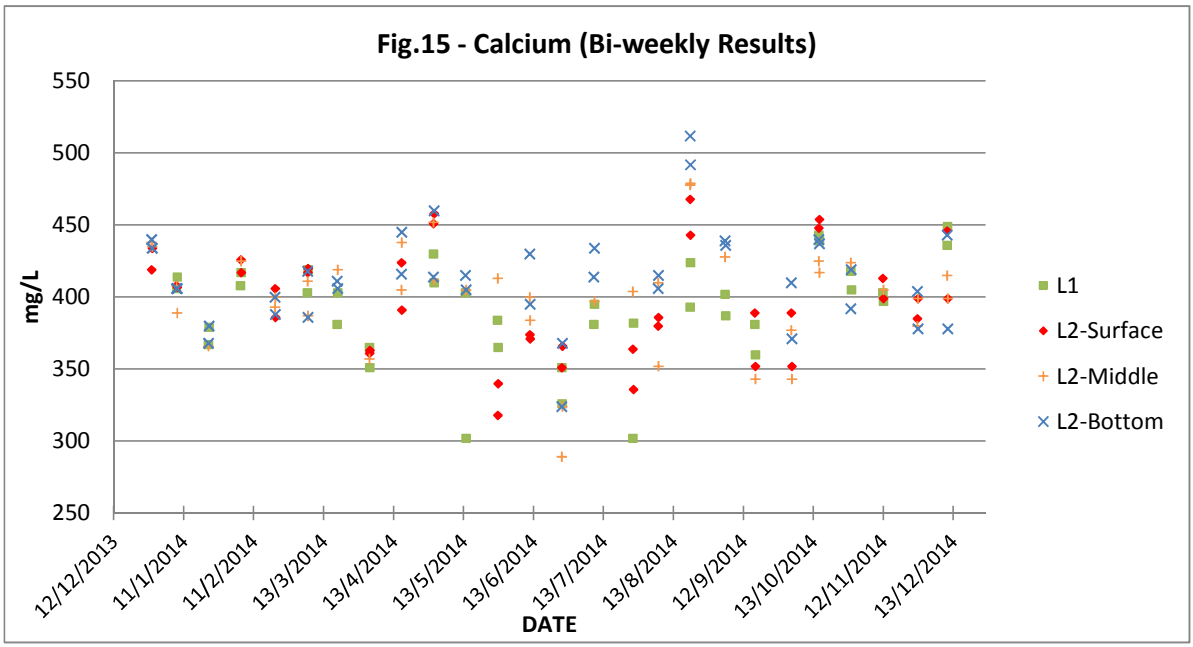


Fig.15 - Calcium (Bi-weekly Results)
550
500
450
400
350
300
250
mg/L
12/12/2013
11/1/2014
11/2/2014
13/3/2014
13/4/2014
13/5/2014
13/6/2014
13/7/2014
13/8/2014
12/9/2014
13/10/2014
12/11/2014
13/12/2014
DATE
L1
L2-Surface
L2-Middle
L2-Bottom

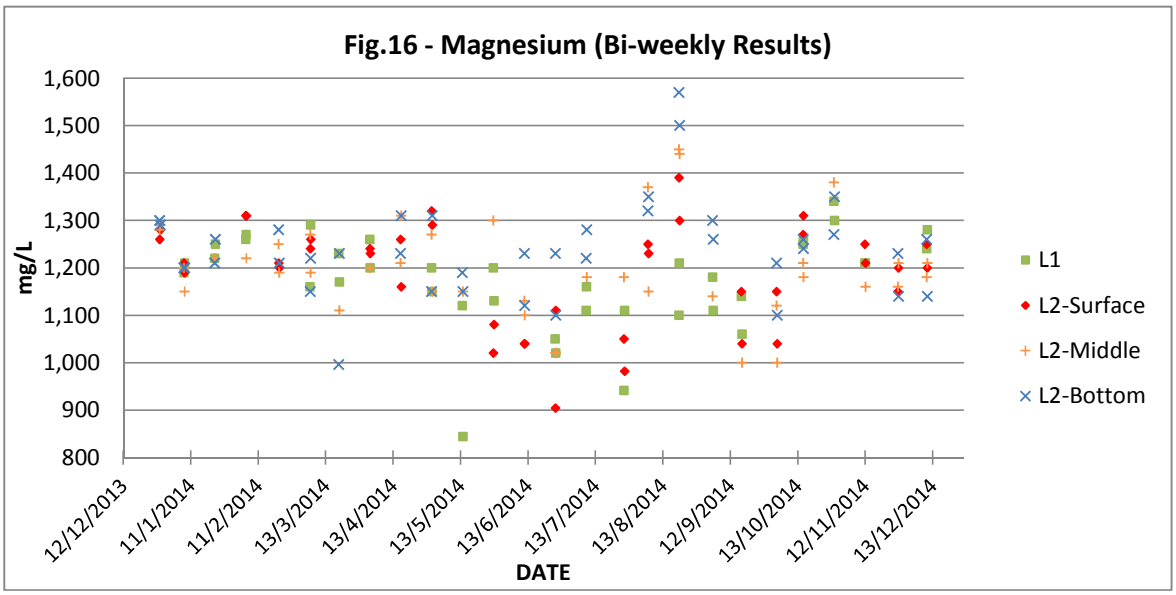


Fig.16 - Magnesium (Bi-weekly Results)
1,600
1,500
1,400
1,300
1,200
1,100
1,000
900
800
mg/L
12/12/2013
11/1/2014
11/2/2014
13/3/2014
13/4/2014
13/5/2014
13/6/2014
13/7/2014
13/8/2014
12/9/2014
13/10/2014
12/11/2014
13/12/2014
DATE
L1
L2-Surface
L2-Middle
L2-Bottom

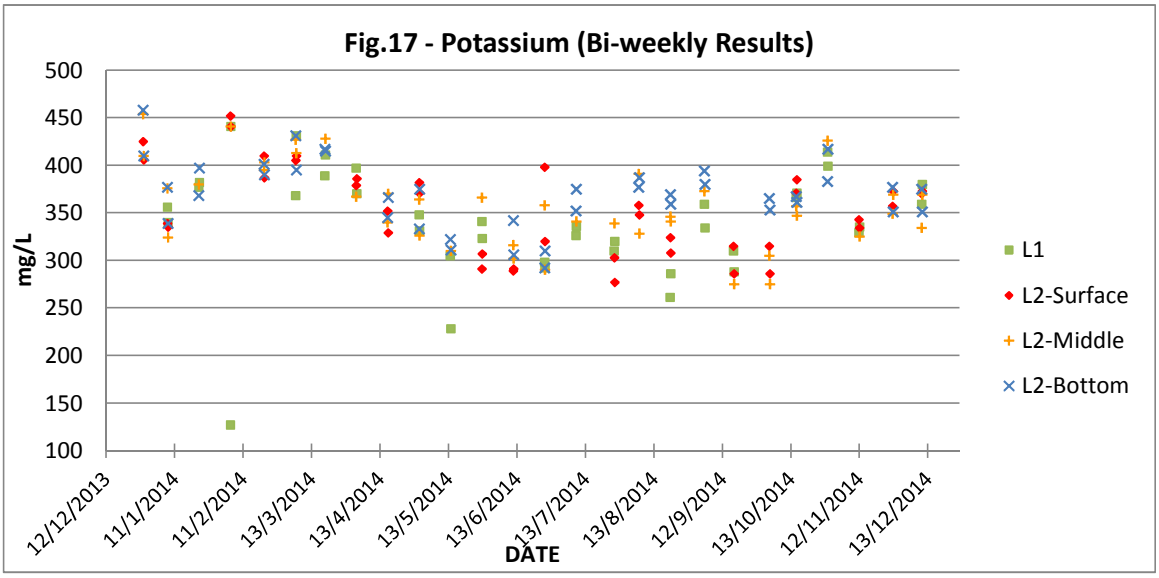


Fig.17 - Potassium (Bi-weekly Results)
500
450
400
350
300
250
200
150
100
mg/L
12/12/2013
11/1/2014
11/2/2014
13/3/2014
13/4/2014
13/5/2014
13/6/2014
13/7/2014
13/8/2014
12/9/2014
13/10/2014
12/11/2014
13/12/2014
DATE
L1
L2-Surface
L2-Middle
L2-Bottom

