J. Environ. Sci.
Institute of Environmental Studies and Research – Ain Shams University

EVALUATION OF EL-GHARBIA DRAIN WATER QUALITY TO INCREASE BENEFITS FROM IT

[5]

El-Sherbiny, H. A.(1); EL-Kassas, H.(2) and El-Saadi A.M.(1)
1) Drainage Research Institute, National Water Research Center 2) Institute of Environmental Studies and Research, Ain Shams University

ABSTRACT

Water quality control is a major issue for Egypt where the severity of present water quality problems varies among different water bodies. Managing the water quality of Gharbia drain is an important issue to ensure suitability of drain water for reuse in irrigation. The assessment of the drain water enhanced substantially by the use of water quality simulation model (HEC-RAS) to investigate environmental impacts based on the principle of treatment. The study activities based on field measurements, laboratory analysis and data interpretation for Biological Oxygen Demand (BOD), Dissolved Oxygen (DO), Total Nitrogen, Organic Nitrogen, Ammonia, Nitrate, Nitrite, Total Phosphorus, Organic Phosphorus and Ortho Phosphate. The pollution load calculated for the point sources that have the most negatively impact on the water quality of the drain were identified and six different scenarios were developed (decreasing the concentration by 25% and 50% from its original value to improve water quality of the drain) using water quality modeling (HEC-RAS model).

The results indicate that the sixth scenario in which 50% improvement in water quality of the point sources of samatay & P.S. 3,4,5,6 due to the increase of wastewater treatment plants efficiency is the best scenario followed by the fourth which propose enhancement in the wastewater plants that are in the reach of Samatay and (5) Pump stations, which results in improving the water quality at these point sources by 50%. And fifth scenario which proposes the enhancement in the wastewater treatment plants that are in the catchment of stations (6, 3, 4) has been improved the water quality by 50%.

Keywords: Gharbia drain, HEC-RAS, Drain water reuse, Water Quality.

INTRODUCTION

Egypt needs to increase and sustain productivity of irrigated agriculture land in Egypt, the present per capita share of water is approximately 603 m^3/yr today, while the per capita share of cultivated land is as low as 0.08 acre (DRI, 1995). Based on the measures towards water resources management, Egypt is also facing serious challenges such as deterioration of water quality and the growing demand-supply gap (DRI, 1997 a:b). Increased industrial growth, together with intensified agriculture, has put a direct impact on the quality. Thus, availability of water became constrained by its degraded quality, which limited its use for specific purposes. Industrial activities, as well as urban centers, negatively affect the water quality of neighboring water bodies as wastewater is dumped into them without proper treatment.

As a non-conventional water resource, agricultural drain water reuse has become an important source of irrigation water in Egypt. It is well developed and prepared as a national policy (NWRP, 2005). Gharbia main drain system is one of the largest drain systems in the Nile Delta and valley. It is located in the central part of Middle Nile Delta. The area served by the drain is about 460,000 acres. Around one billion cubic meter per year is reused from the drain in irrigation purposes (DRI, 2000). It is a considerable amount of water compared to total reuse in Egypt. This is in addition to the large quantity of unofficial drain use which puts the Gharbia drain in the highest priority list for protection from pollution.

The assessment and management of the drain water quantity and quality can be enhanced substantially by the use of water quality simulation model (HEC-RAS) to investigate environmental interventions based on the principle of treatment. The Hydrologic Engineering Center River Analysis System (HEC-RAS) is intended for calculating water surface profiles for steady gradually varied flow in nature or man-made channels. The software allows performing one-dimensional steady, unsteady flow hydraulics, sediment transport/mobile bed computations, and water temperature modeling through a full network of open channels.

The objective of this study is to develop an assessment practice for water quality of the Gharbia main drain system. The assessment and management of water quantity and quality were carried out through water quality simulation model (HEC-RAS) to investigate environmental interventions based on the principle of treatment. The use of the mathematical model will support drain water management and maximize the reuse of drain water of acceptable quality. More specific objectives are as follows:

- Enhancing research capacity to respond to the decision makers for management support of drain water quality issues in Gharbia drain catchment.
- Using water quality model (HEC-RAS) to investigate water quantity/quality objectives and ensure efficient drain water reuse in the catchment.

MATERIALS AND METHODS

The methodology for this study is based on: (a) Assessment of water quality of Gharbia drain system including estimation of pollution loads, and (b) Developing different scenarios of interventions using water quality modeling.

The methodology initiated with conducting field visits across the drain and monitored sources of pollution these locations are chosen according to the noticeable changes expected in water quality as shown in figures (1 and 2) due to contributions from pumping stations into the drain.

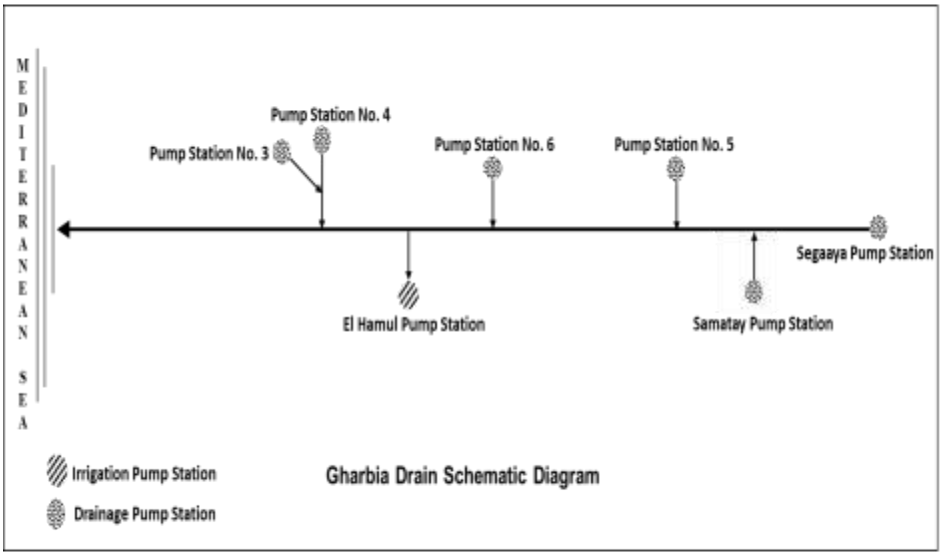

Figure (1): Schematic diagram for El-Gharbia drain system.

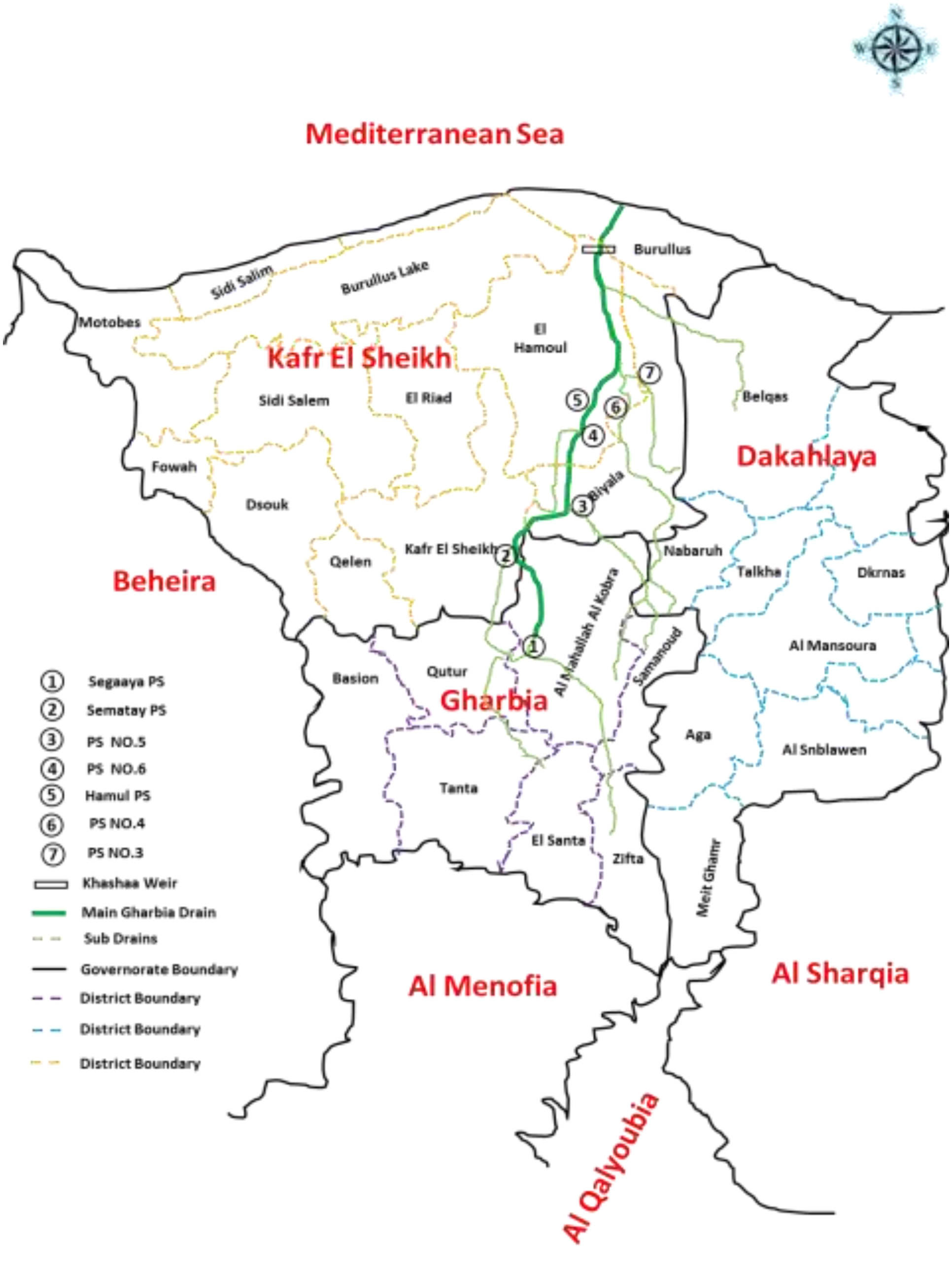

Figure (2): El-Gharbia drain system Layout

After delivering the water samples to laboratory, it was analyzed for the physical and chemicals properties of the selective water quality parameters according to the standard methods mentioned in (Standard Methods for Examination of Water & Wastewater, 20th ed., 1999). The water quality variables are as follows:

- Temperature.
- Biological Oxygen Demand (BOD).
- Dissolved Oxygen (DO).
- (Organic Nitrogen - Ammonia - Nitrate - Nitrite - Organic Phosphorus - Ortho Phosphate).

