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## **ASSESSING THE POLLUTION OF THE WEST BANK WATER RESOURCES**

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### **Introduction**

Water availability is obviously one of the most important and highly sensitive issue facing the Middle Eastern countries in the coming years. Palestine (defined here as the West Bank including East Jerusalem and the Gaza Strip) is one of the Middle Eastern countries that suffers from water scarcity. The major water resources available to the Palestinians in the West Bank are the Jordan River and the West Bank Aquifer which is located under the West Bank and receives most of its rain. Israel, since its occupation the Palestinian Territories in 1967, has monopolized these water resources to its benefit. Palestinians are not allowed to use more than 15% of their groundwater and are denied access to the Jordan River. Water issues in the Palestinian-Israeli peace talks are postponed and will be settled in the permanent status negotiations.

The West Bank Aquifer is the most important source of fresh water available to the Palestinians Unfortunately, during the past twenty eight years, this source of water has been subjected to severe deterioration due to the irresponsible practices of the Israelis. Environmental concerns were not considered a priority throughout the period of Israeli occupation. The Israelis environmental laws, standards or regulations were not applied in the Occupied Territories. Instead, more than two thousand military orders were passed to control all affairs of the Palestinian population in these areas. During the period of occupation, the Israelis ignored the Palestinians needs to have sewage networks, treatment facilities, garbage collection, sanitary landfills or hazardous waste management systems. As a result, all types of wastewater, industrial, domestic and that from medical facilities are discharged untreated to the wadis where it can easily percolate into the groundwater. Solid wastes from homes, industries and hospitals are dumped randomly or into uncontrolled dumping sites where heavy metals and hazardous materials may percolate into the groundwater. Moreover, the Jewish settlers living in the West Bank and Gaza are adding more pressure on the environment as their solid and liquid wastes are also dumped without treatment into the environment. These practices endangered the quality of water in the West Bank Aquifer. This study will try to address the potential problems and sources of pollution to this Aquifer.



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## Background

The main sources of water in Palestine, is the surface water (Jordan River) and the West Bank Aquifer system. The Jordan River is 252 kms long from its source near Banias to the Dead Sea, with a surface catchment area of about 17,665 km<sup>2</sup> (Moore, 1994). The headwaters of the Jordan River originate in the southern and western slopes of Mount Hermon (Figure 1). The river system is composed of the Hasbani, the Dan and the Banias rivers. They flow south in a deep depression from the northern mountains to Lake Tiberias at approximately 200 meters above mean sea level. Downstream of Tiberias is the Lower Jordan river basin which joins the Yarmouk and Zerka Rivers originating from Syria and Jordan in the east. The outlet of this basin is toward the Dead Sea in the South at approximately 400 meters below mean sea level.

Syria, Israel, Lebanon, Jordan and Palestine are all riparians of the Jordan River basin and 80% of the basin is located in Jordan, Israel and Palestine. The natural flow of the river (in the absence of extraction) is estimated to be roughly 1,476 MCM at the entrance to the Dead Sea (Moore, 1994).

This water represents an important component in the water budget to the riparians. Different riparians took water to fulfill their needs from the river basin. The Jordan River's water satisfies around 50% of Israel's and Jordan's demand. Before entering the Lake of Tiberias, the Israelis are diverting approximately 380 MCM/yr. of the Jordan's water to feed the Israel's massive national water carrier, which distributes fresh water right down to the Negeb. Another 450 MCM are siphoned by the Israelis, Syrians and Jordanians from the Yarmouk River (Moore, 1994). As a result, there is no fresh water to flow downstream of Tiberias. The small quantity that reaches the Palestinian riparian in the West Bank is of bad quality. The deterioration of the Jordan River water quality may be due to the upstream utilization by other riparian and saline springs emerged at the downstream of Tiberias, as well as agricultural return flows and disposal of untreated sewage by the Israeli colonies at the Jordan Valley.

The Palestinian's share of this river is estimated at around 220 MCM/yr, but they cannot use it because of the deteriorated quality and because there is no access to the river due to the military closure of the area by the Israelis since 1967.

