Modeling the Effect of Sea Water Intrusion into Shatt Al-Arab River (Iraq)

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Abstract

Recently, the Shatt Al-Arab River (SAAR) in Basra/ south of Iraq, have suffered from high amounts of Total Dissolved Solids (TDS) in the water that is due to reducing the incoming fresh water from the sources which caused the salinity intrusion into the SAAR. The objective of this study is to track the seawater propagation from the Arabian Gulf into SAAR. One-dimensional transport model using HEC-RAS 5.0.5 has been used to making knowledge of the dynamics of TDS into the SAAR. Four cases were taken to estimate the salinity intrusion into the SAAR which were, the low and high discharge that equal to 29 m^3/s and 103 m^3/s which released from Qalat Saleh regulator with high and low tide. It is seen that if the flow is high, the TDS values were between 3000- 4000 mg/l in the case of lowest low tide and highest high respectively, and if the flow is low, the TDS between 1000- 2000 mg/l reach 150 km from the mouth in the case of lowest low tide and highest high respectively. It can be conclude that an increase of the incoming freshwater discharge to 103 m^3/s, will lead to prevents the salinity intrusion towards the center of Basrah city, for both low and high tide.The obtained results show good describtion for the TDS variation from the sea towards the upstream of the SAAR. The model allows the immediate estimation of TDS propagation towards SAAR and can help to ensure the safe water supply to the province.

Keywords: Simulation; Seawater intrusion; Hec-Ras; Shatt Al-Arab River; TDS Variation

1. Introduction

The Rivers that are connected with sea water are affected by two energies; the first is the discharge of the fresh water that flows from lands and the second is the phenomenon of tides coming from the sea. Freshwater flows into the sea when the discharge is large; otherwise, the saltwater penetrates into the River causing a change in the quality of the River especially in the downstream area[1]. Where this area is subject to the influence of seawater more than the freshwater. Moreover, the tidal range and the difference in the densities between the River and the sea could be affected by the freshwater and the phenomena of salinity intrusion [2].

The modeling is considered as one of most common methods that are used in the management of water resources, through the organization of all information that available and used it in an organizer manner leads to finding the real causes affecting the changes of the quality of water sources [3]. Mathematical modeling by using a numerical model of salinity intrusion is considered a costly and takes a long time so most of the researchers tend to used empirical models; therefore there are few studies using simulation by employing computer software to find out TDS distribution along SAAR [4].

Numerical model was used by the Mike II software to study the water quality of the SAAR the (Total Dissolved Solid, Dissolved Oxygen, Total Suspended Solid), a value of 50 m3/sec and 250 m3/sec discharge were used to explore the impact of low and high discharge of river on water quality of the River [5]. A one dimensional, unsteady hydrodynamics model coupled with salinity model were solved numerically by using the explicit finite difference method, with the aid of computer program to simulate the flow and the salinity concentration[6]. Tidal excursion was simulated analytically using 1-D analytical salt intrusion model with the equations of tidal mixing, the model was applied under different river conditions to analyze the seasonal variability of salinity distribution during wet and dry periods during the period extended from March 2014 up to January 2015 for the SAAR [8]. Salinity intrusion using four imperial model with the aid of a computer model was done in the SAAR, the computer model was used to calculate the length of salinity penetration into the River using five different cases of discharge [9]. Longitudinal and vertical salinity measurements were used to predict the extent of seawater intrusion into the SAAR, descriptive analysis with an empirical measurements to determine the TDS and it's relation with the discharge in SAAR estuary [10, 11].

The objective of this study is to give an idea of the increase of TDS values in SAAR due to incoming seawater during the year of 2018 that is due to the crisis of the rise of TDS in the SAAR (especially in the summer season) because of the reduction of freshwater River discharges at the upstream, where there is rare models used to solve this phenomenon in SAAR.

2. Area of Study

The length of the SAAR is about 198 km, starting from the confluence of Euphrates with Tigris rivers to the estuary where it discharges into the Arabian Gulf [12]. The width of the river is varies over its course from about 250-300 m near the Euphrates-Tigris confluence to about 600 m near the center of Basrah city and about 2000 m at the River mouth into the Arabian Gulf [13].

In terms of the geographical setting, an area of 145.190 km2 drains directly to the SAAR region downstream of the Tigris and Euphrates confluence. Several tributaries discharged to the SAAR during its course which is, Al-Sweeb River, Garmah Ali River, Karkheh River, and Karun River. At present, these contributions have been reduced as a result of the policies of the neighboring countries by establishing many dams, that caused a very high increase of the TDS in SAAR due to the effect of Arabian Gulf [11].

In the past, when the discharges of both of the Karkheh and Karun Rivers were found, the seawater intrusion towards the river may reach the distance of a few kilometers upstream of the estuary but not farther than Al Siba city, i.e. south of Basrah city [6]. However, in recent years, the high TDS value approaches to Al- Qurna city (i.e., north of Basrah city) [7]. Therefore the study area in the conducted research was extended from the mouth of the River until Qalat Saleh regulator that is located in the north of Qurna city, i.e. north of Basrah city (See Fig.1).

