

# HARIKE WETLAND

A REPORT  
ON  
STATUS OF WATER QUALITY



**PUNJAB POLLUTION CONTROL BOARD**  
**NABHA ROAD, PATIALA- 147001**

## **Harike Wetland**

### **1. INTRODUCTION**

Harike wetland was recognized as a wetland of International Importance by Ramsar Convention in the year 1990. Harike wetland is also known as "Hari-ke-Pattan", with the Harike Lake in the deeper part of it, is the largest wetland in Northern India and has been formed at the confluence of two major rivers of Punjab namely the Sutlej and the Beas at Harike in Taran Taran Sahib District. This wetland comes under the administrative boundaries of Amritsar, Kapurthala and Ferozepur districts. The rich biodiversity of the wetland which plays a vital role in maintaining the precious hydrological balance in the catchment area with its vast concentration of migratory birds, it was declared a bird sanctuary in 1982 and named as Harike Pattan Bird sanctuary. The Harike wetland covers an area of approx. 4100 hectares.

#### **1.1 Physiography of Harike Wetland**

Harike Wetland has been formed at the confluence of two major rivers of Punjab namely. Satluj and Beas and is located around 31°13'N Latitude and 75° 12'E longitude. This wetland comes under the administrative boundaries of Amritsar, Kapurthala and Ferozepur districts. The construction of Harike barrage in 1952 led to the formation of the Harike lake. The barrage connects the Amritsar, Ferozepur highway.

#### **1.2 Objective**

The quality of water of Harike wetland is under immense pressure owing to over exploitation and due to various sources of pollution, with a result that its rich flora and fauna is under threat.

Water quality, being an important factor in the conservation of wetland, it is necessary to know the existing water quality, as well as to keep a constant watch on it for further improvement.

### **2. Monitoring by Punjab Pollution Control Board**

Punjab Pollution Control Board has conducted monitoring of Harike wetland to study the effect on water and sediment quality due to discharge of

domestic/industrial 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 Goindwal sahib
- 2) D/s Goindwal Sahib
- 3) Point source east bein
- 4) Satluj U/s East bein
- 5) Satluj D/s East bein
- 6) Satluj 100m U/s BNU
- 7) Satluj 100m D/s BNU
- 8) Point Source Buddha Nallah
- 9) Beas at Harike
- 10) Satluj at harike
- 11) D/s Harike Lake
- 12) Harike lake
- 13) Ferozepur feeder Canal
- 14) Rajasthan Feeder Canal
- 15) Bikaner Canal



**Harike Lake**







**Satluj at Harike**



**Beas at Harike**



**Harike Reservoir**

### 3. SAMPLING

During the study period i.e. October, 2016 & April, 2017, Harike wetland was monitored at Fifteen locations as per protocol mentioned in **Annexure-I**. Samples were collected from fifteen locations as one of the locations was found dry. These samples were analyzed for various physico-chemical, heavy metals, pesticides & biological parameters as mentioned in **Annexure-II**. Sediment samples were also collected to know the accumulation of various pollutants in the sediments and were analyzed for general parameters, heavy metals and pesticides (**Annexure-III**).

Since the chemical analysis alone cannot provide a true picture of the water quality of the river, biological evaluation of the water is also necessary to confirm its suitability for some of the uses. Hence sample were analyzed for benthic organisms, Benthic macro-invertebrates.

#### 4. Methodology :

Methodology adopted for analysis of various parameters have been prescribed in **Table-I**.

### 5. RESULTS AND DISCUSSIONS

#### 5 (A) Water Samples

The analysis results of physico-chemical parameters, heavy metals and pesticides for the monitoring in the month of October, 2016 and April,2017 indicates as given below.

##### (a) Physical Parameters

##### i) pH

The pH at all the monitoring locations was found varied from 7.0 to 8.1 in the month of October, 2016 and 7.1 to 8.0 during April, 2017.

##### ii) Turbidity

It is caused by the presence of suspended and colloidal matter such as clay, silt, organic and inorganic matter as well as aquatic organism. Turbidity was found to be 3 to 89 NTU in the month of October, 2016 and varied between 4 to 48 in April, 2017.

##### iii) Conductivity

The conductivity of an aqueous solution express its ability to conduct or to carry an electric current which depends largely on the presence of ions and their total concentration, their mobility, their valency and relative concentration and

of course on the temperature. At Harike Wetland the conductivity varied from 218 to 1636  $\mu\text{S}/\text{cm}$  in the month of October, 2016 and 192 to 1694  $\mu\text{S}/\text{cm}$  during April, 2017.

#### **iv) Dissolved oxygen**

Oxygen is required for all the organism to carry out metabolic activities and for production of energy for growth and reproduction. DO level was maximum in all the canals i.e. Ferozepur feeder canal, Rajasthan feeder canal & Bikaner canal. Varying between 2.4 to 8.0 mg/l in the month of October, 2016 and 2.8 to 8.2 mg/l during April, 2017.

### **(b) Inorganic and Non Metallic Constituents**

#### **i) Chloride & Sulphate**

The Chloride contents in Natural water is due to dissolution of salts and discharge of sewage /drains and rain water in Rivers and Lakes. The concentration of chloride varied from 12 to 134 mg/l in the month of October, 2016 and 12 to 102 mg/l during April, 2017. Sulphate compounds originate from the oxidation of sulphite. The concentration of sulphate ions varied from 10 to 126 mg/l in the month of October, 2016 and 7 to 76 mg/l during April, 2017.

#### **ii) Hardness**

Calcium and magnesium exist in the form of oxides, hydroxides, carbonates and bicarbonates in the rocky stony beds which form the traversing ground for the rain waters and impart their character to the flowing water.

Calciferous rocks impart natural hardness to water resources. Hardness of water is caused largely due to calcium and magnesium. Total Hardness was found between 90 to 290 mg/l in the month of October, 2016 and 40 to 226 mg/l during April, 2017.

### **(c) Bio chemical oxygen demand & Chemical Oxygen Demand**

The organic matter present in surface water is broken down by natural process leads to depletion of oxygen. The amount of oxygen present in water helps to sustain aquatic life and it is important to know the BOD value remains below 5 mg/l during October, 2016 & April, 2017, whereas COD varied from 2 to 12 mg/l in the month of October 2016 & 2.5 to 384 mg/l during April, 2017.



## (d) Study of Flora and Fauna

Benthic macro-invertebrates were studied at Harike Wetland in the month of October, 2016 & April, 2017.

List of Benthic species recorded at various sampling points is given in Table-III. Where Symbols indicate as under:-

1. ++ indicates the benthic fauna commonly found.
2. + indicates the benthic fauna rarely present.
3. --- indicates no benthic life observed.
4. BMWP Score:- (Biological Monitoring Working Party) score

Saprobity Index: Method involves the presence of macro-invertebrate benthic fauna up to family level of taxonomic precision.

All possible families having saprobic indicator value (Oxygen availability) are classified on a scale of 1 to 10 according to their preference for saprobic water quality.

Saprobity Index: 
$$\frac{\text{Grand total score}}{\text{Total number of families encountered}}$$

Diversity Index:- The diversity is the ratio of the total number of runs & the total number of organisms encountered. The ratio thus obtained has a value between 0 to 1.

Flora and Fauna in Buddha Nallah:- The water quality of river Satluj is generally 'C' before it meets Buddha Nallah. It receives Buddha Nallah which is a dark black stream indicating the anaerobic conditions inside the Nallah upto about 15-20 km from Wallipur depending upon the availability of water in the River Satluj. The influence of Nallah is visible clearly at left bank of Satluj/over a long stretch. The river water quality becomes the worst after it receives the contents of Buddha Nallah, dropping down to Class 'D'.

There is marked elimination of phyto and zooplanktonic species and BMWP score is zero indicating its adverse/Toxic effect of the contents of Buddha Nallah. The water is not fit for propagation of wild life and fisheries. The dissolved oxygen content in the Buddha Nallah is zero and it is not regained even up to Sidhwan Bet due to less water in the River Satluj and almost nil turbulence during the most part of the year. The Flora and fauna cannot exist under such Environmental conditions.

