Appendices

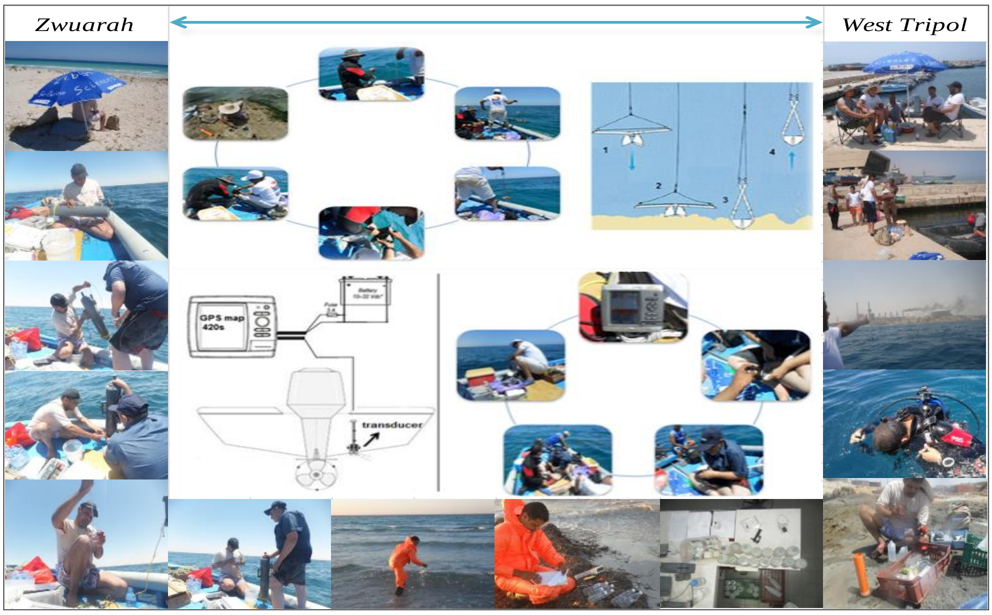
Appendix – 4th Chapter

Appendix 4.1: Calculation of the daily water production from different water sources in Libya-4th Chapter

Supplier Name	Potable water (m^3/day)	Industrial water (m^3/day)	Agriculture water (m^3/day)	Total
GMMR	1,726,260	92,050	2,681,690	4,500,000
GMMR	Potable water (%)	Industrial water (%)	Agriculture water (%)	
	38.36	2.05	59.59	
Desalination plants				
GDCOL	270,000	54	0	
GECOL	86,000	17,200	0	
NOC	20,529.40	82,117.60	0	
LISCo	5000	20,000	0	
IRC	500	4,500	0	
Supplier name	Potable water (m^3/day)	Industrial water (m^3/day)	Agriculture water (m^3/day)	Total
Desalination plants	382,029.40	123,872	0	505,901
Desalination plants	Potable water (%)	Industrial water (%)	Agriculture water (%)	
	75.51	24.49	0	

- **Appendixes-5th Chapter**

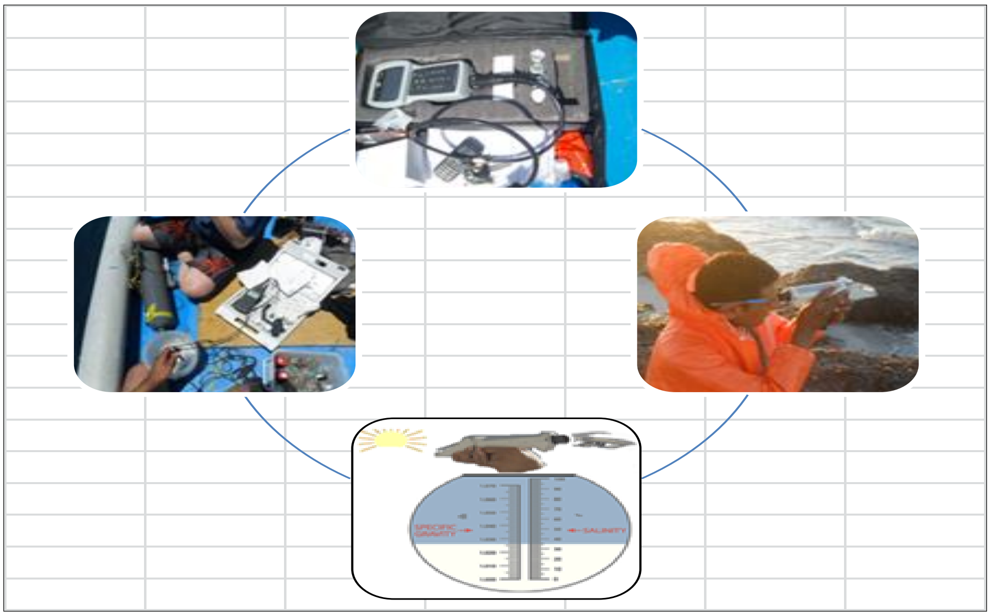
Appendix 5.1: Fieldwork at both sites



- ## Lab work analysis for seawater and brine disposed samples for ZWDP and WTRIS

5.1.1. Measurement of pH, Salinity (mg/l), Dissolved O2 (mg/l) and seawater surface and bottom Temperature (C^0)

Nineteen water chemistry data collected at each site using a YSI 556 multiprobe system at each station, further to use other dives for instance pH, dissolved oxygen, temperature meters and Salinity portable refractometer to insure that the physical characteristics of seawater examined by a YSI 556 multi probe system are correct. The procedure of measurement by using a YSI 556 multi probe includes contacting the four optical sensor ports with the YSI multi Probe by 15 meter waterproof cable, then it is lowered manually in meter increment to the required depth at each station along the transect line. The reading of YSI multi Probe for physical characteristics of seawater is then recorded on the datasheet. Furthermore, after each reading the optical sensor ports are washed by using high purity water in order to protect the sensors.



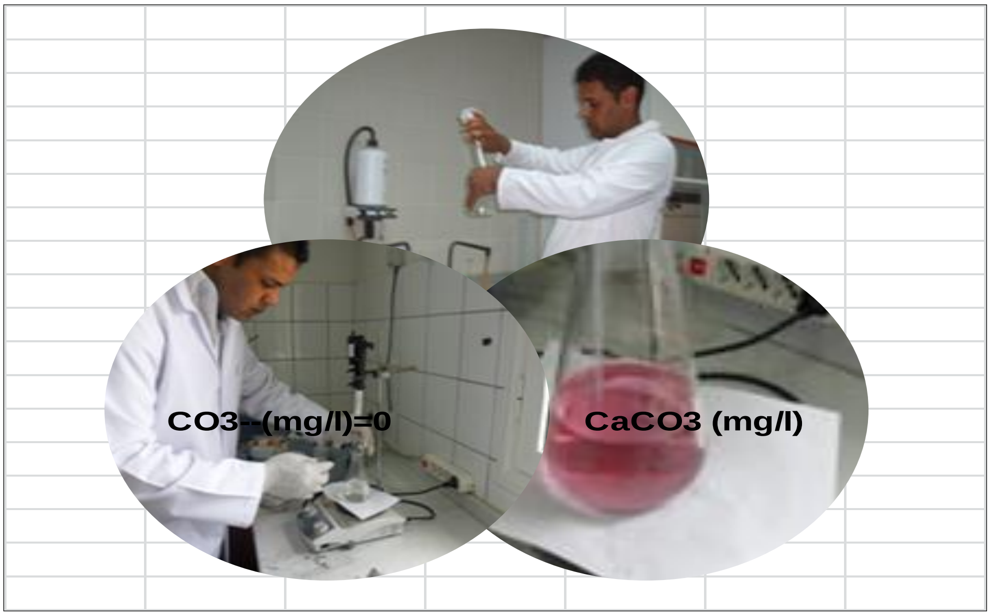
Tools used for measuring pH, Salinity (mg/l), Dissolved O2 (mg/l) and seawater Temperature (C0)

5.1.2. Measurement of Total alkalinity CaCO3 (mg/l), Carbonate CO3-- (mg/l) Bicarbonate HCO3-(mg/l)

Nineteen water chemistry data collected at each site using Method 8203 according to Hach Company the procedure of the experiments for each station involved the following; a 5 ml of seawater sample was taken and then it was diluted in 1000 ml of water distillate. Subsequently, a 100 ml of the preparing sample was transferred by using a graduated cylinder and then it was poured into 250 ml Erlenmeyer flask. Phenolphthalein was added to the solution and then swirled. While swirling the solution the colour did not change, the researcher noted that the concentration of carbonate $CO3^{--}$(mg/l) of seawater was zero. Following this, the Bromcresol Green-Methyl Red Indicator Powder Pillow was placed into the solution and then the sample was titrated by using H_2SO_4. When the colour of the solution changed to the light pink colour, the number of digital titrator was recorded. Therefore, the total alkalinity can be calculated as shown in the formula below:-

$$\text{Total alkalinity} = \text{number obtained from digital titrator}(mg/l) \times 0.4$$

As the alkalinity of seawater is due primarily to the presence of bicarbonate, carbonate, and hydroxide ions and the carbonate $CO3^{--}$ (mg/l) of sea water is zero, hence the total alkalinity equal to bicarbonate $HCO3^{-}$(mg/l).



Procedure of measuring CaCO3 (mg/l), $CO3^{--}$(mg/l) and $HCO3^{-}$(mg/l)

5.1.3. Total Hardness as CaCO3 (mg/l), Calcium Hardness CaCO3 (mg/l) and Magnesium Hardness CaCO3 (mg/l)

Nineteen water chemistry data collected at each site using Method 8213 according to Hach Company the procedure of the experiments for each station involved the following; first, a 25 ml of the papered sample was taken. This was then transferred to Erlenmeyer flask of volume 250 ml. Next, one tablet of hardness indictor was added into the flask and swirled. The titration was completed by using EDTA. When the colour of the solution changed from red to pure blue, the number of digital titrator was recorded. Therefore, the concentration of the total hardness can be calculated as shown in the equation below:-

Total Hardness = number obtained from digital titrator $\times 200 = (mg/l)$, where 200 is diluting constant

From this, the hardness of Ca^{2+} and H Mg^{2+} can be calculated as shown below:

$$HCa^{2+} = Total\ hardness\ (mg/l) \times 0.4$$

$$HMg^{2+} = HCa^{2+}(mg/l) - Total\ hardness\ (mg/l)$$

Calcium (mg/l) and Magnesium (mg/l)

Nineteen water chemistry data collected at each site using the formulas which are represented below to determine the concentration Calcium (mg/l) and Magnesium (mg/l) in seawater.

$$Ca^{2+} = Hardness\ of\ Ca^{2+}\ (mg/l) \times 0.4004$$

$$Mg^{2+} = Hardness\ of\ Mg^{2+}\ (mg/l) \times 0.2428$$

Procedure of measuring CaCO3 (mg/l), $CO3^{--}$(mg/l) and $HCO3^{-}$(mg/l)

5.1.4 Chloride Cl^{-} (mg/l)

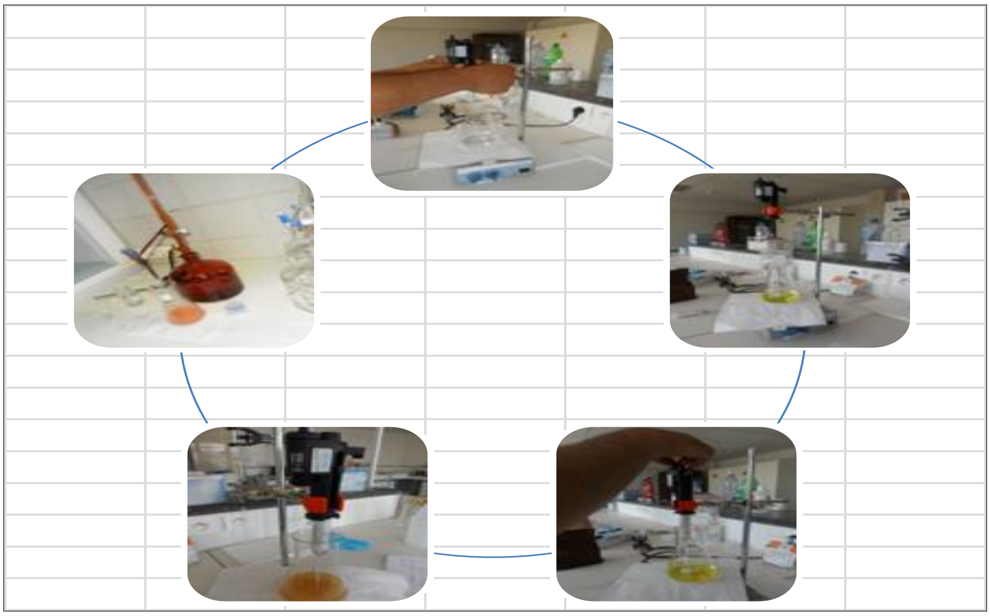
Nineteen water chemistry data collected at each site using Method 8207 according to Hach Company the procedure of the experiments for each station involved the following; A 100 ml of the prepared sample was taken. This was then transferred into the Erlenmeyer flask of volume 250 ml. Next the silver nitrate was added into the flask for titration with the help of the digital titrator. When the colour of the solution changed from yellow to red-brown, the number of digital titrator was recorded. Hence the concentration of Cl- (mg/l) can be calculated from the following formula:-

$$\text{Concentration of Cl}^- = \text{ number was obtained from digital titrator} \times 0.1 \; = (mg/l)$$

Where (0.1) is the multiplier that chosen according to the volume of seawater prepared sample

By multiplying the diluting constant which is 200, so the total concentration of Cl^- can be calculated as following: -

$\text{Total Concentration of Cl}^- \; (mg/l) = \text{ Concentration of Cl}^- \; (mg/l) \times 200 \; = \; (mg/l)$ all the results are then recorded on datasheet.



Procedure of measuring g Chloride Cl^- (mg/l)

5.1.5 Nitrate $NO3^-$(mg/l)

Nineteen water chemistry data collected at each site using Method 8171 according to Hach Company the procedure of the experiments for each station involved the following; A 1 ml of the sample was taken. This was then transferred into cell of volume 2 ml. After that, 2 ml of deionized water was transferred into the second cell of volume 2 ml as blank. Next, a spectrophotometer was prepared on starting method 353 Nitrate MIR PP. Following this, LCK 339 Reagent was added to the prepared sample cell and then the stopper inserted into the cell and then instrument timer was adjusted for a fifteen minute reaction time and then the sample was shook until timer expired. After that, the blank cell was wiped by using tissue and then inserted into the cell holder of a spectrophotometer and then the Zero button was pushed to show on the screen zero mg/l of NO_3^-. The prepared sample was inserted into the cell holder. The reading was taken by pushing reading button and then recorded on the datasheet.

Procedure of measuring Nitrate $NO3^-$ (mg/l)

5.1.6 Phosphorus total $PO4^{3-}$

Nineteen water chemistry data collected at each site using LCK 349 regent according to Hach Company the procedure of the experiments for each station involved the following; A 1 ml of the sample was taken. This was then transferred into cell of volume 2 ml. After that, 2 ml of deionized water was transferred into the second cell of volume 2 ml as blank. Next, a spectrophotometer was prepared on starting method 535 Nitrate MIR PP. Following this, LCK 349 Reagent was added to the prepared sample cell and then the stopper inserted into the cell and then instrument timer was adjusted for a reaction time and then the sample was shook until timer expired. After that, the blank cell was wiped by using tissue and then inserted into the cell holder of a spectrophotometer and then the Zero button was pushed to show on the screen zero mg/l of $Po_4{}^{3-}$. The sample was inserted into the cell holder and then the reading was taken by pushing reading button and then recorded on the datasheet.

5.1.7 Sodium Na^+ (mg/l) and Potassium k^+ (mg/l)

Nineteen water chemistry data collected at each site using BWB-XP Flame Photometer. The procedure of the experiments for each station involved the following; four standard solutions were prepared with a concentration 50,100,150,200 ppm respectively and then dilution formula was used to determine four volumes as represented below.

$$\mathrm{M1\ (PPM)} \times \mathrm{V1(ml)} = \mathrm{M2\ (PPM)} \times \mathrm{V2(ml)}$$

Where the M1 is the molarity of the stock solution 10000 ppm of NaCl. So the V1, V2, V3 and V4 can be calculated as shown below:-

$$10000 \times \mathrm{V1(ml)} = 50 \times 100$$
$$10000 \times \mathrm{V2(ml)} = 100 \times 100$$
$$10000 \times \mathrm{V3(ml)} = 100 \times 100$$
$$10000 \times \mathrm{V4(ml)} = 100 \times 100$$

Following this, four solutions were diluted in deionized water using 100 ml a volumetric flask. Next, the flam of photometer was turned on and then instrument timer was adjusted for a 20 minutes. After that, 10 ml from each standard solution was measured by using the flam photometer and then a graph of the calibration curve for the standard solutions was plotted. Subsequently, 1 ml of seawater sample was diluted by using a 1000 a volumetric flask. This was then measured again using the flam photometer and the reading is recoded and then the concentration of Na^+ determined on the graph of calibration curve which represented the relation between the concentration and absorption. Hence as the diluted solution 1000 ml, so the concentration of Na^+ can be calculated from the following formula:-

$$\text{Cocentration of Na+} = \text{Reading obtained from graph of calibration curve} \times 1000$$

In addition, the same procedure was followed for Potassium k+; however, the standard solutions were prepared with a concentration 5, 10, 15, and 20 ppm respectively.

Procedure of measuring Sodium Na+ (mg/l) and Potassium k+ (mg/l)

5.1.8 Iron (mg/l)

A nineteen water chemistry data collected using Method 8008 according to Hach Company the procedure of the experiments for each station involved the following; a 10 ml of the prepared sample was taken. This was then transferred into cell of volume 10 ml. After that, 10 ml of deionized water was transferred into the second cell of volume 10 ml as blank. Next, a spectrophotometer was prepared on starting method 265 Iron ferroVer. Following this, FerroVer® Iron Reagent Powder Pillow was added to the prepared sample cell and then the stopper was inserted into the cell and shook. The instrument timer was adjusted for a 3 minute reaction time. When the timer expired, the blank cell was wiped by using tissue and then inserted into the cell holder of a spectrophotometer and then the Zero button was pushed to show on the screen zero mg/l of Iron. Following this, the prepared sample was wiped by using tissue and then inserted in the cell holder and then the reading was taken by pushing reading button and then recorded on the datasheet.

Procedure of measuring Iron (mg/l)

5.1.9 Sulfate $SO4^{-2}$ (mg/l)

Nineteen water chemistry data collected at each site using Method 8131 according to Hach Company the procedure of the experiments for each station involved the following; a 1 ml of the sample was taken. This was then transferred into cell of volume 2 ml. After that, 2 ml of deionized water was transferred into the second cell of volume 2 ml as blank. Next, a spectrophotometer was prepared on starting method 690 sulfide. Following this, LCK 353 reagent was added to sample. The stopper was inserted into cell and shook. After that, the instrument timer was adjusted for a 30 minute reaction time. When the timer expired, the blank cell was wiped by using tissue and then inserted into the cell holder of a spectrophotometer and then the Zero button was pushed to show on the screen zero mg/l of So4-2. Following this, the sample was wiped by using tissue and then inserted into the cell holder and then the reading was taken by pushing the reading button and then recorded on the datasheet. All the physico -chemical results for the 38 stations at ZWDP and WTRIS and further to the pure brine which was collected from the final cell of the evaporator are represented **for ZWDP and WTRIS.**

Procedure of measuring Sulfate $SO4^{-2}$ (mg/l)

It has to be noted that all the above experiments have been done according to the methods of Hach Company for water, wastewater and seawater analysis [Hach, (2013)]. Additionally the chemical west disposed under the regulation that mentioned in Hach manual book.

Appendix 5.2: Seabed Sediment Samples Analysis

Sediment samples were analysed physically (Organic content and grain size analysis) for ZWDP and WTRIS. Each sediment sample (200g) is placed in washing tray. The sample is then wished by using distilled water and shaking. The sample is then left for approximately 5-10 minutes and then the Plankton such as Peel seashells are scraped from the washing tray. Sample of distillate water is removed with pipette filler. The sediment sample is then placed in simple filtration paper (18.5 cm Whatman) in order to absorb humidity from the sample and numbered according to the given labelled on the plastic bag. Sediment samples were placed in 150 mm thermal Petri dishes and then dried to a constant weight at 105 ^{0}C for 24 h to determine dry weight. Following this the nineteen crucibles were weighed for each site, after that 10 g from each sample was placed in crucible and heated in an oven to 550 ^{0}C for 4 hours to remove the moisture content, and each sample was reweighed. The loss on ignition was taken as the labile organic content of the sediment and the main purpose of this process is to determine the organic content levels in each sample. After that, the impurities that stalled in thermal Petri dishes at 105 ^{0}C are removed by using Stainless Steel Membrane Filter Tweezers then 100 g from each dried sample was weighed by using Sensitive balance (Mettler

Toledo). The samples were then subjected to a rotap shaker (Octagon 2000) through nine sieves and a pan (mesh sizes 4.750-0.074 mm) and then the samples sieved for 15 to 20 minutes. Fractions of sample retained on the sieve were carefully weighed on a digital balance. Weight values obtained were then converted to cumulative weight percentage.

Table: Organic content level (%) for Zwuarah Desalination Plant

GPS.P	*St*	Latitude	Longitude	WC (g)	WBC (g)	WAC (g)	W (g)	Org (g)	% Org
37	St 1	32.892200	12.182430	43.4	10	51.86	8.46	1.54	4.5
38	St 2	32.895220	12.204580	34.28	10	41.6	7.32	2.68	7.9
39	St 3	32.887240	12.201320	45.18	10	53.24	8.06	1.94	5.6
40	St 4	32.885510	12.200550	47.28	10	55.38	8.1	1.9	5.6
41	St 5	32.885300	12.195690	46.72	10	54.98	8.26	1.74	5.1
42	St 6	32.888560	12.192220	47.3	10	55.56	8.26	1.74	5.1
43	St 7	32.889007	12.187804	43.76	10	52.11	8.35	1.65	4.8
44	St 8	32.902530	12.175740	44	10	51.48	7.48	2.52	7.3
45	St 9	32.900362	12.174861	43.72	10	51.7	7.98	2.02	5.9
46	St 10	32.898550	12.173006	46.74	10	54.5	7.76	2.24	6.5
47	St 11	32.896554	12.171383	43.94	10	52.23	8.29	1.7	4.9
48	St 12	32.895202	12.171271	43.85	10	52.17	8.32	1.68	4.9
49	St 13	32.892919	12.174963	46.74	10	55.56	8.82	1.18	3.4
50	St 14	32.891360	12.177020	46.74	10	55.78	9.04	0.96	2.8
51	St 15	32.890755	12.179172	49.1	10	57.7	8.6	1.4	4.1
52	St 16	32.896058	12.189978	44.8	10	52.82	8.02	1.98	5.8
53	St 17	32.892424	12.202064	43.74	10	51.46	7.72	2.28	6.6
54	St 18	32.895530	12.179240	43.74	10	52.26	8.52	1.48	4.4
55	St 19	32.892700	12.187170	44.12	10	52.36	8.24	1.76	5.1

Table: Organic content level (%) for West Tripoli Desalination Plant

GPS.P	*St*	Latitude	Longitude	WC (g)	WBC (g)	WAC (g)	W (g)	Org (g)	% Org
63	St 1	32.834690	12.964960	46.36	10	54.25	7.89	2.11	8.47
64	St 2	32.832150	12.962390	42.37	10	50.47	8.1	1.9	7.6
65	St 3	32.834623	12.979451	44.89	10	52.79	7.9	2.1	8.43
66	St 4	32.832140	12.977600	41.65	10	50.14	8.49	1.51	6.06
67	St 5	32.830880	12.971510	34.52	10	43.22	8.7	1.3	5.22
68	St 6	32.830880	12.967900	46.72	10	55.4	8.68	1.32	5.3
69	St 7	32.829670	12.961240	34.78	10	43.54	8.76	1.24	4.97
70	St 8	32.827290	12.967090	43	10	51.76	8.76	1.24	4.97
71	St 9	32.826820	12.965150	42	10	51.74	9.74	0.26	1.04
72	St 10	32.826051	12.961663	47.32	10	57.05	9.73	0.27	1.08
73	St 11	32.827919	12.969882	43.27	10	52.73	9.46	0.54	2.16
74	St 12	32.828930	12.969240	41.98	10	50.38	8.4	1.6	6.42
75	St 13	32.828874	12.972887	40.97	10	50.33	9.36	0.64	2.57
76	St 14	32.829930	12.976570	44.8	10	53.93	9.13	0.87	3.49
77	St 15	32.835910	12.972850	45.13	10	52.72	7.59	2.41	9.7
78	St 16	32.833140	12.969500	46.29	10	54.32	8.03	1.97	7.9
79	St 17	32.833960	12.975690	44.65	10	52.65	8	2	8.03
80	St 18	32.830322	12.974870	42.67	10	51.72	9.05	0.95	3.81
81	St 19	32.828360	12.964400	44.11	10	53.43	9.32	0.68	2.72

Note: WC (g) is weight of container, WBC (g) is weight before combustion, WAC (g) is weight after combustion with container (g), W (g) is weight of samples without container (g), Org (g) is [Difference in weight] = Organic content (g), % - Org is percentage of Organic content.

Results from the sieving allowed the calculation of Mean grain size (Mz), Graphic kurtosis (KG), Inclusive Graphic Skewness (SKI) and Inclusive Graphic Standard Deviation ($_{\delta}$I) by using a graph of cumulative weight percent against phi (Ø) that plotted on probability log sheet to determine the sediment type according to folk (1974) formulas (**Appendix 5.3 for ZWDP and appendix 5.4 for WTRIS**). Grain-size statistical parameters and graphic representations are given in Phi units (Ø). The Phi unites is a logarithmic transformation of millimetres into whole integers according to the formula which is illustrated below:-

Ø=-Log$_2$d, where d=grain diameter in millimetres.

The parameters calculated for these analyses included the following:-

- Median Grain Size

The median grain size is that which separates 50% of the sample from the other, where half the particles by weight are larger and half are smaller than the median. This parameter is measured in phi units.

Median Grain size= 2.2 Ø (50% of cumulative graph)

- Mean Grain Size (Mz)

The mean grain size is average grain size and its used to classify sediment by using the following formula:-

$$\boldsymbol{Mz = \frac{Ø16+Ø50+Ø84}{3}}$$

Where Ø16, Ø50 and Ø84 represent the size at 16, 50 and 84 percent of the sample by weight. This parameter is also measured in phi units and the sediment classified as following: 0 -1 Ø as Coarse sand, 1-2 Ø as Medium sand, 2-3 as fine sand, 3-4 as very fine sand and > 4 Ø as Mud

- Graphic Kurtosis

Kurtosis is measure of peakedness in a curve by using the following formula:-

$$\boldsymbol{KG = \frac{Ø95 - Ø5}{2.44 * (Ø75 - Ø25)}}$$

Where Ø95, Ø5, Ø75 and Ø25 represent the phi values at 95, 5, 75 and 25 percentiles. A verbal classification scale is represented as following from 0.41-0.67 Ø as very platykurtic, 0.67-0.9 Ø as platykurtic, 0.9-1.11 as mesokurtic, 1.11-1.50 Ø as leptokurtic, 1.5-3 Ø as very leptokurtic and ≥3 extremely leptokurtic.

- Inclusive Graphic Skewness (SKI)

Skewness measures the degree to which a cumulative curve approaches symmetry. Inclusive graphic skewness is determined by the following equation:-

$$\boldsymbol{SKI} = \frac{\textbf{Ø84+Ø16}-\textbf{2(Ø50)}}{\textbf{2(Ø84}-\textbf{Ø16)}} + \frac{\textbf{Ø95+Ø5}-\textbf{2(Ø50)}}{\textbf{2(Ø95}-\textbf{Ø5)}}$$

Where Ø84, Ø16, Ø95 and Ø5 represent the phi values at 84, 16, 95 and 5 percentiles. This formal includes a measure of tails of cumulative curve as well as the central portion. Folk (1974) presented a verbal classification scale as following from +0.1 to -0.1 as nearly symmetrical, -0.1 to -0.3 as coarse-skewed and -0.3 to -1.0 as strongly coarse skewed.

- Inclusive Graphic Standard Deviation (δI)

Standard deviation is a method of measuring the grain size variation of a sample by encompassing the largest parts of the size distribution as measured from a cumulative curve. The inclusive Graphic standard deviation is determined by the following equation:-

$$\boldsymbol{\delta}\textbf{I} = \frac{\textbf{Ø84}-\textbf{Ø16}}{\textbf{4}} + \frac{\textbf{Ø95}-\textbf{Ø5}}{\textbf{6.6}}$$

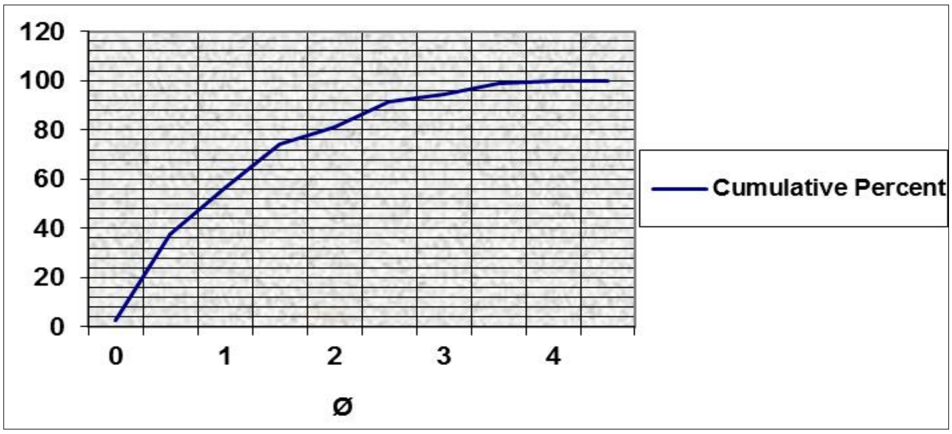
Where Ø84, Ø16, Ø95 and Ø5 represent the phi values at 84, 16, 95 and 5 percentiles. Folk (1974) presented a verbal classification scale for sorting as following δI<0.35 as very well sorted, 0.35-0.50Ø as well sorted, 0.50-0.71Ø as moderately well sorted, 0.71-1Ø as moderately sorted,1-2Ø as poorly sorted, 2-4Ø as very poorly sorted and >4Ø as extremely poorly sorted. The Classification used for defining sediment type and degree of sediment kurtosis (KG), Skewness (SKI) and Standard Deviation (δI) are presented in the chapter 5.

Procedure Sediments Analysis in the lab

Appendix 5.3: Calculation for ZWDP

- **Sample (Station 37)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	2.49	2.49
Test Sieve 2	35.28	37.77
Test Sieve 3	18.54	56.31
Test Sieve 4	17.74	74.05
Test Sieve 5	7.13	81.18
Test Sieve 6	10.35	91.53
Test Sieve 7	2.94	94.47
Test Sieve 8	4.38	98.85
Test Sieve 9	0.96	99.81
Test Sieve 10	0.18	99.99
Total (g)	***99.99***	



A graph of cumulative weight percent against phi (Station 37)

- **<u>Calculation – St 37</u>**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

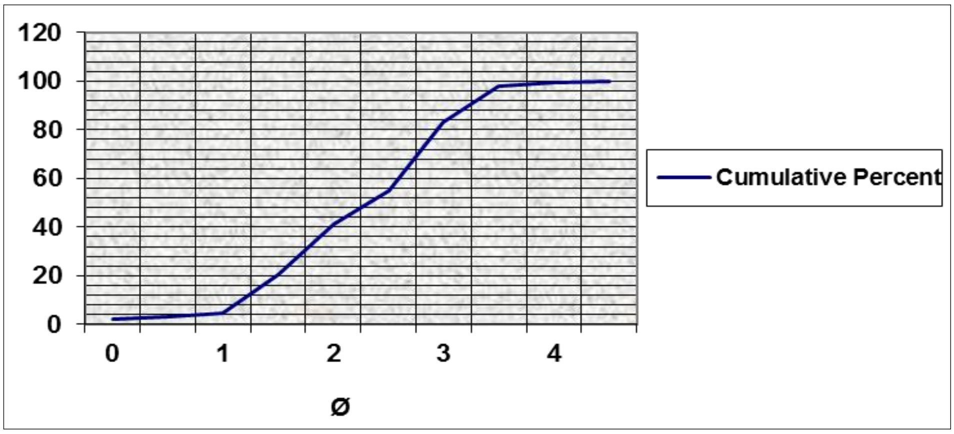
Number	Ø
5	0.3
16	0.5
25	0.6
50	1.1
75	1.6
84	2.7
95	3.1

→

Parameter	Result- St 37
Mz	1.43
KG	1.15
SkI	0.3
δI	0.97

- **Sample- (Station 38)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	2.07	2.07
Test Sieve 2	1.13	3.2
Test Sieve 3	1.59	4.79
Test Sieve 4	15.56	20.35
Test Sieve 5	20.6	40.95
Test Sieve 6	13.9	54.85
Test Sieve 7	28.29	83.14
Test Sieve 8	14.6	97.74
Test Sieve 9	1.65	99.39
Test Sieve 10	0.6	99.99
Total (g)	99.99	



A graph of cumulative weight percent against phi (Station 38)

- **<u>Calculation - St 38</u>**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$\delta I = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

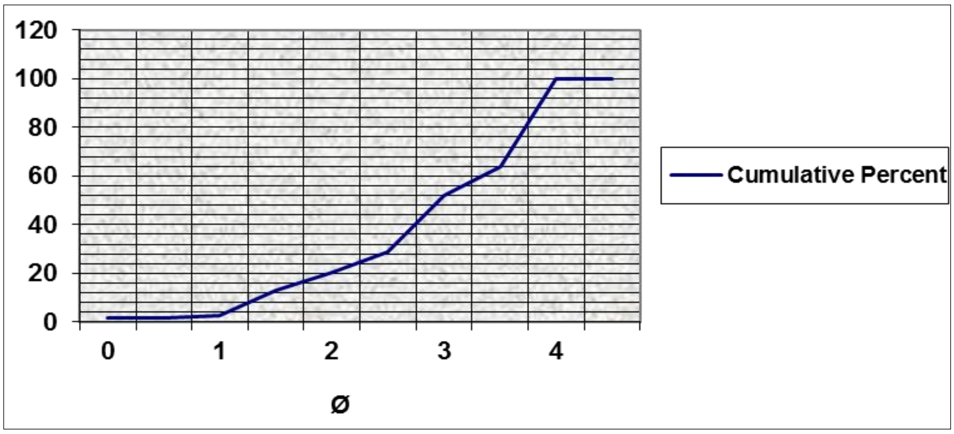
Number	Ø
5	1.4
16	1.6
25	1.8
50	2.6
75	3.1
84	3.2
95	3.6

→

Parameter	Result- St 37
Mz	2.46
KG	0.69
SkI	-0.2
δI	0.70

- **Sample –(Station 39)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	1.43	1.43
Test Sieve 2	0.21	1.64
Test Sieve 3	1.03	2.67
Test Sieve 4	10.38	13.05
Test Sieve 5	7.38	20.43
Test Sieve 6	8.18	28.61
Test Sieve 7	23.59	52.2
Test Sieve 8	11.8	64
Test Sieve 9	36	100
Test Sieve 10	0	100
Total	***100***	



A graph of cumulative weight percent against phi (Station 39)

- <u>**Calculation - St 39**</u>

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

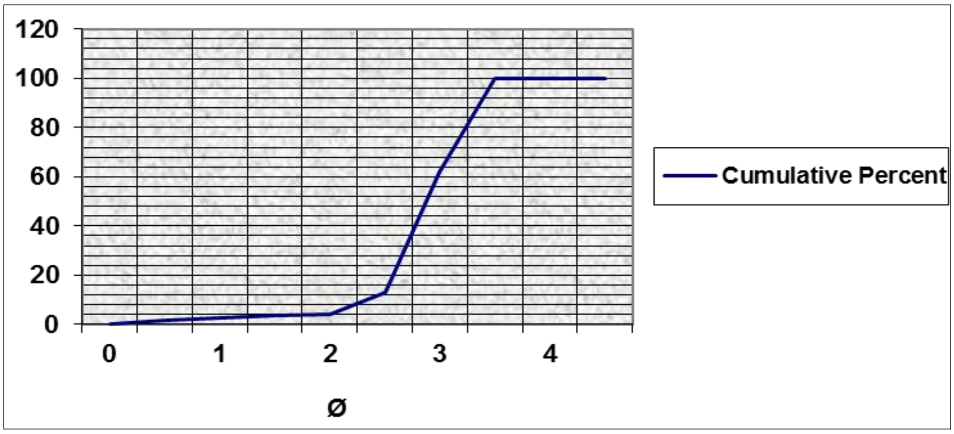
Number	Ø
5	1.4
16	1.9
25	2.6
50	3.2
75	3.9
84	4
95	4.2

→

Parameter	Result- St 39
Mz	3.03
KG	0.88
SkI	-0.3
δI	0.98

- **Sample – (Station 40)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	0.28	0.28
Test Sieve 2	1.41	1.69
Test Sieve 3	1.15	2.84
Test Sieve 4	0.85	3.69
Test Sieve 5	0.47	4.16
Test Sieve 6	8.76	12.92
Test Sieve 7	49.11	62.03
Test Sieve 8	37.76	99.79
Test Sieve 9	0.2	99.99
Test Sieve 10	0	99.99
Total (g)	99.99	



A graph of cumulative weight percent against phi (Station 40)

- <u>**Calculation – St 40**</u>

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$\delta I = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

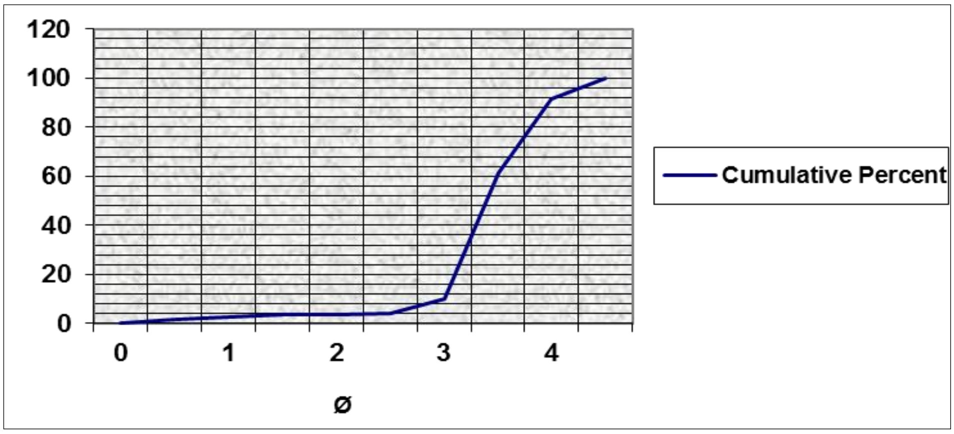
Number	Ø
5	2.4
16	2.7
25	2.9
50	3.1
75	3.4
84	3.6
95	3.7

→

Parameter	Result- St 40
Mz	3.13
KG	1.07
SkI	0
δI	0.42

- **Sample – (Station 41)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	0.24	0.24
Test Sieve 2	1.46	1.7
Test Sieve 3	1.06	2.76
Test Sieve 4	0.67	3.43
Test Sieve 5	0.41	3.84
Test Sieve 6	0.3	4.14
Test Sieve 7	6.15	10.29
Test Sieve 8	51	61.29
Test Sieve 9	30	91.29
Test Sieve 10	8.7	99.99
Total (g)	99.99	



A graph of cumulative weight percent against phi (station 41)

- **<u>Calculation – St 41</u>**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

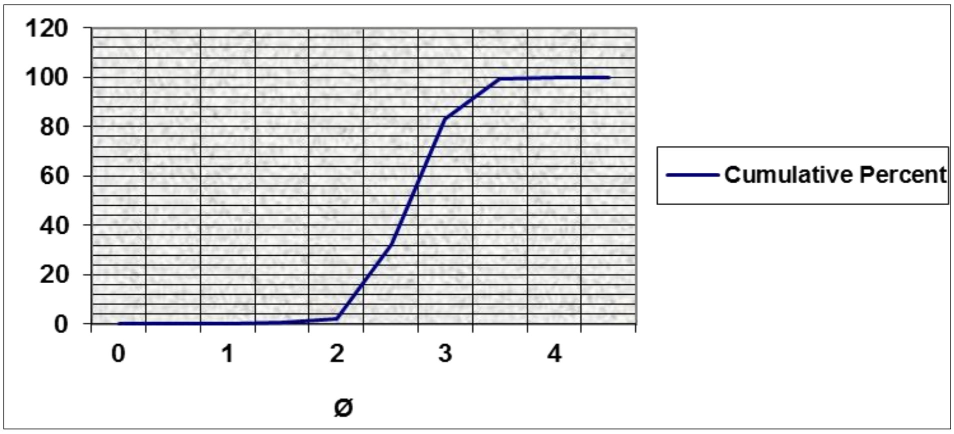
Number	Ø
5	2.9
16	3.3
25	3.4
50	3.6
75	4
84	4.1
95	4.4

→

Parameter	Result- St 41
Mz	3.60
KG	1.02
SkI	0.3
δI	0.50

- **Sample- (Station 42)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	0.04	0.04
Test Sieve 2	0.15	0.19
Test Sieve 3	0.13	0.32
Test Sieve 4	0.45	0.77
Test Sieve 5	1.28	2.05
Test Sieve 6	30.12	32.17
Test Sieve 7	51.18	83.35
Test Sieve 8	16.2	99.55
Test Sieve 9	0.44	99.99
Test Sieve 10	0	99.99
Total	99.99	



A graph of cumulative weight percent against phi (station 42)

- **<u>Calculation – St 42</u>**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

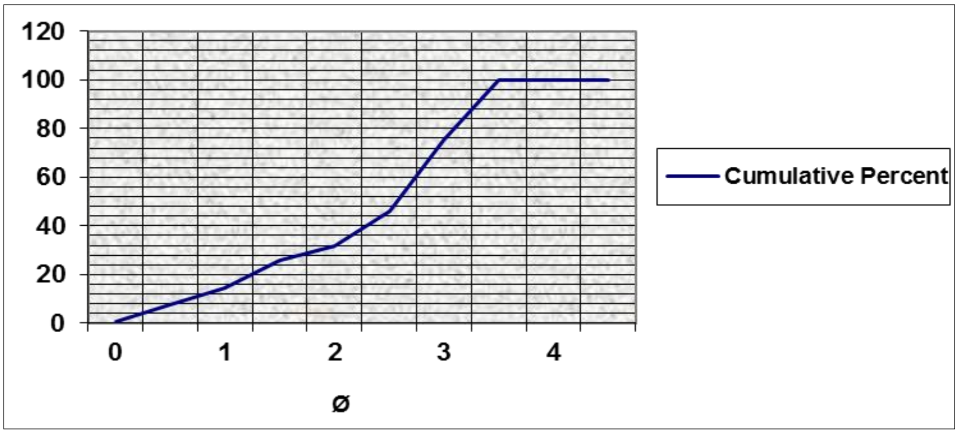
Number	Ø
5	2.3
16	2.5
25	2.6
50	2.9
75	3.3
84	3.4
95	3.6