Eight major sites in El-Gharbia drain system were selected as described in table (1). At least three independent samples were collected from each site in clean sterilized glass containers and stored in an iced cooler box and delivered immediately to the Central Laboratory for Environmental Quality Monitoring, National Water Research Center "CLEQM-NWRC" where it has been analyzed.

Table (1): Sample Sites in El Gharbia Drain

Location Name	Description
Segaaya P.S.	Segaaya drain outfall
Sematay P.S.	Sematay drain outfall
P.S.3	Lifting drain water to El-Gharbia main drain down stream Hamule P.S. on Gharbia drain
P.S.4	Lifting drain water downstream P.S.3 & then to Gharbia main drain
P.S.5	Lifting drain water to Gharbia main drain downstream sematay P.S. on Gharbia drain
P.S.6	Lifting drain water to Gharbia main drain downstream P.S.5 on Gharbia drain
Sematay Segaaya Mixing	Water quality monitoring location
Ezbet el-Nil Bridge	Water quality monitoring location
Hamule P.S	Mixing drain water from Gharbia main drain downstream P.S.6 to Tira Canal on Gharbia drain

* P.S: Pump Station

According to Figures (1 and 2), Samatay pump station collects the drain water from the areas of Qotour, Kafr El-Sheikh and Mahalla al-Kubra with a total population of 1,251,528, and area served of 28,775 feddans. The catchment is served by two WWTP(s) namely (Nemra El-Basal and Sakha) with a total design capacity of 103,000 m^3 / day for the two plants, while the total sewage drain produced by this served area is 141,739 m^3/day with deficit up to 38,739 m^3/day or by the percentage of 38%.

Pump Station 5 collects the drain water of Samanud, Mahalla, Biala and Hamoul areas with a total of 273 villages where the total population is 123,290,7 inhabitants, the served area is 72,200 feddans, the catchment is served by a 6 WWTP(s) stations namely (Ziad, Hamoul, Dimitio, Ebshan, Elzfaran, El-Kolia and Beshbish) With a design capacity of 41400 m^3 / day for the six plants, while the total sewage resulting from such area is 143,137 m^3/day with a deficit up to 101,737 m^3/ day or 275%.

Station 6 collects the drain water from Kafr El-Sheikh and El Hamoul areas. The total number of villages is 117 villages, the total population is 400,700, the area served is 39,290 feddans, and the number of treatment plants in this area is two plants (Sidi Ghazi and Hamoul) with a design capacity of 27000 m3/day for both plants. The total sewage drain resulting from such area is 44011 m^3/ day with a deficit up to 17011 or 63%.

Pump stations (3 and 4) collect drain water from Belqas, Nabarouh, Bila and Hamoul areas. the total numbers of villages are 283 with a total population of 1036219 inhabitants, a serving area is 112670 and a number of treatment plants in this area are 4 plants (Messra Bilqas- Nabarouh, Kafr El Garida-Bella) with a design capacity of 520,000 m^3/day while the total sewage drain resulting from such area was 111,637 m^3/day with a deficit of up to 59,537 m^3/day or 114%.

Estimation of the pollution loads to be used in the implementation of simulation that will be conducted by using the mathematical models:

The pollution Load can be calculated according to the following equation: Load= Concentration (C) X Discharge (Q)

Principles of Model Formulation:

Basis: The bases for mathematical models are the fundamental physical and chemical laws, such as the laws of conservation of mass, energy, and momentum.

Assumptions: It involves making as many simplifying assumptions as reasonable. The assumptions that are made should be carefully considered and listed. They impose limitations on the model that should always be kept in mind when evaluating its predicted results (Luyben, 1996).

Calibration: The HEC-RAS model was calibrated by adjusting the Manning's roughness coefficient to better match.

Verification: The verification can be obtained by designing experiments to test the validity of a dynamic model can sometimes be a real challenge and should be carefully thought out.

Scenarios: Proposing different scenarios by decreasing the concentration by 25% and 50%. For selective point sources from its original value to improve water quality of the drain then testing these scenarios impact on the drain using water quality modeling (ie., HEC-RAS model). The Scenarios Schematic Diagram presented in figures (3, 4 and 5).

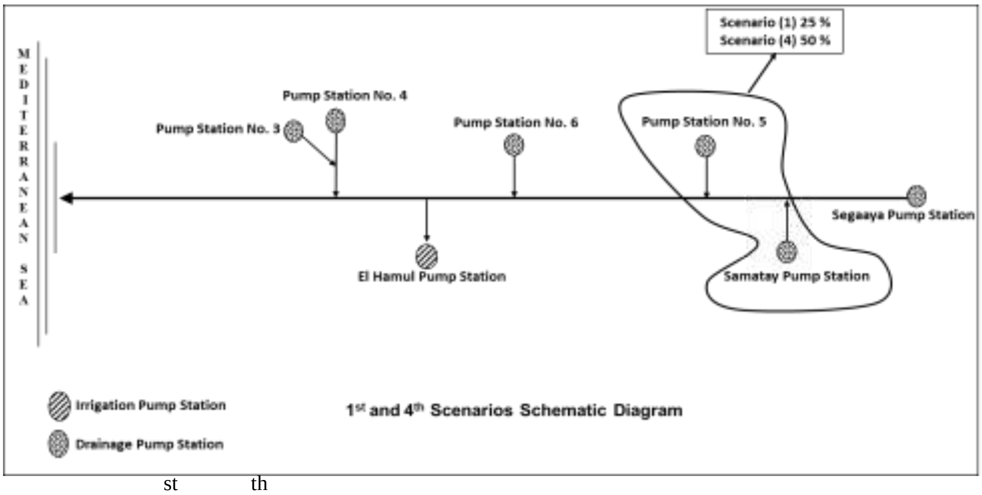

Figure (3): 1st and 4th Scenarios Schematic Diagram

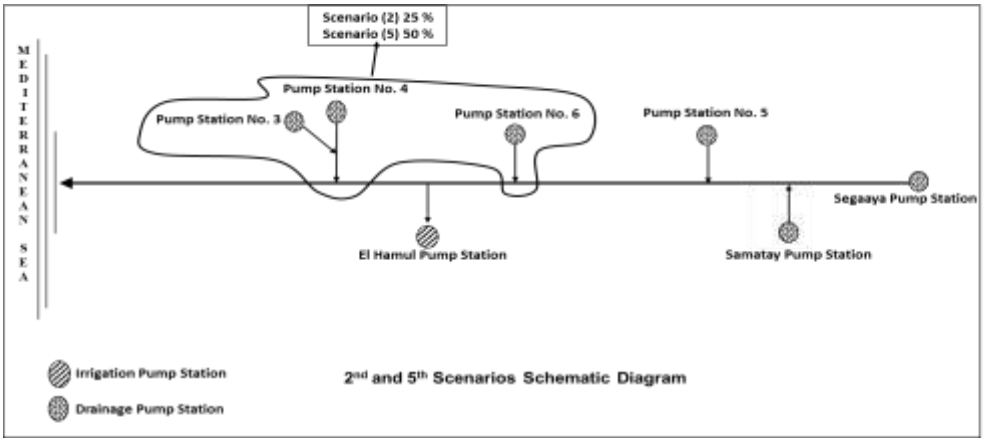

Figure (4): 2nd and 5th Scenarios Schematic Diagram

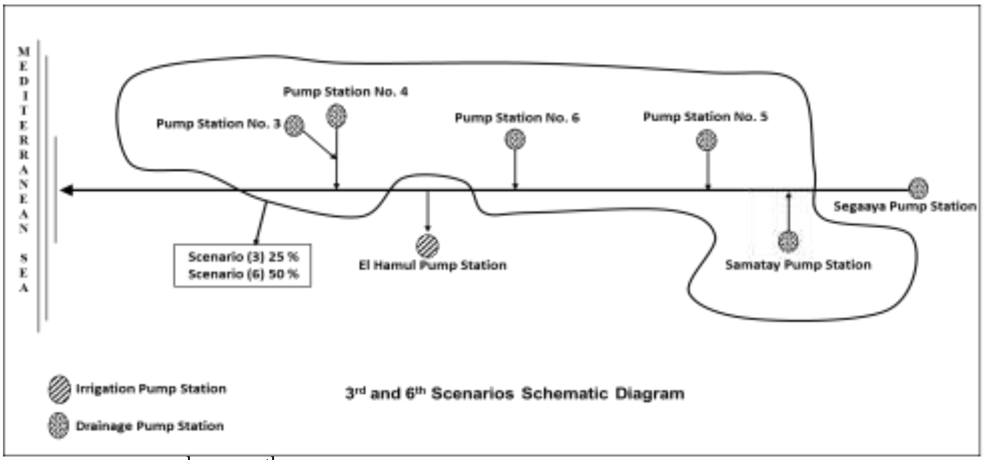

Figure (5): 3rd and 6th Scenarios Schematic Diagram

The First scenario**:** The First scenario is the improvement of the treatment plants at Samatay and Pump stations (5) catchments thus assumed improving the water quality at the point sourse by 25%.

The second scenario**:** The second scenario is the improvement of treatment of the wastewater plants that are in the catchment of stations 4, 3, 6, which assumed in improving water quality at these point sources by 25%.

The Third scenario**:** The third scenario is improving the treatment of the wastewater plants that are in the catchment of Samatay, (5, 6, 3 and 4) Pump stations, which assumed in improving water quality at these point sources by 25%.

The Fourth scenario**:** The fourth scenario is the improving the treatment of the wastewater plants that are in the catchment of Samatay and Pump stations (5), which assumed in improving the water quality of these point sources by 50%.

The Fifth scenario**:** The Fifth scenario is the improvement of the treatment of the wastewater stations that are in the reach of stations (6, 3, 4), which assumed to improve the water quality at these point sources by 50%.

The Sixth scenario: The Sixth scenario is the improvement of the treatment of the wastewater plants that are in the catchment of Samatay, pump Stations (5, 6, 3 and 4), the assumed improvement of the water quality at these point sources is by 50%.

RESULTS

Pollutant load has been calculated, the point sources have been classified according to its negative impact on the water quality of Gharbia drain as shown as Figure (6, 7 and 8).

