E1121
Volume 3

ISLAMIC REPUBLIC OF IRAN

PROJECT MANAGEMENT UNIT
INTERNATIONAL BANK FOR RECONSTRUCTION & DEVELOPMENT (IBRD)

Urban Water Supply & Waste water Project
(PHRD # TF-026482)

Environmental & Social Assessment for the Project Areas in the Cities of Rasht, Anzali, Sari & Babol

Draft Final Environmental Assessment Report for Rasht and Anzali

February ,2005

In Association

Pars Ab Tadbir Consulting
Engineering Company
No.40,Nosrat Street, North Kargar Ave.,
Tehran, Iran

National Engineering services
Pakistan (Pvt) Limite, Koi Nasr (Geesha)
Between 13 &15 Street, Block No.170/4,
4th Floor, Tehran-14476,Iran

ISLAMIC REPUBLIC OF IRAN

MINISTRY OF ENERGY

RASHT AND ANZALI WATER SUPPLY AND SANITATION PROJECT

ENVIRONMENTAL ASSESSMENT

EXECUTIVE SUMMARY
(FINAL DRAFT)

February, 2005

ISLAMIC REPUBLIC OF IRAN
RASHT AND ANZALI WATER SUPPLY AND SANITATION PROJECT
ENVIRONMENTAL ASSESSMENT - EXECUTIVE SUMMARY

TABLE OF CONTENTS

Islamic Republic of Iran
Rasht and Anzali Water Supply and Sanitation Project

Environmental Assessment - Executive Summary

List of Abbreviations

BOD	Biochemical Oxygen Demand
C&EGWSS	Central & East Gilan Water Supply Scheme
CC	Construction Contractor
DoEG	Department of Environment Guilan
DC	Design Consultants
DOE	Department of Environment
EA	Environmental Assessment
EHC	Environmental High Council
EMP	Environmental Management Plan
ESO	Environmental and Safety Officer
EU	European Union
FAO	Food and Agriculture Organization
GRWA	Gilan Regional Water Authority
GWWC	Gilan Water and Wastewater Company
JEK	Jihad-e-Keshavarzi
MOAJ	Ministry of Agriculture Jihad
MOE	Ministry of Energy
MOHME	Ministry of health and Medical Education
MoRA	Municipalities of Rasht and Anzali
NGO	Non-Governmental Organization
OP	Operational Policy
PMU	Project Management Unit
QA/QC	Quality Assurance and Quality Control
RWB	Regional Water Board
TOR	Terms of Reference
UFW	Unaccounted for Water
US EPA	Unites States Environmental Protection Agency
WB	World Bank
WHO	World Health Organization
WTP	Water Treatment Plant
WTPO	Water Treatment Plant Operator
WWTO	Wastewater Treatment Operator
WWTP	Wastewater Treatment Plant

Introduction

Problems such as the present unreliable water supply system, the inconsistent quality of drinking water, the lack of proper wastewater collection system and poor water and wastewater management, coupled with rapid growth of population and expansion of urban centres has prompted the Government of Iran to consider water supply and sanitation projects as a high priority. Among others currently under development, the Rasht and Anzali Water Supply and Sanitation Project is being developed by the Iranian Ministry of Energy to provide adequate water supply and sewerage systems for both cities.

Rasht is the capital of Gilan Province and is located 320 km north of Tehran, while ***Anzali*** is the second largest city of Gilan Province and is located at the coast of the Caspian Sea 40 km north west of Rasht. The present population of Rasht is 500,000 and is projected to reach 956,600 by year 2027; whereas the present population of Anzali is 118,000 and reaches 143,000 in the summer because of tourism. Anzali's population is projected to reach 252,000, including tourists, by the year 2027.

Zarjoob and Goharood are the main rivers flowing through Rasht while Anzali is located around Anzali Lagoon, a wetland of international ecological importance. These two rivers and Anzali Lagoon eventually flow into the Caspian Sea.

It is estimated that around 85% of the population of Rasht and Anzali are currently connected to the cities' water supply system. Water quality monitoring indicates that the water supply is of acceptable quality and in compliance with national and WHO standards. Chemical, Physical and bacteriological analyses are conducted on a daily basis at various points including water sources, storage reservoirs and distribution network. The major problems raised by the Gilan Water and Wastewater Company is the high percentage of unaccounted for water, particularly for Rasht due to the old age of the system. The UFW in Rasht is estimated at 36%, whereas at Anzali it is estimated at 26%. Rehabilitation of the network has been initiated but is proceeding at a very slow rate due to limited financial resources.

Similar to other cities in Iran, wastewater collection, treatment and disposal are the main environmental concerns in Rasht and Anzali. The major problem in both cities is the discharge of wastewater into the natural water bodies running through these cities. In Rasht raw wastewater is discharged to Zarjoob and Goharood river, which eventually reaches Anzali Lagoon, whereas in Anzali the wastewater is discharged to the Caspian Sea and to Anzali lagoon where pollution levels are increasing and are seriously affecting its environmental conditions.

Moreover, due to the high ground water level in both cities, the sewage is leading to the contamination of ground water and causing infectious diseases. In view of these conditions, which are causing health hazards, and serious repercussions on the cities' developments, the implementation of this wastewater treatment plan project has become a high priority.

The objectives of this Water and Sanitation Project are:

- Improving access of the cities' residents to adequate water supply
- Providing sufficient water supply quantities up to the year 2027
- Providing water quality in accordance with prevailing drinking water quality standards;
- Providing satisfactory wastewater collection and treatment;
- Improving health conditions of the targeted population;
- Reducing surface and ground water pollution and improving environmental conditions within the project area

The execution of the project will have positive environmental impacts in terms of reducing pollution of natural resources, generation of significant economical, social and public health benefits, and will facilitate the enforcement of existing environmental regulations and standards by the government.

Potential negative impacts from the proposed project are mainly related to the construction phase of the project, and are thus of temporary nature. Other negative impacts that might arise from the project will be mitigated through appropriate measures. The present report summarizes the findings of the environmental assessment study that was conducted and the environmental management plan that will be adopted for the project.

Project Description

The feasibility study for Rasht and Anzali water and wastewater management has been prepared to meet the study area requirements up to the year 2027.

This Project envisages improvement and extension of the existing water supply system in Rasht and Anzali, provision of facilities for wastewater collection and its disposal as well as the construction of treatment plants in each city. The Project is expected to provide facilities to a population of 956,600 in Rasht covering an area of 9,850 hectares and to nearly 252,000 inhabitants of Anzali with an area of 3,095 hectares by the year 2027. The required works for water and wastewater will be completed over four phases, with phase one from year 2005 to year 2009, phase two from year 2010 to year 2012, phase three from year 2013 to year 2018, and phase four from year 2018 till year 2027.

Water supply:

At present 89 % of Rasht's population are covered by the water supply network. The total average water demand of Rasht city is 123,600 m^3/day and is expected to increase to around 238,600 m^3/day in the year 2027. As for Anzali City, 85 % of its population are covered by the water supply network. The total average water demand of Anzali city is 26,840 m^3/day and is expected to increase to around 56,740 m^3/day in the year 2027. The current water demand of the two cities is provided from the C&EGWSS, which provides water also to other cities in east and central areas of Gilan. The C&EGWSS depend on the surface water of Sefidrood River, and the groundwater of Emamzadeh Hashem deep wells. Sefidrood River water is treated at Sangar WTP and Emergency WTP using conventional treatment processes comprising of flocculation, sedimentation, filtration and chlorination. Sangar WTP presently provides 259,200 m^3/day, which accounts for 74% of the total supply quantity, and shall provide 518,400 m^3/day in year 2027. The Emergency WTP presently provides 25,920 m^3/day, and shall provide 51,840 m^3/day by year 2027, whereas Emamzadeh Hashem wells provide 64,800 m^3/day. GRWA intends to develop additional wells at Lahijan and Sangar during the last phase of the project to increase the total ground water sources by an additional 90,480 m^3/day. As part of the proposed project, the following water works will be executed:

<u>*Rasht*</u>

The proposed first phase extension (2005 to 2009) of the water supply system in Rasht includes:

- Rehabilitation of 14.2 km of distribution piping
- 174 km extension of distribution piping and mains
- Construction of 30,000 m^3 reservoir at Lakan
- Rehabilitation of two existing 2,500 m^3 capacity elevated storage tank.
- Construction of two 40,000 m^3 ground reservoirs and related facilities
- Provision of control and instrumentation system

<u>*Anzali*</u>

The proposed first phase extension (2005 to 2009) of the water supply system in Anzali includes:

- Replacement of 1.3 km of distribution mains
- 12 km extension of distribution piping and mains
- 71.9 km extension of laterals
- 69.9 km replacement of laterals
- Provision of control and instrumentation system

The extension of works in the 2nd to 4th phase (2010 to 2027) includes extension of emergency water treatment plant by an additional capacity of 300 liters/sec, the development of new wells at Sangar having 500 liters/sec capacity and at Astaneh with capacity of 500 liters/sec, laying of 865 km of pipes in Rasht and 143 km of pipes in Anzali for extension and rehabilitation of the distribution network at both cities.

The project will deliver water quality according to the prevailing drinking water standards and will accommodate the maximum daily water demands which are estimated at 1.3 times the total average water demands, or 188,051 m^3 per day at year 2009. Table 1 presents water quality of surface and groundwater resources.

Wastewater:

Rasht

Rasht city is divided into western, eastern, and central drainage zones. Currently, 85% of its population is connected to a combined wastewater and storm drainage collection network, which discharges into Zarjoub and Goharood rivers. The rivers are severely polluted and during the summer season, when their flows are minimal, they are transformed to sewers. The wastewater management plan in Rasht city is to collect the wastewater generated in the three drainage zones of the city and convey them by gravity and pumping to a single wastewater treatment plant located 4 km to the north-east of the city. It is forecasted that by end of phase 1, 45% of the population will be connected to the new collection system and will be generating 50,860 m^3/day. These flows will be treated to secondary treatment level with additional nutrient removal for control of nitrogen and phosphorus levels. The treated effluent of Rasht WWTP will be discharged to Zarjoub River, ultimately discharging to Anzali lagoon, which in turn discharges to the Caspian Sea. The target of the project is to cover all the city by year 2027 serving 956,600 people with a total generated flow of 200,500 m^3/day.

At present wastewater collection system in Rasht is under construction, with priority given to the central drainage area as it has the highest population density. Land for effluent outfalls, and land for collection network pumping stations has been acquired by GWWC. Pipelines will be laid within the right of way of public streets. The land for phase 1 of the Rasht WWTP works was acquired, and construction of the phase 1 facilities with capacity of 80,000 m^3/day, is currently in progress. A full EA was not performed for the under construction WWTP. Consequently and as part of the EA study of the proposed Rasht and Anzali project, a post environmental review was undertaken with respect to sitting, engineering design, technical and environmental performance as well as any potential risks related to the operation of the WWTP.

Anzali

Anzali city is divided by Anzali lagoon into two drainage zones; called Anzali and Ghazian. Currently, 70% of its population is connected to a combined wastewater and storm drainage collection network, which discharges into either Anzali lagoon, which is currently classified as eutrophic in many of its parts, or into the Caspian Sea, through eight existing large sewer outfalls. The wastewater management plan in Anzali city is to collect the wastewater generated in each drainage zone and convey it by gravity and pumping to a central WWTP serving that zone. Thus, there will be two WWTPs: one in Western Anzali and one in Ghazian. It is forecasted that by end of phase 1, 65% of the population will be connected to the collection system and will be generating 19,710 m^3/day. These flows will be treated to secondary treatment level with additional nutrient removal for control of nitrogen and phosphorus levels. The treated effluent of West Anzali WWTP will be discharged to Anzali Lagoon, which in turn discharges to the Caspian Sea. The treated effluent of East Anzali WWTP will be discharged to Talebabad River, which ultimately discharges to the Caspian Sea. The target of the project is to cover all the city by year 2027 serving 252,000 people with a total generated flow of 51,160 m^3/day.

At present wastewater collection system in Anzali is under construction, The land for both treatment plants, effluent outfalls, and collection network pumping stations has been acquired by GWWC. Pipelines will be laid within the right of way of public streets. Phase 1 of the West Anzali WWTP works with capacity of 18,700 m^3/day, is currently in progress. A full EA was not performed for the construction of the WWTP. Consequently and similar to Rasht WWTP a post review was undertaken.

As part of the proposed project, the following wastewater works will be executed:

<u>Rasht</u>

The proposed first phase extension (2005 to 2009) of the wastewater collection and treatment system in Rasht includes:

- Construction of 68,400 house connections
- 260 km of laterals
- 252 km of interceptors
- 31 km of trunk mains
- 20 lift stations
- Upgrading of the Rasht WWTP by including Biological Nutrient Removal (BNR)
- Provision of emergency raw wastewater storage tank with 24 hour capacity for phase 1.
- The provision of septage management works

Anzali

The proposed first phase extension (2005 to 2009) of the wastewater collection and treatment system in Anzali includes:

- Construction of 27,000 house connections
- 133 km of laterals
- 207 km of interceptors
- 17 km of trunk mains
- 14 lift stations
- Upgrading of the Anzali West WWTP by including biological nutrient removal.
- Provision of emergency raw wastewater storage tank with 24 hour capacity for phase 1.
- The provision of septage management works.
- Construction of the first module at East Anzali WWTP

The extension of works in the 2nd to 4th phase (2010 to 2027) includes extension of the Rasht WWTP and the two WWTPs at Anzali, the expansion of the collection and conveyance network, the construction of additional pumping stations.

The process design of the treatment plants was developed based on influent loads that were estimated from the long term data acquired at Esfahan and Tehran treatment plants and on guidelines issued by the Organization of Planning and Management. The design treated effluent quality is in accordance with Iranian standards for discharge to surface water bodies. These effluent standards include among others, concentration limits for BOD, COD, suspended solids, nitrogen, phosphorus, and fecal coliform. Table 2 presents the design influent and effluent criteria for all treatment plants. It should be noted that since the discharge of all treatment plants is eventually reaching the sensitive water body of Anzali lagoon, additional features have been incorporated in the design of the Rasht and Anzali WWTPs to increase their performance and reliability. These features include: (1) the provision of BNR for controlling nitrogen and phosphorus to minimum levels achieved by biological treatment systems, (2) the provision of 24 hour emergency storage tank for raw sewage in case of upset in plant performance (3) the provision of UV disinfection in lieu of chlorine to eliminate the possibility of harmful chlorination by-products.

Sludge treatment for Rasht WWTP is achieved through blending, thickening, and anaerobic digestion, and dewatering by belt filter presses to 30% dry solids content. Sludge treatment for Anzali West and East WWTPs is achieved through thickening and dewatering to 30% dry solids content. The projected sludge quantity from Rasht WWTP is 26 m^3/day at year 2009, and 111 m^3/day at year 2027. The projected sludge quantities from both West and East Anzali WWTP is 28 m^3/day for year 2027. The initial sludge disposal scheme proposed was incineration, since sludge disposal by re-use in agriculture within Gilan province was rejected due to public opposition in application to agricultural fields predominantly cultivated by rice, unfavorable weather conditions due to high humidity and rain for most of the year which prevents sludge drying in open beds, and the higher cost of landfilling when compared to cost of incineration as based on the actual contracted price. However and as concluded by the post environmental review, the proposed incineration system does not meet the prevailing WB guidelines and other international standards in terms of emission levels and other environmental criteria. Therefore re-use of sludge in agriculture outside Gilan province or at its borders, where agricultural and climatic conditions are more favorable has been identified as the more appropriate method for this project.

Policy, Legal and Regulatory Framework

The competent body for EA as defined in Decree 138 of 12/04/1994 is the Iranian Department of Environment (DOE), under the authority of the Environmental High Council (EHC) which is composed of senior representatives of government ministries, senior academics and advisers to the Iranian government. Environmental Assessment (EA) in Iran was enabled by Note 82 of the Law for the Second State Economical, Social and Cultural Development Plan of 1994, amended by Note 105 of the Third Development Plan. EA was approved by the EHC through Decree 138 and detailed requirements for conducting EA were defined in the Code of Practice of 23/12/1997. In addition to the defined project types that are subject to EA, the EHC may also require an EA for any other large project.

In addition to Environmental Assessment, there exist a wide range of regulations regarding environmental protection including the Environmental Protection Act of 1974 and its executive by-law dated 1975, the Clean Water Act of 1982 that was amended in 1994, the executive by-law on the prevention of water pollution (1994), the Air Pollution Abatement Act of 1995 and its executive by-law dated 1997, the Game and Fish law of 1957 with subsequent amendments made in 1975 and 1996. Also, there are standards for drinking water, effluent discharges, noise levels and ambient air quality. The project will adhere to the aforementioned laws and standards. With respect to the re-use of sludge as a soil conditioner for agriculture, the project, if this application is adopted, will ensure compliance with the EU Directive with respect to toxic elements, the WHO guidelines including the limit of less than 1 intestinal nematode egg per 100gms of dry solids as well as the FAO guidelines for sludge reuse.

With respect to industries, existing national legislation provides for control of industrial discharges. DOE is mandated with the enforcement of the limits for industrial discharges and has secured so far an impressive record in terms of enforcement of the laws and regulations against polluters by issuing warnings, imposing fines and eventually bringing them to courts. Moreover, the project will only provide connections to industries that are inside the cities of Rasht and Anzali. Industrial complexes outside Rasht and Anzali will have to treat their effluents separately and DOE will be responsible for the industrial effluents discharging into the receiving water bodies and will ensure that they are pre-treated to levels which comply with the World Bank's Pollution Prevention and Abatement Handbook, taking into account the treatment efficiency that can be achieved by the treatment plant for the various parameters of concern. In summary, the project will abide by all national laws and standards and will follow internationally accepted best practices.

Institutional Arrangement for Environment Management

A number of governmental organizations have responsibilities for managing and monitoring environmental impacts. The Guilan Water and Wastewater Company (GWWC) which is in charge of water supply as well as wastewater collection and treatment will be in charge of managing, operating and maintaining the project. Among its duties, the GWWC will have responsibility for ensuring the supply of adequate water quality and quantity. GWWC will also be responsible for controlling discharges into the wastewater collection system and as such will be responsible for ensuring that industries pre-treat their wastewater before discharging it into the collection network.

The DOE will have the responsibility for monitoring the environmental impacts. It will monitor construction activities, will check water quality in the rivers and in Anzali Lagoon and will ensure compliance with effluent standards for industries and wastewater treatment plants. The DOE will also monitor the quality of sludge to be used for soil conditioning, if this application is adopted by the projected.

The Ministry of Agriculture Jihad has responsibility to supervise and regulate the reuse of treated sludge, if reuse in agriculture is adopted, while the Ministry of Health and Medical Education will be responsible for monitoring water quality and the occurrence of water borne diseases.

Baseline Information

The environmental baseline conditions were investigated within this study area and for adjacent areas that could potentially be affected by the project. Baseline information has been quantified within three main topic areas - physical, biological and socio-economic.

The major source of water in Rasht and Anzali is surface water. There are two rivers flowing in Rasht; Zarjoob (Siahrood) River and Goharood River, which join to form a main river called Syghlanroodbar (Pirbazar), which discharges into Anzali Lagoon and eventually into the Caspian Sea. The two rivers are mostly used for irrigation purpose. Based on 25 years of records the annual average flow at the GRWA bridge in Zarjoob river is 5.73 m^3/sec. As for Goharood the annual average of the flows measured at Lakan is 1.08 m^3/sec based on 10 years of measurements. Both rivers are highly polluted as they receive considerable wastewater discharges and pollutants from other sources such as solid wastes, or agricultural runoff. The available data on the water quality of these rivers confirm the deteriorating quality of the rivers where the BOD_5 levels in both rivers measured up to 30 mg/l when the normal level for clean rivers should be less than 1 mg/l and DO levels measured as low as 1.8 mg/l when DO saturation concentration is around 10 mg/l.

The other important river is Sephidrood, the main source of drinking water for Rasht and Anzali city. This river however only crosses through part of the project area and runs to the north east. Sephidrood river quality at Sangar WTP intake, is typically turbid with high TSS and TDS, however generally it is compliant with Iranian drinking water quality standards. As for the groundwater in the area of influence of the project, it comprises a smaller part of the water supply system. Generally each well has 20 to 30 l/sec capacity. The water supply wells of Emamzadeh Hashem, and Sangar are located to the south east of the Rasht city and generally have good water quality.

Anzali is characterized by numerous short rivers (Rogas), which eventually discharge to Anzali lagoon; among which is Pirbazar Roga, which originates from the two rivers of Rasht city. Some of these rivers convey domestic sewage originated by the communities discharging into them. The sum total of the surface water that enters Anzali Lagoon is 2,400 million m^3/year.

Anzali Lagoon, the most prominent environmental feature in the project area, is listed as a 'wetland of international importance' under the 1971 Ramsar Convention due to its importance as a natural wetland characteristic of the southern Caspian lowlands, and as such, supports an extremely diverse wetland flora and fauna. This Lagoon is located on the South West of the Caspian Sea and is connected to the sea through a channel called Ghazian. The current total area of the wet land, covering both lagoon and the marsh land is 193 km^2. The lagoon itself is around 80 km^2 with average of depth ranges of 1 to 3 m. The wet lands include two wild life refuge areas, two protected areas, and four no hunting areas. The site has been placed on the Ramsar Montreux Record of priority sites for conservation action since December 1993, due to environmental degradation: the diminishing areas of the wetland and the lagoon, the excessive growth of reed beds, decreased production of fish quantities, and the eutrophication which is causing excessive water fern growth. According to a recent study by JICA on the integrated management of the lagoon's ecosystem, the lake is eutrophic at several locations as confirmed by measurements of chemical oxygen demand (COD) and total phosphorus (TP) in five locations of the lagoon. According to this study, the major adverse effects on the wetland are arising from the watershed, while other adverse effects were attributed to activities within the wetland. Adverse effects from the watershed to the wetland are as follows: (1) Inflow of polluted water; (2) Inflow and dumping of garbage; (3) Inflow of sediment; and (4) Changes of the water level of the Caspian Sea. Of these factors, the inflow of polluted water is the most serious factor due to the discharge of organic loads, which cause oxygen depletion, and the discharge of nutrients (nitrogen and phosphorus) which cause excessive algal growth and thus eutrophic conditions. The main contribution of polluted water comes from urban domestic wastewater, of which the discharge of Rasht and Anzali cities represent 83% of the total. The long term level changes in the Caspian Sea is the main cause for salinity changes in Anzali lagoon, which has adverse impacts on its aquatic ecosystem.

There is one industrial city 25 km south of Rasht and two large industrial complexes 10 km away from Anzali City. These industrial cities will include a number of industry types and will produce different wastewater qualities. However, these industries will not be connected to the proposed sewerage system, but will have their own central treatment facility, which will be monitored by the DoEG. Nevertheless, there are scattered small size industries in both cities. These industries include soft drinks, canning, chemicals, dairy, and slaughterhouse. In Rasht there are 17 industries producing 355 m^3/day of wastewater, with only 7 generating more than 10 m^3/day. Whereas in Anzali there are only four industries. According to current policy that limits the operation of industries to rural areas of the City, no further industrial development within the urban areas of the cities is expected. Furthermore, existing legislation provides for the control of industrial discharges which are monitored by the Department of Environment

Agricultural areas are dispersed around Rasht and Anzali, with the majority located outside the urban areas. The total areas of cultivated lands in Rasht and Anzali amount to 62,860 hectares and 42,849 hectares respectively. Rice cultivation is the predominant agricultural activity in the region, with over 90% of cultivated areas are used for rice growing. Other crops include cereals, fruits and tea crops. Present irrigation sources include natural rainfall, supplemented occasionally by river water.

Although both Rasht and Anzali cities are among the oldest cities in north Iran, yet there are no structures or remains of any archeological or historical significance according to the Cultural and Heritage Department, Gilan.

Impacts of the Project

The environmental assessment indicated that the execution of the project will have long term positive environmental impacts in terms of reducing pollution of natural resources, generation of significant economical, social and public health benefits, and will enable the government to enforce existing environmental regulations and standards.

The project will extend and rehabilitate water networks to ensure 100% water supply coverage, provide good quality water on a continuous basis, cater for population growth and to reduce unaccounted for water. Besides, it will improve health conditions of the population by providing them with adequate water quantity and quality from sustainable sources.

The provision of wastewater collection and treatment facilities will have a strong long term positive effect on the overall environment and on public health conditions. There will be improvement in the water quality in the streams and rivers that flow throughout Rasht city. A major benefit of the project is the protection of groundwater resources from contamination by untreated sewage, and the elimination of direct sewage discharge to the Caspian Sea from Anzali City. Furthermore, by eliminating the direct discharge of raw sewage from Rasht and Anzali cities, the project will substantially reduce the current organic and nutrient loads that are originating from urban centers on Anzali Lagoon, and will thus address one of the major environmental problems affecting Anzali Lagoon today.

The project will not cause any threat to the natural habitats of the project area, as the project components are far away from them. By implementing the project the ecological conditions of the surface water bodies in the project area will improve. Therefore, the project will assist in the restoration of the degraded water quality of Anzali wetlands and hence contribute positively to the conservation of natural habitats.

As a result of the project, economic benefits will occur in terms of increased water volume of good quality, increased tourism activities, and lower medical costs associated with treating water-borne diseases.

Finally, the wastewater treatment facilities will also provide an opportunity to better control industrial discharges through enforcing pretreatment and connection to the collection system as stipulated in the Iranian law.

Major Potential Adverse Impacts of the Project

Drinking Water Quantity and Quality: treated water quantity and quality should meet water demand as well as allowable drinking water standards set by the Iranian Government and WHO. Among the parameters of concern are the bacteriological contamination of the water, the concentration level of nitrate, the presence of nitrite and the concentration of heavy metals. In order to safeguard public health, it is imperative that regular monitoring of raw and treated water at the treatment plants, storage reservoirs and in the distribution network be implemented to ensure that drinking water limits are not exceeded.

Treated Effluent Quality: the treated effluent should be of acceptable quality so that it can be safely discharged into water bodies. This means that the effluent quality should meet the standards for discharge into water bodies. One major concern is the concentration level of nutrients such as ammonia, nitrate and phosphate which could result in algal growth in the receiving water bodies. Regular monitoring of these variables will be required to ensure strict adherence to the prevailing standards.

Sludge Quality: In the case of dried sludge re-use by farmers as soil conditioner or fertilizer, the sludge quality will have to comply with the FAO, EU and WHO guidelines for the use of sludge in agriculture including the limit of less than one intestinal nematode egg per 100 gm of dry solids and the limits on the concentration of heavy metals. The adopted treatment processes, the one year storage period, and the control of industrial discharges to the sewage system would have to ensure that the WHO nematode standard and EU and FAO guidelines on the level of toxic substances would not be exceeded for the use of sludge in agriculture.

Other Impacts: Adverse environmental impacts during the construction phase might be significant, however they are only temporary. Typical impacts are those of dust, noise, traffic congestion, and disturbance to the residents of the area. Good construction practices would mitigate most of these temporary impacts to acceptable levels. Moreover, the project will have a positive impact on employment resulting from the increased construction activities.
The project will have no significant long term negative impact on air quality, climate, biological environment, socio-economic conditions, or other development projects.

In summary, once operational, most of the impacts of the Project will be positive.

Analysis of Alternatives to the Project

The option of continuing with the current water supply system and wastewater disposal methods as well as alternative water supply schemes and other wastewater treatment processes have been explored and compared in terms of capital costs, operational costs, land requirements, length of transmission lines, consumed energy, environmental impacts, management needs, reliability of the process and local conditions.

The "no project" option would avoid the temporary environmental impacts of installing pipelines and constructing treatment plants, however this option is rejected on the grounds of economic cost and adverse long-term environmental and social impacts. It would mean a whole region with poor water supply quality and no wastewater collection and treatment.

Under such conditions severe adverse environmental impacts such as pollution, flooding, and poor health conditions would increase and the prevailing environmental conditions will further deteriorate.

Moreover, the economic benefits of the proposed project are greater than the cost of not implementing it; taking into account revenues from tariffs for water supply and wastewater, the cost of the degradation of surface and ground water resources; the cost of treating additional water quantities to compensate for the high unaccounted for water; the high maintenance cost for the aged water supply system; lost working days due to water related diseases; cost of medical treatment; and costs of wastewater disposal by tankers.

With respect to wastewater collection and treatment, a number of alternatives have been considered including on-site sanitation, decentralized treatment and centralized treatment. On-site sanitation in Rasht and Anzali has proved to be difficult to achieve because of the high ground water level. People living in areas served with on-site sanitation facilities face severe difficulties disposing their sewage, and in many instances there are no controlled disposal of septage from these facilities. Furthermore, the government has already initiated the construction of Rasht and West Anzali WWTP wastewater treatment plant and various sections of the collection and conveyance networks are implemented, which would offer a more feasible and reliable method for sewage disposal to house owners. Hence, the option of on-site sanitation is rejected. Taking into consideration the environmental limits set by the department of environment regarding the construction of treatment plants within city limits and the construction of one plant for Rasht near the city boundaries and two plants for Anzali near its boundaries, the option of decentralized treatment by having additional plants serving sub-areas of the two cities was also rejected based on cost, availability of land and potential adverse environmental impacts.

The proposed activated sludge process and other processes (aerated lagoons and stabilization ponds) were also evaluated and compared. Since the plots of land for Rasht and West Anzali WWTP have already been acquired and since land availability in general is very limited in both cities, both the stabilization ponds and the aerated lagoons were rejected, as they would require larger areas. The activated sludge system was selected in view of reliability and operational flexibility; furthermore, the activated sludge process was found to be most suitable for upgrading the under construction plants by including (BNR) process, which is required for nitrogen and phosphate nutrients removal according to the revised designs of the plants.

Environmental Management Plan (EMP)

The EMP identifies feasible cost effective measures to mitigate any adverse environmental impacts that might occur during the construction and operation of the project. The EMP covers mitigation measures, monitoring and institutional strengthening.

Mitigation of Adverse Environmental Impacts

Mitigation measures have been identified to ensure that the defined objectives of the project are achieved whilst preventing and reducing any adverse environmental impacts. The mitigation measures are to be executed by the construction contractor (construction phase) and the treatment plant operators (operation phase) with supervision by the GWWC. Tables 4, 5 and 6 summarize the major impacts and the mitigation measures for the construction and operation phases.

Water Quantity: Geological and hydrogeological studies and data acquired between 1953 to 1989 of the Sephidrood river and its basin, the main source of water supply for Rasht and Anzali, confirm that on average the annual flow of this river is 149 m^3/sec at Roudabar upstream of Sangar WTP. This flow and the 1,700 million m^3 capacity of Sefidrood dam, as well as the other groundwater sources and the water of Shar Bijar River are sufficient to meet the year 2027 maximum demand of 8.3 m^3/sec of Central and East Gilan area, which encompass the project area.

The water balance for the study area during the first phase was prepared on the basis of the population figures (650,200 for the year 2004 and 746,700 for the year 2009), the maximum water demand (188,051 m^3/d and 211,249 m^3/d for the years 2004 and 2009 respectively) and the yield of wells and the treatment plant capacity at Sangar dam (see Table 3). The water balance indicates that the total water resources will by far exceed the water demand of the project area during the first phase.

Water Quality: Water quality analyses of surface and ground water are summarized in Table 1. The analyses indicate that the water quality is chemically acceptable. The concentrations of all chemical parameters are below the maximum allowable standards set by the Iranian Government and WHO. The Project is expected to improve quality of water in the rivers, Anzali Lagoon and the Caspian Sea. The provision of a wastewater network for collecting and diverting the generated wastewater to treatment plants will certainly minimize potential bacteriological contamination of ground water. Furthermore, the proposed project will finance the regular monitoring of water quality. During project implementation, a continuous monitoring program would be implemented to ensure that treated water would always meet the required standards. The monitoring program will cover biological and physical parameters as well as heavy metals and pesticides residues.

Effluent Quality: The proposed secondary treatment level is based on activated sludge process with provision for nutrient control by the BNR system, which would ensure a treated effluent of acceptable quality for discharge in receiving water bodies. This process will result in the reduction of BOD_5, total nitrogen, total phosphorus and fecal coliforms, to levels that are in accordance with prevailing standards. Emergency storage of raw wastewater for 24 hour is also provided to provide further mitigation measure for the protection of Anzali Lagoon from any upset in the treatment process. As soon as the wastewater treatment plants start operating, monitoring of BOD_5, suspended solids, , total phosphorus, total nitrogen, and fecal coliforms, in the influent and effluent will be conducted by the GWWC to ensure adherence to the required standard.

In view of the treated effluent quality, which will be in compliance with the prevailing standards for discharge to water bodies, and the dilution effects of the rainy season, no adverse impacts are envisaged on the rivers of Zarjoob and Goharood in Rasht and on Anzali lagoon and Rogas in Anzali.

In fact, the environmental state of the rivers is expected to improve in comparison to the base condition due to improved water quality of the discharging rivers.

Sludge Quality: The sludge treatment processes of the two treatment plants include: sludge blending, thickening, anaerobic digestion, and sludge dewatering. These processes will ensure the elimination of toxics and pollutants in the sludge. For the use of dried sludge in agriculture as soil conditioner or fertilizer, the project will ensure compliance with FAO, EU and WHO applicable guidelines including the limit of less than one intestinal nematode egg per 100 gm of dry solids by monitoring the quality of treated sludge and ensuring a drying period of one year

Moreover, national guidelines for sludge re-use would be developed in coordination with line ministries (Ministry of Energy, Department of Environment, Ministry of Agriculture Jihad, Ministry of health and Medical Education, etc.) and concerned stakeholders. These guidelines would set out good standards of practice and monitoring and define roles and responsibilities. Training workshops on re-use of treated sludge will also be provided to all concerned stakeholders.

Solid Wastes: Generated solid wastes from water and wastewater treatment plants, screening and grit from the inlet works as well as dried sludge from water treatment plants will be collected and hauled by the GWWC to the existing landfill sites which are located outside the cities. Considering, the quality of raw surface water and the water treatment processes, the level of toxic substances in the sludge generated from water treatment plants can not exceed the EU limits with respect to the concentration of heavy metals. Nevertheless and as an extra precaution, GWWC will ensure that dried sludge will not be mixed with other types of waste but will be located in a specific cell and signs will be posted notifying of the special waste contamination.

Industrial Discharges: The discharge of untreated industrial effluents can affect the performance of the wastewater treatment plants, resulting in a lower quality treated effluent. The project will only provide connections to those industries that do not discharge toxics that affect the performance of the wastewater treatment plants. The discharge of industrial effluents will be subject to the approval of both the Director of the treatment plant and the director of the DOE. The project will ensure that the industrial effluent discharges are pretreated to levels which comply with the World Bank Environmental Guidelines stated in the "Pollution Prevention and Abatement Handbook", taking into consideration the achievable reductions at the treatment plants for all important parameters of concern. For those industries for which their industrial effluents will not be pre-treated, and/or will not be connected to the network, the DOE will require that each polluting industrial establishment will prepare a compliance action plan (CAP), which will address the pollutants of concern, the type of pre-treatment required and the investments and monitoring costs of the pre-treatment facility. Operational permits for these industries will be subject to the implementation of the CAP as yearly monitored by the GWWC and enforced by the DOE.

Moreover, under the World Bank funded sewage project for Tehran, standards for industrial effluent discharged into sewage systems are being developed in close coordination with DOE and other concerned line ministries. These standards include the following industrial sectors: food, textiles, tanneries, pulp and paper, metal, pharmaceutical and electronic industries as well as general standards for the remaining industrial sector. Also, the DOE has promulgated standards for industrial discharges to surface waters. The project will ensure compliance with all these standards, where applicable and the promulgation of a national law for the discharge of industrial effluents to sewage networks.

Septage Handling: The project will include septage handling facilities at Rasht and West Anzali WWTP for receiving the septage from on-site disposal facilities. The septage will be co-treated with the wastewater that is discharged to the plant from the collection network.

Other Issues: The general disruption during construction will be mitigated by coordinated planning of construction activities. This will include coordination with all concerned authorities prior to the start of the construction activities. Other adverse impacts due to construction activities will be mitigated through the adoption of Good Environmental Practice Procedures. For instance noisy construction activities can be limited to normal working hours and providing muffler to minimize noise nuisance. Dust emissions can be avoided by using dust suppression measures such as periodically sprinkling water in certain areas, providing appropriate covers and removal of excess material from the site. Dangerous activities in public areas will be controlled to reduce risk to the public, traffic and warning signs will be placed at construction sites, trenches will be provided by fences, or railings.

The construction contract document will incorporate all requirements to minimize disturbance from construction activities, which will be monitored by the Supervision Engineer and the Environment Officer of GWWC to ensure compliance and implementation of the required provisions by the Contractor.

The final design process will detail and finalize construction drawings and tender documents of the project components. This process has incorporated final review of the designs by environmental specialists to ensure that all required environmental issues are properly addressed and tender documents include specific provisions concerning environment, health, safety as well as the use of archeological chance find procedures in the event that unknown archeological and/or historical sites are encountered in the course of construction.

Furthermore, pre-tender conferences will be held to brief pre-qualified contractors on the effective implementation of mitigation measures. All pre-qualified contractors will be called to a pre-tender conference at which environmental, health and safety issues will be outlined. Cultural heritage issues in Rasht and Anzali will be also addressed. The contractors will be briefed on: (i) chance find procedures, (ii) special procedures to be adopted in the vicinity of sites defined as requiring protection, (iii) penalties for non-compliance, and (iv) coordination with concerned authorities.

Liaison arrangements will be established between the public, contractors, and the Project Management Unit. A procedure will be established to allow the general public to lodge complaints at the Project Management Unit about excessive disturbance.

The contractors will provide suitable and reliable equipment for construction, with a formal maintenance program to ensure efficient operations. GWWC will develop and establish appropriate safety procedures for the operation and maintenance of the water and wastewater treatment plants. All employees of the contractors and GWWC will get suitable training in occupational health, safety, and emergency preparedness procedures for earthquakes. Safety equipment will also be provided.

Odors emissions from the wastewater treatment plants will be minimized by the provision of odour removal equipment at Rasht WWTP, and by careful planning and implementation of the plant operation and maintenance procedures at all treatment plants. Regular Odor emissions monitoring from the wastewater treatment plants will be implemented to mitigate any non-compliance by taking appropriate operating measures.

The GWWC will develop and implement monitoring programs for raw water, treated water, surface water, raw wastewater, treated effluent and sludge and industrial discharges to the sewage. GWWC will also provide advisory services to industries.

The DOE will establish formal programs for monitoring discharges to the environment from the wastewater treatment plants and industries, treated sludge, surface water, and soil including actions to be taken in case of non-compliance. It will use existing, update or will develop a system of controls on discharges to Zarjoob and Goharood rivers and Anzali Lagoon. DOE will also develop a system for the enforcement of standards related to industrial discharges.

The Ministry of Health and Medical Education will establish a program for monitoring drinking water quality and the occurrence of water-borne diseases. A public hygiene education campaign will be also conducted by the Ministry including videotapes, TV programs and distribution of leaflets.

For sludge re-use programs, the Ministry of Agriculture Jihad will establish and implement formal programs for monitoring the quality of soil at the location of application including actions to be taken in case of deterioration in quality.

Monitoring Plan

Monitoring of construction activities will have to ensure that mitigation measures of construction impacts are being implemented properly, while monitoring of operation activities is to ensure that no unforeseen negative impacts are arising. Tables 7 to 11 provide the proposed monitoring requirements during the construction and operational phases.

During construction, the monitoring program will include dust and noise. Monitoring of the water supply will include biological, physical and chemical parameters as well as heavy metals and pesticides residues. During the operation of the wastewater system, monitoring will include data on BOD, COD, suspended solids, phosphates, nitrates, salinity, heavy metals, fecal coliform and nematodes eggs. Water quality monitoring in Zarjoob, Goharood and Anzali lagoon will include data on BOD, COD, suspended solids, pH, phosphates, nitrates, salinity, and heavy metals. The treated sludge will be monitored for BOD_5, suspended solids, total nitrogen, nematodes, and coliforms.

The Ministry of Health will monitor the occurrence of water borne diseases and the DOE will develop and implement its own monitoring program for Quality Assurance and Quality Control and will generate and issue periodic review reports.

If significant adverse impacts are identified by the concerned responsible organizations, appropriate mitigation measures will be taken and arrangements for amendments of the environmental management plan will be made. The Ministry of Energy will have the overall responsibility to ensure that adverse impacts are maintained to acceptable levels and corrective actions are taken when required.

A project monitoring report will be prepared on the effectiveness of the EMP once every 6 months and will be sent to the World Bank after review and approval of DOE.

Institutional Strengthening

The institutional arrangement and capacities of the organizations in-charge with the implementation and management of the proposed project were reviewed with the intention of providing technical assistance and proposing reinforcement of these organizations as required.

Training programs will be designed and implemented with the assistance of local and international experts and will include:

GWWC, Treatment Plant Operators, Rasht and Anzali Municipality and DOEG: At the initiation of the project, a training workshop will be provided to the staff of the GWWC, Ministry of Energy, Rasht and Anzali Municipalities and DOE to raise environmental awareness and to clarify the specific environmental requirements related to the project. A two day workshop will then be provided and will cover the following topics:

- Effective implementation of mitigation measures
- Project supervision
- Sampling and analysis
- Monitoring and evaluation

GWWC, Municipality, DOEG and Line Ministries: A two day workshop will be provided to the staff of GWWC, Municipality, and representatives of line ministries to strengthen capacities in the application of treated effluent.

Laboratory Staff of Water and Wastewater Treatment Plants: A one week training workshop will be provided to strengthen capacities in sampling and analysis methods, environmental monitoring, quality assurance and quality control as well as safety procedures.

Staff at Water and Wastewater Treatment Plants: A one day training workshop on occupational health, safety and earthquake emergency preparedness procedures will be provided.

Workshops and awareness campaigns will be also implemented to raise awareness of farmers, NGOs and residents of Rasht and Anzali; these would include:

Local NGOs, communities and farmers: Training would be provided through 1 or 2 days workshop for local NGOs, communities and farmers, focusing on public awareness and on re-use of treated sludge for agricultural purposes.

Awareness campaign and pamphlets: two awareness campaigns will be conducted; pamphlets in Farsi will be distributed to all farmers highlighting the adverse health and public safety impacts resulting from the use of untreated effluents; and measures to be taken when using treated sludge. A public hygiene education campaign will be also conducted by the Ministry of Education.

An assessment of analytical capacities of the laboratories at the GWWC and at the wastewater treatment plants has been conducted; additional required equipment were also identified and will be supplied as part of the proposed project. For the Anzali East Wastewater Treatment Plant, a fully equipped laboratory will be provided as part of the construction contract.

Technical assistance will be provided to the DOE to set up baseline data on existing environmental conditions and to develop a quality assurance and a quality monitoring program as well as an enforcement program for industrial discharges. Similarly, technical assistance will be provided to the Ministry of Health and Medical Education to set up baseline data on the occurrence of water borne diseases and to develop a monitoring program for their occurrence.

Cost Estimate

The cost of the Environmental Management Plan during construction (mitigation measures including additional treatment and monitoring) will be borne mostly by the contractor (construction phase) and the Supervision Engineer who will make the necessary provision as part of their contracts for this project.

During the operation phase, mitigation measures and monitoring activities will be implemented by the operator of each plant. Sangar existing water treatment plant and the emergency water treatment plant will be operated by GWWC. Hence, the required mitigation measures and monitoring activities will be implemented by GWWC as part of their mandates. Similarly for the Rasht and Ilyaran wastewater treatment plants, both of which will be operated by GWWC with one year supervision by the Contractor, hence the cost of mitigation measures and monitoring requirements will be borne by GWWC.

A total amount of 1,804,000 dollars will be allocated for the implementation of the environmental management plan as detailed in Table 9-11 and will be included in the project cost. It should be noted that the total cost does not include the following:

- Cost of additional treatment incorporated in the design of the project;
- Cost of mitigating negative construction impacts (included in the construction contract cost);

- Cost of mitigation measures and environmental monitoring of the East Anzali WWTP (included in the construction and operation and maintenance contract cost);
- Cost of setting up a new laboratory at the East Anzali wastewater treatment plant (included in construction cost).
- Cost of Environment and Safety Officer at PMU (included in PMU cost).

Public Involvement

Numerous governmental and non-governmental organizations were consulted at various stages of project preparation. At the initiation of the project, technical, financial, environmental and social issues associated with the project were discussed in meetings attended by the design Consultants, representative of the City councils, Rasht and Anzali municipalities, Gilan Regional Water Board and various other stakeholders. Terms of Reference for the EI studies were developed and shared with the key stakeholders in scoping meetings, which were held as of December 2002.

The preparation process for the environmental assessment included public consultations which were carried out at various stages. The consultations involved line ministries, city authorities, provincial departments of environment, operating water and wastewater companies, local communities, NGOs and the public.

Upon the completion of the draft EA report, the executive summary was translated to Farsi and a public hearing was held on the 12th and 13th of January 2005. The meeting was attended by more than 250 participants from various organizations including representatives of GWWC, local health authorities, local law enforcement authorities, Gilan Regional Water Board, NGOs, Rasht municipality, Anzali municipality, DOE of Gilan, members of the press, experts and professionals from the community of Rasht and Anzali. Invitation letters were prepared in Farsi and were accompanied with the draft Executive Summary. Announcements about the meeting were also made through the local newspapers and public bulletin boards. The meeting was covered by the local newspapers, television and radio. The meeting consisted of an opening session, a presentation of the project financial arrangements and the current cooperation between the World Bank and GWWC. This presentation was followed by a short documentary film which showed the current status of the water and wastewater services in the two cities and the ongoing works of these facilities. The film was followed by a presentation of the project's major components and the environmental aspect of each component. The common view held was that the project should be implemented as soon as possible as it would result in improved health and welfare benefits not only to Rasht and Anzali cities but for the whole region.

The main concerns expressed by some of the stakeholders were the environmental impacts of the project, particularly the effluent and sludge from the wastewater treatment plants. A university professor requested clarification on how the project will impact environmental state of the local rivers and Anzali Lagoon, as well as the Caspian Sea. It was clarified that adequate design provisions have been incorporated to include biological nutrient removal (BNR) systems within the wastewater treatment plants. This, together with the proper collection and treatment of wastewater in the two cities, will improve the quality of the local rivers, and the lagoon, and will have a positive impact on the environment. A concern was raised regarding the proposed disposal of the sludge from the wastewater treatment plants and the reuse of treated sludge in agriculture considering the constraints and the health quality limits required by various standards. It was clarified that the design took into account sludge application rates, sludge and soil monitoring to address all the requirements of the national and international standards.

