

KANJLI
WETLAND
A REPORT
ON
STATUS OF WATER QUALITY



PUNJAB POLLUTION CONTROL BOARD
NABHA ROAD, PATIALA- 147001

1. INTRODUCTION:

Kanjli wetland is located in the District Kapurthala of Punjab state. It is a Ramsar site declared as a wetland by the Ministry of Environment & Forest, Government of India. It has a catchment area of about 183 hectares. The site is considered to be very valuable from ecological and religious point of view as it is associated with Shri Guru Nanak Dev ji. Although Kanjli wetland is smaller in size as compared to the Harike and the Ropar wetlands, it is very important as it attracts large number of migratory birds.

The Kanjli wetland was monitored at 7 locations in the month of October, 2016 and April, 2017 for general parameters, metals and pesticides in water and in sediments samples.

1.1 Physiography of Kanjli Wetland:

Kanjli wetland area is located at 31° 32'N latitude and 75° 76'E longitude in district Kapurthala in the State of Punjab. It is basically a catchment area and has been created by the erection of barrage downstream. Kali Bein is a rivulet near Kapurthala which feeds the lake. This rivulet deviates from river Beas at Budhan Barket Regulator near Muradpur village in Hoshiarpur district and moves toward Kanjli wetland.

Although Kanjli wetland is smaller in size as compared to Harike wetland, it is important as it attracts a large number of migratory birds. Further this area forms a part of the same ecological region providing habitat for similar flora and fauna. The catchment area of Kanjli wetland is more or less flat with slope towards the Bein rivulet. The catchment area mostly consists of agricultural fields. The maximum depth recorded is about 7.6 m (25 feet). The lake has maximum depth at center near Boat Club area and is shallower near the banks as well as near the Barrage. At upstream excess water overflows the Barrage thereby maintaining the level of Kanjli lake throughout the year. At upstream Kanjli lake, at certain points water is taken by the farmers for irrigation purposes. Surface run offs from the catchment area carry some pollutants into the wetland. There is no industrial discharge into the kanjli wetland. The discharge of STP Begowal and STP Bholath falls into Holy Bein. However, downstream of the barrage of kanjli wetland, domestic discharge of STP of Kapurthala and Sultanpur Lodhi falls into the Kali bein which deteriorates the water quality of the rivulet at the downstream of the Kanjli wetland. The environment of this entire area has been deteriorating due to over

exploitation and misuse with the result that its rich flora and fauna is fast disappearing and the flock of migratory birds which it used to attract has also gone down in number.

Monitoring of the Kanjli wetland was carried out by Punjab Pollution Control Board for the physico-chemical, biological, heavy metals & pesticides for the months of October, 2016 and April, 2017.

1.2 Objectives:

Monitoring of Kanjli Wetland has been done to keep a watch on the trends in variation of water quality. Ground Water Samples were also collected to assess the ground water quality in the area between Hamira (Jagatjit) Distillery & Kanjli wetland and to know the adverse effects on the ground water quality, if any.

2. Monitoring by Punjab Pollution Control Board:

Punjab Pollution Control Board has conducted monitoring of Kanjli wetland to study the effect on water and sediment quality due to discharge of domestic wastewater/surface run offs. The monitoring for water and sediment samples was carried out in the month of October, 2016 and April, 2017 at following locations:

1. U/s Sultanpur Lodhi (Bein on GT Road)
2. Near Barrage
3. D/s Barrage
4. Near Boat Club
5. D/s Kanjli
6. U/s Boat Club Near Vill. Badashpur
7. D/s Sultanpur Lodhi Near Sultanpur Lodhi Town



Upstream Boat Club



Upstream Sultanpur Lodhi G.T. Road



Near Barrage



Near Boat club



Downstream Barrage



Downstream Kanjli



Downstream Sultanpur Lodhi

Ground Water Monitoring Locations

The Monitoring of ground water was carried out between Hamira Distillery & Kanjli lake at the following locations

S. No.	Point of sample collection
1	Hand pump Bus Stand Subhanpur
2	Vikas Khanna, Petrol Pump Badshpur
3	Gurdwara Nizampur More vill. Badshapur
4	Sr. Partap Sing Vill. Dham
5	Kuldeep general Store Bholla Vill. Dham
6	S. kulwant Singh, Submersible
7	Chaman lal near Railway Station Hamira
8	Sh. Sukhdev Singh

3. SAMPLING

The samples were collected as per protocol (**Annexure-I**) from the seven sampling locations mentioned above in October, 2016 & April, 2017. These samples were analysed for physico-chemicals parameters, heavy metals and pesticides (**Annexure-II**).

