EXHIBIT 1

INDIAN RIVER COUNTY
PUBLIC WORKS DEPARTMENT
STORMWATER DIVISION
1801 27th Street
VERO BEACH, FLORIDA 32960
Phone: (772) 226-1562
kmccully@ircgov.com

INTEROFFICE MEMORANDUM

TO: Richard Szpyrka, P.E., Public Works Director
Vincent Burke, P.E., Utility Director

DATE: January 25, 2018

FROM: Keith McCully, P.E., Stormwater Engineer
Eric Charest, Environmental Compliance Specialist

SUBJECT: **RESULTS OF THE PHASE 1 WATER QUALITY STUDY OF THE IRFWCD 8TH STREET CANAL BETWEEN 90TH AVENUE AND 74TH AVENUE**

Discussion:

In discussions with Indian River Farms Water Control District (IRFWCD) Superintendent David Gunter, Commissioner Zorc identified four areas within the IRFWCD's canal system that appear to be "hot spots" regarding external nutrient loading, meaning the four areas require high maintenance to control excessive aquatic plant growth. The four problem areas are:

- Area #1: The C-1 Canal along 8th Street between 90th Avenue and 74th Avenue;
- Area #2: The A-3 Canal along 26th Street between 74th Avenue and 66th Avenue;
- Area #3: The J-5 Canal along 21st Street SW east of 20th Avenue together with the Lateral J Canal from the J-5 Canal north to 5th Street SW; and
- Area #4: The Lateral G Canal from 81st Street to the North Relief Canal.

On August 16, 2016 the County Commission instructed Public Works Stormwater Division to study the Indian River Farms Water Control District (IRFWCD) 8th Street Canal between 90th Avenue and 74th Avenue (Area #1). IRFWCD suggests this canal section experiences high nutrient loadings compared to other nearby canals, requiring frequent maintenance activities to remove excessive aquatic plant growth. The primary goal of the study is to determine if suspected seepage from the County's West Regional Wastewater Treatment Facility's wetland system/deep settling pond or nearby artesian wells may be entering the canal and adding nutrients, contributing to excessive aquatic plant growth. For the original study, six sample points were determined and the locations appear in Figure 1. Beginning September 13, 2016, field sampling personnel from PACE Analytical Services, Inc. (PACE) collected canal water samples at each location once per week for eight weeks plus one rain event. The samples were preserved immediately after collection and transported to PACE's laboratory for analysis. Each sample was tested for total phosphorus, total nitrogen, nitrite-nitrate nitrogen, and total Kjeldahl nitrogen. The six locations and nine sampling events produced fifty-four samples. Each sample was tested for four parameters, resulting in 216 results.

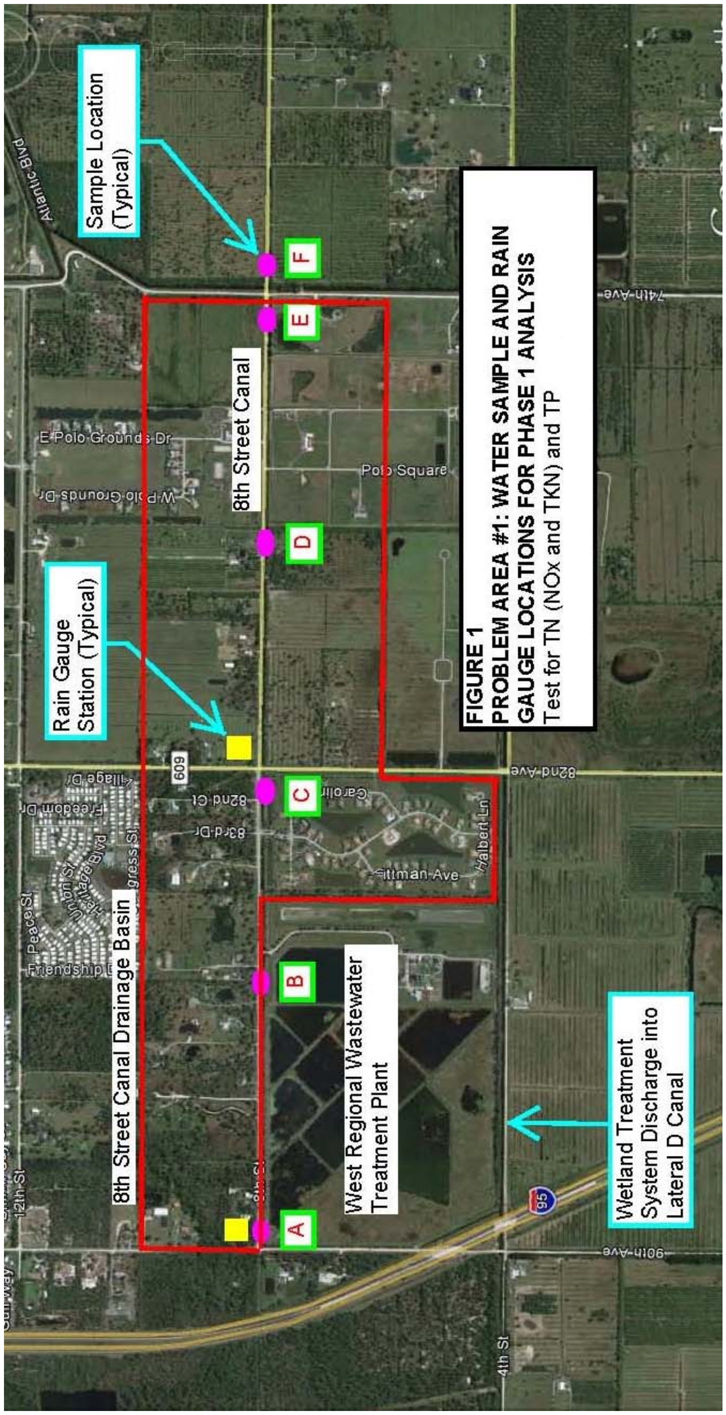


FIGURE 1
PROBLEM AREA #1: WATER SAMPLE AND RAIN GAUGE LOCATIONS FOR PHASE 1 ANALYSIS
Test for TN (NOx and TKN) and TP

STUDY RESULTS

Results are presented in Table 1. At the time of sample collection, various field readings were also collected (Dissolved Oxygen, Temperature, pH, Specific Conductance, and Turbidity).