→

Parameter	Result- St 42
Mz	2.93
KG	0.76
SkI	0.1
δI	0.42

- **Sample – (Station 43)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	0.78	0.78
Test Sieve 2	6.98	7.76
Test Sieve 3	6.54	14.3
Test Sieve 4	11.79	26.09
Test Sieve 5	5.57	31.66
Test Sieve 6	14.62	46.28
Test Sieve 7	28.96	75.24
Test Sieve 8	24.57	99.81
Test Sieve 9	0.19	100
Test Sieve 10	0	100
Total	100	



A graph of cumulative weight percent against phi (station 43)

- **Calculation – St 43**

I. Mean grain size (Mz)

$$Mz = \frac{Ø16+Ø50+Ø84}{3}$$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$$

III. Inclusive Graphic Skewness (SK_I)

$$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$$

IV. Inclusive Graphic Standard Deviation (δI)

$$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$$

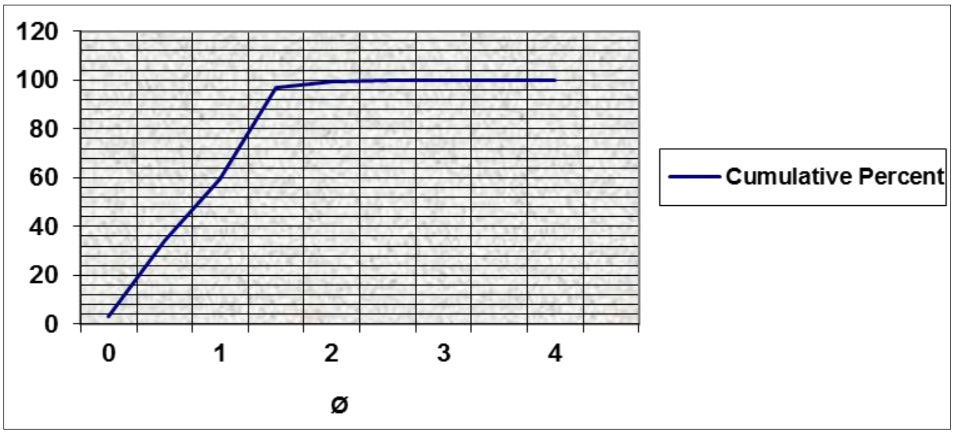
Number	Ø
5	0.6
16	1.4
25	1.6
50	2.8
75	3.3
84	3.4
95	3.7

→

Parameter	Result- St 43
Mz	2.53
KG	0.74
SkI	-0.4
δI	0.96

- **Sample- (Station 44)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	3.13	3.13
Test Sieve 2	31.25	34.38
Test Sieve 3	25.2	59.58
Test Sieve 4	37.27	96.85
Test Sieve 5	2.6	99.45
Test Sieve 6	0.3	99.75
Test Sieve 7	0.05	99.8
Test Sieve 8	0.2	100
Test Sieve 9	0	100
Test Sieve 10	0	100
Total (g)	100	



A graph of cumulative weight percent against phi (station 44)

- **Calculation – St 44**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

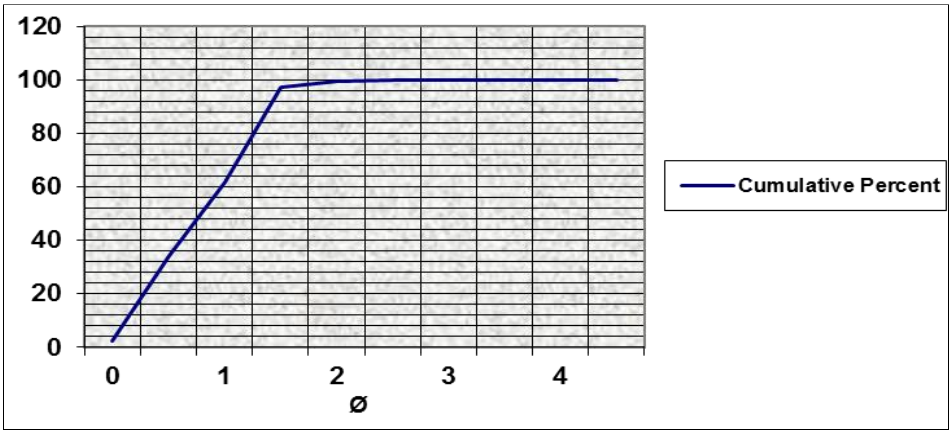
Number	Ø
5	0.3
16	0.49
25	0.6
50	1.1
75	1.49
84	1.6
95	1.7

→

Parameter	Result- St 44
Mz	1.06
KG	0.43
SkI	-0.1
δI	0.49

- **Sample – (Station 45)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	2.14	2.14
Test Sieve 2	32.27	34.41
Test Sieve 3	27.4	61.81
Test Sieve 4	35.22	97.03
Test Sieve 5	2.3	99.33
Test Sieve 6	0.4	99.73
Test Sieve 7	0.27	100
Test Sieve 8	0	100
Test Sieve 9	0	100
Test Sieve 10	0	100
Total	100	



A graph of cumulative weight percent against phi (station 45)

- **<u>Calculation - St 45</u>**

I. Mean grain size (Mz)

$$Mz = \frac{Ø16+Ø50+Ø84}{3}$$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$$

III. Inclusive Graphic Skewness (SK_I)

$$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$$

IV. Inclusive Graphic Standard Deviation (δI)

$$\delta I = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$$

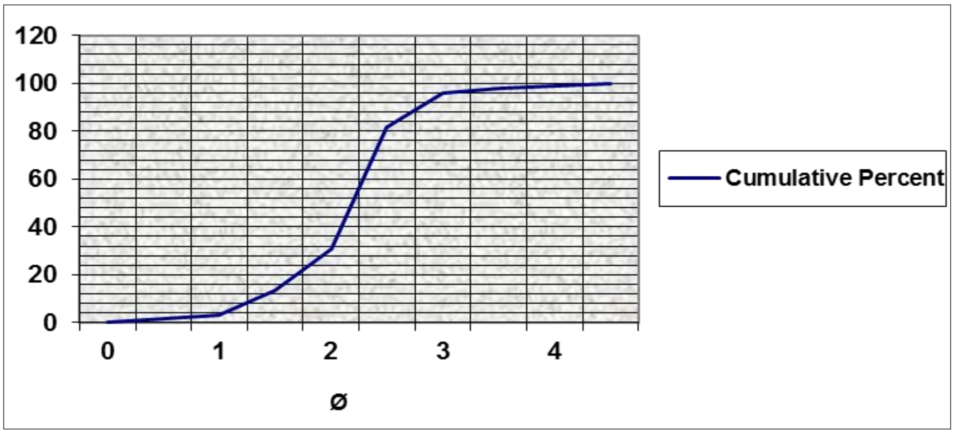
Number	Ø
5	0.29
16	0.49
25	0.6
50	1
75	1.5
84	1.59
95	1.7

→

Parameter	Result- St 45
Mz	1.03
KG	0.60
SkI	0
δI	0.49

- **Sample- (Station 46)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	0.3	0.3
Test Sieve 2	1.49	1.79
Test Sieve 3	1.26	3.05
Test Sieve 4	10.4	13.45
Test Sieve 5	17.32	30.77
Test Sieve 6	50.79	81.56
Test Sieve 7	14.4	95.96
Test Sieve 8	2.2	98.16
Test Sieve 9	0.9	99.06
Test Sieve 10	0.93	99.99
Total	99.99	



A graph of cumulative weight percent against phi (station 46)

- <u>**Calculation - St 46**</u>

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$$

III. Inclusive Graphic Skewness (SK_I)

$$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$$

IV. Inclusive Graphic Standard Deviation (δI)

$$\delta I = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$$

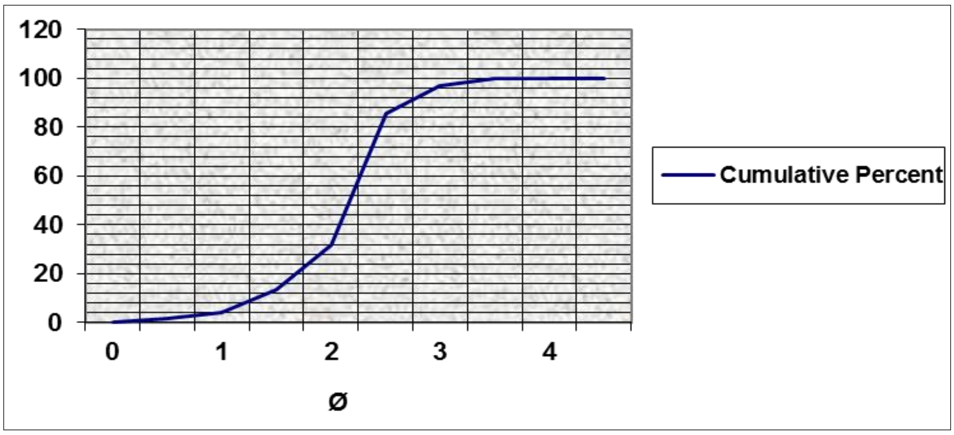
Number	Ø
5	1.4
16	1.7
25	2.1
50	2.4
75	2.6
84	2.7
95	3.1

→

Parameter	Result- St 46
Mz	2.26
KG	1.39
SkI	-0.3
δI	0.51

- **Sample-(Station 47)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	0.36	0.36
Test Sieve 2	1.49	1.85
Test Sieve 3	2.26	4.11
Test Sieve 4	9.4	13.51
Test Sieve 5	18.32	31.83
Test Sieve 6	53.79	85.62
Test Sieve 7	11.4	97.02
Test Sieve 8	2.97	99.99
Test Sieve 9	0	99.99
Test Sieve 10	0	99.99
Total (g)	99.99	



A graph of cumulative weight percent against phi (station 47)

- **Calculation – St 47**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

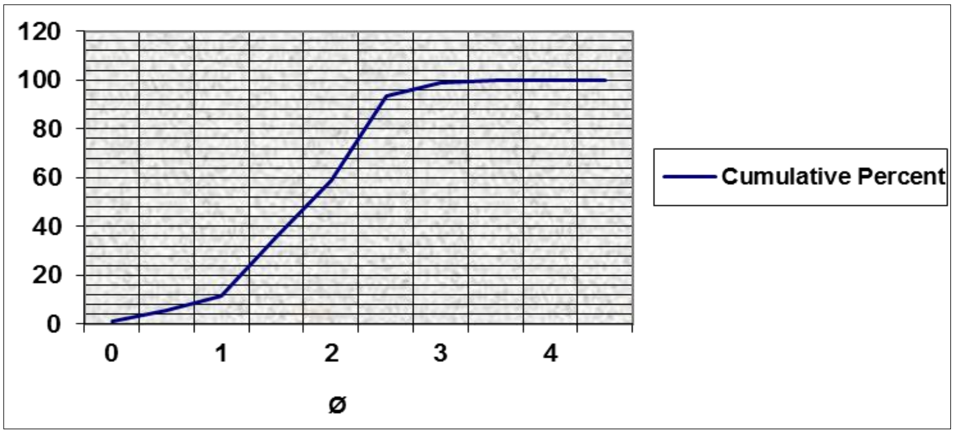
Number	Ø
5	1.3
16	1.8
25	2.1
50	2.4
75	2.6
84	2.75
95	3.2

→

Parameter	Result- St 47
Mz	2.26
KG	1.39
SkI	-0.2
δI	0.51

- **Sample- (Station 48)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	1.09	1.09
Test Sieve 2	4.33	5.42
Test Sieve 3	5.98	11.4
Test Sieve 4	24.17	35.57
Test Sieve 5	23.43	59
Test Sieve 6	34.46	93.46
Test Sieve 7	5.24	98.7
Test Sieve 8	1.25	99.95
Test Sieve 9	0.04	99.99
Test Sieve 10	0	99.99
Total (g)	100	



A graph of cumulative weight percent against phi (Station 48)

- **Calculation – St 48**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

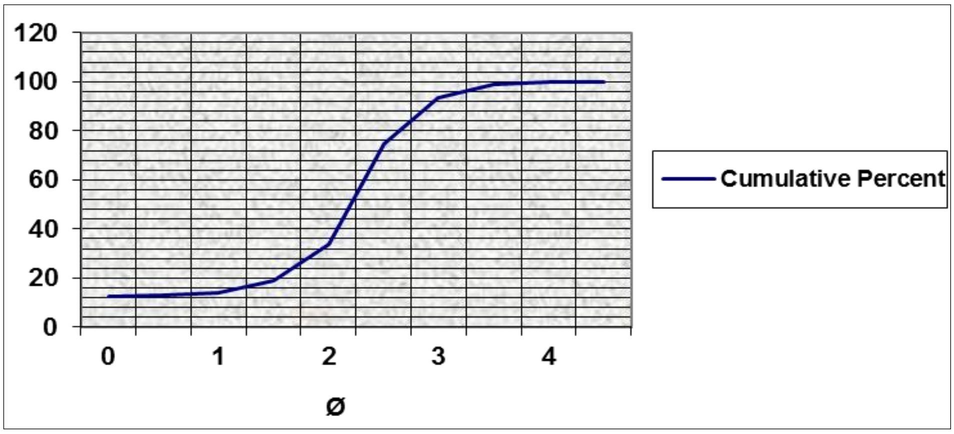
Number	Ø
5	0.7
16	1.4
25	1.5
50	2.1
75	2.5
84	2.6
95	3

→

Parameter	Result- St 48
Mz	2.03
KG	0.94
SkI	-0.2
δI	0.65

- **Sample -(Station 49)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	12.49	12.49
Test Sieve 2	0.53	13.02
Test Sieve 3	0.81	13.83
Test Sieve 4	5.3	19.13
Test Sieve 5	14.79	33.92
Test Sieve 6	40.65	74.57
Test Sieve 7	18.67	93.24
Test Sieve 8	5.85	99.09
Test Sieve 9	0.9	99.99
Test Sieve 10	0	99.99
Total (g)	99.99	



A graph of cumulative weight percent against phi (station 49)

- **Calculation – St 49**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

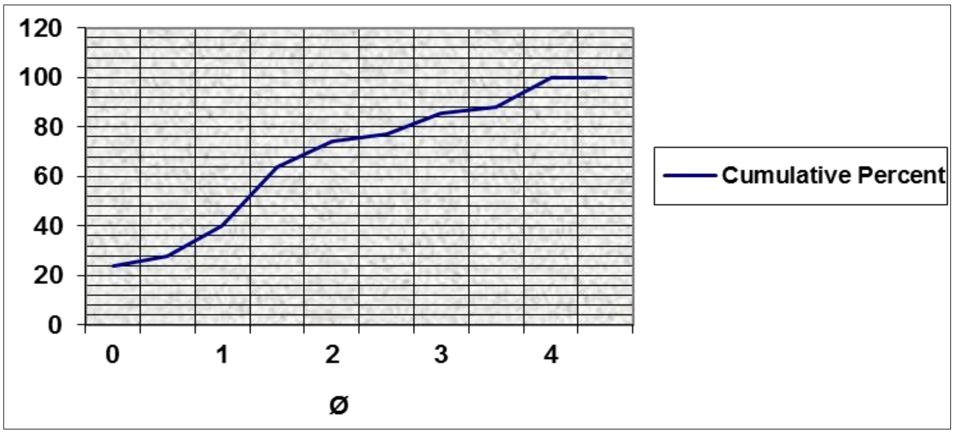
Number	Ø
5	0
16	1.4
25	1.9
50	2.4
75	2.6
84	3
95	3.4

→

Parameter	Result- St 49
Mz	2.26
KG	1.99
SkI	-0.3
δI	0.91

- **Sample- (Station 50)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	24.12	24.12
Test Sieve 2	3.53	27.65
Test Sieve 3	12.62	40.27
Test Sieve 4	23.45	63.72
Test Sieve 5	10.38	74.1
Test Sieve 6	3.09	77.19
Test Sieve 7	8.45	85.64
Test Sieve 8	2.65	88.29
Test Sieve 9	11.71	100
Test Sieve 10	0	100
Total (g)	100	



A graph of cumulative weight percent against phi (station 50)

- **<u>Calculation – St 50</u>**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$\delta I = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

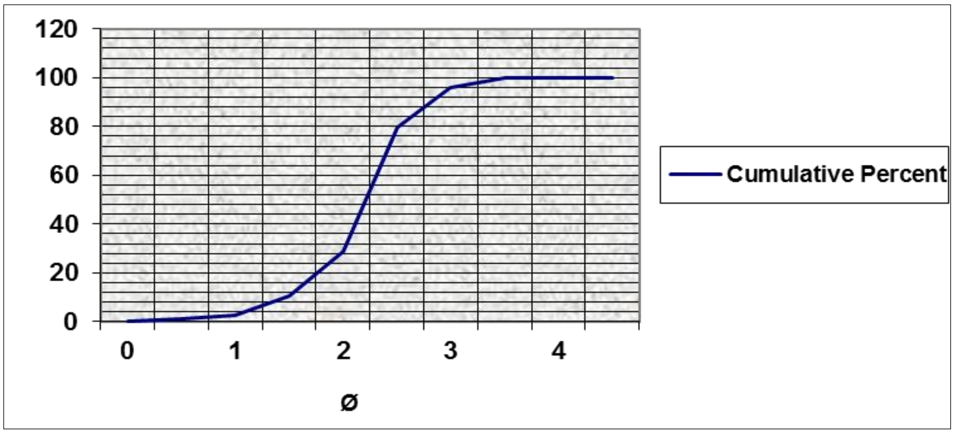
Number	Ø
5	0
16	0
25	0.5
50	1.4
75	2.2
84	3.1
95	4.1

→

Parameter	Result- St 50
Mz	1.50
KG	0.99
SkI	0.2
δI	1.40

- **Sample- (Station 51)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	0.19	0.19
Test Sieve 2	0.89	1.08
Test Sieve 3	1.46	2.54
Test Sieve 4	8.22	10.76
Test Sieve 5	17.93	28.69
Test Sieve 6	50.98	79.67
Test Sieve 7	16.09	95.76
Test Sieve 8	4.09	99.85
Test Sieve 9	0.14	99.99
Test Sieve 10	0	99.99
Total	99.99	



A graph of cumulative weight percent against phi (station 51)

- **<u>Calculation – St 51</u>**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

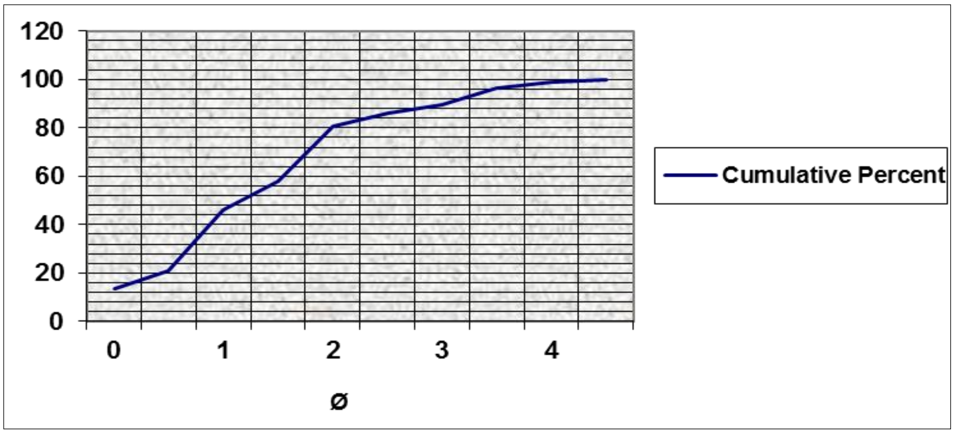
Number	Ø
5	1.3
16	1.9
25	2.1
50	2.4
75	2.6
84	2.9
95	3.1

→

Parameter	Result- St 51
Mz	2.40
KG	1.54
SkI	-0.1
δI	0.52

- **Sample- (Station 52)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	13.29	13.29
Test Sieve 2	7.69	20.98
Test Sieve 3	25.19	46.17
Test Sieve 4	11.76	57.93
Test Sieve 5	22.68	80.61
Test Sieve 6	5.67	86.28
Test Sieve 7	3.48	89.76
Test Sieve 8	6.66	96.42
Test Sieve 9	2.68	99.1
Test Sieve 10	0.89	99.99
Total	99.99	



A graph of cumulative weight percent against phi (station 52)

- **Calculation - St 52**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$\delta I = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

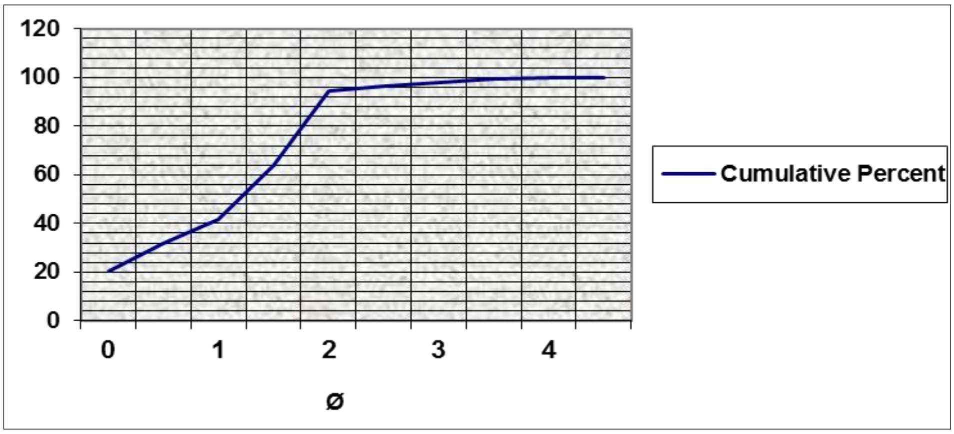
Number	Ø
5	0
16	0.3
25	0.8
50	1.39
75	2.1
84	2.5
95	3.6

→

Parameter	Result- St 52
Mz	1.40
KG	1.13
SkI	0.1
δI	1.07

- **Sample-(Station 53)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	20.45	20.45
Test Sieve 2	11.46	31.91
Test Sieve 3	9.75	41.66
Test Sieve 4	22.09	63.75
Test Sieve 5	30.75	94.5
Test Sieve 6	2.09	96.59
Test Sieve 7	1.27	97.86
Test Sieve 8	1.57	99.43
Test Sieve 9	0.56	99.99
Test Sieve 10	0	99.99
Total	99.99	



A graph of cumulative weight percent against phi (station 53)

- **<u>Calculation – St 53</u>**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

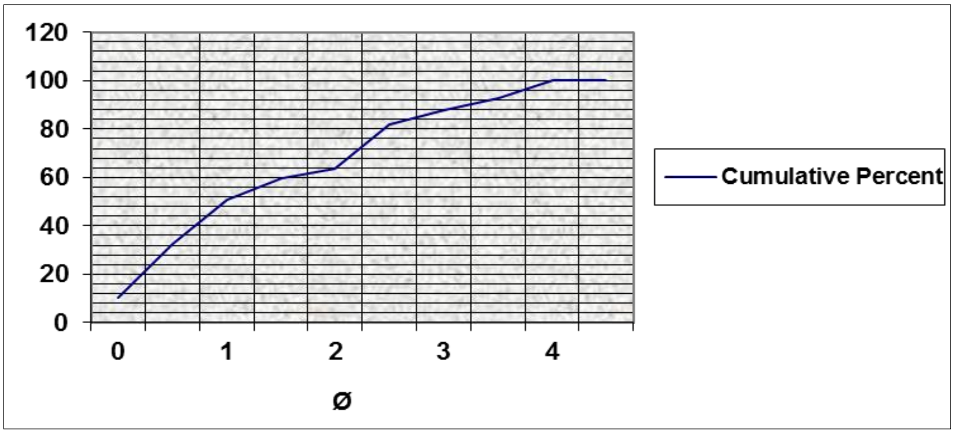
Number	Ø
5	0
16	0
25	0.5
50	1.47
75	1.8
84	2.1
95	2.37

→

Parameter	Result- St 53
Mz	1.19
KG	0.75
SkI	-0.3
δI	0.88

- **Sample – (Station 54)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	10.34	10.34
Test Sieve 2	22.16	32.5
Test Sieve 3	18.38	50.88
Test Sieve 4	8.74	59.62
Test Sieve 5	3.98	63.6
Test Sieve 6	18.48	82.08
Test Sieve 7	5.87	87.95
Test Sieve 8	4.98	92.93
Test Sieve 9	7.07	100
Test Sieve 10	0	100
Total (g)	100	



A graph of cumulative weight percent against phi (station 54)

- <u>**Calculation - St 54**</u>

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

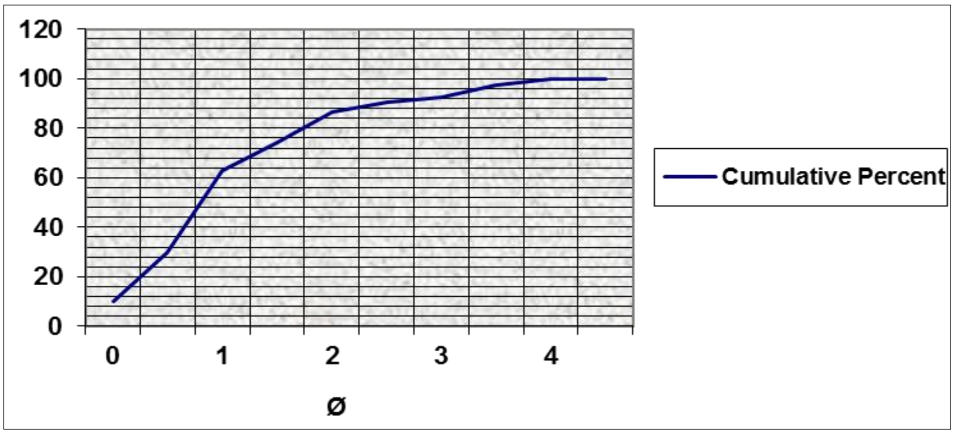
$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

Number	Ø
5	0
16	0.4
25	0.6
50	1.2
75	2.53
84	2.9
95	3.7

Parameter	Result- St 54
Mz	1.50
KG	0.79
SkI	0.4
δI	1.19

- **Sample –(Station 55)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	9.87	9.87
Test Sieve 2	20.15	30.02
Test Sieve 3	33.85	63.87
Test Sieve 4	10.58	74.45
Test Sieve 5	12.12	86.57
Test Sieve 6	3.79	90.36
Test Sieve 7	2.35	92.71
Test Sieve 8	4.78	97.49
Test Sieve 9	2.5	99.99
Test Sieve 10	0	99.99
Total (g)	99.99	



A graph of cumulative weight percent against phi (station 55)

- **<u>Calculation – St 55</u>**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

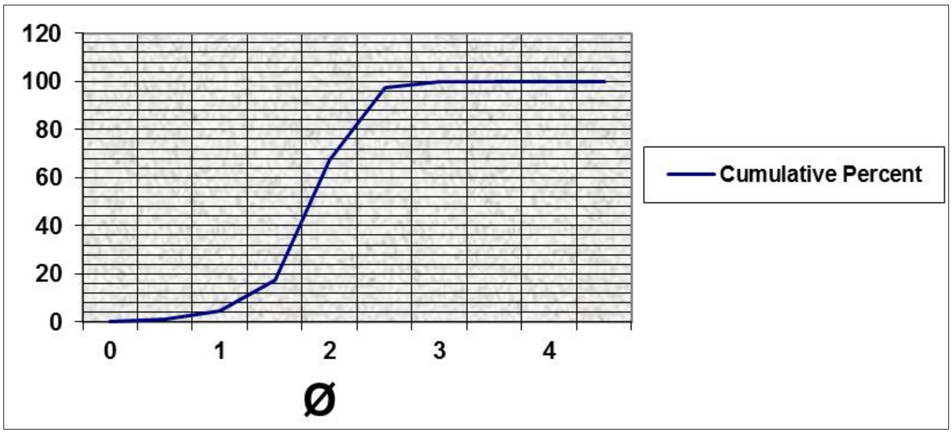
Number	Ø
5	0
16	0.39
25	0.6
50	1.19
75	1.4
84	2.1
95	3.49

Parameter	Result- St 55
Mz	1.23
KG	1.79
SkI	0.2
δI	0.96

Appendix 5.4: Calculation for WTRIS

- **Sample-(Station 63)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	0.19	0.19
Test Sieve 2	0.91	1.10
Test Sieve 3	3.32	4.42
Test Sieve 4	12.86	17.28
Test Sieve 5	50.09	67.37
Test Sieve 6	30.01	97.38
Test Sieve 7	2.50	99.88
Test Sieve 8	0.11	99.99
Test Sieve 9	0.00	99.99
Test Sieve 10	0.00	100
Total	100	



A graph of cumulative weight percent against phi (station 63)

- **<u>Calculation – St 63</u>**

V. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

VI. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

VII. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

VIII. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

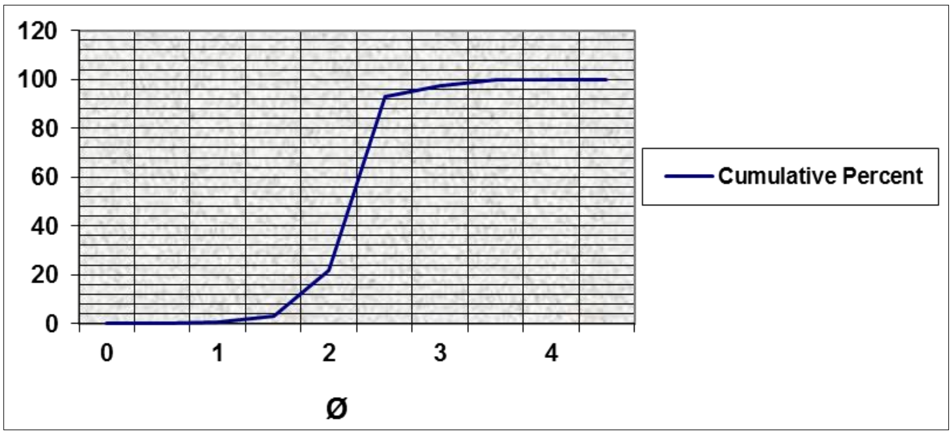
Number	Ø
5	1.4
16	1.7
25	1.8
50	2.1
75	2.4
84	2.5
95	2.7

→

Parameter	Result- St 63
Mz	2.1
KG	0.89
SkI	-0.04
δI	0.40

- **Sample-(Station 64)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	0.07	0.07
Test Sieve 2	0.30	0.37
Test Sieve 3	0.34	0.71
Test Sieve 4	2.53	3.24
Test Sieve 5	18.43	21.67
Test Sieve 6	71.39	93.06
Test Sieve 7	4.35	97.41
Test Sieve 8	2.56	99.97
Test Sieve 9	0.02	99.99
Test Sieve 10	0.00	100
Total	**100**	



A graph of cumulative weight percent against phi (station 64)

- **Calculation – St 64**

I. Mean grain size (Mz)

$$Mz = \frac{Ø16+Ø50+Ø84}{3}$$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$$

III. Inclusive Graphic Skewness (SK_I)

$$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$$

IV. Inclusive Graphic Standard Deviation (δI)

$$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$$

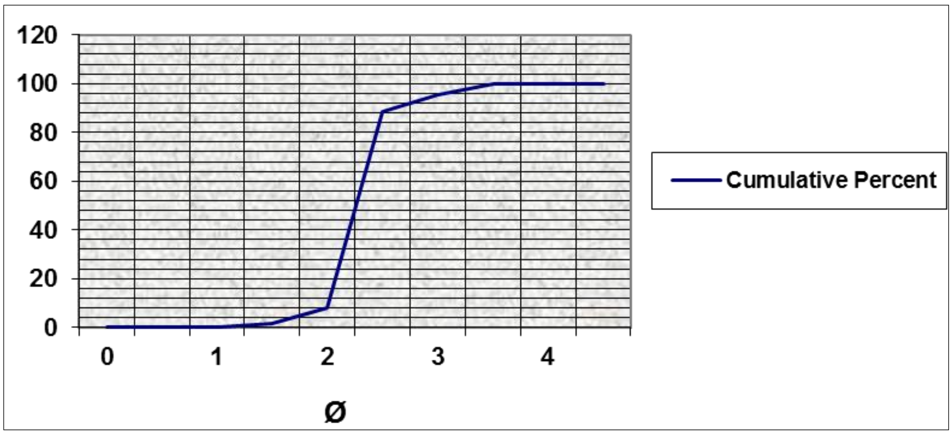
Number	Ø
5	1.8
16	2.1
25	2.39
50	2.49
75	2.6
84	2.67
95	3

→

Parameter	Result- St 64
Mz	2.42
KG	2.34
SkI	-0.26
δI	0.32

- **Sample- (Station 65)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	0.03	0.03
Test Sieve 2	0.14	0.17
Test Sieve 3	0.18	0.35
Test Sieve 4	1.06	1.41
Test Sieve 5	6.88	8.29
Test Sieve 6	80.29	88.58
Test Sieve 7	7.04	95.62
Test Sieve 8	4.37	99.99
Test Sieve 9	0	99.99
Test Sieve 10	0	99.99
Total	99.99	



A graph of cumulative weight percent against phi (station 65)

- **<u>Calculation – St 65</u>**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

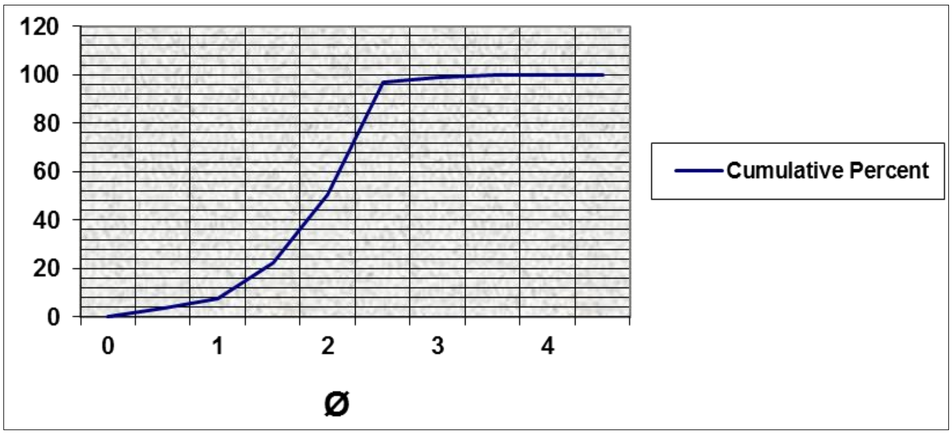
Number	Ø
5	2.1
16	2.3
25	2.4
50	2.5
75	2.6
84	2.67
95	3.4

→

Parameter	Result- St 65
Mz	2.49
KG	2.73
SkI	0.15
δI	0.29

- **Sample- (Station 66)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	0.31	0.31
Test Sieve 2	3.49	3.8
Test Sieve 3	3.73	7.53
Test Sieve 4	15.03	22.56
Test Sieve 5	28.05	50.61
Test Sieve 6	46.39	97
Test Sieve 7	1.92	98.92
Test Sieve 8	0.98	99.9
Test Sieve 9	0.09	99.99
Test Sieve 10	0.00	100
Total	100	



A graph of cumulative weight percent against phi (station 66)

- **<u>Calculation – St 66</u>**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

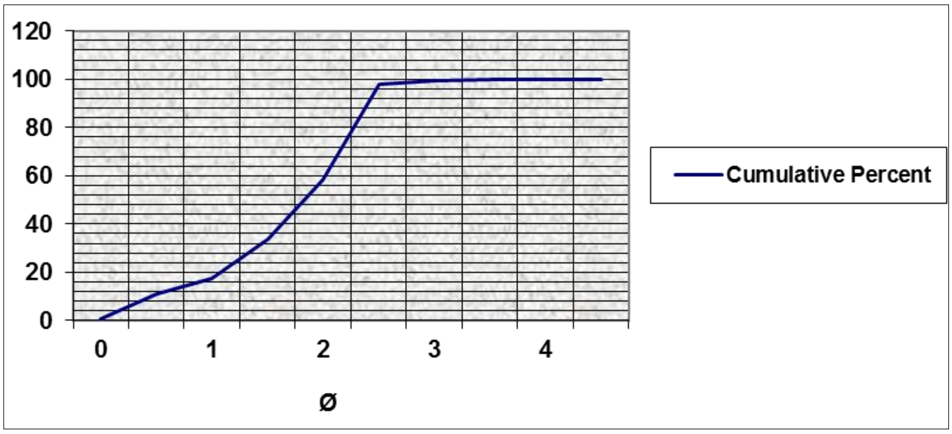
$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

Number	Ø
5	1
16	1.51
25	1.7
50	2.2
75	2.5
84	2.59
95	2.7

Parameter	Result- St 66
Mz	2.1
KG	0.87
SkI	-0.34
δI	0.53

- **Sample-(Station 67)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	0.50	0.5
Test Sieve 2	10.50	11
Test Sieve 3	6.60	17.6
Test Sieve 4	16.21	33.81
Test Sieve 5	24.71	58.52
Test Sieve 6	39.36	97.88
Test Sieve 7	1.74	99.62
Test Sieve 8	0.38	100
Test Sieve 9	0.00	100
Test Sieve 10	0.00	100
Total	100	



A graph of cumulative weight percent against phi (station 67)

- **<u>Calculation – St 67</u>**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$\delta I = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

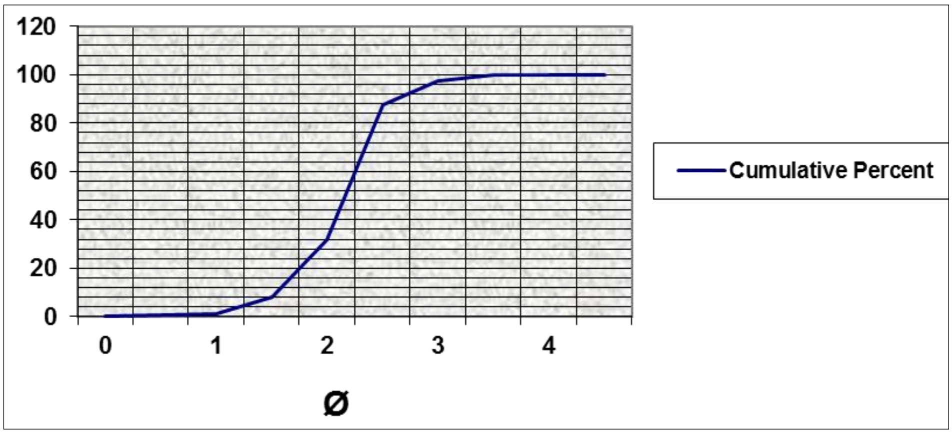
Number	Ø
5	0.4
16	1.1
25	1.5
50	2.09
75	2.48
84	2.53
95	2.6

→

Parameter	Result- St 67
Mz	1.91
KG	0.92
SkI	-0.07
δI	0.69

- **Sample-(Station 68)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	0.06	0.06
Test Sieve 2	0.43	0.49
Test Sieve 3	0.83	1.32
Test Sieve 4	7	8.32
Test Sieve 5	23.28	31.6
Test Sieve 6	55.99	87.59
Test Sieve 7	9.9	97.49
Test Sieve 8	2.43	99.92
Test Sieve 9	0.01	100
Test Sieve 10	0	100
Total	100	



A graph of cumulative weight percent against phi (station 68)

- **<u>Calculation – St 68</u>**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$\delta I = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

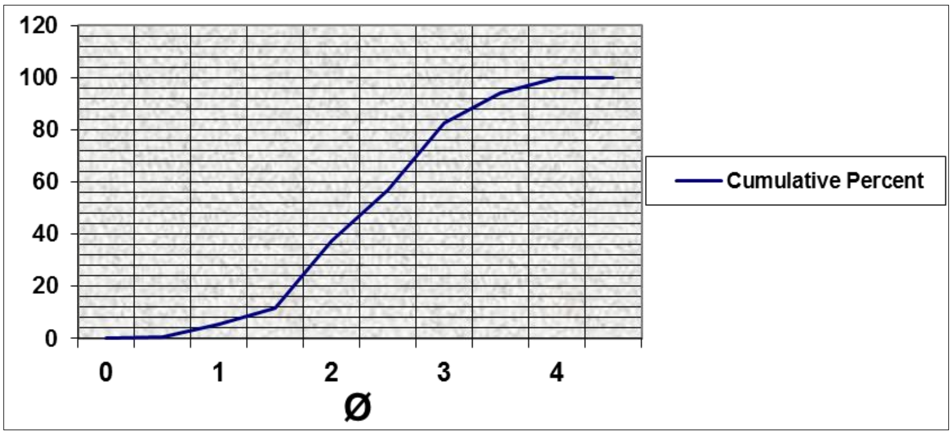
Number	Ø
5	1.58
16	1.9
25	2.1
50	2.4
75	2.6
84	2.7
95	3.1

→

Parameter	Result- St 68
Mz	2.30
KG	1.25
SkI	-0.50
δI	0.43

- **Sample-(Station 69)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	0.09	0.09
Test Sieve 2	0.52	0.61
Test Sieve 3	4.87	5.48
Test Sieve 4	5.97	11.45
Test Sieve 5	26.14	37.59
Test Sieve 6	19.35	56.94
Test Sieve 7	25.49	82.43
Test Sieve 8	11.78	94.21
Test Sieve 9	5.78	100
Test Sieve 10	0	100
Total	100	



A graph of cumulative weight percent against phi (station 69)

- **<u>Calculation – St 69</u>**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

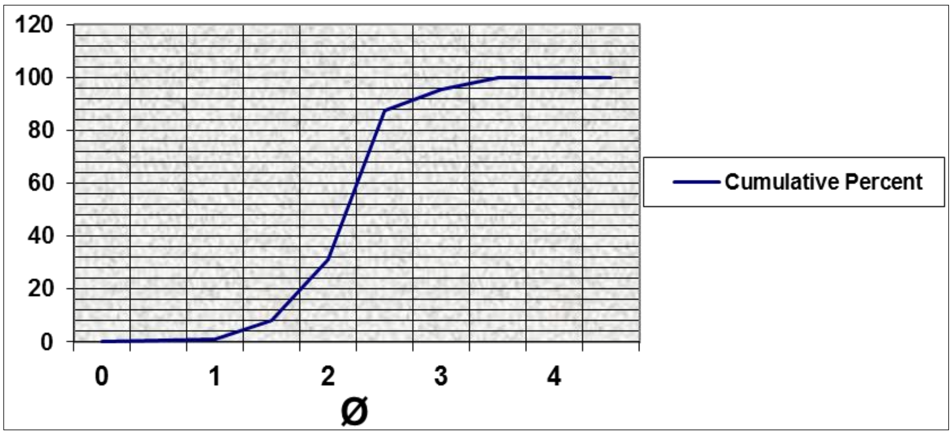
Number	Ø
5	1.3
16	1.8
25	2
50	2.51
75	3.1
84	3.4
95	3.6

→

Parameter	Result- St 69
Mz	2.57
KG	0.86
SkI	0.03
δI	0.75

- **Sample- (Station 70)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	0.05	0.05
Test Sieve 2	0.44	0.49
Test Sieve 3	0.63	1.12
Test Sieve 4	7.2	8.32
Test Sieve 5	23	31.32
Test Sieve 6	56.27	87.59
Test Sieve 7	8	95.59
Test Sieve 8	4.34	99.93
Test Sieve 9	0	100
Test Sieve 10	0	100
Total	100	



A graph of cumulative weight percent against phi (station 70)

- **<u>Calculation – St 70</u>**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