**Figure 1:** Headwaters of the Jordan River



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Groundwater, is the most important source of fresh water supply to Palestinians in the West Bank. The aquifer system in the West Bank is composed of dolomite and limestone rocks of the lower Cenomanian and Turonian ages.

The annual rainfall in the West Bank is estimated at 3,000 MCM. Around 600-650 MCM of this rain is estimated to infiltrate the soil to replenish the aquifers annually. Figure (2) shows a schematic diagram that illustrates the water's flow path to form different groundwater basins. There are two general directions of flow for the groundwater of the West Bank Aquifer, east and west. The system can be divided according to flow into three groundwater basins:

1. The Western Basin which is the largest and has a safe yield of 350 MCM per year;
2. The Northeastern Basin which has an annual safe yield of 140 MCM; and
3. The Eastern Basin whose safe yield is 125 MCM per year.

Soon after its occupation of the West Bank in June 1967, Israel seized absolute control over the West Bank's natural resources. A serious discrepancy exists in the amounts of water supplied to Palestinians and Israelis. Palestinians are permitted to use only a small fraction of the total amount of their water resources. Of the total available groundwater in the West Bank, the Israelis illegally utilize 483 MCM/year, while Palestinians are using only 118 MCM/year.

## **Methodology**

The Applied Research Institute of Jerusalem had followed the following steps to determine the sources of pollution that could deteriorate the quality of the West Bank aquifer:

### **1- Analysis of Aerial Photographs**

Aerial photographs are a very important tool that can clearly indicate the location of the pollution source. The scale and overlap of the aerial photographs play a crucial role in the data accuracy. A total of 310 aerial photographs, covering the northern part of the West Bank, have been used in the analysis (Figure 3).

These aerial photographs were taken in May, 1995 having an overlap of 30-35% and a scale of 1:20,000. Ten major features were distinguished from the aerial photographs. Some of them have also sub-features which can be distinguished.



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## 2- Field work

The field work was conducted to collect and validate data that are difficult to obtain through the base maps and aerial photographs. Also, as aerial photos are covering the northern area of the West Bank, data for the southern part was not available. Collection of the missing data was done through literature review, maps from different sources and field surveys and checks. The field work was conducted on a district bases to cover the whole area of the West Bank. The following steps were conducted to complete the field work:

1. *Field survey:* Different questionnaires were prepared to cover the municipal solid and liquid waste generated from each Palestinian human built-up area. Another questionnaires for the industrial facilities and medical centers were also prepared to estimate the quantities, quality and methods of disposal of the industrial and medical waste. Field visits to the municipalities, village councils, different industries and medcenters were conducted.
2. *Field check:* Some of the features such as dumping sites, cisterns, wells and springs were very difficult to be distinguished from aerial photographs with a scale of 1:20,000. Intensive field checks using the Global Positioning System (GPS) were performed to determine the location of these items.
3. *Water sampling:* Water samples from different wells and springs were collected to measure the physical and chemical analysis. Physical parameters such as temperature, conductivity and pH were conducted in the field while the major cations and anions were conducted at the laboratory.

## 3- Integration of the Map Data in the GIS

The Geographic Information System (GIS) is a very useful tool that provides an integrative approach to determine, analyze and solve the environmental problems. After completion the analysis and the smoothing process of the map data, the smoothed features (layers) were then digitized. To do this, a registration process was performed where the coordinates of each item of the map were determined by using known reference points (ground control points) and the Global Positioning System (GPS). Two GIS software packages were used namely PAMAP and Arc\Info. PAMAP is used for the digitizing process, while Arc\Info is used for the analysis and map production.

## Results and Discussion

The analysis of aerial photographs, along with the field surveys and checks and water analysis help in the identification of the pollution sources over the West Bank Aquifer. The following describes the different pollution sources in the West Bank that may affect the groundwater quality.