TABLE 1 - 8th Street Canal Water Quality - Phase 1 Study

SAMPLE DATE	SAMPLE POINT A				SAMPLE POINT B				SAMPLE POINT C				SAMPLE POINT D				SAMPLE POINT E				SAMPLE POINT F			
	NITROGEN (mg/l)				NITROGEN (mg/l)				NITROGEN (mg/l)				NITROGEN (mg/l)				NITROGEN (mg/l)				NITROGEN (mg/l)			
	NO_x-N	TKN	TN (PACE)	TP (mg/l)	NO_x-N	TKN	TN (PACE)	TP (mg/l)	NO_x-N	TKN	TN (PACE)	TP (mg/l)	NO_x-N	TKN	TN (PACE)	TP (mg/l)	NO_x-N	TKN	TN (PACE)	TP (mg/l)	NO_x-N	TKN	TN (PACE)	TP (mg/l)
9/13/2016	0.03	1.70	1.70	0.19	0.03	2.40	2.40	0.26	0.03	2.40	2.40	0.25	0.09	1.60	1.70	0.16	0.27	1.30	1.50	0.14	0.06	0.73	0.80	0.14
9/20/2016	0.03	1.20	1.30	0.12	0.03	2.50	2.50	0.22	0.06	2.30	2.40	0.25	0.14	1.50	1.60	0.14	0.45	1.20	1.60	0.15	0.09	0.64	0.73	0.12
9/27/2016	0.10	2.30	2.40	0.26	0.04	2.20	2.30	0.24	0.03	2.40	2.40	0.24	0.13	1.60	1.80	0.20	0.31	1.10	1.40	0.17	0.14	0.96	1.10	0.20
9/30/2016	0.19	1.20	1.40	0.07	0.03	2.50	2.50	0.24	0.03	2.30	2.30	0.25	0.08	1.50	1.60	0.15	0.32	1.20	1.50	0.14	0.12	0.90	1.00	0.13
10/4/2016	0.08	0.88	0.96	0.06	0.03	2.50	2.50	0.25	0.03	2.10	2.10	0.25	0.08	1.50	1.60	0.16	0.34	1.00	1.40	0.14	0.14	0.99	1.10	0.19
10/11/2016	--	1.10	1.70	0.05	0.03	2.40	2.40	0.24	0.03	2.10	2.20	0.29	0.08	1.50	1.60	0.19	0.17	1.10	1.30	0.19	0.03	1.20	1.20	0.46
10/18/2016	0.03	1.20	1.20	0.08	0.03	2.20	2.20	0.21	0.03	2.00	2.00	0.20	0.11	1.50	1.60	0.15	0.53	0.92	1.50	0.13	0.15	0.78	0.93	0.18
10/25/2016	0.01	0.92	0.93	0.06	0.01	2.30	2.30	0.20	0.02	2.20	2.20	0.22	0.17	1.40	1.60	0.13	0.60	0.80	1.40	0.15	0.11	0.67	0.78	0.14
11/1/2016	0.01	1.00	1.00	0.10	0.01	3.90	3.90	0.29	0.02	2.30	2.30	0.22	0.13	1.70	1.80	0.14	0.79	0.80	1.60	0.11	0.14	0.57	0.71	0.07
COUNT	8	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
AVERAGE	0.06	1.28	1.40	0.11	0.02	2.54	2.56	0.24	0.03	2.23	2.26	0.24	0.11	1.53	1.66	0.16	0.42	1.05	1.47	0.15	0.11	0.83	0.93	0.18

NO_x-N = Nitrite + Nitrate Nitrogen

TKN = Total Kjeldahl Nitrogen

= rain event

Visual Observations on June 1, 2017

On June 1, 2017, a visual observation of the canal Study Area by Stormwater Division personnel indicated (1) thick duckweed at the westernmost section; (2) scattered duckweed, water lettuce, algae, and miscellaneous grasses throughout most of the rest of the canal; (3) thick growth of vegetation in the canal just west of 82nd Avenue; and (4) thick eel grass growing on the canal bottom west of 74th Avenue. A significant flow of artesian water was entering the canal from a ranchette residence located north of the canal about 400 feet east of Sample Point A. The discharge appears to be artesian well water overflow from a pond(s) on the property. Staff observed a significant flow of water in the canal from west to east, discharging into the Lateral C Canal at 74th Avenue. Most of the water in the canal appeared to be artesian water as it was clear and had a slight milky appearance, indicative of an artesian source.

Water in the canal flows from west to east and the ranchette pipe discharge was the largest observed contributor of flow in the canal.

Staff also noted several suspected seepage points along the southern canal bank abutting the West Regional Wastewater Treatment Facility (WRWWTF) wetland system. The seepage points were slightly above the canal water surface and appeared to contain white sulfur bacteria. Small but constant flows were observed discharging into the canal at each location.

<u>Visual Observation Summary</u>
- Noticeable seepage points along the canal bank adjacent to the WRWWTF wetland system implies some seepage into the canal may be occurring or possibly groundwater intrusion. Sulfur bacteria appears to be growing at the seepage points.
- The lush vegetation in the canal immediately west of 82nd Avenue indicates nutrients are present in the canal water.
- The flow of water is to the east into the Lateral C Canal at 74th Avenue.
- There appears to be a significant artesian well water input into the canal and a significant source of this water is from a ranchette west of Sample Point B.

Laboratory Results for Nitrogen

Certain forms of nitrogen in water can contribute to algae blooms in the Lagoon. Total nitrogen is the sum of total Kjeldahl nitrogen (TKN) and nitrite/nitrate nitrogen or NOx. TKN is the sum of organically bound nitrogen (such as amino acids or complex organic molecules containing nitrogen) and ammonia nitrogen. i.e. TKN = total organic nitrogen + ammonia nitrogen. Ammonia and NOx are the forms available for direct uptake by plants. In order for organic nitrogen to become biologically available, it must be acted upon by enzymes such as deaminase, or certain environmental factors that strip amine groups from the organic complex. If the organic nitrogen molecules are anthropogenic in origin, such as associated with synthetically created organic compounds, then plant access to the nitrogen may be even more difficult. Because Total Nitrogen is the sum of NOx and TKN, its discussion is meaningless with respect to this analysis.

a. Nitrite/Nitrate Nitrogen (NOx) Results

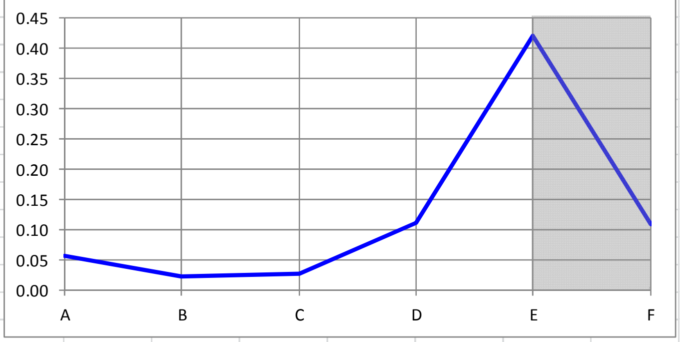
Table 2 and Figure 2 show the average NOx concentrations at the various sample locations along the canal length.

