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Assessment Of Water Quality Of HAZIRA CREEK Using Arc GIS

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Abstract - *creek pollution has been investigated with the help of Arc GIS. This system will provide pollution spread rate of the Hazira creek coastal area near Surat in Gujarat, India. The samples were analyzed with the aid of various Chemical, Biological and Physical parameters such as pH, Temperature, Total dissolved solids (TDS), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical oxygen demand (COD), Turbidity, Hardness, Conductivity. The Geographic Information System facilitates to scrutinize various creek pollution such as Industrial pollution, sewage pollution and anthropogenic pollution. The water samples were collected from regular interval of 1 km which includes the industrial outfall and sewage outlets. The various samples were gone through diverse laboratory analysis. The further results of the samples were stored in Arc GIS database and maps were generated according to the results.*

Keywords- *Creek, Water Pollution, sampling, ArcGIS, Colour Mapping, GPS*

I. INTRODUCTION

A tidal creek or estuary is the portion of a stream that is affected by ebb and flow of ocean tides in the case that the subject stream discharges to an ocean or sea. Pollution is described as introduction of harmful or artificial substance into the natural environment that causes adverse change. Pollution can either be human activity or natural disaster which cause environment to become contaminated. Water bodies are primary dump sites for disposal of waste especially the effluence from industry that are near them due to unplanned urbanization and rapid growth of industrialization. This effluence from industry has a great toxic influence on quality as they can alter physical, chemical, biological nature of the receiving water body. Polluted water can harm plants and animals, restrict recreation, spoil scenery, damage economic uses or pose a threat to fisheries. Some pollution comes from sources which can be pin-pointed, for example a factory or intensive agriculture discharging its wastes into a drain which are called 'point' sources. How badly an estuary is affected mainly depends upon how well the estuary is flushed with sea water when the tides go in and out. Water exchange between an estuary and the sea is limited by the tidal range (rise and fall), size of the estuary, and size depth of the inlet channel. An estuary with a deep, open channel to the sea will be flushed by the tide and able to cope with more pollution before showing symptoms than an estuary with restricted tidal exchange.

GIS:

GIS stands for Geographic Information System. GIS is an information system dealing with geographic information. Geography is science that studies the land, the features, the inhabitants, and the phenomena of the Earth. Therefore the term geographic information would mean any information that is geographic in nature or that pertains to some features on earth is geographic information. Geographic information is exchangeable as geospatial information or simply spatial information.

WATER QUALITY PARAMETERS

***Temperature*:** Water temperature expresses how hot or cold the water is.

***pH*:** It indicates pH of water. The low number indicates the more acidic water. The high number indicates more basic water. pH of 7 is considered neutral. The logarithmic scale means that each number below 7 is 10 times more acidic than the previous number when counting down. When counting up above 7. Each number is 10 times more basic than the previous number.

***Turbidity*:** It is a measure of water clarity how much the material suspended in water decreases the passage of light through the water.

***Conductivity*:** Conductivity is a measure of capability of water to pass the electrical flow. This ability is directly related to the concentration of ions in the water.

***Hardness*:** Hardness is the amount of dissolved calcium (Ca^{+}) and magnesium (Mg^{+}) in the water.

***Total Dissolve Solid*:** Total dissolved solids are materials in the water that will pass through a filter with a 2.0 µm or smaller nominal average pore size

Dissolve Oxygen: Dissolved oxygen is the level of free, non-compound oxygen present in water or other liquids. It is an important parameter in assessing water quality because of its influence on the organisms living within a body of water.

Biological Oxygen Demand (BOD): Biochemical oxygen demand is the amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic material present in a given water sample at certain temperature over a specific time period.

Chemical Oxygen Demand (COD): COD analysis is a measurement of the oxygen-depletion capacity of a water sample contaminated with organic waste matter.

II. STUDY AREA

The study area falls in the downstream of *Tapi* River belt which extends up to *Hazira* Creek having length of almost 25 km. The sampling initiated from *Sardar* bridge (N21°11′15" E72°48'30") including cable stayed bridge, *Adajan gam*, *umra gam*, ONGC bridge, *magdalla* port ,*mora limla*, L&T Jetty, and ESSAR upto *Hazira* Beach (N21°04'20" E72°39'27").