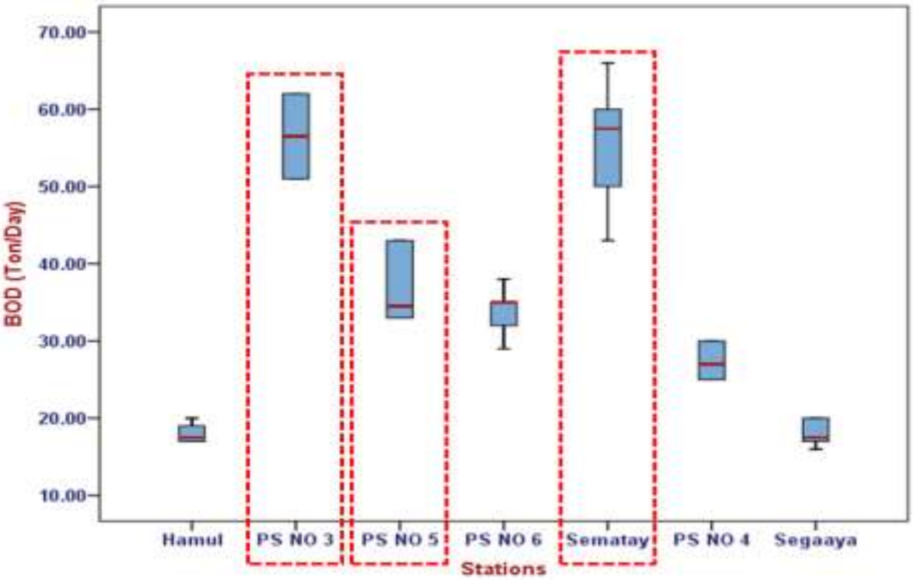

Figure (6): Pollutant load of BOD for all the stations

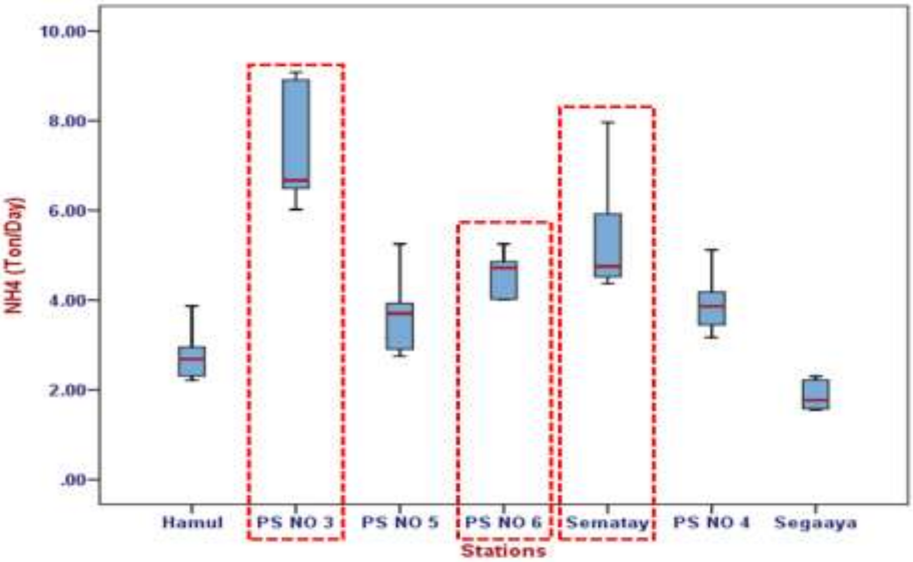

Figure (7): Pollutant load of NH_4 for all the stations

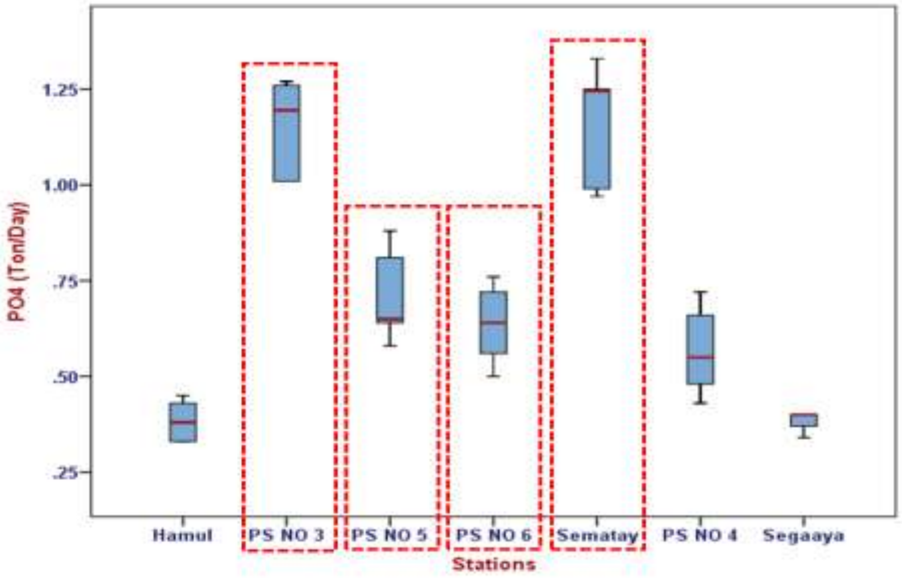

Figure (8): Pollutant load of PO_4 for all the stations

Table (2) represent The Water Quality Parameters of Point Sources measured in winter season and have been used to run the model. It is clear that the BOD value ranged from 53.17 to 58.33. DO ranged from 1.4 -2 mg/l along the drain for example.

Table (2): The Water Quality Parameters of Point Sources

Locations	**Water Quality Parameter**							
	DO	**BOD**	**Org N**	**NH_4**	**NO_2**	**NO_3**	**Org P**	**PO_4**
Segaaya PS	1.47	53.83	6.91	5.55	0.14	11.45	2.21	1.20
Sematay PS	1.40	55.67	5.24	5.35	0.15	15.45	2.31	1.16
PS NO.5	1.65	55.83	6.42	5.67	0.13	14.97	2.28	1.08
PS NO.6	1.90	58.33	9.60	7.53	0.12	11.95	2.42	1.10
Hamul PS	1.90	53.17	2.92	8.18	0.13	16.33	2.13	1.12
PS NO.4,3	2.00	55.00	6.18	7.51	0.12	14.69	2.32	1.13

Water Quality Assessment: Table (3) represent the observed and simulated water quality parameters with respect to (Segaaya and Sematay mixed), Ezbet El Nile Bridge and Gharbia Main Drain (Km 46.40) showed very low variation in most water quality parameters between the measured and simulated values. So that it was clear that the model was adequate to fit water quality simulation.

Table (3): The observed and simulated water quality parameters

Location		**Water Quality Parameter**							
		DO	**BOD**	**NH_4**	**NO_3**	**NO_2**	**Org N**	**PO_4**	**Org P**
Segaaya and Sematay mixed (Km 54.6)	Observed	1.80	54.5	5.36	15	0.18	5.40	1.17	2.28
	Simulated After Model Calibration	1.60	55.38	4.32	13.95	0.14	4.40	1.60	3.40
Gharbia Main Drain (Km 46.4)	Observed	2.11	55	5.43	15	0.2	5.70	1.15	2.28
	Simulated After Model Calibration	2.00	56.43	4.45	13.20	0.13	4.71	1.50	3.20
Ezbet El Nile Bridge (Km 38.6)	Observed	2.40	56	5.4	14.9	0.26	5.68	1.15	2.27
	Simulated After Model Calibration	2.01	57.43	4.60	13.40	0.10	4.50	1.30	3.50

The mean squared error was calculated and it is clear that the lowest error recorded in NH_4 concentrations for Segaaya and Sematay mixed, NO_3 concentrations for Ezbet El Nile Bridge but the highest error ratio was recorded for DO concentrations for Segaaya and Sematay mixed and Ezbet El Nile Bridge as shown in table (4).

Table (4): The mean squared error

	Mean Squared Error							
	DO	**BOD**	**NH_4**	**NO_3**	**NO_2**	**OrgN**	**PO_4**	**OrgP**
Segaaya and Sematay mixed	0.00371	0.02455	0.00339	0.14165	0.000	0.00005	0.000	0.010
Gharbia Main Drain (Km 46.4)	0.01580	0.05593	0.00604	0.1410	0.000	0.00886	0.010	0.010
Ezbet El Nile Bridge	0.00425	0.00609	0.01859	0.000	0.000	0.01016	0.010	0.000

Where, the mean squared error represents the closeness of a regression line to a set of points by taking the distances from the points to the regression line (i.e. these distances are the “errors”) and squaring them. The squaring is necessary to remove any negative signs.

Table (5) represents the meteorological data of point sources that have been used as the required input data model for both winter and summer season. These results were collected from the metrological stations along the drain.

Table (5): Meteorological Data of Point Sources

		Atmospheric pressure (mb)	**Air Temp . (°C)**	**Humidity (%)**	**Solar Radiation (Short Wave Radiation) W/m2**	**Cloudiness (%)**	**Wind Speed (mph)**
Segaaya PS	**Winter**	1022	16.2	71	86.67	48	4
Sematay PS		1022	16.2	71	86.67	48	4
PS NO.5		1022	16.3	69	86.67	62	4
PS NO.6		1022	16.5	66	86.67	59	6
PS NO.4,3		1023	15.8	58	86.67	57	5
Segaaya PS	**Summer**	1011	38.2	50	268.61	21	4
Sematay PS		1011	38.2	50	268.61	21	4
PS NO.5		1011	37.2	54	268.61	23	4
PS NO.6		1011	35.7	57	268.61	16	4
PS NO.4,3		1011	36.7	52	268.61	14	5

In order to use the water quality model for the scenario input prediction, a calibration is done comparing the model output with the measured data for the year (2015/2016). The criteria with respect to the required accuracy of the simulation have been determined and the procedure for calibration continued until the error of the network reduced to the acceptable level as shown in figure (9, 10, 11, 12 and 13).