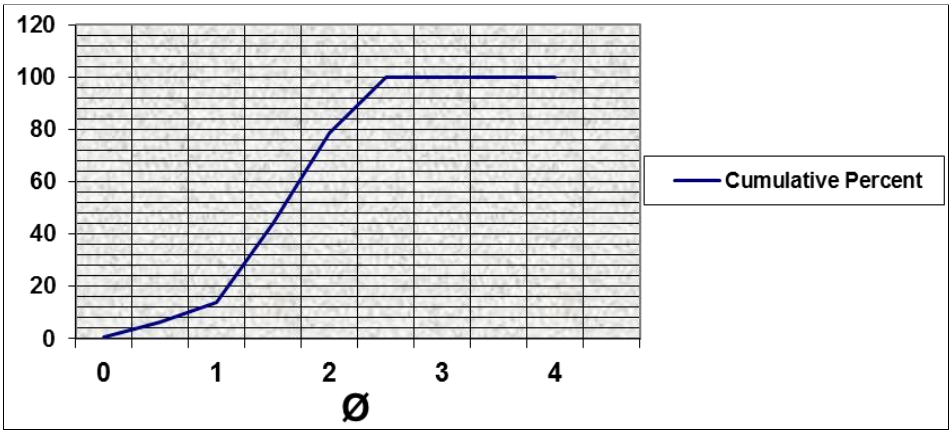
Number	Ø
5	1.6
16	1.9
25	2.1
50	2.4
75	2.6
84	2.7
95	3.3

→

Parameter	Result- St 70
Mz	2.3
KG	1.39
SkI	-0.07
δI	0.46

- **Sample- (Station 71)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	0.41	0.41
Test Sieve 2	5.76	6.17
Test Sieve 3	7.66	13.83
Test Sieve 4	30.06	43.89
Test Sieve 5	34.81	78.70
Test Sieve 6	21.24	99.94
Test Sieve 7	0.05	99.99
Test Sieve 8	0.00	99.99
Test Sieve 9	0.00	100
Test Sieve 10	0.00	100
Total	100	



A graph of cumulative weight percent against phi (station 71)

- **Calculation – St 71**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

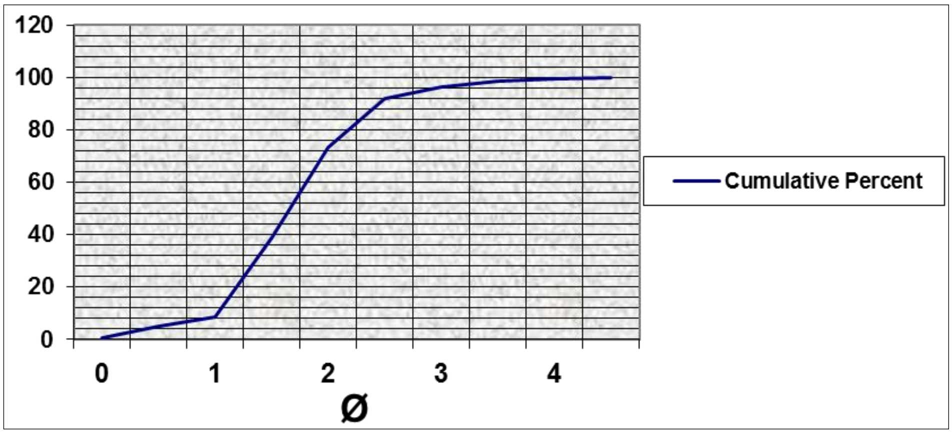
Number	Ø
5	0.7
16	1.3
25	1.49
50	1.7
75	2.1
84	2.4
95	2.6

→

Parameter	Result- St 71
Mz	0.70
KG	2.54
SkI	0.11
δI	0.37

- **Sample-(Station 72)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	0.75	0.75
Test Sieve 2	4.18	4.93
Test Sieve 3	3.56	8.49
Test Sieve 4	30.21	38.70
Test Sieve 5	34.70	73.40
Test Sieve 6	18.46	91.86
Test Sieve 7	4.60	96.46
Test Sieve 8	1.98	98.44
Test Sieve 9	0.93	99.37
Test Sieve 10	0.63	100
Total	100	



A graph of cumulative weight percent against phi (station 72)

- **<u>Calculation – St 72</u>**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

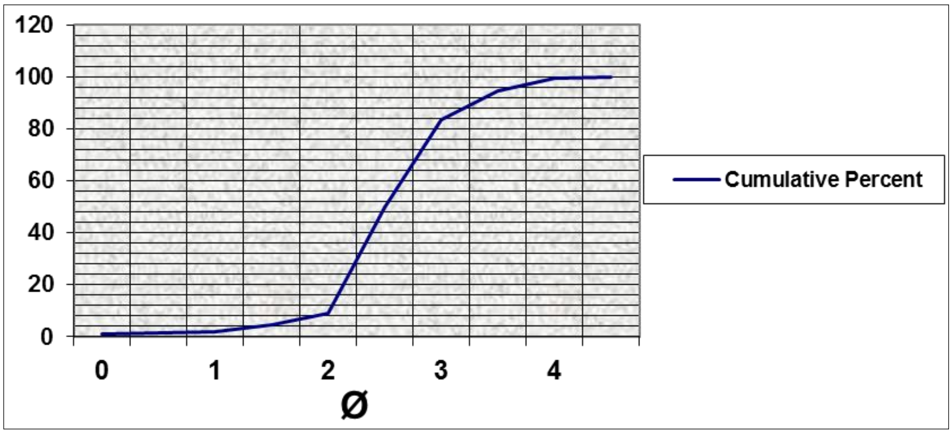
Number	Ø
5	0.9
16	1.4
25	1.5
50	1.9
75	2.4
84	2.5
95	3

→

Parameter	Result- St 72
Mz	0.93
KG	0.96
SkI	0.07
δI	0.59

- **Sample-(Station 73)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	0.87	0.87
Test Sieve 2	0.65	1.52
Test Sieve 3	0.29	1.81
Test Sieve 4	2.54	4.35
Test Sieve 5	4.76	9.11
Test Sieve 6	40.51	49.62
Test Sieve 7	34	83.62
Test Sieve 8	10.53	94.15
Test Sieve 9	5.3	99.45
Test Sieve 10	0.55	100
Total	100	



A graph of cumulative weight percent against phi (station 73)

- **<u>Calculation – St 73</u>**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

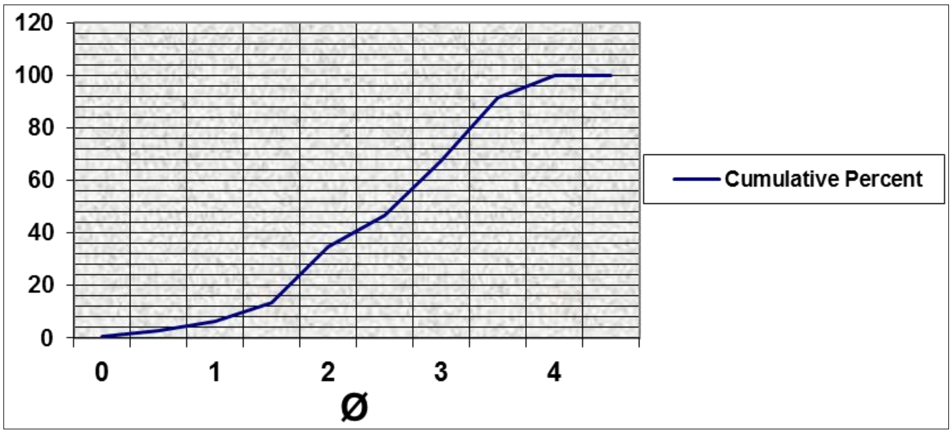
Number	Ø
5	1.7
16	2.37
25	2.489
50	2.6
75	3.1
84	3.3
95	3.6

→

Parameter	Result- St 73
Mz	2.76
KG	1.26
SkI	0.28
δI	0.52

- **Sample-(Station 74)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	0.58	0.58
Test Sieve 2	2.3	2.88
Test Sieve 3	3.61	6.49
Test Sieve 4	6.74	13.23
Test Sieve 5	21.34	34.57
Test Sieve 6	12.24	46.84
Test Sieve 7	20.88	67.72
Test Sieve 8	23.94	91.66
Test Sieve 9	8.33	99.99
Test Sieve 10	0	100
Total	100	



A graph of cumulative weight percent against phi (station 74)

- **<u>Calculation – St 74</u>**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

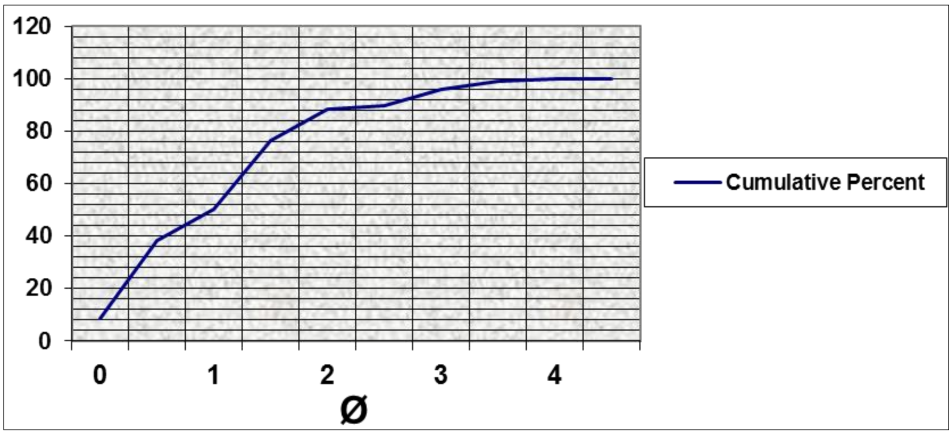
Number	Ø
5	1.1
16	1.8
25	2.1
50	2.8
75	3.49
84	3.6
95	4

→

Parameter	Result- St 74
Mz	2.73
KG	0.86
SkI	-0.14
δI	0.89

- **Sample- (Station 75)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	8.74	8.74
Test Sieve 2	29.69	38.43
Test Sieve 3	11.65	50.08
Test Sieve 4	26.13	76.21
Test Sieve 5	12.23	88.44
Test Sieve 6	1.28	89.72
Test Sieve 7	6.24	95.96
Test Sieve 8	2.84	98.8
Test Sieve 9	1.09	100
Test Sieve 10	0	100
Total	100	



A graph of cumulative weight percent against phi (station 75)

- **<u>Calculation – St 75</u>**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

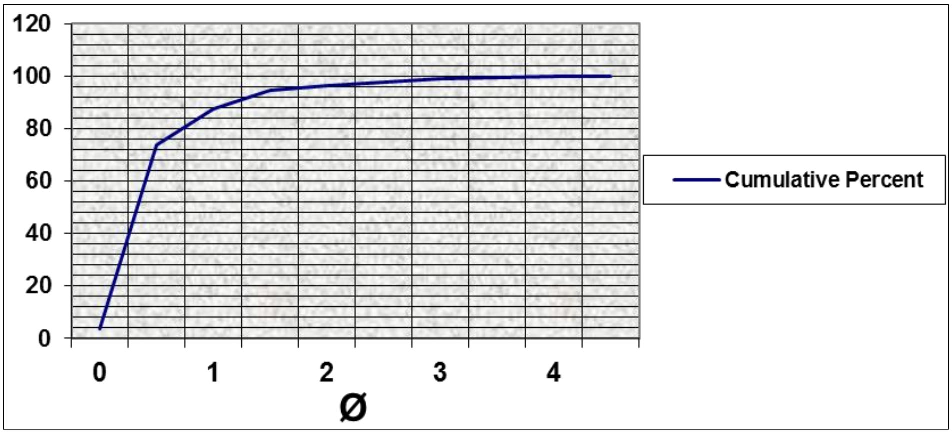
Number	Ø
5	0
16	0.4
25	0.52
50	1.4
75	1.6
84	2.1
95	3.1

→

Parameter	Result- St 75
Mz	1.30
KG	1.18
SkI	-0.04
δI	0.89

- **Sample-(Station 76)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	3.58	3.58
Test Sieve 2	70	73.58
Test Sieve 3	13.78	87.36
Test Sieve 4	7.25	94.61
Test Sieve 5	1.89	96.5
Test Sieve 6	1.24	97.74
Test Sieve 7	1.23	98.97
Test Sieve 8	0.49	99.46
Test Sieve 9	0.53	100
Test Sieve 10	0	100
Total	100	



A graph of cumulative weight percent against phi (Station 76)

- **<u>Calculation – St 76</u>**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$\delta I = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

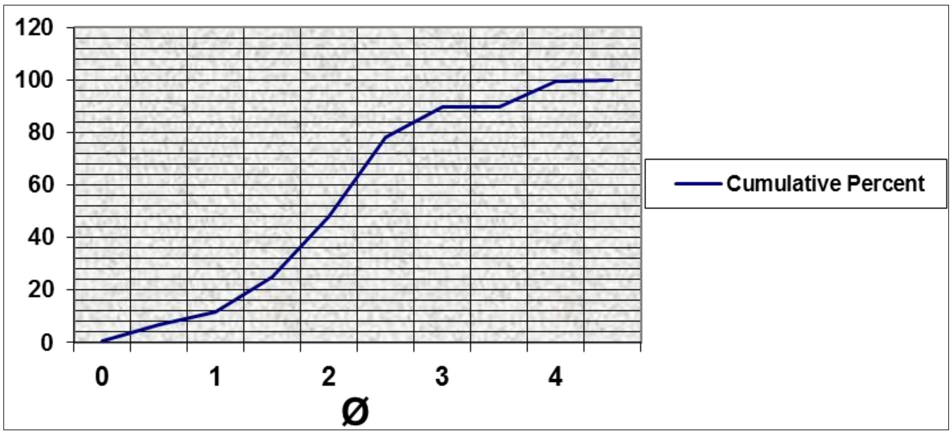
Number	Ø
5	0.3
16	0.4
25	0.49
50	0.6
75	0.7
84	1.1
95	1.6

→

Parameter	Result- St 76
Mz	1.80
KG	1.28
SkI	0.48
δI	0.56

- **Sample-St 77**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	0.59	0.59
Test Sieve 2	6.2	6.79
Test Sieve 3	4.89	11.68
Test Sieve 4	13.27	24.95
Test Sieve 5	23.18	48.13
Test Sieve 6	30.24	78.37
Test Sieve 7	11.35	89.72
Test Sieve 8	7.56	97.28
Test Sieve 9	2.12	99.4
Test Sieve 10	0.6	100
Total	100	



A graph of cumulative weight percent against phi (station 77)

- **<u>Calculation – St 77</u>**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

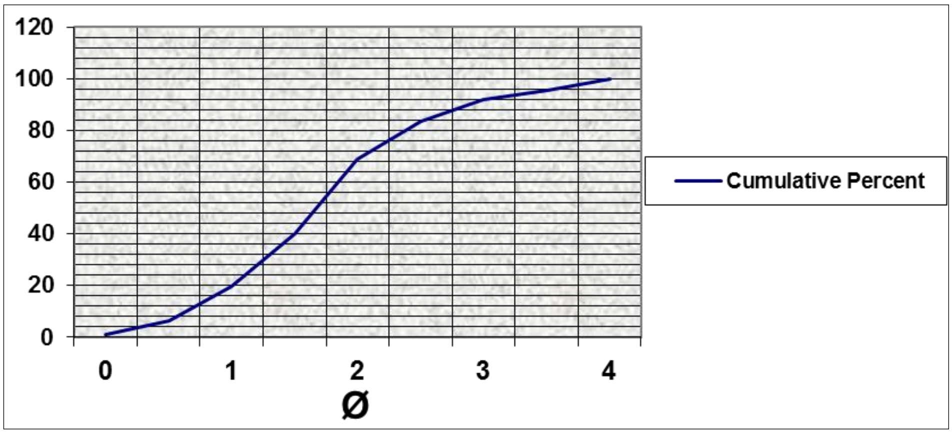
Number	Ø
5	0.6
16	1
25	1.7
50	2.4
75	2.7
84	3
95	4

→

Parameter	Result- St 77
Mz	2.13
KG	1.39
SkI	-0.23
δI	1

- **Sample-(Station 78)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	0.83	0.83
Test Sieve 2	5.46	6.29
Test Sieve 3	13.52	19.81
Test Sieve 4	20.09	39.90
Test Sieve 5	29.10	69
Test Sieve 6	14.69	83.61
Test Sieve 7	8.03	91.72
Test Sieve 8	3.68	95.40
Test Sieve 9	4.58	100
Test Sieve 10	0	100
Total	100	



A graph of cumulative weight percent against phi (station 78)

- **<u>Calculation – St 78</u>**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

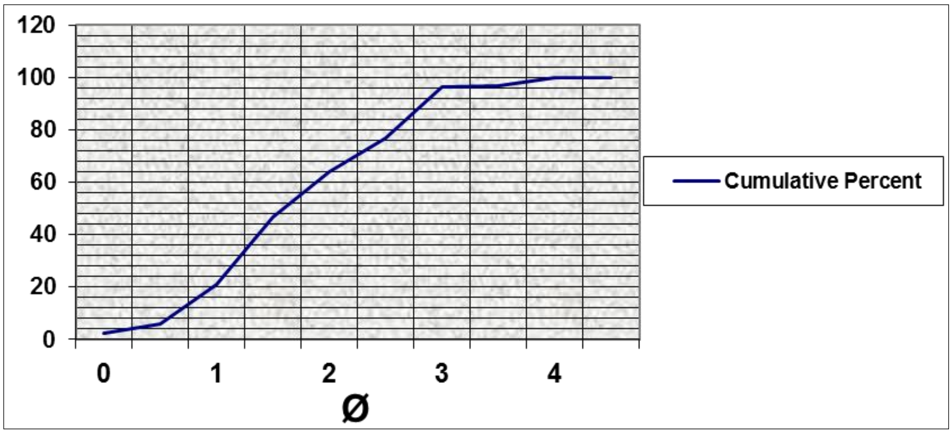
Number	Ø
5	0.6
16	1.1
25	1.4
50	1.9
75	2.4
84	2.7
95	3.7

→

Parameter	Result- St 78
Mz	1.90
KG	0.85
SkI	0.08
δI	0.83

- **Sample-(Station 79)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	2.30	2.30
Test Sieve 2	3.44	5.74
Test Sieve 3	15.38	21.12
Test Sieve 4	25.61	46.73
Test Sieve 5	17.35	64.08
Test Sieve 6	12.95	77.03
Test Sieve 7	19.33	96.36
Test Sieve 8	0.34	96.70
Test Sieve 9	3.30	100
Test Sieve 10	0	100
Total	100	



A graph of cumulative weight percent against phi (station 79)

- **Calculation – St 79**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$\delta I = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

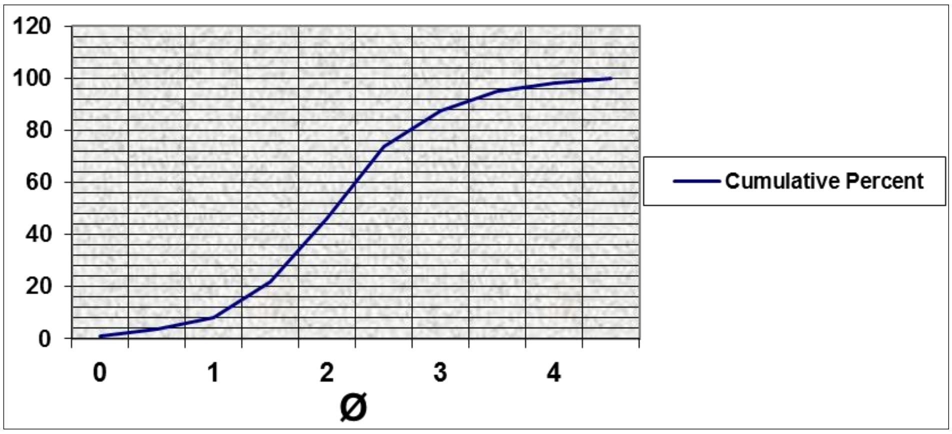
Number	Ø
5	0.7
16	1.1
25	1.4
50	1.8
75	2.6
84	2.9
95	3.2

→

Parameter	Result- St 79
Mz	1.93
KG	0.85
SkI	0.16
δI	0.82

- **Sample-(Station 80)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	1.14	1.14
Test Sieve 2	2.35	3.49
Test Sieve 3	4.69	8.18
Test Sieve 4	13.78	21.96
Test Sieve 5	24.49	46.45
Test Sieve 6	27.26	73.71
Test Sieve 7	13.93	87.64
Test Sieve 8	7.37	95.01
Test Sieve 9	3.24	98.25
Test Sieve 10	1.75	100
Total	100	



A graph of cumulative weight percent against phi (station 80)

- **<u>Calculation – St 80</u>**

I. Mean grain size (Mz)

$Mz = \frac{Ø16+Ø50+Ø84}{3}$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$

III. Inclusive Graphic Skewness (SK_I)

$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$

IV. Inclusive Graphic Standard Deviation (δI)

$δI = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$

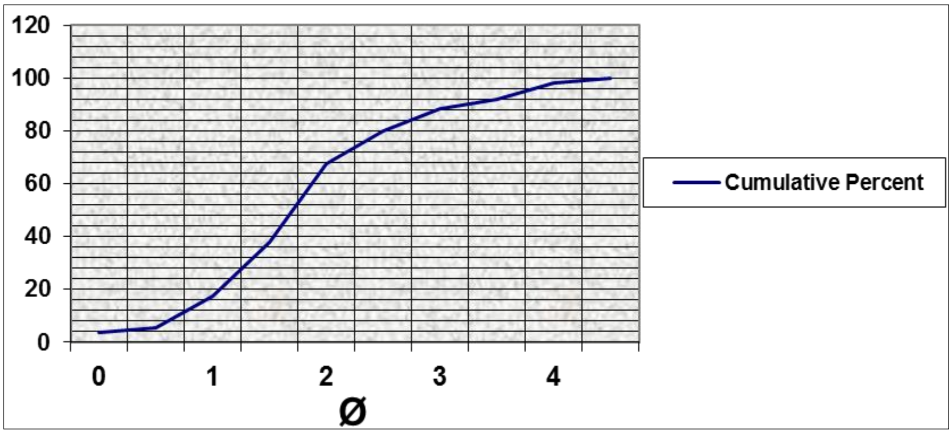
Number	Ø
5	1
16	1.6
25	1.8
50	2.4
75	2.8
84	3.1
95	3.6

→

Parameter	Result- St 80
Mz	3
KG	1.07
SkI	-0.07
δI	0.77

- **Sample-(Station 81)**

Sieve	Wight (g)	Cumulative Percent
Test Sieve 1	3.7	3.7
Test Sieve 2	1.67	5.37
Test Sieve 3	11.85	17.22
Test Sieve 4	20.42	37.64
Test Sieve 5	30.1	67.74
Test Sieve 6	12.15	79.89
Test Sieve 7	8.43	88.32
Test Sieve 8	3.49	91.81
Test Sieve 9	6.16	97.97
Test Sieve 10	2.03	100
Total	100	



A graph of cumulative weight percent against phi (station 81)

- **Calculation – St 81**

I. Mean grain size (Mz)

$$Mz = \frac{Ø16+Ø50+Ø84}{3}$$, Ø=-log 2 and the diameter (mm)

II. Graphic Kurtosis (KG)

$$KG = \frac{Ø95-Ø5}{2.44*(Ø75-Ø25)}$$

III. Inclusive Graphic Skewness (SK_I)

$$SKI = \frac{Ø84+Ø16-2(Ø50)}{2(Ø84-Ø16)} + \frac{Ø95+Ø5-2(Ø50)}{2(Ø95-Ø5)}$$

IV. Inclusive Graphic Standard Deviation (δI)

$$\delta I = \frac{Ø84-Ø16}{4} + \frac{Ø95-Ø5}{6.6}$$

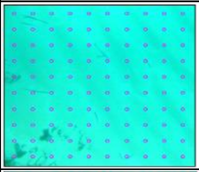
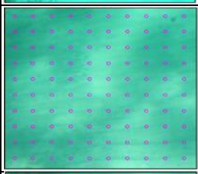
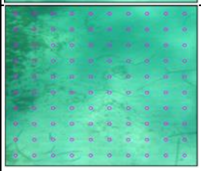
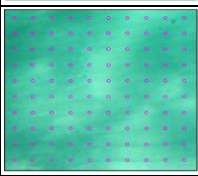
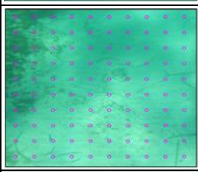
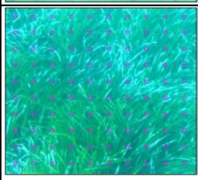
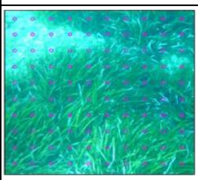
Number	Ø
5	0.6
16	1.3
25	1.49
50	1.9
75	2.5
84	3
95	4

→

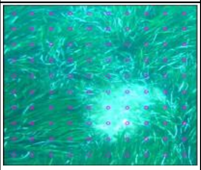
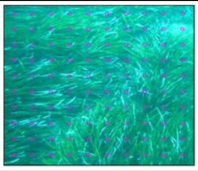
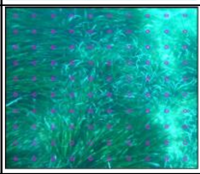
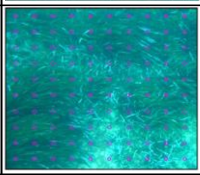
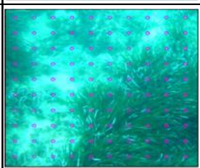
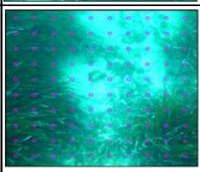
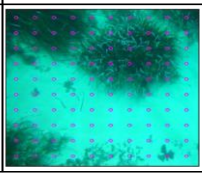
Parameter	Result- St 81
Mz	2.06
KG	1.38
SkI	0.26
δI	0.49

Appendix 5.5: Biological Sample Collection

- **ImageJ Analysis for Zwuarah Desalination Plant**

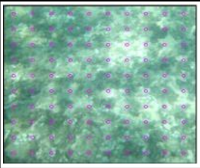
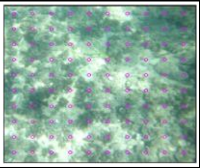
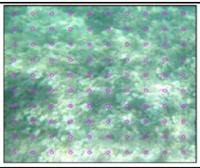
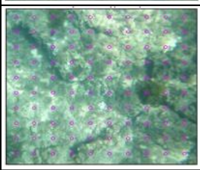
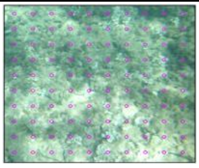
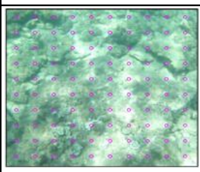
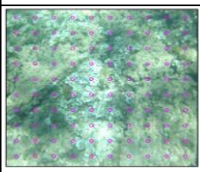
Biological Data Analysis: ImageJ																
Simple ID: Zwuarah Plant						**TEST REPORT - IMAGE ANALYSIS**										
Site Nr	Station Nr	Vido Nr	video length (m:s)	Sea bottom images	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	Laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Total of Dots
1	37	1	00:50:00		1	100	0	0	0	0	0	0	0	0	0	100
1	37	1	00:50:00		2	100	0	0	0	0	0	0	0	0	0	100
1	37	1	00:50:00		3	85	0	0	0	15	0	0	0	0	0	100
1	37	1	00:50:00		4	100	0	0	0	0	0	0	0	0	0	100
1	37	1	00:50:00		5	92	0	0	0	8	0	0	0	0	0	100
1	38	2	01:30:00		1	0	100	0	0	0	0	0	0	0	0	100
1	38	2	01:30:00		2	9	91	0	0	0	0	0	0	0	0	100

Biological Data Analysis: ImageJ

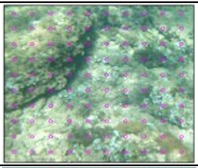
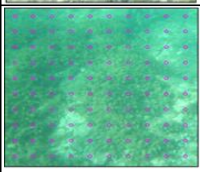
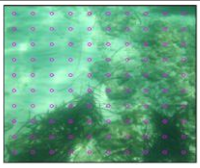
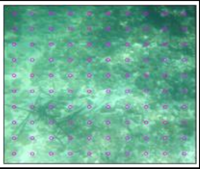
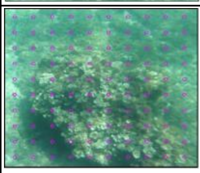
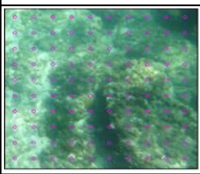
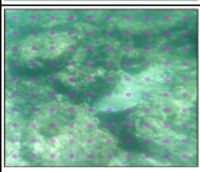
Simple ID: Zwuarah Plant						TEST REPORT - IMAGE ANALYSIS										
Site Nr	Station Nr	Vido Nr	video length (m:s)	Sea bottom images	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	Laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Total of Dots
1	38	2	01:30:00		3	6	94	0	0	0	0	0	0	0	0	100
1	38	2	01:20:00		4	0	100	0	0	0	0	0	0	0	0	100
1	38	2	01:30:00		5	6	94	0	0	0	0	0	0	0	0	100
1	38	2	01:30:00		6	0	98	0	2	0	0	0	0	0	0	100
1	38	2	01:30:00		7	12	56	0	19	13	0	0	0	0	0	100
1	38	2	01:30:00		8	12	60	0	18	10	0	0	0	0	0	100
1	38	2	01:30:00		9	19	46	27	8	0	0	0	0	0	0	100

Biological Data Analysis: ImageJ

Simple ID: Zwuarah Plant | **T E S T R E P O R T - IMAGE ANALYSIS**

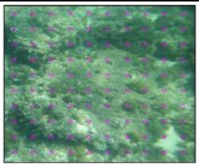
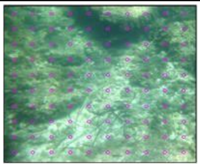
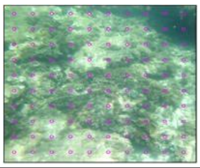
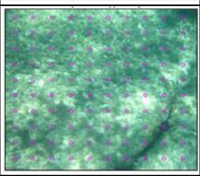
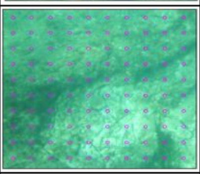
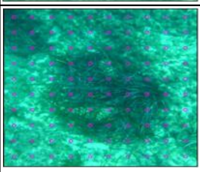
Site Nr	Station Nr	Vido Nr	video length (m:s)	Sea bottom images	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	Laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Total of Dots
1	39	3	01:30:00		1	0	0	0	83	2	0	0	15	0	0	100
1	39	3	01:30:00		2	3	0	1	96	0	0	0	0	0	0	100
1	39	3	01:30:00		3	0	0	0	40	0	0	0	60	0	0	100
1	39	3	01:30:00		4	0	0	0	95	0	3	0	2	0	0	100
1	39	3	01:30:00		5	0	0	0	75	0	0	0	25	0	0	100
1	39	3	01:30:00		6	0	0	0	28	58	0	0	14	0	0	100
1	39	3	01:30:00		7	0	0	0	0	74	0	0	26	0	0	100

Biological Data Analysis: ImageJ

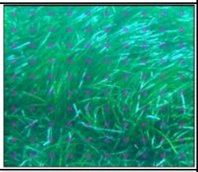
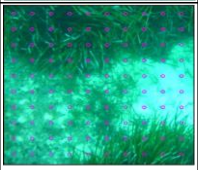
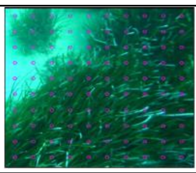
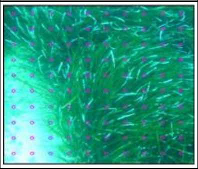
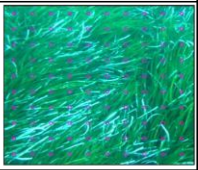
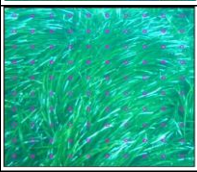
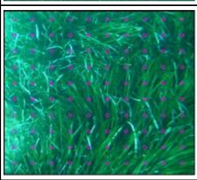
Simple ID: Zwuarah Plant						T E S T R E P O R T - IMAGE ANALYSIS											
Site Nr	Station Nr	Vido Nr	video length (m:s)	Sea bottom images	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	Laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Total of Dots
1	39	3	01:30:00		8	0	0	0	58	23	0	0	19	0	0	100
1	39	3	01:30:00		9	5	0	0	0	4	0	0	13	79	0	100
1	40	4	01:30:00		1	56	12	0	0	32	0	0	0	0	0	100
1	40	4	01:30:00		2	8	27	0	0	65	0	0	0	0	0	100
1	40	4	01:30:00		3	0	0	0	80	0	0	0	20	0	0	100
1	40	4	01:30:00		4	14	0	0	86	0	0	0	0	0	0	100
1	40	4	01:30:00		5	7	4	0	63	0	0	26	0	0	0	100

Biological Data Analysis: ImageJ

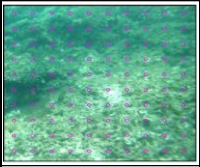
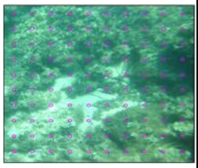
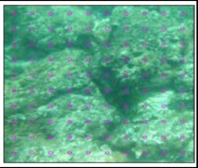
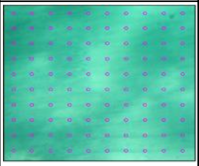
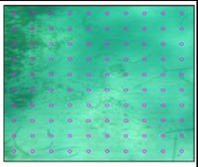
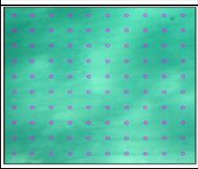
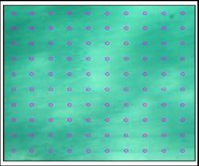
Simple ID: Zwuarah Plant | **TEST REPORT - IMAGE ANALYSIS**

Site Nr	Station Nr	Vido Nr	video length (m:s)	Sea bottom images	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	Laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Total of Dots
1	40	4	01:30:00		6	0	0	0	60	0	0	40	0	0	0	100
1	40	4	01:30:00		7	14	0	0	73	0	0	13	0	0	0	100
1	40	4	01:30:00		8	0	0	0	65	0	0	23	12	0	0	100
1	40	4	01:30:00		9	2	0	0	19	55	0	15	9	0	0	100
1	42	5	00:20:00		1	5	0	0	95	0	0	0	0	0	0	100
1	42	5	00:20:00		2	0	0	0	100	0	0	0	0	0	0	100
1	44	6	01:20:00		1	5	42	53	0	0	0	0	0	0	0	100

Biological Data Analysis: ImageJ

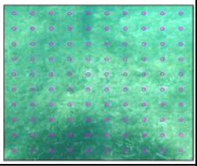
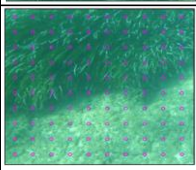
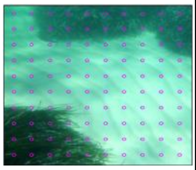
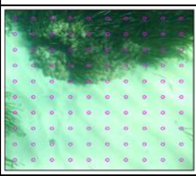
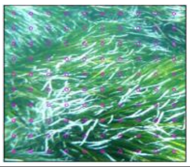
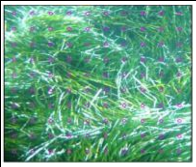
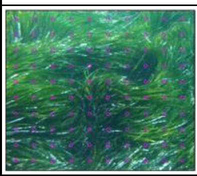
Simple ID: Zwuarah Plant						T E S T R E P O R T - IMAGE ANALYSIS											
Site Nr	Station Nr	Vido Nr	video length (m:s)	Sea bottom images	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	Laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Total of Dots
1	44	6	01:20:00		2	0	100	0	0	0	0	0	0	0	0	100
1	44	6	01:20:00		3	14	37	14	35	0	0	0	0	0	0	100
1	44	6	01:20:00		4	9	83	8	0	0	0	0	0	0	0	100
1	44	6	01:20:00		5	14	86	0	0	0	0	0	0	0	0	100
1	44	6	01:20:00		6	0	100	0	0	0	0	0	0	0	0	100
1	44	6	01:20:00		7	0	100	0	0	0	0	0	0	0	0	100
1	44	6	01:20:00		8	0	100	0	0	0	0	0	0	0	0	100

Biological Data Analysis: ImageJ

Simple ID: Zwuarah Plant						TEST REPORT - IMAGE ANALYSIS											
Site Nr	Station Nr	Vido Nr	video length (m:s)	Sea bottom images	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	Laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Total of Dots
1	45	7	00:30:00		1	0	0	0	74	0	0	0	24	0	2	100
1	45	7	00:30:00		2	5	0	5	78	0	0	0	12	0	0	100
1	45	7	00:30:00		3	2	0	9	76	0	0	0	13	0	0	100
1	46	8	00:20:00		1	100	0	0	0	0	0	0	0	0	0	100
1	46	8	00:20:00		2	92	0	0	8	0	0	0	0	0	0	100
	47	9	00:20:00		1	100	0	0	0	0	0	0	0	0	0	100
1	47	9	00:20:00		2	100	0	0	0	0	0	0	0	0	0	100

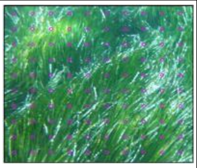
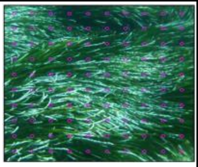
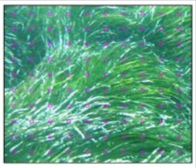
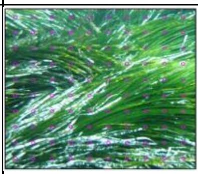
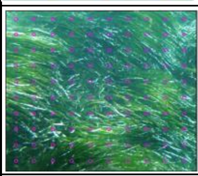
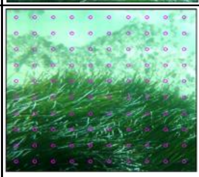
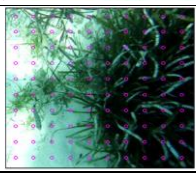
Biological Data Analysis: ImageJ

Simple ID: Zwuarah Plant — **T E S T R E P O R T - IMAGE ANALYSIS**

Site Nr	Station Nr	Vido Nr	video length (m:s)	Sea bottom images	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	Laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Total of Dots
1	52	10	00:40:00		1	1	0	39	61	0	0	0	0	0	0	100
1	52	10	00:40:00		2	1	0	51	48	0	0	0	0	0	0	100
1	52	10	00:40:00		3	66	34	0	0	0	0	0	0	0	0	100
1	52	10	00:40:00		4	73	27	0	0	0	0	0	0	0	0	100
1	53	11	01:40:00		1	0	100	0	0	0	0	0	0	0	0	100
1	53	11	01:40:00		2	0	100	0	0	0	0	0	0	0	0	100
1	53	11	01:40:00		3	0	100	0	0	0	0	0	0	0	0	100

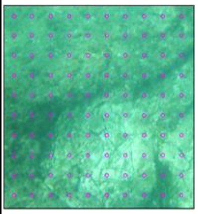
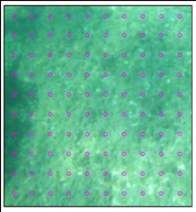
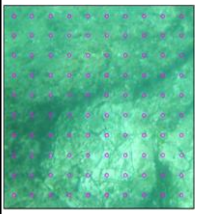
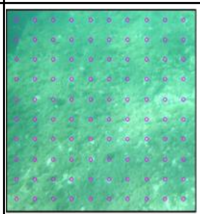
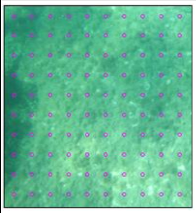
Biological Data Analysis: ImageJ

Simple ID: Zwuarah Plant | **TEST REPORT - IMAGE ANALYSIS**

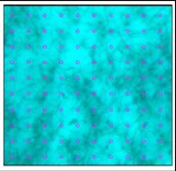
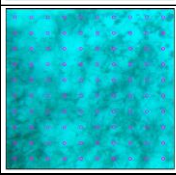
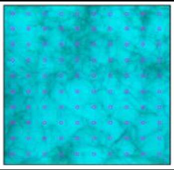
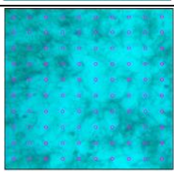
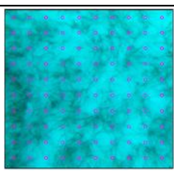
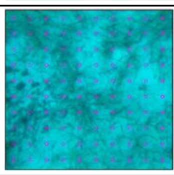
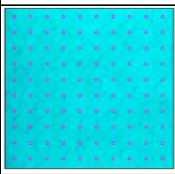
Site Nr	Station Nr	Vido Nr	video length (m:s)	Sea bottom images	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	Laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Total of Dots
1	53	11	01:40:00		4	0	100	0	0	0	0	0	0	0	0	100
1	53	11	01:40:00		5	0	100	0	0	0	0	0	0	0	0	100
1	53	11	01:40:00		6	0	100	0	0	0	0	0	0	0	0	100
1	53	11	01:40:00		7	0	100	0	0	0	0	0	0	0	0	100
1	53	11	01:40:00		8	0	100	0	0	0	0	0	0	0	0	100
1	53	11	01:40:00		9	13	58	0	29	0	0	0	0	0	0	100
1	53	11	01:40:00		10	16	79	0	5	0	0	0	0	0	0	100

Biological Data Analysis: ImageJ

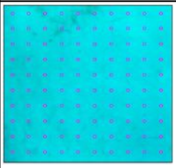
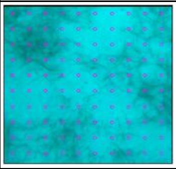
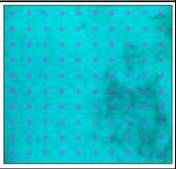
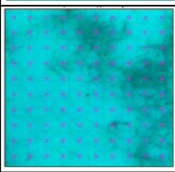
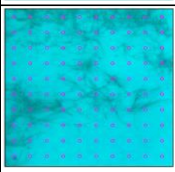
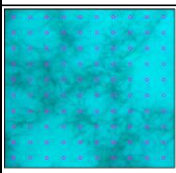
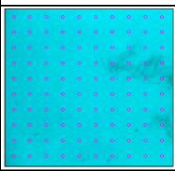
Simple ID: Zwuarah Plant — **T E S T R E P O R T - IMAGE ANALYSIS**

Site Nr	Station Nr	Vido Nr	video length (m:s)	Sea bottom images	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	Laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Total of Dots
1	54	12	00:20:00		1	5	0	0	95	0	0	0	0	0	0	100
1	54	12	00:20:00		2	0	0	0	100	0	0	0	0	0	0	100
1	55	13	00:30:00		1	8	0	0	93	0	0	0	0	0	0	100
1	55	13	00:30:00		2	3	0	0	98	0	0	0	0	0	0	100
1	55	13	00:30:00		3	3	0	0	97	0	0	0	0	0	0	100

