The Islamic University-Gaza
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OPTIMAL WATER RESOURCES MANAGEMENT IN THE SOUTHERN GAZA STRIP

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بسم الله الرحمن الرحيم

﴿ قُلْ أَرَءَيْتُمْ إِنْ أَصْبَحَ مَآؤُكُمْ غَوْراً فَمَنْ يَأْتِيكُم بِمَآءٍ مَّعِينٍ ﴾.

(الملك: الآية 30)

ABSTRACT

Gaza Strip with its continuing water scarcity and limited available resources can not afford to continue with the present situation through the endemic mismanagement of water resources. The growing gap between water supply and water demand is calling for the mobilization of any additional conventional and non-conventional water resources. Pumping from closely spaced wells in the southern governorates of Gaza Strip has resulted in the formation of deep cones of depression in the groundwater table in the vicinity of the pumping centers. Water-level measurements indicate that there has been a steady decline in the groundwater table level in the vicinity of these pumping centers for the past 20 years.

Israeli authorities have recently evacuated Gaza Strip settlements. As a result, large areas with good quality water became available to the Palestinian use. Reconfiguration of the water supply systems will then be necessary for optimal utilization of the groundwater resources for the whole area. The proposed supply redistribution along with the utilization of treated wastewater and the desalination of large quantities of seawater are all considered crucial measures to close the gap between the supply and the demand, relief the stress on the groundwater aquifer, and ensure a long term sustainability of the water resources.

As we are faced with a multi-dimensional problem that involved both the groundwater system and the overland management system, a combined simulation-optimization techniques are used to predict aquifer behavior while simultaneously select the optimal set of management alternatives.

Visual Mod Flow (VMF) which is based on a finite-difference code and its integrated modules is used for groundwater flow simulation. In addition to that a Genetic Algorithms (GA) code is used to search the global optimal set of management alternatives to the water resources in the southern governorates. The VMF is utilized to define the groundwater system constraints for each planning horizon and to predict the behavior of the aquifer in response to supply reconfiguration. Based on the resource constraints, the target quality constraints for different users, and the socioeconomic factors the GA select the optimal set of supply alternatives considering all the available conventional and non-conventional options.

The results show that supplying part of domestic demand from evenly distributed set of wells in the settlements areas and reducing the production from the current problematic areas will significantly improve the groundwater table level in the area. The results also shows that in order to satisfy the quality constraints for both domestic and agricultural users, a large quantity of fresh water should be conveyed from outside the aquifer system (i.e. seawater desalination). This will improve the quality of domestic supply which in turns improves the quality of the effluent and as a result the reuse of effluent will not be constrained by quality (salinity).

الخلاصة

إن قطاع غزة بندرة مصادره المائية لا يمكن له أن يستمر بوضعه الحالي من حيث عدم فاعلية إدارة مصادر المياه وقلة الموارد التنموية. فالفجوة المتزايدة بين العرض و الطلب على المياه توجب إيجاد مصادر مياه إضافية سواء تقليدية أو غير تقليدية.

فالضخ المتواصل من آبار متقاربة في المحافظات الجنوبية من قطاع غزة أدى لنشوء مناطق ينخفض فيها مستوى المياه الجوفية إلى عدة أمتار ما دون المستوى الطبيعي. فقياسات مناسيب المياه سجلت انخفاضا مطردا في محيط مناطق الضخ خلال العشرين عاما الماضية. وبالإشارة إلي جلاء إسرائيل مؤخرا عن مستوطنات قطاع غزة فان هذا بدوره يوفر مساحات واسعة بمياه ذات جودة جيدة تحت تصرف الفلسطينيين.

إن إعادة توزيع مصادر المياه والمتمثلة بالآبار والمياه الجوفية سيكون ضروريا من أجل الاستفادة المثلى من الخزان الجوفي من المنطقة بكاملها. وإن إعادة التوزيع المقترحة لاماكن وكميات الضخ من الآبار إضافة لاستخدام المياه العادمة المعالجة وتحلية كميات كبيرة من مياه البحر تعتبر إجراءات ضرورية لتقليل الهوة بين العرض والطلب على المياه، وتخفيف الضغط الواقع على الخزان الجوفي، وضمان ديمومة لمصادر المياه على المدى البعيد.

وحيث أننا بصدد مشكلة متعددة الأبعاد والتي تشمل الخزان الجوفي والنظام المائي على الأرض، لهذا سيتم الاستعانة بتقنيات المحاكاة والمفاضلة وذلك لتصور تصرف الخزان الجوفي وبالتالي اختيار القيم المثلى من الخيارات الممكنة.

النموذج الرياضي(*VMF*) الذي يعتمد على (*Finite Difference Code*)، سيستخدم كنظام نمذجة لحركة المياه الجوفية، بالإضافة اعتمادا*Genetic Algorithm* للبحث عن القيم المثلى لكميات المياه من المصادر المختلفة. (*VMF*) يستخدم لوضع المحددات لنظام الخزان الجوفي في كل خطة، وتتبع تصرف الخزان الجوفي للتوزيعات المختلفة، اعتمادا على محددات المصادر ومحددات الجودة لكل المستخدمين، اخذين بعين الاعتبار العوامل الاجتماعية والاقتصادية. ثم يقوم(*GA*) باختيار القيم المثلى لكل المصادر المتاحة مع اعتبار الخيارات التقليدية وغير التقليدية المتوفرة.

لقد أظهرت النتائج أن إمداد جزء من الاحتياجات المنزلية من مجموعة من الآبار موزعة في منطقة المستوطنات، مع تقليل الإنتاج من المناطق الحالية، سيؤدي بشكل ملحوظ، إلى تحسين منسوب المياة الجوفية في المنطقة، و لقد أظهرت النتائج أيضا أنه لتحسين الجودة لكل من المياه المنزلية والمياه الزراعية، فانه لا بد من توريد كميات كبيرة من المياه من خارج نظام الخزان الجوفي، (مثل تحلية مياه البحر). سيؤدي هذا إلى تحسين الجودة للمياه المنزلية والتي بدورها ستنعكس على جودة المياه العادمة المعالجة وتصبح غير مقيدة بالملوحة لإعادة استخدامها.

Dedication

To my beloved wife, Sons, Daughter, Parents, and all my family I dedicate this work

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ACRONYMS AND ABBREVIATIONS

AMSL : Above Mean Sea Level
BMSL : Below Mean Sea Level
BOD : Biochemical Oxygen Demand
CAMP : Coastal Aquifer Management Plan
Cl : Chloride
COD : Chemical Oxygen Demand
EPA : Environmental Protection Agency
GA : Genetic Algorithm
Gene : Generation
GIS : Geographic Information Systems
GP : Genetic Programming
GSWDP : Gaza Sea Water Desalination Plant
IRP : Integrated Resources Planning
Max : Maximum
MCM : Million Cubic Meter
Min : Minimum
MOA : The Ministry of Agriculture
MOPIC : Ministry of Planning and International Cooperation
NIS : New Israeli Shekel
O.F : Objective Function
PCBS : Palestinian Central Bureau of Statistics
PHG : Palestinian Hydrology Group
PNA : Palestinian National Authority
PWA : Palestinian Water Authority
RMS : Root Mean Square
RO : Reverse Osmosis

TDS : Total Dissolved Solids

TSS : Total Suspended Solids

USAID : United State Agency for International Development

VMF : Visual ModFlow

WDM : Water Demand Management

WHO : World Health Organization

WWTP : Waste Water Treatment Plant

CHAPTER "1"

INTRODUCTION

1. INTRODUCTION

Increasing competition for water among urban, agricultural, and environmental water users and the relative absence of new inexpensive water sources has led to the need to jointly consider a wide range of options to improve the reliability and reduce the costs of water supplies. These options may involve structural, operational, and economic solutions involving yield enhancement, demand management, and water transfers (Jenkins et al,2000). Proper management of coastal water resources is important to satisfy demand, to maintain supplies, and to sustain associated terrestrial ecosystem (shamir et.al.,1984). The management of any system means making decisions aimed at achieving the system's goals, without violating specified technical and non technical constraints.

In the management of a ground-water system in which decisions must be made with respect to both water quality and water quantity, a tool is needed to provide the decision maker with information about the future response of the system to the effects of management decisions (Bear et.al.,1992). Scarcity and the limited options for augmenting supply to meet the needs of a growing economy and population strongly suggest that water resource management should focus on efficient supply and efficient usage of existing resources (Mac Groger,2000).

Water has long been recognized as a key to Gaza Strip wealth and economic well being**.** People in the Gaza Strip have lived under occupation for tens of years and still have been able to build a new society. But, how can they live without water?. Groundwater is the only source of supply in the area, but is rapidly deteriorating. Mining of the aquifer storage, and a degradation in its quality to such a level where it loses its value, are the major causes behind the deterioration. In recent years public attention, including the non-governmental organizations, have sharply focused on both groundwater quantity and quality. But groundwater management was neither formulated as a long-term planning policy, nor even seriously studied by policy makers (Abdul-Halim,1996).

This study addresses how to integrate the economic analysis and engineering modeling of water resources measures with the traditional analysis and modeling

1.1 The Study Area

1.1.1 Study Area Location

Gaza strip Figure (1.1) is located in the southeastern Mediterranean coast. The total area of the Gaza Strip is 365 square kilometers (km^2), of which 210 km^2 under Palestinian full authority.

The Gaza Strip falls in the transitional zone between two major climatic zones, the Mediterranean and the arid tropical zone. Average rainfall in southern Gaza Strip is in the range of 250 mm/year. In the sand dune area the recharge rate is about 60% of the total rainfall , in the clayey area is about 25% (PWA,1998). The Gaza Strip embodies five governorates, namely Northern Gaza, Gaza, Middle, KhanYunis and Rafah.

Israeli authorities have recently evacuated Gaza Strip settlements. As a result, large areas with good water quality became available to the Palestinian use.

The study area comprises Khan Yunis and Rafah governorates which are located in the southern part of Gaza Strip is considered a good site to study the influence of redistribution of municipal wells after Israel withdrawal from settlements Figure (1.1).

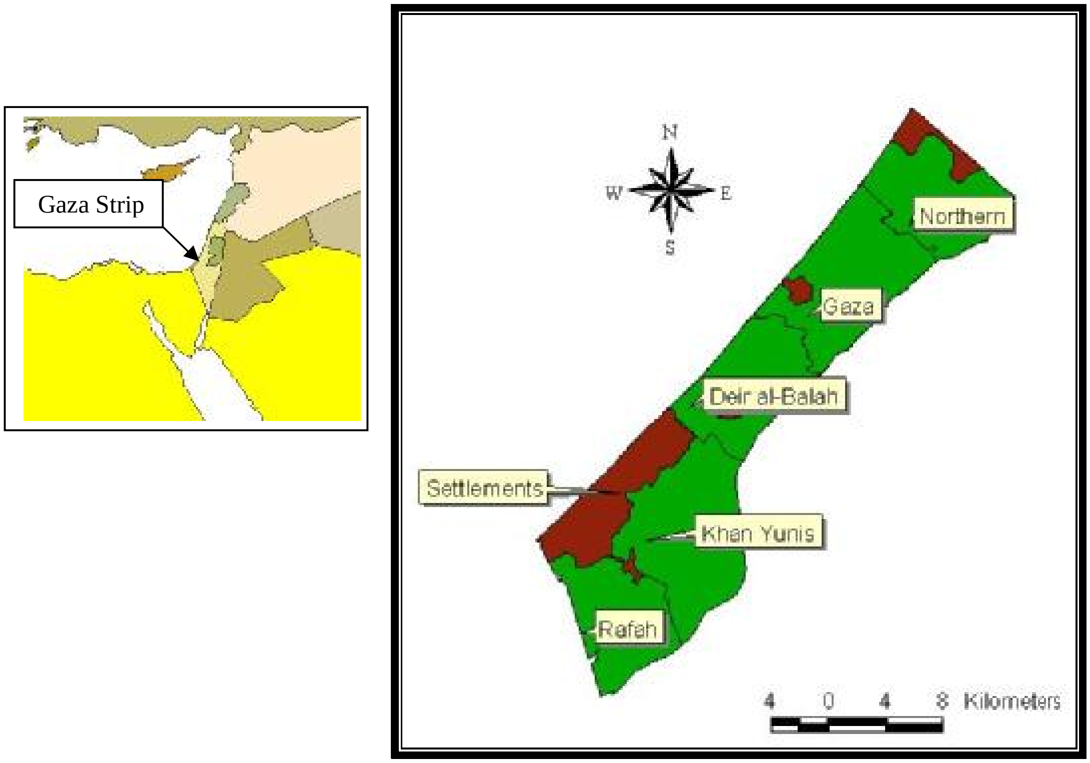


Figure (1.1): Gaza Strip Location

The availability of safe clean water is diminishing rapidly. Demand continually outstrips renewable supply. The ever- increasing population creates an increased pressure on water demand that affects directly the socio-economic development, and limit achieving remarkable economic growth and social prosperity (PWA,2002).

Gaza aquifer is a saline coastal aquifer with fresh water lenses floating above saline water, both near the coast and inland. The groundwater recharge comes mainly from rainfall and the rainfall varies from north (about450mm/yr) to the south (200mm/yr), and highly recharged area where the sand dunes exist in the north and part in Mawasi area, beside the agricultural return flow, lateral inflow from the Gaza eastern border(Metcalf and Eddy,2000).

The high intensive pumping for different purposes as well as the poor water resources management had led to depletion of available ground water storage and degradation of water quality. If uncontrolled pumping is allowed to continue, the aquifer, which is the primary source for the Gaza Strip, will become unusable as a source of fresh municipal water. This critical situation requires immediate efforts to improve the water situation in terms of quality and quantity, and to manage the limited water resources available to exploit fully in a sustainable and an environmentally safe manner (Metcalf and Eddy,2000).

1.1.2 Aquifer & Geology:

The coastal aquifer consists of interfering continental and marine units composed of sandstone, calcareous sands, siltstone, and red loamy stone. The bottom formation consists of thick compact marine clay (Saqyieh formation), This layer is dipping toward the sea at an average slope of 10m per kilometer (MOPIC,1998).

The hydrogeology of the coastal aquifer consists of one sedimentary basin, the post-Eocene marine clay (Saqyieh) which fills the bottom of the aquifer, Pleistocene sedimentary deposits of alluvial sands, graded gravel, conglomerates, pebbles and mixed soils constitute the regional hydrological system. Intercalated clay deposits of marine origin separate these deposits, these clay lenses are randomly distributed in the area. Their thickness is decreasing to the east and basically they can be classified as aquitards. In the eastern plains the aquifer is semi-confined with an average thickness of 10 m clay, becoming phreatic 4 km from the sea (MOPIC,1998).

The regional ground water flow is mainly westward towards the Mediterranean Sea. Most of the recharge occurs at dunes areas near the west coast from dunes occurring in the coastal aquifer itself and from the adjacent uphill area in the east zone. The maximum saturated thickness of the aquifer ranges from 180m near the sea to a few meters near the eastern aquifer boundary. Natural average groundwater heads decline sharply east of Gaza Strip and then gradually decline toward the sea (MOPIC,1998).

1.2 Problem Definition

In the Gaza Strip, the groundwater coastal plain aquifer is the only natural source of fresh water. However, the available groundwater is severely overused due to growing population and economic development. Pumping from closely spaced wells in the southern governorates of Gaza strip has resulted in the formation of deep cones of depression in the vicinity of the pumping centers. Water-level measurements indicate that there has been a steady decline in water levels in the vicinity of these pumping centers for the past 20 years (PWA data bank,2003).

The current population of the Gaza Strip is approximately 1.38 million according to Palestinian Central Bureau of Statistics(PCBS, 2005), inhabiting 60 percent of the Gaza Strip area (365 km^2). The remaining area of the strip was occupied by around 8,000 Israeli settlers and their security buffer zones. The current annual Palestinian utilization of aquifer water is estimated at 140 Mm^3, mostly bad quality water in terms of chlorides and nitrates (Metcalf and Eddy,2000). Of the 80 liter/capita/day of water delivered, only about 13 liter/capita/day meet World Health Organization (WHO) quality standards (Metcalf and Eddy,2000). Israeli annual abstraction from the settlement areas is estimated between 5 and 9 Mm^3 of relatively good quality water (Metcalf and Eddy, 2000).

Southern Gaza Strip, in particular, suffers from cute water shortages. Water demand greatly exceeds the available overused supply. This situation has caused a sever drop in the water table, more than 5 meters below the mean sea level in year 2003, as shown in Figure (1.2).

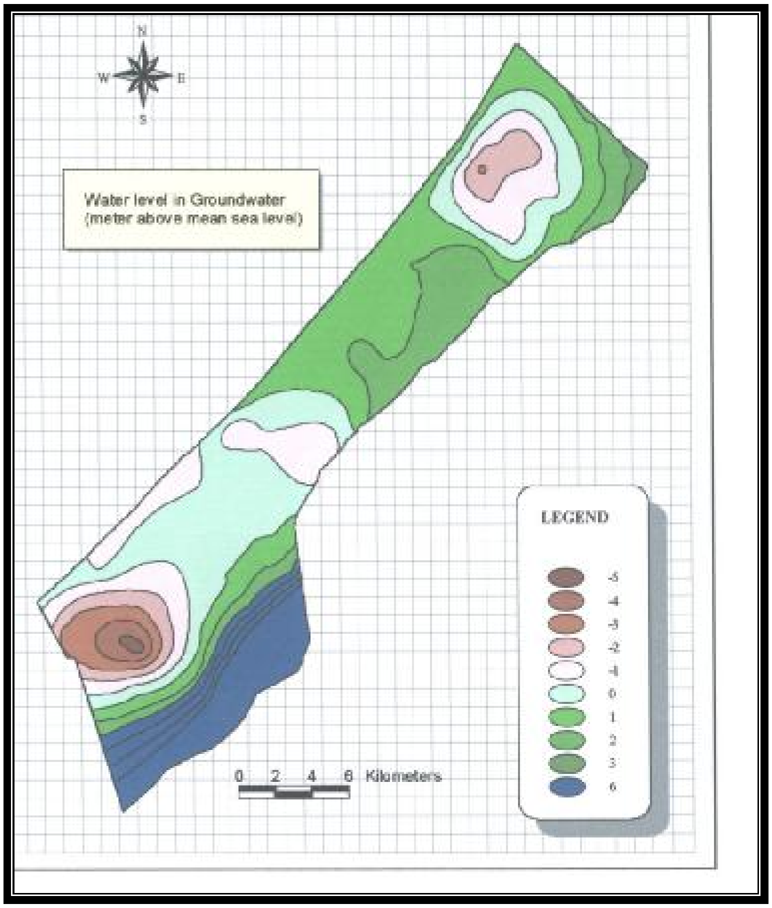


Figure (1.2) : Water level Contour Map (PWA-databank,2003)

The Southern Gaza Strip represented by Khan Yunis and Rafah areas, suffers from a net negative balance between inflows and outflows, because the rate at which groundwater is being extracted is higher than the rate at which it is being replenished (Metcalf & Eddy, 2000).This negative balance is reflected in decreasing water levels in many parts of the aquifer system as well as continuous increase in aquifer salinity.

The protection from depletion is mainly induced by taking drastic action to save and sustain the aquifer, better control on water allocation, abstractions with a priority to domestic supply, through suitable reconfiguration of domestic supply.

Demand for water substantially exceeds available supply. The water shortage has forced an already troubled people further into a state of despair. More and more Gazans are spending part of their limited grocery budget on imported bottled water, seeking to avoid public health problems caused by polluted tap water in the Strip. Quality of drinking water aside, availability is a central problem. Water supply is intermittent at best, and many localities suffer without water for days and weeks at a time. The average daily water consumption for the Palestinians in Gaza currently hovers around 80 liters .The minimum World Health Organization value is 100 lcd (Metcalf and Eddy, 2000).

Chloride concentration is ascribed to two main sources. One originates from the encroachment of seawater, the other is a result of natural existing old chloride salts especially in the eastern parts of Gaza Strip sedimentary deposits (Metcalf and Eddy, 2000). Deep aquifers usually contain very poor water with very high chloride content. Concentration increases with depth, with values from 10,000 to 20,000 and up to 60,000 mg/1 being recorded in the lowest sub-aquifers see Figure(1.3)(PWA-databank,2003).

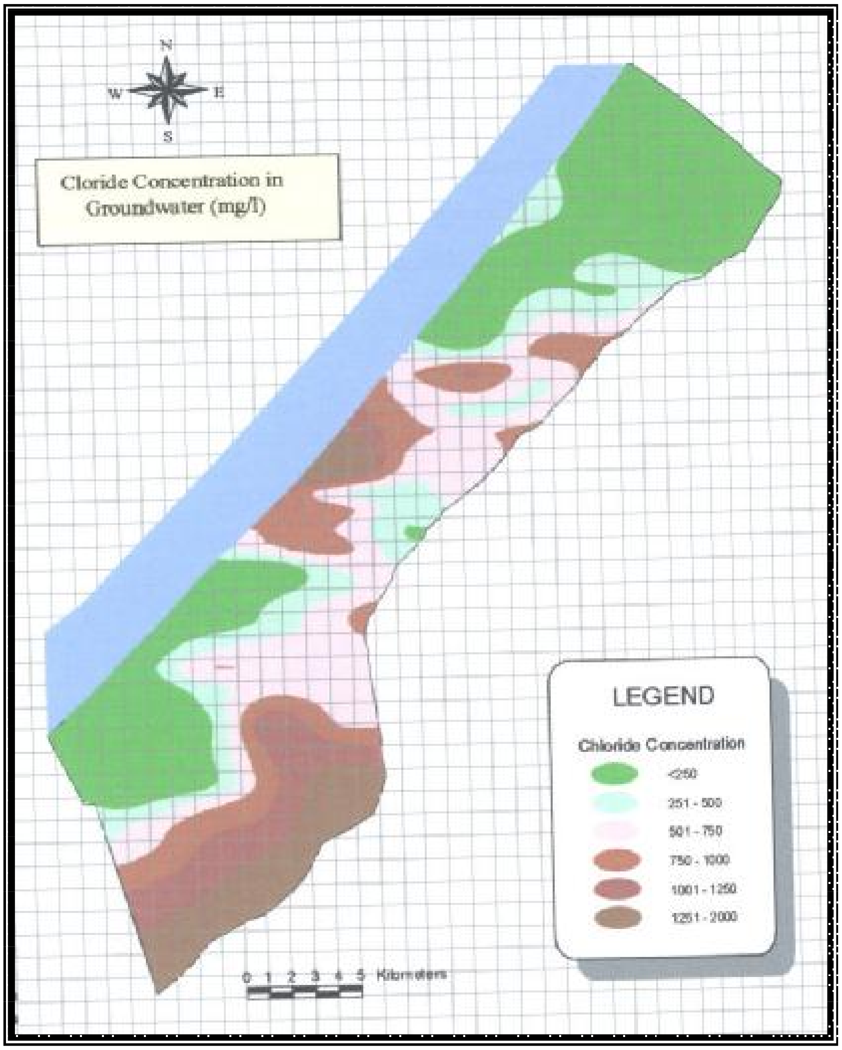


Figure (1.3) : Chloride Concentration Map (PWA-databank,2003)

As a matter of fact, many wells used for irrigation or drinking water supply in various urban centers have been abandoned in recent years due to high chloride content.

Damage to agriculture is expected through increase of salinity in irrigation water. Moreover, the original high chloride concentration of municipal water and its pre-treated effluent makes it very difficult to use purified wastewater in recharge (MOA,1998).

Reconfiguration of the supply systems may be necessary for optimal utilization of the groundwater resources for the whole area, accompanied with developing non conventional water resources like wastewater reuse and sea water desalination, Which should be adopted in the near future since redistribution of domestic wells can serve only for few years.

1.3 Objectives:

To achieve optimal domestic water supply & demand management in southern Gaza strip after Israeli withdrawal from settlements, many objectives must be realized:

a) Propose optimal reconfiguration of domestic water supply & demand allocation all over the southern Gaza Strip supposing removal of settlements, based on environmental, social, and economic requirements, considering all constraints, to sustain reasonable water level.

b) Develop integrated domestic water supply demand scenarios considering different stakeholder interests, efficient use of Groundwater, reuse of treated wastewater, and sea water desalination.

c) Propose measures to partially mitigate the existing and future aquifer deterioration problems including quantity & quality.

1.4 METHODOLOGY:

This research aims to define the problems concerning the domestic water supply and demand in southern Gaza Strip, and to promote measures to mitigate these problems. To achieve research objectives, the following methodology was followed:

Stage 1: Literature review:

To review relevant literature in order to build up suitable concept about supply & demand theories, this includes available references, researches, articles, journals, papers, reports, and similar studies.

Stage 2: Data collection:

Data collection includes, water supply production, distribution, water quality in terms of Cl^-, TDS, population and demand centers distribution, geology & soil properties, recharge quantities including rainfall, distribution for water &wastewater services, exiting tariffs, existing institutional set up, network water &waste water efficiencies. Data sources include Palestinian Water Authority (PWA),Palestinian Central Bureau of Statistics (PCBS), Palestinian Hydrology Group (PHG), Municipalities & Village councils, Ministry of Planning & International Co-operation (MOPIC), in addition to other water related institutions.

Stage3: Field Survey:

The field survey includes meeting and interviewing people concerned in water industry management.

Stage 4 : GIS&MODEFLOW model formulation :

Managing and analyzing large spatial databases is difficult with traditional modeling tools. As a result we used Geographic Information Systems (GIS), specifically ArcView to manage, manipulate, and analyze the spatial data for our ground water model.

Visual Modflow (VMF)and its integrated modules, are used to quantify, and analyze the raw input data. Many scenarios for domestic supply and demand reconfiguration are introduced.

Stage 4 : OPTIMIZATION MODEL :

Genetic algorithm (GA) is used as a global optimization method, to find optimal values of water quantities from different resources. The resulted optimal values for water quantities were introduced into the groundwater model to predict water level contour maps in the next years. Figure (1.4) shows the methodology flow chart.

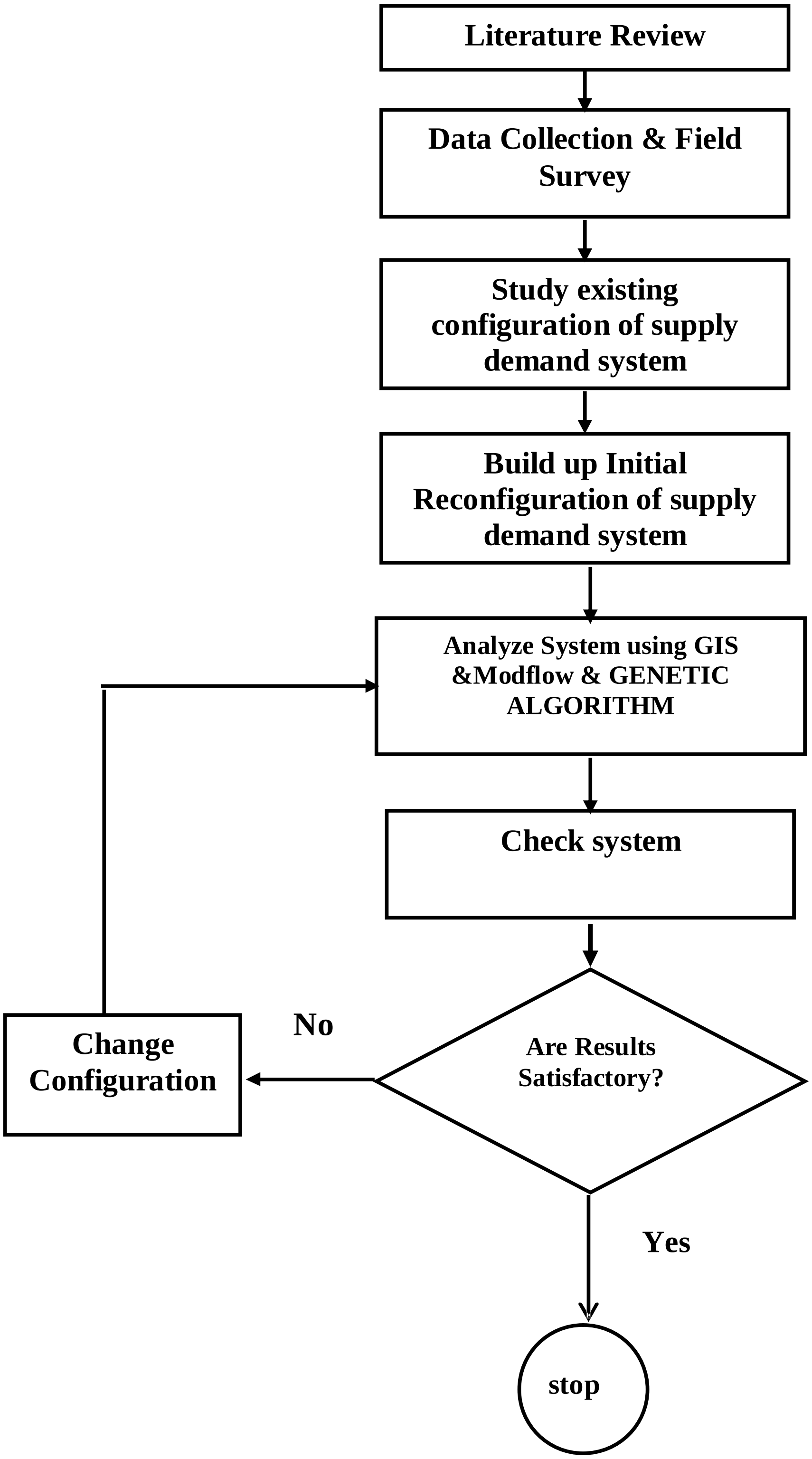


Figure (1.4): Methodology Flow Chart

1.5 Thesis Organization

The thesis is composed of the following seven chapters that cover the proposed subject as illustrated below:

Chapter"1": is an introduction part which presents the study area, problem statement, objectives of the research and the research methodology

Chapter"2": The literature review which highlights supply demand management measures and the economic value of water. It also describes Groundwater modeling based on finite difference method, and optimization techniques specifically Genetic Algorithm approach. The literature review presents related local and international previous studies, and the subject contribution to water resources management policies.

Chapter"3": The conceptual model which involves Ground water model including model boundaries, number of layers, groundwater flow conditions, abstraction quantities and spatial recharge distribution, and aquifer properties. The conceptual model also involves the optimization model which include the objective function and the constraints using genetic algorithm.

Chapter"4": focuses on the processes of calibration and validation of the model.

Chapter"5": The alternatives for management options for water use are demonstrated which include groundwater, wastewater reuse, and seawater desalination.

Chapter"6": The results of the study with optimal values of water quantities and the optimal reconfiguration of water supply.

Chapter"7": A summary of the research findings and recommendations.

CHAPTER "2"

LITERATURE REVIEW

2. LITERATURE REVIEW

2.1 Water resource management

"We made from water every living thing. Will they not then believe?"

(Qur-an, Sura El Anbiaa', verse 30).

With world population growing rapidly, and with our desire for a higher, more controlled standard of living, we depend on our water resources for the necessities of life as well as for the enjoyment of our leisure. We wish to have a regulated environment protected against the extremes of nature.

The management of any system means making decisions aimed at achieving the system’s goals, without violating specified technical and nontechnical constraints imposed on it. In a ground-water system, management decisions may be related to rates and location of pumping and artificial recharge, changes in water quality, location and rates of pumping in pump-and-treat operations, etc.(Bear et al,1992).

Groundwater is one of the most important components of the hydrologic cycle. In many areas, irrigated agricultural production is dependent on the availability of groundwater. The common-property of aquifers, however presents difficulties in managing the rate of groundwater use and development. In the common-property situation, the action of each individual pumper influences the cost of pumping for all others. Each pumper perceives his withdrawal only in terms of his own costs and benefits. Since costs to third parties are incurred that are not compensated for in the market, the result can be an inefficient allocation of resources due to a greater than optimal rate of extraction (Azarmnia, 1989).

Since the mid 1960s, numerical models have been used extensively for groundwater resource management. Management includes planning, implementation, and adaptive control of policies and programs related to the exploration, inventory, development and operation of water resources containing groundwater (Solaimanian,1989).

In recent decades, numerical simulation models have been used as tools for evaluating and managing groundwater resources. Groundwater management models may include an optimization algorithm to compute optimal well locations, and temporally- varying pumping rates. The use of combined simulation-optimization models for aquifer hydraulic management has increased within the last ten years. Combined models predict aquifer behavior, while simultaneously selecting the best set of management decisions for specified objectives and constraints (Tung, 1985)

Water resource management has to deal with quantity as well as quality problems. The quantity problem refers to a steady decline in the physical availability of water in the face of rapidly increasing demand in many parts of the world (Gunatilake, 2001). The unprecedented demand on water resources during the last half of this century is largely the result of population growth and urbanization, together with changes in production and consumption. Even if the physical availability exceeds the demand, poor water quality can cause water scarcity. The quality problem is largely due to accumulation of pollutants such as chemicals, dyes, fertilizers, bacteria, and organic wastes"(Gunatilake,2001).

Aquifer management models that combine simulation with optimization help in understanding how social and economic forces interact with the water resource allocation. Just as a simulation model is a tool to understand the physical/chemical behavior of an aquifer system, a management model can be thought of as a tool, which provides insight into the economic and social consequences, the influence of a unit change in an independent decision variable such as pumping or recharge at a pre-selected well location upon a variety of dependent variables like drawdown and velocity at specified observation points .

The past paradigm of expanding water supply as the demand increased can no longer be continued. Water use efficiencies in all sectors, and especially in the irrigation sector, are feasible options to sustain socio-economic growth within a water scarce environment.

The option of Water Demand Management is becoming a known phrase in the sector publications around the world. However, a drastic change in the water resources management is needed soon, in many countries of the world, in order to prevent serious problems and disputes. First signs of inter-boundary water conflicts which could develop into military involvements, in the Middle East as well as other regions. (Arlosoroff,2002).

Efficient use of water means that the contribution of water to human welfare is the maximum that may be achieved ,where people are poor and where food supply is not always assured.

Failure to realize that scarcity requires careful allocation of water and that such allocation is often not assured in a hands-off policy, is one of the roots of inefficient use of water. The other root is the failure, or the absence of political courage, to realize that over-utilization of water destroys the resources-aquifers, rivers, soils, lakes, and habitats. This last failure is regarded sometimes as the creation of problems for future generations, but these generations are here already. Water resources are tolerant to our actions, despite abuses they have suffered and are suffering they have continued to serve users for decades. But the days of judgment are coming; It is time we face reality and insist on efficient allocation and use of water. Sustainability is one aspect of efficiency in the distribution of the benefit of water equally over long periods of time is the other aspect (Arlosoroff,2002).

Management decisions are aimed at minimizing the cost while maximizing the benefits to be derived from operating the system. The value of management’s objective function (e.g., minimize cost and maximize effectiveness of remediation) usually depends on both the values of the decision variables (e.g.,areal and temporal distributions of pumpage) and on the response of the aquifer system to the implementation of these decisions. Constraints are expressed in terms of future values of state variables of the considered ground-water system, such as water table elevations and concentrations of specific contaminants in the water. Typical constraints may be that the concentration of a certain contaminant should not exceed a specified value, or that the water level at a certain location should not drop below specified levels. Only by comparing predicted values with specified constraints can decision makers conclude whether or not a specific constraint has been violated (Heijde et al,1985).

An essential part of a good decision-making process is that the response of a system to the implementation of contemplated decisions must be known before they are implemented.

2.2 The economic value of water

One of Dublin principles is that water has an economic value and should be recognized as an economic good taking into account affordability and equity criteria.

The benefits of water resources development are not limited to water use activities contributing to specific aspects of socio-economic development. The water resources development is an important factor in economic growth. Increasing of the economic growth is often adopted as specific socio-economic development objective in which water is an essential element of input of the economic development.

2.2.1 Economic Performance Objective

The objective is to maximize the net economic benefits of water . Water is valued according to the economic principle of willingness-to-pay, i.e., water is worth what users are willing to pay for it. Variable costs of water supply operations are also included in this economic objective.

Economic costs include in addition to financial costs, external costs such as environmental damage and social costs (health hazards, resettlement, etc.). The economic price should reflect the scarcity of the resource, which is generally expressed in the opportunity cost (the cost of not being able to use the resource for another economic activity) (Savenije,1997).

The economic value and the willingness to pay is not easily determined. Some users are willing to pay a higher price than others. Willingness to pay is not always the right argument to establish the economic price. In addition, willingness to pay is dynamic depending on many parameters which include affordability, scarcity of the resource and depreciation of the resource. Since all these parameters are time dependent and can be influenced by external and internal factors, the willingness to pay is a volatile parameter (Savenije, 1997).

According to Roger (1997), the value of the water should reflect the willingness to pay of the user. The value of water to a user is the cost of obtaining the water plus the opportunity cost. Ignoring the opportunity cost, part of the value will be under value water, lead to failure to invest, and cause serious misallocation of the resource between users. The opportunity cost concept also applies to issues of water and environmental quality.

The value in use is typically expected to be higher than the full cost for sustainable economic development.

2.2.2 Valuing water

For industrial and agricultural uses the value to users is at least as large as the marginal value of product, for domestic use, the willingness to pay for water represents a lower bound on its value.

2.2.3 Agricultural Water Demand

The agricultural sector is considered to be the main water consumer in Gaza Strip as it consumes more than 70% of the total water supply at present time (MOA,1998). In order to achieve the main objectives of reducing water demand the two main sub objectives stated below have to be fulfilled.

- Increasing the efficiency of water use by maximizing the economic output of unit volume of water.
- Increasing the efficiency of water use by using the least amount of water to satisfy certain crop requirements without affecting the yield and increasing water supply and distribution efficiency.

The Ministry of Agriculture (MOA) has put the water price as 0.2 US$/m^3 in the calculation of the economic efficiency of crop (MOA,1998).

The irrigated crops form 65% of total agricultural area in Gaza Strip. The main types of irrigated crops are citrus and vegetables which cover about 77% of the total irrigated area. The remaining 23% are cultivated with olives, fruits, greenhouse and fodder (MOA,1998).

The political and socio-economic situation in the Gaza district is completely unstable. The progress of the peace process may affect the future crop pattern. The discarding of the Israeli settlement from the Gaza district will increase the land for development and may result in increasing the agricultural area especially in southern Gaza Strip.

As a direct result of the water shortage problem and the directive to keep potable water for domestic use. It is expected that the use of potable water for agriculture will be further restricted. This will result in an increase of the cultivation of product that allow the reuse of treated wastewater. The Ministry of Agriculture proposed the following four types of crops to be irrigated by treated wastewater, citrus, fruits, olives, and fodder. This was due to the following :

- They require a medium level of treatment which means low cost.
- These crops cover the major part (55%) of the total agricultural area in Gaza Strip(MOA,1998).

2.2.4 Domestic Water Demand

The domestic sector is considered to be one of the two main water consumer in Palestine next to agriculture.

The objective of domestic demand management is to achieve a sort of balance between supply and demand. From this general objective two main sub-objectives are derived:

- Efficiency of the water use.
- Efficiency of water supply and distribution.

The gap between demand and supply is increasing. To solve the problem of water scarcity, treated wastewater should be reused in irrigation and brackish water and seawater desalination for domestic use. Also using economic efficiency for using water by selecting the crops that use less water with a high value.

Demand on water resources for house hold, commercial, industrial and agricultural purposes are increasing greatly. Growing urbanization increases domestic water use, while supplying wastewater that can be used for non potable purposes such as agriculture can be an economically attractive purpose.

The good-quality water resources available for agricultural use tend to decrease as population growth enhances domestic water use and within the next few decades, treated sewage effluent will become the main source of water for irrigation in Southern Gaza Strip.

2.2.5 Economic value of reclaimed water

Nava Haruvy (1997), studied the cost-benefit analysis for agricultural reuse of wastewater in Israel. The area has similar characteristics of wastewater and crops in Gaza Strip, in addition to the same environmental and health hazards evaluation.

His numbers and figures can be considered. This is due to the closest of the two areas in Palestine.

Consideration of optimal treatment level relates to costs and hazards as well as to the beneficial aspects of effluent reuse. The same applies to other reuse decisions such as the location of wastewater irrigation, since conveyance to regions far away from an active aquifer results in high conveyance costs. Moreover, the costs of producing or treating wastewater are not necessarily reflected in the price to farmers, as affected by recovery costs and allocation factors, and should be considered in political decision making (Haruvy, 1994).

Economic considerations become more significant as the use of reclaimed sewage increases. For any wastewater decision-making issue, one should analyze multifarious aspects of costs, risks and benefits. The analysis will be based on maximization of nation-wide net benefit, evaluated as total benefits minus total costs and value of environmental damage (Haruvy ,1994).