Some benthic macro-invertebrates were found at Beas at Harike and at U/s Goindwal Sahib. No benthic fauna could be found at U/S & D/S Buddha Nallah & point near East Bein. Similarly in canals less fauna was found.

### **e) Heavy Metals**

Copper, Nickel, Arsenic, Mercury, Cadmium, Lead & Chrome were not detected at any sampling location. Iron was detected ranging from 0.06 to 0.38 mg/l in the month of October 2016 & 0.12 to 0.17 mg/l during April, 2017 and Zinc was varied from 0.09 to 0.1 mg/l in October, 2016 and 0.09 mg/l to 0.28 mg/l during April, 2017.

Nickel, Chrome, Cadmium & Lead were not detected in sediment samples except Zinc which was detected ranging from 0.02 to 0.12 mg/gm in the month of October 2016 & upto 0.1 mg/gm during April, 2017.

### **f) Pesticides**

The pesticides i.e Alpha HCH, Beta HCH, Gama HCH, 4,4' DDT, 4,4' DDE, 4,4' DDD, Alpha Endosulphan, Beta Endosulphan, Dieldrin, Aldrin, Endrin, Endrin Aldehyde & Methyl Parathion were analyzed in the water samples collected in October, 2016 and April, 2017 using Gas Chromatograph–Mass Spectrophotometer. The pesticides were not detected in all the samples collected during the period of study.

## **5. Sediment Samples**

The sediment samples were collected in the month of October, 2016 and April, 2017 and the results are tabulated in **Table-II & IV**.

## 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 used have been identified and is as under:**

<b>Designated-Best-Use</b>	<b>Class of water</b>	<b>Criteria</b>
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 mg/l or less
Outdoor bathing (Organised)	B	pH between 6.5 and 8.5 Dissolved Oxygen 5 mg/l or more Total Coliform MPN/100ml 500 or less BOD 3 mg/l or less
Drinking water source after conventional treatment and disinfection	C	pH between 6 and 9 Total Coliform MPN/100ml 5000 or less Dissolved Oxygen 4 mg/l or more BOD 3 mg/l or less
Propagation of Wild life and Fisheries	D	pH between 6.5 and 8.5 Dissolved Oxygen 4 mg/l or more Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	pH between 6.0 and 8.5 Electrical Conductivity at 25oC micro mhos/cm Max. 2250 Sodium absorption Ratio Max. 26 Boron Max. 2 mg/l

## **Conclusions**

The water quality of Harike Lake conforms to Class-B as per the designated best use criteria of classification at Harike pattan which is largely due to the confluence of the river beas, which is a relatively cleaner river with the river Sutlej. The river Sutlej is the most affected in terms of pollution which is from the Budha Nallah on the left bank and the East bein on the right bank before it reaches Harike to form the lake with the river beas, the meagre flow of water in the river Sutlej also aggravates the problem as the dilution water is not available except during the rainy season and the quality of water is deteriorated in the whole stretch of river Sutlej till it reaches harike. The quality of water downstream of Budha Nallah and downstream of East Bein remains 'E' except during the rainy season.

## **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:

- To keep vigil on the level of pollution, regular monitoring of the point sources of pollution i.e. Budha Nallah and East Bein needs to be checked and the discharges of sources of pollution falling into the Budha Nallah and the East Bein need to be controlled and their quality needs to be kept under checked.
- In-situ low cost treatment systems need to be installed in all the out falls falling into Budha Nallah and East Bein.
- Deforestation in the catchment area should be strictly prohibited to minimize surface runoffs.
- Afforestation in the catchment area of wetland should be enhanced to avoid soil erosion.
- Source of pollution from agricultural & other activities must be identified & plugged.
- Water level at Harike reservoir should be maintained to save biotic life.

**Table-I (i) Analysis Results of Physico-Chemical, Biological, in water samples in Oct., 2016 ( Harike Wetland)**

<b>1.</b>	<b>Field Observations</b>	<b>Beas at Harike</b>	<b>Satluj at Harike</b>	<b>Harike Lake</b>	<b>D/s Harike</b>	<b>D/s Goindwal Sahib</b>
<b>Co-ordinates</b>	<b>Longitude</b>	E 74°57'5"	E 74°56'57"	E 74°56'54"	E 74°56'40"	E 74°07'50"
	<b>Latitude</b>	N 31°09'2"	N 31°08'34"	N 31°08'41"	N 31°08'53"	N 31°20'20"
i)	Weather	Sunny	Sunny	Sunny	Sunny	Sunny
ii)	Approximate depth of main stream/depth of water table	Aprox. 7.0M	Aprox. 6.2M	Aprox. 10.0M	Aprox 1.0 m	Aprox 4.4 m
iii)	Colour and intensity	Colourless	Colourless	Colourless	Colourless	Colourless
iv)	Odor	Odourless	Odourless	Odourless	Odourless	Odourless
v)	Visible effluent discharge	Nil	Nil	Nil	Nil	Nil
vi)	Human activities around station.	Boating Site and Fishing	Nil	Nil	Fishing	NIL
<b>2.</b>	<b>Core Parameters</b>					
i)	Temperature (Air/Water) °C	28/21	27/22	28/22	28/22	27/21
ii)	pH	8.0	7.6	7.8	8.1	7.7
iii)	Conductivity µS/cm	276	338	283	254	272
iv)	DO (mg/l)	7.8	7.2	7.4	7.2	7.4
v)	BOD (mg/l)	BDL	BDL	BDL	1.6	BDL
vi)	Nitrate-N (mg/l)	2.0	2.0	2.4	0.2	0.4
vii)	Ammonia-N (mg/l)	1.0	1.2	1.4	3.0	0.8
viii)	Total Coliform MPN/100ml	370	1100	400	450	680
ix)	Faecal Coliform MPN/100ml	180	450	200	200	200
<b>3.</b>	<b>Bio Monitoring</b>					
i)	Saprobity Index	5.6	-	-	-	2.5
ii)	Diversity Index	0.3	-	-	-	0.3
<b>4.</b>	<b>General Parameters</b>					
i)	COD (mg/l)	6	12	10	8.0	2.0
ii)	TKN (mg/l)	1.8	2.0	2.2	4.6	1.6
iii)	Total Dissolved Solids (mg/l)	193	204	192	155	149
iv)	Total Fixed Solids (mg/l)	182	196	178	142	140
v)	Total Suspended Solids (mg/l)	14	21	16	16	9
vi)	Turbidity (NTU)	4	7	5	22	5
vii)	Hardness (mg/l)	118	148	118	145	55
viii)	Fluoride (mg/l)	0.6	0.6	0.8	0.8	0.6
ix)	Chloride (mg/l)	22	28	24	30	18
x)	Sulphate (mg/l)	14	18	16	26	14
xi)	Total Alkalinity (mg/l)	108	162	114	85	45
xii)	P-Alkalinity (mg/l)	BDL	BDL	BDL	BDL	BDL
xiii)	Phosphate (mg/l)	1.0	2.0	1.8	0.6	0.8
xiv)	Sodium (mg/l)	10	19	21	18	14
xv)	Potassium (mg/l)	2.8	2.2	2.6	3.0	2.9
xvi)	Calcium (mg/l)	28	36	30	36	12
xvii)	Magnesium (mg/l)	11	14	10	13.36	6