Sediment samples were also collected in the month of October, 2016 and April, 2017 to know the accumulation of various pollutants in the sediments. These samples were analysed for physico-chemical parameters including heavy metals and pesticides (**Annexure-III**).

Since the chemical analysis alone cannot provide a true picture of the water quality, biological evaluation of the water is also necessary to confirm the suitability for its use. Hence samples were analysed for benthic organisms. Benthic micro invertebrates were collected with hand-net against the flow of water. The saprobity index and diversity indices were also studied during October, 2016 and April, 2017. The results are given in (**Table-II to VI**). The samples were also collected for microbiological studies i.e. Total and Faecal coliform.

Diversity index has also been studied. It is the number of families encountered/total number of organism.

4. Methodology

The methodology adopted for analysis of various parameters has been given in **Table- I**.

5. RESULTS AND DISCUSSIONS:

Water Samples:

The water samples were collected from seven monitoring locations in October, 2016 & April 2017 for various parameters. The analysis results indicate that:

(a) Physical Parameters:

i) pH:

pH at all the monitoring locations was found to vary between 7.1 to 7.8 during October 2016 whereas pH varies from 7.4 to 7.8 in April, 2017.

ii) Turbidity:

Turbidity is caused by a wide variety of suspended matter which ranges in sizes from colloidal to coarse dispersions depending upon the velocity of flow or upon the degree of turbulence. It varies from 19 to 25 NTU in October, 2016 & from 6 to 18 NTU during the month of April, 2017.

iii) Total Dissolved Solids:

The concentration of total dissolved solids varied from 160 to 228 mg/l in October, 2016 and from 174 to 264 mg/l in April, 2017.

iv) Conductivity:

The conductivity of an aqueous solution expresses its ability to conduct or to carry an electric current which depends largely on the presence of ions. The measurement of conductivity is thus important to establish the degree of mineralization to assess the effect of the total concentration of ions which can have an effect on the plants, animals and naturally occurring micro flora and fauna.

The conductivity varied between 266 to 380 $\mu\text{s}/\text{cm}$ in October, 2016 and from 290 to 440 $\mu\text{s}/\text{cm}$ in April, 2017.

v) Dissolved Oxygen:

Oxygen is the prime requirement of all the living organisms in one form or the other for carrying out their metabolic activities and for the production of energy essential for growth and reproduction. Oxygen depletes rapidly when the organic matter is consumed by the microorganisms naturally present in the stream. It is therefore, an indicator of organic pollution. Concentration of the dissolved oxygen also varies with the time of the day.

Dissolved Oxygen varied between 4.8 to 6.3 mg/l in October, 2016 and from 4.5 to 7.6 mg/l in April, 2017.

vi) Total Coliform

Total Coliform count was found in the same range of 390 to 790 MPN/100ml in October, 2016 as well as in April, 2017.

(b) Inorganic and Non Metallic Constituents

i) Chloride & Sulphate:

Chloride occurred naturally in rock salt. The concentration of chloride varied from 18 mg/l to 32 mg/l in October, 2016 and from 10 mg/l to 30 mg/l in April, 2017. Sulphate was found in the range of 16 mg/l to 36 mg/l in October, 2016 and in the range of 14 mg/l to 28 mg/l in April, 2017

ii) Hardness:

Calcium and Magnesium exist in the form of hydroxides, carbonates and bicarbonates. Hardness of water is caused largely due to calcium and magnesium.

Total Hardness varied from 120 to 160 mg/l in October, 2016 and from 116 to 156 mg/l in April, 2017.

iii) Alkalinity:

The Alkalinity varied from 72 to 104 mg/l in October, 2016 and from 76 to 100 mg/l in April, 2017.

(c) Biochemical Oxygen Demand:

The organic matter which enters in the aquatic system is broken down under natural conditions to various end products by the naturally occurring micro-organisms and in this process dissolved oxygen depletion takes places resulting in an ecological imbalance affecting aquatic life and causing nuisance. Hence it becomes essential to know the amount of oxygen that would be needed by the natural micro-organisms for stabilizing a bio-degradable waste under aerobic conditions whereas BOD represents the amount of oxygen required for stabilizing waste when the waste is oxidized.

Presence of BOD in water indicates that the water is polluted with organic matter. Concentration of BOD was found in the range of 1.6 to 4.0 mg/l in October, 2016 and in the range of 1.7 to 3.6 mg/l in April, 2017.

(d) Study of Flora and Fauna

The Biological study was carried out in October 2016 and April 2017. The four sampling points in and around Kanjli wetland had good plantation and Benthic fauna with Ephemeroptera, Oligochaeta Chironomids and molluscs. Saparobidty index at these point was good. The plantations in an around and the wetland provided a good habitat to insects.