Table 1: Water Quality Analyses for Surface and Groundwater Resources in Rasht and Anzali

Parameter	Sefidrood River	Shahr Bijar River	Fehlman Wells & Shallow wells of Sangar	Sangar WTP Treated Water Quality	[1]Iranian Standard Max Desirable/Max Permissible	WHO Standard Max Desirable/Max Permissible
Turbidity, JTU	12-566	-	5-7.3	0.2-2	5 / 25	5 / 25
Colour, PT-CO	0.4-8	-	7-9	0-6	5 / 20	5 / 50
pH	7.5-8.3	6.85-9.4	7.2-7.8	7.2-7.9	7-8.5 / 6.5-	7-8.5 / 6.5-
TDS, mg/l	240-1446 Ave: 677	69-417 Ave:158	550-700	250-1456	500 / 2000	[2]500 / 1500
Total Hardness as mg/l $CaCO_3$	160-425 Ave: 309	100-109 Ave: 156	270-300	160-415	-- / 500	[2]100 / 500
NO_2, mg/l	0.0003-0.6	0.004	0.003-	0.003-0.5	0 / 1	3
Mg, mg/l	8.5-42.5 Ave: 27.2	0.1-8.46	22-28	8.9-47	30 / 150	2150
Fe, mg/l	0-0.18	0	0.05-0.28	0-0.18	0.1 / 1	[2]0.1 / 1
Mn, mg/l	0-2.82	-	-	0-0.15	0.05 / 0.5	0.05 / 0.5
SO_4, mg/l	37-301 Ave:216	0-7	57-110	55.7-315	250 / 400	200 / 400
Cl, mg/l	50-590 Ave:203	0.02-10 Ave:6	99-174	52-639	200 / 600	200 / 600
Ca, mg/l	44-126 Ave:80	28-54 Ave:42			250	
Na, mg/l	90	4			200	
NO_3, mg/l	0.44-27.7	0.4	0.44	0.44-17.44	-- / 45	50
NH_4, mg/l	0.02-0.6	-	0.1-0.15	0.015-0.5	0.05 / 0.5	-
F, mg/l	0.21-0.62	-	0.34-0.55	0.21-0.96	0.9 / 1.2 Min Required: 0.8	0.6 /1.5

1: **Potable standard according to Management & Planning Organization, MOE**

2: **1971 standard**

Table 2: Influent and Effluent Design Data for Wastewater Treatment Plants

Parameter	Unit	Influent	Effluent
Rasht WWTP Revised Design Parameters			
Average BOD_5 concentration	mg/l	238	30
Average TSS concentration	mg/l	286	40
Phosphorus Concentration	mg/l as P	14	1
NO_3 concentration as N	mg/l as N	40	11
Fecal Coliforms	MPN/100 ml	10^5-10^6	400
Anzali WWTP revised Design Parameters			
Average BOD_5 concentration	mg/l	246	
Average TSS concentration	mg/l	295	
Phosphorus Concentration	mg/l as P	14	1
NO_3 concentration	mg/l as N	40	11
Fecal Coliforms	MPN/100 ml	10^5-10^6	400

Table 3: Water Balance of East and Central Gilan

Year	2004	2009	2017	2027
Water Demand				
1. Population				
Rasht	506,800	581,900	725,700	956,600
Anzali	143,400	164,600	202,200	252,000
Subtotal 1	650,200	746,700	927,900	1,208,600
[1]Central Gilan	554,900	609,900	691,600	[†]763,957
[2]East Gilan	602,100	661,400	770,400	[†]851,001
Subtotal 2	1,157,000	1,271,300	1,462,000	1,614,958
Grand Total	**1,807,200**	**2,018,000**	**2,389,900**	**2,823,558**
2. Maximum Daily Demand, m^3/day				
Rasht	154,500	170,875	221,125	298,250
Anzali	33,551	40,374	56,288	70,926
Subtotal 1	188,051	211,249	277,413	369,176
[1]Central Gilan	86,685	103,527	131,229	[†]144,958
[2]East Gilan	120,520	142,800	185,074	[†]204,744
Subtotal 2	207,205	246,327	316,303	349,702
Grand Total	**395,256**	**457,576**	**593,716**	**718,878**
Water Supply				
3. Water Resources Capacity, m^3/day				
Sangar WTP	259,200	518,400	518400	518400
Emergency WTP	25,920	25,920	25920	51840
Emamzadeh Fehlman Wells	64,800	64,800	64800	64800
Sangar Fehlman Wells				47,280
Lahijan Astaneh Wells				43,200
Total	**349,920**	**609,120**	**609,120**	**725,520**
4. Water Balance, m^3/day	**-45,336**	**151,544**	**15,404**	**6,642**

[1]Cental Gilan includes: Khoshbijar, Khomam, Sangar, Kouchesfahan and Lashtenesha and rural areas of Rasht and Anzali

[2]East Gilan includes; Lahijan, Astaneh Ashrafieh, Dehshal, Kia Shahr, Siahkal, Langarood and Komeleh

Table 4: Environmental Mitigation Measures during the Construction Phase

Potential Impacts	Mitigation Measures	Responsible Organization	
		Performing	QA/QC
Noise generation	• Selection of up to date, well maintained plant with reduced noise levels ensured by suitable in built damping techniques. • Confining noisy work to normal working hours in the day. • Providing the construction workers with suitable hearing protection and training them in its use. • Restricting construction traffic movements during the night time.	DC/PMU	DOE
Generation of dust	• Construction activities causing dust will not be carried out on excessively windy days. • Excavation work will be sprayed with water • To cover stockpiles of excavated material with tarpaulins • Provide construction workers with masks and train them for their use	CC	DOE
Traffic congestion	• Advance warnings to the affected residents and road users • Advance programme for proposed transportation activities, type of vehicles and number of trips. • Continual services of the police for the diversion and control of traffic	MoRA CC	DOE
Damage to access roads and streets	Site access roads will be inspected regularly and repairs made where necessary; All roads and streets used for laying pipes will be covered and paved.	CC	DOE
Water pollution	• Ensure proper control on fuel and oil spillage. • Unauthorized bore wells shall not be allowed • Untreated effluents shall not be allowed to be directly disposed of in water bodies	CC RWB DoEG	DOE

Potential Impacts	Mitigation Measures	Responsible Organization	
		Performing	QA/QC
Public safety and site security	• Construction employees shall be trained in safety procedures for all relevant aspects of construction • Training of appropriate number of site personnel in first aid • Development of formal emergency procedures for each construction site required in the event of an accident • Appropriate public education regarding health and safety • To adopt safety measures like flags, warning tapes and barriers.	PMU/GWWC CC	DOE
Air pollution	• Waste are not to be burnt on site • Construction machinery, vehicles and generators to minimize exhaust emissions by properly maintaining and tuning them.	CC	DOE
Generation of wastes and spoil disposal	• Minimize wastes generated during construction and reuse construction wastes where practicable; • Use appropriate methods for the storage of waste materials; • Dispose of wastes to an appropriate site. • Transporting spoil in closed containers • The spoil material should be filled in layers and properly rolled and sprinkled to avoid any negative environmental impacts.	CC/PMU	DOE

CC	Construction Contractor
DC	Design Consultants
DoEG	Department of Environment Guilan
MoRA	Municipalities of Rasht and Anzali
GWWC	Guilan Water and Wastewater Company
PMU	Project Management Unit
RWB	Regional Water Board

Table 5: Environmental Mitigation Measures during the Operation Phase of Water Supply System

Potential Impacts	Mitigation Measures	Responsible Organization	
		Performing	QA/QC
Degradation of water quality	• Ensure proper operation and maintenance of the water treatment plant. • Continuous monitoring of raw water and treated water as well as water quality at various locations within the water supply system; avoid cross contamination with sewage; • Chlorination should be monitored and controlled so that contamination free water is available to consumers without excessive amount of chlorine.	GWWC	DOE
Reduction in available water supply	• Provide metered connections • Prohibit illegal connections to the network; avoid leakage in the network; ensure proper maintenance of the system including treatment plant, pumping stations, pipelines and house connections.	GWWC	DOE
Health and Safety	• Train the concerned officials of the WTP about health and safety procedures. • Ensure that operation and maintenance personnel of the WTP are fully aware of the hazards involved in the running of a system of this nature. • Emergency procedures will be developed in the event of the release of chlorine gas.	GWWC	DOE

Table 6: Environmental Mitigation Measures during the Operation Phase of Wastewater System

Potential Impacts	Mitigation Measures	Responsible Organization	
		Performing	QA/QC
Health and environmental risks associated with discharge of treated effluent	• Regular monitoring of effluent quality discharging from the WWTP • Untreated effluents shall be treated before disposing off into river. Disinfection to be used before disposal at all times • Aquatic life shall be monitored regularly • Dispose of wastewater into rivers after proper treatment • Capacity building, training and awareness.	GWWC/DoEG	DOE
Sludge quality and the risk of public and farmers acquiring infection	• Drying beds for one-year storage will be provided to dry and store sludge following de-watering and digestion. • Monitoring of nematodes, coliforms and heavy metal content of treated sludge. • Transportation of treated sludge in closed containers. • Capacity building, training and awareness	GWWC	DOE
Odor generation from the wastewater treatment plant	• Careful operation of odour control equipment • Careful planning and implementation of operation and maintenance. • Providing covers to equipments and containers that are likely to cause odor nuisance.	GWWC	DOE

Potential Impacts	Mitigation Measures	Responsible Organization	
		Performing	QA/QC
Health and Safety	• Train the concerned officials of the WWTP about health and safety procedures. • Ensure that operation and maintenance personnel of the WWTP are fully aware of the hazards involved in the running of a system of this nature. • All site employees will be trained in hygienic procedures designed to avoid infection from wastewaters and sludge. • Emergency procedures will be developed in the event of the release of chlorine gas. • Workers will also be inoculated against infectious diseases and be under medical surveillance.	GWWC	DOE

Table 7: Environmental Monitoring Program for the Construction Phase

Environmental Parameter to be monitored	Monitoring Location	Frequency	Standard	Responsible Organization	
				Performing	QA/QC
Noise	At construction Sites and Surroundings	Weekly	70 dB (A)	DoEG	DOE
Air Quality and Dust	At construction Sites and Surroundings	Weekly	150 $\mu g/m^3$	DoEG	DOE

Table 8: Environmental Monitoring Program during the Operation of the Water Supply System

Environmental Parameter to be monitored	Monitoring Location	Frequency	Standard	Responsible Organization	
				Performing	QA/QC
pH Turbidity Coliforms Fecal coliforms Fecal Streptocoques	At WWTP Site	Weekly	6.5 – 8.5 5 NTU 0/100 ml 0/100 ml 0/100 ml	GWWC	MHME
Conductivity Ammonium Nitrates Nitrites Chlorides Phosphates Calcium Magnesium Sodium Potassium Sulfates Iron	At WWTP Site	Weekly	400 µS/cm 0.05 – 0.5 mg/l 0 - 45 mg/l 3 mg/l 25 – 200 mg/l 1.0 mg/l 100 mg/l 30 – 50 mg/l 20 – 150 mg/l 10 –12 mg/l 250 mg/l 50 – 200 mg/l	GWWC	MHME
Herbicide and Pesticides Ni Cr Zn Cd Pb Hg	At Water Sources (treatment plant, dam and wells)	Monthly	0.1 µg/l 0.02 mg/l 0.05 mg/l 3 mg/l 0.003 mg/l 0.01 mg/l 0.001 mg/l	GWWC	MHME
Ammonium Phosphates Nitrites Chlorides Total coliforms Fecal coliforms Fecal streptocoques Residual chlorine	At Water Reservoirs	daily	0.05 – 0.5 mg/l 1.0 mg/l 0 mg/l 25 – 200 mg/l 0/100 ml 0/100 ml 0/100 ml 0.2-0.8 mg/l	GWWC	MHME
Total coliforms Fecal coliforms Fecal streptocoques Residual chlorine	At Distribution Network	Every day	0/100 ml 0/100 ml 0/100 ml 0.2-0.8 mg/l	GWWC	MHME

MHME: Ministry of Health and Medical Education

Table 9: Environmental Monitoring Program for the Treated Effluent

Environmental Parameter to be monitored	Monitoring Location	Frequency	Standard	Responsible Organization	
				Performing	QA/QC
BOD COD PH Oil and grease TSS Total Phosphorus Total Nitrogen Nematode eggs Fecal coliform.	At WWTP site	Every day	25 mg/l 125 mg/l 6 – 9 10 mg/l 50 mg/l 10 mg P/l 30 mg N/l ≤1 egg/liter 200 MPN/100 ml	GWWC	DOE
Heavy metals Phosphate Ammonia Nitrate Fluoride Sulfate Sulfide DO Phenols TDS	At Wastewater Plants and in river after discharge	Weekly	10 mg/l 5 mg/l 10 mg/l 90 mg/l 20 mg/l 500 mg/l 1 mg/l	GWWC	DOE
Cadmium Chromium Copper Iron Lead Selenium Silver Zinc	At Wastewater Plants and in river after discharge	Monthly	0.1 mg/l 0.1 mg/l 0.5 mg/l 3.5 mg/l 0.1 mg/l 0.1 mg/l 0.5 mg/l 2.0 mg/l	GWWC	DOE
Chlorine (in event of use)	At the discharge from the outfall or at 1 km from the WWTP	Weekly	0.2 mg/l	GWWC	DOE

Table 10: Environmental Monitoring Program for the Treated Sludge

Environmental Parameter to be Monitored	Monitoring Location	Frequency	Standard	Responsible Organization	
				Performing	QA/QC
Nematode eggs (egg/100gm solids)	At Wastewater Plants	Every Batch	<1	GWWC	DOE
Heavy Metals (mg/kg sludge): Cd Cu Ni Pb Zn Cr	At Wastewater Plants	Every Batch	20 – 40 1000 – 1750 300 – 400 750 – 1200 2500 – 4000 16-25	GWWC	DOE

Table 11: Cost Estimate of Environmental Management Plan

Component	Quantity	Unit rate in 1000 US$	Total Cost in 1000 US$	
			Rasht	**Anzali**
GWWC International environmental consultant to provide technical assistance to GWWC	14 months	12 /month	84	84
Environmental Monitoring Program for Water Supply System	5 years	30/year for R 15/year for A	150	75
Environmental Monitoring Program for WWTP	4 years	75/year for R 50/year for A	300	200
Subtotal			**534**	**359**
Studies, Training and Awareness Development of baseline data on water related diseases and a monitoring program for the occurrence of these diseases			25	25
Development and implementation of a QA/QC monitoring program for the proposed project to be implemented by DOEG			30	30
Development of earthquake emergency preparedness plan			6	6
Development of Compliance Action Plan (CAP)	11 CAPs	4/CAP	28	16
Two days workshop to GWWC, Treatment Plant Operators, Rasht and Anzali Municipality and DOEG on environmental management, monitoring, analysis and evaluation	2 workshop	7/workshop	7	7
Two days workshops for GWWC, Municipality, DOEG and Line Ministries on treated sludge re-use	2 workshop	7/workshop	7	7
One week training workshop to Staff of Water and Wastewater Treatment Plants on laboratory sampling, analysis, environment monitoring and QA/QC	4 workshop	4/workshop	8	8

Table 11: Cost Estimate of Environmental Management Plan-Continued

Component	Quantity	Unit rate in 1000 US$	Total Cost in 1000 US$	
			Rasht	Anzali
Studies, Training and Awareness One day training workshop on occupational health and safety to staff at Water and Wastewater Treatment Plants	4 workshop	1/workshop	2	2
One day workshop for local NGOs, communities and farmers, focusing on public awareness and on re-use of treated sludge for agricultural purposes.	4 workshop	1/workshop	2	2
Awareness campaigns and pamphlets			25	25
Subtotal			**140**	**140**
Laboratory Equipment GWWC			171.5	171.5
Rasht WWTP			148.6	
West Anzali WWT				148.6
Subtotal			**320.1**	**286.9**
Monitoring and Evaluation at the project level	2 MM	12	12	12
Subtotal Per City			1,086	911
Total			**1,804**	

GENERAL TABLE OF CONTENTS

GENERAL LIST OF TABLES

LIST OF FIGURES

LIST OF ANNEXES

LIST OF ABBREVIATIONS

BOD	Biochemical Oxygen Demand
C&EGWSS	Central & East Gilan Water Supply Scheme
CC	Construction Contractor
DoEG	Department of Environment Guilan
DC	Design Consultants
DOE	Department of Environment
EA	Environmental Assessment
EHC	Environmental High Council
EMP	Environmental Management Plan
ESO	Environmental and Safety Officer
EU	European Union
FAO	Food and Agriculture Organization
GRWA	Gilan Regional Water Authority
GWWC	Gilan Water and Wastewater Company
JEK	Jihad-e-Keshavarzi
MOAJ	Ministry of Agriculture Jihad
MOE	Ministry of Energy
MOHME	Ministry of health and Medical Education
MoRA	Municipalities of Rasht and Anzali
NGO	Non-Governmental Organization
OP	Operational Policy
PMU	Project Management Unit
QA/QC	Quality Assurance and Quality Control
RWB	Regional Water Board
UFW	Unaccounted for Water
US EPA	United States Environmental Protection Agency
TOR	Terms of Reference
WB	World Bank
WHO	World Health Organization
WTP	Water Treatment Plant
WTPO	Water Treatment Plant Operator
WWTO	Wastewater Treatment Operator
WWTP	Wastewater Treatment Plant

1 Introduction

1.1 Overview

The Ministry of Energy of the Islamic Republic of Iran has commissioned Pars Ab Tadbir Consulting Engineers to conduct an Environmental Assessment Study (EA) for the Rasht and Anzali Water Supply and Sanitation Project. The EA study is a component of Project Feasibility Study required for appraisal by the World Bank.

Rasht is the capital of Gilan Province while ***Anzali*** is its 2nd largest city. These cities are located 320 Km North of Tehran. Anzali is the coastal city while Rasht is located about 20 Km. south of the Caspian Sea. The present population of Rasht and Anzali is 500,000 and 118,000 respectively, and is projected to reach 956,600 and 252,000 by the year 2027.

Zarjoob and Goharood are the main rivers flowing through Rasht while Anzali is located around Anzali Lagoon, a wetland of international ecological importance. These rivers and Anzali Lagoon eventually flow into the Caspian Sea.

It is estimated that around 85% of the population of Rasht and Anzali are currently connected to the cities' water supply system. Potable water is supplied from ground and surface water resources. Surface water is provided through the Sangar Dam and ground water is provided from Fehlman wells in the vicinity of the Treatment Plant at Sangar, as well as some limited private wells in the cities. Water quality monitoring indicates that the water supply is of acceptable quality and in compliance with national and WHO standards. Chemical, Physical and bacteriological analyses are conducted on a daily basis at various points including water sources, storage reservoirs and distribution network. The major problem raised by the Gilan Water and Wastewater Company is the high percentage of unaccounted for water (around 36 % in Rasht and 25 % in Anzali). Rehabilitation of the network has been initiated but is proceeding at a very slow rate due to limited financial resources.

Wastewater collection, treatment and disposal are the main environmental concerns in Rasht and Anzali. Presently, a combined wastewater collection system which includes wastewater and surface water runoffs resulting from rainfall and infiltration, although inappropriate and inadequate, partially serves the city. About 85% of the population in Rasht and 70% of Anzali's population are connected to the existing sewerage system. Surface water and sewage are collected through these existing channels and pipes and directly discharged into local rivers and surface water bodies, namely Zarjoob and Goharood Rivers in Rasht and Anzali Lagoon in Anzali.

Rasht, being the biggest population centre on the up stream stretches of the river, is the major polluter for Zarjoob and Goharood rivers, where pollution levels are increasing and are seriously affecting the environmental conditions in Anzali lagoon.

During the summer season, the water quality of the both rivers deteriorate drastically emitting noxious odours and presenting serious health hazards to the public. Thus, the uncontrolled discharge of sewage is causing severe environmental damage and serious health hazards to the inhabitants of the cities.

The Ministry of Energy is developing this project to provide adequate and reliable water supply and wastewater management systems.

1.2 Terms of Reference

The Terms of Reference for this study are issued by the World Bank document entitled "Environmental Assessment of Rasht and Anzali Water Supply and Wastewater Project ".

In preparing this Environmental Assessment, reference has been made to the requirements of the World Bank Operational Directive OD 4.01 of October 1991 entitled 'Environmental Assessment of the Investment Projects and Programme, Scope and Process' by J.A.N Wallis, published by the Economic Development Institute of the World Bank in December 1989, 'Environmental Assessment Sourcebook' published by the World Bank Environment Department in 1999, and the requirements for Environmental Assessment within the Islamic Republic of Iran.

The project is classified as Category A in accordance with World Bank classification system, and would therefore require a full EA study.

1.3 Objectives of the Environmental Assessment

The objective of this environmental assessment study is to identify the Project's potential positive and negative environmental effects, and to recommend adequate measures to mitigate the predicted negative impacts of the project.

The EIA study will first describe the project in terms of the proposed project components, the current and future needs, the development phases of the project, and the project costs. It will establish the environmental baseline conditions. It will evaluate the potential impact of the project in terms of the biological, physical, and socio-economic environments. It will provide recommendations for mitigating the predicted impacts during the construction and operational phase of the project.

2 Policy, Legal and Administrative Framework

2.1 General

In order to successfully implement and operate the proposed water supply and sanitation project for Sari and Babol cities, it is essential to have, on the one hand, an adequate legal and regulatory framework, and, on the other hand, an efficient institutional and organizational framework to enforce the related legislation, policies and standards and effectively manage the project.

The construction and operation of the proposed Project will be governed and affected by the existing legislation and other regulatory controls that are specific to the Project and the local, regional and national environment.

In this context, this chapter presents the relevant existing policy and legislative framework as well as the organizational and institutional framework.

2.2 Policy Framework

With its unique and invaluable biodiversity and abundant resources, Iran has remarkable potential for sustainable development and growth. Yet the pressures stemming from population growth, unsustainable use of resources, plus urbanization, industrialization, and infrastructure development etc. are threatening its environment.

The Islamic Republic of Iran has established a comprehensive legislative foundation for environmental policy. Rooted in the constitution and the rich heritage of Islamic culture and jurisprudence, this body of law provides an effective instrument for the protection of environment, enduring management of natural resources and realization of sustainable development. These laws have been enacted on the basis of national, social and economic circumstances, and in accordance with the mandate of each sector and its relationship to the environment.

The Department of Environment (DoE) as the highest national authority concerning environmental matters, is committed to ensuring proper implementation of these laws and also to the monitoring of the state of the environment in the Islamic Republic of Iran.

It is the duty of the Islamic Republic of Iran to guarantee that its children witness clean seas and undefiled mountains, clear skies, sparkling water in cities and the revival of endangered species like the Persian Fallow Deer. All this should be accomplished in their lifetime.

2.2.1 National Policies

Macro Environmental Policies

The Third Five-Year Economic, Social and Cultural Development Plan of the Islamic Republic of Iran:

Article 104

In order to protect the environment and achieve sustainable utilization of the natural resources of the country, the enforcement of the following regulations is necessary:

The utilization of the country's natural resources must pay attention to the potential of these resources. In order to achieve this, the Government is obliged not only to preserve the rate of increase in the country's production and to make sustainable use of these resources, but also to take appropriate measures to preserve the balance of the natural environment in executing projects such as preserving pastures for livestock, protecting forest reserves, protecting important cultural assets, migrating tribes and the villagers, achieving harmonious management of essential resources, and institutionalizing the participation of the public in planning, decision making, and project execution.

The executive regulations of this section include the environmental rules developed by the Department of Environment in collaboration with the Ministry of Agriculture Jihad and ratified by Cabinet.

I. In order to reduce the sources of environmental pollution, especially the pollution of natural resources and the water resources of the country, productive industrial units are obliged to ensure their technical systems are capable of complying with environmental regulations and are to take appropriate measures to reduce the risk of polluting the environment. The expenses of these pollution control devices are considered as acceptable outlays for these units. Industrial units which do not follow these regulations and whose activities damage and pollute the environment are fined in proportion to the damage that they have inflicted on the environment. Financial penalties gained in this way are placed in public funds, which are used, in a yearly budget for environmental improvement projects. The regulations of this section, including the amount of fines and the conditions and methods of collecting and spending them, are proposed by the Department of Environment to be ratified by a Cabinet Committee.

Article 105

All the massive plans and projects for productive units must be studied prior to construction and evaluated to stand the test of the regulations proposed by the Environmental High Council and ratified by the Ministers' Committee. Observing the standards is obligatory for the designers and executors of these plans and projects. It is the duty of the Organization of Planning and Budget to supervise the proper implementation of this article. The Department of Environment is obliged to provide the practical and executive methods for the construction and shall place such projects under environmental protection. As such if environmental articles and standards are observed, the construction and the development of projects are permitted to continue – if not the projects are stopped.

2.2.2 International Cooperation

International, regional and bilateral cooperation have been important priorities for the Islamic Republic of Iran in all fields and particularly in areas related to sustainable development and the environment. Iran is a committed signatory member of most environmental conventions. The Iranian government has ratified a large number of international environmental treaties, among which the following are of importance.

- The Convention on Wetlands of International Importance, Especially waterfowl Habitats, RAMSAR, 1971.
- The MARPOL Convention
- The London Dumping Convention
- The Convention for the Protection of the World Cultural Heritage, 1972.
- The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matters.
- The Convention on International Trade in Endangered Species of Flora and Fauna (CITES) 1973.
- The Vienna Convention for the Protection of the Ozone Layer, 1985.
- The Basel Convention on the Control of Trans-boundary Movement of Hazardous Wastes and their Disposal, 1989.
- The Convention on Biological Diversity, 1992.
- The United Nations Framework Convention on Climate Change, 1992.
- The United Nations Convention to Combat Desertification, 1994.
- The 1995 Paris Convention to Combat Desertification

- The Montreal Protocol on Substances that Deplete the Ozone Layer, 1987.
- The Kyoto Protocol on the Control of Greenhouse Gases, 1997.
- The Kuwait Regional Convention for Cooperation on the Protection of the Marine Environment form Pollution, 1978.
- The Kuwait Protocol on the Protection of Marine Environment from Land Based Pollution, 1990.

In addition, the Islamic Republic of Iran is a member in several international organizations and committees, among which are:

- The Commission on Sustainable Development.
- The United Nations Environment Program.
- The International Union for the Conservation of Nature and Natural Resources (IUCN).
- The International Water- fowl Research Bureau.
- The Regional Organization for the Protection of Marine Environment (ROPME).
- The South Asian Countries' Environment Program (SACEP).

2.3 Legal and Administrative Framework

2.3.1 Legal Framework

The legislation and other regulatory controls affect the construction and operation of the Project. This not only affects the Project but also, in a broad sense, the local, regional and national environment.

The legal framework for environmental protection and management of the Islamic Republic of Iran comprises the following:

- The constitution of the Islamic Republic of Iran
- Domestic laws, regulations and by-laws
- Environmental international conventions, treaties and agreements to which Iran has ratified or adhered to

The relevant existing legislation and regulations in the same sequence as mentioned above are described below:

The constitution of Islamic Republic of Iran, approved in December 1979 has a provision of Article 50 pertaining to environmental protection. This article expresses the State's commitment to protect the environment as a whole.

Article 50 states that:

> *In the Islamic Republic, **the protection of the environment**, in which the present and the following generations should have a social life of constant development, **is a public responsibility**. As a result, every economic or other forms of activity, the execution of which necessitates the pollution or the irretrievable destruction of the environment is forbidden.*

Since the establishment of DoE in 1974, several laws and regulations have been enacted to ensure environmental conservation and wide range of environmental issues. The list of existing Environmental Laws and Legislation in the Islamic Republic of Iran is presented in Annex **B-I**.

The environmental laws that are of relevance to this project include:

- Environmental Protection & Enhancement Act, 1974 and its amendment of 1992.
- Game and Fish Law, 1974 and its amendment approval of 1996.
- The clauses number 81, 82, and 83 on the Laws of the Second Five-Year Economic, Social, and Cultural Development Plan, 1994.
- The Law of Islamic Punishment, 1996 with amendments of 1997.
- The Law of Just Distribution of Water, 1982.
- The Law for Protection and Utilization of Aquatic Life Resources, 1995.
- The Law of the Amendment of the Fifth Article of the Law of the Protection and Proper Utilization of the Forests and Pastures of Iran, 1975.
- The Law for Reclaimed Coastal Lands, 1975.
- The Law for Protection and Preserving the Natural Resources and Forest Regions of the Country, 1992.
- The Law on Establishment of Water & Wastewater Companies, 1990.
- The Law of Preserving the Efficiency of the Agricultural Lands and Gardens, 1995.
- Air Pollution Act, 1995.
- Regulations for prevention of water pollution. These regulations, ratified in May 7th, 1994, are presented in **Annex B-II**.

The most relevant executive by-laws and the ratified parliamentary approvals related to the environment are:

- The Executive By-law for the Prevention of Water Pollution, 1994.
- The Executive By-law of Air Pollution Act, 2000,
- The Executive By-law for Noise Pollution Control, 1999,
- The Executive Bylaw for Environmental Health, 1992,
- The Executive Bylaw for Environmental Protection & Enhancement Act, 1975,
- The Regulations for the Proper Utilization of the Lands and Construction of Buildings and Establishments Outside the Legal Boundaries of the Cities, 1976 and its amendment of 1994,
- The Criteria for Sitting of Industries (approval of the Cabinet) 1999,
- The ratified approval number 138 of the Environmental High Council about those Projects that should be subject to Environmental Impact Assessment,
- The regulations for Environmental Impact Assessment, as approved by the Environmental High Council in their meeting of December 22nd, 1997. These are presented in **Annex B-III** of this Report.

2.3.1.1 Regulations for the Control of Air and Noise Pollution

The Islamic Consultative Assembly ratified the law for the prevention of Air Pollution in 1995. This law is organized in six chapters and has 36 articles and 14 comments. According to the law, sources of air pollution are divided into the following three groups:

- The motorized vehicles.
- The factories, workshop, and power plants.
- The commercial, domestic, and other sources.

According to the law, spreading pollutants above their permissible amount from any of the above sources is forbidden and will result in legal prosecutions for any delinquent person or organization.

The Department of Environment in collaboration with other related organizations are responsible to prepare and compile the necessary regulations for the execution of this law. Based on this law, various standards to control the pollution emitted from mobile (automobiles) and immobile sources have been compiled and publicized. Furthermore, the standards of ambient air concerning the permissible density of the classic polluting factors, including S02, NOx, SPM, and CO, have been introduced and publicized.

According to Article 27 of this law, it is forbidden to pollute the environment with irritating noise. The regulations and the standards for the control of noise pollution have been compiled and issued by the Department of Environment.

2.3.1.2 Surface and Groundwater Quality

Other than the 1973 Regulations of the Department of Environment, there are no specific laws regarding groundwater quality.

The organization responsible to control water pollution in Iran is the Department of Environment.

The Department of Environment evaluates the water quality according to the regulations stipulated in the 1975 Environmental Protection and Enhancement Act.

In order to set compatible laws and regulations, the Department of Environment as well as the Ministry of Energy were given authority to classify various water resources including surface water, ground water, lakes and seas depending on their usage potential. Article 6 of the Executive By-Law on the Prevention of Water Pollution states that "General classification" of " receiving waters" whether surface or underground waters, lakes and coastal waters, based on their natural power for the absorption and natural filtration of pollutants, shall be determined gradually and according to priorities set by the DoE in collaboration with the ministries and organizations referred to in Article 3 of this executive By-Law.

These are as follows:

- Class 1, Potable supply
- Class 2, Fisheries and animal life
- Class 3, Irrigation
- Class 4, Industry
- Class 5, Recreation
- Class 6, Small rivers and road ditches not covered under classes 1 to 5

When water pollution issues are being investigated within Environmental Assessment studies, all waters are considered as Class 2, unless other classifications are determined.

The discharge of any waste to any of the above classes of water requires a special license from the DOE or other related authorities.

The Regulations for the discharge of wastes to any of the above-mentioned classes of water are mainly related to the conditions of the receiving bodies of water, such as:

- For Classes 1 to 5 waters, these conditions encompass increases in temperature, suspended solids (SS) and chemical substances; reductions in dissolved oxygen; and limits on pH.
- For Classes 1, 2, and 5 waters there are additional conditions for toxic substances, limits on settleable solids and exclusion of pathogenic organisms.
- For Class 1 waters, there is an additional condition on biochemical oxygen demand (BOD_5). Also, the storage of rubbish and waste materials on riverbanks is prohibited.
- For Class 6 waters, there is an additional condition, which prohibits the discharge of wastes containing feces or wastes of industrial or agricultural origin into drains of public roads, although such discharges are allowed under certain conditions when the disposal to a public sewer or to underground strata is impossible.

Besides, effluents discharging into receiving bodies of water should have the following criteria:

- The effluents shall not emit objectionable odors nor contain organisms.
- The settleable solids content of the effluent shall not exceed a certain limit.
- Effluents containing industrial or agricultural wastes shall not exceed certain limits regarding temperature and pH.
- Effluents shall be free of fuels, including petrol and lubricating oil.

The above-mentioned classification does not contain standards, and, as such, the Japanese surface water quality standards are used. Thus, for the purpose of this EIA, the Japanese standards are used to indicate the river water quality that can be used for the water supply treatment plants. These are presented in Section 2.3.2 (Standards) of this Chapter.

Conditions for the discharge of industrial wastewater into public sewers are also covered in the Regulations. Permission is required by license from the appropriate authority for the discharge of all such effluents and in considering an application for a discharge, the authority is required to consider the protection of sewers and wastewater treatment works, the safety of health of personnel, and the cost of treatment.

Industries are required to construct their own treatment plants but in special circumstances they may be allowed to directly discharge their wastewater in the sewerage system for treatment elsewhere.

General conditions for the issue of licenses to discharge industrial wastewater are given in the Regulations and these include limits on temperature, pH values, suspended solids, oil and grease, and size of particles. They also prohibit certain inflammable and toxic substances. Industries must provide sampling chambers and, if required by the designated authority, flow measurement facilities. In addition, the designated authority shall be allowed to take samples of wastewater and measurements of flow.

It is interesting to mention that in a 1996 Law on collection of some government revenue, a provision was adopted to impose on industrial and mining plants to set aside an amount of 0.1% of their earnings in a specific account to be spent on environmental enhancement and protection under the supervision of the DoE. This is one of the few economic instruments for environmental purposes in Iran.

2.3.1.3 Discharges of Wastewater

In order to discharge any waste to any of the above classes of water, a special license must be acquired from the Ministry of Energy.

The regulations that exist for various polluting factors are mainly related to the condition of receiving water bodies. For Class 1 to Class 5 waters, the environmental conditions are primarily temperature, suspended solids, chemical substances, and reduction in dissolved oxygen and pH changes. For the Class 1 waters there is an additional condition on Biochemical Oxygen Demand (BOD_5). There are also conditions related to toxic substances that could be examined for waters categorized under Classes 1, 2 and 5.

The conditions set for wastewater discharge to the waters categorized under Classes 1, 2 and 5 include limits on suspended solids and exclusion of pathogenic organisms. They also prohibit storage of rubbish and waste materials on riverbanks for Class 1 waters. These regulations prohibit the discharge of waste containing feces or agricultural or industrial wastes into the Class 6 waters, unless disposal to public sewer or underground strata is impossible and in cases that effluents do not emit offensive odor. In order to discharge these wastewaters a special license must be obtained through the Department of Environment or its local offices. The Department is required to consider the protection of sewers, safety and health of personnel and cost of treatment.

Industries may be requested to construct their own treatment plant but in special cases direct discharge to water bodies is permitted. Generally, the waste being discharged has to qualify certain limits on pH, temperature, suspended solids, fat or grease and size of particles. Discharges of toxic and inflammable substances are also prohibited. The designated authority shall have the permission to take samples of the wastewater to measure its quality and quantity.

Other than the above-mentioned regulations, the Department of Environment (DoE) has published separate standards in 1973 entitled "Maximum Permissible Discharge of Pollutants to the Environment". These standards are defined by end use; surface water, groundwater, and irrigation. The irrigation standards appear to be based on FAO standards. The source of other standards is unknown.

The Pollution Prevention and Abatement Handbook also recommends the collection and removal of domestic and municipal wastewater to protect public heath and to improve the immediate environment; in particular this is important where inadequate disposal is resulting in groundwater pollution.

The Clean Water Act 1982 placed new responsibilities for the owners of water wells and subterranean canals. This Act requires them to control the water pollution within their ability and, in cases beyond their ability, to consult with the relevant government organizations. One major initiative of the Clean Water Act is to require institutions using water for various purposes to ensure their wastewater is treated. Issues of both water quantity and quality are of concern. The reuse of wastewater is one of the main options being considered as a new source of water in regions where water is scarce. The standards required for the safe use of wastewater and the amount and type of wastewater treatment needed are contentious. Many organizations have been involved in devising standards for the use of treated wastewater in agriculture.

2.3.1.4 Disposal and Reuse of Sludge

At present, there is no law regarding the disposal and reuse of sludge except what was included in the Regulations for the Prevention of Water Pollution (May, 1994), whereby it is stipulated that the sludge or other solid materials generated by wastewater treatment works must be properly treated before their final disposal, so as not to cause any pollution to the environment.

2.3.1.5 Disposal of Solid Waste and Industrial Wastewater

The following articles are taken from the Regulations for the Prevention of Water Pollution that was ratified on May 7th, 1994 and presented in Annex **BII.**

Article 7

The Department of Environment is obliged to collect samples of the sewage and the solid waste materials, according to the previously prepared program, in order to determine the kind and the rate of pollution related to each source. If the severity of pollution in any of these sources of pollution exceeds the standard limits of article (5) of the present paper of regulations, the Department will warn the responsible person to take measures for stopping the pollution. In this warning, the type of pollution and its rate will be specified, and with respect to the potentials and equipment available, the deadline to prevent the spreading of pollution will be determined and directly stated.

Note: Considering the industrial complexes and towns which possess their own public sewer system, the Department will collect samples from the sewers of the industrial and non-industrial parts of the towns and complexes and will take the appropriate measures in stopping the pollution with the responsibility of the company or the complex.

If the units established in these towns and complexes have industrial sewage containing poisonous substances of heavy metals, which cannot be controlled through the municipal sewer system, according to the decision of the Department of Environment, that unit will be asked to construct a system of sewage works of its own.

2.3.1.6 Pollution Abatement

The following articles are taken from the Islamic Penal Code – TAAZIRAT-Approved on 1996.05.23.

Article 688

Any act constituting a threat to public health, including the contamination of drinking water, or distribution of contaminated drinking water, unsanitary disposal of human and animal feces and wastes, pouring poisonous materials into rivers, disposing of trash on the streets, unlawful slaughtering of animals, **illegal use of raw sewage or waste water from sewage treatment plants for agricultural purposes is prohibited,** and should offenders not be liable to stricter penalty under other laws, they shall be sentenced to imprisonment of up to 1 year.

Note 1: The task of identifying whether the committing of any one of the offenses mentioned above constitutes a threat to public health or it is merely the pollution of the environment shall lie between the Ministry of Health and Medical Education and the Department of the Environment.

Note 2: Pollution of the Environment is defined as the mixing or scattering of foreign materials in water, free air, soil or ground to the extent that their physical, chemical and biological characteristics are changed in such ways as to become harmful to humans, living animals and plants, or damaging to structures and buildings.

Note 83 of the Law of the Second Five-Year Economic, Social and Cultural Development Plan of the Islamic Republic of Iran:

Note 83: To prevent and eliminate the pollution of water resources caused by industrial effluents, industries and factories located in cities and industrial townships are required to establish and operate facilities for the collection and conveyance of effluents and set up industrial waste water treatment installations based on the standards of the Department of the Environment and with the collaboration and/or the supervision of water and sewage companies of Provinces.

The current, 3rd Five-Year Plan, October 2001, has two major provisions, Article 104 and 134, which define the applicable policies.

The Executive By-Law on the Prevention of Water Pollution of 1994 – Article 20 mentions that "DoE shall adopt and implement required measures for the prevention of water pollution and encourage all responsible entities to eliminate pollution and shall provide incentives to find suitable means and devices and shall conduct research to achieve this objective". The same By-Law in its Article 3 states that "DoE through collaboration with the Ministries of Energy, Agriculture*, Jihad-e Sazandegi*, Health and Medical Education and other ministries and organizations concerned, shall act according to the case involved, in the inspection and identification of the quality of waters in Iran in respect to pollution". However Note 1 of Article 3 states that "the Ministry of Health and Medical Education shall follow its own regulations for the control of drinking water systems from the catchment's bases".

2.3.1.7 Protected Areas and Natural Habitats

The Game and Fish Law updated on December 16, 1996, is to ensure the preservation, protection and reproduction of wildlife. As per the Executive By-Law on the Game and Fish Law (1967), Article 19, Ordinary permits are issued upon request from applicants for hunting wild mammals, birds, reptiles, and aquatic animals of any value, either for one or more groups, or collectively for all of the four groups. These four groups limit the time (seasons and hours), place (National Parks, Protected Areas and private Reserves), kind (Protected Animals) and means (kind of weapons, ammunition, methods and devices used). Hunting in Protected Areas and Private Reserves, and also hunting Protected Animals with Ordinary Permits are prohibited. Special Permits are issued for hunting in National Parks and Protected Areas and also for hunting Protected Animals. However, with reference to Article 7 of the Executive By-Law on the Environmental Protection and Enhancement Act, hunting in National Parks is entirely prohibited.

Wildlife regulations have been introduced by the DoE to protect endangered species, such as Persian fallow deer, Caspian tiger, bear, Asiatic Cheetah etc. Presently there

* Ministry of Agriculture and Ministry of Jihad-e Sazandegi (Construction and Development) both are now combined and called Ministry of Jihad –e Keshavarzi

are eleven (11) National Parks, twenty five (25) Wildlife Refuges, forty seven (47) Protected Areas, six (6) National Natural Monuments and nine (9) Biosphere Reserves in the Islamic Republic of Iran.

Some of the most important Regulations Governing National Parks, national Nature monuments, Wildlife Refuges and Protected Areas are:

- Executive By-Law on the Environmental Protection and Enhancement Act (Approved by the Council of Ministers on 1975.02.20 with Subsequent Amendments Thereof)

Article 8

Grazing animals, felling trees, uprooting shrubs, encroachment upon or the destruction of the environment and , in general , any action that causes damage to and destruction of vegetation or leads to any form of alteration of ecosystems in the National Parks and national Nature Monuments shall be prohibited, except for cases arising from the necessity of protecting forest wildlife, improving National Parks and National nature Monuments or conducting allowed scientific and geological studies in conformity with the provisions of the Law of the Protection and Exploitation of Forests and Ranges, where such actions are executed by the country's Forest and Range Organization, or by the Department of the Environment, or by other authorized organizations or persons.(1)

Note: Domestic animals entering National Parks and National Nature Monuments shall be driven out from these areas by the functionaries of the " Department " and violator(s) shall be prosecuted according to the provisions of the Law.(2)

Article 10

Entering and passing through areas referred to in Section 3 part (a) of the Environmental Protection and Enhancement Act, with the exception of areas where public roads exist, shall be according to the regulations enacted by the "Department".

Article 11

Felling trees, uprooting shrubs, encroachment upon and destruction of the living environment, cutting thistles, burning wood into charcoal and, in general, any action that may lead to the eradication of vegetation and alteration of ecosystems in the wildlife refuges and protected areas that constitute land belonging to the government shall be prohibited without acquiring needed permits.(1)

1- Amendment approved by the Council of Ministers on 19.04.1995.

2- Amendment approved by the Council of Ministers on 19.04.1995.

1- Amendment approved by the Council of Ministers on 19.04.1995.

Note 1: Implementing approved industrial and mining projects in the wildlife refuges and protected areas, in conformity with existing regulations, shall be exempted from the provisions of this Article.

Note 2: Grazing of animals, in reference to the amount and quality of grazed material, in wildlife refuges and protected areas shall conform to the agreement between the Forest and Range Organization and the " Department " and regulations prepared thereof.

Note 3: Herding animals into and grazing in wildlife refuges and protected areas without permits or in excess of quantities indicated in the permits issued, which are contrary to the provisions of this Article, shall be prohibited. The functionaries of the "Department "shall drive out the animals, and violator(s) shall be prosecuted according to regulations thereof. (1)

Note 4: Hunting or fishing in wildlife refuges and protected areas and rivers shall require special permits issued by the "Department." (2)

Article 12

Ministries and governmental institutes and firms, with prior approval from the "Department", can conduct their intended studies, investigations and operations in protected areas and wildlife refuges within the framework of their legal authorities.

Article 14

Designation of areas referred to in Section 19 of the Environmental Protection and Enhancement Act shall be subject to the fulfillment of at least one of the following requirements and criteria:

- Existence of one or more sources in the area polluting or threatening the pollution of the environment.
- Human activities in industry, agriculture, trade or the like adversely affecting the environment or causing changes in the natural conditions of the area or threatening the area with environmental changes.
- Existence of large centers of population in the area and the necessity of adopting precautionary measures to prevent pollution harmful to human health.

1- Amendment approved by the Council of Ministers on 19.04.1995.

2, 3- Amendment approved by the Council of Ministers on 19.04.1995.

- Existence of one or more national parks, national nature monuments, wildlife refuges or protected areas in the vicinity or within the boundaries of the region, and the necessity of preventing changes or the degradation of the natural conditions in these four mentioned areas.

2.3.1.8 Archaeological and Cultural Heritage

The first rule in regard to protection of the cultural inheritance goes to 1930. In this year 10 legal articles were approved. Some of these important articles are:

In *Article* 83 of the Iranian Constitution it is stated that:

Buildings and government properties which are recognized as national heritage cannot be transferred to others unless by approval of the Islamic Parliament, and if they are not recognized as having special heritage value.

According to a legal article, approved in 1979, any excavation for antique relics is prohibited.

Preservation of the Cultural Heritage is considered important in the Islamic laws and regulations. In Article 558 of these regulations it is stated that:

Any body who damages some or all buildings, lands, yards, or collection of religious, historical and cultural places which are recorded in the list of national Iranian relics, will be sentenced to prison from 1 to 10 years in addition to the imposition of fines.