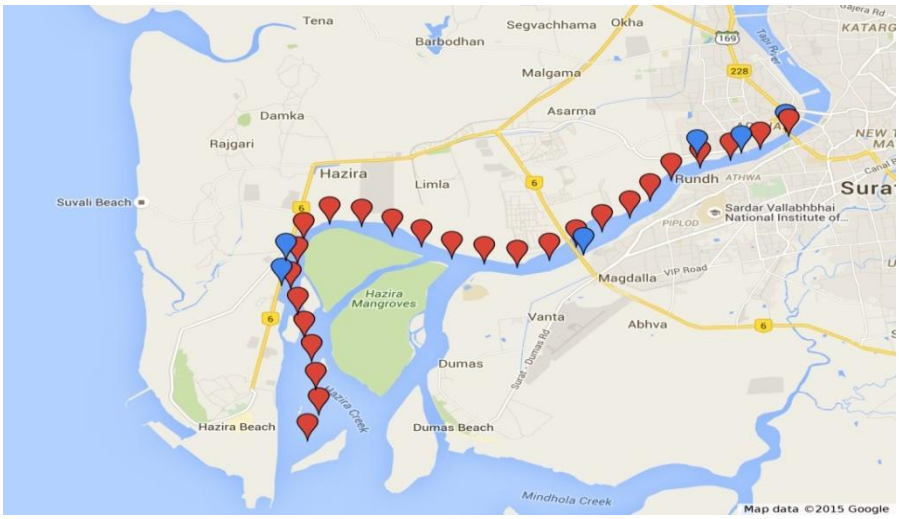

Figure 1

SAMPLING LOCATION

***Equipment*:** *GARMIN waterproof GPS 60* was used to locate the sampling points.

Sr.	Location	Longitude Latitude
L-1	*Sardar* Bridge	N21°11′15" E72°48'30"
L-2	Government Quarters	N21°10'55" E72°48'5"
L-3	*Ambika Niketan* Temple	N21°10'42" E72°47'32"
L-4	*Rundh*	N21°10′38" E72°46'58"
L-5	*Iscon* Mall	N21°10'23" E72°46'27"
L-6	City Gymkhana	N21°09'55" E72°46'10"
L-7	Ryan International School	N21°09'29" E72°45'49"
L-8	*Magdalla* Police Line	N21°09'10" E72°45'21"
L-9	ONGC	N21°08'43" E72°44'48"
L-10	*Magdalla* Port	N21°08'32" E72°44'16"
L-11	c.k. college of engineering & technology	N21°08'34" E72°43'41"
L-12	*Limla* Village	N21°08′36" E72°43'07"
L-13	*Limla* Village	N21°08′46" E72°42'33"
L-14	NTPC Power Plant	N21°08'55" E72°41'59"
L-15	Mora	N21°09'16" E72°41'33"
L-16	L & T Jetty	N21°09'09" E72°40'02"
L-17	L & T Shipbuilding Jetty 2	N21°08'29" E72°39'27"
L-18	*Essar* Projects India Limited	N21°08'10" E72°39'22"
L-19	*Essar* Projects India Limited	N21°07'26" E72°39'24"
L-20	*Essar* Heavy Engg. Services	N21°07'09" E72°39'32"
L-21	*Essar* Petrol Pump	N21°06'25" E72°39'33"
L-22	*Essar* Power	N21°06′58" E72°39'33"
L-23	*Essar*	N21°05′22" E72°39'35"
L-24	*Hazira* Village	N21°05'03" E72°39'33"
L-25	*Hazira* Beach	N21°04'20"E72°39'27"

GIS MAPPING

Software: Arc GIS 10.0

Method: Kriging
A surface of ozone concentration using the default Geo-statistical Analyst settings was created (interpolated). The parameters were used as point dataset as the input dataset and ordinary kriging method was used to interpolate the ozone values at the locations where values were not known.

Steps:

- Click the Geo-statistical Analyst arrow on the Geo-statistical Analyst toolbar and click Geo-statistical Wizard The Geo-statistical Wizard dialog box appears:

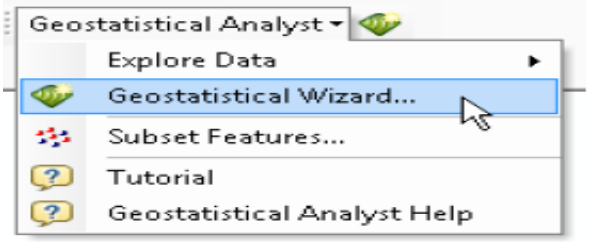

Figure 2

- Click Kriging/Co-Kriging in the Methods list box.
- Click the Source Dataset arrow and click.
- Click the Data Field arrow and click the PARAMETERS attribute.

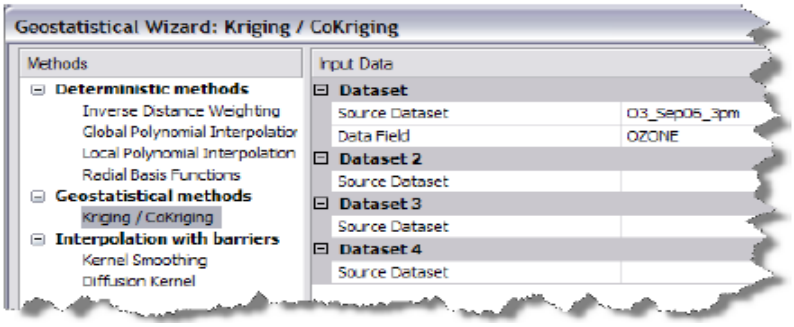

Figure 3

- Click Next.
- By default, Ordinary (kriging) and Prediction (map) are selected on the dialog box. Since the method to map the ozone surface is selected, you could click Finish to create a surface using the default parameters.
- Click Next.
- The semivariogram/covariance model is displayed, allowing you to examine spatial relationships between measured points. You can assume that things that are closer together are more alike than things that are farther apart.