TABLE 2 -8th Street Canal NOx-Nitrogen (mg/l)

SAMPLE DATE	A	B	C	D	E	F
9/13/2016	0.03	0.03	0.03	0.09	0.27	0.06
9/20/2016	0.03	0.03	0.06	0.14	0.45	0.09
9/27/2016	0.10	0.04	0.03	0.13	0.31	0.14
9/30/2016	0.19	0.03	0.03	0.08	0.32	0.12
10/4/2016	0.08	0.03	0.03	0.08	0.34	0.14
10/11/2016	--	0.03	0.03	0.08	0.17	0.03
10/18/2016	0.03	0.03	0.03	0.11	0.53	0.15
10/25/2016	0.01	0.01	0.02	0.17	0.60	0.11
11/1/2016	0.01	0.01	0.02	0.13	0.79	0.14
COUNT	8	9	9	9	9	9
AVERAGE	**0.06**	**0.02**	**0.03**	**0.11**	**0.42**	**0.11**

NO_X-N = Nitrite + Nitrate Nitrogen

FIGURE 2 - AVERAGE NOx NITROGEN ALONG CANAL (mg/l)



The canal section between Sample Points A and C covers the northern boundary of the WRWWTF plus a residential subdivision and ranchette parcels. In this canal section, the average NOx concentration is approximately 0.04 mg/l. Note however, that Sample Point A was located at the far western reach of the 8th Street Canal. Although the 8th Street Canal has a pipe connection to the adjacent D-4 Sublateral Canal running north-south along 90th Avenue, the two canals are not hydraulically connected except during extreme rainfall events. This is because the connecting pipe's invert is installed higher than the D-4 Canal's normal water level. As a result, the 8th Street Canal water at Sample Point A is normally stagnant and very shallow. Because of this, we suspect water samples from Sample Point A had a high risk of contamination with detritus, which could cause elevated sample results. If Sample Point A results are dismissed, the average NOx concentration in this canal section is approximately 0.03 mg/l.

As discussed later in the TKN results section, the highest TKN value occurs at Sample Point B opposite the wetland, which might imply some leaching of water into the canal from the wetland cells. If so, one might ask why the canal NOx concentration is not elevated also at Sample Point B. If such seepage is occurring, the low NOx values at this location are most likely due to the reduction of NOx by bacteria in the soil, which through biological denitrification reduces the nitrogen in the NOx molecule to a gaseous form.

Average NOx concentrations increase 0.01 mg/l from Sample Point B to Sample Point C. Concentrations begin to increase sharply east of Sample Point C, reaching 0.11 mg/l at Sample Point D and 0.42 mg/l at Sample Point E, which is a little west of the canal's connection to the Lateral C Canal paralleling 74th Avenue. Sample Point F is located east of the Lateral C Canal and is not influenced by the 8th Street Canal to the west. The average NOx concentration at Sample Point F is 0.31 mg/l lower than the concentration at Sample Point E, indicating elevated NOx concentration in the Study Area section.

<u>NOx Summary</u>

- NOx nitrogen is readily available for uptake by plants.
- Average canal NOx concentrations are relatively low up to Sample Point C (about the halfway point in the Study Area), which is about 4,600 feet east of the WRWWTF's deep settling pond.
- Average concentrations at Sample Point D are approximately 3.7 times greater than at Sample Point C.
- Average concentrations increase east of Sample Point D, with the concentrations at Sample Point E being 3.8 times greater than those at Sample Point D and 14.0 times greater than those at Sample Point C.
- The average NOx concentration at the Study Area's discharge point into the Lateral C Canal (Sample Point E) is 3.8 times higher than the concentration in the canal at Sample Point F (the canal's eastern section's discharge point into the Lateral C Canal). The results imply an elevated NOx concentration in the Study Area.

b. Total Kjeldahl Nitrogen (TKN) Results

TKN is the sum of organic nitrogen and ammonia nitrogen concentrations. Ammonia nitrogen is the only portion of TKN that is readily accessible for uptake by plants. Table 3 and Figure 3 show the average TKN concentrations at the various sample locations along the canal length. As discussed in the NOx Section, the data for Sample Point A is likely contaminated and therefore assumed unreliable.

TABLE 3 - 8th Street Canal TKN (mg/l)

SAMPLE DATE	A	B	C	D	E	F
9/13/2016	1.70	2.40	2.40	1.60	1.30	0.73
9/20/2016	1.20	2.50	2.30	1.50	1.20	0.64
9/27/2016	2.30	2.20	2.40	1.60	1.10	0.96
9/30/2016	1.20	2.50	2.30	1.50	1.20	0.90
10/4/2016	0.88	2.50	2.10	1.50	1.00	0.99
10/11/2016	1.10	2.40	2.10	1.50	1.10	1.20
10/18/2016	1.20	2.20	2.00	1.50	0.92	0.78
10/25/2016	0.92	2.30	2.20	1.40	0.80	0.67
11/1/2016	1.00	3.90	2.30	1.70	0.80	0.57
COUNT	9	9	9	9	9	9
AVERAGE	**1.28**	**2.54**	**2.23**	**1.53**	**1.05**	**0.83**

FIGURE 3 - AVERAGE TKN NITROGEN ALONG CANAL (mg/l)

Data shows that the highest TKN concentrations in the canal are in the vicinity of Sample Point B. Concentrations gradually decrease from Sample Point B as the water travels east to the Study Area discharge just east of Sample Point E. The WRWWTF is a biological wastewater treatment facility that uses bacteria, diatoms, paramecium, and other single-celled microorganisms to remove waste products from influent wastewater. Because the nitrogen associated with the ammonia molecule is easily available to the microorganisms, there should be no ammonia present in the treated water entering the wetland system because the ammonia will be converted to NOx by the microorganisms. This fact was confirmed in discussions with County Division of Utility Services personnel. Therefore, any TKN that might enter the canal from the WRWWTF wetland system will be comprised solely of organic nitrogen, which is very difficult for plants to utilize.

Figure 4 clearly shows the TKN concentration decreases as the water travels toward the Lateral C Canal. This indicates the TKN is either being diluted by other water inputs or else a significant portion of the TKN is in the ammonia form. If the latter case is true, canal vegetation is removing the ammonia nitrogen as the water flows east, thereby reducing the TKN value. Ammonia in water is generally associated with septic tank effluent or livestock waste.

Average TKN concentration decreases 0.31 mg/l From Sample Point B to Sample Point C. Concentrations decrease another 0.70 mg/l from Sample Point C to Sample Point D and they drop 0.48 mg/l between Sample Point D and Sample Point E. The average TKN reduction from Sample Point B to Sample Point E was 1.49 mg/l. The average TKN at Sample Point E is 0.22 mg/l higher than that measured at Sample Point F, indicating the 8th Street Canal west of the Lateral C Canal has a greater TKN loading than the canal section east of the Lateral C Canal.