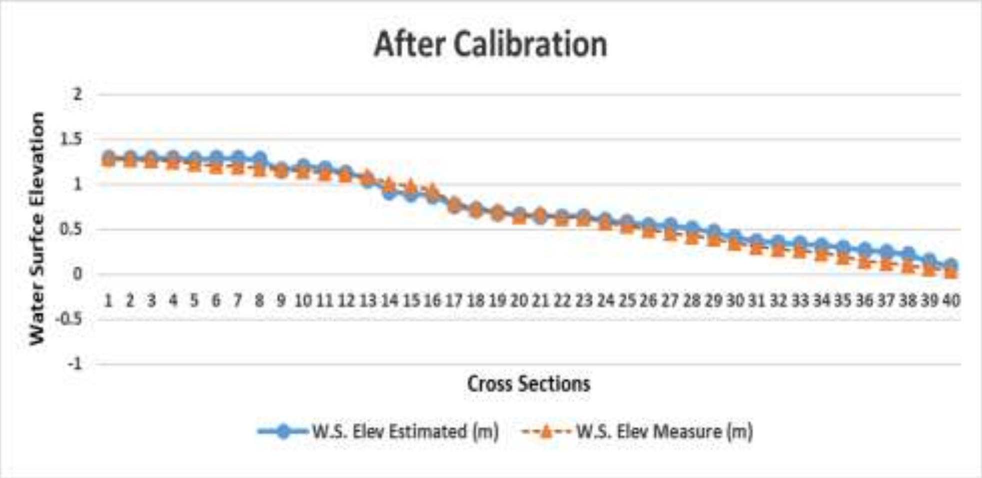

Figure (9): The Model Result for water surface elevation after Calibration

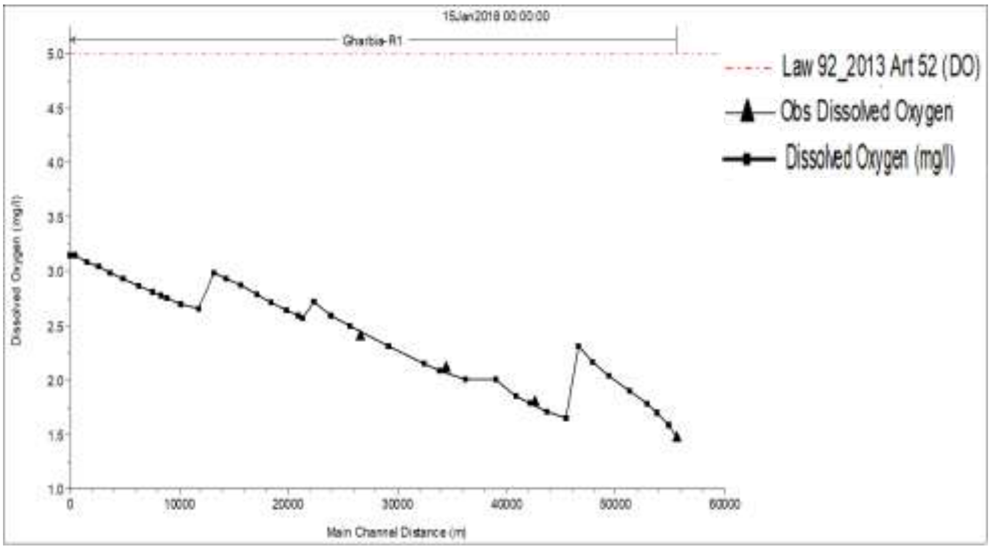

Figure (10): The Model Result for DO after Calibration

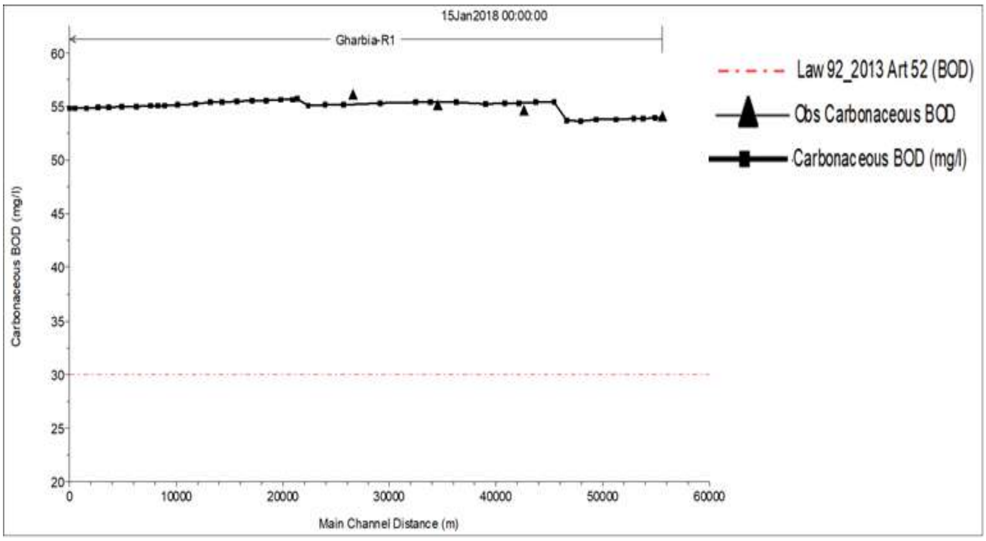

Figure (11): The Model Result for BOD after Calibration

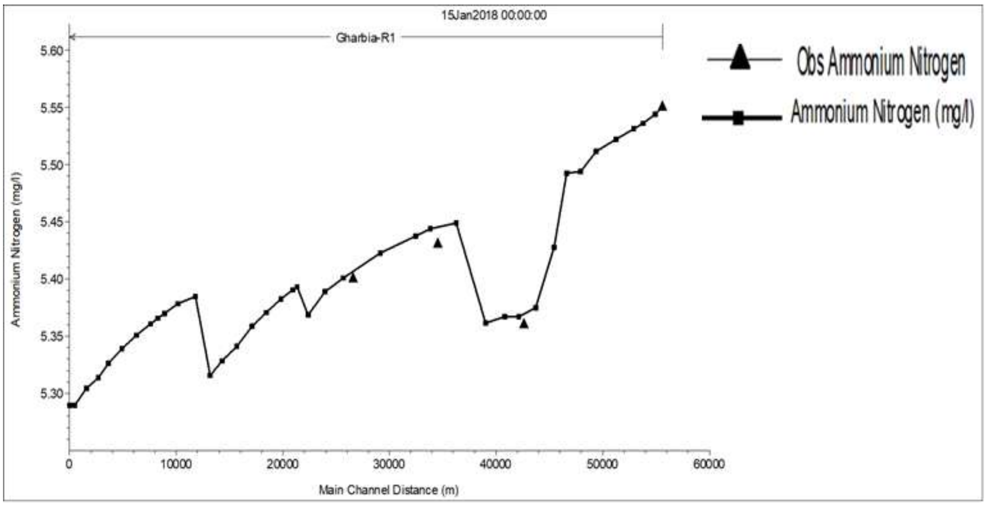

Figure (12): The Model Result for NH_4 after Calibration

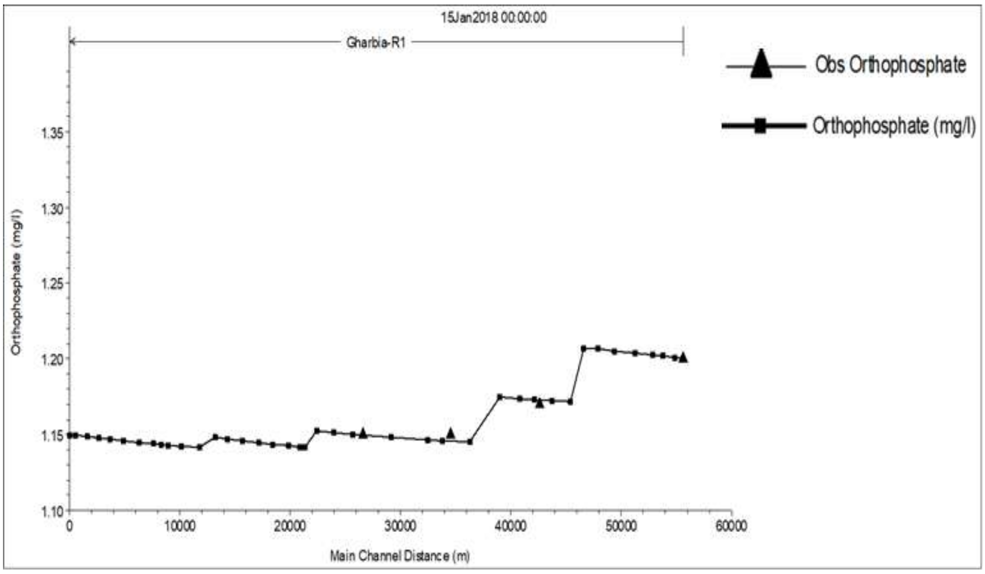

Figure (13): The Model Result for PO_4 after Calibration

The validation of the calibrated model is done by using a different set of data (2015/2016) as shown in figures (14, 15, 16, and 17).