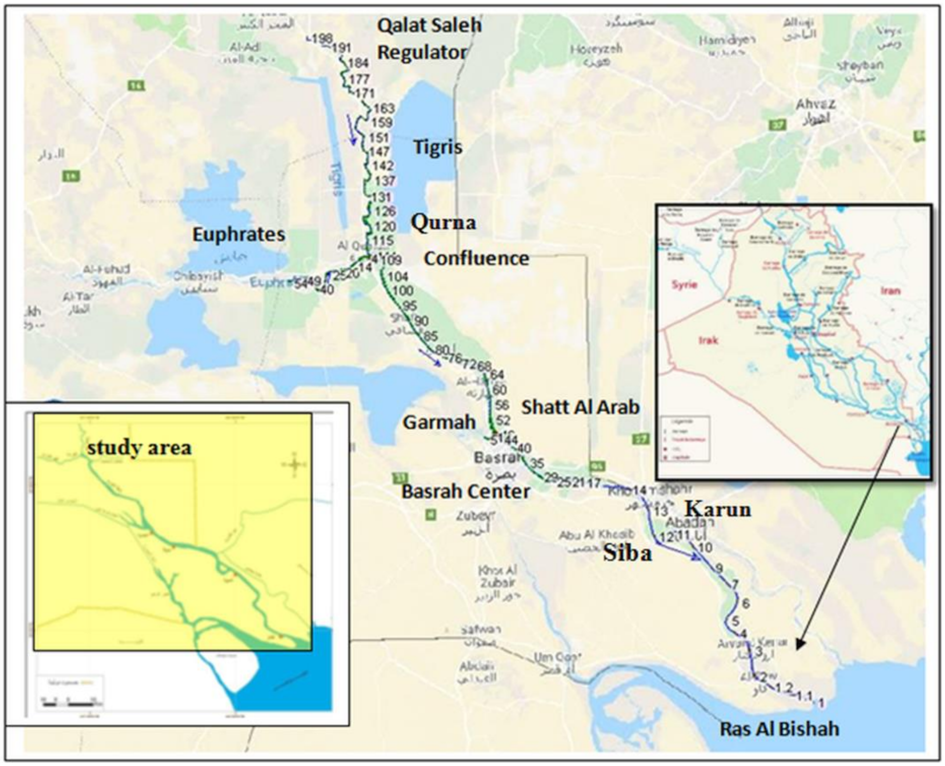

Figure 1. Schematic Diagram of the Area of Study

3. Data And Methods

The practical measurements of the River cross-sections; the intervals between sections; the freshwater discharge, the stages, and the TDS were done in the year of 2018 in different locations along the River[14].

A numerical model of finite-difference was used to simulate the tidal flow by the aids of Hec-Ras software. The River was subdivided into four reaches which were Tigris; Euphrates; SAAR and Garmah Rivers (see Fig.1).

The origin was taken near to the estuary in Ras Al Bishah region south of Basrah city. The simulation was done for 10 months of operation program, an implicit finite difference scheme was used to represent the model. The methodology is based on the practical data which were measured by the water resources directorate staff along the year.

4. Mathematical Formulation

4.1 Hec-Ras Model

The Hydrologic Engineering Centre River Analysis System (HEC-RAS 5.0.5) model was used in this study [15]. The model is to exam the spatial changes of TDS in the SAAR and its estuary. Daily measurements of TDS and discharge were measured in different stations along the river whereas the stages were measured hourly [16].

A one-dimensional unsteady water quality model HEC-RAS has been used to simulate TDS distribution. The simulation of the hydrodynamic system of the SAAR has been performed.

The outputs of the transport model were the data of TDS variation from upstream to downstream of SAAR at various hydrodynamic conditions. The model can identify the location that the seawater can be effective in the River at the year of 2018.

Where, this year was the extremely arid year, which the flow rate that is released from Qalat Saleh regulator has recorded the lowest values, wherase, the TDS was recorded the highest values. Therefore, these conditions have caused a crisis in potable water to the people who live in Basrah city because most of the water treatment plants were located along the SAAR.

4.2 Hydraulic Model

The equations for the hydrodynamic simulation of surface water flow are shallow water equations in which the Z-direction component of the velocity (w) is assumed to equal zero and the variables can be vertically integrated [17].

The depth-averaged equations of shallow water are :

Continuity equation:

$$\frac{\partial h}{\partial t}+\frac{\partial (hu)}{\partial x}+\frac{\partial (hv)}{\partial y}=0 \qquad (1)$$

Momentum equations:

$$\frac{\partial (hu)}{\partial t}+\frac{\partial (hu^2)}{\partial x}+\frac{\partial (huv)}{\partial y}=-hg\frac{\partial Z}{\partial x}+\frac{\tau_{xx}}{\rho}+F_x \qquad (2)$$

$$\frac{\partial (hv)}{\partial t}+\frac{\partial (huv)}{\partial x}+\frac{\partial (hv^2)}{\partial y}=-gh\frac{\partial Z}{\partial y}+\frac{\tau_{yy}}{\rho}+F_y \qquad (3)$$

The turbulent stresses τij were calculated with the classical k-ε turbulence model that are utilizing the eddy viscosity.

$$\tau_{ij}=\nu_t\left(\frac{\partial u_i}{\partial x_j}\right)=\frac{Ck^2}{\varepsilon}\left(\frac{\partial u_i}{\partial x_j}\right) \qquad (4)$$

4.3 Transport Model

The water quality modeling is always applied as an additional tool for water quality management [18]. The model of TDS variation was achieved using the water quality model included in HEC-RAS. It is based on the one-dimensional transport equation [15]:

$$\frac{\partial h}{\partial t}+\frac{\partial (hu)}{\partial x}+\frac{\partial (hv)}{\partial y}=0 \qquad (5)$$

$$\frac{\partial AC}{\partial t}+\frac{\partial VAC}{\partial X}=\frac{\partial}{\partial X}\left[DxA\ \frac{\partial C}{\partial X}\right] \qquad (6)$$

Where, C is TDS concentration, mg/l; Dx is the longitudinal dispersion coefficient in (m2/s); V is flow velocity in (m/s).

The dispersion coefficient was calculated using the Kashefipour–Falconer equation [19]:

$$Dx= 10.612\ h\ U\left(\frac{U}{U*}\right) \qquad (7)$$

Where U* is a shear velocity, U is a cross-sectional average velocity, h is a depth.

4.4 The Schematic of River System

The schema of the River system consists of four River reaches, as shown in Fig.1. These reaches included: about 196 km of SAAR from the confluence at Al-Qurnah district to the estuary near to Ras Al-Bishah region; about 28 Km of Euphrates River; about 90 Km of Tigris River from the confluence to Qalat Saleh regulator and about 3 km of Garmah River. Therefore, the total length of the River reaches in the area under study is about 317 Km. The total length of the main channel from Qalat Saleh regulator (i. e. station 198) to the estuary (i.e. station 1) is about 286 km (see Fig.1).

4.5 The Boundary Conditions

In this study, the upstream boundary conditions were the daily flow discharges from Tigris River that are released from Qalat Saleh regulator at cross-section (198), as shown in Fig.1. The discharge from Euphrates and Garmah Rivers are considered zero because of the construction of the dams at these Rivers to prevent the waters of these Rivers to discharges into the SAAR. On the other hand, the boundary conditions at the downstream were the hourly water stages and daily TDS of SAAR at section (1) which is nearby to Ras Al Bishah region. The upstream and downstream boundary conditions are taken for 10 months which have extended from 01 January 2018 to 30 October 2018.

