Design of Water Treatment Plant and Sewer Network for the Ramah City

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Abstract

Clean water is a basic requirement for maintaining public health. The purpose of this project is to design a water treatment system for city of Ramah which will satisfy the water demand while maintain the high quality. Initial data for this project was collected from various sources including ministry of statistics, google map etc. Based on the previous population record and using arithmetic population growth pattern future population in the year 2045 was calculated. Water demand was also estimated to be 150 L/capita/day. To satisfy the total future water demand a conventional water treatment plant consist of rapid mix, flocculation basin, sedimentation, filtration and disinfection process was designed. USEPA guideline and Water treatment an Excel spread sheet was developed to facilitate the process. The final design consists of in line mechanical mixing with diameter 410 mm. Flocculation chamber of size 200.2 m3 with 3 compartments and each one has volume of 66.7 m3 . Sedimentation basin of volume 300.4 m3 . Rapid sand filter of 4.2 m depth, and a chlorine contact basin of 7.2 m length It is expected that this treatment plant will be able to satisfy the water need for the city for the next 23 years. The wastewater network for the city were also designed using excel and the EPASWMM program following current code and specification. 24 hours simulation of flow showed no flooding in any junction. The total length of the wastewater main is 8328 m which consists of 1041 m with 200 mm, 1551 m with 250 mm, 1497 m with 300 mm, 1209 m with 350 mm and 4581m with 450 mm length and diameter respectively. CAD drawing of pipe profiles and manhole section were prepared. A Parshall flume with width of 0.3m , water depth inside the flume of 0.17 m.

Problem Statement

Ramah City, is far about 120 km of the Riyadh city and the area of Ramah Governorate is 15,900 km2 , and its population is about 28,055 capita. The city of Al-Rama needs a project to establish a water treatment plant to produce usable and pure water and provide it to the people of the town, and to design a water treatment plant that works until 2045. Also, in the project, the city of Ramah needs a sewage network that covers the beauty of the city, including homes, mosques, and public and private facilities.

Objectives

- Explore and identity the different types of processes in a water treatment plant (WTP).
- Finding of water demand and water supply in 2045.
- Reduce the impurities and provide treated water.
- Reduce the objectionable color, odor and turbidity.
- Design wastewater network for Ramah city, that meet all criteria (velocity, slope and flooding).
- Simulate design of wastewater network by using software EPASWMM and Parshall flume design.

Methodology

Two different topics are done in this project the first one is the designing of the water treatment plant for Ramah city that contain several stages of for well water treatment starting from water intake then coagulation, flocculation, sedimentation, filtration and the last one is water disinfection basin. And all design are with respect to the future population and water demand in 2045. The second one is the designing of wastewater network for Ramah city which will facilitate the movement and the collection for wastewater by using the EPASWMM program and by using equations and finding the appropriate pipes size with respect to all standards for velocity, slope and flooding then, comparing between the results.

Location

It is 120 km from Riyadh and its location in the northern east of Riyadh as shown in Figure 2.1.

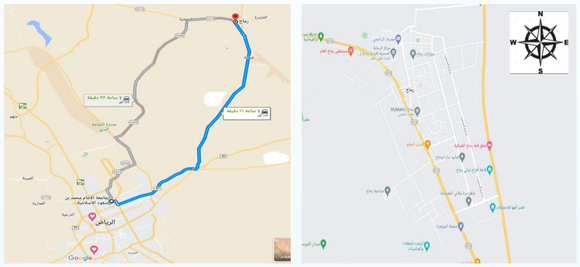

Figure 2.1 Location of Ramah

Results

A typical step-by-step design for Water Treatment Plant units was presented. Procedures, detailed calculations illustrated. Water treatment plant consist of rapid mix, flocculation basin, sedimentation, filtration and disinfection process was designed. The final design consists of in line mechanical mixing with diameter 410 mm. Flocculation chamber of size 200.2 m3 with 3 compartments and each one has volume of 66.7 m3 . Sedimentation basin of volume 300.4 m3 . Rapid sand filter of 4.2 m depth, and a chlorine contact basin of 7.2 m length. Design wastewater network and Parshall flume. Procedures, detailed calculations, and drawings were illustrated. Finding the elevation for Ramah city from google earth then dividing the areas depending on their elevations, then finding the wastewater flow for each area. By changing the pipe size by using trial and error until the conditions are achieved (velocity and minimum slope depending on diameter of each pipe).