- **ImageJ Analysis for West Tripoli Desalination Plant**

Biological Data Analysis: ImageJ																	
Simple ID: West Tripoli Plant					TEST REPORT - IMAGE ANALYSIS												
Site Nr	Station Nr	video length (m:s)	Sea bottom images	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Sea Anemone	Total of Dots
2	63	59:00		1	58	0	42	0	0	0	0	0	0	0	0	100
2	63	59:00		2	55	0	45	0	0	0	0	0	0	0	0	100
2	63	59:00		3	62	0	38	0	0	0	0	0	0	0	0	100
2	63	59:00		4	63	0	37	0	0	0	0	0	0	0	0	100
2	63	59:00		5	60	0	40	0	0	0	0	0	0	0	0	100
2	63	59:00		6	46	0	54	0	0	0	0	0	0	0	0	100
2	64	59:00		1	100	0	0	0	0	0	0	0	0	0	0	100

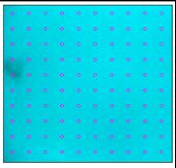
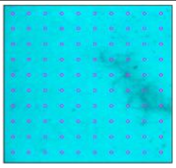
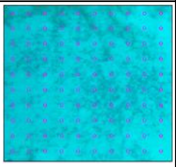
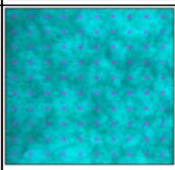
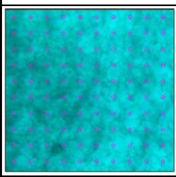
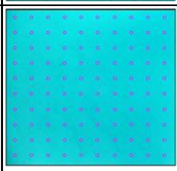
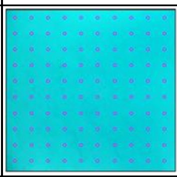
Biological Data Analysis: ImageJ

Simple ID: West Tripoli Plant					T E S T R E P O R T - IMAGE ANALYSIS											
Site Nr	Station Nr	video length (m:s)	Sea bottom images	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Sea Anemone	Total of Dots
2	64	50:00		2	96	0	4	0	0	0	0	0	0	0	0	100
2	64	50:00		3	64	0	36	0	0	0	0	0	0	0	0	100
2	64	50:00		4	78	0	22	0	0	0	0	0	0	0	0	100
2	64	50:00		5	70	0	30	0	0	0	0	0	0	0	0	100
2	65	01:30		1	65	0	35	0	0	0	0	0	0	0	0	100
2	65	01:30		2	72	0	28	0	0	0	0	0	0	0	0	100
2	65	01:30		3	95	0	5	0	0	0	0	0	0	0	0	100

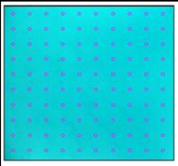
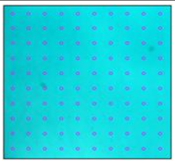
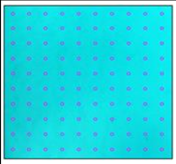
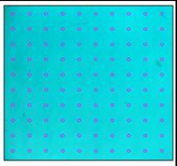
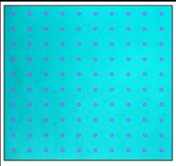
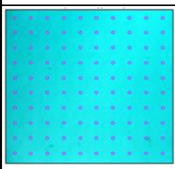
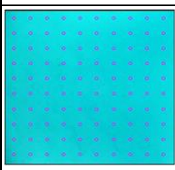
Biological Data Analysis: ImageJ

Simple ID: West Tripoli Plant

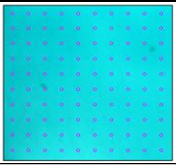
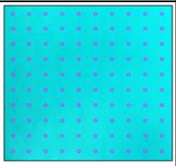
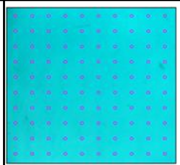
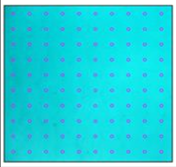
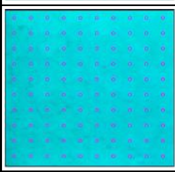
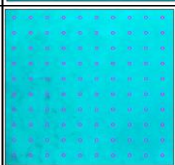
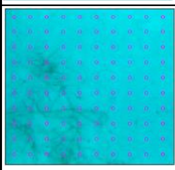
T E S T R E P O R T - IMAGE ANALYSIS

Site Nr	Station Nr	video length (m:s)	Sea bottom images	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Sea Anemone	Total of Dots
2	65	01:30		4	98	0	2	0	0	0	0	0	0	0	0	100
2	65	01:30		5	92	0	8	0	0	0	0	0	0	0	0	100
2	65	01:30		6	80	0	20	0	0	0	0	0	0	0	0	100
2	65	01:28		7	45	0	55	0	0	0	0	0	0	0	0	100
2	65	01:28		8	6	0	94	0	0	0	0	0	0	0	0	100
	66	00:20		1	100	0	0	0	0	0	0	0	0	0	0	100
	66	00:20		2	100	0	0	0	0	0	0	0	0	0	0	100

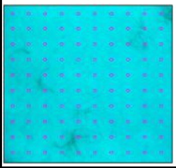
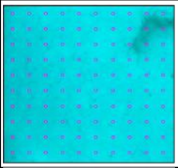
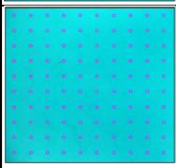
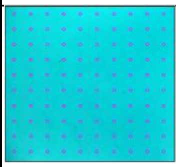
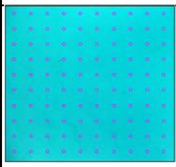
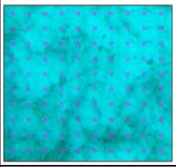
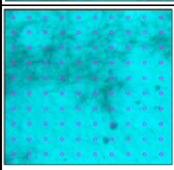
Biological Data Analysis: ImageJ

Simple ID: West Tripoli Plant					T E S T R E P O R T - IMAGE ANALYSIS											
Site Nr	Station Nr	video length (m:s)	Sea bottom images	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Sea Anemone	Total of Dots
2	67	01:00		1	100	0	0	0	0	0	0	0	0	0	0	100
2	67	01:00		2	100	0	0	0	0	0	0	0	0	0	0	100
2	67	01:00		3	100	0	0	0	0	0	0	0	0	0	0	100
2	67	01:00		4	100	0	0	0	0	0	0	0	0	0	0	100
2	67	01:00		5	100	0	0	0	0	0	0	0	0	0	0	100
2	67	01:00		6	100	0	0	0	0	0	0	0	0	0	0	100
2	68	00:50		1	100	0	0	0	0	0	0	0	0	0	0	100

Biological Data Analysis: ImageJ

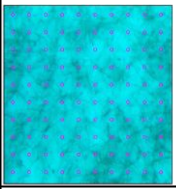
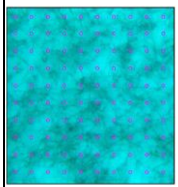
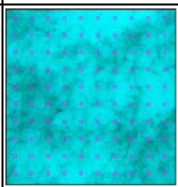
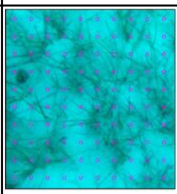
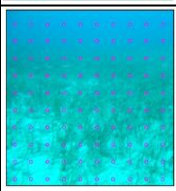
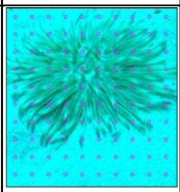
Simple ID: West Tripoli Plant					TEST REPORT - IMAGE ANALYSIS											
Site Nr	Station Nr	video length (m:s)	Sea bottom images	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Sea Anemone	Total of Dots
2	68	00:50		2	100	0	0	0	0	0	0	0	0	0	0	100
2	68	00:50		3	100	0	0	0	0	0	0	0	0	0	0	100
2	68	00:50		4	100	0	0	0	0	0	0	0	0	0	0	100
2	68	00:50		5	100	0	0	0	0	0	0	0	0	0	0	100
2	69	00:50		1	100	0	0	0	0	0	0	0	0	0	0	100
2	69	00:50		2	100	0	0	0	0	0	0	0	0	0	0	100
2	69	00:50		3	83	0	17	0	0	0	0	0	0	0	0	100

Biological Data Analysis: ImageJ

Simple ID: West Tripoli Plant					TEST REPORT - IMAGE ANALYSIS											
Site Nr	Station Nr	video length (m:s)	Sea bottom images	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Sea Anemone	Total of Dots
2	69	00:50		4	95	0	5	0	0	0	0	0	0	0	0	100
2	69	00:50		5	96	0	4	0	0	0	0	0	0	0	0	100
2	74	00:30		1	100	0	0	0	0	0	0	0	0	0	0	100
2	74	00:30		2	100	0	0	0	0	0	0	0	0	0	0	100
2	74	00:30		3	100	0	0	0	0	0	0	0	0	0	0	100
2	77	01:20		1	67	0	33	0	0	0	0	0	0	0	0	100
2	77	01:20		2	68	0	32	0	0	0	0	0	0	0	0	100

Biological Data Analysis: ImageJ

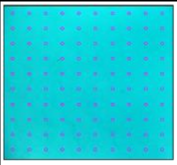
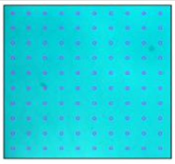
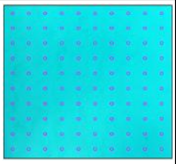
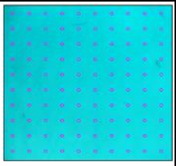
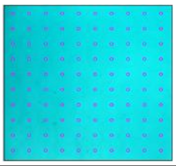
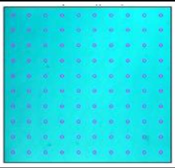
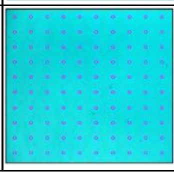
Simple ID: West Tripoli Plant — **T E S T R E P O R T - IMAGE ANALYSIS**

Site Nr	Station Nr	video length (m:s)	Sea bottom images	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Sea Anemone	Total of Dots
2	77	01:20		3	60	0	40	0	0	0	0	0	0	0	0	100
2	77	01:20		4	59	0	41	0	0	0	0	0	0	0	0	100
2	77	01:20		5	82	0	18	0	0	0	0	0	0	0	0	100
2	77	01:20		6	45	1	54	0	0	0	0	0	0	0	0	100
2	77	01:20		7	10	0	87	0	0	0	0	0	0	3	0	100
2	77	01:20		8	29	0	0	0	0	0	0	0	0	0	71	100

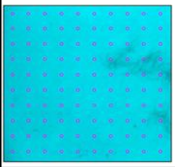
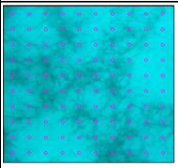
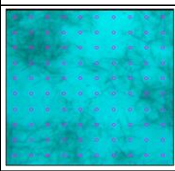
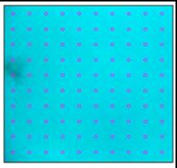
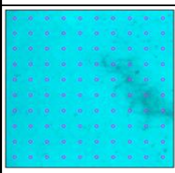
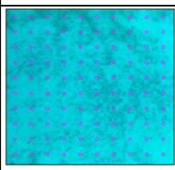
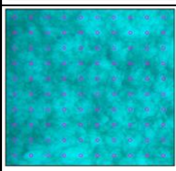
Biological Data Analysis: ImageJ

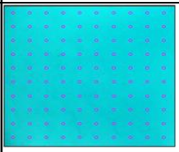
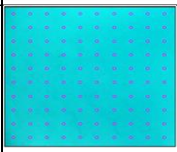
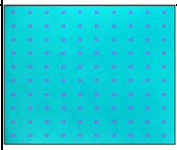
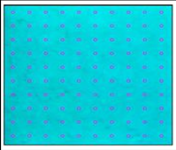
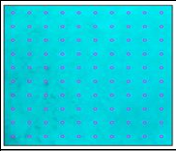
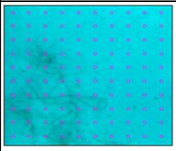
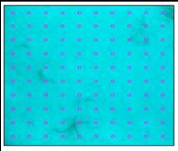
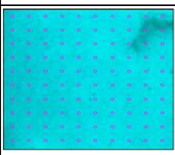
Simple ID: West Tripoli Plant

T E S T R E P O R T - IMAGE ANALYSIS

Site Nr	Station Nr	video length (m:s)	Sea bottom images	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Sea Anemone	Total of Dots
2	78	01:10		1	100	0	0	0	0	0	0	0	0	0	0	100
2	78	01:10		2	100	0	0	0	0	0	0	0	0	0	0	100
2	78	01:10		3	100	0	0	0	0	0	0	0	0	0	0	100
2	78	01:10		4	100	0	0	0	0	0	0	0	0	0	0	100
2	78	01:10		5	100	0	0	0	0	0	0	0	0	0	0	100
2	78	01:10		6	100	0	0	0	0	0	0	0	0	0	0	100
2	78	01:10		7	100	0	0	0	0	0	0	0	0	0	0	100

Biological Data Analysis: ImageJ

Simple ID: West Tripoli Plant					TEST REPORT - IMAGE ANALYSIS												
Site Nr	Station Nr	video length (m:s)	Sea bottom images	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Sea Anemone	Total of Dots
2	79	01:10		1	69	0	32	0	0	0	0	0	0	0	0	100
2	79	01:10		2	84	0	17	0	0	0	0	0	0	0	0	100
2	79	01:10		3	97	0	4	0	0	0	0	0	0	0	0	100
2	79	01:10		4	96	0	4	0	0	0	0	0	0	0	0	100
2	79	01:10		5	86	0	14	0	0	0	0	0	0	0	0	100
2	79	01:10		6	63	0	38	0	0	0	0	0	0	0	0	100
2	79	01:10		7	26	0	75	0	0	0	0	0	0	0	0	100

Biological Data Analysis: ImageJ																	
Simple ID: West Tripoli Plant					TEST REPORT - IMAGE ANALYSIS												
Site Nr	Station Nr	video length (m:s)	Sea bottom images	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Sea Anemone	Total of Dots
2	80	00:30		1	100	0	0	0	0	0	0	0	0	0	0	100
2	80	00:30		2	100	0	0	0	0	0	0	0	0	0	0	100
2	80	00:30		3	100	0	0	0	0	0	0	0	0	0	0	100
2	81	00:50		1	100	0	0	0	0	0	0	0	0	0	0	100
2	81	00:50		2	92	0	9	0	0	0	0	0	0	0	0	100
2	81	00:50		3	89	0	11	0	0	0	0	0	0	0	0	100
2	81	00:50		4	96	0	4	0	0	0	0	0	0	0	0	100
2	81	00:50		5	95	0	5	0	0	0	0	0	0	0	0	100

- **Ecosystem composition at both sites**

Appendix 5.6: Mean and ± Standard Error for Community Composition at ZWDP

Biological Data Analysis: MEAN, STANDARD DEVIATION & STANDARD ERROR															
Simple ID: Zwuarah Station				Ecosystem composition of Zwuarah Desalination Station											
Site Nr	Station Nr	Vido Nr	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Total of Dots	Total
1	37	1	1	100	0	0	0	0	0	0	0	0	0	100	
1	37	1	2	100	0	0	0	0	0	0	0	0	0	100	
1	37	1	3	85	0	0	0	15	0	0	0	0	0	100	
1	37	1	4	100	0	0	0	0	0	0	0	0	0	100	
1	37	1	5	92	0	0	0	8	0	0	0	0	0	100	
Bio Statistical			Number (N)=	5	5	5	5	5	5	5	5	5	5		
			Mean=	95.4	0	0	0	4.6	0	0	0	0	0		
			Standard Deviation=	6.77	0.00	0.00	0.00	6.77	0.00	0.00	0.00	0.00	0.00		
			Standard Error=	3.03	0.00	0.00	0.00	3.03	0.00	0.00	0.00	0.00	0.00		
			% of the Mean=	95.40%	0.00%	0.00%	0.00%	4.60%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Deviation=	50.00%	0.00%	0.00%	0.00%	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Error=	50.08%	0.00%	0.00%	0.00%	50.08%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
1	38	2	1	0	100	0	0	0	0	0	0	0	0	100	
1	38	2	2	9	91	0	0	0	0	0	0	0	0	100	
1	38	2	3	6	94	0	0	0	0	0	0	0	0	100	
1	38	2	4	0	100	0	0	0	0	0	0	0	0	100	
1	38	2	5	6	94	0	0	0	0	0	0	0	0	100	
1	38	2	6	0	98	0	2	0	0	0	0	0	0	100	
1	38	2	7	12	56	0	19	13	0	0	0	0	0	100	
1	38	2	8	12	60	0	18	10	0	0	0	0	0	100	
1	38	2	9	19	46	27	8	0	0	0	0	0	0	100	
Bio Statistical			Number (N)=	9	9	9	9	9	9	9	9	9	9		
			Mean=	7.11	82.11	3.00	5.22	2.56	0.00	0.00	0.00	0.00	0.00		
			Standard Deviation=	6.58	21.59	9.00	7.97	5.13	0.00	0.00	0.00	0.00	0.00		
			Standard Error=	2.19	7.20	3.00	2.66	1.71	0.00	0.00	0.00	0.00	0.00		
			% of the Mean=	7.11%	82.11%	3.00%	5.22%	2.56%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Deviation=	13.09%	42.95%	17.90%	15.85%	10.20%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Srandard Error=	13.07%	42.96%	17.90%	15.87%	10.20%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
1	39	3	1	0	0	0	83	2	0	0	15	0	0	100	
1	39	3	2	3	0	1	96	0	0	0	0	0	0	100	
1	39	3	3	0	0	0	40	0	0	0	60	0	0	100	
1	39	3	4	0	0	0	95	0	3	0	2	0	0	100	
1	39	3	5	0	0	0	75	0	0	0	25	0	0	100	
1	39	3	6	0	0	0	28	58	0	0	14	0	0	100	
1	39	3	7	0	0	0	0	74	0	0	26	0	0	100	
1	39	3	8	0	0	0	58	23	0	0	19	0	0	100	
1	39	3	9	5	0	0	0	4	0	0	13	79	0	100	
Bio Statistical			Number (N)=	9	9	9	9	9	9	9	9	9	9		
			Mean=	0.89	0.00	0.11	52.78	17.83	0.33	0.00	19.28	8.78	0.00		
			Standard Deviation=	1.83	0.00	0.33	37.80	28.55	1.00	0.00	17.67	26.33	0.00		
			Standard Error=	0.61	0.00	0.11	12.60	9.52	0.33	0.00	5.89	8.78	0.00		
			% of the Mean=	0.89%	0.00%	0.11%	52.78%	17.83%	0.33%	0.00%	19.28%	8.78%	0.00%		100%
			% of the Standard Deviation=	1.61%	0.00%	0.29%	33.29%	25.15%	0.88%	0.00%	15.56%	23.19%	0.00%		100%
			% of the Standard Error=	1.61%	0.00%	0.29%	33.30%	25.16%	0.87%	0.00%	15.56%	23.20%	0.00%		100%
1	40	4	1	56	12	0	0	32	0	0	0	0	0	100	
1	40	4	2	8	27	0	0	65	0	0	0	0	0	100	
1	40	4	3	0	0	0	80	0	0	0	20	0	0	100	
1	40	4	4	14	0	0	86	0	0	0	0	0	0	100	
1	40	4	5	7	4	0	63	0	0	26	0	0	0	100	
1	40	4	6	0	0	0	60	0	0	40	0	0	0	100	
1	40	4	7	14	0	0	73	0	0	13	0	0	0	100	
1	40	4	8	0	0	0	65	0	0	23	12	0	0	100	
1	40	4	9	2	0	0	19	55	0	15	9	0	0	100	
Bio Statistical			Number (N)=	9	9	9	9	9	9	9	9	9	9		
			Mean=	11.22	4.78	0.00	49.56	16.89	0.00	13.00	4.56	0.00	0.00		
			Standard Deviation=	17.72	9.24	0.00	33.87	26.71	0.00	14.48	7.40	0.00	0.00		
			Standard Error=	5.91	3.08	0.00	11.29	8.90	0.00	4.83	2.47	0.00	0.00		
			% of the Mean=	11.22%	4.78%	0.00%	49.56%	16.89%	0.00%	13.00%	4.56%	0.00%	0.00%		100%
			% of the Standard Deviation=	16.19%	8.44%	0.00%	30.95%	24.40%	0.00%	13.23%	6.76%	0.00%	0.00%		100%
			% of the Standard Error=	16.20%	8.44%	0.00%	30.95%	24.40%	0.00%	13.24%	6.77%	0.00%	0.00%		100%

Biological Data Analysis: MEAN, STANDARD DEVIATION & STANDARD ERROR

Simple ID: Zwuarah Station — Ecosystem composition of Zwuarah Desalination Station

Site Nr	Station Nr	Vido Nr	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Total of Dots	Total
1	42	5	1	5	0	0	95	0	0	0	0	0	0	100	
1	42	5	2	0	0	0	100	0	0	0	0	0	0	100	
Bio Statistical			Number (N)=	2	2	2	2	2	2	2	2	2	2		
			Mean=	2.50	0.00	0.00	97.50	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Deviation=	3.54	0.00	0.00	3.54	0.00	0.00	0.00	0.00	0.00	0.00		
			Stanadrd Error	2.50	0.00	0.00	2.50	0.00	0.00	0.00	0.00	0.00	0.00		
			% of the Mean=	2.50%	0.00%	0.00%	97.50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Deviation=	50.07%	0.00%	0.00%	50.07%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Stanadrd Error=	50.00%	0.00%	0.00%	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
1	44	6	1	5	42	53	0	0	0	0	0	0	0	100	
1	44	6	2	0	100	0	0	0	0	0	0	0	0	100	
1	44	6	3	14	37	14	35	0	0	0	0	0	0	100	
1	44	6	4	9	83	8	0	0	0	0	0	0	0	100	
1	44	6	5	14	86	0	0	0	0	0	0	0	0	100	
1	44	6	6	0	100	0	0	0	0	0	0	0	0	100	
1	44	6	7	0	100	0	0	0	0	0	0	0	0	100	
1	44	6	8	0	100	0	0	0	0	0	0	0	0	100	
Bio Statistical			Number (N)=	8	8	8	8	8	8	8	8	8	8		
			Mean=	5.25	81.00	9.38	4.38	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Deviation=	6.30	26.54	18.38	12.37	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Error=	2.23	9.38	6.50	4.38	0.00	0.00	0.00	0.00	0.00	0.00		
			% of the Mean=	5.25%	81.00%	9.38%	4.38%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Deviation=	9.91%	41.73%	28.90%	19.45%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Error=	9.91%	41.72%	28.90%	19.40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
1	45	7	1	0	0	0	74	0	0	0	24	0	2	100	
1	45	7	2	5	0	5	78	0	0	0	12	0	0	100	
1	45	7	3	2	0	9	76	0	0	0	13	0	0	100	
Bio Statistical			Number (N)=	3	3	3	3	3	3	3	3	3	3		
			Mean=	2.33	0.00	4.67	76.00	0.00	0.00	0.00	16.33	0.00	0.67		
			Standard Deviation=	2.52	0.00	4.51	2.00	0.00	0.00	0.00	6.66	0.00	1.15		
			Standard Error=	1.45	0.00	2.60	1.15	0.00	0.00	0.00	3.84	0.00	0.67		
			% of the Mean=	2.33%	0.00%	4.67%	76.00%	0.00%	0.00%	0.00%	16.33%	0.00%	0.67%		100%
			% of the Standard Deviation=	14.96%	0.00%	26.78%	11.88%	0.00%	0.00%	0.00%	39.55%	0.00%	6.83%		100%
			% of the Stanadrd Error=	14.92%	0.00%	26.75%	11.83%	0.00%	0.00%	0.00%	39.50%	0.00%	6.89%		100%
1	46	8	1	100	0	0	0	0	0	0	0	0	0	100	
1	46	8	2	92	0	0	8	0	0	0	0	0	0	100	
Bio Statistical			Number (N)=	2	2	2	2	2	2	2	2	2	2		
			Mean=	96.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Deviation=	5.66	0.00	0.00	5.66	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Error=	4.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00		
			% of the Mean=	96.00%	0.00%	0.00%	4.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Deviation=	50.04%	0.00%	0.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Error=	50.00%	0.00%	0.00%	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
1	47	9	1	100	0	0	0	0	0	0	0	0	0	100	
1	47	9	2	100	0	0	0	0	0	0	0	0	0	100	
Bio Statistical			Number (N)=	2	2	2	2	2	2	2	2	2	2		
			Mean=	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Deviation=	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Stanadard Error	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			% of the Mean=	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Deviation=	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		0%
			% of the Standard Error=	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		0%

Biological Data Analysis: MEAN, STANDARD DEVIATION & STANDARD ERROR

Simple ID: Zwuarah Station				Ecosystem composition of Zwuarah Desalination Station											
Site Nr	Station Nr	Vido Nr	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Total of Dots	Total
1	52	10	1	0.5	0	38.5	61	0	0	0	0	0	0	100	
1	52	10	2	1	0	51	48	0	0	0	0	0	0	100	
1	52	10	3	66	34	0	0	0	0	0	0	0	0	100	
1	52	10	4	73	27	0	0	0	0	0	0	0	0	100	
Bio Statistical			Number (N)=	4	4	4	4	4	4	4	4	4	4		
			Mean=	35.13	15.25	22.38	27.25	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Deviation=	39.80	17.84	26.34	31.91	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Error=	19.90	8.92	13.17	15.96	0.00	0.00	0.00	0.00	0.00	0.00		
			% of the Mean=	35.13%	15.25%	22.38%	27.25%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Deviation=	34.34%	15.39%	22.73%	27.53%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Error=	34.34%	15.39%	22.73%	27.54%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
1	53	11	1	0	100	0	0	0	0	0	0	0	0	100	
1	53	11	2	0	100	0	0	0	0	0	0	0	0	100	
1	53	11	3	0	100	0	0	0	0	0	0	0	0	100	
1	53	11	4	0	100	0	0	0	0	0	0	0	0	100	
1	53	11	5	0	100	0	0	0	0	0	0	0	0	100	
1	53	11	6	0	100	0	0	0	0	0	0	0	0	100	
1	53	11	7	0	100	0	0	0	0	0	0	0	0	100	
1	53	11	8	0	100	0	0	0	0	0	0	0	0	100	
1	53	11	9	13	58	0	29	0	0	0	0	0	0	100	
1	53	11	10	16	79	0	5	0	0	0	0	0	0	100	
Bio Statistical			Number (N)=	10	10	10	10	10	10	10	10	10	10		
			Mean=	2.90	93.70	0.00	3.40	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Deviation=	6.15	14.17	0.00	9.13	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Error=	1.95	4.48	0.00	2.89	0.00	0.00	0.00	0.00	0.00	0.00		
			% of the Mean=	2.90%	93.70%	0.00%	3.40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Deviation=	20.87%	48.10%	0.00%	30.99%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Error=	20.92%	48.06%	0.00%	31.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
1	54	12	1	5	0	0	95	0	0	0	0	0	0	100	
1	54	12	2	0	0	0	100	0	0	0	0	0	0	100	
Bio Statistical			Number (N)=	2	2	2	2	2	2	2	2	2	2		
			Mean=	2.50	0.00	0.00	97.50	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Deviation=	3.54	0.00	0.00	3.54	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Error=	2.50	0.00	0.00	2.50	0.00	0.00	0.00	0.00	0.00	0.00		
			% of the Mean=	2.50%	0.00%	0.00%	97.50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Deviation=	50.07%	0.00%	0.00%	50.07%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Error=	50.00%	0.00%	0.00%	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
1	55	13	1	8	0	0	93	0	0	0	0	0	0	100	
1	55	13	2	3	0	0	98	0	0	0	0	0	0	100	
1	55	13	3	3	0	0	97	0	0	0	0	0	0	100	
Bio Statistical			Number (N)=	3	3	3	3	3	3	3	3	3	3		
			Mean=	4.33	0.00	0.00	95.67	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Deviation=	2.75	0.00	0.00	2.75	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Error=	1.59	0.00	0.00	1.59	0.00	0.00	0.00	0.00	0.00	0.00		
			% of the Mean=	4.33%	0.00%	0.00%	95.67%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Deviation=	49.91%	0.00%	0.00%	49.91%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Error=	50.00%	0.00%	0.00%	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%

Biological Data Analysis: MEAN, STANDARD DEVIATION & STANDARD ERROR				
Ecosystem composition of Zwuarah Desalination Station				
Simple ID: Zwuarah Station				
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
37	Sand	95.40	50.00	50.08
	Posidonia oceanica	0.00	0.00	0.00
	Cymodocea nodosa	0.00	0.00	0.00
	Sea algae	0.00	0.00	0.00
	Sea rocks	4.60	50.00	50.08
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
Total %		100	100	100
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
38	Sand	7.11	13.09	13.07
	Posidonia oceanica	82.11	42.95	42.96
	Cymodocea nodosa	3.00	17.90	17.90
	Sea algae	5.22	15.85	15.87
	Sea rocks	2.56	10.20	10.20
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
Total %		100	100	100
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
39	Sand	0.89	1.61	1.61
	Posidonia oceanica	0.00	0.00	0.00
	Cymodocea nodosa	0.11	0.29	0.29
	Sea alga	52.78	33.29	33.30
	Sea rocks	17.83	25.15	25.16
	Taonia atomaria	0.33	0.88	0.87
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	19.28	15.56	15.56
	Sargassum vulgare	8.78	23.19	23.20
	Fish	0.00	0.00	0.00
Total %		100	100	100
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
40	Sand	11.22	16.19	16.20
	Posidonia oceanica	4.78	8.44	8.44
	Cymodocea nodosa	0.00	0.00	0.00
	Sea algae	49.56	30.95	30.95
	Sea rocks	16.89	24.40	24.40
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	13.00	13.23	13.24
	Padina pavonica	4.56	6.76	6.77
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
Total %		100	100	100

Biological Data Analysis: MEAN, STANDARD DEVIATION & STANDARD ERROR				
Ecosystem composition of Zwuarah Desalination Station				
Simple ID: Zwuarah Station				
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
42	Sand	2.50	50.07	50.00
	Posidonia oceanica	0.00	0.00	0.00
	Cymodocea nodosa	0.00	0.00	0.00
	Sea algae	97.50	50.07	50.00
	Sea rocks	0.00	0.00	0.00
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
Total %		100	100	100
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
44	Sand	5.25	9.91	9.91
	Posidonia oceanica	81.00	41.73	41.72
	Cymodocea nodosa	9.38	28.90	28.90
	Sea algae	4.38	19.45	19.40
	Sea rocks	0.00	0.00	0.00
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
Total %		100	100	100
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
45	Sand	2.33	14.96	14.92
	Posidonia oceanica	0.00	0.00	0.00
	Cymodocea nodosa	4.67	26.78	26.75
	Sea algae	76.00	11.88	11.83
	Sea rocks	0.00	0.00	0.00
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	16.33	39.55	39.50
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.67	6.83	6.89
Total %		100	100	100
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
46	Sand	96.00	50.04	50.00
	Posidonia oceanica	0.00	0.00	0.00
	Cymodocea nodosa	0.00	0.00	0.00
	Sea algae	4.00	50.04	50.00
	Sea rocks	0.00	0.00	0.00
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
Total %		100	100	100

Biological Data Analysis: MEAN, STANDARD DEVIATION & STANDARD ERROR				
Ecosystem composition of Zwuarah Desalination Station				
Simple ID: Zwuarah Station				
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
47	Sand	100.00	0.00	0.00
	Posidonia oceanica	0.00	0.00	0.00
	Cymodocea nodosa	0.00	0.00	0.00
	Sea alga	0.00	0.00	0.00
	Sea rocks	0.00	0.00	0.00
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
Total %		100	0	0
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
52	Sand	35.13	34.34	34.34
	Posidonia oceanica	15.25	15.39	15.39
	Cymodocea nodosa	22.38	22.73	22.73
	Sea algae	27.25	27.53	27.54
	Sea rocks	0.00	0.00	0.00
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
Total %		100	100	100
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
53	Sand	2.90	20.87	20.92
	Posidonia oceanica	93.70	48.10	48.06
	Cymodocea nodosa	0.00	0.00	0.00
	Sea algae	3.40	30.99	31.01
	Sea rocks	0.00	0.00	0.00
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
Total %		100	100	100
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
54	Sand	2.50	50.07	50.00
	Posidonia oceanica	0.00	0.00	0.00
	Cymodocea nodosa	0.00	0.00	0.00
	Sea algae	97.50	50.07	50.00
	Sea rocks	0.00	0.00	0.00
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
Total %		100	100	100
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
55	Sand	4.33	49.91	50.00
	Posidonia oceanica	0.00	0.00	0.00
	Cymodocea nodosa	0.00	0.00	0.00
	Sea algae	95.67	49.91	50.00
	Sea rocks	0.00	0.00	0.00
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
Total %		100	100	100

Appendix 5.7: Mean and ± Standard Error for Community Composition at WTRIS

Biological Data Analysis: MEAN ,STANDARD DEVIATION & STANDARD ERROR																
Simple ID: West Tripoli Station				Ecosystem composition of West Tripoli Plant												
Site Nr	Station Nr	Vido Nr	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Sea Anemone	Total of Dots	Total
2	63	1	1	58	0	42	0	0	0	0	0	0	0	0	100	
2	63	1	2	55	0	45	0	0	0	0	0	0	0	0	100	
2	63	1	3	62	0	38	0	0	0	0	0	0	0	0	100	
2	63	1	4	63	0	37	0	0	0	0	0	0	0	0	100	
2	63	1	5	60	0	40	0	0	0	0	0	0	0	0	100	
2	63	1	6	46	0	54	0	0	0	0	0	0	0	0	100	
Bio Statistical			Number (N)	6	6	6	6	6	6	6	6	6	6	6		
			Mean=	57.33	0.00	42.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Deviation=	6.25	0.00	6.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Error	2.55	0.00	2.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			% of Mean=	57.33%	0.00%	42.67%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of theStandard Deviation=	50.00%	0.00%	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Error=	50.00%	0.00%	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
2	64	2	1	100	0	0	0	0	0	0	0	0	0	0	100	
2	64	2	2	96	0	4	0	0	0	0	0	0	0	0	100	
2	64	2	3	64	0	36	0	0	0	0	0	0	0	0	100	
2	64	2	4	78	0	22	0	0	0	0	0	0	0	0	100	
2	64	2	5	70	0	30	0	0	0	0	0	0	0	0	100	
Bio Statistical			Number (N)	5	5	5	5	5	5	5	5	5	5	5		
			Mean=	81.60	0.00	18.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Deviation=	15.84	0.00	15.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Error	7.08	0.00	7.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			% of the Mean=	81.60%	0.00%	18.40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Deviation=	50.01%	0.00%	50.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Error=	50.00%	0.00%	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
2	65	3	1	65	0	35	0	0	0	0	0	0	0	0	100	
2	65	3	2	72	0	28	0	0	0	0	0	0	0	0	100	
2	65	3	3	95	0	5	0	0	0	0	0	0	0	0	100	
2	65	3	4	98	0	2	0	0	0	0	0	0	0	0	100	
2	65	3	5	92	0	8	0	0	0	0	0	0	0	0	100	
2	65	3	6	80	0	20	0	0	0	0	0	0	0	0	100	
2	65	3	7	45	0	55	0	0	0	0	0	0	0	0	100	
2	65	3	8	6	0	94	0	0	0	0	0	0	0	0	100	
Bio Statistical			Number (N)	8	8	8	8	8	8	8	8	8	8	8		
			Mean=	69.13	0.00	30.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Deviation=	31.02	0.00	31.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Error	10.97	0.00	10.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			% of the Mean=	69.13%	0.00%	30.88%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Deviation=	49.99%	0.00%	49.99%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Error=	50.00%	0.00%	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
2	66	4	1	100	0	0	0	0	0	0	0	0	0	0	100	
2	66	4	2	100	0	0	0	0	0	0	0	0	0	0	100	
Bio Statistical			Number (N)	2	2	2	2	2	2	2	2	2	2	2		
			Mean =	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Deviation=	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Error	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			% of the Mean=	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Deviation=	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		0%
			% of the Standard Error=	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		0%

Biological Data Analysis: MEAN ,STANDARD DEVIATION & STANDARD ERROR

Simple ID: West Tripoli Station				Ecosystem composition of West Tripoli Plant												
Site Nr	Station Nr	Vido Nr	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Sea Anemone	Total of Dots	Total
2	67	5	1	100	0	0	0	0	0	0	0	0	0	0	100	
2	67	5	2	100	0	0	0	0	0	0	0	0	0	0	100	
2	67	5	3	100	0	0	0	0	0	0	0	0	0	0	100	
2	67	5	4	100	0	0	0	0	0	0	0	0	0	0	100	
2	67	5	5	100	0	0	0	0	0	0	0	0	0	0	100	
2	67	5	6	100	0	0	0	0	0	0	0	0	0	0	100	
Bio Statistical			Number (N)	6	6	6	6	6	6	6	6	6	6	6		
			Mean =	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Deviation=	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Error=	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			% of the Mean=	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Deviation=	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		0%
			% of the Standard Error=	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		0%
2	68	6	1	100	0	0	0	0	0	0	0	0	0	0	100	
2	68	6	2	100	0	0	0	0	0	0	0	0	0	0	100	
2	68	6	3	100	0	0	0	0	0	0	0	0	0	0	100	
2	68	6	4	100	0	0	0	0	0	0	0	0	0	0	100	
2	68	6	5	100	0	0	0	0	0	0	0	0	0	0	100	
Bio Statistical			Number (N)	5	5	5	5	5	5	5	5	5	5	5		
			Mean=	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Deviation=	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Error	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			% of the Mean=	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Deviation=	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		0%
			% of the Standard Error=	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		0%
2	69	7	1	100	0	0	0	0	0	0	0	0	0	0	100	
2	69	7	2	100	0	0	0	0	0	0	0	0	0	0	100	
2	69	7	3	83	0	17	0	0	0	0	0	0	0	0	100	
2	69	7	4	95	0	5	0	0	0	0	0	0	0	0	100	
2	69	7	5	96	0	4	0	0	0	0	0	0	0	0	100	
Bio Statistical			Number (N)	5	5	5	5	5	5	5	5	5	5	5		
			Mean=	94.80	0.00	5.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Deviation=	6.98	0.00	6.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Error	3.12	0.00	3.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			% of the Mean=	94.80%	0.00%	5.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Deviation=	50.00%	0.00%	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Error=	50.00%	0.00%	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
2	74	8	1	100	0	0	0	0	0	0	0	0	0	0	100	
2	74	8	2	100	0	0	0	0	0	0	0	0	0	0	100	
2	74	8	3	100	0	0	0	0	0	0	0	0	0	0	100	
Bio Statistical			Number (N)	3	3	3	3	3	3	3	3	3	3	3		
			Mean =	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Deviation=	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Error	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			% of the Mean=	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Deviation=	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		0%
			% of the Standard Error=	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		0%

Biological Data Analysis: MEAN ,STANDARD DEVIATION & STANDARD ERROR

Simple ID: West Tripoli Station — **Ecosystem composition of West Tripoli Plant**

Site Nr	Station Nr	Vido Nr	Photo Nr	Sand	Posidonia oceanica	Cymodocea nodosa	Sea algae	Sea rocks	Taonia atomaria	laurencia pinnatifida	Padina pavonica	Sargassum vulgare	Fish	Sea Anemone	Total of Dots	Total
2	77	9	1	67	0	33	0	0	0	0	0	0	0	0	100	
2	77	9	2	68	0	32	0	0	0	0	0	0	0	0	100	
2	77	9	3	60	0	40	0	0	0	0	0	0	0	0	100	
2	77	9	4	59	0	41	0	0	0	0	0	0	0	0	100	
2	77	9	5	82	0	18	0	0	0	0	0	0	0	0	100	
2	77	9	6	45	1	54	0	0	0	0	0	0	0	0	100	
2	77	9	7	10	0	87	0	0	0	0	0	0	3	0	100	
2	77	9	8	29	0	0	0	0	0	0	0	0	0	71	100	
Bio Statistical			Number (N)	8	8	8	8	8	8	8	8	8	8	8		
			Mean=	52.50	0.13	38.13	0.00	0.00	0.00	0.00	0.00	0.00	0.38	8.88		
			Standard Deviation=	23.40	0.35	25.56	0.00	0.00	0.00	0.00	0.00	0.00	1.06	25.10		
			Standard Error	8.27	0.13	9.04	0.00	0.00	0.00	0.00	0.00	0.00	0.38	8.88		
			% of the Mean=	52.50%	0.13%	38.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.38%	8.88%		100%
			% of the Standard Deviation=	31.00%	0.46%	33.86%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.40%	33.25%		100%
			% of the Standard Error=	30.98%	0.49%	33.87%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.42%	33.27%		100%
2	78	10	1	100	0	0	0	0	0	0	0	0	0	0	100	
2	78	10	2	100	0	0	0	0	0	0	0	0	0	0	100	
2	78	10	3	100	0	0	0	0	0	0	0	0	0	0	100	
2	78	10	4	100	0	0	0	0	0	0	0	0	0	0	100	
2	78	10	5	100	0	0	0	0	0	0	0	0	0	0	100	
2	78	10	6	100	0	0	0	0	0	0	0	0	0	0	100	
2	78	10	7	100	0	0	0	0	0	0	0	0	0	0	100	
Bio Statistical			Number (N)	7	7	7	7	7	7	7	7	7	7	7		
			Mean=	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Deviation=	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Error	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			% of the Mean=	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Deviation=	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		0%
			% of the Standard Error=	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		0%
2	79	11	1	69	0	32	0	0	0	0	0	0	0	0	100	
2	79	11	2	84	0	17	0	0	0	0	0	0	0	0	100	
2	79	11	3	97	0	4	0	0	0	0	0	0	0	0	100	
2	79	11	4	96	0	4	0	0	0	0	0	0	0	0	100	
2	79	11	5	86	0	14	0	0	0	0	0	0	0	0	100	
2	79	11	6	63	0	38	0	0	0	0	0	0	0	0	100	
2	79	11	7	26	0	75	0	0	0	0	0	0	0	0	100	
Bio Statistical			Number (N)	7	7	7	7	7	7	7	7	7	7	7		
			Mean=	74.07	0.00	25.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Deviation=	24.96	0.00	24.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Error	9.44	0.00	9.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			% of the Mean=	74.07%	0.00%	25.93%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Deviation=	49.98%	0.00%	49.96%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Error=	50.02%	0.00%	50.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
2	80	12	1	100	0	0	0	0	0	0	0	0	0	0	100	
2	80	12	2	100	0	0	0	0	0	0	0	0	0	0	100	
2	80	12	3	100	0	0	0	0	0	0	0	0	0	0	100	
Bio Statistical			Number (N)	3	3	3	3	3	3	3	3	3	3	3		
			Mean=	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Deviation=	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Error	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			% of the Mean=	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Deviation=	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		0%
			% of the Standard Error=	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		0%
2	81	13	1	100	0	0	0	0	0	0	0	0	0	0		
2	81	13	2	92	0	9	0	0	0	0	0	0	0	0		
2	81	13	3	89	0	11	0	0	0	0	0	0	0	0		
2	81	13	4	96	0	4	0	0	0	0	0	0	0	0		
2	81	13	5	95	0	5	0	0	0	0	0	0	0	0		
Bio Statistical			Number (N)	5	5	5	5	5	5	5	5	5	5	5		
			Mean=	94.20	0.00	5.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Deviation=	4.19	0.00	4.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			Standard Error	1.87	0.00	1.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
			% of the Mean=	94.20%	0.00%	5.70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Deviation=	49.70%	0.00%	50.29%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%
			% of the Standard Error=	49.60%	0.00%	50.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		100%