Wastewater quality or treatment level are defined by various constituents, such as: (a) macroorganic matter-biochemical oxygen demand (BOD), chemical oxygen demand (COD) and total suspended solids (TSS), which are reduced by common reclamiation processes; (b) microorganic pollutants, i.e., stable organic matter that may affect health through leaching to ground water; (c) trace elements resulting from industrial water use; (d) pathogenic microorganisms, the concentration of which can be reduced significantly through wastewater reclamation and disinfection; (e) nutrients such as nitrogen and phosphorous which serve both as a pollution hazard and a fertilizer; and (f) salinity, increased inorganic soluble salts in wastewater caused by urban and industrial use, which are not removed during the conventional reclamation processes (EPA, 1992)

Treatment processes are divided into primary, secondary and advanced processes. Primary treatment includes basic treatment such as screening of coarse solids and grit removal. Secondary treatment includes low-rate processes such as stabilization ponds with high land and low capital and energy inputs, and high-rate processes such as activated sludge with low land and high capital and energy inputs (Pettygrove and Asano, 1985). Tertiary stages further improve quality by nitrification-denitrification (to reduce the nitrogen level) and soil and aquifer treatment.

The quality of wastewater should be adapted to the intended uses. While there are regulations and recommendations for treatment levels, there is a degree of freedom in choosing whether to restrain or release some parameters, such as the nitrate content.

The legally mandated treatment levels for a municipality of more than 10,000 citizens are BOD and TSS of 20 and 20mg/1 respectively, which can be obtained by secondary treatment processes. Criteria for river disposal are "10/10" mg/1 BOD and TSS and restricted levels of ammonium. Recommended levels for agricultural use are "20/30" for most cops, excluding raw-eaten vegetables (Shelef, 1991), which are attained through secondary treatment processes. Primary treatment can be adapted to crops that are not consumed by humans, while tertiary treatment is required for unrestricted use.

Levels of nitrate in potable water that exceed 45-90mg/1 are considered hazardous; they can cause methemoglobinemia in infants. Levels of nitrogen in treated effluent should be coordinated with crop needs and such effluent should be applied by irrigation technologies and practices designed to minimize leaching to groundwater. For example, citrus orchards irrigated with 6000 m^3 per ha, can consume nitrogen levels of approximately 45 mg/1 without significant leaching if applied by proper methods (Haruvy ,1994).

Treatment costs (operation, maintenance and capital recovery) are affected by the required level and extent of effluent treatment The addition of any treatment stage results in higher treatment costs, for example, (relating to treatment of 14 mcm), the basic stage of activated sludge treatment costs US\$0.12/m^3, while the addition of a nitrification- denitrification stage adds US\$0.07/m^3.

Direct costs comprise net value of benefits, e.g., direct and indirect benefits minus direct and indirect costs. Direct benefits from irrigated agriculture are expressed as the marginal value of water in agriculture, estimated as US\$0.36 /m^3.

Estimates of environmental damage caused by nitrate leaching were targeted at maximization of profits and including constraints on cultivated area and water supply, as well as restrictions on nitrogen leaching. The damage was estimated as approximately US\$ 0.10/m ^{3}. The cost of health damage was estimated as US\$0.4/m^3.

The direct cost, including storage and conveyance of river disposal is US\$ 0.40/m^3, while the cost of irrigations US\$0.27/ m^3 or, including the value of nutrients value in wastewater, US$ 0.22/ m^3; hence, agricultural reuse directly saves US$0.40-0.22 = US$0.18/ m^3. Local irrigation, compared with tertiary treatment saves US$0.57-0.22=US$0.35/m^3. Direct benefits from irrigated agriculture Hence, net benefits (minus direct costs) amount to US$ - 0.40/ m^3 for river disposal, and US$0.14 – (-0.40) = $0.54/ m^3. When the value of the irrigation contribution to aquifer recharge US$- 0.07/ m^3 is added and the damage due to nitrogen seepage-estimated as US$0.10/ m^3 is deducted, local effluent reuse is seen to save US$0.11-(-0.40) = US$0.51/ m^3 .

2.3 Groundwater Modeling

Numerical simulation models have been used as tools for evaluating and managing groundwater resources. Groundwater management models may include an optimization algorithms to compute optimal well locations, and temporally-varying pumping rates. The use of combined simulation- optimization models for aquifer hydraulic management has increased within the last ten years (Azarmnia,1989).Combined models predict aquifer behavior, while simultaneously selecting the best set of management decisions for specified objectives and constrains (Tung ,1985).

A groundwater model is a numerical representation of a natural system. To make the model an acceptable representation (Through it can never be exact) one must simulate the natural system as closely as possible using available aquifer information and the basic laws governing flow in porous media. A model may be defined as a simplified version of a real world system (here, a ground-water system) that approximately simulates the relevant excitation-response relations of the real world system. Since real-world systems are very complex, there is a need for simplification in making planning and management decisions. The simplification is introduced as a set of assumptions which expresses the nature of the system and those features of its behavior that are relevant to the problem under investigation. These assumptions will relate, among other factors, to the geometry of the investigated domain, the way various heterogeneities will be smoothed out, the nature of the porous medium (e.g., its homogeneity, isotropy), the properties of the fluid (or fluids) involved, and the type of flow regime under investigation. Because a model is a simplified version of a real-world system, no model is unique to a given ground-water system (EPA,1992).

Different sets of simplifying assumptions will result in different models, each approximating the investigated ground-water system in a different way. The first step in the modeling process is the construction of a conceptual model consisting of a set of assumptions that verbally describe the system's composition, the transport processes that take place in it, the mechanisms that govern them, and the relevant medium properties. This is envisioned or approximated by the modeler for the purpose of constructing a model intended to provide information for a specific problem, as shown in Figure (2.1).

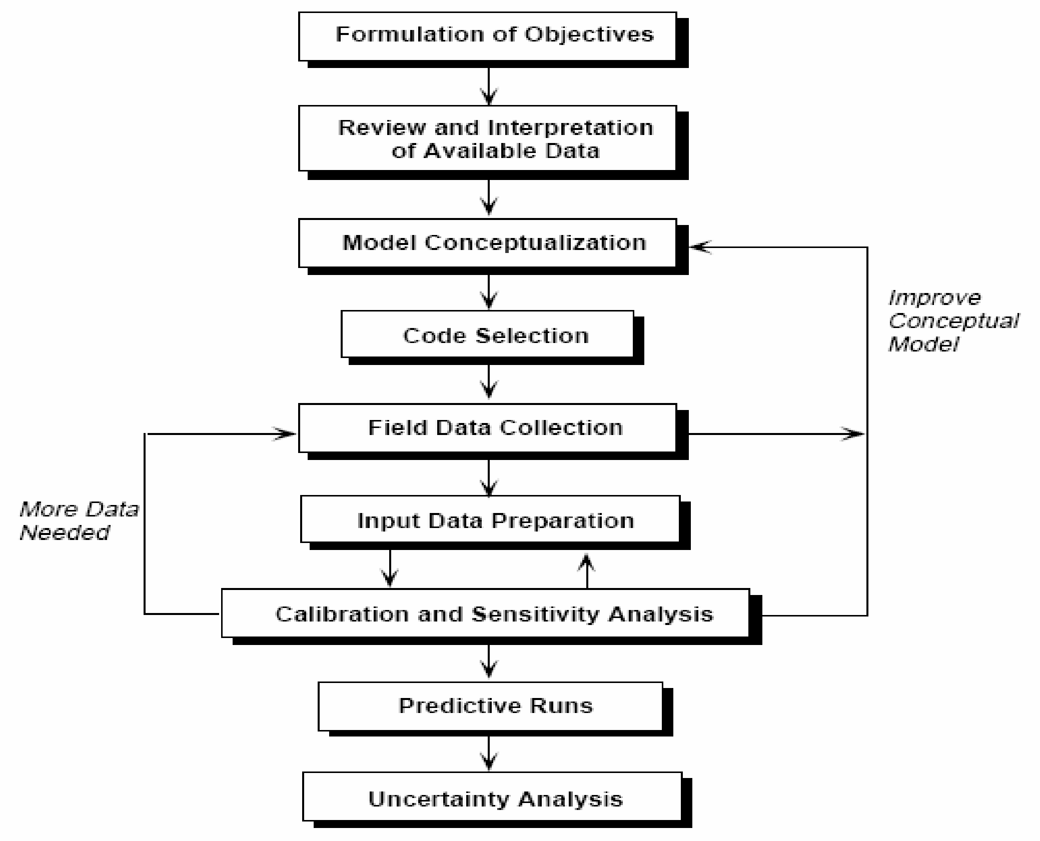


Figure (2.1): Model Application Process (EPA,1992)

Ground water modeling is a tool used to build on an existing sound understanding of site hydrogeologic conditions. This basic foundation must be developed through hydrogeologic site characterization. A ground water model can not be used as a substitute for data collection in the field. Characterization of the hydrogeology of a site or facility is required by both federal and state regulations. Comprehensive hydrogeologic characterization is essential for undertaking hydrogeologic modeling to be used in decision making.

2.3.1 Modeling objectives

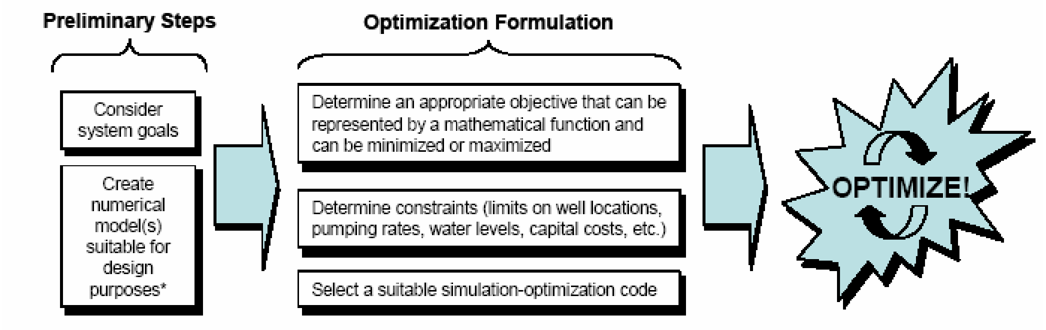
Ground water models are commonly used to:

- Identify data gaps during hydrogeologic characterization,
- Aid in the design of a monitoring well network capable of detecting a release from a waste disposal facility.
- Determine the potential impacts of contaminated ground water on nearby wells or surface water bodies.
- Aid in selection and design of remedial actions to control, or remove and treat, contaminated ground water.

The level of detail required to meet these objectives will depend on many factors, including the regulatory requirements to be served by the modeling study, the potential risk to public health or the environment from making a wrong decision based on model results, the complexity of site hydrogeology, and economic constraints. For example, the level of detail necessary to provide a conceptual understanding of ground water flow at a site may be much lower than that necessary to assess exposure of a nearby population to ground water contamination or to trigger regulatory action.

2.4 Optimization Modeling

"Optimization tools and principles have made it possible to develop prescriptive models for optimal management of large scale water resources systems, incorporating ubiquitous uncertainties in the prediction of natural processes and the economic impacts." (MAYS,1996). Optimization models are used to select a water management strategy when many alternative strategies may be employed to meet a particular objective. The use of an optimization model requires the definition of an objective that can be quantified (Loucks et al, 1981). In theory, such models can select the "best" among an infinite number of options. This capability could be achieved through simulation only by modeling every possible option and comparing results, an impossible undertaking except in trivial cases. On the other hand, optimization models frequently cannot perform as detailed simulation as can simulation models. Thus, optimization models are often used to determine a general, desirable system configuration. Subsequently, a simulation model is used to more accurately compute system response to implementing of the optimal strategy computed by the optimization model, (see Figure 2.2).



Figure(2.2):Optimization model Formulation(EPA,2002).

An optimization model includes an equation, the value of which is maximized or minimized. This objective function is a mathematical description of a specific policy goal. Values of variables in the model are systematically changed until an optimal objective value is obtained. Both the objective function and the constraints are mathematical expressions in terms of system properties (model parameters) and conditions (state and decision variables). In addition to functional constraints, limits (bounds) may be imposed on the system variables so that the variables cannot assume undesirable values. Thus an optimization model consists of 1)An objective function.2) Constrains, and 3) Bounds(MAYS,1996).

An optimization model seeks to identify 'the best possible solution', i.e., the solution providing the optimal value of the objective function. The final optimal solution consists of the optimal objective value and a value for each system variable.

In most cases the specific combination of variable values at the optimum is as important to the investigator as the optimum objective value. Whenever there is more than one objective to be achieved, a multi objective optimization model is required.

An optimization problem in water resources may be formulated in a general framework with an objective function to Optimize f (X) Subject to constraints

$g(X) = 0$

And bound constraints on the decision variables

$\underline{X}<X<\overline{X}$

Where x is a vector of n decision variables ($x_1,x_2, \ldots, x_n$), g(x) is a vector of m equations called constraints, and $\underline{x}$ and x represent vectors of the lower and upper bounds, respectively, on the decision variables. In general, the objective equation is to be maximized or minimized. Maximizing f (x) is equivalent to minimizing $- f$ (x) or vice versa (MAYS,1996).

Every optimization problem has two essential parts: the objective function and the set of constraints. The objective function describes the performance criteria of the system. Constraints describe the system or process that is being designed or analyzed, which can be of two forms: equality constraints and inequality constraints. A feasible solution to an optimization problem is a set of values of the decision variables that simultaneously satisfies the constraints. The feasible region is the region of feasible solution defined by the constraints. An optimal solution is a set of values of the decision variables that satisfies the constraints and provides an optimal value of the objective function (MAYS,1996).

Depending upon the nature of the objective function and the constraints, an optimization problem can be classified as: (1) linear vs. nonlinear, (2) deterministic vs. probabilistic, (3) static vs. dynamic, (4) continuous vs. discrete, and (5) lumped parameter vs. distributed parameter. Linear programming problems consist of a linear objective function where all constraints are linear. Nonlinear programming problems have nonlinear constraints and/or the objective function. Deterministic problems consist of parameters that can be assigned fixed values, whereas probabilistic problems consist of parameters that are considered as random variables. Static problems do not explicitly consider the variable time aspect, whereas dynamic problems do consider variable time. Static problems are referred to as mathematical programming problems, and dynamic problems are often referred to as optimal control problems, which involve difference or differential equations. Continuous problems have variables that can take on continuous values, whereas with discrete problems, the variables must take on discrete values. Typically, discrete problems are posed as integer programming problems, in which the variables must be integer values. A lumped problem considers the parameters and variables to be homogeneous throughout the system, whereas distributed problems must take into account detailed variations of system behavior from one location to another.

The method of optimization used depends on: (1) the type of objective function, (2) the type of constraints, and (3) the number of decision variables. If such a problem were to be modeled using the approaches discussed in the previous section, the resulting model could literally have millions of simultaneous nonlinear constraints. It would not be possible to solve such a problem, even with the powerful computer hardware and software that has become so readily available. Problems that are so intractable--because of their dimensionality and/or nonlinearity--are quite common in water resources engineering (e.g., groundwater optimization such as the above, optimal operation of multiple reservoir systems in large river basins, multiple constituent water quality management, etc.). This has led to the development and application of non-traditional optimization methods that are robust, but not based on classical mathematical approaches, such as linear programming or gradient methods. Genetic algorithms (GA) represent one such set of robust methods (MAYS,1996).

2.4.1 Genetic Algorithms

Genetic algorithms (GAs) belongs to a family of increasingly popular global optimization methods that are designed to overcome the multimodality of the objective function without incurring the enormous expense of exhaustive search. GA is based on the mechanics of natural selection and natural genetics, which combines an artificial survival of the fittest with genetic operators of abstracted from nature(Goldberge,1989).Using GA, the search begins from a population of parameters realization, not a single realization as more conventional optimization procedure might. The objective function information is used directly rather than derivatives of it.

2.4.1.1 Bases of Genetic Algorithms.

A GA is a search algorithm based upon the mechanics of natural selection, derived from the theory of natural evolution.

GAs simulate mechanisms of population genetics and natural rules of survival in pursuit of the ideas of adaptation. Indeed this has led to a vocabulary borrowed from natural genetics.

Goldberg (1989) identifies the following as the significant differences between GAs and more traditional optimization methods:

- GAs work with a coding of the parameter set, not with the parameters themselves.
- GAs search from a population of points, not a single point.
- GAs use objective function information, not derivatives or other auxiliary knowledge.
- GAs use probabilistic transition rules, not deterministic rules.

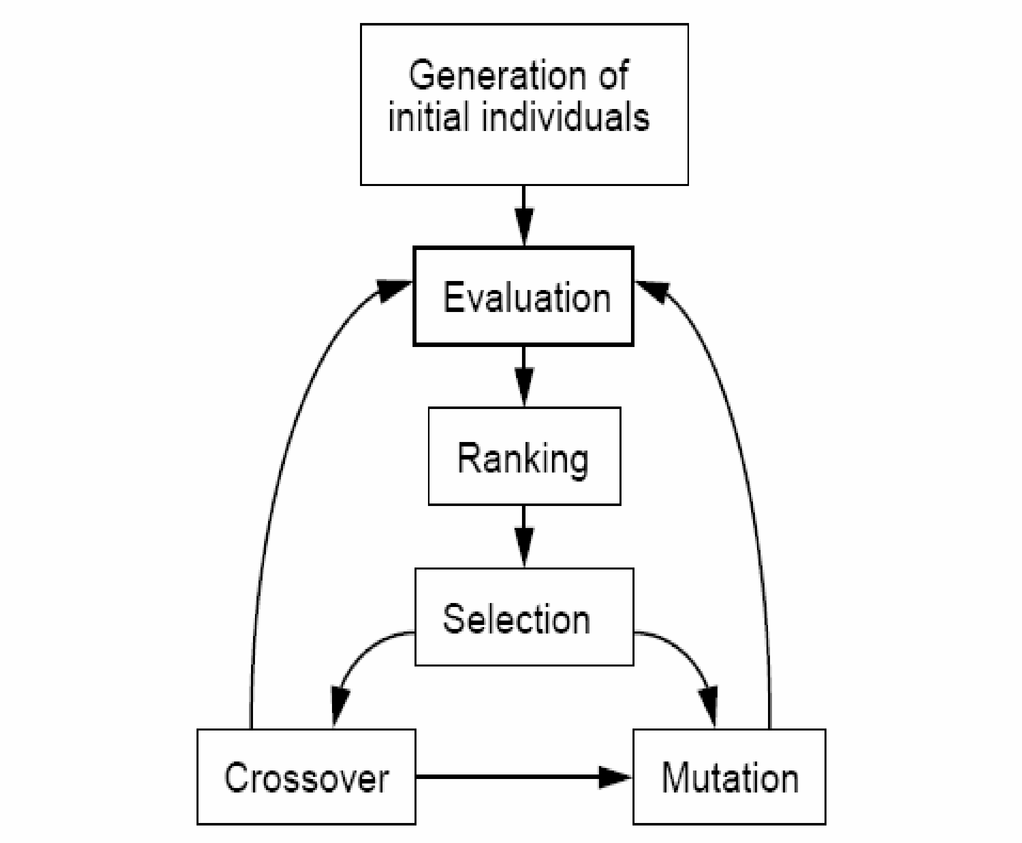
A GA is a robust method for searching the optimum solution to a complex problem, although it may not necessarily lead to the best possible solution. A GA generally represents a solution using strings (also referred to as chromosomes) of variables that represent the problem.

A genetic algorithm tries to simulate the natural evolution process. Its purpose is to optimize a set of parameters. In the original idea, proposed by John Holland. the genetic information is encoded in a bit string of fixed length, called the parameter string or individual. A possible value of a bit is called an allele. Each parameter string represents a possible solution to the examined problem.

The basic GA operators are crossover, selection and mutation. It starts with the random generation of an initial set of individuals, the initial population see Figure (2.3).

The individuals are evaluated and ranked. Since the number of individuals in each populations kept constant, for each new individual an old one has to be discarded, in general the one with the worst fitness value. There are two basic operators to generate new individual: mutation and crossover.

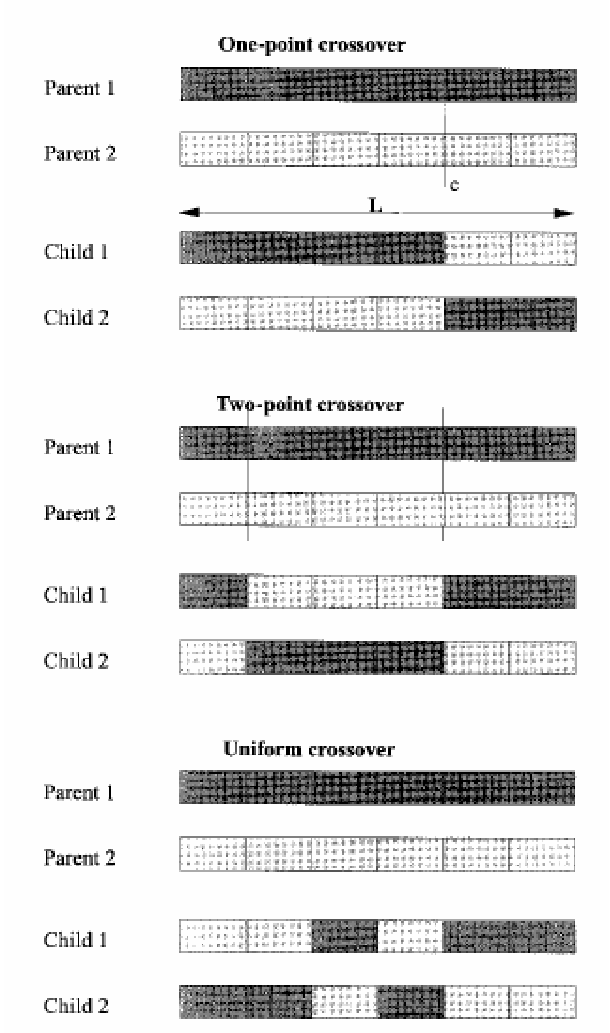
- Mutation may be applied to offspring produced by crossover or, as an independent operator, at random to any individual in the population.



Figure(2.3) The Principle Structure of a Genetic Algorithm(Koehn,1994)

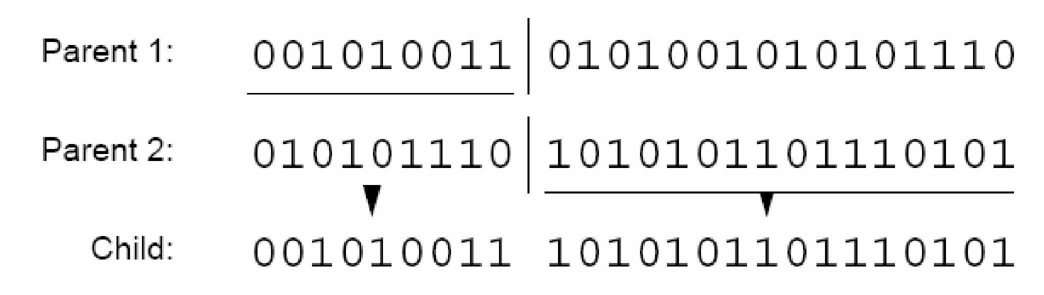
- Crossover simulates the sexual generation of a child, or offspring from two parents. This is performed by taking parts of the bit-string of one of the parents and the other parts from the other parent and combining both in the child. There are three basic kinds of crossover: one point, two-point and uniform, as shown in Figure (2.4) and Figure (2.5).

Genetic Programming (GP) has been used in water resources engineering only in recent years. It is robust and computationally efficient for many types of problems, especially those that are highly nonlinear. Darwin’s Theory of Evolution and the basic genetic operations of sexual reproduction have inspired it. As a result, much of the terminology used in GP/GA is derived from these origins in biology.

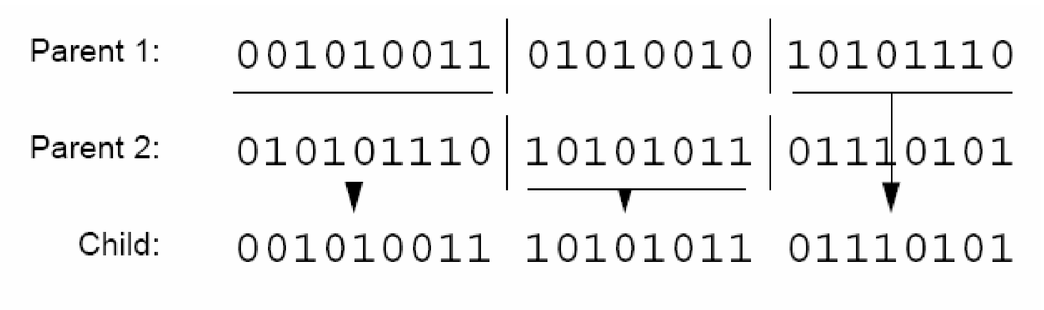


Figure(2.4): Approaches to crossover(Wardlaw et al,1999)

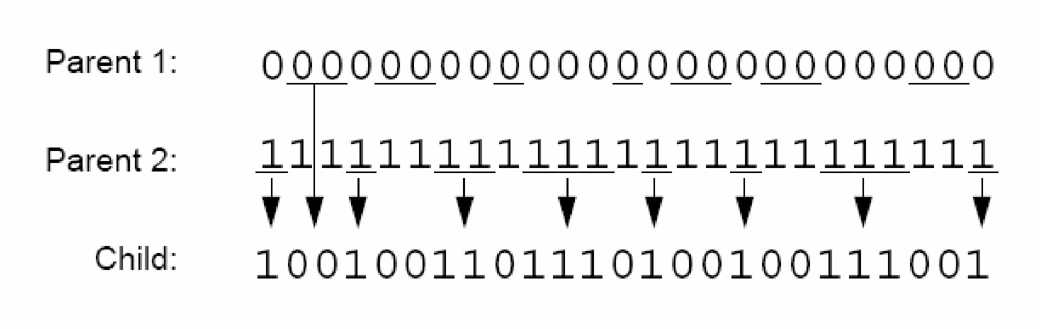
In general, those individuals that are most suited for survival in the environment in which they live will produce the greatest number of offspring. Thus they will pass more of their genetic material to subsequent generations than other, less fit individuals . their offspring will be better suited for survival than the offspring of other, less fit individuals This process of more fit individuals passing their genetic material to a greater number of offspring than less fit individuals is known as “survival of the fittest”. GP is a branch of operations research whereby these biological processes are used as a set of principles for constructing optimization algorithms; these algorithms generate “populations” of decisions or management policies that become more and more fit with each succeeding generation.



One Point Crossover



Two Point Crossover



Uniform Crossover

Figure (2.5) Kinds of crossover(Koehn,1994)

2.4.1.2 Relationship of GA to Optimization

The process of biological evolution is one wherein, with each succeeding generation, individuals are produced that are, on average, better fit for the environment in which they live. As such, it is a type of optimization process which, in a sense, creates “better” individuals with each iteration.

Presumably, then, given enough iterations (i.e., with enough generations of a population living in an environment of interest) and a way of measuring the quality or desirability of an organism, an individual would eventually be produced having physical characteristics that, in total, would be in the neighborhood of an “optimal solution”. This connection between genetics and evolution on the one hand and optimization on the other begins to become more obvious when considering the relationship in the terminology they use.

2.5 **Previous studies *related to this study***

2.5.1 Local studies

Previous studies related to study title have been implemented in Gaza Strip.

- Abdul-Latif.Abdul-Halim (1996) proposed strategies in perennial yield management and water quality optimization in the Gaza Strip Aquifer:
  - Pricing of water based on the "Use Pays Principle". This price of water should cover the capital, operation, maintenance and the environmental costs of providing water
  - Operation controls such as leak detection in water supplies.
  - Efficient use of domestic demand and ways of influencing water consumption in other sectors
  - Physical control of well drilling and pumping.

- Ziad Mimi (2000), developed statistical domestic water demand model to asses the factors which influence domestic water use, and determine the parameters that may help in demand management in West Bank. The developed model indicates that water utility authorities can use price as a tool to ration water or encourage reduced water consumption in households. The price elasticity for households in Rammallah derived from the model was -0.6, meaning that if other factors are held constant, a 10 percent increase in price would lead to about 6 percent change (decrease) in the amount of water purchased.
- Yousef Ghuraiz (2002), studied the major factors on which water pricing should be built in the Gaza Strip to enhance the appropriate water pricing to play a key role in the development of a sustainable water service. The major factors were water consumption, water quality and quantity of supplied service, socioeconomic

situation, willingness to pay, ability and affordability, illegal connections, public awareness community participation in decision making, institutional arrangement and the political situation. The result of the study reveal that the average price "3.0 NIS per m^3" for improved water supply service, that matches the WHO standard, is a suitable price for domestic use.

- Khalid Qahaman(2004) presented an attempt to establish sustainable development and management policies for utilization of coastal aquifer in the Gaza Strip. The result of study showed that using optimization/simulation approach in the Gaza Strip can improve planning and management policies and can give better decision for aquifer utilization.
- Maha. Muhaisen (2004) proposed hierarchical approach for integrated water resources planning and management in the Gaza Strip. The application of the approach on the Gaza Strip situation showed that the priorities of projects planning and implementation should be devoted to Reclaimed water, particularly waste water treatment and reuse. In addition to seawater desalination , which could contribute to solve the deficit in fresh water and cover, the gap between water demand and supply.
- J.C Elnaboulsi, (1999) introduced a model for constrained peak –load water and wastewater pricing and capacity planning, the paper proposed the design of drinking water and sewage optimal rates ,the model provides important guidance in the design of efficient water rates and in the development of different water utilities planning strategies, water and sewage price setting practices which are based on historical average age cost fail to efficiently ration water when water resources are insufficient, or when reservoirs, pipelines and wastewater facilities reach their capacity and fail to provide price signals conveying the true costs of providing drinking water and collecting and treating wastewater.
- Palestinian water authority carried out many reports in water resources management in Gaza governorates. Coastal Aquifer Management Program (CAMP) introduced integrated aquifer management plan, it explained also the current balance for the Gaza coastal aquifer, and defined the net negative balance between inflows and outflows (Metcalf&Eddy,2000).

2.5.2 International Studies

- There have been numerous attempts to develop indices defining water scarcity. The most famous is the water scarcity index that was developed by Prof.Malin Falkenmark(1989a), published in AMBIO. According to Gleick (1993a), scarcity is the relation of human need and reserve of water resources. Gleick claims in his articles that the minimum availability of water for an individual should be 100cubic meters/year. WHO defines the minimum water requirements as 150 l/c/d .
- El Toro Area Groundwater Study. The County of Monterey requested this study to assess the capability of groundwater resources in the El Toro area to support major increases in population. The four purposes of the study are: (1) perform a thorough hydrogeologic investigation of the El Toro area, concentrating on an analysis of the quantity and quality of available groundwater resources within its boundaries; (2) based on demographic, water use, recharge, and storage analyses, assess the safe yield and adequacy of the groundwater supply; (3) identify present and potential problems related to the use of groundwater within the area and suggest mitigating solutions for dealing with these problems; and, (4) prepare a comprehensive report which includes an action plan for future management of the area's groundwater resources.
- North Montery County Moratorium Area Groundwater Study, In 1980 Monterey County imposed a one-year subdivision and development moratorium in the Prundale/Aromas area due to complaints from residents of water shortages from private wells and subsequent U.S. Geological surveys indicating problems with the existing extraction systems. The objectives of this study were to: (1) perform a thorough hydrologic investigation of the moratorium area, concentrating on a quantitative analysis of available groundwater resources within its boundaries; (2) assess the safe yield and adequacy of the groundwater supply based on demographics, water use, and recharge analysis; and (3) examine feasible and acceptable alternatives, both short-term and long-term, for meeting water demands within the area. These alternatives may range from schemes of local groundwater extraction and distribution, to the importation of surface or groundwater from other areas.

- Simonovic (2000) proposed tools for water Management, he dealed with water-related data availability and natural variability and natural variability of domain variables in time and space affecting the uncertainty of water resources decision making. National and international database, both static and dynamic, now provide much of the necessary information in digital form. The trend in providing public access to all water-related data at reasonable cost and in a user friendly format will continue and will play an important role in supporting tools for water decision making, good data communicated through powerful networks, will empower the people to make wise decisions on how to make best use of limited water resources.
- Chavula (2002) submitted country report "Constrained to the implementation of water demand management in Malawi and proposed measures for overcoming them".

The report highlights the proposed measures for overcoming the constraints, which include the need to:

- Enhance policy makers, "service providers" and consumers "awareness about WDM through various types of media campaigns, workshops, changed curricula, and training courses.
- Lobby for political commitment for WDM.
- Review and revise policy so that WDM is incorporated in the countries water resources Policy and Strategies, and so that the regulatory framework is strengthened.
- Ensure that capacity is built to implement WDM and the necessary financial resources are made available through enhanced commitment from government and overseas donors and through enhanced cost recovery from customers.
- Ensure that adequate incentives exist to encourage service providers and their customers to adopt appropriate WDM technologies and those adequate penalties exist and are enforced to overcome non-compliance.

CHAPTER "3"

CONCEPTUAL MODEL

3. CONCEPTUAL MODEL

3.1 Ground Water Model

Three dimensional numerical finite difference guasi steady state flow model is developed. This model is generally used to predict the long term decline in water levels under various pumping conditions. Concepulation of the model involves the specification of the model boundaries, number of layers, groundwater flow conditions, abstraction quantities and spatial distribution, recharge distribution, and aquifer properties.

The model is used as a tool to check the aquifer response to management actions. Good management requires the ability to forecast the aquifer's response to planned operations, such as pumping and recharging (Bear et al.,1987). Certain assumptions and simplification are used to simplify the real system. Selecting the appropriate conceptual model for a given problem is one of the most important steps in the modeling process. Oversimplification may lead to a model that lacks the required information, while under simplification may result in a costly model, or in the lack of data required for model calibration and parameter estimation, or both. It is, therefore, important that all features relevant to a considered problem be included in the conceptual model and that irrelevant ones be excluded.

Selection of the appropriate conceptual model for a given problem is not necessarily a conclusive activity at the initial stage of the investigations. Instead, modeling should be considered as a continuous activity in which assumptions are reexamined, added, deleted and modified as the investigations continue. It is important to emphasize that the availability of field data required for model calibration and parameter estimation dictates the type of conceptual model to be selected and the degree of approximation involved (Bear et al.,1987).

The next step in the modeling process is to express the (verbal) conceptual model in the form of a mathematical model. The solution of the mathematical model yields the required predictions of the real-world system’s behavior in response to various sources and/or sinks. (Ahlfeld et al.,2000), combined methods for optimization techniques to numerical models for the simulation of Ground water flow .

Data for years 1998-2000 were selected for steady state model since rainfall records represent the long term average in the southern Gaza Strip, also municipal abstraction and water level data are available from 1997 through 2003.

The main sources of model raw data were the Palestinian Water Authority (PWA), Municipalities, Village Councils and Ministry of Agriculture. The data obtained for model formulation were:

- Well names, coordinates, screen interval, wells construction data and pumping rate.
- Water level data.
- Recharge data.
- Aquifer geometry.
- Aquifer properties from previous modeling efforts.

3.1.1 Software Description

Previously, there have been two modeling exercises related to the study area:

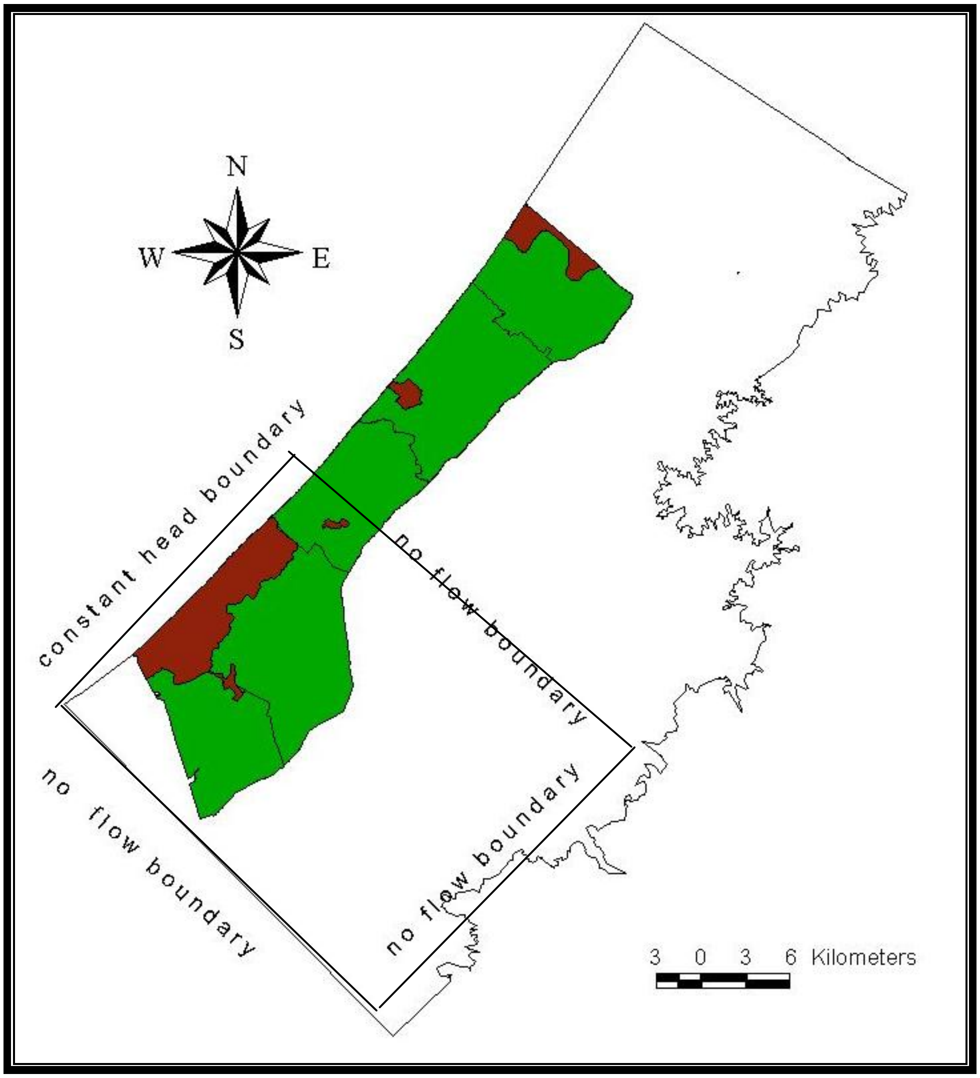
1) A regional groundwater model has been constructed for the southern part of the coastal aquifer focusing on Gaza strip and using the DYN software. This was a MS-DOS based software manufactured by CDM-consultants and is limited to the use of PWA and CAMP project.
2) A local growndwater model has been constructed for the hydrogeological evaluation of the infiltration system. The consultant (VA-Project AB, Sweco Viak AB and an under consultant at Tyréns, all in Sweden) has used MODFLOW. Modflow with its connected modules, as a commercial product and operates in a Windows environment. It has been on the market for about 10 years and is well established. It is fully available for PWA and consultants.

For the work under consideration, Visual Modflow (VMF) and its integrated modules is chosen. VMF is based on the finite-difference code MODFLOW (Harbaug and McDonald 1988) and contains four integrated modules:

- MODFLOW – Groundwater flow model.
- ZONE BUDGET – Water balance within user defined zones.
- MODPATH – Particle tracing.
- MT3D (Model Tracking 3D) – Substance or solute transport.

3.1.2 Model Boundaries:

Based on the previous modeling efforts (CAMP,2000), and the simulated water level contours for the year 1998, the model domain was chosen to fit stable boundary conditions. The Model Domain encloses an area of 22x33 km in the southern part of the Gaza Strip. Figure 3.1 shows the selected model domain as part of the coastal aquifer.



Figure(3.1): Southern Gaza Strip Model Domain Map

Hydro-geologically there is no sufficient information available for the entire model domain. Therefore primary effort has been made finding data for the central part of the Model Domain. The reason for expanding the Model Domain beyond the Data Area is to minimize the effects of Model Boundaries in the central part of the Model. The model boundary conditions are selected as follows:

- Eastern Boundary is a no flow boundary marked by physical limits of the aquifer system about 33 kilometers east of the Mediterranean sea.
- Northern Boundary located 1km north of Khan yunis Governorate at a location where equipotential lines are parallel to the sea shore and perpendicular to the chosen boundary, it is considered a no flow boundary.
- Southern Boundary assumed a no flow boundary since it is taken far enough in Egypt to avoid disturbing simulation results.
- Western Boundary is formed by the Mediterranean Sea which is assigned as a constant head.
- The upper boundary is defined by water table which rise and fall according to hydrologic changes.
- Lower boundary corresponds to the top of the Saqiya Group which is clay layer defines the bottom of the aquifer.

3.1.3 Stratigraphy

Although the greater part of the Gaza strip has a topsoil of stiff clay, the pumping test at the site in August 2002, clearly indicates that the aquifer is an unconfined, phreatic aquifer. Furthermore, clayey and silty layers have been found on the site during soil investigations by drilling. The layers are found both in the unsaturated and saturated zone.