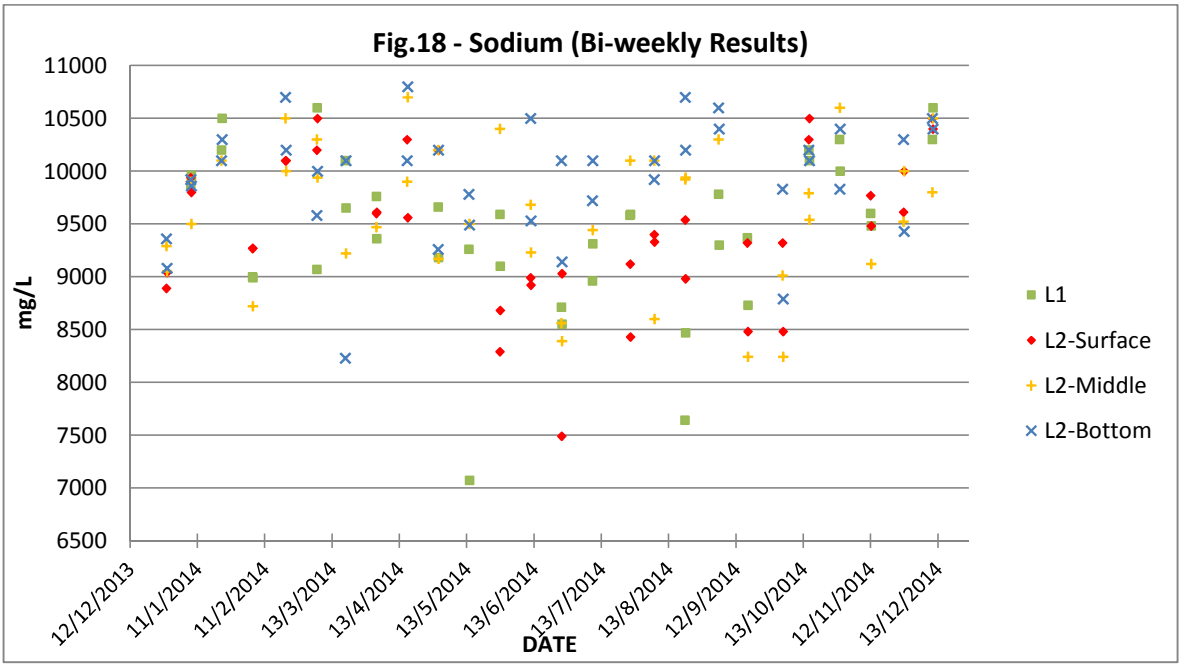
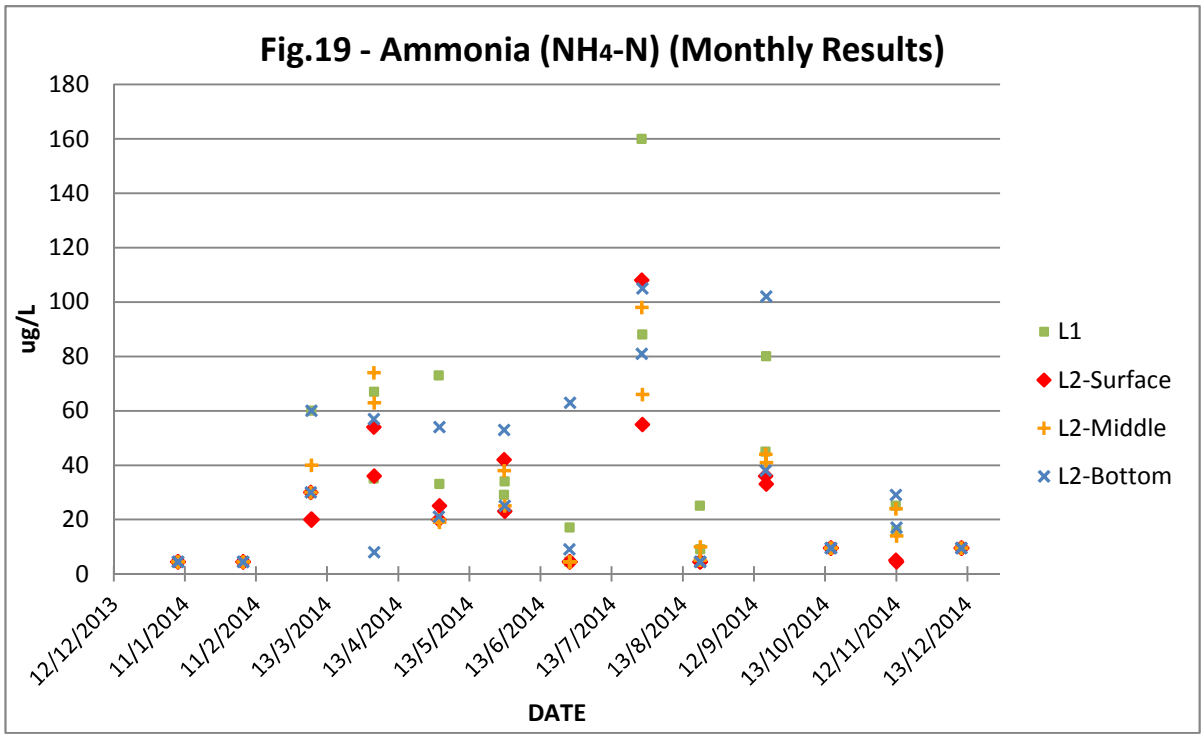
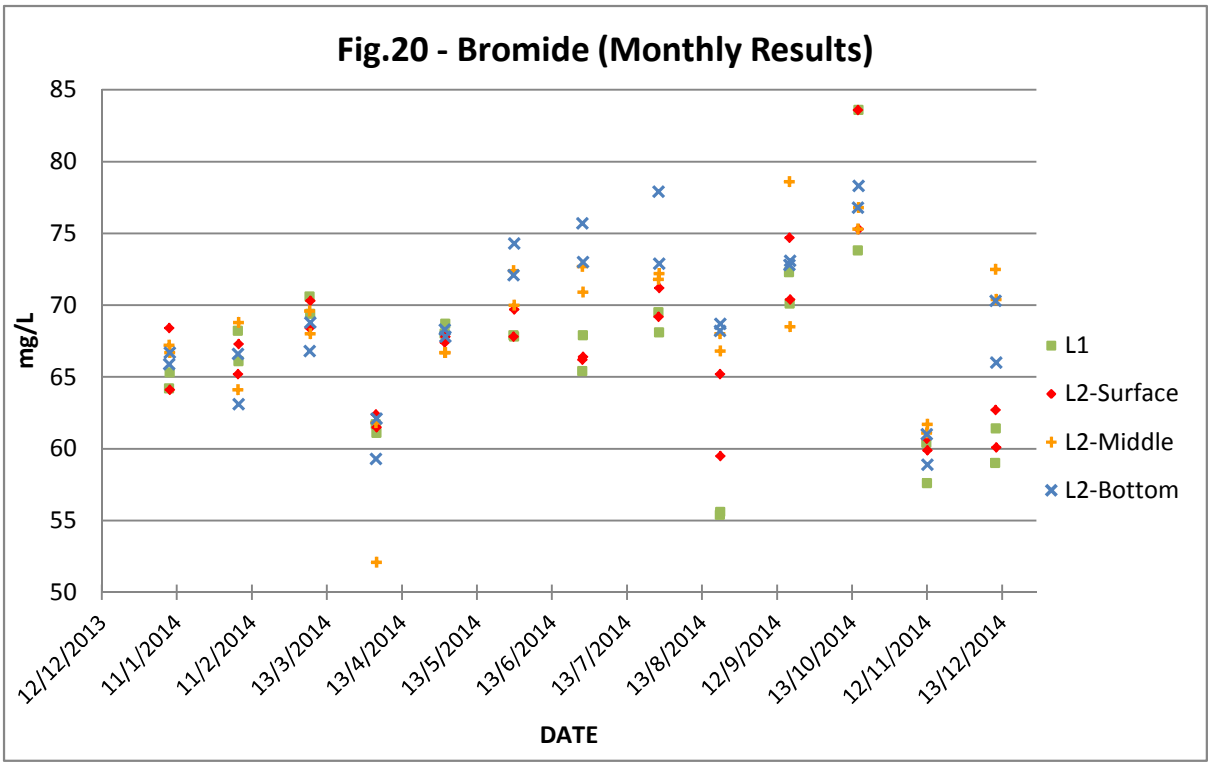