The List of benthic species found at various points is given in the **Table-V**.

(e) Sodium and Potassium

Sodium and potassium were found in the range of 9.0 mg/l to 14.6 mg/l and 2.0 mg/l to 4.4 mg/l in October, 2016 respectively and sodium was in the range of 25 mg/l to 59 mg/l and potassium from 4.33 mg/l to 7.82 mg/l in the month of April, 2017.

(f) Heavy Metals

The heavy metals i.e. Zinc, Iron, Copper, Chrome, Nickel, Arsenic, Mercury, Lead & Cadmium were analyzed in the samples collected in October, 2016 and April, 2017 using Atomic Absorption Spectrophotometer. In October, 2016 the concentration of iron varied from 0.10 mg/l to 0.20 mg/l and Zn concentration was found to be 0.10 mg/l at U/S Boat Club and 0.09 mg/l at downstream Sultanpur Lodhi. In April, 2017 the concentration of iron varied between 0.12 mg/l to 0.23 mg/l and Zn was found to be 0.11 mg/l at upstream Boat Club and downstream Sultanpur Lodhi. The heavy metals were found below detection limit in the remaining samples analyzed.

(g) Pesticides

The pesticides i.e. 4,4-DDD, Endrin Aldehyde, 4,4-DDE, Heptachlor, Delta-BHC, Beta-BHC, Anilophos, Gama-BHC, Chloropyriphos, Endrin, Alpha-BHC, Endosulfan-sulphate, Aldrin, Methyl parathion, Dieldrin, Endo-sulphan-I, Endo-sulphan-II, 4,4-DDT, Malathion were analyzed in the samples collected in October, 2016 and the pesticides 4,4'-DDD, Endrin Aldehyde, 4,4'-DDE, Delta-HCH, Beta-HCH, Gama-HCH, Endrin, Alpha-BHC, Endosulfan-sulphate, Aldrin, Methyl parathion, Dieldrin, Endo-sulphan-I, Endo-sulphan-II, 4,4'-DDT were analyzed in the samples collected in April, 2017 using Gas Chromatograph–Mass Spectrophotometer. The pesticides were found below detection limit in all the samples analyzed.

5 (B) Sediment Samples:

The sediment samples were collected from the seven monitoring locations in October, 2016 and April, 2017. The analysis results indicate that:

(a) Physico-Chemical Parameter:

(i) pH:

pH at all the monitoring locations was found to vary between 6.5 to 8.7 in October, 2016 and between 6.2 to 9.0 in April, 2017.

(ii) Conductivity:

The conductivity varied between 114 to 291 $\mu\text{s}/\text{cm}$ in October, 2016 and from 130 to 371 $\mu\text{s}/\text{cm}$ in April, 2017.

(iii) Chloride & Sulphate:

The concentration of chloride varied from 42 $\mu\text{g}/\text{g}$ to 208 $\mu\text{g}/\text{g}$ in October, 2016 and varied from 54 $\mu\text{g}/\text{g}$ to 226 $\mu\text{g}/\text{g}$ in April, 2017. The concentration of Sulphate varied from 120 $\mu\text{g}/\text{g}$ to 220 $\mu\text{g}/\text{g}$ in October, 2016 and from 125 $\mu\text{g}/\text{g}$ to 294 $\mu\text{g}/\text{g}$ in April, 2017.

(iv) Calcium & Magnesium:

The concentration of calcium varied from 216 $\mu\text{g}/\text{g}$ to 560 $\mu\text{g}/\text{g}$ in October, 2016 and from 204 $\mu\text{g}/\text{g}$ to 590 $\mu\text{g}/\text{g}$ in April, 2017. The concentration of magnesium varied from 84 $\mu\text{g}/\text{g}$ to 180 $\mu\text{g}/\text{g}$ in October, 2016 and from 82 $\mu\text{g}/\text{g}$ to 193 $\mu\text{g}/\text{g}$ in April, 2017.

(b) Heavy Metals:

The sediment samples were analyzed for heavy metals i.e. Chrome, Nickel, Lead & Cadmium. Chrome, Nickel, Lead & Cadmium were found below detection Limit (BDL) in all the samples using Atomic Absorption Spectrophotometer except zinc. The value of Zn varied from 0.00 mg/g to 0.09 mg/g in October, 2016 and from 0.01 mg/g to 0.03 mg/g in April, 2017.