4.5.1 The Upstream Boundary Condition

As explained previously, the main source of the incoming discharge to the SAAR is the Tigris River, which is released from Qalat Saleh regulator. The daily discharge of the Tigris River for the period 1-January 2018 to 30- October 2018, was used to represent the upstream boundary condition as shown in Fig.2.

The maximum discharge for the SAAR at section (198) that is released from Qalat Saleh regulator, was 103 m3/s which was measured in 20 September 2018 and minimum discharge was 29 m3/s which was measured in 13 February 2018. In this unsteady flow simulation model, the values of Manning's roughness coefficient (n) for the main channel of SAAR was 0.033 and 0.06 for banks [20], the result of Hec- Ras model show that the values of (n) give the closest agreement between simulated and observed computed hydrograph.

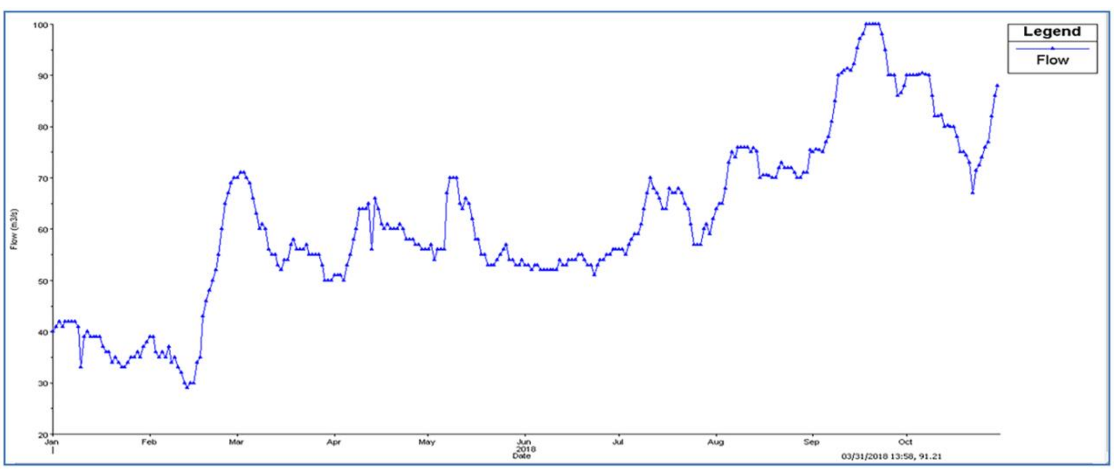

Figure 2. The Daily Measurements of Discharge (Upstream Boundary Condition)[14]

4.5.2 The Downstream Boundary Condition

The hourly water stages of SAAR at cross-section (1) which is nearby Ras Al Bishah region was adopted as a downstream boundary condition. The downstream boundary conditions were taken for 10 months which have extended from 01 January 2018 to 30 October 2018, as shown in Fig.3.

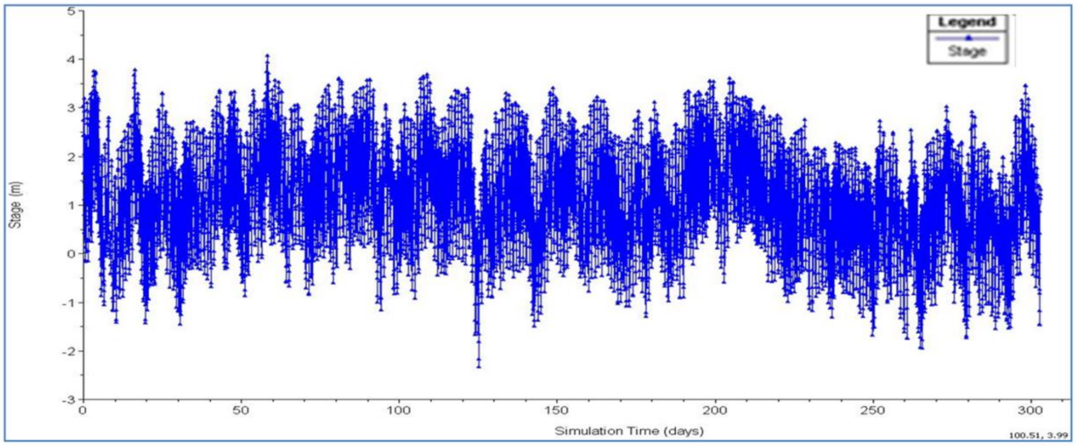

Figure 3. The Hourly Measurements of Stages (Downstream Boundary Condition)[14]

4.5.3 The Tds Boundary Conditions

The data of TDS were taken for the period extended from 1 January 2018 to 30 October 2018 in different stations. Section (198) in Tigris River has been considered as a location of upstream boundary condition at Qalat Saleh regulator, see Fig.4. Section (1) near to Ras Al- Bishah region was considered as a location of the downstream boundary condition, see Fig.5. The data of the dispersion coefficient of the hydraulic model were found between 25 to 500 m2/s [21]. Finally, the adopted value of the dispersion coefficient was equal to 78 m2/s because it gives the closest agreement between simulated and observed TDS graph.

