GROUND WATER QUALITY OF AL-MAHED RESIDENTIAL ASSEMBLAGE (ENVIRONMENTAL STUDY)

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Abstract:

Hydrological study was carried out for the Al-Mahed basin area which located at about five Km. of Ainsifin town . High permeability formation at the surface caused high in filtration to aquifer. The topography of Al-Mahed basin area is controlled by the underlying structure and the contrast of the rock type toughness.

Water samples were taken from seven existing wells penetrating Mugdadiya formation at Al-Mahed Residential Assemblage were collected and analyzed for the major ions. Besides other ,seven samples collected in sterilized bottles of 100 ml capacity for biological properties .

The analysis showed that Alkalinity , ranging from 220 to 400 ppm , Total Hardness from 400 to 800 ppm , Nitrate NO_3 from 1.9 to 6.03 and total coliform bacteria /100 ml ranged from 15 to 140.Quality characteristics of the studied ground water do not suit domestic use . These water are contaminated and may be risky.

نوعية المياه الجوفية المستخدمة في مجمع المهد السكني(دراسة بيئية)

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الكلمات المفتاحية: مياه جوفية، منطقة المهد، بيني، نوعية مياه، مجمع سكني.

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المستخلص:

درست الخواص الهيدرولوجية لمنطقة مجمع المهد السكني والذي يقع على بعد ٥ كيلو متر جنوب شرق مدينة عين سفني ، وتبين أن هنالك إرتشاح كبير بالمياه السطحية نتيجة للنفاذية العالية للتكوينات الجيولوجية السطحية . كما لوحظ أن الوضع التركيبي انعكس على طبوغرافية المنطقة

أخذت سبع نماذج مياه من أبار المنطقة التي تخترق تكوين المقدادية . تم تحليل هذه النماذج كيميائيا لإيجاد الايونات الموجبة والسالبة . فضلاً عن اخذ سبع نماذج إضافية في قناني معقمة سعة ١٠٠مللتر وذلك لإجراء الفحوصات البايولوجية عليها.

اظهر التحليل الكيميائي للنماذج بان القاعدية تتراوح مابين ٢٢٠- ٤٠٠جزء بالمليون . العسرة الكلية تتراوح مابين ١٩٠-٦٠٣ ملغم / لتر.واظهر التحليل البايولوجي بان بكتريا الكوليفورم تتراوح بين ١٥ -١٤٠ .

أظهرت نتائج التحاليل بان الخصائص النوعية للمياه الجوفية للمنطقة غير صالحة للاستخدامات المنزلية وذلك لان هذه المياه ملوثة وتشكل خطورة وبحاجة إلى معالجة.

INTRODUCTION:

Al-Mahed residential assemblage basin area is located in the NE part of Iraq at about 5 km southeast of AinSifni town, between Latitude 36° 41′ 40″ & Longitude 43° 25′ 00. Topography of the area is controlled by the underlying structure & the contrast of the rock toughness. Few shallow valleys passing through the basin particularly to the west of the Assemblage draining the high land to the south . River Gomel is making the east boundary of the basin area running from north to south fig (1).

Structurally , the MahedAssemblage is situated in a syncline confined mainly by AinSifni anticline from the north and the Maglub anticline from the south. The low structural anticline in the study area called Al-Mahed anticline . The catchment area covered by conglomerate , pebbley sandstone and mudstone .

The studied area has not been tackled by Iraqi and other researchers .Therefore a

focus is made on International Literature . Humans have used springs and wells as sources of water for thousands of years . Very early in human history ,it was noted that the taste and chemical quality of spring and well water differ from place to place (Back et al .,1995).

Many cultures developed elaborate mythologies to explain why spring and well waters differed so much in their chemical quality . It was common ,for example, to rationalize these differences in moral terms Good-quality drinking water was associated with good deities and poor-quality water were associated with evil deities (Chapelle,2000).

One of the principal difficulties of understanding ground water geochemistry is due to chemical heterogeneity of most aquifer systems .The rock and sediments that form most aquifers were often deposited over long periods of time and under variety of geologic conditions .Thus, the chemical composition of the rock or sediment matrix of aquifers is seldom constant.

The chemical and microbiological agents that are adversely impacting the quality of ground water are coming from a variety of sources , including land application of agricultural ,chemicals, animal wastes , septic-tank disposal system for sewage- treatment lagoons, land application of organic wastes (Fetter,1988).Contamination of ground water most often results in a situation that can not be detected by human senses .Ground Water contamination can be due to bacteriological or toxic agents or simply to an increase in common chemical constituents to a concentration where by the usefulness of the water is impaired . The major questions of ground water geochemistry have come directly from practical , human problems (Drever,2004).

The purpose of this study is to determine the water quality and to determine the extent of ground water contamination from known designated source . Which is only existing wells would be sampled .