**Table-I (i) Analysis Results of Heavy metals and Pesticides in water samples in Oct., 2016 ( Harike Wetland)**

<b>5. Trace Metals</b>						
		<b>Beas at Harike</b>	<b>Satluj at Harike</b>	<b>Harike Lake</b>	<b>D/s Harike</b>	<b>D/s Goindwal Sahib</b>
i)	Arsenic (mg/l)	BDL	BDL	BDL	BDL	BDL
ii)	Nickel (mg/l)	BDL	BDL	BDL	BDL	BDL
iii)	Copper (mg/l)	BDL	BDL	BDL	BDL	BDL
iv)	Mercury (mg/l)	BDL	BDL	BDL	BDL	BDL
v)	Chromium (mg/l)	BDL	BDL	BDL	BDL	BDL
vi)	Cadmium (mg/l)	BDL	BDL	BDL	BDL	BDL
vii)	Zinc (mg/l)	0.10	BDL	BDL	BDL	BDL
viii)	Lead (mg/l)	BDL	BDL	BDL	BDL	BDL
ix)	Iron(mg/l)	0.19	0.29	0.24	0.22	0.18
<b>6. Pesticides</b>						
i)	Alpha HCH (µg/l)	BDL	BDL	BDL	BDL	BDL
ii)	Beta HCH (µg/l)	BDL	BDL	BDL	BDL	BDL
iii)	Gama HCH (µg/l)	BDL	BDL	BDL	BDL	BDL
iv)	4,4' DDT (µg/l)					
v)	4,4' DDE (µg/l)					
vi)	4,4' DDD (µg/l)	BDL	BDL	BDL	BDL	BDL
vii)	Alpha Endosulphan (µg/l)	BDL	BDL	BDL	BDL	BDL
viii)	Beta Endosulphan (µg/l)	BDL	BDL	BDL	BDL	BDL
ix)	Dieldrin (µg/l)					
x)	Aldrin (µg/l)					
xi)	Endrin(µg/l)	BDL	BDL	BDL	BDL	BDL
xii)	Endrin Aldehyde(µg/l)					
xiii)	Methyl Parathion (µg/l)	BDL	BDL	BDL	BDL	BDL

**Table-I (ii) Analysis Results of Physico-Chemical, Biological, in water samples in Oct, 2016 ( Harike Wetland)**

<b>1.</b>	<b>Field Observations</b>	<b>U/s Buddha Nallah</b>	<b>D/s Buddha Nallah</b>	<b>D/s East Bein</b>	<b>U/s Goindwal Sahib</b>	<b>U/s East Bein</b>
<b>Co-ordinates</b>	<b>Longitude</b>	E 75° 6'40"	E 75°6'58"	E 74°6'27"	E 75°9'43"	E 75°6'58"
	<b>Latitude</b>	N 31°8'8"	N 31°7'93"	N 31°8'27"	N 31°22'28"	N 31°7'93"
i)	Weather	Sunny	Sunny	Sunny	Sunny	Sunny
ii)	Approximate depth of main stream/depth of water table	1.5 m	3.4 m	Approx. 1.6M	Approx. 4.0 M	Approx. 1.6M
iii)	Colour and intensity	Colorless	Greyish	Light Greyish	Colorless	Colorless
iv)	Odor	Odorless	Stinky	Foul Smell	odourless	odourless
v)	Visible effluent discharge	Nil	Nil	Nil	Nil	Nil
vi)	Human activities around station.	Fishing	Nil	Cattle grazing and bathing	Immersion of ashes	Cattle grazing and bathing
<b>2.</b>	<b>Core Parameters</b>					
i)	Temperature (Air/Water) °C	29/21	29/22	29/21	29/22	28/20
ii)	pH	7.8	7.6	7.8	7.9	7.6
iii)	Conductivity µS/cm	404	434	936	260	588
iv)	DO (mg/l)	6.8	3.0	2.4	7.6	6.0
v)	BOD (mg/l)	BDL	34	19	BDL	BDL
vi)	Nitrate-N (mg/l)	0.8	1.8	2.8	0.2	1.0
vii)	Ammonia-N (mg/l)	1.4	2.8	3.8	0.6	1.2
viii)	Total Coliform MPN/100ml	1000	43000	32000	560	1000
ix)	Faecal Coliform MPN/100ml	400	21000	17000	370	560
<b>3.</b>	<b>Bio Monitoring</b>					
i)	Saprobity Index	-	-	-	3.0	-
ii)	Diversity Index	-	-	-	0.3	-
<b>4.</b>	<b>General Parameters</b>					
i)	COD (mg/l)	6.8	3.0	2.4	7.6	6.0
ii)	TKN (mg/l)	2.1	4.2	5.8	1.2	1.8
iii)	Total Dissolved Solids (mg/l)	295	530	577	140	356
iv)	Total Fixed Solids (mg/l)	270	512	540	136	341
v)	Total Suspended Solids (mg/l)	13	34	19	8	14
vi)	Turbidity (NTU)	6	30	24	3	18
vii)	Hardness (mg/l)	90	158	160	45	85
viii)	Fluoride (mg/l)	0.8	1.8	2.0	0.6	1.6
ix)	Chloride (mg/l)	36	92	88	15	36
x)	Sulphate (mg/l)	28	78	76	10	28
xi)	Total Alkalinity (mg/l)	62	128	108	38	48
xii)	P-Alkalinity (mg/l)	BDL	BDL	BDL	BDL	BDL
xiii)	Phosphate (mg/l)	BDL	BDL	BDL	BDL	BDL
xiv)	Sodium (mg/l)	27.4	35.9	29	11	15
xv)	Potassium (mg/l)	5.8	10.5	4.2	3.3	2.6
xvi)	Calcium (mg/l)	21.6	37.6	36.8	10	22
xvii)	Magnesium (mg/l)	8.64	15.12	16.32	BDL	7.2

**Table-I (ii) Analysis Results of Heavy metals and Pesticides in water samples in Oct, 2016 ( Harike Wetland)**

<b>5. Trace Metals</b>		<b>U/s Buddha Nallah</b>	<b>D/s Buddha Nallah</b>	<b>D/s East Bein</b>	<b>U/s Goindwal Sahib</b>	<b>U/s East Bein</b>
i)	Arsenic (mg/l)	BDL	BDL	BDL	BDL	BDL
ii)	Nickel (mg/l)	BDL	BDL	BDL	BDL	BDL
iii)	Copper (mg/l)	BDL	BDL	BDL	BDL	BDL
iv)	Mercury (mg/l)	BDL	BDL	BDL	BDL	BDL
v)	Chromium (mg/l)	BDL	BDL	BDL	BDL	BDL
vi)	Cadmium(mg/l)	BDL	BDL	BDL	BDL	BDL
vii)	Zinc (mg/l)	0.10	0.10	BDL	0.09	BDL
viii)	Lead(mg/l)	BDL	BDL	BDL	BDL	BDL
ix)	Iron(mg/l)	0.06	0.13	0.38	0.16	0.17
<b>6 Pesticides</b>						
i)	Alpha HCH ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
ii)	Beta HCH ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
iii)	Gama HCH ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
iv)	4,4' DDT ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
v)	4,4' DDE ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
vi)	4,4' DDD ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
vii)	Alpha Endosulphan ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
viii)	Beta Endosulphan ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
ix)	Dieldrin ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
x)	Aldrin ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
xi)	Endrin( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
xii)	Endrin Aldehyde( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
xiii)	Methyl Parathion ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL

**Table-I (iii) Analysis Results of Physico-Chemical, Biological in water samples in Oct., 2016 ( Harike Wetland)**

<b>1.</b>	<b>Field Observations</b>	<b>Point source of East Bein</b>	<b>Point Source of Buddha Nallah</b>	<b>Ferozpur Feeder Canal</b>	<b>Rajasthan Feeder Canal</b>	<b>Bikaner Canal</b>
<b>Co-ordinates</b>	<b>Longitude</b>	E 75°6'40"	E 75°39'4"	E 74°56'56"	E 74°56'57"	E 74°50'59"
	<b>Latitude</b>	N 31°8'8"	N 30°58'22"	N 31°7'37"	N 31°7'36"	N 31°1'42"
i)	Weather	Sunny	Sunny	Sunny	Sunny	Sunny
ii)	Approximate depth of main stream/depth of water table	Aprox. 1.0 m	Aprox. 2.8 m	Aprox. 3.5 m	Aprox. 4.0 m	Aprox. 4.0 m
iii)	Colour and intensity	Blackish	Blackish	Colourless	Colourless	Colourless
iv)	Odour	Foul	Stinky	odourless	odourless	odourless
v)	Visible effluent discharge	Nil	Nil	Nil	Nil	Nil
vi)	Human activities around station.	Nil	Nil	Nil	Nil	Nil
<b>2.</b>	<b>Core Parameters</b>					
i)	Temperature (Air/Water) °C	27/21	29/26	27/21	27/21	26/22
ii)	pH	7.2	6.8	7.7	7.7	8.0
iii)	Conductivity µS/cm	1636	1596	284	309	218
iv)	DO (mg/l)	-	-	8.0	7.7	8.0
v)	BOD (mg/l)	108	78	1.2	1.8	0.8
vi)	Nitrate-N (mg/l)	5.2	2.8	BDL	BDL	BDL
vii)	Ammonia-N (mg/l)	9.4	4.0	1.2	1.8	1.0
viii)	Total Coliform MPN/100ml	31000	46000	400	450	370
ix)	Faecal Coliform MPN/100ml	17000	21000	180	200	180
<b>3.</b>	<b>Bio Monitoring</b>					
i)	Saprobity Index	-	-	3.3	-	-
ii)	Diversity Index	-	-	0.3	-	-
<b>4.</b>	<b>General Parameters</b>					
i)	COD (mg/l)	256	264	8.0	9.6	6.4
ii)	TKN (mg/l)	18.4	6.0	2.2	3.0	2.0
iii)	Total Dissolved Solids (mg/l)	981	1246	178	192	136
iv)	Total Fixed Solids (mg/l)	906	1202	173	182	124
v)	Total Suspended Solids (mg/l)	96	72	6	10	11
vi)	Turbidity (NTU)	89	50	8	14	12
vii)	Hardness (mg/l)	290	290	90	105	115
viii)	Fluoride (mg/l)	2.4	2.2	0.6	0.6	0.8
ix)	Chloride (mg/l)	134	120	16	20	12
x)	Sulphate (mg/l)	126	84	11	14	10
xi)	Total Alkalinity (mg/l)	210	190	65	85	60
xii)	P-Alkalinity (mg/l)	BDL	BDL	BDL	BDL	BDL
xiii)	Phosphate (mg/l)	4.8	3.8	1.6	2.2	2.0
xiv)	Sodium (mg/l)	208	269.5	23	20	28
xv)	Potassium (mg/l)	19.5	26.3	2.2	2.4	200
xvi)	Calcium (mg/l)	72	78.4	22	26	26
xvii)	Magnesium (mg/l)	26.4	22.56	5.3	12	9.6

**Table-I (iii) Analysis Results of Heavy metals and Pesticides in water samples in Oct, 2016 ( Harike Wetland)**

<b>5.</b>	<b>Trace Metals</b>	<b>Point source of East Bein</b>	<b>Point Source of Buddha Nallah</b>	<b>Ferozpur Feeder Canal</b>	<b>Rajasthan Feeder Canal</b>	<b>Bikaner Canal</b>
i)	Arsenic (mg/l)	BDL	BDL	BDL	BDL	BDL
ii)	Nickel (mg/l)	0.11	0.95	BDL	BDL	BDL
iii)	Copper (mg/l)	BDL	0.46	BDL	BDL	BDL
iv)	Mercury (mg/l)	BDL		BDL	BDL	BDL
v)	Chromium (mg/l)	0.13	0.84	BDL	BDL	BDL
vi)	Cadmium (mg/l)	BDL	0.51	BDL	BDL	BDL
vii)	Zinc (mg/l)	0.75	3.28	BDL	BDL	BDL
viii)	Lead (mg/l)	BDL	BDL	BDL	BDL	BDL
ix)	Iron (mg/l)	3.59	4.72	0.20	0.22	0.24
<b>6.</b>	<b>Pesticides</b>					
i)	Alpha HCH ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
ii)	Beta HCH ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
iii)	Gama HCH ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
iv)	4,4' DDT ( $\mu\text{g/l}$ )					
v)	4,4' DDE ( $\mu\text{g/l}$ )					
vi)	4,4' DDD ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
vii)	Alpha Endosulphan ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
viii)	Beta Endosulphan ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
ix)	Dieldrin ( $\mu\text{g/l}$ )					
x)	Aldrin ( $\mu\text{g/l}$ )					
xi)	Endrin( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
xii)	Endrin Aldehyde( $\mu\text{g/l}$ )					
xiii)	Methyl Parathion ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL



**Table-II (i) Analysis Results of Physico-Chemical, Heavy Metals and Pesticides in Sediment samples in Oct., 2016( Harike Wetland)**

1.	Field Observations	Beas at Harike	Satluj at Harike	Harike Lake	D/s Harike	D/s Goindwal Sahib
<b>Co-ordinates</b>	<b>Longitude</b>	E 74°57'5"	E 74°56'57"	(Sample could not be collected)	E 74°56'40"	E 74°07'50"
	<b>Latitude</b>	N 31°09'2"	N 31°08'34"		N 31°08'53"	N 31°02'020"
i)	Weather	Sunny	Sunny		Sunny	Sunny
ii)	pH	7.0	7.4		7.3	7.7
iii)	Conductivity µS/cm	140	195		176	266
iv)	Chloride mg/gm	78	110		96	210
v)	Sulphate mg/gm	70	86		84	140
vi)	Calcium mg/gm	168	188		182	216
Vii)	Magnesium mg/gm	70	76	74	94	
<b>Trace Metals</b>						
i)	Nickel (mg/gm)	BDL	BDL	(Sample could not be collected)	BDL	BDL
ii)	Chromium (mg/gm)	BDL	BDL		BDL	BDL
iii)	Cadmium (mg/gm)	BDL	BDL		BDL	BDL
iv)	Zinc (mg/gm)	0.12	0.05		0.02	0.05
v)	Lead (mg/gm)	BDL	BDL		BDL	BDL
<b>Pesticides</b>						
i)	Alpha HCH (µg/gm)	BDL	BDL	(Sample could not be collected)	BDL	BDL
ii)	Beta HCH (µg/gm)	BDL	BDL		BDL	BDL
iii)	Gama HCH(µg/gm)	BDL	BDL		BDL	BDL
iv)	4,4' DDT (µg/gm)	BDL	BDL		BDL	BDL
v)	4,4' DDE (µg/gm)	BDL	BDL		BDL	BDL
vi)	4,4' DDD (µg/gm)	BDL	BDL		BDL	BDL
vii)	Alpha Endosulphan (µg/gm)	BDL	BDL		BDL	BDL
viii)	Beta Endosulphan (µg/gm)	BDL	BDL		BDL	BDL
ix)	Dieldrin(µg/gm)	BDL	BDL		BDL	BDL
x)	Aldrin (µg/gm)	BDL	BDL		BDL	BDL
xi)	Endrin (µg/gm)	BDL	BDL		BDL	BDL
xii)	Endrin Aldehyde(µg/gm)	BDL	BDL		BDL	BDL
xiii)	Methyl Parathion (µg/gm)	BDL	BDL		BDL	BDL

**Table-II (ii) Analysis Results of Physico-Chemical, Heavy Metals and Pesticides in Sediment samples in April, 2017 (Harike Wetland)**