## 1- Increasing the Salinity of the Lower Jordan River

The water quality of the Lower Jordan River suffers from constant deterioration. By the time it reaches the Dead Sea, the water is highly saline and loaded with heavy metals and other pollutants. The increasing salinity of the water is due to the diversion of the brackish water originates in saline springs and wells in Israel to the Lower Jordan River in a way to control the salinity in the Lake Tiberias.

## 2- Pollution from Wastewater

Wastewater is a major source of pollution that affects the ground water quality if disposed untreated to the environment. The major urban areas in the West Bank extend over the central highlands of geographic Palestine. These highlands are the main recharge area of the West Bank aquifers. Figure 4 shows the distribution of Palestinian built up areas in the West Bank, classified according to population ranges. Approximately 75% of the Palestinians in the West Bank depend on cesspits for the disposal of the domestic wastewater. Only 40-50% of the people living in the major cities have access to sewage collection networks. Yet, the existing networks are inadequate; many are very old from the Ottoman period and poorly designed which result in a regular leakage and flooding of the systems. In most cases, the collected wastewater is disposed freely to streams and wadis. Treatment facilities, if exist, are not working properly.

The improper disposal and reuse of wastewater especially over the highly permeable areas of the karstic, limestone West Bank aquifers, will certainly endanger the quality of the groundwater. Further future mismanagement of the wastewater will increase the adverse effect on groundwater and threatens the adequacy of its water for human consumption. Recycling and reuse of wastewater, if carried out with sufficient consideration of health, ecological and environmental safeguards, can be a highly beneficial to the environment and as a water conservation strategy. It has the potential to serve as a major source of water for agriculture in the near future. Figure 5 shows the streams in the West Bank where untreated sewage is flowing. Table 1 shows the estimated quantities of domestic wastewater generated in the different districts in the West Bank and the quantities collected by sewage networks.

**Table 1:** Wastewater generation and collection in the West Bank for the 1996.

District	Population*	Wastewater Production (MCM/yr)	% of Population Using Cesspits and Open Channels	% of Population Connected to Sewage network	Wastewater in Sewage Collection Network (MCM)
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<b>Tulkarm</b>	199,562	7.7	70	30	2.32
<b>Nablus</b>	370,884	16.4	62	38	6.2
<b>Jenin</b>	187,601	4.9	87	13	0.64
<b>Ramallah</b>	197,737	6.2	78	22	1.37
<b>Jerusalem</b>	228,585	9.3	60	40	3.7
<b>Jericho</b>	23,852	2.0	100	0	0.0
<b>Bethlehem</b>	141,952	3.1	65	35	1.08
<b>Hebron</b>	309,792	5.8	83	17	1.0
<b>Total/Average</b>	1,659,965	55.4	75	25	16.31
<i>Population are estimated from PBS, 1996</i>					
<i>Source: ARIJ survey</i>					

The quantities of generated wastewater will increase dramatically with the projected increase in population and the per capita consumption. The forecast of wastewater generated for the 1996-2020, is detailed in Table 2. Appropriate management programs for the wastewater collection and treatment are badly needed in the West Bank, hence to stop polluting the groundwater and to use the treated wastewater for irrigation.

<b>Table 2: Forecast of wastewater generated in the West Bank for the 1994-2020</b>				
<b>Year</b>	<b>Growth rate</b>	<b>Population (thousands)</b>	<b>Water Consumption (MCM)</b>	<b>Generated Wastewater (MCM)</b>
<b>1994</b>	3.6%	1,510.5	63.1	5td>139.4
<b>2010</b>	2.5%	3,137.0	317.8	254.2
<b>2020</b>	2.5%	4,015.6	508.0	406.4
<i>* total population plus an assumed 400 thousands returnees.</i>				
<i>population growth rate and estimates are based on Isaac et al, 1994</i>				

## Wastewater Quality

The characteristics of wastewater in the West Bank has not been well analyzed as the lack of collection networks in some areas makes sampling difficult. The BOD level (Biochemical Oxygen Demand) of sewage in the West Bank averages 600 mg/l. This is higher than the BOD level in developed countries which commonly have BOD levels of 200-300 mg/l. This high level is due to the fact that the per capita consumption of water in Palestine is suppressed by political restrictions applied by Israel on Palestinian water use, therefore the generated wastewater is highly concentrated.