(c) Pesticides:

The pesticides i.e. 4,4-DDD, Endrin Aldehyde, 4,4-DDE, Heptachlor, Delta-BHC, Beta-BHC, Anilophos, Gama-BHC, Chloropyriphos, Endrin, Alpha-BHC, Endosulfan-sulphate, Aldrin, Methyl parathion, Dieldrin, Endo-sulphan-I, Endo-sulphan-II, 4,4-DDT, Malathion were analyzed in the sediments samples collected in April, 2017 and the pesticides i.e. 4,4'-DDT, Endrin Aldehyde, 4,4'-DDE, Gamma-HCH, Delta-HCH, Beta-HCH, Endrin, Alpha-HCH, Endosulphan-Sulphate, Aldrin, Methyl Parathion, Dieldrin, Endo-sulphan-I, Endo-sulphan-II, 4,4'-DDD were

analyzed in the sediments samples collected in April, 2017 using Gas Chromatograph –Mass Spectrophotometer. The pesticides were found Below Detection Limit (BDL) in all the samples analyzed.

Ground Water Samples:

08 nos. ground water samples were collected from the adjoining areas of Kanjli wetland in October, 2016 and April, 2017 and analysed for different parameters.

The results of ground water samples collected during October, 2016 & April, 2017 have been tabulated in **Table-VI**.

6. Designated Best Use (DBU) Classification:

The objective of DBU Concept is aimed at restoring and /or maintaining natural water bodies or their parts to such a quality as water body is put to, the use which demands highest quality of water is termed as "DBU", and accordingly the water body is designated.

Primary water quality criteria for different uses have been identified and is as under:

Designated Best-Use	Class of Water	Criteria
Drinking water source without conventional treatment but after disinfection	A	pH between 6.5 and 8.5 Total Coliform MPN/100ml 50 or less Dissolved Oxygen 6mg/l or more BOD = 2.0
Outdoor bathing (Organised)	B	pH between 6.5 and 8.5 DO 5mg/l or more Total Coliform MPN/100ml 500 or less BOD 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	pH between 6 to 9 Total Coliform MPN/100ml 5000 or less DO 4mg/l or more BOD 3mg/l or less
Propagation of Wild Life and Fisheries	D	pH between 6.5 to 8.5 D O 4mg/l or more Free Ammonia (as N) 1.2 mg/l or less

Irrigation, Industrial Cooling, Controlled Waste Disposal	E	pH between 6.0 to 8.5 Electrical Conductivity at 25 ⁰ C micro S/cm Max.2250 Sodium absorption Ratio Max. 26 Boron Max. 2mg/l
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7. CONCLUSION:

The Board has monitored the wetland, collected & analyzed samples for physico chemical, biological, heavy metals and pesticides parameters.

- The quality of water in Kali Bein at Upstream Lodhi (Bein on G.T. Road is very good and conforms to **Class-B**.
- The quality of water at Kanjli Near Barrage conforms to **Class-B**.
- The quality of water at Kanjli Near Boat Club conforms to **Class-B**.
- The quality of water at Downstream Kanjli conforms to **Class-B**.
- The quality of water at U/s Boat Club Near Village Badashpur conforms to **Class-B**.
- The quality of water at D/s Sultanpur Lodhi Near Sultanpur Lodhi Town conforms to **Class-C** due to sewage discharge of Sultanpur Lodhi and Kapurthala.

8. RECOMMENDATIONS:

Since the aim is the restoration and maintenance of the lake quality by eliminating or reducing polluted discharges to the extent possible and practicable, therefore the following recommendations are made:

- Animal and Human activity along the wetland drain is required to be checked.
- Proper level of water is required to be maintained in the rivulet to save the biotic life in it, especially at D/s the reservoir.
- To keep vigil on the level of pollution, regular monitoring of the lake water must be carried out.

- The effluent discharge of STP Begowal and STP Bholath now into Holly bein should be diverted to onto land for irrigation /plantation mode.
- Deforestation in the catchment area should be strictly prohibited to minimize surface runoffs.
- Aforestation in the catchment area of wetland needs to be enhanced to avoid soil erosion.

Table-I Methodology Adopted for Analysis

S.No.	Parameter	Method
1	pH	Glass Electrode Method
2	D.O.	Iodometric / Azide Modification
3	Conductance	Electrical Conductance
4	T.S.S	Gravimetric Method
5	T.D.S	Gravimetric Method
6	C.O.D.	Open Reflux Method
7	B.O.D	3 days Iodometric method
8	Chloride	Argentometric Method
9	Sulphate	Gravimetric Method
10	Total Hardness	EDTA Titration Method
11	Calcium	EDTA Titration Method
12	Magnesium	EDTA Titration Method
13	Phosphate	Colorometric Method
14	Nitrate	Ion Selective Electrode
15	Nitrite	Colorometric Method
16	Amm. Nitrogen	Nesslerization
17	TKN	Kjeldhal Method
18	Alkalinity	Titration Method
19	Turbidity	Nephelometric Method
20	Fluoride	Ion Selective Electrode
21	T.Coli/F.Coli	MPN Multiple Tube Technique
22	Pesticide	GCMS
23	Metals	Atomic Absorption Spectrophotometric