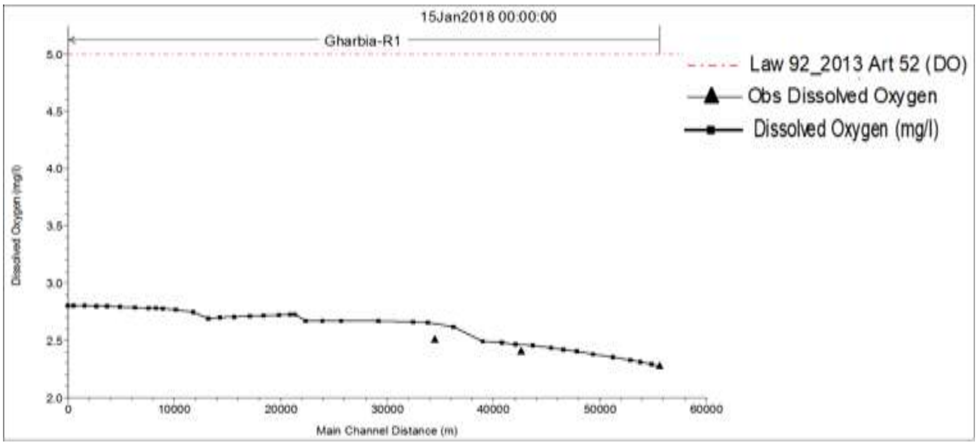

Figure (14): The Model Result for DO after Verification

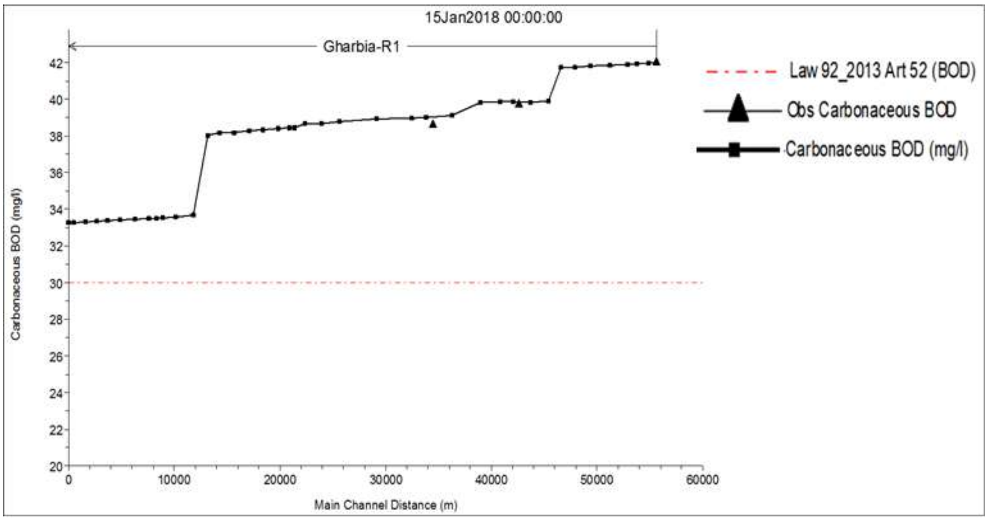

Figure (15): The Model Result for BOD after Verification

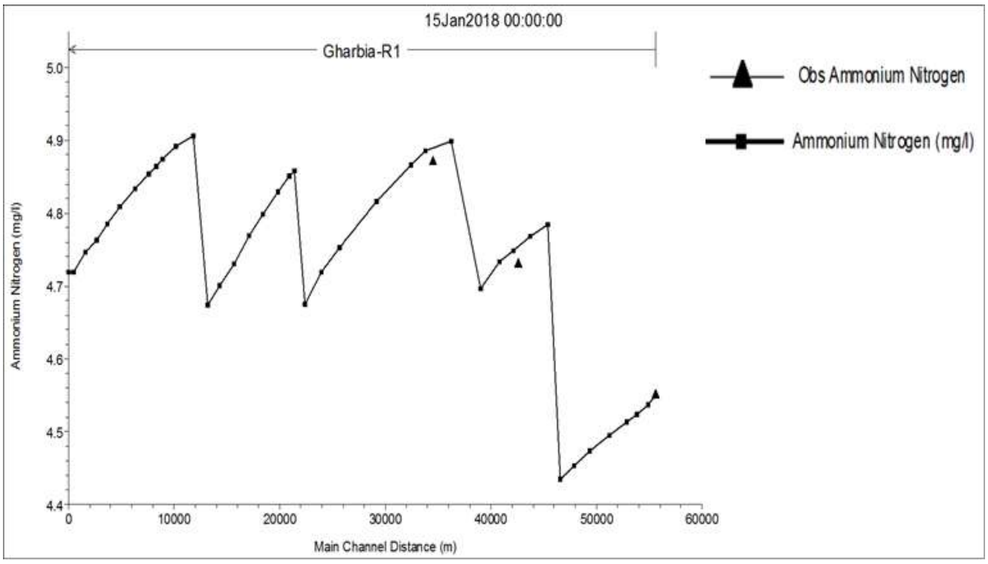

Figure (16): The Model Result for NH_4 after Verification

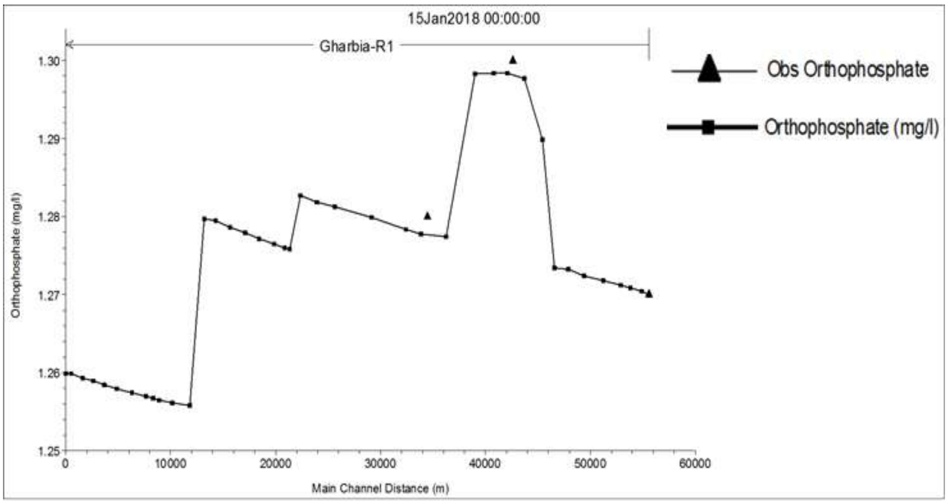

Figure (17): The Model Result for PO_4 after Verification

The model results output represented the velocity, water surface profile and total discharge along the main drain as shown in the figures (18, 19 and 20).

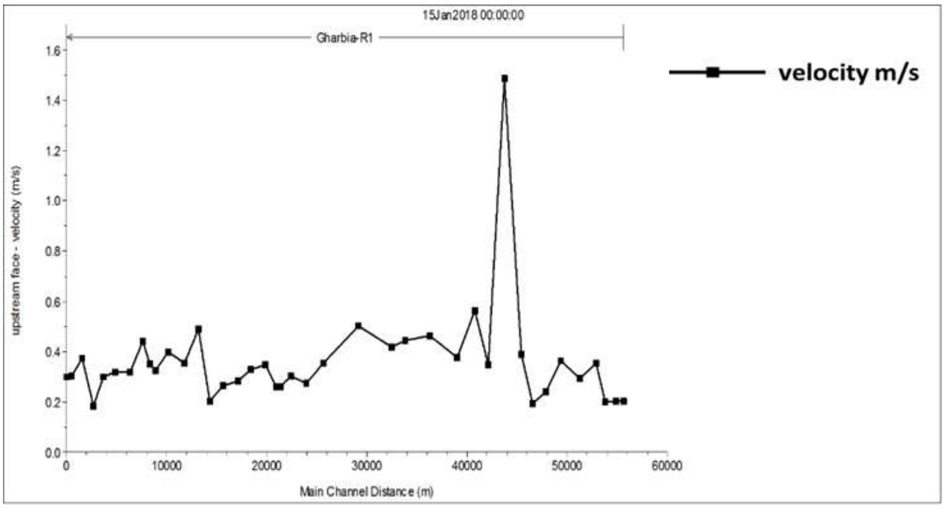

Figure (18): The Velocity along the main Drain

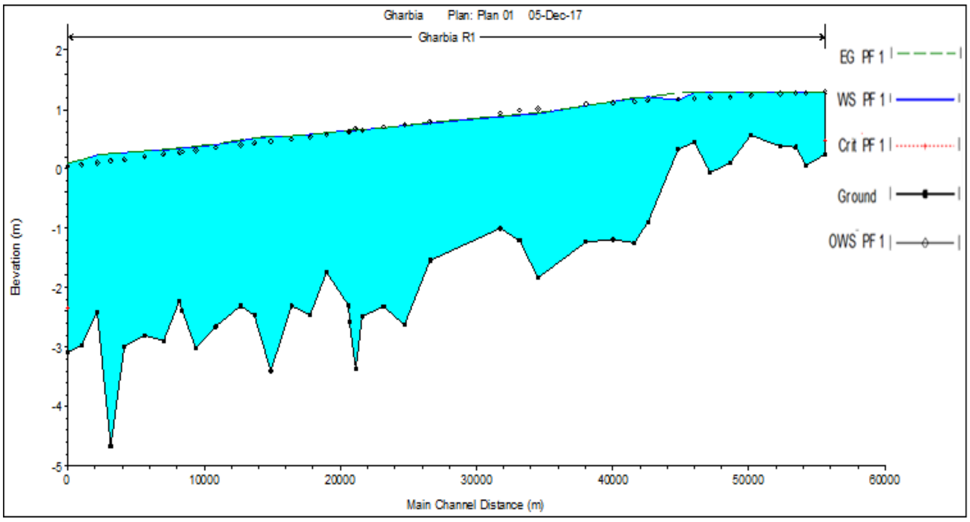

Figure (19): Water Surface Profile along the main drain

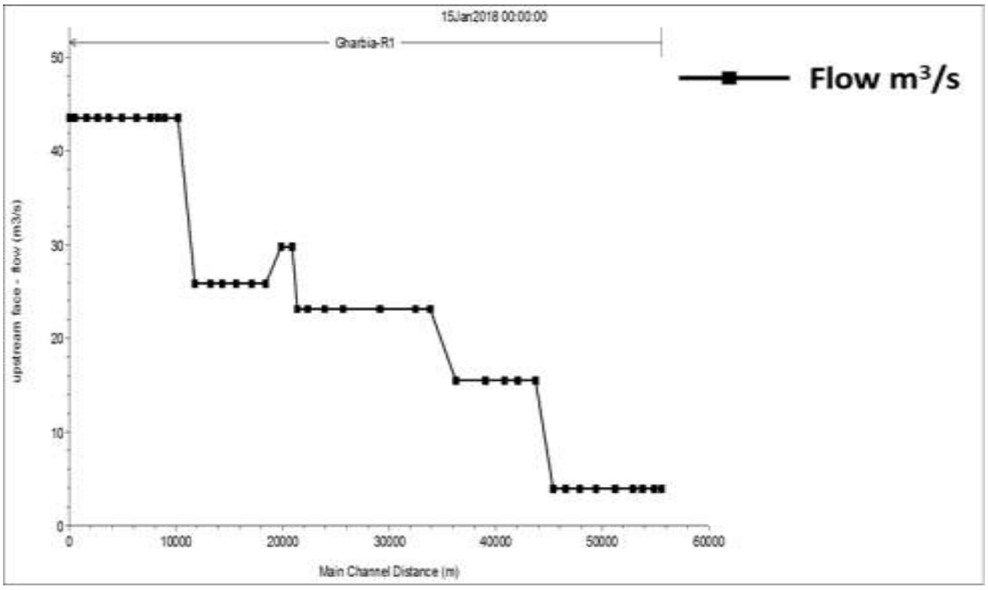

Figure (20): Total Discharge along the main drain

According to figure (18) the velocity, at Km 67.5 at the beginning of the drain, was 0.2 m/s and reached to 0.3 m/s at km12 at the end of the drain.