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## Wastewater Treatment in the West Bank

Wastewater treatment has not been a priority through the years of Israeli occupation in the West Bank. The four existing treatment plants are completely inadequate and introducing partial treatment to approximately 5.3% of the generated wastewater in the West Bank. Most of these treatment plants are either overloaded, under designed or have a mechanical failure and therefore, waste is discharged without treatment or with only partial treatment into the wadis.

The treatment plants in the West Bank are located in Tulkarm, Jenin, Ramallah and Hebron. All of them were built during the 1970's and are designed as aerated ponds. The systems have not been well maintained and are functioning at very low efficiency, if at all. There has been no central authority responsible for the design and management of these plants, each community is responsible for the plant in its area.

## Impact of the Israeli colonies

Israel adds to the wastewater problem of the West Bank significantly. The generated wastewater from the 306,800 settlers living in the West Bank and in East Jerusalem is being disposed of without proper treatment. Figure 6 shows the location of Israeli colonies in the West Bank. As the consumption of water for Israelis is significantly higher than for Palestinians, so is the amount of wastewater they generate. The Israeli settler annual water consumption averages 140 m<sup>3</sup> per year for domestic purposes, which is almost four times the per capita Palestinian consumption. This means that the settlers in the West Bank and in East Jerusalem discharge into the environment approximately 34.4 MCM of wastewater per year compared to the 55.4 MCM of wastewater generated by Palestinians.

Although information about wastewater treatment in the colonies is not fully available, the survey shows that wastewater from colonies is either disposed through cesspits or collected in networks which open into the surrounding land. Since the colonies are invariably located on hill crests and ridges, their untreated wastewaterpresumably flows in the direction of the lower lying Palestinian homes, water resources and agricultural lands. Many Palestinian villages are suffering from the flowing wastewater as it causes several health problems and damages to their agricultural land. Figure 5 shows the Palestinian affected areas from the Israeli colonies or related industrial zones.

The many cases of environmental pollution resulted from the Israeli settlers irresponsible practices that affects the Palestinian localities in the West Bank have been registered. The following are some examples of these cases:

- The wastewater from the Alfeh Menasheh colony, estimated at 336,000 m<sup>3</sup> per year, is discharged into the adjacent Palestinian lands especially of Habla village



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and Qalqiliya city. The generated wastewater passes through the agricultural lands and damages the planted fields. It also adversely affects the water resources, and accumulates in sewage pools that create different diseases and cause health and environmental hazards.

- The city of Qalqiliya also suffers from the wastewater generated by the Israeli colony of Tsur Eyal, located at a higher elevation across the green line. The generated raw wastewater from the colony is collected in a pond few meters away to the west of Qalqiliya city. This pond was established by the Israeli Authorities in the eighties to collect the wastewater from the adjacent colonies and to irrigate the cotton and corn fields. The presence of this wastewater pond is causing serious health diseases to the residents and to the planted crops. The farmers in the area complain from the spread of the white mosquitoes which attack and transmit different diseases to their crops (Al-Quds newspaper, 21/10/1996).
- Ari'el colony, in the north part of the West Bank, produces 1.43 MCM per year of wastewater. This wastewater is discharged untreated into Wadi el Matwi passing through Salfit city. It adversely impacts the environment and contaminates the ground water.
- The Israeli colonies of Yaqqir, Qarna Shamron, and Emmanue', located in the Nablus district together generate around 908,700 m<sup>3</sup> of wastewater per year. The wastewater is released directly to the nearby Wadi Qana which runs over the groundwater recharge area of the Western Aquifer. Wastewater from these colonies therefore seeps into the ground and pollutes the aquifer. The wadi also passes through a nature reserve where the flowing wastewater pollutes the natural systems there.
- The Israeli colony of Roush Zourim, located nearby El Jaba'a village in Hebron district, releases its wastewater into wadi Samit and polluting the springs located in this valley. The untreated sewage from the colony causes several hazards to El-Jaba'a village by creating insects and releasing bad odors. The amount of wastewater produced by this colony is estimated at 31,360 m<sup>3</sup> per year.
- The wastewater from Al-Majnouna Israeli military camp is flowing since a long time near the artesian wells followed to Dura municipality and threatening the water resources at this area.
- The wastewater of the colonies of Danial and Afrat is damaging approximately 30 dunums of the vine yards owned by villagers from Al-Khader.
- Most of the Israeli colonies in the Jerusalem district lack the infrastructure required for the sewage collection and disposal. Wastewater from these colonies flows down the fields and valleys. Qatanna village is one example where wastewater from nearby Kibbutz Ma'aleh Hameshah flows into the center of the village, forming lagoons near the houses and village schools. Added to this, the wastewater flowing from Neve Ya'acov passes through Hizma village land and reaches E'in Farrah spring, to the east of the village. Villagers reported that the wastewater flow affects the water quality of the spring and prevents villagers from utilizing its water for any purpose.



