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Hydraulic Evaluation Of The Water Treatment Plants In Baghdad City

Adnan A. Al. Samawi
Department of Building and Construction
University of Technology

Lilian Y. M. Al. Saka
Environment& water Ccenter
Mosul Universty

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ABSTRACT

This study is an attempt to evaluate the suitability of the water supply plants of the city of Baghdad, These plants are: A, B, C, D, E, F and G. Important topographical and hydraulic parameters, such as; location of water plant site relative to river (upstream or downstream), type of river section (on straight reach or on bend reach), location of plant site relative to river bank (west side of river or east side of river), type of intake (good or poor), were investigated to assess the operating situation of each water supply station.

The results of the study indicated that the water supply plant is the most suitable one according to the investigated parameters .The Al Karama water supply plant was found to be the most unsuitable one. It is recommended that such plant should be put out of service.

التقييم الهيدروليكي لمحطات الماء في مدينة بغداد

الملخص

تقدم هذه الدراسة محاولة لتقييم صلاحية محطات تصفية المياه في مدينة بغداد،المحطات هي بالترتيب(A,B,C,D,E,F,G) وعلى اساس التقيم الهيدروليكي لمواقع مآخذ محطات التصفية الموجود اعتماداً على الخصائص الهيدروليكية مثل موقع المحطة نسبة الى النهر (اعلىالنهرأو اسفل النهر)، نوع مقطع النهر في تلك المنطقة(مستقيم، منحني) الجهة التي تقع عليها المحطة (غرب، شرق) ونوع الماخذ (جيد أو ردئ).

نتائج الدراسة تشير الى ان مآخذ محطات الماء الموجوده في مدينة بغداد ملائمة عدا مآخذ مشروع الكرامة غير مطابق للنقاط اعلاه .لذلك عند اختيار مآخذ محطة تصفية يجب مراعاة التقيم الهيدروليكي.

INTRODUCTION

Assessment of the quantity of water available from a particular source is of a vital importance and is the subject of the rapidly developing science of hydrology. Having obtained a suitable quality of water by selection of source and treatment processes the treated water must be delivered to the consumer via a complex network of trunk main,service reservoirs and distribution main. (Fig 1) illustrates the appropriate sites of water supply and wastewater disposal systems. (Tebbutt, 1973).

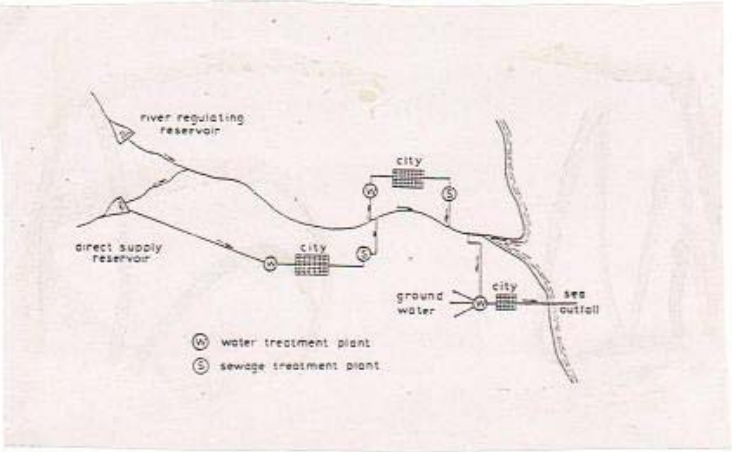


Fig. 1: water supply and wastewater disposal (Tebbutt, 1973)

LOCATION OF THE WATER PLANT INTAKE

Al-Layla, et al; (1977), stated that some points must be considered in selecting the location of an intake as follow:

1. The intake should be located in a place where there is no fast current which may damage the intake causing interruption in the water supply.
2. The ground near the intake should be stable. A straight section of the river is always preferable, as the risk of erosion of the bank in this case is minimum.
3. The approach to the intake should be free from obstacles.
4. The inlet should be well below the surface of the river or the lake for receiving cooler water and for preventing the entry of floating matter. To prevent the entry of suspended matter near the bottom, the inlet point should also be well a bove the bottom of the water body.
5. To avoid possible contamination of the bank, the intake should be located at some distance from the bank.
6. Intake should be located on the upstream of the town.