Fig.18 - Sodium (Bi-weekly Results)
11000
10500
10000
9500
9000
8500
8000
7500
7000
6500
mg/L
12/12/2013
11/1/2014
11/2/2014
13/3/2014
13/4/2014
13/5/2014
13/6/2014
13/7/2014
13/8/2014
12/9/2014
13/10/2014
12/11/2014
13/12/2014
DATE
L1
L2-Surface
L2-Middle
L2-Bottom



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



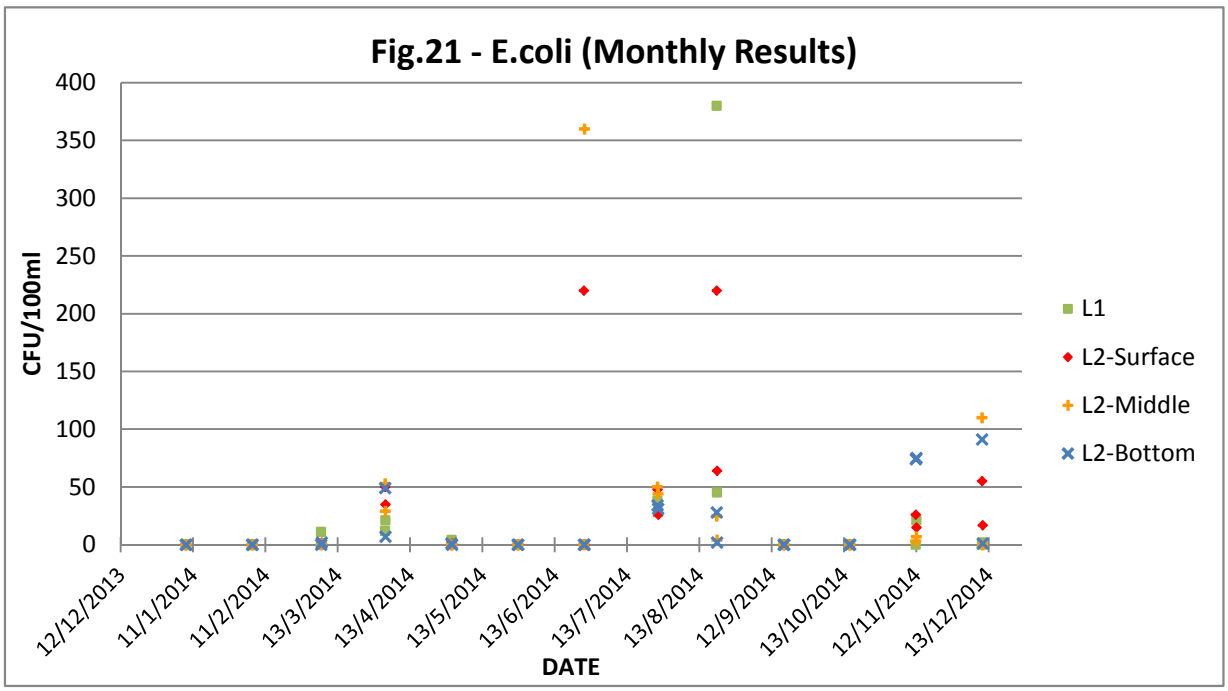


Fig.21 - E.coli (Monthly Results)
CFU/100ml
400
350
300
250
200
150
100
50
0
12/12/2013
11/1/2014
11/2/2014
13/3/2014
13/4/2014
13/5/2014
13/6/2014
13/7/2014
13/8/2014
12/9/2014
13/10/2014
12/11/2014
13/12/2014
DATE
L1
L2-Surface
L2-Middle
L2-Bottom