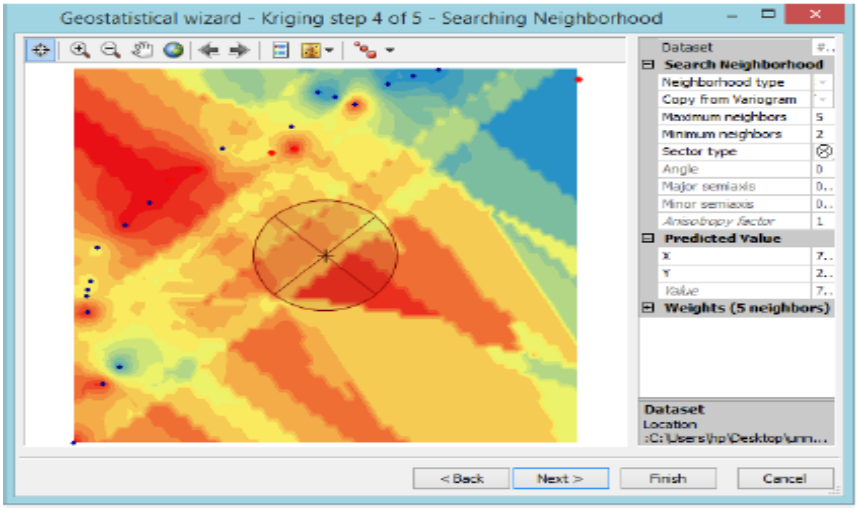

Figure 4

- Click Next.
- The crosshairs show a location that has no measured value. To predict a value at the crosshairs, you can use the values at the measured locations. Using the surrounding points, you can predict values for the unmeasured location

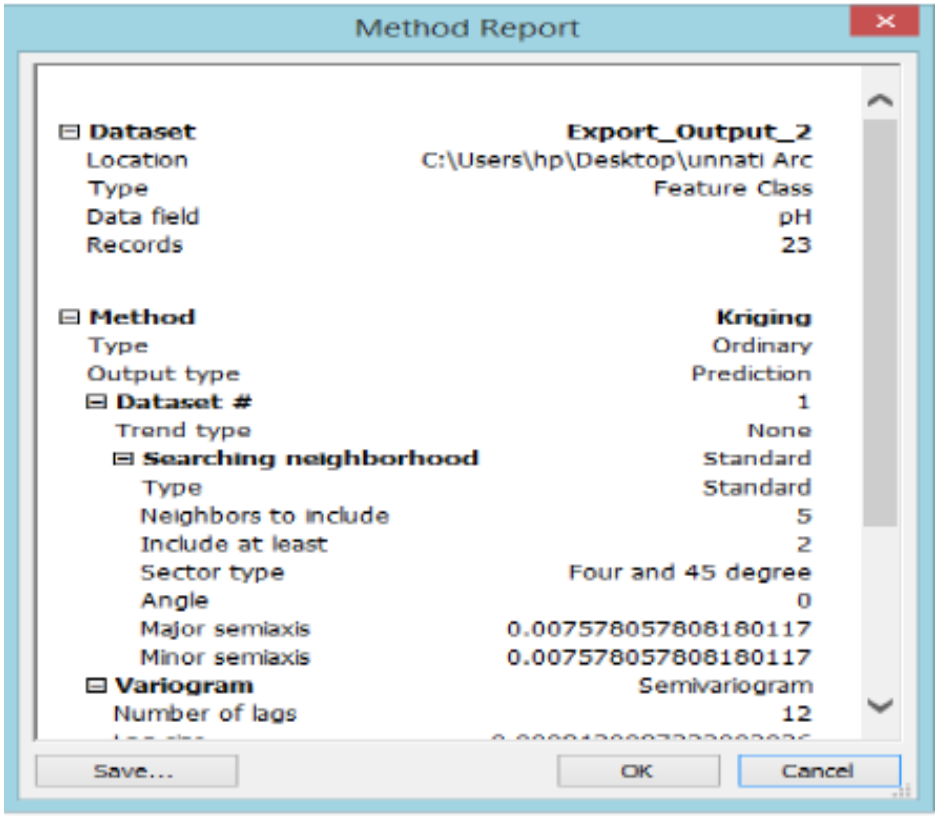

Figure 5

- Click Next.
- The cross-validation diagram gives you an idea of how well the model predicts the values at the unknown locations.
- Click Finish.
- The Method Report dialog box summarizes information on the method (and its associated parameters) that will be used to create the output surface.