Table II- Analysis Results of Physico-Chemical & Biological in water samples in October, 2016 (Kanjli Wetland)

I.	Field Observations	U/S G.T. Road	U/S Boat Club	Near Boat Clubl	Near Barrage	D/S Barrage	D/S Kanjli	D/S Sultanpur Lodhi
Co-ordinates	Longitude	75° 24' 48" E	75° 23' 47" E	75° 22' 47" E	75° 22' 49" E	75° 22' 26" E	75° 22' 28" E	75° 10' 46" E
	Latitude	31° 28' 4" N	31° 26' 23" N	31° 24' 44" N	31° 24' 43" N	31° 24' 42" N	31° 24' 30" N	31° 12' 50" N
i)	Weather	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
ii)	Approximate depth of main stream/depth of water table	1.0	1.1	1.2	1.3	1.0	1.1	1.1
iii)	Colour and intensity	Almost clear	Almost clear	Almost clear	Almost clear	Almost clear	Almost clear	Turbid
iv)	Odor	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless
v)	Visible effluent discharge	Nil	Nil	Nil	Nil	Nil	Nil	Nil
vi)	Human activities around station.	Nil	Nil	Nil	Human Bathing	Human Bathing	Nil	Nil
2.	Core Parameters							
i)	Temperature (Air/Water)°C	32/24	32/23	32/25	32/25	31/24	31/24	29/24
ii)	pH	7.1	7.5	7.5	7.8	7.3	7.1	7.2
iii)	Conductivity µS/cm	302	278	280	266	274	268	380
iv)	DO (mg/l)	6.2	6.0	6.1	6.1	6.3	6.0	4.8
v)	BOD (mg/l)	2.0	1.8	2.1	2.0	1.6	2.1	4.0
vi)	Nitrate-N (mg/l)	1.6	1.7	1.8	1.7	1.6	1.8	2.0
vii)	Ammonia-N (mg/l)	0.8	0.9	1.0	1.0	0.9	1.2	2.8
viii)	Total Coliform MPN/ 100 ml	430	390	430	460	490	580	790
ix)	Faecal Coliform MPN/ 100 ml	170	130	210	210	220	250	490
3.	Biomonitoring							
i)	Saprobity Index	3.3	3.5	3.3	3.0	3.0	2.5	2.5
ii)	Diversity Index	0.35	0.35	0.30	0.30	0.30	0.25	0.25
4.	General Parameters							
i)	COD (mg/l)	16	14	14	18	15	18	28
ii)	TKN (mg/l)	1.4	1.5	1.8	1.7	1.8	1.9	3.6
iii)	TDS (mg/l)	182	170	180	160	184	162	228
iv)	TFS (mg/l)	160	148	151	134	156	136	182
v)	TSS (mg/l)	18	17	26	17	20	22	34
vi)	Turbidity (mg/l)	22	21	24	20	22	19	25
vii)	Total Hardness (mg/l)	156	136	128	120	144	124	160
viii)	Fluoride (mg/l)	0.3	0.5	0.4	0.3	0.4	0.4	0.6
ix)	Chloride (mg/l)	20	18	22	20	22	18	32
x)	Sulphate (mg/l)	18	16	17	17	18	17	36
xi)	Total Alkalinity (mg/l)	84	88	92	76	100	72	104
xii)	P-Alkalinity (mg/l)	ND	ND	ND	ND	ND	ND	ND
xiii)	Phosphate as P (mg/l)	0.8	0.9	0.8	0.7	0.8	0.6	1.0
xiv)	Sodium (mg/l)	10.8	12.2	14.6	13.0	9.2	9.0	12.0
xv)	Potassium (mg/l)	4.0	4.4	4.0	3.8	3.0	2.6	2.0
xvi)	Calcium (mg/l)	42	38	37	35	40	34	45
xvii)	Magnesium (mg/l)	12.6	9.7	8.7	7.7	10.6	9.7	11.6

Table-II Analysis Results of Physico-Chemical, Biological in water samples in April, 2017 (Kanjli Wetland)