The (Metcalf and Eddy, 2000) model final report indicates that the top clay layer extends up to 2 km inland. The second clay layer extends up to 1.5 km and the third deep clay layer extends up to 3.5 km inland. The average depths of those layers are -60, -100, and -130 to-160 (m) respectively. Most, if not all, of the wells, screens are located above the deep clay layer. Near the coast these clay layers divide the aquifer into 3 subaquifers. In the east these layers pinches out, so the aquifer is regarded as one single aquifer.

3.1.4 Aquifer Layers:

For the purpose of this study, the model is discretized vertically into 5 layers. The top of layer 1 is the ground surface elevation. The bottom elevation of layers 1, 2, 3 and 4 are -20m, -30m, -40m and -50m below mean sea level respectively. The bottom of layer 5 is the top of Saqiya formation as shown in Figure(3.2).

This discretization is done based on well log information to better represent the different aquifer layers.

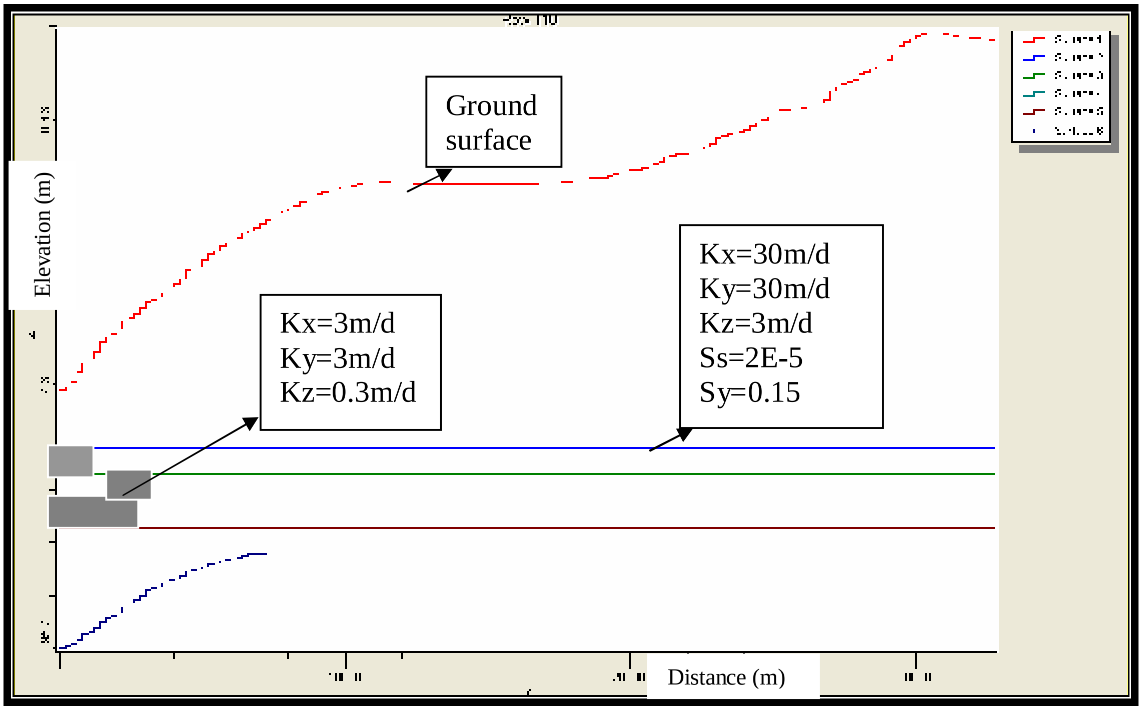


Figure (3.2): Aquifer layers in Southern Gaza Strip

3.1.5 Grid Size:

The model domain was discretized into a uniform square grid comprising 110 rows and 165 columns with a grid spacing of 200m, which was judged adequate in view of the available data.

3.1.6 Hydraulic Properties:

The default hydraulic parameters of the model is based on Coastal Aquifer Management Plan(CAMP) data and the interpretation of pumping tests in the area as shown in Figure (3.2).

Using this information, aquifer performance under different operating conditions was estimated. This model was calibrated and verified using the available up-to-date information regarding water levels 1998, 2000, 2003. At any given location, the increase in water level is a function of pumping practices and aquifer properties.

3.1.7 Recharge:

A GIS Spatial Analyst is used to calculate the net recharge to the aquifer in winter days and in summer days. The net recharge comprises of; recharge from rain, irrigation return flow, water networks losses, wastewater leakages, existing treatment plants and recharge basins, and recharge from treated wastewater irrigation in the Israeli side of the model. The details are illustrated below:

3.1.7.1 Recharge From Rain:

Recharge from rainfall was quantified as the average seasonal rainfall multiplied by an infiltration factor. Based on the rainfall records from 15 rainfall stations, Thiessen polygons interpolation method was used to calculate the aerial rainfall distribution over the model domain cells. The value of the rainfall in each cell is then multiplied by the an infiltration factor based on the soil type. Infiltration coefficient 0.2, 0.25, 0.6 for clay, Loess, and Sand soil types, Infiltration factor for impervious surfaces was considered zero (Metcalf and Eddy, 2000).

3.1.7.2 Recharge From irrigation:

In the (CAMP, 2000) model report, it was assumed that 0.25 of water pumped for irrigation return to the aquifer in Gaza Area. The same assumption was considered in the Israeli side for irrigated agriculture (Metcalf and Eddy, 2000).

3.1.7.3 Recharge From un-piped Wastewater:

In areas not connected to wastewater networks, especially Khan Yunis Governorate people use septic tanks or cess/percolation pits to dispose their sewage. From 80% to 85% of the Rafah Governorate population are connected to wastewater networks (LEKA, 2003). Most of the produced un-piped sewage seeps to the aquifer through the percolation pits. The rest is transported to the wastewater treatment plant via tanker trucks. 80% of the water consumption is assumed to be a non-consumptive use and thus turns into wastewater. In each area the produced wastewater is multiplied by a seepage factor (network connection percentage) to estimate the leakage into the aquifer from the un-piped sewage (WRAP, 1995).

3.1.7.4 Water Supply Network Losses Recharge:

This was calculated based on water consumption and the physical water supply network losses in each area in the model domain. Figure 3.3 show the GIS distribution of the total hydrologic recharge for the year 1998.

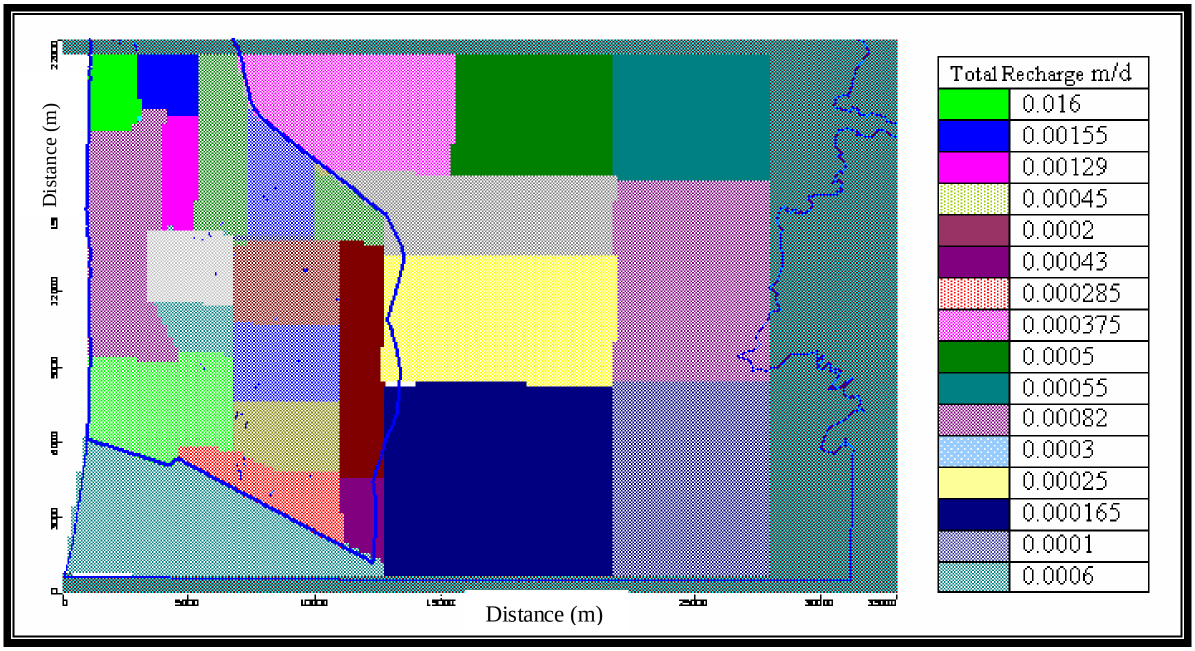


Figure (3.3): Total Recharge Map

3.1.8 Abstraction:

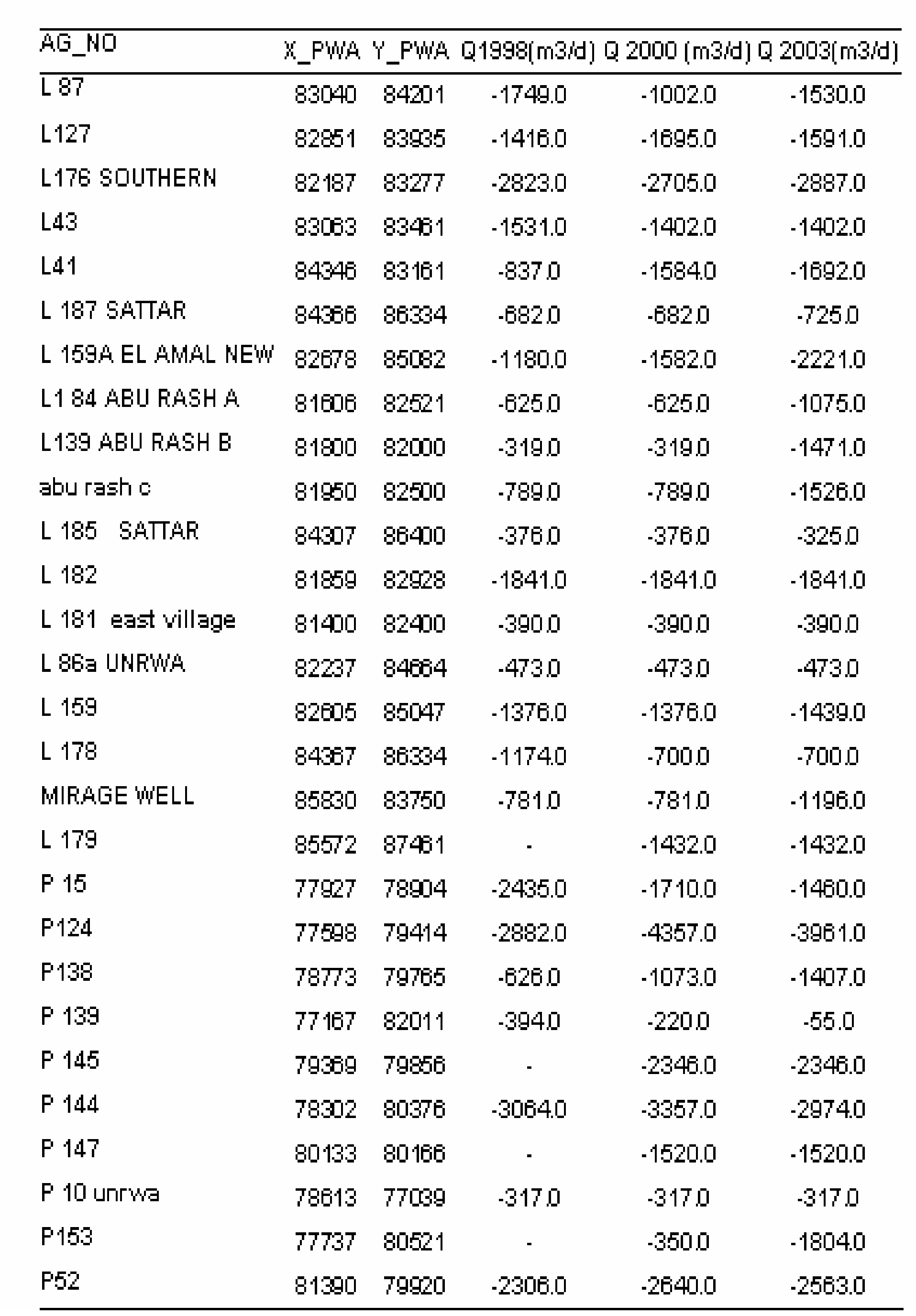
Ground water is the main source for Palestinian agriculture, municipal, industrial and settlement demands in Khan yunis and Rafah Governorates.

Abstraction for agriculture has been relatively stable in Khan Yunis and Rafah Governorates and it is expected to decrease due to increase in urbanization and decrease in land use for agriculture.

3.1.8.1 Abstraction Components:

Within the model area, 1300 wells have been defined and parameterized with a given average discharge based on available data (data from PWA). The abstraction from domestic wells is recorded monthly. Data is also available for years 1998, 2000 and 2003. Very limited data is available about agricultural wells abstraction. In most of agricultural wells the abstraction rates were estimated based on information from Ministry of Agriculture about irrigated areas, crop patterns, and crop water requirements (Metcalf and Eddy, 2000). There are about 28 Municipal wells in the two Governorates abstracted about 14,5MCM in the year 2000 (PWA Database). Detailed abstraction records are shown in Table (3.1) .

Table (3.1): Municipal wells abstraction rate (PWA-databank, 2004)



AG_NO	X_PWA	Y_PWA	Q1998(m3/d)	Q 2000 (m3/d)	Q 2003(m3/d)
L 87	83040	84201	-1749.0	-1002.0	-1530.0
L127	82851	83935	-1416.0	-1695.0	-1591.0
L176 SOUTHERN	82187	83277	-2823.0	-2705.0	-2887.0
L43	83063	83461	-1531.0	-1402.0	-1402.0
L41	84346	83161	-837.0	-1584.0	-1692.0
L 187 SATTAR	84366	86334	-682.0	-682.0	-725.0
L 159A EL AMAL NEW	82678	85082	-1180.0	-1582.0	-2221.0
L1 84 ABU RASH A	81606	82521	-625.0	-625.0	-1075.0
L139 ABU RASH B	81800	82000	-319.0	-319.0	-1471.0
abu rash c	81950	82500	-789.0	-789.0	-1526.0
L 185 SATTAR	84307	86400	-376.0	-376.0	-325.0
L 182	81859	82928	-1841.0	-1841.0	-1841.0
L 181 east village	81400	82400	-390.0	-390.0	-390.0
L 86a UNRWA	82237	84664	-473.0	-473.0	-473.0
L 159	82605	85047	-1376.0	-1376.0	-1439.0
L 178	84367	86334	-1174.0	-700.0	-700.0
MIRAGE WELL	85830	83750	-781.0	-781.0	-1196.0
L 179	85572	87461	-	-1432.0	-1432.0
P 15	77927	78904	-2435.0	-1710.0	-1460.0
P124	77598	79414	-2882.0	-4357.0	-3961.0
P138	78773	79765	-626.0	-1073.0	-1407.0
P 139	77167	82011	-394.0	-220.0	-55.0
P 145	79369	79856	-	-2346.0	-2346.0
P 144	78302	80376	-3064.0	-3357.0	-2974.0
P 147	80133	80166	-	-1520.0	-1520.0
P 10 unrwa	78613	77039	-317.0	-317.0	-317.0
P153	77737	80521	-	-350.0	-1804.0
P52	81390	79920	-2306.0	-2640.0	-2563.0

About 26 wells have been operating inside Gush Qatif the largest Israeli settlement in the south. Those wells are arranged in a line about 1,5km from the shore and are placed about 500m a part(Metcalf and Eddy, 2000), (see the map Figure 3.4).

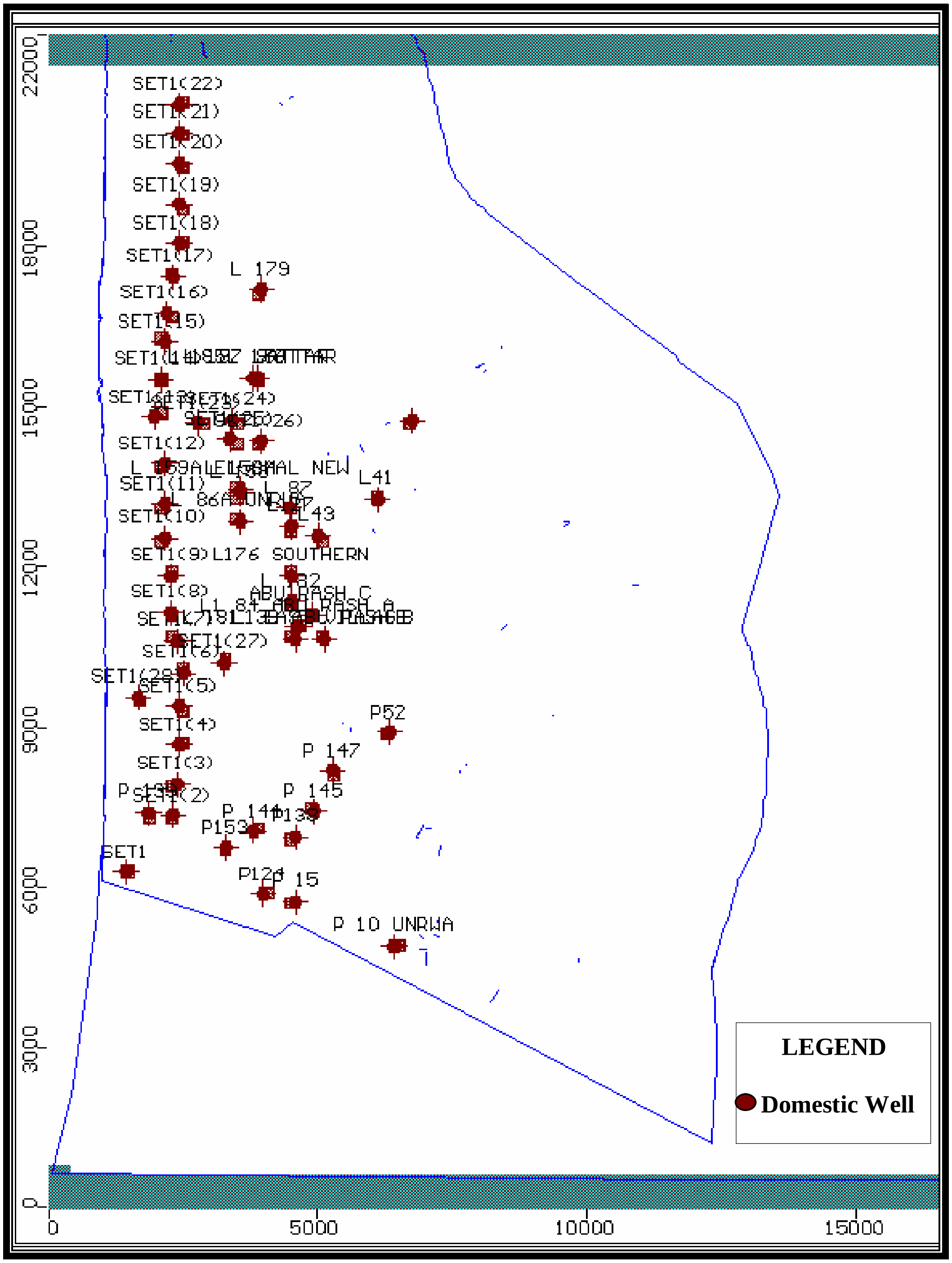
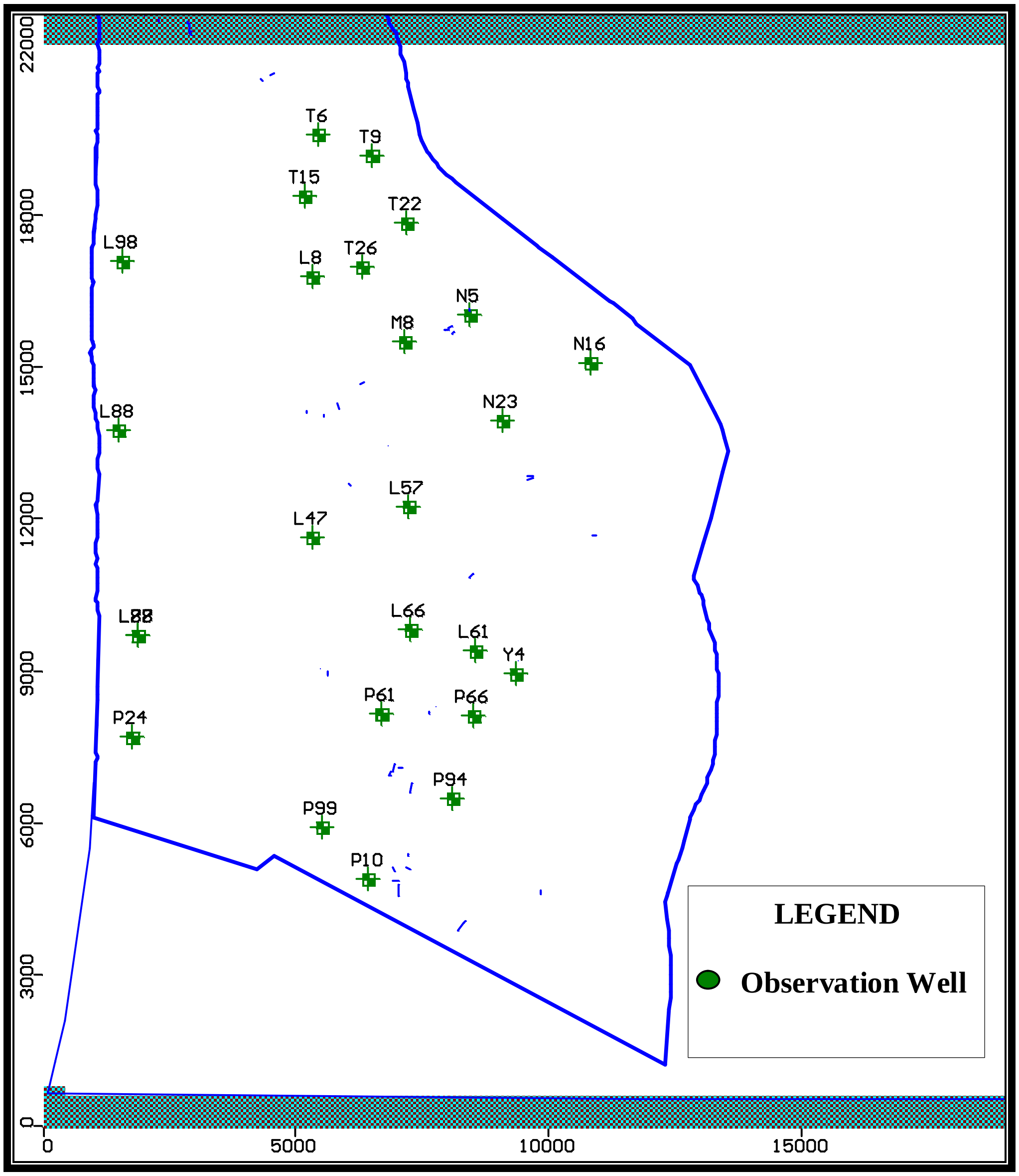


Figure (3.4): Existing Palestinian municipal wells and settlement wells (PWA-databank, 2004)

Records for each well abstraction is not available, the estimated abstraction from the settlement is between 4 and 5 Mm^3 /y (Metcalf and Eddy, 2000). The linear arrangement of shallow wells allows for minimizing impacts on hydraulic gradient and sea water intrusion.

24 wells were selected as head observation wells for the model regional calibration as shown in Figure (3.5). The selection was based on the availability of good hydrograph for these wells.



Figure(3.5): Observation Wells (PWA-databank, 2004)

3.1.9 Ground water flow regime:

Ground water flows regionally towards the Mediterranean Sea. Over pumping disturbed the flow regime. Dramatic large cones of depression has been formed in Khan Yunis and Rafah Governorates. Water levels have been dramatically lowered by several meters.

3.2 Optimization Model

3.2.1 Objective Function

The present optimization problem is to maximize the net benefit of output of alternative sources of water in Southern Gaza Strip.

This is also expressed as profit = Revenue – Cost

Or $P = R - C$

The benefit (revenue) and cost functions are functions of control design variables.

Where $P = MaxPofit$

$Q_i =$ available Quantity of water (Mm^3) from Resources 1,2,3,4,5.

$V_i =$ Economic value of cubic meter of water for purposes (Domestic and Agriculture).

$C_i =$ Cost of cubic meter of water from Resources 1,2,3,4,5.

The objective function is subjected to design function and constraint set which represent the transformation of resource inputs to resource outputs of products.

3.2.2 Constraint Functions

3.2.2.1 Resource constraint

$Q_i \le b_i$

where b_i – The upper limit of water Quantity obtained from resource $i = 1,2,3.....6$ as follows:

Q_1 = Abstracted groundwater from Areas controlled by (PNA) for domestic use.

Q_2 = Abstracted groundwater from Areas controlled by (PNA) for irrigation.

Q_3 = Abstracted groundwater from settlement areas for domestic use.

Q_4 = Treated wastewater to be used for irrigation.

Q_5 = desalinated water from Regional sea water desalination plant for Domestic use.

3.2.2.2 Quality Constraint

* Domestic Quality

$q_1 =$ quality of ground water from Areas controlled by (PNA), for domestic use in terms of TDS.

$q_3 =$ quality of ground water from settlement areas in terms of TDS.

$q_5 =$ quality of Desalinated water in terms of TDS.

* Agriculture quality

$$\frac{Q_2 * q_2 + Q_4 * q_4}{\sum Q} \leq qua_{Ag}$$

where:

$q_2 =$ quality of ground water for irrigation in terms of TDS.

$q_4 =$ quality of treated wastewater for irrigation in terms of TDS

$qua_{Ag} =$ allowable quality for irrigation purposes in terms of TDS.

3.2.2.3 Cost constraints

$C_1 =$ cost of abstracted groundwater from Areas controlled by (PNA) for domestic use $(\$/\mathrm{m}^3)$

$C_2 =$ cost abstracted groundwater from Areas controlled by (PNA) for irrigation $(\$/\mathrm{m}^3)$

$C_3 =$ cost of abstracted groundwater from settlement areas for domestic use Treated wastewater to be used for irrigation in ($\$/\mathrm{m}^3$).

$C_4 =$ cost of treated wastewater to be used for irrigation (Tertiary + treated + conveyance) in ($\$/\mathrm{m}^3$).

$C_5 =$ cost of desalinated water from Regional sea water desalination plant for Domestic use in $(\$/\mathrm{m}^3)$.

§ *Objective Function*

$$MAX\ B = (Q_1 + Q_3 + Q_5) * V_1 + (Q_2 + Q_4) * V_2 - (Q_1 * C_1 + Q_2 * C_2 + Q_3 * C_3 + Q_4 * C_4 + Q_5 * C_5)$$

Where:

$V_1 =$ **The economic value of domestic water in** $(\$/\mathrm{m}^3)$.

$V_2 =$ **The economic value of Irrigation water in** $(\$/\mathrm{m}^3)$.

- ***Resource constraint***

$Q_1 + Q_3 + Q_5 \geq Q_{MI}$ **(Municipal and Industrial) demand;**

$Q_2 + Q_4 \geq Q_{Ag}$ **(Agricultural) demand;**

$$qua_{MI} = \frac{(q_1 * Q_1 + q_3 * Q_3 + q_5 * Q_5)}{(Q_1 + Q_3 + Q_5)};$$

$$qua_{AG} = \frac{(q_2 * Q_2 + q_4 * Q_4)}{(Q_2 + Q_4)}$$

$$Y_{ie} = a\,TDS + b$$

Where Y_{ie} is The Crop Yield .

$$Yield = -0.0039\,TDS + 130$$

$$V_{AG} = \frac{Yield}{Max\ \text{Yield}} * Value\ \text{of}\ Tww(0.51)$$

$$V_{MI} = \text{Value}(\text{desalinated water}) * \frac{400}{qua_{MI}}$$

<u>Note</u>:

- 0.51 \$/m^3 is the economic value of treated waste water,(see chapter 2).
- 400 mg/l is the maximum expected TDS for desalinated water.

CHAPTER "4"

CALIBRATION AND VALIDATION

4. CALIBRATION AND VALIDATION

4.1 CALIBRATION*:*

Calibration is the iterative process of adjusting the parameters in the model, such as hydraulic conductivity, transmissivity and dispersivity, so the model adequately represents the real ground water system. Every model must be calibrated and validated before it can be used as a tool for predicting the behavior of a considered system (EPA,1992). This is accomplished by comparing the model results to a set of field observations. The calibration data set should include measurements over the lateral and vertical extent of the model area. For a flow model this data will often consist of water level measurements from monitoring wells and piezometers.

Calibration is evaluated by analyzing the residuals, or differences between observed and simulated values, at specific locations. Calibration may be conducted by trial and error, changing the values of parameters until a good correlation is obtained between observed behavior of the ground water regime and the model results. Calibration should proceed by first changing those parameters with the lowest level of accuracy, and then fine-tuning the simulation by adjusting other parameters. It must focus on parameters that are not measurable like recharge which is of regional significance.

The main objective behind the calibration effort is to represent the flow characteristics and general behavior of the aquifer system.

Potential head measurements should be presented in the form of contour maps and cross sections of observed and simulated values. The general shape of the potentiometric surface should be similar, including mounds, depressions and general flow directions. An x-y scatter plot of observed versus simulated heads will show the magnitude and any trends in residuals.

The model was calibrated against 1998 observed water head. Input parameters such as hydraulic conductivity total porosity and effective porosity were calibrated in CAMP Project. The only parameter to be calibrated in the present study is the real recharge.

Through a trial and error procedure a real recharge was suitably adjusted after each simulation run until a good match was achieved between the calculated and observed water levels. The calculated water head map for the year 1998 is shown in Figure (4.1). The calculated VS observed water level in the observation wells plot against the 45° line is shown in Figure (4.2).

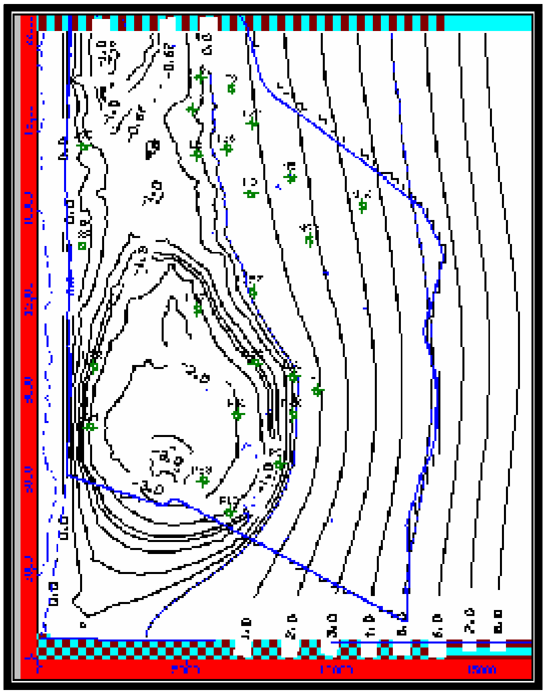


Figure (4.1): Calculated Water level For Year 1998

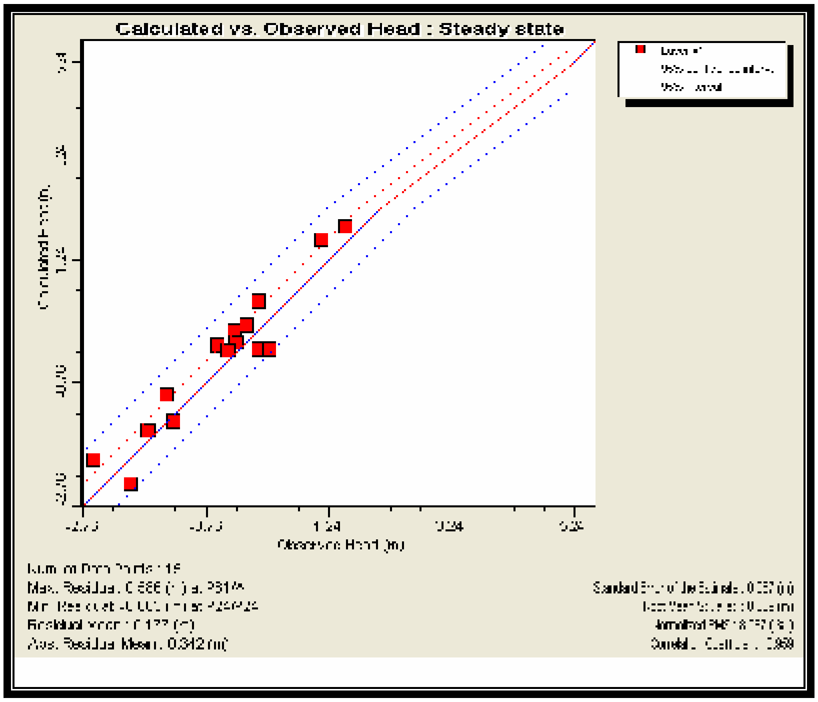


Figure (4.2): Calculated Water Level Versus Observed Level For Year 1998

4.2 Sensitivity Analysis

Sensitivity analysis is the process of characterizing the effects of changes in parameters or boundary conditions on the behavior of the calibrated model.

Sensitivity analysis can be performed both before and after model calibration. Before calibration, sensitivity analysis can identify the primary factors to be considered during calibration. When performed after calibration, sensitivity analysis helps to define the effect of parameters on model results. Sensitivity analysis is conducted by altering model parameters and boundary conditions within reasonable ranges and observing changes in simulation results.

If a small change in a parameter produces a large change in model results, the model is sensitive to that parameter. Sensitive parameters should be characterized by good field data to reduce uncertainty in model results.

Hydraulic conductivity values calibrated in (CAMP, 2000) will be altered by increasing and decreasing Kx and Ky by 20%.

So the calibrated model of year 1998 will be run two times, first: for Kx =35m/d, Ky =35m/d , Second: for Kx =25m/d,Ky=25m/d.

Figure 4.3 shows calculated water levels for the first case, while Figure 4.4 shows the calculated water level versus observed head for Year 1998 (Kx, Ky =35m/d)

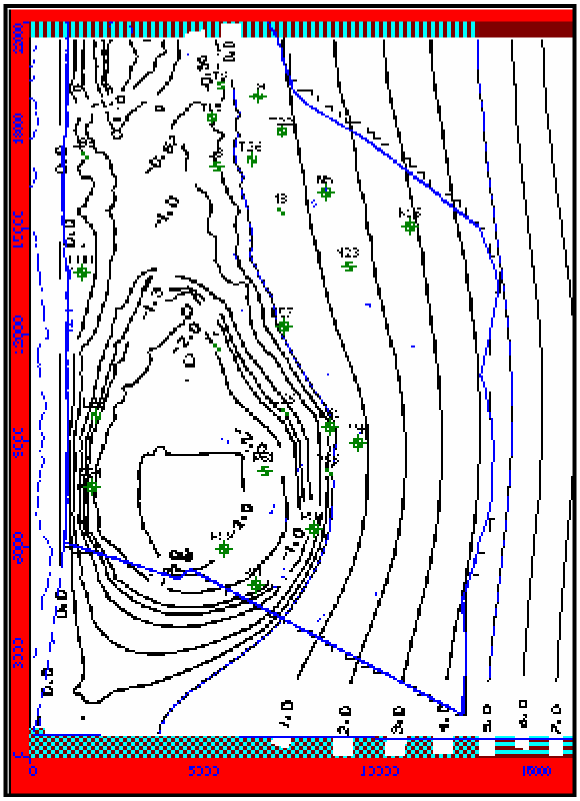


Figure (4.3)Calculated Water level For Year 1998(Kx,Ky=35m/d)

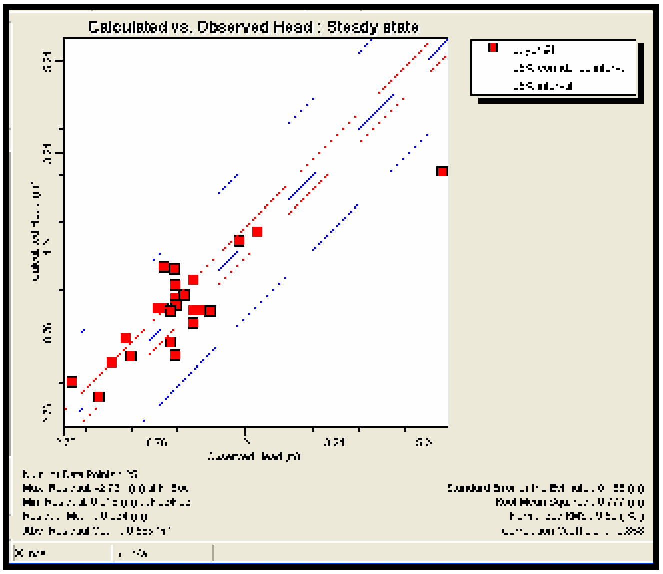
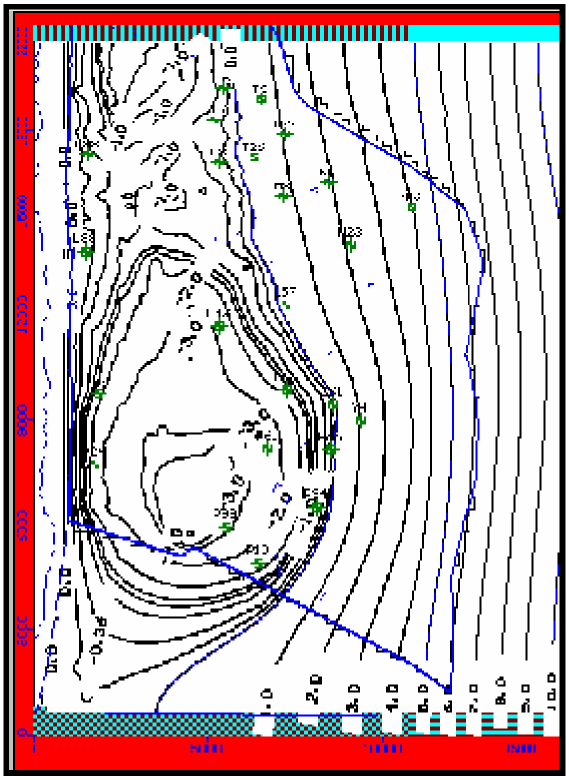


Figure (4.4):Calculated Water Level Versus Observed Level For Year 1998 (Kx,Ky=35m/d)

Figure 4.5 shows calculated water levels for the second case, while Figure 4.6 shows the calculated water level versus observed head for year 1998 (Kx, Ky=25m/d).



Figure(4.5))Calculated Water level For Year 1998(Kx,Ky=25m/d).

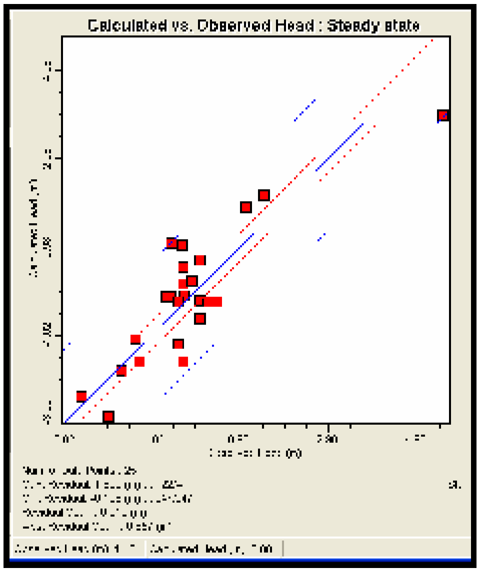


Figure (4.6)Calculated Water level Versus Observed Water Level For Year 1998 (Kx,Ky=25m/d)

The head levels shown in Figures (4.5), (4.6) prove that change in hydraulic conductivity produces small change in water level.

Hence hydraulic conductivity is not a sensitive parameter in the aquifer model

Specific porosity Ss, specific yield Sy, total porosity, and effective porosity also were checked for sensitivity analysis by altering them two times as follows:

First time: Ss= 2.5E-5 ,Sy= 0.2 , total porosity= 0.4 effective porosity= 0.3

Second time: Ss= 1.5E-5 ,Sy=0.2 , total porosity= 0.3 effective porosity=0.2

Running the model, the water level and correlation coefficient are shown in Figures (4.7),(4.8),(4.9) ,and Figure(4.10). .

Very small changes were noticed in water level, and correlation coefficient which proves that the model is not sensitive to the hydraulic parameters, specific porosity, specific yield, total porosity and effective porosity .