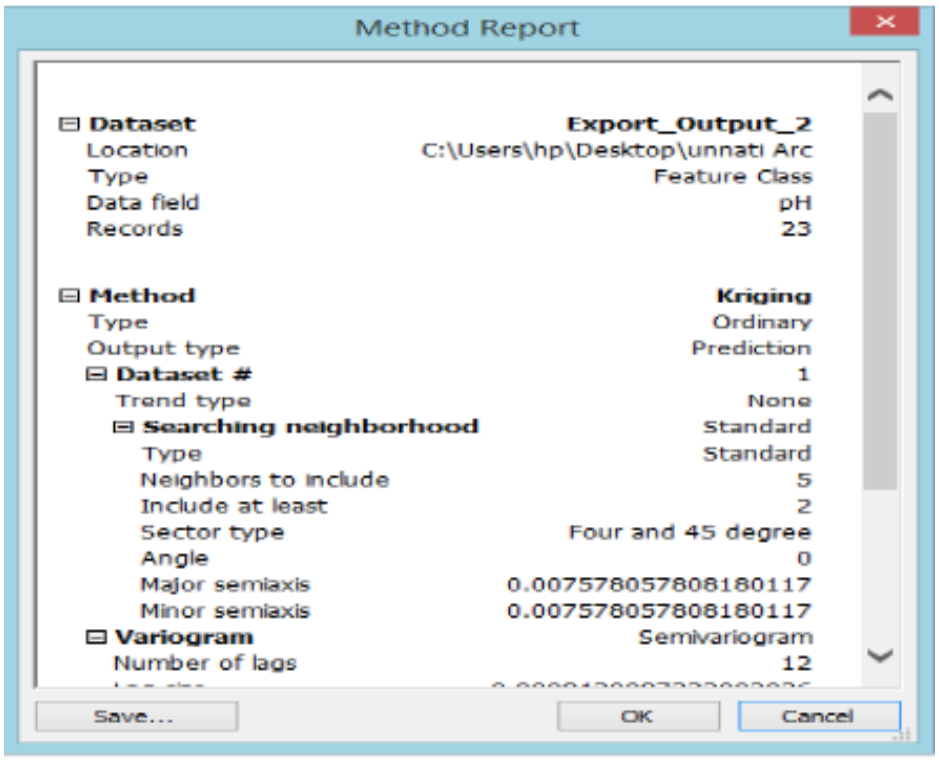

Figure 6

III. RESULTS

Sr. no.	location	pH	Temp. (C^0)	TDS (g/l)	Conductivity (mS/cm)	Hardness (mg/l)	DO (mg/l)	COD (mg/l)	BOD (mg/l)	Turbidity (NTU)
Permissible limits	**creek**	**5.5-9**	**Not >5** C^0	**-**	**-**	**-**	**4**	**250**	**1.0**	**10**
L-1	N21°11′15” E72°48’30”	7.78	28.7	12.24	21.9	2700	4.02	398.3	4.1	23.4
L-2	N21°10’55” E72°48’5”	7.77	28.6	13.8	25	3600	4.11	220.8	4.93	22.8
L-3	N21°10’42” E72°47’32”	7.74	28.5	16.64	29.8	4000	5.66	104.4	5.36	22.2
L-4	N21°10′38” E72°46’58”	7.67	28.7	21	36.5	4800	5.98	206.3	5.09	10.00
L-5	N21°10’23” E72°46’27”	7.54	28.6	23.6	42.2	5200	6.52	218	4.44	0.323
L-6	N21°09’55” E72°46’10”	7.43	28.6	23.9	42.9	5300	6.23	195.5	7.53	0.285
L-7	N21°09’29” E72°45’49”	7.39	28.9	25.2	45	5500	5.97	188	8.88	0.257
L-8	N21°09’10” E72°45’21”	7.28	29.2	26.3	47.5	5900	4.04	157.9	8.07	0.568
L-9	N21°08’43” E72°44’48”	7.19	29.2	26.9	48.3	6300	3.74	113	7.36	0.886
L-10	N21°08’32” E72°44’16”	7.56	29.6	26.7	47.8	6200	6.62	244	6.18	1.510
L-11	N21°08’34” E72°43’41”	7.6	29.4	27	47.9	7900	6.5	280	5.92	1.180
L-12	N21°08′36” E72°43’07”	7.59	29.7	27.2	48.3	8700	6.07	318	4.04	0.524
L-13	N21°08′46” E72°42’33”	7.91	29.8	28.7	50	8000	6.99	372	3.13	0.466
L-14	N21°08’55” E72°41’59”	7.92	29.8	29	51.8	7000	7.21	379	2.56	0.377
L-15	N21°09’16” E72°41’33”	7.88	30	28.7	50.9	6900	7.25	386	2.21	0.343
L-16	N21°09’09” E72°40’02”	7.85	30	28.3	48	6500	7.8	389.7	2.04	0.301
L-17	N21°08’29” E72°39’27”	7.82	30.2	28.8	49.9	6800	6.9	394.3	1.77	0.290
L-18	N21°08’10” E72°39’22”	7.79	30.2	27.5	47.3	6000	7.13	398.8	1.43	0.250

L-19	N21°07'26" E72°39'24"	7.83	30.2	27.9	49	6700	7.2	404.1	1.83	0.241
L-20	N21°07'09" E72°39'32"	7.87	30.4	28.2	50.2	7000	7.55	411.3	2.29	0.234
L-21	N21°06'25" E72°39'33"	7.89	30.44	28.5	50.5	7100	7	417	2.57	0.259
L-22	N21°06'58" E72°39'33"	7.89	30.5	28.4	50.5	6900	6.88	394	2.39	0.270
L-23	N21°05'22" E72°39'35"	7.92	30.7	28.8	51.2	7400	6.88	378	2.18	0.283
L-24	N21°05'03" E72°39'33"	7.94	30.7	29	51.6	7900	6.89	363	1.97	0.211
L-25	N21°04'20" E72°39'27"	7.93	30.8	29	51.5	8000	7	357.4	1.88	0.267