The highest value was recorded at km 56.8 and it was 1.49 m/sec where the lowest value was at km 15.1 and it was 0.18 m/s.

Figure (19): The water depth at Km 67.5 at the beginning of the drain was 0.24 m and reached to 3.08 at km12 at the end of the drain. The highest water depth at km15 was -4.66 m along the drain.

Figure (20): the discharge at Km 67.5 at the beginning of the drain was 3.59 m^3/s and reached to 43.52 m^3/s at km 12 at the end of the drain. The discharge has been increased at km 58 to 15.52 m^3/s due to the drain of Samatay P.S. to the drain. The discharge also increased at km 46.4 to 23.1 m^3/s due to the drain of Pump stations (5) to the drain.

The discharge increased at km 33.1 to 29.8 m^3/s due to the drain of Pump stations (6) to the drain. And the discharge decreased at km 32.6 to 25.9 m^3/s due to El-Hamol uptake from the drain, the discharge increased at the end of the drain at km 12 and reached to 543.52 due to the drain of Pump stations (3, 4).

Model Scenarios and Interventions: The six water quality scenarios are presented in figures (21, 22, 23, 24, 25, 26, 27 and 28).

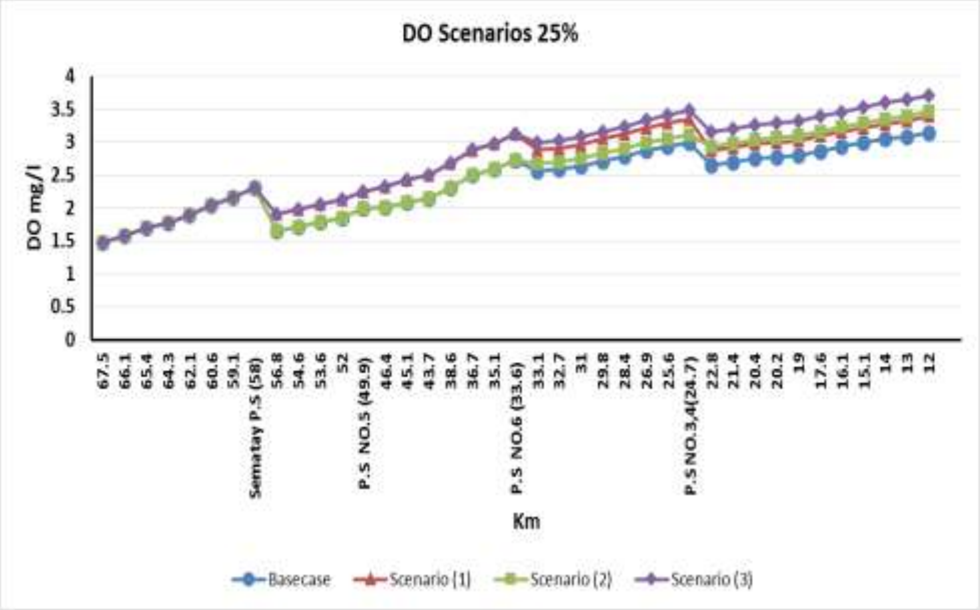

Figure (21): Dissolved Oxygen Scenarios (25%)

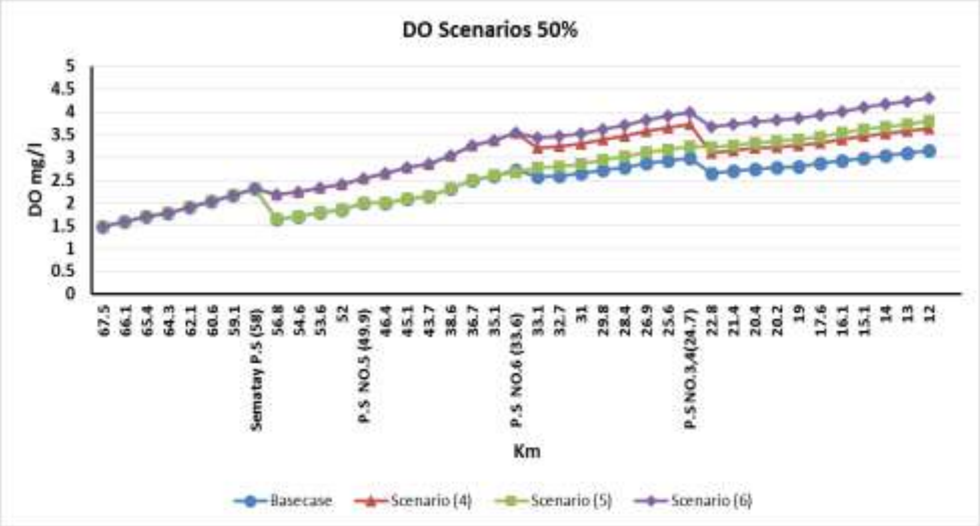

Figure (22): Dissolved Oxygen Scenarios (50%)

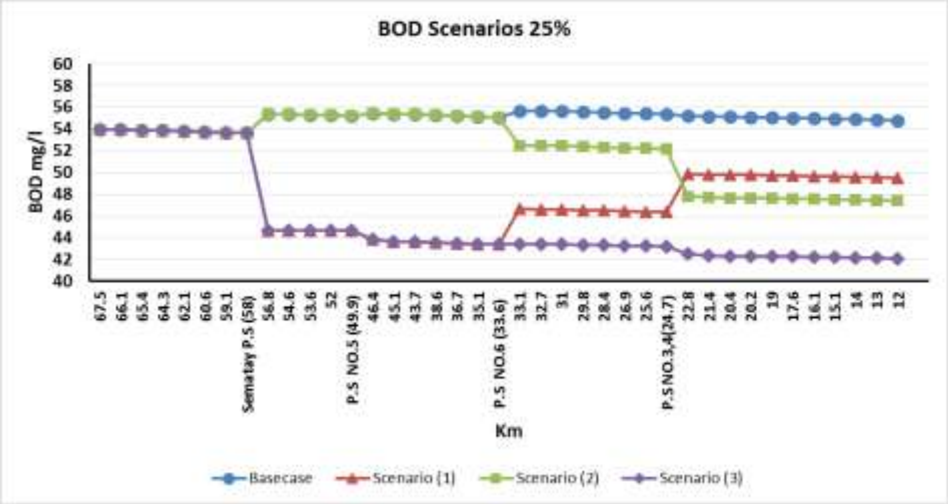

Figure (23): BOD Scenarios (25%)

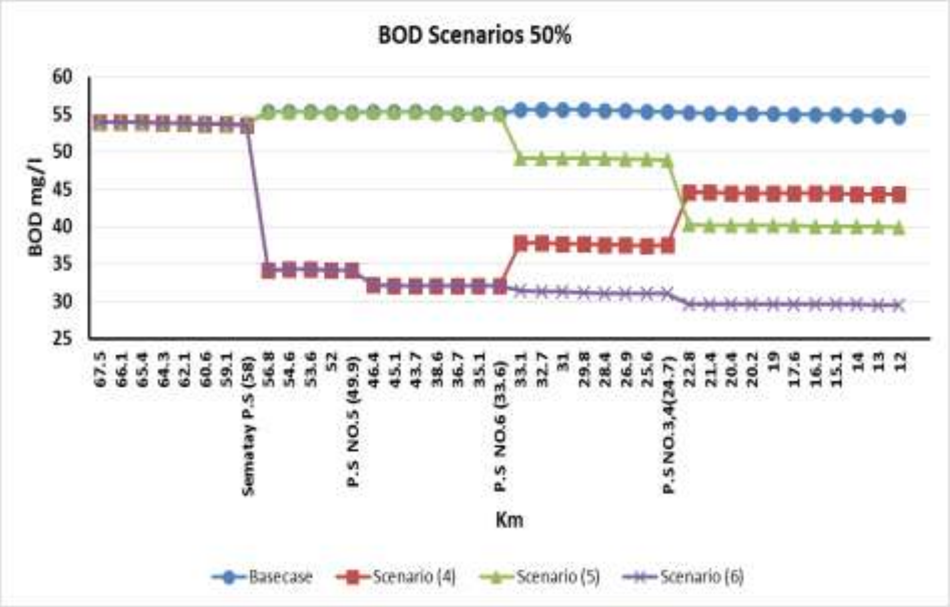

Figure (24): BOD Scenarios (50%)

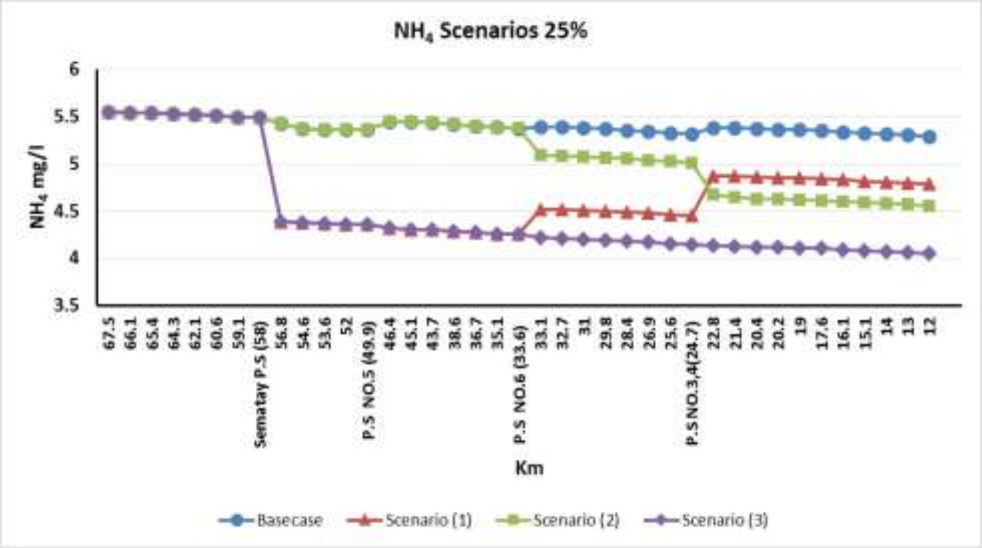

Figure (25): NH4 Scenarios (25%)