1.	Field Observations	U/s Buddha Nallah	D/s Buddha Nallah	D/s East Bein	U/s Goindwal Sahib	U/s East Bein
Co-ordinates	Longitude	E 75° 6'40"	E 75°6'58"	E 74°6'27"	E 75°9'43"	E 75°6'58"
	Latitude	N 31°8'8"	N 31°7'93"	N 31°8'27"	N 31°22'28"	N 31°7'93"
i)	Weather	Sunny	Sunny	Sunny	Sunny	Sunny
ii)	pH	8.1	8.3	8.0	8.0	8.1
iii)	Conductivity µS/cm	161	192	388	262	339
iv)	Chloride mg/gm	66	78	188	200	160
v)	Sulphate mg/gm	40	52	146	140	110
vi)	Calcium mg/gm	120	152	298	216	224
Vii)	Magnesium mg/gm	52	64	116	80	88
<b>Trace Metals</b>						
i)	Nickel (mg/gm)	BDL	BDL	BDL	BDL	0.04
ii)	Chromium (mg/gm)	BDL	BDL	BDL	BDL	0.23
iii)	Cadmium (mg/gm)	BDL	BDL	BDL	BDL	BDL
iv)	Zinc (mg/gm)	0.01	0.02	0.07	0.03	0.15
v)	Lead (mg/gm)	BDL	BDL	BDL	BDL	BDL
<b>Pesticides</b>						
i)	Alpha HCH (µg/l)	BDL	BDL	BDL	BDL	BDL
ii)	Beta HCH (µg/l)	BDL	BDL	BDL	BDL	BDL
iii)	Gama HCH (µg/l)	BDL	BDL	BDL	BDL	BDL
iv)	4,4' DDT (µg/l)	BDL	BDL	BDL	BDL	BDL
v)	4,4' DDE (µg/l)	BDL	BDL	BDL	BDL	BDL
vi)	4,4' DDD (µg/l)	BDL	BDL	BDL	BDL	BDL
vii)	Alpha Endosulphan (µg/l)	BDL	BDL	BDL	BDL	BDL
viii)	Beta Endosulphan (µg/l)	BDL	BDL	BDL	BDL	BDL
ix)	Dieldrin (µg/l)	BDL	BDL	BDL	BDL	BDL
x)	Aldrin (µg/l)	BDL	BDL	BDL	BDL	BDL
xi)	Endrin(µg/l)	BDL	BDL	BDL	BDL	BDL
xii)	Endrin Aldehyde(µg/l)	BDL	BDL	BDL	BDL	BDL
xiii)	Methyl Parathion (µg/l)	BDL	BDL	BDL	BDL	BDL

**Table-II (iii) Analysis Results of Physico-Chemical, Heavy Metals and Pesticides in Sediment samples in April, 2017 (Harike Wetland)**

1.	Field Observations	Point source of East Bein	Point Source of Buddha Nallah	Ferozpur Feeder Canal	Rajasthan Feeder Canal	Bikaner Canal
<b>Co-ordinates</b>	<b>Longitude</b>	E 75°6'40"	E 75°39'4"	(Sample could not be collected)	(Sample could not be collected)	(Sample could not be collected)
	<b>Latitude</b>	N 31°8'8"	N 30° 58'22"			
i)	Weather	Sunny	Sunny			
ii)	pH	7.7	8.5			
iii)	Conductivity µS/cm	667	377			
iv)	Chloride mg/gm	386	155			
v)	Sulphate mg/gm	420	286			
vi)	Calcium mg/gm	372	443			
Vii)	Magnesium mg/gm	152	101			
<b>Trace Metals</b>						
i)	Nickel (mg/gm)	BDL	0.03	(Sample could not be collected)	(Sample could not be collected)	(Sample could not be collected)
ii)	Chromium (mg/gm)	BDL	0.08			
iii)	Cadmium (mg/gm)	BDL	BDL			
iv)	Zinc (mg/gm)	0.16	0.18			
v)	Lead (mg/gm)	BDL	BDL			
<b>Pesticides (µg/gm)</b>						
i)	Alpha HCH (µg/gm)	BDL	BDL	(Sample could not be collected)	(Sample could not be collected)	(Sample could not be collected)
ii)	Beta HCH (µg/gm)	BDL	BDL			
iii)	Gama HCH (µg/gm)	BDL	BDL			
iv)	4,4' DDT (µg/gm)	BDL	BDL			
v)	4,4' DDE (µg/gm)	BDL	BDL			
vi)	4,4' DDD (µg/gm)	BDL	BDL			
vii)	Alpha Endosulphan (µg/gm)	BDL	BDL			
viii)	Beta Endosulphan (µg/gm)	BDL	BDL			
ix)	Dieldrin (µg/gm)	BDL	BDL			
x)	Aldrin (µg/gm)	BDL	BDL			
xi)	Endrin (µg/gm)	BDL	BDL			
xii)	Endrin Aldehyde (µg/gm)	BDL	BDL			
xiii)	Methyl Parathion (µg/gm)	BDL	BDL			

**Table-III (i) Analysis Results of Physico-Chemical, Biological, Heavy metals and Pesticides in water samples in April, 2017 (Harike Wetland)**

<b>1.</b>	<b>Field Observations</b>	<b>Beas at Harike</b>	<b>Satluj at Harike</b>	<b>Harike Lake</b>	<b>D/s Harike</b>	<b>D/s Goindwal Sahib</b>
<b>Co-ordinates</b>	<b>Longitude</b>	E 74°57'5"	E 74°56'57"	E 74°56'54"	E 74°56'40"	E 74°07'50"
	<b>Latitude</b>	N 31°09'2"	N 31°08'34"	N 31°08'41"	N 31°08'53"	N 31°20'20"
i)	Weather	Sunny	Sunny	Sunny	Sunny	Sunny
ii)	Approximate depth of main stream/depth of water table	Aprox. 7.0M	Aprox. 6.0M	Aprox. 10.0M	Aprox 1.0 m	Aprox 4.2 m
iii)	Colour and intensity	Colourless	Colourless	Colourless	Colourless	Colourless
iv)	Odor	Odourless	Odourless	Odourless	Odourless	Odourless
v)	Visible effluent discharge	Nil	Nil	Nil	Nil	Nil
vi)	Human activities around station.	Boating Site and Fishing	Nil	Nil	Fishing	NIL
<b>2.</b>	<b>Core Parameters</b>					
i)	Temperature (Air/Water) °C	34/24	33/22	34/25	35/21	32/24
ii)	pH	8.01	7.92	7.99	7.83	7.77
iii)	Conductivity µS/cm	309	290	238	256	362
iv)	DO (mg/l)	8.0	7.0	7.4	7.2	7.3
v)	BOD (mg/l)	BDL	BDL	BDL	BDL	BDL
vi)	Nitrate-N (mg/l)	0.4	0.8	0.4	0.6	0.6
vii)	Ammonia-N (mg/l)	0.4	1.0	0.6	0.6	0.8
viii)	Total Coliform MPN/100ml	460	1300	330	450	700
ix)	Faecal Coliform MPN/100ml	170	450	110	200	330
<b>3.</b>	<b>Bio Monitoring</b>					
i)	Saprobity Index	4.7	-	-	-	2.5
ii)	Diversity Index	0.4	-	-	-	0.4
<b>4.</b>	<b>General Parameters</b>					
i)	COD (mg/l)	2.5	6	4	4	12
ii)	TKN (mg/l)	1.0	1.6	1.4	1.2	1.4
iii)	Total Dissolved Solids (mg/l)	184	169	120	131	232
iv)	Total Fixed Solids (mg/l)	178	153	106	120	214
v)	Total Suspended Solids (mg/l)	4	9	10	9	12
vi)	Turbidity (NTU)	14	4.8	4.0	5.0	7
vii)	Hardness (mg/l)	60	50	40	42	58
viii)	Fluoride (mg/l)	0.4	0.3	0.4	0.5	0.8
ix)	Chloride (mg/l)	19	14	12	15	20
x)	Sulphate (mg/l)	12	10	10	7	14
xi)	Total Alkalinity (mg/l)	55	35	40	30	48
xii)	P-Alkalinity (mg/l)	Nil	Nil	NIL	NIL	NIL
xiii)	Phosphate (mg/l)	1.0	0.8	0.6	0.8	1.0
xiv)	Sodium (mg/l)	29	22	19	18	16
xv)	Potassium (mg/l)	3.16	2.43	2.20	2.15	3.22
xvi)	Calcium (mg/l)	16	12	10	10	14.4
xvii)	Magnesium (mg/l)	4.8	4.8	3.6	4.08	5.28

**Table-III (i) Analysis Results of Physico-Chemical, Biological, Heavy metals and Pesticides in water samples in April, 2017 (Harike Wetland)**