MAPS GENERATED THROUGH Arc GIS

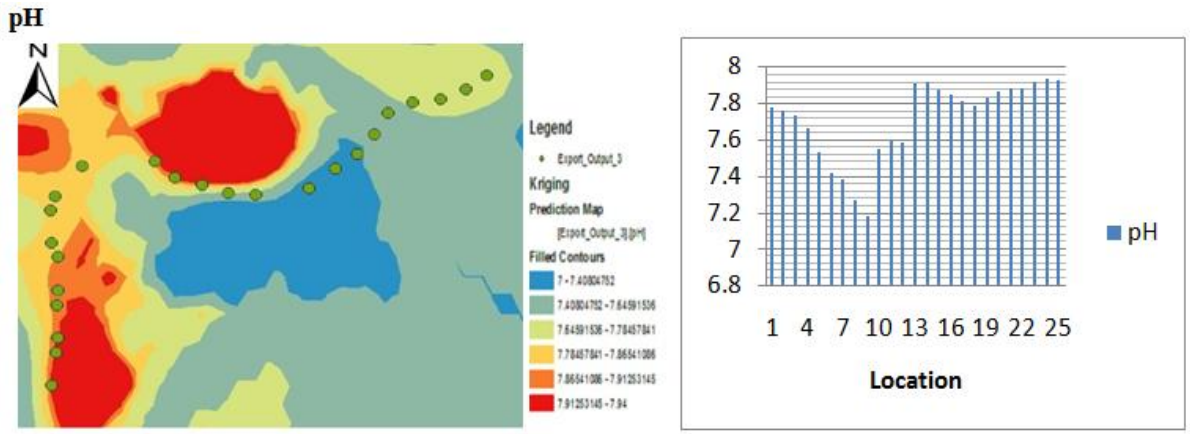

Figure 7

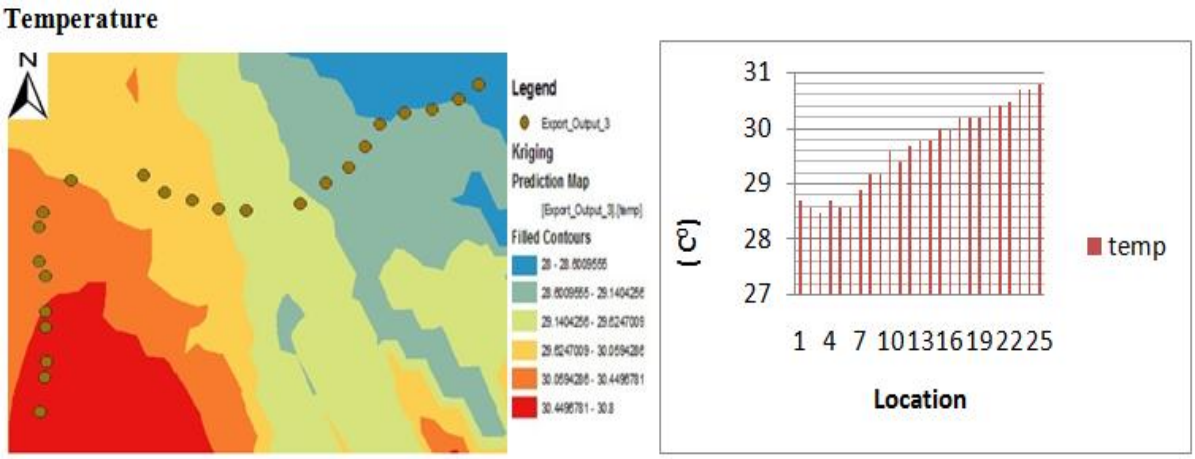

Figure 8

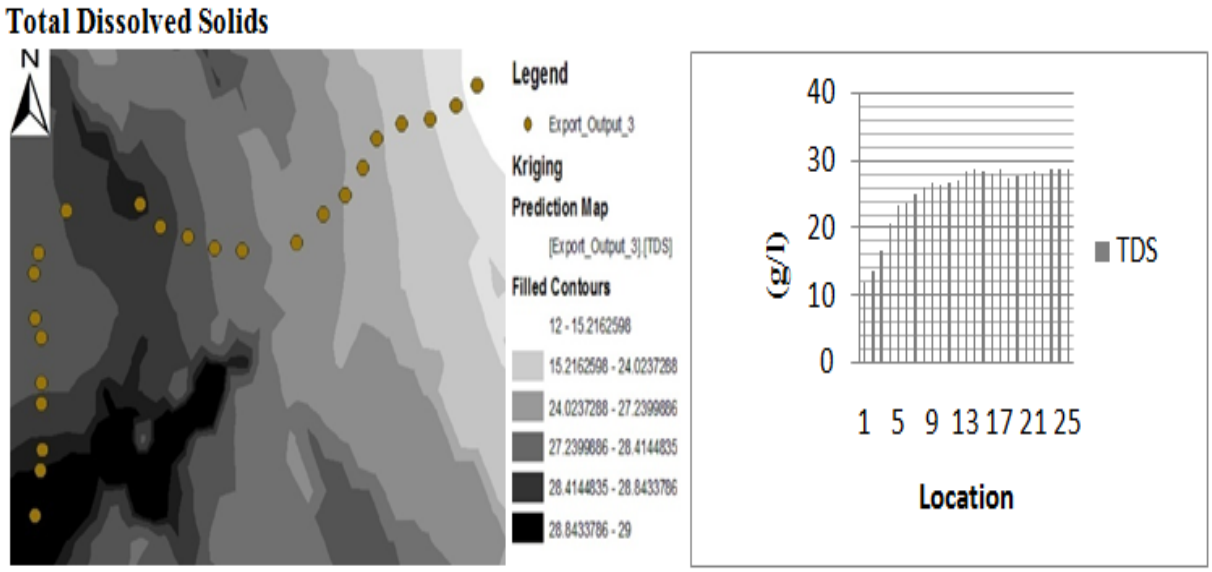

Figure 9

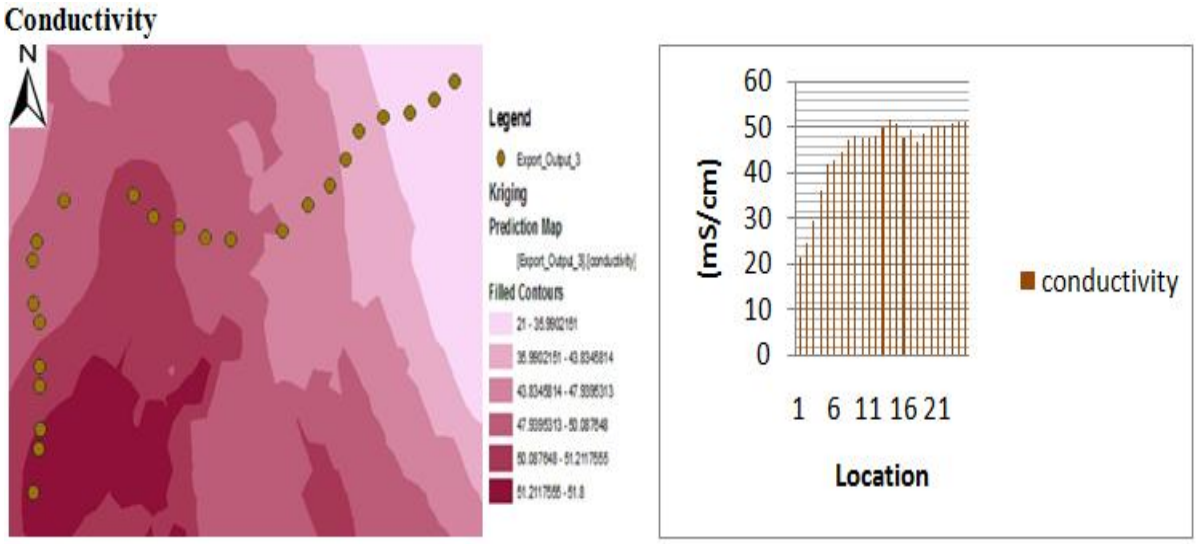

Figure 10

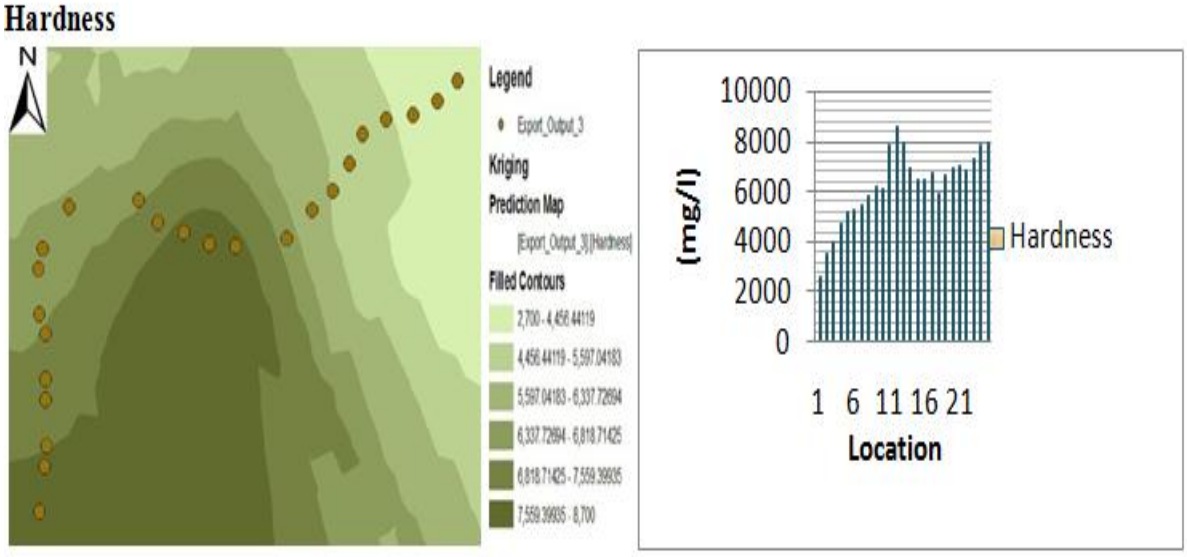

Figure 11

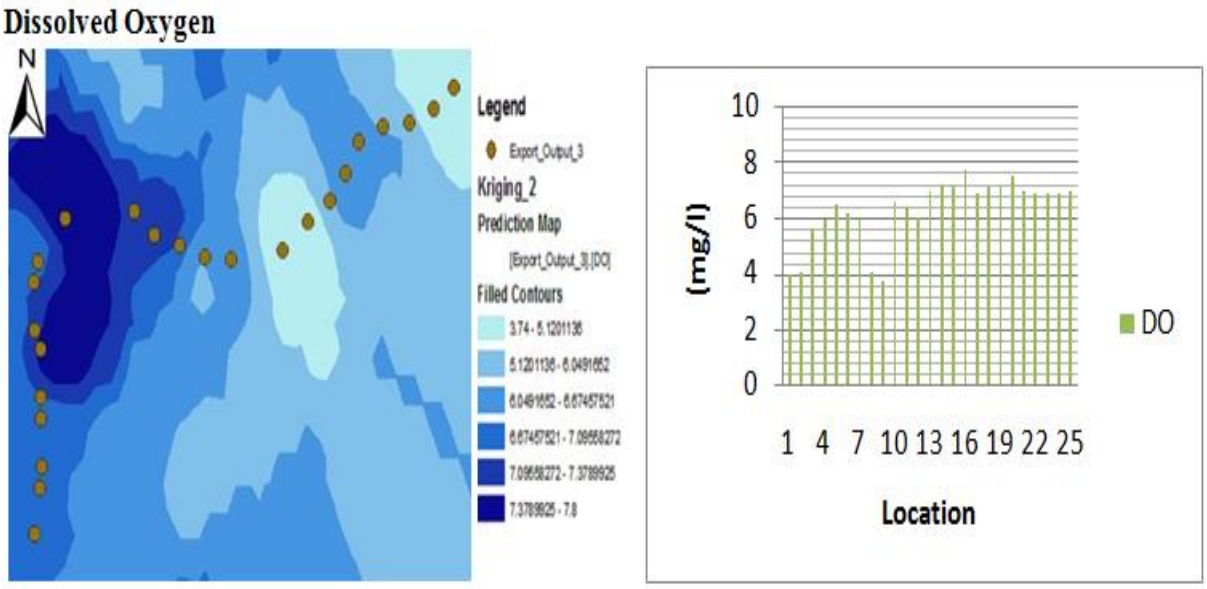

Figure 12

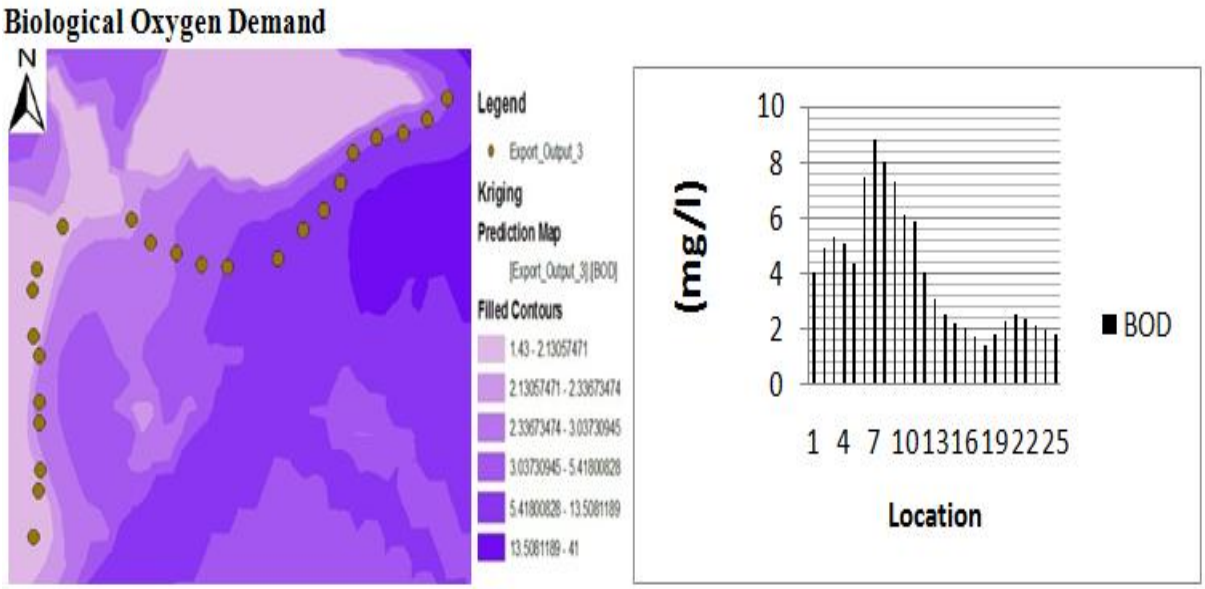

Figure 13

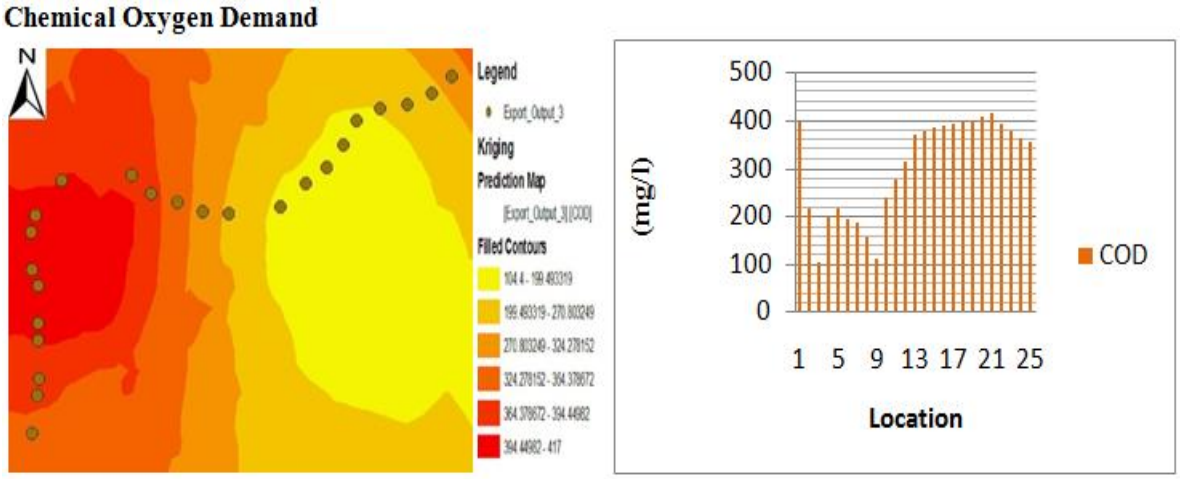

Figure 14

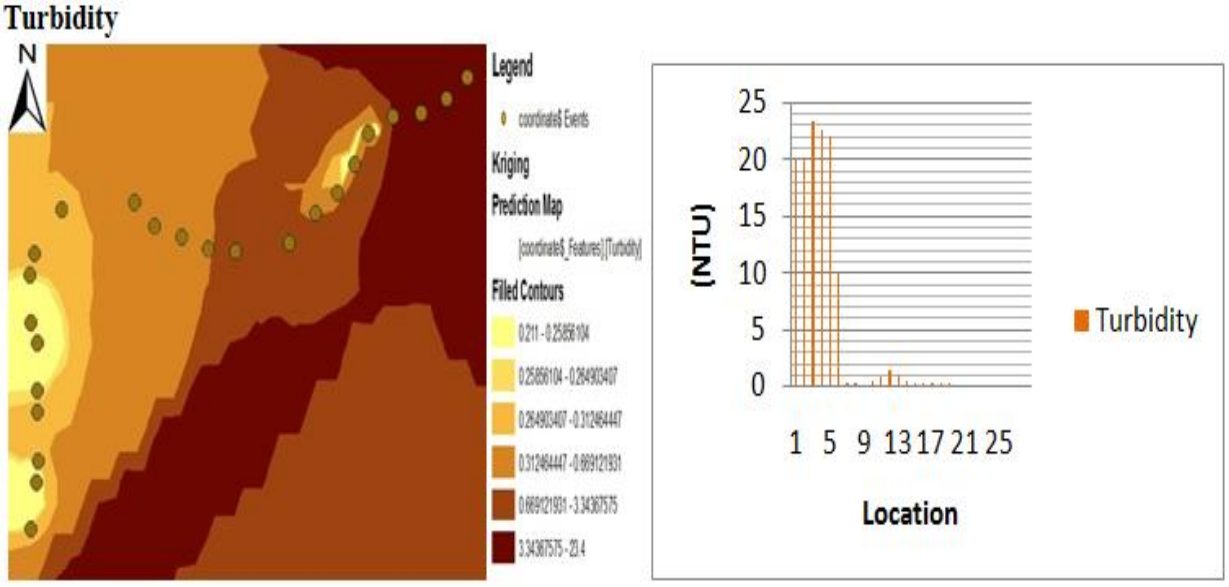

Figure 15

IV. ***CONCLUSION***

25 samples were collected from *Tapi* river and *Hazira* creek at the interval of 1 km approximately. The samples were analysed for pH, Temperature, DO, BOD, COD, Hardness, TDS, Turbidity, Conductivity physiochemical parameters. The results obtained