The law has identified specific punishments for those who do not respect the laws and regulations related to the preservation of Cultural Heritage.

According to Article 563 of these regulations, anybody who affects the integrity of areas of religious and historical lands which are recorded in the list of national Iranian relics that have not got any private owner, can be sentenced to prison from 6 months to 2 years.

Futhermore, according to Regional Urban laws and regulations that were approved in 1987, it was requested that the Urban Land Development Organization and the Ministry of Housing should be committed to the preservation of the Cultural Heritage in urban development projects.

2.3.1.9 Environmental Assessment

The Department of Environment is familiar with the environmental impact assessment concept and has established a special office for following up on the EA issue.

The legal basis for Environmental Impact Assessment (EIA) is also established by Note 82 of the Law of the 2nd State Economical, Social and Cultural Development Plan 1994, amended by Notes 104 and 105 of the 3rd Development Plan, and implemented through Decree number 138 on Environmental Impact Assessment (EIA) after its approval by the Environmental Protection High Council (EPHC) dated April 12, 1994.

Note 82 of the Law of the 2nd State Economical, Social and Cultural Development Plan part A states that "In the entire course of the Second Plan, all economic and social activities shall be carried out in conformity with environmental considerations, based on which the following measures are deemed compulsory :

1. Large-scale projects and schemes in industrial and services sectors, prior to implementation and during construction, must be evaluated and be based on patterns approved by the "Environmental Protection High council"
2. Industrial and mining operations must be performed with the aim of sustainable development and carried out in the framework of environmental Protection Standards.
3. Exploitation of the country's natural resources must be in line with the environmental potential and sustainable capacity so that in addition to correct utilization of natural resources, environmental balance shall be ensured and
4. Energy use in the country must be based on revised patterns of consumption towards the reduction of pollution caused by fuels"

Based on the Environmental High Council (EHC) approval No. 138 of April 13th 1994, the undertaking of environmental assessment for the following projects became legally mandatory:

1. Petrochemical Plants.
2. Refineries.
3. Power Plants (more than 100 MW capacities).
4. Steel Mills.
5. Dams and other water construction projects (man-made lakes, water and irrigation projects etc.).
6. Industrial Estates (more than 100 hectares).
7. Airports.

Based on consequent approvals of EHC, other development projects were added to this list as follows:

8. Major road projects
9. Major railroad projects
10. Agro-Industry units,

11. Industrial slaughter houses,

12. Sitting of urban solid waste landfills for cities with more than 200,000 population,

13. Solid waste recycling or compost units

14. Eco-tourism projects

15. Gas and oil transmission lines projects,

16. Sea oil platform projects

17. Oil storing projects

As previously mentioned, the Environmental High Council ratified the general pattern of evaluating the environmental impact proposed by the Department of Environment during its meeting on December 22nd, 1997. According to this pattern, the environmental assessment of construction projects is carried out in two stages; the first stage is brief and general, and the second stage is detailed. The text of the country's policy for environmental assessment is given in Annex **B-III** of this Report.

The policy for environmental assessment called, "the Criteria for the Environmental Assessment for the Seven Kinds of Projects" has been prepared by the Organization of Planning and Budget and the Department of Environment.

According to Article 1 of the Regulations concerning environmental impacts, ratified by the Environmental High Council on 22nd December, 1997, the executors of these seven kinds of projects and plans, while preparing their report for finding and evaluating the location, should prepare an environmental assessment compatible with the regulatory outline and guidelines.

According to this policy, the executors of the plans and projects should present a brief report to the Department of Environment, after proper examination of the case, within one month, to highlight the critical environmental factors that should be considered.

The executors of the plans will then prepare an environmental assessment report based on the points announced by the Department of Environment.

The environmental assessment for construction and operation are to be prepared separately and the experts responsible for preparing the assessment have to indicate the main activities carried out to reduce the detrimental impacts on the environment as well as their related costs.

The experts preparing the report on the environmental assessment are to express their findings in one of the following three ways:

- The execution of the project without special activities.

- The execution of the project with special activities to reduce the negative impacts (expenses of the activities included)
- The non-execution of the project due to the severity and wide extent of its negative impacts on the environment.

The Department of Environment, on the basis of the above-mentioned regulations, would declare its final decision within a three-month period.

A committee that consists of experts and academic authorities, representatives of the Management & Planning Organization, Forest & Rangelands Organization, the Standard Institution and Industrial Studies as well as a representative of the ministry or the organization proposing the plan is formed and is headed by Department of the Environment.

The examination of the reports on environmental assessment is undertaken in the headquarters of the Department of the Environment within the Environmental Impact Assessment Bureau.

2.3.2 Standards

2.3.2.1 Existing Iranian Standards

The existing standards in the Islamic Republic of Iran, which are presented here below, have been prepared according to articles 3 and 5 of the Regulations for the Prevention of Water Pollution (1994), in collaboration with the Ministries of Hygiene, Health and Medical Education, Power (presently Ministry of Energy), Industries, Mines and Metals, Interior Affairs, and Agriculture Jihad by the Department of Environment. These are presented in Annex B-IV and include the following:

- Drinking water standard of the Institute of Standards and Industrial Research of Iran (**Annex B-IV-1**).
- Sewage Effluent Standard of the Department of the Environment (**Annex B-IV-2**).
- Industrial Discharge Into Sewage Collection System Standard of the Ministry of Industry (**Annex B-IV-3**).
- Outdoors Noise Standard of the Department of the Environment (**Annex B-IV-4**).
- Air Pollution Standard of the Department of the Environment (**Annex B-IV-5**).

Drinking Water Standard (Annex B-IV-1)

The Management and Planning Organization published the full list of Drinking Water standards (1992, No 116-3). However, the Water and Wastewater Company no longer use these standards. The formal drinking water standard that must be used (June 1997, No. 1053 and 1986, No. 1011) is the one developed by Institute of Standards and Industrial Research of Iran (ISIRI).

The drinking water standard includes:

- Maximum permissible and desirable levels for different physical parameters, such as, turbidity, color, odor, pH, taste and oil.
- Maximum permissible limits for toxic metals (e.g., As, Pb, Cr...).
- Maximum permissible limits for toxic organics (e.g., DDT, lindane, THMs...).
- Maximum permissible limits for inorganic substances (e.g., TDS; NO_3^-; NO_2^-; NH_3; Al; Zn...).
- Maximum permissible limits for microbial parameters will be according to WHO standards.

Sewage Effluent Standard (Annex B-IV-2)

The sewage effluent standard includes a long list of contaminants whereby the maximum permissible limits are indicated for the quality of wastewater before its discharge into (i) surface water bodies; (ii) absorbing wells and (iii) irrigation canals for agriculture use.

Since the standard covers the wastewater effluent re-use issue, it also sets limits to microbial pollution; namely, Fecal Coliform No/100ml; Total Coliform No/100ml (MPN) and Nematode egg.

Industrial Discharge Into Sewage Collection System Standard (Annex B-IV-3)

The industrial effluent quality, which is set by the Ministry of Industry, includes a list of contaminants with their corresponding threshold limit values. These limits shall be respected by the industries that wish to connect to the sewerage system.

The list of contaminants includes the following parameters: Temperature; pH; Total oil & grease; Sulphates; Suspended solids (SS); BOD_5; Phenol and creosol; heavy metals; and radioactivity. However, the list does not include the required level for COD.

Outdoors Noise Standard (Annex B-IV-4)

The outdoors noise standard set limits for different types of zoning and differentiates between: Residential area; Residential- commercial area; Commercial area;

Residential-Industrial area; and Industrial area. It also differentiates between noise levels during day and night time.

Air Pollution Standard (Annex B-IV-5)

The air pollution standard covers major air pollutants, such as, carbon monoxide, sulfur dioxide, Non-Methane Hydrocarbons, nitrogen dioxide... and sets limits for each pollutant on the basis of:

- Annual average levels.
- Maximum 8-hour concentration levels.
- Maximum 1-hour concentration levels.

2.3.2.2 Standards Proposed in this EIA

For the purpose of this EIA, the following standards are proposed to be used, applied and enforced for the proposed Project:

- Iranian drinking water standard (**Annex B-IV-1**), which have been developed by the Iranian Institution of Standards and Industrial Research. This standard will be supplemented with the Japanese water standards (**Annex B-IV-6**); namely, those related to the following:
    - Conservation of the Living Environment in rivers.
    - Conservation of the Natural Environment and Uses of rivers.
    - Environmental Quality Standards for Water Pollutants Regarding Human Health (annual mean values for different pollutants).
    - Monitoring Substances and Guideline Values.
- Sewage Effluent Standards of the Department of the Environment (Iran) (**Annex B-IV-2**). The standard's part that deals with the use of treated wastewater in irrigation, will be supplemented with the following:
    - FAO Guidelines for Maximum Permissible Concentration of Elements in Water Used for Irrigation (**Annex B-IV-7**).
    - WHO Guidelines (1989) for the Recommended Microbiological Quality for Wastewater Use in Agriculture (**Annex B-IV-8**).
- Industrial Discharge Into Sewage Collection System Standard of the Ministry of Industry (**Annex B-IV-3**). The World Bank Pollution Prevention and Abatement Handbook, which sets the limits for the different types of industries, will supplement the Iranian Ministry of Industry standard *(Industrial effluent discharges are to be pre-treated to levels that comply with*

the limits prescribed in this handbook before their discharge in the wastewater collection system).

- Outdoors Noise Standards of the Department of Environment (**Annex B-IV-4**).
- Air Pollution Standards of the Department of Environment (**Annex B-IV-5**).
- Since no Iranian standards are available for sludge utilization in agriculture, the WHO and European Directive (Annex B-IV-9) will be used.

The above-mentioned standards and limits will therefore be used to monitor the quality of drinking water, wastewater effluent and sludge in this Project. These limits are also presented in the monitoring program described in Chapter 9 of this Report.

2.3.2.3 Comparison of Relevant Standards

The assessment of the different environmental parameters relevant to the proposed Project, led to the undertaking of a comparison between the international environmental standards and those applicable in I.R Iran. In most cases, the stricter standards have been used to indicate the severity of an environmental problem (surface and ground water pollution) or to ensure the attainment of hygienic quality (for example in drinking water).

For instance, comparing the WHO drinking water quality Standard with that of the Iranian standard; it was found that the former is less stringent on nitrate concentration than the latter. Both standards compare equally on turbidity, chromium, mercury and nickel, while for parameters such as total coliforms, TDS, chloride, sulphate, zinc, cadmium and lead the WHO standard is more stringent than the national standard. Thus, since the WHO standard is more complete and stringent on the majority of the parameters, and especially on those that have a direct negative impact on health, it is proposed to use this standard for evaluating the quality of the water.

So far, and as mentioned earlier, there are no standards in the I.R. Iran regarding surface water quality and sludge use in agriculture. In the absence of such standards, and for the purpose of this EIA, it is proposed, to supplement the Iranian standards by using the following standards:

- The Japanese surface water quality standards (**Annex B-IV-6**) related to the following:
    - o Conservation of the living environment in rivers (Refer to table below)
    - o Uses of river water (Refer to table below)

- The European Union (EU) Directive on "Sludge in Agriculture" (86/278/EEC). This directive indicates the maximum permissible concentration limits of potentially toxic elements (PTEs) in the sludge to be applied to agricultural land and the receptive soil.

As previously mentioned, the reuse of wastewater effluent and sludge in agriculture are to comply with the applicable European Union (EU), World Health Organization (WHO) and Food and Agriculture Organization (FAO) Guidelines, including concentrations of cadmium, chromium, nickel, led and zinc.

Furthermore, the treated sludge quality shall comply with the World Health Organization (WHO) guideline limit for intestinal nematode eggs, which is less than 1 per 100 grams dry weight of sludge.

2.4 Administrative Framework

Under the constitution, the Environmental Protection High Council (EPHC) is chaired by the President of Islamic Republic of Iran and by a 1994 Law; the Vice- President is its executive arm. The EPHC comprises Ministers of the following Ministries;

- Ministry of Agriculture
- Ministry of Jihad-e Sazandegi
- Ministry of Industry
- Ministry of Interior
- Ministry of Housing and Urban Development
- Ministry of Health and Medical Education
- The Director of Planning and Budget Organization
- The Director of the DoE and
- Four qualified persons recommended by the Chairman of the EPHC appointed for a term of three (3) years.

The EPHC has a specific committee called the Sustainable Development Committee (SDC). The SDC prepares the reports for discussion on issues of environmental protection and management etc.

The Environmental Protection and Enhancement Act of 1974 established the Department of Environment (DoE) under the EPHC as an authority for controlling activities harmful to the environment in Iran. It is a corporate body with financial independence functioning under the supervision of EPHC. The Vice-President of Iran is the Chairman of the DoE. The DoE along with its Provincial Environmental Offices is the Principal Environmental Protection Agency with a clear mandate to monitor implementation of environmental policies and enforce relevant laws and regulations. The DoE is responsible for the inspection and identification of the quality of waters in Iran in respect to pollution and is an important stakeholder in the context of the proposed water & wastewater project. The organization chart of DoE is shown in Figure 2.1.

Based on the information provided by Chief and Director of DoE-Gilan, DoE was established in Rasht since 1972. The jurisdiction of Regional DoE is limited to Gilan Province. However, the jurisdiction for local offices of DoE for different cities of Gilan Province is limited to the boundary of each city. The DoEG is working under the central DoE Office, Tehran and maintains working relations with other ministries and departments in the region i.e. Ministries of Fisheries, Industries and Mines, Agriculture etc. as well as with other departments like Water and Wastewater Company, Gilan. One of the permanent members of the Water and Wastewater Company of Gilan is from the DoE. This member attends all the important decision making meetings of the Company.

Presently there are about three hundred and fifty (350) employees working in the Provincial Department of Environment- Gilan (DoEG) and 91 and 26 employees working in Rasht and Anzali DoE offices respectively. The main office and the central public relation office of DoEG is in Rasht but there are also offices in other cities of Gilan province. One Research Station in Anzali is working under DoE which is equipped with water and wastewater laboratory and 16 personnel are working in this center.

The role of DoEG is very important in the development of Rasht, Anzali and other cities of the Province. The Department of Environment has one wastewater testing laboratory in Rasht which has a capacity to carry out physical, chemical and microbiological parameters to find out the quality of water and wastewater. For heavy metal tests and nematode eggs test on water and wastewater, samples are forwarded to Tehran Province, Water and Sewerage Company, where the facilities are available to test these parameters.

Presently, the DoE has suggested to the Ministry of Energy to have a proper sewerage system and wastewater treatment plants especially for the cities of Rasht and Anzali. However, Gilan Water and Wastewater Company will take care of all the components of water and wastewater project including the treatment plants, water and wastewater testing laboratories, water and sewage house connections etc. As such, there will be no direct role of DoEG in this project. The Department is also concerned about the minimization of deforestation, proper solid waste disposal sites, reduction of pollution loads into rivers, port and the Caspian Sea. In this regard, DoE requires industries to have a proper treatment of their effluent. There are industrial zones in Rasht and

Anzali and DoE is responsible for the industrial effluent from these zones entering in to the receiving water bodies.

The Islamic Republic of Iran prepares its 5 year plan. Based on this plan, DoEG prepares its plan and forwards it to the DoE Tehran Office. It is then reviewed by the Environmental Protection High Council and after approval of the Parliament; the plan is sent back to the DoEG for implementation. The DoEG is also responsible for educating citizens on environment directly and through the NGOs.

2.4.1 Key Government Organizations

A. *The Ministry of Energy*:

The Ministry of Energy oversees a major part of the country's development and resource exploitation activities. This Ministry is responsible for: generating & distributing energy for light and heavy industry consumption, supply and improvement of energy consumption, supply and distribution of water to all sectors of society, urban sewage system control, quantitative and qualitative protection of water resources, and implementing river and coastal development plans.

Whilst the Ministry of Energy is the lead entity with overall responsibility for the implementation of the proposed Project, there are a number of other ministries, local government departments and service agencies with direct involvement in the environment. If the Project is to be constructed and operated successfully it is vital that the actions of these various ministries, organizations and bodies are adequately coordinated.

B. *Department of the Environment:*

The Department of Environment (DoE) is the competent authority for approving EIA reports as defined in Note 2 of Decree 138. The DoE processes the EIA reports and gives its recommendations to the government directorate responsible for the Project. In case the Project execution is found to be inconsistent with the recommendations of the DoE, then as per Article 9 of the 1997 Code of Practice, the DoE shall notify the relevant Ministry and any controversy shall be resolved by the decision of the President of The Islamic Republic of Iran.

In addition, the DOE is responsible to the Environmental High Council, consisting of representatives from various Ministries.

The DOE is responsible for all aspects of environmental protection, including water pollution control, effluent discharge standards, and wildlife conservation.

The responsibilities of the Department of Environment with respect to water and wastewater issues include:

- Conducting economic and scientific research and studies concerning environmental protection and enhancement.
- Preparing plans for the elimination or reduction of pollution in any area or province.
- Monitoring and enforcing the regulations.
- Controlling pollution and preventing any disturbance in environmental balance by:
    - Controlling of any such alterations in the biological, chemical or physical condition of land, water and air caused by various physical developments as may induce changes in the natural conditions, including alteration and degradation of river-beds, degradation of forests and rangelands, marine ecological changes, disturbance in the natural drainage of waters and modification in and destruction of wetlands;
    - Recommending standards and criteria for the purposes of controlling and preventing the pollution of water, air and land; discharge of refuse, including garbage and industrial waste matter; and other issues affecting the environment.

The DoEG is also responsible for monitoring the planning of other Ministries and Departments in the region, like Ministry of Energy, Industries and Mines, Fisheries, Agriculture, etc. whose work have effect on the environment.

Regarding future development plans of DoEG, the following are the set priorities:

- Sewerage system for the cities of Rasht and Anzali
- Wastewater treatment plants for the above cities.
- Air pollution
- Solid waste management

C. ***The Ministry of Agriculture Jihad***

During the last decade, the Ministry of Agriculture Jihad (established in 2001 by merging two ministries together; the Ministry of Agriculture and that of Jihad Sazandegi) has focused its actions for the protection of the environment and sustainable development. Among the most important measures taken for achieving environmental protection and economic growth, the Ministry attempted to reduce the consumption of chemical fertilizers and poisonous pesticides and proposed plans to replace the old methods of pest control with new techniques. According to the decisions and ratified criteria of this Ministry (1) no hazardous high-risk pesticide can be imported and used and (2) the subsidy for buying agricultural chemicals are to be gradually omitted and (3) additional consumption of additives will be gradually adjusted to the specific need of the land and the product efficiency.

The Cabinet meeting on 2nd February, 1994, has set some objectives to the Ministry of Agriculture Jihad that are directly related to the utilization of water resources. These were:

- Conducting scientific and economic experiments and studies on different fields of Agriculture Jihad (including studies concerning proper exploitation of water resources) and publishing their results.
- Conducting any research or taking any executive and supervisory measures in order to improve the general knowledge for proper exploitation of water, land, etc.
- Conducting research studies concerning the water and the soil inside the specific fields, including correction and renovation of old irrigation systems and sewage as well as constructing tributary irrigation systems, irrigation channels, etc.
- Improving the efficiency of irrigation through proper selection of development projects and by changing inappropriate methods of irrigation.
- Conducting research studies planning and exercising small projects for developing water resources (subject to approval of Ministry of Energy).
- Fulfilling the responsibilities of executing the law of Just Distribution of Water

According to the general laws of the country, some of the responsibilities concerning the protection and proper utilization of water and aquatic life resources as well as forest and pasture resources that were under the responsibility of the Ministry of Jihad, and were lately transferred to the Ministry of Agriculture Jihad, are as follows:

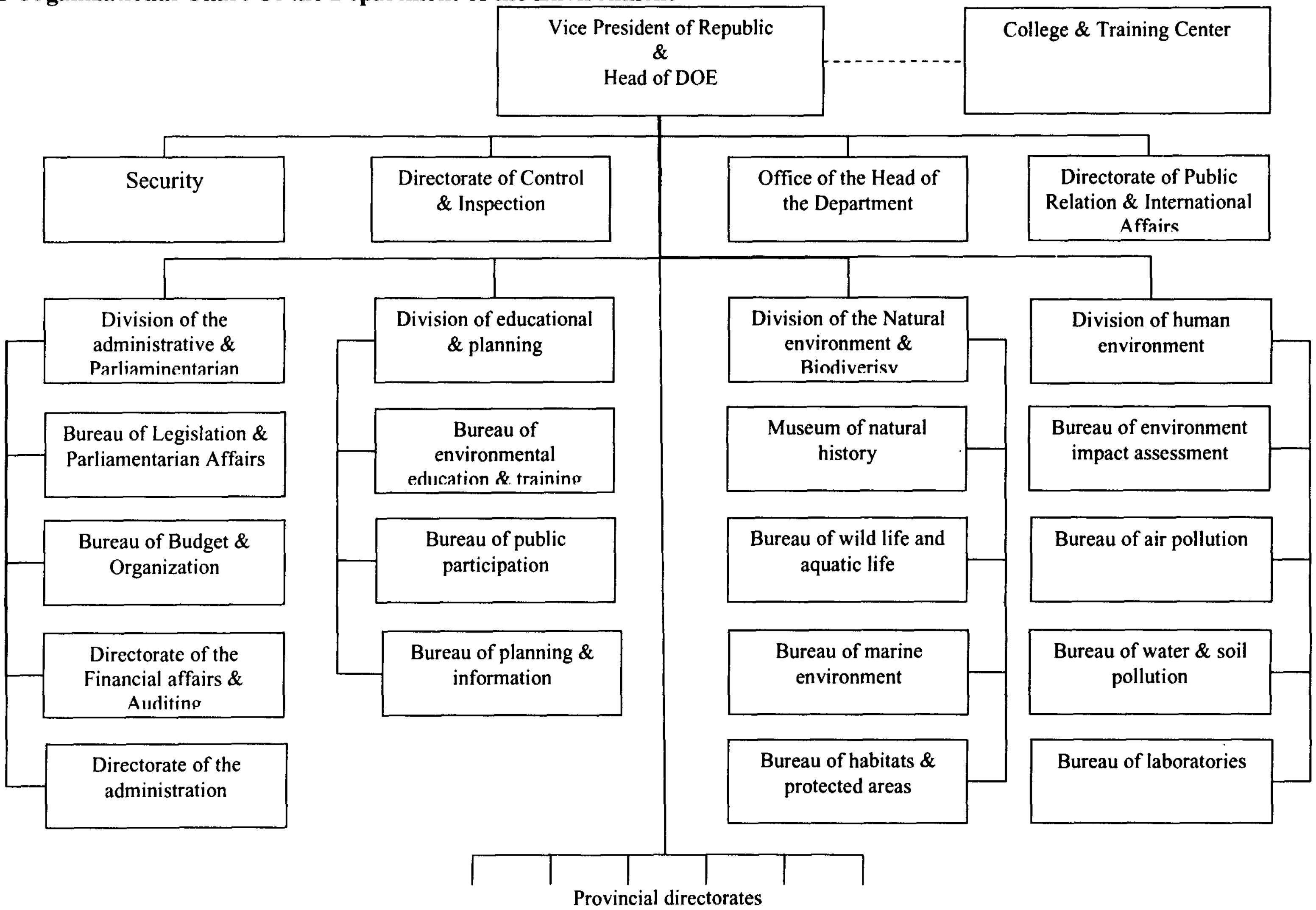
- Conducting comprehensive research studies on the water resource of the country and presenting plans for proper exploitation of the lands.
- Developing policies and taking the required measures to preserve, renovate, develop, expand, and put into proper use all the water and aquatic life resources.
- Policy-making, planning, constructing, developing, and maintaining the systems of potable water (provision, treatment, transmission, and distribution) in villages as well as the proper disposal of the wastewater.

In Gilan Province, about 2,300 employee are working for the Ministry of Agriculture, which is working under the Central Ministry of Jihad-e-Keshavarzi but the Governor of Province (Ostandar) can interfere in the working as per the official legal framework.

The future programs of this Ministry are:

- Combining the small agricultural land into bigger lands
- Improving water management
- Development of sprinkling pressure system for irrigation
- Use of biological techniques to control pest
- Use of mechanical equipments in agriculture
- Development of Dairy farms, Fish farms and bees farms etc.

Figure 2.1 Organizational Chart Of the Department of the Environment



D. ***Gilan Water and Wastewater Company***

The Law of 1990 of the Islamic Republic of Iran on Water and Wastewater Companies hands responsibility for the water supply, collection, treatment and disposal of wastewater to each province's Water and Wastewater Company. Regional Water and Wastewater Companies like the one in Gilan are private organizations that act as private entities and are owned by the Government of Islamic Republic of Iran. The Government only pays for the capital cost of the Projects, however, regular operation and maintenance of the projects are self financed by the tariff generated through the projects.

These companies take care of technical, financial aspects as well as planning and operations of water supply, sewerage, water and wastewater treatment, wastewater disposal projects and are responsible for construction, operation and maintenance of these utilities in the urban centers of the Province. In the past, these responsibilities were with Regional Water Boards (RWB) i.e. Gilan Regional Water Board. In the case of Rasht and Anzali, the Gilan Water and Wastewater Company (GWWC) is responsible for water supply, wastewater, treatment and disposal for these cities. The organizational structure of the GWWC is shown in **Figure 2.2** and that of Rasht and Anzali water and wastewater company is shown in **Figure 2.3** and **2.4**.

The Regional Water Board (RWB) is controlled by the Central Government through the Ministry of Energy and was established in 1962 and is now only responsible for provincial surface or ground water source development. Transmission of water for agriculture and industry is also the responsibility of the Regional Water Board. The RWB coordinates with the Regional Water and Wastewater Companies for financing water supply projects. There are about 700 employees in the RWB- Gilan. The RWB develops the water source, prepares a water supply scheme based on this water source, and provides necessary project components like transmission mains, reservoirs etc. to provide water to the community. After exploration, the RWB hands over the water source to the Regional Water and Wastewater Company (RWWC) e.g. Water Treatment Plant at Sangar was constructed by the RWB and is being operated by the Gilan Water and Wastewater Company. This plant is presently producing 3 m^3 of potable water.

Figure 2.2: Organization Chart of Guilan Water and Wastewater Company

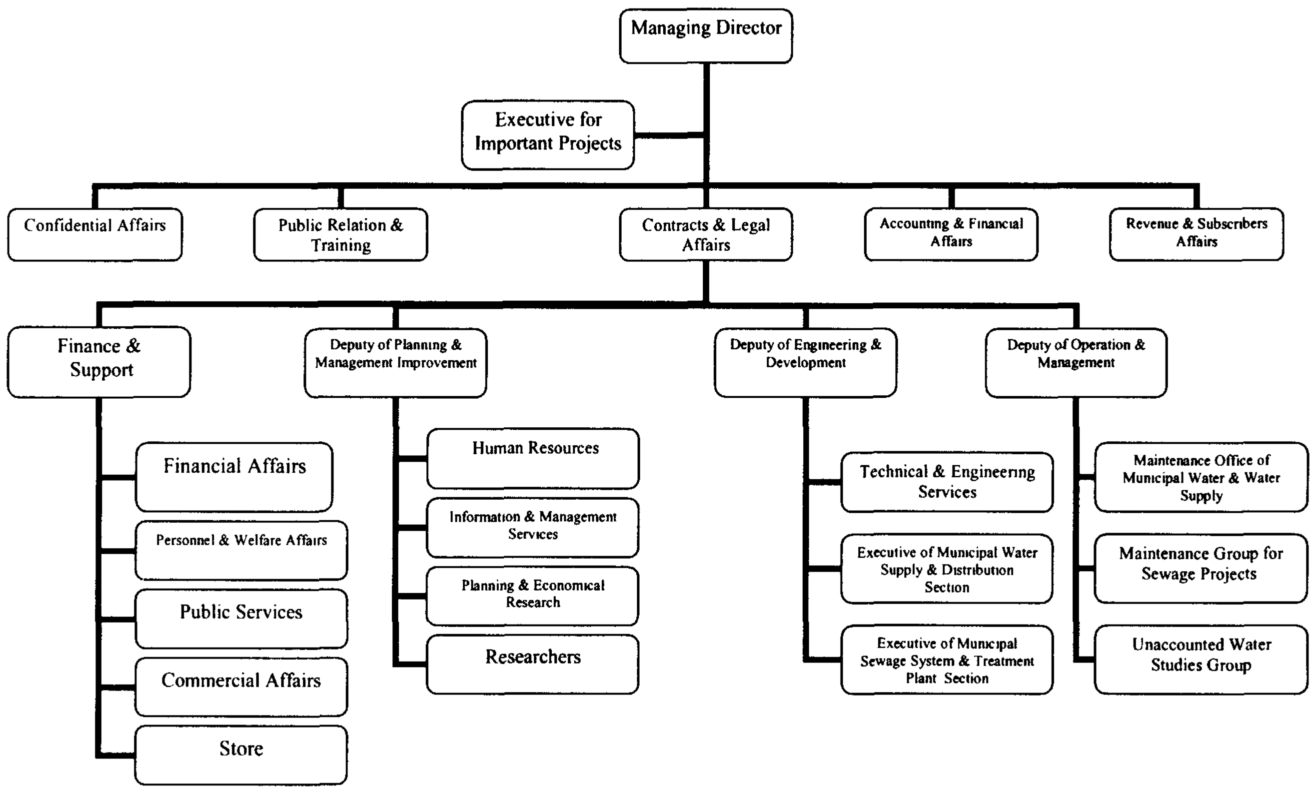


Figure 2.3: Organization Chart of Rasht Water and Wastewater Company

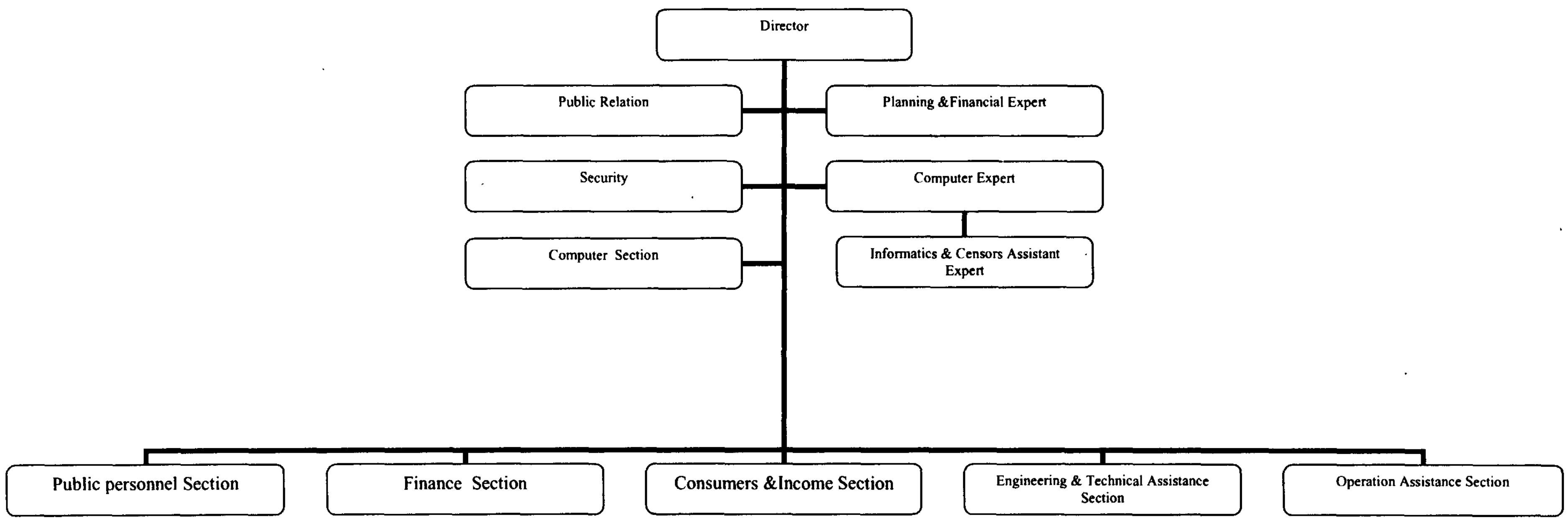
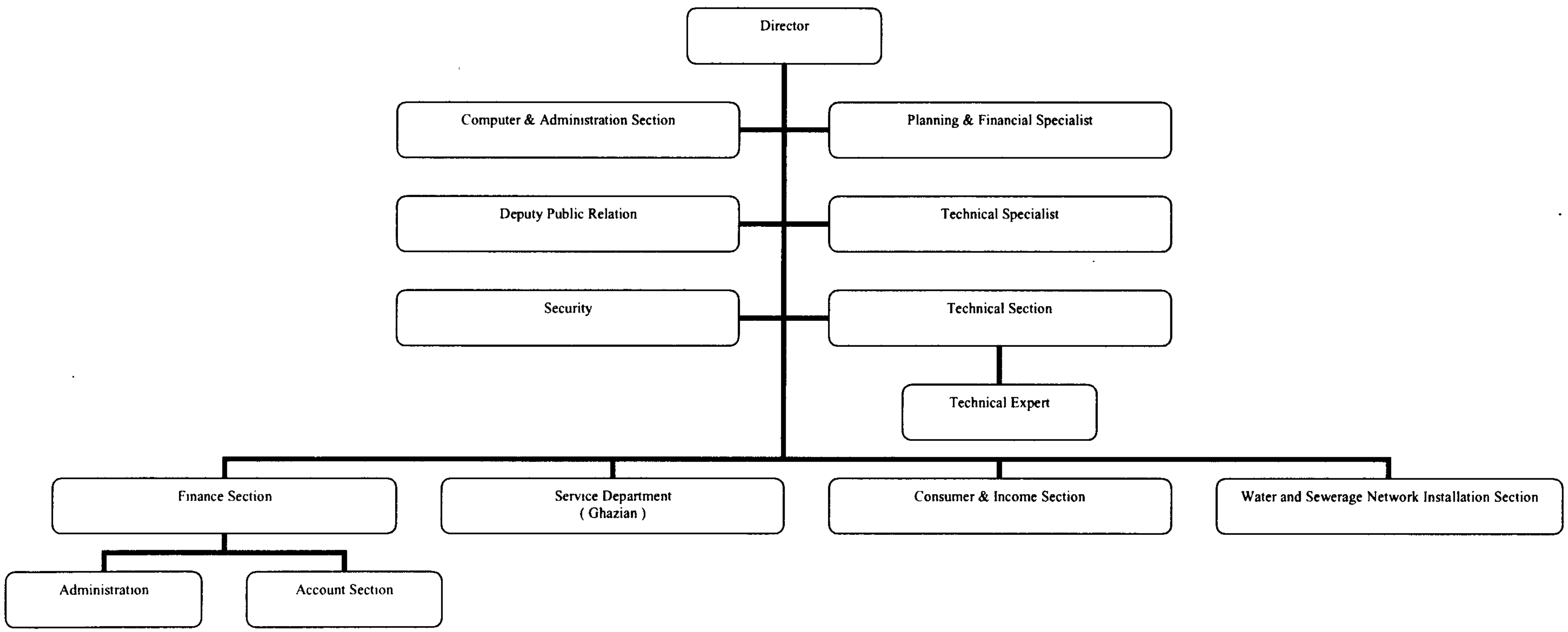


Figure 2.4: Organization Chart of Anzali Water and Wastewater Company



The RWWCs are responsible for distribution networks, elevated tanks of the urban centres and for providing house connections. The RWB sells water to the RWWCs and charge the Gilan Water and Wastewater Company for the raw water supplied to the Company. Rates for supplying raw water are as follows:

- Underground water — Rials 20 / m^3 (US$ 0.25 / 100 m^3)
- Surface water — Rials 90 / m^3 (US$ 1.125 / 100 m^3)
- Drinking water well (Fehlman wells) — Rials 50 / m^3 (US$ 0.625 / 100 m^3)

The Ministry of Energy holds overall control of these organizations and has established an Advisory and Support Unit to assist the Regional WWC and RWB.
The Gilan Water and Wastewater Company is a private company owned by the Ministry of Energy. Different share holders of the Company and their shares are as follows:

- Municipality — 49 %
- National Water and Wastewater Engineering Company — 10 %
- Water and Wastewater Companies of other province — 06 %
- Regional Water Board — 35 %

Total: 100 %

The corporate structure of the company comprises a Board of Directors with Managing Director of GWWC being one of its members. As a Chairman of National Water and Wastewater Engineering Company, and representative of the shareholders, the Minister of Energy forms the General Assembly.

2.4.2 Other Government Organizations

A. ***The Ministry of Health and Medical Education***

The articles and the comments of the Regulations concerning the environmental health ratified by the Cabinets in 1992 not only defined the term "potable water" and explained its various kinds of pollution but also gave the responsibility of constant supervision on the quality of potable water to the Ministry of Health. According to the second section of the third article, governmental and private companies and institutions, which provide potable water, have to observe all the hygienic conditions, rules, and standards demanded by the Ministry of Health and Medical Education.

According to article number four of this executive bylaw, a Committee for the Protection of Potable Water Resources has been formed in each province and is headed by the Province Governor General and the membership of provincial managers and director generals of the Ministry of Health & Medical Education, Department of Environment, Regional Water Organization of the province, Organization of Agriculture Jihad, Management & Planning Organization and Water & Sewage Company. The committee is to examine possible causes of water pollution and ways for treatment and protection of water resources.

The Ministry of Health is therefore responsible for public health, control of foodstuff, drinking water and medical care. The Ministry of Health has an important role in monitoring the effectiveness of the proposed Project in terms of public health improvements and in the establishment of public health education programs.

B. Ministry of Housing and Urban Development

The Ministry of Housing and Urban Development is responsible for the control of land-use, town planning and building regulations. As such, the Ministry has an important role in ensuring that the capacity of existing and proposed water and sewerage facilities has been addressed in the future land-use plans of the city and is properly protected and that no inappropriate developments take place around them. Regarding its building regulation responsibilities, the Ministry has to ensure that new developments make adequate provision for connecting to the public sewer.

C. Ministry of Industries and Mines

The Ministry of Industries and Mines is responsible for industrial development in Iran. Thus, it has an important role in the control of industrial effluent discharges to public sewers and watercourses.

The Ministry also provides training and advice to industrialists and financial assistance for upgrading or installing treatment facilities. On the other hand, and whenever necessary, the Ministry enforces relocation of industries.

The Ministry of Industries and Mines has its own standards which have to be followed by the industrial units before discharging the industrial effluent into the sewerage system and are shown in Chapter 3 (Project Description) of the Report.

D. *Institute of Standard and Industrial Research*

Affiliated by the Ministry of Industries and Mines, this institute is responsible for settling and publishing national (official) standards.

E. ***Ministry of Labor and Social Affairs***

The Ministry of Labor and Social Affairs is responsible for labor affairs and for establishing and enforcing occupational safety regulations.

This Ministry will monitor and enforce the application of the occupational safety regulations during construction and operation of the Project.

F. ***Universities and Research Institutes***

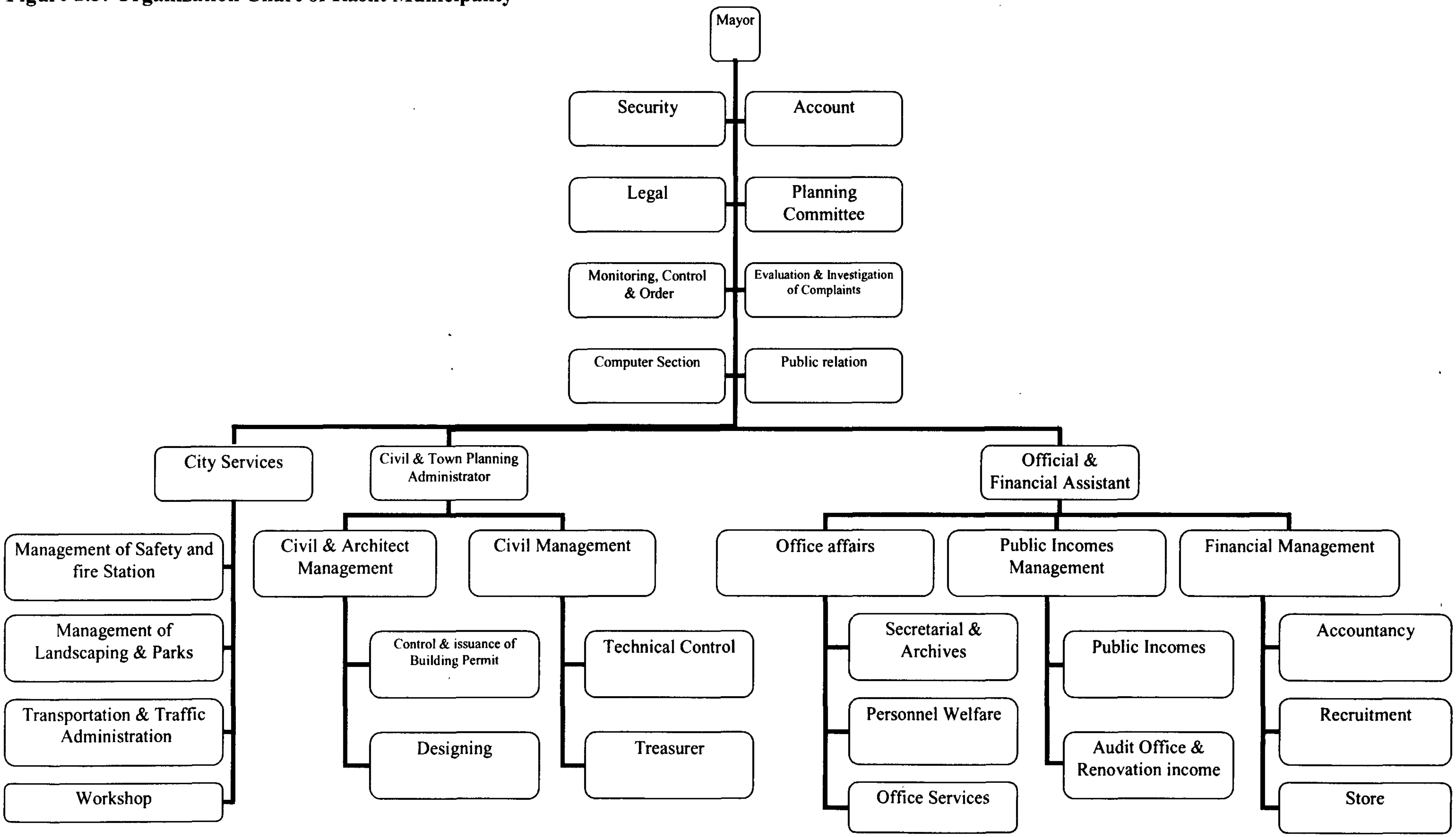
There are different universities in Iran conducting different environmental activities including environmental sciences, environmental planning & management, environmental engineering (water and wastewater, air), natural resources...

Many universities have joint projects with related Ministries in different environmental fields through their research centers especially for wastewater management projects. Thus, these universities may play a consultative role and conduct particular research work regarding special issues such as wastewater and sludge reuse.

G. ***Rasht and Anzali Municipalities***

The law on Municipality grants some environmental mandates and responsibilities to the municipalities. The Municipalities of Rasht and Anzali regulate all standard local government functions, including solid waste collection, street cleaning, surface water drainage, building control, traffic management, parks and open spaces. The Municipalities, as a law, have an important role in the enforcement of building control standards regarding the provision of sewerage, and connections to public sewers of new and existing development. The construction of the new sewerage networks throughout the City will have significant impacts on traffic and the Municipality needs to be closely involved in the development of traffic mitigation measures for the scheme. Municipalities are bound to notify architectural or engineering companies responsible for new urban development of the requirements of the DoE regulations. Section 20 of the Environmental Code of the Islamic Republic of Iran states the "Subject to the approval of the EPHC, the DoE may devolve part of its responsibilities and powers with regard to the implementation of the provisions of Section 11, 12 and 13 (related to factories and workshops contributing to pollution, and penalty clauses) hereof upon the municipalities or government agencies and/ or organization concerned, as the case may be, whereupon such municipalities, agencies or organizations shall assume responsibility for the implementation thereof. The Organization Chart of Rasht Municipality is shown in Figure 2.5.

Figure 2.5: Organization Chart of Rasht Municipality *



H. Cultural Heritage Organization

According to the laws and regulations, the Cultural Heritage Organization has the following responsibilities:

- Prepare and regulate the ancients' relics research programs in the country.
- Study and recognize of precincts, hills buildings and historical collections and prepare a list of maps.
- Implement all the legal affairs related to cultural heritage and pursue all the penal claims against the infringers as claimants.
- Take the necessary action to recognize and reclaim Iranian cultural properties.
- Prepare and perform necessary plans to secure and safeguard, repair and revive master pieces
- Encourage the people to participate in all activities related to promoting, saving, and reviving cultural heritage.

The Cultural Heritage Organization as well as the Ministry of Research, Science and Technology are responsible for Archaeological and Cultural Heritage. The Cultural Heritage Organization is directly responsible for the preservation of the cultural and historical monuments and artifacts. Cultural Heritage includes ancient relics which depict the historical development of the human race.

The organizations whose work is related to the preservation of the Cultural Heritage are set out in Table 2-1.

Table 2-1: The Organizations related to the Preservation of Cultural Heritage

No.	Institutions	Responsibilities
1	The Cultural Heritage Organization	- Prepare and regulate to carry out researching program about the remaining the ancients relics - Prepare and perform necessary plans to secure and safeguard, repair and revive master pieces. - Study and recognition of precincts, hills buildings and historical collections and the preparation of list of maps of them - Implement all the legal affairs related to cultural inheritance and pursue all the penal claims against the infringers as claimants.
2	Municipalities	Preservation of cultural and historical monuments in urban development projects; necessary consultation with the Cultural Heritage Organization in case of finding any historical monument or artifact
3	The Judicial Court	In charge of punishment of those who do not respect the laws and regulations related to the preservation of cultural heritage.
4	The Ministry of Housing	Preservation of cultural and historical monuments and artifacts while implementing urban development projects; necessary consultation with the Cultural Heritage Organization
5	The Urban Land Development Organization	Preservation of the cultural and historical monuments and artifacts

I. Legal Aspects of NGOs

The international Development Agencies generally support the role of NGOs as change agents and envisage their active participation in development projects. NGOs in many countries of the world are playing this role as alternative development agencies within the legal framework of their respective countries. The Operational directive (OD 14.70) of the World Bank encourages the involvement of NGOs in Bank supported activities whenever appropriate.