Biological Data Analysis: MEAN, STANDARD DEVIATION & STANDARD ERROR				
Ecosystem composition of of West Tripoli Desalination Station				
Simple ID: West Tripoli Plant				
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
63	Sand	57.33	50.00	50.00
	Posidonia oceanica	0.00	0.00	0.00
	Cymodocea nodosa	42.67	50.00	50.00
	Sea algae	0.00	0.00	0.00
	Sea rocks	0.00	0.00	0.00
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
	Sea Anemone	0.00	0.00	0.00
Total %		100	100	100
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
64	Sand	81.60	50.01	50.00
	Posidonia oceanica	0.00	0.00	0.00
	Cymodocea nodosa	18.40	50.01	50.00
	Sea algae	0.00	0.00	0.00
	Sea rocks	0.00	0.00	0.00
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
	Sea Anemone	0.00	0.00	0.00
Total %		100	100	100
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
65	Sand	69.13	49.99	50.00
	Posidonia oceanica	0.00	0.00	0.00
	Cymodocea nodosa	30.88	49.99	50.00
	Sea algae	0.00	0.00	0.00
	Sea rocks	0.00	0.00	0.00
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
	Sea Anemone	0.00	0.00	0.00
Total %		100	100	100
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
66	Sand	100.00	0.00	0.00
	Posidonia oceanica	0.00	0.00	0.00
	Cymodocea nodosa	0.00	0.00	0.00
	Sea algae	0.00	0.00	0.00
	Sea rocks	0.00	0.00	0.00
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
	Sea Anemone	0.00	0.00	0.00
Total %		100	0	0

Biological Data Analysis: MEAN, STANDARD DEVIATION & STANDARD ERROR				
Ecosystem composition of West Tripoli Desalination Station				
Simple ID: West Tripoli Plant				
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
67	Sand	100.00	0.00	0.00
	Posidonia oceanica	0.00	0.00	0.00
	Cymodocea nodosa	0.00	0.00	0.00
	Sea algae	0.00	0.00	0.00
	Sea rocks	0.00	0.00	0.00
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
	Sea Anemone	0.00	0.00	0.00
Total %		100	0	0
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
68	Sand	100.00	0.00	0.00
	Posidonia oceanica	0.00	0.00	0.00
	Cymodocea nodosa	0.00	0.00	0.00
	Sea algae	0.00	0.00	0.00
	Sea rocks	0.00	0.00	0.00
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
	Sea Anemone	0.00	0.00	0.00
Total %		100	0	0
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
69	Sand	94.80	50.00	50.00
	Posidonia oceanica	0.00	0.00	0.00
	Cymodocea nodosa	5.20	50.00	50.00
	Sea algae	0.00	0.00	0.00
	Sea rocks	0.00	0.00	0.00
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
	Sea Anemone	0.00	0.00	0.00
Total %		100	100	100
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
74	Sand	100.00	0.00	0.00
	Posidonia oceanica	0.00	0.00	0.00
	Cymodocea nodosa	0.00	0.00	0.00
	Sea algae	0.00	0.00	0.00
	Sea rocks	0.00	0.00	0.00
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
	Sea Anemone	0.00	0.00	0.00
Total %		100	0	0

Biological Data Analysis: MEAN, STANDARD DEVIATION & STANDARD ERROR				
Ecosystem composition of West Tripoli Desalination Station				
Simple ID: West Tripoli Plant				
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
77	Sand	52.50	31.00	30.98
	Posidonia oceanica	0.13	0.46	0.49
	Cymodocea nodosa	38.13	33.86	33.87
	Sea algae	0.00	0.00	0.00
	Sea rocks	0.00	0.00	0.00
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.38	1.40	1.42
	Sea Anemone	8.88	33.25	33.27
Total %		100	100	100
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
78	Sand	100.00	0.00	0.00
	Posidonia oceanica	0.00	0.00	0.00
	Cymodocea nodosa	0.00	0.00	0.00
	Sea algae	0.00	0.00	0.00
	Sea rocks	0.00	0.00	0.00
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
	Sea Anemone	0.00	0.00	0.00
Total %		100	0	0
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
79	Sand	74.07	49.98	50.02
	Posidonia oceanica	0.00	0.00	0.00
	Cymodocea nodosa	25.93	49.96	50.02
	Sea algae	0.00	0.00	0.00
	Sea rocks	0.00	0.00	0.00
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
	Sea Anemone	0.00	0.00	0.00
Total %		100	100	100
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
80	Sand	100.00	0.00	0.00
	Posidonia oceanica	0.00	0.00	0.00
	Cymodocea nodosa	0.00	0.00	0.00
	Sea algae	0.00	0.00	0.00
	Sea rocks	0.00	0.00	0.00
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
	Sea Anemone	0.00	0.00	0.00
Total %		100	0	0
Station Nr	Parmater	% Mean	% Standard Deviation	% Standard Error
81	Sand	94.20	49.70	49.60
	Posidonia oceanica	0.00	0.00	0.00
	Cymodocea nodosa	5.70	50.29	50.13
	Sea algae	0.00	0.00	0.00
	Sea rocks	0.00	0.00	0.00
	Taonia atomaria	0.00	0.00	0.00
	Laurencia pinnatifida	0.00	0.00	0.00
	Padina pavonica	0.00	0.00	0.00
	Sargassum vulgare	0.00	0.00	0.00
	Fish	0.00	0.00	0.00
	Sea Anemone	0.00	0.00	0.00
Total %		100	100	100

Appendix 5.8: Similarity index ANOSIM (Differences in the Community Composition between Stations at ZWDP

ANOSIM
Analysis of Similarities
One-Way Analysis
Resemblance worksheet
Name: Resem1
Data type: Similarity
Selection: All

Factor Values
Factor: Stations
37
38
39
40
42
44
45
46
47
52
53
54
55

Factor Groups

Sample	Stations
S1	37
S2	37
S3	37
S4	37
S5	37
S6	38
S7	38
S8	38
S9	38
S10	38
S11	38
S12	38
S13	38
S14	38
S15	39
S16	39
S17	39
S18	39
S19	39
S20	39
S21	39
S22	39
S23	39
S24	40
S25	40
S26	40
S27	40
S28	40
S29	40
S30	40
S31	40
S32	40
S33	42
S34	42
S35	44
S36	44
S37	44
S38	44
S39	44
S40	44
S41	44
S42	44
S43	45
S44	45

S45	45
S46	46
S47	46
S48	47
S49	47
S50	52
S51	52
S52	52
S53	52
S54	53
S55	53
S56	53
S57	53
S58	53
S59	53
S60	53
S61	53
S62	53
S63	53
S64	54
S65	54
S66	55
S67	55
S68	55

Global Test
Sample statistic (Global R): 0.632
Significance level of sample statistic: 0.01%
Number of permutations: 10000 (Random sample from a large number)
Number of permuted statistics greater than or equal to Global R: 0

Pairwise Tests

Groups	R Statistic	Significance Level %	Possible Permutations	Actual Permutations	Number >= Observed
37, 38	1	0.05	2002	2002	1
37, 39	0.912	0.05	2002	2002	1
37, 40	0.606	0.2	2002	2002	4
37, 42	1	4.8	21	21	1
37, 44	1	0.08	1287	1287	1
37, 45	1	1.8	56	56	1
37, 46	0.091	33.3	21	21	7
37, 47	-0.2	100	21	21	21
37, 52	0.563	0.8	126	126	1
37, 53	1	0.03	3003	3003	1
37, 54	1	4.8	21	21	1
37, 55	1	1.8	56	56	1
38, 39	0.911	0.02	24310	10000	1
38, 40	0.709	0.01	24310	10000	0
38, 42	1	1.8	55	55	1
38, 44	-0.028	55.6	24310	10000	5563
38, 45	1	0.5	220	220	1
38, 46	1	1.8	55	55	1
38, 47	1	1.8	55	55	1
38, 52	0.677	0.1	715	715	1
38, 53	0.144	3.9	92378	10000	387
38, 54	1	1.8	55	55	1
38, 55	1	0.5	220	220	1
39, 40	0.162	3.6	24310	10000	364
39, 42	-0.023	43.6	55	55	24
39, 44	0.943	0.01	24310	10000	0
39, 45	-0.16	75	220	220	165
39, 46	0.847	1.8	55	55	1
39, 47	0.931	1.8	55	55	1
39, 52	0.577	0.8	715	715	6
39, 53	0.961	0.02	92378	10000	1
39, 54	-0.023	43.6	55	55	24
39, 55	0.044	38.2	220	220	84
40, 42	-0.111	61.8	55	55	34
40, 44	0.733	0.04	24310	10000	3
40, 45	-0.003	44.1	220	220	97
40, 46	0.45	7.3	55	55	4
40, 47	0.55	1.8	55	55	1
40, 52	0.243	5.5	715	715	39
40, 53	0.821	0.02	92378	10000	1
40, 54	-0.111	61.8	55	55	34

40, 55	-0.094	65.5	220	220	144
42, 44	0.966	2.2	45	45	1
42, 45	0.917	10	10	10	1
42, 46	1	33.3	3	3	1
42, 47	1	33.3	3	3	1
42, 52	0.143	26.7	15	15	4
42, 53	1	1.5	66	66	1
42, 54	-0.5	100	3	3	3
42, 55	0.083	50	10	10	5
44, 45	0.957	0.6	165	165	1
44, 46	1	2.2	45	45	1
44, 47	1	2.2	45	45	1
44, 52	0.577	0.8	495	495	4
44, 53	0.07	12.4	43758	10000	1241
44, 54	0.966	2.2	45	45	1
44, 55	0.957	0.6	165	165	1
45, 46	1	10	10	10	1
45, 47	1	10	10	10	1
45, 52	0.259	20	35	35	7
45, 53	1	0.3	286	286	1
45, 54	0.917	10	10	10	1
45, 55	1	10	10	10	1
46, 47	0	100	3	3	3
46, 52	-0.071	53.3	15	15	8
46, 53	1	1.5	66	66	1
46, 54	1	33.3	3	3	1
46, 55	1	10	10	10	1
47, 52	0	46.7	15	15	7
47, 53	1	1.5	66	66	1
47, 54	1	33.3	3	3	1
47, 55	1	10	10	10	1
52, 53	0.875	0.1	1001	1001	1
52, 54	0.143	26.7	15	15	4
52, 55	0.111	28.6	35	35	10
53, 54	1	1.5	66	66	1
53, 55	1	0.3	286	286	1
54, 55	0.083	50	10	10	5

Outputs
Worksheet: Resem2

Appendix 5.9: Similarity, Dissimilarity, and Abundance between stations (SIMPER TEST) at ZWDP

SIMPER
Similarity Percentages - species contributions

One-Way Analysis

Data worksheet
Name: Data1
Data type: Abundance
Sample selection: All
Variable selection: All

Parameters
Resemblance: S17 Bray Curtis similarity
Cut off for low contributions: 90.00%

Factor Groups

Sample	Stations
S1	37
S2	37
S3	37
S4	37
S5	37
S6	38
S7	38
S8	38
S9	38
S10	38
S11	38
S12	38
S13	38
S14	38
S15	39
S16	39
S17	39
S18	39
S19	39
S20	39
S21	39
S22	39
S23	39
S24	40
S25	40
S26	40
S27	40
S28	40
S29	40
S30	40
S31	40
S32	40
S33	42
S34	42
S35	44
S36	44
S37	44
S38	44
S39	44
S40	44
S41	44
S42	44
S43	45
S44	45
S45	45
S46	46
S47	46
S48	47
S49	47
S50	52
S51	52
S52	52
S53	52
S54	53

S55	53
S56	53
S57	53
S58	53
S59	53
S60	53
S61	53
S62	53
S63	53
S64	54
S65	54
S66	55
S67	55
S68	55

Group 37
Average similarity: 92.40

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sand	95.40	91.60	13.98	99.13	99.13

Group 38
Average similarity: 74.89

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Posidonia oceanica	82.11	70.25	3.36	93.81	93.81

Group 39
Average similarity: 43.54

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sea algae	52.78	30.17	0.98	69.28	69.28
Padina pavonica	19.33	9.85	1.18	22.62	91.90

Group 40
Average similarity: 42.47

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sea algae	49.56	30.19	0.98	71.09	71.09
laurencia pinnatifida	13.00	4.69	0.58	11.05	82.15
Sea rocks	16.89	3.31	0.29	7.78	89.93
Sand	11.22	2.89	0.65	6.80	96.73

Group 42
Average similarity: 95.00

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sea algae	97.50	95.00	#######	100.00	100.00

Group 44
Average similarity: 69.54

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Posidonia oceanica	81.00	66.79	2.50	96.05	96.05

Group 45
Average similarity: 89.33

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sea algae	76.00	74.67	64.66	83.58	83.58
Padina pavonica	16.33	12.33	21.36	13.81	97.39

Group 46
Average similarity: 92.00

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sand	96.00	92.00	#######	100.00	100.00

Group 47
Average similarity: 100.00

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sand	100.00	100.00	#######	100.00	100.00

Group 52

Average similarity: 30.50

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sand	35.13	11.58	0.43	37.98	37.98
Sea algae	27.25	8.00	0.41	26.23	64.21
Cymodocea nodosa	22.38	6.42	0.41	21.04	85.25
Posidonia oceanica	15.25	4.50	0.41	14.75	100.00

Group 53
Average similarity: 88.27

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Posidonia oceanica	93.70	87.87	5.16	99.55	99.55

Group 54
Average similarity: 95.00

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sea algae	97.50	95.00	#######	100.00	100.00

Group 55
Average similarity: 96.69

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sea algae	96.00	93.71	38.39	96.92	96.92

Groups 37 & 38
Average dissimilarity = 92.02

	Group 37	Group 38				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	95.40	7.11	44.14	10.07	47.97	47.97
Posidonia oceanica	0.00	82.11	41.06	3.99	44.61	92.59

Groups 37 & 39
Average dissimilarity = 97.31

	Group 37	Group 39				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	95.40	0.89	47.23	14.77	48.53	48.53
Sea algae	0.00	52.78	26.39	1.46	27.12	75.65
Padina pavonica	0.00	19.33	9.66	1.15	9.93	85.58
Sea rocks	4.60	17.89	9.44	0.78	9.70	95.28

Groups 38 & 39
Average dissimilarity = 94.34

	Group 38	Group 39				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Posidonia oceanica	82.11	0.00	41.03	4.01	43.50	43.50
Sea algae	5.22	52.78	24.94	1.49	26.43	69.93
Padina pavonica	0.00	19.33	9.66	1.15	10.24	80.17
Sea rocks	2.56	17.89	9.22	0.72	9.77	89.95
Sargassum vulgare	0.00	8.78	4.37	0.35	4.63	94.58

Groups 37 & 40
Average dissimilarity = 87.24

	Group 37	Group 40				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	95.40	11.22	42.09	4.68	48.24	48.24
Sea algae	0.00	49.56	24.78	1.53	28.40	76.64
Sea rocks	4.60	16.89	9.21	0.83	10.56	87.20
laurencia pinnatifida	0.00	13.00	6.50	0.94	7.45	94.65

Groups 38 & 40
Average dissimilarity = 86.88

	Group 38	Group 40				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Posidonia oceanica	82.11	4.78	38.67	3.47	44.51	44.51
Sea algae	5.22	49.56	23.33	1.58	26.85	71.36
Sea rocks	2.56	16.89	8.87	0.75	10.21	81.57
laurencia pinnatifida	0.00	13.00	6.50	0.95	7.48	89.05
Sand	7.11	11.22	5.73	0.80	6.60	95.65

Groups 39 & 40
Average dissimilarity = 59.51

Species	Group 39 Av.Abund	Group 40 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	52.78	49.56	19.33	1.36	32.47	32.47
Sea rocks	17.89	16.89	12.64	0.94	21.25	53.72
Padina pavonica	19.33	4.56	8.56	1.07	14.38	68.10
laurencia pinnatifida	0.00	13.00	6.50	0.95	10.92	79.02
Sand	0.89	11.22	5.51	0.67	9.26	88.28
Sargassum vulgare	8.78	0.00	4.37	0.35	7.34	95.61

Groups 37 & 42
Average dissimilarity = 97.50

Species	Group 37 Av.Abund	Group 42 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	0.00	97.50	48.75	37.00	50.00	50.00
Sand	95.40	2.50	46.45	13.46	47.64	97.64

Groups 38 & 42
Average dissimilarity = 93.11

Species	Group 38 Av.Abund	Group 42 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	5.22	97.50	46.14	11.33	49.55	49.55
Posidonia oceanica	82.11	0.00	41.06	3.92	44.09	93.65

Groups 39 & 42
Average dissimilarity = 46.83

Species	Group 39 Av.Abund	Group 42 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	52.78	97.50	22.39	1.23	47.81	47.81
Padina pavonica	19.33	0.00	9.66	1.13	20.63	68.44
Sea rocks	17.89	0.00	8.94	0.65	19.10	87.53
Sargassum vulgare	8.78	0.00	4.37	0.34	9.32	96.86

Groups 40 & 42
Average dissimilarity = 48.94

Species	Group 40 Av.Abund	Group 42 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	49.56	97.50	23.97	1.45	48.98	48.98
Sea rocks	16.89	0.00	8.44	0.65	17.25	66.23
laurencia pinnatifida	13.00	0.00	6.50	0.93	13.28	79.51
Sand	11.22	2.50	5.36	0.66	10.95	90.47

Groups 37 & 44
Average dissimilarity = 94.75

Species	Group 37 Av.Abund	Group 44 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	95.40	5.25	45.08	10.54	47.57	47.57
Posidonia oceanica	0.00	81.00	40.50	3.22	42.74	90.32

Groups 38 & 44
Average dissimilarity = 26.43

Species	Group 38 Av.Abund	Group 44 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Posidonia oceanica	82.11	81.00	12.04	1.13	45.56	45.56
Cymodocea nodosa	3.00	9.38	5.51	0.65	20.84	66.40
Sea algae	5.22	4.38	4.15	0.74	15.69	82.08
Sand	7.11	5.25	3.46	1.28	13.08	95.17

Groups 39 & 44
Average dissimilarity = 96.21

Species	Group 39 Av.Abund	Group 44 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Posidonia oceanica	0.00	81.00	40.48	3.24	42.07	42.07
Sea algae	52.78	4.38	25.27	1.45	26.27	68.34
Padina pavonica	19.33	0.00	9.66	1.15	10.04	78.38

Sea rocks	17.89	0.00	8.94	0.66	9.30	87.68
Cymodocea nodosa	0.11	9.38	4.70	0.55	4.88	92.56

Groups 40 & 44
Average dissimilarity = 89.42

	Group 40	Group 44				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Posidonia oceanica	4.78	81.00	38.11	2.88	42.62	42.62
Sea algae	49.56	4.38	23.78	1.55	26.60	69.22
Sea rocks	16.89	0.00	8.44	0.67	9.44	78.67
laurencia pinnatifida	13.00	0.00	6.50	0.95	7.27	85.94
Sand	11.22	5.25	5.61	0.75	6.28	92.21

Groups 42 & 44
Average dissimilarity = 94.38

	Group 42	Group 44				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	97.50	4.38	46.56	7.61	49.34	49.34
Posidonia oceanica	0.00	81.00	40.50	3.16	42.91	92.25

Groups 37 & 45
Average dissimilarity = 97.67

	Group 37	Group 45				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	95.40	2.33	46.53	14.07	47.65	47.65
Sea algae	0.00	76.00	38.00	44.96	38.91	86.55
Padina pavonica	0.00	16.33	8.17	2.90	8.36	94.91

Groups 38 & 45
Average dissimilarity = 92.70

	Group 38	Group 45				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Posidonia oceanica	82.11	0.00	41.06	3.96	44.29	44.29
Sea algae	5.22	76.00	35.39	9.04	38.17	82.46
Padina pavonica	0.00	16.33	8.17	2.95	8.81	91.27

Groups 39 & 45
Average dissimilarity = 40.23

	Group 39	Group 45				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	52.78	76.00	16.74	1.25	41.61	41.61
Sea rocks	17.89	0.00	8.94	0.65	22.23	63.84
Padina pavonica	19.33	16.33	6.20	0.96	15.42	79.25
Sargassum vulgare	8.78	0.00	4.37	0.35	10.86	90.11

Groups 40 & 45
Average dissimilarity = 46.56

	Group 40	Group 45				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	49.56	76.00	14.78	1.00	31.74	31.74
Sea rocks	16.89	0.00	8.44	0.66	18.14	49.88
laurencia pinnatifida	13.00	0.00	6.50	0.93	13.96	63.84
Padina pavonica	4.56	16.33	6.44	1.77	13.84	77.68
Sand	11.22	2.33	5.33	0.66	11.46	89.14
Posidonia oceanica	4.78	0.00	2.39	0.54	5.13	94.27

Groups 42 & 45
Average dissimilarity = 22.83

	Group 42	Group 45				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	97.50	76.00	10.75	6.57	47.08	47.08
Padina pavonica	0.00	16.33	8.17	2.74	35.77	82.85
Cymodocea nodosa	0.00	4.67	2.33	1.16	10.22	93.07

Groups 44 & 45
Average dissimilarity = 92.75

	Group 44	Group 45

Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Posidonia oceanica	81.00	0.00	40.50	3.19	43.67	43.67
Sea algae	4.38	76.00	35.81	6.00	38.61	82.28
Padina pavonica	0.00	16.33	8.17	2.94	8.81	91.08

Groups 37 & 46
Average dissimilarity = 7.00

	Group 37	Group 46				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	95.40	96.00	2.70	1.05	38.57	38.57
Sea rocks	4.60	0.00	2.30	0.72	32.86	71.43
Sea algae	0.00	4.00	2.00	0.95	28.57	100.00

Groups 38 & 46
Average dissimilarity = 91.44

	Group 38	Group 46				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	7.11	96.00	44.44	11.70	48.60	48.60
Posidonia oceanica	82.11	0.00	41.06	3.92	44.90	93.50

Groups 39 & 46
Average dissimilarity = 96.00

	Group 39	Group 46				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	0.89	96.00	47.53	20.97	49.51	49.51
Sea algae	52.78	4.00	25.28	1.47	26.33	75.84
Padina pavonica	19.33	0.00	9.66	1.13	10.07	85.90
Sea rocks	17.89	0.00	8.94	0.65	9.32	95.22

Groups 40 & 46
Average dissimilarity = 85.67

	Group 40	Group 46				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	11.22	96.00	42.39	4.80	49.48	49.48
Sea algae	49.56	4.00	23.67	1.56	27.63	77.11
Sea rocks	16.89	0.00	8.44	0.65	9.86	86.96
laurencia pinnatifida	13.00	0.00	6.50	0.93	7.59	94.55

Groups 42 & 46
Average dissimilarity = 93.50

	Group 42	Group 46				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	2.50	96.00	46.75	17.17	50.00	50.00
Sea algae	97.50	4.00	46.75	17.17	50.00	100.00

Groups 44 & 46
Average dissimilarity = 94.25

	Group 44	Group 46				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	5.25	96.00	45.38	12.34	48.14	48.14
Posidonia oceanica	81.00	0.00	40.50	3.16	42.97	91.11

Groups 45 & 46
Average dissimilarity = 93.67

	Group 45	Group 46				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	2.33	96.00	46.83	19.01	50.00	50.00
Sea algae	76.00	4.00	36.00	15.21	38.43	88.43
Padina pavonica	16.33	0.00	8.17	2.74	8.72	97.15

Groups 37 & 47
Average dissimilarity = 4.60

	Group 37	Group 47				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	95.40	100.00	2.30	0.72	50.00	50.00
Sea rocks	4.60	0.00	2.30	0.72	50.00	100.00

Groups 38 & 47
Average dissimilarity = 92.89

Species	Group 38 Av.Abund	Group 47 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	7.11	100.00	46.44	14.54	50.00	50.00
Posidonia oceanica	82.11	0.00	41.06	3.92	44.20	94.20

Groups 39 & 47
Average dissimilarity = 99.11

Species	Group 39 Av.Abund	Group 47 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	0.89	100.00	49.53	51.89	49.97	49.97
Sea algae	52.78	0.00	26.39	1.44	26.62	76.60
Padina pavonica	19.33	0.00	9.66	1.13	9.75	86.35
Sea rocks	17.89	0.00	8.94	0.65	9.02	95.37

Groups 40 & 47
Average dissimilarity = 88.78

Species	Group 40 Av.Abund	Group 47 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	11.22	100.00	44.39	5.16	50.00	50.00
Sea algae	49.56	0.00	24.78	1.51	27.91	77.91
Sea rocks	16.89	0.00	8.44	0.65	9.51	87.42
laurencia pinnatifida	13.00	0.00	6.50	0.93	7.32	94.74

Groups 42 & 47
Average dissimilarity = 97.50

Species	Group 42 Av.Abund	Group 47 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	2.50	100.00	48.75	33.77	50.00	50.00
Sea algae	97.50	0.00	48.75	33.77	50.00	100.00

Groups 44 & 47
Average dissimilarity = 94.75

Species	Group 44 Av.Abund	Group 47 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	5.25	100.00	47.38	15.58	50.00	50.00
Posidonia oceanica	81.00	0.00	40.50	3.16	42.74	92.74

Groups 45 & 47
Average dissimilarity = 97.67

Species	Group 45 Av.Abund	Group 47 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	2.33	100.00	48.83	43.39	50.00	50.00
Sea algae	76.00	0.00	38.00	42.49	38.91	88.91
Padina pavonica	16.33	0.00	8.17	2.74	8.36	97.27

Groups 46 & 47
Average dissimilarity = 4.00

Species	Group 46 Av.Abund	Group 47 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	96.00	100.00	2.00	0.87	50.00	50.00
Sea algae	4.00	0.00	2.00	0.87	50.00	100.00

Groups 37 & 52
Average dissimilarity = 64.88

Species	Group 37 Av.Abund	Group 52 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	95.40	35.13	30.14	1.68	46.45	46.45
Sea algae	0.00	27.25	13.63	0.96	21.00	67.46
Cymodocea nodosa	0.00	22.38	11.19	0.96	17.24	84.70
Posidonia oceanica	0.00	15.25	7.63	0.96	11.75	96.45

Groups 38 & 52
Average dissimilarity = 76.83

	Group 38	Group 52

Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Posidonia oceanica	82.11	15.25	33.43	2.58	43.51	43.51
Sand	7.11	35.13	17.31	1.20	22.53	66.04
Sea algae	5.22	27.25	13.63	1.13	17.73	83.78
Cymodocea nodosa	3.00	22.38	11.19	1.02	14.56	98.34

Groups 39 & 52
Average dissimilarity = 80.58

	Group 39	Group 52				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	52.78	27.25	21.17	1.40	26.27	26.27
Sand	0.89	35.13	17.47	1.02	21.68	47.95
Cymodocea nodosa	0.11	22.38	11.18	0.97	13.88	61.83
Padina pavonica	19.33	0.00	9.66	1.14	11.99	73.82
Sea rocks	17.89	0.00	8.94	0.66	11.10	84.92
Posidonia oceanica	0.00	15.25	7.62	0.97	9.46	94.37

Groups 40 & 52
Average dissimilarity = 72.56

	Group 40	Group 52				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	49.56	27.25	19.21	1.33	26.47	26.47
Sand	11.22	35.13	17.31	1.18	23.86	50.33
Cymodocea nodosa	0.00	22.38	11.19	0.97	15.42	65.75
Sea rocks	16.89	0.00	8.44	0.66	11.64	77.39
Posidonia oceanica	4.78	15.25	7.63	1.09	10.51	87.90
laurencia pinnatifida	13.00	0.00	6.50	0.94	8.96	96.86

Groups 42 & 52
Average dissimilarity = 71.31

	Group 42	Group 52				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	97.50	27.25	35.13	2.37	49.26	49.26
Sand	2.50	35.13	17.38	1.00	24.36	73.62
Cymodocea nodosa	0.00	22.38	11.19	0.92	15.69	89.31
Posidonia oceanica	0.00	15.25	7.63	0.92	10.69	100.00

Groups 44 & 52
Average dissimilarity = 75.58

	Group 44	Group 52				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Posidonia oceanica	81.00	15.25	32.88	2.21	43.50	43.50
Sand	5.25	35.13	17.38	1.14	22.99	66.49
Sea algae	4.38	27.25	13.63	1.03	18.03	84.52
Cymodocea nodosa	9.38	22.38	11.70	1.10	15.48	100.00

Groups 45 & 52
Average dissimilarity = 69.00

	Group 45	Group 52				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	76.00	27.25	24.38	1.69	35.33	35.33
Sand	2.33	35.13	17.31	1.01	25.09	60.42
Cymodocea nodosa	4.67	22.38	11.19	1.15	16.21	76.63
Padina pavonica	16.33	0.00	8.17	2.88	11.84	88.47
Posidonia oceanica	0.00	15.25	7.63	0.95	11.05	99.52

Groups 46 & 52
Average dissimilarity = 62.88

	Group 46	Group 52				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	96.00	35.13	30.44	1.64	48.41	48.41
Sea algae	4.00	27.25	13.63	1.06	21.67	70.08
Cymodocea nodosa	0.00	22.38	11.19	0.92	17.79	87.87
Posidonia oceanica	0.00	15.25	7.63	0.92	12.13	100.00

Groups 47 & 52
Average dissimilarity = 64.88

	Group 47	Group 52

Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	100.00	35.13	32.44	1.76	50.00	50.00
Sea algae	0.00	27.25	13.63	0.92	21.00	71.00
Cymodocea nodosa	0.00	22.38	11.19	0.92	17.24	88.25
Posidonia oceanica	0.00	15.25	7.63	0.92	11.75	100.00

Groups 37 & 53
Average dissimilarity = 97.10

	Group 37	Group 53				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Posidonia oceanica	0.00	93.70	46.85	6.90	48.25	48.25
Sand	95.40	2.90	46.25	10.89	47.63	95.88

Groups 38 & 53
Average dissimilarity = 19.57

	Group 38	Group 53				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Posidonia oceanica	82.11	93.70	9.51	0.99	48.58	48.58
Sand	7.11	2.90	3.68	1.22	18.82	67.40
Sea algae	5.22	3.40	3.60	0.79	18.40	85.80
Cymodocea nodosa	3.00	0.00	1.50	0.35	7.67	93.47

Groups 39 & 53
Average dissimilarity = 97.19

	Group 39	Group 53				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Posidonia oceanica	0.00	93.70	46.82	6.93	48.18	48.18
Sea algae	52.78	3.40	25.45	1.47	26.19	74.37
Padina pavonica	19.33	0.00	9.66	1.15	9.94	84.31
Sea rocks	17.89	0.00	8.94	0.66	9.20	93.51

Groups 40 & 53
Average dissimilarity = 91.39

	Group 40	Group 53				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Posidonia oceanica	4.78	93.70	44.46	5.52	48.65	48.65
Sea algae	49.56	3.40	23.94	1.56	26.20	74.85
Sea rocks	16.89	0.00	8.44	0.67	9.24	84.09
laurencia pinnatifida	13.00	0.00	6.50	0.95	7.11	91.20

Groups 42 & 53
Average dissimilarity = 96.10

	Group 42	Group 53				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	97.50	3.40	47.05	10.17	48.96	48.96
Posidonia oceanica	0.00	93.70	46.85	6.79	48.75	97.71

Groups 44 & 53
Average dissimilarity = 21.50

	Group 44	Group 53				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Posidonia oceanica	81.00	93.70	10.30	0.89	47.91	47.91
Cymodocea nodosa	9.38	0.00	4.69	0.54	21.80	69.71
Sea algae	4.38	3.40	3.46	0.54	16.10	85.81
Sand	5.25	2.90	3.05	1.00	14.19	100.00

Groups 45 & 53
Average dissimilarity = 96.13

	Group 45	Group 53				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Posidonia oceanica	0.00	93.70	46.85	6.85	48.73	48.73
Sea algae	76.00	3.40	36.30	8.10	37.76	86.49
Padina pavonica	16.33	0.00	8.17	2.95	8.50	94.99

Groups 46 & 53
Average dissimilarity = 96.45

	Group 46	Group 53

Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Posidonia oceanica	0.00	93.70	46.85	6.79	48.57	48.57
Sand	96.00	2.90	46.55	12.82	48.26	96.84

Groups 47 & 53
Average dissimilarity = 97.10

	Group 47	Group 53				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	100.00	2.90	48.55	16.21	50.00	50.00
Posidonia oceanica	0.00	93.70	46.85	6.79	48.25	98.25

Groups 52 & 53
Average dissimilarity = 81.53

	Group 52	Group 53				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Posidonia oceanica	15.25	93.70	39.23	3.78	48.11	48.11
Sand	35.13	2.90	17.49	1.07	21.45	69.56
Sea algae	27.25	3.40	13.63	1.04	16.71	86.28
Cymodocea nodosa	22.38	0.00	11.19	0.97	13.72	100.00

Groups 37 & 54
Average dissimilarity = 97.50

	Group 37	Group 54				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	0.00	97.50	48.75	37.00	50.00	50.00
Sand	95.40	2.50	46.45	13.46	47.64	97.64

Groups 38 & 54
Average dissimilarity = 93.11

	Group 38	Group 54				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	5.22	97.50	46.14	11.33	49.55	49.55
Posidonia oceanica	82.11	0.00	41.06	3.92	44.09	93.65

Groups 39 & 54
Average dissimilarity = 46.83

	Group 39	Group 54				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	52.78	97.50	22.39	1.23	47.81	47.81
Padina pavonica	19.33	0.00	9.66	1.13	20.63	68.44
Sea rocks	17.89	0.00	8.94	0.65	19.10	87.53
Sargassum vulgare	8.78	0.00	4.37	0.34	9.32	96.86

Groups 40 & 54
Average dissimilarity = 48.94

	Group 40	Group 54				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	49.56	97.50	23.97	1.45	48.98	48.98
Sea rocks	16.89	0.00	8.44	0.65	17.25	66.23
laurencia pinnatifida	13.00	0.00	6.50	0.93	13.28	79.51
Sand	11.22	2.50	5.36	0.66	10.95	90.47

Groups 42 & 54
Average dissimilarity = 2.50

	Group 42	Group 54				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	2.50	2.50	1.25	0.87	50.00	50.00
Sea algae	97.50	97.50	1.25	0.87	50.00	100.00

Groups 44 & 54
Average dissimilarity = 94.38

	Group 44	Group 54				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	4.38	97.50	46.56	7.61	49.34	49.34
Posidonia oceanica	81.00	0.00	40.50	3.16	42.91	92.25

Groups 45 & 54

Average dissimilarity = 22.83

Species	Group 45 Av.Abund	Group 54 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	76.00	97.50	10.75	6.57	47.08	47.08
Padina pavonica	16.33	0.00	8.17	2.74	35.77	82.85
Cymodocea nodosa	4.67	0.00	2.33	1.16	10.22	93.07

Groups 46 & 54
Average dissimilarity = 93.50

Species	Group 46 Av.Abund	Group 54 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	96.00	2.50	46.75	17.17	50.00	50.00
Sea algae	4.00	97.50	46.75	17.17	50.00	100.00

Groups 47 & 54
Average dissimilarity = 97.50

Species	Group 47 Av.Abund	Group 54 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	100.00	2.50	48.75	33.77	50.00	50.00
Sea algae	0.00	97.50	48.75	33.77	50.00	100.00

Groups 52 & 54
Average dissimilarity = 71.31

Species	Group 52 Av.Abund	Group 54 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	27.25	97.50	35.13	2.37	49.26	49.26
Sand	35.13	2.50	17.38	1.00	24.36	73.62
Cymodocea nodosa	22.38	0.00	11.19	0.92	15.69	89.31
Posidonia oceanica	15.25	0.00	7.63	0.92	10.69	100.00

Groups 53 & 54
Average dissimilarity = 96.10

Species	Group 53 Av.Abund	Group 54 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	3.40	97.50	47.05	10.17	48.96	48.96
Posidonia oceanica	93.70	0.00	46.85	6.79	48.75	97.71

Groups 37 & 55
Average dissimilarity = 95.35

Species	Group 37 Av.Abund	Group 55 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	0.00	96.00	47.84	41.37	50.17	50.17
Sand	95.40	4.67	45.22	13.41	47.42	97.60

Groups 38 & 55
Average dissimilarity = 91.84

Species	Group 38 Av.Abund	Group 55 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	5.22	96.00	45.24	11.37	49.26	49.26
Posidonia oceanica	82.11	0.00	40.92	3.96	44.55	93.81

Groups 39 & 55
Average dissimilarity = 46.85

Species	Group 39 Av.Abund	Group 55 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	52.78	96.00	21.70	1.21	46.32	46.32
Padina pavonica	19.33	0.00	9.63	1.14	20.56	66.88
Sea rocks	17.89	0.00	8.91	0.65	19.03	85.91
Sargassum vulgare	8.78	0.00	4.35	0.35	9.29	95.20

Groups 40 & 55
Average dissimilarity = 47.84

Species	Group 40 Av.Abund	Group 55 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	49.56	96.00	23.15	1.42	48.38	48.38
Sea rocks	16.89	0.00	8.42	0.66	17.59	65.97

laurencia pinnatifida	13.00	0.00	6.48	0.93	13.54	79.51
Sand	11.22	4.67	5.15	0.68	10.76	90.28

Groups 42 & 55
Average dissimilarity = 3.32

Species	Group 42 Av.Abund	Group 55 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	2.50	4.67	1.74	1.55	52.50	52.50
Sea algae	97.50	96.00	1.58	1.64	47.50	100.00

Groups 44 & 55
Average dissimilarity = 93.44

Species	Group 44 Av.Abund	Group 55 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	4.38	96.00	45.66	7.61	48.87	48.87
Posidonia oceanica	81.00	0.00	40.37	3.19	43.20	92.07

Groups 45 & 55
Average dissimilarity = 22.37

Species	Group 45 Av.Abund	Group 55 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	76.00	96.00	9.97	6.94	44.56	44.56
Padina pavonica	16.33	0.00	8.14	2.83	36.39	80.94
Cymodocea nodosa	4.67	0.00	2.33	1.20	10.40	91.34

Groups 46 & 55
Average dissimilarity = 91.36

Species	Group 46 Av.Abund	Group 55 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	4.00	96.00	45.85	18.32	50.18	50.18
Sand	96.00	4.67	45.52	17.74	49.82	100.00

Groups 47 & 55
Average dissimilarity = 95.35

Species	Group 47 Av.Abund	Group 55 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	0.00	96.00	47.84	39.09	50.17	50.17
Sand	100.00	4.67	47.51	35.16	49.83	100.00

Groups 52 & 55
Average dissimilarity = 70.14

Species	Group 52 Av.Abund	Group 55 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sea algae	27.25	96.00	34.26	2.37	48.85	48.85
Sand	35.13	4.67	17.13	1.07	24.42	73.27
Cymodocea nodosa	22.38	0.00	11.15	0.94	15.90	89.17
Posidonia oceanica	15.25	0.00	7.60	0.95	10.83	100.00

Groups 53 & 55
Average dissimilarity = 95.68

Species	Group 53 Av.Abund	Group 55 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Posidonia oceanica	93.70	0.00	46.69	6.85	48.80	48.80
Sea algae	3.40	96.00	46.15	10.18	48.23	97.03

Groups 54 & 55
Average dissimilarity = 3.32

Species	Group 54 Av.Abund	Group 55 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	2.50	4.67	1.74	1.55	52.50	52.50
Sea algae	97.50	96.00	1.58	1.64	47.50	100.00

Appendix 5.10: Similarity index ANOSIM (Differences in the Community Composition between the Stations) at WTRIS

ANOSIM
Analysis of Similarities

One-Way Analysis

Resemblance worksheet
Name: Resem1
Data type: Similarity
Selection: All

Factor Values
Factor: Stations
63
64
65
66
67
68
69
74
77
78
79
80
81

Factor Groups

Sample	Stations
S1	63
S2	63
S3	63
S4	63
S5	63
S6	63
S7	64
S8	64
S9	64
S10	64
S11	64
S12	65
S13	65
S14	65
S15	65
S16	65
S17	65
S18	65
S19	65
S20	66
S21	66
S22	67
S23	67
S24	67
S25	67
S26	67
S27	67
S28	68
S29	68
S30	68
S31	68
S32	68
S33	69
S34	69
S35	69
S36	69
S37	69
S38	74
S39	74
S40	74
S41	77
S42	77

S43	77
S44	77
S45	77
S46	77
S47	77
S48	77
S49	78
S50	78
S51	78
S52	78
S53	78
S54	78
S55	78
S56	79
S57	79
S58	79
S59	79
S60	79
S61	79
S62	79
S63	80
S64	80
S65	80
S66	81
S67	81
S68	81
S69	81
S70	81

Global Test
Sample statistic (Global R): 0.31
Significance level of sample statistic: 0.01%
Number of permutations: 10000 (Random sample from a large number)
Number of permuted statistics greater than or equal to Global R: 0

Pairwise Tests

Groups	R Statistic	Significance Level %	Possible Permutations	Actual Permutations	Number >= Observed
63, 64	0.411	0.4	462	462	2
63, 65	0.176	5.6	3003	3003	169
63, 66	1	3.6	28	28	1
63, 67	1	0.2	462	462	1
63, 68	1	0.2	462	462	1
63, 69	0.968	0.2	462	462	1
63, 74	1	1.2	84	84	1
63, 77	-0.047	67.4	3003	3003	2025
63, 78	1	0.06	1716	1716	1
63, 79	0.295	2.6	1716	1716	44
63, 80	1	1.2	84	84	1
63, 81	0.995	0.2	462	462	1
64, 65	-0.143	91.6	1287	1287	1179
64, 66	0.218	28.6	21	21	6
64, 67	0.544	1.5	462	462	7
64, 68	0.48	4.8	126	126	6
64, 69	0.074	27	126	126	34
64, 74	0.308	12.5	56	56	7
64, 77	-0.018	47	1287	1287	605
64, 78	0.594	1	792	792	8
64, 79	-0.119	86.5	792	792	685
64, 80	0.308	12.5	56	56	7
64, 81	0.144	19.8	126	126	25
65, 66	0.216	24.4	45	45	11
65, 67	0.471	0.5	3003	3003	14
65, 68	0.401	1.5	1287	1287	19
65, 69	0.042	30.1	1287	1287	388
65, 74	0.266	10.9	165	165	18
65, 77	-0.002	43.7	6435	6435	2811
65, 78	0.536	0.06	6435	6435	4
65, 79	-0.12	99.7	6435	6435	6417
65, 80	0.266	10.9	165	165	18
65, 81	-0.019	47.9	1287	1287	617
66, 67	0	100	28	28	28
66, 68	0	100	21	21	21
66, 69	-0.091	61.9	21	21	13
66, 74	0	100	10	10	10

66, 77	0.371	11.1	45	45	5
66, 78	0	100	36	36	36
66, 79	0.325	13.9	36	36	5
66, 80	0	100	10	10	10
66, 81	0.327	19	21	21	4
67, 68	0	100	462	462	462
67, 69	0.296	6.1	462	462	28
67, 74	0	100	84	84	84
67, 77	0.576	0.1	3003	3003	4
67, 78	0	100	1716	1716	1716
67, 79	0.587	0.2	1716	1716	3
67, 80	0	100	84	84	84
67, 81	0.592	1.5	462	462	7
68, 69	0.22	16.7	126	126	21
68, 74	0	100	56	56	56
68, 77	0.52	0.2	1287	1287	3
68, 78	0	100	792	792	792
68, 79	0.521	0.6	792	792	5
68, 80	0	100	56	56	56
68, 81	0.54	4.8	126	126	6
69, 74	0.015	46.4	56	56	26
69, 77	0.334	1.6	1287	1287	21
69, 78	0.355	4.5	792	792	36
69, 79	0.044	29.3	792	792	232
69, 80	0.015	46.4	56	56	26
69, 81	-0.1	81	126	126	102
74, 77	0.411	6.1	165	165	10
74, 78	0	100	120	120	120
74, 79	0.381	5	120	120	6
74, 80	0	100	10	10	10
74, 81	0.4	12.5	56	56	7
77, 78	0.628	0.05	6435	6435	3
77, 79	0.039	22.7	6435	6435	1461
77, 80	0.411	6.1	165	165	10
77, 81	0.345	1.4	1287	1287	18
78, 79	0.646	0.06	1716	1716	1
78, 80	0	100	120	120	120
78, 81	0.632	1	792	792	8
79, 80	0.381	5	120	120	6
79, 81	0.014	35.5	792	792	281
80, 81	0.4	12.5	56	56	7