<b>5.</b>	<b>Trace Metals</b>	<b>Beas at Harike</b>	<b>Satluj at Harike</b>	<b>Harike Lake</b>	<b>D/s Harike</b>	<b>D/s Goindwal Sahib</b>
i)	Arsenic (mg/l)	BDL	BDL	BDL	BDL	BDL
ii)	Nickel (mg/l)	BDL	BDL	BDL	BDL	BDL
iii)	Copper (mg/l)	BDL	BDL	BDL	BDL	BDL
iv)	Mercury (mg/l)	BDL	BDL	BDL	BDL	BDL
v)	Chromium (mg/l)	BDL	BDL	BDL	BDL	BDL
vi)	Cadmium (mg/l)	BDL	BDL	BDL	BDL	BDL
vii)	Zinc (mg/l)	BDL	BDL	BDL	BDL	BDL
viii)	Lead (mg/l)	BDL	BDL	BDL	BDL	BDL
ix)	Iron(mg/l)	0.17	0.15	0.14	0.13	0.22
<b>6.</b>	<b>Pesticides</b>					
i)	Alpha HCH ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
ii)	Beta HCH ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
iii)	Gama HCH ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
iv)	4,4' DDT ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
v)	4,4' DDE ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
vi)	4,4' DDD ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
vii)	Alpha Endosulphan ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
viii)	Beta Endosulphan ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
ix)	Dieldrin ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
x)	Aldrin ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
xi)	Endrin( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
xii)	Endrin Aldehyde( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
xiii)	Methyl Parathion ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL



**Table-III (ii) Analysis Results of Physico-Chemical, Biological, in water samples in April, 2017 ( Harike Wetland)**

<b>1.</b>	<b>Field Observations</b>	<b>U/s Buddha Nallah</b>	<b>D/s Buddha Nallah</b>	<b>D/s East Bein</b>	<b>U/s Goindwal Sahib</b>	<b>U/s East Bein</b>
<b>Co-ordinates</b>	<b>Longitude</b>	E 75° 6'40"	E 75°6'58"	E 74°6'27"	E 75°9'43"	E 75°6'58"
	<b>Latitude</b>	N 31°8'8"	N 31°7'93"	N 31°8'27"	N 31°22'28"	N 31°7'93"
i)	Weather	Sunny	Sunny	Sunny	Sunny	Sunny
ii)	Approximate depth of main stream/depth of water table	0.5 m	3.0 m	Approx. 1.6M	Approx. 4.0 M	Approx. 1.5M
iii)	Colour and intensity	Colorless	Greyish	Light Greyish	Colorless	Colorless
iv)	Odor	Odorless	Stinky	Foul Smell	odourless	odourless
v)	Visible effluent discharge	Nil	Nil	Nil	Nil	Nil
vi)	Human activities around station.	Fishing	Nil	Cattle grazing and bathing	Immersion of ashes	Cattle grazing and bathing
<b>2.</b>	<b>Core Parameters</b>					
i)	Temperature (Air/Water) °C	34/25	35/28	33/24	32/24	34/25
ii)	pH	7.33	7.17	7.90	7.58	7.51
iii)	Conductivity µS/cm	564	1694	1054	340	646
iv)	DO (mg/l)	7.0	2.6	2.8	7.4	7.0
v)	BOD (mg/l)	2.0	105	25	BDL	4.0
vi)	Nitrate-N (mg/l)	0.6	4.2	3.0	0.4	1.0
vii)	Ammonia-N (mg/l)	0.8	6.4	3.6	0.8	1.4
viii)	Total Coliform MPN/100ml	3500	94000	46000	630	1100
ix)	Faecal Coliform MPN/100ml	940	46000	23000	230	230
<b>3.</b>	<b>Bio Monitoring</b>					
i)	Saprobity Index	-	-	-	2.5	-
ii)	Diversity Index	-	-	-	0.4	-
<b>4.</b>	<b>General Parameters</b>					
i)	COD (mg/l)	16	384	84	8	16
ii)	TKN (mg/l)	1.4	12	6.4	1.2	2.0
iii)	Total Dissolved Solids (mg/l)	388	976	675	220	415
iv)	Total Fixed Solids (mg/l)	378	862	592	204	380
v)	Total Suspended Solids (mg/l)	16	84	76	10	28
vi)	Turbidity (NTU)	15	48	36	4	20
vii)	Hardness (mg/l)	104	226	168	52	88
viii)	Fluoride (mg/l)	0.8	2.0	2.2	0.8	1.4
ix)	Chloride (mg/l)	46	102	84	14	32
x)	Sulphate (mg/l)	32	76	76	12	24
xi)	Total Alkalinity (mg/l)	72	196	114	30	42
xii)	P-Alkalinity (mg/l)	Nil	Nil	NIL	NIL	NIL
xiii)	Phosphate (mg/l)	1.0	3.6	1.6	0.6	1.0
xiv)	Sodium (mg/l)	38	49	159	16	104
xv)	Potassium (mg/l)	4.72	9.55	4.96	3.51	2.85
xvi)	Calcium (mg/l)	25.6	56	39.2	12	20.8
xvii)	Magnesium (mg/l)	9.72	20.89	15.8	5.2	8.16

**Table-III (ii) Analysis Results of Heavy metals and Pesticides in water samples in April, 2017 ( Harike Wetland)**

<b>5.</b>	<b>Trace Metals</b>					
		<b>U/s Buddha Nallah</b>	<b>D/s Buddha Nallah</b>	<b>D/s East Bein</b>	<b>U/s Goindwal Sahib</b>	<b>U/s East Bein</b>
i)	Arsenic (mg/l)	BDL	BDL	BDL	BDL	BDL
ii)	Nickel (mg/l)	BDL	BDL	BDL	BDL	BDL
iii)	Copper (mg/l)	BDL	BDL	BDL	BDL	BDL
iv)	Mercury (mg/l)	BDL	BDL	BDL	BDL	BDL
v)	Chromium (mg/l)	BDL	BDL	BDL	BDL	BDL
vi)	Cadmium (mg/l)	BDL	BDL	BDL	BDL	BDL
vii)	Zinc (mg/l)	0.10	0.28	0.09	0.13	BDL
viii)	Lead (mg/l)	BDL	BDL	BDL	BDL	BDL
ix)	Iron (mg/l)	0.12	0.38	0.31	0.19	0.18
<b>6</b>	<b>Pesticides</b>					
i)	Alpha HCH ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
ii)	Beta HCH ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
iii)	Gama HCH ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
iv)	4,4' DDT ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
v)	4,4' DDE ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
vi)	4,4' DDD ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
vii)	Alpha Endosulphan ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
viii)	Beta Endosulphan ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
ix)	Dieldrin ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
x)	Aldrin ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
xi)	Endrin( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
xii)	Endrin Aldehyde( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL
xiii)	Methyl Parathion ( $\mu\text{g/l}$ )	BDL	BDL	BDL	BDL	BDL