The NGO community in Iran is assessed as essentially nascent, small and lacks the sector orientation and training. The legal framework is also not conducive for NGO involvement in Water and Wastewater Projects.

However, it is strongly recommended that the NGOs should be a legal part of the monitoring and evaluation of the project activities as well as partners in mitigating the negative impacts on local community.

2.4.3 Overall Environmental Management

The construction phase of the project will be monitored by the Environment and Safety Officer (ESO) in the Technical Support Unit (TSU) as part of his contract.

The Department of the Environment (DOE) will be responsible for the control of water pollution and monitor its compliance against applicable related standards. Thus, the DOE will monitor the:

- Water quality in the Zarjoob and Goharood Rivers and Anzali lagoon
- The quality of the discharged effluents in the environment (whether it is a public river or water course...)

and control its compliance with the applicable standards.

The Ministry of Agriculture Jihad will be responsible for monitoring the use of sludge and treated wastewater in agriculture under the supervision of the DOE. The qualified and skillful staff of the Ministry will perform the monitoring program. An evaluation of responsibilities and capabilities of organizations to fulfill these responsibilities is provided in Chapter 9 of this Report.

The GWWC however, will be responsible for controlling the quality of the discharged industrial effluents in the wastewater collection network. As such, the GWWC will be responsible for ensuring that industries treat their wastewater before discharging it in the collection system or the natural environment.

The rehabilitation of the existing and the construction of both the water network and sewerage networks throughout the Cities will have significant impacts on traffic. The Municipality will need to be closely involved in the development of traffic mitigation measures during the implementation of the project.

Monthly monitoring reports will be presented to Gilan Water and Wastewater Company (GWWC) during the construction and operation phases of the Project. The reports will highlight environmental issues, describe the applied mitigation measures (as proposed in the Environmental Management Plan) and propose corrective actions and improvements.

An overall project coordination committee needs to be established to ensure proper coordination among the different representatives of the diverse ministries and organization involved in the Project.

2.5 Conclusion

The Islamic Republic of Iran has standards and regulations governing the key likely environmental parameters for this Project – particularly with regard to:

- water quality (potable water standards and effluent standards;
- air quality;
- protection of rare and endangered species and habitats;
- noise and vibration;
- preservation of cultural heritage.

Iran also has strict policies to protect the environment and to assess significant development projects through the EIA process. These policies have been enshrined with new laws, policies and standards, which compare favorably with international standards.

The only exception is in regard to standards for sludge and surface water where Iran's standards have not yet been established. In this regard, and for the purpose of this EIA WHO and EU standards for sludge and Japanese standards for surface water quality shall be used. On the other hand, whenever an existing standard is unclear or outdated or less stringent than those internationally recognized, it is proposed to use the latter.

Since there are many ministries and governmental agencies, which have managing and monitoring responsibilities and prerogatives on the issues raised by the proposed Project, it is recommended to establish an overall project coordination committee to ensure proper coordination among the different representatives of the various players.

SECTION 3

PROJECT DESCRIPTION

3.1 Project Location and Setting

The project area covers the cities of Rasht and Anzali, which are located in Gilan province in the north east of Iran as shown on maps number 1 and 2 in Annex A.

Situated at a distance of 320 km to the north of Tehran, Rasht is the capital of Gilan, and the largest city in the province. It is currently inhabited by around 500,000 people living on 7,000 hectares of presently developed areas. The boundary of the project area in Rasht is the city's approved boundaries as shown on Map C&EGWSS-IR-101-3 in Annex A, which encompass an area of 9,850 Ha.

Anzali city is the second most important city in Gilan after Rasht. It is located on the southern coast of the Caspian Sea and to the north of Rasht Township. The city is partly bordering Anzali lagoon, which due to its ecological significance, has rendered Anzali a tourist resort. In fact the Lagoon divides Anzali into an eastern part called Ghazian and a western part called Anzali. The city also has harbor facilities, which enables Iran to trade with the other states that are located on the Caspian Sea. Anzali's population is currently estimated at 118,000, which increases to 143,000 during the summer season due to tourism. The boundary of the project area in Anzali is the city's approved boundaries as shown on Map C&EGWSS-IR-101-3 in Annex A, which encompass an area of 3,095 Ha.

3.2 Project Outline

The feasibility study for Rasht & Anzali water and wastewater management has been prepared to meet the study area requirements up to the year 2027. The study covered the two cities' boundaries with a total area of 12,945 ha having a forecast population of 1,208,600 (tourists included) in the year 2027. In accordance with feasibility study, the project area can be divided to two identified zones: (1) Rasht having an area of 9,850 ha with a forecast total population of 956,600 for year 2027 and (2) Anzali having an area of 3,095 ha with a forecast total population of 252,000 (tourists included) in the year 2027.

The required water and wastewater works will be completed over four phases. The first phase, called the emergency phase, is expected to be carried out between the years 2005-2009; the second phase will commence in 2010 and continue until 2012; the third phase will begin in 2013 and continue until the year 2018; and finally the fourth phase, which will commence in the year 2018 and will be ending at the project's completion in 2027.

The Rasht and Anzali Water Supply and Sanitation Project will cover works to be included in the first phase, defined by the feasibility (2005 to 2009).These works can be described by the following:

<u>Water Supply Component</u>

- Construction of transmission main from Saravan reservoir to Lakan storage tank
- Construction of water reservoir at Lakan
- Expansion and upgrading of the water supply network
- Replacement and rehabilitation of existing distribution system
- Installation of pressure reducing valves for modulating the pressure in various parts of the network
- Provision of control and instrumentation in the water supply system

It is to be pointed out that other works that are part of the water supply system are currently being constructed under other contracts administered by GRWA. These works include:

- Rehabilitation of the two elevated storage tanks at Rasht
- Transmission main from Ghazian to Anzali ground water reservoir
- Ground and elevated water tanks with pumping system at Ghazian

Other water supply works undertaken by GRWA and shall be executed in the future, and comprise of the following:

- Expansion of the existing Sangar WTP
- Construction of two ground reservoirs with pumping facilities adjacent to the Rasht elevated storage tanks

<u>Wastewater Collection and Treatment Component</u>

- Provision of house connections
- Construction of interceptors and laterals
- Construction of trunk mains with pumping and lift stations;

- Construction of first module at Ghazian wastewater treatment plant
- Construction of the discharge outfall for conveying the treated effluent from Ghazian wastewater treatment plant to Talebabad River.
- Upgrading the currently under construction Rasht WWTP process. The upgrade works shall include the provision of BNR system, and the provision of emergency storage facility.
- Upgrading the currently under construction Anzali WWTP process. The upgrades works shall include the provision of BNR system, and the provision of emergency storage facility.

It is to be pointed out that other works that are part of the wastewater collection and treatment system are currently being constructed under earlier contracts. These works include:

- The first module in the Wastewater Treatment Plant at Rasht
- The discharge outfall from Rasht WWTP to Saighalan River
- The first two modules of Anzali WWTP at Ilyaran
- The discharge outfall for conveying the treated effluent from Ilyaran wastewater treatment plant to a water body tributary to Anzali Lagoon.

The following table presents a summary of the population growth, anticipated connection rate, corresponding water demand levels and generated wastewater flows that were used for the development of the feasibility study.

Table 3-1: Population and Demand Growth Levels of Project Area

Item	Description	Project period			
		2009	*2012*	*2017*	*2027*
Rasht					
1	Population	581,900	632,100	725,700	956,600
WATER SUPPLY					
2	Population connected to water distribution network	564,300	632,100	725,700	956,600
3	Population connected to distribution system , %	97	100	100	100
4	Total water demand (lit/s)	1,550	1,770	2,050	2,760
WASTEWATER					
4	Population connected to collection system	259,900	384,200	582,000	956,600
5	Population connected to collection system, %	45	61	80	100
6	Total wastewater flow in (lit/s)	589	890	1,387	2,321
Anzali					
1	Population (summer season)	164,600	178,700	202,200	252,000
WATER SUPPLY					
2	Population connected to water distribution network	162,900	178,700	202,200	252,000
3	Population connected to supply system, %	99	100	100	100
4	Total water demand (lit/s)	395	444	521	657
WASTEWATER					
5	Population connected to collection system	108,000	145,000	183,200	252,000
6	Population connected to collection system, %	65	81	91	100
7	Total wastewater flow in (lit/s)	228	312	418	592

3.3 Water Supply

3.3.1 Central & East Gilan Water Supply Scheme (C&EGWSS)

The water supply requirements of both Rasht and Anzali are provided by the Central and East Gilan Water Supply Scheme, which is the main water supply project of the province. In addition to Rasht and Anzali, the scheme provides water to the neighboring townships and rural areas of Lahijan, Langerood, and Astaneh Ashrafieh.

This scheme was developed to meet the water demand for a year 2017 population of 2.3 million people, 1.3 million of which reside in urban areas and the rest live in rural areas. In accordance with the feasibility study, the average water consumption of above areas of Central and East Gilan in 2027 is currently estimated 574,000 m^3 per day (6,300 liters per second). The maximum daily demand in these areas at year 2027, when considering a peaking factor of 1.25, is estimated to be 719,000 m^3 per day (8,300 liters per second). This quantity of water will be supplied from the following sources as follows[1]:

• Sangar Water Treatment Plant (current capacity 3000 l/s)	6,000 l/s
• Existing Sangar ground water sources of Fehlman and Emamzadeh wells and Emergency Water Treatment Plant (current capacity 300 l/s)	1,000 l/s
• Extension of Emergency Water Treatment Plant	500 l/s
• Extension of Sangar ground water sources (Fehlman wells)	500 l/s
Total	**8,300 l/s**

3.3.2 Description of C&EGWSS to Rasht and Anzali

The C&EGWSS to Rasht and Anzali is presented on drawings C&EGWSS-IR-100 and C&EGWSS-IR-101-2, and comprise of the following components:

Water Sources & Intake Structures

Raw water for the supply scheme is obtained from three sources: the rivers of Sefidrood, Shahre Bijar, and the Fehlman wells which are replenished from the Sefidrood basin.

[1] Background Report on Rasht Water Supply Network Extension and Relevant Facilities by Iranab Consulting Engineers- February 2002.

The Shahr Bijar River provides the raw water to Sangar Treatment Plant via a diversion dam and two 1400 mm pipelines discharging the water to the Guilerud irrigation canal, which conveys the water finally to the Sangar Water Treatment Plant. Sefidrood River also provides water to Sangar treatment plant via Emam Reza diversion dam, which diverts the water to Guilrud irrigation canal. Due to the lower quality of Sefidrood River, the maximum withdrawal rate from this river is set at 1.5 m^3/sec and is restricted to the season when the suspended solids has low concentration. The Sefidrood River also provides water to the Emergency Treatment Plant through the Sangar Left Canal.

Water Treatment Plants and Conveyance to Intermediate Storage

The Sangar Water Treatment Plant has a present capacity of 3 m^3/sec and utilizes a conventional water treatment process, which is comprised of the following units:

- Raw Water Intake Structure
- Coarse and Fine Screens
- Raw Water Pumping Station
- Destabilization and Distribution Structure
- Primary Settling Tanks
- Chemical Preparation Buildings
- Coagulation and Flocculation chamber
- Clarification tanks
- Filtration
- Disinfection
- Treated water reservoir and high lift pumping station

The high lift pumping station conveys the treated water from the 10,000 m^3 reservoir located on the plant site to the 50,000 m^3 Saravan reservoir, which is 55 m higher in elevation than the treated reservoir and located 4 km away from it, via two 1250 mm diameter pre-stressed concrete lines.

At the present, the sludge produced amounts to 420,000 tons of dry solids per year, and is expected to reduce to 190,000 tons of dry solids when most of the raw water will be sourced from Shahr Bijar River. With regard to sludge treatment and disposal, at present the sludge produced in the plant is discharged at the downstream end of Guilerud irrigation canal. However, considering the amount of sludge produced, a sludge treatment and disposal system is currently under design and is expected to be in operation in the next two years. This system will comprise of: (1) gravity thickening using belt thickeners (2) sludge conditioning using polyelectrolyte (3) mechanical dewatering using belt filter presses to 30% solids content and (4) final sludge disposal to Rasht municipal solid waste disposal site located in Saravan.

As for the Emergency Water Treatment Plant, it also utilizes a conventional water treatment process and has a current capacity of 300 l/sec. The WTP is comprised of the following units:

- Raw Water Intake Structure
- Primary Settling Tanks
- Pulsator clarification unit
- 3,000 m^3 treated water reservoir and booster pumping station

The booster pumping station conveys the treated water from the treatment plant directly to Rasht via a 700 mm transmission line. The present sludge production is estimated at 42,000 tons per and is expected to reach 84,000 tons/year in 2027. Currently the sludge is disposed off to the Saravan solid waste disposal site.

With regard to the Emamzadeh Hashem's Fehlman well water, it is pumped to a 6,000 m^3 reservoir situated at Shah Abbassi height at about 20 km distance from Saravan reservoir, wherein it is transferred through a 700 mm pre-stressed concrete gravity line to the 50,000 m^3 Saravan reservoir.

It is to be noted that chlorine is injected at a dosing rate of 2-5 mg/l at the water treatment facilities, pumping stations at the wells, and immediately after the storage reservoirs.

Intermediate Storage & Distribution

Following storage at the Saravan water tank, the water is conveyed to Rasht, Anzali, and Khomam via two pre-stressed concrete pipelines of 700 mm and 1250 mm to Rasht, which are then reduced to 500 mm and 1000 mm between Rasht to Anzali.

3.3.3 Water Supply System Quality

The quality of the raw water sources as well as the quality of the treated water that form part of C&EGWSS is presented in Table 3-2 below. Iranian drinking water standards, and WHO standard are also presented in the same table for comparison purposes.

Table 3-2: C&EGWSS Water Quality

Parameter	Sefidrood River	Shahr Bijar River	Fehlman Wells & Shallow wells of Sangar	Sangar WTP Treated Water Quality	[1]Iranian Standard Max Desirable/Max Permissible	WHO Standard Max Desirable/Max Permissible
Turbidity, JTU	12-566	-	5-7.3	0.2-2	5 / 25	5 / 25
Colour, PT-CO	0.4-8	-	7-9	0-6	5 / 20	5 / 50
pH	7.5-8.3	6.85-9.4	7.2-7.8	7.2-7.9	7-8.5 / 6.5-9.2	7-8.5 / 6.5-9.2
TDS, mg/l	240-1446 Ave: 677	69-417 Ave:158	550-700	250-1456	500 / 2000	[2]500 / 1500
Total Hardness as mg/l $CaCO_3$	160-425 Ave: 309	100-109 Ave: 156	270-300	160-415	-- / 500	[2]100 / 500
NO_2, mg/l	0.0003-0.6	0.004	0.003-	0.003-0.5	0 / 1	3
Mg, mg/l	8.5-42.5 Ave: 27.2	0.1-8.46	22-28	8.9-47	30 / 150	2150
Fe, mg/l	0-0.18	0	0.05-0.28	0-0.18	0.1 / 1	[2]0.1 / 1
Mn, mg/l	0-2.82	-	-	0-0.15	0.05 / 0.5	0.05 / 0.5
SO_4, mg/l	37-301 Ave:216	0-7	57-110	55.7-315	250 / 400	200 / 400
Cl, mg/l	50-590 Ave:203	0.02-10 Ave:6	99-174	52-639	200 / 600	200 / 600
Ca, mg/l	44-126 Ave:80	28-54 Ave:42			250	
Na, mg/l	90	4			200	
NO_3, mg/l	0.44-27.7	0.4	0.44	0.44-17.44	-- / 45	50
NH_4, mg/l	0.02-0.6	-	0.1-0.15	0.015-0.5	0.05 / 0.5	-
F, mg/l	0.21-0.62	-	0.34-0.55	0.21-0.96	0.9 / 1.2 Min Required: 0.8	0.6 /1.5

[1]: **Potable standard according to Management & Planning Organization, MOE**

[2]: **1971 standard**

From above table it can be seen, that the treated water quality is in compliance with prevailing standards, with the exception of the minimum value required for Fluoride in accordance with Iranian standards. It should be noted though, that according to the latest WHO drinking water quality standards, there is no minimum health related guideline value for Fluoride.

3.3.4 Water Supply System Quantities

The water supply and demand situation throughout the four phases of the project is examined in this section to assert that the proposed scheme is being reasonably developed to meet the growing water demand in the project area.

Capacity of Water Resources

In accordance with table 6-1a of the project feasibility study the capacity the water supply resources of C&EGWSS are as follows:

- Sefidrood River: 120 m^3/sec
- Shahr Bijar River: 0.38-81.5 m^3/sec, with average flow of 6.25 m^3/sec
- Fehlman Wells, and shallow wells: 1.3 m^3/sec

The capacity figures provided for the rivers are based on 31 years (1967-1988) of measurement that were undertaken by GRWA, and reflect the annual average supply capacity of each source. It is obvious that the sum total of the capacity of resources exceed by far the 8.3 m^3/sec of year 2027 demand.

Capacity of C&EGWSS Supply Facilities

The C&EGWSS is comprised of developing water treatment facilities, pumping stations, transmission lines, and water storage facilities. According to the Rasht feasibility study, the works related to transmission lines, pumping stations, and storage tanks have been identified and sized and were put on high construction priority by the National Management and Planning Organization and the MOE, due to the critical water supply situation in Central and East Gilan. It is anticipated that these works will be completed in the year 2007.

As the Guilerud Canal (12 m^3/sec capacity) and Sangar left Canal are presently of adequate capacity to meet the target year requirements, the capacity of the C&EGWSS facilities will be limited by the capacity of its treatment plants and supply sources. The capacity of the treatment plants and the planned expansion program is outlined in the table below.

Table 3-3: C&EGWSS Supply Facilities Capacities

	Present Capacity	Expansion Capacity and Target Year
Emergency WTP	300 l/s	300 l/s by year 2027
Sangar WTP	3,000 l/s	3,000 l/s by year 2009
Fehlman Wells	700 l/s	500 l/s between 2017 & 2027
Lahijan Astaneh Wells	250 l/s	500 l/s between 2017 & 2027
Grand Total	4,000 l/s	4,300 l/s
Total future capacity	8,300 l/s	

Water Demand for Rasht, Anzali, and Central and East Gilan

The water demand for Rasht was estimated according to the requirements of the feasibility study TOR, which split the water demand to domestic, commercial and industrial (non-domestic) and Unaccounted For Water. The domestic water demand has been estimated based on Directive No. 117 issued by the Ministry of Energy, wherein the future water demand is a function of living standards, public health, and other factors. The present water demand per capita is estimated at 137 l/day and is expected to increase to 150 l/day by the year 2027. The non-domestic demand was estimated at 28% of the domestic water demand in the year 2004 and is expected to increase to 33% of the domestic water demand by year 2027. With regard to Unaccounted for Water, the GWWC estimates that currently it stands at 36% of the total water demand and expects it to reduce to 20% by the year 2027 as a result of the plans that were drawn to reduce UFW in compliance with the requisites of MOE directive No. 117-3. Based on the above estimates in demand, population forecasts, and the network coverage, which is expected to increase from 89 % to 100 % in year 2012, the forecast of the average demand for Rasht city was calculated at 123,600 m^3/day (1,430 l/s) in year 2004 and 238,600 m^3/day (2,760 l/s) in year 2027.

In a similar manner to Rasht, the non-domestic demand of Anzali was estimated at 31% to 32% of the domestic demand. Also the UFW was estimated at 24% of domestic water demand in the year 2004 and is expected to decrease to 15% by the year 2027. As for network coverage, it is estimated at 85% at the present time and is expected to reach 100% by year

2012. Based on these figures, and the estimates of per capita domestic demand and the forecast of the population growth rate, the water demand in Anzali was calculated at 26,840 m^3/day (311 l/s) in the year 2004 and 56,740 m^3/day (657 l/s) in the year 2027.

As for the remaining areas of the central and east Gilan, the water demand was estimated as part of the study for the C&EGWSS system conducted in the year 1991. At that time, the plans were made to cater for the demand in the year 2017; however in view of the decreasing population growth rate, and the additional water resources developed in the rural areas, it is currently forecasted that the C&EGWSS will cover this region's water demand up to the year 2027. According to the feasibility study, the plan will provide on average 365,800 m^3/day (4234 l/s) to 2,018,000 people in year 2009 and on average 573,600 m^3/day (6,639 l/s) to 2,823,600 in year 2027. The demand of Rasht and Anzali and the remaining areas of the Gilan province are shown in table 3-4 below.

Rasht and Anzali Water Balance

Based on the water demand of the two cities, the expansion program of water resources and the water treatment plants, and the water demand of the remaining areas in East and Central Gilan, the water balance for the project area was determined and is represented in table 3-4 below.

As can be seen from the table, only at the initial years of phase 1 there is a deficit in the water supply, which according to the feasibility study will be limited to the east Gilan areas that do not include the present project areas of Rasht and Anzali. The distribution of the water resources throughout the different phases of the project and among the different areas of the C&EGWSS project are also shown in the drawings in Annex A.

Table 3-4: Water Balance of East and Central Gilan

Year	2004	2009	2017	2027
Water Demand				
1. Population				
Rasht	506,800	581,900	725,700	956,600
Anzali	143,400	164,600	202,200	252,000
Subtotal 1	650,200	746,700	927,900	1,208,600
[1]Central Gilan	554,900	609,900	691,600	†763,957
[2]East Gilan	602,100	661,400	770,400	†851,001
Subtotal 2	1,157,000	1,271,300	1,462,000	1,614,958
Grand Total	**1,807,200**	**2,018,000**	**2,389,900**	**2,823,558**
2. Maximum Daily Demand, m^3/day				
Rasht	154,500	170,875	221,125	298,250
Anzali	33,551	40,374	56,288	70,926
Subtotal 1	188,051	211,249	277,413	369,176
[1]Central Gilan	86,685	103,527	131,229	†144,958
[2]East Gilan	120,520	142,800	185,074	†204,744
Subtotal 2	207,205	246,327	316,303	349,702
Grand Total	**395,256**	**457,576**	**593,716**	**718,878**
Water Supply				
3. Water Resources Capacity, m^3/day				
Sangar WTP	259,200	518,400	518400	518400
Emergency WTP	25,920	25,920	25920	51840
Emamzadeh Fehlman Wells	64,800	64,800	64800	64800
Sangar Fehlman Wells				47,280
Lahijan Astaneh Wells				43,200
Total	**349,920**	**609,120**	**609,120**	**725,520**
4. Water Balance, m^3/day	**-45,336**	**151,544**	**15,404**	**6,642**

[1]Central Gilan includes: Khoshbijar, Khomam, Sangar, Kouchesfahan and Lashtenesha and rural areas of Rasht and Anzali

[2]East Gilan includes; Lahijan, Astaneh Ashrafieh, Dehshal, Kia Shahr, Siahkal, Langarood and Komeleh

†Figures were assumed based on 1% population growth rate and per capita demand constant between 2017 and 2027.

3.3.5 RASHT Existing Water Supply System

The water distribution network was constructed in the year 1970, wherein some 42 km of asbestos cement pipes of diameters 100 to 400 mm where installed in the city's main streets. This basic network which served the town's central area was fed by 2.5 km of transmission lines of 500 to 700 mm pre-stressed concrete pipes.

3.3.5.1 Water Distribution System

The initial system installed in 1970 served the city's inhabitants through taps installed in public locations. Within two years, the network expanded by the construction of 43 km of lateral lines made of 63 mm and larger diameter asbestos cement piping, and gradually as the city expanded and the water demand increased, house connections were installed to replace the public taps initially constructed.

The growth in the water supply network occurred in haphazard manner. Around 1,403 km of asbestos cement piping and cast iron piping was installed without planning and without the implementation of good engineering practices. As a result of these construction conditions, the water pressure at the boundaries of the city and in new developed area drops during the summer season when the demand for water supply becomes high. This inadequate water supply situation is aggravated by (1) the fact the piping system has a high leakage rate due to its old age and corroded conditions, (2) direct connection of the water supply network to the transmission mains without intermediate storage.

The foregoing network conditions have resulted in a high Unaccounted for Water rate, estimated by the Gilan Water and Wastewater Company at 44% in the year 2001, which exceeds the country's average of 30%. As a matter of fact, GWWC reported that the number of breakage in the distribution system in the year 2003 amounted to 4,617 cases.

With regard to the extent of coverage, the network currently serves 78,408 connections, which represent 85% of the total demand in the city. The outstanding 15% not supplied through the city's network, obtain their water through shallow wells of unacceptable water quality, according to the feasibility study.

3.3.5.2 Water Storage System

Presently, Rasht has no storage facilities. The three previously constructed elevated water tanks for maintaining water pressure in the city's water supply network have been severely damaged by the tremors that occurred in 1992. The 1,500 m^3 elevated water tank was completely destroyed, whereas the other two 2,500 m^3 water tanks have sustained heavy damages and are currently under repair and strengthening.

It should be noted though, that the two elevated storage tanks do not have the sufficient storage volume for the city's future population of 1 million; therefore additional storage facilities will be required as outlined in the proceeding sections.

3.3.6 ANZALI Existing Water Supply System

The water distribution network was constructed in the year 1972, wherein some 15 km of asbestos cement pipes of diameters 100 to 300 mm where installed in the city's main streets. This basic network which served the town's central network was fed by 4 km of transmission lines of 500 mm pre-stressed concrete pipes.

3.3.6.1 Water Distribution System

The initial system installed in 1972 served the city's inhabitants through taps installed in public locations. Within two years, the network expanded by the construction of 47 km of lateral lines made of 63 mm and larger diameter asbestos cement piping, and gradually as the city expanded and the water demand increased, house connections were installed to replace the public taps initially constructed.

The growth in the water supply network occurred in haphazard manner; wherein around 185 km of mainly asbestos piping was installed without planning and without the implementation of good engineering practices. As a result of these construction practices, the water pressure in some parts of the distribution system, specially in Ghazian is inadequate due to old age and the partly undersized piping system

The foregoing network conditions have resulted in the Unaccounted for Water rate of 26% in the year 2001 according to the estimates of the Gilan Water and Wastewater Company. This UFW rate is less than the country's average of 30%. GWWC reported that the number of breakage in the distribution system in the year 2003 had amounted to 844 cases.

With regard to the extent of coverage the network currently serves 17,600 connections, which represent 85% of the total demand in the city. It is anticipated that 100% service coverage will be achieved by the year 2012 through the gradual implementation of the expansion program.

3.3.6.2 Water Storage System

The storage facilities at Anzali comprise of a 10,000 m^3 ground water reservoir and 1,500 m^3 elevated storage tank in Anzali sector. These facilities will be complemented by additional storage tanks in the Ghazian sector as will be discussed in the proceeding sections.

3.3.7 Objective of Water Supply Plan

Due to the major shortfalls described in the preceding section, the current water supply problems will intensify and aggravate in view of the anticipated increase in population growth and associated urban development.

The objectives of the Rasht & Anzali water and wastewater plan are to address these problems by expanding the potable water network and upgrading the water supply facilities to achieve the following:

- Provide sufficient water supply quantities up to the year 2027 and
- Provide water quality in accordance with prevailing drinking water quality standards.

In order to achieve these objectives, the plan attempts to accomplish the following:

1. Expand the existing water treatment facilities and increase the ground water resources to guarantee the required supply of water to meet the demand at various stages of the plan;
2. Stabilize water pressure in various points of the water distribution network by providing pressure reducing valves at the appropriate locations;
3. Increase water storage capacity through the construction of suitably designed storage reservoirs to meet peak water demands and to eliminate excessive pressure build up through direct pumping into the network;
4. Rehabilitate the network, and replace worn-out pipes to reduce UFW to acceptable standard levels;
5. Expand the current work by the construction of new transmission mains.

3.3.8 Existing Sangar Water Treatment plant

The water treatment plant at Sangar supplying both Rasht and Anzali with water is based on rapid sand filtration process. The sequence of water treatment could be summarized as follows:

- Pre - Chlorination as initial treatment
- Coagulation and flocculation and sedimentation to get rid of suspended solids
- Rapid sand filtration
- Post chlorination

Other facilities available at the water treatment plant are described as below:

- Laboratory facilities

  A 70 square meter laboratory with necessary equipment is provided to ensure appropriate water quality.

- Supplementary buildings
  - An administration building of 345 square meter area including rooms for manager, secretary and staff is provided
  - Transformer building
  - A workshop and spare parts storage building of 185 square meter area
  - A guard house of about 40 sq.m.

3.3.9 Proposed Water Supply Plan Phasing

The target year 2027 was selected for the Plan for Expansion of Rasht and Anzali Water Distribution Network based on the results of studies conducted on existing facilities, projected limits on the physical expansion of the two cities, the current and identified resources of potable water supply and finally, the Ministry of Energy directive concerning this region's water supply requirements.

To achieve the objectives set for the year 2027, the project was subdivided into the following four phases:

- Phase I, 2005 – 2009
- Phase II, 2010 – 2012

- Phase III, 2013 – 2018
- Phase IV, 2018 – 2027

3.3.10 Summary of the Water Supply Works

The water supply system can be described in terms of the works that will be conducted in each phase per following;

FIRST PHASE EXTENSION (2005 to 2009)

1. Water Treatment Plant at Sangar
    - Increasing the capacity of the existing water treatment plant by 3,000 litres/sec. This task will be undertaken by GRWA, and does not fall within the responsibility of GWWC.
2. Transmission main, Reservoirs and Pumping Stations
    - Construction of 15 Km 1250 mm diameter pre-cast concrete transmission main from Saravan reservoir to Lakan storage tank by GRWA.
    - Construction by GRWA of two 40,000 m^3 ground water reservoir with pumping systems adjacent to the elevated tanks in Rasht. Each pumping station has a rated capacity of 1,100 liters/sec.
    - Construction of a 30,000 m^3 ground reservoir at Lakan with and 4 Km. ductile iron 1000 mm transmission main to Rasht City.
3. Water Distribution System
    - Laying of 22.9 Km. ductile iron pipe lines ranging in diameter from 500 mm to 1000 in Rasht
    - Laying of 166 Km. polyethylene and ductile iron pipe lines ranging in diameter from 100 mm to 400 mm in Rasht
    - Laying of 13.3 Km. ductile iron pipe lines for rehabilitation and extension of Anzali network, ranging in diameter from 300 mm to 500 mm.
    - Laying of 142 Km. polyethylene pipe lines for rehabilitation and extension of Anzali network, ranging in diameter from 63 mm to 250 mm.
    - Installation of control and instrumentation system in Rasht and Anzali.

SECOND TO FOURTH PHASE EXTENSION (2010 to 2027)

1. Water Treatment Plants & Water Resources

   - Increasing the capacity of the existing emergency water treatment plant by 300 liters/sec. This task will be undertaken by GRWA, and does not fall within the responsibility of GWWC.
   - Increasing the capacity of the Sangar Fehlman wells by 500 liters/sec. This task will be undertaken by GRWA, and does not fall within the responsibility of GWWC.
   - Increasing the capacity of the Astaneh Fehlman wells by 500 liters/sec. This task will be undertaken by GRWA, and does not fall within the responsibility of GWWC.

2. Water Distribution System

   - Laying of 35.6 Km. ductile iron pipe lines ranging in diameter from 500 mm to 1000 in Rasht.
   - Laying of 830 Km. polyethylene and ductile iron pipe lines ranging in diameter from 100 mm to 400 mm in Rasht.
   - Laying of 2 Km. ductile iron pipe lines for rehabilitation of Anzali network, ranging in diameter from 300 mm to 500 mm.
   - Laying of 141 Km. polyethylene pipe lines for rehabilitation and extension of Anzali network, ranging in diameter from 63 mm to 250 mm.

3.3.11 Projected Costs of the Water Supply Works

The cost estimate of the water supply project throughout its phases is as follows: (figures are in US Dollars):

Table 3-5: Water Supply Works Projected Costs (US$)

Item	Project Component	First Phase (2005-2009)	Second to Fourth Phase (2010-2027)
A. Base Costs for Rasht Water Supply Works			
1.	Distribution system; 110-200 mm pipe Dia	22,303,900	43,637,500
2.	Water Supply Line; 250-900 mm pipe Dia.	11,213,725	15,215,625
3.	Feed Line; 1000 mm Dia.	1,792,375	1,637,500
4.	Lakan 30,000 m^3 reservoir and relevant facilities	1,875,000	0
5.	Saravan-Lakan Transmission Main by GRWA	6,250,000	0
6.	Rehabilitation of Existing Elevated Tanks; 2x2,500 m^3 by GRWA	500,000	
7.	2x40,000 m^3 ground water reservoirs with pumping stations and relevant facilities by GRWA	5,625,000	
8.	Control and Instrumentation System	225,000	137,500
Subtotal A Base Costs		49,785,000	60,628,125
Contingencies A		8,245,127	23,459,111
Engineering & Construction Supervision A		4,062,109	5,886,107
Total for Rasht water Supply works		**62,092,236**	**89,973,343**
B. Base Costs for Anzali Water Supply Works			
1.	Completion of transmission main from Ghazian reservoir to Anzali Reservoir by GRWA	625,000	0
2.	Ghazian 30,000 m3 ground reservoir with pumping station and elevated tank	2,500,000	0
3.	Distribution network pipe mains 300-500 mm	1,400,000	307,500
4.	Distribution network lateral and sub-lateral 63-250 mm	4,617,500	4,425,000
5.	Control and Instrumentation	68,750	41,250
Subtotal B Base Costs		9,211,250	4,773,750
Contingencies B		1,434,485	2,167,503
Engineering & Construction Supervision for B		745,201	485,888
Total for Anzali Water Supply Works		**11,390,936**	**7,427,141**
Grand Total for Water Supply Works		**73,483,172**	**97,400,484**

3.3.12 Pre-Construction Activities

The most important initiatives required before commencing the execution of the planned water project are:

1. Land Acquisition

- Land acquisition for transmission mains, force mains, and distribution piping.

All the water distribution pipes, transmission mains, and distribution piping, will be constructed within the limits of existing roads, and therefore there is no need for land acquisition.

- Land acquisition for Saravan- Lakan transmission main

The transmission line will be laid within the limits of the irrigation channel reservation area, which belong to GRWA. Therefore there is no need for any land acquisition.

- Land acquisition for storage reservoirs, valve chambers and pump stations

The land required for constructing the 30,000 m^3 Lakan reservoir belongs to the Natural Resources Department, which has given it away to Gilan University. The acquisition of the land from both Gilan University and the Natural Resources Department is currently in process.

The land required for constructing the two 40,000 m^3 ground reservoirs and the related pumping stations has been already procured by the GRWA 26 years ago. Similarly, GRWA already acquired the land needed for the 30,000 m3 ground reservoir, elevated tank and related facilities in Ghazian.

- Land acquisition for extension of Sangar WTP and Emergency WTP and related facilities.

The land required for this purpose has already been procured by Gilan Regional Water Authority.

2. Resettlement of People

No resettlement of people will be necessary for the construction activities in the project.

3. Planning and Liaison

The construction of the water supply network and the other works of the project will require that construction activities are carefully planned to minimize disruption and that good liaison is maintained with other authorities.

The planning and liaison process should commence during the design of the project. At this stage, consultations with municipality, police traffic department, and various utility companies are conducted to ensure minimal disturbance to the population, and avoidance of possible conflict with other utility services.

4. Public Consultations

Considering the scale of this project, it is inevitable that the public will suffer in the short term from construction disturbances. It is therefore imperative that public awareness of the long term benefits of the project be raised at the commencement of the project. Consultations during the initial planning phase, as well as subsequent phases, will assist in the smooth running of the project. The subject of public consultation is further discussed in Chapter 5.

3.3.13 Construction Activities

Construction of the project is to be carried out under several contracts. It is planned that several contracts be made, covering the first phase works, for the different components the project. A preliminary schedule of the contracts is as follows:

Rasht

- Five contracts for distribution system extension.
- One contract for the distribution system replacement.
- One contract for the Lakan 30,000 m^3 water reservoir.
- One contract for the control and instrumentation.

Anzali

- Three contracts for distribution system extension.
- Three contracts for the distribution system replacement.
- One contract for the control and instrumentation.

3.3.14 Post-Construction Activities

Following construction and commissioning of the works, operation and maintenance activities will comprise mostly of inspections, routine maintenance, and monitoring. Regular maintenance and inspections of all the projects components will be conducted in accordance with an agreed maintenance plan. The maintenance and inspection activities will include among others, physical status of the network, illegal connections, operating conditions of all the works, and periodic maintenance jobs.

Monitoring activities will be conducted for raw and treated water quality in all the components of the supply system to ensure full compliance with Iranian and other applicable Standards for potable water. Details on this subject are provided in Chapter 9.

3.4 Wastewater Collection, Treatment and Disposal in Rasht

3.4.1 Overview of Rasht And Anzali

Similar to many urban areas in Iran, Rasht and Anzali's wastewater management facilities are way underdeveloped and lack the basic components of a proper wastewater management system. Presently, a combined wastewater collection system which includes wastewater and surface water runoffs resulting from rainfall and infiltration, although inappropriate and inadequate, partially serves the city. About 85% of the population in Rasht and 70% of Anzali's population are connected to the existing sewerage system.

Rasht, being the biggest population centre on the up stream stretches of the Zarjoob and Goharood rivers, is the major polluter of these rivers, where pollution levels are increasing and are seriously affecting the environmental conditions in Anzali lagoon. During the summer season, the water quality of both rivers deteriorate drastically emitting noxious odours and presenting serious health hazards to the public as discussed in chapter 4.

Moreover, due to the high ground water level (0.5-1m below ground level) and inadequate sewerage system in both cities, the sewage is leading to the contamination of ground water. As there is no proper sewerage system in the city, some of the dwellings which are not connected with the existing traditional sewerage system due to topography or other reasons, have their own absorption wells in the vicinity of their houses. These absorption wells are actually pits without any bottom that contaminate the ground water which is being used by some of the local inhabitants through private wells in their houses.

In view of these conditions, which are causing health hazards, and serious repercussions on the city's development, the implementation of this wastewater project has become a high priority.

3.4.1.1 Objective of Sanitation Plan for Rasht and Anzali

Due to the major problems described in the preceding section, the current sanitation problems will intensify and aggravate in view of the anticipated increase in population growth and associated development.

The objectives of the Rasht and Anzali Water and Wastewater Project are to address these problems by expanding the wastewater collection network and developing the required treatment facilities to achieve the following:

- Improving public health conditions by providing the required wastewater management facilities;
- Protection of groundwater and surface water sources from pollution, thereby improving environmental conditions; and
- Achieving short- and long-term economic, social and sanitary advantages for the region.

3.4.1.2 Proposed Sanitation Plan Phasing

The target year 2027 was selected for development of the Rasht and Anzali sanitation plan based on the results of studies conducted on existing facilities, projected limits on the physical expansion of the city, and the current wastewater generation rates.

To achieve the objectives set for the year 2027, the project was subdivided into the following four phases:

1. Phase 1: 2005 – 2009
2. Phase 2: 2010 – 2012
3. Phase 3: 2013 – 2017
4. Phase 4: 2019 – 2027

Based on this plan, the number of population served by the end of phase 1 is 259,900 in

Rasht, representing 45% of its total population at that year, and generating 50,860 m^3/day of wastewater. In Anzali, 108,000 people representing 65% of that city's population at year 2009 and generating 19,710 m^3/day of wastewater will be served by 2009.

By the end of the fourth phase, there will be full coverage for the whole project area, with 956,600 people served in Rasht, generating 200,500 m^3/day of sewage, and a further 252,000 people in Anzali generating 51,160 m^3/day of sewage.

3.4.2 Drainage Zones in Rasht

The urban area of Rasht is divided into three drainage zones; the central zone located between the Zarjoob and Goharood rivers, and the eastern and western zones. Surface water and sewage are collected through existing channels and pipes and are being discharged into Zarjoob and Goharood rivers flowing in the eastern and western part of the city respectively. Downstream from Rasht City, these rivers join together and become the Pir Bazar Roga, which eventually discharges into Anzali lagoon and ultimately into the Caspian Sea.

Other areas within Rasht City are not connected to this combined collection system. Wastewater in these areas is discharged into surface bodies, open drainage channels and ditches. Traditional absorption wells for discharging wastewater are seldom used in Rasht due to the high ground water table and impermeable soil in the city.

3.4.3 Design

Detailed design has already been prepared for Rasht wastewater collection and disposal facilities. The feasibility Study of the project are currently in its final stage of preparation.

3.4.4 Wastewater Generation and Projected Flow in Rasht:

As reported in the Feasibility Study, the average wastewater generation in Rasht is taken as 85% of the water demand. By taking this ratio based on the amount of water consumption, the total per capita sewage generation rate (domestic and non-domestic) for the year (2009) and the target year (2027) becomes 156 lpcd and 170 lpcd, respectively. Ground water infiltration due to the high groundwater table is defined as 15 lpcd, as per the guidelines of PMO. Surface water infiltration is estimated at 25 lpcd.

Wastewater flow projections for Rasht at the first stage of planning (year 2007) till 2027 are shown in **Table 3-6**

Table 3-6: Projected Wastewater Flow for Rasht

Phase	Year	Population	% of Population Connected	Wastewater Flow (m^3/day)
Existing	2004	506,800	0	0
1	2007	550,600	28	29,920
end of 1	2009	581,900	45	50,860
2.	2012	632,100	61	76,920
3.	2017	725,700	80	119,800
4.	2027	956,600	100	200,500

3.4.5 Project components in Rasht:

The following lists the works in Rasht wastewater collection and disposal that will be undertaken during the first phase:

- Construction of wastewater collection system in priority areas.
- Construction of trunk mains, pumping/ lift stations etc.
- Completion of construction of Rasht Wastewater Treatment Plant.

The city wastewater collection network in Rasht is divided into three zones; Western, Central and Eastern zones.

First phase extension (year 2005 to 2009) includes the following:

- Laying of 513 Km. of pipe with diameter 200 mm to 500 mm.
- Laying of 160 Km of house connection sewer
- Laying of 31 Km. of trunk main (diameter ≥600 mm)
- Providing 68,000 house connections
- Construction of 20 pumping station
- Completion of Construction of the first module of the wastewater treatment plant with a capacity of 80,000 m^3/ day, and upgrading its performance by including BNR

and emergency storage tank.

- Laying of 430 m outfall main from wastewater treatment plant to Saighalan River.

3.4.6 Proposed Wastewater Scheme and Status of Works

A wastewater treatment plant in Rasht is presently under construction on a 19.5 hectares (300m x 650m) land plot already acquired for this purpose. This treatment plant is located about 4 Km. North West of Rasht, close to Pir Bazar road along the Zarjoob River. The original design capacity of this treatment plant is 63,000 m^3/day, extendable to 90,000 m^3/day. The Feasibility Consultant has subsequently proposed the modification of the existing plant to include a biological nutrient removal (BNR) system, which would reduce the capacity of the plant to 80,000 m^3/day. This will cover wastewater flows from all zones of Rasht (central, eastern and western) up to mid-2013. One pumping station in each of the central, eastern and western zones of Rasht will pump wastewater to the wastewater treatment plant currently under construction. About 20 lift/ pumping stations are required for the conveying the sewerage system of Rasht city to the WWTP during phase 1.

For the extension of the existing treatment plant from 2013 to 2027, Gilan Water and Wastewater Company are in the process of purchasing about 40 hectares of additional land. The purchase of this land is in process. By acquiring this land, a total of about 60 hectare land will be available for the design 2027.

3.4.7 Treatment process of Rasht WWTP

The wastewater treatment plant currently under construction was originally designed with the following design parameters:

Table 3-7: Initial Specifications for Rasht Wastewater Treatment Plant (under construction)

Item	Unit	Value
Average Capacity of WWTP	m^3/day	90,000
Population Equivalent	Persons	428,500
Wastewater Flow rate	Lpcd	210
BOD_5	g/m^3	238
BOD_M	kg/d	21,420
TSS_1	g/m^3	286
TSS_M	kg/d	25,740
TP	mg/l as PO_4^{3-}	4.64
TP	kg/d as PO_4^{3-}	418

Wastewater Treatment Scheme

Construction of the treatment plant is currently ongoing. The plant is designed based on the activated sludge process, and comprises three modules. Components of this process are as follows:

- Inlet works comprising mechanical and manual bar screens and flow measurement system;
- Preliminary treatment including aerated grit chambers;
- Primary sedimentation tanks consisting of three circular tanks and primary sludge pump station;
- Aeration tanks, consisting of three tanks equipped with surface aerators;
- Circular secondary sedimentation tanks (clarifiers) consisting of three tanks and excess sludge pump station;
- A chlorination unit equipped with a proportional dosage system for chlorine gas injection;
- Sludge treatment facilities, including sludge thickeners and anaerobic digestion

tanks;

- Mechanical sludge dewatering devices consisting of a belt filter press system;
- Incineration plant for dewatered sludge incineration, consisting of a complete plant including air pollution control equipment;
- Standby power generators: 2 sets of diesel generators providing a total output of 1.1MW, for operation of essential equipment during power failures.

As there is no need for reuse of effluent in agricultural irrigation due to availability of suitable quality irrigation water (see discussion on agriculture in chapter 4), the treated effluent will be used for stream augmentation by discharging it to Zarjoob River.

Upgrade and Modification of Scheme

As stated above, the Feasibility Study Consultant has subsequently proposed to modify the design of the plant currently under construction to reduce the levels of nutrients (nitrogen and phosphorus) in the effluent. This was deemed to be necessary due to the sensitivity of Anzali Lagoon, which is suffering from overload of nutrients in effluents reaching the lagoon with the occurrence of eutrophication in recent years. Accordingly, the Feasibility Study proposes an upgrade of the wastewater treatment plant to include an anaerobic/anoxic and aerobic (A^2/O) BNR process. Other changes and modifications proposed to the plant include:

- o Provision of treated effluent disinfection unit using UV as an alternative for replacing the current disinfection system in future;
- o Operating the WWTP in extended aeration mode due to reduced loading in the plant's initial phase of operation, which would result in rescheduling the construction of the anaerobic sludge digesters to subsequent phases of the project.
- o Construction of a sludge blending tank for complete mixing of primary and secondary sludge

The capacity of the modified wastewater treatment plant currently under construction would be 80,000 m^3/day. Therefore, this plant will be able to sufficiently treat the sewage flows in Rasht expected through the year 2013, after which a new extension of the treatment plant would be required up to the end of the planning period (2027).