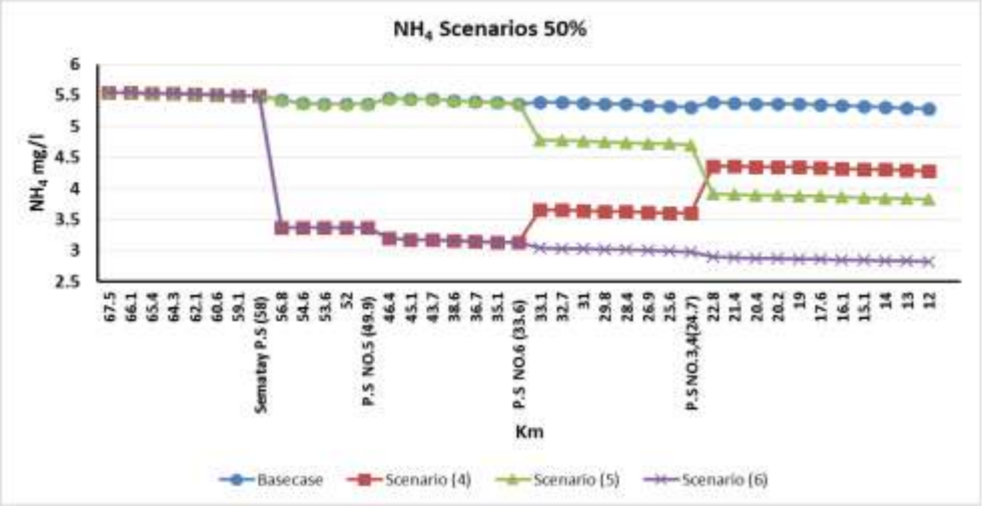

Figure (26): NH4 Scenarios (50%)

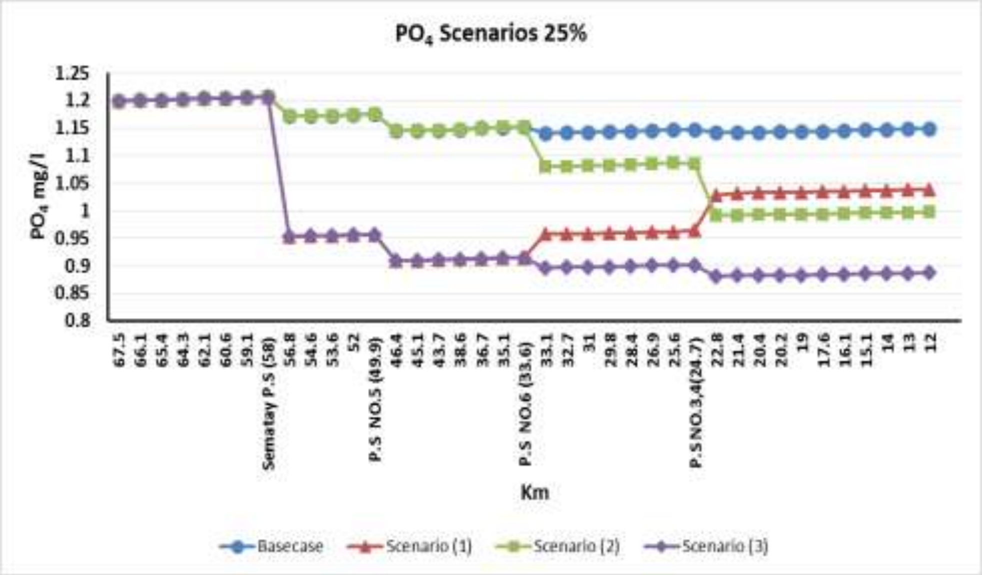

Figure (27): Ortho-Phosphate Scenarios (25%)

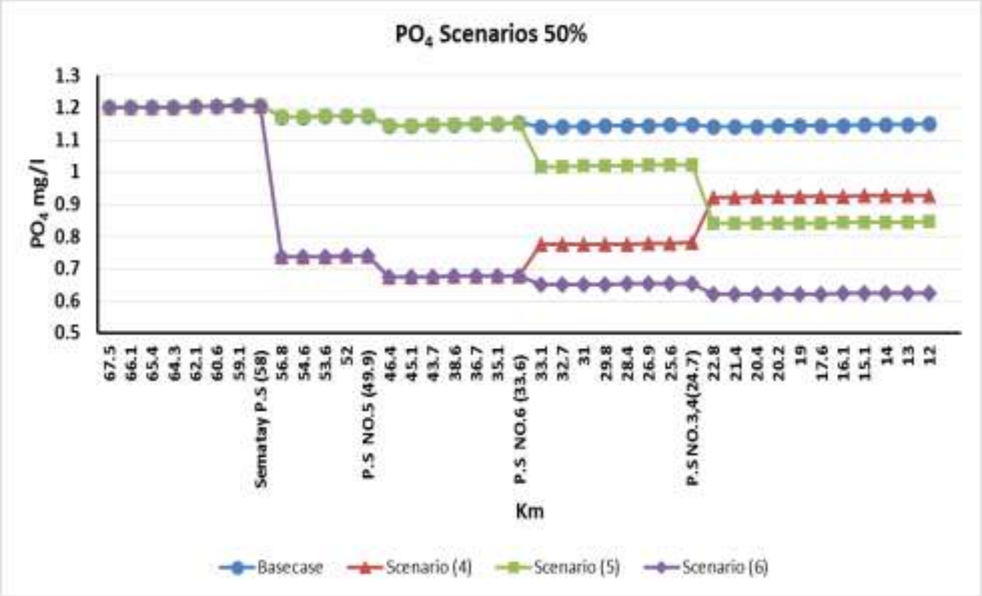

Figure (28): Ortho-Phosphate Scenarios (50%)

And the improvement ratios in different water quality parameters are presented in figures (29, 30, 31 and 32).