<i>I.</i>	<i>Field Observations</i>	<i>Upstream Sultanpur G.T. Road</i>	<i>U/S Boat Club</i>	<i>Near Boat Club</i>	<i>Near Barrage</i>	<i>Downstream Barrage</i>	<i>Downstream Kanjli</i>	<i>Downstream Sultanpur Lodhi</i>
<i>Co-ordinates</i>	Longitude	75° 24' 48" E	75° 23' 47" E	75° 22' 47" E	75° 22' 49" E	75° 22' 26" E	75° 22' 28" E	75° 10' 46" E
	Latitude	31° 28' 4" N	31° 36' 23" N	31° 24' 44" N	31° 24' 43" N	31° 24' 42" N	31° 24' 30" N	31° 12' 50" N
i)	Weather	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
ii)	Approximate depth of main stream/depth of water table in meter	1.0	1.1	1.2	1.3	1.0	1.1	1.1
iii)	Colour and intensity	Almost clear	Almost clear	Almost clear	Almost clear	Almost clear	Almost clear	Almost clear
iv)	Odor	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless
v)	Visible effluent discharge	Nil	Nil	Nil	Nil	Nil	Nil	Nil
vi)	Human activities around station.	Nil	Nil	Nil	Human bathing	Human bathing	Nil	Nil
2.	<i>Core Parameters</i>							
i)	Temperature (Air/Water)°C	37/26	41/28	37/26	39/25	39/27	38/27	41/28
ii)	pH	7.4	7.6	7.7	7.6	7.8	7.7	7.6
iii)	Conductivity µmho/cm	318	312	290	306	320	316	440
iv)	DO (mg/l)	7.2	7.1	7.4	7.2	7.6	7.1	4.5
v)	BOD (mg/l)	2.1	1.8	2.3	1.7	1.9	2.3	3.6
vi)	Nitrate-N (mg/l)	1.4	1.6	1.5	1.4	1.8	1.7	1.8
vii)	Ammonia-N (mg/l)	0.6	0.7	0.8	1.0	1.0	1.4	3.6
viii)	Total Coliform MPN/100 ml	390	390	490	460	490	490	790
ix)	Faecal Coliform MPN/100 ml	170	170	220	210	220	220	330
3.	<i>Bio Monitoring</i>							
i)	Saprobity Index	3.5	4.0	3.0	4.0	3.5	2.5	2.5
ii)	Diversity Index	0.35	0.35	0.3	0.35	0.3	0.25	0.25
iii)	P/R ratio							
4.	<i>General Parameters</i>							
i)	COD (mg/l)	16	14	20	16	16	18	24
ii)	TKN (mg/l)	1.4	1.2	1.5	1.8	1.9	2.0	4.2
iii)	TDS (mg/l)	191	187	174	183	192	190	264
iv)	TFS (mg/l)	168	160	140	150	152	158	196
v)	TSS (mg/l)	14	12	18	17	12	14	40
vi)	Turbidity (mg/l)	08	06	10	07	08	06	18
vii)	Total Hardness (mg/l)	148	128	124	116	132	120	156
viii)	Fluoride (mg/l)	0.11	0.18	0.16	0.15	0.17	0.20	0.14
ix)	Chloride (mg/l)	10	12	14	16	14	16	30
x)	Sulphate (mg/l)	16	14	15	18	16	14	28
xi)	Total Alkalinity (mg/l)	80	84	88	80	92	76	100
xii)	P-Alkalinity (mg/l)	ND	ND	ND	ND	ND	ND	ND
xiii)	Phosphate (mg/l)	0.28	0.30	0.21	0.32	0.18	0.32	0.6
xiv)	Sodium (mg/l)	31	45	37	25	28	49	59
xv)	Potassium (mg/l)	4.92	5.12	5.02	4.33	4.51	5.61	7.82
xvi)	Calcium (mg/l)	34	36	32	30	34	30	40
xvii)	Magnesium (mg/l)	15.5	9.2	10.6	9.7	11.6	10.6	13.6

Table-V: Benthic Table (Kanjli Wetland, October 2016 & April, 2017)