Proposed Expansion of Rasht WWTP

As discussed above, an expansion to the wastewater plant currently under construction in Rasht is required by mid-2013. The proposed design capacity of this expansion plant is 120,000 m^3/day consisting of three treatment modules, each with a capacity of 40,000 m^3/day. The combined capacities of both the plant under construction and the proposed expansion plant will be 200,000 m^3/day, which would serve the forecast wastewater flows of Rasht City up to the year 2027. The design criteria for the expansion plant in Rasht is shown in Table 3-8 below.

Table 3-8: Design Criteria for Rasht Expansion WWTP

Parameter	Unit	Value
1. Population in target year	Persons	575,000
2. Volume of produced wastewater plus infiltration	m^3/day	120,000
3. Average BOD_5 concentration	mg/l	238
4. Average TSS concentration	mg/l	286
5. Phosphorus Concentration	mg/l as PO_4	4.6
6. TKN concentration	mg/l	40
7. pH of raw wastewater	-	7.5
8. Organic loading of plant	kg $BOD_{5/d}$	28,560
9. Solid loads entering plant	kg SS/d	34,329
10. Influent Phosphorus loading	kg/day as PO_4	557
11. Influent TKN loading	kg/day	4800

The proposed expansion plant will include the following:

- Preliminary Treatment units including: manual and mechanical screens and flow meters to measure the flow rate (Parshall flume);
- Preliminary treatment systems including: aerated grit and grease removal chambers;
- Primary sedimentation tanks, consisting of four circular tanks equipped with hoppers, sludge scrapers and primary sludge pumps;
- Main A^2/O reactor including: Anaerobic, anoxic and aerobic units with surface aerators;
- Final sedimentation tanks (clarifiers) consisting of four circular tanks;

- Effluent disinfection units, using UV systems equipped with high-voltage UV lamps;
- Sludge treatment and stabilization system including sludge Gravity Belt Thickener (GBT), sludge blending tank, and temperature phased anaerobic digesters or Thermophilic Mesophilic digesters (TPAD), and biogas storage tanks;
- Sludge dewatering system including belt filter presses (BFP)
- Fully equipped laboratory to monitor the quality of raw and treated wastewater

3.4.7.1 Effluent quality

The effluent quality limits for the treatment plant are those required by the Department of Environment (DOE) for discharge to surface water bodies. These requirements are included in appendix B-IV-2 and are represented in Table 3-9 below.

Table 3-9: Effluent Quality of WWTP Discharging to Surface Water

Sr. No.	Parameter	Standard value
1.	BOD_5 (mg/L)	30
2.	COD (mg/L)	60
3.	TSS (mg/L)	40
4.	Settable Solids(mg/L)	0
5.	DO- minimum(mg/L)	2
6.	Oil and grease (mg/L)	10
7.	Detergents (mg/L – ABS)	1.5
8.	pH	6.5-8.5
9.	Radioactivity (pci/ L)	0
10.	Turbidity (NTU)	50
11.	Colour (pt–co)	75
12.	Total Phosphate (mg/L – P)	≤ 1
13.	Ammonia (mg/L)	2.5
14.	Nitrite (mg/L – NO_2)	10
15.	Nitrate (mg/L – NO_3)	50
16.	Total Coliforms (No. /100 ml)	1000
17.	Coliform (No. /100 ml)	400

3.4.7.2 Treated Sludge Drying and Disposal

The final sludge disposal methods were investigated by the feasibility consultant, where it was confirmed that land application of sludge is not possible in view of the following:

- There is great public opposition to use of sludge in agriculture, since the predominant crop in the project area is rice, which has a very high commercial value. Agricultural practices include hand cultivation; and therefore due to a combination of commercial interests and social and religious beliefs, and health concerns, the application of treated sludge or treated effluent is unacceptable in the project area.
- The project area is characterized by humid and rainy weather for the greater part of the year (9 to 10 months) with up to 2000 mm rain, thus any scheme which relies on drying beds will invariably fail.
- Land filling of sludge was found to be feasible; however only at Saravan since land is not available in the vicinity of the treatment plant. The economic analysis conducted for this option in the feasibility study concluded that this method is 130% more expensive than incineration, which was based on the proposed price by the Contractor currently constructing the plant.
- Incineration was explored and was preferred due to its low space requirements and was found to be less costly as described above

Therefore an incinerator with a capacity of 4 tons/ hour is proposed for Rasht Wastewater Treatment Plant to burn the sludge which has 30% solid contents. (Note: after discussions with the World Bank team and the Consultants preparing the EIA, it was agreed that the risks and impacts for operating the incinerator outweigh the benefits and to study land disposal options. At the time of writing this EIA report, the Gilan WWC has been in discussion with the neighboring province of Qazvin to find the land for composting and storage of the sludge before land application.)

Sludge Production

By the year 2027, the Rasht Wastewater Treatment Plant will be producing an estimated quantity of 111 m^3/day of digested dewatered sludge (alternatively 176 m3/day of dewatered sludge without digestion) with 30% solid content. In addition, the proposed WWTP for Anzali will also produce an estimated 28 m^3/day of sludge by 2027 (discussed in further detail in the proceeding section). The Feasibility Study proposes that the Rasht incinerator be used for sludge from both Rasht and Anzali WWTPs. Total sludge thus collected will be 139 m^3/day of digested dewatered sludge (alternatively 204 m3/day of dewatered sludge without digestion). The incinerator capacity and its mode of operation is discussed in chapter 8.

The sludge incineration component of the project was subsequently examined in further detail as part of the post-environmental review (see Chapter 8), and found to be unacceptable. Accordingly, an alternative sludge management plan is under consideration by GWWC, GRWA, and relevant authorities. In this alternative plan, the dewatered and stabilized sludge will be hauled to an appropriate site for land application.

Drawings 7 and 8 in Annex A show the layout plans for the under construction and expansion WWTP in Rasht, respectively, which show the proposed facilities for both treatment plants.

3.4.7.3 Manpower Requirements

In accordance with feasibility study, the manpower required to operate Rasht WWTP is estimated for the ultimate year of operation at 9 engineers, 28 technicians, 8 clerks, 8 semiskilled workers, and 24 unskilled workers.

3.4.7.4 Chemical and Energy Consumption

The electrical power requirement of the treatment plant under construction is estimated to be 3.2 MVA, which will be supplied by the city's main power distribution system. Standby power is provided at 1.1 MW. The chemical and energy consumption of the treatment plant for each module is summarized in the table below:

Table 3-10: Chemical and Energy Requirements for Rasht WWTP

Description	Module 1 Year 2007	Module 2 Year 2009	Module 3 Year 2013	Total for Modules 1,2,3
Treatment plant capacity (m3/day)	26,700	26,700	26,700	80,000 m^3/day
Total energy requirement (kW)	495	870	1305	1305
Total chlorine requirement (tons/year)	200	400	600	600
Total Poly-electrolyte requirement (tons/year)	12	24	36	36

3.5 Wastewater Collection, Treatment and Disposal in Anzali

3.5.1 Drainage Zones

Anzali city is divided by a river flowing from the Anzali lagoon to the Caspian Sea. The urban area of Anzali is divided into two drainage zones, the eastern and western zones called Ghazian and Anzali respectively. Surface water and sewage are collected through existing channels and pipes and discharge into Rogas (rivers) then to Anzali lagoon and ultimately into the Caspian Sea. There are 32 sewage outfalls from Anzali into the lagoon, while 20 sewage outfalls from Ghazian discharge directly into the lagoon (see Exhibits 1, 2 in Annex G). There are 8 outfalls of the collection systems in Anzali that have direct outlets to Caspian Sea (see Exhibit 3 in Annex G).

Due to the natural drainage basin and the dividing river of Anzali, the city requires two independent sewerage systems, trunk mains and wastewater treatment plants.

The wastewater treatment plant in the western part of Anzali is called Ilyaran and is located at Margodeh. The effluent from this treatment plant will be disposed into the lagoon and finally get discharged into the Caspian Sea.

The eastern wastewater treatment plant in Ghazian is called Talebabad. This treatment plant is proposed to be located on the western edge of Talebabad River, some 200 m away and the treated effluent from treatment plant will be discharged into this river. Up to December 2004, there was no progress on the construction of influent trunk sewer or treatment plant in this part of the city.

3.5.2 Collection System Design

Detailed design and tender documents for Anzali wastewater collection and disposal facilities, trunk sewer, Ghazian sewerage, electro-mechanical works of several pumping stations, and eastern and western wastewater treatment plants have been prepared[2]. Due to the mild slope of the city and the shallow groundwater level, Anzali sewerage system is designed to have fourteen (14) pump stations for phase 1.

[2] Anzali Sewage Project, General description prepared for World Bank Delegation by Parsconsult Engineering Company- April, 2002.

3.5.3 Wastewater Generation and Projected Flow in Anzali

Average wastewater generation is taken as 85% of the domestic demand. By taking the amount of water consumption into account, the total per capita sewage (domestic and non-domestic) for the first year (2009) and the target year (2027) would be 143 and 163 lpcd, respectively, according to the Feasibility Study consultant. Ground water infiltration due to the high groundwater table is defined as 15 lpcd, as per the guidelines of PMO. Surface water infiltration is estimated at 25 lpcd.

Wastewater flow projections for Anzali at the first stage of planning (year 2007) till 2027 are shown in Table 3-11.

Table 3-11: Wastewater Projections in Anzali from 2007 till 2027

Phase	Year	Population	% of Population Connected	Wastewater Flow (m^3/ day)
Existing	2004	143,400	0	0
1.	2007	155,800	42	11,770
End of 1.	2009	164,600	65	19,710
2.	2012	178,700	81	26,950
3.	2017	202,200	91	36,100
4.	2027	252,000	100	51,160

3.5.4 Project Components:

The first phase extension of the wastewater collection and disposal systems in Anzali will comprise of the following:

- Construction of wastewater collection system in priority areas.
- Construction of trunk mains, pumping/ lift stations etc.
- Completion of the wastewater treatment plant currently under construction at Ilyaran (western part of Anzali) and possibly the second treatment plant in Ghazian (eastern part of Anzali)

First phase extension (year 2005 to 2009) includes the following:

- Laying of 206.5 Km. pipes with diameter 200 mm to 500 mm.

- Laying of 133 Km of house connection sewer
- Laying of 17 Km. of trunk main (diameter >600 mm)
- Providing 27,000 house connection
- Construction of 14 nos. pumping station
- Construction of first two modules of Ilyaran and Ghazian wastewater treatment plants with a capacity of 20,000 m^3/day and 14,000 m^3/day.
- Laying of outfall main from wastewater treatment plants to respective receiving bodies.

3.5.5 Proposed Wastewater Scheme and Status of Works at Western WWTP

Anzali's western Wastewater treatment plant is presently being constructed on a 14 hectare piece of land in Ilyaran. The total land required for the plant is reportedly 21 hectares. The purchase of remaining land by the Gilan Water and Wastewater Company has already been completed. Trunk sewer line of 600 mm diameter is under construction. It was informed by the GWWC that the length of sewer forcemain from Anzali to West Wastewater Treatment Plant (Ilyaran) is 5.5 km. About 95% Km of the sewer has been laid while laying of another 5% is in progress.

3.5.6 West WWTP Treatment process

The western Anzali treatment plant under construction is designed in three modules of 10,000 m^3/day capacity per module, each module covering a population of 50,000 persons. Currently two modules are under construction. The major design criteria of the western treatment plant are:

Table 3-12: Design Criteria for Western Treatment Plant in Anzali

Item	First Phase	Extension Phase
Population (persons)	100,000	150,000
Wastewater flow rate (lcpd)	200	250
Capacity (m^3/day)	20,000	30,000
Organic Loading (kg BOD_5/d)	4,000	7,040

Solid Loading (kg/d)	4,800	8,320

The designed treatment process for this plant is the Extended Aeration Activated Sludge Process. Major components of this process for wastewater, sludge processing, as well as for disinfection are as follows:

- Inlet works comprising mechanical and manual bar screens and magnetic flow meter for flow measurement;
- Preliminary treatment including aerated grit chambers;
- Aeration tanks equipped with surface aerators
- Circular secondary sedimentation tanks (clarifiers) and excess sludge pump station
- A disinfection unit equipped with UV system applying high rate UV lamps of 400 volts
- Sludge treatment facilities including sludge thickeners, mechanical sludge dewatering devices consisting of a belt filter press; and sludge storage area and tanks with a storage capacity of three months.

In order to provide maximum protection for the lagoon, the Feasibility Consultant has proposed the modification of the exiting process to include for Biological nutrient removal. This system will significantly remove phosphorous and nitrogen from the wastewater which will have a positive impact and result in reduction of the eutrophication problem of Anzali Lagoon. The subject is further discussed in the Post Environmental Review Chapter

Moreover, the original plant design was based on a combined sewerage and surface runoff collection system, which has since been re-configured to a separate collection system, thus reducing the amount and characteristics of wastewater flows.

By modifying the Extended Aeration process at the western plant, the following revised design parameters are used:

Table 3-13: Revised Design Parameters of Anzali WWTP

Specification	Unit	Value
Population Equivalent (PE)	Persons	138,600
Wastewater flowrate	Lpcd	203
Daily average flowrate	m^3/d	28,000
Hourly maximum flowrate	m^3/d	2,112
BOD_5 generation	g/cap.d	50
BOD_5 concentration	mg/l	246
BOD_M (organic loading)	kg BOD_5 /d	6,900
TSS generation	g/cap.d	60
TSS concentration	mg/l	295
TSS_M (Solids loading)	kg TSS/d	8,260

3.5.7 Proposed Treatment Plant for Eastern Anzali (Ghazian)

In view of the proposed modifications to the western plant in Anzali and the change in process to include a BNR, the maximum capacity of the western plant will be kept at around 28,000 m^3/d. The wastewater flows from Anzali's eastern zone will be treated in the proposed treatment plant in Ghazian. The proposed plant is based on the following design criteria:

Table 3-14: Design Criteria for Anzali's Eastern Zone WWTP (Ghazian)

Parameter	Unit	Value
1. Population in target year	Persons	113,400
2. Volume of produced wastewater plus infiltration	m^3/day	23,000
3. Average BOD_5 concentration	mg/l	246
4. Average TSS concentration	mg/l	295
5. Phosphorus Concentration	mg/l as PO_4	4.6
6. TKN concentration	mg/l	40
7. pH of raw wastewater	-	7.5
8. Organic loading of plant	kg BOD_5/d	5,660
9. Solid loads entering plant	kg SS/d	6,790
10. Influent Phosphorus loading	kg/day as PO_4	208
11. Influent TKN loading	kg/day	920

The Feasibility Consultant proposed an activated sludge system combined with an A^2/O BNR removal process for the Ghazian Plant, which would consist of the following:

- Manual and mechanical screens and flow meters to measure the flow rate (Parshall flume);
- Preliminary treatment systems including: aerated grit and grease removal chambers;
- Primary sedimentation tanks, consisting of four circular tanks equipped with hoppers, sludge scrapers and primary sludge pumps;
- Main A^2/O reactor including: Anaerobic, anoxic and aerobic units with surface aerators;
- Final sedimentation tanks (clarifiers) consisting of four circular tanks;
- Effluent disinfection units, using UV systems equipped with high-voltage UV lamps;
- Sludge treatment and stabilization system including sludge Gravity Belt Thickener (GBT), and sludge blending tank
- Sludge dewatering system including belt filter presses (BFP).

3.5.8 Effluent Quality

The effluent quality will be in compliance with the Iranian Standards for discharge to surface water bodies, as presented on table 3-9. Moreover, since biological nitrogen removal will be incorporated in the design of both plants, it is envisaged that total nitrogen in the effluent will be less than 10 mg/l.

3.5.9 Treated Sludge Production

Similar to Rasht, the application of sludge to land is not feasible due to public opposition for use in agriculture, and is even more restricted due to the very limited availability of land. Therefore in accordance with the feasibility study, the sludge will be hauled to Rasht for incineration. One incinerator has been planned for Rasht Wastewater Treatment Plant and the same can be utilized for the sludge produced from the Wastewater Treatment Plants in Anzali.

Anzali's two treatment plants combined will produce an estimated 28 m^3/day of sludge by 2027. The sludge will have 30% solid contents. Sludge produced at Anzali wastewater treatment plants will be transported to Rasht for incineration, which has an incinerator with a capacity of 4 tons/ hour

The sludge incineration component of the project was subsequently examined in further detail as part of the post-environmental review (see Chapter 8), and found to be unacceptable. Accordingly, an alternative sludge management plan is under consideration by GWWC, GRWA, and relevant authorities. In this alternative plan, the dewatered and stabilized sludge will be hauled to an appropriate site for land application.

Drawings 11 and 12 in Annex A show the layout plans for wastewater treatment plant at Eastern and Western zones of Anzali respectively which show the proposed facilities for both the treatment plants.

3.5.10 Chemical and Energy consumption

The chemical and energy consumption of the treatment plants at the end of phase 1 and 4 are summarized in the table below:

Table 3-15: Chemical and Energy Requirements of western & Eastern Anzali Treatment Plant

Description	At Year 2009	At Year 2027
West WWTP at Ilyaran		
Treatment Plant Capacity (m^3/day)	10,000	30,000
Total energy requirement (Kw)	270	800
Total Lime requirement (tons/year)	.38	114
Total Poly-electrolyte requirement (tons/year)	0.7	2
East WWTP at Ghazian		
Treatment Plant Capacity (m^3/day)	6,080	23,020
Total energy requirement (Kw)	100	375
Total Lime requirement (tons/year)	127	480
Total Poly-electrolyte requirement (tons/year)	4	15

3.6 Industries in Rasht and Anzali

3.6.1 Industrial Wastewater in Rasht

Industries in Rasht can be classified into two groups:

1. Rasht Industrial City (RIC)
2. Scattered industries located in Rasht

As planned, a separate treatment plant will be designed for the effluent of RIC which will not be connected to the proposed sewerage system. The various industrial activities operating in RIC include beverage, textile, electrical, chemical, sewing, ceramic and food industries. The effluent from RIC is not in the scope of this Project. However, industrial and commercial units, located in Rasht city, most of them on Rasht - Tehran road, will discharge their effluent into the proposed sewerage system. Presently, these units are discharging their effluent into the adjacent streams which eventually discharge into two main rivers; Goharood and Zarjoob in Rasht. The industrial units will have to pre-treat their effluent before discharging into the sewerage system to the level specified by the Ministry of Industry regulations for Industrial Effluent Quality Standard for Discharging to Sewerage System. The type and number of industries is further considered in chapter 4

3.6.2 Industrial Wastewater in Anzali

Regarding industrial effluent, there are two industrial complexes in Anzali which are called Hasan Rood and Beshm Complexes in the East and Western side of the city respectively. These industries are of large size and the two zones are located outside the city. Industrial activities operating in these zones include chemical, metal, wood, mineral (non-metal) and food industries. Effluent from these industries will not be connected to the proposed sewerage system of Anzali. The two industrial complexes will have their own treatment facilities whereby the DoE will be responsible for ensuring effluent compliance with the discharge standards.

In addition to the two large industrial complexes, there are scattered industries located inside Anzali. These industries are small in size and will be connected to discharge their effluent into the proposed sewerage system. At present, these units are discharging effluent into their adjacent streams which eventually discharge into Anzali lagoon. However, these industrial units must pre-treat their effluent before discharging into the sewerage system to the level specified by the Ministry of Industry regulations given in **Table 3 in appendix B-IV.** The type and number of industries is further considered in chapter 4.

3.7 Pre Construction activities

The following pre construction activities should also be performed in addition to the technical design of the Project.

3.7.1 Land Acquisition

- Land acquisition for main pipes and laterals

Pipes will be laid in public properties, parallel to and within the boundaries of existing access roads. Therefore, land acquisition is not required for these works. Location and routing of the pipes, however will be coordinated with the regional authorities responsible for other utility services, such as the Electricity Board, the Regional Water Board, and the Communications Department.

- Land acquisition for treatment plants

Land for the Rasht treatment plant has already been acquired except for the extension phase where GWCC is in the process of acquiring the land. Land for Anzali's western and eastern plants has been acquired. Land for outfalls of all treatment plants has been acquired.

3.7.2 Resettlement of People

No resettlement of people will be necessary during the construction activities in the project.

3.7.3 Coordination

Coordination with the Department of Environment and the Ministry of Industry to identify potential industrial users of the sanitary network and to ensure that pre-treatment of industrial effluents is being followed.

Other pre-construction activities will be the same as those discussed in section 3.3.12.

3.8 Construction Activities

Construction of the project is to be carried out under several contracts. It is planned that several contracts be made covering the first phase works, for the different components of the project. A preliminary schedule of the contracts is as follows:

Rasht

- 3 Contracts for house connections
- 9 Contracts for collection system trunk mains, interceptors, and laterals
- 3 Contracts for pumping stations
- 1 Contract for upgrading the wastewater treatment plant under construction to BNR and installation of UV system

Anzali

- 2 Contracts for house connections
- 9 Contracts for collection system trunk mains, interceptors, and laterals
- 2 Contracts for pumping stations
- 1 Contract for upgrading the wastewater treatment plant under construction to BNR

- 1 Contract for emergency reservoir for treatment plant under construction
- 1 Contract for first module of eastern wastewater treatment plant
- 1 contract for power transmission of eastern wastewater treatment plant

3.9 Post-Construction Activities

Following construction and commissioning of the works, operation and maintenance activities will comprise mostly of inspections, routine maintenance, and monitoring. Regular maintenance and inspections of all project components will be conducted in accordance with the agreed maintenance plans. The maintenance and inspection activities will include among others, physical status of the network, illegal connections, operating conditions of all the works, and periodic maintenance jobs.

Monitoring at the treatment plants will comprise of process monitoring for ensuring that process parameters are optimized, as well as environmental monitoring for mitigation of adverse potential impacts. In this instance, monitoring activities will be conducted for raw and treated wastewater qualities, treated sludge quality, air quality and receiving water bodies. Monitoring activities will be required to ensure full compliance with Iranian and other applicable Standards governing discharge to a water source.

Post-construction activities will also include capacity-building activities. These topics are all discussed in detail in Chapter 9.

3.10 Wastewater Project Projected Costs

The cost of the wastewater collection and treatment project for Rasht and Anzali is as follows:

Table 3-16: Wastewater Collection & Treatment Works Projected Costs (US$)

Item	Project Component	First Phase (2005-2009)	Second to Fourth Phase (2010-2027)
A. Base Costs for Rasht Wastewater Collection & Treatment Works			
1.	Execution of House Connections	18,835,500	39,527,405
2.	Execution of collection system laterals	5,550,688	16,171,313
3.	Execution of Collection System Interceptors	24,590,338	70,631,250
4.	Execution of Trunk mains > 600 mm dia	7,108,225	7,160,288
5.	Execution of Pumping Stations	11,931,113	11,135,720
6.	Upgrading of the under construction WWTP to BNR and Installation of UV system	1,875,000	0
7.	Construction of Emergency raw wastewater storage reservoir of the under construction WWTP	3,500,000	5,250,000
8.	Completion of under construction collection system	12,899,000	0
9.	Execution of Extension for WWTP	0	25,000,000
10.	Execution of Power Transmission line for WWTP	0	125,000
Subtotal A Base Costs		86,289,863	175,000,975
Contingencies A		13,362,868	83,894,953
Engineering & Construction Supervision A		6,975,691	18,013,869
Total for Rasht Wastewater Collection & Treatment Works		**106,628,421**	**276,909,797**
B Base Costs for Anzali Wastewater Collection & Treatment Works			
1.	Execution of House Connections	7,130,000	4,425,000
2.	Execution of collection system laterals	1,747,500	1,375,000
3.	Execution of Collection System Interceptors	12,914,625	9,500,000
4.	Execution of Trunk mains > 600 mm diameter.	4,206,375	241,250
5.	Execution of Pumping Stations	5,455,375	1,367,375
6.	Completion of the under construction WWTP & main Pumping St B.	1,073,750	2,250,00
7.	Upgrading of the under construction WWTP to BNR & Construction of Emergency reservoir	3,125,000	0
8.	Completion of under construction collection system (Western Zone)	5,250,000	0
9.	Execution of first module for Ghazian WWTP	3,750,000	2,500,000
10.	Execution of Power Transmission line for WWTP	87,500	0
Subtotal B Base Costs		44,740,125	19,408,625

Table 3-16: Wastewater Collection & Treatment Works Projected Costs (US$) (cont'd)

Item	Project Component	First Phase (2005-2009)	Second to Fourth Phase (2010-2027)
Contingencies B		7,512,766	8,781,629
Engineering & Construction Supervision for B		3,657,702	2,130,818
Total for Anzali Wastewater Collection & Treatment Works		55,912,000	30,321,072
Grand Total for Wastewater Collection & Treatment Works		162,539,014	307,230,869

4 Baseline Environmental Data

4.1 Introduction

In this section the environmental baseline data for the study area of both Rasht and Anzali Water and Wastewater Treatment Project shall be examined under three headings: Physical, Ecological Environment, Human and Economic Development, and Quality of Life. Since the project effects extend beyond the cities of Rasht and Anzali, the environmental conditions of the outlying area in Central and Eastern Gilan Province shall also be studied. This outlying area is indicated on map 13 in Annex A and termed the "Area of Influence". It is 63 km long by 38 km wide, with an overall area of 729 km^2.

To acquire data on the existing environment, environmental engineers conducted site surveys and observations and relied on existing project-related reports and background reports prepared by the feasibility study Consultants, in addition to Government agencies such as the Department of Environment (DoE), Gilan Water and Wastewater Company (GWWC) and Municipalities of Rasht and Anzali.

The City of Rasht, capital of the Gilan Province, is located in the northern part of Iran, 320 Km. from Tehran and about 20 Km. south of the Caspian Sea. It is located between 36° 34' to 38° 27' North (Latitude) and 48° 53' to 50° 34' East (longitude), with a total area of 6,797 hectares, as reported in 1997, which is expected to increase to 9,850 hectares by 2027.

As for the city of Anzali, the second most important city in the Gilan Province, it is located about 40 Km North West of Rasht at a 37° 28 ; North (Latitude) and 49° 28 ; East (Longitude) with a total area of 3,095 hectares. Anzali is surrounded by the Caspian Sea from the North, Anzali Lagoon in South and Khomam and Rezvanshahr cities in the East and West respectively.

4.2 Physical Environment

4.2.1 Topography

Within the area of influence of the project, the topography of its southern part is characterized by medium level mountainous terrain, called the Emam Zadeh Hashem heights. The highest level of these heights is about 750 m above sea level. As we move north, the elevation decreases and at a distance of 10 km from these heights, the elevation above sea level reaches 100 m. Another 5 km to the north, the terrain changes to an extended plain with a very mild slope towards the coastline of the Caspian Sea in the North.

The average elevation of Rasht city is – 6.9 m and maximum elevation is 9.30 m above sea level. The land around Rasht city is used mostly for harvesting of rice. Orange orchards and other trees are also abundant around the city.

As for Anzali city it consists mostly of flat land. The city has an elevation difference of approximately 4 meters. The average elevation of the city is – 23 m and the highest elevation of the city is - 21 m, while the lowest is - 25m, which is the level of the Caspian Sea.

4.2.2 Climate

Rasht is the best representative of the Gilan climate with its moderate and humid weather in summer and cold weather in winter. The main reasons for this climate are:

- Presence of Alborz Mountains, with their height and direction (Adiabatique phenomena)
- Presence of Caspian Sea in the vicinity;
- Flora cover on the soil;
- Local winds;
- Geographical location

The climate of Anzali city is the same as that of Rasht with moderate & humid weather called Caspian moderate weather. Temperature, humidity & rainfall data for Rasht, as presented in the proceeding sections, has been taken from Rasht Weather Station.

4.2.2.1 Temperature

As mentioned above, Rasht climate can be described as moderate, humid and mostly cloudy and is known as the Caspian moderate weather. Table 4-1 provides a summary of the maximum & minimum annual temperatures for Rasht and Anzali in the last eleven (11) years from 1992 to 2002. This record shows that the maximum and minimum temperatures in Rasht are 41 ^{0}C and -6 ^{0}C respectively. Whereas this record shows that the maximum and minimum temperatures in Anzali are 34.5 ^{0}C and –3 ^{0}C respectively.

Table 4-2 provides a summary of the maximum and minimum monthly temperatures of Rasht and Anzali for the year 1999-2000. The maximum daytime temperature in Rasht is 36 ^{0}C in August and minimum temperature is –4.4 ^{0}C in December of that year. As for Anzali, the hottest months are July and August while the coldest months are January and February. Table 4-2 shows the maximum and minimum monthly temperatures of Anzali for the year 2000-2001 to be 31.4 ^{0}C in August and minimum temperature is 1 ^{0}C in January.

Table 4-1: Maximum and Minimum Annual Temperatures for Rasht and Anzali

Station	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Rasht											
Maximum Temperature (C)	35.0	35.5	36.5	36.5	39.0	41.0	36.5	36.0	37.0	36.0	36.0
Minimum Temperature (C)	-6.0	-1.0	-2.0	-2.5	-1.0	-3.5	-0.5	0.5	-1.0	-4.5	-3.0
Anzali											
Maximum Temperature (C)	30.6	34.5	33.5	30.8	33.0	33.0	34.0	34.0	33.0	31.0	32.5
Minimum Temperature (C)	-2.6	-1.0	0.0	0.0	0.4	0.0	0.5	1.0	-0.5	-3.0	1.0

Table 4-2: Max. and Min. Monthly Temperatures in Rasht and Anzali (2001)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rasht												
Max T (C)	22.5	23.0	30.0	29.2	30.8	31.4	35.0	36.0	35.4	24.4	24.4	27.8
Min T (C)	-2.0	-1.6	4.6	8.0	10	14.8	17.8	17.8	9.0	1.6	0.0	-4.4
Anzali												
Max T (C)	21.0	19.6	25.0	24.4	30.0	29.8	32.0	31.4	26.0	20.6	23.2	25.0
Min T (C)	1.0	2.4	8.0	9.0	12.8	16.6	22.0	19.0	12.6	5.6	4.0	2.0

4.2.2.2 Precipitation

Rasht city is a flat area close to the Caspian Sea and is influenced by sea weather. The annual maximum and minimum rainfall in Rasht in eleven (11) years from 1990 to 2000 was 1,490 mm and 1,027 mm respectively. The monthly maximum and minimum rainfall in the year 1999-2000 was 241.9 mm in August and 5.6 mm in May respectively. In 1999 -2000, there were 134 rainy days in a year.

A summary of the total rainfall in Anzali in eleven (11) years from 1992 to 2002 shows maximum and minimum rainfall of 1,856 mm and 1,256 mm respectively. In the year 2000-2001, total monthly maximum and minimum rainfall was 351.1 mm and 4 mm in the months of August and May respectively

A summary of the total rainfall in 11 years and a monthly distribution of the total rainfall in the year 1999-2000 for both Rasht and Anzali is shown in **Table 4-3** and **4-4 respectively**

Table 4-3: Annual Rainfall (mm) for Rasht and Anzali over 10 years

Station	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11
Rasht (1990 – 2000)	1288	1284	1483	1458	1490	1106	1281	1453	1286	1027	1256
Anzali (1993 – 2002)	1769	1489	1856	1713	1596	1401	1503	1453	1486	1747	1256

Table 4-4: Monthly Total Rainfall (mm) in Rasht and Anzali (2000)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rasht	143.3	124.0	41.6	106.9	5.6	50.1	22.5	242.0	108.5	236.4	100.6	115.0
Anzali	124.7	115.5	22.0	57.4	4.0	46.1	25.4	351.1	219.1	335.3	104.0	190.0

4.2.2.3 Relative Humidity

Relative humidity is almost the same for the two cities. The maximum and minimum humidity in Rasht is 98% and 57% respectively and for Anzali is 98% and 58% respectively, based on an eleven-year record (1992 to 2002). Table 4-5 presents the maximum and minimum humidity from 1992 to 2002 in both cities.

Table 4-6 presents the monthly maximum and minimum humidity in year 2000 in Rasht city. As can be seen, highest is recorded in February, whereas the minimum humidity is recorded in May.

Table 4-5 Maximum and Minimum Annual Humidity (%) for Rasht and Anzali

Station	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Rasht											
Maximum	97	96	97	97	97	-	95	97	96	97	97
Minimum	65	65	60	60	59	-	69	62	57	60	67
Anzali											
Maximum	95	91	94	93	89	92	93	96	96	98	93
Minimum	72	76	68	73	70	69	70	69	58	83	81

Table 4-6 Max. and Min. Monthly Humidity (%) in Rasht

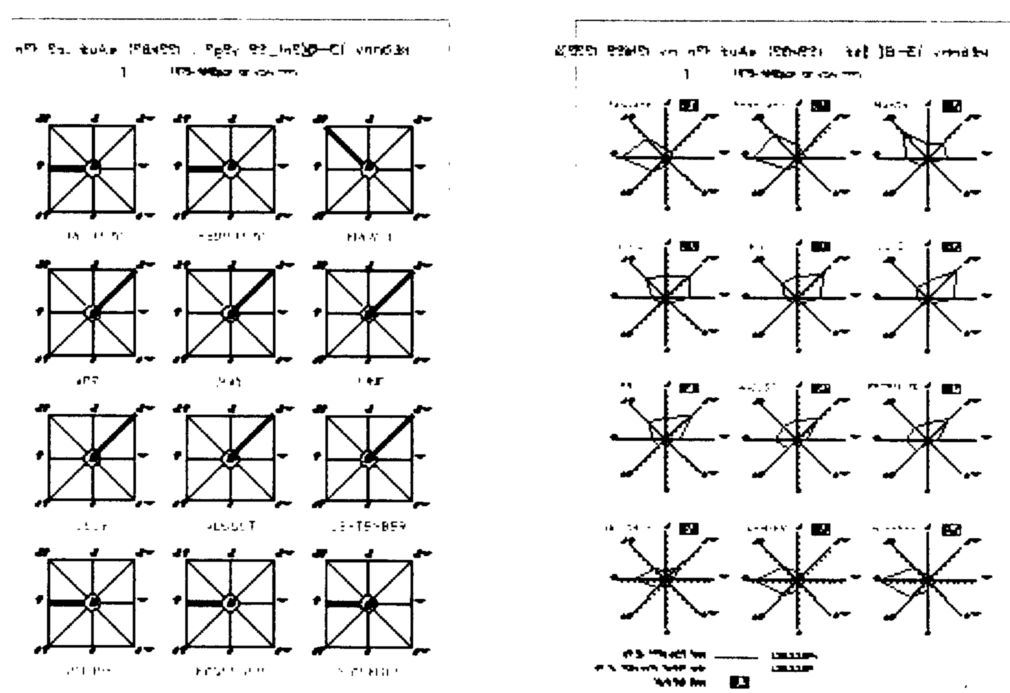
Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rasht (2000)												
Max	**96**	**98**	**93**	**94**	**88**	**87**	**89**	**93**	**94**	**94**	**96**	**94**
Min	**71**	**75**	**71**	**76**	**58**	**62**	**65**	**73**	**70**	**71**	**74**	**74**

4.2.2.4 Wind

Wind is an important factor because it affects the rate of evaporation and consequently the amount of water. There are two types of wind which influence Gilan weather. One is blowing from North and North East direction (Siberia) toward Gilan, causing snow & rain in the winter season. Others are North-Westerly winds, blowing from Atlantic Ocean and Canada as well as those blowing from the Mediterranean Sea, causing rain in winter & increased humidity in summer. The influence of these winds in Gilan Province is more pronounced (because of its location in the North West) as compared to Mazandaran Province.

According to the Feasibility Study, the prevailing wind direction in Anzali is from north-east to south-west, with a maximum wind velocity of 29.8 m/s. A wind rose diagram depicting the prevailing wind conditions in Rasht and Anzali is shown below:

Figure 4.1 Wind Rose Diagrams for Rasht and Anzali



Evaporation

Data on monthly evaporation rates, as measured by the GWWC over a 4-year period (1998-2001) is shown in tables 4-7 and 4-8 below, and indicate that the average evaporation rate for Rasht is 1030.6 mm/month and 1020.0 mm/month in Anzali.

Table 4-7 Average Monthly Evaporation Rates for Rasht

Average monthly evaporation from pan at Rasht station **Ref: Gilan Regional Water Authority**

	(sep 22 - oct 21)	(oct 21 - nov 20)	(nov 21- dec 20)	(dec 21 - jan 19)	(jan 20 - feb 18)	(feb 19 - mar 20)	(mar 20 - april 18)	(april 19 - may 20)	(may 21 - june 19)	(june 21 - july 21)	(july 22 - aug 21)	(aug 22 - sep 21)	
	mehr	aban	azar	dey	bahman	esfand	farvardin	ordibehesh t	khordad	tir	mordad	shahriva r	Average annualy
Evaporatio n from pan	66.2	44.3	27.8	33.7	37.9	20.2	69.9	94.9	209.1	163.5	151.5	111.6	1030.6

Table 4-8 Average monthly evaporation rate for Anzali

Average monthly evaporation from pan at Anzali station (1998-2002) **Ref: Gilan Regional Water Authority**

	(sep 22 - oct 21)	(oct 21 - nov 20)	(nov 21- dec 20)	(dec 21 - jan 19)	(jan 20 - feb 18)	(feb 19 - mar 20)	(mar 20 - april 18)	(april 19 - may 20)	(may 21 - june 19)	(june 21 - july 21)	(july 22 - aug 21)	(aug 22 - sep 21)	
	mehr	aban	azar	dey	bahman	esfand	farvardin	ordibehesh t	khordad	tir	mordad	shahriva r	Average annualy
Evaporatio n from pan	66.9	32.7	22.5	20.4	30.6	49.7	56.2	83.4	178.6	200.2	190.6	105.0	1036.76 7

4.2.3 Air Quality

No air quality surveys have been undertaken in the project area. Ambient Air Standards in the Islamic Republic of Iran are given in **Annex B-IV-5.** There are no records of air quality data; however most of the pollution is generated by vehicular traffic and industrial activity in the city. It should be noted that there is no Thermal Power Plant in both Rasht and Anzali, which could produce air pollution through NO_x and SO_x. In the absence of air quality data, future assessment of impacts will be based on forming new baseline conditions in the Project area.

4.2.4 Noise Pollution

Noise levels in both Rasht and Anzali are of similar nature, however, sampling for noise pollution has not been carried out so far and as such no data is available for Rasht and Anzali.

Similar to other medium sized cities, the major and continuous source of noise in the two cities is traffic. Construction activities also generate noise pollution, however their effect is localized and have limited duration period. It should be noted that industries also contribute to noise pollution particularly heavy industries; however in this case major industrial institutions are located in industrial cities outside the cities' limits as discussed in proceeding paragraphs, and therefore do not affect the noise levels in the project area.

Noise levels are usually measured in decibels (dB, which is usually weighted to correspond with the perception of noise by the human ear (A). The dB(A) scale of measurement is logarithmic. **Table 4-9** provides an indication of relative sound dB(A) levels compared to various activities including sound levels of vehicles on roads.

Table 4-9: Relative Sound Levels

Sound Level dB(A)	Activity
40 – 50	Rural Area
55	Quiet background conversation
60	General office
72	Passenger car @ 60 km/hr at 7 metre distance
85	Heavy diesel lorry @ 40 km/hr at 7 metre distance
90	Hazard to hearing from continuous exposure
95	Pneumatic drill (un-silenced) at 7 metre distance

4.2.5 Geology

4.2.5.1 The Regional Formations

Rasht area straddles the Alborz Mountains which are in North West of Tehran and is bounded by the Caspian Sea in the North. In the south, it also includes part of the Qazvin plain. A broadly conformable sequence of Precambrian and Cam bro-Ordovician sediments similar to that known elsewhere in the other sites of Iran. No Silurian rocks have been recognized. Lower Carboniferous sediments are thin and absent in the South. The upper Permian Ruteh limestone is widespread and in many sections over lies the partly red, clastic Dorud formation (Lower Permian); and is usually overlaid by the dolomitic limestones of the Elika Formation (Triassic)[1]

In the late Triassic Age, faulting and local folding affected the area; in the South Caspian area they were accompanied by intrusion of granites.

The succeeding Lower Jurassic Shemshak Formation which rests uncomfortably on Traiassic, Permian and less commonly older rocks records a period of tectonic instability previously unmatched in the area. In the South a mainly clastic coal – bearing sequence is some 1,000 meters thick and has a substantial thickness of volcanics at its base; in the northeast it exceeds 3,400 m and includes much coarse conglomerate with metal sediments and quartz debris derived from a rising land mass nearby in the southern Caspian. Thick Upper Turassic Necomian sediments, occurring in a strike-parallel belt in the northern part of the mountains zone record the next phase of instability, and further strike – parallel troughs, each filled with up to 1,500 meters of volcanic, were formed during the Aptian –Albian Stages of the Lower Cretaceous and during the Senonian, in the central and northern parts of the mountain zone respectively. Maestrichtian sandy limestones are locally preserved in the northwest.

Rocks of Paleocene age are unknown, and the Paleogene sequence commenced with an Eocene marine transgression on to a rugged landscape in the central and southern parts of the mountains. The paleogene rocks are predominantly volcanic and consist of a three-phase stratified sequence up to 6,000 in thick, interrupted by eruptive rocks from central volcanoes. The first phase is represented mostly by submarine tuffs and sediments, the second (subaerial) phase, probably Oligocene, by mixed basic lavas, and the third by vitreous and site lavas with substantial dacitic and rhyolitic flows.

Neogene red clastic sediments, interblended in Part with evaporate minerals, probably of marine derivation, are preserved up to 3,000 meters thick in partly fault-bounded, intermontane basins. The Neogene sediments have themselves been involved in an episode of late Neogene faulting and local thrusting. Coarse-grained acid intrusives were emplaced from late paleogene time until perhaps as late as the end of the Neogene.

[1] Report on geology of Rasht and Anzali from Central Geological Department, Tehran.

A history of fluctuating base level is recorded in the Quaternary sediments and terraced features of the Caspian drainage catchment. In the mountain zone, Quaternary features of special interest include a substantial trachytic lava flow in the Alamut valley, and the glaciers and moraines of the highest ground.

Traces and small deposits of copper, lead and iron occur in the region, and limestone, gypsum and coal are present in industrial quantities as well as that of kaolin, alunite and silica.

As for Anzali area, it covers a strip of Caspian coastal plain together with a major part of the North Western Alborz Range in the North West of Iran. [2]

The rocks range form Late Precambrian to Recent. The oldest are in the easterly hill-front and adjacent deep valleys draining to the Caspian. Two metamorphic complexes have been recognized, which are overlain by Paleozoin and Mesozoic sediments. In the more northerly Shanderman-Asalem area, occur schist and gneiss of the greenschist amphibolite transition facies, with associated ultrabasic rocks. The more southerly Gasht area shows an upper division of schistose phyllite and muscovite chlorite schist, above a biotitic schist and gneiss with aluminosilicate prphyroblasts. Rb-Sr analyses indicate a Devonian age for the metamorphism of the originally Precambrian sediments.

A sporadically distributed and partly eroded quartzite of possible Triassic age, is unconformably overlain by the Shemshak Formation, mainly of Lower to Middle Jurassic age but locally descending below that. The Shemshak Formation includes volcanic tuff in its upper part in the Shafa Rood, Shanderman Rood headwaters area.

In the central area, Middle to Upper Jurassic reefal and backreef limestones overlie the Shemshak Formation, and pass up into the Cretaceous.

Tertiary formations occur only to the west of the main Talesh divide with evidence of an old shore-line on the western flank. Late Paleogene and Neogene volcanic and "red bed" formations make up the western flank of the area.

Quaternary gravels and terrace deposits, high-level lake beds, landslides and rock flows, complete the sequence in the mountain areas. The coastal deposits of the Caspian Sea, with related estuarine and fluviatile sediments, exist at a number of levels and were controlled by the mainly regrssional history of the Caspian since the end of the Tertiary.

Evidence of vulcanicity is present at Present Precambrian, Lower Paleozoic Upper Paleozoic, Jurassic, Cretaceous and Tertiary levels. It is the Tertiary volcanics which cover the greatest ground area. Related dyke rocks are also present.

Ultrabasic rocks occur within the metamorphics and also as fault-bounded strips of sheared

[2] Report on geology of Rasht and Anzali from Central Geological Department, Tehran.

serpentinite.

Structurally, the region is complex, with axial fold and major fault trends curving from north-northeast through north to northwest. With an anomalous southeastern section veering to the north-east. The main mountain range is itself complex, being formed of two major anticlinal zones which are separated by a partly transverse synclinal, thrust-faulted on its northeastern flank. Both these upwarps have metamorphic cores overlain by a somewhat lacunary Paleozoic cover encroaches on the western half of the range, mainly in the north, where it makes up part of the crestal area. The western flank of the Alborze is made up of a reverse faulted zone, locally with overturning, strips of Jurassic sediment being caught up against the upturned and locally overturned Paleogene formation on the west. The main "Neogne" basins then follow to the west, with major upwarps of Paleogene volcanics forming their western flanks, bounded in turn by still other "Neogene" basins.

4.2.5.2 Seismology

Gilan Province is located in an active seismic region of Iran with many faults in the province. Of these faults, the closest to the project are the seismically active faults of Talesh to the east of the project area and Lahijan to the west of the project area, followed by Masullah earthquake fault to the south of the project area. A record of the earthquake and seismic activities in Gilan Province is shown in the table below:

Table 4-10 Record of Seismic Activity in Gilan Province

Date	Geographical Coordinates		Location and Description	Depth (km)	Magnitude	
	North	East			MB	MS
4 Nov 78	37.61	48.84	Earthquake felt between Rasht and Zanjan	33	6	6.3
22 Aug 80	37.14	50.12	Earthquake felt in Caspian Sea	33	5.2	5.1
24 Aug 89	41.69	49.27	Earthquake felt at Gilan border with USSR	33	5.2	
20 June 90	36.96	49.40	Forty to fifty thousand deaths, more than sixty thousand injured, four hundred thousand homeless caused landslides in Rasht and Zanjan, nearly all houses in Roubar and Manjil were destroyed, sever destruction in Khalkhal and Now Shahr			
21 June 90	36.79	49.79		10	5.4	4.8
21 June 90	36.64	49.80	Some deaths. Extensive destruction in Lowshan (Manjil)	15	5.8	5.3
24 June 90	36.86	49.41	Felt in Gilan province. Extensive landslides in Rostamabad region. Rasht Roudsar Road was closed.	10	5.1	4.7
6 July 90	36.86	49.30	Two injured. Two regional roads were closed. Earthquake felt in Rasht and Tehran	35	5.3	4.4
2 May 2003	37.14	49.26			4.1	

4.2.5.3 Soil

The soil in Rasht is mostly of clayey nature, and deposited in 7 different zones as shown in the classification table below:

Table 4-11 Classification of Rasht Soil

Zone	Code	Soil Type
A	CL	Clay with medium stiffness
B	GH-GC	Coarse grain with high density
C	SP-SC	Sand
D	GM-GC	Coarse grain with medium density
E	CL	Clay with high stiffness
F	SP	Sand
G	SC	Sand

In Anzali, the soil profile is mostly sedimentary in nature, consisting primarily of a mix of clay, silt and sand.