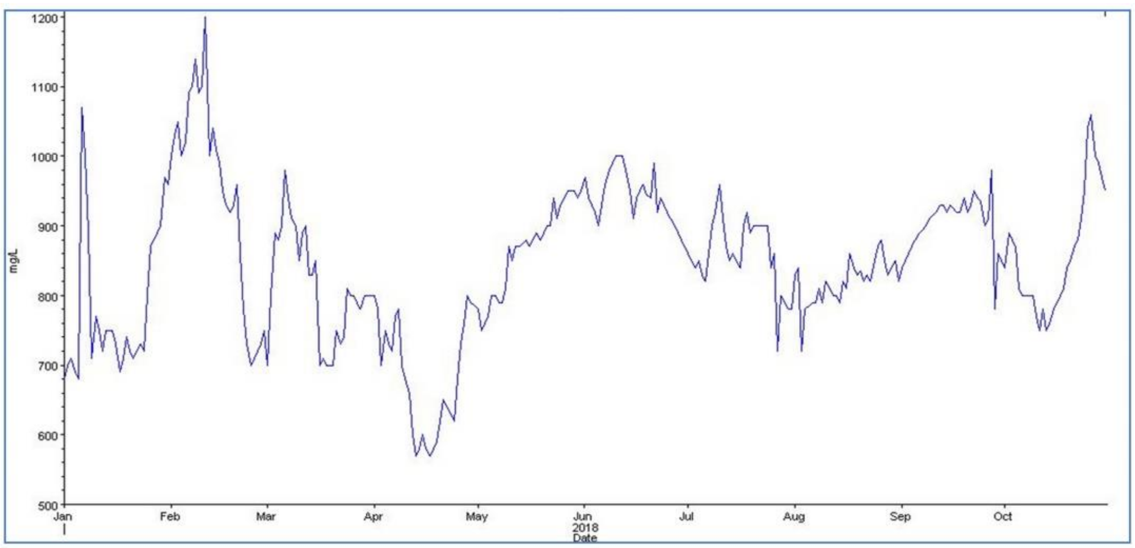

Figure 4. The Daily TDS Measurements at Station 198[14]

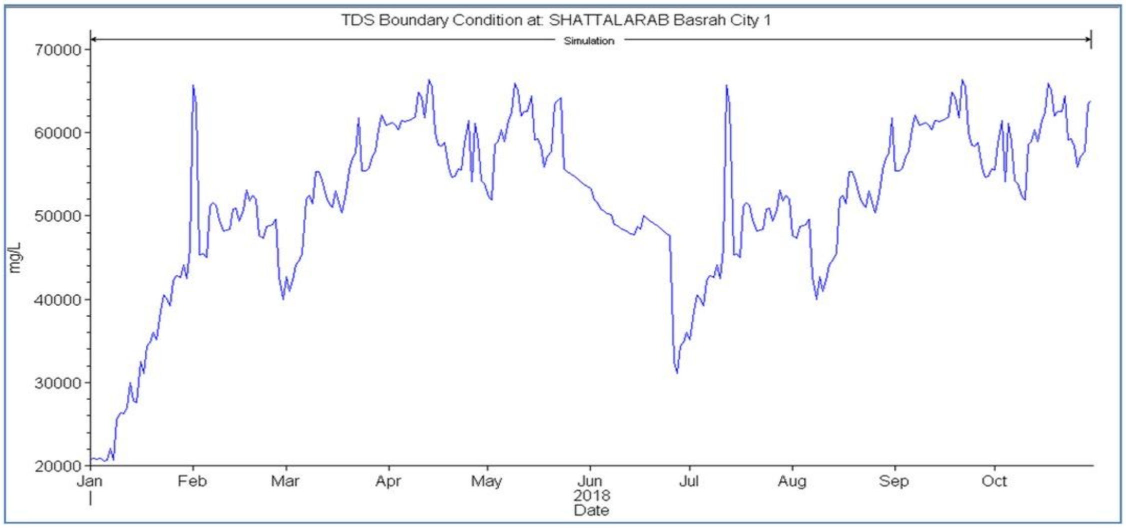

Figure 5. The Daily TDS Measurements at Station 1[14]

4.6 The Investigated Sections

Four sections were adopted to investigate the TDS variation into the River, which were, Section (17) about 106 km from the mouth; Section (35) about 123 km from the mouth; Section (44) about 132 km from the mouth and section (60) about 150 km from the mouth (see Fig.6).

Figure 6. The Investigation Sections in the SAAR

5 Results and Discussion

The model started from upstream at the section (198) (at Tigris river), and it finished at the downstream at section (1) (in SAAR estuary near to Ras Al –Bishah region), during 10 months records of the daily discharge and the TDS values in section (198), the hourly measured stages and the daily TDS values in the section (1) were taken as boundary conditions to the hydrodynamic and transport model.

5.1 The Hydrodynamic Model

After giving all the input parameters to the software for the computation, the output in terms of graphs was obtained including the profile for the water level in the case of maximum water level as shown in Fig. 7 for SAAR and Tigris River.

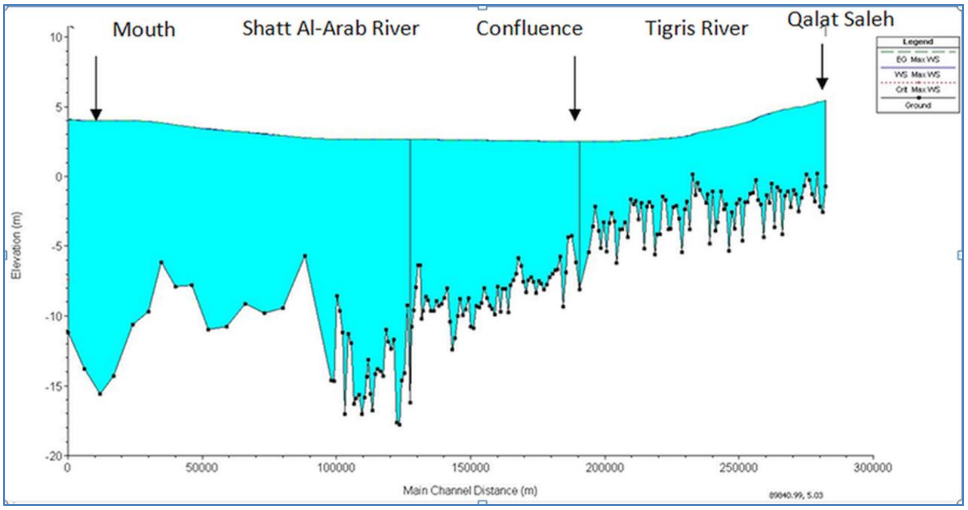

Figure 7.The Maximum Water Level Profile in the SAAR and Tigris Rivers During the Period of Study.

5.2 The Tds Model

The simulated scenarios of TDS were defined considering the following two factors that influence TDS variation: River discharge (released from Qalat Saleh regulator) and tidal situation (lowest low tide or highest high tide that measured in the mouth). Figs.8 and 9 show the results of these simulations for low incoming discharge which was 29 m3/s that measured in 13 February 2018 with two characteristics of the tide which were low and high tides respectively. It is seen that if the incoming flow was low, the TDS values are equals to 11636 mg/l at section (17); 5626 mg/l at section (35); 4688 mg/l at section (44) and 3531 mg/l at section (60) in the case of low tide. wherase, the TDS values were equals to 10272 mg/l at section (17); 5326 mg/l at section (35); 4413 mg/l at section (44) and 3187 at section (60) in the case of high tide.