LITHOLOGY AND HYDROLOGY

1. Mugdadiya Formation :

It is at Pliocene age and composed entirely of molasse like terrigenousclastics. The alternations of tough resistant pebbly sandstone units which the friable easily eroded mudstone and siltstone units has resulted in the formation of geomorphic features like small ridges, cliffs and hills. The measured thickness of the formation exceeds (70 m) although its thickness can reach (220 m) (Dunnington, 1958) , where the rest of thickness is mostly covered in Al- MahedAssemblage flat area .

2. Bi- Hassan Formation:

This formation composed mainly of massive conglomerate beds alternating with thick sandstone and mudstone beds. Thickness of individual conglomeratic bed exceeds 20m. The mudstones with frequent siltstone laminations of mostly friable to medium tough. Sand stone beds are mostly tough to very tough exceeding 30 m in thickness, yellowish –brown in colour , medium to course grained), (Dunnington, 1958).

3.Quaternary Sediments:

Are mostly represented by slope cover, which are derived from the hills surrounding the area , forms from the pebbles of Bi-Hassan formation.

HYDROLOGICAL CONDITIONS AT THE AREA:

The catchment area which drains the rainfall flow towards the study area reaches about (61)km^2. Infiltration to the aquifer is very high confirmed by the drainagedensitiesof the area which is equal to 0.76 (Al-Hamdani , 2003) this figure indicates that thearea is covered by permeable formation.

There are many aquifers that can be distinguished in the area , but they are very deep .However the most important aquifer which are supplying the water to the

assemblage via the drilling wells is Mugdadiya aquifer.

MugdadiyaAquifer:

It covers most of the study area , it is about 200m thick , the maximum thickness occurs at the trough of syncline near the residential Assemblage , composed of coarse to very coarse sand grained , with porosity ranging from20 to 30%. This range of porosity gives the aquifer characteristics of medium to high permeability.

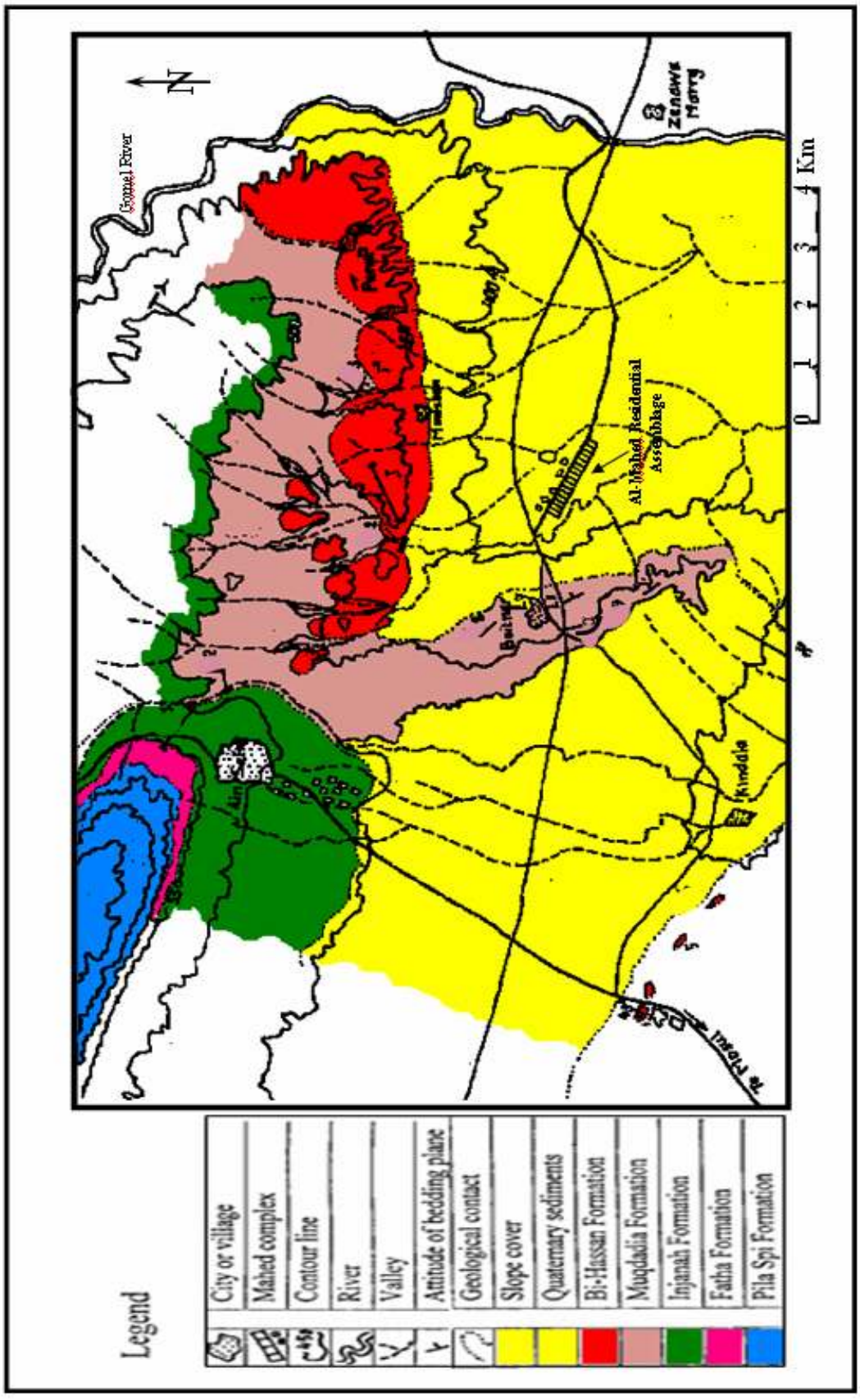

Fig. 1 : Geological Map of Al-Mahed Complex and Surrounding area

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GROUND WATER CHARACTERISTICS