**Table-III (iii) Analysis Results of Physico-Chemical, Biological, in water samples in APRIL, 2017 ( Harike Wetland)**

<b>1.</b>	<b>Field Observations</b>	<b>Point source of East Bein</b>	<b>Point Source of Buddha Nallah</b>	<b>Ferozpur Feeder Canal</b>	<b>Rajasthan Feeder Canal</b>	<b>Bikaner Canal</b>
<b>Co-ordinates</b>	<b>Longitude</b>	E 75°06'40"	E 75°39'4"	E 74°56'56"	E 74°56'57"	E 74°50'59"
	<b>Latitude</b>	N 31°8'8"	N 30°58'22"	N 31°7'37"	N 31°7'36"	N 31°1'42"
i)	Weather	Sunny	Sunny	Sunny	Sunny	Sunny
ii)	Approximate depth of main stream/depth of water table	Aprox. 1.2 m	Aprox. 2.3 m	Aprox. 3.5 m	Aprox. 4.0 m	Aprox. 4.0 m
iii)	Colour and intensity	Blackish	Blackish	Colourless	Colourless	Colourless
iv)	Odour	Foul	Stinky	odourless	odourless	odourless
v)	Visible effluent discharge	Nil	Nil	Nil	Nil	Nil
vi)	Human activities around station.	Nil	Nil	Nil	Nil	Nil
<b>2.</b>	<b>Core Parameters</b>					
i)	Temperature (Air/Water) °C	34/25	38/30	33/21	34/24	33/24
ii)	pH	7.56	7.26	7.80	7.86	7.97
iii)	Conductivity µS/cm	1580	1856	241	248	192
iv)	DO (mg/l)	0.0	0	8.2	8.0	8.0
v)	BOD (mg/l)	118	180	BDL	BDL	BDL
vi)	Nitrate-N (mg/l)	4.8	4.8	0.2	BDL	BDL
vii)	Ammonia-N (mg/l)	9.6	7.2	0.8	1.0	0.6
viii)	Total Coliform MPN/100ml	94000	120000	450	840	400
ix)	Faecal Coliform MPN/100ml	49000	49000	200	310	220
<b>3.</b>	<b>Bio Monitoring</b>					
i)	Saprobity Index	-	-	3.5	-	-
ii)	Diversity Index	-	-	0.3	-	-
iii)	P/R ratio					
<b>4.</b>	<b>General Parameters</b>					
i)	COD (mg/l)	280	576	2.0	1.6	1.6
ii)	TKN (mg/l)	16.0	14.8	1.6	1.8	1.6
iii)	Total Dissolved Solids (mg/l)	1012	1299	151	159	126
iv)	Total Fixed Solids (mg/l)	989	1102	140	144	113
v)	Total Suspended Solids (mg/l)	102	142	7	6	6
vi)	Turbidity (NTU)	92	54	5.4	6.0	5.2
vii)	Hardness (mg/l)	286	302	55	70	45
viii)	Fluoride (mg/l)	2.8	2.8	0.3	0.5	0.4
ix)	Chloride (mg/l)	142	142	16	14	10
x)	Sulphate (mg/l)	130	110	11	10	7
xi)	Total Alkalinity (mg/l)	214	264	42	45	35
xii)	P-Alkalinity (mg/l)	NIL	Nil	NIL	NIL	NIL
xiii)	Phosphate (mg/l)	4.8	4.2	1.0	1.2	1.0
xiv)	Sodium (mg/l)	155	280	17	17	18
xv)	Potassium (mg/l)	20.63	24.51	2.42	2.65	2.53
xvi)	Calcium (mg/l)	68	72	14	18	11.2
xvii)	Magnesium (mg/l)	27.8	29.65	4.8	6.00	4.08

**Table-III (iii) Analysis Results of Heavy metals and Pesticides in water samples in APRIL, 2017 ( Harike Wetland)**

<b>5.</b>	<b>Trace Metals</b>	<b>Point source of East Bein</b>	<b>Point Source of Buddha Nallah</b>	<b>Ferozpur Feeder Canal</b>	<b>Rajasthan Feeder Canal</b>	<b>Bikaner Canal</b>
i)	Arsenic (mg/l)	BDL	BDL	BDL	BDL	BDL
ii)	Nickel (mg/l)	BDL	0.24	BDL	BDL	BDL
iii)	Copper (mg/l)	BDL	0.20	BDL	BDL	BDL
iv)	Mercury (mg/l)	BDL	BDL	BDL	BDL	BDL
v)	Chromium (mg/l)	BDL	0.35	BDL	BDL	BDL
vi)	Cadmium (mg/l)	BDL	BDL	BDL	BDL	BDL
vii)	Zinc (mg/l)	0.66	2.91	BDL	BDL	BDL
viii)	Lead (mg/l)	BDL	BDL	BDL	BDL	BDL
ix)	Iron (mg/l)	2.83	3.87	0.15	0.12	0.13
<b>6.</b>	<b>Pesticides</b>					
i)	Alpha HCH (µg/l)	BDL	BDL	BDL	BDL	BDL
ii)	Beta HCH (µg/l)	BDL	BDL	BDL	BDL	BDL
iii)	Gama HCH (µg/l)	BDL	BDL	BDL	BDL	BDL
iv)	4,4' DDT (µg/l)	BDL	BDL	BDL	BDL	BDL
v)	4,4' DDE (µg/l)	BDL	BDL	BDL	BDL	BDL
vi)	4,4' DDD (µg/l)	BDL	BDL	BDL	BDL	BDL
vii)	Alpha Endosulphan (µg/l)	BDL	BDL	BDL	BDL	BDL
viii)	Beta Endosulphan (µg/l)	BDL	BDL	BDL	BDL	BDL
ix)	Dieldrin (µg/l)	BDL	BDL	BDL	BDL	BDL
x)	Aldrin (µg/l)	BDL	BDL	BDL	BDL	BDL
xi)	Endrin (µg/l)	BDL	BDL	BDL	BDL	BDL
xii)	Endrin Aldehyde (µg/l)	BDL	BDL	BDL	BDL	BDL
xiii)	Methyl Parathion (µg/l)	BDL	BDL	BDL	BDL	BDL

**Table-IV (i) Analysis Results of Physico-Chemical, Heavy Metals and Pesticides in Sediment samples in April, 2017 ( Harike Wetland)**

1.	Field Observations	Beas at Harike	Satluj at Harike	Harike Lake	D/s Harike	D/s Goindwal Sahib
<b>Co-ordinates</b>	<b>Longitude</b>	E 74°57'5"	E 74°56'57"	(Sample could not be collected)	E 74°56'40"	E 74°07'50"
	<b>Latitude</b>	N 31°09'2"	N 31°08'34"		N 31°08'53"	N 31°20'20"
i)	Weather	Sunny	Sunny		Sunny	Sunny
ii)	Approximate depth of main stream/depth of water table	Aprox. 7.0M	Aprox. 6.0M		Aprox 1.0 m	Aprox 4.2 m
iii)	pH	6.9	7.2		7.1	7.9
iv)	Conductivity µmho/cm	159	183		174	288
v)	Chloride mg/gm	80	103		88	242
vi)	Sulphate mg/gm	68	88		80	160
vii)	Calcium mg/gm	164	184		180	248
Viii)	Magnesium mg/gm	68	72		70	96
<b>Trace Metals</b>						
i)	Nickel (mg/gm)	BDL	BDL	(Sample could not be collected)	BDL	BDL
ii)	Chromium (mg/gm)	BDL	BDL		BDL	BDL
iii)	Cadmium (mg/gm)	BDL	BDL		BDL	BDL
iv)	Zinc (mg/gm)	0.01	BDL		BDL	BDL
v)	Lead (mg/gm)	BDL	BDL		BDL	BDL
<b>Pesticides (µg/gm)</b>						
i)	Alpha HCH (µg/gm)	BDL	BDL	(Sample could not be collected)	BDL	BDL
ii)	Beta HCH (µg/gm)	BDL	BDL		BDL	BDL
iii)	Gama HCH (µg/gm)	BDL	BDL		BDL	BDL
iv)	4,4' DDT (µg/gm)	BDL	BDL		BDL	BDL
v)	4,4' DDE (µg/gm)	BDL	BDL		BDL	BDL
vi)	4,4' DDD (µg/gm)	BDL	BDL		BDL	BDL
vii)	Alpha Endosulphan (µg/gm)	BDL	BDL		BDL	BDL
viii)	Beta Endosulphan (µg/gm)	BDL	BDL		BDL	BDL
ix)	Dieldrin (µg/gm)	BDL	BDL		BDL	BDL
x)	Aldrin (µg/gm)	BDL	BDL		BDL	BDL
xi)	Endrin (µg/gm)	BDL	BDL		BDL	BDL
xii)	Endrin Aldehyde (µg/gm)	BDL	BDL		BDL	BDL
xiii)	Methyl Parathion (µg/gm)	BDL	BDL		BDL	BDL

**Table-IV (ii) Analysis Results of Physico-Chemical, Heavy Metals and Pesticides in Sediment samples in April, 2017 (Harike Wetland)**