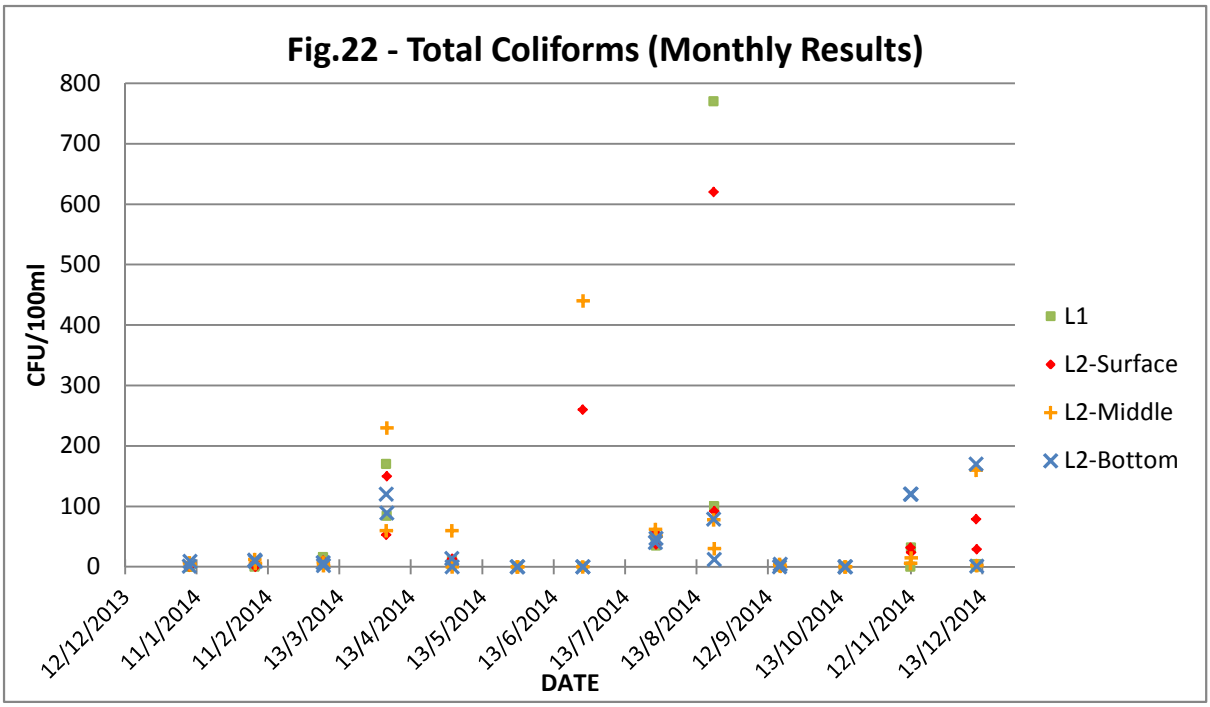
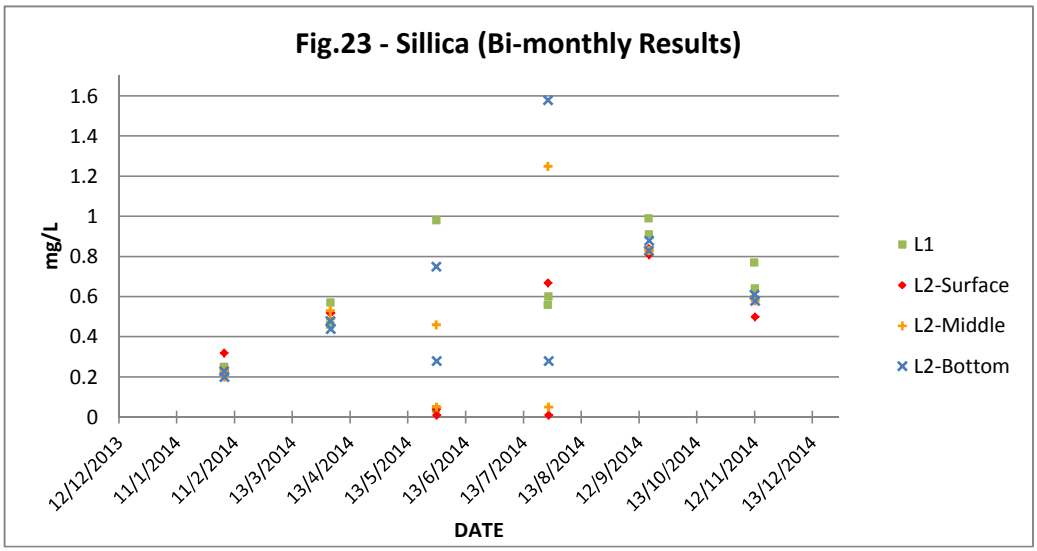
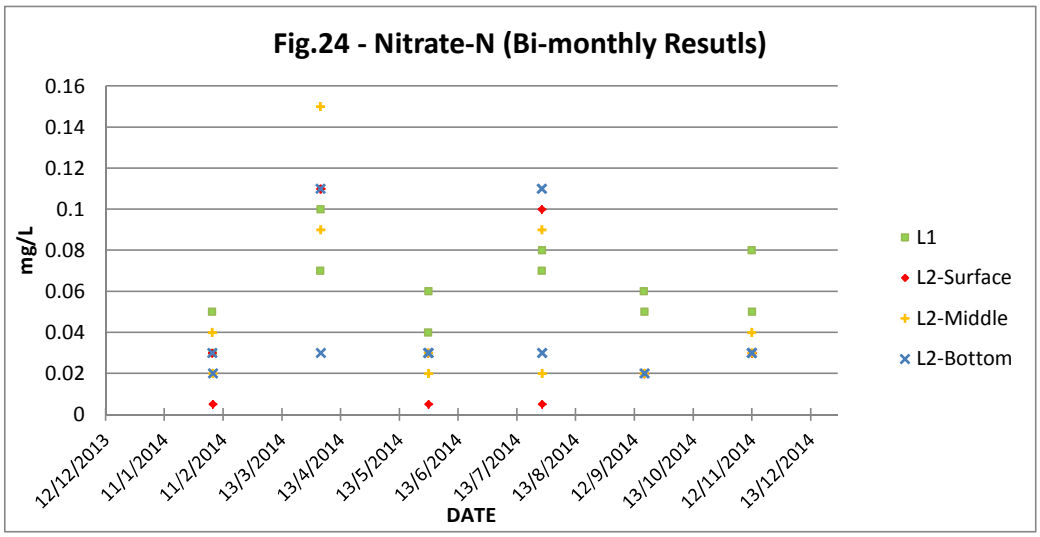


Fig.22 - Total Coliforms (Monthly Results)
CFU/100ml
800
700
600
500
400
300
200
100
0
12/12/2013
11/1/2014
11/2/2014
13/3/2014
13/4/2014
13/5/2014
13/6/2014
13/7/2014
13/8/2014
12/9/2014
13/10/2014
12/11/2014
13/12/2014
DATE
L1
L2-Surface
L2-Middle
L2-Bottom





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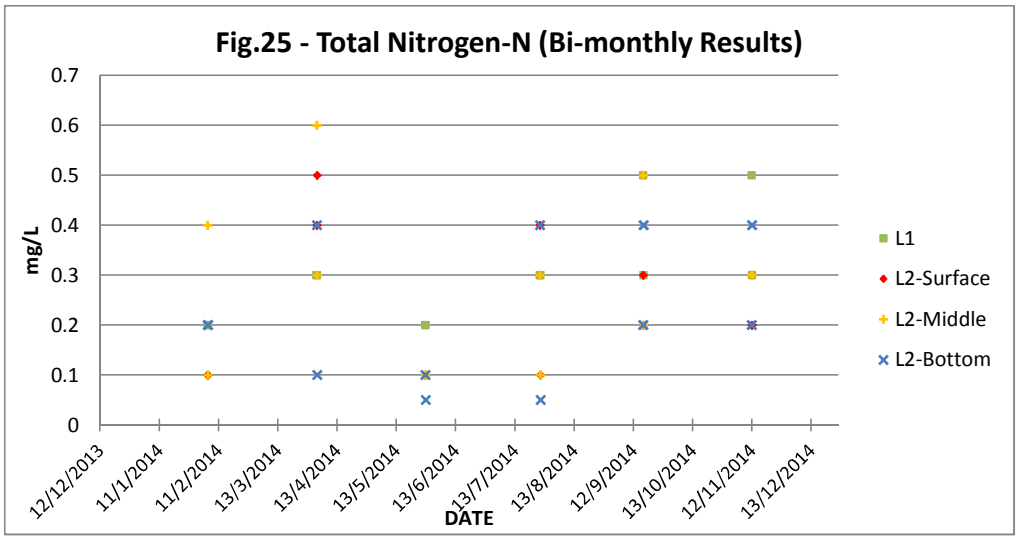