Helmut et al; (1989), listed principles for the arrangement of the intake structures on rivers as follow:

1. The topographical conditions upstream of the structure. Damming leading to a rise in water level, which in turn may lead to flooding of the bank areas for upstream of the structure.
2. The geotechnical conditions of the bank zones.
3. Height of the bank a bove the river bottoms.
4. The ratio of the quantity of diverted water at low discharge.
5. The channel width in the tapping point (dependence of the water level at times of low discharge in the river, meandering at low discharge in wide rivers).
6. The routing of the diversion canals.
7. The intake structure must not narrow the cross section of flow of the channel.

8. The location of an intake structure must be chosen so that the largest possible portion of the bed load remains in the river and is not taken in the diversion canal with the diverted water.

Rangwala et al; (1997) stated that the location of an intake should be carefully made following are the important considerations which govern the selection of site of an intake:

1. Controlling devices.
2. Cost.
3. Navigation channels.
4. Permanency of supply.
5. Quality of water.
6. Situation.

LOCATIONS OF WATER PLANTS IN BAGHDAD

1. Treatment works: A works is in the north of Baghdad on the West Bank, on straight reach of the Tigris River.
2. Treatment works: B treatment works is located close to the northern boundary of the city approximately (1Km) downstream of the north bridge, which were complete in 1981. It is downstream on a straight reach by the east of the river.
3. Treatment works: C treatment works is situated within the city area on the west bank of the Tigris, the water works were completed in 1954 and 1961, respectively .The intake is in a good location where a deep stable channel exists on the outside of a bend.
4. Treatment works: D treatment works is situated within the city area on the east bank of the Tigris downstream of the Sarafiya railway bridge near the medical city. Four streams of different design were completed in about 1932, 1945, 1961and 1976,respectively. The intakes are in a good location where a deep and stable channel exists.
5. Treatment works: E treatment works is situated within the city area on the West Bank adjacent to Umm Al Qanazir island. Two streams of different design are used. They were completed in about 1964 and 1970. The intake is in a poor location on what is now the minor river channel between the island and the West Bank, a short distance downstream from the khir river outlet into river channel.
6. Treatment works: a treatment works for Dora on the west bank of the river just downstream of Dora power station, within the city area, was completed in 1982. The location of the intake appears to be favorable from the point of view of a stable deep-water channel.
7. Treatment works: G treatment works is located close to the present downstream limit of city development on the east bank of the river, between part of the Rasheed Army camp and the river, ashort distance downstream of the Dora bridge .The area around the treatment works includes various industrial developments.

THE NATURAL HYDRAULIC BEHAVIOR OF THE RIVER AND TECHNICAL MEASURES TAKEN.

*Physical laws: In straight section of a river or stream, the water flows approximately even in the cross- section of the channel, parallel to the banks. When the bed load transport begins, the bed load is transported accordingly on the bottom of the river. In bends the direction of the bottom flow changes compared with the surface flow (Fig 2). Aspiral forms, which transport the bed, load to the inner side of the river. The bed load is diverted from the deflecting bank. It could be concluded from this that the most favourable site for the construction of an intake structure is the deflecting bank. (Helmut et al., 1989).