were mapped in the software of ARC-GIS 10.0. And the concentration of the particular parameter in certain portion of river is indicated.

From the readings and map obtained, the following conclusion can be obtained:

1) The range of pH is 7.19 -7.94 which are in permissible limit provided by "GPCB". At the starting point – S*ardar Bridge*, pH was 7.78 which decrease up to the L-9 – *ONGC Bridge* having pH 7.19. The sewage and storm outlet fall under this area could be the reason of fall in pH. After L-9 pH surge to 7.56 at 10th point- ONGC Port and then keeps on increasing with minor variation until it reaches last point- *Hazira beach*. Industrial outfall could be the main cause of this increment.

2) TDS, Hardness, Conductivity which are inter-related to each other shows the same trend along the belt of testing. These parameters having their least reading at 1st location- *Sardar Bridge* upswing as they move towards Hazira beach. This could be because of increase in salt content as there is transition from river to sea.

3) Dissolved oxygen at 1st point - S*ardar Bridge* is 4.02 which gradually rise up to 6th point of *Karuna Sagar* having 6.23 mg/l DO, which reduces till the 9th point - *ONGC Bridge* having minimum DO of 3.74 mg/l because of direct contamination of water. This value sharply rises to 6.62mg/l at next point- ONGC Port which is commencement of Hazira creek.

4) At beginning, BOD of water is lowest at 4.1mg/l, rises as far as 8th position- *Magdalla police line* having 8.07 mg/l. The reduction again takes place from that point onwards extending to 18th position- *Hazira Police Station* till it reaches 1.43 mg/l. The fluctuation is noted from that point beyond.

5) COD shows most fluctuation along the belt. COD having high reading at starting position - *Sardar Bridg*e reduces along the way up till 9th position - *ONGC Bridge* which again increases gingerly extending to 21st position - *Essar industry*. The area between 9th and 21st position comprise of large industries, thus contain industrial outfall. Downtrend is again observed up to 25th position- *Hazira beach*.

6) The results shows that turbidity is highest at 1st location - *Sardar Bridg*e reduces as one moves forward towards 21st location- *Hazira beach*.

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