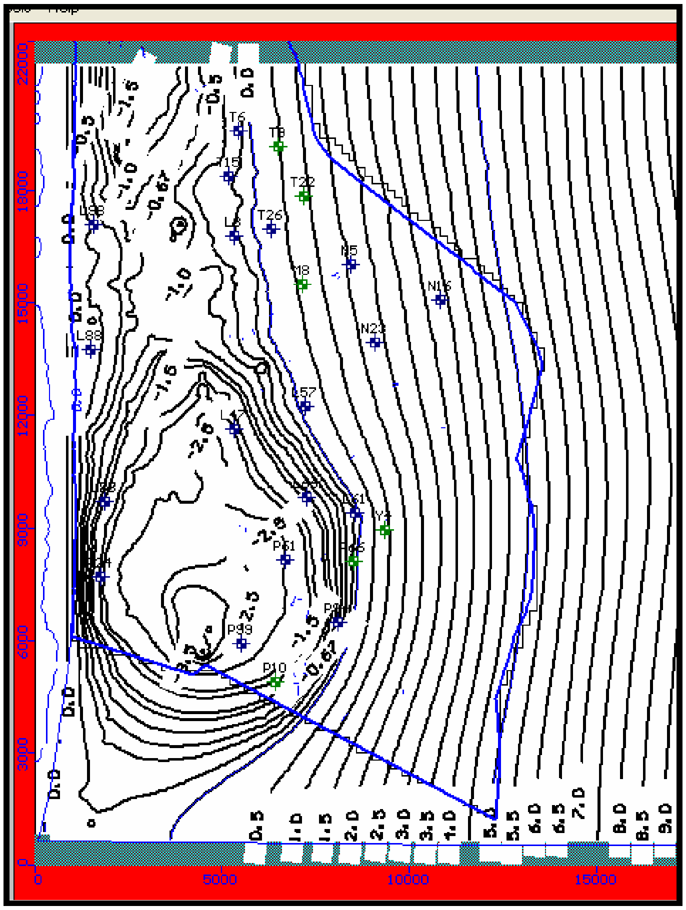
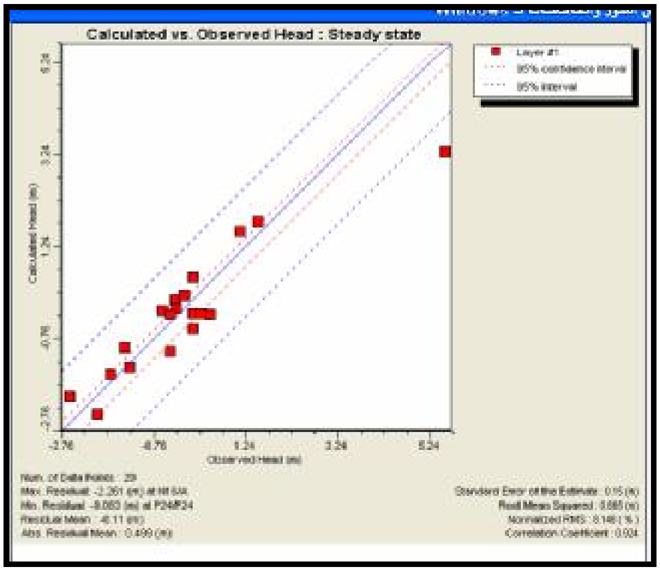


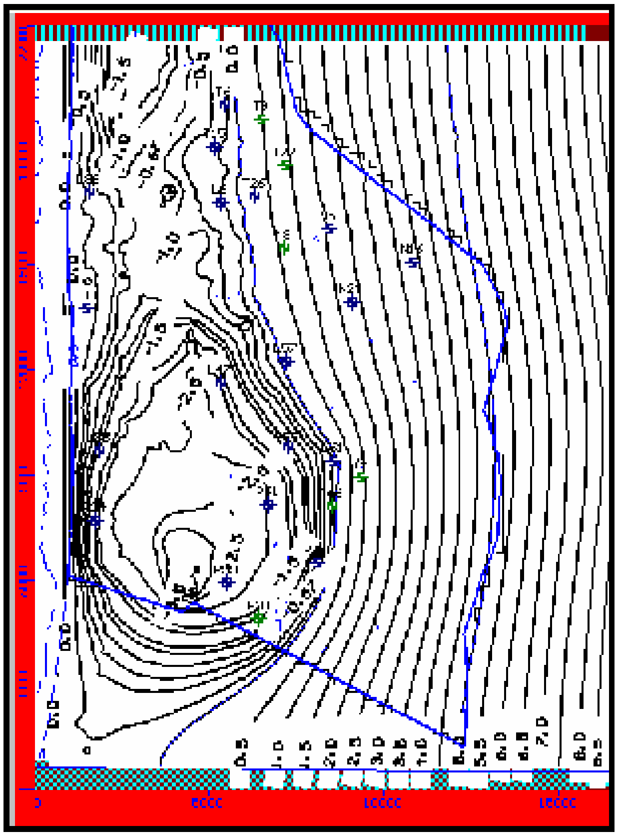
Figure (4.7) Calculated Water level For Year 1998(Ss= 2.5E-5 ,Sy= 0.2 , total porosity= 0.4 effective porosity= 0.3)



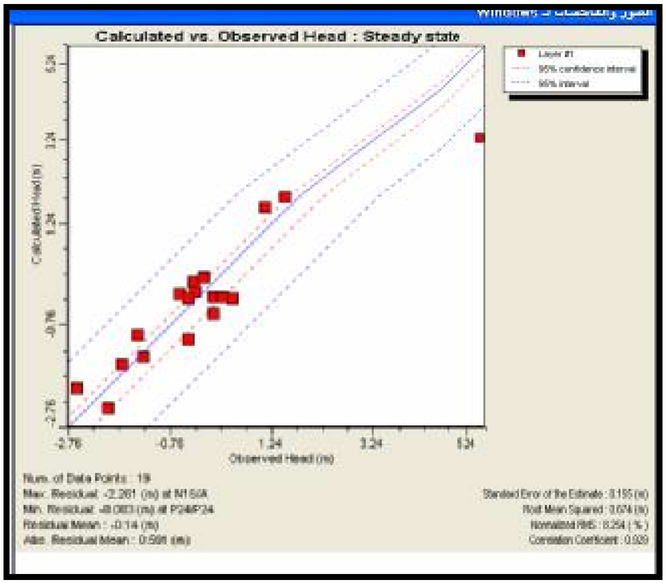
Num. of Data Points : 29
Max. Residual: -2.261 (m) at [illegible]
Min. Residual: -0.003 (m) at P24/P24
Residual Mean : -0.11 (m)
Abs. Residual Mean : 0.499 (m)

Standard Error of the Estimate : 0.15 (m)
Root Mean Squared : 0.685 (m)
Normalized RMS : 8.146 (%)
Correlation Coefficient : 0.924

<u>**Figure (4.8):Calculated Water level Versus Observed Water Level For Year 1998 (Ss= 2.5E-5 ,Sy= 0.2 , total porosity= 0.4 effective porosity= 0.3)**</u>



<u>**Figure(4.9): Calculated Water level For Year 1998(Ss= 1.5E-5 ,Sy=0.2 , total porosity= 0.3 effective porosity=0.2)**</u>



Num. of Data Points : 19
Max. Residual: -2.261 (m) at N150A
Min. Residual: -0.003 (m) at P24/P24
Residual Mean : -0.14 (m)
Abs. Residual Mean : 0.591 (m)

Standard Error of the Estimate : 0.155 (m)
Root Mean Squared : 0.674 (m)
Normalized RMS : 8.254 (%)
Correlation Coefficient : 0.929

Figure (4.10): Calculated Water level Versus Observed Water Level For Year 1998 (Ss= 1.5E-5 ,Sy=0.2 , total porosity= 0.3 effective porosity=0.2)

4.3 VALIDATION:

The calibration process, adjusting parameters in the model until the simulation closely matches observed values, creates a non-unique solution. Many different combinations of parameters may give results that meet the calibration criteria; each combination may fit better in some areas of the site and worse in others. For this reason, calibration alone can not be accepted as verification of a model's accuracy. Freberg (1988) showed that a good model calibration does not necessarily lead to good predictive capabilities. Therefore, the model must be validated, if possible, to further ensure that it accurately represents the ground water regime.

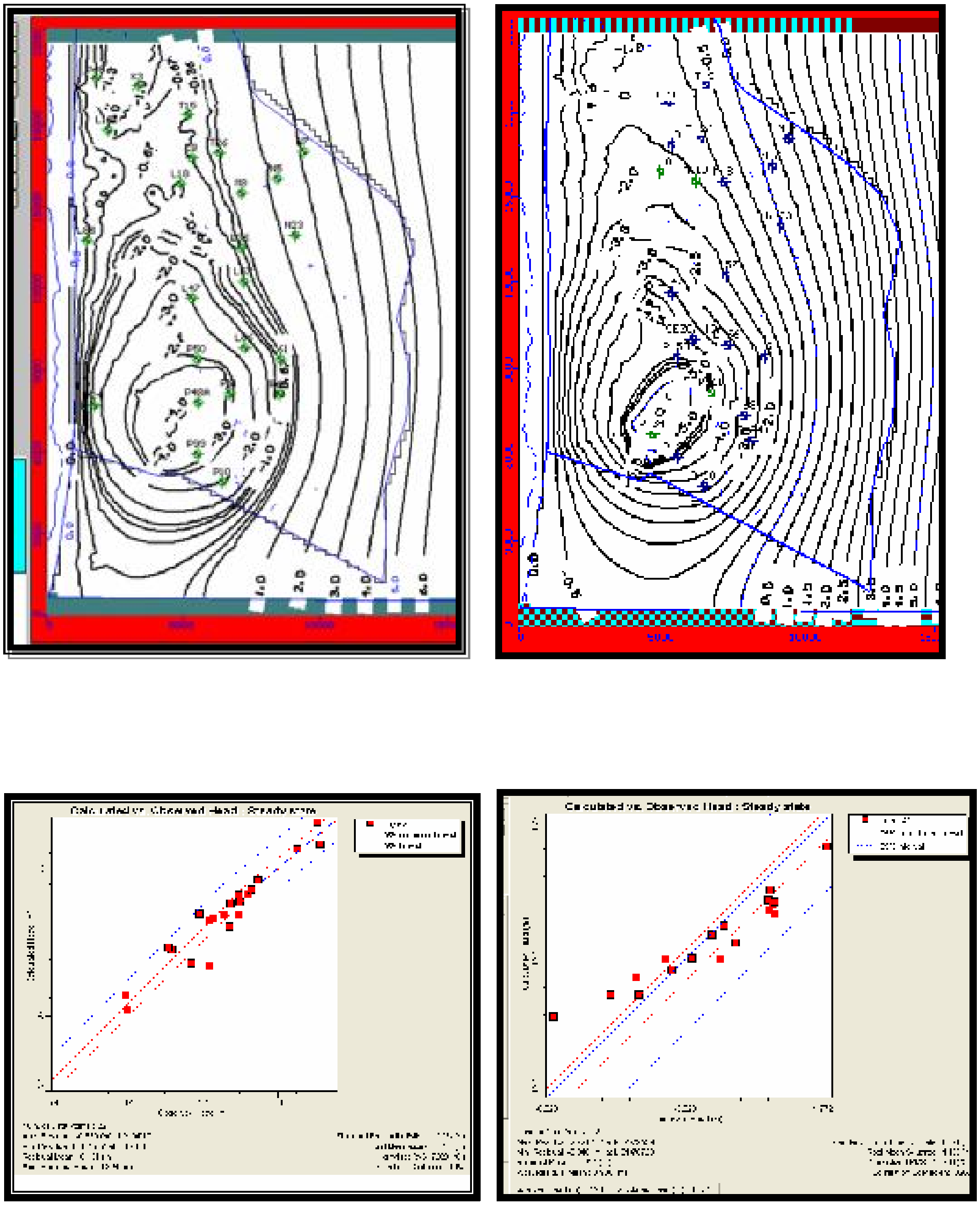
Validation is the process of comparing the calibrated model to another, independent, data set for the ground water regime. This should be another historical period with different stresses, which will demonstrate the predictive capability of the calibrated site model. The use of two data sets, adds a degree of confidence. The quality of validation testing depends on the degree to which the site simulation is "stressed beyond" the calibration data on which it is based. If the calibrated model truly approximates the physical behavior of the ground water regime, it should provide a reasonably good simulation of the validation data set.

Validation tested for the calibrated model to reproduce the water table maps for the study area for years 2000 and 2003 pumping rate and water level for years 2000, 2003 based on PWA data base were introduced for the model Figure (4.11). There is a good match between the observed and calculated water levels.

- **<u>Correlation coefficient</u>**: is the measure of the degree of relationship or interdependence between the calculated and measured values of water head
- **<u>Root Mean Square</u>**: = $$\sqrt{\frac{(\sum(\text{calculated head-measured head}))^2}{\text{No of observed wells}}}$$

Analyzing correlation coefficient and root mean square for the years 1998, 2000, 2003 shows that correlation coefficient is more than 95%, and root mean square is less than 10% for the three years, which means that the calibrated model can be used to represent the physical actual aquifer system in the study area, Figure (4.11).

So the model has been developed as a management tool to evaluate operational schemes for groundwater to guide safe supply in the future. The calibration results showed that the model is reasonable representation of the aquifer system. So it can be used to simulate futural management options, and to monitor the aquifer responds.



Figure(4.11): Calculated VS Observed Head for years 2000, 2003

CHAPTER "5"

MANAGEMET OPTIONS

5. MANAGEMENT OPTIONS

The largest and cheapest un- tapped water resource in the world, is hidden in the expression “Water Demand Management”/Water Conservation/Increase of efficient water use(Arlosoroff,2002).

Water supply and demand management in Gaza Strip, aims to manage the limited water resources available to exploit fully in a sustainable and an environmentally safe manner (PWA, 2002).

New water resources to be added to the aquifer system is needed to minimize the water defict and to improve the groundwater in terms of quality and Quantity. Certain aspects of water demand management and water quality management should be considered to support management of the aquifer at its sustainable capacity. Implementation of the management plan will require sustainable sources of revenue as well as strong regulatory body (PWA, 2002).

Maddaus, (2001) highlighted the key steps in the Integrated Resources planning (IRP) Figure (5.1):

- Demographic Trends, historic water use, economic indicators and climate data are needed to prepare a water demand forecast.
- The existing and planned conservation programs, such as plumbing codes, landscape ordinances, rebate programs should be accounted for in the forecasts.
- Forecasts are needed for normal, dry year, and critical dry year conditions, wet years in future years.
- Supply Side Planning starts with the safe yield of existing supplies and, if inadequate for future needs, locates alternative ground or surface water supplies to meet all or part of future demands.
- Demand Side Planning identifies additional conservation methods and wastewater reclamation projects to reduce demand and quantifies their costs and savings. In addition, short-term demand reduction possibilities in critical dry years are quantified.
- The Supply Reliability Evaluation ties together the probability of a supply shortage with the short term demand reductions that could be used to balance

supply and demands in droughts. The result is a tabulation of the magnitude and frequency of imposition of mandatory short-term demand reduction programs.

- Resource Strategies are the alternatives which combine new supply development and demand reduction alternatives into a manageable number of combinations.
- Evaluate Resource Strategies involves traditional economics analysis plus consideration of water quality and other environmental impacts.
- The utility Goals and Policies enter into the evaluation of supply reliability and the resource strategies.
- Financial Planning is needed at the end to assure that the IRP projects can be funded. The water rate design may be radical enough to cause a reduction in water demand that needs to be factored in.
- Public Input is shown at a couple of key points, but needs to be recognized as continuous throughout the process).

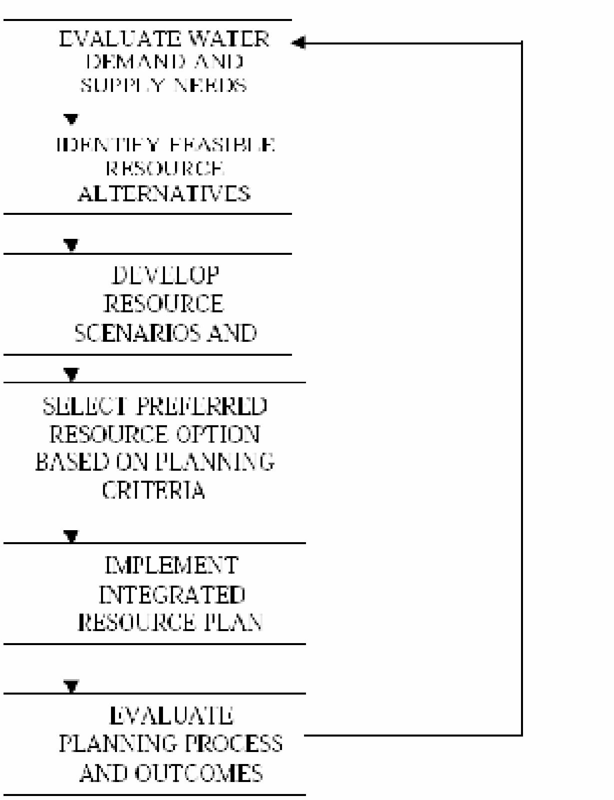


Figure (5.1) Typical IRP Process (Maddaus, 2001)

5.1 Demand Management

The definition of demand management proposed is: “The adaptation and implementation of a strategy (policies and initiatives) by a water institution to influence the water demand and usage of water in order to meet any of the following objectives: economic efficiency, social development, social equity, environmental protection, sustainability of water supply and services, and political acceptability”(Savenije,1997).

Demand management should not be regarded as the objective but rather a strategy to meet a number of objectives. One reason why the full potential of demand management is often not recognized is because it is often perceived or understood in a limited context. It is common for people to equate demand management only to programs such as communications campaigns or tariff increases. Demand management should equate to the development and implementation of strategies and initiatives associated to managing water usage.

5.2 Objectives of water resources management

- Provide quantity and quality of water for domestic purpose in compliance with WHO standards.
- Supply adequate quality and sufficient quantity of water that is required for planned agricultural production.
- Managing the Gaza Coastal at its safe yield and preventing further deterioration of the aquifer water quality (PWA,2002).

5.3 Constraints to water supply management

- Water resources in Gaza Strip are limited and characterized by a high temporal variability in rainfall.
- The unequal special distribution of these water resources, overexploitation, increase in water demand, usage of non-efficient irrigation techniques, vulnerability of these water resources to pollution .

5.4 Constraints to water demand management(WDM):

- Lack of appreciation by the general public (people and politicians) for the need for WDM and the benefits accruing from its implementation.
- Inadequate policy and weak regulatory framework for supporting WDM strategies.
- Inadequate implementation capacity, like shortage of trained manpower and financial resources.
- Weak incentives for the adoption of new technology.

These constraints result in reconsideration of the policies concerning water resources management. This management should be based on an integrated approach considering supply and demand of water. The adoption of such a strategy depends largely on the control of inputs and outputs.

The concept of integrated water resources management requires not only the usage of groundwater to satisfy the water demand for socio-economic development , but also the development of non-conventional water resources such as wastewater treatment and salt/brackish water desalinization.

5.5 Management Prospects in Southern Gaza Strip

The policy to meet the growing demand for water must focus on combined supply and demand activities and investments, while the long range solution lies with the total re-use of its wastewater as well as brackish and sea-water desalination, an expensive unlimited source of water, which will be a major supplementary source of fresh water as of 2010 and on.

5.5.1 Redistribution of Municipal Wells

The new political situation represented by the withdrawal of Israel from colonies suggest new vision for ground water management, which means optimal ground water Abstraction from the whole area.

According to PWA, The Israeli colonies are 17 colonies with a total area of about 22.38 km^2 while the Israeli control area around the colonies is about 20.42Km^2. Hence the total area for Israeli control area including the colonies would be about 42.8Km^2 :

- The topography surface of the area ranges from 0m to about 60m AMSL.
- The unsaturated zone thickness ranges from few meters near the shore line as in the Mawasi area "very close to the Mediterranean Sea" to about 60-70m in the eastern part of these areas.
- The average groundwater saturated thickness in the area about 80m.
- The average porosity in the northern area is about 20% (assumed).
- The water storage beneath these areas is about 680MCM.
- The groundwater quality in the area known to be fresh water even with its closest to the sea but it seems that they could manage the seawater intrusion in the area. This assumption came from the drilled wells around the Israeli control area for the municipalities while the gathered data from the water quality aspects seems to be fresh.
- The average renewable recharge water from rainfall only is about 5-8MCM if 50%-60% rain water recharged to the groundwater is assumed in the area with an average rainfall of 250 to 300mm/yr. Knowing that they abstract water with almost the same recharged water and balancing the storage beneath the colonies. (PWA, 2004).

Redistribution of Municipal Wells to include the wells in the settlements area, and drilling new wells to sustain suitable abstraction that does not exceed the maximum well rate recommended by PWA, is one of the option that will mitigate the stress on the aquifer as will be shown in the next chapter.

5.5.2 Conventional Options

Some of the main instruments of the water resources development are:

➡ **Water Pricing** :

Water pricing is possibly the most hated water conservation measure by several consumers. This stems from the fact that water is looked upon as a public good and therefore not to paid for. Progressive block rates coupled with total metering system (for every farmer, house, apartment and industry), prices must be updated automatically with a cost of living formula, minimization of subsidies etc. For Domestic Water Pricing in Gaza Strip see (Ghuraiz,2002).

- **Water rationing:**

Water rationing is one of the traditional methods that are usually adopted when the demand for water resources exceeds the supply. This may take the form of cutting off water supply in one area while supplying the other, and vice versa, however, consumers are given advance warning prior to the implementation of such an operation.

- **Efficiency of Water Use**

Water efficiency is the planned management of water to prevent waste, overuse, and exploitation of the resource. Effective water efficiency planning seeks to "do more with less" without sacrificing comfort or performance. Water efficiency planning is a resource management practice that incorporates analysis of costs and uses of water; specification of water-saving solutions; installation of water-saving measures; and verification of savings to maximize the cost-effective use of water resources.

Continued policies concentrate on mixed tools including: (a) allocations, norms and progressive block rates for each sector, and (b) research, development and implementation of agronomic techniques, implementation of Drip Irrigation techniques and automation of irrigation) as well as wide scale implementation of technological means to improve water use efficiency and reduce water consumption in the domestic sector, commercial, industrial and the irrigation of urban parks and gardens.

- **Public Awareness:**

Public Awareness campaigns aim at making the water consumer appreciate the necessity of conserving water. Both the print and electronic media in Gaza Strip must accomplish this task. Common messages comprise advising consumers to use the shower during periods of water scarcity as opposed to the path. Consumers are also advised to use a cup filled with water for brushing teeth rather than using a running tap. as the latter wastes a lot of water.

- **Water Conservation.**

The definition of water conservation proposed is:

“The minimization of loss or waste, the preservation, care and protection of water resources and the efficient and effective use of water” (Savenije,1999).

It is important to recognize that water conservation should be both an objective in water resource management and water services management as well as a strategy.

There are a number of strategies that can be employed to reduce the amount of water consumed at a facility. In general terms, these methods include:

- System optimization (i.e., efficient water systems design, leak detection, and repair);
- Water conservation measures.
- Water reuse/recycling systems**.**

More specifically, a wide range of technologies and measures can be employed within each of these strategies to save water and associated energy consumption. These include:

- Water-efficient plumbing fixtures (ultra low-flow toilets and urinals, waterless urinals, low-flow and sensored sinks, low-flow showerheads, and water-efficient dishwashers and washing machines)
- Irrigation and landscaping measures (water-efficient irrigation systems, irrigation control systems, low-flow sprinkler heads, water-efficient scheduling practice) .
- Water recycling or reuse measures (Gray water and process recycling systems).

A large amount of water is lost in homes through toilet flushing. It is common practice to request consumers during periods of water scarcity to put two standard bricks in the tanks of flush toilet units in order to conserve water.

➡ **Agricultural Sector Water Allocations System**

The irrigation water allocations must reflect the potential economic gains by introduction of new irrigation technologies, changes of cropping patterns, and move away from crops where the product value per unit of water is relatively low.

5.5.3 Non Conventional Options

Water resources must be developed and managed efficiently in order to meet present and future water needs, in an environmentally sustainable way. Wastewater reclamation and reuse, desalination and storm water recharge together with renewable aquifer capacity will provide quantity of the water that would satisfy water demands in the Gaza Strip for the next 20-years.(PWA,2002).

In order to meet the increased overall water demand and to reverse the process of salt water intrusion, sustainable quantities must be added to the water cycle and wastewater should be used to the extent feasible. Developing new water resources is based on :

- Reclamation of wastewater and maximize the use of the reclaimed water for agriculture.
- Improve Pumped groundwater quality needed for domestic use.
- Introduce new water resources especially sea water desalination to maintain the water balance condition to the positive condition.

5.5.3.1 Proposed Southern Wastewater Treatment Plant

It is proposed that the new wastewater treatment plant will receive effluent from the Khan Yunis and Rafah Governorates.

A feasibility study for the wastewater treatment plant for Kan Yunis & Rafah was proposed by JICA..

The project consists of two phases. The first phase up to year 2010 with a design capacity of 53,400 m^3/d. The second phase up year 2025, with a design capacity of 159,400 m^3/d. The design loads for the two phases are shown in Table (5.1) (MOPIC/JICA,1997).

Table (5.1) The design loads for southern WWTP

		First Phase	**Year 2025 load**
Average dry weather flow	m^3/d	53,400	159,400
BOD	t/d	22.2	66.3
Total N	t/d	5.7	16.9
Total P	t/d	1.2	3.6

Source (MOPIC/JICA, 1997)

The treatment process in the first phase is proposed to be activated sludge with tertiary treatment by soil filtration. In the second phase a nitrification-de-nitrification step is to be added.

About 32 hectare is required for the first phase, while in the second phase 13.5 hectare is required for treatment plant and another 60 hectare for soil filters.(Ouda, 1999).

5.5.3.2 Proposed Gaza Sea Water Desalination Plant

Desalination increases the total amount of available water in the hydrological cycle, but wastewater reuse does not. The same water is used repeatedly, after treatment to improve its conditions regarding its future use(Antonio,2005).

The Feasibility Study (PWA, CDM 2003) reports that the United States (US) Government is working to fulfill future needs has been established in accordance with the provisions of Article 40, Interim Agreement between Palestine and Israel. The agreement aims to strengthen cooperation already established by the Israeli-Palestine-American Water Committee. So the US addresses the issue of brackish or seawater desalination in the Gaza Strip. On this sake, United State Agency for International Development (USAID) has been committed to the Palestinian National Authority to give a grant for designing, constructing, and supervising the RO Gaza Sea Water Desalination Plant (GSWDP) in Deir El Balah City. The production capacity of phase (1) is estimated at 60,000m^3/day (~ 20 MCM/year) and the plant is assumed to be in operation by the year 2005. But now, and because of political conditions, this date may be postponed. The production phases are estimated according to the PWA, CAMP report (2001) as follows:

Phase 1: 60,000M^3/day in operation by 2005.
Phase 2: 60,000M^3/day in operation by 2008.
Phase 3: 20,000M^3/day in operation by 2014.
Phase 4: 10,000M^3/day in operation by 2018.

The target final capacity shall be 150,000M^3/day (~ 55 MCM/year) by the year 2020. Seawater intake shall be employed for the feed water to the plant (Al-Jamal, et al,2000).

The quality of raw water from Mediterranean Sea is approximately 40,000Mg/L as total dissolved solids (TDS). The produced water must meet salinity level (TDS) of 350Mg/L to meet the World Health Organization (WHO) standards for other water quality constituents. The source of power for the proposed plant is from the new 140 MW thermal power plant vita the Gaza West Grid Substation, located about 11Km from the plant site. The anticipated power cost is about US$0.055/KWh for the facility. The land is being provided by the PWA and is located about 650m from the sea. (Ismael, 2003)

The estimated cost of a potable cubic meter produced from the RO Sea water desalination plant at the Middle Area plant according to the Trugina study (Austrian consultant) and submitted to PWA-Gaza was found at US$0.9/M^3. (Ismael, 2003)

The expected quantity for southern area based on hydraulic calculations is 8 MCM in phase 1, 16 MCM in phase 2. and 20 MCM in Final phase.

5.6 Population Projection

Population projection for Khan Yunis and Rafah Governorates for year 2006,2010 and 2020 are shown in Table (5.2), assuming population growth rate 3.8%,until year 2010, and population growth rate 3.2 %, until year 2020,based on Palestinian Bureau of Statistics census (PCBS,1997).

Table 5.2 Population Projection

Year	1997	2006	2010	2020
Khan Yunis & Rafah Governorates	323569	452560	525451	719995

5.7 The Projected Domestic Water Demand

Mainly the population growth and socio-economic development control water demand for the different uses, and will shape in the future domestic water demand. Water losses through transmition pipeline and water distribution system are included. Therefore domestic demand presents quantity of water at water supply source that should be delivered to the customers.

The projected domestic water demand assuming 150 L/capita/day for years 2006, 2010 and year 2020 as shown in Table (5.3).

Table 5.3 Domestic Water Demand

Year	2006	2010	2020
Khan Yunis & Rafah Governorates	24.8 Mm^3	29 Mm^3	40 Mm^3

5.8 The Projected Agriculture Water Demand

The existing agriculture water demand in Southern Gaza Strip is estimated about 30MCM. Neither the water nor the land support an increase in agricultural activities. This is occurring as a result of the growth of urban areas, which expand into agricultural land, there must be a trend to select crops of less water needs.

5.9 Wastewater Reuse Opportunity and Production

5.9.1 Reclaimed water reuse for agriculture

There are several opportunities for reclaimed wastewater in Southern Gaza Strip for agriculture, landscape irrigation, aquaculture, ground recharge and industrial use.

The projection of the total amount of sewage production is presented in Table (5.4) (assuming 80% of consumed water enters into sewage collection network)

Table 5.4 Projected Wastewater Productions

Year	Population	Water Consumption L/c/d	Wastewater production (MCM/year)
2010	525451	100	15-19
2020	719995	100	21-25

Water consumption is assumed 100L/c/d considering about 25%-35 % losses. The suggested crops which can be irrigated with reclaimed wastewater are olives, palm, citrus, almond and fodder with using drip irrigation (MOA,1998).

5.9.2 Groundwater Recharge

There are opportunities for recharge operations in Southern Gaza Strip when reclaimed wastewater is not used for agriculture purposes (winter time), to protect under ground fresh water against sea water intrusion. Groundwater recharge may also provide further treatment and storage of reclaimed wastewater. Secondary treatment plus partially denitrified effluent is recommended for recharge operation.

Recharge could be achieved by the process of infiltration. An area of 0.25km^2 would be needed to recharge 10 MCM/year at infiltration rate of 11 cm/day. (MOPIC/JICA 1997).

5.10 Economic Value and Cost of Water

The fact that water can be perceived differently according to different stakeholders, times, and places and thus there are many sources of value. It is necessary to concentrate on understanding economic values such as the concepts of economic efficiency and willingness to pay, it does not discuss directly other sources of value, which can divide stakeholders (e.g., people who view water as a human right and those who view it as a commodity that can be the property of an individual). Other sources of value include environmental values, which consider water as having value apart from its present or future usefulness to humans; social values which consider that water should be universally available at an affordable price; and public health values where clean water is a necessary condition for the health of populations. Another aspect of the challenge in valuing water is to understand what is being valued: water can be perceived as a substance, as source or as a service. For instance, public utilities managers believe they actually provide water services (treating and delivering).

Urban economic value for water is measured by what would happen if future water supplies do not keep up with population growth and the consequence that the amount of water use per household is reduced.

Palestinians in the Gaza Strip who are of a high economic and social level can afford additional expenses and they are currently purchasing imported potable bottled water. Alternatively, others purchase RO purified brackish water offered in 20 liters large plastic gallons from small local vendors. Also, household RO units for home use are now a big business in the Gaza Strip (Assaf, 2001).

The family consists of 5 persons consumes one large plastic gallon/d with a price 1NIS/Gallon for drinking and cooking purposes. This means that this family will pay 30 NIS/month for drinking and cooking water in addition to about 60 NIS/month for tap water for other household purposes (washing, toilet flushing, etc). Assuming consumption 500 L/d which equals about 15 m3/month of tap water.

The total pay equals 90 NIS for 15.6 m^3, This represents the willing to pay which means the economic value of domestic water.

So the economic value of domestic cubic meter equals 90/15.6=5.8 NIS/ m^3, about (1.3 US $/$m^3$).

The economic value of wastewater used for agriculture equals (0.51 US $/$m^3$,) while the cost of wastewater is about (0.1 US $/$m^3$)(Haruvy,1997). See chapter 2 for details.

The economic value of groundwater used for agriculture is variable according to its quality which affect crop yield.

The MOA has put the water price for agriculture purposes as (0.2 US $/ m^3). The water price for municipal water in Southern Gaza Strip is around (0.3 US $/$m^3$). Table (5.5) shows the economic value and cost of cubic meter from different sources.

Table 5.5 Projected economic and cost value of water

purpose	Economic Value US $/m3	Cost US $/m3
Domestic water(ground water)	1.3	0.3
Agriculture water (groundwater)	≤ 0.51	0.2
Desalinated water	1.3	0.9
Treated waste water	0.51	0.10

(Source: see previous page for details)

CHAPTER "6"

RESULTS AND DISCUSSION

6. RESULTS AND DISCUSSION

The model is used to simulate the future movement of ground water and the response of the ground water system to various remedial action scenarios. Conditions that are vastly different from the calibration and validation conditions, such as high pumping rates or drawdowns, may invalidate the model as a representation of the physical system.

Domestic wells in Palestinian Authority Area is shown in Figure (6.1). Pumping from these closely spaced wells in the southern governorates of Gaza Strip has resulted in the formation of deep cones of depression in the vicinity of the pumping centers. Water-level measurements indicate that there has been a steady decline in water levels in the vicinity of these wells which means long term ground water mining, (Walker et al, 2000).

6.1 Current situation 2006:

Unconventional options such as wastewater reuse can not be utilized at this time due to very low level of wastewater treatment. Also no serious steps have been taken towards seawater desalination therefore the short term solution of the current situation is limited to redistribution of domestic wells. Israel has evacuated Gaza Strip settlements , large areas with good water quality are available now to the Palestinian use. Reconfiguration of the supply system will then be necessary for optimal utilization of the groundwater resources for the whole area. The Management options are limited to :

- Closing the wells with high TDS (more than 2000mg /l).
- Reducing well pumping rate to 115 m^3/hr for 12 hours recommended by PWA (personal communication with PWA resources department,2005).
- Using the Existing settlements wells for domestic supply at the same rate before withdrawal.

- The settlements wells are proposed to supply domestic water at rate of 375 m^3/d (the same assumed rate before withdrawal).
- Another line of 20 wells are proposed to be drilled one kilometer to the east of the old wells ,(1000) m apart to supply water for domestic use at a rate of 550 m^3/d.The total abstracted water from settlements area will be about $8x10^6$ m^3 per year. The remaining domestic water required is to be abstracted from Palestinian Authority area which is about $13x10^6$ m^3 for year 2006.
- Pumping rate for some over pumped wells which caused sharp drop in water levels in recent years is to be reduced, particularly wells, P124,P139,P145,P144,P52,L181,L178, as shown in Table (6.1), It takes into consideration that maximum pumping rate is 115 m^3/hour for 12 hours a day (PWA recommendation). Some poor quality wells which have total dissolved solids (TDS) more than 2000 mg/l were closed such as wells L185, L86a,P10, Table(6.2). Other wells with bad quality and over pumping rate, should reduce pumping rate, such as wells, L87, L41,L43,L127, Table(6.2). The new drilled wells in settlements area can provide consumers with better quality water. The remaining wells should pump at a pumping rate shown in Table(6.2). Figure 6.1 and Figure 6.2 show existing and proposed reconfiguration of domestic wells in Palestinian Authority area and settlements area.

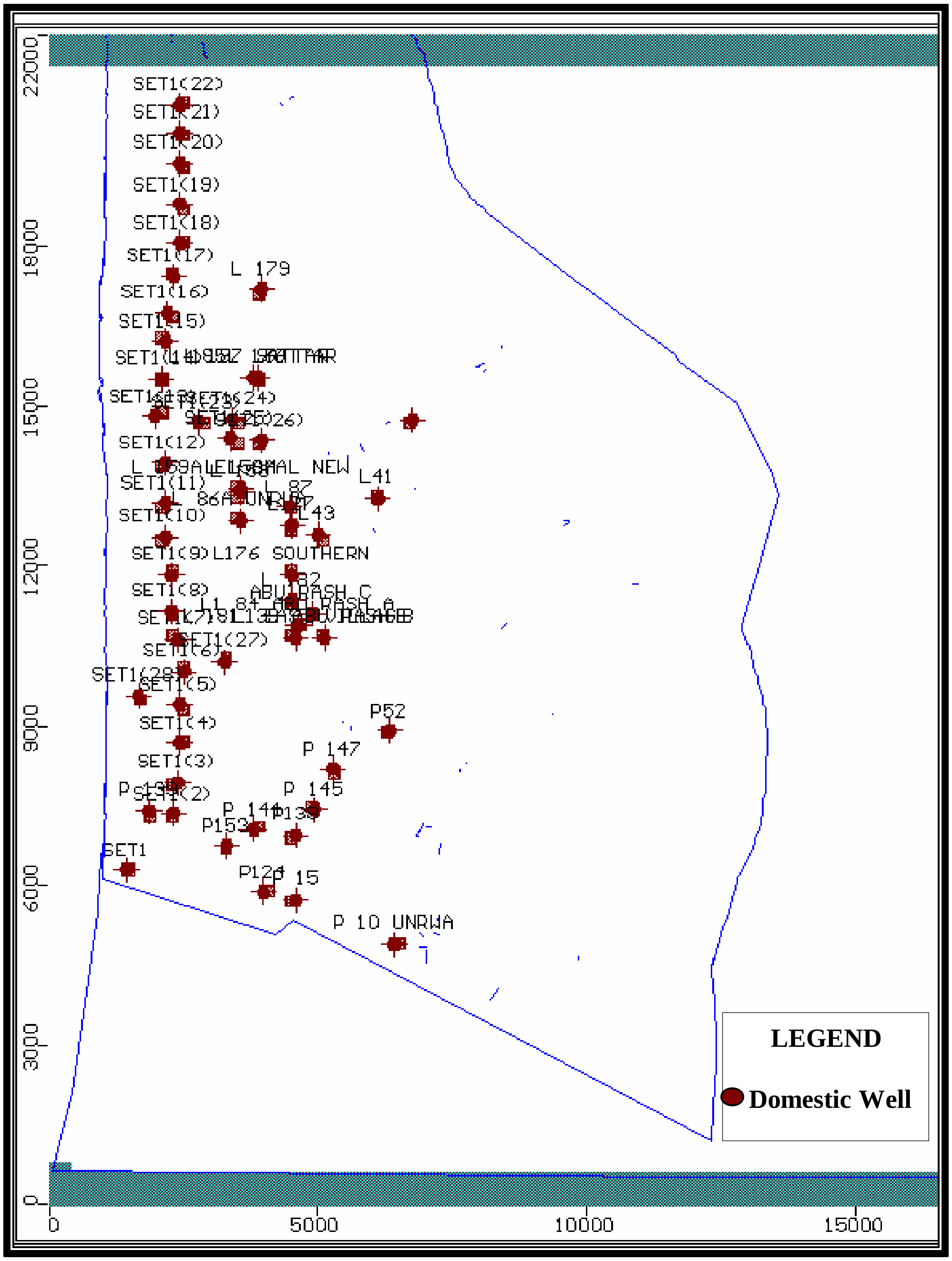


Figure (6.1): Existing Palestinian municipal wells &settlement wells.