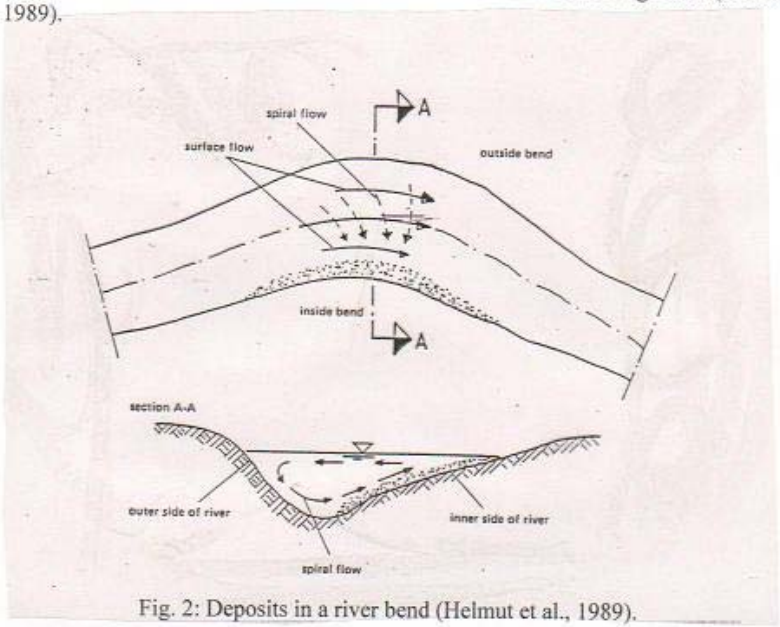
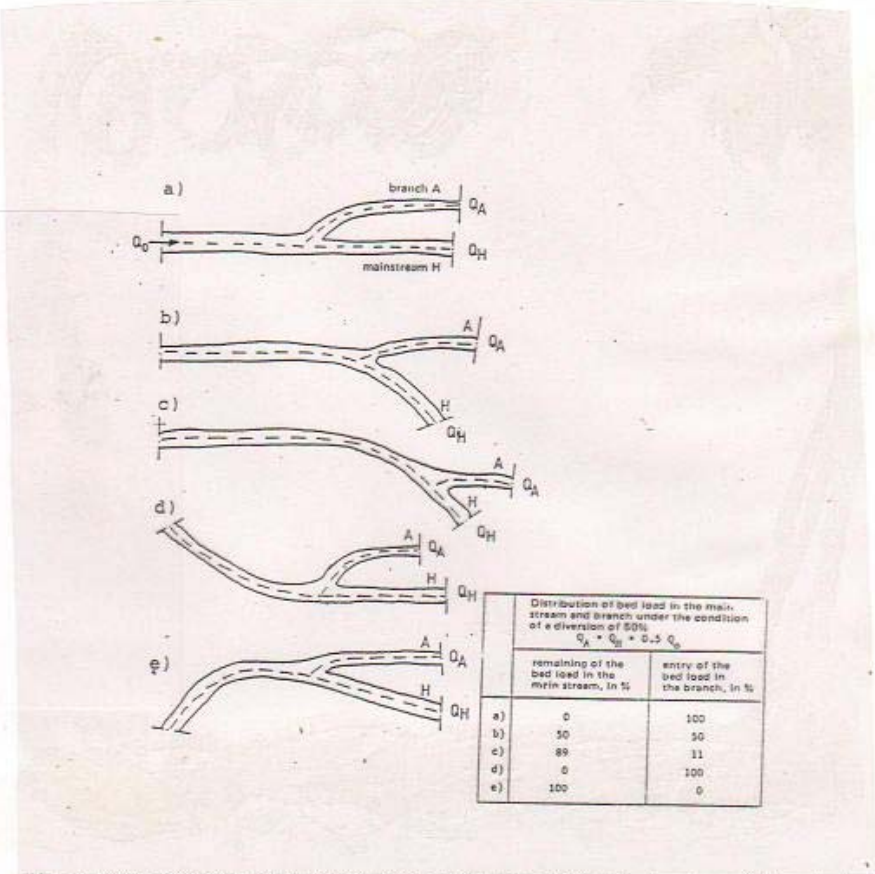


Fig. 2: Deposits in a river bend (Helmut et al., 1989).

*Technical measures: As technical measures bed load - deflecting structures in the form of groundsills and flushing canals. The following principle can be derived from the physical relationships:

1. The intake structure is necessary to construct on a straight river section.
2. Intake structures should be arranged on the outside bend.
3. According to the rules of river training, special measures for keeping off the bed load are always necessary whenever more than 50% of the water is diverted from the river (Fig. 3) shows the percentage of the bed Load into branch (intake) and main stream for many configurations.



	Distribution of bed load in the main stream and branch under the condition of a diversion of 50% $Q_A = Q_H = 0.5\ Q_0$	
	remaining of the bed load in the main stream, in %	entry of the bed load in the branch, in %
a)	0	100
b)	50	50
c)	89	11
d)	0	100
e)	100	0

Fig. 3: Entry of bed load in lateral intakes without additional structures (Helmut et al., 1989).

4. Technical measures are always necessary.
- For intake structure where the water is not dammed up.
- For intake structure where the water is dammed up, as the capacity of the silting space in front of the fixed weir is Limited and the entrance of bed Load into the intake structure cannot be prevented in the Long term, (Fig. 4).