		<i>U/S Sultanpur Lodhi</i>		<i>Near Barrage</i>		<i>D/S Barrage</i>		<i>Near Boat Club</i>		<i>D/S Kanjali</i>		<i>U/S Boat Club</i>		<i>D/S Sultanpur Lodhi</i>	
		<i>Oct 16</i>	<i>Apr 17</i>	<i>Nov 14</i>	<i>Jan 15</i>	<i>Nov 14</i>	<i>Jan 15</i>	<i>Nov 14</i>	<i>Jan 15</i>	<i>Nov 14</i>	<i>Jan 15</i>	<i>Nov 14</i>	<i>Jan 15</i>	<i>Nov 14</i>	<i>Jan 15</i>
1.	Species														
	Ephemeroptera														
	Baetide (4)			++	++				++				++		
	Caenidae (7)	++	++		++		++	++				++	++		
	Ephemerallibae (10)														
2.	Trichoptera														
	Hydropside (6)														
	Pletoemidae (7)														
	Limeplilidae (7)														
3.	Heteroptera														
	Microneta (5)														
	Notonecta (5)														
	Hydrometra (5)														
	Corixidae (5)														
4.	Odonata														
	Zygoptera (8)	-													
	Anisoptera (8)														
	Coleoptera (8)														
5.	Oligochaeta (1)		++				++					++			
6.	Prawns & Fish														
7.	Hydrocarina														
8.	Planarians (5)														
	Similidae (5)														
9.	Molluscs														
	Planorbir (3)	++	++	++		++	++	++	++			++	++	++	++
	Lymea (3)	++	++	++	++	++	++	++	++	++	++	++	++		
10.	Chironmids (2)	-		++	++				++	++	++		++	++	++
	Saprobity index	13/4=3.3	14/4=3.5	12/4=3.0	16/4=4.0	6/2=3.0	14/4=3.5	13/4=3.0	12/4=3.0	5/2=2.5	5/2=2.5	14/4=3.5	16/4=4.0	5/2=2.5	5/2=2.5
	Diversity index	4/11=0.35	4/11=0.35	4/12=0.3	4/11=0.35	2/6=0.3	4/12=0.3	4/12=0.3	4/12=0.3	2/8=0.25	2/8=0.25	4/11=0.35	4/11=0.35	2/8=0.25	2/8=0.25

A.	<i>++ indicates the benthic fauna commonly found.</i>
B.	<i>+ indicates the benthic fauna rarely present.</i>
C.	<i>--- indicates no benthic life observed.</i>
D.	BMWP Score: - <i>(Biological Monitoring Working Party) score</i>
	<i>Or</i>
	Saprobity Index:

Table-VI Ground Water Samples under Kanjli Wetland (October 2016)

S. No.	Point of sample collection	Co-ordinates (Longitude & Latitude)	Depth appx ft	pH	EC μ S/cm	TDS mg/l	TSS mg/l	Cl ⁻ mg/l	SO ₄ ²⁻ mg/l	Color	Mg mg/l	Ca mg/l	TH mg/l	F ⁻ mg/l	T. Alk mg/l	Turb NTU
1	Hand pump Bus Stand Subhanpur	31°28'04"N, 75°24'25"E	150	7.1	545	338	BDL	16	18	Clear	21.3	64	248	0.20	156	BDL
2	Vikas Khanna, Petrol Pump Badshpur	31°26'49"N, 75°23'33"E	250	7.2	458	293	BDL	20	20	Clear	17.4	54	208	0.28	140	BDL
3	Gurdwara Nizampur More vill. Badshapur	31°26'48"N, 75°23'36"E	150	7.4	492	295	BDL	24	12	Clear	18.4	58	220	0.40	148	BDL
4	Sr. Partap Sing Vill. Dham	31°26'12"N, 75°23'23"E	220	7.4	1123	730	BDL	62	52	Clear	28.1	85	328	0.32	212	BDL
5	Kuldeep general Store Bholla Vill. Dham	31°25'34"N, 75°22'58"E	120	7.3	1052	726	BDL	58	56	Clear	27.2	82	316	0.50	200	1.0
6	S. kulwant Singh, Submersible	31°24'40"N, 75°22'27"E	150	8.2	450	288	BDL	18	30	Clear	16.5	51	196	0.30	136	BDL
7	Chaman lal near Railway Station Hamira	31°27'35"N, 75°26'52"E	270	7.8	448	301	BDL	28	26	Clear	15.5	51	192	0.40	124	BDL
8	Sh Sukhdev Singh	31°27'19"N, 75°25'56"E	80	7.3	480	327	BDL	26	32	Clear	18.4	56	216	0.45	144	BDL

Note : T.Coli & F.Coli were found ND in all the above samples

Table-VI Ground Water Samples under Kanjli Wetland (April 2017)