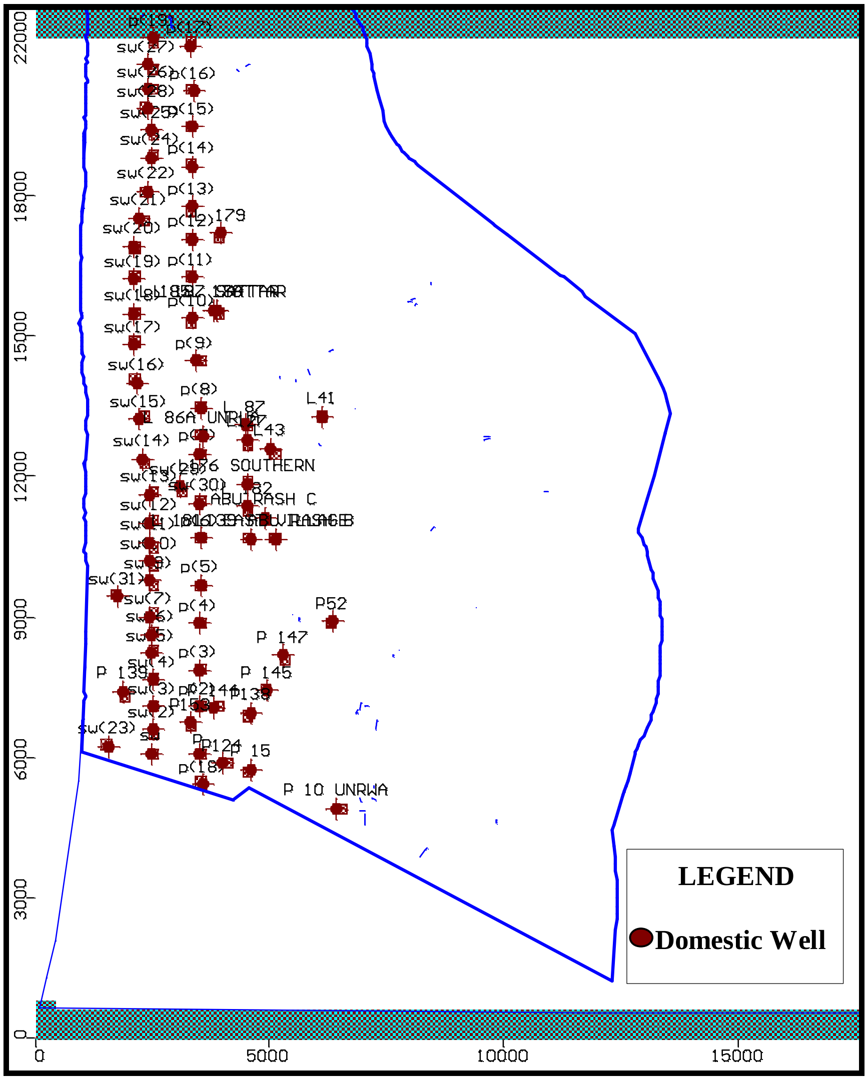


Figure (6.2): Proposed Reconfiguration of Palestinian Municipal Wells &Settlement Wells

In year 2003 abstracted domestic water from Palestinian Authority area was about 16.0x10^6 m^3 in addition to 4x10^6 m^3 was estimated to be abstracted by Israelis from settlements area. The total proposed abstracted domestic water in year 2006 from Palestinian Authority area is 13x10^6 m3 in addition to 8x10^6 m^3 from settlement area.

The total quantity abstracted from PNA area in year 2003 was about 16X$10^6$$m^3$ .the weighted average TDS for all wells was 1327mg/l as shown in Table (6.1).

Table (6.1) Domestic Wells Water Quality (PWA-databank,2004)

Well Name	Cl	TDS	Q2003(m3/d)	Q*TDS
L87	954	2591	-1530	-3964230
L127	737.5	2337	-1591	-3718167
L176	451	1321	-2887	-3813727
L43	744	2360	-1402	-3308720
L41	966	2839	-1692	-4803588
L187	472.6	1661	-725	-1204225
L159A	315	1229	-2221	-2729609
L184	157.5	592	-1075	-636400
L139	479	1587	-1471	-2334477
Abo rashwan c	422	1326	-1526	-2023476
L185	1396	3676	-325	-1194700
L182	512	1420	-1841	-2614220
L181	112.8	480	-390	-187200
L86a	1174	2684	-473	-1269532
L159	472.6	1661	-1439	-2390179
L178	157.5	592	-700	-414400
Mirage well	114.6	399	-1196	-477204
L179	437.6	1376	-1432	-1970432
P15	443.9	1327	-1460	-1937420
P124	458.2	1383	-3961	-5478063
P138	186.2	730	-1407	-1027110
P139	143.2	611	-550	-336050
P145	286.4	951	-2346	-2231046
P144	293.6	850	-2974	-2527900
P147	160	587	-1520	-892240
P10	986.7	2876	-317	-911692
P153	114.6	399	-1804	-719796
P52	178	662	-2563	-1696706
		Total=	-42818	-56812509

Average TDS= **1326.84**

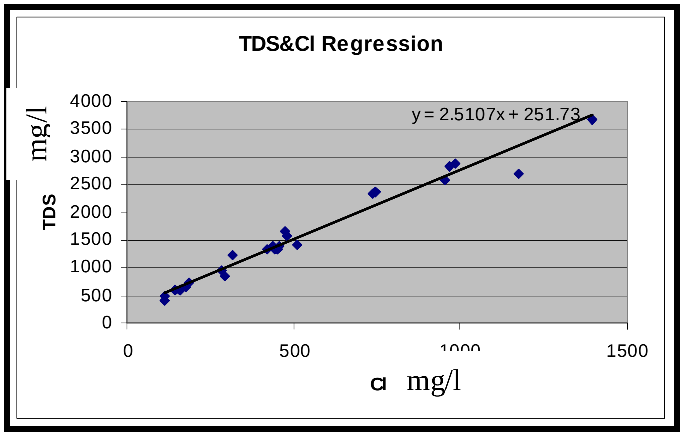


Figure (6.3) Linear regression of TDS VS Chloride concentration.

For the proposed redistribution of wells between PNA area and the area after removal of settlements, and the proposed pumping rate, the quantities abstracted are about 13x10^6 m^3 from PNA area ,and 8x10^{6}m^3 from evacuated area. The remaining needed quantities about 3 MCM to be provided by mekorot (Israeli National Water Company). Average TDS for domestic water for PNA area=1226 mg/l Table 6.2.

Table (6.2) Domestic Well Quality 2006 (Proposed)

Well Name	Cl	TDS	Q2006(m3/d)	Q*TDS
L87	954	2591	-1380	-3575580
L127	737.5	2337	-1380	-3225060
L176	451	1321	-2887	-3813727
L43	744	2360	-1380	-3256800
L41	966	2839	-1380	-3917820
L187	472.6	1661	1380	2292180
L159A	315	1229	-2221	-2729609
L184	157.5	592	-1075	-636400
L139	479	1587	-1471	-2334477
Abo rashwan c	422	1326	-1526	-2023476
L185	1396	3676	0	0
L182	512	1420	-1841	-2614220
L181	112.8	480	-1380	-662400
L86a	1174	2684	0	0
L159	472.6	1661	-1439	-2390179
L178	157.5	592	-1380	-816960
Mirage well	114.6	399	-1196	-477204
L179	437.6	1376	-1432	-1970432
P15	443.9	1327	-1460	-1937420
P124	458.2	1383	-1380	-1908540
P138	186.2	730	-1407	-1027110
P139	143.2	611	-1380	-843180
P145	286.4	951	-1380	-1312380
P144	293.6	850	-1380	-1173000
P147	160	587	-1520	-892240
P10	986.7	2876	0	0
P153	114.6	399	-1804	-719796
P52	178	662	-1380	-913560
		Total	-35079	-4.3E+07
			Average TDS=	**1222.366**

According to available information about water quality of settlement area. It is assumed that Cl =250 mg/l. Figure (6.3) shows a linear regression of TDS versus chloride concentration for wells in the southern Gaza Strip. Based on that the TDS in the settlement area equals 2.51Cl + 251.73, which means that TDS = 880 mg/l.

Average TDS = (13*1226+8*880)/21 =1094 mg/l

Hence noticeable improvement in terms of water quality is achieved through better reconfiguration of domestic wells.

Running Modflow for many trials of different reconfiguration of wells and proposed pumping rate, noticeable improvement in water level from year 2003 Figure (6.4) to year 2006 Figure (6.5) in spite of the increase in abstracted water, the water level in the cone of depression area raised from about -6m below mean sea water level to about -3.5 m below mean sea water level . This is of course referred to redistribution of domestic wells over a larger area, which mitigate upconoing, and reduce sea water intrusion.

Calculated water levels due to new reconfiguration is shown in Figure (6.5) .

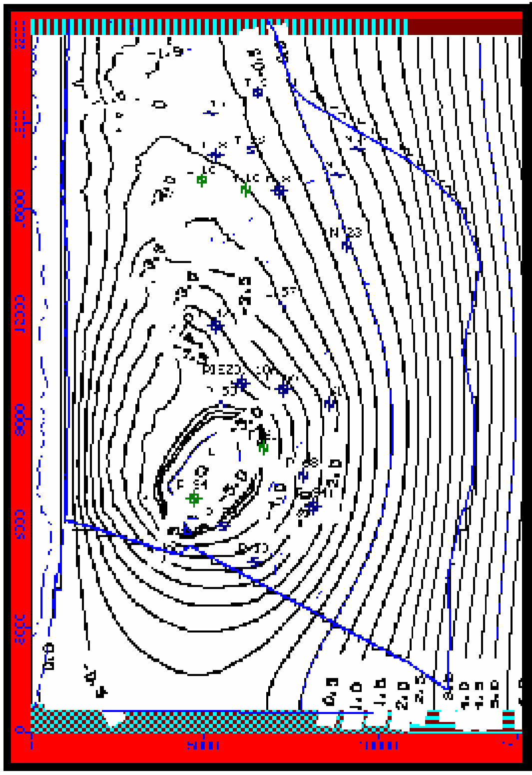


Figure (6.4): Water Level Year 2003

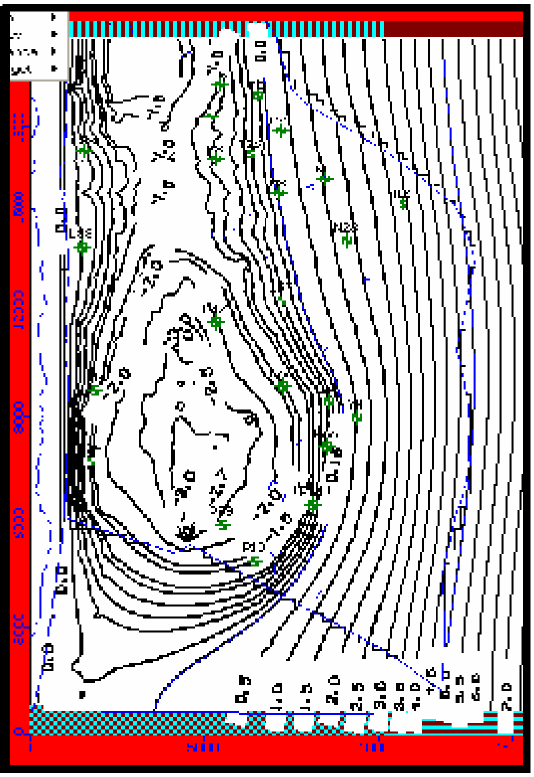
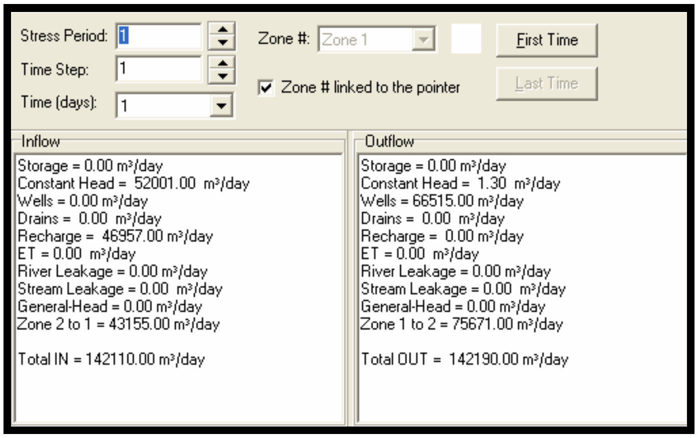


Figure (6.5): Calculated Water Level Year 2006

The model area were divided into two zones :

Zone "1" for area outside Gaza Strip, and zone "2" for Gaza Strip area. Zone budget for years 2003 and year 2006 are shown in Figures (6.6), (6.7), (6.8) and (6.9).



Stress Period: 1
Time Step: 1
Time (days): 1
Zone #: Zone 1
☑ Zone # linked to the pointer

Inflow

Storage = 0.00 m³/day
Constant Head = 52001.00 m³/day
Wells = 0.00 m³/day
Drains = 0.00 m³/day
Recharge = 46957.00 m³/day
ET = 0.00 m³/day
River Leakage = 0.00 m³/day
Stream Leakage = 0.00 m³/day
General-Head = 0.00 m³/day
Zone 2 to 1 = 43155.00 m³/day

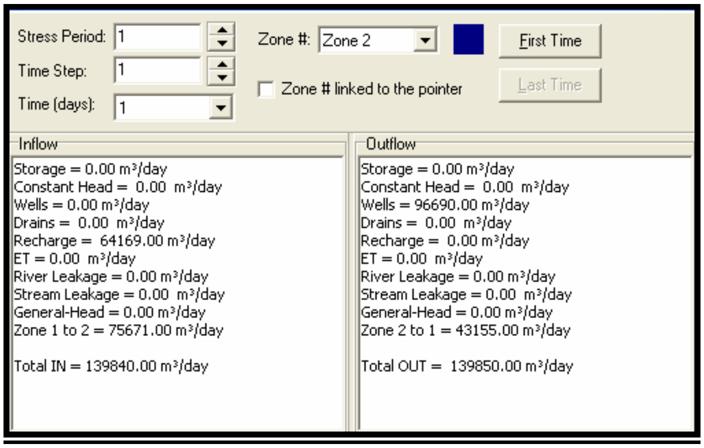
Total IN = 142110.00 m³/day

Outflow

Storage = 0.00 m³/day
Constant Head = 1.30 m³/day
Wells = 66515.00 m³/day
Drains = 0.00 m³/day
Recharge = 0.00 m³/day
ET = 0.00 m³/day
River Leakage = 0.00 m³/day
Stream Leakage = 0.00 m³/day
General-Head = 0.00 m³/day
Zone 1 to 2 = 75671.00 m³/day

Total OUT = 142190.00 m³/day

Figure (6.6) Zone Budget Year 2003(zone1)



Stress Period: 1
Time Step: 1
Time (days): 1
Zone #: Zone 2
☐ Zone # linked to the pointer

Inflow

Storage = 0.00 m³/day
Constant Head = 0.00 m³/day
Wells = 0.00 m³/day
Drains = 0.00 m³/day
Recharge = 64169.00 m³/day
ET = 0.00 m³/day
River Leakage = 0.00 m³/day
Stream Leakage = 0.00 m³/day
General-Head = 0.00 m³/day
Zone 1 to 2 = 75671.00 m³/day

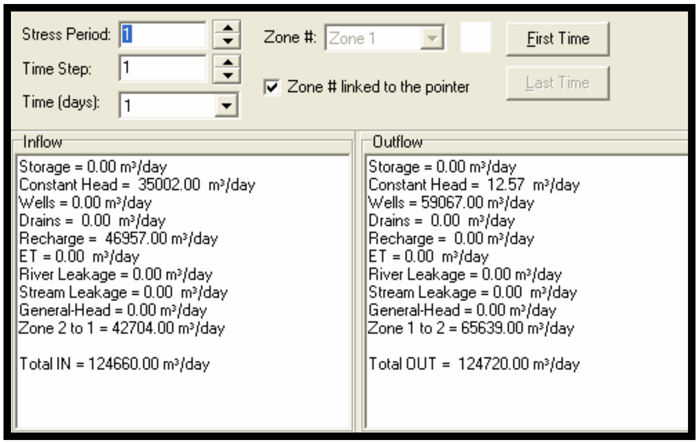
Total IN = 139840.00 m³/day

Outflow

Storage = 0.00 m³/day
Constant Head = 0.00 m³/day
Wells = 96690.00 m³/day
Drains = 0.00 m³/day
Recharge = 0.00 m³/day
ET = 0.00 m³/day
River Leakage = 0.00 m³/day
Stream Leakage = 0.00 m³/day
General-Head = 0.00 m³/day
Zone 2 to 1 = 43155.00 m³/day

Total OUT = 139850.00 m³/day

Figure (6.7) Zone Budget Year 2003(zone2)



Stress Period: 1
Time Step: 1
Time (days): 1
Zone #: Zone 1
☑ Zone # linked to the pointer

Inflow

Storage = 0.00 m³/day
Constant Head = 35002.00 m³/day
Wells = 0.00 m³/day
Drains = 0.00 m³/day
Recharge = 46957.00 m³/day
ET = 0.00 m³/day
River Leakage = 0.00 m³/day
Stream Leakage = 0.00 m³/day
General-Head = 0.00 m³/day
Zone 2 to 1 = 42704.00 m³/day

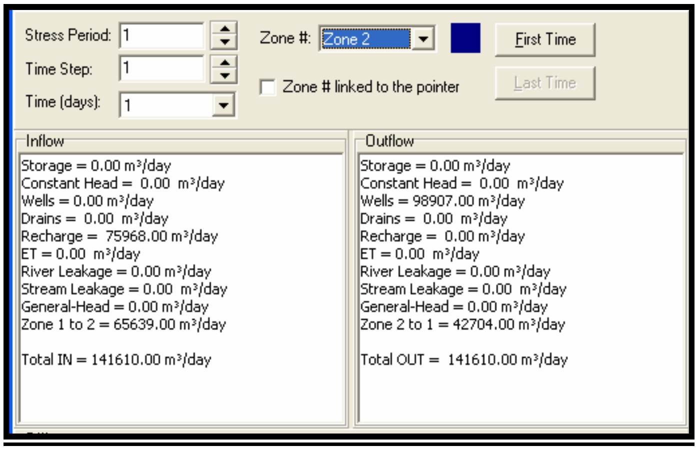
Total IN = 124660.00 m³/day

Outflow

Storage = 0.00 m³/day
Constant Head = 12.57 m³/day
Wells = 59067.00 m³/day
Drains = 0.00 m³/day
Recharge = 0.00 m³/day
ET = 0.00 m³/day
River Leakage = 0.00 m³/day
Stream Leakage = 0.00 m³/day
General-Head = 0.00 m³/day
Zone 1 to 2 = 65639.00 m³/day

Total OUT = 124720.00 m³/day

Figure (6.8) Zone Budget Year 2006(zone1)



Stress Period: 1
Time Step: 1
Time (days): 1
Zone #: Zone 2

Inflow

```
Storage = 0.00 m³/day
Constant Head =  0.00  m³/day
Wells = 0.00 m³/day
Drains =  0.00  m³/day
Recharge =  75968.00 m³/day
ET = 0.00  m³/day
River Leakage = 0.00 m³/day
Stream Leakage = 0.00  m³/day
General-Head = 0.00 m³/day
Zone 1 to 2 = 65639.00 m³/day

Total IN = 141610.00 m³/day
```

Outflow

```
Storage = 0.00 m³/day
Constant Head =  0.00  m³/day
Wells = 98907.00 m³/day
Drains =  0.00  m³/day
Recharge =  0.00 m³/day
ET = 0.00  m³/day
River Leakage = 0.00 m³/day
Stream Leakage = 0.00  m³/day
General-Head = 0.00 m³/day
Zone 2 to 1 = 42704.00 m³/day

Total OUT =  141610.00 m³/day
```

Figure (6.9) Zone Budget Year 2006(zone2)

The quantity of seawater intrusion reduced from 52000 m^3/d in year 2003 to about 35002 m^3/d in year 2006 .This disagree with the presumption that redistribution of domestic wells and utilizing settlements wells could increase the problem of seawater intrusion.

The net lateral flow from zone 1 to zone 2 =65639-42704= 22935 m^3/d which equals 8.5 MCM/year. The vertical recharge =75968 m^3/d which equals 27.7 MCM/year. Therefore, the totals recharge equal 36 MCM/year. The abstracted water for irrigation estimated to be about 30MCM,in addition to 24 MCM for domestic use. The Gap between abstraction and recharge about 18 MCM.

6.2 Short term situation year 2010

As mentioned before the total projected domestic demand for southern Gaza Strip in year 2010 is about $30x10^6$ m^3.

In order to maintain the water balance to the positive condition and to fulfill the domestic water demand in terms of quality and quantity, a new water resources should be introduced into water system, seawater desalination has been viewed as the most feasible option since it adds large quantities of fresh water from outside the groundwater system. In addition to that increasing the reuse of treated effluent serves goals such as sustainable agriculture, preserving scares water resources, and maintaining environmental quality. Also irrigation with wastewater may reduce purification levels and fertilization costs, because soil and crops serve as bio-filter, and wastewater contain nutrients (Haruvy,1997).

In year 2010, assuming water loss between 25% and 35%, the quantity of wastewater available ranges between $15x10^6$-$18x10^6$ m^3, in Southern Gaza Strip, considering 80% of wastewater inters sewer system.

The first phase of the large RO seawater desalination plant is expected to be finished within two years. If this happens it will be good alternative to minimize the water deficit and fulfill domestic water demand.

About $22x10^6m^3$ is expected to be produced in the first phase, the southern Gaza strip with its severe water condition in 2010, must be given the first priority .This will relief stress on the aquifer, prevent further deterioration of its water quality, and mitigate the continuous decline in water level and upconing of brine water. According to pipelines proposed to serve southern and northern Gaza Strip the diameters are 800mm,and 1000mm,respectively. Hydraulically this means that about 8.0 Mm^3 will reach Southern Governorates. If other factors are taken into consideration, the quantity may increase to about $12x10^6$ m^3.

The CAMP project indicated that abstracted water from settlements area was in the range of $5x10^6$-$8x10^6$ m^3/year.

The maximum abstraction from aquifer to cover domestic needs should not exceed the overuse quantity extracted in year 2003 about $16x10^6$ m^3/year.while the maximum abstraction for irrigation is assumed not to exceed $30x10^6$ m^3/year.

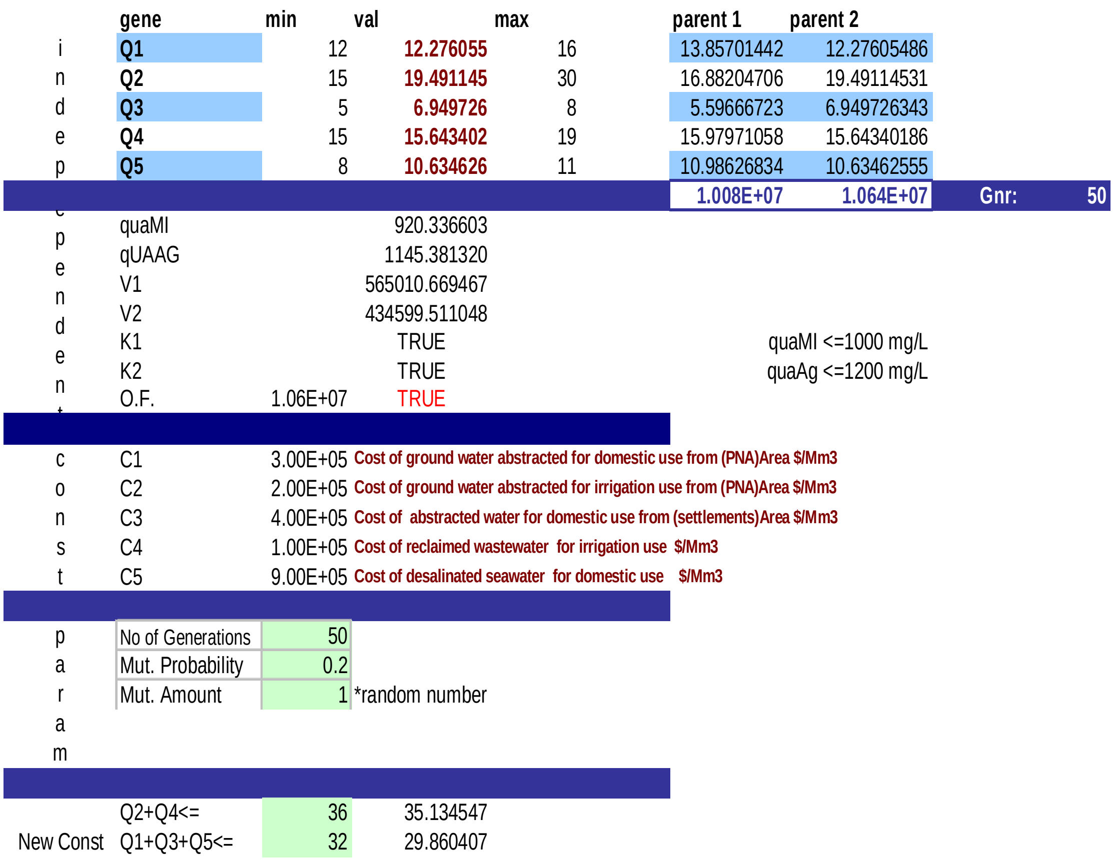
These minimum and maximum quantities are introduced to the GA model to choose the optimal quantities that can fulfill the water needs to satisfy the different constraints regarding quality of water supplied to Municipal and agriculture sectors.

The economic values of domestic and irrigation water was identified in the previous chapter. In addition to the symbols which will be used in the GA model.

The GA model performs the optimization process through 50 generations which is enough to get stable solution for the different parameters. In each generation the model chooses the fittest genes to be the parents for the next generation based on a certain fitness criteria. Ultimately, after a number of generations, the optimal solution will be realized. Table 6.3 shows the results of the GA model for the year 2010, and Figure

6.10 shows the graphical presentation of the independent variables and the objective function through the optimization process

Table (6.3) GA Model Results for Year 2010



	gene	min	val	max	parent 1	parent 2		
i	**Q1**	12	**12.276055**	16	13.85701442	12.27605486		
n	**Q2**	15	**19.491145**	30	16.88204706	19.49114531		
d	**Q3**	5	**6.949726**	8	5.59666723	6.949726343		
e	**Q4**	15	**15.643402**	19	15.97971058	15.64340186		
p	**Q5**	8	**10.634626**	11	10.98626834	10.63462555		
					1.008E+07	**1.064E+07**	**Gnr:**	**50**
e p	quaMI		920.336603					
e	qUAAG		1145.381320					
n	V1		565010.669467					
d	V2		434599.511048					
e	K1		TRUE			quaMI <=1000 mg/L		
n	K2		TRUE			quaAg <=1200 mg/L		
t	O.F.	1.06E+07	TRUE					
c	C1	3.00E+05	Cost of ground water abstracted for domestic use from (PNA)Area $/Mm3					
o	C2	2.00E+05	Cost of ground water abstracted for irrigation use from (PNA)Area $/Mm3					
n	C3	4.00E+05	Cost of abstracted water for domestic use from (settlements)Area $/Mm3					
s	C4	1.00E+05	Cost of reclaimed wastewater for irrigation use $/Mm3					
t	C5	9.00E+05	Cost of desalinated seawater for domestic use $/Mm3					
p	No of Generations	50						
a	Mut. Probability	0.2						
r	Mut. Amount	1	*random number					
a								
m								
	Q2+Q4<=	36	35.134547					
New Const	Q1+Q3+Q5<=	32	29.860407					

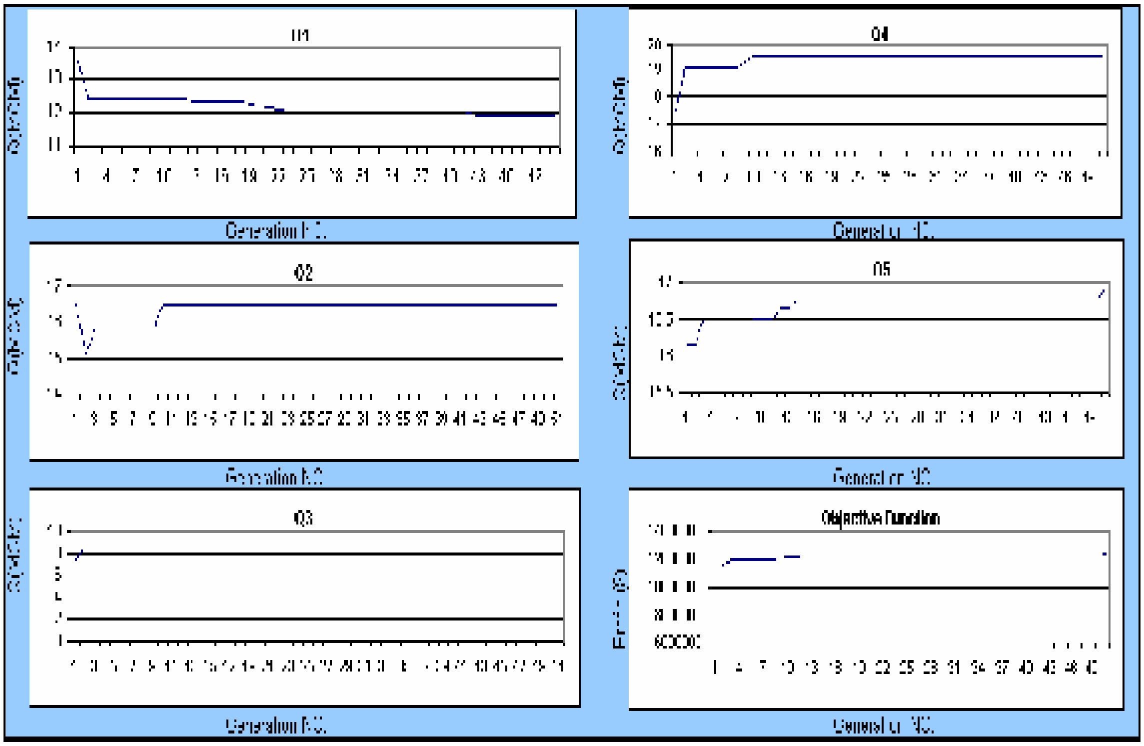


Figure (6.10) Generations for Optimal Quantities of Water from Different Resources Year 2010

From the results table the following can be read:

Q1(Abstracted Groundwater for domestic use from the PNA area)=12.28x10^{6} m^{3}

Q2(Abstracted Groundwater for irrigation use from the PNA area)=19.5x10^{6} m^{3}

Q3(Abstracted Groundwater for domestic use from the settlements area)=7x10^{6} m^{3}

Q4(Reclaimed Wastewater for irrigation use in the)=15.6x10^{6} m^{3}

Q5(Desalinated seawater for domestic use from regional desalination plant)=10.6x10^{6} m^{3}

Domestic water (M&I) quality, and agricultural water quality is as follows:

quaMI=920 mg/l(TDS)

quaAg=1145 mg/l(TDS)

Viewing the results we can see that the model take the maximum available quantity from desalinated water, and water abstracted from settlement area due to availability of fresh water, and reduce abstracted ground water from (PNA)area to achieve the domestic water constraint quaMI =1000 mg/l(TDS).

The quality of domestic water improved from 1326 mg/l(TDS) to 920 mg/l(TDS) as a result of reconfiguration of domestic wells between (PNA) area and settlements area, in addition to the mix of groundwater with desalinated water.

The quality of irrigation water also improved from 1326 mg/l(TDS) to 1145 mg/l(TDS), as a result of using treated wastewater beside groundwater for agricultural purposes.

Irrigation water depends on the available wastewater with a big ratio compared with Abstracted groundwater, this of course refers to two reasons:

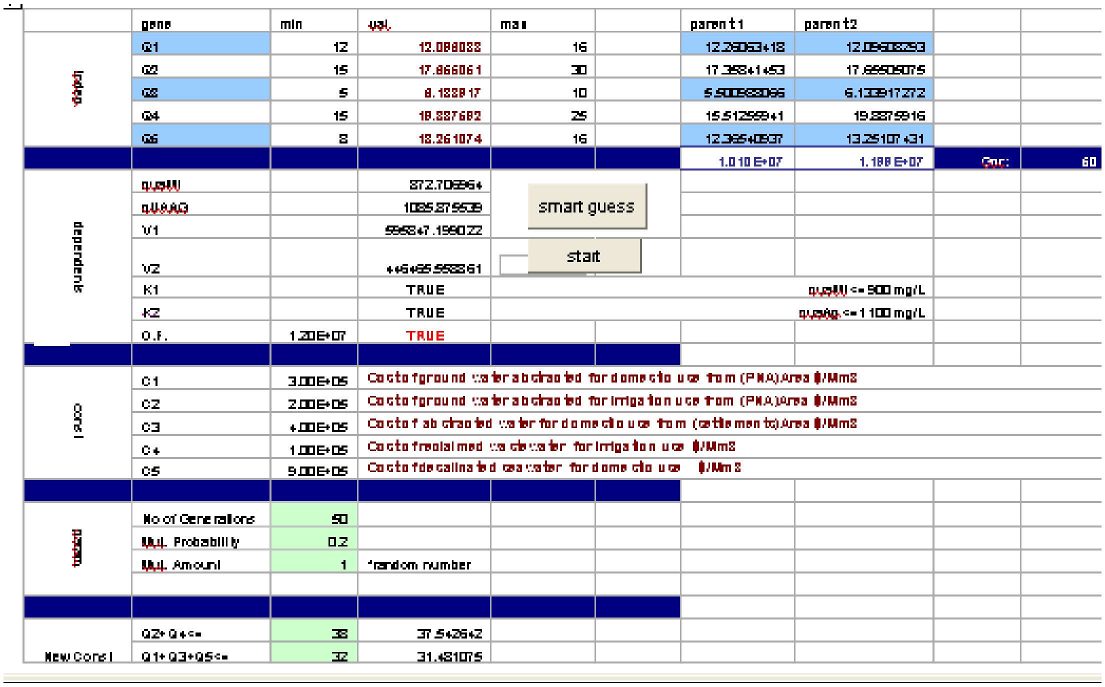
First: the GA model takes the economic value of wastewater in consideration since it is more than that of abstracted ground water

Second: the cost paid by the farmer for wastewater is less than that of abstracted groundwater.

The quality of domestic water can be improved more if we increase desalinated water in the mix.

Table 6.4 shows that if the MI quality constraint is more restricted to 800mg/l no feasible solution can be achieved, unless we allow more seawater desalination to be introduced to the system. In reverse if we release the quality constraint the GA model will choose more water from the cheaper sources. The GA needs $13.25x10^6$ m^3 desalinated water to improve quaMI to 873mg/l(TDS) , this of course will be reflected in improvement in quality of wastewater which appears in the excess of quantity of wastewater to about $19.8x10^6$ m^3 which improved the quality of agricultural water to 1085 mg/l(TDS).

Table(6.4) GA Model Results for year 2010 (hypothetical)



	gene	min	val.	max		parent1	parent2		
indep.	Q1	12	12.088033	16		12.26063418	12.09608293		
	Q2	15	17.866061	30		17.35841453	17.69505075		
	Q3	5	8.183817	10		5.500983096	6.133917272		
	Q4	15	18.887682	25		15.51255941	19.8875916		
	Q5	8	13.261074	16		12.38540937	13.25107431		
						1.010E+07	1.188E+07	Gnr:	60
dependents	qualW		872.708964						
	qWAAG		1085.279539						
	V1		595847.159022						
	V2		4454465.558361						
	K1		TRUE				qualW <= 500 mg/L		
	K2		TRUE				qualAg <= 1100 mg/L		
	O.F.	1.20E+07	TRUE						
const	C1	3.00E+05	Cost of ground water abstracted for domestic use from (PNA)Area $/Mm3						
	C2	2.00E+05	Cost of ground water abstracted for irrigation use from (PNA)Area $/Mm3						
	C3	4.00E+05	Cost of abstracted water for domestic use from (settlements)Area $/Mm3						
	C4	1.00E+05	Cost of reclaimed waste water for irrigation use $/Mm3						
	C5	9.00E+05	Cost of desalinated sea water for domestic use $/Mm3						
param	No of Generations	50							
	Mut. Probability	0.2							
	Mut. Amount	1	*random number						
	Q2+Q4<=	38	37.542642						
New Const	Q1+Q3+Q5<=	32	31.481075						

The optimal quantities obtained by GA model will be used as input values in the groundwater modflow model to see the effect on water levels. The calculated water levels raised to about -2 m in the cone of depression area as shown in Figure (6.11).

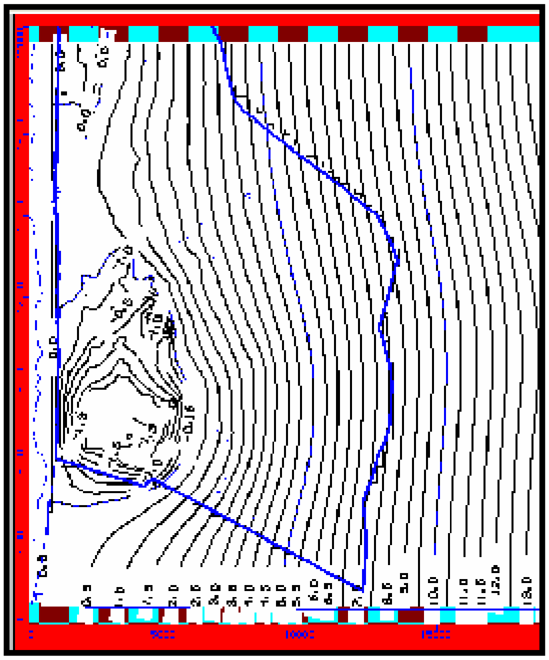
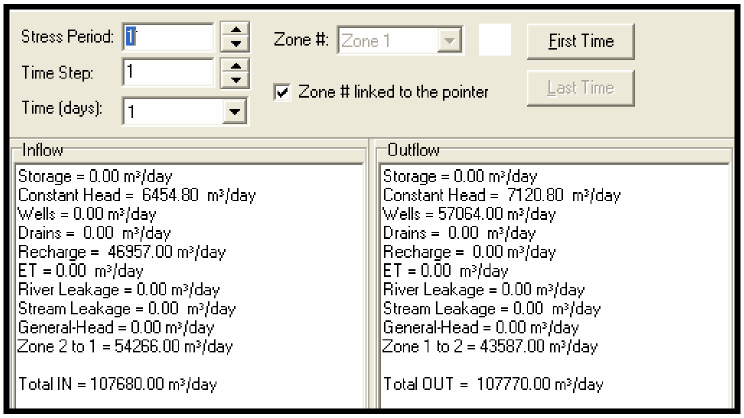


Figure (6.11): Calculated Water Level Year 2010

This level shows improvement in water quantity which means reducing upconing of brackish water

Improvement also occurred in terms of seawater intrusion, the zone budget Figures 6.12 and 6.13 show that seawater intrusion is about 6454m^3/d, which. Compaired with year 2006 sea water intrusion reduced from 35002 m^3/d to 6454m^3/d .Reduction in seawater intrusion means improvement in groundwater quality.



Stress Period: 1
Time Step: 1
Time (days): 1
Zone #: Zone 1
☑ Zone # linked to the pointer

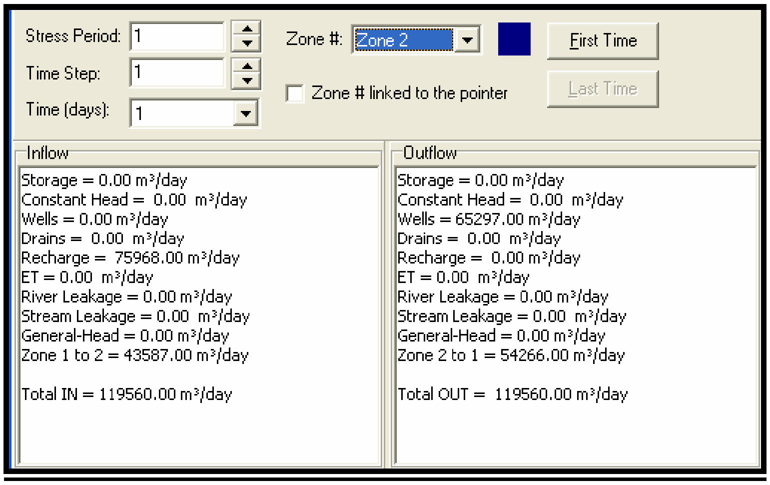
Inflow
Storage = 0.00 m³/day
Constant Head = 6454.80 m³/day
Wells = 0.00 m³/day
Drains = 0.00 m³/day
Recharge = 46957.00 m³/day
ET = 0.00 m³/day
River Leakage = 0.00 m³/day
Stream Leakage = 0.00 m³/day
General-Head = 0.00 m³/day
Zone 2 to 1 = 54266.00 m³/day

Total IN = 107680.00 m³/day

Outflow
Storage = 0.00 m³/day
Constant Head = 7120.80 m³/day
Wells = 57064.00 m³/day
Drains = 0.00 m³/day
Recharge = 0.00 m³/day
ET = 0.00 m³/day
River Leakage = 0.00 m³/day
Stream Leakage = 0.00 m³/day
General-Head = 0.00 m³/day
Zone 1 to 2 = 43587.00 m³/day

Total OUT = 107770.00 m³/day

Figure (6.12) Zone Budget Year 2010 (zone1)



Stress Period: 1
Time Step: 1
Time (days): 1
Zone #: Zone 2
☐ Zone # linked to the pointer

Inflow
Storage = 0.00 m³/day
Constant Head = 0.00 m³/day
Wells = 0.00 m³/day
Drains = 0.00 m³/day
Recharge = 75968.00 m³/day
ET = 0.00 m³/day
River Leakage = 0.00 m³/day
Stream Leakage = 0.00 m³/day
General-Head = 0.00 m³/day
Zone 1 to 2 = 43587.00 m³/day

Total IN = 119560.00 m³/day

Outflow
Storage = 0.00 m³/day
Constant Head = 0.00 m³/day
Wells = 65297.00 m³/day
Drains = 0.00 m³/day
Recharge = 0.00 m³/day
ET = 0.00 m³/day
River Leakage = 0.00 m³/day
Stream Leakage = 0.00 m³/day
General-Head = 0.00 m³/day
Zone 2 to 1 = 54266.00 m³/day

Total OUT = 119560.00 m³/day

Figure (6.13) Zone Budget Year 2010 (zone2)

There are several computer software available for solving linear and non linear problems, e.g. LINDO, LINGO and Solver.