HYDRAULIC ASSESSMENT OF WATER TREATMENT PLANTS IN BAGHDAD CITY

(Fig. 5) shows the location of the water treatment plants. (Table 1) shows an assessment of the hydraulics, of all water treatment plants in Baghdad City. According to the hydraulic parameters; such as location of water plants relative to river (upstream or

downstream), type of section (straight reach or bend reach), location of bank (west side of river or east side of river), type of intake (good or poor).

A plant is considered to be the best of all plants according to these hydraulic parameters. On the East Side of the river, B plant is situated downstream on a straight reach.

D is located downstream on a straight reach by the East Side of the river. On the West Side bank of the river, C and F are located downstream on a bend. E is located downstream of the river on a bend and the West Side of the river with poor intake as a result of Al Khair river discharges. It is a bout 500 m a bove the E plant. G plant is situated on a bend to the East Side of the river with poor intake. (Table 2) shows the arrangement of the plants.

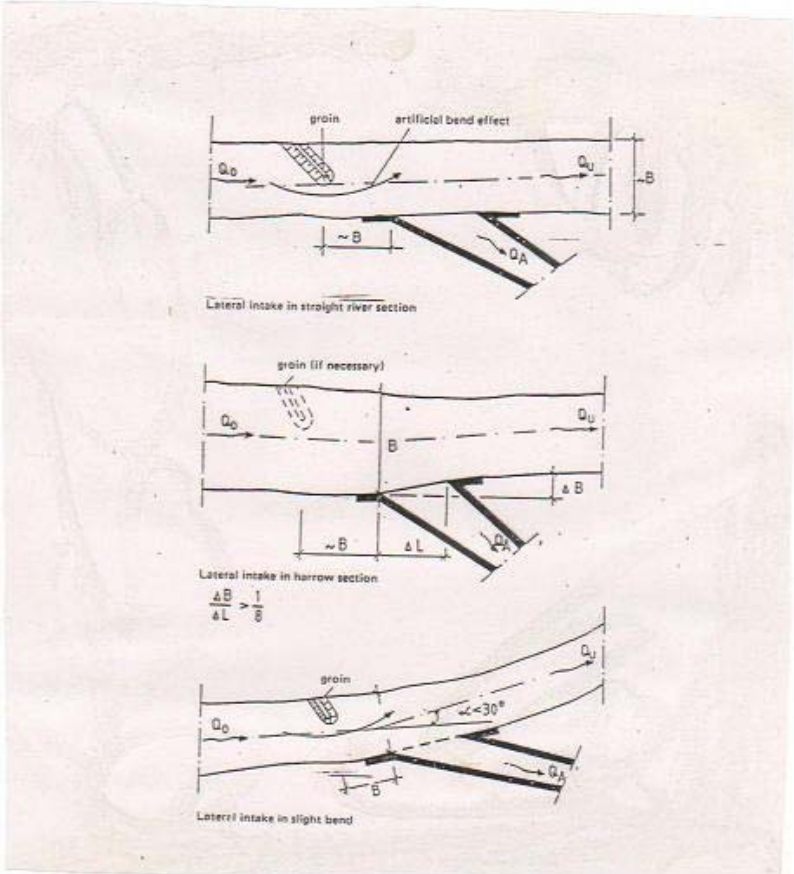


Fig. 4: Lateral intake without damming and replling of bed load from intake by technical measures (Helmut et al., 1989).