4.2.5.4 Minerals

There are various mineral concentrations present in Gilan Province. As reported, there are fifty (50) quarries in Gilan Province where Marble, Coal, Sand etc. are being extracted. Out of these quarries, there is only one (1) sand quarry located in the Project area in Lakan which has reserves of about 149,700 tons.

In Anzali city, there are four (4) quarries from where various mineral concentrates are extracted. Detail of these quarries, their location and elements present are presented in **Table 4-12.**

Table 4-12: Metallic Mineral occurrences in Anzali city

Sr. No.	Location	Geographical location (Latitude/Longitude)	Element Present
1.	Hezarrubar-Gashtroodkhan watershed	37° 02 ;N 49° 06 ;E	Ba, Pb, Sulphate, Sulphide
2.	Kuria	37° 12 ;N 49° 08 ;E	Fe, As, (Cu); Sulfides
3.	Bachlur- Jamalabad bridge	37° 01 ;N 49° 02 ;E	Cu; Carbonate(malachite)
4.	Spur between heads of Qalehroodkhan and Gashtroodkhan	37° 02 ;N 49° 07 ;E	Minor Ba, Cu, Pb, Zn, Trace Ni, Cr

4.2.5.5 Water logging and salinity on Land

Water logging and salinity problems were not observed in Rasht and Anzali cities due to the general mild slope towards the north and the steeper slopes towards the various rivers and Egos that run through the project area. However there is some salinity changes and logging in the Anzali marsh lands due to changes in the level of the Caspian Sea. This subject is further considered in the proceeding paragraphs.

4.2.6 Water Resources

There are several rivers in the area of influence, of which the major rivers are the Sephidrood, the Zarjoob and the Goharood Rivers. All the rivers and rogas in the project's area of influence run exclusively in Iran, and Iran is the lowest downstream riparian. Sephidrood River, on which Sangar Dam is located, is a major river that flows to the south and east of the project area. Although the river is passing through the area of influence, we include below some information on the hydrology of the river due to its importance in the water supply to the project. The quality aspects of the river were discussed in Chapter 3.

The Sephidrood river originates from sources in Kurdestan, Azerbaijan and Tehran provinces, which form its main tributaries: the Ghezel Ozan from Kurdestan and Azerbaijan, and the Shahrood from Tehran. The river's total length is 650 km with an average annual flowrate, as measured at the Roudbar Station (1953-1989), of 149 m^3/sec. The minimum measured flow rate was 33 m^3/sec, whereas the maximum rate was 465 m^3/sec. The watershed area of the

Sephidrood covers 59,400 km^2, and the River is dammed at the Sephidrood Dam, which holds a reservoir with a capacity of 1,700 million m^3.

4.2.6.1 Surface Water Resources in Rasht

There are two rivers flowing in Rasht; Zarjoob (Siahrood) River and Goharood River, flowing in the east and west of Rasht, respectively. After passing through the city from the South towards the North, the rivers join and form a main river called Syghlanroodbar (Pirbazar), which discharge into Anzali Lagoon and eventually into the Caspian Sea. Water that is obtained through pumping from these rivers is used to irrigate the agricultural lands surrounding them.

Flow figures for the two rivers are shown in table 4-13 below. There are two sets of measurements for Zarjoob River: the first set is at Behdan based on 10 years of measurements and the second is at GRWA bridge downstream of the first station and is based on 25 years of measurements. The flow measurements at GRWA station indicate that the average annual flow is 2.45 times that of Behdan station due to additional streams discharging to the river and the additional sewage discharges from the city as will be discussed in the proceeding sections of this report. The absolute maximum flow measured at the bridge station is 23.9 m^3/sec and the absolute minimum flow is 0.95 m^3/sec. Based on average monthly measurements, the maximum flow occurs in November and the minimum flow occurs in September.

As for Goharood the annual average of the flows measured at Lakan is 1.08 m^3/sec, and the maximum measured flow based on the monthly average is 2.02 m^3/sec and occurs in October. Whereas the minimum measured flow based on the monthly averages is 0.12 m^3/sec, and occurs in August.

Table 4-13: Average Monthly Flow of Zarjoob and Goharood Rivers (m^3/sec)

Month	Zarjoob River		Goharood River
	Behdan ST	GRWA Bridge ST	Lakan
October	3.84	4.57	2.02
November	4.18	8.49	1.67
December	3.11	7.35	1.47
January	2.57	5.65	1.27
February	3.3	7.36	1.39
March	3.82	8.36	1.69
April	2.4	5.52	1.07
May	1.14	5.17	0.55
June	0.75	4.5	0.32
July	0.98	4.34	0.16
August	0.52	4.06	0.12
September	1.65	3.51	1.17
Annual Ave.	2.34	5.73	1.08
Max based Monthly Ave	4.18	8.5	2.02
Min based Monthly Ave	0.52	3.5	0.12
Absolute Max		23.9	
Absolute Min		0.95	

Data on the quality of Goharood and Zarjoob Rivers' water is shown in **Table 4-14** and **4-15.** This data was generated from different locations within the city. For Zarjoob River the first set of data was taken over a six months period from two different locations, whereas the second set of data was taken at the same period from five different locations. For Goharood River the first set of data was taken over a nine months period from one location, whereas the second set of data was taken at the same period from five different locations.

The Quality of Zarjoob River Water

Physical, chemical and microbiological analysis of Zarjoob River water shows that the river is heavily polluted. As evidence of the degree of pollution level, it can be noted that:

- The BOD_5 measurement range is between 32 and 1.8 mg/l, where the highest concentration in the river exceeds the effluent discharge standards of 30 mg/L.
- The DO level is in the range of 8 to 1.3 mg/l, where the natural DO saturation level for the river's altitude can range between 12 to 8 mg/l depending on the water temperature.
- The presence of fecal and total coliforms in concentrations exceeding the national discharge standards of 400 and 1000 coliforms per 100ml.
- The presence of ammonia and the high levels of COD

With regard to the water quality of the Ego, it can be noted the BOD levels and TSS levels are somewhat on the low side demonstrating that these conduits are infiltrated by the surface or ground water. Also it can be noted that the difference in temperature between the Ego water (diluted sewage) and that of the river ranges between 5 to 7 °C.

The Quality of Goharood River Water

The quality of Goharood River is not any better than that of Zarjoob River; where the data presented in Table 4-15 confirm its high pollution level and indicate the following:

- The BOD_5 measurement range is between 30 and 1.6 mg/l, where the highest concentration in the river equals the effluent discharge standards of 30 mg/L.
- The DO level is in the range of 10.8 to 3.2 mg/l, where the natural DO saturation level for the river's altitude can range between 12 to 8 mg/l depending on the water temperature.
- The presence of fecal and total coliforms in concentrations exceeding the national discharge standards of 400 and 1000 coliforms per 100ml.

Sources of Pollution of Goharood and Zarjoob Rivers

Residential areas, hospitals and industries discharge their effluents in Goharood and Zarjoob Rivers in Rasht. Other sources of pollution are surface runoff from the city and agricultural lands, where the run off introduces run off containing fertilizers, and pesticides.

As a result of this pollution level, the rivers emit bad smells and have a grayish color in the summer when the base flows are low. These conditions prompted many citizens to describe these two rivers as open sewers. Odor problems increase in the summer when the temperature increases and biodegradation takes place at a much higher rate than in winter. It has been claimed by some citizens that these rivers once sustained fish and other aquatic species, but now they have no aquatic life at all.

Table 4-14: Results of Physical, Chemical and Microbiological Tests on Water Samples of Zarjoob River

Parameter	Mar-Sept 2001				December 03, 2002									
	[1]Behdan		[1]Taxi Rani		Iraq Bridge		Toshiba Bridge		Zarjoob Bridge		Bosar Bridge		Golsar hospital	
	Max	Min	Max	Min	Ego*	River	Ego	River	Ego	River	Ego	River	Ego	River
Air temp.°C					10	10	10	10	10	7.5	8	10	10	10
Water temp. °C	26	12	28	11.5	15	10	17	11	11	11	16	10	18	11
pH	8.25	7.48	7.89	7.11	7.35	7.8	7.57	7.70	7.6	7.8	7.52	7.8	7.55	7.8
EC	1,211	562	2,170	1,130	-	-	-	-	-	-	-	-	-	-
TDS	763	354	1367	712	-	-	-	-	-	-	-	-	-	-
TSSmg/l					103	94	85	139	72	90	64	183	184	108
DOmg/l	8	5	6.2	1.3	-	-	-	-	-	-	-	-	-	-
COD mg/l	54.3	5.6	88.3	7.2	169	102	73	352	179	125	223	123	176	127
BOD_5 mg/l	22.3	1.8	32	4.8	60	15	60	15	80	20	65	15	55	12
NH_4mg/l	0.83	0.026	4.3	0.79	7.63	4.78	6.23	3.39	35.93	2.71	14.65	3.98	12.74	5.1
NO_3mg/l	0.95	0.29	0.44	0.006	1.318	1.943	1.465	1.747	0.613	1.099	0.518	1.837	0.228	0.237
NO_2mg/l	.08	0.002	0.05	0.008	0.315	0.098	1.29	0.42	0.182	0.058	0.061	0.103	0.048	0.108
PO_4 mg/l	.08	0.01	0.91	0.04	-	-	-	-	-	-	-	-	-	-
Total Coliforms /100ml	52,000	24,000	72,000	32,000	-	-	-	-	-	-	-	-	-	-
Faecal Coliforms/100ml	48,000	18,000	48,000	26,000										

Ego*: Sample taken from Ego where Ego is local name for underground channel carrying wastewater from city and discharging into river, lagoon or sea.

[1] Six measurements taken in six different months in the River at the two locations.

Table 4-15: Results of Physical, Chemical and Microbiological Tests on Water Samples of Goharood River

Parameter	June 2001 to Feb 2002			December 07, 2002									
				From Lamp Factotry		Razi		Gohrsara St		Taleshm Bridge		Farzaneh St	
	[2]Discharge standards	[1]Max	Min	Ego*	River	Ego	River	Ego	River	Ego	River	Ego	River
Air temp.°C				13	13	13	13	13	13	13	13	13	13
Water temp. °C		26	7.5	18	11	15	12	18	12	15	12	19	14
pH	6.5-8.5	7.9	7	6.75	7.6	7.35	7.8	7.55	7.9	8.3	8.4	7.8	8.2
EC		1,151	216										
TDS		725	136										
TSSmg/l	40			263	99.5	72	111	57.4	43.4	41.8	95.6	204.5	47
DOmg/l	2	10.8	3.2										
COD mg/l	60	44.5	5.4	674	48	173	55	284	71	118	85	458	160
BOD_5 mg/l	30	16.6	1.6	360	8	50	8	150	13	20	8	70	30
NH_4mg/l	2.5	4.6	0.27	19.5	4.54	36.4	19.95	6.08	4.71	21.56	2.34	34.23	8.04
NO_3mg/l	50	0.99	0.008	0.72	9.07	0.63	1.02	0.82	0.95	0.69	1.08	0.75	0.93
NO_2mg/l	10			0.27	0.06	0.07	0.15	0.11	0.043	0.04	0.04	0.13	0.07
PO_4 mg/l	6	0.845	0	-	-	-	-	-	-	-	-	-	-
Total Coliforms /100ml	1000	24,000	10,000	-	-	-	-	-	-	-	-	-	-
Faecal Coliforms/100ml	400	24,000	4,000										

[1] Nine measurements taken in six different months in the River at the two locations.
[2] For complete standards see table 2 in annex B-IV.

4.2.6.2 Surface Water Resources in Anzali

Rivers in Anzali

There are many rivers (Rogas) which discharge into the Anzali Lagoon. Some of these Rogas convey domestic wastewater discharged from communities of the cities which adjoin them such as: Rasht, Anzali, Siyah Mazgi, Shaft, Masuleh, Fuman, Marjaghal, Somehsara, and Masal. The largest pollutant loads of domestic origin reaching the Anzali wetlands is conveyed through Pirbazar, which is formed by the joining of Goharood and Zarjoob Rivers and conveys wastewater from Rasht city. The contributing pollutant loads to the Anzali wetlands and the lagoon is further discussed in the proceeding sections.

The average flow, length and source of Rogas entering Anzali Lagoon are presented in **Table 4-16**

Table 4-16: Average flow, length and source of Rogas discharge into Anzali Lagoon

Sr. No.	Name of Rogas	Average Flow (million m^3/year)	Length (Km.)	Source
1.	Chafrood	66.22	34	South West of Talesh mountains
2.	Bahambar	64.65	-	Morghak River
3.	Morghak	159.57	30	South West of Talesh mountains
4.	Khalkaee	159.10	35	South West of Talesh mountains
5.	Palangvar	185.50	-	Teynanrood, Tatafrood and Zarjoob rivers.
6.	Masoolehroodkhan	197.41	22	Masoolehdagh mountains
7.	Shahkhazaz	352.57	17.8	Gashtroodkhan and Ghalehroodkhan
8.	Gazroodbar	40.00	40	-
9.	Pasikhan	469	3	Siahmazgi, Choobar and Chenarroodkhan rivers
10.	Pirbazar	274.36	-	Zarjoob and Goharood rivers
11	Ghanadi	29.3		
12	Khomamrur	122.7		
13.	Bijrud	56.8		
14.	Tash	47.3		
15	East Streams	172.3		
Total flow		2,397 million m^3/ year (6.56 million m^3/day)		

Anzali Lagoon

The geographical location of Anzali Lagoon is between 36° 05 ; to 37° 34 ;North (latitude) and 48° 46 ; to 49° 43 ; East (longitudes). It is one of the most famous and largest lagoons in the world. The Anzali piece of land started appearing after 14th century A.G. At the end of 15th century, water level in the Caspian Sea decreased and lands comprising Anzali and Ghazian cities appeared out of sea. This Lagoon is located on the South West of the Caspian Sea and is connected to the sea through a channel called Ghazian. This connector plays an important role in decreasing and increasing the water level in Anzali Lagoon due to ebb and tides phenomenon and wind direction, etc. The channel divides the city into two sections, Ghazian in the East and Anzali in the West. There are many separate islands in the Lagoon, which are covered by bulrush, reeds and other aquatic plants. These islands act as a barrier between fresh river water and salty water of the Caspian Sea

The current total area of the wet land, covering both lagoon and the marsh land is 193 km^2. In 1915, the area of Anzali Lagoon was 270 Km^2, which decreased to 200 Km^2 in 1940. This area has tremendously decreased with the passage of time and is 80 Km^2 at present. Moreover, the average depth has decreased from 30 meters to about 2 meters. Anzali Lagoon has a catchment basin of 3,740 Km^2 and presently about one (1) million inhabitants residing in Rasht, Anzali, Shaft, Fuman, Masal, and Somehsara, and other smaller towns are discharging their domestic and industrial waste in it. Furthermore, agricultural run off with high concentrations of pesticides and fertilizers, due to their wide application on land, contributes to the lagoon's deterioration.

In 1997, the length and width of Anzali Lagoon as reported by the Sephidrood Water and Energy Company were about 25 km. and 3 km., respectively[3] while its depth was 1 to 3 meters. The area of the Lagoon varies between 69 Km^2 to 120 Km^2 depending on the low and high water levels. At that time, about forty five (45) Rogas (small rivers) were reported to be entering Anzali Lagoon. Nowadays, only about 14 Rogas (rivers) are left which enter the Lagoon. These Rogas and the artesian flow are the source of water for the Lagoon. The total surface water reaching the lagoon from these Rogas is 2,397 million m^3 per year.

Anzali Lagoon comprises four (4) secondary lagoons, which are Sheijan Lagoon (East), Ab Kenar Lagoon (West), Hendeh Khaleh Lagoon (Central), and Sia Keshim Lagoon (South).

The Lagoon is listed as a 'wetland of international importance' under the 1971 Ramsar Convention due to its importance as a natural wetland characteristic of the southern Caspian lowlands, and as such, supports an extremely diverse wetland flora and fauna. The Ramsar

[3] First Phase Study for Water Distribution Network Extension for Anzali By Pars Jooyab Consultants- 1998

Site encompasses the whole of the Anzali wetland, Sia Keshim Marsh, Selke protected area, and several other shallow impoundments ("ab-bandans") bordering the marshes.

The site has been placed on the Ramsar Montreux Record of priority sites for conservation action since December 1993. The site is on the Montreux Record for many reasons: The expanded reedbeds that came up due to water level changes have not started to fade away, which is a continuing problem. Other problems include major eutrophication due to pollution, resulting in the massive spread of water-fern *Azolla* sp., increased hunting pressure (up to 200,000 birds per season), and poaching (especially at Sia Keshim). The Department of the Environment has recently taken steps to establish a non-hunting area at Sorkan Kol in the central wetland. The entire site is closely monitored now by the Department of the Environment.

Production potential for fish harvesting in Anzali Lagoon has considerably decreased. About 60 years ago, fish harvesting was 6,000 to 8,000 tons per year, however, it has now decreased to 300 tons per year. Reasons for this decrease are wastewater entering from municipal and industrial areas upstream of Anzali Lagoon as well as the reduction of surface area and depth, due to human activities like land reclamation, and increased sediment build up, etc.

A recent study (2003-2004) on the integrated management for the ecosystem protection of the Anzali Lagoon, the surrounding wetland and watershed area by the Japan International Cooperation Agency (JICA) identified some of the changes of wetland structure and instability of the ecological environment. According to the project's findings, major adverse effects on the wetland are arising from the watershed, while other adverse effects were attributed to activities within the wetland. Adverse effects from the watershed to the wetland are as follows:

(1) Inflow of polluted water;

(2) Inflow and dumping of garbage;

(3) Inflow of sediment; and

(4) Changes of the water level of the Caspian Sea.

Adverse Effects within the Wetland include:

(1) Overuse (hunting and fishing);

(2) Uncontrolled boat use; and

(3) Encroachment by development and agricultural expansion.

Inflow of Polluted Water

Water pollution is one of the most serious environmental problems in the wetland. The direct consequence of the inflow of the polluted water is organic pollution, namely the elevated level of organic material in water. This problem is notable in the Pirbazar River downstream of Rasht, and a canal near the Anzali Port, which receives untreated wastewater from houses located along the canal. In these water bodies, the level of COD is as high as 200 mg/L, which is close to the level of raw sewage, and the DO level is low due to decomposition of organic material in water. In such water bodies, fish species that are tolerant to polluted water, such as carps, become dominant.

Eutrophication probably has an indirect but more significant impact on the wetland ecosystem than the organic pollution problem. The high levels of incoming nutrients, such as phosphorus and nitrogen, seem to be causing excessive growth of macrophytes, such as *Phragmites*, *Typha spp.*, various submerged plants and phytoplankton in the wetland. Dead plants rapidly accumulate in the bottom sediment making the wetland shallower. This accumulation of organic matter accelerates the spread of emergent macrophytes; once the water depth becomes shallower than about 0.5 m, macrophytes, such as *Phragmites*, propagate quickly. The decomposition of the plant detritus also depletes oxygen in water, and results in fish kills in the wetland, for example in Siahkeshim area.

The cause of excessive growth of an invasive species, *Azolla* spp., has also been attributed to eutrophication. Azolla has an ability to fix atmospheric nitrogen, and it can be a significant source of nitrogen to the wetland, though its impact on nitrogen dynamics in the wetland is yet to be investigated. Azolla now covers as much as 25% of the wetland, and is significantly affecting the distribution of plants and the habitats of waterfowl.

Other water-quality related problems include pollution by pesticides and heavy metals. Pesticides, such as Diazinon and Paraquat, are widely used in the watershed for rice cultivation, and their impacts on the wetland ecosystem have not been fully investigated. Similarly, the levels of most heavy metals are not extremely high, but further investigation is needed to elucidate the impacts of heavy metals on the wetland ecosystem.[4]

Wastewater Load Contributions

The JICA study has identified domestic wastewater in the urban areas as the largest pollution source of COD and T-P to the wetland with Rasht and Anzali cities accounting for 83 % of the total urban population in 2003. Other sources and their contribution of COD and T-P load to the wet land are shown in Table 4-17 below:

[4] JICA – Study on the Integrated Management for the Ecosystem Conservation of Anzali Wetland, Final Progress Report, February 2004, Nippon Koei Co. Ltd.

Table 4-17: Estimated Pollution Load to Anzali Wet Land (JICA study)

Pollution Source	COD Load in tons/year		T-P Load in tons/year	
	Present (2003)	% of total	Present (2003)	% of total
Domestic Wastewater in Urban Areas	37,958	35.7%	488	56.8%
Domestic Wastewater in Rural Areas	6,045	5.7%	78	9.1%
Industrial Effluent	329	0.3%	11	1.3%
Livestock Waste	22,205	20.9%	168	19.5%
Farming Land	21,223	19.95%	55	6.4%
Natural Environment	18,612	17.5%	59	6.9%
Total	106,371	100%	859	100%

Changes in Caspian Sea Level

Unlike a tidal marsh, which is influenced by short-term tidal cycles, the Anzali Wetland is affected by the long-term fluctuation of the Caspian Sea; the level of the Caspian Sea has changed about 2.3 m in the last 30 years, with the record low in 1977 (-28.44 m) and the record high in 1994 (-26.10 m).

This long-term fluctuation of the water level markedly affects the wetland ecosystem, such as the area of open water, area of shore, depths of water, and thus habitats of flora and fauna. The fluctuation of the water level also affects the water quality of the wetland, in particular salinity, and its impact on the aquatic ecosystem, e.g., composition of fish species, has been pointed out (Holčil and Oláh, 1992[5]).

The Quality of Anzali Lagoon

Data regarding the quality of Anzali Lagoon was gathered from twenty five (25) various locations in the Lagoon. A summary of the measurements is included in Table 4-18 below. The Results show the following:

[5] J. Holčil and J. Oláh, Fish, Fisheries and Water Quality in Anzali Lagoon and Its Watershed, FAO, UNDP/IRA/88/001, 1992.

- pH of all these samples was in the range of 7.55 to 9.25.
- BOD_5 is in the range of 8 to 2 mg/l with an average of all the samples at 3 mg/l
- COD is in the range of 56 to 10 mg/l with an average of all the samples at 22 mg/l
- The sum of the NH_4, NO_3, and NO_2 based on average values is 0.9 mg/l and based on maximum value is 5.59 mg/l
- PO_4 is in the range of 0.74 to 0.0006 mg/l with an average of all the samples at 0.07 mg/l
- Fecal coliform is in the range of $11x10^4$ to 15 coliforms/100 ml with an average of all the samples at 14,982

Although the number of samples is relatively limited compared to the lagoon area, nonetheless the results indicate pollution due to domestic wastewater origin as demonstrated by the fecal coliform levels. This result is further demonstrated by the maximum BOD_5 levels and COD levels; the maximum values of the latter exceed US EPA criteria for eutrophic levels. Also the phosphate levels exceed the 0.02 mg/l limit for eutrophic levels per US EPA criteria.

Table 4-18: Results of physical, chemical and microbiological tests on water samples of Anzali Lagoon

Sr. No.	Parameters	No. of Measurement	Average	Maximum	Minimum
1	Air Temp. (°C)	25	15	18 (Shayjan & Shilesar)	14 (Ghannadi & Lalehka & Bijrood)
2	Water Temp. (°C)	25	14	17 (Anzali Bridge & Ghazian Bridge)	11 (Gazroodbar & Nargestan)
3	pH mg/l	25	8	9.25 (Central Section)	7.55 (Eastern Part)
4	TSS mg/l	25	55	184 (Ghazian Bridge)	23 (Siah Darvishan)
5	COD mg/l	25	22	56 (Ghazian Bridge)	10 (Eastern Part & Siah Keshim)
6	BOD mg/l	25	3	8 (Pirbazar)	2 (Ghannadi & Gazroodbar & Chemesghal & Klosar)
7	NH_4 mg/l-N	25	0.43	3.662 (Pirbazar)	0.031 (Klosar)
8	NO_3 mg/l-N	25	0.45	1.751 (Gazroodbar)	0.004 (Chemesghal)
9	NO_2 mg/l-N	25	0.02	0.177 (Madar Channel)	0.001 (Central Section)

Table 4-18: Results of physical, chemical and microbiological tests on water samples of Anzali Lagoon (cont'd)

Sr. No.	Parameters	No. of Measurement	Average	Maximum	Minimum
10	Faecal Coliform (No. /100ml)	25	14982	$11*10^4$ (Madar Channel &Chemesghal)	15 (Central Section)
11	Turbidity mg/l	25	6	15 (Morghak Khalkaee)	2.5 (Madar Channel)
12	SS mg/l	25	0.03	Less than 0.1 (In 7 Station)	0 (In 18 Station)
13	PO_4 mg/l-P	25	0.07	0.739 (Pirbazar)	0.0006 (Espand)
14	DO mg/l	25	10	13.3	2.3 (Espand)
15	TDS mg/l	25	1292	8080 (Anzali Bridge)	362 (Behmbar)
16	Conductivity (µmhos/cm)	25	2391	15141 (Anzali Bridge)	933 (Behmbar)
17	Total Coliform (No. /100ml)	25	190225	$11*10^5$ (Nargestan)	930 (Hendekhaleh)

JICA Study Findings on Water Quality in Anzali Wetland

According to the JICA Study, water quality surveys conducted in the wetland three times between September and December, 2003, indicated high values of COD, T-N and T-P throughout the wetland, although the recorded values differ from point to point.

Figure 7 in Annex H (Excerpt of JICA report) provides a schematic presentation of the sample collection locations, and the results of the testing at each location. These are also elaborated in the proceeding paragraphs.

(a) Organic Pollution

Table 4-19 shows the distribution of COD concentrations in the wetland, and US EPA eutrophication criteria for comparison. According to the criteria, most of the wetland except for Siahkesim can be classified as highly polluted water.

Table 4-19 Distribution of COD Concentrations in the Wetland

(Unit: mg/L)

Area	Eastern part of wetland	Central Part of wetland	Environs of Anzali city	Siahkeshim	Lagoon area	Average
Average	37	39	43	27	44	38
Range	22 - 61	12 - 107	13 - 195	15 - 50	13 - 67	12.9 – 67.2
Criteria of Eutrophic Condition (US EPA)	High: COD >30 mg/L, Moderate: COD 20 -30 mg/L Slight: COD 10 – 20 mg/L, Minimal: COD <10 mg/L					

About half of the organic (COD) pollution load is discharged from Rasht through the eastern part of the wetland to the Caspian Sea. High COD values are recorded in the eastern part and in the environs of Anzali city, which have the highest recorded COD concentrations. This area receives pollution loads from untreated wastewater from Anzali.

According to DOE officials, there is an anaerobic zone at the bottom of Siahkesim, although the average recorded COD is relatively low.

(b) Nutrients

Table 4-20 shows the distribution of T-P concentrations in the wetland, and three international eutrophication criteria for comparison. According to these criteria, the wetland is classified as completely eutrophic throughout the wetland.

Table 4-20 Total Phosphate Concentrations in Wetland Water

(Unit: mg/L)

Area		Eastern part of wetland	Central Part of wetland	Environs of Anzali city	Siahkeshim	Lagoon area	Average
Average		0.28	0.20	0.32	0.13	0.09	0.20
Range		0.17 – 0.42	0.11 – 0.30	0.16 – 0.50	0.08 – 0.29	0.04 – 0.29	0.04 – 0.50
Criteria of Eutrophic Condition	Vollenweider	0.03 – 0.1 mg/L					
	US EPA	> 0.02 mg/L					
	OECD[6]	0.035 – 0.1 mg/L					

About 57 % of the T-P pollution load is discharged to the eastern part of the wetland and the environs of Anzali city. The environs of Anzali city are recorded as having the highest T-P values. The T-P concentrations in the western part are also high, whilst the values in Siahkesim and the Lagoon are recorded as being relatively low.

(2)Heavy Metal and Other Toxic Materials

(a) Heavy Metals in Sediment

There is no significant difference in the concentrations of heavy metals in the sediments of the wetland and of the rivers, and those values are less than the international standards shown in Table 4-21. This means that there is no heavy metal pollution problem in the wetland.

Table 4-21 Analytical Result of Heavy Metals in Sediment

(Unit: mg/kg)

Area	Cd	Pb	Cr^{6+}	As	Cu	Zn
Wetland	n.d. - 0.2	n.d. - 50.9	4.3. - 40.6	0.002 – 0.102	18.8 - 86.4	31.9 - 221.5
River	n.d. - 0.2	11.2 - 43.4	3.2. - 39.0	0.012 – 0.257	36.4 - 63.8	49.3 - 144.8
Canadian Criteria for aquatic life*	3.5	913.0	90.0	17.0	197.0	315.0

* : Probable Effect Level, Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, 1999

(b) Pesticide and Herbicide

Pesticides and herbicides, such as Diazinon and Paraquat, are widely used in the basin, though little is known about their environmental impacts. Apparently birds and fish are quite susceptible to Diazinon, while Paraquat is moderately toxic to birds and fish. Evaluation of the pesticide and herbicide results is still on-going.[7]

[6] Fixed Boundary System, OECD Trophic Terminology and Prediction, see http://lakes.chebuoto.org/TPMODELS/OECD/trophic.htm

[7] JICA – Study on the Integrated Management for the Ecosystem Conservation of Anzali Wetland, Final Progress Report, February 2004, Nippon Koei Co. Ltd.

4.2.6.3 Caspian Sea

Caspian Sea Environmental Cooperation

In November 2003, the city of Tehran hosted a Conference of Plenipotentiaries to adopt and sign the Framework Convention for the Protection of the Marine Environment of the Caspian Sea, inaugurated by Vice-President and Head of the Department of Environment. Ministers and senior officials from five littoral states of the Caspian Sea including Azerbaijan, Iran, Kazakhstan, Russia, and Turkmenistan attended this conference.

The five countries have caused damage to the sea by discharging polluted effluents, urban wastes, over-fishing, and mismanagement of coastal zones and introduction of alien species. However, in Iran, there are major projects underway to complete urban sewage collection and purification systems in the coastal areas. Adding industrial effluents and waste are strictly monitored and urban waste management programs are being implemented.

This ground breaking convention, the first legally binding treaty on any subject to be adopted by the five neighbors, will coordinate regional efforts to reverse an environmental crisis brought about by habitat destruction, pollution and the over-exploitation of fish and other marine life.

The Convention needs to be signed and ratified by the participating governments – a process that can take a couple of years – so that it will enter into force and become legally binding. The Convention will commit its member governments to preventing and reducing pollution, restoring the environment, using the Sea's resources in a sustainable and reasonable manner, and cooperating with one another and with international organizations to protect the environment.

Unfortunately there is no data available on the sea water quality in the project area. However, at the present time there are eight sewer outfalls conveying wastewater from Anzali city, and discharging it to the Caspian Sea directly. These outfalls will be phased out as part of the wastewater collection scheme provided by the project.

4.2.6.4 Ground Water Resources

Rasht

In year 2000, there were thirty seven (37) water wells in the city of Rasht with a total capacity of 1,100 litres/sec. These are only used in emergency cases when Sephidrood river quality becomes highly turbid. The capacity of water wells in Rasht in general is between 20 to 30 litres/sec. Data regarding the quality of some water wells in Rasht are shown in **Table 4-22** WHO guidelines for these parameters are also given in the table in order to compare between Rasht water well quality and WHO standards. The water quality data indicates that values of

NO_2, NO_3 and NH_4 are within WHO guidelines. However, 2 measurements out of the 10 measurements show that iron levels exceed the required guidelines. In accordance with the latest WHO standards though, there is no health based guideline value for Iron.

The data provided does not include measurement on fecal coliform; however these wells whenever they are used are treated with chlorine for disinfection.

Anzali

Ground water is the secondary source of potable water for Anzali city, and is used only when the water provided though Sangar WTP is short due to Sephidrood River high turbidity. Generally, the capacity of water wells in Anzali is between 20 to 30 liters/sec. Data regarding the quality of some of the water wells in Khachkine area (close to Anzali city) is shown in **Table 4-23**. Similar to the ground water quality of Rasht, values of NO_2, NO_3 and NH_4 are within WHO guidelines. However, values of Fe exceed the guidelines in all samples. As discussed in the preceding section, the 0.3 mg/l guideline value is not health based. Also, it should be noted that turbidity level in 33% of the measurements taken exceeded the desirable level of 5 NTU according to Iranian standards, however all measurements are below 25. No fecal coliform measurements are available, but it should be noted that all wells are chlorinated prior to use for disinfection purposes.

Table 4-22: Quality of Rasht well water

Well No.	Date	Water Temp. (°C)	Turbidity (NTU)	DO (mg/l)	EC (µmohs)	pH	Hardness (mg/l)	NO_2 (mg/l)	NO_3 (mg/l)	NH_4 (mg/l)	PO4 (mg/l)	Mn (mg/l)	Fe (mg/l)
Golsar well no.1	Feb 13, 2002	19	1	9	931.4	7.46	250	0.003	0.44	0.25	0.4	0	0.10
	Sep 24, 2001	20	1	1.1	927.3	7.78	170	0.003	0.44	0.05	0.5	0	0.03
	Aug 5, 2001	20	0	1.8	869	7.62	150	0.003	0.44	0.40	0.5	0	0.50
	May 30, 01	29	1	2	885.7	7.84	190	0.003	0.44	0.35	0.2	0	0.01
Golsar well no.2	Feb 13, 2002	18	1	1.4	841.2	7.37	235	0.003	0.44	0.30	0.4	0	0.20
	Sep. 24, 01	20	1	1.3	927.3	7.73	170	0.003	0.44	0.50	0.7	0	0.10
	Aug. 5, 2001	20	0	1.6	908.5	7.64	180	0.003	0.44	0.20	0.6	0	0.01
	May 30, 01	19	1	2.3	964.6	7.76	255	0.003	0.44	0.60	0.8	0	0.01
Golsar well no.3	Feb. 13, 02	18	2	2	1003.4	7.30	200	0.003	0.44	0.30	0.1	0	0.04
	Aug. 5, 2001	19	1	1.6	701.2	7.46	255	0.003	0.44	0.20	0.6	0	0.50
Emamzadeh Hashem well	Sep. 24, 01	19	2	5.7	825	7.35	200	0.003	0.44	0.10	0.6	0	0.05
WHO Standards		-	**5/25**	-	-	-	-	**3**	**50**	**1.5**	-	**0.1***	**0.3**

*: Standard value 0.1 mg/l for staining of laundry& sanitary ware problems & 0.5 mg/l as health base provisional guideline value

Table 4-23: Physical and Chemical quality of Anzali Wells (Khachkine wells)

Sr. No.	Date	Temp. (^{0}C)	Turbidity (NTU)	DO (mg/l)	EC (μmohs/cm)	pH	Hardness (mg/l)	NO_2 (mg/l)	NO_3 (mg/l)	NH_4 (mg/l)	PO_4 (mg/l)	Mn (mg/l)	Fe (mg/l)
1.	June 29, 2000	18.0	6	2.00	557.0	7.40	310	0.008	0.21	0.074	0.962	0.550	1.440
	Aug. 09, 2000	18.0	21	1.01	969.0	7.46	350	0.002	1.54	0.137	0.938	0.429	0.822
	Nov. 15, 2000	16.8	12	1.24	994.0	7.23	350	0.703	1.00	0.127	0.853	0.480	2.170
2.	June 29, 2000	18.5	3	6.00	830.0	7.80	250	0.005	0.00	0.042	1.009	0.357	1.030
	Aug. 09, 2000	18.0	18	1.45	932.0	7.71	310	0.001	0.00	0.820	0.856	0.294	0.759
	Nov. 15, 2000	18.5	3	6.00	830.0	7.80	290	0.005	0.00	0.042	1.009	0.357	1.030
3.	June 29, 2000	17.3	3	0.71	950.0	7.68	305	0.201	0.60	0.870	2.716	0.347	0.926
	Aug. 09, 2000	16.8	5	1.73	981.0	7.54	310	0.060	0.49	0.843	0.871	0.081	1.235
	Nov. 15, 2000	17.6	6	1.12	840.0	7.60	205	0.008	0.26	0.031	0.909	0.394	0.932
4.	Oct. 09, 2000	17.0	2	3.40	947.0	7.83	225	0.003	0.44	0.550	0.500	0.072	1.234
	June 29, 2000	17.4	1	1.42	996.0	7.91	230	0.001	0.56	1.736	0.130	0.321	0.987
5.	Oct. 09, 2000	17.0	3	3.00	665.5	7.81	265	0.020	0.44	0.350	1.000	0.298	0.502
	June 29, 2000	17.4	1	1.42	995.0	7.91	230	0.001	0.56	1.736	0.013	0.250	0.708
6.	Oct. 09, 2000	17.0	2	1.30	965.5	7.87	245	0.003	0.44	0.350	0.500	2.770	4.400
	June 29, 2000	17.5	3	1.59	103.7	7.60	260	0.001	0.07	0.034	0.008	0.158	0.378
	WHO Standards		**5/25**					**3**	**50**	**1.5**		**0.1***	**0.3**

*: Standard value 0.1 mg/l for staining of laundry& sanitary ware problems & 0.5 mg/l as health base provisional guideline value.

4.3 Biological Environment

In this section the terrestrial and aquatic ecosystems, fauna, flora and protected species and sensitive habitats in the project area are studied.

4.3.1 Terrestrial Ecosystems

4.3.1.1 Flora

The vegetation in Rasht project area is divided into three groups:

- Water and Water Border Flora around Goharood and Zarjoob Rivers
- Pasture Flora of Rasht City
- Forest Flora of Rasht City

On the other hand, in Anzali, the forest and pasture ecosystems are located around Anzali lagoon.

The land around both Rasht and Anzali city is agricultural land and is full of vegetation, trees and fruit orchards. Natural vegetation is decreasing due to increased agricultural activity and forest/pasture utilization by human and animals and in the case of Anzali, has also decreased due to the city development (new land use). In Anzali, there is also man-made forestation which could be seen along the road and around the housing areas.

Main flora in Rasht and in and around Anzali Lagoon, Forest flora, and Pasture flora are shown in Annex C, and are discussed in the proceeding paragraphs.

4.3.1.2 Fauna

There are various habitats in the Project area and different fauna species live in or migrate to this area. However, Anzali Lagoon is the most important place of these habitats. A list of mammalians in Rasht city and birds in both Rasht and Anzali is provided in Annex C, and are discussed in the proceeding paragraphs

4.3.1.3 Aquatic Ecosystems

- Anzali Lagoon

  The Anzali complex is comprised of large, shallow, currently eutrophic freshwater lagoons, shallow impoundments ("ab-bandans"), marshes and seasonally flooded grasslands in the southwest Caspian lowlands. It is separated from the Caspian Sea by a sand dune barrier of about 1 km wide, with open grassland, pomegranate shrub and sand dune vegetation. The entire marsh and lagoon complex drains into the deep-water harbour of Bandar Anzali through the main channel at the Northeast end of the main lagoon. The wetland is bordered to the north by sand dunes with grassland and scrubby vegetation, and the south by cultivated land (mainly rice) and patches of woodland.

The dominant vegetation throughout much of the Anzali wetland consists of vast beds of Phragmites australis which in places grow to six meters height. Due to falling levels of the Caspian Sea in the late 1960s, a rapid expansion of the Phragmites reed began, and by the early 1980s, large parts of the main wetland were covered by this reed. The recent rapid rise in water level in the wetland stopped the expansion of Phragmites and recreated open water areas. The new water areas support vast beds of the water lily Nelumbo nucifera var.caspica, and a very rich growth of other floating and submerged vegetation. Anzali wetland and its satellite wetlands are extremely important for a wide variety of breeding, passage and wintering waterfowl.

4.3.2 Sensitive Habitats and Nature Reserves

Anzali Lagoon provides wintering habitat to several species of threatened birds: Phalacrocorax pygmaeus, Pelecanus onocrotalus, Pelecanus crispus, Anser erythropus, Oxyura leucocephala, Haliaeetus albicilla, Aquila heliaca, A. clanga, Falco peregrinus, F. cherrug, F. columbarius, Asio flammeus, Circus aeruginosus. In general the wetland supports huge numbers of wintering ducks, geese, swans and coots, and the riverine area and the marsh support large breeding colonies of Ardeidae, and several species of terns and shorebirds. Anzali wetland supports over 1% of the regional Middle East wintering populations of several species of waterbirds. Anzali and Sia Keshim are important spawning and nursery grounds for several fish species.

The wetland is the most important wintering area in Iran for *Phalacrocorax pygmaeus*. *Scolopax rusticola* is a common winter visitor to the surrounding damp woodlands and scrub. The wetlands support a large breeding colony of *Chlidonias hybridus*, colonies of six species of *Ardeidae*, and a resident population of *Porphyrio porphyrio*. *Acrocephalus melanopogon* and *A. arundinaceus* are very common breeding birds in the reedbeds. Many birds of prey also winter at the wetland, such as *Haliaeetus* albicilla, *Aquila clanga*, *Falco peregrinus*, *Falco cherrug*, *Falco columbarius*, *Asio flammeus*, *Circus aeruginosus*, and *Aquila chrysaetos*. Mammals include the golden jackal *Canis aureus*, common otter *Lutra lutra*, jungle cat Felis *chaus*, wild boar *Sus scrofa*, white-toothed shrew *Crocidura leucodon*, crested porcupine *Hystrix indica* and wolf *Canis lupus*.

There are two (2) prohibited hunting areas in Rasht which are given below:

1. **Chokam area:** This area is located between Rasht and the Eastern part of Anzali Lagoon, which is located towards the West of Rasht. This prohibited hunting area covers about 250 hectares.

2. **Ejdeha Balooch:** This prohibited hunting area around Rasht is spread over 250 hectares.

The Department of the Environment has recently taken steps to establish a non-hunting area at **Sorkan Kol** with an approximate area of 250 ha in the central wetland of Hossein Bekandeh, and Ghalm Godeh.

In Anzali, two (2) reserves have been established in the Anzali Lagoon complex:

1. The central portion of **Sia Keshim** Marsh (3,515 ha) in the South West of Anzali Lagoon was first established as a Protected Region in 1967. The reserve was enlarged to 6,701 ha and upgraded to Wildlife Refuge in 1971, but reduced to its present size of 4,500 ha and downgraded to a protected area in the 1980s.
2. **Selke Ab-bandan** (360 ha) has been protected as a wildlife refuge since 1970.

4.3.3 Rare or Endangered Species

Rare and endangered species around Rasht areas are provided below:

- **Endangered species**[8]

In Rasht area, the only endangered bird specie is Branta ruficolis from Anatidae family. Other protected bird species in Rasht area are shown below:

- Anatidae Family: Anser albifrons and Anser fabalis
- Podicepidae Family: Podiceps auritus
- Ardeinae Family: Ardeola ralloides and Ixobrychus minutus

The Red list of IUCN (1994) has listed Iranocypris typhlops from Cyprinidae family and one species from Balitoridae family as endangered fish in the rivers of Rasht.

In Anzali, endangered species are provided in Table 4-24 below.

[8] Department of Environment, Gilan

Table 4-24 Endangered Species in Anzali

Sr. No.	Science Name	Family	CITES	IUCN
Mammals				
1.	Felis chaus	Felis Chaus		*E
2.	Lutra lutra	Mustelidae	*Annex 1	
Reptiles				
1.	Emys orbicularis	-		*V
2.	Testudo graeca iberica	-		E
3.	Mauremys caspica caspica	-		V
4.	Vipera albia cornuta	-		V
Amphibians				
1.	Batra chuperus percicus	-		*R
2.	Rana Macroonemis pseudodalmatina	-		V
3.	Common Eurasian	-		R
4.	Pelobates syriacus	-		R

*Annex 1: Endangered species are very low in numbers and must be protected. Import and export of these species is not allowed. Special permission is required to do it.

*E: Endangered *V: Vulnerable *R: Rare

- **Rare Species:**

Rare fish species in the rivers of Rasht are as follows:

Abramis sapa, Leucaspius delineatus, Pelecus cultratus and Khipowitschia caucasica.

A list of the rare and vulnerable Fish in Anzali Lagoon is presented below:

Table 4-25 Rare and Vulnerable Fish in Anzali Lagoon

Family name	(species)
1. Petromyzonidae	(caspiomyzon wagneri)
2. Acipenseridae	(Acipenser persicus, Acipenser stellatus)
3. Clupeidae	(Alosa caspia Persica, Clupeonella cultiventris)
4. Cyprinidae	(Abramis brma orientalis, Aspius aspius taeniatus, Alburnus fillippi, Barbus brachycephalus caspius, Barbus capito, Blica pjoerkna, Capoeta capoeta graculis, Carassius auratus, Chalcalburnus chalcoides, Ctenopharyodon idella)
5. Atherinidae	
6. Syngnathidae	(Syngnathus abaster)
7. Percidae	(Perca fluviatillis, Sander lucioperca)
8. Mugilidae	(Lisa aurata)
9. Gobiidae	(Neogobius Platyrostris constructor, Proterorhinus marmoratus)
10. Gasterosteidae	(Gasterosteus aculeatus, Pungitius Platygaster)

4.3.4 Species of Commercial or other Importance

Birds of commercial importance in Rasht area are given in Annex C at the end of this report. However, fish are the only species in Anzali, which are of commercial importance as shown in the same Annex.

4.4 Socio-Economic Environment

At present, potable water is taken from the Sangar Water Treatment Plant and is supplied to Rasht by a transmission main and then to Anzali. In addition to this, ground water supplies for drinking and irrigation are also available and some houses have their own water wells to get potable water. Agricultural land is available in the vicinity of Rasht and Anzali and is irrigated by high precipitation, through ground water as well as the rivers passing through the city.