- Percolation of wastewater from cesspits of Argaman colony, located to the east of Al-Izbedat village, pollutes the groundwater in this area. Al-Izbedat village depends totally on the groundwater wells for domestic and agricultural use. The nine wells in the village, of which five of them are owned by people from the village are presently polluted. Villagers are using the polluted water for cleaning and agricultural purposes, while drinking water is bought from other areas via water tankers.

**Table 3: Palestinian localities affected by the wastewater disposed of from Israeli colonies**

District	Israeli colony	Affected location
Nablus	Sha'ar Tikva	Beit Amin
Nablus	'Emmanue	Wadi Qana
Nablus	Yaqqir	Wadi Qana
Nablus	Qarna Shamron	Wadi Qana
Nablus	Argaman	Al-Izbedat
Nablus	Ari'al	Wadi El Matwi
Tulkarm	Alfeh Menasheh	Habla, Qalqiliya
Tulkarm	Tsur Eyal *	Qalqiliya
Jerusalem	Ma'aleh Hameshah *	Qatanna
Ramallah	Talmon A	Al-Janiya
Bethlehem	Danial	Al-Khader Land
Bethlehem	Afrat	Al-Khader Land
Bethlehem	Har Gilo	Al-Walajeh
Hebron	Rosh Zurim	El Jaba'a
Hebron	Al-Majnouna military camp	Dura

\* Israeli colony inside the green line.

Source: ARIJ survey, 1996, Ministry of Health, Environmental Health Department, 1996

The problem of wastewater disposed from the Israeli colonies will certainly exaggerate if the Israeli government continues to adopt the policy of colony expansion in the West Bank and East Jerusalem.

### 3- Pollution from Agricultural Practices

Pesticide residues can become airborne either as a vapor or absorbed onto dust particles, which can blanket water and fall on soil a distance from the spraying site. Surface



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drainage from treated croplands contains pesticides especially when surface irrigation is the main method of irrigation. In the 1994, approximately 302.7 tons of pesticides including sulfur and 200 tons of methyl bromide were used by farmers for the agricultural pest control in the West Bank. Unfortunately, data about the quantities of pesticides used by settlers in the cultivated areas in the West Bank are not available. Pesticides in soil and surface water will move down through the soil and may reach the groundwater table.

Fertilizers are another source of groundwater contamination coming from agricultural practices. It is estimated that 30,000 tons of fertilizers are annually used in the West Bank. Unfortunately, the fertilizers quantities used by the settlers in the West Bank are not available. Figure 7 shows the Palestinian and Israeli cultivated areas in the West Bank where fertilizers and pesticides are used.

Nitrate level in the groundwater is used as indicator to pollution. Nitrates have been measured in 225 groundwater wells in the West Bank. Then, a nitrate contour map has been established using the Ground Water for Windows (GWW) software. Figure 8 shows that the nitrates level in many areas has exceeded the permissible nitrate level (45 mg/l) as specified by the WHO. The increase in the nitrate level in the groundwater may result from the fertilizer and pesticide usage or may be due to the disposal of untreated wastewater.