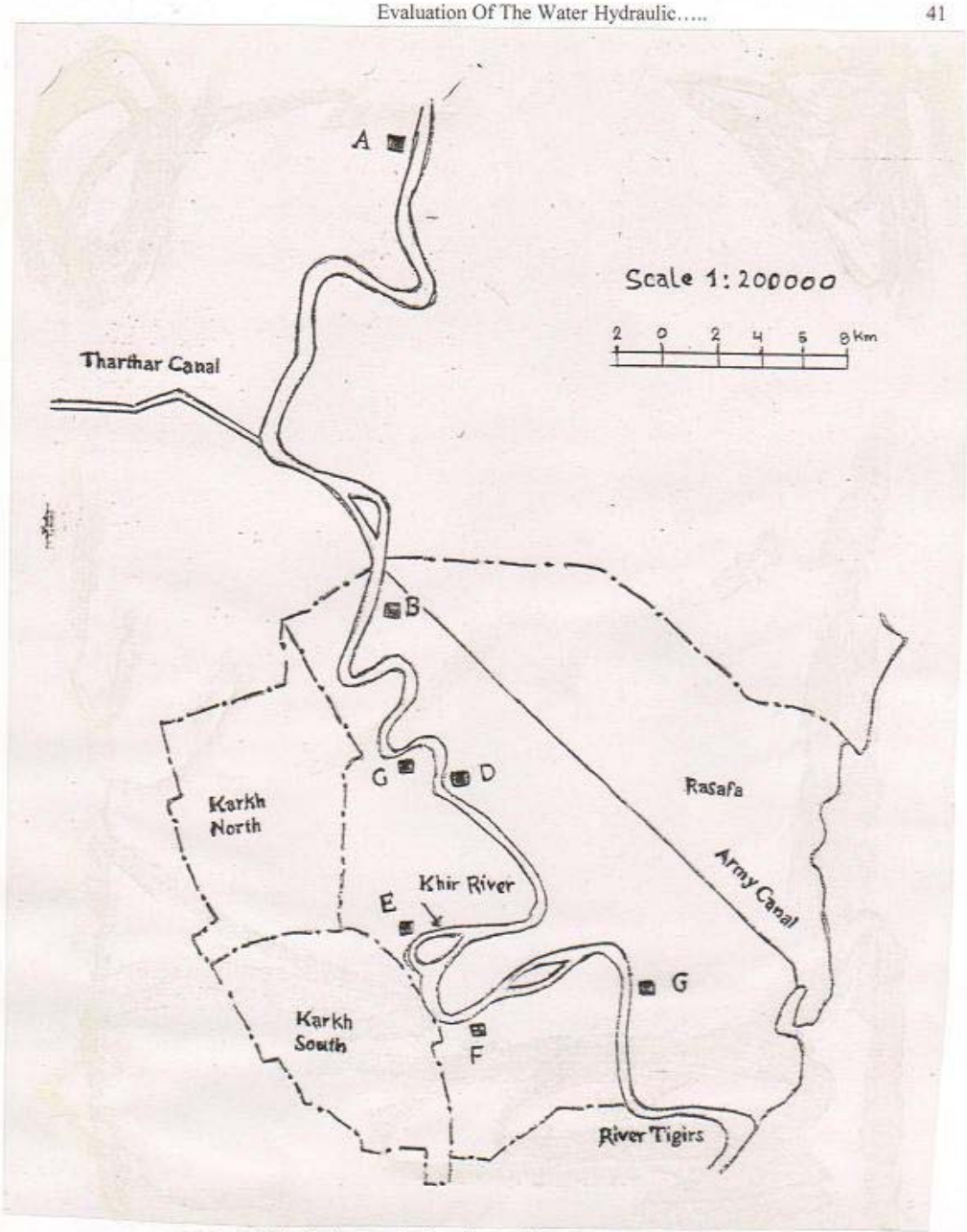


Fig. 5: shows the location of the water treatment plants.

HYDRAULIC EVALUATION OF THE WATER TREATMENT PLANTS ACCORDING TO THE LOCATION OF RIVER TYPE OF SECTION OF RIVER, LOCATION TO BANK, AND TYPE OF INTAKE

All the a bove mentioned points were investigated at site and the final result of the assessment gave the following ranks according to its suitability functionally:

1.A, 2. B, 3. D, 4. C, 5. E, 6. F 7. G.

Table 1: classification of water works according to hydraulic characteristics.

Plant	location to river	type section	location to bank	production (mgd)	type of intake
A	x*	x	x	300	good
B	y**	x	y	100	good
C	y	y	x	50	good
D	y	x	y	40	good
E	y	y	x	30	poor(1)
F	y	y	x	25	good
G	y	y	y	14	poor(2)

* Upstream, straight reach, West Side of river.

** Downstream, bend reach, East Side of river.

(1) Short distance downstream from the Khair River.

(2) The area around the treatment works includes various industrial developments.

Table 2: arrangement of water works according to (table 1).

Arrangement	1	2	3	4	5	6	7
water works	A	B	D	C	E	F	G

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