In order to check the robustness of the GA, the same variables and constraints for year 2010 were introduced into a non linear programming solver (LINGO).

LINGO is a comprehensive tool designed to make building and solving linear, nonlinear and integer optimization models faster, easier and more efficient. LINGO provides a completely integrated package that includes a powerful language for expressing optimization models, a full featured environment for building and editing problems, and a set of fast built-in solvers. The recently released LINGO 9.0 includes a number of significant enhancements and new features.

LINGO will cut development time. It lets you formulate your linear, nonlinear and integer problems quickly in a highly readable form. LINGO's modeling language allows you to express models in a straightforward intuitive manner using summations and subscripted variables -- much like you would with pencil and paper. Models are easier to build, easier to understand, and, therefore, easier to maintain.

LINGO takes the time and hassle out of managing your data. It allows you to build models that pull information directly from databases and spreadsheets. Similarly, LINGO can output solution information right into a database or spreadsheet making it easier for you to generate reports in the application of your choice.

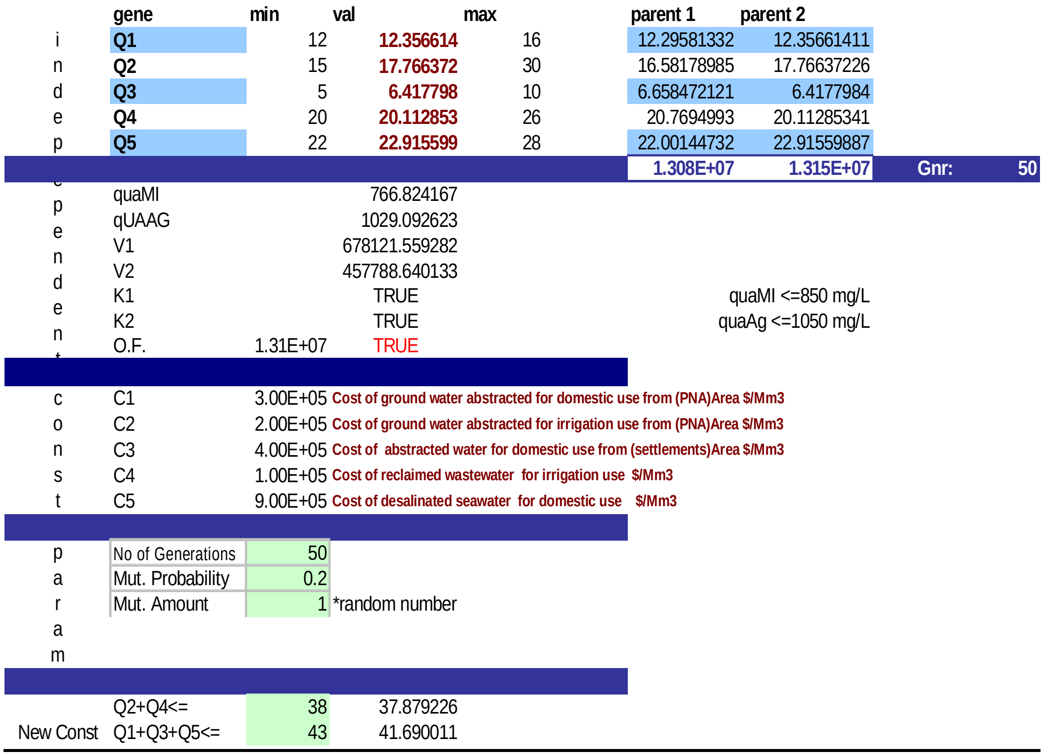
LINGO is available with a comprehensive set of fast, built-in solvers for Linear, Nonlinear (convex & nonconvex), Quadratic, Quadratically Constrained, and Integer Optimization. You never have to specify or load a separate solver, because LINGO reads your formulation and automatically selects the appropriate one.

The results show that the value of objective function (OF) obtained by GA is higher than that obtained by (LINGO), which means that is the value obtained by LINGO is local optima. Due to the very nature of search algorithms it is likely that different starting solutions might converges to different local optima. So the performance of GA is better than that of nonlinear programming for the existing optimization problem, Since GA solved for the global optimal solution. For feasible solution obtained by solver (LINGO), see (Annex c).

6.4 Long term situation year 2020

The projected population by year 2020 will reach about 720,000 inhabitants, in Southern Governorates, with projected domestic water demand about $40x10^6$ m^3.The unconventional water resources will be the main resource for domestic water because of the limited amount which can be abstracted from aquifer. The final phase of regional seawater desalination is proposed to provide at least 22x10^6 m^3 for Southern Governorates. The quantity available of wastewater will reach about 20x10^6-26x10^6 m^3.The GA model after 50 generations solved for optimal quantities see Table (6.5).

Table (6.5) GA Model Results for Year 2020



	gene	min	val	max	parent 1	parent 2		
i	**Q1**	12	**12.356614**	16	12.29581332	12.35661411		
n	**Q2**	15	**17.766372**	30	16.58178985	17.76637226		
d	**Q3**	5	**6.417798**	10	6.658472121	6.4177984		
e	**Q4**	20	**20.112853**	26	20.7694993	20.11285341		
p	**Q5**	22	**22.915599**	28	22.00144732	22.91559887		
e					**1.308E+07**	**1.315E+07**	**Gnr:**	**50**
p	quaMI		766.824167					
e	qUAAG		1029.092623					
n	V1		678121.559282					
d	V2		457788.640133					
e	K1		TRUE			quaMI <=850 mg/L		
n	K2		TRUE			quaAg <=1050 mg/L		
t	O.F.	1.31E+07	TRUE					
c	C1	3.00E+05	**Cost of ground water abstracted for domestic use from (PNA)Area $/Mm3**					
o	C2	2.00E+05	**Cost of ground water abstracted for irrigation use from (PNA)Area $/Mm3**					
n	C3	4.00E+05	**Cost of abstracted water for domestic use from (settlements)Area $/Mm3**					
s	C4	1.00E+05	**Cost of reclaimed wastewater for irrigation use $/Mm3**					
t	C5	9.00E+05	**Cost of desalinated seawater for domestic use $/Mm3**					
p	No of Generations	50						
a	Mut. Probability	0.2						
r	Mut. Amount	1	*random number					
a								
m								
	Q2+Q4<=	38	37.879226					
New Const	Q1+Q3+Q5<=	43	41.690011					

From the results table the following can be read:

Q1(Abstracted Groundwater for domestic use from the PNA area) =12.35x10^6 m^3

Q2(Abstracted Groundwater for irrigation use from the PNA area) =17.7x10^6 m^3

Q3(Abstracted Groundwater for domestic use from the settlements area) =6.4x10^6 m^3

Q4(Reclaimed Wastewater for irrigation use) =20.1 Mm^3

Q5(Desalinated seawater for domestic use from regional desalination plant)=22.9x10^6 m^3

Domestic water (M&I) quality and agricultural water quality is as follows:

quaMI =766 mg/l(TDS)

quaAg =1029 mg/l(TDS)

The generations and the graphs for optimal Q1,Q2,Q3,Q4,Q5 and the objective function is shown in figure (6.14) below.

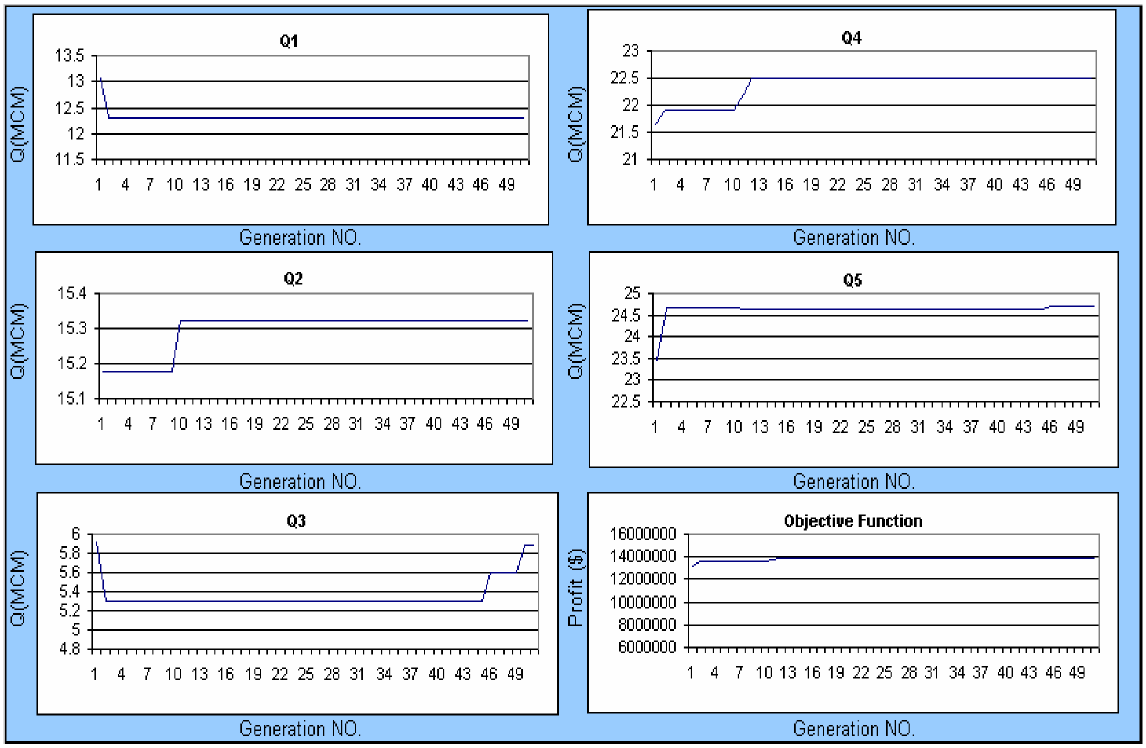


Figure (6.14) Generations and graphs for optimal quantities of water from different resources year 2020

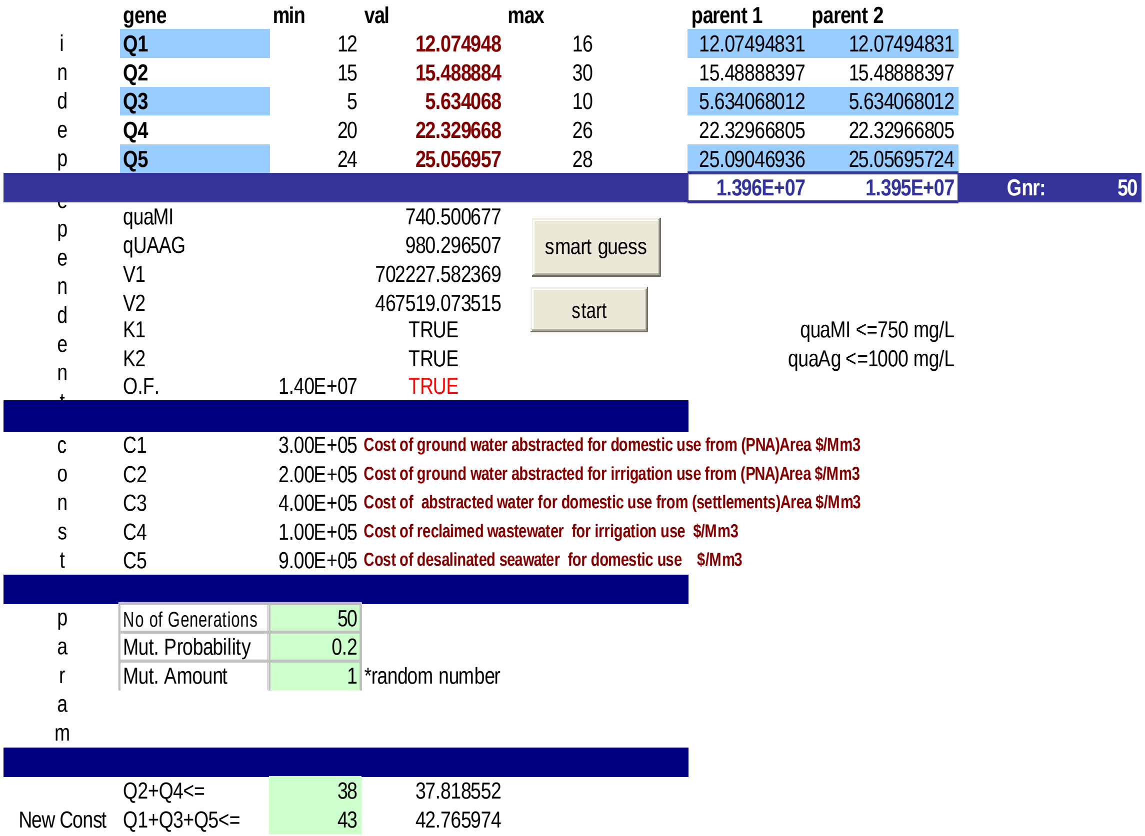
The quality of domestic water improved to 766 mg/l (TDS) as a result of increase of quantities of desalinated water.

The quality of irrigation water also improved to 1029 mg/l(TDS), this is due to improvement occurred in the quality of domestic water which caused improvement in quality of treated wastewater as shown in GA model table(6.6).

The high quantity of wastewater caused reduction in quantities needed to be abstracted from aquifer for irrigation. The excess values can be used for recharge which will increase the fresh water quantities in the aquifer.

Table 6.6 shows hypothetical values for desalinated water. The GA shows that quaMI can be improved to 740 mg/l(TDS) if the lower limit of desalinated water increased to 24x10^6 m^3.The GA needs 25x10^6 m^3. The quality of agricultural water also improved to 980 mg/l (TDS).

Table (6.6) GA Model Results for year 2020 (hypothetical)



	gene	min	val	max		parent 1	parent 2		
i	Q1	12	12.074948	16		12.07494831	12.07494831		
n	Q2	15	15.488884	30		15.48888397	15.48888397		
d	Q3	5	5.634068	10		5.634068012	5.634068012		
e	Q4	20	22.329668	26		22.32966805	22.32966805		
p	Q5	24	25.056957	28		25.09046936	25.05695724		
e						1.396E+07	1.395E+07	Gnr:	50
p	quaMI		740.500677						
e	qUAAG		980.296507		smart guess				
n	V1		702227.582369						
d	V2		467519.073515		start				
e	K1		TRUE				quaMI <=750 mg/L		
n	K2		TRUE				quaAg <=1000 mg/L		
t	O.F.	1.40E+07	TRUE						
c	C1	3.00E+05	Cost of ground water abstracted for domestic use from (PNA)Area $/Mm3						
o	C2	2.00E+05	Cost of ground water abstracted for irrigation use from (PNA)Area $/Mm3						
n	C3	4.00E+05	Cost of abstracted water for domestic use from (settlements)Area $/Mm3						
s	C4	1.00E+05	Cost of reclaimed wastewater for irrigation use $/Mm3						
t	C5	9.00E+05	Cost of desalinated seawater for domestic use $/Mm3						
p	No of Generations	50							
a	Mut. Probability	0.2							
r	Mut. Amount	1	*random number						
a									
m									
	Q2+Q4<=	38	37.818552						
New Const	Q1+Q3+Q5<=	43	42.765974						

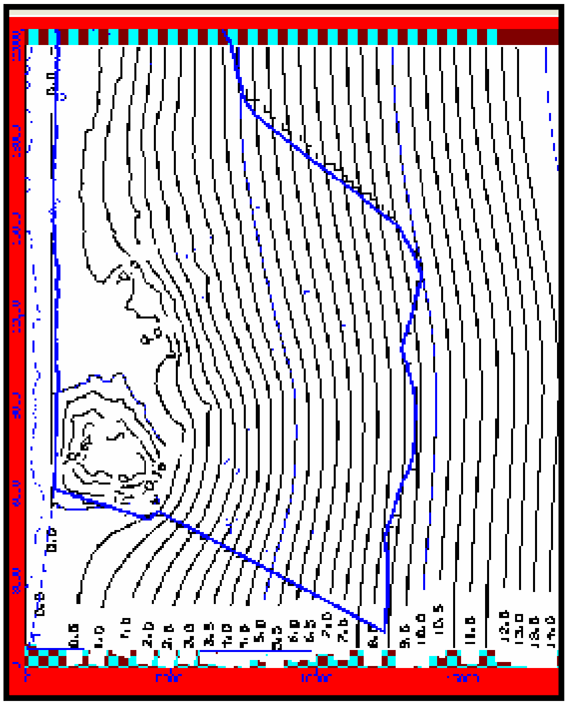
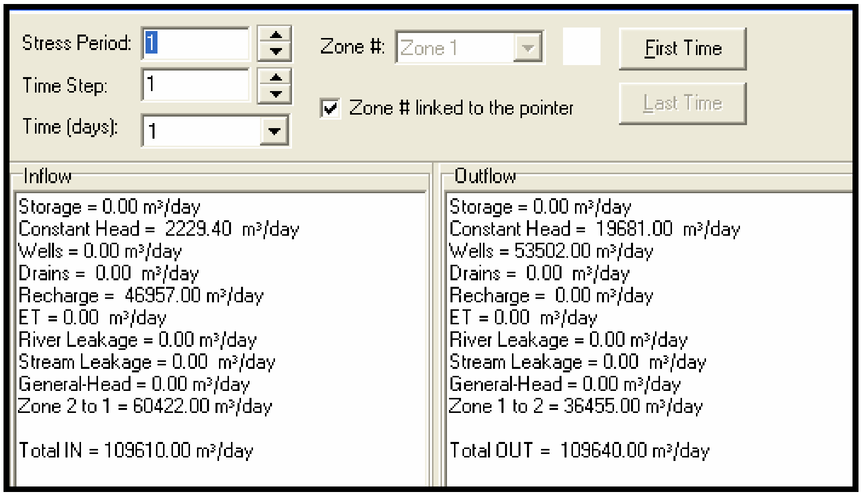


Figure (6.15): Calculated Water Level Year 2020

The optimal quantities obtained by GA model will be used as input values in the groundwater modflow model to see the effect on water levels. Figure 6.15 shows rising of water level to about -1.0m below sea water level which means noticeable improvement in terms of aquifer quantities and qualities.

Improvement occurred in terms of seawater intrusion, the zone budget shows that flux is about 2229 m^3/d which is about $0.8x10^6$ per year. Comparing with year 2010 sea water intrusion reduced from 6454 m^3/d to 2229 m^3/d Figure (6.16) .Reduction in seawater intrusion means improvement in groundwater quality



Stress Period: 1
Time Step: 1
Time (days): 1
Zone #: Zone 1
☑ Zone # linked to the pointer

Inflow

Storage = 0.00 m³/day
Constant Head = 2229.40 m³/day
Wells = 0.00 m³/day
Drains = 0.00 m³/day
Recharge = 46957.00 m³/day
ET = 0.00 m³/day
River Leakage = 0.00 m³/day
Stream Leakage = 0.00 m³/day
General-Head = 0.00 m³/day
Zone 2 to 1 = 60422.00 m³/day

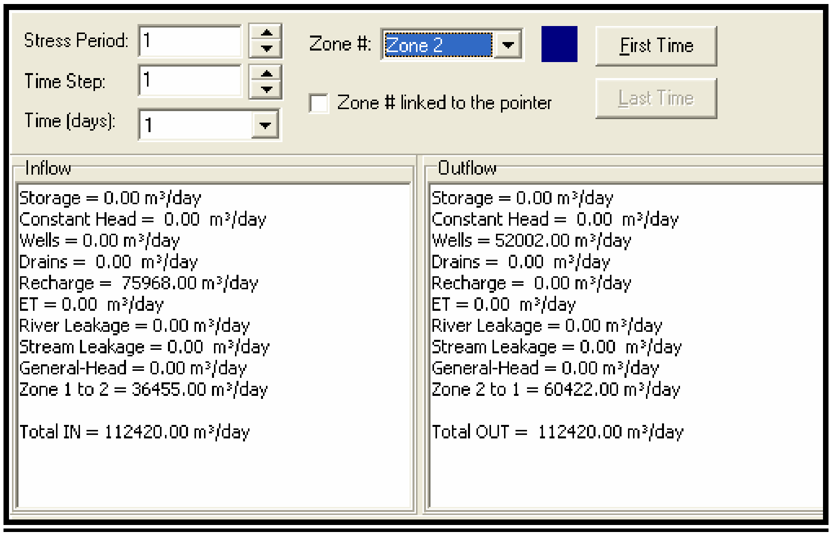
Total IN = 109610.00 m³/day

Outflow

Storage = 0.00 m³/day
Constant Head = 19681.00 m³/day
Wells = 53502.00 m³/day
Drains = 0.00 m³/day
Recharge = 0.00 m³/day
ET = 0.00 m³/day
River Leakage = 0.00 m³/day
Stream Leakage = 0.00 m³/day
General-Head = 0.00 m³/day
Zone 1 to 2 = 36455.00 m³/day

Total OUT = 109640.00 m³/day

Figure (6.16) Zone Budget Year 2020 (zone1)



Stress Period: 1
Time Step: 1
Time (days): 1
Zone #: Zone 2
☐ Zone # linked to the pointer

Inflow

Storage = 0.00 m³/day
Constant Head = 0.00 m³/day
Wells = 0.00 m³/day
Drains = 0.00 m³/day
Recharge = 75968.00 m³/day
ET = 0.00 m³/day
River Leakage = 0.00 m³/day
Stream Leakage = 0.00 m³/day
General-Head = 0.00 m³/day
Zone 1 to 2 = 36455.00 m³/day

Total IN = 112420.00 m³/day

Outflow

Storage = 0.00 m³/day
Constant Head = 0.00 m³/day
Wells = 52002.00 m³/day
Drains = 0.00 m³/day
Recharge = 0.00 m³/day
ET = 0.00 m³/day
River Leakage = 0.00 m³/day
Stream Leakage = 0.00 m³/day
General-Head = 0.00 m³/day
Zone 2 to 1 = 60422.00 m³/day

Total OUT = 112420.00 m³/day

Figure (6.17) Zone Budget Year 2020 (zone2)

Summary for aquifer improvement with time according to the measures, which have been proposed, is shown in Table (6.7).

Table (6.7) Summary for aquifer improvement

Year	Water level in cone of depression zone (BMSL)	qua MI TDS (mg/l)	qua Ag TDS (mg/l)	Seawater intrusion m^3/d
2003	**-6 m**	**1326**	**1326**	**52000**
2006	**-3.5 m**	**1222**	**1222**	**35000**
2010	**-2 m**	**920**	**1145**	**6454**
2020	**-1 m**	**766**	**1029**	**2229**

CHAPTER "7"

CONCLUSIONS AND RECOMMENDATIONS

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

1. The proposed reconfiguration of wells locations and wells pumping rate in this study resulted in rising the water level from -6m (BMSL) to -3.5 m (BMSL) in the cone of depression zone. Abstraction from wells must be controlled so that it does not exceed the recommended rate by this study, 375 m^3/d for the first line of wells close to the sea shore, 550 m^3/d for second proposed line of wells far about 2.5 kilometer from seashore and 1380 m^3/d for the remaining domestic wells.
2. The genetic algorithm optimization model has showed that mixing of good fresh water from settlement area with current municipal water and desalinated water will improve the domestic water quality to a good extent close to WHO guidelines for drinking water. To have better quality more quantities of desalinated water must be provided:
    - In year 2010 Southern Gaza Strip needs $29x10^6$ m^3 of water for domestic use, $12.0x10^6$ m^3 to be abstracted from aquifer from PNA area, $7x10^6$ m^3 to be abstracted from the settlements area aquifer, $10.0x10^6$ m^3 to be provided from regional desalination plant. The domestic water quality obtained equals 920 mg/l (TDS). The water level has risen to about -2m (BMSL), and seawater intrusion reduced noticeably.
    - In year 2020 Southern Gaza Strip needs $40x10^6$ m^3 water for domestic use, $12.0x10^6$ m^3 to be abstracted from aquifer from PNA area, $6.0x10^6$ m^3 to be abstracted from the settlements area aquifer, $22x10^6$ m^3 to be provided from regional desalination plant. The domestic water quality obtained equals 766mg/l (TDS). The water level has risen to about -1m (BMSL)

3. Improvement of domestic water leads to improvement of treated wastewater. This will allow more flexibility in using the treated effluent for irrigation and aquifer recharge. Wastewater irrigation can maintain agriculture, provide an attractive resource and reduce supply costs if it is monitored regularly and applied cautiously:
    - In year 2010 Southern Gaza Strip needs for irrigation use 19.5x10^6 m^3 of water to be abstracted from aquifer, and 15.5x10^6 m^3 from reclaimed wastewater. The agricultural water quality obtained has a TDS concentration of 1145 mg/l .
    - In year 2020 Southern Gaza Strip needs for irrigation use 17x10^6 m^3 of water, to be abstracted from aquifer, and 20x10^6 m^3 from reclaimed wastewater. The agricultural water quality obtained has a TDS concentration of 1029 mg/l .
4. The existing gap between water supply and demand in Southern Gaza Strip (18 MCM), can only be bridged by introducing large quantities of fresh water from outside the aquifer system.
5. Upon Israel withdrawal from settlements the new expected stable situation will give a chance for investments on Seawater desalination Which should be implemented in the near future, as practical new freshwater resources to cover domestic needs with substantial quantities of fresh water in a relatively short time and good quality.
6. The groundwater aquifer has been and should remain the main source of water for Southern Gaza Strip, but the current levels of abstraction (54 MCM) should be significantly reduced to the renewable quantities (36MCM).

7. Economic, social and environmental aspects are important considerations in any decision-making regarding the reuse options to maintain the positive balance of the Aquifer.
8. A consolidated coordination must exist between stakeholders to maximize the utilization of water resources in a sustainable way, and legal frameworks around water usage would have to be instituted.
9. Mathematical modeling has helped us to present the overall tendency of the physical system, to allow for the prediction of the system response to remedy actions, and to analyze the uncertainty in the modeling parameters. The availability of good quality data is a precondition to obtain satisfactory results.

7.2 Recommendations

1. Redistribution of pumping wells and a lower rate of abstraction is preferred to avoid upconing of brackish water.
2. For wells located in the settlement areas near the cost, the study recommends a lower rate of abstraction than inland wells ($400m^3/d$) to maintain the seawater wedge stable without any further intrusion inland.
3. A major part of the sand dunes areas should be reserved for aquifer natural recharge to attain recovery for water abstracted from settlements area.
4. The wastewater should be treated and reused to the maximum extent feasible, to be used for irrigation or aquifer recharge to relief the stress on the aquifer.
5. Apriority should be given to seawater desalination projects as urgent solutions to secure fresh water in the short and long term.
6. Water supply management particularly, drilling of wells, metering of wells, pumping rate should be strongly controlled by empowered institutional body.

7. Microlevel study must be done to select reasonable locations for new proposed wells to be drilled according to new proposed urbanization in evacuated area.
8. Microlevel study is recommended to select the exact suitable locations for effluent recharge.

7.3 Further Needed Studies

- A groundwater model is to be developed for contaminants transport in Southern Gaza Strip to follow up the deterioration of groundwater quality.
- Research work is encouraged to be elaborated on the level of treatment required to wastewater and its effect on the crop yield, beside to the evaluation of the environmental, health, and socio-economical impacts.
- Further studies are recommended for Quality of brine water from deep aquifer as an alternative source for desalination to cover domestic water needs from economical point of view.

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List of Annexes

Annex A

Genetic Algorithm Model

```
Public NoGener As Integer
Public NoG As Integer
Public Pop As Integer
Public ii As Integer
Public intr As Boolean
Dim Parents() As Single
Dim Child() As Single
Dim NoElite As Integer
Dim MutProb As Single
Dim MutProbSp As Single
Dim MutAmount As Integer
Dim CP As Integer
Dim COProb As Single
Dim SumFitness As Double
Dim Fitness() As Single
Dim ElitOrder() As Integer
Dim counter As Integer

Function CrossOver(ByVal iter)
ReDim Fitness(Pop) As Single
ReDim ElitOrder(Pop) As Integer
counter = 1
ReDim Child(NoG, Pop) As Single
For ii = 1 To Pop

Breed: Randomize
' DetermineCP (0)
   For j = 1 To NoG
   rndparent = 1 + CInt(Rnd(2))
   'Debug.Print rndparent, "  "
   Child(j, ii) = Parents(j, rndparent)
   If intr = True Then Exit Function
   Next j

mutate (ii)
If intr = True Then Exit Function
CalcFitness (ii)
'PrintChild (ii)
If Not CheckChild(ii) Then GoTo Breed


Next ii
SortFit
NewParents iter + 1
End Function

Function CalcFitness(ByVal flag)
```

```
For j = 1 To NoG
Sheet1.Cells(j + 1, 4) = Child(j, flag)
Next j
Fitness(flag) = Sheet1.Cells(14, 3)
SumFitness = SumFitness + Fitness(flag)

'SumFitness should be put to zero when starting a new generation
End Function

Function DetermineCP(ByVal stpt, ByVal leng)
Randomize
CP = stpt + CInt((leng - stpt) * Rnd(1))
End Function

Function SortFit()
'Number of Elite individuals should be specified
'so this loop can be made shorter
Dim Maxx As Single
Dim MAxOld As Double

Maxx = -9999
MAxOld = 1E+99


For i = 1 To Pop


   For j = 1 To Pop
   If Fitness(j) > Maxx And Fitness(j) < MAxOld Then
   Maxx = Fitness(j)
   ElitOrder(i) = j

   End If
   Next j
MAxOld = Maxx
Maxx = -9999
'Debug.Print ElitOrder(i)
Next i


End Function


Function ReadParents(ByVal MCno, ByVal FCno) As Variant
ReDim Parents(NoG, 2)

For k = 1 To NoG
Parents(k, 1) = Sheet1.Cells(1 + k, MCno)
Parents(k, 2) = Sheet1.Cells(1 + k, FCno)
```

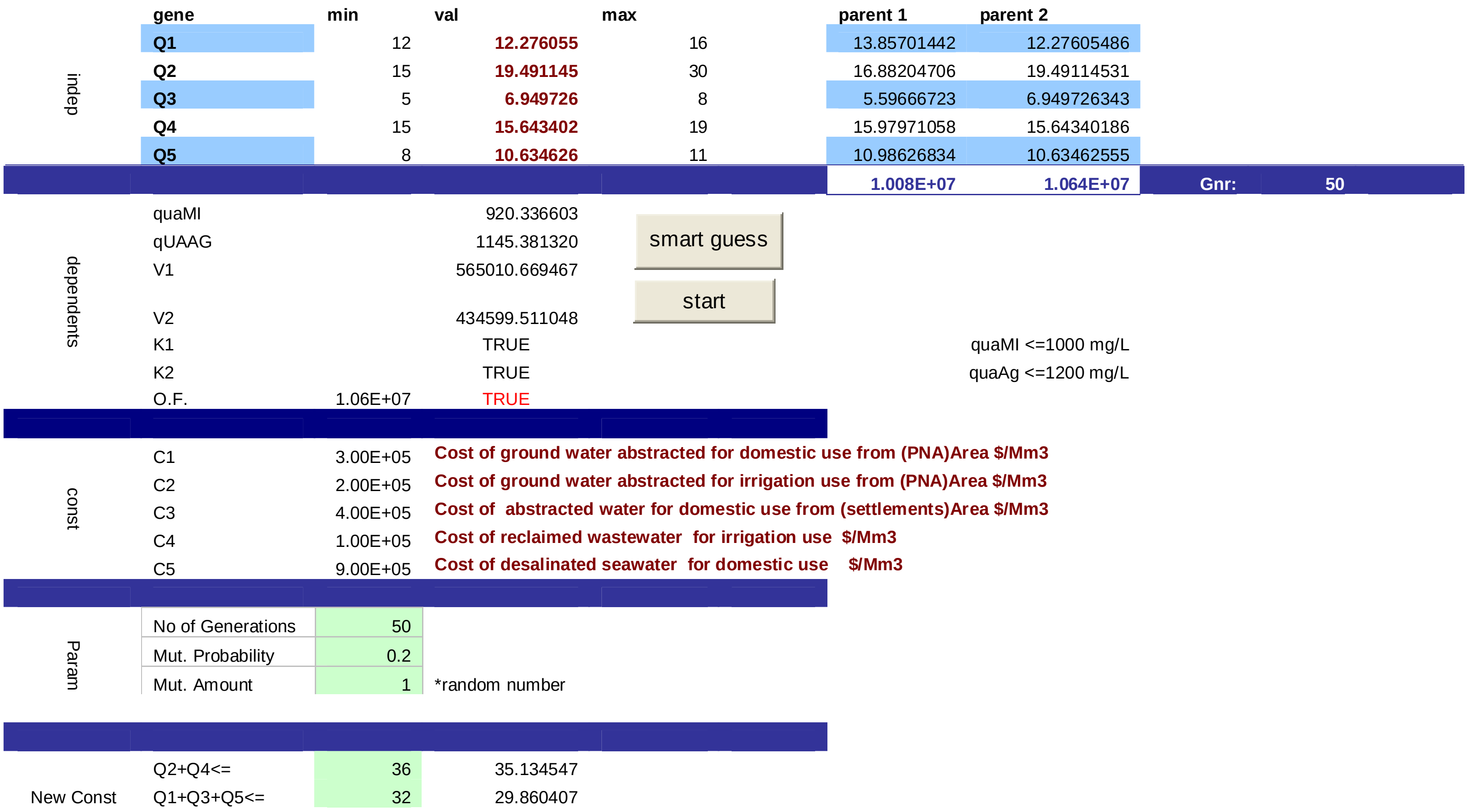
```
Next k

End Function

Function PrintChild(ByVal flag)
counter = counter + 1
For i = 1 To NoG
Sheet2.Cells(i, counter) = Child(i, flag)
Next i
Sheet2.Cells(NoG + 1, counter) = Fitness(flag)

End Function

Function NewParents(ByVal iter)

For k = 1 To NoG
Sheet1.Cells(1 + k, 7) = Child(k, ElitOrder(1))
Sheet1.Cells(1 + k, 8) = Child(k, ElitOrder(2))

Next k

Sheet1.Cells(2 + NoG, 7) = Fitness(ElitOrder(1))
Sheet1.Cells(2 + NoG, 8) = Fitness(ElitOrder(2))

'Keep history to make plots possible

For k = 1 To NoG
Sheet2.Cells(1 + k, iter + 1) = (Child(k, ElitOrder(1)) + Child(k, ElitOrder(2))) / 2

Next k

Sheet2.Cells(2 + NoG, iter + 1) = (Fitness(ElitOrder(1)) + Fitness(ElitOrder(2))) / 2

End Function

Function mutate(ByVal flag)

MutProbSp = Sheet1.Cells(23, 3)
MutAmount = Sheet1.Cells(24, 3)
Randomize
If (Rnd() < MutProbSp) Then
Randomize

    For k = 1 To NoG

        Randomize
        MutProb = Rnd()
        If (MutProb < 0.2) Then
        Randomize
        Child(k, flag) = Child(k, flag) - Rnd() * MutAmount * Child(k, flag)
```

```
      ElseIf (MutProb > 0.8) Then
      Randomize
      Child(k, flag) = Child(k, flag) + Rnd() * MutAmount * Child(k, flag)
      End If

   Next k

End If
CheckChild (flag)

End Function

Function CheckChild(ByVal flag)

Dim St As Boolean
St = True

suma = 0
   For k = 1 To NoG
   lb = Sheet1.Cells(k + 1, 3)
   ub = Sheet1.Cells(k + 1, 5)
   If Child(k, flag) > lb And Child(k, flag) < ub Then suma = suma + 1
   Next k
If Not (suma = NoG) Then St = False

   For j = 1 To NoG
   Sheet1.Cells(j + 1, 4) = Child(j, flag)
   Next j
With Sheet1
cc1 = (.Cells(3, 4) + .Cells(5, 4)) <= .Cells(28, 3)
cc2 = (.Cells(2, 4) + .Cells(4, 4) + .Cells(6, 4)) <= .Cells(29, 3)
If Not (.Cells(12, 4) And .Cells(13, 4) And .Cells(14, 4) And cc1 And cc2) Then St =
False
End With
CheckChild = St

End Function
```

Annex B

Genetic Algorithm Results

Short term situation year 2010



	gene	min	val	max	parent 1	parent 2		
indep	**Q1**	12	**12.276055**	16	13.85701442	12.27605486		
	Q2	15	**19.491145**	30	16.88204706	19.49114531		
	Q3	5	**6.949726**	8	5.59666723	6.949726343		
	Q4	15	**15.643402**	19	15.97971058	15.64340186		
	Q5	8	**10.634626**	11	10.98626834	10.63462555		
					1.008E+07	**1.064E+07**	**Gnr:**	**50**
dependents	quaMl		920.336603	smart guess				
	qUAAG		1145.381320					
	V1		565010.669467	start				
	V2		434599.511048					
	K1		TRUE			quaMl <=1000 mg/L		
	K2		TRUE			quaAg <=1200 mg/L		
	O.F.	1.06E+07	TRUE					
const	C1	3.00E+05	**Cost of ground water abstracted for domestic use from (PNA)Area $/Mm3**					
	C2	2.00E+05	**Cost of ground water abstracted for irrigation use from (PNA)Area $/Mm3**					
	C3	4.00E+05	**Cost of abstracted water for domestic use from (settlements)Area $/Mm3**					
	C4	1.00E+05	**Cost of reclaimed wastewater for irrigation use $/Mm3**					
	C5	9.00E+05	**Cost of desalinated seawater for domestic use $/Mm3**					
Param	No of Generations	50						
	Mut. Probability	0.2						
	Mut. Amount	1	*random number					
	Q2+Q4<=	36	35.134547					
New Const	Q1+Q3+Q5<=	32	29.860407					

Q1	Q2	Q3	Q4	Q5	OF
13.52834	16.46149	7.302913	17.44328	16.13375	11044640
12.40825	15.14018	8.803617	19.07245	16.13375	11732986
12.40825	15.80813	8.803617	19.07245	16.50846	11908912
12.40825	15.80813	8.803617	19.07245	16.50846	11908912
12.40825	15.80813	8.803617	19.07245	16.50846	11908912
12.40825	15.80813	8.803617	19.07245	16.50846	11908912
12.40825	15.80813	8.803617	19.07245	16.50846	11908912
12.40825	15.80813	8.803617	19.07245	16.50846	11908912
12.40825	15.80813	8.803617	19.29551	16.49171	11992522
12.40825	16.47608	8.803617	19.51857	16.49171	12195882
12.40825	16.47608	8.803617	19.51857	16.49171	12195882
12.40825	16.47608	8.803617	19.51857	16.64627	12220858
12.31442	16.47608	8.803617	19.51857	16.64627	12234342
12.314422	16.47608	8.8036175	19.51857	16.784094	12256904
12.31442	16.47608	8.803617	19.51857	16.78409	12256904
12.31442	16.47608	8.803617	19.51857	16.78409	12256904
12.31442	16.47608	8.803617	19.51857	16.78409	12256904
12.31442	16.47608	8.803617	19.51857	16.78409	12256904
12.2206	16.47608	8.810236	19.51857	16.78409	12271308
12.1901	16.47608	8.810236	19.51857	16.78409	12275841
12.1596	16.47608	8.810236	19.51857	16.78409	12280373
12.11145	16.47608	8.810236	19.51857	16.78409	12287594
12.06329	16.47608	8.810236	19.51857	16.78409	12294812
12.06329	16.47608	8.810236	19.51857	16.78409	12294812
12.06329	16.47608	8.810236	19.51857	16.78409	12294812
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11.99306	16.47608	8.810236	19.51857	16.78409	12305480
11.92283	16.47608	8.810236	19.51857	16.78409	12316143
11.92283	16.47608	8.810236	19.51857	16.78409	12316143
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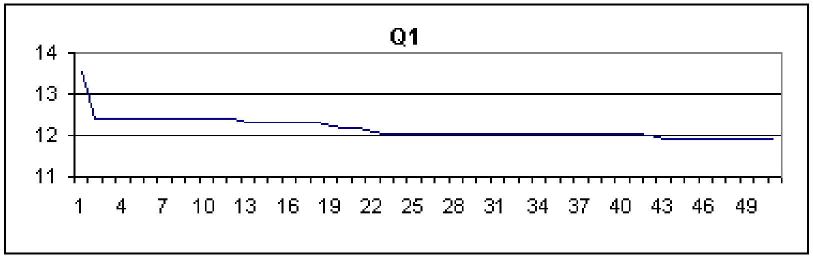
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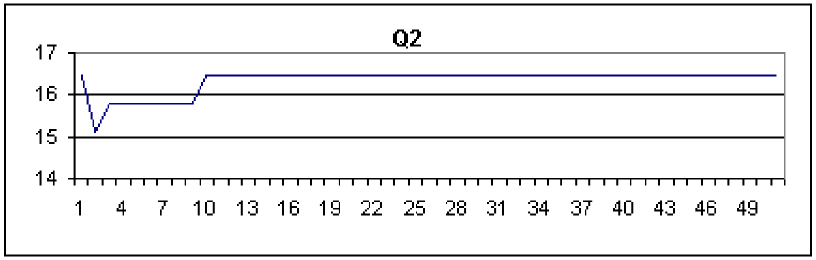
12
11
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49