Drainage system of the runoff water flows from north to the south . The measured water level at the 7- existing wells at the assemblage range from 20-25 m below the ground surface. The dominant direction at ground water flow is towards the dip of the beds. i.e. towards the residential Assemblage ,(Al-Hamdani , 2003) .

Recharge to the area is mostly from the rainfall via the permeable formation of which exposed at the surface . The high

permeability at the surface is confirmed by the absence of deep and large valleys . Only a few shallow valleys crossing the area .
Within the basin area ,the discharge of the water of the aquifer is only via wells which exist at the Assemblage. These wells according to their depth penetrated the Mugdadiya aquifer. The deepest one may reach the upper part of Injanah aquifer .The measured discharge of the well ranges from 7 to 9 L/sec. The whole wells produce about (4000-5000) m^3/day.

METHODOLOGY

According to protocols developed by the APHA, AWWA, WPCF (1998) seven samples for routine chemical analysis and seven samples for biological analysis had been collected from the seven existing wells atthe residential area of AL-Mahed.It was difficult to collect a sample of ground water that is actually representative of the chemistry of the water as it exists in the ground .(Fetter,1988).

RESULTS AND DISCUSSION

Chemical And Biological Properties of Ground Water:

The analysis of chemical samples were carried out for the majorcations and anions as shown in table (1):

Table-1:Chemical analysis of ground water in AL-Mahed residential Assemblage.

No. / parameter	1	2	3	4	5	6	7
Alk	400	400	220	380	240	400	390
TH	540	460	800	400	660	600	640
CaH	200	200	180	240	220	190	230
MgH	340	260	620	160	440	410	410
Ca^{+2}	80	80	72	96	88	76	92
Mg^{+2}	81.6	62.4	149	38.4	105.6	98.4	98.4
SO_4^{-2}	99.4	116.5	181.4	113	90.7	86.5	160.6
Cl^{-1}	75	30	160	40	40	40	45
NO_3^-	1.9	2.3	2.76	6.03	3.25	1.87	2.5

Contour maps were used to study the real distribution of the ions asfollows:

Ca^{+2}:

The real distribution ofCa ion in ppm inside the Assemblage is shownin (Figure 2). The lowest value ofCa ion occurs in the well No.3 is 72ppm. The highest value occurs in the well No.4. Ca ion concentrationdecreased towards the north of the Assemblage area.

Mg^{+2} :

The real distribution of Mg ion is shown in (Figure 3). High concentration occurs in the well No.3, and the lowest concentration occurs in the well No.4 exactly opposite the distribution of Ca ion It gives an indication of ion exchange between Ca and Mg, as well as Mg is more solibel.
Source of Mg probably came from the cementing material of the Bi- Hassan conglomerate.