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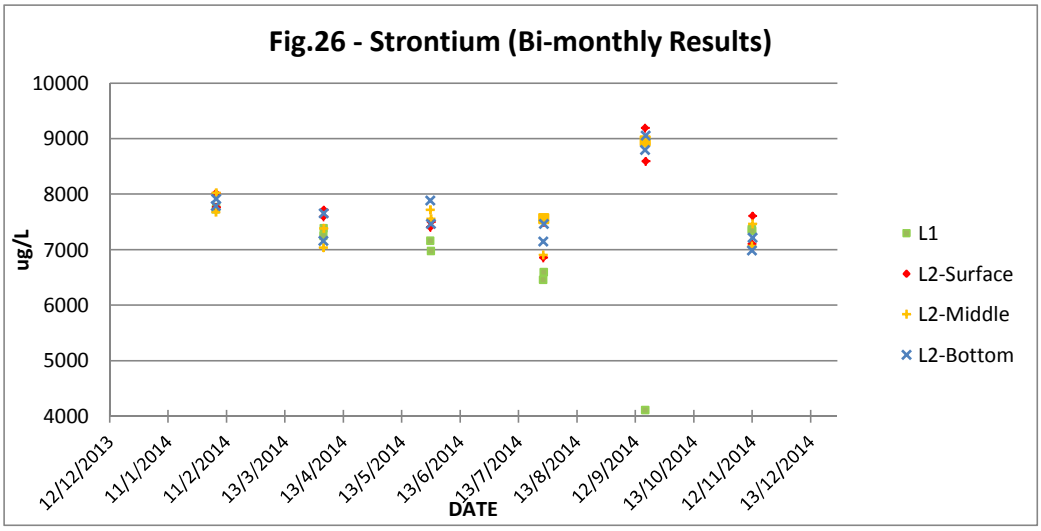

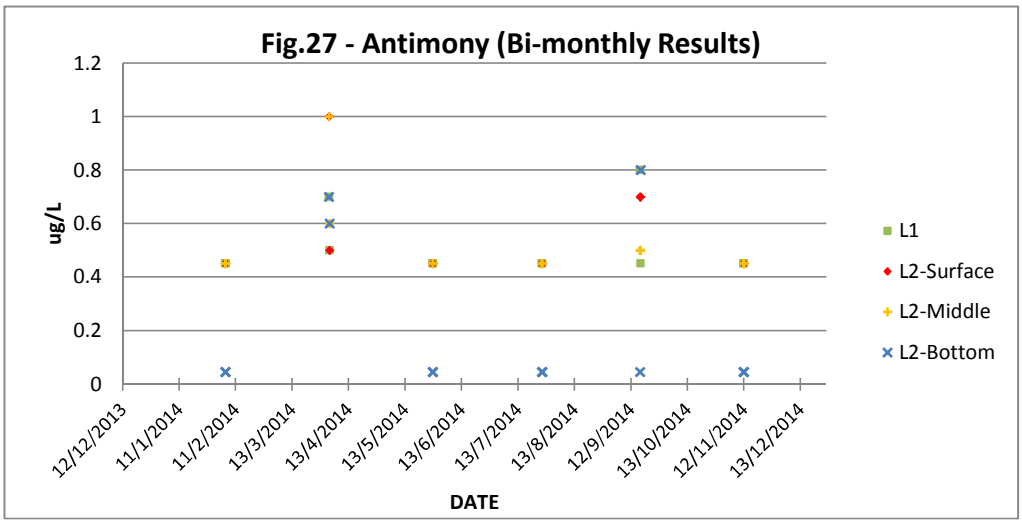

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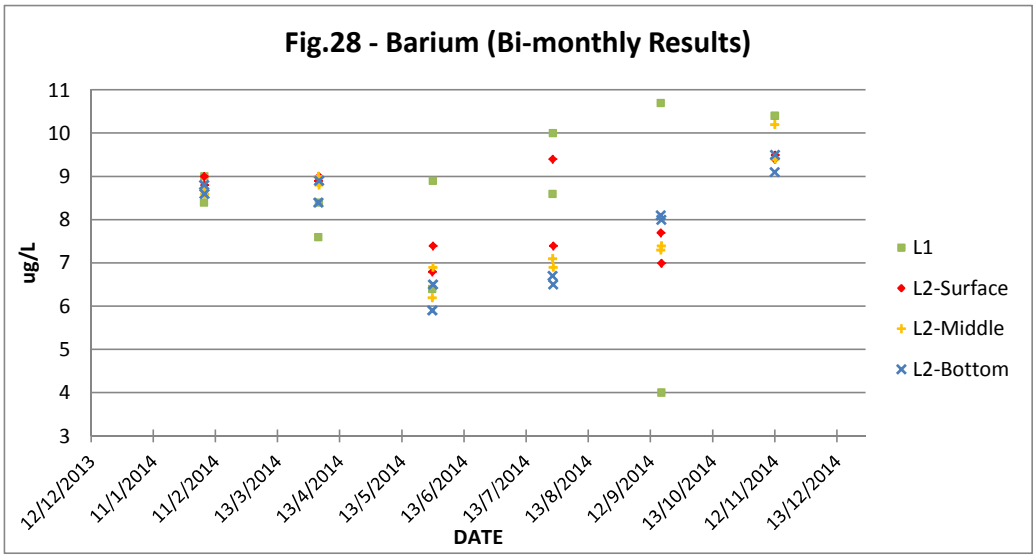