<u>TKN Summary</u>

- TKN is composed of ammonia nitrogen and organic nitrogen, with the ammonia nitrogen being readily available to plants while the organic nitrogen component is not.
- The average TKN concentration drops as the water flows east into the Lateral C Canal, and it is 3.06 times greater at Sample Point B than at the Study Area discharge at Sample Point E.
- The highest average TKN concentrations appeared at Sample Point B, which is opposite the WRWWTF wetland. However, all TKN that might leach into the 8th Street Canal from the wetland is expected to be in the organic form and therefore unavailable to plants.
- The significant reduction of average TKN values from Sample Point B to Sample Point E indicates dilution of TKN by downstream water inputs, or else a significant amount of the TKN present is in the form of ammonia nitrogen and is being removed by plants, or both.
- If there is insignificant dilution occurring downstream of Sample Point B, then ammonia nitrogen is present. This means that a significant amount of the TKN at Sample Point B is comprised of ammonia nitrogen, and its source must be other than the wetland system, and therefore possibly emanating from properties on the north side of 8th Street. Such sources may include septic seepage, artesian well flow, irrigation runoff, and/or legacy loads.

- The average TKN concentration at the Study Area's discharge point into the Lateral C Canal (Sample Point E) is 1.3 times higher than the concentration in the canal at Sample Point F (the canal's eastern section's discharge point into the Lateral C Canal). The results imply a slightly elevated TKN concentration in the Study Area.

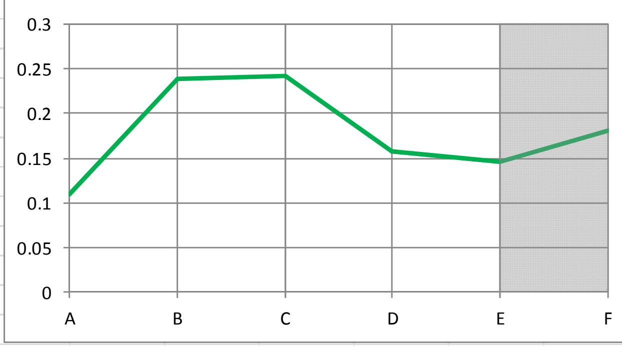
Laboratory Results for Total Phosphorus

Total Phosphorus (TP) is the sum of inorganic phosphorus (typically referenced as ortho-phosphorus) and organic and polyphosphate phosphorus. The ortho-phosphorus is available for direct biological uptake. The organic and polyphosphate phosphorus is generally considered unavailable for biological uptake. Therefore, any TP reduction noted is most likely due to the consumption of ortho-phosphorus by canal vegetation. TP concentrations at the sample points are presented in Table 4 and Figure 4. As discussed, values at Sample Point A are considered unreliable.

TABLE 4 - 8th Street Canal TP (mg/l)

SAMPLE DATE	A	B	C	D	E	F
9/13/2016	0.19	0.26	0.25	0.16	0.14	0.14
9/20/2016	0.12	0.22	0.25	0.14	0.15	0.12
9/27/2016	0.26	0.24	0.24	0.20	0.17	0.20
9/30/2016	0.07	0.24	0.25	0.15	0.14	0.13
10/4/2016	0.06	0.25	0.25	0.16	0.14	0.19
10/11/2016	0.05	0.24	0.29	0.19	0.19	0.46
10/18/2016	0.08	0.21	0.20	0.15	0.13	0.18
10/25/2016	0.06	0.20	0.22	0.13	0.15	0.14
11/1/2016	0.10	0.29	0.22	0.14	0.11	0.07
COUNT	9	9	9	9	9	9
AVERAGE	**0.11**	**0.24**	**0.24**	**0.16**	**0.15**	**0.18**

FIGURE 4 - AVERAGE TP ALONG CANAL (mg/l)



Data indicates that the greatest average TP concentrations occur between Sample Points B and C, sharply decreasing between Sample Point C and Sample Point D, with an additional slight decrease between Sample Point D and Sample Point E. Average TP at the eastern section of the 8th Street Canal's discharge into the Lateral C Canal is only slightly greater than the discharge concentration from the Study Area.

The WRWWTF is a tertiary treatment plant, meaning that under normal operating conditions, it produces a flow to its downstream wetland treatment system of 1.00 mg/l TP or less. The treatment plant's biological processes should remove most of the inorganic phosphorus present in the wastewater it receives. However, the type of phosphorus present in the canal water was not determined in the study. The average TP concentration between Sample Points B and C is relatively constant, indicating little additional TP loading in that canal section. The data points in Table 4 indicate that individual high TP readings switch back and forth between the two sample points. As the water flows east in the canal toward its discharge into the Lateral C Canal, average TP concentrations decrease, indicating either dilution from other water inputs or uptake of inorganic phosphorus by plants, or both Average TP drops by 0.08 mg/l from Sample

Point C to Sample Point D, but drops only 0.01 mg/l between Sample Point D and the discharge into the Lateral C Canal at Sample Point E. The average TP at Sample Point E is 0.03 mg/l lower than that measured at Sample Point F, indicating the 8th Street Canal east of the Lateral C Canal has a slightly greater TP loading than the Study Area section.