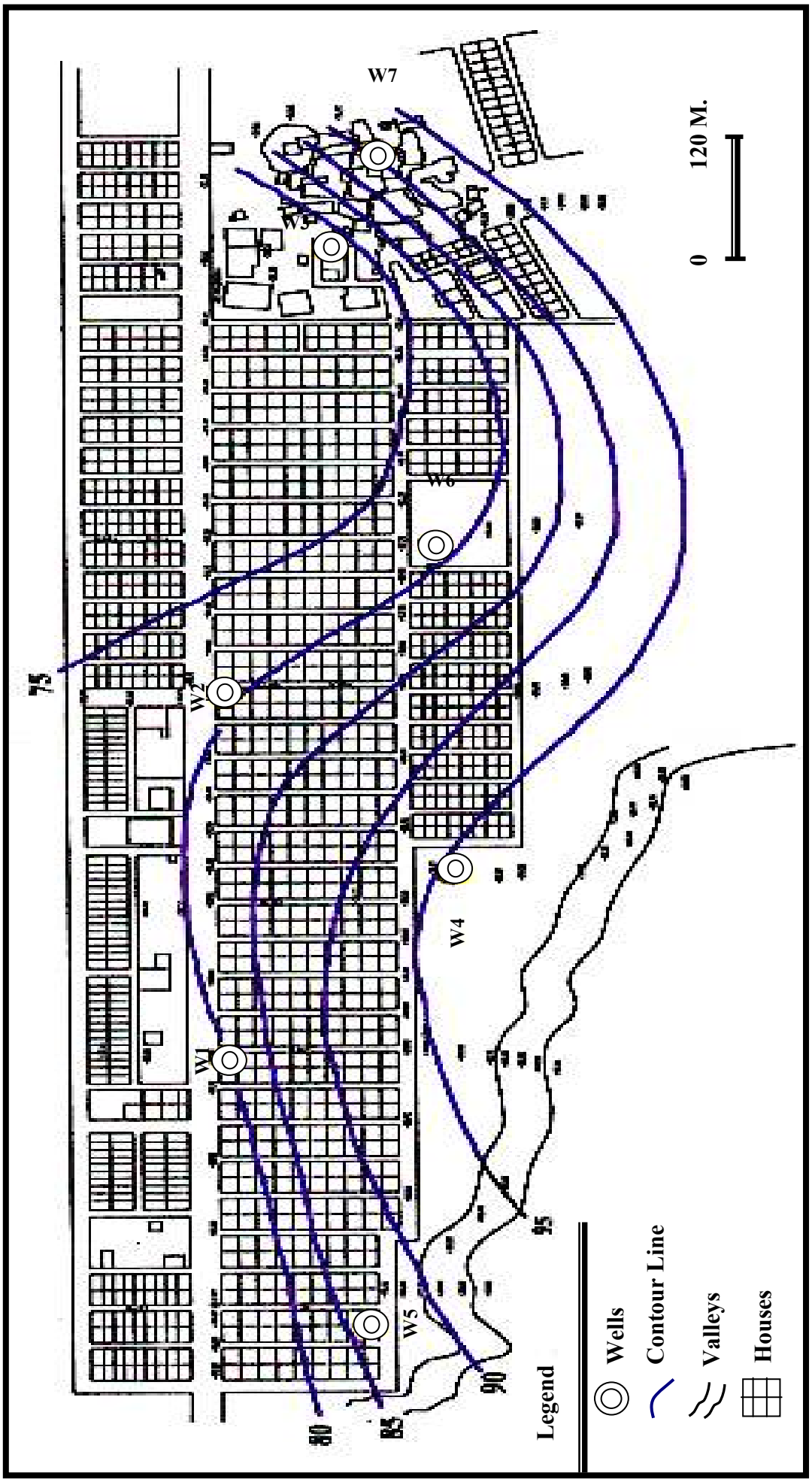

Fig. -2 : Contour map of Ca-ion, concentration in ppm

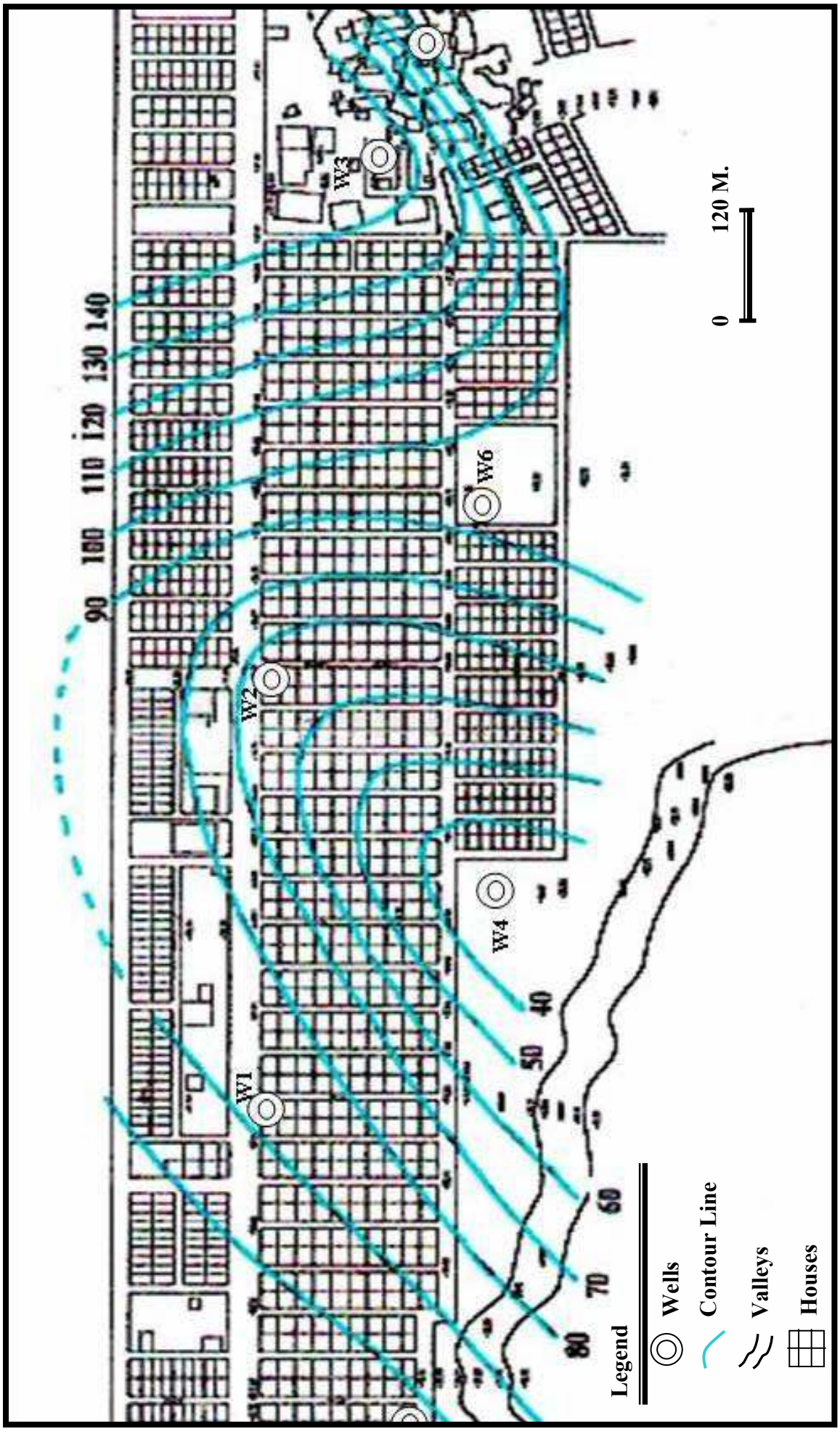

Fig.3: Contour map of Mg-ion, concentration in ppm

SO_4 :

As shown in (Figure 4), contour map of $S0_4$ ion distributionshows that concentration increases towards the well No.3 to about181ppm, and the lowest concentration is about 86.5ppm in the well No.6. There is no clear image about the source of sulphate . However it is believed that the water drained the cultivated area which carrying $S0_4$ from fertilizer infiltrated to the aquifer at the north of the Assemblage .

Cl^{-1} :

Distribution of Cl ion is shown in (Figure 5). Theconcentration of Cl ion ranges between (30-70)ppm, where the lowestvalue occurs in the well No.2 and the highest value occurs in thewell No. 1.

NO^{-}_3 :

The values of nitrate are used as indication of the ground watercontamination in the Assemblage area. It ranges from (1.87-6.03)ppm, asshown in (Figure 6). Despite these values are within the range ofdrinking water but comparatively wellsnumber (4, 5) show higherconcentrations than the other wells. These values are probably caused byinduced infiltration of water from the valley that drained the cultivatedareas and the sewage water of the Assemblage (Plate 1).

BIOLOGICAL PROPERTIES

Special samples of water were collected from the seven existingwells, to examine the presence of coliform (Table 2). The distribution ofcoliform per 100 ml in the area is shown in (Fig.7). The number ofcoliform are ranging from (50-75) cell /100ml except well No.2 where thecoliform reached to 150cell / 100ml.

The contaminant well is located at themiddle part of the Assemblage area where the ponds of sewage water are located around (Plate 2) where septic tank effluents and sewage are disposed.

The high values of coliform are indicatingcontamination of the water wells from the sewage water, due to the highinfiltration through the Bi-Hassan Formation as well as human activity.

it appears that some of the physical and chemical water quality of the studied wells was relatively good. However, from bacteriological point of view, the water is contaminated. The reason stayed behind this contamination may be cross connection occurring between water supply pipes and wastewater ponds where suction take place with in the network.

Also it is noted that some of pipes pass through house septic tanks. This water supply will inevitably cause pollution of water sources. Besides, the soil of the area is high permeable. This encourages infiltration of accumulated wastes to ground water. This is clearly shown in plate 1b.

Table-2: Number ofcoliform/100ml

WellNo.	1	2	3	4	5	6	7
Coliform No./ 100ml	15	140	35	35	15	75	45

According to WHO,1981 the number ofcoliform in thewater for domestic uses should not exceed 1cell /100ml and according tothe UKStandard, the water is considered satisfactoryif the number of coilform /100ml between (1-3)cell .As shown in (Table 3) the water of the wellsexceeds these standards, the water of the Assemblage iscontaminated.