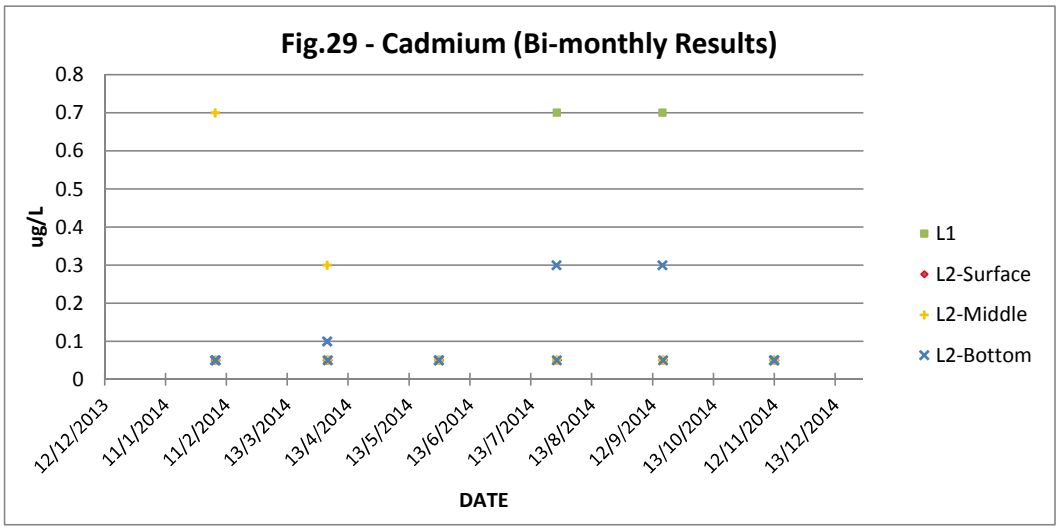

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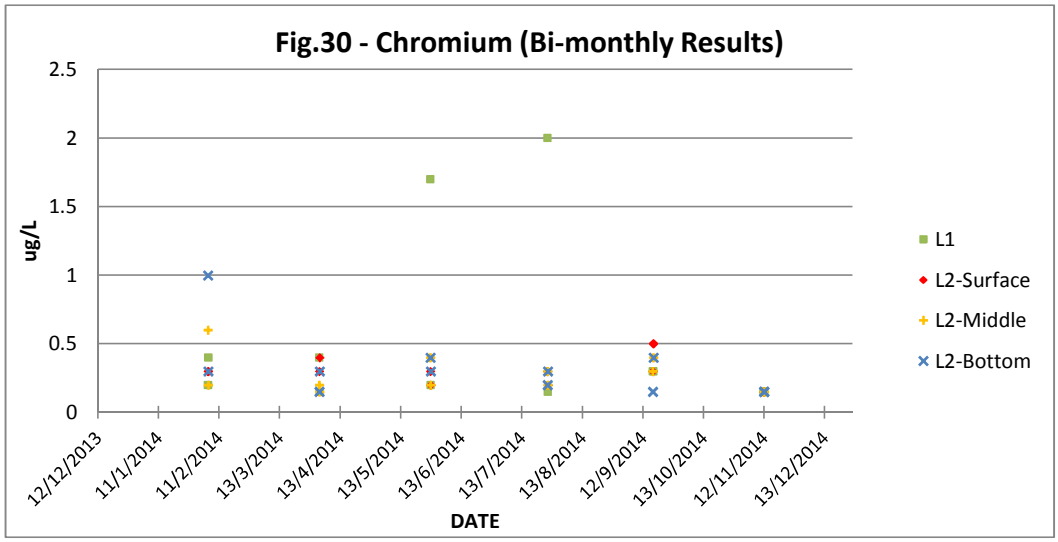

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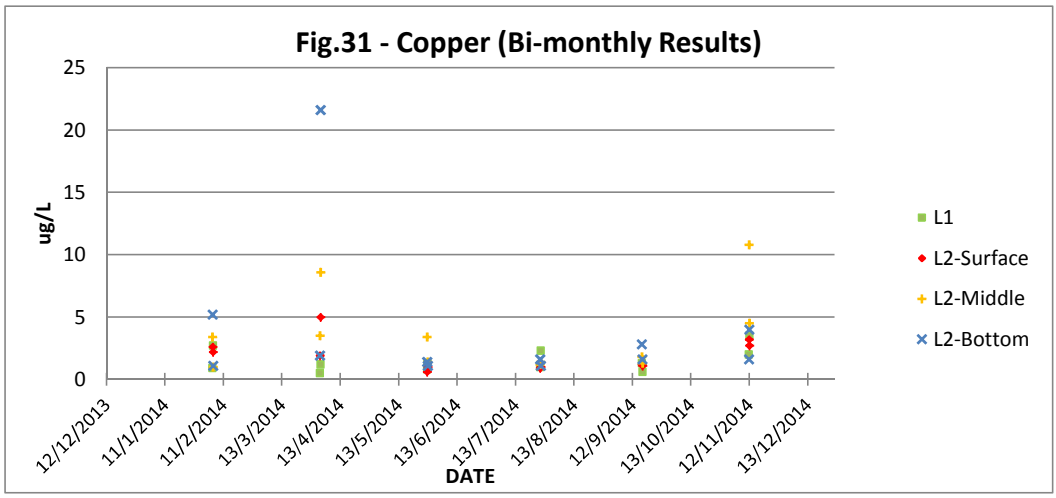

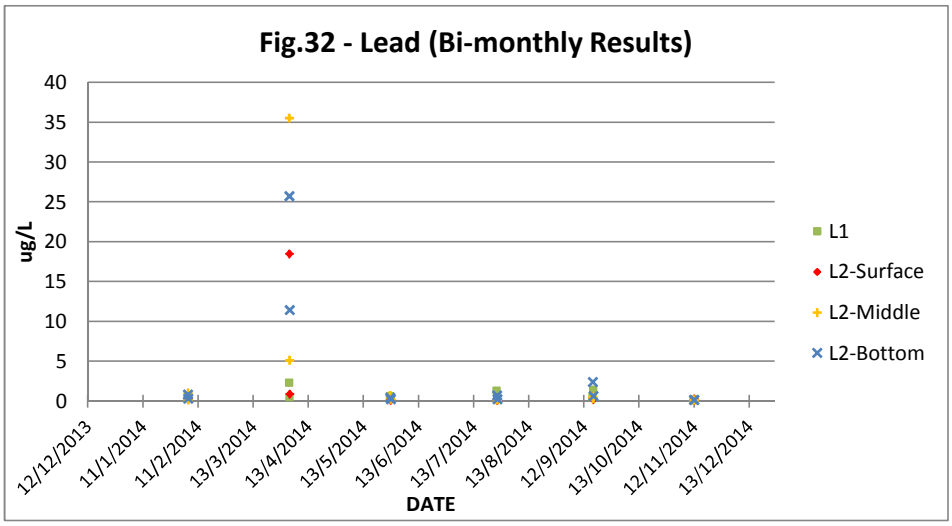

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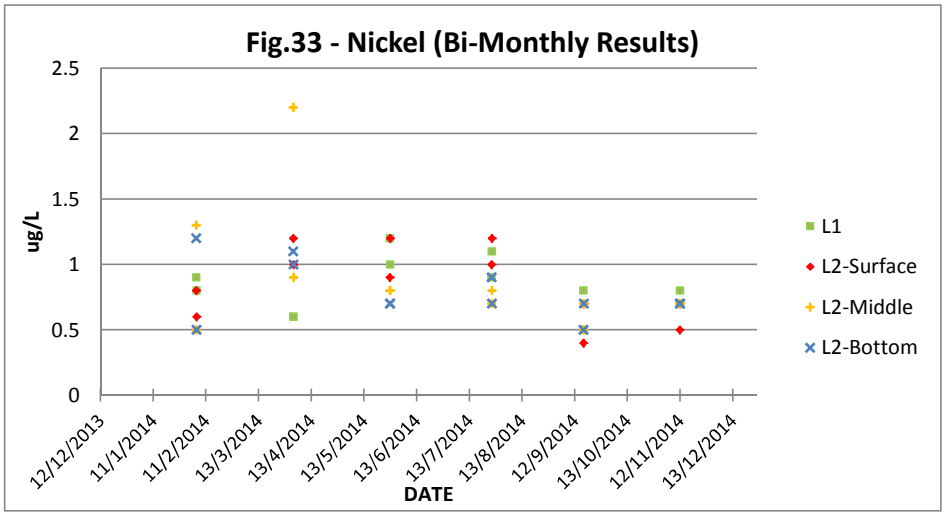