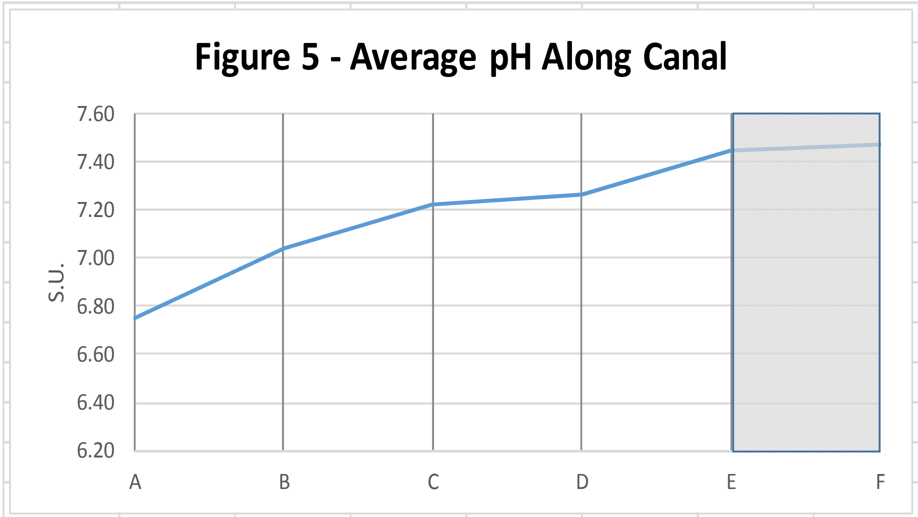
TP Summary

- TP is composed of ortho-phosphate plus organic and polyphosphate, with the ortho-phosphate being readily available to plants while the organic and polyphosphate forms are not.
- The average TP concentration drops as the water flows east into the Lateral C Canal, and it is 1.60 times greater at Sample Points B/C than at the Study Area discharge at Sample Point E.
- The highest average TP concentrations appeared at Sample Points B/C and Sample Point B is opposite the WRWWTF wetland. However, it is expected that most of the ortho-phosphate originally present in the WRWWTF effluent would have been removed by the biological process.
- The reduction of average TP values from Sample Point C to Sample Point E indicates dilution of TP by downstream water inputs, or else a significant amount of the TP present is in the form of ortho-phosphate, or both.
- Because of the notable TP reduction east of Sample Point C, if there is insignificant dilution occurring downstream of Sample Point C, then ortho-phosphate is present. This means that much of the TP at Sample Points B/C is comprised of ortho-phosphate.
- The average TP concentration at the Study Area's discharge point into the Lateral C Canal (Sample Point E) is 1.2 times lower than the concentration in the canal at Sample Point F (the canal's eastern section's discharge point into the Lateral C Canal). The results imply a slightly elevated TP concentration in the canal section east of the Study Area.

FIELD DATA

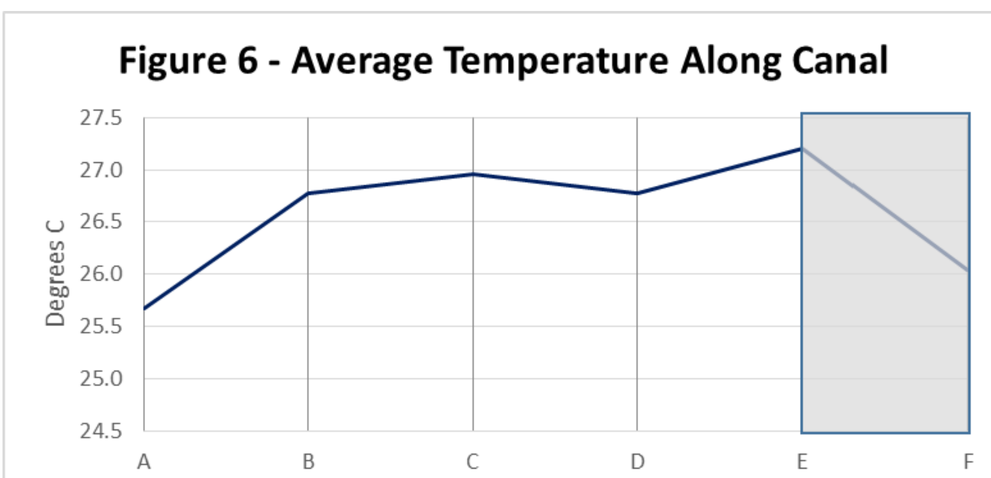
Various field data was collected during the Phase 1 sampling program. While it is difficult to draw many helpful conclusions from this data, some general comments follow.

a. **pH** – pH is a measure of how acidic or basic water is and ranges from 0 to 14, with 7 being neutral. pH values less than 7 indicate water is acidic and greater than 7 indicates the water is a base. Each pH number represents a 10-fold change in the acidity or basicness of the water. For example, water with a pH of 5 is ten times more acidic than water with a pH of 6. pH is important because it determines the solubility and biological availability of constituents such as nitrogen and phosphorus. The average pH along the 8th Street Canal is shown below in Figure 5.

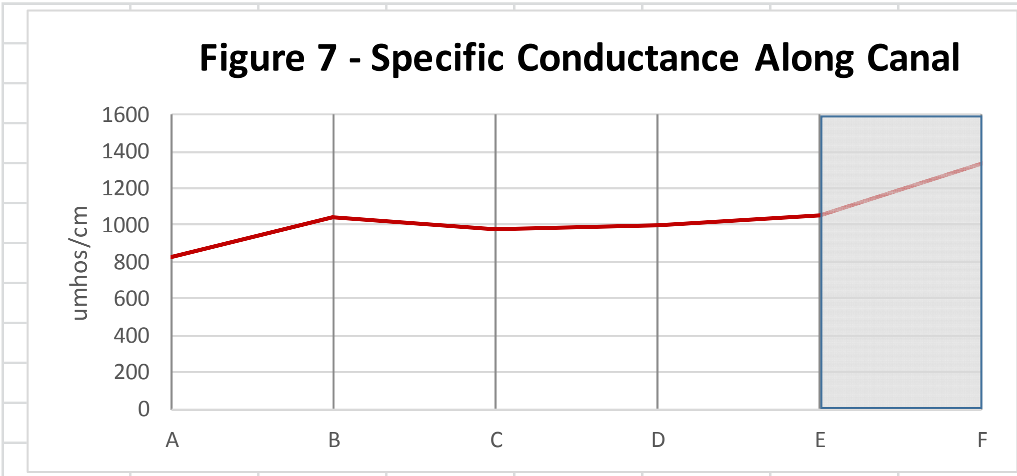


As indicated above, the average pH gradually rises in the canal from a low of 6.75 at Sample Point A to 7.45 at Sample Point E, an increase of 0.70 units. The water changes from just slightly acidic at Sample Point A to almost neutral at Sample Point B. The pH at Sample Points E and F are nearly identical. Average pH increases equally between Sample Points B and C and between Sample Points D and E.

b. **Temperature** – Average water temperature in the Study Area is shown graphically in Figure 6. It ranges from an average 25.7^{o} C (78.26^{o} F) at Sample Point A to 27.2^{o} C (80.96^{o} F) at Sample Point E, for a delta of 1.5^{o} C (2.7^{o} F). The small temperature variances could be due to changes in water temperature in certain sections from pipe discharges from ponds, etc. or because of water surface shading by overhanging trees and other vegetation.