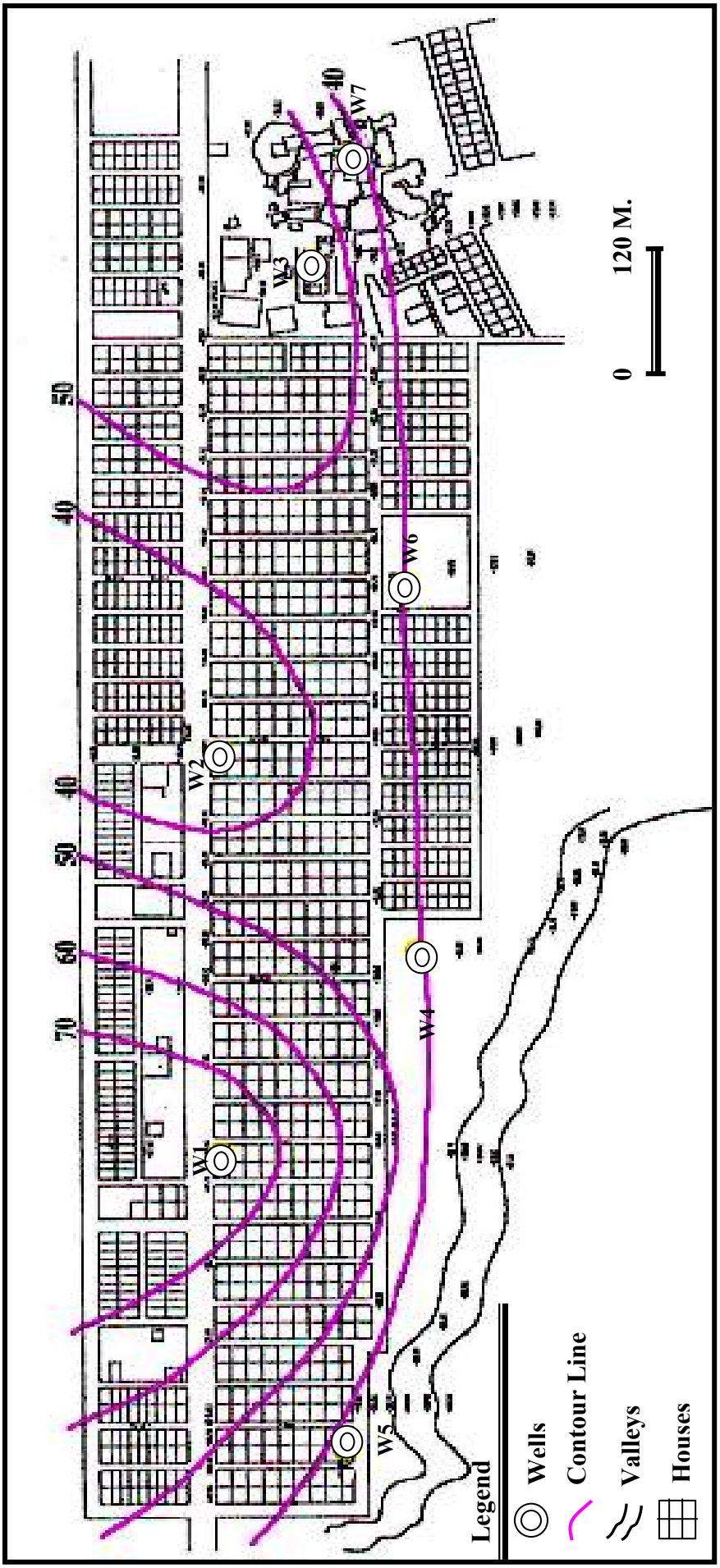

Fig.-4: Contour map of SO_4^- ion, concentration in ppm.