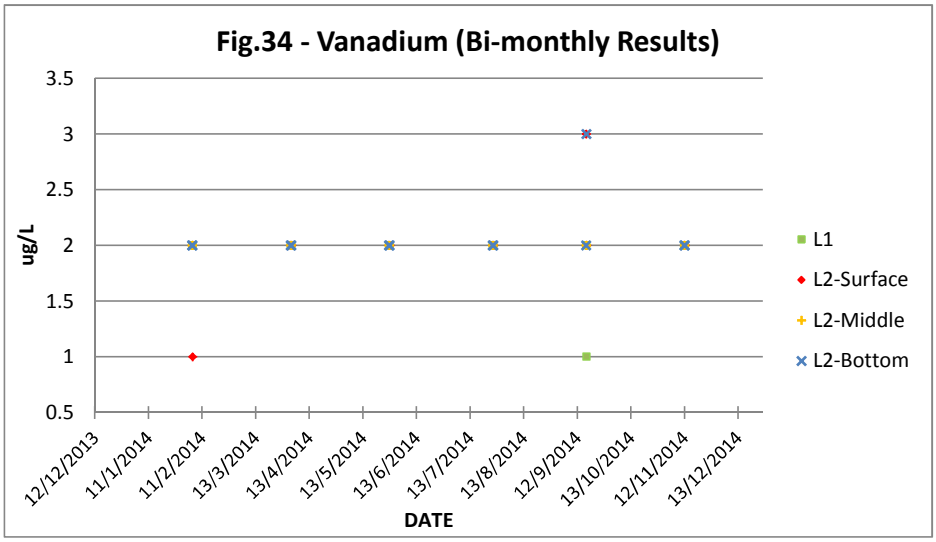

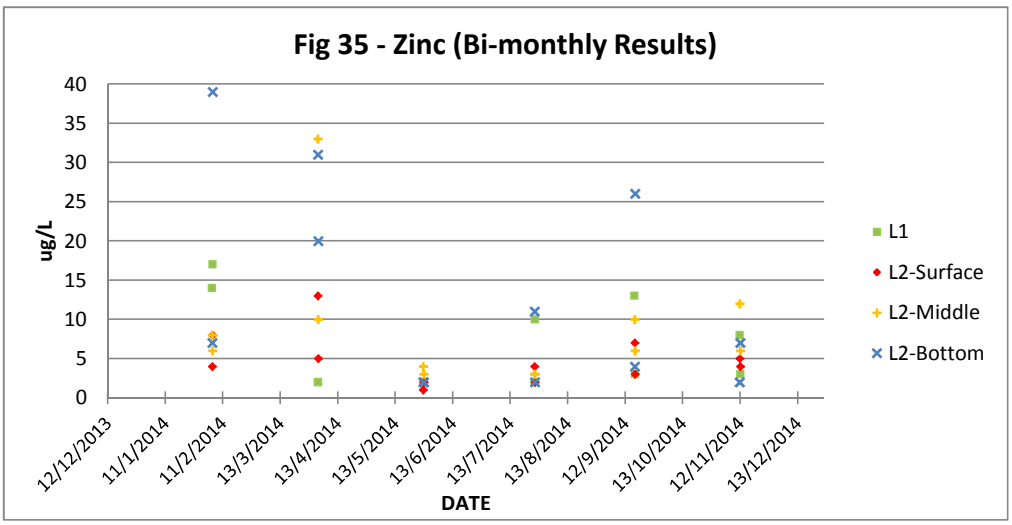

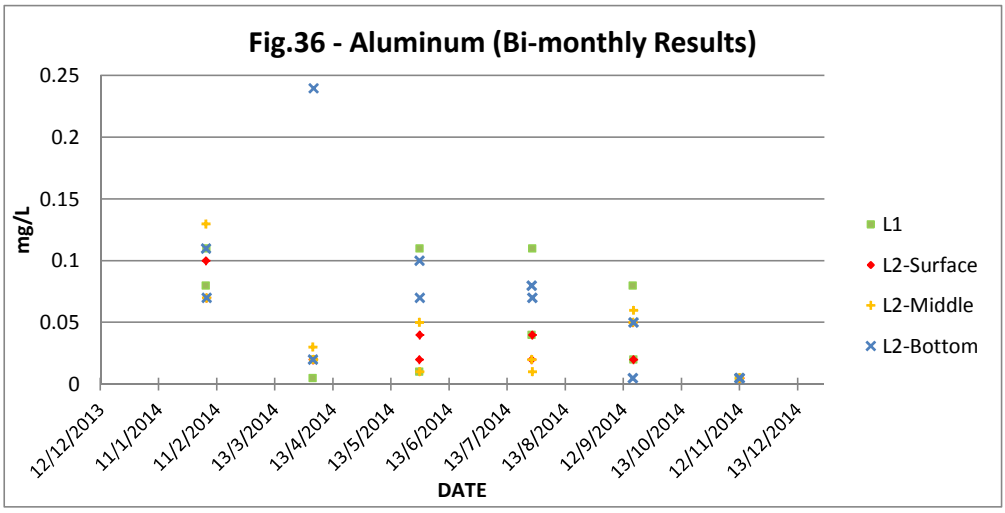

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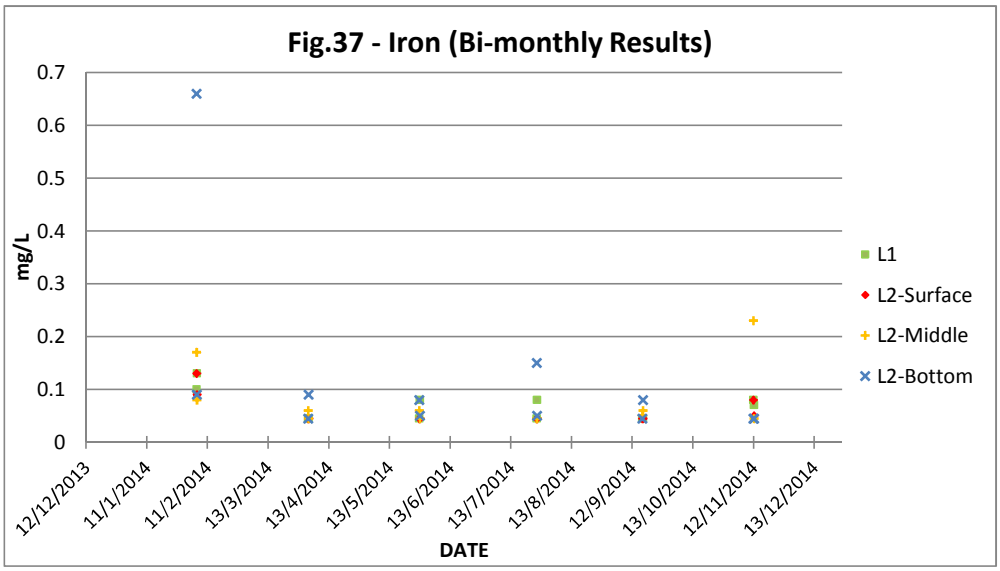