1.	Field Observations	U/s Buddha Nallah	D/s Buddha Nallah	D/s East Bein	U/s Goindwal Sahib	U/s East Bein
Co-ordinates	Longitude	E 75° 6'40"	E 75°6'58"	E 74°6'27"	E 75°9'43"	E 75°6'58"
	Latitude	N 31°8'8"	N 31°7'93"	N 31°8'27"	N 31°22'28"	N 31°7'93"
i)	Weather	Sunny	Sunny	Sunny	Sunny	Sunny
ii)	Approximate depth of main stream/depth of water table	0.5 m	3.0 m	Approx. 1.6M	Approx. 4.0 M	Approx. 1.5M
iii)	pH	8.1	8.3	8.0	8.0	8.1
iv)	Conductivity $\mu$ S/cm	161	192	388	262	339
v)	Chloride mg/gm	66	78	188	200	160
vi)	Sulphate mg/gm	40	52	146	140	110
vii)	Calcium mg/gm	120	152	298	216	224
Viii)	Magnesium mg/gm	52	64	116	80	88
<b>Trace Metals</b>						
i)	Nickel (mg/gm)	BDL	BDL	BDL	BDL	BDL
ii)	Chromium (mg/gm)	BDL	BDL	BDL	BDL	BDL
iii)	Cadmium (mg/gm)	BDL	BDL	BDL	BDL	BDL
iv)	Zinc (mg/gm)	BDL	BDL	0.00	0.01	0.00
v)	Lead (mg/gm)	BDL	BDL	BDL	BDL	BDL
<b>Pesticides (<math>\mu</math>g/gm)</b>						
i)	Alpha HCH ( $\mu$ g/gm)	BDL	BDL	BDL	BDL	BDL
ii)	Beta HCH ( $\mu$ g/gm)	BDL	BDL	BDL	BDL	BDL
iii)	Gama HCH ( $\mu$ g/gm)	BDL	BDL	BDL	BDL	BDL
iv)	4,4' DDT ( $\mu$ g/gm)	BDL	BDL	BDL	BDL	BDL
v)	4,4' DDE ( $\mu$ g/gm)	BDL	BDL	BDL	BDL	BDL
vi)	4,4' DDD ( $\mu$ g/gm)	BDL	BDL	BDL	BDL	BDL
vii)	Alpha Endosulphan ( $\mu$ g/gm)	BDL	BDL	BDL	BDL	BDL
viii)	Beta Endosulphan ( $\mu$ g/gm)	BDL	BDL	BDL	BDL	BDL
ix)	Dieldrin ( $\mu$ g/gm)	BDL	BDL	BDL	BDL	BDL
x)	Aldrin ( $\mu$ g/gm)	BDL	BDL	BDL	BDL	BDL
xi)	Endrin ( $\mu$ g/gm)	BDL	BDL	BDL	BDL	BDL
xii)	Endrin Aldehyde ( $\mu$ g/gm)	BDL	BDL	BDL	BDL	BDL
xiii)	Methyl Parathion ( $\mu$ g/gm)	BDL	BDL	BDL	BDL	BDL

**Table-IV (iii) Analysis Results of Physico-Chemical, Heavy Metals and Pesticides in Sediment samples in April, 2017 (Harike Wetland)**

<b>1.</b>	<b>Field Observations</b>	<b>Point source of East Bein</b>	<b>Point Source of Buddha Nallah</b>	<b>Ferozpur Feeder Canal</b>	<b>Rajasthan Feeder Canal</b>	<b>Bikaner Canal</b>
<b>Co-ordinates</b>	<b>Longitude</b>	E 75°6'40"	E 75°39'4"	(Sample could not be collected)	(Sample could not be collected)	(Sample could not be collected)
	<b>Latitude</b>	N 31°8'8"	N 30°58'22"			
i)	Weather	Sunny	Sunny			
ii)	Approximate depth of main stream/depth of water table	Aprox. 1.2 m	Aprox. 2.3 m			
iii)	pH	7.7	8.5			
iv)	Conductivity $\mu\text{S/cm}$	667	377			
v)	Chloride mg/gm	386	155			
vi)	Sulphate mg/gm	420	286			
vii)	Calcium mg/gm	372	443			
Viii)	Magnesium mg/gm	152	101			
<b>Trace Metals</b>						
i)	Nickel (mg/gm)	BDL	BDL	(Sample could not be collected)	(Sample could not be collected)	(Sample could not be collected)
ii)	Chromium (mg/gm)	BDL	BDL			
iii)	Cadmium (mg/gm)	BDL	BDL			
iv)	Zinc (mg/gm)	0.03	BDL			
v)	Lead (mg/gm)	BDL	BDL			
<b>Pesticides</b>						
i)	Alpha HCH ( $\mu\text{g/gm}$ )	BDL	BDL	(Sample could not be collected)	(Sample could not be collected)	(Sample could not be collected)
ii)	Beta HCH ( $\mu\text{g/gm}$ )	BDL	BDL			
iii)	Gama HCH ( $\mu\text{g/gm}$ )	BDL	BDL			
iv)	4,4' DDT ( $\mu\text{g/gm}$ )	BDL	BDL			
v)	4,4' DDE ( $\mu\text{g/gm}$ )	BDL	BDL			
vi)	4,4' DDD ( $\mu\text{g/gm}$ )	BDL	BDL			
vii)	Alpha Endosulphan ( $\mu\text{g/gm}$ )	BDL	BDL			
viii)	Beta Endosulphan ( $\mu\text{g/gm}$ )	BDL	BDL			
ix)	Dieldrin ( $\mu\text{g/gm}$ )	BDL	BDL			
x)	Aldrin ( $\mu\text{g/gm}$ )	BDL	BDL			
xi)	Endrin ( $\mu\text{g/gm}$ )	BDL	BDL			
xii)	Endrin Aldehyde ( $\mu\text{g/gm}$ )	BDL	BDL			
xiii)	Methyl Parathion ( $\mu\text{g/gm}$ )	BDL	BDL			

## Annexure-I

### Sampling Locations

- 1 U/s Goindwal sahib
- 2 D/s Goindwal Sahib
- 3 Point source east bein
- 4 Satluj U/s East bein
- 5 Satluj D/s East bein
- 6 Satluj 100m U/s BNU
- 7 Satluj 100m D/s BNU
- 8 Point Source Buddha Nallah
- 9 Beas at Harike
- 10 Satluj at harike
- 11 D/s Harike Lake
- 12 Harike lake
- 13 Ferozepur feeder Canal
- 14 Rajasthan Feeder Canal
- 15 Bikaner Canal

Note:- Point Source of Goindwal Sahib - Dry



## **Annexure-II**

### **Parameters analyzed in water samples**

- pH
- BOD (mg/l)
- COD(mg/l)
- TDS(mg/l)
- TSS(mg/l)
- Ammonical Nitrogen(mg/l)
- Sulphate(mg/l)
- Chloride(mg/l)
- Conductivity ( $\mu\text{mho/cm}$ )
- Total Hardness(mg/l)
- Alkalinity(mg/l)
- Dissolved Oxygen(mg/l)
- Nitrate(mg/l)
- Turbidity (NTU)
- Fluoride (mg/l)
- Phosphate (mg/l)
- Calcium(mg/l)
- Magnesium(mg/l)
- TKN(mg/l)
- Coliform(Total and Fecal)  
(MPN/100 ml)
- p-Alkalinity (mg/l)
- Temperature (Air/Water)
- Biomonitoring (Saprobity Index and  
Diversity Index)

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

<b>1.</b>	<b><i>Field Observations</i></b>
i)	Weather
ii)	Approximate depth of main stream/depth of water table
<b>2.</b>	<b><i>Core Parameters</i></b>
ii)	pH
iii)	Conductivity
iv)	Chloride
v)	Sulphate
vi)	Calcium
vii)	Magnesium
<b>3.</b>	<b><i>Trace Metals</i></b>
i)	Nickel
ii)	Chromium
iii)	Cadmium
iv)	Zinc
v)	Lead
<b>4.</b>	<b><i>Pesticides</i></b>
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