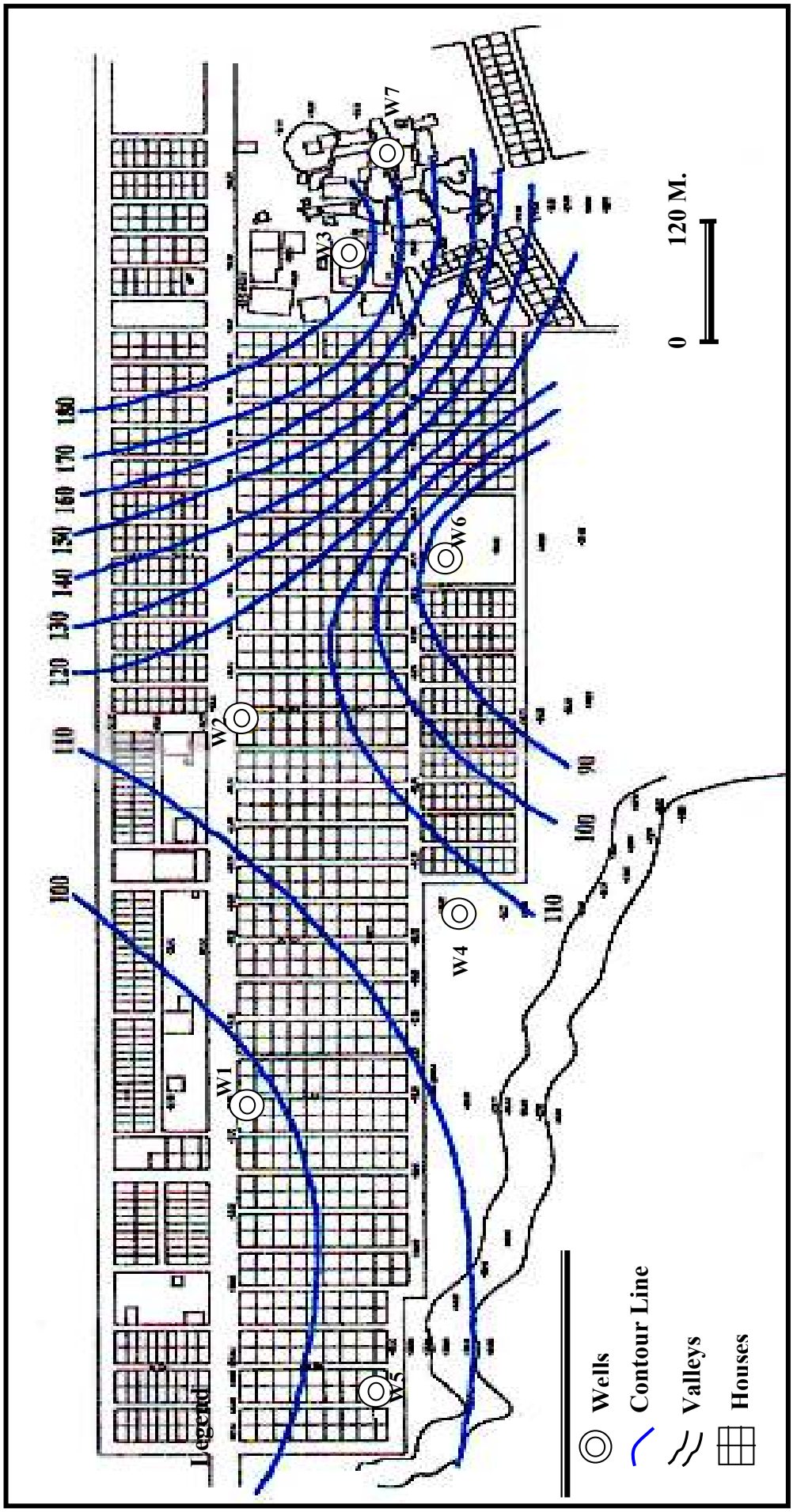

Fig.-5: Contour map of Cl-ion, concentration in ppm.

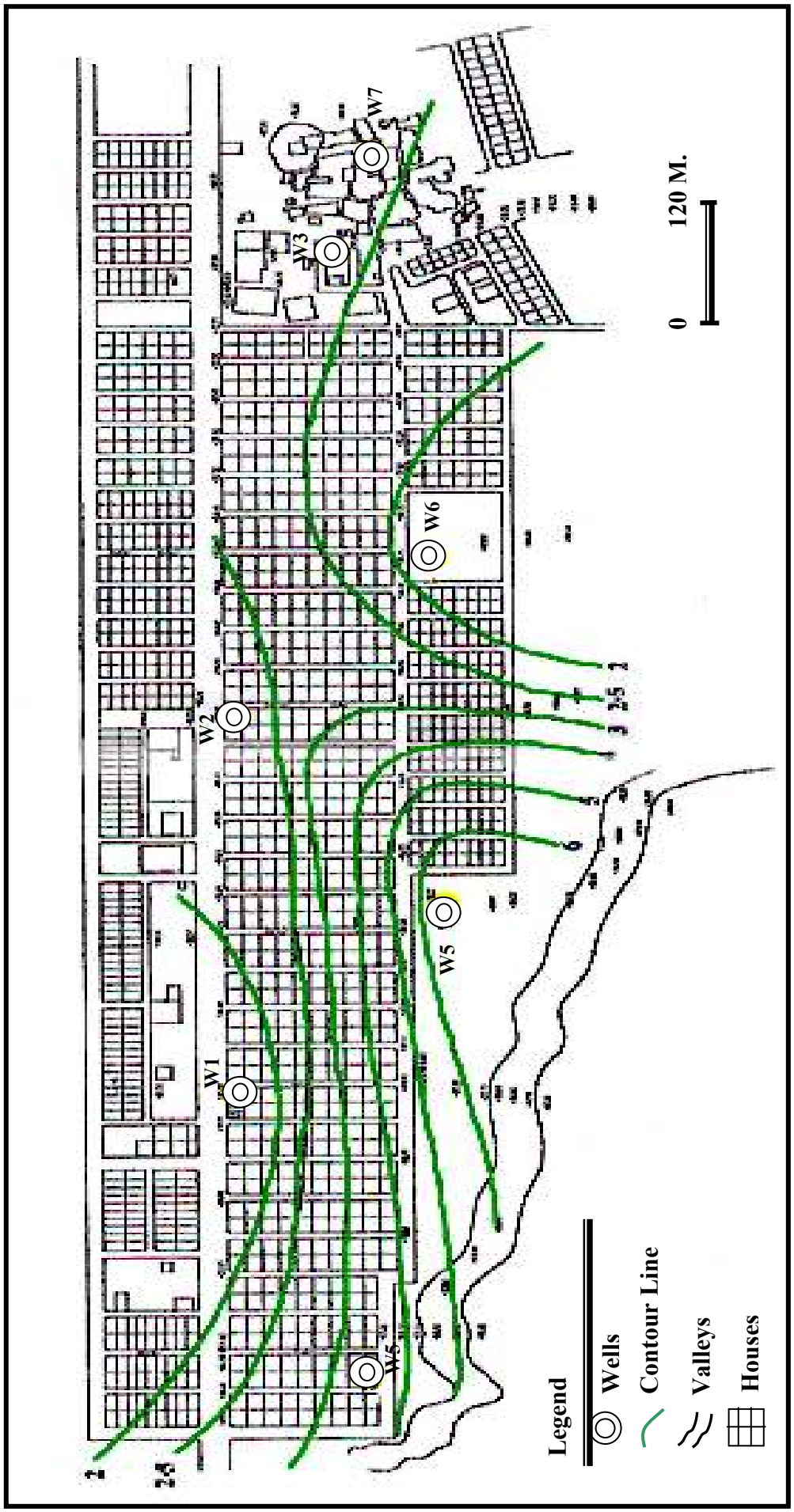

Fig.-6: Contour map of NO_3-ion, concentration in ppm.