#### 4- Pollution from Municipal Solid Waste

With the existing management, Palestine faces an increasing solid waste problem. The daily estimated generated domestic solid waste in the West Bank averages 1,470 tons/day. The quantities generated is coming more and more with the increase in population and changes in people habits. The forecast of solid waste generation for 1996-2020, is detailed in Table 4.

**Table 4:** Forecast of solid waste quantities in the West Bank for the 1996-2020

Year	Growth rate	Population (thousands)	Estimated quantities (Tons/day)	Estimated quantities (Tons/year)
1996	3.6%	1,640	1,476	538,740
2000	3.2%	2,289.4*	2,060.5	752,082
2005	3.2%	2,680	2,412	880,380
2010	2.5%	3,137	2,823.3	1,030,504
2015	2.5%	3,550	3,195	1,166,175
2020	2.5%	4,015.6	3,614	1,319,110

\* total population plus an assumed 400 thousands returnees.

population growth rate and estimates are based on Isaac et al, 1994



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A considerable amount of solid waste that increases the pressure on the West Bank's environment, is that generated by the 306,800 Israeli settlers living in the West Bank and East Jerusalem. It is estimated that the daily of domestic waste generated by each Israeli settler is 1.3 kg. Thus, the total quantity is estimated to be 145,580 tons of solid waste generated by the Israeli settlers living in the West Bank in 1995. Although Palestinians are not able to know exactly where the settlers are disposing their daily solid waste, it is believed that the generated waste are disposed in the West Bank and are often taken to the same places where the Palestinians dump their waste.

Solid waste piles are a prominent feature of the landscape in Palestine, representing a wide-spread problem, both in terms of management and ultimate disposal. The generated solid waste in the West Bank is dumped in open areas, roadsides and entrances of the villages. The increasing waste generated by the growing community of the West Bank is not only inadequately collected but also dumped without planning. These piles are often burned or left to decay. When rain comes, the hazardous materials in the garbage move down, contaminating the ground water.

None of the dumping sites in the West Bank are designed as sanitary landfills where they are not lined to prevent leachate percolation. The choice of the dumping site is done arbitrary without any consideration to the soil characteristics, topography or future planning. Dumping sites are located on public land, village land, or private land. They may be adjacent to built up areas, agricultural land, wells, or sensitive groundwater recharge areas. Figure 9 shows the location of the dumping sites registered in the West Bank.

## **5- Pollution from Industrial Activities**

There are no proper waste management programs for either hazardous or non-hazardous wastes generated by industrial establishments in the West Bank. The Israeli laws for industrial waste management were not applied. Therefore, all types of wastes are released untreated into the environment. Untreated wastewater percolates with all its contaminants into the groundwater.

Some of the industrial effluents may contain heavy metals such as effluents from the tanning industries, textile industries, metal finishing and electroplating industries. There is no special treatment for the different effluents. All effluents are disposed untreated either through cesspits or sewage networks that ends in streams. The tanning industries, for example which is mainly located at the industrial zone of Hebron city, produce effluents contaminated with chromium ions. These effluents are discharged untreated to the sewage network of Hebron city ending to wadi As-Samn to the south of the city. Moreover, electroplating industries, located at different industrial zones of the West Bank, are also generating hazardous materials such as heavy metals and low pH effluents.



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Their effluents are usually discharged to the environment untreated through cesspits or sewage networks.

Other industrial effluents may carry high organic load and total suspended solid such as the effluents generated from olive oil mills, slaughter houses and dairy industries. There are approximately 300 olive mills in the West Bank. The liquid waste equals almost 1.5 m<sup>3</sup>/ton of pressed olive. This large amount (approximately 100,000 m<sup>3</sup> in 1994) is of extremely concentrated effluent (42,000 mg/l BOD & 65,000 mg/l TSS), is potentially injurious to the environment. It is released untreated into the sewage networks, or onto open areas without any consideration to its environmental impact on the groundwater or land. Figure 10 shows the location of different olive mills in the West Bank.