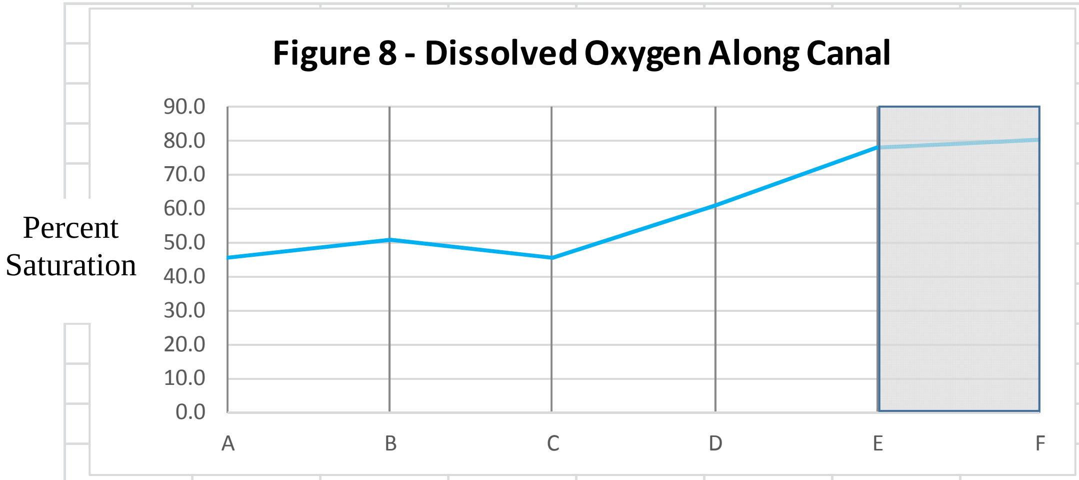
c. **Specific Conductance** – Specific conductance is a measure of how well water can conduct an electrical current. Conductance increases with increasing amount and mobility of ions which result from the breakdown of compounds. Specific conductivity can be used to indirectly measure the presence of dissolved solids in water, such as chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, and iron.[1] The higher the specific conductance value, the more dissolved solids (referred to as total dissolved solids or TDS) are present. Figure 7 shows the average specific conductance along the canal.



Specific conductance (SC) in the canal west of the Lateral C Canal ranged from a low of 831 umhos/cm at Sample Point A to 1,059 umhos/cm at Sample Point E, resulting in a range of 228 umhos/cm. An intermediate peak occurred at Sample Point B, being only 11 umhos/cm less than that at Sample Point E. Sample Point F's average SC was the highest, at 1,340 umhos/cm or 315 umhos/cm greater than Sample Point E's average. However, Sample Point F is east of the Lateral C Canal and therefore represents a different water source. Because there are many ions that contribute to specific conductance, it is not possible to identify those that might be present in the canal water in this instance. However, the observed suspected artesian well discharge into the canal could be expected to contribute many of the ions listed above.

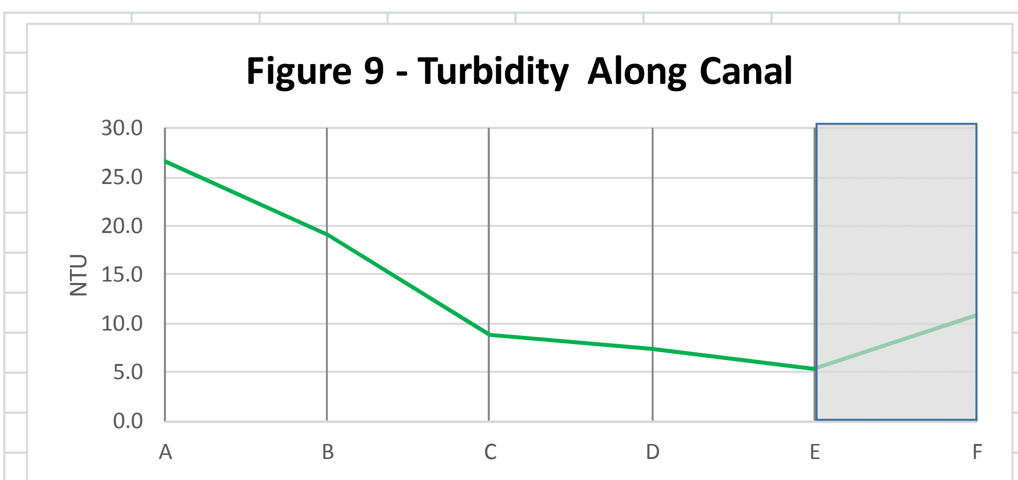
d. **Dissolved Oxygen Saturation** – Dissolved oxygen (DO) is the amount of gaseous oxygen that is present (dissolved) in the water. Dissolved oxygen levels are influenced by many factors including fish, invertebrates, bacteria and plants. Average DO in the Study Area is shown graphically in Figure 8.

[1] http://bcn.boulder.co.us/basin/data/NEW/info/SC.html



DO saturation is reported as the percentage of dissolved oxygen concentration relative to the concentration when completely (100%) saturated at the temperature of the measurement depth.[2] Average DO saturation west of the Lateral D Canal ranged from 45.6% at Sample Points B and C to 77.9% at Sample Point E. The highest saturations were recorded at Sample Points D, E, and F, with Sample Point F's average DO saturation being only 2.2% higher than that at Sample Point E, which was the highest average west of the Lateral C Canal. The canal section west of Sample Point D had the lowest DO saturation.

e. **Turbidity** – Turbidity makes a water appear cloudy or opaque. It is the measure of relative clarity of a liquid. The more cloudy or opaque the water the higher the turbidity measurement. Material that causes water to be turbid includes clay, silt, finely divided organic and inorganic particles, algae, soluble colored organic compounds (e.g. tannins produced by decaying leaves), plankton, and other microscopic organisms. Average turbidity in the Study Area is presented in Figure 9. Values are reported in nephelometric turbidity units or NTUs.



[2] http://www.lakeaccess.org/russ/oxygen.htm

The lowest average turbidity reading occurred at Sample Point E (5.3 NTU) and the highest at Sample Point A (26.7 NTU). A high reading at Sample Point A would be expected since it is located at the canal's western terminus and normally experiences no flow. The next highest average reading occurred at Sample Point B (19.1 NTU). In fact, average turbidity decreases from Sample Point A to Sample Point E, perhaps influenced by clear artesian well water discharges into the canal and the filtering out of particulate matter by aquatic vegetation as the water flows east to the discharge point just east of Sample Point E. The average turbidity at Sample Point F (10.8 NTU) was twice that of the value at Sample Point E.