S. No.	Point of sample collection	Co-ordinates (Longitude & Latitude)	Depth appx ft	pH	EC μ S/cm	TDS mg/l	TSS mg/l	Cl ⁻ mg/l	SO ₄ ²⁻ mg/l	Color	Mg mg/l	Ca mg/l	TH mg/l	F ⁻ mg/l	T. Alk mg/l	Turb NTU
1	Hand pump Bus Stand Subhanpur	31°28'04"N, 75°24'25"E	150	7.8	585	350	BDL	18	16	Clear	21.3	67	256	0.32	176	BDL
2	Vikas Khanna, Petrol Pump Badshpur	31°26'49"N, 75°23'33"E	250	7.3	643	384	BDL	22	24	Clear	24.3	74	284	0.20	188	BDL
3	Gurdwara Nizampur More vill. Badshapur	31°26'48"N, 75°23'36"E	150	7.6	509	306	BDL	26	28	Clear	21.3	62	244	0.50	172	BDL
4	Sr. Partap Sing Vill. Dham	31°26'12"N, 75°23'23"E	220	7.8	1152	692	BDL	64	68	Clear	31.1	93	360	0.40	292	BDL
5	Kuldeep general Store Bholla Vill. Dham	31°25'34"N, 75°22'58"E	120	7.2	908	544	BDL	52	58	Clear	26.2	83	316	0.26	272	1.1
6	S. kulwant Singh, Submersible	31°24'40"N, 75°22'27"E	150	8.1	498	298	BDL	24	32	Clear	18.4	54	212	0.32	152	BDL
7	Chaman lal near Railway Station Hamira	31°27'35"N, 75°26'52"E	270	7.8	502	302	BDL	30	28	Clear	20.4	61	236	0.28	168	BDL
8	Sh Sukhdev Singh	31°27'19"N, 75°25'56"E	80	7.6	816	490	BDL	48	40	Clear	28.6	80	312	0.32	248	BDL

Note : T.Coli & F.Coli were found ND in all the above samples

Annexure-I**Monitoring Protocol for Water and Sediment Samples**

S.No.	Parameters to be Monitored	Frequency
1	Water Samples	Twice (October & April)
a	Field Observations	Twice (October & April)
b	Core Observations	Twice (October & April)
c	General Parameters	Twice (October & April)
d	Bio Monitoring	Twice (October & April)
e	Trace Metals	Twice (October & April)
f	Pesticides	Twice (October & April)
2	Sediment Samples	Twice (October & April)
a	General Parameters, Trace Metals & Pesticides	Twice (October & April)

Annexure-II**Parameters Analysed in the Water Samples**

1.	<i>Field Observations</i>
i)	Weather
ii)	Approximate depth of main stream/depth of water table
iii)	Colour and intensity
iv)	Odor
v)	Visible effluent discharge
vi)	Human activities around station.
2.	<i>Core Parameters</i>
i)	Temperature (Air/Water)
ii)	pH
iii)	Conductivity
iv)	DO
v)	BOD
vi)	Nitrate-N
vii)	Ammonia-N
viii)	Total Coliform
ix)	Faecal Coliform
3.	<i>Bio Monitoring</i>
i)	Saprobity Index
ii)	Diversity Index
4.	<i>General Parameters</i>
i)	COD
ii)	TKN
iii)	Total Dissolved Solids
iv)	Total Fixed Solids
v)	Total Suspended Solids
vi)	Turbidity
vii)	Hardness
viii)	Fluoride
ix)	Boron
x)	Chloride
xi)	Sulphate
xii)	Total Alkalinity
xiii)	P-Alkalinity
xiv)	Phosphate
xv)	Sodium
xvi)	Potassium
xvii)	Calcium
xviii)	Magnesium
5.	<i>Trace Metals</i>
i)	Arsenic
ii)	Nickel
iii)	Copper
iv)	Mercury
v)	Chromium

vi)	Cadmium
vii)	Zinc
viii)	Lead
ix)	Iron
6.	Pesticides
i)	Alpha HCH
ii)	Beta HCH
iii)	Gama HCH
iv)	4,4' DDT
v)	4,4' DDE
vi)	4,4' DDD
vii)	Alpha Endosulphan
viii)	Beta Endosulphan
ix)	Dieldrin
x)	Aldrin
xi)	Endrin
xii)	Endrin Aldehyde
xiii)	Methyl Parathian

Annexure-III**Parameters Analysed in the Sediment Samples**

1.	<i>Field Observations</i>
i)	Weather
ii)	Approximate depth of main stream/depth of water table
2.	<i>Core Parameters</i>
ii)	pH
iii)	Conductivity
iv)	Chloride
v)	Sulphate
vi)	Calcium
vii)	Magnesium
3.	<i>Trace Metals</i>
i)	Nickel
ii)	Chromium
iii)	Cadmium
iv)	Zinc
v)	Lead
4.	<i>Pesticides</i>
i)	Alpha HCH
ii)	Beta HCH
iii)	Gama HCH
iv)	4,4' DDT
v)	4,4' DDE
vi)	4,4' DDD
vii)	Alpha Endosulphan
viii)	Beta Endosulphan
ix)	Dieldrin
x)	Aldrin
xi)	Endrin
xii)	Endrin Aldehyde
xiii)	Methyl Parathion