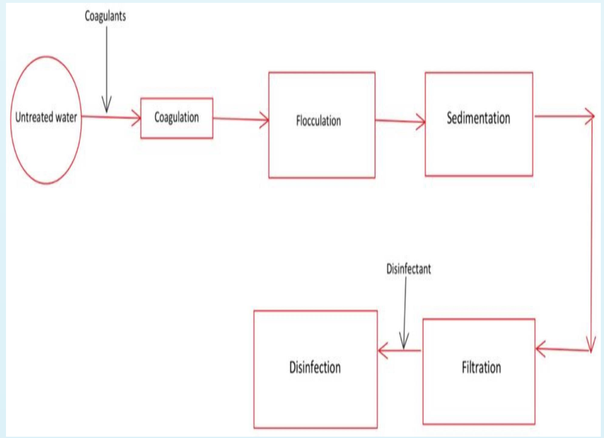

Figure 2.4 The steps from untreated water tank to disinfection tank.

Figure 3.1 Divided areas of Ramah City

Figure 3.2 Slopes

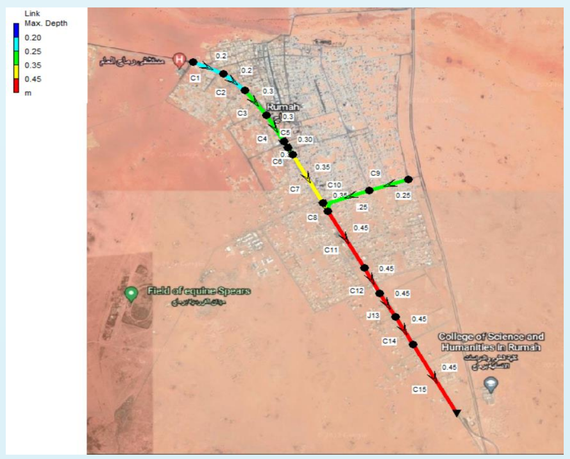

Figure 3.3 Diameters of conduits

Conclusion

❑ Water Treatment Plant

A typical step-by-step design for Water Treatment Plant units was presented. Procedures, detailed calculations, and drawings were illustrated.

- Obtained flow rate 5767.08 m3 /day and future pollution of 48059 capita in 2045.
- In coagulation, the selected model is AZ-7(2).
- In flocculation, one basin with three compartment and the selected process is hydromica
- mixing.
- In sedimentation, two basins with four stages (inlet zone, settling zone, outlet zone and
- sludge zone).
- In filtration, five basins and each basin will contain one cell and two troughs.
- n disinfection, one basin with '' average'' classification of performance.

❑ Design of Wastewater Network

A typical wastewater network, Parshall flume. Procedures, detailed calculations, and drawings were illustrated.

- The wastewater for Ramah city was designed which is 8328 m long.
- The pipe size ranges from 200 mm to 450 mm which meet all criteria of (slope, velocity and no flooding).
- The PVC type with n=0.013 of pipes is selected.
- All-important profile and drawing for network, manholes section and Parshall flume is created by using AutoCAD program.
- Flow was modeled for the 24 hours periods.
- Most of pipes are maintaining self-cleaning velocity at least once a day which achieve velocity 0.6 m/s "to remove any solids" except the first three pipe which don't achieve. 0.6 m/s but achieve 0.3 m/s and this because of the slope and low flow.
- Model shows that there is no flooding in all junction during 24 hours periods.
- Parshall flume is designed with depth of water inside the flume (Ha)=0.77 m.

QR Code

Report

Drawing