## Industrial Zones

The existing Palestinian industrial zones are located either at the entrances of the towns, near the dumping sites or very close to the built-up areas (Figure 10). An environmental impact assessment studies to the proposed industrial zones were not conducted by responsible people. Moreover, the infrastructure of water and sewage networks are in bad conditions, causing many environmental problems, facilities for the solid waste disposal or storage for the hazardous waste are not there. In general, environmental conditions in the existing industrial zones are poor. Several problems are associated with these areas such as improper disposal of solid and liquid waste, poor building quality and inappropriate infrastructure. Moreover, many of the industrial firms are located outside the industrial zones at residential or commercial areas.

Moreover, at least seven Israeli industrial zones, occupying an area of 302.345 hectares, are distinguished in the West Bank (Figure 10). The type of industrial activities, their wastes and disposal methods are not accessible to the Palestinians. Many Palestinian localities are suffering from the industrial effluents generated from the Israeli industrial zones especially that generated from Barqan and Qiryat Arba' industrial zones. The industrial zone of the Israeli colony Qiryat Arba' is considered a major environmental disaster in the area. For the last seven years, this colony is being dispose its industrial wastewater especially that coming from the wine industries beside the Hebron-Bani Na'im road. This effluent damages the vine yards and affecting some Palestinian houses at Bani Na'im village.

Also, the Barqan colony with its industrial zone, disposes both its domestic and industrial wastes into the planted lands of Burqin, Kafr ed Dik, and Sarta. It is estimated that Barqan industrial zone generates 810,000 m<sup>3</sup> per year. In 1991 and 1992, the Israeli Regional Council (Shomron) had conducted a study to evaluate the composition of the generated industrial waste. The study showed that the generated industrial waste was not meeting the standards and contained toxic and hazardous chemicals from the electroplating



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factories. Although the Israeli officials are informed about the problem but they do not work to stop this disaster.

Table 5 summarizes some of the affected Palestinian localities from the Israeli industries in the West Bank.

<b>Colony</b>	<b>Industry</b>	<b>Affected Palestinian location</b>
Halmeesh	Fiberglass and tanning	Al-Nabi Saleh village
Barqan	Electroplating and military industry	Kafr Al-Dik, Sarta, and Burqin villages
Qiryat Arba'	Wine industry	Bani Na'im
Israeli Industrial zone at the green line	Fertilizers and Gas canister	Tulkarm city, agricultural areas

## 6- Pollution from Gas Stations

The ignorance of environmental considerations in the gas stations in the West Bank is forming a major source of pollution to the groundwater. Many gas stations are located in shops in the residential areas where the fuel tanks are located inside the residential buildings. It is estimated that there are approximately 127 gas stations in the West Bank, and thus gas pumping stations and the fuel tanks are not well maintained and are often not in service. The Israeli company (Dor) is responsible for the mechanical maintenance of the gas stations where it hires only one engineer to maintain all the Palestinian gas stations. The fuel, in most of the gas stations, is kept in underground tanks. These tanks are not monitored or checked for leakage. Even above ground tanks often have small leaks that are not repaired or maintained. Figure 9 shows the location of most of the gas stations in the West Bank.

Furthermore, many of the gas stations include car maintenance and oil change centers. Used oil is either collected in special tanks to be sold as a fuel or in many cases disposed into cesspits, where hazardous materials in the used oil could penetrate into the groundwater.

## Conclusion

The ignorance of the West Bank environment by the Israeli Authorities and the lack of environmental regulations and standards had resulted in the exposure of the water resources in the West Bank to many sources of pollution, hazardous and non-hazardous.



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This situation, if continued, will result in a damage to these major sources of fresh water. The PNA, since receiving authority in Areas A in the West Bank, started rehabilitation programs for the damaged environment. Water and sewage networks for major are designed and some of them are under implementation. Environmental laws, standards and regulations to control the disposal of industrial and hazardous waste are under study. The problem of hazardous waste generated from medical centers is addressed and an incinerator was installed at the Jericho district and other incinerators to be installed in the near future. Achievements of the PNA during the past two years are more than what have been done during the last 28 years of Israeli occupation.

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