Figs.10 and 11 show the results of these simulations for high incoming discharge, which was 103 m3/s that measured in 20 September 2018 with the low and high tides respectively. It is seen that if the incoming discharge is high, the TDS values are equals to 1084 mg/l at section (17); 1052 mg/l at section (35); 1047 mg/l at section (44) and 1026 mg/l at section (60) in the case of low tide. wherase, the TDS values are equals to 1075 mg/l at section (17), 1051 mg/l at section (35), 1045 mg/l at section (44) and 1023 at section (60) in the case of high tide.

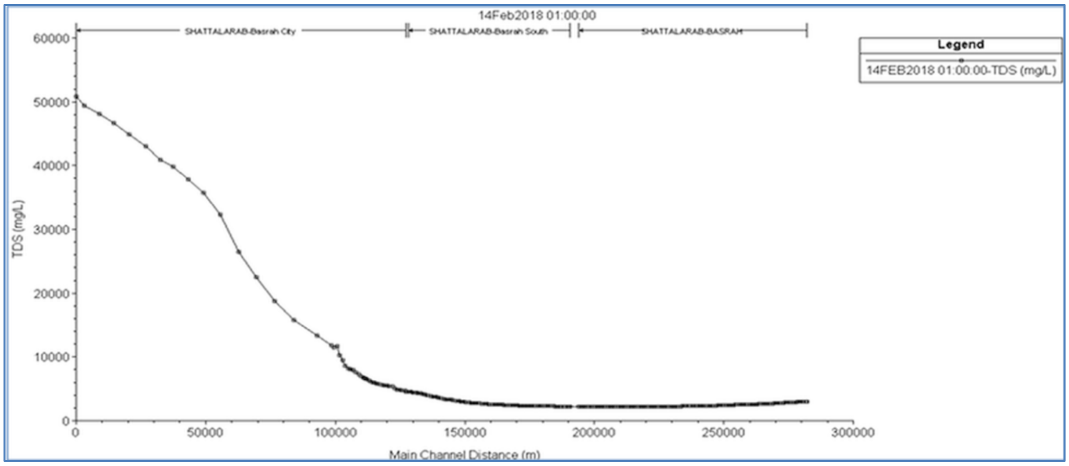

Figure 8. TDS Calculations at Low Tide for River flow rate of 29 m^3/s in 13 Feb.2018

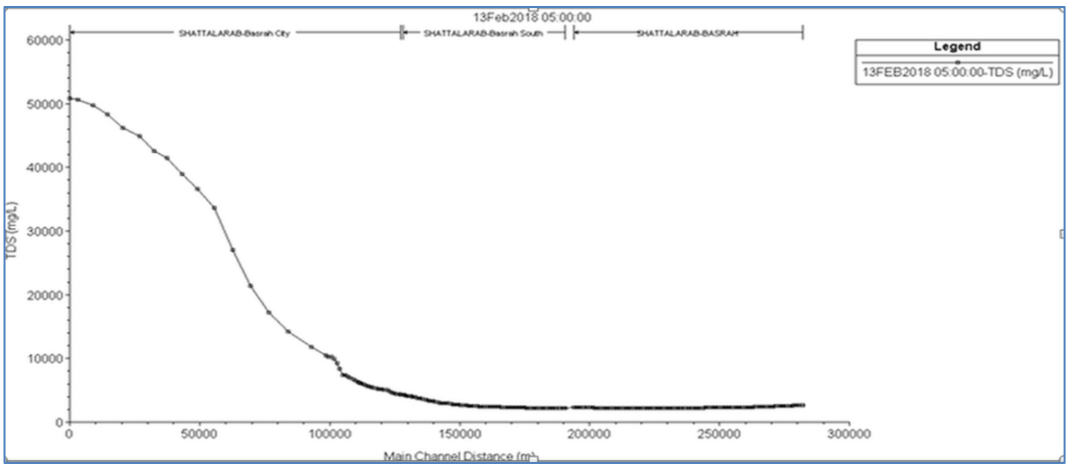

Figure 9. TDS Calculations at High Tide for River flow rate of 29 m^3/s in 13 Feb.2018

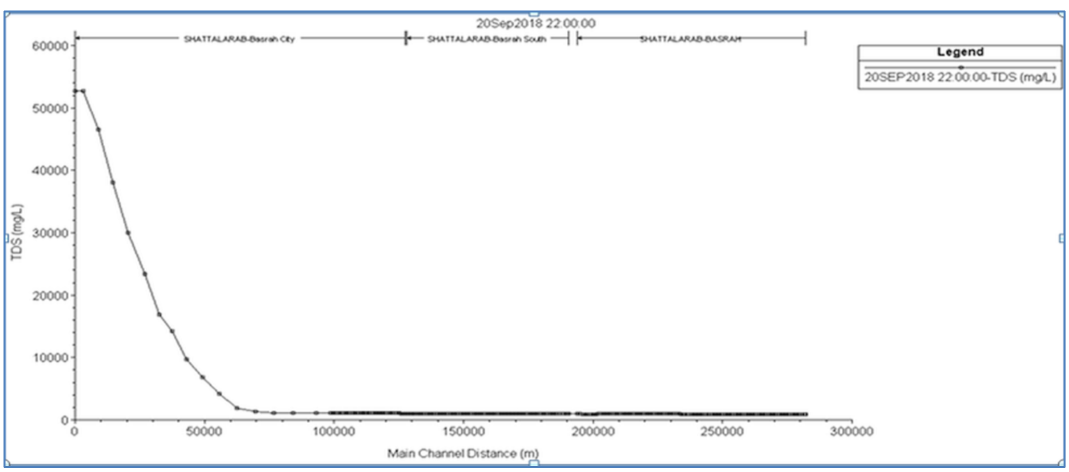

Figure 10. TDS Calculations at Low Tide for River flow rate of 103m^3/s in 20 Sep. 2018