ADDITIONAL ANALYSES – JULY 20, 2017 and August 11, 2017

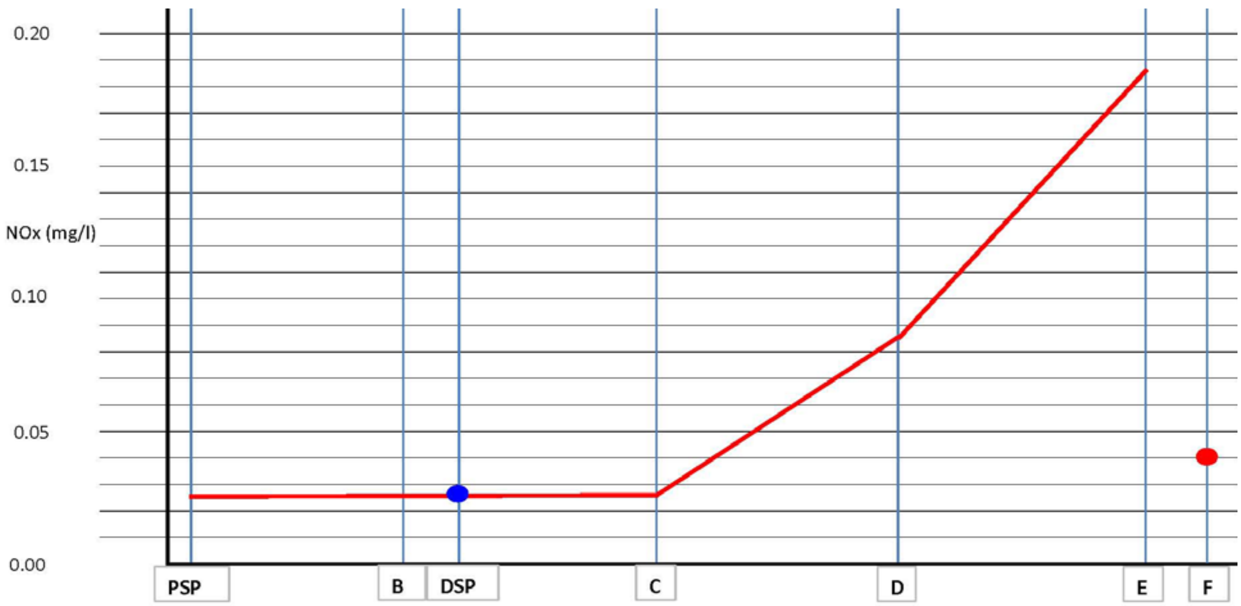
On July 20, 2017 and August 11, 2017, two more sample sets were taken at the six original sample points and at a pipe discharge west of Sample Point B (labeled PSP) and in the northwest corner of the WRWWTF wetland's deep settling pond (labeled DSP). The locations are shown on Figure 10. The samples were analyzed for ammonia nitrogen and ortho-phosphate in addition to the previously tested constituents. Because the pipe discharge constituted all of the canal flow in its western reach (except for groundwater seepage), its measurements were considered as canal water measurements at that location and therefore, a line was drawn on each graph connecting Sample Point PSP with Sample Point B. Data for Sample Point A was not plotted for the reasons previously discussed. Note that the WRWWTF wetland system's northern treatment cells abutting the 8th Street Canal during this period were dried for maintenance and therefore, cannot be considered a contributor to nutrients measured during these two sample events.

Figure 10 – NEW SAMPLE POINT LOCATIONS

a. Nitrite/Nitrate Nitrogen (NOx) Results

Figure 11 shows NOx Nitrogen sample results. As seen on Figure 10, the average NOx in the canal between Sample Points PSP and C is very low. NOx concentrations begin to climb somewhere after Sample Point C and continue to increase through sample Point E as was seen in previous sampling results. The average NOx concentration into the Lateral C canal at Sample Point E was 4.6 times greater than the NOx discharging into the Lateral C Canal from the east at Sample Point F. Neither the PSP pipe discharge or the WRWWTF wetland system/deep settling pond appear to be contributing noticeable NOx to the 8th Street Canal. The majority of nitrogen entering the wetland system/deep settling pond from the WRWWTF is in the form of NOx based on the biological processes taking place in the WRWWTP.

Figure 11 – NOx NITROGEN RESULTS



SAMPLE DATE	A	PSP	B	DSP	C	D	E	F
7/20/2017	0.025	0.025	0.025	0.025	0.025	0.095	0.130	0.054
8/11/2017	0.025	0.025	0.025	0.025	0.025	0.085	0.240	0.025
AVERAGE	**0.025**	**0.025**	**0.025**	**0.025**	**0.025**	**0.090**	**0.185**	**0.040**

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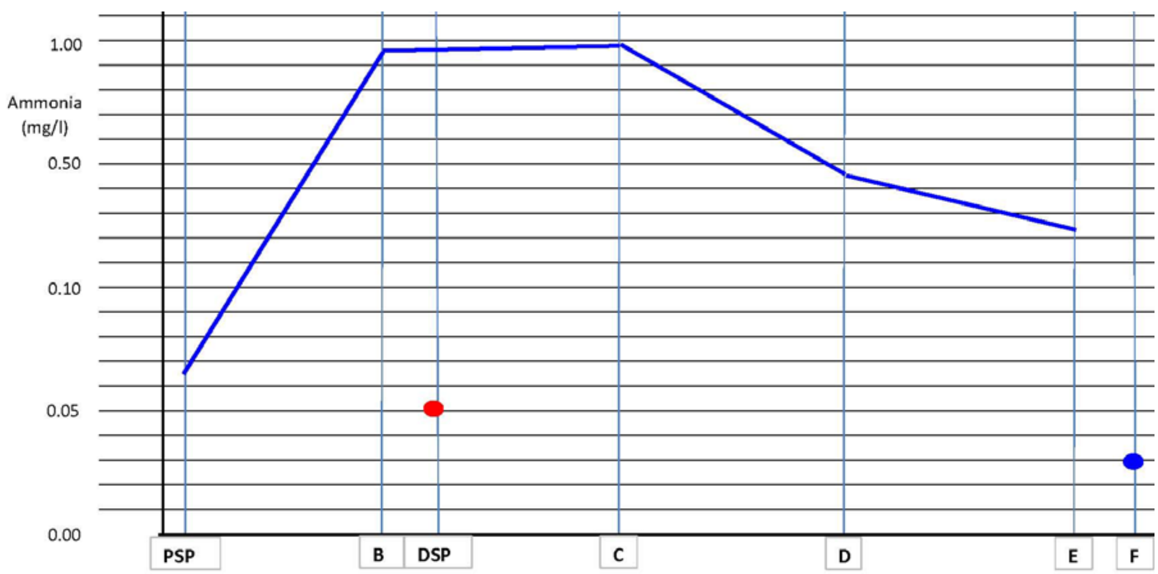
b. Ammonia Nitrogen Results

Figure 12 shows ammonia nitrogen sample results. The average ammonia nitrogen concentrations from the pipe discharge and the deep settling pond are minimal. Ammonia nitrogen begins to rise significantly after Sample Point PSP, reaching maximum values between Sample Points B and C. After that, the ammonia nitrogen begins to drop, although at the discharge into the Lateral C Canal, its values are almost 7.8 times greater than the average ammonia nitrogen discharging into the Lateral C Canal from the east at Sample Point F. It is possible that the steady decrease in ammonia nitrogen from Sample Point C eastward is at least partially due to uptake by aquatic vegetation in the canal. Dilution from other canal discharge sources may also be a factor. The potential of a leaking sewage force main into the WRWWTF or its air release valve at the canal as ammonia nitrogen contribution was considered, however an examination of pertinent data and equipment by IRCDUS eliminated those possibilities. Ammonia levels in the deep settling pond sampling site were minimal.