Q2
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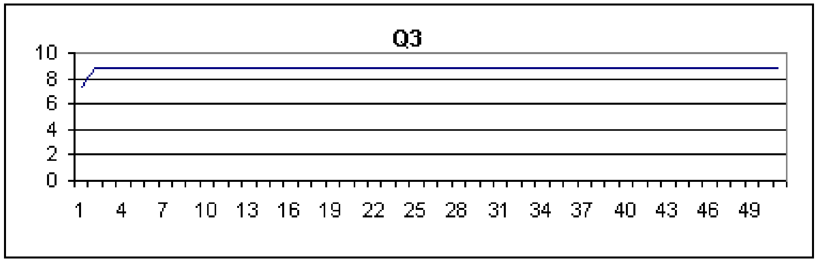
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4
2
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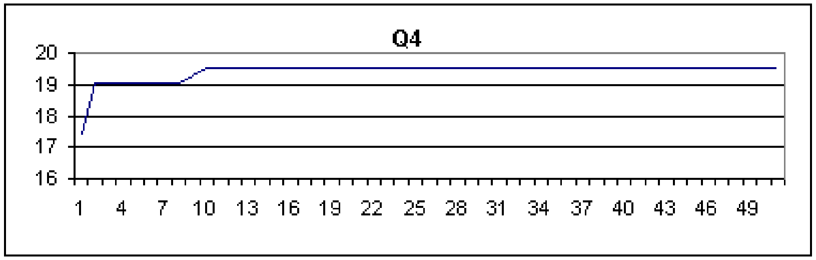
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49


Q4
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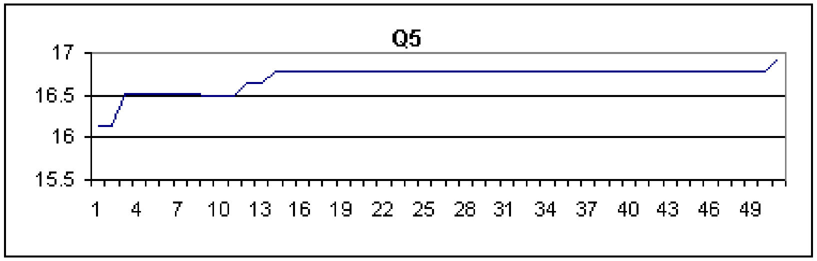
19
18
17
16
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49


Q5
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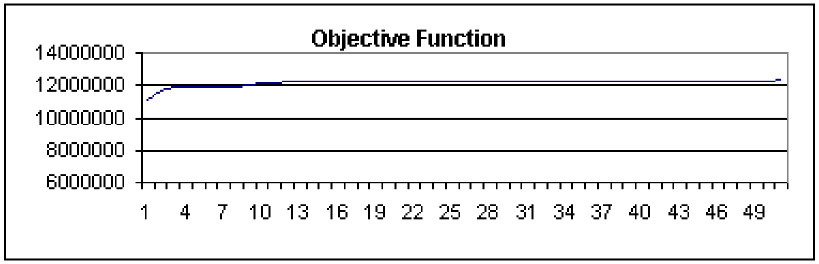
16.5
16
15.5
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49


Objective Function
14000000
12000000
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8000000
6000000
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49

Short term situation year 2010 (hypothetical)

	gene	min	val	max	parent 1	parent 2		
indep	**Q1**	12	**12.096083**	16	12.26063418	12.09608293		
	Q2	15	**17.655051**	30	17.35841453	17.65505075		
	Q3	5	**6.133917**	10	5.500988066	6.133917272		
	Q4	15	**19.887592**	25	15.51255941	19.8875916		
	Q5	8	**13.251074**	16	12.36540937	13.25107431		
					1.010E+07	**1.199E+07**	**Gnr:**	**50**
dependents	quaMl		872.706964					
	qUAAG		1085.875539	smart guess				
	V1		595847.199022					
	V2		446465.558861	start				
	K1		TRUE			quaMl <=900 mg/L		
	K2		TRUE			quaAg <=1100 mg/L		
	O.F.	1.20E+07	TRUE					
const	C1	3.00E+05	**Cost of ground water abstracted for domestic use from (PNA)Area $/Mm3**					
	C2	2.00E+05	**Cost of ground water abstracted for irrigation use from (PNA)Area $/Mm3**					
	C3	4.00E+05	**Cost of abstracted water for domestic use from (settlements)Area $/Mm3**					
	C4	1.00E+05	**Cost of reclaimed wastewater for irrigation use $/Mm3**					
	C5	9.00E+05	**Cost of desalinated seawater for domestic use $/Mm3**					
param	No of Generations	50						
	Mut. Probability	0.2						
	Mut. Amount	1	*random number					
	Q2+Q4<=	38	37.542642					
New Const	Q1+Q3+Q5<=	32	31.481075					

Q1	Q2	Q3	Q4	Q5	OF
12.51543	17.84281	5.415762	16.1289	12.63424	10433978
12.51543	18.32721	5.500988	16.74524	12.63424	10776649
12.51543	18.32721	5.500988	16.74524	12.90308	10794028
12.51543	18.32721	5.500988	16.74524	12.90308	10794028
12.26063	18.32721	5.500988	16.74524	12.78855	10800629
12.26063	18.32721	5.500988	16.74524	12.78855	10800629
12.26063	18.32721	5.500988	16.74524	12.78855	10800629
12.26063	18.32721	5.500988	16.74524	12.78855	10800629
12.26063	18.32721	5.500988	16.74524	12.78855	10800629
12.26063	18.32721	5.500988	16.74524	12.78855	10800629
12.26063	18.32721	5.500988	16.74524	12.78855	10800629
12.26063	18.32721	5.500988	16.74524	12.78855	10800629
12.26063	18.32721	5.500988	16.74524	12.78855	10800629
12.26063	18.32721	5.500988	16.74524	12.78855	10800629
12.26063	18.32721	5.500988	16.74524	12.78855	10800629
12.26063	18.32721	5.500988	16.74524	12.78855	10800629
12.26063	18.32721	5.500988	16.74524	12.78855	10800629
12.26063	18.32721	5.500988	16.74524	12.78855	10800629
12.26063	18.32721	5.500988	16.74524	12.78855	10800629
12.26063	18.32721	5.863057	16.74524	12.78855	10836164
12.26063	18.32721	6.225125	16.74524	12.78855	10871360
12.26063	18.32721	6.225125	16.74524	12.98617	10883928
12.26063	18.32721	6.225125	16.74524	12.98617	10883928
12.26063	18.32721	6.225125	16.74524	12.98617	10883928
12.26063	18.32721	6.225125	16.74524	13.10173	10891414
12.26063	18.32721	6.225125	16.74524	13.10173	10891414
12.26063	18.32721	6.225125	16.74524	13.10173	10891414
12.26063	18.32721	6.225125	16.74524	13.10173	10891414
12.26063	18.32721	6.225125	16.74524	13.10173	10891414
12.26063	18.32721	6.225125	16.74524	13.10173	10891414
12.26063	18.32721	6.225125	16.74524	13.10173	10891414
12.26063	18.32721	6.225125	16.74524	13.10173	10891414
12.26063	18.32721	6.225125	16.74524	13.10173	10891414
12.13472	18.32721	6.225125	16.74524	13.13421	10901034
12.13472	18.32721	6.225125	16.74524	13.13421	10901034
12.13472	18.32721	6.225125	16.74524	13.13421	10901034
12.13472	18.32721	6.225125	16.74524	13.13421	10901034
12.0088	18.32721	6.298672	16.74524	13.13421	10915575
12.0088	18.32721	6.298672	16.74524	13.13421	10915575
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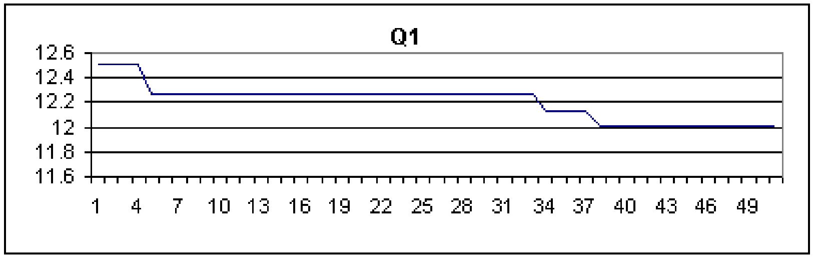
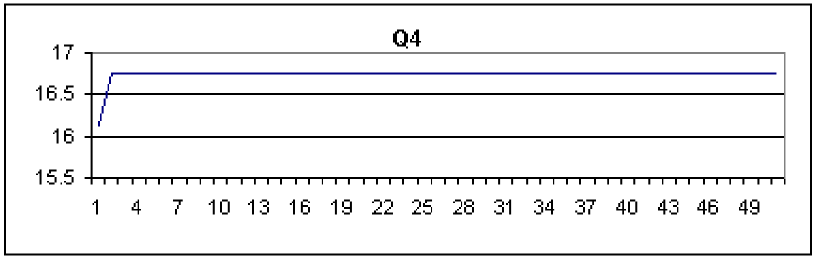

Q1
12.6
12.4
12.2
12
11.8
11.6
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49


Q4
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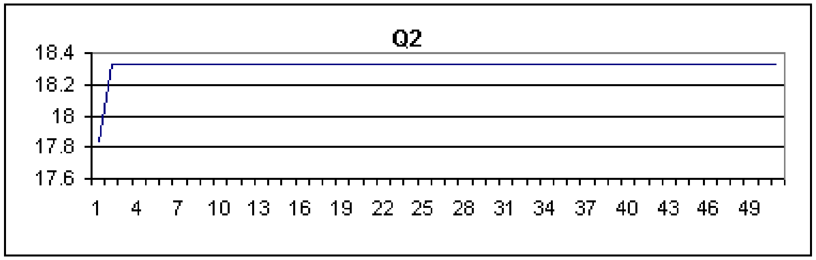
16.5
16
15.5
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49


Q2
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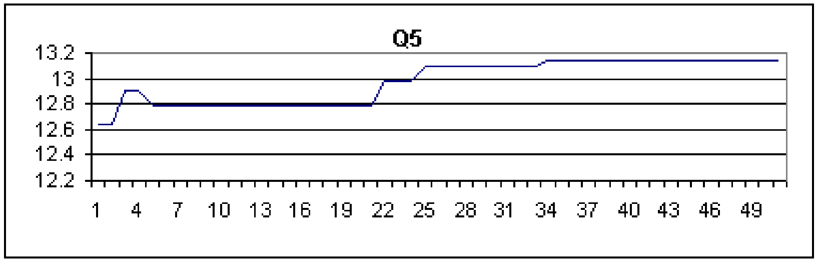
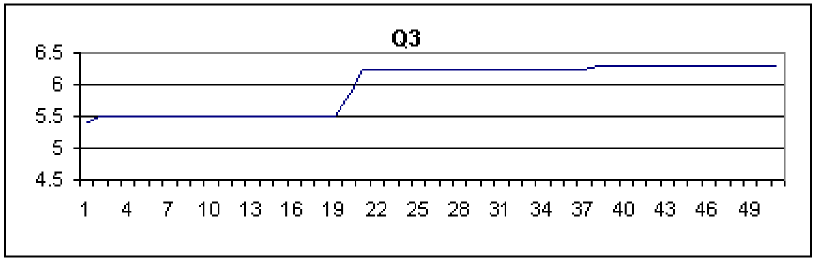
18.2
18
17.8
17.6
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49


Q5
13.2
13
12.8
12.6
12.4
12.2
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49


Q3
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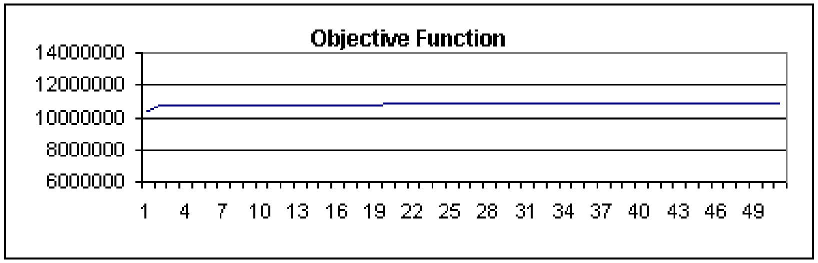
5.5
5
4.5
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49


Objective Function
14000000
12000000
10000000
8000000
6000000
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49

Short term situation year 2020

	gene	min	val	max	parent 1	parent 2		
indep	**Q1**	12	**12.356614**	16	12.29581332	12.35661411		
	Q2	15	**17.766372**	30	16.58178985	17.76637226		
	Q3	5	**6.417798**	10	6.658472121	6.4177984		
	Q4	20	**20.112853**	26	20.7694993	20.11285341		
	Q5	22	**22.915599**	28	22.00144732	22.91559887		
					1.308E+07	**1.315E+07**	**Gnr:**	**50**

dependents	quaMI		766.824167	
	qUAAG		1029.092623	
	V1		678121.559282	
	V2		457788.640133	
	K1		TRUE	quaMI <=850 mg/L
	K2		TRUE	quaAg <=1050 mg/L
	O.F.	1.31E+07	TRUE	

smart guess

start

const	C1	3.00E+05	**Cost of ground water abstracted for domestic use from (PNA)Area $/Mm3**
	C2	2.00E+05	**Cost of ground water abstracted for irrigation use from (PNA)Area $/Mm3**
	C3	4.00E+05	**Cost of abstracted water for domestic use from (settlements)Area $/Mm3**
	C4	1.00E+05	**Cost of reclaimed wastewater for irrigation use $/Mm3**
	C5	9.00E+05	**Cost of desalinated seawater for domestic use $/Mm3**

param	No of Generations	50	
	Mut. Probability	0.2	
	Mut. Amount	1	*random number

	Q2+Q4<=	38	37.879226
New Const	Q1+Q3+Q5<=	43	41.690011

Q1	Q2	Q3	Q4	Q5	OF
13.07053	15.1762	5.91028	21.65409	23.46187	13224172
12.30369	15.1762	5.298166	21.89976	24.66121	13592432
12.30369	15.1762	5.298166	21.89976	24.66121	13592432
12.30369	15.1762	5.298166	21.89976	24.66121	13592432
12.30369	15.1762	5.298166	21.89976	24.66121	13592432
12.30369	15.1762	5.298166	21.89976	24.66121	13592432
12.30369	15.1762	5.298166	21.89976	24.66121	13592432
12.30369	15.1762	5.298166	21.89976	24.66121	13592432
12.30369	15.1762	5.298166	21.89976	24.68724	13596523
12.30369	15.3223	5.298166	21.89976	24.68724	13625535
12.30369	15.3223	5.298166	22.19665	24.61633	13737415
12.30369	15.3223	5.298166	22.49354	24.61633	13860497
12.30369	15.3223	5.298166	22.49354	24.61633	13860497
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12.30369	15.3223	5.298166	22.49354	24.61633	13860497
12.30369	15.3223	5.599107	22.49354	24.71328	13885753
12.30369	15.3223	5.599107	22.49354	24.71328	13885753
12.30369	15.3223	5.599107	22.49354	24.71328	13885753
12.30369	15.3223	5.599107	22.49354	24.71328	13885753
12.30369	15.3223	5.890833	22.49354	24.71328	13895398
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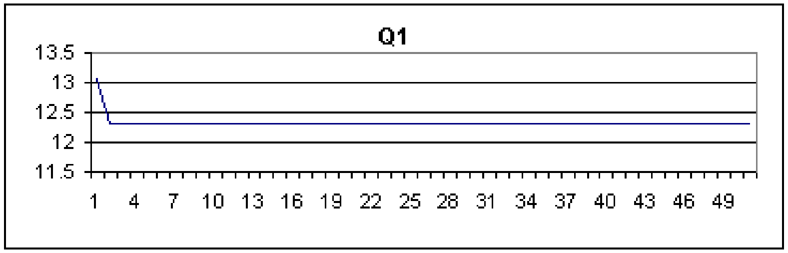
Q1
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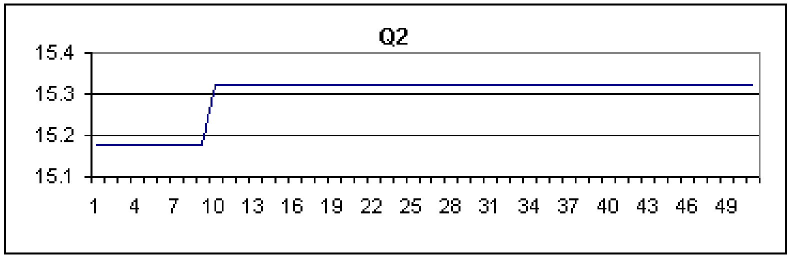
13
12.5
12
11.5
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49


Q2
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15.3
15.2
15.1
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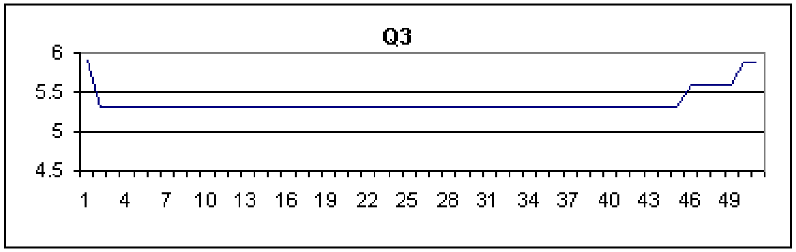
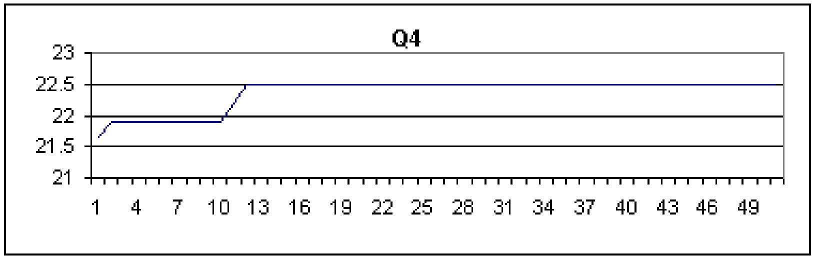
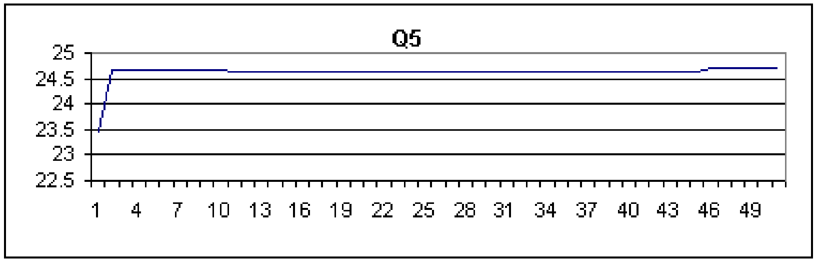
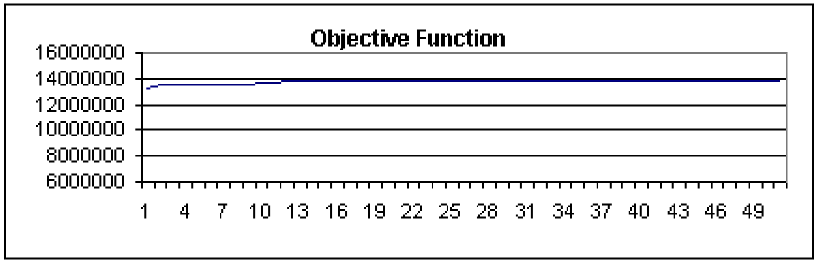

Q3
6
5.5
5
4.5
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49


Q4
23
22.5
22
21.5
21
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49


Q5
25
24.5
24
23.5
23
22.5
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49


Objective Function
16000000
14000000
12000000
10000000
8000000
6000000
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49

Short term situation year 2020 (hypothetical)

	gene	min	val	max	parent 1	parent 2		
indep	**Q1**	12	**12.074948**	16	12.07494831	12.07494831		
	Q2	15	**15.488884**	30	15.48888397	15.48888397		
	Q3	5	**5.634068**	10	5.634068012	5.634068012		
	Q4	20	**22.329668**	26	22.32966805	22.32966805		
	Q5	24	**25.056957**	28	25.09046936	25.05695724		
					1.396E+07	**1.395E+07**	**Gnr:**	**50**

smart guess

start

dependents	quaMl		740.500677	
	qUAAG		980.296507	
	V1		702227.582369	
	V2		467519.073515	
	K1		TRUE	quaMl <=750 mg/L
	K2		TRUE	quaAg <=1000 mg/L
	O.F.	1.40E+07	TRUE	

const	C1	3.00E+05	**Cost of ground water abstracted for domestic use from (PNA)Area $/Mm3**
	C2	2.00E+05	**Cost of ground water abstracted for irrigation use from (PNA)Area $/Mm3**
	C3	4.00E+05	**Cost of abstracted water for domestic use from (settlements)Area $/Mm3**
	C4	1.00E+05	**Cost of reclaimed wastewater for irrigation use $/Mm3**
	C5	9.00E+05	**Cost of desalinated seawater for domestic use $/Mm3**

param	No of Generations	50	
	Mut. Probability	0.2	
	Mut. Amount	1	*random number

	Q2+Q4<=	38	37.818552
New Const	Q1+Q3+Q5<=	43	42.765974

Q1	Q2	Q3	Q4	Q5	OF
12.30028	15.34136	5.339086	21.23462	24.64006	13348780
12.07495	15.48888	5.634068	22.32967	24.64006	13887738
12.07495	15.48888	5.634068	22.32967	24.64006	13887738
12.07495	15.48888	5.634068	22.32967	24.64006	13887738
12.07495	15.48888	5.634068	22.32967	24.64006	13887738
12.07495	15.48888	5.634068	22.32967	24.64006	13887738
12.07495	15.48888	5.634068	22.32967	24.64006	13887738
12.07495	15.48888	5.634068	22.32967	24.64006	13887738
12.07495	15.48888	5.634068	22.32967	24.64006	13887738
12.07495	15.48888	5.634068	22.32967	24.64006	13887738
12.07495	15.48888	5.634068	22.32967	24.64006	13887738
12.07495	15.48888	5.634068	22.32967	24.64006	13887738
12.07495	15.48888	5.634068	22.32967	24.64006	13887738
12.07495	15.48888	5.634068	22.32967	24.64006	13887738
12.07495	15.48888	5.634068	22.32967	24.64006	13887738
12.07495	15.48888	5.634068	22.32967	24.64006	13887738
12.07495	15.48888	5.634068	22.32967	24.64006	13887738
12.07495	15.48888	5.634068	22.32967	24.64006	13887738
12.07495	15.48888	5.634068	22.32967	24.68217	13894416
12.07495	15.48888	5.634068	22.32967	24.68217	13894416
12.07495	15.48888	5.634068	22.32967	24.68217	13894416
12.07495	15.48888	5.634068	22.32967	24.68217	13894416
12.07495	15.48888	5.634068	22.32967	24.68217	13894416
12.07495	15.48888	5.634068	22.32967	24.68217	13894416
12.07495	15.48888	5.634068	22.32967	24.88858	13927336
12.07495	15.48888	5.634068	22.32967	24.88858	13927336
12.07495	15.48888	5.634068	22.32967	24.88858	13927336
12.07495	15.48888	5.634068	22.32967	25.07371	13956916
12.07495	15.48888	5.634068	22.32967	25.07371	13956916
12.07495	15.48888	5.634068	22.32967	25.07371	13956916
12.07495	15.48888	5.634068	22.32967	25.07371	13956916
12.07495	15.48888	5.634068	22.32967	25.07371	13956916
12.07495	15.48888	5.634068	22.32967	25.07371	13956916
12.07495	15.48888	5.634068	22.32967	25.07371	13956916
12.07495	15.48888	5.634068	22.32967	25.07371	13956916
12.07495	15.48888	5.634068	22.32967	25.07371	13956916
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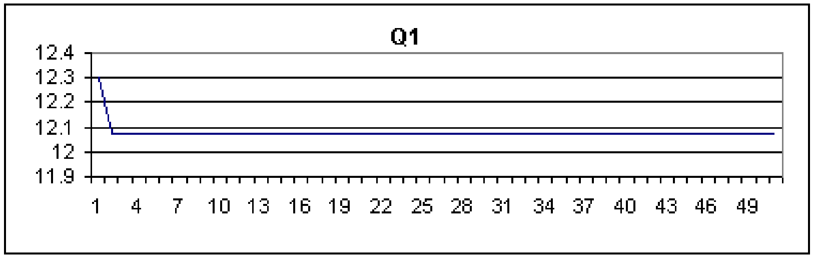
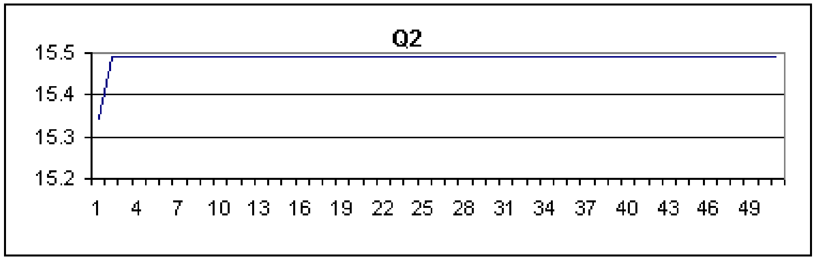
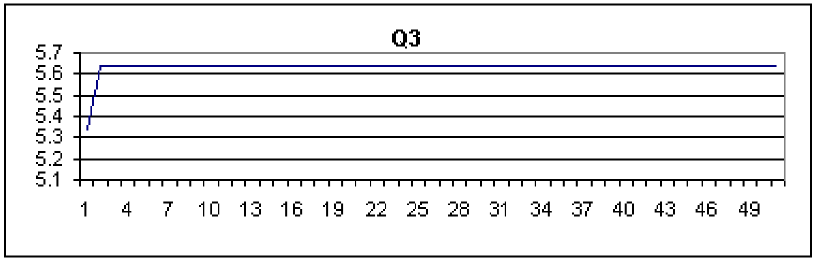
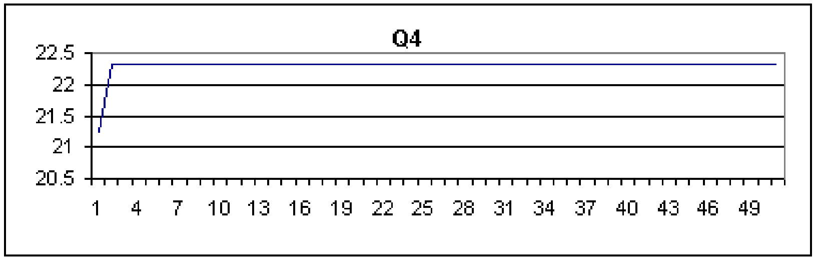
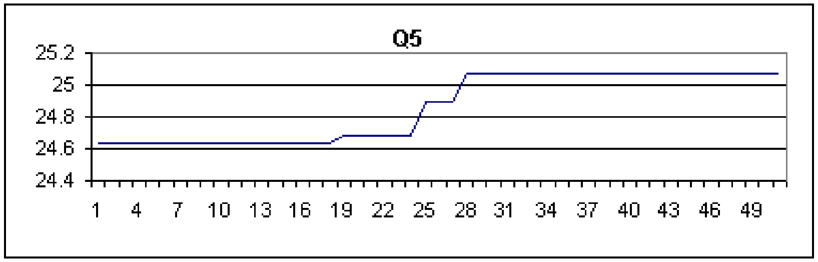
12.07495	15.48888	5.634068	22.32967	25.07371	13956916
12.07495	15.48888	5.634068	22.32967	25.07371	13956916
12.07495	15.48888	5.634068	22.32967	25.07371	13956916
12.07495	15.48888	5.634068	22.32967	25.07371	13956916
12.07495	15.48888	5.634068	22.32967	25.07371	13956916
12.07495	15.48888	5.634068	22.32967	25.07371	13956916
12.07495	15.48888	5.634068	22.32967	25.07371	13956916
12.07495	15.48888	5.634068	22.32967	25.07371	13956916
12.07495	15.48888	5.634068	22.32967	25.07371	13956916
12.07495	15.48888	5.634068	22.32967	25.07371	13956916
12.07495	15.48888	5.634068	22.32967	25.07371	13956916
12.07495	15.48888	5.634068	22.32967	25.07371	13956916
12.07495	15.48888	5.634068	22.32967	25.07371	13956916

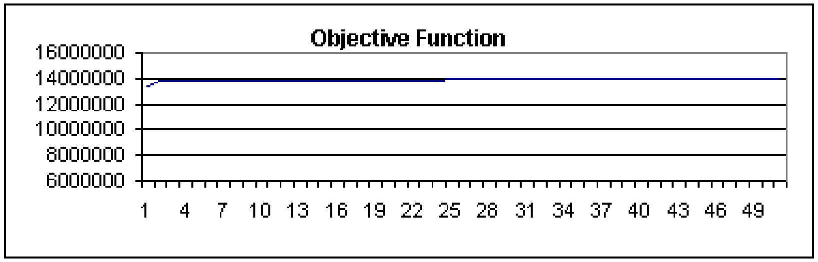

Q1
12.4
12.3
12.2
12.1
12
11.9
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49


Q2
15.5
15.4
15.3
15.2
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49


Q3
5.7
5.6
5.5
5.4
5.3
5.2
5.1
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49


Q4
22.5
22
21.5
21
20.5
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49


Q5
25.2
25
24.8
24.6
24.4
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49


Objective Function
16000000
14000000
12000000
10000000
8000000
6000000
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49

Annex C

Lingo Results

```
MAXB =(Q1+Q3+Q5)*V1+(Q2+Q4)*V2-
(Q1*C1+Q2*C2+Q3*C3+Q4*C4+Q5*C5);


Q1+Q3+Q5>=30;
Q2+Q4>=36;
quaMI=(1443*Q1+1000*Q3+400*Q5)/(Q1+Q3+Q5);


qUAAG=(1443*Q2+Q4*quaMI)/(Q2+Q4);
quaMI<=950;



V1=1.3*1000000*400*(Q1+Q3+Q5)/(1443*Q1+1000*Q3+400*Q5);
V2=(0.51*1000000/100)*(130-0.0391*(1443*Q2+Q4*quaMI)/(Q2+Q4));


Q1<=16;
Q2<=30;
Q3<=8;
Q4<=19;
Q5<=11;

C1=0.3*1000000;
C2=0.2*1000000;
C3=0.4*1000000;
C4=0.1*1000000;
C5=0.9*1000000;
```

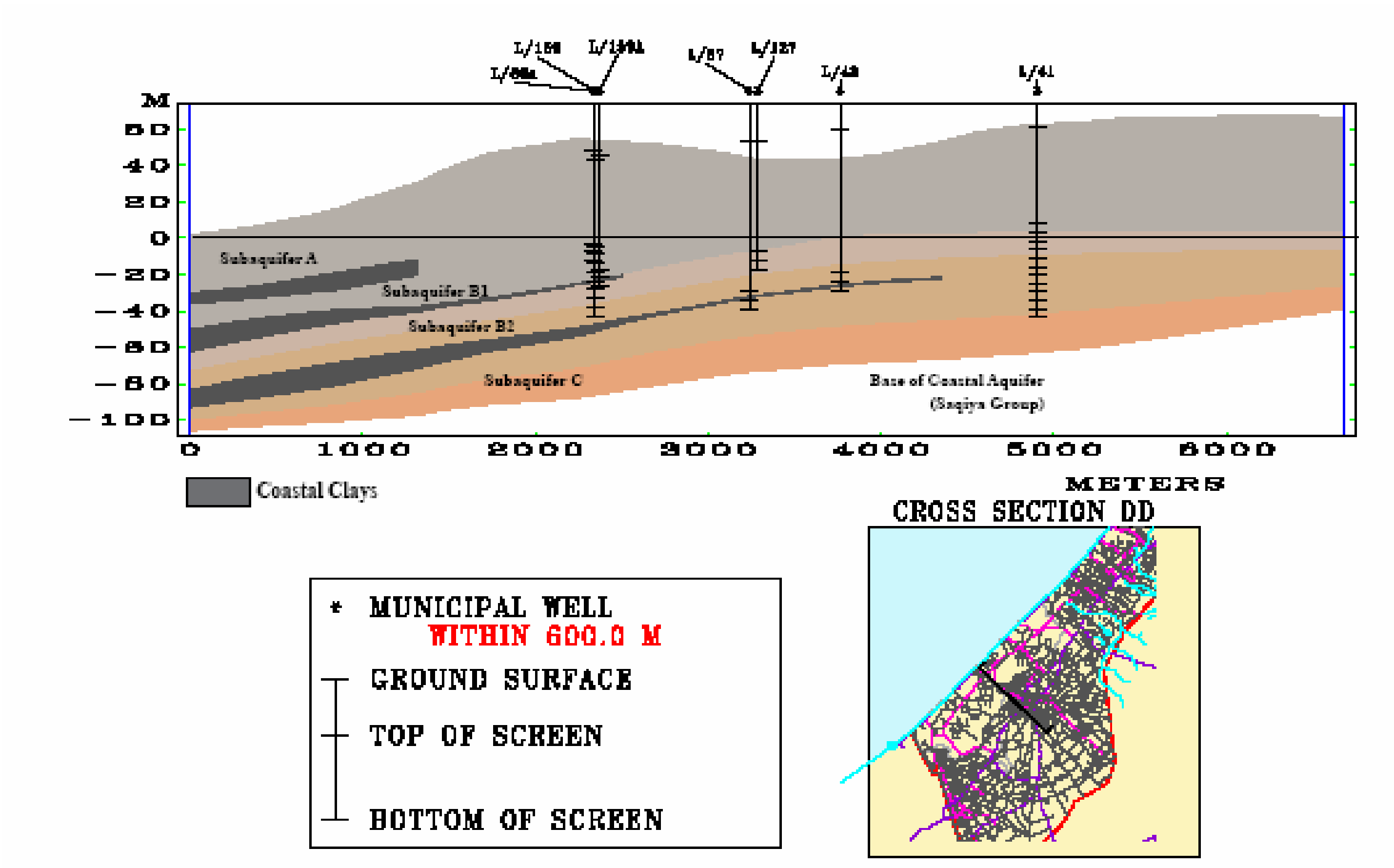
```
Feasible solution found.
Total solver iterations:                            65

                                        Variable           Value
                                            MAXB        7874372.
                                              Q1        11.46045
                                              Q3        8.000000
                                              Q5        11.00000
                                              V1        547368.4
                                              Q2        30.00000
                                              Q4        6.643850
                                              V2        393075.7
                                              C1        300000.0
                                              C2        200000.0
                                              C3        400000.0
                                              C4        100000.0
                                              C5        900000.0
                                           QUAMI        950.0000
                                           QUAAG        1353.615

                                             Row    Slack or Surplus
                                               1       -1.439582
                                               2       0.4604470
                                               3       0.6438503
                                               4      -0.1216824E-04
                                               5      -0.1318191E-04
                                               6        0.000000
                                               7      -0.9977849E-02
                                               8      -0.2628605E-02
                                               9        4.539553
                                              10        0.000000
                                              11        0.000000
                                              12        12.35615
                                              13        0.000000
                                              14        0.000000
                                              15        0.000000
                                              16        0.000000
                                              17        0.000000
                                              18        0.000000
```

Annex D

Hydrological Data



<u>**Model Cross Section (Khanyunis)**</u>

ID	REGION	NAME	L_USE	AVERAGE_AN	RAIN_99_00	RAIN_00_01	RAIN_01_02	RAIN_02_03	RAIN_03_04	SOIL	INFILT_FAC
11	Gaza	al-Qarara	Open/Rainfed	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Urban	320.5	257	551	391	373	319	Sand	0.200
11	Gaza	al-Qarara	Urban	320.5	257	551	391	373	319	Sand	0.200
11	Gaza	al-Qarara	Irrigated Citrus	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Unirrigated	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Unirrigated	320.5	257	551	391	373	319	Clay loam	0.200
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Clay loam	0.200
11	Gaza	al-Qarara	Open/Rainfed	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Urban	320.5	257	551	391	373	319	Sand	0.200
11	Gaza	al-Qarara	Urban	320.5	257	551	391	373	319	Sand	0.200
11	Gaza	al-Qarara	Urban	320.5	257	551	391	373	319	Sand	0.200
11	Gaza	al-Qarara	Urban	320.5	257	551	391	373	319	Sand	0.200
11	Gaza	al-Qarara	Urban	320.5	257	551	391	373	319	Sand	0.200
11	Gaza	al-Qarara	Irrigated Citrus	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Unirrigated	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
11	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	257	551	391	373	319	Sand	0.600
13	Gaza	al-Qarara	Unirrigated	320.5	192	381	312	298	208	Clay loam	0.200
13	Gaza	al-Qarara	Open/Rainfed	320.5	192	381	312	298	208	Sand	0.600

ID	REGION	NAME	IRR_CODE	IRR_DEPTH	RCH_IRR	SEPTIC_FAC	CON_DEPTH	RCH_PIPES	RCH_WW	RCH_TP	RCH_TWW	RCH_TOTAL
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
11	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000749769
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000310728
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000680952
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
11	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
11	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
11	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
11	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000749769
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
11	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
13	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000310728
13	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993

ID	REGION	NAME	RCH_WT_RAI	RCH_RAIN_Y	RCH_RAIN_9	RCH_RAIN_0	RCH_RAIN_0	RCH_RAIN_0	RCH_RAIN_0
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00022292	0.00017562	0.00028164	0.00060384	0.00042849	0.00040877	0.00034959
11	Gaza	al-Qarara	0.00022292	0.00017562	0.00028164	0.00060384	0.00042849	0.00040877	0.00034959
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00022292	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00022292	0.00017562	0.00028164	0.00060384	0.00042849	0.00040877	0.00034959
11	Gaza	al-Qarara	0.00059314	0.00017562	0.00028164	0.00060384	0.00042849	0.00040877	0.00034959
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00022292	0.00017562	0.00028164	0.00060384	0.00042849	0.00040877	0.00034959
11	Gaza	al-Qarara	0.00022292	0.00017562	0.00028164	0.00060384	0.00042849	0.00040877	0.00034959
11	Gaza	al-Qarara	0.00022292	0.00017562	0.00028164	0.00060384	0.00042849	0.00040877	0.00034959
11	Gaza	al-Qarara	0.00022292	0.00017562	0.00028164	0.00060384	0.00042849	0.00040877	0.00034959
11	Gaza	al-Qarara	0.00022292	0.00017562	0.00028164	0.00060384	0.00042849	0.00040877	0.00034959
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00022292	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
11	Gaza	al-Qarara	0.00059314	0.00052685	0.00084493	0.00181151	0.00128548	0.00122630	0.00104877
13	Gaza	al-Qarara	0.00022292	0.00017562	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	al-Qarara	0.00059314	0.00052685	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384

ID	REGION	NAME	L_USE	AVERAGE_AN	RAIN_99_00	RAIN_00_01	RAIN_01_02	RAIN_02_03	RAIN_03_04	SOIL	INFILT_FAC
13	Gaza	al-Qarara	Urban	320.5	192	381	312	298	208	Sand	0.200
13	Gaza	al-Qarara	Unirrigated	320.5	192	381	312	298	208	Sand	0.600
13	Gaza	al-Qarara	Irrigated Vegetables and G	320.5	192	381	312	298	208	Sand	0.600
13	Gaza	al-Qarara	Unirrigated	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	al-Qarara	Urban	316.8	192	381	312	298	208	Clay loam	0.200
13	Gaza	al-Qarara	Urban	316.8	192	381	312	298	208	Clay loam	0.200
13	Gaza	al-Qarara	Unirrigated	316.8	192	381	312	298	208	Clay loam	0.200
13	Gaza	al-Qarara	Open/Rainfed	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	al-Qarara	Open/Rainfed	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	al-Qarara	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	al-Qarara	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	al-Qarara	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	al-Qarara	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	al-Qarara	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	al-Qarara	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	al-Qarara	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	al-Qarara	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	al-Qarara	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	al-Qarara	Unirrigated	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	al-Qarara	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	al-Qarara	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	al-Qarara	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	al-Qarara	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	al-Qarara	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	al-Qarara	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	al-Qarara	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	al-Qarara	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Open/Rainfed	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Open/Rainfed	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Khan Younis	Open/Rainfed	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200