Outputs
Worksheet: Resem2

Appendix 5.11: Similarity, Dissimilarity, and Abundance between Stations (SIMPER TEST) at WTRIS

SIMPER
Similarity Percentages - species contributions

One-Way Analysis

Data worksheet
Name: Data1
Data type: Abundance
Sample selection: All
Variable selection: All

Parameters
Resemblance: S17 Bray Curtis similarity
Cut off for low contributions: 90.00%

Factor Groups

Sample	Stations
S1	63
S2	63
S3	63
S4	63
S5	63
S6	63
S7	64
S8	64
S9	64
S10	64
S11	64
S12	65
S13	65
S14	65
S15	65
S16	65
S17	65
S18	65
S19	65
S20	66
S21	66
S22	67
S23	67
S24	67
S25	67
S26	67
S27	67
S28	68
S29	68
S30	68
S31	68
S32	68
S33	69
S34	69
S35	69
S36	69
S37	69
S38	74
S39	74
S40	74
S41	77
S42	77
S43	77
S44	77
S45	77
S46	77
S47	77
S48	77
S49	78
S50	78
S51	78
S52	78

S53	78
S54	78
S55	78
S56	79
S57	79
S58	79
S59	79
S60	79
S61	79
S62	79
S63	80
S64	80
S65	80
S66	81
S67	81
S68	81
S69	81
S70	81

Group 63
Average similarity: 92.80

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sand	57.33	53.73	8.93	57.90	57.90
Cymodocea nodosa	42.67	39.07	16.25	42.10	100.00

Group 64
Average similarity: 80.40

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sand	81.60	71.80	7.12	89.30	89.30
Cymodocea nodosa	18.40	8.60	0.75	10.70	100.00

Group 65
Average similarity: 64.89

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sand	69.13	51.57	1.70	79.47	79.47
Cymodocea nodosa	30.88	13.32	0.98	20.53	100.00

Group 66
Average similarity: 100.00

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sand	100.00	100.00	#######	100.00	100.00

Group 67
Average similarity: 100.00

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sand	100.00	100.00	#######	100.00	100.00

Group 68
Average similarity: 100.00

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sand	100.00	100.00	#######	100.00	100.00

Group 69
Average similarity: 92.20

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sand	94.80	90.90	13.08	98.59	98.59

Group 74
Average similarity: 100.00

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sand	100.00	100.00	#######	100.00	100.00

Group 77
Average similarity: 62.25

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sand	52.50	38.82	1.84	62.36	62.36

Cymodocea nodosa	38.13	23.43	1.44	37.64	100.00

Group 78
Average similarity: 100.00

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sand	100.00	100.00	#######	100.00	100.00

Group 79
Average similarity: 71.88

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sand	74.43	59.93	2.49	83.38	83.38
Cymodocea nodosa	26.29	11.95	1.13	16.62	100.00

Group 80
Average similarity: 100.00

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sand	100.00	100.00	#######	100.00	100.00

Group 81
Average similarity: 94.71

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sand	94.40	91.62	32.39	96.74	96.74

Groups 63 & 64
Average dissimilarity = 24.27

	Group 63	Group 64				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	57.33	81.60	12.13	1.56	50.00	50.00
Cymodocea nodosa	42.67	18.40	12.13	1.56	50.00	100.00

Groups 63 & 65
Average dissimilarity = 27.71

	Group 63	Group 65				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	57.33	69.13	13.85	1.75	50.00	50.00
Cymodocea nodosa	42.67	30.88	13.85	1.75	50.00	100.00

Groups 64 & 65
Average dissimilarity = 25.48

	Group 64	Group 65				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	81.60	69.13	12.74	1.07	50.00	50.00
Cymodocea nodosa	18.40	30.88	12.74	1.07	50.00	100.00

Groups 63 & 66
Average dissimilarity = 42.67

	Group 63	Group 66				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	57.33	100.00	21.33	7.16	50.00	50.00
Cymodocea nodosa	42.67	0.00	21.33	7.16	50.00	100.00

Groups 64 & 66
Average dissimilarity = 18.40

	Group 64	Group 66				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	81.60	100.00	9.20	1.23	50.00	50.00
Cymodocea nodosa	18.40	0.00	9.20	1.23	50.00	100.00

Groups 65 & 66
Average dissimilarity = 30.88

	Group 65	Group 66				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	69.13	100.00	15.44	1.03	50.00	50.00
Cymodocea nodosa	30.88	0.00	15.44	1.03	50.00	100.00

Groups 63 & 67
Average dissimilarity = 42.67

Species	Group 63 Av.Abund	Group 67 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	57.33	100.00	21.33	7.37	50.00	50.00
Cymodocea nodosa	42.67	0.00	21.33	7.37	50.00	100.00

Groups 64 & 67
Average dissimilarity = 18.40

Species	Group 64 Av.Abund	Group 67 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	81.60	100.00	9.20	1.28	50.00	50.00
Cymodocea nodosa	18.40	0.00	9.20	1.28	50.00	100.00

Groups 65 & 67
Average dissimilarity = 30.88

Species	Group 65 Av.Abund	Group 67 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	69.13	100.00	15.44	1.05	50.00	50.00
Cymodocea nodosa	30.88	0.00	15.44	1.05	50.00	100.00

Groups 66 & 67
All the dissimilarities are zero

Groups 63 & 68
Average dissimilarity = 42.67

Species	Group 63 Av.Abund	Group 68 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	57.33	100.00	21.33	7.35	50.00	50.00
Cymodocea nodosa	42.67	0.00	21.33	7.35	50.00	100.00

Groups 64 & 68
Average dissimilarity = 18.40

Species	Group 64 Av.Abund	Group 68 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	81.60	100.00	9.20	1.27	50.00	50.00
Cymodocea nodosa	18.40	0.00	9.20	1.27	50.00	100.00

Groups 65 & 68
Average dissimilarity = 30.88

Species	Group 65 Av.Abund	Group 68 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	69.13	100.00	15.44	1.05	50.00	50.00
Cymodocea nodosa	30.88	0.00	15.44	1.05	50.00	100.00

Groups 66 & 68
All the dissimilarities are zero

Groups 67 & 68
All the dissimilarities are zero

Groups 63 & 69
Average dissimilarity = 37.47

Species	Group 63 Av.Abund	Group 69 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	57.33	94.80	18.73	4.36	50.00	50.00
Cymodocea nodosa	42.67	5.20	18.73	4.36	50.00	100.00

Groups 64 & 69
Average dissimilarity = 16.40

Species	Group 64 Av.Abund	Group 69 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	81.60	94.80	8.20	1.33	50.00	50.00
Cymodocea nodosa	18.40	5.20	8.20	1.33	50.00	100.00

Groups 65 & 69
Average dissimilarity = 27.73

Species	Group 65 Av.Abund	Group 69 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	69.13	94.80	13.86	0.99	50.00	50.00
Cymodocea nodosa	30.88	5.20	13.86	0.99	50.00	100.00

Groups 66 & 69
Average dissimilarity = 5.20

Species	Group 66 Av.Abund	Group 69 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	100.00	94.80	2.60	0.79	50.00	50.00
Cymodocea nodosa	0.00	5.20	2.60	0.79	50.00	100.00

Groups 67 & 69
Average dissimilarity = 5.20

Species	Group 67 Av.Abund	Group 69 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	100.00	94.80	2.60	0.82	50.00	50.00
Cymodocea nodosa	0.00	5.20	2.60	0.82	50.00	100.00

Groups 68 & 69
Average dissimilarity = 5.20

Species	Group 68 Av.Abund	Group 69 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	100.00	94.80	2.60	0.82	50.00	50.00
Cymodocea nodosa	0.00	5.20	2.60	0.82	50.00	100.00

Groups 63 & 74
Average dissimilarity = 42.67

Species	Group 63 Av.Abund	Group 74 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	57.33	100.00	21.33	7.27	50.00	50.00
Cymodocea nodosa	42.67	0.00	21.33	7.27	50.00	100.00

Groups 64 & 74
Average dissimilarity = 18.40

Species	Group 64 Av.Abund	Group 74 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	81.60	100.00	9.20	1.25	50.00	50.00
Cymodocea nodosa	18.40	0.00	9.20	1.25	50.00	100.00

Groups 65 & 74
Average dissimilarity = 30.88

Species	Group 65 Av.Abund	Group 74 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	69.13	100.00	15.44	1.04	50.00	50.00
Cymodocea nodosa	30.88	0.00	15.44	1.04	50.00	100.00

Groups 66 & 74
All the dissimilarities are zero

Groups 67 & 74
All the dissimilarities are zero

Groups 68 & 74
All the dissimilarities are zero

Groups 69 & 74
Average dissimilarity = 5.20

Species	Group 69 Av.Abund	Group 74 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	94.80	100.00	2.60	0.80	50.00	50.00
Cymodocea nodosa	5.20	0.00	2.60	0.80	50.00	100.00

Groups 63 & 77
Average dissimilarity = 23.04

	Group 63	Group 77

Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cymodocea nodosa	42.67	38.13	9.50	1.16	41.23	41.23
Sand	57.33	52.50	8.85	1.18	38.43	79.66
Sea Anemone	0.00	8.88	4.44	0.37	19.26	98.92

Groups 64 & 77
Average dissimilarity = 33.45

	Group 64	Group 77				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	81.60	52.50	15.58	1.30	46.56	46.56
Cymodocea nodosa	18.40	38.13	13.19	1.21	39.42	85.99
Sea Anemone	0.00	8.88	4.44	0.37	13.27	99.25

Groups 65 & 77
Average dissimilarity = 36.36

	Group 65	Group 77				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	69.13	52.50	16.39	1.42	45.08	45.08
Cymodocea nodosa	30.88	38.13	15.28	1.31	42.03	87.11
Sea Anemone	0.00	8.88	4.44	0.38	12.20	99.31

Groups 66 & 77
Average dissimilarity = 47.50

	Group 66	Group 77				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	100.00	52.50	23.75	2.10	50.00	50.00
Cymodocea nodosa	0.00	38.13	19.06	1.54	40.13	90.13

Groups 67 & 77
Average dissimilarity = 47.50

	Group 67	Group 77				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	100.00	52.50	23.75	2.15	50.00	50.00
Cymodocea nodosa	0.00	38.13	19.06	1.58	40.13	90.13

Groups 68 & 77
Average dissimilarity = 47.50

	Group 68	Group 77				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	100.00	52.50	23.75	2.14	50.00	50.00
Cymodocea nodosa	0.00	38.13	19.06	1.57	40.13	90.13

Groups 69 & 77
Average dissimilarity = 42.95

	Group 69	Group 77				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	94.80	52.50	21.15	1.83	49.24	49.24
Cymodocea nodosa	5.20	38.13	17.11	1.48	39.84	89.09
Sea Anemone	0.00	8.88	4.44	0.37	10.33	99.42

Groups 74 & 77
Average dissimilarity = 47.50

	Group 74	Group 77				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	100.00	52.50	23.75	2.12	50.00	50.00
Cymodocea nodosa	0.00	38.13	19.06	1.56	40.13	90.13

Groups 63 & 78
Average dissimilarity = 42.67

	Group 63	Group 78				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	57.33	100.00	21.33	7.39	50.00	50.00
Cymodocea nodosa	42.67	0.00	21.33	7.39	50.00	100.00

Groups 64 & 78
Average dissimilarity = 18.40

Species	Group 64 Av.Abund	Group 78 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	81.60	100.00	9.20	1.28	50.00	50.00
Cymodocea nodosa	18.40	0.00	9.20	1.28	50.00	100.00

Groups 65 & 78
Average dissimilarity = 30.88

Species	Group 65 Av.Abund	Group 78 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	69.13	100.00	15.44	1.05	50.00	50.00
Cymodocea nodosa	30.88	0.00	15.44	1.05	50.00	100.00

Groups 66 & 78
All the dissimilarities are zero

Groups 67 & 78
All the dissimilarities are zero

Groups 68 & 78
All the dissimilarities are zero

Groups 69 & 78
Average dissimilarity = 5.20

Species	Group 69 Av.Abund	Group 78 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	94.80	100.00	2.60	0.82	50.00	50.00
Cymodocea nodosa	5.20	0.00	2.60	0.82	50.00	100.00

Groups 74 & 78
All the dissimilarities are zero

Groups 77 & 78
Average dissimilarity = 47.50

Species	Group 77 Av.Abund	Group 78 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	52.50	100.00	23.75	2.15	50.00	50.00
Cymodocea nodosa	38.13	0.00	19.06	1.58	40.13	90.13

Groups 63 & 79
Average dissimilarity = 25.78

Species	Group 63 Av.Abund	Group 79 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	57.33	74.43	12.98	1.94	50.37	50.37
Cymodocea nodosa	42.67	26.29	12.79	1.88	49.63	100.00

Groups 64 & 79
Average dissimilarity = 21.33

Species	Group 64 Av.Abund	Group 79 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cymodocea nodosa	18.40	26.29	10.73	1.16	50.30	50.30
Sand	81.60	74.43	10.60	1.16	49.70	100.00

Groups 65 & 79
Average dissimilarity = 28.23

Species	Group 65 Av.Abund	Group 79 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cymodocea nodosa	30.88	26.29	14.14	1.15	50.06	50.06
Sand	69.13	74.43	14.10	1.15	49.94	100.00

Groups 66 & 79
Average dissimilarity = 25.81

Species	Group 66 Av.Abund	Group 79 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cymodocea nodosa	0.00	26.29	13.08	1.09	50.69	50.69
Sand	100.00	74.43	12.73	1.07	49.31	100.00

Groups 67 & 79
Average dissimilarity = 25.81

Species	Group 67 Av.Abund	Group 79 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cymodocea nodosa	0.00	26.29	13.08	1.12	50.69	50.69
Sand	100.00	74.43	12.73	1.10	49.31	100.00

Groups 68 & 79
Average dissimilarity = 25.81

Species	Group 68 Av.Abund	Group 79 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cymodocea nodosa	0.00	26.29	13.08	1.12	50.69	50.69
Sand	100.00	74.43	12.73	1.10	49.31	100.00

Groups 69 & 79
Average dissimilarity = 22.51

Species	Group 69 Av.Abund	Group 79 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cymodocea nodosa	5.20	26.29	11.38	1.01	50.54	50.54
Sand	94.80	74.43	11.14	1.00	49.46	100.00

Groups 74 & 79
Average dissimilarity = 25.81

Species	Group 74 Av.Abund	Group 79 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cymodocea nodosa	0.00	26.29	13.08	1.11	50.69	50.69
Sand	100.00	74.43	12.73	1.09	49.31	100.00

Groups 77 & 79
Average dissimilarity = 34.49

Species	Group 77 Av.Abund	Group 79 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	52.50	74.43	15.72	1.40	45.57	45.57
Cymodocea nodosa	38.13	26.29	14.10	1.32	40.89	86.46
Sea Anemone	8.88	0.00	4.42	0.37	12.82	99.28

Groups 78 & 79
Average dissimilarity = 25.81

Species	Group 78 Av.Abund	Group 79 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cymodocea nodosa	0.00	26.29	13.08	1.12	50.69	50.69
Sand	100.00	74.43	12.73	1.10	49.31	100.00

Groups 63 & 80
Average dissimilarity = 42.67

Species	Group 63 Av.Abund	Group 80 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	57.33	100.00	21.33	7.27	50.00	50.00
Cymodocea nodosa	42.67	0.00	21.33	7.27	50.00	100.00

Groups 64 & 80
Average dissimilarity = 18.40

Species	Group 64 Av.Abund	Group 80 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	81.60	100.00	9.20	1.25	50.00	50.00
Cymodocea nodosa	18.40	0.00	9.20	1.25	50.00	100.00

Groups 65 & 80
Average dissimilarity = 30.88

Species	Group 65 Av.Abund	Group 80 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	69.13	100.00	15.44	1.04	50.00	50.00
Cymodocea nodosa	30.88	0.00	15.44	1.04	50.00	100.00

Groups 66 & 80
All the dissimilarities are zero

Groups 67 & 80

All the dissimilarities are zero

Groups 68 & 80
All the dissimilarities are zero

Groups 69 & 80
Average dissimilarity = 5.20

Species	Group 69 Av.Abund	Group 80 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	94.80	100.00	2.60	0.80	50.00	50.00
Cymodocea nodosa	5.20	0.00	2.60	0.80	50.00	100.00

Groups 74 & 80
All the dissimilarities are zero

Groups 77 & 80
Average dissimilarity = 47.50

Species	Group 77 Av.Abund	Group 80 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	52.50	100.00	23.75	2.12	50.00	50.00
Cymodocea nodosa	38.13	0.00	19.06	1.56	40.13	90.13

Groups 78 & 80
All the dissimilarities are zero

Groups 79 & 80
Average dissimilarity = 25.81

Species	Group 79 Av.Abund	Group 80 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cymodocea nodosa	26.29	0.00	13.08	1.11	50.69	50.69
Sand	74.43	100.00	12.73	1.09	49.31	100.00

Groups 63 & 81
Average dissimilarity = 36.93

Species	Group 63 Av.Abund	Group 81 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	57.33	94.40	18.52	5.34	50.13	50.13
Cymodocea nodosa	42.67	5.80	18.42	5.25	49.87	100.00

Groups 64 & 81
Average dissimilarity = 15.96

Species	Group 64 Av.Abund	Group 81 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	81.60	94.40	7.99	1.42	50.06	50.06
Cymodocea nodosa	18.40	5.80	7.97	1.43	49.94	100.00

Groups 65 & 81
Average dissimilarity = 26.83

Species	Group 65 Av.Abund	Group 81 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	69.13	94.40	13.43	0.95	50.05	50.05
Cymodocea nodosa	30.88	5.80	13.40	0.96	49.95	100.00

Groups 66 & 81
Average dissimilarity = 5.69

Species	Group 66 Av.Abund	Group 81 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cymodocea nodosa	0.00	5.80	2.90	1.42	50.87	50.87
Sand	100.00	94.40	2.80	1.43	49.13	100.00

Groups 67 & 81
Average dissimilarity = 5.69

Species	Group 67 Av.Abund	Group 81 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cymodocea nodosa	0.00	5.80	2.90	1.47	50.87	50.87
Sand	100.00	94.40	2.80	1.48	49.13	100.00

Groups 68 & 81
Average dissimilarity = 5.69

Species	Group 68 Av.Abund	Group 81 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cymodocea nodosa	0.00	5.80	2.90	1.47	50.87	50.87
Sand	100.00	94.40	2.80	1.47	49.13	100.00

Groups 69 & 81
Average dissimilarity = 5.81

Species	Group 69 Av.Abund	Group 81 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cymodocea nodosa	5.20	5.80	2.94	1.30	50.51	50.51
Sand	94.80	94.40	2.88	1.27	49.49	100.00

Groups 74 & 81
Average dissimilarity = 5.69

Species	Group 74 Av.Abund	Group 81 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cymodocea nodosa	0.00	5.80	2.90	1.45	50.87	50.87
Sand	100.00	94.40	2.80	1.45	49.13	100.00

Groups 77 & 81
Average dissimilarity = 42.49

Species	Group 77 Av.Abund	Group 81 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Sand	52.50	94.40	20.93	1.86	49.27	49.27
Cymodocea nodosa	38.13	5.80	16.87	1.50	39.71	88.98
Sea Anemone	8.88	0.00	4.43	0.37	10.43	99.41

Groups 78 & 81
Average dissimilarity = 5.69

Species	Group 78 Av.Abund	Group 81 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cymodocea nodosa	0.00	5.80	2.90	1.48	50.87	50.87
Sand	100.00	94.40	2.80	1.48	49.13	100.00

Groups 79 & 81
Average dissimilarity = 21.65

Species	Group 79 Av.Abund	Group 81 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cymodocea nodosa	26.29	5.80	10.93	0.98	50.46	50.46
Sand	74.43	94.40	10.73	0.97	49.54	100.00

Groups 80 & 81
Average dissimilarity = 5.69

Species	Group 80 Av.Abund	Group 81 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Cymodocea nodosa	0.00	5.80	2.90	1.45	50.87	50.87
Sand	100.00	94.40	2.80	1.45	49.13	100.00

Appendix 5.12: Principal Component Analysis (PCA) (Physico-Chemical Data) at ZWDP

PCA
Principal Component Analysis

Data worksheet
Name: Data3
Data type: Environmental
Sample selection: All
Variable selection: All

Eigenvalues

PC	Eigenvalues	%Variation	Cum.%Variation
1	13.5	67.6	67.6
2	2.77	13.8	81.4
3	1.35	6.8	88.2
4	0.843	4.2	92.4
5	0.49	2.4	94.9

Eigenvectors
(Coefficients in the linear combinations of variables making up PC's)

Variable	PC1	PC2	PC3	PC4	PC5
Depth (m)	0.089	-0.234	0.680	-0.123	-0.096
T1 sea surface (°C)	-0.192	0.404	-0.002	0.087	0.166
T2 sea bottom (°C)	-0.192	0.337	-0.141	0.072	-0.230
pH	0.007	0.365	0.578	-0.352	0.168
Salinity (PSU)	-0.228	-0.243	0.073	0.153	0.362
Total alkalinity CaCO3 (mg/L)	-0.244	-0.182	-0.023	-0.101	-0.222
Bicarbonate HCO3-(mg/L)	-0.244	-0.182	-0.023	-0.101	-0.222
Total Hardness as CaCO3 (mg/L)	-0.259	0.017	-0.047	-0.170	0.152
Ca+2 Hardness as CaCO3 (mg/L)	-0.259	-0.110	-0.074	0.002	0.039
Mg+2 Hardness as CaCO3 (mg/L)	-0.263	-0.014	-0.045	-0.117	0.119
Cl- (mg/L)	-0.226	-0.249	0.089	0.124	0.389
NO3-(mg/L)	-0.208	0.279	0.181	0.378	-0.240
SO4^2- (mg/L)	-0.263	-0.070	0.123	-0.009	-0.074
PO4^3- (mg/L)	-0.257	0.035	0.158	0.057	0.178
Na+ (mg/L)	-0.214	-0.134	0.008	-0.407	-0.502
k+ (mg/L)	-0.265	-0.037	0.092	0.111	-0.200
Ca+2 (mg/L)	-0.253	-0.147	-0.113	-0.076	0.112
Mg+2 (mg/L)	-0.263	-0.014	-0.045	-0.117	0.119
Fe (mg/L)	-0.222	0.215	0.167	0.426	-0.150
O2 (mg/L)	0.127	-0.405	0.189	0.471	-0.160

Principal Component Scores

Sample	SCORE1	SCORE2	SCORE3	SCORE4	SCORE5
St 1	-2.45	-2.38	2.14	-0.742	0.14
St 2	4.41	0.142	1.64	0.541	0.692
St 3	3.12	2.06	0.902	-0.628	8.28E-2
St 4	2.33	2.58	-0.386	-0.818	0.128
St 5	1.72	2.28	7.46E-2	-1.05	0.39
St 6	-1.06	-2.72	-0.564	0.642	0.372
St 7	-1.64	-2.91	1.13	7.41E-2	0.202
St 8	5	0.397	-0.756	2.3	1.42
St 9	1.04	-0.699	-0.826	0.35	-1.17
St 10	-0.309	0.719	-0.508	-0.767	-0.489
St 11	-0.804	-0.561	-1.31	0.177	-0.393
St 12	-0.787	-0.316	-2.4	0.293	-0.407
St 13	0.697	-0.574	-1.04	-3.44E-2	-0.41
St 14	-11.1	3.08	1.07	1.68	-0.262
St 15	-5.96	-0.565	-1.33	-1.63	1.61
St 16	1.41	0.213	0.709	-0.271	-0.17
St 17	1.93	-0.599	0.949	0.139	-0.812
St 18	1.15	-0.144	0.304	-0.112	-0.654
St 19	1.32	-4.1E-3	0.208	-0.146	-0.273

Outputs
Plot: Graph3

Appendix 5.13: Principal Component Analysis (PCA) (Organic content level & Grain size) at ZWDP

PCA
Principal Component Analysis

Data worksheet
Name: Data4
Data type: Environmental
Sample selection: All
Variable selection: All

Eigenvalues

PC	Eigenvalues	%Variation	Cum.%Variation
1	1.07	53.7	53.7
2	0.925	46.3	100.0

Eigenvectors
(Coefficients in the linear combinations of variables making up PC's)

Variable	PC1	PC2
Organic Materials	0.707	0.707
Mz	-0.707	0.707

Principal Component Scores

Sample	SCORE1	SCORE2
St 1	0.133	-1.02
St 2	1.08	1.8
St 3	-0.666	1.1
St 4	-0.824	1.12
St 5	-1.52	1.29
St 6	-0.905	0.674
St 7	-0.689	0.161
St 8	2.09	0.259
St 9	1.29	-0.601
St 10	0.531	0.889
St 11	-0.36	-3.05E-3
St 12	-0.183	-0.246
St 13	-1.22	-0.862
St 14	-0.889	-1.92
St 15	-0.983	-0.371
St 16	0.89	-0.329
St 17	1.57	-2.16E-2
St 18	-3.01E-2	-1.06
St 19	0.682	-0.847

Outputs
Plot: Graph4

Appendix 5.14: Principal Component Analysis (PCA) (Physico-chemical data) at WTRIS

PCA
Principal Component Analysis

Data worksheet
Name: Data3
Data type: Environmental
Sample selection: All
Variable selection: All

Eigenvalues

PC	Eigenvalues	%Variation	Cum.%Variation
1	14.5	72.5	72.5
2	1.99	10.0	82.5
3	1.41	7.1	89.5
4	0.951	4.8	94.3
5	0.435	2.2	96.5

Eigenvectors
(Coefficients in the linear combinations of variables making up PC's)

Variable	PC1	PC2	PC3	PC4	PC5
Depth (m)	0.186	0.270	0.054	0.294	-0.765
T1 sea surface (°C)	-0.235	0.104	0.187	0.217	0.089
T2 sea bottom (°C)	-0.234	0.133	0.213	0.186	0.018
pH	-0.019	0.023	0.555	-0.732	-0.190
Salinity	-0.181	-0.116	0.432	0.416	0.247
Total alkalinity CaCO3 (mg/L)	-0.235	0.309	0.004	0.003	-0.012
Bicarbonate HCO3-(mg/L)	-0.235	0.309	0.004	0.003	-0.012
Total Hardness as CaCO3 (mg/L)	-0.257	-0.083	-0.049	-0.050	-0.188
Calcium Hardness as CaCO3 (mg/L)	-0.253	0.138	0.069	-0.008	-0.077
Magnesium Hardness as CaCO3 (mg/L)	-0.248	-0.174	-0.098	-0.066	-0.229
Cl- (mg/L)	-0.233	-0.251	-0.095	-0.157	0.015
NO3-(mg/L)	-0.201	0.437	-0.114	0.025	-0.010
SO4^2- (mg/L)	-0.245	0.112	-0.193	-0.099	0.192
Phosphorus total PO4^3- (mg/L)	-0.248	-0.015	0.148	-0.049	-0.067
Na+ (mg/L)	-0.180	-0.340	-0.347	0.058	-0.274
k+ (mg/L)	-0.249	-0.045	-0.160	-0.083	0.147
Ca+2 (mg/L)	-0.253	0.138	0.069	-0.008	-0.077
Mg+2 (mg/L)	-0.248	-0.174	-0.098	-0.066	-0.229
Fe (mg/L)	-0.138	-0.451	0.370	0.251	-0.134
O2 (mg/L)	0.254	0.041	0.160	0.038	0.011

Principal Component Scores

Sample	SCORE1	SCORE2	SCORE3	SCORE4	SCORE5
St 1	3.61	0.843	-0.409	1.44	-0.971
St 2	2.43	0.402	-0.495	0.916	-0.82
St 3	2.98	0.714	6.71E-2	9.92E-2	-0.719
St 4	1.83	-7.9E-2	-0.414	9.24E-2	-6.55E-2
St 5	0.751	-0.768	-1.4	0.735	0.659
St 6	1.23	-0.39	0.207	0.641	1.01
St 7	1.48	-6.52E-2	0.151	-0.366	-0.384
St 8	-6.69	-1.56	3.03	2.13	3.71E-2
St 9	-10	4.24	-1.01	-0.109	0.139
St 10	-2.04	-0.852	0.541	-0.516	0.301
St 11	-3.84	-1.14	0.476	-1.34	-0.922
St 12	-2.3	-1.02	-1.46	0.449	-6.4E-2
St 13	-1.63	-1.41	-5.79E-2	-1.57	-0.182
St 14	0.807	-0.925	-1.1	-2.99E-2	0.893
St 15	4.16	0.918	0.957	-0.365	-0.764
St 16	5.3	2.33	2.51	-0.895	1.09
St 17	2.66	0.189	-1.08	0.775	0.499
St 18	5.98E-2	-0.79	-0.588	-0.797	0.476
St 19	-0.772	-0.646	8.81E-2	-1.29	-0.215

Outputs
Plot: Graph3

Appendix 5.15: Principal Component Analysis (PCA) (Organic content level & Grain size) at WTRIS

PCA
Principal Component Analysis

Data worksheet
Name: Data4
Data type: Environmental
Sample selection: All
Variable selection: All

Eigenvalues

PC	Eigenvalues	%Variation	Cum.%Variation
1	1.31	65.4	65.4
2	0.691	34.6	100.0

Eigenvectors
(Coefficients in the linear combinations of variables making up PC's)

Variable	PC1	PC2
Organic Materials	0.707	-0.707
Mz	0.707	0.707

Principal Component Scores

Sample	SCORE1	SCORE2
St 1	0.821	-0.894
St 2	1.02	-0.24
St 3	1.33	-0.361
St 4	0.177	-0.25
St 5	-0.309	-0.285
St 6	0.241	0.222
St 7	0.517	0.67
St 8	0.155	0.308
St 9	-3.04	-0.786
St 10	-1.38	0.852
St 11	1.52E-2	1.67
St 12	1.12	0.498
St 13	-1.83	-0.389
St 14	-0.912	3.43E-2
St 15	1.18	-1.18
St 16	0.402	-1.01
St 17	0.475	-1
St 18	0.782	1.56
St 19	-0.768	0.587

Outputs
Plot: Graph4

Appendix 5.16: Relation between Physico-chemical Data and Community Composition (SPSS - Nonparametric Tests) at ZWDP

```
*Nonparametric Tests: One Sample.
NPTESTS
/ONESAMPLE TEST (Score1 Score2 Score3 Score4 Score5 P.oceanica)
 /MISSING SCOPE=ANALYSIS USERMISSING=EXCLUDE
 /CRITERIA ALPHA=0.05 CILEVEL=95.
```

Nonparametric Tests

Notes		
Output Created		22-MAY-2014 13:17:45
Comments		
Input	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	19
Syntax		NPTESTS /ONESAMPLE TEST (Score1 Score2 Score3 Score4 Score5 P.oceanica) /MISSING SCOPE=ANALYSIS USERMISSING=EXCLUDE /CRITERIA ALPHA=0.05 CILEVEL=95.
Resources	Processor Time	00:00:00.28
	Elapsed Time	00:00:00.30

[DataSet0]

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Score1 is normal with mean 0.00 and standard deviation 3.67.	One-Sample Kolmogorov-Smirnov Test	.600	Retain the null hypothesis.
2	The distribution of Score2 is normal with mean -0.00 and standard deviation 1.66.	One-Sample Kolmogorov-Smirnov Test	.575	Retain the null hypothesis.
3	The distribution of Score3 is normal with mean 0.00 and standard deviation 1.16.	One-Sample Kolmogorov-Smirnov Test	.987	Retain the null hypothesis.
4	The distribution of Score4 is normal with mean -0.00 and standard deviation 0.92.	One-Sample Kolmogorov-Smirnov Test	.845	Retain the null hypothesis.
5	The distribution of Score5 is normal with mean -0.00 and standard deviation 0.70.	One-Sample Kolmogorov-Smirnov Test	.902	Retain the null hypothesis.
6	The distribution of P.oceanica is normal with mean 14.43 and standard deviation 31.94.	One-Sample Kolmogorov-Smirnov Test	.001	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

```
NONPAR CORR
/VARIABLES=Score1 P.oceanica
 /PRINT=SPEARMAN TWOTAIL NOSIG
 /MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes

Output Created		22-MAY-2014 13:18:01
Comments		
Input	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	19
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=Score1 P.oceanica /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00
	Number of Cases Allowed	174762 cases[a]

a. Based on availability of workspace memory

[DataSet0]

Correlations

			Score1	P.oceanica
Spearman's rho	Score1	Correlation Coefficient	1.000	.673**
		Sig. (2-tailed)	.	**.002**
		N	19	19
	P.oceanica	Correlation Coefficient	.673**	1.000
		Sig. (2-tailed)	.002	.
		N	19	19

**. Correlation is significant at the 0.01 level (2-tailed).

```
NONPAR CORR
/VARIABLES=Score2 P.oceanica
/PRINT=SPEARMAN TWOTAIL NOSIG
/MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes

Output Created		22-MAY-2014 13:18:48
Comments		
Input	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	19
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=Score2 P.oceanica /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00
	Number of Cases Allowed	174762 cases[a]

a. Based on availability of workspace memory

[DataSet0]

Correlations

			Score2	P.oceanica
Spearman's rho	Score2	Correlation Coefficient	1.000	.197
		Sig. (2-tailed)	.	.419
		N	19	19
	P.oceanica	Correlation Coefficient	.197	1.000
		Sig. (2-tailed)	.419	.
		N	19	19

```
NONPAR CORR
/VARIABLES=Score3 P.oceanica
/PRINT=SPEARMAN TWOTAIL NOSIG
 /MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes

Output Created		22-MAY-2014 13:19:02
Comments		
Input	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	19
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=Score3 P.oceanica /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.01
	Number of Cases Allowed	174762 cases[a]

a. Based on availability of workspace memory

[DataSet0]

Correlations

			Score3	P.oceanica
Spearman's rho	Score3	Correlation Coefficient	1.000	.275
		Sig. (2-tailed)	.	.255
		N	19	19
	P.oceanica	Correlation Coefficient	.275	1.000
		Sig. (2-tailed)	.255	.
		N	19	19

```
NONPAR CORR
/VARIABLES=Score4 P.oceanica
/PRINT=SPEARMAN TWOTAIL NOSIG
/MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes

Output Created		22-MAY-2014 13:19:16
Comments		
Input	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	19
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=Score4 P.oceanica /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.02
	Number of Cases Allowed	174762 cases[a]

a. Based on availability of workspace memory

[DataSet0]

Correlations

			Score4	P.oceanica
Spearman's rho	Score4	Correlation Coefficient	1.000	.212
		Sig. (2-tailed)	.	.384
		N	19	19
	P.oceanica	Correlation Coefficient	.212	1.000
		Sig. (2-tailed)	.384	.
		N	19	19

```
NONPAR CORR
 /VARIABLES=Score5 P.oceanica
 /PRINT=SPEARMAN TWOTAIL NOSIG
 /MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes		
Output Created		22-MAY-2014 13:19:27
Comments		
Input	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	19
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=Score5 P.oceanica /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.01
	Number of Cases Allowed	174762 cases[a]

a. Based on availability of workspace memory

[DataSet0]

Correlations				
			Score5	P.oceanica
Spearman's rho	Score5	Correlation Coefficient	1.000	.164
		Sig. (2-tailed)	.	.502
		N	19	19
	P.oceanica	Correlation Coefficient	.164	1.000
		Sig. (2-tailed)	.502	.
		N	19	19

Appendix 5.17: Relation between Organic Content level Data and Community Composition (seagrass) (SPSS - Nonparametric Tests) at ZWDP

```
*Nonparametric Tests: One Sample.
NPTESTS
/ONESAMPLE TEST (Score1 Score2 P.oceanica)
/MISSING SCOPE=ANALYSIS USERMISSING=EXCLUDE
/CRITERIA ALPHA=0.05 CILEVEL=95.
```

Nonparametric Tests

Notes

Output Created		22-MAY-2014 13:26:10
Comments		
Input	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	19
Syntax		NPTESTS /ONESAMPLE TEST (Score1 Score2 P.oceanica) /MISSING SCOPE=ANALYSIS USERMISSING=EXCLUDE /CRITERIA ALPHA=0.05 CILEVEL=95.
Resources	Processor Time	00:00:00.27
	Elapsed Time	00:00:00.27

[DataSet0]

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Score1 is norma with mean -0.00 and standard deviation 1.04.	One-Sample Kolmogorov-Smirnov Test	.711	Retain the null hypothesis.
2	The distribution of Score2 is norma with mean 0.00 and standard deviation 0.96.	One-Sample Kolmogorov-Smirnov Test	.999	Retain the null hypothesis.
3	The distribution of P.oceanica is normal with mean 14.43 and standard deviation 31.94.	One-Sample Kolmogorov-Smirnov Test	.001	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

```
NONPAR CORR
/VARIABLES=Score1 P.oceanica
/PRINT=SPEARMAN TWOTAIL NOSIG
/MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes

Output Created		22-MAY-2014 13:26:25
Comments		
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	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
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Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.01
	Number of Cases Allowed	174762 cases[a]

a. Based on availability of workspace memory

[DataSet0]

Correlations

			Score1	P.oceanica
Spearman's rho	Score1	Correlation Coefficient	1.000	.573*
		Sig. (2-tailed)	.	**.010**
		N	19	19
	P.oceanica	Correlation Coefficient	.573*	1.000
		Sig. (2-tailed)	.010	.
		N	19	19

*. Correlation is significant at the 0.05 level (2-tailed).

Appendix 5.18: Relation between Mean Grain Size Data and Community Composition (seagrass) at ZWDP

```
NONPAR CORR
 /VARIABLES=Score2 P.oceanica
 /PRINT=SPEARMAN TWOTAIL NOSIG
/MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes		
Output Created		22-MAY-2014 13:26:39
Comments		
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	Split File	<none>
	N of Rows in Working Data File	19
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=Score2 P.oceanica /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.01
	Number of Cases Allowed	174762 cases[a]

a. Based on availability of workspace memory

[DataSet0]

Correlations				
			Score2	P.oceanica
Spearman's rho	Score2	Correlation Coefficient	1.000	.359
		Sig. (2-tailed)	.	**.132**
		N	19	19
	P.oceanica	Correlation Coefficient	.359	1.000
		Sig. (2-tailed)	.132	.
		N	19	19

Appendix 5.19: Relation between Physico-chemical Data and Community Composition at WTRIS

```
*Nonparametric Tests: One Sample.
NPTESTS
/ONESAMPLE TEST (Score1 Score2 Score3 Score4 Score5 C.nodosa)
/MISSING SCOPE=ANALYSIS USERMISSING=EXCLUDE
 /CRITERIA ALPHA=0.05 CILEVEL=95.
```

Nonparametric Tests

Notes

Output Created		22-MAY-2014 15:50:39
Comments		
Input	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	19
Syntax		NPTESTS /ONESAMPLE TEST (Score1 Score2 Score3 Score4 Score5 C.nodosa) /MISSING SCOPE=ANALYSIS USERMISSING=EXCLUDE /CRITERIA ALPHA=0.05 CILEVEL=95.
Resources	Processor Time	00:00:00.27
	Elapsed Time	00:00:00.28

[DataSet0]

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Score1 is normal with mean 0.00 and standard deviation 3.81.	One-Sample Kolmogorov-Smirnov Test	.737	Retain the null hypothesis.
2	The distribution of Score2 is normal with mean -0.00 and standard deviation 1.41.	One-Sample Kolmogorov-Smirnov Test	.771	Retain the null hypothesis.
3	The distribution of Score3 is normal with mean 0.00 and standard deviation 1.19.	One-Sample Kolmogorov-Smirnov Test	.658	Retain the null hypothesis.
4	The distribution of Score4 is normal with mean -0.00 and standard deviation 0.98.	One-Sample Kolmogorov-Smirnov Test	.997	Retain the null hypothesis.
5	The distribution of Score5 is normal with mean -0.00 and standard deviation 0.66.	One-Sample Kolmogorov-Smirnov Test	.927	Retain the null hypothesis.
6	The distribution of C.nodosa is normal with mean 8.78 and standard deviation 14.59.	One-Sample Kolmogorov-Smirnov Test	.015	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

NONPAR CORR

/VARIABLES=Score1 C.nodosa
/PRINT=SPEARMAN TWOTAIL NOSIG
/MISSING=PAIRWISE.

Nonparametric Correlations

Notes		
Output Created		22-MAY-2014 15:51:01
Comments		
Input	Active Dataset	DataSet0
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	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	19
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=Score1 C.nodosa /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00
	Number of Cases Allowed	174762 cases[a]

a. Based on availability of workspace memory

[DataSet0]

Correlations				
			Score1	C.nodosa
Spearman's rho	Score1	Correlation Coefficient	1.000	.637**
		Sig. (2-tailed)	.	**.003**
		N	19	19
	C.nodosa	Correlation Coefficient	.637**	1.000
		Sig. (2-tailed)	.003	.
		N	19	19

**. Correlation is significant at the 0.01 level (2-tailed).