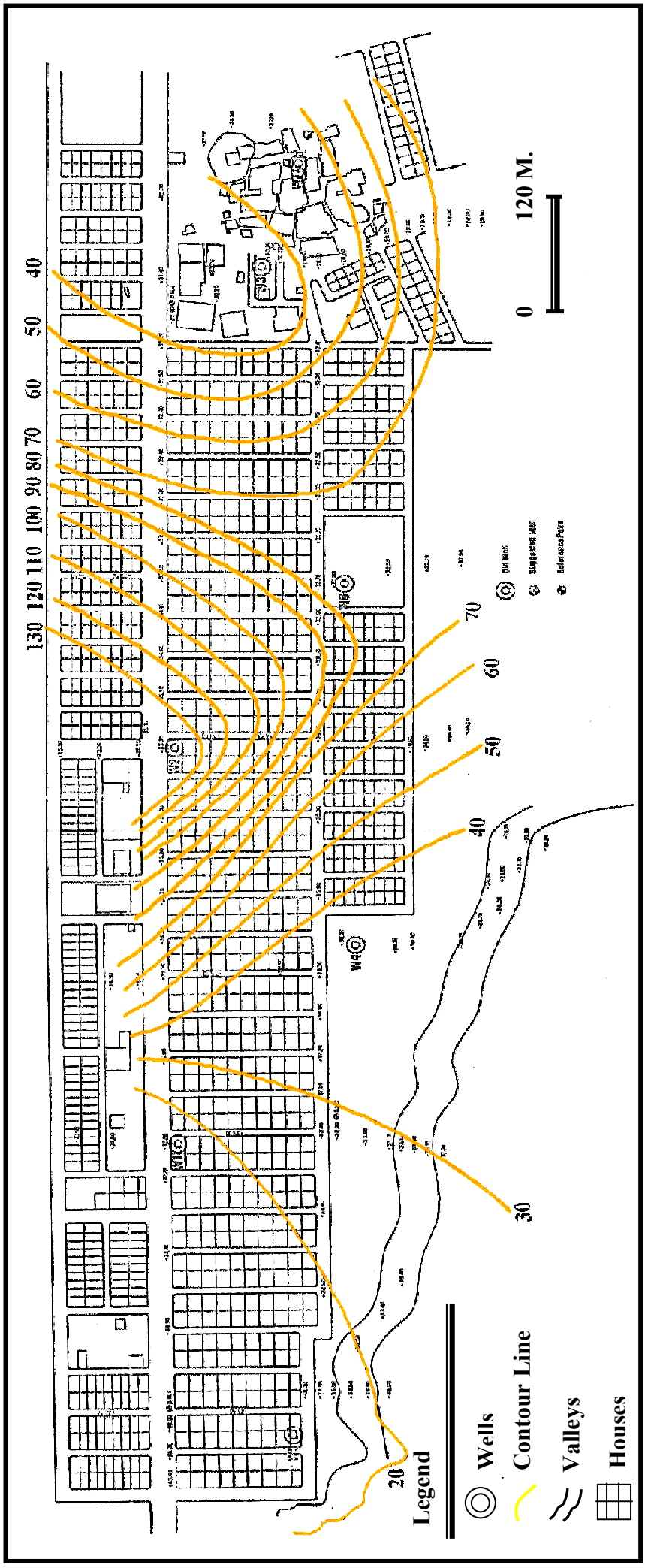

Fig. -7 : contour map of coliform diminution coli/ 100 ml.

Plat(1a): source of No_3 from the sewage water around the well.

Plat(1b): source of NO_3 from the sewage water around the well.

Plat(2): shows the pond of sewage water around the well.

Table-3: Standard ofcoliform according to UK Ministry of health

Class	Description	Coliform No./ 100ml
I	Excellent	0
II	Satisfactory	1-3
III	Suspicious	4-10
IV	Unsatisfactory	10

It is believed that the quality of ground water at the study area is not suited for domestic use . It is risky therefore a treatment is needed before it's used by consumers .

CONCLUSIONS:

1.Drainage system of the runoff water flows from north to the south, recharge to the area is mostly from rainfall via permeable formationswhich are exposed in the area.

2.Depth of the water level is about (20-25)m below the land surface at theresidential Assemblage.

3.Chemical analyses reflects that major cations and anions are within therange of acceptable water.

4-The biological test indicates a number of coliform in the water exceeding allowable limits , which is classified as contaminated water and it is risky as well as donot suit domestic use.

RECOMMENDATIONS:

1.It is very necessary to construct new water supply network far away from house septic tanks.

2.It is highly recommended to dug wells at locations north-east of the

3.Construct wastewater drainage network to avoid ponds of wastes and reduce infiltration.

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