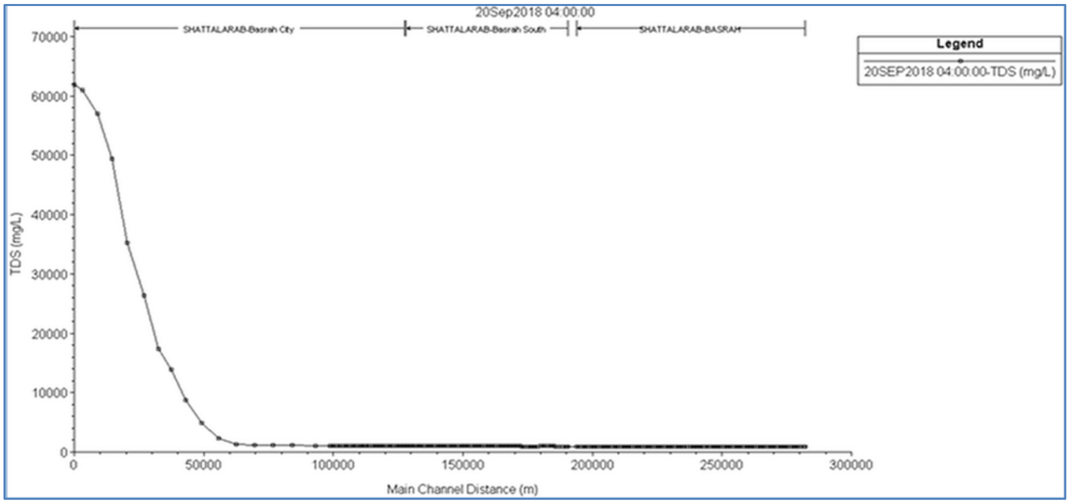

Figure 11. TDS Calculations at High Tide for River flow rate of 103 m3/s in 20 Sep. 2018.

As explained previously the simulated scenarios of TDS were defined considering the two factors that influence the TDS variation: the incoming River discharge (released from Qalat Saleh regulator) and tidal situation (low or high). However, the influence of wind was ignored in the present study.

The increases of discharge from 29 m3/s to 103 m3/s lead to decrease the TDS values about 90% for the case of low and high tide for section 17, and about 70% for the case of low and high tide for section 60.

Fig. 12 presents the results of these simulations for two characteristic flows (29 and 103 m3/s). It is seen that if the flow released from Qalat Saleh regulator (the upstream end) is minimum, the TDS values were between 3000- 4000 mg/l reach to the station 60 that located about 150 km from the mouth in the case of lowest low tide and highest high respectively. So it can be seen that if the flow released from Qalat Saleh regulator is maximum, the TDS between 1000- 2000 mg/l reachs station 60 in the case of lowest low tide and highest high tide respectively. The above results reveal that the first factor to rise the TDS is the upstream river discharge, when the discharge is high the TDS decrease along the river. The second factor affecting the TDS is the tide coming from the Arabian Gulf; the high tide increases TDS and vice versa.

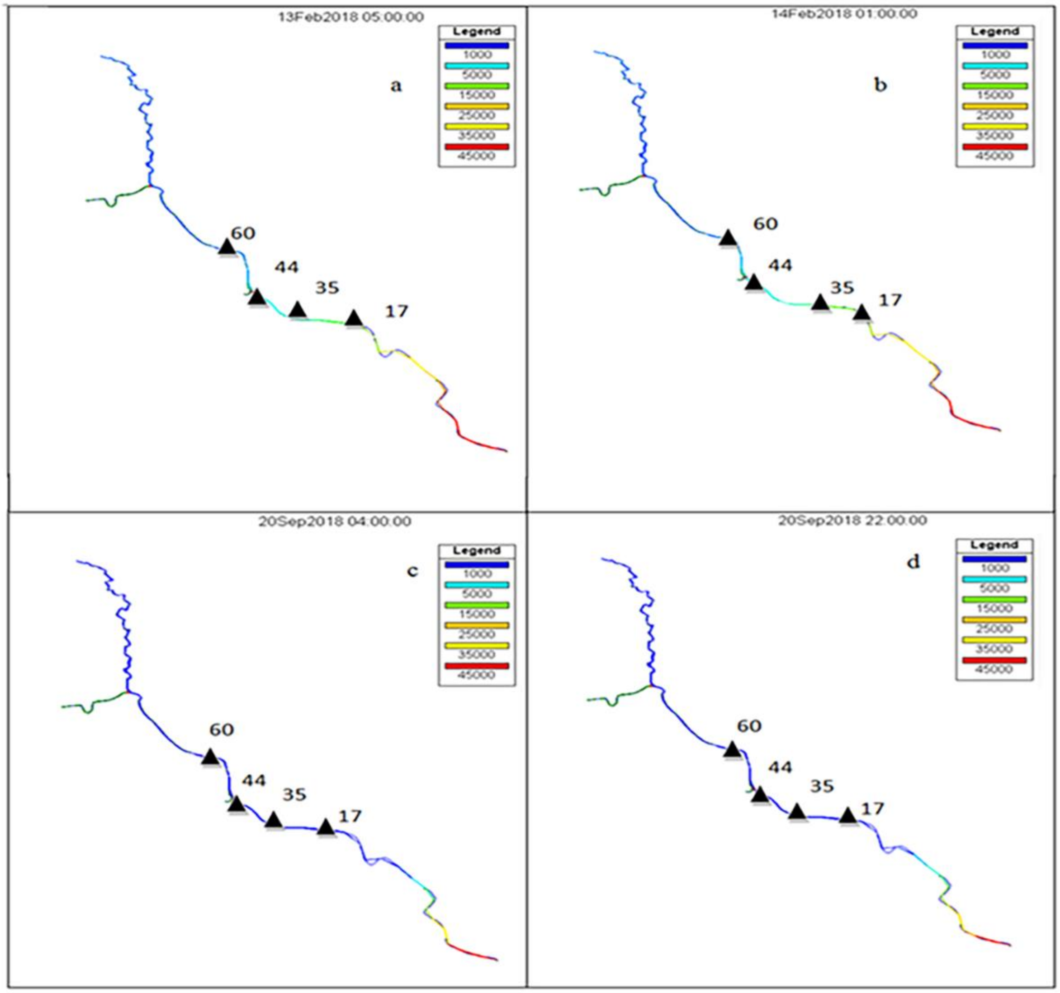

Figure 12.The TDS variations in the SAAR , at (a, c) high tide and (b, d) low tide for low and high values of incoming discharge released from Qalat Saleh regulator Q = 29 m^3/s; (a, b), Q = 103 m^3/s (c,d).