ID	REGION	NAME	IRR_CODE	IRR_DEPTH	RCH_IRR	SEPTIC_FAC	CON_DEPTH	RCH_PIPES	RCH_WW	RCH_TP	RCH_TWW	RCH_TOTAL
13	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000749769
13	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001119993
13	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000396509
13	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000309715
13	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	al-Qarara	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000743687
13	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	al-Qarara	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920

ID	REGION	NAME	RCH_WT_RAI	RCH_RAIN_Y	RCH_RAIN_9	RCH_RAIN_0	RCH_RAIN_0	RCH_RAIN_0	RCH_RAIN_0
13	Gaza	al-Qarara	0.00022292	0.00017562	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	al-Qarara	0.00022292	0.00052685	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	al-Qarara	0.00059314	0.00052685	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	al-Qarara	0.00022292	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	al-Qarara	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	al-Qarara	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	al-Qarara	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	al-Qarara	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	al-Qarara	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	al-Qarara	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	al-Qarara	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	al-Qarara	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	al-Qarara	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	al-Qarara	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	al-Qarara	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	al-Qarara	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	al-Qarara	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	al-Qarara	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	al-Qarara	0.00022292	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	al-Qarara	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	al-Qarara	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	al-Qarara	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	al-Qarara	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	al-Qarara	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	al-Qarara	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	al-Qarara	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	al-Qarara	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Khan Younis	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795

ID	REGION	NAME	L_USE	AVERAGE_AN	RAIN_99_00	RAIN_00_01	RAIN_01_02	RAIN_02_03	RAIN_03_04	SOIL	INFILT_FAC
13	Gaza	Khan Younis	Unirrigated	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Khan Younis	Unirrigated	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Khan Younis	Unirrigated	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Khan Younis	Open/Rainfed	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Open/Rainfed	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Open/Rainfed	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Open/Rainfed	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Open/Rainfed	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Open/Rainfed	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Open/Rainfed	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Open/Rainfed	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Open/Rainfed	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Open/Rainfed	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Open/Rainfed	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200

ID	REGION	NAME	IRR_CODE	IRR_DEPTH	RCH_IRR	SEPTIC_FAC	CON_DEPTH	RCH_PIPES	RCH_WW	RCH_TP	RCH_TWW	RCH_TOTAL
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000396509
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000396509
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000396509
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920

ID	REGION	NAME	RCH_WT_RAI	RCH_RAIN_Y	RCH_RAIN_9	RCH_RAIN_0	RCH_RAIN_0	RCH_RAIN_0	RCH_RAIN_0
13	Gaza	Khan Younis	0.00022292	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Khan Younis	0.00022292	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Khan Younis	0.00022292	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Khan Younis	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Khan Younis	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Khan Younis	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Khan Younis	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Khan Younis	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Khan Younis	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795

ID	REGION	NAME	L_USE	AVERAGE_AN	RAIN_99_00	RAIN_00_01	RAIN_01_02	RAIN_02_03	RAIN_03_04	SOIL	INFILT_FAC
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Khan Younis	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Khan Younis	Unirrigated	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Unirrigated	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600

ID	REGION	NAME	IRR_CODE	IRR_DEPTH	RCH_IRR	SEPTIC_FAC	CON_DEPTH	RCH_PIPES	RCH_WW	RCH_TP	RCH_TWW	RCH_TOTAL
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000743687
13	Gaza	Khan Younis	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000743687
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911

ID	REGION	NAME	RCH_WT_RAI	RCH_RAIN_Y	RCH_RAIN_9	RCH_RAIN_0	RCH_RAIN_0	RCH_RAIN_0	RCH_RAIN_0
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Khan Younis	0.00022292	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00022292	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384

ID	REGION	NAME	L_USE	AVERAGE_AN	RAIN_99_00	RAIN_00_01	RAIN_01_02	RAIN_02_03	RAIN_03_04	SOIL	INFILT_FAC
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Khan Younis	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Bani Suhaila	Open/Rainfed	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Bani Suhaila	Open/Rainfed	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Bani Suhaila	Open/Rainfed	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Bani Suhaila	Open/Rainfed	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Bani Suhaila	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Bani Suhaila	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Bani Suhaila	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Bani Suhaila	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Bani Suhaila	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Bani Suhaila	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Bani Suhaila	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Bani Suhaila	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Bani Suhaila	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Bani Suhaila	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Bani Suhaila	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Bani Suhaila	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Bani Suhaila	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Bani Suhaila	Unirrigated	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Bani Suhaila	Unirrigated	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Bani Suhaila	Unirrigated	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Bani Suhaila	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Bani Suhaila	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Bani Suhaila	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Bani Suhaila	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Bani Suhaila	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Bani Suhaila	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Bani Suhaila	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Bani Suhaila	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Bani Suhaila	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Bani Suhaila	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Bani Suhaila	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Bani Suhaila	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Bani Suhaila	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Bani Suhaila	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Bani Suhaila	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Bani Suhaila	Open/Rainfed	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Bani Suhaila	Open/Rainfed	316.8	192	381	312	298	208	Sand	0.600

ID	REGION	NAME	IRR_CODE	IRR_DEPTH	RCH_IRR	SEPTIC_FAC	CON_DEPTH	RCH_PIPES	RCH_WW	RCH_TP	RCH_TWW	RCH_TOTAL
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Khan Younis	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Bani Suhaila	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Bani Suhaila	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Bani Suhaila	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Bani Suhaila	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Bani Suhaila	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Bani Suhaila	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Bani Suhaila	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Bani Suhaila	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Bani Suhaila	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Bani Suhaila	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Bani Suhaila	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Bani Suhaila	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Bani Suhaila	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Bani Suhaila	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000396509
13	Gaza	Bani Suhaila	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000396509
13	Gaza	Bani Suhaila	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000396509
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911

ID	REGION	NAME	RCH_WT_RAI	RCH_RAIN_Y	RCH_RAIN_9	RCH_RAIN_0	RCH_RAIN_0	RCH_RAIN_0	RCH_RAIN_0
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Khan Younis	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Bani Suhaila	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Bani Suhaila	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Bani Suhaila	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Bani Suhaila	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Bani Suhaila	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Bani Suhaila	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Bani Suhaila	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Bani Suhaila	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Bani Suhaila	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Bani Suhaila	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Bani Suhaila	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Bani Suhaila	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Bani Suhaila	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Bani Suhaila	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Bani Suhaila	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Bani Suhaila	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Bani Suhaila	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Bani Suhaila	0.00022292	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Bani Suhaila	0.00022292	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Bani Suhaila	0.00022292	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Bani Suhaila	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Bani Suhaila	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Bani Suhaila	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Bani Suhaila	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Bani Suhaila	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Bani Suhaila	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Bani Suhaila	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Bani Suhaila	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Bani Suhaila	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Bani Suhaila	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Bani Suhaila	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Bani Suhaila	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Bani Suhaila	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Bani Suhaila	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Bani Suhaila	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Bani Suhaila	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Bani Suhaila	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384

ID	REGION	NAME	L_USE	AVERAGE_AN	RAIN_99_00	RAIN_00_01	RAIN_01_02	RAIN_02_03	RAIN_03_04	SOIL	INFILT_FAC
13	Gaza	Bani Suhaila	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Bani Suhaila	Unirrigated	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Bani Suhaila	Unirrigated	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Bani Suhaila	Unirrigated	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Bani Suhaila	Unirrigated	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Bani Suhaila	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Bani Suhaila	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Bani Suhaila	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Abasan al-Sa	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Unirrigated	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Abasan al-Sa	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Abasan al-Sa	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Abasan al-Sa	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Abasan al-Sa	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Abasan al-Sa	Open/Rainfed	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Abasan al-Sa	Open/Rainfed	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Abasan al-Sa	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Unirrigated	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Abasan al-Sa	Unirrigated	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Abasan al-Sa	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300

ID	REGION	NAME	IRR_CODE	IRR_DEPTH	RCH_IRR	SEPTIC_FAC	CON_DEPTH	RCH_PIPES	RCH_WW	RCH_TP	RCH_TWW	RCH_TOTAL
13	Gaza	Bani Suhaila	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Bani Suhaila	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000743687
13	Gaza	Bani Suhaila	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000743687
13	Gaza	Bani Suhaila	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000743687
13	Gaza	Bani Suhaila	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000743687
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Bani Suhaila	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000396509
13	Gaza	Abasan al-Sa	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Abasan al-Sa	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Abasan al-Sa	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Abasan al-Sa	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Abasan al-Sa	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Abasan al-Sa	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000396509
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000396509
13	Gaza	Abasan al-Sa	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733

ID	REGION	NAME	RCH_WT_RAI	RCH_RAIN_Y	RCH_RAIN_9	RCH_RAIN_0	RCH_RAIN_0	RCH_RAIN_0	RCH_RAIN_0
13	Gaza	Bani Suhaila	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Bani Suhaila	0.00022292	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Bani Suhaila	0.00022292	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Bani Suhaila	0.00022292	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Bani Suhaila	0.00022292	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Bani Suhaila	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Bani Suhaila	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Bani Suhaila	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Abasan al-Sa	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Abasan al-Sa	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Abasan al-Sa	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Abasan al-Sa	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Abasan al-Sa	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Abasan al-Sa	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Abasan al-Sa	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Abasan al-Sa	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Abasan al-Sa	0.00022292	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Abasan al-Sa	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192

ID	REGION	NAME	L_USE	AVERAGE_AN	RAIN_99_00	RAIN_00_01	RAIN_01_02	RAIN_02_03	RAIN_03_04	SOIL	INFILT_FAC
13	Gaza	Abasan al-Sa	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Abasan al-Sa	Urban	311.0	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	311.0	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	311.0	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Urban	311.0	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-Sa	Unirrigated	311.0	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Abasan al-Sa	Unirrigated	311.0	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Abasan al-Sa	Unirrigated	311.0	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Rafah	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Rafah	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Rafah	Open/Rainfed	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Rafah	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Abasan al-ka	Unirrigated	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Abasan al-ka	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-ka	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-ka	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-ka	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-ka	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-ka	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-ka	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-ka	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-ka	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-ka	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-ka	Unirrigated	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Abasan al-ka	Unirrigated	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Abasan al-ka	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Abasan al-ka	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Abasan al-ka	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Abasan al-ka	Unirrigated	311.0	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Abasan al-ka	Urban	311.0	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-ka	Urban	311.0	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Abasan al-ka	Unirrigated	311.0	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Abasan al-ka	Unirrigated	311.0	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Abasan al-ka	Irrigated Vegetables and G	311.0	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Abasan al-ka	Irrigated Vegetables and G	311.0	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Ga'a al-Grai	Unirrigated	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Ga'a al-Grai	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Ga'a al-Grai	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Ga'a al-Grai	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Ga'a al-Grai	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200

ID	REGION	NAME	IRR_CODE	IRR_DEPTH	RCH_IRR	SEPTIC_FAC	CON_DEPTH	RCH_PIPES	RCH_WW	RCH_TP	RCH_TWW	RCH_TOTAL
13	Gaza	Abasan al-Sa	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000393331
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000393331
13	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000393331
13	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.001065251
13	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.001065251
13	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.001065251
13	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.001065251
13	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000396509
13	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000396509
13	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000396509
13	Gaza	Abasan al-ka	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Abasan al-ka	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Abasan al-ka	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000393331
13	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000393331
13	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000393331
13	Gaza	Abasan al-ka	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000763555
13	Gaza	Abasan al-ka	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000763555
13	Gaza	Ga'a al-Grai	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000396509
13	Gaza	Ga'a al-Grai	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Ga'a al-Grai	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Ga'a al-Grai	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Ga'a al-Grai	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920

ID	REGION	NAME	RCH_WT_RAI	RCH_RAIN_Y	RCH_RAIN_9	RCH_RAIN_0	RCH_RAIN_0	RCH_RAIN_0	RCH_RAIN_0
13	Gaza	Abasan al-Sa	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Abasan al-Sa	0.00022292	0.00017041	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017041	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017041	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00017041	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-Sa	0.00022292	0.00025562	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Abasan al-Sa	0.00022292	0.00025562	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Abasan al-Sa	0.00022292	0.00025562	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Rafah	0.00054448	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Rafah	0.00054448	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Rafah	0.00054448	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Rafah	0.00054448	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Abasan al-ka	0.00022292	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Abasan al-ka	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-ka	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-ka	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-ka	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-ka	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-ka	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-ka	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-ka	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-ka	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-ka	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-ka	0.00022292	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Abasan al-ka	0.00022292	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Abasan al-ka	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Abasan al-ka	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Abasan al-ka	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Abasan al-ka	0.00022292	0.00025562	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Abasan al-ka	0.00022292	0.00017041	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-ka	0.00022292	0.00017041	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Abasan al-ka	0.00022292	0.00025562	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Abasan al-ka	0.00022292	0.00025562	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Abasan al-ka	0.00059314	0.00025562	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Abasan al-ka	0.00059314	0.00025562	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Ga'a al-Grai	0.00022292	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Ga'a al-Grai	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Ga'a al-Grai	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Ga'a al-Grai	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Ga'a al-Grai	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795

ID	REGION	NAME	L_USE	AVERAGE_AN	RAIN_99_00	RAIN_00_01	RAIN_01_02	RAIN_02_03	RAIN_03_04	SOIL	INFILT_FAC
13	Gaza	Ga'a al-Grai	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Ga'a al-Grai	Urban	316.8	192	381	312	298	208	Loess/Sandy Loess	0.200
13	Gaza	Ga'a al-Grai	Unirrigated	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Ga'a al-Grai	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Ga'a al-Grai	Irrigated Vegetables and G	316.8	192	381	312	298	208	Loess/Sandy Loess	0.300
13	Gaza	Ga'a al-Grai	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Ga'a al-Grai	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Ga'a al-Grai	Urban	316.8	192	381	312	298	208	Sand	0.200
13	Gaza	Ga'a al-Grai	Unirrigated	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Ga'a al-Grai	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
13	Gaza	Ga'a al-Grai	Irrigated Vegetables and G	316.8	192	381	312	298	208	Sand	0.600
14	Gaza	Abasan al-Sa	Urban	311.0	277	422	425	480	296	Loess/Sandy Loess	0.200
14	Gaza	Abasan al-Sa	Urban	311.0	277	422	425	480	296	Loess/Sandy Loess	0.200
14	Gaza	Abasan al-Sa	Urban	311.0	277	422	425	480	296	Loess/Sandy Loess	0.200
14	Gaza	Abasan al-Sa	Urban	311.0	277	422	425	480	296	Loess/Sandy Loess	0.200
14	Gaza	Abasan al-Sa	Urban	311.0	277	422	425	480	296	Loess/Sandy Loess	0.200
14	Gaza	Abasan al-Sa	Urban	311.0	277	422	425	480	296	Loess/Sandy Loess	0.200
14	Gaza	Abasan al-Sa	Unirrigated	311.0	277	422	425	480	296	Loess/Sandy Loess	0.300
14	Gaza	Abasan al-Sa	Unirrigated	311.0	277	422	425	480	296	Loess/Sandy Loess	0.300
14	Gaza	Abasan al-ka	Urban	311.0	277	422	425	480	296	Loess/Sandy Loess	0.200
14	Gaza	Abasan al-ka	Unirrigated	311.0	277	422	425	480	296	Loess/Sandy Loess	0.300
14	Gaza	Abasan al-ka	Irrigated Vegetables and G	311.0	277	422	425	480	296	Loess/Sandy Loess	0.300
14	Gaza	Abasan al-ka	Urban	311.0	277	422	425	480	296	Loess/Sandy Loess	0.200
14	Gaza	Abasan al-ka	Urban	311.0	277	422	425	480	296	Loess/Sandy Loess	0.200
14	Gaza	Abasan al-ka	Urban	311.0	277	422	425	480	296	Loess/Sandy Loess	0.200
14	Gaza	Abasan al-ka	Unirrigated	311.0	277	422	425	480	296	Loess/Sandy Loess	0.300
14	Gaza	Abasan al-ka	Unirrigated	311.0	277	422	425	480	296	Loess/Sandy Loess	0.300
14	Gaza	Abasan al-ka	Unirrigated	311.0	277	422	425	480	296	Loess/Sandy Loess	0.300
14	Gaza	Abasan al-ka	Irrigated Vegetables and G	311.0	277	422	425	480	296	Loess/Sandy Loess	0.300
14	Gaza	Khuza'a	Urban	311.0	277	422	425	480	296	Loess/Sandy Loess	0.200
14	Gaza	Khuza'a	Unirrigated	311.0	277	422	425	480	296	Loess/Sandy Loess	0.300
14	Gaza	Khuza'a	Unirrigated	218.0	277	422	425	480	296	Loess/Sandy Loess	0.300
17	Gaza	Rafah	Open/Rainfed	316.8	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Irrigated Vegetables and G	316.8	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Irrigated Vegetables and G	316.8	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Open/Rainfed	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Open/Rainfed	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Open/Rainfed	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Urban	238.2	142	284	259	261	186	Sand	0.200
17	Gaza	Rafah	Urban	238.2	142	284	259	261	186	Sand	0.200

ID	REGION	NAME	IRR_CODE	IRR_DEPTH	RCH_IRR	SEPTIC_FAC	CON_DEPTH	RCH_PIPES	RCH_WW	RCH_TP	RCH_TWW	RCH_TOTAL
13	Gaza	Ga'a al-Grai	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Ga'a al-Grai	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Ga'a al-Grai	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000396509
13	Gaza	Ga'a al-Grai	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Ga'a al-Grai	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
13	Gaza	Ga'a al-Grai	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Ga'a al-Grai	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Ga'a al-Grai	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
13	Gaza	Ga'a al-Grai	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000743687
13	Gaza	Ga'a al-Grai	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
13	Gaza	Ga'a al-Grai	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
14	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
14	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
14	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
14	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
14	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
14	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
14	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000393331
14	Gaza	Abasan al-Sa	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000393331
14	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
14	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000393331
14	Gaza	Abasan al-ka	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000763555
14	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
14	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
14	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
14	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000393331
14	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000393331
14	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000393331
14	Gaza	Abasan al-ka	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000763555
14	Gaza	Khuza'a	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
14	Gaza	Khuza'a	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000393331
14	Gaza	Khuza'a	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000342372
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.001065251
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.001065251
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.001065251
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Rafah	0	0.000000000	0.000000000	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000174260
17	Gaza	Rafah	0	0.000000000	0.000000000	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000174260

ID	REGION	NAME	RCH_WT_RAI	RCH_RAIN_Y	RCH_RAIN_9	RCH_RAIN_0	RCH_RAIN_0	RCH_RAIN_0	RCH_RAIN_0
13	Gaza	Ga'a al-Grai	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Ga'a al-Grai	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Ga'a al-Grai	0.00022292	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Ga'a al-Grai	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Ga'a al-Grai	0.00059314	0.00026038	0.00031562	0.00062630	0.00051288	0.00048986	0.00034192
13	Gaza	Ga'a al-Grai	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Ga'a al-Grai	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Ga'a al-Grai	0.00022292	0.00017359	0.00021041	0.00041753	0.00034192	0.00032658	0.00022795
13	Gaza	Ga'a al-Grai	0.00022292	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Ga'a al-Grai	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
13	Gaza	Ga'a al-Grai	0.00059314	0.00052077	0.00063123	0.00125260	0.00102575	0.00097973	0.00068384
14	Gaza	Abasan al-Sa	0.00022292	0.00017041	0.00030356	0.00046247	0.00046575	0.00052603	0.00032438
14	Gaza	Abasan al-Sa	0.00022292	0.00017041	0.00030356	0.00046247	0.00046575	0.00052603	0.00032438
14	Gaza	Abasan al-Sa	0.00022292	0.00017041	0.00030356	0.00046247	0.00046575	0.00052603	0.00032438
14	Gaza	Abasan al-Sa	0.00022292	0.00017041	0.00030356	0.00046247	0.00046575	0.00052603	0.00032438
14	Gaza	Abasan al-Sa	0.00022292	0.00017041	0.00030356	0.00046247	0.00046575	0.00052603	0.00032438
14	Gaza	Abasan al-Sa	0.00022292	0.00017041	0.00030356	0.00046247	0.00046575	0.00052603	0.00032438
14	Gaza	Abasan al-Sa	0.00022292	0.00025562	0.00045534	0.00069370	0.00069863	0.00078904	0.00048658
14	Gaza	Abasan al-Sa	0.00022292	0.00025562	0.00045534	0.00069370	0.00069863	0.00078904	0.00048658
14	Gaza	Abasan al-ka	0.00022292	0.00017041	0.00030356	0.00046247	0.00046575	0.00052603	0.00032438
14	Gaza	Abasan al-ka	0.00022292	0.00025562	0.00045534	0.00069370	0.00069863	0.00078904	0.00048658
14	Gaza	Abasan al-ka	0.00059314	0.00025562	0.00045534	0.00069370	0.00069863	0.00078904	0.00048658
14	Gaza	Abasan al-ka	0.00022292	0.00017041	0.00030356	0.00046247	0.00046575	0.00052603	0.00032438
14	Gaza	Abasan al-ka	0.00022292	0.00017041	0.00030356	0.00046247	0.00046575	0.00052603	0.00032438
14	Gaza	Abasan al-ka	0.00022292	0.00017041	0.00030356	0.00046247	0.00046575	0.00052603	0.00032438
14	Gaza	Abasan al-ka	0.00022292	0.00025562	0.00045534	0.00069370	0.00069863	0.00078904	0.00048658
14	Gaza	Abasan al-ka	0.00022292	0.00025562	0.00045534	0.00069370	0.00069863	0.00078904	0.00048658
14	Gaza	Abasan al-ka	0.00022292	0.00025562	0.00045534	0.00069370	0.00069863	0.00078904	0.00048658
14	Gaza	Abasan al-ka	0.00059314	0.00025562	0.00045534	0.00069370	0.00069863	0.00078904	0.00048658
14	Gaza	Khuza'a	0.00022292	0.00017041	0.00030356	0.00046247	0.00046575	0.00052603	0.00032438
14	Gaza	Khuza'a	0.00022292	0.00025562	0.00045534	0.00069370	0.00069863	0.00078904	0.00048658
14	Gaza	Khuza'a	0.00022292	0.00017918	0.00045534	0.00069370	0.00069863	0.00078904	0.00048658
17	Gaza	Rafah	0.00054448	0.00052077	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00052077	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00052077	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00017426	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	Rafah	0.00017426	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384

ID	REGION	NAME	L_USE	AVERAGE_AN	RAIN_99_00	RAIN_00_01	RAIN_01_02	RAIN_02_03	RAIN_03_04	SOIL	INFILT_FAC
17	Gaza	Rafah	Urban	238.2	142	284	259	261	186	Sand	0.200
17	Gaza	Rafah	Urban	238.2	142	284	259	261	186	Sand	0.200
17	Gaza	Rafah	Urban	238.2	142	284	259	261	186	Sand	0.200
17	Gaza	Rafah	Urban	238.2	142	284	259	261	186	Sand	0.200
17	Gaza	Rafah	Urban	238.2	142	284	259	261	186	Sand	0.200
17	Gaza	Rafah	Urban	238.2	142	284	259	261	186	Sand	0.200
17	Gaza	Rafah	Urban	238.2	142	284	259	261	186	Sand	0.200
17	Gaza	Rafah	Unirrigated	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Unirrigated	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Unirrigated	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Rafah	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	Abasan al-ka	Urban	316.8	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	Abasan al-ka	Unirrigated	316.8	142	284	259	261	186	Loess/Sandy Loess	0.300
17	Gaza	Ga'a al-Grai	Urban	316.8	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	Ga'a al-Grai	Unirrigated	316.8	142	284	259	261	186	Loess/Sandy Loess	0.300
17	Gaza	Ga'a al-Grai	Irrigated Vegetables and G	316.8	142	284	259	261	186	Loess/Sandy Loess	0.300
17	Gaza	Ga'a al-Grai	Unirrigated	316.8	142	284	259	261	186	Loess/Sandy Loess	0.300
17	Gaza	Ga'a al-Grai	Urban	316.8	142	284	259	261	186	Sand	0.200
17	Gaza	Ga'a al-Grai	Urban	316.8	142	284	259	261	186	Sand	0.200
17	Gaza	Ga'a al-Grai	Urban	316.8	142	284	259	261	186	Sand	0.200
17	Gaza	Ga'a al-Grai	Urban	316.8	142	284	259	261	186	Sand	0.200

ID	REGION	NAME	IRR_CODE	IRR_DEPTH	RCH_IRR	SEPTIC_FAC	CON_DEPTH	RCH_PIPES	RCH_WW	RCH_TP	RCH_TWW	RCH_TOTAL
17	Gaza	Rafah	0	0.000000000	0.000000000	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000174260
17	Gaza	Rafah	0	0.000000000	0.000000000	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000174260
17	Gaza	Rafah	0	0.000000000	0.000000000	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000174260
17	Gaza	Rafah	0	0.000000000	0.000000000	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000174260
17	Gaza	Rafah	0	0.000000000	0.000000000	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000174260
17	Gaza	Rafah	0	0.000000000	0.000000000	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000174260
17	Gaza	Rafah	0	0.000000000	0.000000000	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000174260
17	Gaza	Rafah	0	0.000000000	0.000000000	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000565822
17	Gaza	Rafah	0	0.000000000	0.000000000	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000565822
17	Gaza	Rafah	0	0.000000000	0.000000000	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000565822
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Rafah	1	0.001480895	0.000370224	0.63000000	0.00027400	0.00009140	0.00008286	0.000000000	0.000000	0.000936046
17	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	Abasan al-ka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000396509
17	Gaza	Ga'a al-Grai	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	Ga'a al-Grai	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000396509
17	Gaza	Ga'a al-Grai	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
17	Gaza	Ga'a al-Grai	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000396509
17	Gaza	Ga'a al-Grai	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	Ga'a al-Grai	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	Ga'a al-Grai	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	Ga'a al-Grai	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920

ID	REGION	NAME	RCH_WT_RAI	RCH_RAIN_Y	RCH_RAIN_9	RCH_RAIN_0	RCH_RAIN_0	RCH_RAIN_0	RCH_RAIN_0
17	Gaza	Rafah	0.00017426	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	Rafah	0.00017426	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	Rafah	0.00017426	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	Rafah	0.00017426	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	Rafah	0.00017426	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	Rafah	0.00017426	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	Rafah	0.00017426	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	Rafah	0.00017426	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00017426	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00017426	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Rafah	0.00054448	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Abasan al-ka	0.00022292	0.00017359	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	Abasan al-ka	0.00022292	0.00026038	0.00023342	0.00046685	0.00042575	0.00042904	0.00030575
17	Gaza	Ga'a al-Grai	0.00022292	0.00017359	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	Ga'a al-Grai	0.00022292	0.00026038	0.00023342	0.00046685	0.00042575	0.00042904	0.00030575
17	Gaza	Ga'a al-Grai	0.00059314	0.00026038	0.00023342	0.00046685	0.00042575	0.00042904	0.00030575
17	Gaza	Ga'a al-Grai	0.00022292	0.00026038	0.00023342	0.00046685	0.00042575	0.00042904	0.00030575
17	Gaza	Ga'a al-Grai	0.00022292	0.00017359	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	Ga'a al-Grai	0.00022292	0.00017359	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	Ga'a al-Grai	0.00022292	0.00017359	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	Ga'a al-Grai	0.00022292	0.00017359	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384

ID	REGION	NAME	L_USE	AVERAGE_AN	RAIN_99_00	RAIN_00_01	RAIN_01_02	RAIN_02_03	RAIN_03_04	SOIL	INFILT_FAC
17	Gaza	Ga'a al-Grai	Unirrigated	316.8	142	284	259	261	186	Sand	0.600
17	Gaza	Ga'a al-Grai	Irrigated Vegetables and G	316.8	142	284	259	261	186	Sand	0.600
17	Gaza	Ga'a al-Grai	Irrigated Vegetables and G	316.8	142	284	259	261	186	Sand	0.600
17	Gaza	Khuza'a	Urban	218.0	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	Khuza'a	Urban	218.0	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	Khuza'a	Unirrigated	218.0	142	284	259	261	186	Loess/Sandy Loess	0.300
17	Gaza	al-Fukhari	Open/Rainfed	316.8	142	284	259	261	186	Loess/Sandy Loess	0.300
17	Gaza	al-Fukhari	Urban	316.8	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	al-Fukhari	Urban	316.8	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	al-Fukhari	Urban	316.8	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	al-Fukhari	Unirrigated	316.8	142	284	259	261	186	Loess/Sandy Loess	0.300
17	Gaza	al-Fukhari	Open/Rainfed	316.8	142	284	259	261	186	Loess/Sandy Loess	0.300
17	Gaza	al-Fukhari	Open/Rainfed	316.8	142	284	259	261	186	Loess/Sandy Loess	0.300
17	Gaza	al-Fukhari	Open/Rainfed	316.8	142	284	259	261	186	Loess/Sandy Loess	0.300
17	Gaza	al-Fukhari	Urban	316.8	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	al-Fukhari	Urban	316.8	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	al-Fukhari	Urban	316.8	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	al-Fukhari	Urban	316.8	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	al-Fukhari	Urban	316.8	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	al-Fukhari	Urban	316.8	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	al-Fukhari	Urban	316.8	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	al-Fukhari	Urban	316.8	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	al-Fukhari	Urban	316.8	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	al-Fukhari	Urban	316.8	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	al-Fukhari	Urban	316.8	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	al-Fukhari	Unirrigated	316.8	142	284	259	261	186	Loess/Sandy Loess	0.300
17	Gaza	al-Fukhari	Urban	316.8	142	284	259	261	186	Sand	0.200
17	Gaza	al-Fukhari	Unirrigated	316.8	142	284	259	261	186	Sand	0.600
17	Gaza	al-Fukhari	Unirrigated	316.8	142	284	259	261	186	Sand	0.600
17	Gaza	al-Fukhari	Unirrigated	316.8	142	284	259	261	186	Sand	0.600
17	Gaza	al-Fukhari	Urban	238.2	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	al-Fukhari	Unirrigated	238.2	142	284	259	261	186	Loess/Sandy Loess	0.300
17	Gaza	al-Fukhari	Unirrigated	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Fukhari	Urban	218.0	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	al-Fukhari	Urban	218.0	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	al-Fukhari	Unirrigated	218.0	142	284	259	261	186	Loess/Sandy Loess	0.300
17	Gaza	al-Bayuk	Urban	316.8	142	284	259	261	186	Sand	0.200
17	Gaza	al-Bayuk	Unirrigated	316.8	142	284	259	261	186	Sand	0.600
17	Gaza	al-Bayuk	Unirrigated	238.2	142	284	259	261	186	Loess/Sandy Loess	0.300
17	Gaza	al-Bayuk	Open/Rainfed	238.2	142	284	259	261	186	Sand	0.600

ID	REGION	NAME	IRR_CODE	IRR_DEPTH	RCH_IRR	SEPTIC_FAC	CON_DEPTH	RCH_PIPES	RCH_WW	RCH_TP	RCH_TWW	RCH_TOTAL
17	Gaza	Ga'a al-Grai	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000743687
17	Gaza	Ga'a al-Grai	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
17	Gaza	Ga'a al-Grai	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.001113911
17	Gaza	Khuza'a	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	Khuza'a	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	Khuza'a	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000342372
17	Gaza	al-Fukhari	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000396509
17	Gaza	al-Fukhari	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
17	Gaza	al-Fukhari	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
17	Gaza	al-Fukhari	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000766733
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000396509
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000743687
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000743687
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000743687
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000353441
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000614482
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Fukhari	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000342372
17	Gaza	al-Bayuk	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Bayuk	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000743687
17	Gaza	al-Bayuk	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000353441
17	Gaza	al-Bayuk	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000984706

ID	REGION	NAME	RCH_WT_RAI	RCH_RAIN_Y	RCH_RAIN_9	RCH_RAIN_0	RCH_RAIN_0	RCH_RAIN_0	RCH_RAIN_0
17	Gaza	Ga'a al-Grai	0.00022292	0.00052077	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Ga'a al-Grai	0.00059314	0.00052077	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Ga'a al-Grai	0.00059314	0.00052077	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	Khuza'a	0.00022292	0.00011945	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	Khuza'a	0.00022292	0.00011945	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	Khuza'a	0.00022292	0.00017918	0.00023342	0.00046685	0.00042575	0.00042904	0.00030575
17	Gaza	al-Fukhari	0.00059314	0.00026038	0.00023342	0.00046685	0.00042575	0.00042904	0.00030575
17	Gaza	al-Fukhari	0.00022292	0.00017359	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Fukhari	0.00022292	0.00017359	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Fukhari	0.00022292	0.00017359	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Fukhari	0.00022292	0.00026038	0.00023342	0.00046685	0.00042575	0.00042904	0.00030575
17	Gaza	al-Fukhari	0.00059314	0.00026038	0.00023342	0.00046685	0.00042575	0.00042904	0.00030575
17	Gaza	al-Fukhari	0.00059314	0.00026038	0.00023342	0.00046685	0.00042575	0.00042904	0.00030575
17	Gaza	al-Fukhari	0.00059314	0.00026038	0.00023342	0.00046685	0.00042575	0.00042904	0.00030575
17	Gaza	al-Fukhari	0.00022292	0.00017359	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Fukhari	0.00022292	0.00017359	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Fukhari	0.00022292	0.00017359	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Fukhari	0.00022292	0.00017359	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Fukhari	0.00022292	0.00017359	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Fukhari	0.00022292	0.00017359	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Fukhari	0.00022292	0.00017359	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Fukhari	0.00022292	0.00017359	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Fukhari	0.00022292	0.00017359	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Fukhari	0.00022292	0.00017359	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Fukhari	0.00022292	0.00017359	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Fukhari	0.00022292	0.00026038	0.00023342	0.00046685	0.00042575	0.00042904	0.00030575
17	Gaza	al-Fukhari	0.00022292	0.00017359	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Fukhari	0.00022292	0.00052077	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Fukhari	0.00022292	0.00052077	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Fukhari	0.00022292	0.00052077	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Fukhari	0.00022292	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Fukhari	0.00022292	0.00019578	0.00023342	0.00046685	0.00042575	0.00042904	0.00030575
17	Gaza	al-Fukhari	0.00022292	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Fukhari	0.00022292	0.00011945	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Fukhari	0.00022292	0.00011945	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Fukhari	0.00022292	0.00017918	0.00023342	0.00046685	0.00042575	0.00042904	0.00030575
17	Gaza	al-Bayuk	0.00022292	0.00017359	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Bayuk	0.00022292	0.00052077	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Bayuk	0.00022292	0.00019578	0.00023342	0.00046685	0.00042575	0.00042904	0.00030575
17	Gaza	al-Bayuk	0.00059314	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151

ID	REGION	NAME	L_USE	AVERAGE_AN	RAIN_99_00	RAIN_00_01	RAIN_01_02	RAIN_02_03	RAIN_03_04	SOIL	INFILT_FAC
17	Gaza	al-Bayuk	Open/Rainfed	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Bayuk	Urban	238.2	142	284	259	261	186	Sand	0.200
17	Gaza	al-Bayuk	Urban	238.2	142	284	259	261	186	Sand	0.200
17	Gaza	al-Bayuk	Urban	238.2	142	284	259	261	186	Sand	0.200
17	Gaza	al-Bayuk	Urban	238.2	142	284	259	261	186	Sand	0.200
17	Gaza	al-Bayuk	Urban	238.2	142	284	259	261	186	Sand	0.200
17	Gaza	al-Bayuk	Urban	238.2	142	284	259	261	186	Sand	0.200
17	Gaza	al-Bayuk	Urban	238.2	142	284	259	261	186	Sand	0.200
17	Gaza	al-Bayuk	Urban	238.2	142	284	259	261	186	Sand	0.200
17	Gaza	al-Bayuk	Urban	238.2	142	284	259	261	186	Sand	0.200
17	Gaza	al-Bayuk	Urban	238.2	142	284	259	261	186	Sand	0.200
17	Gaza	al-Bayuk	Urban	238.2	142	284	259	261	186	Sand	0.200
17	Gaza	al-Bayuk	Unirrigated	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Bayuk	Unirrigated	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Bayuk	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Bayuk	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Bayuk	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Bayuk	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Bayuk	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Bayuk	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Bayuk	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Bayuk	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Bayuk	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Bayuk	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Bayuk	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Bayuk	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Bayuk	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Bayuk	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Bayuk	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Bayuk	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Bayuk	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Bayuk	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Bayuk	Irrigated Vegetables and G	238.2	142	284	259	261	186	Sand	0.600
17	Gaza	al-Shoka	Urban	238.2	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	al-Shoka	Urban	238.2	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	al-Shoka	Urban	238.2	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	al-Shoka	Urban	238.2	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	al-Shoka	Urban	238.2	142	284	259	261	186	Loess/Sandy Loess	0.200
17	Gaza	al-Shoka	Unirrigated	238.2	142	284	259	261	186	Loess/Sandy Loess	0.300
17	Gaza	al-Shoka	Unirrigated	238.2	142	284	259	261	186	Sand	0.600

ID	REGION	NAME	IRR_CODE	IRR_DEPTH	RCH_IRR	SEPTIC_FAC	CON_DEPTH	RCH_PIPES	RCH_WW	RCH_TP	RCH_TWW	RCH_TOTAL
17	Gaza	al-Bayuk	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000984706
17	Gaza	al-Bayuk	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Bayuk	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Bayuk	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Bayuk	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Bayuk	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Bayuk	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Bayuk	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Bayuk	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Bayuk	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Bayuk	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Bayuk	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Bayuk	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000614482
17	Gaza	al-Bayuk	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000614482
17	Gaza	al-Bayuk	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000984706
17	Gaza	al-Bayuk	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000984706
17	Gaza	al-Bayuk	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000984706
17	Gaza	al-Bayuk	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000984706
17	Gaza	al-Bayuk	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000984706
17	Gaza	al-Bayuk	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000984706
17	Gaza	al-Bayuk	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000984706
17	Gaza	al-Bayuk	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000984706
17	Gaza	al-Bayuk	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000984706
17	Gaza	al-Bayuk	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000984706
17	Gaza	al-Bayuk	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000984706
17	Gaza	al-Bayuk	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000984706
17	Gaza	al-Bayuk	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000984706
17	Gaza	al-Bayuk	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000984706
17	Gaza	al-Bayuk	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000984706
17	Gaza	al-Bayuk	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000984706
17	Gaza	al-Bayuk	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000984706
17	Gaza	al-Bayuk	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000984706
17	Gaza	al-Bayuk	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000984706
17	Gaza	al-Bayuk	1	0.001480895	0.000370224	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000984706
17	Gaza	al-Shoka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Shoka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Shoka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Shoka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Shoka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000222920
17	Gaza	al-Shoka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000353441
17	Gaza	al-Shoka	0	0.000000000	0.000000000	1.00000000	0.00027400	0.00009140	0.00013152	0.000000000	0.000000	0.000614482

ID	REGION	NAME	RCH_WT_RAI	RCH_RAIN_Y	RCH_RAIN_9	RCH_RAIN_0	RCH_RAIN_0	RCH_RAIN_0	RCH_RAIN_0
17	Gaza	al-Bayuk	0.00059314	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Bayuk	0.00022292	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Bayuk	0.00022292	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Bayuk	0.00022292	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Bayuk	0.00022292	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Bayuk	0.00022292	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Bayuk	0.00022292	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Bayuk	0.00022292	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Bayuk	0.00022292	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Bayuk	0.00022292	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Bayuk	0.00022292	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Bayuk	0.00022292	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Bayuk	0.00022292	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Bayuk	0.00022292	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Bayuk	0.00059314	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Bayuk	0.00059314	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Bayuk	0.00059314	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Bayuk	0.00059314	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Bayuk	0.00059314	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Bayuk	0.00059314	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Bayuk	0.00059314	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Bayuk	0.00059314	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Bayuk	0.00059314	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Bayuk	0.00059314	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Bayuk	0.00059314	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Bayuk	0.00059314	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Bayuk	0.00059314	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Bayuk	0.00059314	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Bayuk	0.00059314	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Bayuk	0.00059314	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Bayuk	0.00059314	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Bayuk	0.00059314	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Bayuk	0.00059314	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151
17	Gaza	al-Shoka	0.00022292	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Shoka	0.00022292	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Shoka	0.00022292	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Shoka	0.00022292	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Shoka	0.00022292	0.00013052	0.00015562	0.00031123	0.00028384	0.00028603	0.00020384
17	Gaza	al-Shoka	0.00022292	0.00019578	0.00023342	0.00046685	0.00042575	0.00042904	0.00030575
17	Gaza	al-Shoka	0.00022292	0.00039156	0.00046685	0.00093370	0.00085151	0.00085808	0.00061151