Rasht and Anzali have one and two industrial estates, respectively, where most of the industries are located.

Bandar Anzali is an international seaport and is famous due to its proximity to Anzali Lagoon. Moreover, there is an airport in the city of Rasht.

A carriageway is available in Rasht and Anzali and connects both cities with other parts of the country.

The present structures in Rasht and Anzali cities generally comprise of residential areas, mosques, primary and middle schools and few shrines. Government and private medical clinics are also available.

4.4.1 Population Characteristics

- Present Population

Rasht

During 1987 to 1992, the "Demography statistics on Iranian Cities" calculated and presented the population of Rasht based on a 3.6% annual growth rate. However, the growth rate appears to be overestimated. In 1997, as reported from the 1997 population census, the population of Rasht was 417,749. Accordingly, the population projected for 2002 was 479,602, and the population in 2004 is considered to be 506,800.

Anzali

Population of Anzali is 98,500 according to 1997 census. The population projected for 2002 was 112,000, and the peak population in 2004 is considered to be 143,400 (including seasonal tourist populations).

- Population Projections

Rasht

The population of Rasht is projected to increase at an annual growth rate of 2.8% to reach 550,613 in 2007 and 956,600 in 2027. Population projections of Rasht are based on different growth rates based on the Total Fertility Rate (TFR) and mortality (Life expectancy at birth) by the Feasibility Study Consultants. The projected figures are given in **Table 4-26**.

Table 4-26: Population Projection of Rasht City[9]

Sr. No.	Year	Population	Rate of Growth (%)	Area (Hectare)	Density (persons/hectare)
1.	1997	417,749		6,797	61.46
2.	2002	479,602	2.8	7,209	66.52
3.	2007	550,613	2.8	7,620	72.26
4.	2012	632,138	2.8	8,032	78.70
5.	2017	725,732	2.8	8,638	84.01
6.	2027	956,600	2.8	9,850	97.12

Anzali

The population of Anzali has also been projected with different growth rates based on an estimation of the Total Fertility Rate (TFR) and mortality (Life Expectation at birth) by the Feasibility Study Consultants.

The population projection of Anzali city is given in **Table 4-27**[10].

Table 4-27: Population Projection of Anzali City

Sr. no.	Year	Population	Area (Hectare)	Density (capital/ha)
1.	1997	98,544	3,095	31.84
2.	2002	112,095	3,095	36.22
3.	2007	127,842	3,095	41.31
4.	2012	145,657	3,095	47.06
5.	2017	164,238	3,095	53.07
6.	2022	182,765	3,095	59.05
7.	2027	201,958	3,095	65.26

[9] Progress Report on Feasibility Studies for Water Supply and Wastewater Collection and disposal Facilities for Rasht and Anzali Cities by Iranab Consulting Engineers- November, 2002.

[10] Rasht/ Anzali Water Supply and Wastewater Collection and Disposal - Progress Report no. 1-3 and 1-4 - November, 2002.

The population of Anzali is expected to increase from 112,095 in 2002 to 201,958 residents in 2027. The peak population in 2027, including tourists, is forecasted at 252,000.

- Population Density

The population density of Rasht in 1997 was 62 persons/ hectare, which is expected to increase to 97 persons/ hectare by the year 2027.

The average population density in Anzali is expected to increase from 31.84 persons/ha in 1997 to 65.24 persons/ha by the year 2027, due to the limitation of horizontal expansion of urban areas. The project area is constant throughout the project period (3,095 hectares).

- Gender Distribution

Data on gender is given in **Table 4-28** below, which shows that male and female ratio in Gilan province and Rasht Region, both in urban and rural areas is almost one to one.

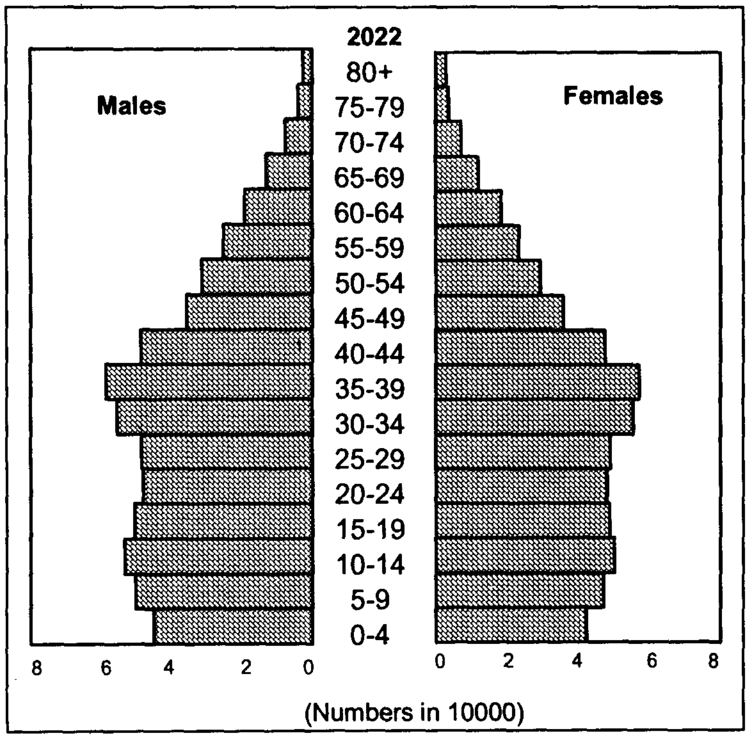
Table 4-28: Gender data in Rasht and Gilan Province (1996-1997)[11]

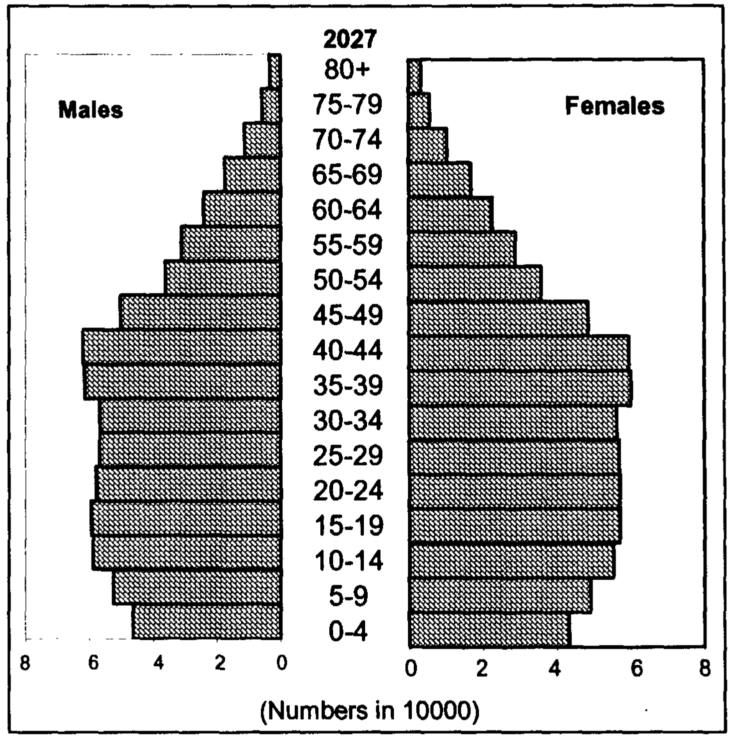
Province/	Total		Urban		Rural	
Region	Male	Female	Male	Female	Male	Female
Gilan	1,115,391	1,126,505	527,838	523,441	587,553	603,064
Rasht	357,590	356,323	230,270	229,056	127,320	127,267

The projected population pyramid for Rasht is shown in Figure 4.2 below, which shows that the population of Rasht is an aging one, although the largest age group will be in their 30s and 40s. The increase in population places further pressure on infrastructure needs.

[11] Gilan Management and Planning Organization.

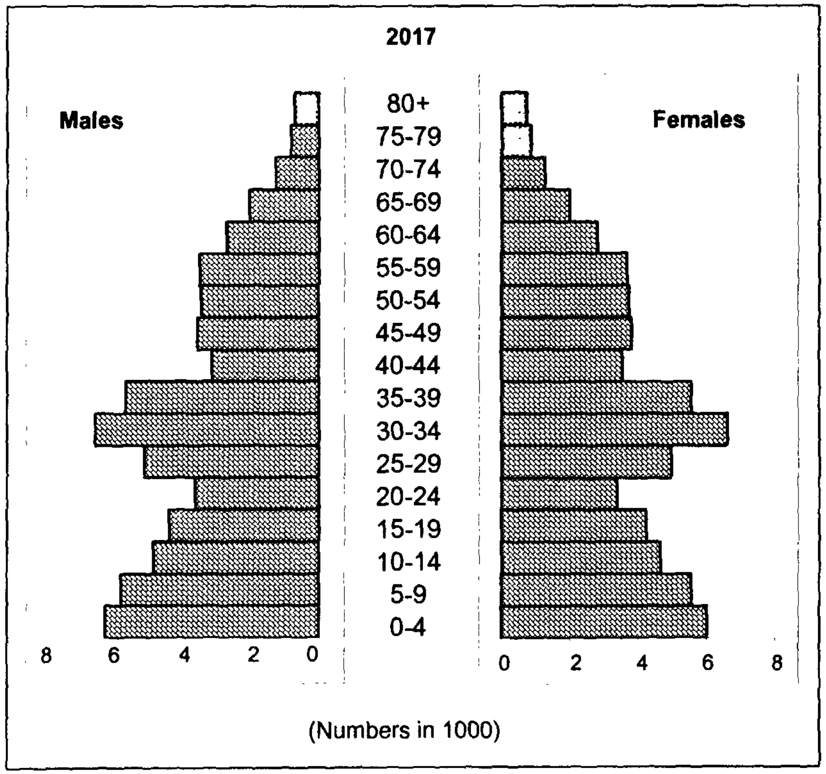
Figure 4-2: Projected Population Pyramid by Age and Sex for Rasht

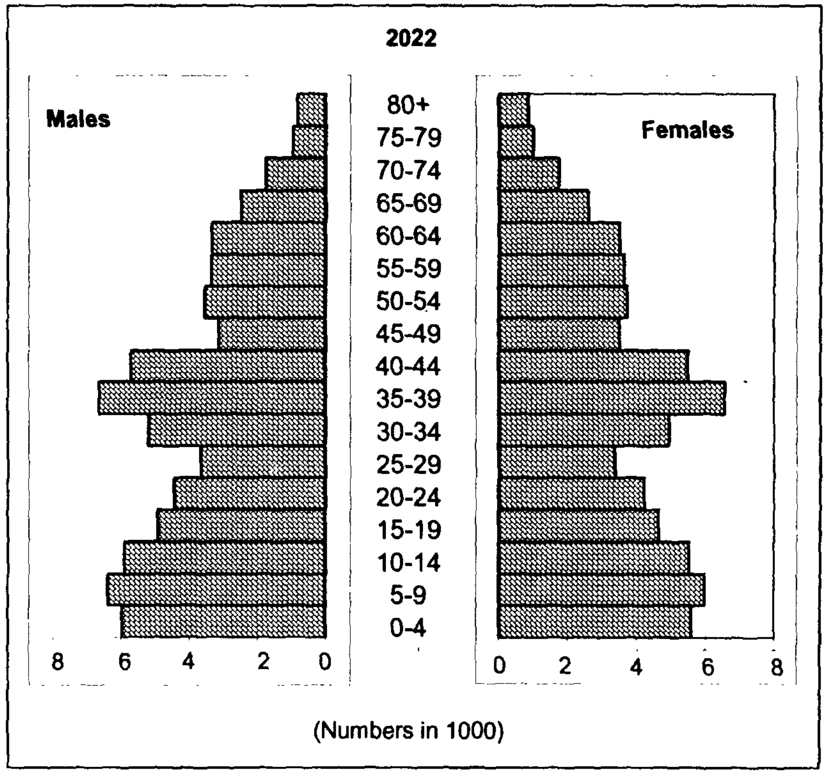




In Anzali, the projected population age pyramid for the years 2017 and 2022 shows that the population in Anzali will be young, and that there will be a "bulge" in the mid-20s to mid-40s in 2017. This bulge will continue to be the highest age group as it moves towards the end of the timeframe for this project such that by 2027 the mid-30s to 40s will dominate the age groups. The projected population figures for Anzali are depicted in the population pyramid shown in figure 4.3, below:

Figure 4.3 Projected Population Pyramid by Age and Sex for Anzali





- Literacy Situation

Data from the 1997 Census reveals that Rasht Region shows high rate of education where about 83% of the population is educated. Table 4-29 shows education data in Rasht and Gilan province between 1996 and 1997.

Table 4-29: Education data in Rasht and Gilan Province (1996-1997)

Province/Region	Educated (%)			Uneducated (%)		
	Total	Urban	Rural	Total	Urban	Rural
Gilan	79.2	87	72.2	20.8	13	27.8
Rasht	83.2	88.4	73.8	16.8	11.6	26.2

Details of educational institutions in Rasht Region and in Rasht city is given below in **Tables 4-30** and **4-31** respectively.

Table 4-30: Types and Number of Schools in Rasht Region

Sr. No.	Description	No. of Schools	Total No. of Students	
			Boys	Girls
1.	Pre School	512	41,553	38,949
2.	Guidance School	306	27,290	25,400
3.	High School	286	26,645	25,400
4.	Pre University	77	26,645	31,376
5.	Others	76	4,763	4,708
	Total:	1259	126,895	125,833

Table 4-25 shows that the overall percentage of boys and girls students in Rasht Region is 50.3% and 49.7% respectively.

Table 4-31: Universities in Rasht City

Sr. No.	Name of university / college	Women	Men	Total
1.	Gilan University	3,318	3,101	6,419
2.	Gilan medical University	1,280	644	1,924
3.	Payam-e- Noor University	1,265	728	1,993
4.	High Education Centre for Teachers	0	725	725
5.	Faculty for teachers	1,062	0	1,062
6.	Azad University	6,146	4,761	10,907
7.	Center for Governmental Management	81	493	574
	Total	13,152	10,452	23,604

Table 4-31 shows that the overall percentage of men and women studying at university level in Rasht Region are 56% and 44% respectively. The above data given in **Table 4-30 and 4-31** shows that the population of Rasht Region studying at different levels is about 35%.

As for Anzali, details of educational institutions is given below in **Tables 4-32** and **4-33**[12].

Table 4-32: Schools in Anzali Region

Sr. No.	Description	Number of Schools	Total No. of students	
			Boys	Girls
1.	Pre School	68	6,068	5,734
2.	Guidance school	53	4,553	3,982
3.	High School	47	5,726	5,866
4.	Pre university	11	476	961
5.	Other Schools	11	2,824	358
	Total	204	19,647	16,901

[12] Gilan Central Department of Education- 2001

Table 4-33: Universities in Anzali City

Sr. No.	Name of university	Woman	Man	Total
1.	Payam-E-Noor University	76	36	112
2.	Free Islamic University	0	130	130
Total		76	166	242

Table 4-33 shows that overall percentage of men and women studying at university level in Anzali Region are 31% and 69% respectively. The above data given in **Table 4-32** and **4-33** shows that population of Anzali Region studying at different levels is about 29.8 %.

The overall education level in Anzali, according to the 1997 census is 88.2%, of which the level was 91.5 for males and 84.9% for females.

Although about 10% of the population is still illiterate, this overall literacy rate is still acceptable for Iran.

4.4.2 Social-Cultural

The Gilan Province has a long cultural history, reflected in its architecture and social structure. Key factors in the social environment are religion and language discussed below.

- Religion:

Generally, religion is one of the most significant factors shaping the cultural and social characteristics of people. Table 4-34 below, shows the distribution of religious groups in Gilan Province. Religious belief is an important part of the culture and is reflected in the people's behavior. For instance, many Muslims, particularly the middle aged and the elderly, consume large volumes of water for hygiene and ablutions according to religious practice.

Table 4-34: Relative Distribution of Religious Groups in Gilan (year 1996)

Religion	Gilan		Rasht	
Muslim	2,241,896	99.88%	713,999	99.85%
Zoroastrian	464	0.02%	168	0.02%
Jewish	16	0.001%	15	0.001%
Christian	239	0.01%	124	0.02%
Others	310	0.01%	210	0.03%
Not Declared	1573	0.07%	580	0.08%

Ref: Statistics Centre of Gilan Province

The majority of people speak Farsi but there are some other dialects, given the ethnic composition. Other languages such as Turkish, Lori, Hebrew, Armenian and Assyrian are also spoken.

4.4.3 Professions

The distribution of employed people in different economic activities is an important indicator of the economic conditions of any city. Major professions identified in Rasht are skilled and unskilled workers, middle level managers, teachers, businesspersons and persons involved in liberal professions such as physicians, lawyers and auditors. A significant number of persons owning agricultural lands around the city also have their permanent residences in the city. Workers in the industrial and public sector organizations share the city work force. Data regarding professions of the inhabitants in Rasht city as reported in the year 1996, is shown in **Table 4-35**.

Table 4-35: Professions in Rasht City [13]

Job Description	%
Agricultural	2.11
Industrial	34.15
Services	62.11
Other Professionals	1.63

Data shows that about 62% of the residents are working in services followed by 34% working in industries. According to this table, Rasht is maintaining a service sector economy, well over the national average of 46.3%.

4.4.4 Employment Situation

The distribution of employed people in different economic activities is an important indicator of the economic conditions of any city. **Table 4-36** shows working and non-working and non-active population of Rasht Region.

[13] Studies on population in Design report of Rasht Wastewater Network by Iran Ab Consultants.

Table 4-36: Employment Situation of Rasht Region [14]

Population > 10 years	Active population		Non-Active population
	With job	Without job	
336,573	110,136	16,809	209,628

Data indicates that among residents above ten (10) years of age, about 32 % are employed, 5 % are unemployed and 63 % are non-active, which is relatively a high figure

Working, non-working and non active population of Anzali are shown in **Table 4-37**.

Table 4-37: Employment Situation of Anzali Region

Population > 10 years	Active population			Non Active population
	Total	With job	Without job	
99,066	36,238	29,791	6,447	62,828

Data indicates that among residents above ten (10) years, about 30 % are employed, 6 % are unemployed and 64 % are non-active in Anzali Region. In this regard, the results of Rasht and Anzali regions are almost similar.

4.4.5 Health

Environmental health is closely related to water quality, hygiene and sanitation as well as the state of water and wastewater infrastructure in urban areas.

As part of the over-all programme for the water and wastewater treatment program in Rasht and Anzali, investigations into water related health issues were undertaken by the World Bank in 2002. The objectives of the Word Bank's environmental health study were two fold:

- To take stock of available statistics and existing literature on water related diseases in the Islamic Republic of Iran, and;
- To establish a baseline with regard to direct and indirect water-related diseases that would help monitor progress and measure the outcome during and after the implementation of the water supply and sanitation project.

These objectives were realized using a combination of desktop research and interviews with relevant government officials.

[14] Rasht Region Population Census - 1995 issued by Iran Census Centre

The study focused on the cluster of diseases traditionally associated with water-borne infections such as Diarrhoea, Dysentery, Cholera, Intestinal helianthus, Gastroenteritis, Infectious hepatitis A and B, and eye and skin infections. Also Malaria, Filariasis, and other vectors, prevalent in certain cities, were also investigated as they can also cause water-born diseases. Moreover, reproductive disorders, cancers, nervous system damage and liver damage could be caused by the presence of high levels of nitrates, nitrites, pesticides, chlorinated solvents and heavy metals such as lead in drinking water.

The study stated that Rasht and Anzali have a high prevailing level of diarrhea especially during the rainy season and also the summer season. Other diseases include hepatitis A, eye diseases, Gastric and esophageal cancers. The various factors that contribute to the rise of diarrhea is (1) infiltration of raw sewage to the old leaking water supply network (2) the increased sedimentation of the water supply network which increases the microbiological contaminants in the water and (3) the rise of the water table during the rainy season that would flood septic tanks and contaminate underground water especially untreated wells.

Additional possible reasons would include use of contaminated Zarjoob and Goharood River water in irrigation., and the private use of untreated well water which is contaminated by wastewater. Figures provided by the Gilan Health and Medical Education University, as shown in Table 4-38 below, indicate that Diarrhea is the predominant contagious disease in Gilan.

Table 4-38 Reported Diseases Cases in Gilan Province, years 2001, and 2002

Disease	**Year 2001**	**First Half of Year 2002**
Diarrhea	7506	4324
Dysentery	115	63
Typhoid	33	7
Hepatitis A	not reported	not reported
Hepatitis B	89	53
Cholera	-	-
Conjunctivitis	6571	3865

Medical Facilities

There are ten (10) private and public hospitals in Rasht region, which constitute 40 % of the total hospitals in Gilan Province. Health related laboratories are also available in the region. Since the city of Rasht is the most densely populated area in Rasht Township, most of these hospitals and laboratories are present there.

As for Anzali, data reveals that there are three (3) polyclinics in the private and public sector and one (1) public hospital in Anzali Region. Health related laboratories are also available. Most medical institutions are located in Anzali City since it is the largest population center in Anzali Township.

A list of the medical institutions and facilities in Rasht & Anzali Region is shown in Table 4-39 below:

Table 4-39: Medical Institutions in Gilan Province & Rasht Region

Province/ Region	Public Hospital		Private Hospital		Laboratory	Medical store
	No	No of Beds	No	No of Beds		
Gilan	5	407	20	2984	145	216
Rasht	3	308	7	1727	47	84
[1]Anzali	1	NA	0		8	15

[1] Anzali also includes 2 public and 1 private poly clinic

Source: Gilan Medical University

4.4.6 Land Use

The estimated population of Rasht City and Rasht Region in 1997 was 417,748 and 713,913 respectively while their respective areas were 67.97 Km^2 and 1,427 Km^2.[15] Rasht City comprises only 4.8 % of the area of Rasht Region whereas 59% of the population of Rasht Region is residing within the city.

On the other hand, the, estimated population of Anzali City and Anzali Region in 2001 was 101,534 and 123,461 and the areas were about 3,094 hectares and 3,080,900 hectares respectively[16]. This shows that Anzali City comprises only 0.1% of the area of Anzali Region at a time where 82% of the population of Anzali Region is residing within the city.

- City Boundaries are shown on drawings RSC-PJ-P1-IR-101 and AVES-IR-17-1 (annex A) for the two cities
- Different Land Uses in Rasht and Anzali
  - Residential Settlements
  - Roads

[15] Department of Management and Planning.

[16] Department of Management and Planning, Gilan

- Rasht is linked to other parts of the country through a proper net work of roads around the city. Various types of roads in the city are:

- Four (4) lane roads: 85 Km.

- Secondary roads: 230 Km.

- Other roads: 12 Km.

Out of 230 Km. of secondary roads, 4 Km. roads are graded track and 226 Km. are asphalt roads.

- Anzali is linked to other parts of the countrythrough a network of roads in and around the city. Details of various roads in Anzali are as follows:

- Principal roads: 40.4 Km

- Secondary roads: 18 Km.

All secondary roads are asphalt roads.

o Recreational areas/Open Spaces

There are six (6) parks with a total area of 6,797 hectares in Rasht city. In addition, two (2) forest parks also exist in Rasht called Saravan and Emamzadeh Hashem parks, with a total area of 342 hectares and 8 hectares respectively. The two forests are outside the boundary of the Influence Area of the project.

Recreational areas in Anzali include few parks with a total area of about 35.7 hectares. Anzali Lagoon with an area of about 80 Km^2 is the largest recreational area and is one of the largest wetland of ecological importance in the world where about two (2) million tourists visit every year.

o New/Future Development areas in the two cities

Construction activities with respect to future development are in progress at some locations within the cities of Rasht and Anzali. In Rasht the expansion areas by 2027 represent around 30 % of the presently built up areas, and in Anzali the new developments are taking place within the present boundaries.

o Institutional Facilities

Schools, universities, government hospitals and other institutional facilities are available in both Rasht and Anzali. These have been elaborated in the preceding paragraphs.

o Commercial Centers/Markets

Commercial centers and markets are available in Rasht and Anzali, as they are the largest cities of Gilan Province. Residents of adjacent villages come to the two cities for shopping and other commercial activities etc.

4.4.7 Industries

There is one industrial estate in Rasht where all industries in the cities should relocate or be established. The industrial estate is located some 25 km to the south of city, and lies outside the project area. The total area of the industrial estate is 420 ha, and includes the following main industrial activities: metal industries, wood industries, chemicals, and electrical industries, ceramics, sewing and textile, as well as food and beverage industries.

The industrial city will have its own central treatment facility. In fact, the IMO at Gilan is sourcing funds for the design and construction of such a facility. In accordance with JICA study report, the treatment facility for this city should have a capacity of 10,500 m^3/day by year 2019.

However, there are some 17 small industrial units in the Project area of Rasht city as well. A few of these industries have pre-wastewater treatment facilities. **Table 4-40** shows the effluent quality of the industries in the project area. Although the total present flow of 355 m^3/day and total COD load of 147 kg/day is negligible when compared to the loads and flows generated by domestic wastewater of the city, nonetheless some industries have effluent qualities that exceed the Iranian effluent standards for industrial discharge. In particular, the slaughter house and the dairy factory would normally have very high strength effluents. All of these industries are discharging their effluent into the rivers currently, and should very soon stop.

The Department of Environment- Gilan is responsible for ensuring the reduction of industrial pollution by enforcing pre-treatment on the industries and by monitoring their discharge into the receiving bodies. Currently, there is only one industry with pre-treatment (polypropylene textile factory). Industries in the city will only be connected to the sewerage network if they have pre-treatment systems.

Table 4-40: Effluent Quality of Industries in Rasht City

No	Industry	Discharge point	Flow (m^3/day)	Water Temp.(^0C)	TSS (mg/l)	pH	Sulphate (mg/l)	BOD (mg/l)	COD (mg/l)	COD (Kg/day)
1.	Niknosh (soft drinks)	Zarjoob river	12. 30	19	1,973	9.0	158	60	343	4.2
2.	Zamzam (soft drinks)	Zarjoob river	0.50	22	116	9.8	69	480	2,902	1.4
3.	Pars textile(textile)	Lakan river	7.61	42	116	7.4	170	240	1,570	11.9
4.	Pars Shahab (electrical)	Zarjoob river	8.30	27	172	11.0	565	6	22	0.2
5.	Iran Poplin (chemical)	Zarjoob river	3.50	12	448	9.9	242	110	540	1.9
6.	Peleh-Abrisham	AW, AU	23.67	25	304	7.9	145	260	1,443	34.2
7.	Iran Barak (stitching)	Goharood (Lakan)	84.35	28	32	8.2	131	38	109	9.2
8.	Chini gilan (ceramics)	Goharood (Lakan)	15.61	25	484	6.25	252	120	370	5.8
9.	Pars Khazar (electrical)	Zarjoob river	128.00	24.5	22	4.7	123	370	580	74.2
10.	Gilan Carpet	Goharood (Lakan)	10.80	20	45	7.3	170	30	48	0.5
11.	Arde Shad (food)	Channel	1.70	17	203	7.3	63	170	729.6	1.2
12.	Arde Asghar nia (food)	Channel/Zarjoob	2.00	19	919	7.4	91	390	1600	3.2
13.	Arde Ahmad zadeh	Channel/Goharood	1.40	-	-	-	-	-	-	-
14.	Gilan Ard	Channel	1.05	-	-	-	-	-	-	-
16.	Sephidrood Slaughter house	Channel/Zarjoob	52.05	-	-		-	-	-	-
17.	Sephidrood Dairy farm	Channel/Zarjoob	2.74	-	-	-	-	-	-	
		Total flow (m^3/day)	355.58			COD loading (Kg./day)				147.9

AW: Absorption well, AU: Agricultural use

As for Anzali, there are two industrial estates which are called Hasan Rood and Beshm Complexes located some 10 km in the Eastern and Western side of the city respectively. The total area of the two industrial estates is 85 ha, and include the following main industrial activities: metal industries, wood industries, chemicals, food, mineral (non-metal) and electrical industries.

The two industrial cities will have their own central treatment facility. In fact, there is one small-scale treatment plant currently under construction in one of the cities. In accordance with JICA study report, the treatment facilities for the two cities should have a total capacity of 2,200 m^3/day by year 2019.

In addition to these two large industrial complexes, there are eight scattered industries located inside Anzali. The quality of wastewater discharged from some of these industries is shown in **Table 4-41.** Although the total BOD_5 and COD load would be negligible when compared to the loads and flows generated by domestic wastewater of the city, nonetheless some industries have effluent qualities that exceed the Iranian effluent standards for industrial discharge. In particular, the Iran fiber factory and the Kadoos Fish Can factory have high strength effluents.

The Department of Environment- Gilan is responsible for ensuring the reduction of industrial pollution by enforcing pre-treatment on the industries and by monitoring their discharge into the receiving bodies. Industries in the city will only be connected to the sewerage if they have pre-treatment systems.

Table 4-41: Quality of wastewater from industries in Anzali city

Sr. No.	Name of industry	Temp. (^{0}C)	TSS (mg/l)	pH	Sulphate (mg/l)	BOD (mg/l)	COD (mg/l)
1.	Iran Fiber	31	3,681	6.2	315	3,250	7,500
2.	Khazar Product Conserve	17	105	7.4	-	480	1,600
3.	Anzali Slaughterhouse	18	108	6.7	58.75	80	250
4.	Kadoos Fish Can	22.2	3,517	7.5	150	823	2,800

4.4.8 Solid Waste Management

The solid wastes in the Rasht and Anzali areas are collected by the relevant municipalities. In accordance with JICA study the waste collection service coverage in Gilan is 65 % on a population basis, and 86 % on waste amount basis. The waste generation rate is about 900 g/person/day in the urban area and 300 g/person/day in the rural areas.

Because of insufficient collection services and also lack of environmental awareness of the residents, some of the solid wastes generated are dumped into the streams, and quite often end up in Anzali wetland.

In Rasht, a solid waste dumping site is located in Saravan forest, 25 Km. away from the city on Rasht-Tehran Road.The landfill site is currently 300m x 600m in area. It is estimated that some 500 tons/day are produced from Rasht of which, 150 tons/day go to a compost plant. As stated in the feasibility study, the composting plant has operational problems, and is not performing as expected.

In Anzali City, there is no solid waste dumping site and waste is often dumped in and around Anzali Lagoon or along the Rogas. This may be due to a lack of environmental awareness of the residents. Raising environmental awareness first will be necessary to reduce improper solid waste dumping.

4.4.8.1 Agricultural Activity

4.4.8.1.1 Agricultural Activity in Gilan Province

Agriculture is a very important economic sector in Gilan. The predominant and most valuable crop is rice, which some rate as being of best quality in the country. Rasht city also has trees and fruit orchards around and to a lesser extent, wheat and barley are also planted. Table 4-42 details the agricultural product variety and its yearly land cultivation in Rasht, as follows:

Table 4-42: Rasht Agricultural Production

Description	Area (Hectares)	Under Cultivation (%)	Production (Tons)
Rice	62,000	98.5	315,883
Cereals	100	1.16	796
Summer Crops	100	1.16	785
Fruits	636	1.18	5,590
Total	62,836	~ 100	323,054

Similarly, there is cultivated land and orchards all around the city of Anzali. About 4,680 hectares of Anzali land are used for agriculture. Rice is a common crop and about 90% of cultivated land is used for its cultivation while wheat is scarcely grown (see Table 4-43).

Table 4-43: Anzali Agricultural Production

Description	Area (Hectares)	Under Cultivation (%)	Production (Tons)
Rice	42,000	90.0	215,883
Cereals	67	1.4	510
Summer Crops	300	6.4	215
Fruits	113	2.2	6,446
Total	42,480	~ 100	223,054

Fertilizer Use and Pesticides

The quantities of pesticides and fertilizers used in Anzali and Rasht are shown in Tables 4-44 and 4-45 below, which demonstrate the wide spread use of the these substances in the agricultural sector in Gilan province.

Table 4-44: Fertilizer Use In Gilan Province Year 2002 (tons/year)

Type of Fertilizer	Rasht	Anzali	Gilan Province
Urea	12,676	624	51,693
Ammonium phosphate	336		336
Ammonium nitrate	2,351		2,351
Ammonium sulfate	154		2,216
Triple super phosphate	886	50	2,653
Potassium sulfate	1,444	300	4,884
Potassium chloride	1,840		5,079
Bio phosphate	22		405
Macro	238		3,863
Others	38	5	1,012

Table 4-45: Pesticides Use In Gilan Province Year 2001 (tons/year)

Type of Pesticides	Rasht	Anzali	Gilan Province
Insecticides	14.4	0.74	1,100.9
Fungicides	12.4	0.84	95.8
Herbicides	9.8	1.2	87.2
Tickicides	1.1	0	20.9
Phosphate tablets	35.3	0.94	140
Mice and rodent killer	2.5	0	6.6
Others	546	8.5	57.1

4.4.8.1.2 Agricultural Activity in Qazvin Province

The Feasibility Consultant and GWWC considered various alternatives for disposing of the treated sewage sludge produced by the Rasht and Anzali WWTPs. As the option of agricultural re-use in Gilan Province was not possible due to climatic conditions and cultural constraints, a possible alternative for re-use of the treated sludge as a natural fertilizer in nearby Qazvin Province is being proposed as a viable alternative. Accordingly, a brief description of Qazvin's agriculture is presented below:

Qazvin Plain (ref. map shown in Exhibit 14 Annex A) is an important agricultural area, which in 2003 totaled 265,261 Ha. This area comprised 147,586 Ha of irrigated land, and 117,675 Ha of rain-fed land. The principal agricultural activity is of fruit orchards and cash crops. 73,276 Ha were cultivated with fruit orchards, of which 72,350 Ha were irrigated. Main orchards include apple, grape, olive, cherry, pistachio, and walnut trees. Main crops cultivated include wheat, barley, corn, cotton, beans, beets, rice, hay, potatoes and tomatoes.

Fertilizer use is widespread with farmers reportedly using various types of chemical fertilizers such as ammonia phosphate, super phosphate, urea, ammonia nitrate, potassium sulfate and matured macro for orchards.

4.4.9 Infrastructure Services

- **Energy**

1. Heating

The energy needed for heating in houses, industries, etc. is generated using electricity, gas and kerosene.

2. Electricity

Power transmission network is operating in the city and is being used by the people residing in the area. The power plant supplying electricity to the residents is located far away from Rasht and Anzali cities.

3. Gas

There is a central gas network in Rasht and Anzali

- **Water Supply, Sewage Collection and Treatment**

The existing services for these infrastructure facilities were discussed at length in Chapter 3

- **Fire Fighting and Civil Defence**
  There are 4 fire fighting stations in Rasht, while there is one in Anzali and one in Ghazian.

- **Abattoir**
  There is one abattoir within Anzali's city boundaries.

- **Cemetery and Mortuary**
  Rasht currently has three operational cemeteries, and 4 inactive ones. In Anzali, there is one cemetery.

- **Public Baths and Toilets**

Rasht used to have as many as 78 public baths as recently as 1996, however, this number has been greatly reduced. In Anzali, there are about 15 operational bathhouses. There are less than 10 public toilets in Anzali.

4.4.10 Tourism

Tourism is one of the important economic sectors in Gilan province, in view of the unique ecological and natural setting of the area. Most of the tourists currently come from within Iran. Obviously, Anzali Lagoon has international importance as discussed in previous paragraphs.

Accommodation

The total number of hotels and lodges in Gilan province amount to 68 offering 3,703 beds for tourist. The number of hotels, rooms, and beds for Anzali and Rasht is detailed in the table below. Also it should be stated that many tourist would rent summer houses to stay in the region. In addition to hotels, the province has some 61 restaurants.

Table 4-46: Accommodation Facilities in Gilan, Rasht, and Anzali

Type of Hotel	Rasht	Anzali	Gilan Province
4 Star Hotel	1	1	2
Number of rooms	99	99	198
Number of beds	198	198	396
3 Star Hotel	1	1	3
Number of rooms	36	76	222
Number of beds	72	152	482
2 Star Hotel	3	2	10
Number of rooms	112	58	279
Number of beds	224	115	567
1 Star Hotel	3	4	14
Number of rooms	65	153	394
Number of beds	129	316	887
Travel Lodge	14	25	39
Number of beds	594	777	1371

Ref: Tourist Organization of Gilan Province

4.4.11 Cultural Heritage

Rasht is one of the oldest cities in the North of Iran. **Table 4-47** below gives a list of historical buildings in Rasht city[17]. All of these structures are located inside the city but none of them is of any historical or archaeological significance as declared by Cultural and Heritage Department, Gilan.

[17] Gilan Province Census 2000-2001 and Cultural and Heritage Department, Tehran.

Table 4-47: Archaeological structures in Rasht

Sr. No.	Description	Classification	History of antiquity
1.	Municipal building	Building	*Pahlavi dynasty
2.	Shahpoor school	Building	Pahlavi dynasty
3.	Kolah Farangi building	Building	*Gagarieh dynasty
4.	Mohammad Khan mosque	Mosque	Gagarieh dynasty
5.	Rasht national library	Building	Gagarieh dynasty
6.	Cultural heritage building	Building	Pahlavi dynasty
7.	Chomar Sara bridge	Bridge	Gagarieh dynasty
8.	Daylaman *Hamam*	Bath House	Saljoghieh dynasty Before 735 A.H*
9.	Abrishami house	House	-
10.	Agheular mosque	Mosque	-
11.	Amin Al Doleh house	House	-
12.	Chinichian Karvansara	Karvansara	-
13.	Monajam Bashi house	House	-
14.	Ostandary building	Building	-
15.	Post office building	Building	-
16.	Municipality library building	Building	-
17.	Iran hotel	Hotel	-

AH*: For Gregorian calendar, add 579 years to A.H.
* Pahlavi dynasty: Period between 1926 to 1978 A.G
* Gararieh dynasty: Period between 1795 to 1925 A.G

Anzali, like Rasht City, is one of the oldest cities in the North part of Iran. There are some archaeological structures in Anzali city as shown in **Table 4-48** but none of them is of any historical or archaeological significance.

Table 4-48: Archaeological structures in Anzali

Sr. no.	Description	Classification	History of antiquity
1.	Mianposhteh palace	Palace	*Pahlavi dynasty
2.	Clock tower	Tower	Pahlavi dynasty
3.	Music building	Building	Pahlavi dynasty
4.	Ghazian bridge	Bridge	Pahlavi dynasty
5.	Municipality building	Building	Pahlavi dynasty

* Pahlavi dynasty: Period between 1926 to 1978 A.G.

4.4.12 Planned Developments

Most of the developments in the project area comprise of road projects:

These can be listed as follows:

- Freeway between Rasht and Qazouin to be completed in 2006
- Road between Foman and Rasht to be completed in 2006
- Road between Anzali and Rasht to be completed in 2006
- Road between Sahagrood and Rasht to be completed in 2006
- Road between Foman and Saravan to be completed in 2006
- Ghazian Bridge (around 200 m) to be completed in 2006

5 Public Involvement

As an integral part of the EA process of Rasht and Anzali Water Supply and Sanitation Project, consultation and communication with various interested groups were undertaken. The Public Involvement (PI) is essential to determine individual and community preferences, facilitate selection of project alternatives, and designing sustainable mitigation plans. Furthermore, PI will assist in understanding likely impacts, and the gathering of environmental data.

The basic components of public involvement is information dissemination, information soliciting, and consultation, all of which promote effective public involvement and occur at various stages of the project development cycle.

5.1 Information Dissemination

Information concerning the project was disseminated very early by GWWC to various stakeholders. Technical, financial, environmental and social issues associated with the project were issued to Gilan Regional Water Board, general public, relevant industrial institutions, the Rasht and Anzali municipalities, The Council of each city, The Department of the Environment, The Ministry of Health and Medical Education, The Ministry of Agricultural Jihad, The Cultural Heritage Organization, Universities, NGOs, and Farmers. Terms of Reference for the EI studies were developed and shared with the key stakeholders in scoping meetings, which were held as of December, 2002. Relevant documentation about the project was issued through letters, and project reports. GWWC also issued monthly bulletins and news letters to inform the public about the project. The aim of this dissemination was to provide accurate information concerning the project objectives, components, likely impacts, environmental concerns, and other issues, which would facilitate information soliciting, and participation at later stages of the EA, as described in the proceeding paragraphs.

5.2 Information Solicitation

Information that is relevant to the EA and that would provide insights were sought from the various stakeholders throughout the EA study. Annex F presents minutes of meetings held by the consultant with various project stakeholders to solicit information relevant to the project and support for the implementation and involvement of the public. In brief, the following outlines the main inputs of selected stakeholders:

- GWWC: Status of water supply system, sewage system, water and wastewater quality records, and assistance in providing technical data.

- RWB: Current plans within the Central and East Gilan Water Supply Scheme and their financing of components currently underway
- Rasht and Anzali Municipalities: urban situation, land acquisition, and building permits.
- Department of Environment: information on local biodiversity, latest update on applicable environmental standards, well water quality records, surface water quality records, Anzali lagoon water quality, and industrial effluent records.
- Ministry of Health and Medical Education: Public health in Rasht and Anzali Cities, and incidence of water borne diseases.
- Ministry of Agriculture Jihad: Agricultural situation, standards of irrigation water, and standards for treated sludge.

5.3 Public Consultation

Following information dissemination and solicitation, public consultation was conducted through interviews, group discussions, and public meetings. Public consultation included also other major stakeholders as detailed in the following paragraphs

5.3.1 Municipality of Rasht

Consultation with the officials of the municipality and the mayor covered the following points

- Role of municipality in the provision of public services
- Components of proposed project, and interface with works conducted by municipalities
- Local council procedures
- Development priorities of the municipality

5.3.2 Municipality of Anzali

Consultation with the officials of the municipality and the mayor covered the same issues stated above with municipality of Rasht.

5.3.3 Department of Environment-Gilan

Consultation with the officials of the provincial office of the Department of Environment Gilan focused on the following issues:

- Jurisdiction, institutional structure, and responsibilities of DOE-Gilan

- Coordination with, Central DOE, MOE and other institutional arrangements
- The urgent requirement for development of municipal wastewater collection and treatment facilities in the project area.
- The urgent requirement for development of industrial wastewater collection and treatment facilities in the project area.
- Other important environmental issues that are of concern to the DOE-Gilan are development of dams in the province and their environmental impact, minimization of deforestation, solid waste management, surface water and Caspian sea environmental degradation.
- Current plans of DOE-Gilan
- Priorities of environmental issues, in which the provision of wastewater collection and treatment systems and the provision of water supply system ranked as the first priority.
- Programs

5.3.4 Public Meeting

Annex F presents the proceedings of the public consultation meetings held on the 12th and 13th of January, 2005. More than 250 people representing the main stake holders, and the public participated in the meeting. The public meetings discussed the project objectives, project description, alternatives to the project and alternate design options available, positive and negative impacts of the project, major environmental issues and mitigatory measures available, and feedback from the public. The speakers presented their discussions using documentary films, power point, and audio visual aids. The main feedback from the public was that the project is urgently needed, it should be executed to a very good quality, government agencies should coordinate with each other, and GWWC capacity should be enhanced to meet the project needs. The main concern of the participants was the potential adverse impacts of the projects on the following:

- The scope of the project and the reduction of pollution in local rivers and surface water bodies, especially nutrients such as phosphorus and nitrogen.
- Reduction of the high UFW rates and how the project will achieve this.
- Health concerns from sludge reuse and disposal.
- Wastewater treatment plant location and the timetable for completion.
- The need to minimize disturbance to the local population, and minimize delays in construction of the project by promoting interagency coordination, planning and

proper implementation of the works

The Proponent and the Consultants to the project assured the participants that the EA studies have addressed these issues very carefully per following:

The project will reduce one of the major sources of pollution to ground and surface water resources by providing proper collection and disposal of urban wastewater in Rasht and Anzali. Furthermore, the proposed wastewater treatment plants are proposed to incorporate BNR removal systems to reduce nutrient levels, such as phosphorus and nitrogen, from the treated effluent, which will further improve the water quality of local rivers and Anzali Lagoon, as well as the Caspian Sea.

The use of sludge in agriculture, will take place after proper treatment by long term storage, which will ensure that the sludge will meet the required application standards. Furthermore, the application of sludge in agriculture will be subject to a plan managed by the MOAJ. Proper monitoring of sludge application and quality will minimize any potential impacts of non-compliant sludge.

The treatment plant locations have been carefully selected so that they cause minimum disturbance to the environment and to the local population. The project will provide 100% coverage for all the residents in Rasht and Anzali by end of the project period, but financial limitations by the government are constraining the project's implementation. Therefore, the WB loan is extremely important for the project's implementation, and to achieve the target milestones of each phase of the project.

The environmental consultant has studied in detail the potential adverse impacts during the construction stage, such as noise, traffic congestion, dust, etc and has included mitigation measures which would minimize these temporary impacts.

5.4 Summary

Numerous governmental and non-governmental organizations were consulted at various stages of project preparation. At the initiation of the project, technical, financial, environmental and social issues associated with the project were discussed in meetings attended by the design Consultants, representative of the City councils, Rasht and Anzali municipalities, Gilan Regional Water Board and various other stakeholders. Terms of Reference for the EI studies were developed and shared with the key stakeholders in scoping meetings, which were held as of December 2002.

The preparation process for the environmental assessment included public consultations which were carried out at various stages. The consultations involved line ministries, city authorities, provincial departments of environment, operating water and wastewater companies, local communities, NGOs and the public.

Upon the completion of the draft EA report, the executive summary was translated to Farsi and a public hearing was held on the 12th and 13th of January 2005. The meeting was attended by more than 250 participants from various organizations including representatives of GWWC, local health authorities, local law enforcement authorities, Gilan Regional Water Board, NGOs, Rasht municipality, Anzali municipality, DOE of Gilan, members of the press, experts and professionals from the community of Rasht and Anzali. Invitation letters were prepared in Farsi and were accompanied with the draft Executive Summary. Announcements about the meeting were also made through the local newspapers and public bulletin boards. The meeting was covered by the local newspapers, television and radio. The meeting consisted of an opening session, a presentation of the project financial arrangements and the current cooperation between the World Bank and GWWC. This presentation was followed by a short documentary film which showed the current status of the water and wastewater services in the two cities and the ongoing works of these facilities. The film was followed by a presentation of the project's major components and the environmental aspect of each component. The common view held was that the project should be implemented as soon as possible as it would result in improved health and welfare benefits not only to Rasht and Anzali cities but for the whole region.