An increase of the incoming freshwater discharge to 103 m3/s, will lead to prevents the salinity intrusion towards the Basrah city, for both low and high tide (Fig. 12c and Fig. 12d). However, the low incoming discharge water for both low and high tide leads to salinity intrusion towards the upstream of Basrah city and it's seen that the TDS values were more than 4000 mg/l in Garmah River causing a dangerous for all conventional water treatment plant that located along the SAAR.

For this reason the current study confirms the need to release the discharge of more than 103 m3/s behind Qalat Saleh regulator. This value will maintain satisfactory water quality to station 60 which is located near to Basrah center, which also maintain fresh water for most water treatment plant located along the banks of SAAR and keep the live of Basrah people.

5.3 Model Calibration And Verification

The hydrodynamic model (i.e. calibrated and validated in earlier time) (US Army Corps of Engineers, 2016) describes the spatiotemporal evolution of velocity and depth. TDS simulations have comparable patterns with field measurements. These results were confirmed by statistical performance tests based on the model outputs.

The TDS values were measured practically at 5 sections along SAAR , which were taken for calibration and verification the model in the date of 14- March 2018 at high tide.

The performance of simulating and observing the TDS concentrations in the River was assessed by calculating the correlation between simulated and observed data. In this study, the accuracy degree of the model was defined with the coefficient of determination R2, the model accuracy statistics. A perfect agreement was found between the computed and the observed TDS values at water discharge of Q= 53 m3/s, which is chosen randomly at 14-March 2018 that leads R2 = 0.9213 as shown in Fig. 13 and Fig. 14.

This result shows the good performance of the model and confirms the results of calibration and verification of the hydrodynamic and the transport model.

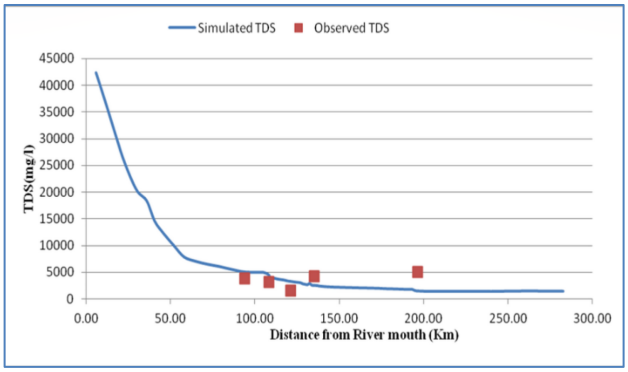

Figure 13. Comparison Between Simulated (the Line) and Observed (the Dots) TDS Values (14 March 2018, High Tide) after Calibration and Verification the Model

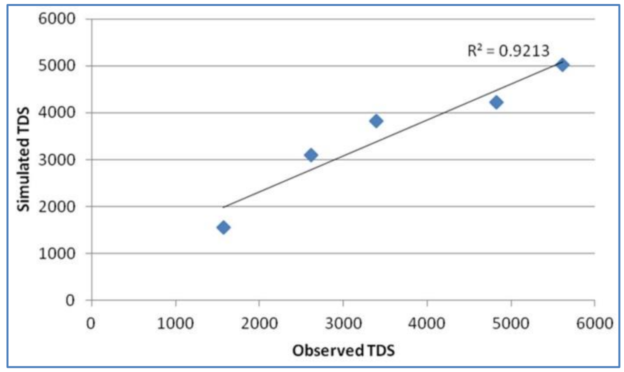

Figure 14. The Comparison Between Observed and Simulated TDS Values on 14 March 2018

6 Conclusions

1- The salinity intrusion from the Arabian Gulf affects a distance of approximately 150 km upstream of the River estuary, with a TDS value which is more than 4000 mg/l in the worst condition which occurred in February /2018 in the case of high and low tide.

2- In the case of upstream river discharge equal to 29 m^3 /s, the TDS values range from 11636 mg/l in section 17 (near the city of Al-Faw) to 3531 mg/l in section 60 (near to Basah center) in the case of low tide. While the TDS values range from 10272 mg/l in section 17 to 3187 in section 60 in the case of high tide.

3- In the case of upstream river discharge equal to 103 m^3/ s, the TDS values range from 1084 mg/l in section 17 to 1026 mg/l in section 60 in the case of low tide. While the TDS values range from 1075 mg/l in section 17 to 1023 in section 60 in the case of high tide.

4- The first factor to rise the TDS is the upstream river discharge, when the discharge is high the TDS decrease along the river and vice versa. The second factor affecting the TDS is the tide coming from the Arabian Gulf; the high tide increases TDS and vice versa.

5- The current study confirms the need to released the discharge of more than 103 m^3/s behind of Qalat Saleh regulator, this value will maintain fresh water to station 60 which is located near to Basrah center, which also maintain fresh water for most water treatment plant that located along the banks of SAAR.

6- The result shows good performance of the model and confirms the results of calibration and verification of the hydrodynamic and the transport model.

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Conflicts of Interest

The author declares that they have no conflicts of interest.

References

[1] Savenije, H. H., “CLASSIFICATION OF ESTUARIES” , in “Salinity and tides in alluvial estuaries”, 2nd ed., Delft, The Netherlands, Elsevier, ch1, sec. 1.2, pp. 5, 2012.

[2] Werner, A. D., Bakker, M., Post, V. E., Vandenbohede, A., Lu, C., Ataie-Ashtiani, B., and Barry, D. A., “Seawater intrusion processes, investigation and management: recent advances and future challenges”, Advances in Water Resources, vol. 51, pp. 3-26,2013.

[3] Loucks, D. P., and van Beek, E. Water resources planning and management: An overview. In Water Resource Systems Planning and Management (pp. 1-49). *Springer, Cham*, 2017.