```
NONPAR CORR
/VARIABLES=Score2 C.nodosa
/PRINT=SPEARMAN TWOTAIL NOSIG
/MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes		
Output Created		22-MAY-2014 15:51:22
Comments		
Input	Active Dataset	DataSet0
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	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	19
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=Score2 C.nodosa /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02
	Number of Cases Allowed	174762 cases[a]

a. Based on availability of workspace memory

[DataSet0]

Correlations				
			Score2	C.nodosa
Spearman's rho	Score2	Correlation Coefficient	1.000	.559*
		Sig. (2-tailed)	.	.013
		N	19	19
	C.nodosa	Correlation Coefficient	.559*	1.000
		Sig. (2-tailed)	.013	.
		N	19	19

*. Correlation is significant at the 0.05 level (2-tailed).

```
NONPAR CORR
/VARIABLES=Score3 C.nodosa
/PRINT=SPEARMAN TWOTAIL NOSIG
/MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes

Output Created		22-MAY-2014 15:51:33
Comments		
Input	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	19
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=Score3 C.nodosa /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00
	Number of Cases Allowed	174762 cases[a]

a. Based on availability of workspace memory

[DataSet0]

Correlations

			Score3	C.nodosa
Spearman's rho	Score3	Correlation Coefficient	1.000	.062
		Sig. (2-tailed)	.	.801
		N	19	19
	C.nodosa	Correlation Coefficient	.062	1.000
		Sig. (2-tailed)	.801	.
		N	19	19

```
NONPAR CORR
/VARIABLES=Score4 C.nodosa
/PRINT=SPEARMAN TWOTAIL NOSIG
/MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes

Output Created		22-MAY-2014 15:51:46
Comments		
Input	Active Dataset	DataSet0
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	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	19
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=Score4 C.nodosa /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00
	Number of Cases Allowed	174762 cases[a]

a. Based on availability of workspace memory

[DataSet0]

Correlations

			Score4	C.nodosa
Spearman's rho	Score4	Correlation Coefficient	1.000	.289
		Sig. (2-tailed)	.	.230
		N	19	19
	C.nodosa	Correlation Coefficient	.289	1.000
		Sig. (2-tailed)	.230	.
		N	19	19

```
NONPAR CORR
 /VARIABLES=Score5 C.nodosa
/PRINT=SPEARMAN TWOTAIL NOSIG
 /MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes		
Output Created		22-MAY-2014 15:51:56
Comments		
Input	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	19
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=Score5 C.nodosa /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00
	Number of Cases Allowed	174762 cases[a]

a. Based on availability of workspace memory

[DataSet0]

Correlations				
			Score5	C.nodosa
Spearman's rho	Score5	Correlation Coefficient	1.000	-.597**
		Sig. (2-tailed)	.	.007
		N	19	19
	C.nodosa	Correlation Coefficient	-.597**	1.000
		Sig. (2-tailed)	.007	.
		N	19	19

**. Correlation is significant at the 0.01 level (2-tailed).

Appendix 5.20: Relation between Organic Content level Data and Community Composition at WTRIS

*Nonparametric Tests: One Sample.
NPTESTS
/ONESAMPLE TEST (Score1 Score2 C.nodosa)
/MISSING SCOPE=ANALYSIS USERMISSING=EXCLUDE
/CRITERIA ALPHA=0.05 CILEVEL=95.

Nonparametric Tests

Notes		
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Comments		
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	Split File	<none>
	N of Rows in Working Data File	19
Syntax		NPTESTS /ONESAMPLE TEST (Score1 Score2 C.nodosa) /MISSING SCOPE=ANALYSIS USERMISSING=EXCLUDE /CRITERIA ALPHA=0.05 CILEVEL=95.
Resources	Processor Time	00:00:00.17
	Elapsed Time	00:00:00.32

[DataSet0]

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Score1 is normal with mean -0.00 and standard deviation 1.14.	One-Sample Kolmogorov-Smirnov Test	.502	Retain the null hypothesis.
2	The distribution of Score2 is normal with mean -0.00 and standard deviation 0.83.	One-Sample Kolmogorov-Smirnov Test	.850	Retain the null hypothesis.
3	The distribution of C.nodosa is normal with mean 8.78 and standard deviation 14.59.	One-Sample Kolmogorov-Smirnov Test	.015	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

```
NONPAR CORR
/VARIABLES=Score1 C.nodosa
/PRINT=SPEARMAN TWOTAIL NOSIG
/MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes

Output Created		23-MAY-2014 12:30:21
Comments		
Input	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	19
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=Score1 C.nodosa /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.01
	Number of Cases Allowed	174762 cases[a]

a. Based on availability of workspace memory

[DataSet0]

Correlations

			Score1	C.nodosa
Spearman's rho	Score1	Correlation Coefficient	1.000	.610**
		Sig. (2-tailed)	.	**.006**
		N	19	19
	C.nodosa	Correlation Coefficient	.610**	1.000
		Sig. (2-tailed)	.006	.
		N	19	19