Figure 12 – AMMONIA NITROGEN RESULTS



SAMPLE DATE	A	PSP	B	DSP	C	D	E	F
7/20/2017	0.140	0.081	0.860	0.053	1.000	0.450	0.280	0.033
8/11/2017	0.027	0.044	0.990	0.049	0.960	0.480	0.160	0.023
AVERAGE	**0.084**	**0.063**	**0.925**	**0.051**	**0.980**	**0.465**	**0.220**	**0.028**

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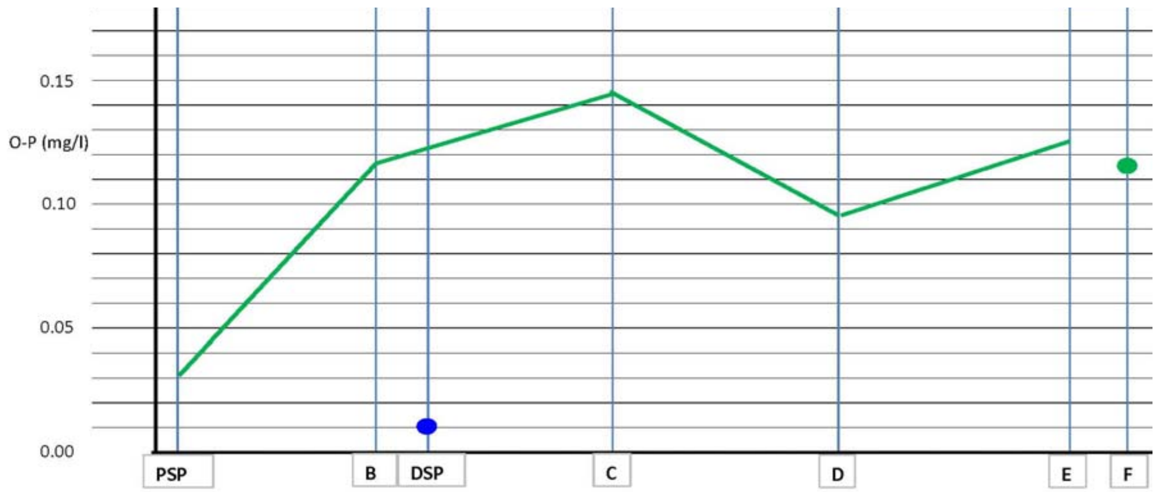
c. Ortho-Phosphate Results

Figure 13 shows ortho-phosphate sample results. The average ortho-phosphate contribution from the pipe discharge is minimal and the ortho-phosphate concentration in the deep settling pond is insignificant. Ortho-phosphate begins to rise significantly after Sample Point PSP, reaching a maximum value at Sample Point C. After that the concentration drops but rises again between Sample Points D and E. The average ortho-phosphate concentration at the discharge into the Lateral C Canal is only about 1.1 times greater than that discharging into the Lateral C Canal from the east at Sample Point F. The steady decrease in ortho-phosphate between Sample Points C and D may be due to uptake by aquatic vegetation in the canal and/or dilution from other canal inputs. The possibility of additions from the WRWWTF's influent sewage force main or the pipe's air release valve have been eliminated from consideration.

Figure 13 – ORTHO-PHOSPHATE RESULTS



SAMPLE DATE	A	PSP	B	DSP	C	D	E	F
7/20/2017	0.038	0.026	0.073	0.008	0.110	0.069	0.140	0.099
8/11/2017	0.088	0.034	0.160	0.013	0.180	0.120	0.110	0.130
AVERAGE	0.063	0.030	0.117	0.011	0.145	0.095	0.125	0.115

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SUMMARY AND RECOMMENDATIONS

The Phase 1 Study's goal was to test only basic parameters at strategic locations to quickly identify nutrient hot spots in the canal, with a specific focus on the WRWWTF wetland/deep settling pond. Initial data indicates that canal NOx values begin increasing at Sample Point C and ramp up significantly between Sample Points D and E. Canal TKN values spike at Sample Point B and the highest TP occurs between Sample Points B and C.

Most likely, discrete point sources are introducing NOx into the canal east of Sample Point C, although some NOx may be present due to conversion of ammonia nitrogen to NOx as part of the nitrogen cycle. Regarding TKN, it is necessary to determine what nitrogen forms are present that are contributing to the TKN totals. TKN is the sum of ammonia nitrogen and organic nitrogen. Ammonia nitrogen is biologically active and readily utilized by plants, while organic nitrogen is not. Therefore, it is useful to identify sources contributing ammonia nitrogen to the canal.

Similarly, only the ortho-phosphorus (inorganic phosphorus) component of TP is readily available for uptake by plants. Therefore, average ortho-phosphorus concentrations must be determined to identify likely contributing sources.

While the Phase 1 Study collected significant data, staff realized that a more detailed breakdown of canal water nitrogen and phosphorus elements is necessary in order to draw defensible conclusions regarding nutrient sources. Therefore, to provide a better snapshot of canal nutrients that are easily assimilated by plants, two supplementary sample sets were taken that included testing for ammonia nitrogen and ortho-phosphorus. Also, two new sample locations were added: a pipe discharge into the canal a little east of Sample Point A; and the northeast corner of the WRWWTF's deep settling pond. These additional samples indicate that neither the pipe discharge or the deep settling pond appear to contribute NOx. The pipe discharge contributes minimal ammonia nitrogen and the deep settling pond contains minimal amounts of ammonia nitrogen due to the upstream wastewater treatment process. Ortho-phosphate contributions, if any, by the pipe appear negligible, while levels of ortho-phosphate in the deep settling pond are minimal.

If the County Commission determines to proceed with a Phase 2 study to try to identify specific potential nutrient contributors east of Sample Point B, staff recommends the following: (1) locate and identify all pipes discharging into the 8th Street Canal east of Sample Point B; and (2) at each pipe discharge, collect water samples and test them for NOx, TKN, ammonia nitrogen, TP, and ortho-phosphorus. All pipe connections may not discharge until a rain event, which will make sampling more difficult due to timing of rainfall runoff into the pipes. Staff recommends three post-rain grab sampling events.

ESTIMATED COST FOR PHASE 2 SAMPLING

Assuming twelve sample locations, the estimated total sampling cost is $3,000. This includes sample collection by PACE Analytical Services, Inc.