[4] Al-Battat, M. Q. J., "Empirical prediction model of salt intrusion along Shatt Al-Arab River, southern Iraq.", Mesopotamian Journal of Marine Science, vol. 34, no.1, pp. 1-12, 2019.

[5] Al-Fartusi, A. J. M., “The low discharge simulation of the Shatt Al Arab River and its influence on water quality”, Mesopotamian Journal of Marine Science, vol. 33, no. 1, pp. 1-18, 2018.

[6] Hamdan, A. N., “Simulation of TDS Intrusion from Arabian Gulf to Shatt Al Arab River”, Basrah Journal for Engineering Science, vol. 16, no.1, pp. 28-32, 2016.

[7] Hamdan, A. N., & Dawood, A. S., “Neural Network Modelling of TDS Concentrations in Shatt Al-Arab River Water”, Engineering and Technology Journal, vo. 34, no.2 Part A , pp. 334-345, 2016.

[8] Abdullah, A. D., Gisen, J. I., Zaag, P. V. D., Savenije, H. H., Karim, U. F., Masih, I., and Popescu, I., “Predicting the salt water intrusion in the Shatt Al-Arab River estuary using an analytical approach”, Hydrology and earth system sciences, vol. 20, no.10, pp. 4031-4042, 2016.

[9] Lafta, A., A., “Computer model and empirical models for prediction of salinity intrusion in estuaries : Shatt Al-Arab River estuary as a case study”, Journal of Basrah Researches: Sciences, vol. 40, no.3B, pp. 161-174, 2014.

[10] Al-Mahdi, A.A., “Salt-wedge procession in Shatt Al-Arab River estuary”, Marina Mesopotamica, vol. 11, no.1, pp. 97-107, 1996.

[11] A.N Hamdan, “Variation Effect of Discharge on Total Dissolved Solid in Shatt Al Arab River” in 2015 the 2nd International Conference of Buildings, Construction and Environmental Engineering (BCEE2-2015), 2015.

[12] Hamdan, A. N., Abbas, A. A., and Najm, A.T., Flood Hazard Analysis of Proposed Regulator on Shatt Al-Arab River, Journal of Hydrology,6, 0080, 2019.

[13] Hamdan, A. N., Controlling The Surface Water of Shatt Al Arab River by using Sluice Gates, Journal of University of Babylon, vol. 24, no. 1, pp. 85-94, .2016.

[14] Water Resources Ministry. Discharge, TDS, and Levels (Records from 2009 up to 2018); Water Resources Directorate in Basrah: Basrah, Iraq, 2018.

[15] US Army Corps of Engineers, Hec-Ras River Analysis System, User Manual, Corps of Engineers (USACE), Hydrologic Engineering Center, 2016.

[16] Water Resources Ministry, Water Resources Directorate in Basrah, " Discharge, TDS, and levels records".

[17] Gharbi, M., Soualmia, A., Dartus, D., and Masbernat, L., "Comparison of 1D and 2D hydraulic models for floods simulation on the Medjerda River in Tunisia", Journal of Mater. Environ. Sci., vol. 7, no. 8, pp. 3017–3026, 2016.

[18] Doole, G. J., Ramilan, T., and Pannell, D. J., "Framework for Evaluating Management Interventions for Water-quality Improvement across Multiple Agents", Environmental modelling & software, vol. 26, no. 7, pp. 860-872, 2011.

[19] Kashefipour, S. M., and Falconer, R. A., "A Longitudinal Dispersion Coefficient in Natural Channels", Water Research, vol. 36, no. 6, pp. 1596-1608, 2002.

[20] Hamdan, A. N., Najm, A. T., and Abbas, A. A., "Flow Simulation of Shatt Al-Arab River by Hec-Ras 5.0.3", International Journal of Advances in Mechanical and Civil Engineering, vol. 15, no. 1, , pp. 31-36, 2018.

[21] AL-Thamiry, H. A. K. , Haider, F. A. and Al-Saadi, A. J.J., "TDS Variation of Euphrates River between Ashshinnafiyah and Assamawa Cities", Journal of Engineering, vol. 19, no.11, pp. 1442-1466, 2013.

نمذجة تأثير توغل مياه البحر إلى نهر شط العرب (العراق)

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الخلاصه

في الآونة الأخيرة ،عانى شط العرب في البصرة / جنوب العراق من القيم العالية للمواد الصلبه الذائبة الكلية (TDS) في المياه بسبب انخفاض المياه العذبة الواردة من المصادر التي تسببت في تسرب الملوحة إلى شط العرب . الهدف من هذه الدراسة هو تتبع توغل مياه البحر من الخليج العربي إلى شط العرب. تم استخدام نموذج الانتقال أحادي البعد باستخدام HEC-RAS 5.0.5 للتعرف على ديناميكية TDS في شط العرب .تم أخذ أربع حالات لتقدير تسرب الملوحة إلى SAAR وهي ، التصريف المنخفض والعالي الذي يساوي 29 م ^{3} / ث و 103 م ^{3} / ث والتي تم إطلاقها من ناظم قلعة صالح مع المد المرتفع والمنخفض. يُلاحظ أنه إذا كان التصريف ضئيلاً ، فإن قيم المواد الصلبة الذائبة تتراوح بين 3000–4000 مجم / لتر على بعد 150 كم من المصب في حالة انخفاض المد والجزر الأعلى على التوالي ، وإذا كان التدفق في الحاله القصوى ، فإن المواد الصلبة الذائبة بين 1000– 2000 ملغم / لتر على بعد 150 كم من المصب في حالة انخفاض المد والجزر الأعلى على التوالي. يمكن الاستنتاج أن زيادة تصريف المياه العذبة الواردة إلى 103 م^3 / ثانية وأكثر ، ستؤدي إلى منع تسرب الملوحة نحو مركز مدينة البصرة ، سواء في المد المنخفض أو المرتفع. تظهر النتائج التي تم الحصول عليها وصفًا جيدًا لتباين TDS من البحر باتجاه أعالي شط العرب . يسمح هذا النموذج بتقدير فوري لانتشار المواد الصلبة الذائبة نحو شط العرب ويمكن أن يساعد في ضمان توفير المياه الصالحة للشرب.

كلمات الدالة: محاكاة، تسرب مياه البحر اللجنة العليا للانتخابات رأس، نهر شط العرب، تباين المواد الصلبة الذائبة.