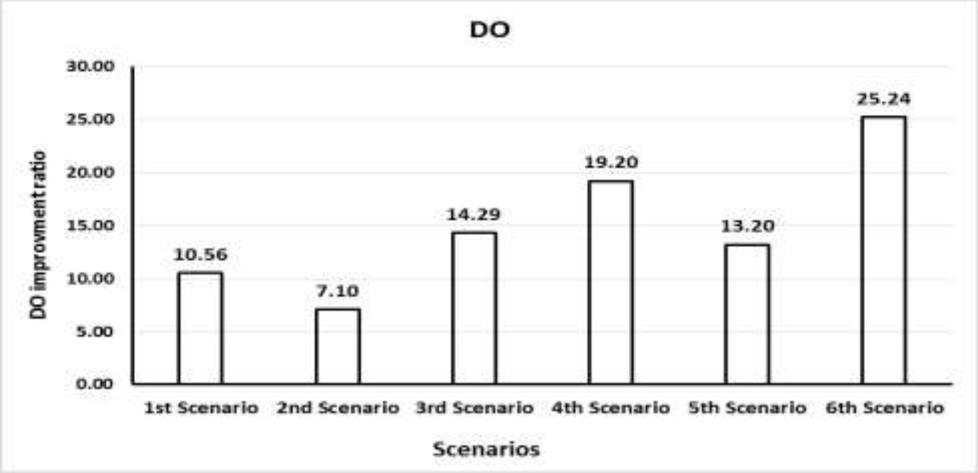

Figure (29): Improvement Ratio of DO for the six Scenarios

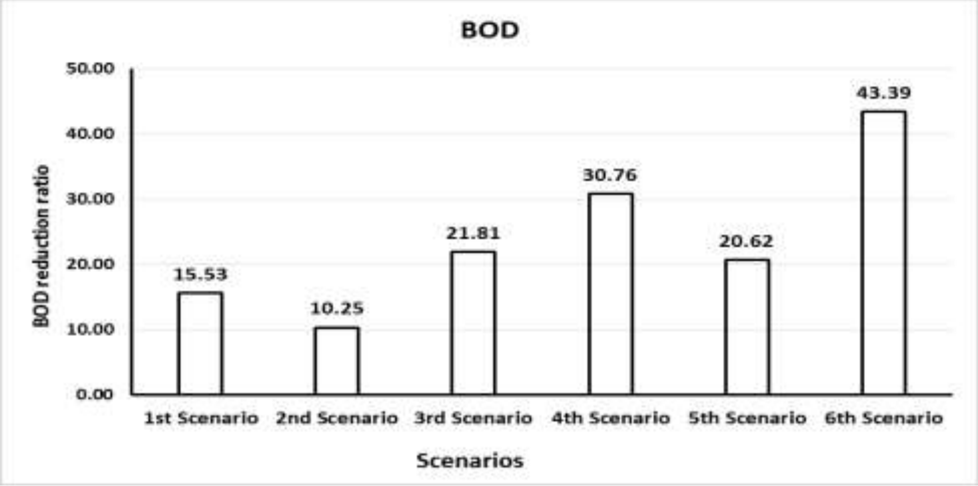

Figure (30): Improvement Ratio of BOD for the six Scenarios

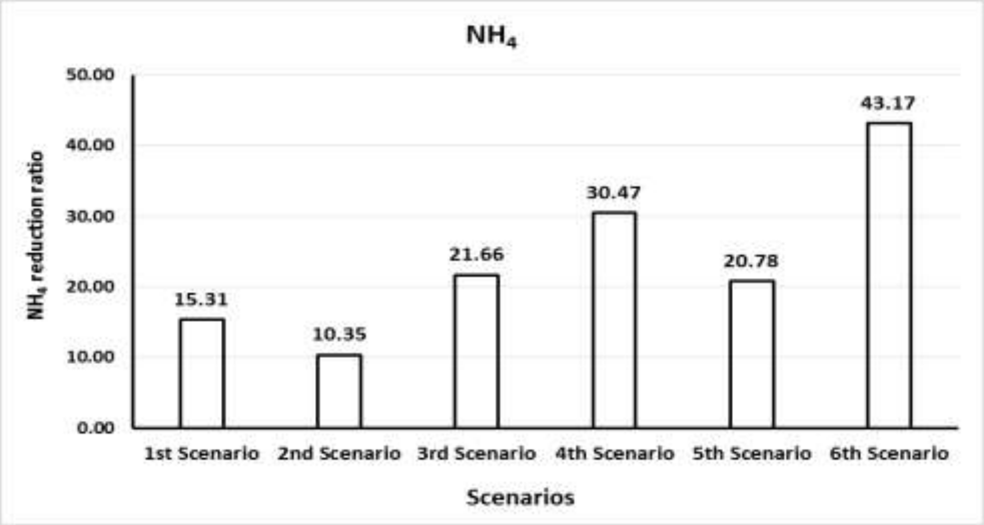

Figure (31): Improvement Ratio of NH4 for the six Scenarios

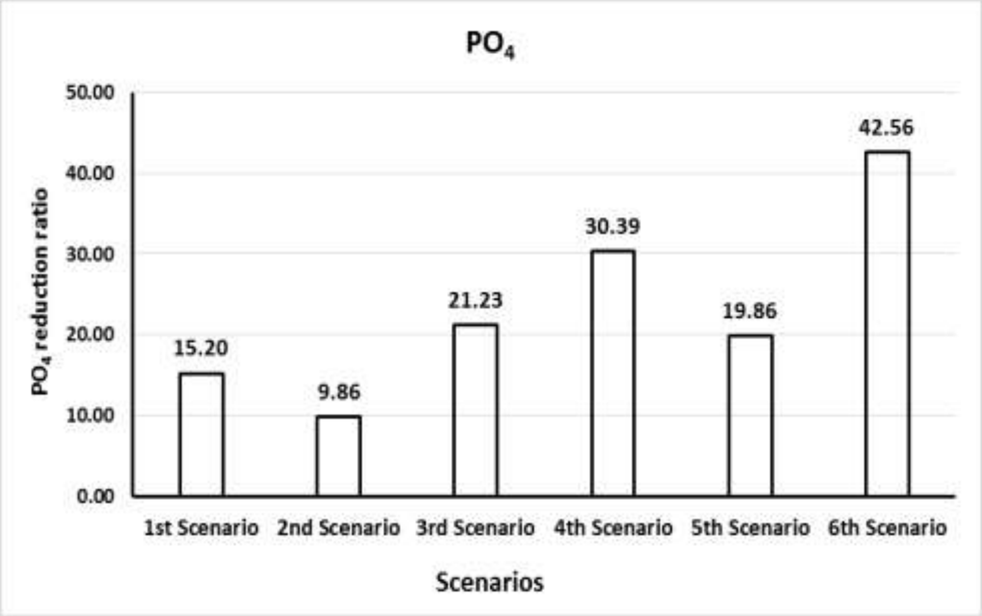

Figure (32): Improvement Ratio of PO4 for the six Scenarios

The First scenario: is the improvement of the treatment of treatment plants at Samatay and Pump stations (5) catchments thus assumed improving the water quality at the point sourse by 25%. The following changes have been occurred from Samatay pumps station to km (12) of the drain:

- Increase in oxygen concentrations by 7-14 %.
- BOD and nitrate concentrations decrease by 9-21 %.
- The decrease in the concentrations of organic nitrogen, ammonia, organic phosphorus and orthophosphate by 9-20 %.
- Decreased in the nitrite concentrations by 10-17 %.

The Second scenario: is the improvement of treatment of the wastewater stations that are in the catchment of stations 4, 3, 6, which assumed in improving water quality at these point sources by 25%. The following changes occurred from the (6) pump station to km (12) of the drain:

- Increase in oxygen concentrations by 3-9 %.
- BOD, Organic Nitrogen, Ammonia, Nitrate, Organic Phosphorus and Orthophosphate concentrations decreased by 5-13 %.
- Nitrite concentration decrease by 2-8 %.

The Third scenario: is improving the treatment of the wastewater plants that are in the catchment of Samatay, (5, 6, 3 and 4) Pump stations, which assumed to improve water quality at these point sources by 25%. The following changes occurred from Samatay pumps station to km (12) of the drain:

- Increase in oxygen concentrations by 10-15 %.
- Decreasing in the BOD and nitrate concentrations by 19-23 %.

- The decrease in the concentrations of organic nitrogen, ammonia and organic phosphorus by 18-23 %.
- The decreasing in nitrite concentrations by 16-19 %.
- The reduction of orthophosphate concentrations by 18-22 %.

The Fourth scenario: is the Improving the treatment of the wastewater plants that are in the catchment of Samatay and Pump stations (5), which assumed in improving the water quality of these point sources by 50%. The following changes occurred from Samatay pumps station to km (12) of the drain:

- Increasing in oxygen concentrations by 13-15 %.
- BOD concentrations decreased by 19-42 %.
- Decrease in the concentrations of organic nitrogen, ammonia and organic phosphorus by 11-27 %.
- Nitrite concentrations decrease by 5-17 %.
- Nitrate concentrations decreases by 11- 26 %.
- The decrease in orthophosphate concentrations by 10-26 %.

The Fifth scenario: is the improvement of the treatment of the wastewater stations that are in the reach of stations (6, 3, 4), which assumed improve the water quality at these point sources by 50%.

The following changes occurred from the (6) pump station to km (12) the drain:

- Increasing in oxygen concentrations by 7-17 %.
- BOD concentrations decreased by 18-27 %.

- Decrease in the concentrations of organic nitrogen, ammonia and organic phosphorus by 11-27 %.
- Nitrite concentrations decrease by 5-17 %.
- Nitrate concentrations decreases by 11-26 %.
- The decrease in orthophosphate concentrations by 10-26 %.

The Sixth scenario: is the improvement of the treatment of the wastewater plants that are in the catchment of Samatay, pump Stations (5, 6, 3 and 4), the assumed improvement of the water quality at these point sources by 50%. The following changes occurred from Samatay pump station to kilo (12) of the drain:

- Increasing in oxygen concentrations by 20-27 %.
- BOD concentrations decrease by 38-46 %.
- Decreased organic nitrogen concentrations by 36-46 %.
- Ammonia concentrations decreased by 37-46 %.
- Nitrite concentrations decreased by 33-41 %.
- Nitrate concentrations decreases by 38-46 %.
- Decreases the concentrations of organic phosphorus by 37-46 %.
- The reduction of orthophosphate concentrations by 37-45 %.

The results indicate that the sixth scenario in which 50% improvement in water quality of the point sources of samatay & P.S. 3,4,5,6 wastewater treatment plants is the best scenario followed by the fourth (enhancement in the wastewater plants that are in the reach of Samatay and (5) Pump stations, which results in improving the water quality at these stations by 50%). And fifth scenario which proposes the enhancement in the wastewater treatment plants that are in the catchment of stations (6, 3, 4) has been improved the water quality by 50%. The implementation of these scenarios depends mainly on the provision of financial allocations.

RECOMMENDATIONS

It is recommended to apply similar study that can be conducted by using two or three-dimensional models in order to facilitate reliable comparison with the current study. Also providing researchers with more accurate data in terms of bathymetric and water quality data will result in better simulation with more understanding the water pollution factors. In this study, the impact of one water quality parameter each time was investigated; therefore, combination of different water quality parameters can be used in the assessment of factors affecting the water quality simulation.

REFERENCES

APHA (American Public Health Association) 1999: Standard methods for the examination of water and wastewater. 20th Ed.

DRI. (Drainage Research Institute) 1995: Reuse of drainage water in the Nile Delta: monitoring, modelling and analysis. Reuse Report No. 50. Cairo, Drainage Research Institute and Wageningen, the Netherlands, DLO Winand Staring Centre.

DRI. (Drainage Research Institute) 1997a: Drainage water in the Nile Delta: Yearbook 1995/96. Reuse monitoring programme, Report No. 41. Cairo, Drainage Research Institute.

DRI. (Drainage Research Institute) 1997b: Drainage water irrigation project. Final report. Cairo, Drainage Research Institute, Louis Berger International, Inc. and Pacer Consultants.

DRI (Drainage Research Institute) 2000: Monitoring and Analysis of Drainage Water Quality Project, Drainage Water Status in the Nile Delta Yearbook 97/98. Technical Report No. 52.

NWRP. (National Water Resources Plan) 2005: Water for Future, 2017. Planning Sector, Ministry of Water Resources and Irrigation, Egypt.

William, L. Luyben (1996): Process Modeling, Simulation, and Control for Chemical Engineers International Edition.

تقويم نوعية مياه مصرف الغربيه لزيادة الإستفاده منها

[٥]

هانى أحمد الشربينى(١)**– هشام إبراهيم القصاص**(٢)**– أيمن محمد خليل السعدى**(١)

١) معهد بحوث الصرف، المركز القومى لبحوث المياه، وزارة الموارد المائية والرى ٢) معهد الدراسات والبحوث البيئية، جامعة عين شمس

المستخلص

تعتبر مراقبة نوعية المياه من القضايا الرئيسية بالنسبة لمصر حيث تختلف حدة مشكلات جودة نوعية المياه الحالية بين مختلف المجارى المائية. وتعد عملية إدارة نوعية المياه لمصرف الغربية من القضايا الهامة لضمان ملائمة مياه الصرف الزراعى لإعادة استخدامها في الري. وقد تم تقييم مياه المصرف بشكل كبير باستخدام نموذج محاكاة نوعية المياه (HEC-RAS). وقد اشتملت أنشطة الدراسة على القياسات الحقلية، التحاليل المعملية وتفسير البيانات وذلك لعناصر نوعية المياه المختلفة مثل الأكسجين الحيوى (BOD)، الأكسجين الذائب (DO)، النيتروجين الكلي، النيتروجين العضوي، الأمونيا، النترات، النتريت، الفوسفور الكلي، الفوسفور العضوي والأرثوفوسفات. وقد تم تحديد حمل الملوث المحسوب وذلك لتحديد المصادر التي لها التأثير الأكثر سلبية على جودة نوعية المياه بالمصرف وتم وضع ستة سيناريوهات مختلفة لتحسين جودة نوعية المياه بنسبة ٢٥٪ و٥٠٪ باستخدام نموذج (HEC-RAS).

وقد أشارت النتائج إلى أن السيناريو السادس تتحسن فيه نوعية المياه عند محطة سماتاى ومحطات طلمبات رقم ٣ و٤ و٥ و٦ هو أفضل سيناريو يليه السيناريو الرابع الذي يقترح تحسين جودة نوعية المياه عند محطة طلمبات سماتاى ومحطة طلمبات (٥). ثم السيناريو الخامس الذي يقترح تحسين جودة نوعية المياه عند محطات طلمبات رقم (٦، ٣، ٤).