**. Correlation is significant at the 0.01 level (2-tailed).

Appendix 5.21: Relation between Mean Grain Size Data and Community Composition (seagrass) at WTRIS

```
NONPAR CORR
/VARIABLES=Score2 C.nodosa
/PRINT=SPEARMAN TWOTAIL NOSIG
/MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes

Output Created		23-MAY-2014 12:30:38
Comments		
Input	Active Dataset	DataSet0
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	N of Rows in Working Data File	19
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=Score2 C.nodosa /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.01
	Number of Cases Allowed	174762 cases[a]

a. Based on availability of workspace memory

[DataSet0]

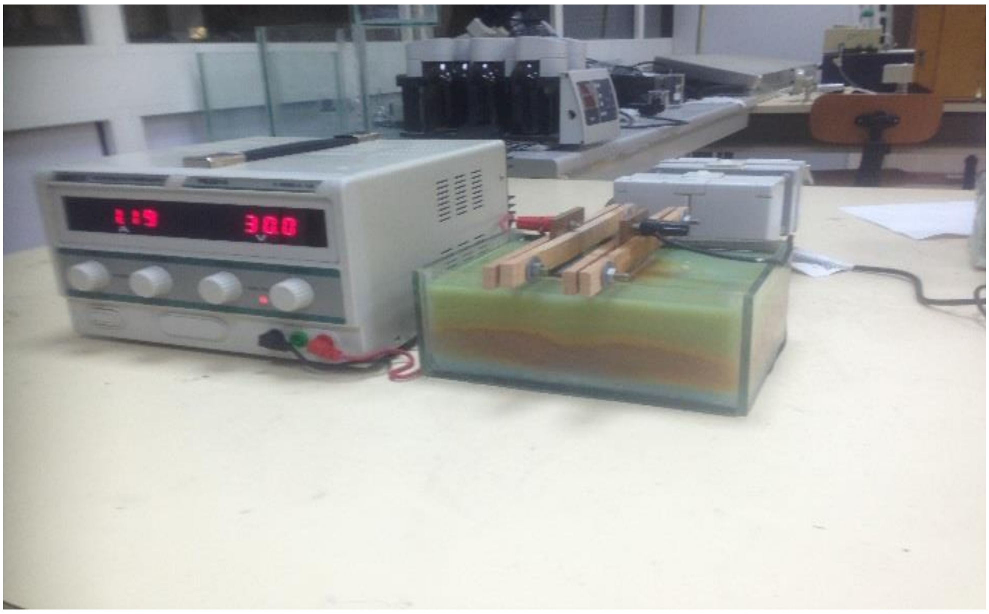
Correlations

			Score2	C.nodosa
Spearman's rho	Score2	Correlation Coefficient	1.000	.405
		Sig. (2-tailed)	.	**.085**
		N	19	19
	C.nodosa	Correlation Coefficient	.405	1.000
		Sig. (2-tailed)	.085	.
		N	19	19

- **Appendix – 6th Chapter**

Appendix 6.1: Different Electrode Materials and Experiment procedure-NaOCl


HUE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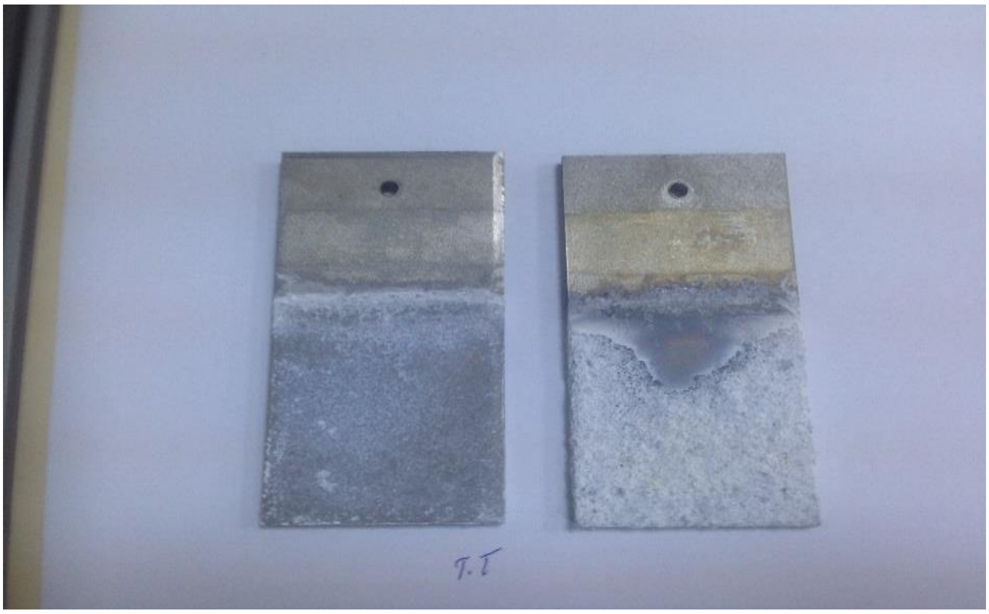
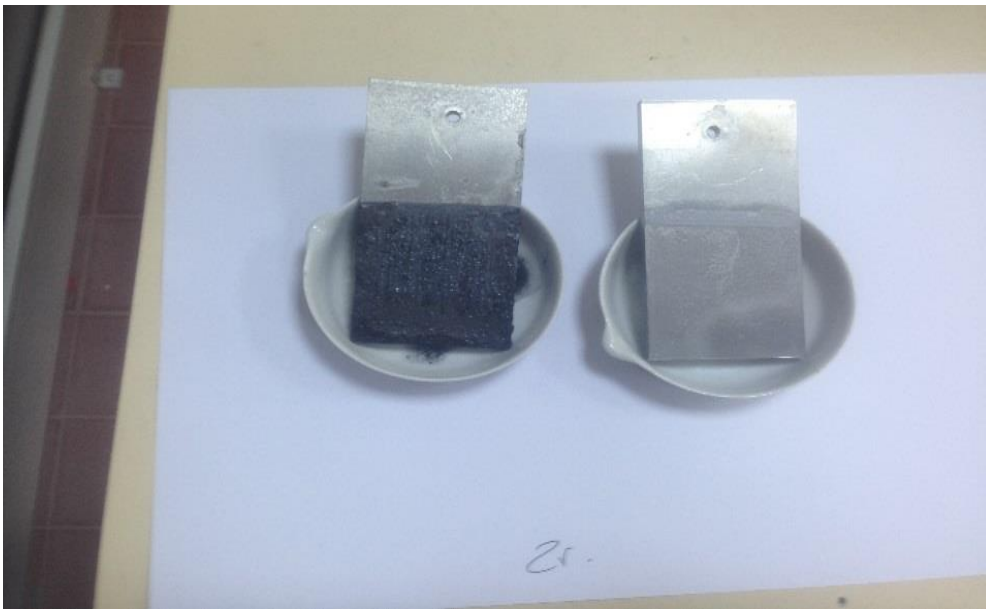
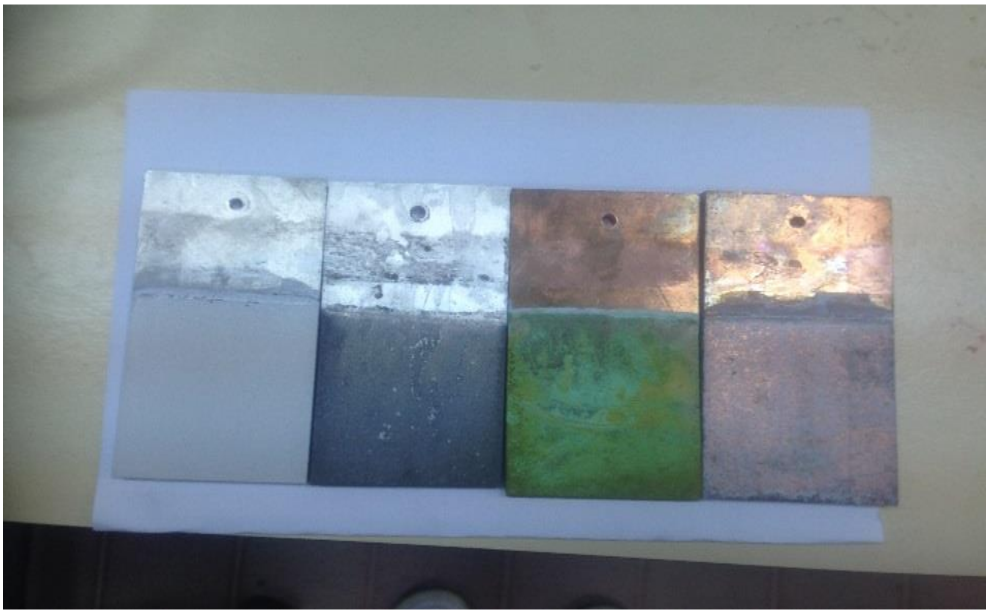
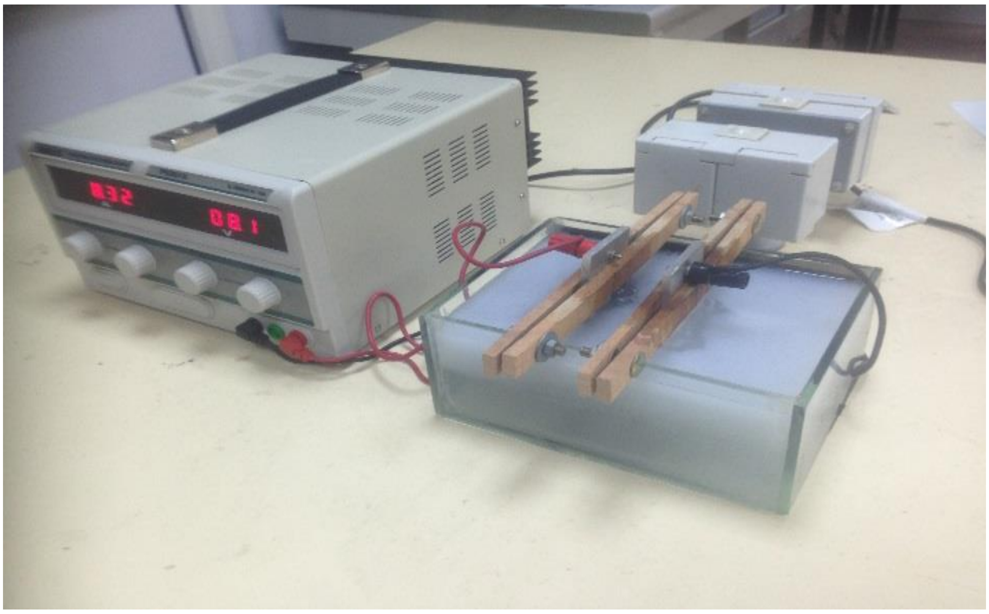
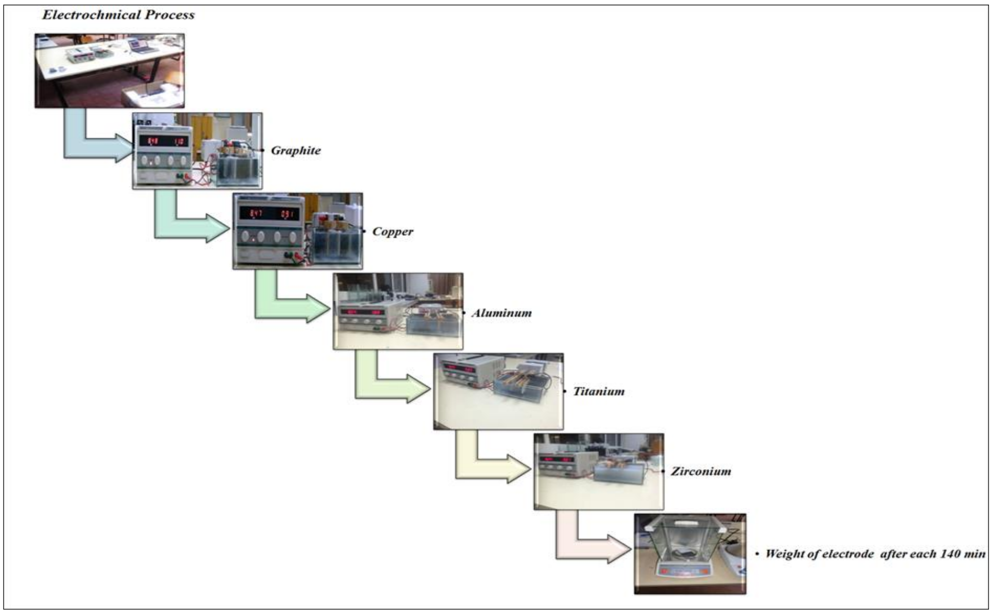
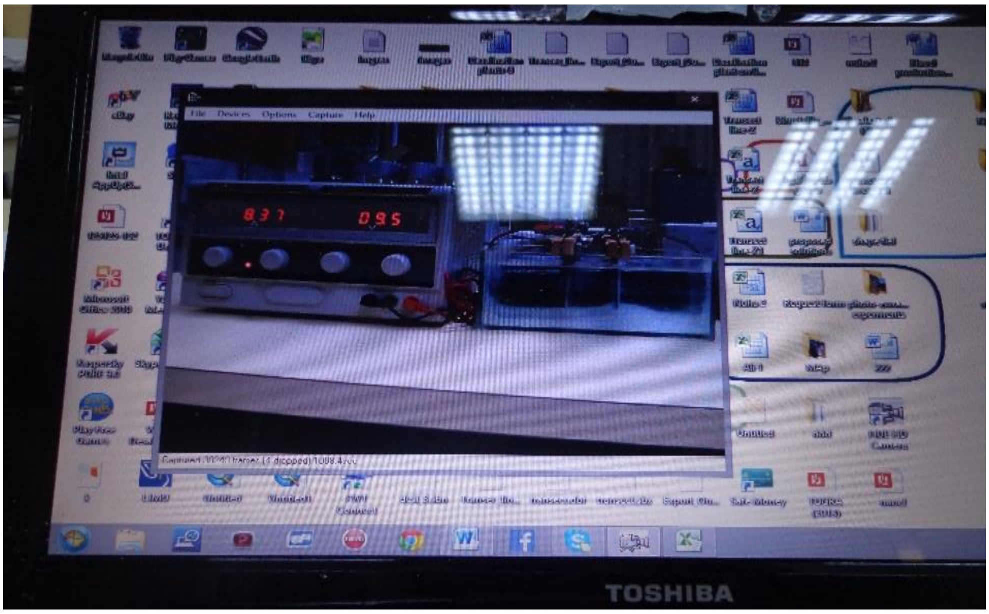



Zr.






Electrochmical Process
Graphite
Copper
Aluminum
Titanium
Zirconium
Weight of electrode after each 140 min



- **Experiment procedure-NaOCl**

a 1 µl of brine sample was transferred into the graduated cylinder of volume 100 ml to be diluted ten-fold by adding deionized water to 100 ml mark on the graduated flask as prepared sample. Next that, spectrophotometer (DR2800) was turned on and the program 80 Chlor. F&T was selected. A 10 ml of deionized water was filled into a round sample as blank. Following this, the blank was wiped by using the white tissue paper and then the zero button was pushed to display 0.00 mg/l Cl_2. After that, a 10 ml of the prepared sample was transferred to a second around cell and then one tablet of DPD free chlorine reagent powder pillow was added into the prepared sample. Next that, the sample is swirled for 20 seconds to mix, and then the prepared sample was placed into the spectrophotometer (DR2800) holder and then the result displayed on the screen. After each experiment which is taken about 1:40 h, the electrodes (anode and cathode) were weighted by using sensitive electronic balance in order to evaluate the corrosion and the scales in each type of electrodes material.

- **Appendixes – 7th Chapter**

Appendix 7.1: Evaporation ponds installation

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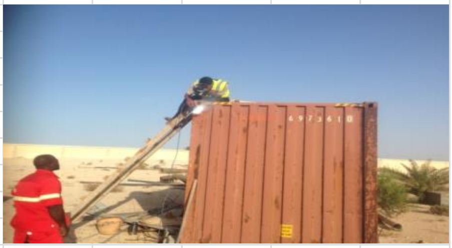

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24

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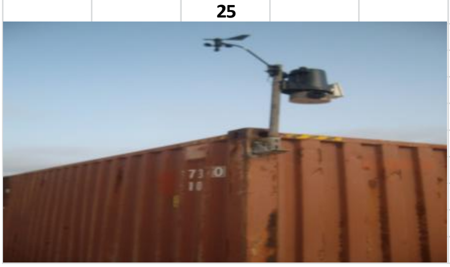

26

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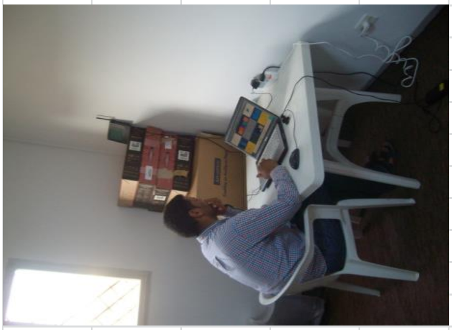

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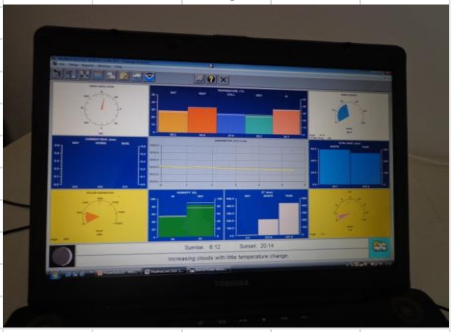

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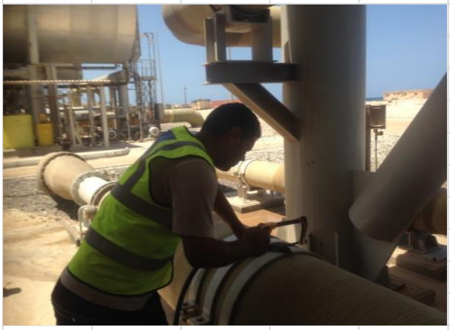

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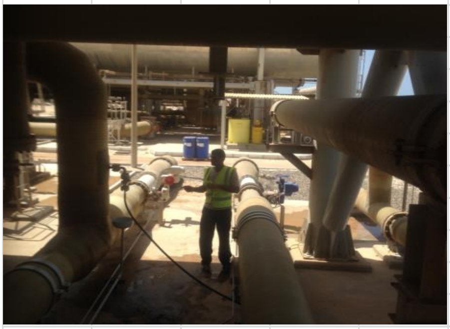
31



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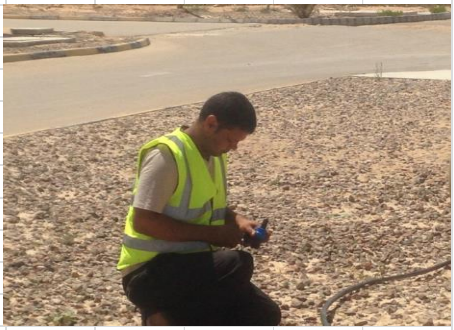

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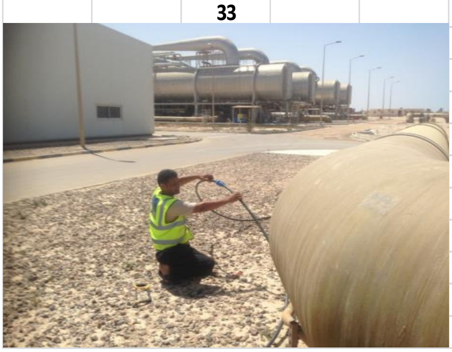

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Appendix 7.2: Laboratory Work One: Chemical Analysis for the Brine of ZWDP

The main goal of these experiments is to identify the chemical compound of the brine, which is transferred into the evaporation ponds.

7.2.1. Determination the Concentration of Cl^- ions in Brine of ZWDP

Aim: To determine the concentration, weight and percentage of chloride ions for brine sample collected from evaporate of thermal desalination plant (ZWDP). As the salinity expected to be quietly high, the chloride ion concentration is determination using Hach method 8207 by titration as explained below.

- **Equipment Used for the Experiment**

- Volumetric flask, 100 ml.
- Conical flasks, 250 ml.
- Digital titrator and stand.
- Pipette (10 ml) and safety filler.
- Graduated cylinder.

- **Materials**

- Brine sample collected from ZWDP.

- Potassium dichromate solution.
- Standard Solution (0.100 M AgNO3).

- **Chemical Reaction Mechanism**

This technique used to detect concentration of chloride ions (ppm) in a solution by using standard solution of silver nitrate (AgNO3). Sliver ions (Ag+) from indissoluble sliver chloride (AgCl) when is added to a solution comprising chloride ions as shown in the equation below: -

$$Ag^{+}\ (aq) + Cl^{-}\ (aq) \longrightarrow AgCl\ (s)$$

The amount of chloride in a solution can be found, by adding sliver ions until sliver chloride is no longer precipitated. The end point of the titration can be indicated by using Potassium chromate (K2CrO4). The end point at which all the chloride ions are precipitated. Chromate ions combine with silver ions into form a red precipitate of sliver chromate (VI) as shown in the following chemical reaction.

$$2Ag^{+}\ (aq) + CrO42^{-}\ (aq) \longrightarrow Ag_2CrO_4\ (s)$$

While both chromate ions and chloride ions are present, however, no sliver chromate is precipitated when all the chloride ions are detached. The sudden appearance of the red sliver dichromate which is indicated the end point of the titration.

- **Procedure of the Experiment**

A 10 ml of the brine, which was collected from the evaporator of ZWDP, was transferred into the volumetric flask of volume 100 ml by graduated cylinder of volume 100 ml to be diluted ten-fold by adding distilled water to zero mark on the flask, and then the flask is stopper and mixed completely. Hach method 8207 was applied in order to obtain sensible results. And more in the experiment process depth is explained in the following steps.

- 100 ml of the sample is transferred by graduated cylinder of volume 100 ml into a 250 ml conical flask.

- After that, A 1 chloride 2 indicator Powder Pillow was added to the sample, next that, the sample was swirled for mix.
- Following this, the silver nitrate was added into the conical flask for titration with help of digital titrator, when the colour of the solution changed from yellow to red brown, the number of digital titrator was recorded in (**Table 7.8**). Therefore, the concentration and percentage of chloride ions in the brine sample was determined by equations **7.16, 7.17, 7.18, 7.19** and **7.20**, which are presented into the calculation section.

Table.7.8: Titration Cartridge Reading for Brine Sample of ZWDP

Titration Trial	Titration Cartridge Reading
Trial-1	1,439.2

- **Calculation**

$$\text{Concentration of Cl}^- \text{ (mg/l)} = \text{ number was obtained from digital titrator} \times 0.1 \quad \textbf{(7.16)}$$

Where (0.1) is the multiplier that chosen according to the volume of seawater prepared sample.

By multiplying the diluting constant, which is 200, so the total concentration of Cl^- can be calculated as from following equation: -

$$\text{Total Concentration of Cl}^- \text{ (mg/l)} = \text{ Concentration of Cl}^- \text{ (mg/l)} \times 200 \quad \textbf{(7.17)}$$

$$\text{Molarity (M)} = \frac{\text{Concentration of chemical element (ppm)}}{1000 \text{ (mol)} \times \text{Molecular Weight of chemical elements}} \quad \textbf{(7.18)}$$

$$\text{Weight (gr)} = \text{Molarity concentration (M)} \times \text{volume of solution (l)} \times \text{Molecular weight} \quad \textbf{(7.19)}$$

$$\text{Percentage of chemical ion (\%)} = \frac{\text{Dissolved weight (gr)}}{\text{Weight of solution (Total) (gr)}} \times 100 \quad \textbf{(7.20)}$$

Therefore, all the results, which were obtained from equations (**7.16, 7.17, 7.18, 7.19** and **7.20**) for the brine sample is presented in (**Table 7.9**). In order to verify our results are correct, the experiment is repeated according to Mohr's Method, and the tools used are shown in (**fig 7.16**).

Table 7.9: Concentration, Molarity, weight & Percentage of Cl- in the Brine Sample of ZWDP

Sample	Concentration of Cl^-(ppm)	Molarity (M)	Weight (gr)	(%) of Cl^-
Brine	28,784	0.81	2.9	2.9

Note:

Mwt of Cl^- =35.5 (g/mol).

Volume of dissolved weight=10ml.

Volume of sample=100ml.

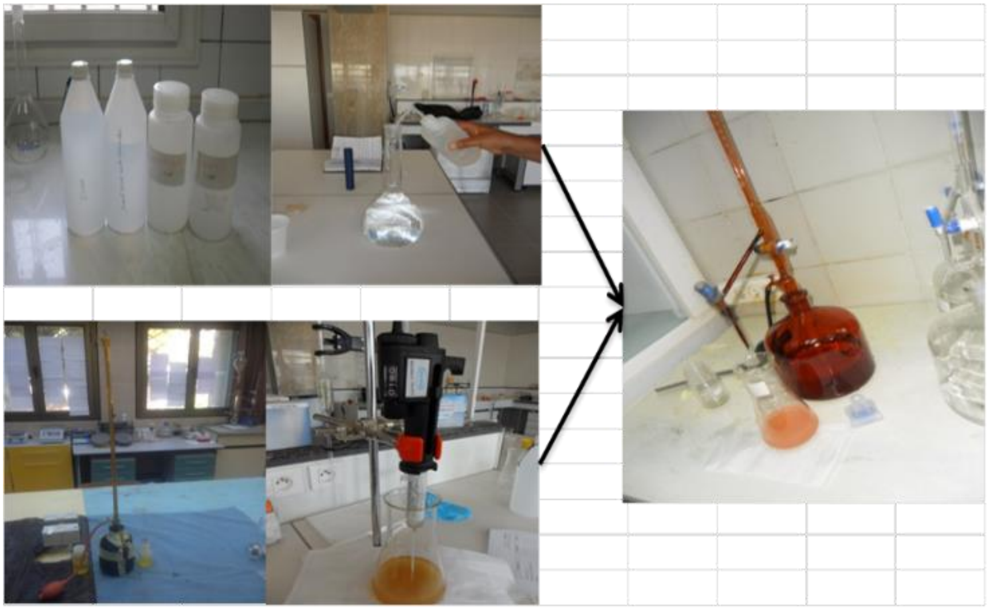


Figure 7.16: Experiment Tools Used

7.2.2. Determination of Salinity in the Brine of ZWDP

Aim: To determine the salinity of the brine sample collected from the evaporator of ZWDP. As the salinity is directly proportional to the amount of the chlorine in brine, and because chlorine has been measured accurately by chemical titration in (**Table 7.8**) above, hence the salinity is calculated using chlorinity equation (7.6) which is expressed in the calculation section.

- **Calculation**

$$\text{Salinity (ppm)} = 1.80655\ \text{xCl}^- \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (\mathbf{7.6})$$

So, as the concentration of Cl^- was collected in (**Table 7.9**), hence the salinity and salinity percentage of the brine are collocated according to equations (**7.20** and **7.21**) and presented in (**Table 7.10**).

Table 7.10: Salinity & Salinity Percentage for Brine Sample of ZWDP

Sample	Concentration of Cl^- (ppm)	Salinity (ppm)	Molarity (M)	Salinity (%)
Brine	28,784	51,999.74	2.9	5.2

Note:

Mwt of H_2O =18 (g/mol).

Volume of dissolved weight=10ml.

Volume of sample=100ml.

7.2.3. Determination Calcium and Magnesium ions in the brine sample of ZWDP

Aim: To determine the calcium and Magnesium ions of brine sample collected. In order to determine the calcium and Magnesium ions in the brine sample, the total hardness and the Calcium hardness were measured and the procedures of titration are done according to Hach Method 8213 by titration as explained below:

- **Total Hardness Experiment**

Aim: To determine the total hardness of the brine sample collected.

- **Equipment Used for the Total Hardness Experiment**

- Volumetric flask, 100 ml.
- Pipette (10 ml) and safety filler (3 valves).
- Conical flask, 250 ml.
- Burette and burette stand.
- Graduated cylinder, 100 ml.

- **Materials**

- Brine sample.

- Buffer Solution (Indictor solution pH 10).
- EDTA, 0.1998 M.
- ManVer 2 Hardness Indicator Powder Pillow.

- **Procedure of the Experiments**

A 100 ml of the prepared sample which has mentioned in section (**7.2.1**) is used for this test and the steps of the experiment are explained below:

- A 100 ml of the prepared sample was taken by graduated cylinder of volume 100 ml and then it was placed into volumetric flask of volume 250 ml.

- A 2 ml of buffer solution, hardness 1 was added and then the volumetric flask is swirled to mix.

- ManVer 2 hardness indictor powder pillow was added. This was then swirled to mix.

- A burette is rinsed with EDTA standard solution (0.1998 M) and then it is filled with EDTA to the "0.00" mark

- After that, the stopcock on the burette is opened slowly to add **EDTA** to the flask; the reading on the burette is taken and recorded as shown in (**Table 7.11**) when the colour solution changed from the red to pure blue. The Total hardness was calculated as shown into the next section.

Table 7.11: Volume of EDTA Consumed (ml) for Measuring T.H in the Brine sample of ZWDP

Sample	Titration Trial	Volume of EDTA consumed (ml)
Brine	Trial -1	52.1

- **Calculation**

$$\text{Total hardness (ppm)} = (\text{Concentration of EDTA (ppm)} \times \text{Volume of EDTA consumed (ml)} \times \text{Mwt of CaCO3(g/mol)} \times 1000 / \text{Volume of sample (ml)} \quad \ldots\ldots\ldots \quad (\mathbf{7.22})$$

Therefore, from the above equation (**7.22**) the total hardness of the brine sample is presented in (**Table 7.12**).

Table 7.12: Total Hardness in the Brine Sample of ZWDP

Sample	Total Hardness (ppm)
Brine	10,419

Note:

Mwt of $CaCO_3$=100.09 (g/mol).

EDTA=0.1998 M.

Volume of dissolved weight=10ml.

Volume of sample=100ml.

- **Calcium Hardness Experiment**

Aim: To determine the calcium hardness in the brine sample collected.

- **Equipment Used for the Calcium Hardness Experiment**

- Volumetric flask, 100 ml.
- Pipette, 10 ml and safety filler (3 valves).
- Conical flask, 250 ml.
- Burette and burette stand.

- **Materials**

- Brine sample.
- Buffer Solution (Indictor solution pH 12).
- EDTA 0.1998 M.
- ManVer 2 Hardness Indicator Powder Pillow.

- **Procedure of the Experiment**

A 100 ml of the prepared sample which has mentioned in section **(7.2.1)** is used for this experiment, the steps of the experiment are described below:

- A 100 ml of the prepared sample was taken. This was transferred by graduated cylinder of volume 100 ml into volumetric flask of volume 250 ml.

- A burette is rinsed with EDTA standard solution (0.1998 M) and then it is filled of EDTA to Zero mark.

- A 1 ml of 8 N Potassium hydroxide standard solution was added by using 1 ml dropper into the flask, and then the flask is swirled to mix.

- A 1 CalVer 2 Calcium indictor Powder Pillow was added into the flask. After that, the flask was swirled to mix.

- After that, the stopcock on the burette is opened slowly to add EDTA into the flask in order to be titrated. The reading on the burette was recorded in (**Table 7.13**) when the colour solution changed from the red to pure blue. hardness, ions and percentage of calcium and Magnesium are calculated by using the following equation which explained into the calculation section.

Table 7.13: Volume of EDTA Consumed (ml) for Measuring Calcium Hardness in the Brine sample of ZWDP

Sample	Titration Trial	Volume of EDTA consumed (ml)
Brine	Trial-1	20.54

- **Calculation**

$$\text{Calcium hardness } (ppm) = (\text{Concentration of EDTA (ppm)} \times \text{Volume of EDTA consumed (ml)} \times \text{Mwt of Ca(g/mol)} \times 1000 / \text{Volume of sample (ml)} \qquad (7.23)$$

Note:

Mwt of Ca^{+}=40 (g/mol).

Volume of sample=10 ml.

EDTA=0.1998 M.

Volume of dissolved weight=10 ml.

Volume of sample (total) =100 ml.

Therefore, the Calcium hardness calculated by the above equation (**7.23**), and all the results of four brine samples are presented in (**Table 7.14**).

Table 7.14: Calcium Hardness in the Brine Sample of ZWDP

Sample	Calcium Hardness (ppm)
Bine	1,642

$$\text{And , Magnesium Hardness (ppm)} = \text{Total Hardness (ppm)} - \text{Calcium hardness (ppm)} \ldots\ldots\ldots\ldots \quad (\mathbf{7.24})$$

Therefore, the Magnesium hardness calculated by equation (**7.24**), and all the results are represented in (**Table 7.15**).

Table 7.15: Magnesium Hardness in the Brine Sample of ZWDP

Sample	Magnesium Hardness (ppm)
Bine	8,777

Calcium and Magnesium ions are calculated from the following equations:

$$\text{Calcium ion } (Ca^{2+})(ppm) = \text{Calcium hardness } (ppm) \times 0.2428 \ldots\ldots \quad (\mathbf{7.25})$$

$$\text{Magnesium ion } (Mg^{2+})(ppm) = \text{Magnesium hardness } (ppm) \times 0.4004 \ldots\ldots\ldots\ldots \quad (\mathbf{7.26})$$

Hence, the calcium and magnesium ions calculated from the above questions (**7.25** and **7.26**), and all the results were represented in (**Table 7.16**).

Table 7.16: Calcium & Magnesium Ions in the Brine Sample of ZWDP

Sample	Calcium ions(ppm)	Magnesium ions (ppm)
Bine	399	3,514

In addition, molarity, weight and percentage of calcium and Magnesium ions were calculated according to questions (**7.18, 7.19** and **7.20**) which are mentioned in early section (**7.2.1**) and all the results of the brine sample are offered in (**Table 7.17**). And the tools used for the experiments are illustrated in (**fig 7.17**).

Table 7.17: Molarity, Weight & Percentage of Calcium and Magnesium Ions in the Brine sample of ZWDP

Sample	(M) Ca^{2+}	(M) Mg^{2+}	Ca^{2+} (gr)	Mg^{2+} (gr)	Ca^{2+} (%)	Mg^{2+} (%)
Brine	0.00997	0.145	0.0399	0.3514	0.04	0.4

Note:

(M): Molarity.

Mwt of Ca^{2+} =40 (g/mol).

Mwt of Mg^{2+} =24.305 (g/mol).

Volume of dissolved weight=10 ml.

Volume of sample (total) =100 ml.

Figure 7.17. Experiment Tools

7.2.4. Determination Sodium Na+ (mg/l) and Potassium k+ (mg/l) in the Brine Sample of ZWDP

Aim: To determine the Sodium and Potassium ions in the brine sample collected. Sodium and Potassium ions are determined in the brine sample by using BWB XP flam photometer.

- **Equipment Used for the Experiment**

- BWB XP Flame Photometer.
- 13 kg Propane gas cylinder.
- 2 label beakers, 100 ml.

- Volumetric flask, 100 ml.
- Pipette (10ml) and safety filler (3 valves).
- Sodium 10,000 mg/l Calibration standard.
- Potassium Standard 10,000 mg/l Calibration standard.

- **Materials**

- Brine sample.
- Deionized water.
- 2X4 diluted standard samples for Sodium and Potassium concentration.

- **Procedure of the Experiment**

A 100 ml of the prepared sample, which has mentioned in section (**7.2.1**), is used for this test and the processes of the experiment are explained below.

- A 10 ml of the Sodium 10,000 mg/l Calibration standard was transferred by pipette of 10 ml volume into volumetric flask of volume 100 ml. After that, the deionized water is added into the sample which was placed into the volumetric flask to the mark, and then is transferred into the labelled beaker (1000 ppm) and mixed.

- Next that, A 10 ml of 1000 ppm standard solution was transferred by the pipette into volumetric flask of volume 100 ml. After that, the deionized water is added into the sample which was placed into the volumetric flask to the mark. And then is transferred into the labelled beaker (100 ppm) and mixed.

- After that, A 10 ml of 100 ppm standard solution was transferred by the pipette into the volumetric flask of volume 100 ml. Following this, the deionized water is added into the sample which was placed into the volumetric flask to the mark. And then is transferred into the labelled beaker (10 ppm) and mixed.

- Next that, A 10 ml of 10 ppm standard solution was transferred by the pipette into the volumetric flask of volume 100 ml. Following this, the deionized water is added into the sample which was placed into the volumetric flask to the mark. And then is transferred into the labelled beaker (1 ppm) and mixed.

- BWB XP flam photometer was turned on, and then it was calibrated by used deionized water, in order to achieve zero point. Next that Sodium and Potassium ions were chosen from the menu of BWB XP as ions to be measured and then the standard solution of Sodium was used for calibration. Following this, each sample was placed in small beaker to be measured for Sodium ions.

- After that, the same procedure were repeated for potassium, but the calibration method was with standard solution of potassium, and all the results which were recorded for Sodium and Potassium ions are presented in (**Table 7.18**).

Table 7.18: Sodium and Potassium Ions in the Brine sample of ZWDP

Sample	Reading of BWB XP Na^+ (ppm)	Reading of BWB XP K^+ (ppm)
Brine	12,870	561

Additionally, the morality, weight and percentage of Na^+ and K^+ were calculated according to equations (**7.18, 7.19** and **7.20**) which are mentioned in early section (**7.2.1**) and presented in (**Table 7.19**). The tools used in the experiment are presented in (**fig 7.18**).

Table 7.19: Molarity, weight & Percentage of Sodium & Potassium in the Brine Sample of ZWDP

Sample	(M) Na^+	(M) K^+	Na^+ (gr)	K^+ (gr)	Na^+ (%)	K^+ (%)
Brine	0.56	0.014	1.3	0.05	1.3	0.05

Note:

(M): Molarity.

Mwt of Na+=23 (g/mol).

Mwt of K+=39.09 (g/mol).

Volume of dissolved weight=10 ml.

Volume of sample (total) =100 ml.

Figure 7.18: Experiment Tools

7.2.5. Determination Sulfate ions $SO4^{2-}$ in the Brine Sample of ZWDP

Aim: To determine the Sulfate ions SO_4^{2-} ions of the brine sample collected. Sulfate ions $SO4^{2-}$ion is determined of the brine sample collected based upon Hach method 8051.

- **Equipment used for the experiment**

- A spectrophotometer (DR2800, Hach).
- Sample cells, round glass, Hach.
- Pipette (10ml) and safety filler (3 valves).
- White tissue paper.

- **Materials**

- Brine sample.
- Deionized water.
- SulfaVer 4 Reagent Powder Pillow.

- **Procedure of the Experiment**

A 10 ml of from the prepared sample which has mentioned in section (7.2.1) is used for this test and the processes of the experiment are explained below:

- A 10 ml of the prepared sample was taken by the pipette. This was transferred into 10 ml cell round glass.

- The spectrophotometer (DR2800, Hach) was prepared on starting method 680 Sulfate.

- Following this SulfaVer 4 regent powder pillow was added to the first sample (into the cell round glass). And then the stopper was inserted into the cell and it was shook.

- Next that, the instrument timer was adjusted for a 5 minute reaction time, and when the timer expired, the blank cell was wiped by using white tissue paper.

- After that, a 10 ml of deionized water was transferred into the second cell round glass of volume 10 ml as blank.

- After that, the blank was inserted into the cell holder of a spectrophotometer (DR2800, Hach) and then the Zero button was pushed to show on the screen zero mg/l of $SO4^{2-}$.

- Following this, the sample was wiped by using tissue and then inserted into the cell holder after 5 minutes the reading was taken by pushing reading button, and the result of the brine sample is presented in (**Table 7.20**).

Table 7.20: Reading of DR2800 of $SO4^{2-}$ in the Brine Sample of ZWDP

Sample	DR2800) Reading of $SO4^{2-}$ (ppm)
Brine	8,500

As well as, molarity, weight and percentage of of $SO4^{2-}$ of brine sample was calculated according to equations (**7.18, 7.19** and **7.20**) which are mentioned in section (7.2.1) and the results are presented in (**Table 7.21**). The tools used for the experiment are presented in (**fig 7.19**).

Table 7.21: Molarity, weight & Percentage of SO_4^{2-} in the Brine Sample of ZWDP

Sample	(M) SO_4^{2-}	SO_4^{2-} (gr)	SO_4^{2-} (%)
Brine	0.09	0.85	0.85

Note:

(M): Molarity.

Mwt of $SO4^{2-}$ =96.09 (g/mol).

Volume of dissolved weight=10 ml.

Volume of sample (total) =100 ml.

Figure 7.19: Experiment Tools

Appendix 7.3: Laboratory Work Two: Chemical analysis for the five brine samples collected from evaporation ponds in five weeks up to the salt crystallization stage (Halite)

Five brine samples were collected from the evaporation ponds during four weeks and the salts harvested was collected in the fifth week starting from 5th August 2014 to 8th September 2014 as shown in (**Table 7.22)**. The main goal of these experiments is to identify the chemical compound of the brine placed into the evaporation ponds at different salinity level.

Table 7.22: Samples collected from the evaporation ponds

Week	Date	Samples
First week	05/08/2014 06/08/2014 07/08/2014 08/08/2014 09/08/2014 10/08/2014 11/08/20140	Collected from the evaporation pond at the end of the first week

Second week	12/08/2014 13/08/2014 14/08/2014 15/08/2014 16/08/2014 17/08/2014 18/08/2014	Collected from the evaporation pond at the end of the second week
Third Week	19/08/2014 20/08/2014 21/08/2014 22/08/2014 23/08/2014 24/08/2014 25/08/2014	Collected from the evaporation pond at the end of the third week
Fourth week	26/08/2014 27/08/2014 28/08/2014 29/08/2014 30/08/2014 31/08/2014 01/09/2014	Collected from the evaporation pond at the end of the fourth week
Fifth week	02/09/2014 03/09/2014 04/09/2014 05/09/2014 06/09/2014 07/09/2014 08/09/2014	Collected from the evaporation pond at the end of the fifth week as salt

7.3.1. Determine the Concentration of Cl^- ions in the Four Brine Samples Collected from Evaporation Ponds up to the fourth week

Aim: To determine the concentration, weight and percentage of chloride ions of four brine samples collected from the evaporation ponds. As the salinity expected to be quietly high, the chloride ion concentration is determination using Hach method 8207 by titration as explained in section (**7.2.1**) for the brine sample of ZWDP. All equipment, materials, calculation equations and procedure for the experiment was similar to experiment which is stated in section (**7.2.1**), all the readings of titration cartridge for the four brine samples are presented in (**Table 7.23**).

Table 7.23: Titration Cartridge Reading for Brine Samples Collected from Evaporation Ponds

Titration Trial	Titration Cartridge Reading
Trial-1	2,130
Trial-2	2,665
Trial-3	5,325
Trial-4	10,665

Therefore, all the results which were obtained from equations (**7.16, 7.17, 7.18, 7.19** and **7.20**) for the four brine samples are presented in (**Table 7.24)**.

Table 7.24: Concentration, Molarity, Weight & Percentage of Cl^- in Brine Samples Collected from Evaporation Ponds

Sample	Concentration of Cl^-(ppm)	Molarity (M)	Weight (gr)	(%) of Cl^-
Sample-1	42,600	1.2	4.26	4.26
Sample-2	53,600	1.51	5.36	5.36
Sample-3	106,500	3	10.65	10.65
Sample-4	213,300	6.008	21.33	21.33

Note:

Mwt of Cl^- =35.5 (g/mol).

Volume of dissolved weight=10ml.

Volume of sample=100ml.

7.3.2. Determination of Salinity in the Four Brine Samples Collected from Evaporation Ponds

Aim: To determine the salinity for four brine samples collected. As the salinity is directly proportional to the amount of the chlorine in brine, and because chlorine s been measured accurately by chemical titration in (**Table 7.23**) in section (**7.3.1**), hence the salinity is calculated using chlorinity equation. So all the results, which were obtained from equation (**7.18, 7.19, 7.20 and 7.21)** which are mentioned in section (**7.3.1 and 7.3.2**) for measuring salinity and the percentage of the four brine samples are presented in (**Table 7.24**).

Table 7.24: Salinity & Salinity Percentage for Brine Samples Collected from Evaporation Ponds

Sample	Concentration of Cl^- (ppm)	Salinity (ppm)	Salinity (%)
Sample-1	42,600	76,959.03	7.7
Sample-2	53,600	96,831.08	9.7

Sample-3	106,500	192,397.58	19.2
Sample-4	213,300	385,337.12	38.5

Note:

Mwt of H_2O =18 (g/mol).

Volume of dissolved weight=10ml.

Volume of sample=100ml.

7.3.3 Determination Calcium and Magnesium ions in the Four Brine Samples Collected from Evaporation Ponds

Aim: To determine the calcium and Magnesium ions of four brine samples collected from the evaporation ponds. In order to determine the calcium and Magnesium ions in the four brine samples, the total hardness and the Calcium hardness were measured and the procedures of titration are done according to Hach Method 8213 by titration, which is explained in section (**7.2.3**) for the brine sample of ZWDP. All equipment, materials, calculation equation and procedure for the experiment was similar to experiment, which is stated in section (**7.2.3**). The volume of EDTA consumed for measuring total hardness for four brine samples are presented in (**Table 7.25**) and the total hardness of four brine samples are provided in (**Table 7.26**).

Table 7.25: Volume of EDTA Consumed (ml) for Measuring T.H in Brine Samples Collected from Evaporation Ponds

Sample	Titration Trial	Volume of EDTA consumed (ml)
Sample -T.H-1	Trial -1	3.74
Sample -T.H-2	Trial -2	5.4443
Sample -T.H-3	Trial -3	13.4747
Sample -T.H-4	Trial -4	37.9395

Table 7.26: Total Hardness of Four Brine Samples Collected from Evaporation Ponds

Sample	Total Hardness (ppm)
Sample -1	7,479.36

Sample -2	10,887.45
Sample -3	26,946.7
Sample -4	75,871.4

Note:
Mwt of CaCO3=100.09 (g/mol).
EDTA=0.1998 M.
Volume of dissolved weight=10ml.
Volume of sample=100ml.

In addition, the experiment of calcium hardness was similar to the experiment which is clarified in section (**7.2.3**) for the brine sample of ZWDP, and by using the equations (**7.23** and **7.24**) which is mentioned in section (**7.2.3**) the calcium and Magnesium hardness results for the four brine samples as well as the volume of EDTA consumed are presented in (**Table 7.27**).

Table 7.27: Volume of EDTA Consumed (ml) for Measuring Calcium Hardness in the four Brine Samples and Magnesium Hardness.

Sample	Titration Trial	Volume of EDTA consumed (ml)	Calcium Hardness (ppm)	Magnesium Hardness (ppm)
Sample-1	Trial-1	1.546	1,235.6	6,243.76
Sample-2	Trial-2	2.0613	1,647.45	9,240.76
Sample-3	Trial-3	3.092	2,471.17	24,475.5
Sample-4	Trial-4	6.184	4,942.33	70,929.07

Hence, the calcium and magnesium ions for the four brine samples are calculated from the questions (**7.25** and **7.26**), which stated in section (**7.2.3**), and all the results were presented in (**Table 7.28**) below.

Table 7.28: Calcium & Magnesium Ions of Four Brine Samples Collected from Evaporation Ponds

Sample	Calcium Ions(ppm)	Magnesium Ions (ppm)
Sample -1	300	2500
Sample -2	400	3700
Sample -3	600	9800
Sample -4	1200	28400

In addition, molarity, weight and percentage of calcium and Magnesium ions were calculated according to questions (**7.18, 7.19** and **7.20**) which are mentioned in early section (**7.2.3**) and all the results of four brine samples are offered in (**Table 7.29**).

Table 7.29: Molarity, Weight & Percentage of Calcium and Magnesium Ions of Four Brine Samples Collected from Evaporation Ponds

Sample	(M) Ca^{2+}	(M) Mg^{2+}	Ca^{2+} (gr)	Mg^{2+} (gr)	Ca^{2+} (%)	Mg^{2+} (%)
Sample-1	0.0075	0.102	0.03	0.25	0.03	0.25
Sample-2	0.01	0.15	0.04	0.37	0.04	0.37
Sample-3	0.015	0.4	0.06	0.98	0.06	0.98
Sample-4	0.03	1.17	0.12	2.48	0.12	2.84

Note:

(M): Molarity.

Mwt of Ca^{2+} =40 (g/mol).

Mwt of Mg^{2+} =24.305 (g/mol).

Volume of dissolved weight=10 ml.

Volume of sample (total) =100 ml.

7.3.4. Determination Sodium Na^{+} (mg/l) and Potassium k^{+} (mg/l) in the Brine Samples Collected from Evaporation Ponds

Aim: To determine the Sodium and Potassium ions for four brine samples collected. Sodium and Potassium ions are determined in the brine samples by using BWB XP flam photometer. All equipment, materials, and procedure for the experiment was similar to experiment which is stated in section (**7.2.3**) for the brine sample of ZWDP, and all the results which were recorded for Sodium and Potassium ions of the BWB XP flam photometer are presented in (**Table 7.30**).

Table 7.30: BWB XP Reading of Sodium & Potassium for Four Brine Samples Collected from Evaporation Ponds

Sample	Reading of BWB XP Na^{+} (ppm)	Reading of BWB XP K^{+} (ppm)
Sample-1	15870	652
Sample-2	20220	792
Sample-3	71580	2660
Sample-4	82500	7040

Additionally, the morality, weight and percentage of Na^+ and K^+ were calculated according to equations (**7.18, 7.19** and **7.20**) which are mentioned in early section (**7.2.3**) and presented in (**Table 7.31**).

Table 7.31: Morality, Weight & Percentage of Sodium & Potassium for Four Brine Samples Collected from Evaporation Ponds

Sample	(M) Na+	(M) K+	Na+ (gr)	K+ (gr)	Na+ (%)	K+ (%)
Sample-1	0.69	0.02	1.587	0.065	1.587	0.065
Sample-2	0.88	0.02	2.002	0.079	2.022	0.079
Sample-3	3.11	0.07	7.151	0.266	7.158	0.266
Sample-4	8.25	0.18	18.975	0.704	18.98	0.704

Note:

(M): Molarity.

Mwt of Na+=23 (g/mol).

Mwt of K+=39.09 (g/mol).

Volume of dissolved weight=10 ml.

Volume of sample (total) =100 ml.

7.3.5. Determination Sulfate ions SO_4^{2-} in the Four Brine Samples Collected from Evaporation Ponds

Aim: To determine the Sulfate ions $SO4^{2-}$ions for the four brine samples collected. Sulfate ions $SO4^{2-}$ ion is determined of four brine samples collected based upon Hach method 8051. All equipment, materials, and procedure for the experiments were similar to experiment, which is stated in section (**7.2.4**). The result of $SO4^{2-}$ions, which are obtained from DR2800 for the four brine samples are presented into (**Table 7.26**).

Table 7.32: DR 2800 Reading of SO42− (ppm) for Four Brine Samples Collected from Evaporation Ponds

Sample	(DR2800) Reading of $SO4^{2-}$ (ppm)
Sample-1	3,700
Sample-2	5,100
Sample-3	10,300
Sample-4	85,100

As well as, molarity, weight and percentage of of $SO4^{2-}$ for each sample was calculated according to equations (**7.18, 7.19** and **7.20**) which are mentioned in section (**7.2.4**) and the results for the four brine samples are presented in (**Table 7.33)**.

Table 7.33: Molarity, Weight & Percentage of $SO42^{-}$ for Four Brine Samples Collected from Evaporation Ponds

Sample	(M) $SO4^{2-}$	$SO4^{2-}$ (gr)	$SO4^{2-}$ (%)
Sample-1	0.0385	0.37	0.37
Sample-2	0.053	0.51	0.51
Sample-3	0.107	1.03	1.03
Sample-4	0.886	8.51	8.51

Note:

(M): Molarity.

Mwt of $SO4^{2-}$ =96.09 (g/mol).

Volume of dissolved weight=10 ml.

Volume of sample (total) =100 ml.

Appendix 7.4: Laboratory Work Three: Chemical analysis of Salt Harvested from Evaporation Ponds in the fifth week

The salt was harvested from the evaporation ponds in the fifth weeks after all the brine place into the ponds evaporated, hence the main objective of these experiments is to measure the chemical elements in the salt harvested.

7.4.1. Purity Percentage of the Salt Harvested from Evaporation Ponds

Aim: To determine the percentage of salt purity that was harvested from evaporation ponds.

- **Equipment Used for the Experiment**

- Electric Hot Air Oven (Temperature Range: 50 ºC to 250 ºC)
- Thermal crucible
- Sensitive Electronic Balance

- **Materials**

- 1kg of salt harvested from the evaporation ponds

- **Procedure of the Experiment**

- A 1.0072 gr of the salt weighted by using sensitive electronic balance, after that, the thermal crucible was weighted and it was 93.7635 gr.

- Next that, the electric hot air oven was prepared at 150 ºC for 24 hours.

- Following this, A 1.0072 gr of the salt was put in the thermal crucible, and then it was transferred to the electric even.

- After 24 hours, the sample was taken from the oven, and the salt was weighted again and it was 94.5766 gr. In addition to this, the following equation was applied to determine the percentage of salt purity.

$$\text{Percentage of Salt purity (\%)} = \frac{\text{Weight of salt after drying process} - \text{Weight of thermal Crucible}}{\text{Weight of the original salt sample (which has measured before putting it in the crucible)}} \times 100 \quad \textbf{(7.27)}$$

$$\text{Therefor, \% purity } = \frac{94.5766 - 93.7635}{1.0072} \times 100 = 80.73\%$$

7.4.2. Moisture Percentage of the Salt Harvested from Evaporation Ponds

Aim: To determine the percentage of moisture in the salt, that was harvested from evaporation ponds.

- **Equipment Used for the Experiment**

- Electric Hot Air Oven (Temperature Range: 50 ºC to 250 ºC).
- Thermal crucible.
- Sensitive Electronic Balance.

- **Materials**

- 1kg of salt harvested from the evaporation ponds.

▪ **Procedure of the Experiment**

- A 15.0003 gr of the salt weighted by using sensitive electronic balance, next that, the electric hot air oven was prepared at 150 ºC for 24 hours.

- Following this, the sample of the salt was placed into the electric even. After 24 hours, the salt sample was taken from the oven, and the sample was reweighted and it was 14.9224 gr. Further to this, equation (7.**13**) was applied to determine the percentage of moisture in the salt harvested from the evaporation ponds. And tools are used for the experiment are illustrated in **fig 7.20**.

$$\text{Percentage of Moisture in the salt (\%)} = \frac{\text{Weight of the salt before drying process} - \text{Weight after drying process}}{\text{Weight of salt before drying process}} \times 100 \text{ (Muftah, 2014)}$$

.... (**7.28**)

$$\text{Therefore \% of moisture} = \frac{15.0003 - 14.9224}{15.0003} \times 100 = 0.52\%$$

Figure 7.20: Experiment Tools

Appendix 7.5: Determine the Concentration of Cl^- ions in the Salt Harvested from Evaporation ponds

Aim: To determine the concentration, weight and percentage of chloride ions and salinity of salt harvested from evaporation ponds. As the salinity expected to be very high, the chloride ion concentration is determination using Hach method 8207 by titration, which explained in section (**7.2.1**) for the feeding brine sample.

- **Equipment Used for the Experiment**

- Volumetric flask, 100 ml.
- Conical flask, 250 ml.
- Ultrasonic Bath.
- Burette and burette stand.
- Pipette (10 ml) and safety filler.
- Graduated cylinder

- **Materials**

- A 1.003 gr of salt harvested from evaporation ponds as sample.
- Potassium dichromate (VI) solution.
- Standard Solution (0.100 M $AgNO3$).

- **Sample Preparation**

As the salt in the form of ions crystal and in order to measure the chemical properties, the sample was prepared. A 1.003 gr of the salt which was harvested from the evaporation ponds was placed into volumetric flask of volume 100 ml to be diluted ten-fold by adding deionized water to the mark on the flask. Following this, the volumetric flask was placed into Grant Ultrasonic Bath for period ranged from 20-30 minutes in order to melt the salt. After that, salt sample was ready to be analysed. And tool used for the melting the salt in experiment is shown in (**fig 7.21**). The chemical reaction mechanism was the same of the reaction mechanism which has been mentioned in early section (**7.2.1**) for the brine sample of ZWDP.

Figure 7.21: Experiment Tools

- **Procedure of the Experiment**

The procedure of the experiment for determining the chloride ions was the same procedure which has been done for brine samples in section (**7.2.1**), however in this experiment the titration was completed by the burette and the volume of sample taken for titration was 10 ml. The reading on the burette was taken as shown in (**Table 7.34**) and the following equations **(7.29, 7.30 and 7.31)** which are represented in the next section have been applied in order to obtain the concentration, weight and percentage of chlorides.

Table 7.34: Volume of AgNO3 Consumed (ml) for Salt Harvested Sample from Evaporation Ponds

Titration Trial	Volume of AgNO3 consumed (ml)
Trial-1	14.1

- **Calculation**

$$\text{Concentration of chloride (ppm)} = (\text{Concentration of stanard solution AgNO3 (M)} \times \text{ burette reading (ml)} \times \text{molecular weight of chlorid (gr/mol)} \times 1000)/(\text{Volume of sample taken}) \quad \ldots\ldots (\mathbf{7.29})$$

$$\text{Chlorides ppm} = \frac{0.1 \times 14.1 \times 35.5 \times 1000}{10} = 5005.5 \text{ ppm}$$

Therefore, molarity, weight and percentage of of Cl^- for salt sample were calculated according to equations (**7.18, 7.19 and 7.20**) which are mentioned in section (**7.2.1**) and the results are showed in (**Table 7.35**).

Table 7.35: Molarity, Weight & Percentage of Cl- for Salt Harvested Sample from Evaporation Ponds

Sample	Cl^- (M)	Cl^- (gr)	Cl^- (%)
NaCl	0.141	0.5	0.5

Note:

(M): Molarity.

Mwt of Cl^- =35.5 (g/mol).

Volume of dissolved weight=1.003 gr.

Volume of sample (total) = (100+1.003) ml.

7.5.1. Determination of Salinity in the Salt Harvested from Evaporation Ponds

Aim: To determine the salinity of salt harvested from evaporation ponds. The salinity was determined by suing the equation (**7.21**), which is mentioned in pervious section (7.2.2) for brine sample of ZWDP. As well as, the percentage of the salinity in the salt was determined according to equation (**7.20**) which is revealed in section (**7.2.1**), and the results are presented in (**Table 7.36**).

Table 7.36: Salinity & Salinity Percentage of Salt Harvested Samples from Evaporation Ponds

Sample	NaCl (M)	NaCl (gr)	Salinity (ppm)	Salinity (%)
NaCl	0.155	0.9043	9042.7	0.9

Note:

(M): Molarity.

Mwt of NaCl=58.443 (g/mol).

Volume of dissolved weight=10 ml.

Volume of sample (total) = (100+1.003) ml.

7.5.2. Determination Calcium and Magnesium ions in the Salt Harvested from Evaporation Ponds

Aim: To determine the calcium and Magnesium ions in the salt harvested from evaporation ponds. In order to determine the calcium and Magnesium ions in the salt harvested from the evaporation ponds, the total hardness and the Calcium hardness are measured and the procedures of titration are done according to Hach Method by titration.

- **Total Hardness Experiment**

A 10 ml of the sample prepared was tested for this experiment, and the experiment procedure was similar to the process which has been motioned above in section (**7.2.3**). The reading on the burette is recorded as shown in (**Table 7.37**), and total hardness was calculated according to equation (**7.22**) which is mentioned in section (**7.2.3**) for the brine sample as shown into the next section.

Table 7.37: Volume of EDTA Consumed (ml) for Measuring Total Hardness in Salt Harvested Sample from Evaporation Ponds

Titration Trial	Volume of EDTA consumed (ml)
Trial-1	0.3

- **Calculation**

$$\text{Therfore, Total hardness } = 0.1998 \times 0.3 \times 100.09 \times \frac{1000}{10} = 599.94\text{ppm}$$

- **Calcium Hardness Experiment**

A 10 ml of the sample prepared was tested for this experiment, and procedure of the experiment was the same process which has been motioned in early section (**7.2.3**). The reading on the burette is recorded as shown in (**Table 7.38**) and calcium and magnesium hardness was calculated according to equations (7.8 and 7.9) which have been stated in section (**7.2.3**) for the brine sample of ZWDP, additionally the calcium and magnesium ions were calculated according to equations (7.9,7.10 and 7.11) which are stated in pervious section (**7.2.3**). Moreover, the weight and percentage of calcium and magnesium ions are calculated and presented into the next section according to equation (**7.18, 7.19** and **7.30**) in early section (7.2.1).

Table 7.38: Volume of EDTA Consumed (ml) for Measuring Calcium Hardness in Salt Harvested from Evaporation ponds

Titration Trial	Volume of EDTA consumed (ml)
Trial-1	0.2

- **Calculation**

The calcium and Magnesium hardness results are presented in (Table 7.33) according to equation (**7.23** and **7.24**) in section 7.2.3.

Table 7.39: Calcium & Magnesium Hardness in the Salt Harvested from Evaporation Ponds

Sample	Calcium Hardness (ppm)	Magnesium Hardness (ppm)
NaCl	159.84	440.0995

Therefore, the calcium and Magnesium ions were calculated and represented in (**Table 7.40**) according to equation (**7.25** and **7.26**) which is stated in section 7.2.3.

Table 7.40: Calcium and Magnesium Ions in the Salt Harvested from Evaporation Ponds

Sample	Calcium ions (ppm)	Magnesium ions (ppm)
NaCl	38.809	176.22

Additionally, morality, weight and percentage of calcium and magnesium ions are calculated according to equations (**7.18, 7.19 and 7.20**) which have been mentioned in section (**7.2.1**), and all the results are presented in (**Table 7.41**).

Table 7.41: Morality, weight & Percentage of Calcium & Magnesium Ions in the Salt Harvested from Evaporation Ponds

Sample	(M) Ca^{2+}	(M) Mg^{2+}	Ca^{2+} (gr)	Mg^{2+} (gr)	Ca^{2+} (%)	Mg^{2+} (%)
NaCl	0.0009702	0.00725	0.0038809	0.017622	0.00384	0.01744

Note:

(M): Molarity.

Mwt of Ca^{2+} = 40 (g/mol).

Mwt of Mg^{2+}= 24.3050 (g/mol).

Volume of dissolved weight=10 ml.

Volume of sample (total) = (100+1.003) ml.

7.5.3. Determination Sodium Na+ (mg/l) and Potassium k+ (mg/l) in the Salt Harvested from Evaporation Ponds

Aim: To determine the Sodium and Potassium ions in the salt harvested from the evaporation ponds. Sodium and Potassium ions are determined in salt by using BWB XP flam photometer.

- **Equipment used for the experiment**

- BWB XP Flame Photometer.
- 13 kg Propane gas cylinder.
- 4 label beakers, 100 ml.
- Volumetric flask, 100 ml.
- Pipette (2ml) and safety filler (3 valves).
- Sodium 10,000 mg/l Calibration standard.
- Potassium Standard 10,000 mg/l Calibration standard.

- **Materials**

- 100 ml of prepared sample.
- Deionized water.
- 4 diluted standard samples for Sodium and Potassium concentration.

- **Procedure of the Experiment**

The procedure of the experiment for determining sodium and potassium ions was similar to the technique which has been done for brine sample of ZWDP in section (7.2.3), however in this experiment 1 gr of salt melted into 500 ml. And the reading from the screen of BWB XP flam photometer was recorded and presented in (**Table 7.42**).

Table 7.42: Reading of BWB XP for Measuring Sodium and Potassium Ions in the Salt Harvested from Evaporation Ponds

Sample	Reading of BWB XP Na+ (ppm)	Reading of BWB XP K+ (ppm)
NaCl	637	2.3

Additionally, the morality, weight and percentage of Na^+ and K^+ were calculated according to equations (7.**18**, **7.19** and **7.20**) which are mentioned in early section (**7.2.1**) and all results are presented in (**Table 7.43**).

Table 43: Morality, weight & Percentage of Sodium & Potassium Ions in the Salt Harvested from Evaporation Ponds

Sample	Na+ (M)	K+ (M)	Na+ (gr)	K+ (gr)	Na+ (%)	K+ (%)
NaCl	0.028	0.000059	0.322	0.00115	0.32	0.00023

Note:

(M): Molarity.

Mwt of Na+=23 (g/mol).

Mwt of K^+=39.09 (g/mol).

Volume of dissolved weight=10 ml.

Volume of sample (total) = (500+1) ml.

Weight of salt=1gr

7.5.4. Determination Sulfate ions SO42− in Salt Harvested from Evaporation Ponds

Aim: To determine the Sulfate ions $SO4^{2-}$ions in salt harvested from evaporation ponds. Sulfate ions $SO4^{2-}$ion is determined in salt harvested based upon Hach method 8051.

- **Equipment Used for the Experiment**

- A spectrophotometer (DR2800, Hach).
- Sample cells, round glass, Hach.
- Pipette (2ml) and safety filler (3 valves).
- White tissue paper.

- **Materials**

- 10 ml Papered sample.
- Deionized water.
- SulfaVer 4 Reagent Powder Pillow.

- **Procedure of the Experiment**

The procedure of the experiment for determining Sulfate ions was the same procedure, which has been done for brine of ZWDP in section (**7.2.4**), and the reading from the screen of DR2800 was recorded and presented in (**Table 7.44**).

Further to this, the percentage of $SO4^{2-}$ions was calculated according to equation (**7.19**) in section (**7.2.4**).

Table 7.44: Reading of DR2800 for Measuring SO42^{-} in the Salt Harvested from Evaporation Ponds

Sample	(DR2800) Reading of $SO4^{2-}$ (ppm)
NaCl	116

As well as, molarity, weight and percentage of of $SO4^{2-}$ for salt sample was calculated according to equations (**7.18, 7.19** and **7.20**) which have been stated in section (7.2.1) and the results are presented in (**Table 7.45**).

Table 7.45: Molarity, weight & Percentage of $SO4^{2-}$ in the Salt Harvested from Evaporation Ponds

Sample	(M) $SO4^{2-}$	$SO4^{2-}$ (gr)	$SO4^{2-}$ (%)
NaCl	0.0012	0.0116	0.0115

Note:

(M): Molarity.

Mwt of $SO4^{2-}$ =96.09 (g/mol).

Volume of dissolved weight=10 ml.

Volume of sample (total) = (100+1.003) ml.

7.5.5. Determination the Crystal Shape of Salt Harvested from Evaporation Ponds

Aim: To identify the crystal shape of salt harvested from the evaporation ponds. The crystal shape of the salt harvested from the evaporation ponds is tested under scanning electron microscope (ESEM).

- **Equipment Used for the Experiment**

- Scanning electron microscope (SEM)
- LED compound siedentopf Microscope with digital camera

- **Materials**

- 2 gr of salt harvested from evaporation ponds

- **Procedure of the Experiment**

0.2 gr of the salt harvested from the evaporation ponds was dried under the vacuum process by using SEM, Next that the image of the salt harvested was taken and saved. Following this, the same procedure of the experiment was done by using the LED compound siedentopf Microscope with digital camera; however, the salt sample did not dry. All the photos, which have been taken, will be presented into result section. Additionally, the tools used for taken the images of the salt are presented in (**fig 7.22)**.

Figure 7.22: Experiment Tools

Appendix 7.6: Summarization of Results

All the results which are obtained for the brine sample of ZWDP, four brine samples collected from evaporation ponds and salt harvested are summarized and offered in the result section of chapter 7.

Appendix 7.7: SEM and EDX Analysis for the salt yield from the evaporation ponds

Project 1 16/01/2017 14:27:07

Project: Project 1
Owner: supervisor

Sample: Sample 1
Type: Default

Spectrum Label: Spectrum 1
Live time 119.9 s
Acquisition geometry (degrees):
Tilt = 0.3
Azimuth = 0.0

Elevation = 35.0
Accelerating voltage = 20.00 kV
Total spectrum counts = 128465

Sample data :	Energy (eV)	Resn. (eV)	Area
Strobe :	7.5	53.16	1332751
Optimization data : Manganese K series			
	Energy (eV)	Resn. (eV)	Area
Strobe :	.0	55.01	7561
Optimization element :	5893.4	128.34	7252

Sample is unpolished X-ray corrections may be approximate.
Sample is uncoated
The element used for optimization was Manganese
Detector efficiency: Read from file (x-act 3.efy)

Spectrum processing:
No peaks omitted

Processing option: All elements analyzed (Normalised)
Number of iterations = 2
Standard:

O SiO2 1-Jun-1999 12:00 AM
Na Albite 1-Jun-1999 12:00 AM
Mg MgO 1-Jun-1999 12:00 AM
Si SiO2 1-Jun-1999 12:00 AM
Cl KCl 1-Jun-1999 12:00 AM

Element	App Conc.	Intensity Corrn.	Weight%	Weight% Sigma	Atomic%
O K	0.21	0.8166	28.22	1.30	39.30
Na K	0.45	1.1079	41.38	0.97	40.10
Mg K	0.03	0.5167	5.06	0.50	4.64
Si K	0.00	0.7265	0.28	0.21	0.22
Cl K	0.19	0.7968	25.05	0.69	15.74
Totals			100.00		

inca

Appendix 7.8: Cost Estimation of Evaporation Ponds Installation in Libya

Item	Description and Specification	Unit	1st tender and project completion time			2nd tender and project completion time			3rd tender and project completion time		
			LYD	USA	Time	LYD	USA	Time	LYD	USA	Time
Land Cost	▪ The land location (Latitude 32°53'40" N and longitude 12°10'40.3" E) that has been chosen to build the evaporation ponds is unsuitable for farming because it's a saline dry and wet land located on the coastline, known as Sabkha. ▪ The total area required to implement the project is 3,000,040 m^2 (1000 m widths 30, 40 m long) as shown in fig **7.4**. The actual	**Hectare**	**10,000**	**6,896.5**	**The total time of implemented 6 evaporation ponds of the total 300,00,00 m^2 is one year**	**10,000**	**6,896.5**	**The total time of implemented 6 evaporation ponds of the total 300,00,00 m^2 is one year**	**10,000**	**6,896.5**	**The total time of implemented 6 evaporation ponds of the total 300,00,00 m^2 is one year**

	surface area is 300, 00, 00 m^2. • Each tender should submit the price of the land located on the map in fig.7.4										
Site clearing and preparation	▪ Land clearing is the removal of any existing material from a site and this involves clearing away rocks, debris and vegetation. Specification of total area required to be cleared is (3,000,040 m^2). ▪ All the work should be conducted in accordance with applicable environmental standards and industry best practice. All the	**Hectare**	**15,000**	**10,344.83**		**17,000**	**11,724.12**		**2,0000**	**13,793.1**	

	waste should be disposed of in accordance with the project waste management plan. • Each tender should submit the price per hectare for clearing and preparation.										
Earthwork	▪ This includes soil settlement, site slope, compacting, pond excavation, and building banks for the evaporation ponds. ▪ The site should be sloped gradually from the north at 10 cm to the south at 8 cm to enable the reject brine and seawater to flow by gravity into the ponds.	**Hectare**	**3,200**	**2,206.9**		**3,500**	**2,413.8**		**4,000**	**2,758.6**	

	▪ Soil vibration roller should be used at the site with compacting force up to 20 tonnes and the Proctor compaction test should be applied to determine the soil compaction properties. ▪ The total number of evaporation ponds to be constructed is 6, each of which has length of 1,000 m and 500m width as shown in fig 7.4. ▪ Building banks surrounding the ponds should be from the existing soil and excavated earth at the site. ▪ Banks should be 1.20 m high and										

	4.5 m width at the crest to allow vehicular access as shown in fig 7.4. The slope of the inner bank should be 1:2 and the outside bank a slope of 1:5 to reduce the erosion (as shown in the fig 7.4. The banks should be compacted during construction using a compact roller. • Each tender should submit the price per hectare for earthwork.										
Installation pipeline system	▪ This includes supply and installing pipeline to convey the brine disposal from desalination plants and	**Meter**	**160,000**	**110,344.8**		**187,000**	**128,965.52**		**195,500**	**134,827.59**	

	seawater make-up to the evaporation ponds. ▪ The pipeline should be a 8-inch diameter polyethylene installed and buried underground at a minimum depth of 3 m with length approximately **8,500** m passed throughout two concrete inspection chamber systems which should be created during installation process at the site as shown in the fig 7.4. ▪ Valves should be designed at the inlet of each evaporation pond.										

	▪ Brine and seawater centrifugal pumps at ZWDP should be connected via the pipeline system to evaporation ponds and then connected to the power system via the control room at ZWDP in order to convey the brine and seawater to the ponds. ▪ Mechanical equipment such as butterfly valves with pressure regulating valves should be modified to control the flow and need to be connected to control room at ZWDP in accordance with engineering specifications.										

	▪ The two concrete inspection chamber dimensions should be 1000 mm width × 1000 mm length × 1500 mm depth and 600 mm top section for metal cover and the wall thickness 150 mm. The diameters of inlet and outlet section should be 9 inch. ▪ Location of the piping network systems underground to convey the brine and seawater into the ponds should be created according to the location in fig. The diameter of piping network systems for inlet 1 and 2 are 4 inch. The										

	pipeline system should have a 30-year design life. • Each tender should submit the price of 1,800 meter of installing the pipeline system including the price, the mechanical elements, IT, electrical work and the installation of two concrete inspection chambers.										
Lining the pond	▪ High Density Polyethylene (HDPE) temperature up to 80ºC should be installed as the primary or top layer of the lined ponds in order to protect the groundwater and to enhance the	**Hectare**	**70,000**	**48,275.9**		**80,000**	**55,172.4**		**85,000**	**58,620.69**	

	evaporation within the ponds. ▪ Black colour and the thickness of high-density polyethylene (HDPE) should be 5mm and 6 m width and 120 m length per roll. ▪ HDPE should be installed over clay liner and other geomembranes due to it being the most compatible material for site conditions and regulations. ▪ All liners must be strong enough to withstand stress during salt cleaning. ▪ Subsurface drainage system should also be installed in the north side at the										

	end corner for each pond towards the sea. The diameter should be 10 inch. The location of drainage system is shown in fig 7.4. ▪ Geomembrane panels should be welded together and tested for strength throughout the installation performed by certified technicians, and the required test should be applied. • Each tender should submit the price per Hectare for earthwork										
Site access	▪ An existing asphalt road, approximately 400 meters in	**400 m**	**127,800**	**88,137.95**		**128,000**	**88,275.85**		**136,000**	**93,793.11**	

	length and 6-meter width should be implemented to access the evaporation ponds site. This should be linked with the ZWDP road and evaporation ponds site as shown in fig 7.4. ▪ Land clearing which involves the removal of any existing material from road proposed should be done. ▪ Earthwork such as soil settlement, site slope and compacting should be applied as preliminary treatment before laying the foundations. ▪ Placing and compacting the										

	limestone layer with thickness 20 cm and 8-meter width along the road planned and the compact test should be applied to ensure stability of the first layer. ▪ Placing and compacting layers with an unbound mixture of coarse and fine crushed stone, as well as crushed sand with thickness 20 cm and 7 m width. ▪ The compact test should be applied to ensure the stabilization of bottom layers in order to achieve the desired load-bearing capacity and absorb traffic loads. Placing the bituminous layer, a 7 m width with an average 1.5										

	kg/m^2, and then placing and compacting the hot asphalt layer with thickness of 6 cm and 7 m width. ▪ Creating the road line marking required and following the specifications of the road highway legislation should be applied. • Each tender should submit the price of a 400 m section of the road proposed.										
lighting system installation	▪ Installing 9-meter solar road light with foundations on the road. The quantity required is 8. Brand name LED Street Lights. The locations of installation are	**24 pieces**	**26,181.8**	**18,056.43**		**30,000**	**20689.6**		**33,000**	**22758.6**	

	shown in fig 7.4 on each 50 meters on the right side of the road. ▪ Installing 9-meter solar road light with foundation for the evaporation ponds, the locations of installation are shown in fig 7.4. The quantity required is 16. Brand name LED Street Lights. ▪ Electrical engineering testing should be applied. • Each tender should submit prices to include the price of installation and connection with the main power supply.										

Installation Davis Vantage Pro2 Wireless weather station at the site of implemented evaporation ponds	▪ This includes installation of a Davis vantage Pro2 wireless weather station as shown in fig 7.4 and connecting the weather station to the control room in order to record the metrological data. ▪ Each tender should submit the price including the price of weather station installation connecting with the control room.	**1 piece**	**1,000**	**689.7**		**1,200**	**827.6**		**1,500**	**1,034.5**	
Design Safety Factors	Safety factors should be incorporated into the design and installation of the evaporation ponds project to reflect key sensitivities, including contingencies, environmental and social conditions. Each tender is obligated to these conditions.										

Appendix 7.9: Statistical Analysis (Metrological data and wt of ions composition of the five brine samples)

PCA
Principal Component Analysis

Data worksheet
Name: Data1
Data type: Environmental
Sample selection: All
Variable selection: All

Eigenvalues

PC	Eigenvalues	%Variation	Cum.%Variation
1	2.38	47.6	47.6
2	1.08	21.5	69.1
3	0.722	14.4	83.5
4	0.532	10.6	94.2
5	0.291	5.8	100.0

Eigenvectors
(Coefficients in the linear combinations of variables making up PC's)

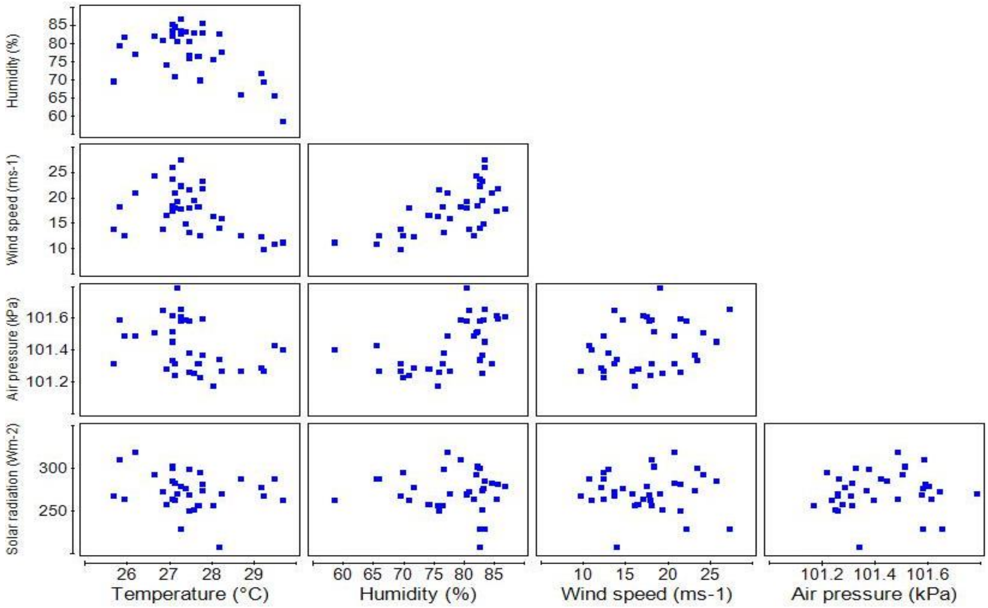
Variable	PC1	PC2	PC3	PC4	PC5
Temperature (°C)	-0.476	0.250	0.350	0.744	0.185
Humidity (%)	0.570	0.187	0.016	0.097	0.794
Wind speed (ms-1)	0.504	0.192	-0.410	0.567	-0.469
Air pressure (kPa)	0.437	-0.086	0.840	-0.009	-0.310
Solar radiation (Wm-2)	0.051	-0.926	-0.065	0.339	0.142

Principal Component Scores

Sample	SCORE1	SCORE2	SCORE3	SCORE4	SCORE5
05-Agu-14	0.868	-0.152	-1.01	0.438	0.65
06-Agu-14	1.1	-0.797	-1.24	0.942	0.211
07-Agu-14	1.26	-2.14	-0.548	8.83E-2	-0.518
08-Agu-14	1.6	-1.98	0.134	-0.623	-0.292
09-Agu-14	1.83	-0.675	-0.517	0.552	-0.423
10-Agu-14	1.73	-0.141	-0.768	1.02	-0.266
11-Agu-14	1	-1.21	0.201	0.309	0.348
12-Agu-14	-0.641	-1.29	0.124	-0.169	0.574
13-Agu-14	-1.85	-1.19	-0.58	-0.189	0.158
14-Agu-14	-2.55	-0.795	1E-2	0.398	-0.253
15-Agu-14	1.41	-0.189	0.905	9.77E-2	0.688
16-Agu-14	1.35	0.294	0.966	-0.35	0.413
17-Agu-14	2.24	2.14	0.422	0.521	-1.13
18-Agu-14	1.4	1.94	0.498	-0.129	-0.54
19-Agu-14	-0.679	2.79	0.359	-0.753	0.834
20-Agu-14	-2.3	-0.126	0.371	0.689	0.461
21-Agu-14	-2.88	0.171	0.507	0.231	0.43
22-Agu-14	-3.54	0.164	1.25	0.507	-1.22
23-Agu-14	-2.74	-0.718	1.3	0.779	-0.296
24-Agu-14	1.48	4.25E-3	0.66	1	0.264
25-Agu-14	1.58	-6.65E-2	1.71	-2.18E-2	-0.649
26-Agu-14	0.715	0.111	0.833	5.07E-2	-5.76E-2
27-Agu-14	-1	0.275	-0.399	0.371	0.599
28-Agu-14	0.802	0.404	-0.676	1.08	0.186
29-Agu-14	0.688	-0.251	1.09	-0.274	0.609
30-Agu-14	0.798	-0.426	1.32	-0.923	0.175
31-Agu-14	0.726	-0.245	0.289	-1.89	0.494
01-Spe-14	-1.31	0.79	-0.95	3.24E-2	0.376
02-Spe-14	-0.882	0.221	-1.13	-0.433	-0.642

03-Spe-14	-0.524	-0.621	-0.884	-2.06	-0.751
04-Spe-14	-0.559	0.374	-0.824	-0.802	-0.25
05-Spe-14	0.113	1.17	-0.949	0.12	0.624
06-Spe-14	-0.205	1.07	-1.15	0.179	-0.481
07-Spe-14	-0.46	0.727	-0.504	7.9E-3	-7.76E-2
08-Spe-14	-0.559	0.375	-0.826	-0.801	-0.251

Outputs
Plot: Graph2



PCA
Principal Component Analysis

Data worksheet
Name: Data1
Data type: Environmental
Sample selection: All
Variable selection: All

Eigenvalues

PC	Eigenvalues	%Variation	Cum.%Variation
1	4.92	82.1	82.1
2	1.06	17.7	99.8
3	1.3E-2	0.2	100.0
4	7.49E-4	0.0	100.0

Eigenvectors
(Coefficients in the linear combinations of variables making up PC's)

Variable	PC1	PC2	PC3	PC4
Cl- (%)	-0.445	-0.113	0.853	-0.076
Ca2+ (%)	-0.023	-0.969	-0.166	-0.139
Mg2+ (%)	-0.451	0.010	-0.071	-0.406
Na+ (%)	-0.450	-0.025	-0.334	0.306
K+ (%)	-0.450	-0.034	-0.091	0.678
SO42− (%)	-0.439	0.215	-0.348	-0.507

Principal Component Scores

Sample	SCORE1	SCORE2	SCORE3	SCORE4

11-Agu-14	1.21	0.494	9.44E-2	3.86E-2
18-Agu-14	1.03	0.171	0.115	-3.81E-2
25-Agu-14	-0.211	-1.82	-2.28E-2	5.12E-3
01-Spe-14	-3.76	0.574	-1.57E-2	-6.5E-4
08-Spe-14	1.73	0.579	-0.171	-4.9E-3

Outputs
Plot: Graph2