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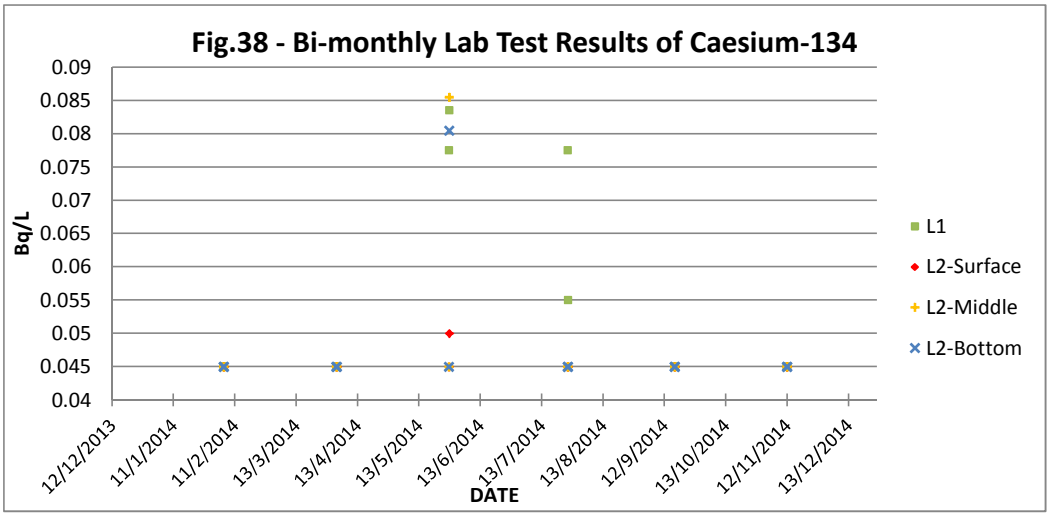

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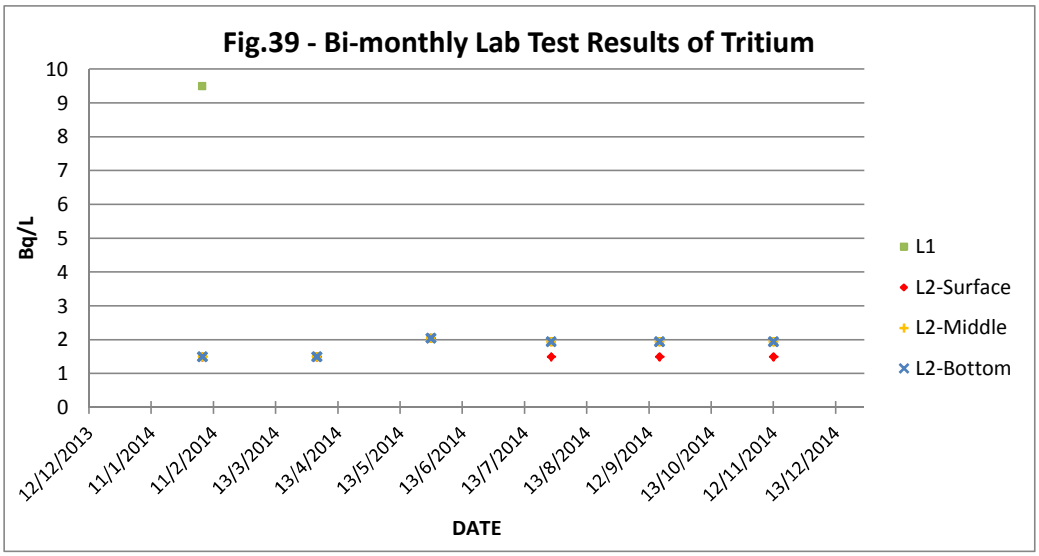

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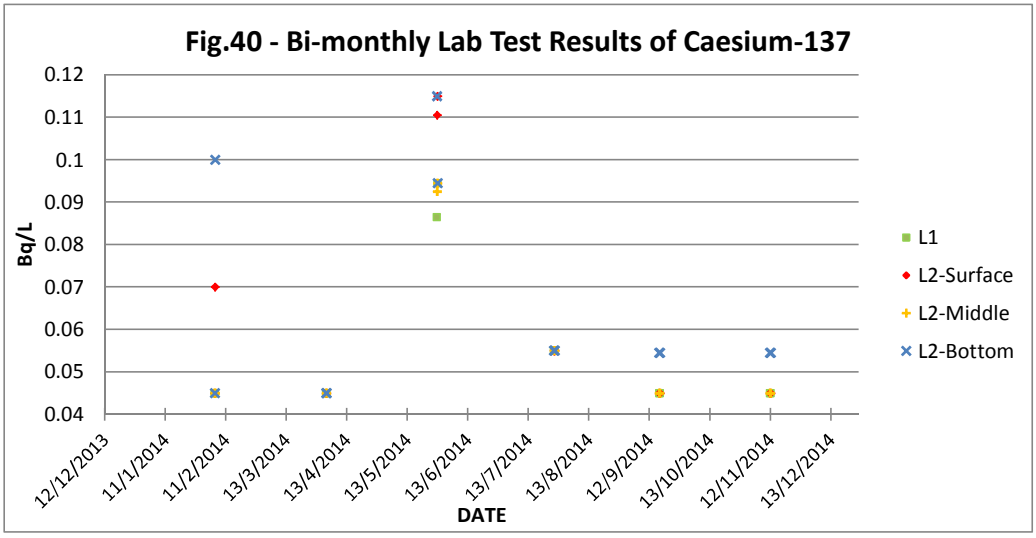

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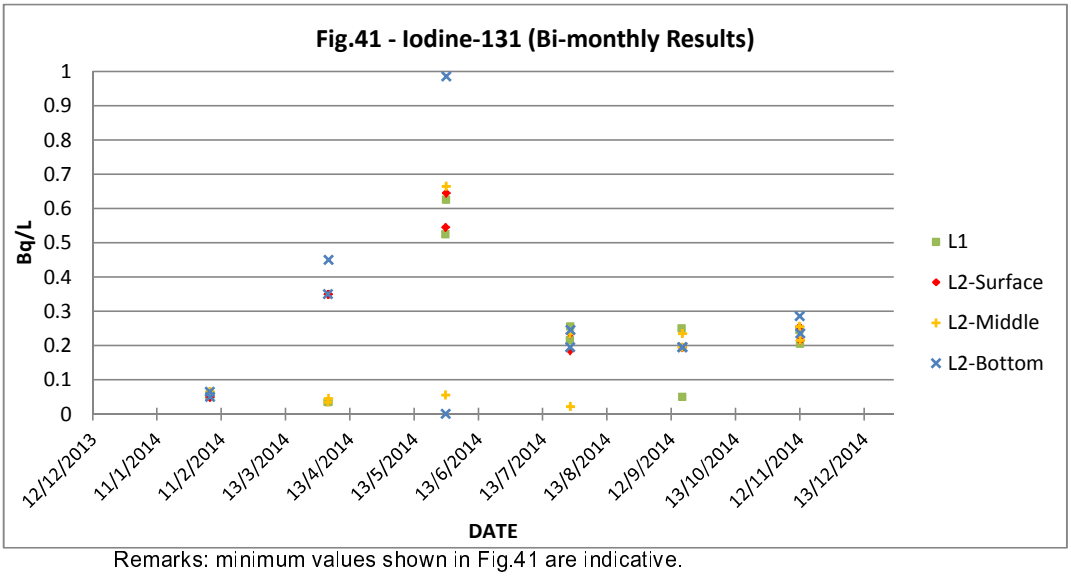

Remarks: minimum values shown in Fig.41 are indicative.