The main concerns expressed by some of the stakeholders were the environmental impacts of the project, particularly the effluent and sludge from the wastewater treatment plants. A university professor requested clarification on how the project will impact environmental state of the local rivers and Anzali Lagoon, as well as the Caspian Sea. It was clarified that adequate design provisions have been incorporated to include biological nutrient removal (BNR) systems within the wastewater treatment plants. This, together with the proper collection and treatment of wastewater in the two cities, will improve the quality of the local rivers, and the lagoon, and will have a positive impact on the environment. A concern was raised regarding the proposed disposal of the sludge from the wastewater treatment plants and the reuse of treated sludge in agriculture considering the constraints and the health quality limits required by various standards. It was clarified that the design took into account sludge application rates, sludge and soil monitoring to address all the requirements of the national and international standards.

6. POTENTIAL ENVIRONMENTAL IMPACTS OF THE PROPOSED PROJECT

This section identifies the main potential impacts that could arise from the implementation of this project, analyzes these impacts, and assesses their significance so that negative impacts can be properly mitigated and positive ones are enhanced. Most of the assessment is based on professional judgment, previous experience, as well as from other literature information (research papers and reports). Identification of potential impacts is done during both construction and operation phases.

6.1 Impacts on the Geophysical Environment

6.1.1 Changes of Land Use

Change of land use is a permanent effect, occurring at the Construction phase of the project. The various component of the project will either not cause changes in land use or cause a limited one time change in land use in view of the following:

- Water supply lines and sewers will be constructed in publicly owned property.

- The site for phase 1 of the wastewater treatment plant at Rasht has already been acquired whereas arrangements for further acquisition of lands adjacent to the existing site for the subsequent stages are underway. The total area that will be acquired for the development of this facility is 59.5 hectares. The site is located near Zarjoob River and is comprised of agricultural lands that are currently not cultivated. Similarly for Anzali, land for the first stage works for the West WWTP at Ilyaran and the land for the East WWTP located near Talebabad have been acquired. The total area that will be acquired for the development of the West WWTP is 14 hectares, and that for the East WWTP is 17 hectares. All these lands are comprised of agricultural lands that are currently not cultivated.

- The sites for most of the 25 lift/ pump stations in Rasht and 21 lift/pump stations in Anzali have been acquired by GWWC. These sites are about 500 m^2 each, and mostly comprise of vacant lots of land that are not developed within the two cities. The few remaining lands for these stations are in the process of purchasing by GWWC.

- The remaining components of the project comprising of water storage tanks, water pumping stations, and pressure relief valves will be constructed on lands that belong to the government and currently serving no specific use.

6.1.2 Relocation of People

The project will not require relocation of people or demolition of property. As stated in the preceding paragraph, the sewers, water supply lines, water tanks, and pressure reducing valves will be constructed on publicly owned property. As for the Wastewater treatment plants, they will be located outside the cities. The nearest residential area to any of the treatment facilities is located some 2 to 3 km away. Therefore sufficient buffer distance is available to mitigate potential odor and noise impacts arising from the operation of these treatment facilities. Therefore no relocation of the residents would be envisaged.

6.1.3 Disturbance during Construction

The following impacts are likely to occur during the laying of water supply and sewer lines, as well as during the construction of the wastewater treatment plants. However this will be a short-term impact during the construction phase of the Project, affecting different people at different times.

Laying of water supply and sewer lines would cause the following negative impacts on the residents of the locality:

- Difficulty encountered in access to residences and buildings;
- Noise pollution during trench excavation and construction activity;
- Possible effects of vibration on old and weak buildings;
- Closure of roads or section of roads causing traffic congestion and detours resulting in longer travel times;
- Difficulty for pedestrians passing through constructed areas;
- Dust pollution resulting from construction activities;
- Movement of heavy vehicles used for construction can cause traffic jams;
- Construction of sewer house connections by households may cause disturbance to the local inhabitants;
- Disturbance due to relocation of utility lines of water supply, gas, electricity, telephone, etc. specially in the areas where As Built drawings of these utility lines are not available.

These impacts will be experienced by the residents of the area where construction activities will take place but will be limited to a short period of time. Similarly, impacts on the pedestrians passing through the under construction area will also be time limited. It is worth noting that in some areas of downtown Rasht, where traffic is heavy and the excavation is deep, the laying of sewers is proceeding with micro-tunneling, which does not lead to road closure and will cause minimal restriction to traffic.

Construction of Anzali Wastewater treatment plants will cause very little disturbance since they are located outside the city of Anzali; at some 2 km distance from the city. The roads leading to both treatment plants from the city are used mostly to access the agricultural area and some other dispersed residential settlements. Therefore there is little traffic movements along these roads, and consequently the impact of heavy construction traffic will be minimal.

With regard to Rasht wastewater treatment plant, although it is located outside the city, yet there are scattered farmers' houses at some 300 m away, and also a cluster of residential houses is located at 800 m distance; therefore during construction disturbances due to noise, dust, and some restriction to local traffic may be experienced by the local inhabitants.

The short term negative impacts due to construction activities should be considered against the permanent positive impact of greatly increased amenity to the streets of Rasht and Anzali. The positive impact of the project, covered elsewhere in this chapter, greatly outweigh the construction disturbances.

6.1.4 Noise and Vibration

The potential noise impact for this Project encountered during its construction period will be due to two main types of noise.

- Noise due to construction of water supply system, sewerage system and wastewater treatment plants.
- Noise due to the vehicles carrying construction materials and spoil.

Noise due to construction of water supply and sewerage system will be mainly due to the excavation of roads while laying these services in streets. This activity will have significant noise impacts on pedestrians and residents of properties along the water supply and sewer line routes.

The phasing of water supply and sewer construction should ensure that noise impacts on the residents and pedestrians are only for a short period of time and this shall be limited to normal daytime working hours. No construction will take place on holidays, and after the normal daytime working hours. Noise impacts, although temporary, should be mitigated using standard silencing equipment. In this regard, Iranian and internationally recognized regulations limiting noise should be included in the Contract Documents in chapters pertaining to specifications for construction works and supply of mechanical and electrical equipment.

Drilling and mechanical digging of road surfaces will produce vibrations and the level of vibrations could potentially cause structural damage to foundations of old buildings. This aspect should be taken care of, especially in the city centre of Rasht, which is part of the old city. Much of the vibration will be alleviated by the use of bored rather than percussive drilling techniques and use of dead weight rather than vibratory compaction equipment.

The other source of noise will be from the vehicles carrying construction material and spoil for installing water supply system, sewerage system and wastewater treatment plants. This material and spoil will be transported through the existing road network in Rasht and Anzali. Spoil transportation will also increase vehicle movement in Rasht and Anzali up to some extent, for which mitigation measures have been given in the environmental management plan.

During the operational phase of the Project, the only noise source will be due to the operation of the wastewater treatment plant. This noise will mainly result from the operation of pumping equipment and standby generators in case of main power failure. The land around wastewater treatment plants in Rasht and Anzali is agricultural. There is no residential area around the sites of wastewater treatment plants at Anzali, whereas at Rasht some isolated dwellings are at more than 300 m distance. This buffer distance as well as, the noise level standards required by the project specifications are sufficient to mitigate the noise to acceptable levels. As such, there will be no direct effect due to the operation of the wastewater treatment plants on the population of Rasht and Anzali. In addition, boundary walls surrounding the sites will also act as sound barriers and reduce noise impacts to acceptable levels.

6.1.5 Air Quality

During construction, particulate matter and gaseous emissions from construction machinery may create nuisance and can have adverse health impacts. The quality and nature of machinery used in the Project should be such that these impacts are not severe.

Substantial quantities of dust in and around active construction areas in Rasht and Anzali will also be generated from vehicular movement during construction. The impact of dust will be high especially on unpaved roads due to the movement of heavy construction machinery. The installation of aggregate processing plant may also generate dust thereby polluting the environment. However, as stated earlier, these impacts will be of short duration while mitigation measures have been given elsewhere in this report to reduce these impacts.

6.1.6 Visual Impact

Visual impacts will occur at the construction and operation phase. By nature, construction activities for the various project components will cause a reduction in the visual amenity in some areas. These impacts, however, will be short term and will be of significance close to parks and attractive historical places. The wastewater treatment plant sites in Rasht and Anzali are surrounded by agricultural land. All of the WWTPs will be enclosed by high walls which will serve as a barrier to their surroundings. The structures of WWTPs in Rasht, East and West Anzali will be concentrated within the boundary limits of wastewater treatment plants. No significant negative visual impacts of the wastewater treatment plant are expected on the surroundings. The visual impact may be improved by planting trees, plants and with proper landscaping.

6.1.7 Impacts on Traffic and Transportation

There will be impacts on traffic flow in Rasht and Anzali due to the following reasons:

- Closure and diversion of roads during water supply and sewerage construction;
- Traffic used to transport raw materials and spoil during construction of the project's components;
- Sludge transport from the Anzali and Rasht wastewater treatment plants to sludge drying area (see chapter 8 for ultimate sludge disposal)

The impact on traffic will be temporary during the construction period only and will be site specific. This impact will cease as soon as the water supply and sewerage system in the cities is completed.

As for the sludge transport from Anzali plants to Rasht WWTP, it is a long term negative effect, which however is very minor as described in paragraph 6.12

The impact of construction of wastewater treatment plants on traffic has been addressed in paragraph 6.1.3.

6.1.8 Soil Quality

The deterioration of soil quality, if properly controlled, is not foreseen during the construction phase of the Project. The machinery used in construction should be properly overhauled and routine maintenance of all machinery and equipment should be ensured in a confined place or workshop. The oil and lubricants should be properly disposed of in an environmentally safe manner.

6.1.9 Odor

Potential unpleasant odor emissions will result from the sewage network during its initial operation and from the three wastewater treatment plants.

During the commissioning of the sewerage network if the number of house connections is small, the flows that will be generated will be much less than the design flows of the sewers. In this situation, solids deposition will be inevitable, and during the warm months of the year, the solids will decompose to emit unpleasant odors from release of hydrogen sulfide and other gases. These gases will eventually leave the sewer system through manholes to disturb the public. However, this impact will have a short-term duration and can be mitigated by the accelerated construction of the house connections to reach minimum flow conditions that prevent solids deposition. The project will ensure that sufficient connections will be made to the system to reach minimum flow conditions in the shortest possible time by including this requirement in the construction tender documents.

Odors may be generated at the pumping and lift stations in the network of both cities or at the discharge of pumping stations forcemains. At pumping stations, if the wet wells design and pumping units are not operating properly, it is possible that odors be emitted due to solids deposition and subsequent decomposition. During warm weather when sewage temperature is high and when there is no contact with oxygen, as is the case for forcemains, sulfur reducing bacteria will generate sulfides, which under turbulent conditions can be emitted as H_2S gas, as in the case of the forcemain discharge point. In Rasht there are 20 pumping stations, of which 5 in the first phase are either located near residential houses or their forcemain discharge in an area near residential houses. In Anzali there are 23 pumping stations, of which 6 in the first phase are located near residential areas or their forcemains are discharging near residential areas. Therefore there is potential odor impact in these locations, which can present nuisance to the local inhabitants, and hence must be mitigated either by very careful design of these facilities or by the provision of odor control equipment. Also for Rasht WWTP, the forcemain of the two pumping stations upstream of the plant have lengths that exceed 1 km, and therefore the potential for sulfide generation is high, and most likely there will be odor emissions during warm weather at the wet well of the WWTP. Since, individual houses are at distances of 300 m or more, it would be imperative to provide positive measures for odor control. The subject is further discussed in chapter 8, and the mitigation measures for odor control of the network pumping stations is considered in chapter 9.

Odor is normally a main public concern with regard to wastewater treatment plants. Odors from wastewater treatment plants are inevitable. They result from rotting of organic matter which may produce NH3 and other malodorous compounds. Sulfate reduction may result in the production of H2S. The wastewater treatment plants in Anzali are located away from the residential areas which minimizes the odor problem likely to affect the inhabitants of these cities. Odor can further be minimized by installing odor control equipment, as the case is for Rasht, and through careful planning and implementation of plant operation and maintenance procedures. This results in preventing the formation and liberation of odorous substances in the wastewater treatment plant.

Under normal operation of the plant, intensified aeration may be effective in removal of some odor compounds. In many wastewater treatment plants, the units are covered and the air is treated in a compost filter to minimize environmental impacts. For Rasht WWTP, it is imperative that odor control equipment be installed at the wet well of the inlet pumping station where odors released from the inlet sewer can be treated, and from the sludge handling operations where odor emission is also likely.

It is obvious that odors will increase in the summer months. In case the wastewater treatment plants are operated and maintained properly, odor problems will neither be severe nor frequent at Anzali WWTPs. As for Rasht, odors will be minimized to acceptable levels and according to standards provided that odor control equipment is installed on site.

The provision of proper plant operations, landscaping and trees around site boundaries, odor control equipment as recommended for Rasht, and sufficient buffer distance from the cities will minimize the effect of any odor emission.

The overall effect of the project will be a long term reduction in odor problems through the provision of the sewerage system. The current practice of discharging raw sewage into the Zarjoob and Goharood Rivers, as well as the Anzali Lagoon, is causing significant odor problems directly affecting the health and well-being of the inhabitants, and affecting the tourist industry. The provision and operation of the sewerage system will cause a halt to the discharge of raw sewage in these surface waters, and thus eliminate the odor emissions in Rasht and Anzali.

6.2 Impacts on the Socio-Economic Environment

6.2.1 Impacts on the Population

According to the feasibility study, the current population growth rate for Rasht is estimated at 2.8% per year. The growth rate for Anzali is based on an annual growth rate of 2.58% in 1997, decreasing to 2.0% in 2022 to 2027 due to a forecast drop in the birth rate, which can be foreseen in view of the government's family planning campaign. The reduction in disease rates may, however, reduce mortality rates. It is difficult to predict with any degree of confidence what effect the project will have on population levels. However, with the reduction in illness associated with proper management of sewage and an improved reliable water supply system, the life expectancy will likely increase.

6.2.2 Impacts on Employment and Income Distribution

The Project is expected to generate employment opportunities for the local people of Rasht and Anzali in management, operation and maintenance of the treatment plants, water supply and sewerage networks, and pumping stations. Most of the positions will be permanent and a few will be created to cover environmental monitoring. The number of construction jobs to be created will not be known until the construction commences for all activities, however, it most certainly will be several thousands. The staffing requirements will be for engineers, technicians, clerks, skilled labor and unskilled labor. The economic benefits likely to be accrued from the Project have been discussed in the Social Impact Assessment Report in detail. It is obvious that economic impact resulting from this Project will be positive on the overall economic conditions of these areas.

It is not possible to assess whether the project would have any effects on income distribution, although in the short term it is unlikely.

6.2.3 Urban Development

The provision of a reliable and suitable water supply system as well as a sewage collection network for Rasht and Anzali will facilitate construction in undeveloped areas in both cities. Consequently, positive economic impacts in terms of construction activity and employment will result.

6.3 Impacts on the Cultural Environment

6.3.1 Impacts on Historical and Cultural Sites

Rasht, being one of the older cities in Iran, as discussed in earlier chapters, has some historical buildings, and older structures particularly in the city's center, that are not of archeological significance according to the Cultural Heritage Organization, Gilan. Therefore, the project has carefully considered the sensitivity of these sites to avoid and minimize associated possible adverse effects. Lists of historical structures in Rasht and Anzali are given in Section 4 of this report.

Historical and cultural sites are potentially affected by three types of impact:

- Destruction or demolition;
- Vibration and settlements resulting from construction activities; and
- Effect on the amenity value of these sites.

This project will not require the demolition of any buildings of historical or cultural importance. Water supply and sewer lines shall be carefully aligned in streets on the other side of these structures during design stage and water supply pipes will be laid near the property line with suitable spacing from sewer.

Indirect effects during construction on historical buildings due to vibration, drilling and compacting equipment shall be mitigated by good construction practices and techniques.

No archaeological remains are reported in Rasht and Anzali. However, During the extensive excavation of the city's streets it is possible that archeological remains may be discovered. The Cultural Heritage Organization will be consulted in this instance, and the Chance Find procedures discussed in Chapter 9, will be implemented. The specifications of all contract documents will include reference to this organization and the Chance Find procedures.

Long term permanent impact of the Project on the cultural environment will be positive due to improved sewerage system and resulting facilities.

6.3.2 Impacts on Public Attitudes

Consultations with the public and non-governmental organization (discussed in previous chapter of this report) provided some indications regarding public attitude towards the project. The main concerns expressed were related to the implementation process, peoples' ability to pay, disruption of public services, and the capacity and capability of the Water & Waste Water Company to implement the program. Once the project's components are completed, however, and the project benefits realized, the public will be supportive of this project.

6.4 Impacts on Surface Waters

It is expected that the project will have a direct positive effect on the quality of surface water, with consequential health effects, as it has done on other cities, but such predictions will be difficult to quantify at this stage and will depend on the effectiveness of project implementation.

6.4.1 Impacts of Increased Water Extraction on Water Sources

The water sources that provide water to both Rasht and Anzali are comprised of Sephidrood River, Shahr Bijar River, and the Fehlman Wells. The water balance discussed in earlier chapters demonstrated that these resources are able to meet the water demand of the project throughout its phases. In order to determine the long term impact of this project on the resources' capacities, the following table provides a summary the extraction rates at year 2027 versus the capacity of these resources:

Table 6-1: Resource Usage at target year of the Project

	Sephidrood River Annual Flow	Shahr Bijar River Annual Flow	East Gilan Wells Aquifer Yield
Source Capacity	6000 million m^3/year	200 million m^3/year	150 million m^3/year
Year 2027 extraction rate by Project for Water Supply	23.5 million m^3/year	70.7 million m^3/year	14 million m^3/year
Total Demand of Project	108.2 million m^3/year		
Total Agricultural Irrigation demand of Gilan	2668 million m^3/year		
Year 2027 extraction rate by Other Areas for Water Supply	281 million m^3/year		

Ref: Gilan Book

The above table indicates the following:

- The sum of the water demand by the project at year 2027, by urban and rural areas for water supply outside the project in Gilan at year 2027, and by agricultural irrigation is 3057.2 million m^3/year, and represents 48% of total capacity of the sources used for the project.
- The extraction rate by the project at year 2027 from Sephidrood River is 0.4 % of its capacity, from Shahr Bijar River is 35% of its capacity, and from the aquifer of East Gilan is 9.3% of its safe yield.

Therefore based on above, the water demand by the project will not affect the capacity and sustainability of the water resources used.

Also it should be noted that Capacity of Sangar Dam is much higher than the proposed water extraction for the project. Considering that the capacity of dam is 139 m^3/sec, presently only 2.15% of total dam capacity is being taken out for potable water supply which will be increased to 4.32% by the year 2027.

6.4.2 Impact of Increased Water Extraction on Water Quality

Presently, water is being taken from Sangar Water Treatment Plant for Rasht and Anzali. Its capacity will be increased to cater for the additional demand of these cities and quality of water will be controlled at the treatment plant. Effluent quality of treated water from Sangar

Water Treatment Plant is given in Section 4 of this report, which is in accordance with WHO standards. Same standards will be maintained for the extended water treatment plant at Sangar and quality will be controlled at the treatment plant. As such no impact of increased water extraction on water quality is envisaged, in fact since the major source of water to this plant will be Shahr Bijar River instead of Sephidrood River, the treated effluent quality of the WTP will be improving.

6.4.3 Adverse Impact on Drinking Water Quantity and Quality

Treated water quantity and quality should meet water demand as well as allowable drinking water standards set by the Iranian Government and WHO. Among the parameters of concern are the bacteriological contamination of the water, the concentration level of nitrate, the presence of nitrite and the concentration of heavy metals.

Potable water for Rasht and Anzali is supplied from the Sangar Dam and well water. Following treatment, both surface water and ground waters are stored in reservoirs for subsequent pumping in the distribution network. In the event of an upset in the performance of the Sangar water treatment plant, the water quality may deteriorate resulting in possible contamination with pathogens or imbalanced pH levels, etc. Furthermore, damage to the potable water distribution system may result in cross contamination with raw sewage and thus, present a health hazard to the inhabitants of the two cities. Also, damage to the network and partial stoppage of the Sangar Water Treatment Plant may cause water supply shortages.

In order to safeguard public health, it is imperative that regular monitoring of raw and treated water at the treatment plant, storage reservoirs and in the distribution network be implemented to ensure that drinking water limits are not exceeded, and that plant and network are in good operating conditions.

6.4.4 Impacts of Discharge of Treated Wastewater on Zarjoob and Goharood Rivers (Surface Water)

Presently, untreated wastewater is being discharged into Zarjoob and Goharood Rivers in Rasht and in Anzali lagoon and the Caspian Sea at Anzali, where current BOD_5 levels in the lagoon have reached 30 mg/l and DO levels have reached less than 1 mg/l, which indicates the high degree of pollution in these rivers. Due to the construction of the sewerage network and treatment plant, sewage will be properly collected, treated and discharged to Pirbazar. This will result in improvement of the physiochemical and microbiological quality of water in Zarjoob, and Goharood rivers. As an indication to the pollutant loads that are reaching these rivers, we can assume that sewerage from at least two thirds of the present connected population is discharging to Zarjoob and Goharood, representing 14 tons of BOD_5 per day. Once the collection network is constructed, there will be no load on these two rivers and only 30% of this load (i.e. 4 tons/day) will be discharged to Pirbazar river by year 2027 (see discussion in chapter 8, on impact of treated effluent on Zarjoob River). Therefore it is anticipated that quality of both rivers will dramatically improve where DO levels can increase to at least 90% of their saturation levels.

The average annual discharge of the Goharood River is 34.06 million cubic meters, and that of the Zarjoob River is 180 million cubic meters out of which the basic current amounts to 44% and the rest is surface runoff. During the dry seasons, this latter portion mainly consists of wastewater and drainage. Therefore, the discharge of domestic and industrial wastewater in the sewerage network will cause a decrease in the river's discharge quantities. However, this issue is overshadowed by the significant positive impacts foreseen on the qualities of these rivers.

6.4.5 Impact Relating to Industrial Discharges

The DOE has promulgated a national law for industrial discharge to surface water bodies and has undertaken a program for monitoring industrial discharges to surface waters.

This project will promote the environmental awareness concerning the need to control industrial wastewater discharges whether to surface bodies or to the sewage network. As discussed in Chapter 9, a training workshop is included as part of institutional strengthening, and is expected to contribute towards controlling industrial discharges. Therefore, the project will provide an opportunity to better control industrial discharges through enforcing pretreatment and connection to the collection system as stipulated in the Iranian law.

With regard to the remaining industries within the two cities, these will be subject to monitoring by the DOE, which will ensure that industrial effluents are pre-treated to the required standards prior to discharge to any central facility.

Therefore, it is expected that this project will contribute towards controlling industrial wastewater discharges, and hence, lead indirectly to improvements in the quality of surface waters.

6.4.6 Impacts on Anzali Lagoon

Through the provision of wastewater collection network, and the control of industrial wastewater discharge as described in the previous paragraph, the quality of the *rogas* and rivers discharging into Anzali Lagoon, and subsequently into the Caspian Sea, will be greatly improved. A major cause of the present environmental damage to the lagoon will be significantly reduced, and therefore, the lagoon's water quality will improve over a period of time. As pointed out in chapter 4, it is estimated that 38,000 tons of COD per year are discharged to the lagoon from urban sources, which represent 35% of the total COD load that the lagoon receives from various polluting sources; similarly it is estimated that 488 tons of TP per year are discharged from urban sources representing 56% of the total phosphorus load that the lagoon receives form different sources. The elimination of raw sewage discharge to Zarjoob, Goharood, and to Anzali lagoon by the project will reduce these pollutant loads by an estimated 85%. Thus, it is expected that COD, BOD_5, TP, and TN levels in the lagoon will drop, and dissolved oxygen levels will increase.

However, it should be noted that the treated effluent from the treatment plants of Rasht and Anzali will include some residual suspended solids, dissolved salts, and minor nutrient content. It would be difficult to quantify the effects of the residual pollutants on the lagoon due to the complexity of lagoon's ecosystem, which involves mass transfer in various routes (water-sediment, water-atmosphere, plant and animal-water, etc). However, the concentration of these constituents will be diluted by the Rivers and the volume of water in the lagoon, and will be insignificant. In this respect, the total volume of the surface water that the lagoon receives is estimated at 2,400 million m^3 per year whereas the total annual volume discharged from all treatment plants at year 2027 amounts to 92 million m^3. Therefore the volume discharged represents less than 4% of the total volume that the lagoon receives from surface waters, in addition to which groundwater flow to the lagoon has to be added. Thus, it can be concluded that the effluent flow and its constituents will have insignificant effect on the lagoon's ecosystem. With regard to the salt balance of the lagoon, it can be noted that the major changes occurring in the lake is due to water level changes of the Caspian sea, which would affect the lagoons salt content much more markedly than the salt content of the treated effluent.

Based on the above, the environmental state of the lake will be greatly enhanced in comparison to the base-line condition due to improved water quality of the discharging rivers.

6.4.7 Impacts on the Caspian Sea

Presently there is direct sewage discharge to the Caspian Sea from eight sewer outfalls from Anzali City. Furthermore, the Caspian Sea receives pollutant loads indirectly through the eutrophic waters of Anzali lagoon. The project will eliminate the direct discharge of sewage to the Caspian Sea, and will result in improving the water quality of Anzali lagoon as described above. Therefore, the environmental state of Caspian Sea at the Anzali coast is expected to improve as a result of the project.

6.5 Impacts on Ground Water

6.5.1 Impacts on Ground Water Quality

The project will have a long term positive effect on the quality of ground water, since it will reduce the discharge of contaminants to ground water. The use of cesspools, a major source for pollutant infiltration to the groundwater will be gradually phased out as sewers will be constructed to convey the wastewaters to treatment at the designated facilities. Also sewage infiltration to the groundwater from surface discharge will be eliminated. With elimination of pathogens, nitrates, harmful organics, heavy metals, and through recharge of cleaner surface water, the quality of the ground water will be enhanced, and compliance with the prevailing water supply standards will be met and ensured by the provision of the chlorination facilities.

The current practice of irrigation with raw sewage and the use of untreated sludge from cesspits will be greatly minimized by the implementation of the project. These practices would cause ground water contamination as a result of their discharge on land, and therefore under the current project they will stop and consequently the water quality will be improved.

6.5.2 Impacts on Ground Water during Construction

During the construction phase, groundwater quality may be affected by the disposal of solid waste such as debris, wash-water of facilities, and accidental spills of oil from storage tanks. For this project the impact will be more pronounced due to the high water table. The implementation of mitigation measures and environmentally sound construction practices would greatly reduce the occurrence and scale of such impacts. The potential impacts due to construction are in all cases temporary, and are outweighed by the positive long term impacts.

6.5.3 Impacts on Ground Water Due to Sewer Connections

The provision of sewer connections would cause the stoppage of groundwater recharge through cesspits or through surface infiltration. Thus it is anticipated that water table levels will slightly drop as a result.

6.5.4 Impacts on Ground Water Resources

A number of studies have been conducted to assess the ground water capacity of Emam Zadeh, Sangar, and Lahijan aquifer. In accordance with the feasibility study, these studies confirm that the current ground water resources have a safe yield capacity of 150 million m^3/year. Under the current plan adopted by the project, the maximum water supply rate from these resources is 14 million m^3/year in the target year of the project representing less than 22% of the total water supply to the project area. Therefore the maximum supply rate from the groundwater resources is less than 9.3% of their safe yield capacity; hence the project would not diminish the resource capacities.

As stated above, the recharge of the aquifers by the illicit discharges and effluents of the cesspits will be stopped, thus reducing the quantities of water recharging the wells. However, this issue is outweighed by the significant reduction of pollution levels in the aquifers.

6.6 Impacts on Agriculture

This section is included to address possible impacts of sludge re-use in agriculture for the preferred option of sludge disposal by agricultural re-use in Qazvin Province as discussed in chapter 8.

6.6.1 Impact on Crop Production

The project will have a beneficial effect on crop production at the area of application by providing an assured supply of a natural fertilizer in the form of treated sewage sludge.

There is the potential for the following additional measures to be taken in conjunction with the project to further improve crop yields:

- Creation of an effective support service for farmers;
- More effective weed control; and
- Use of modern high yield wheat varieties.

6.6.2 Impact on Fertilizer Consumption

The three main nutrients required by crops are nitrogen, phosphorus, and potassium. Potassium concentrations are usually very low in both treated sewage effluent and sludge. Current local practice in fertilizer application is to use 400 kg of urea and 45 kg of ammonium phosphate per hectare for wheat production. Based on the estimated sludge quantities from all three treatment plants of 14,000 tons/year at year 2027, the equivalent quantity of urea provided by the sludge would be 300 tons, and the equivalent quantity of ammonium phosphate would be 33 tons. The sludge produced at the treatment plants can therefore reduce consumption of artificial fertilizer by equivalent amounts, if offered at reduced prices.

6.6.3 Impact on Soil Quality

Sludge will add organic matter to the agricultural soils of the project area. This will have little effect for many years, given the proposed application rate of 8 tons/hectare/year. Current low levels of nitrogen and phosphate will be raised by the use of sludge, and the effect of this on soil quality will be positive. Furthermore the treated sludge will supply many of the trace elements required for crop growth, such as zinc, iron, manganese, etc.

However, it should be noted that there are constraints on the application of treated effluent and treated sludge due to heavy metal build up. Guidelines for maximum permissible concentration of trace elements in irrigation water are provided by FAO according to the type of soil and the period of application. These guidelines (annex B) include among others concentration limits of nickel, lead, manganese, cadmium, zinc, chromium, etc. Also EC directives (annex B) provide concentration limits for potentially toxic elements (PTE) in sludge and soil over a 10 year annual rate of addition period.

It would be difficult to assess the extent of heavy metal build up due to the application of treated sludge and the irrigation with treated effluent, as this would require an evaluation of current levels of trace metals in the soil. Nonetheless, the potential for heavy metal build up in the soils will be there, and is best mitigated by a careful monitoring program of trace elements in the raw sewage, treated effluent, soil, and plants as described in Chapter 9.

6.6.4 Impact on Crop Quality

The potential impact on crops of using sludge in agriculture is the accumulation of heavy metals. This has implications for human and livestock nutrition and can arise from crops taking up excessive amounts of certain elements that are toxic to humans and livestock. The limit values for heavy metals in sludge and soils are designed to ensure that concentrations in crops do not exceed safe levels.

It is difficult at this stage to determine whether any elements are likely to accumulate in crops at levels that exceed the recommended limits, for the reasons stated in the previous paragraph.

The impact on crop quality cannot therefore be assessed at this stage. Adverse impacts can be prevented only by detailed monitoring of:

- Treated sludge after storage
- Soils at a number of locations throughout the agricultural area; and
- The different crops grown.

6.6.5 Impact on Agricultural Workers

The WHO guidelines for sludge and effluent reuse in agriculture are designed to prevent health risks to consumers of crops and agricultural workers. Provided that these standards are met, there will be no adverse impacts on agricultural workers. The methods by which sludge will be applied to the crops will be designed to minimize human contact with sludge. Sludge will be ploughed into the soil immediately after application. No adverse impacts will take place if appropriate guidelines will be issued and followed.

6.7 Impact on Health

6.7.1 Health Impacts of Wastewater Reuse in Agriculture

Health Impacts arising from the reuse of treated effluent have been a matter of considerable concern and scrutiny in arid and semi-arid zones of the world. One result of this has been the production of guidelines to protect public health. Most notable of these are the so-called

Engelberg standards, promulgated under the auspices of the WHO.

It is considered essential to maximize the potential improvements to public health arising from the implementation of the project. Hence, sewage treatment process is designed in such a matter to ensure that it can be operated at all times so that the treated effluent meets the WHO guidelines. These guidelines are based on the epidemiological studies concerning health impacts of excreta disposal and effluent reuse. At the present time, they present the most appropriate guidelines to underpin the design of sewage treatment processes and effluent and sludge disposal options. The quality objectives applied to the treated effluent are in accordance with the Engelberg standards.

In order to meet the criteria for eggs of intestinal nematodes or helminthes (less than 1 per liter) and fecal coliforms (less than 1,000/100 ml) the treatment process must be designed in such a way that these criteria are consistently achieved. As described in Chapter 3, the three plants are designed to employ chlorination in order to achieve the fecal coliform standard, even though treated wastewater from Rasht and Anzali will not be used for irrigating agricultural land in these cities. (The health aspect of chlorination is discussed below, although the Feasibility Study Consultant has subsequently proposed to substitute chlorination with a UV disinfection system to mitigate impact on the Anzali Lagoon) Agricultural lands are irrigated by high precipitation in Rasht and Anzali, through good quality ground water for irrigation from private wells as well as from surface water. As such there is no need for treated wastewater to be used for irrigation both in Rasht and Anzali fields. Nonetheless, since treated effluent is discharge in Zarjoob and Goharood, the effluent can indirectly be reused through the water of these rivers.

The implementation of the project, though, will improve irrigation practices indirectly by the improvement in river and groundwater quality which are used as irrigation sources in the dry season (May-July). As a result of stopping the discharge of raw sewage to these water bodies, the pollutant levels and the disease carrying microorganisms will drastically reduce resulting in safer and superior water quality for use in irrigation.

6.7.2 Adverse Impacts Due to Agricultural Reuse of Sewage Sludge

The original plan included the disposal of sludge through incineration; however, and as discussed in chapter 8, disposal of treated sludge by re-use in agriculture or in landscaping due to its fertilizer value is presently the preferred option. The two main issues of concern to public health are heavy metals and nematode levels.

Heavy metals tend to accumulate in soils or in agricultural products to affect human health. FAO or national guideline values for heavy metal content in sludge should be observed and regular monitoring of sludge and soil should be implemented.

As for nematode levels, WHO standards require storage for one year before application on agricultural lands. Therefore any contemplation of sludge use in agriculture should comply with stated requirements. Appropriate mitigation and monitoring programs need to be in place with effective implementation to eliminate potential health impacts. These subjects are further discussed in the proceeding section.

6.7.3 Impacts on Public Health

The current practice of human excreta disposal through traditional sewerage system into surface water sources without any treatment will be stopped. Presently, untreated wastewater is discharged into the rivers of Rasht and Anzali. The waters of Zarjoob and Goharood are partly used for irrigation, thus there is a risk of disease transmission to farmers or consumers due to the rivers' polluted states particularly in summer when there is very little dilution. Anzali lagoon is a focal point for tourism where about two (2) million visitors come every year. The lagoon is used for recreational purposes (including fishing and hunting), and the practice of discharging untreated wastewater results in direct contact of people with the contaminated waters, which has a significant impact on the incidence of water related diseases. The construction of proper sewerage systems and wastewater treatment plants will minimize the direct contact of users with contaminated water, the route of transmission of infection from 'human to wastewater to human' will be broken, thereby reducing the risk of disease transmission. This will have a positive impact on public health.

Other benefits are considered likely to accrue from implementation of the scheme. In summary, the principal benefits are considered to be those mentioned below:

- Connection to an integrated sewerage system will significantly reduce the amount of sewage disposed of to the local rivers and open watercourses which are used by some farmers as a source of irrigation water.
- Prevention of groundwater contamination with nitrates and possibly microorganisms (viruses) are considered to pose the greatest risk in this respect.
- Prevention of cross contamination of potable water supply system through the rehabilitation of the old existing network and disinfection of these supplies with required chlorine doses.
- The supply of adequate quantities of water having good quality and compliant with national and WHO standards.

6.7.4 Adverse Impact of Chlorination

Although the feasibility Consultant has proposed the use of UV disinfection in lieu of chlorine in Rasht and Anzali WWTPs, nonetheless this section will address the impact of Chlorine as it is used in drinking water supply, and it is quite possible that it will be used at the WWTPs. Care should be taken for transportation, storage, and use of chlorine. There is always a risk of human injury in the event of an accidental release of chlorine gas. These risks should be minimized by giving careful attention to the design of chlorine storage and handling facilities. In addition, adequate means of ventilation, provision of safety equipment, and a well defined emergency response procedure must be put in place as per the international practices. However, chlorine has been successfully and safely used for Rasht and Anzali water supply systems for many years in the past. At present, water treated at Sangar Dam is chlorinated before pumping into the transmission and distribution networks.

During operational stage of wastewater treatment plants at Rasht and Anzali, an appropriate mitigation and monitoring program needs to be put in place and effectively implemented, if chlorine is used, to minimize the risks associated with chlorination of wastewater. This could be achieved by using the smallest dose of chlorine for achieving the WHO standards for wastewater effluent quality. In addition, the use of Sodium Hypochlorite (NaOCl) could also be considered in place of liquid gas chlorine at the detailed design stage to reduce the risk of accidents.

6.7.5 Adverse Impact Due to Operation of Sewage Treatment Plants

One issue of concern regarding the operation of activated sludge plants is that of aerosol production and the resultant public health impacts. Studies on the health impact of wastewater facilities on surrounding populations have been inconclusive in determining whether increased reporting rates of illness were significantly associated with proximity to the plant or due to socio-economic factors.

A study of the distribution of heterotrophic bacteria in the vicinity of an unenclosed activated wastewater sludge plant observed that only heterotrophic bacteria remained at significantly higher than base-line densities beyond 250 meters downwind from the center of the aeration tanks. Furthermore, this study confirmed similar observations that densities were higher at night, presumably due to the lack of sunlight's killing action.

Studies of treatment plant workers have produced no evidence to suggest that exposure to sewage aerosols increase their risk of contracting an infectious disease.
It is, therefore, concluded that operation of the wastewater treatment plant will not pose a risk to the health of workers or those who work in the immediate premises, or to the local housing communities, the nearest house of which in Rasht is more than 300 m away. To avoid negative impacts regarding health and safety of workers and public, officials of the wastewater treatment plants will be trained about health and safety procedures. All employees of WWTP will be trained in hygienic procedures to avoid getting infection from wastewater and sludge. The workers will be inoculated against infectious diseases and will be kept under medical surveillance. A detailed Environmental Management Plan is given in Section 9 of this report.

It is reasonable to conclude, therefore, that the operation of the Rasht and Anzali treatment plants will not pose a risk to health of the operators or those who live or work in the adjacent areas as the distance to the nearest developments is more than 300 meters from the perimeter of each plant. Also, workers will follow occupational health and safety practices in addition to undergoing medical surveillance.

6.7.6 Adverse Impact Due to Pests

Vermin act as vectors for human diseases, including salmonellosis (cockroaches), malaria (mosquitoes) and leptospirosis (rodents).

It is considered that the project will have little impact on the prevalence of rodents and cockroaches. Insects that enter the domestic environment may promote disease transmission by moving fecal pathogens into houses and onto food. The actual contribution to human disease via this route is unclear and the direct fecal-oral route is the more probable major route of transmission.

The removal of human excreta from the immediate vicinity of domestic dwellings will reduce the possibility that transmission of fecal pathogens directly to food may occur. The control of human excreta will not eliminate the risk completely since alternative breeding sites will exist. A program of insecticidal control will be required to control the populations of flies and cockroaches. Preventing insects coming into contact with human excreta should reduce the proportion of the population which harbor pathogens exclusively of fecal origin (such as poliovirus, Hepatitis A, Shigella, Entamoeba histocylitica and the eggs of roundworms and hookworms).

6.7.7 Adverse Impacts Due to Asbestos Cement Piping

Although this project does not include provision of asbestos cement piping, nonetheless since the existing water supply network utilizes asbestos cement piping adverse health impacts can arise from this material. Asbestos is a known human carcinogen by the inhalation route. Therefore, if replacement of asbestos cement piping is required, maximum health care should be provided to the workers to minimize risk of asbestos inhalation. Furthermore, the tender documents of the project shall explicitly disallow the purchase and installation of new asbestos piping, and shall specify safety handling and replacement of such pipes.

6.8 Adverse Impact of Incineration on Air Quality

Incineration produces large volumes of flue gases. These gases carry residues from incomplete combustion and a wide range of potentially harmful pollutants. The pollutants and their concentration depend on the composition of the sludge and the combustion conditions. However, these gases always carry ash, heavy metals, and a variety of organic and inorganic compounds.

The impacts of the proposed incinerator and its effects air and on the environment is further discussed in chapter 8, as the option of incineration has been reconsidered.

6.9 Impacts on the Biological Environment

6.9.1 Impact on Habitats

As discussed in chapter 4, there are several habitats in the area of influence of the project, the most important of which is the Anzali wetland. The Anzali wetland includes two natural reserve areas and two no-hunting areas. The project will not cause any threat to these natural habitats as the project components, with the exception of the wastewater treatment plants, are sited away from these areas.

The only part of the project which will cause a permanent loss of habitat is the wastewater treatment plant sites at both Rasht and Anzali. The total land, which amounts to 81 hectares, has already been acquired by GWWC for all three sites. These sites are situated in agricultural areas, where the plots themselves have little vegetation of any type. There is almost certainly no flora or fauna of any value present. With regard to the Rasht WWTP and Anzali West WWTP, the first phase is already under construction, and the impacts of these works on the biological environment are discussed in Chapter 8.

Construction of the treatment plants provides considerable opportunity for ecological enhancement at the vicinity of the three sites. Consideration has been given to the planting of trees and shrubs around the site perimeters to provide visual & noise screening, and a new habitat. The overall long term effect of the treatment plants on the local flora and fauna could therefore, be positive.

During the operational phase, the ecological conditions of the surface water bodies in the project area will improve as discussed in the proceeding paragraph. Therefore, the project will assist in the restoration of the degraded water quality of Anzali wetlands and hence contribute positively to the conservation of natural habitats.

6.9.2 Impact on Rare or Endangered Species

Rare or endangered species in Rasht and Anzali lagoon are given in Section 4 (Environmental baseline data) of this report. In Rasht area the bird specie *Branta Ruficolis* from Anatidae family is considered endangered, and according to IUCN Red List (1994) *Iranocypri sTtyphlops* from Cyprinidae family and one species from Balitoridae family are endangered fish species in the rivers of Rasht. In Anzali the mammalian *Felis Chaus*, and the reptilian *Testudo Graeca Iberica* are listed as endangered species.

The project will not cause any significant loss or degradation of natural habitats in the area of influence. In fact, implementation of the project will improve the quality of Rasht's rivers and Anzali Lagoon's waters by: (1) reducing the eutrophic level of Anzali lagoon through reducing nutrient discharge, and therefore the ecosystem in the lagoon will regain some of its original balance (2) improving the oxygen levels in the lagoon and the river by reducing current BOD and COD levels, and (3) reducing the amount of heavy metal build-up and pathogenic diseases in these water bodies through enforcing pre-treatment on industry and controlling industrial effluent discharge. Therefore the habitats of these protected and endangered species will generally be improving, and thus these species will be further protected.

6.9.3 Disturbance to Fauna

There is some evidence which suggests that certain construction activities can have adverse effects on animals in the vicinity of the works. This issue will be applicable to the components of the project constructed outside the cities, such as the treatment plants and effluent outfalls. The possible disturbance effects of constructing these works have been considered. Since the land around the wastewater treatment plants in Rasht and Anzali is agricultural land, there are no residences or animals around the sites, except for the variety of birds described for the Lagoon area. There will be no disturbance to the fauna due to the construction of the wastewater treatment plants. While in operation, the treatment plants will result in a slightly higher ambient noise level around the site, but experience suggests that birds and other animals adapt to this and suffer no adverse effects.

6.9.4 Impact on Marine and Aquatic Ecology

Implementation of the project in Rasht and Anzali will improve the water quality by treating the wastewater and discharging the effluent into the Zarjoob River and Anzali lagoon in Rasht and Anzali respectively. This will improve the surface water quality of rivers in Rasht and in Anzali lagoon as well as in the Caspian Sea. The ecological effects of this change can not be accurately quantified but the impact will certainly be positive.

6.10 Impact on Climate

The impact of the project on regional and global climates will almost certainly be negligible. However, certain aspects of the scheme will produce emissions of gases which are believed to contribute to global warming. The treatment of sewage and sludge at the wastewater treatment plants will convert much of the organic matter in the sewage to methane and carbon dioxide. At the Rasht treatment plant, the methane produced will be flared, converting it to carbon dioxide. The total methane gas production at Rasht WWTP is 20,318 m^3/day at year 2027. With regard to Anzali WWTP, currently there is no digestion process that will result in the formation of methane gas; however if digesters are incorporated as discussed in chapter 8, the total gas production is 2,850 m^3/day at year 2027.

It should be recognized that this sewage currently decomposes anaerobically in sewage wells through natural processes, producing similar quantities of methane and carbon dioxide. Since methane has a contribution to global warming approximately 21 times that of carbon dioxide on a molecule-for-molecule basis (one molecule of carbon is converted to one molecule of carbon dioxide), burning of the methane can be considered as reducing any contribution from Rasht's sewage to global warming.

However, the power consumed by the plants will be generated by burning fossil fuels (fuel oil or gas) which produce carbon dioxide. The average power consumption of all plants will be 3.5 MW (over 24 hour days and seven day weeks) The emissions produced by the generation of this additional power will be negligible in comparison with those already produced by the country.

Transport requirements for both construction and operational phases will produce emissions of carbon dioxide, carbon monoxide and nitrogen oxides. The quantities of these gases will be small in comparison to those produced by the total vehicle usage in Rasht and Anzali.

At the treatment plant sites, sizeable bodies of water will be exposed to the atmosphere and evaporation will occur. The estimated evaporation rate at year 2027 from all plants is 8 mm/day , which is expected since the weather is rainy and humid for most of the year in Rasht and Anzali, it is unlikely that significant evaporation rates will take place from these water bodies. Therefore, no sizeable variation on current evaporation rates is expected, and so, relative humidity will be unaffected.

In conclusion, it is considered unlikely that the project will have any significant adverse effects on the local, regional or global climates.

6.11 Impacts on Other Planned Developments

The Project has no impact on any other planned development. The sites for wastewater treatment plants in Rasht and Anzali are located away from the city. No government plan is likely to be disturbed due to implementation of this project.

6.12 Impact on Traffic during operation stage

Sludge hauling to a location 150 km away from the project area, in Qazvin province or on the border of Gilan with Qazvin, will be required for implementation of the re-use in agriculture scheme as discussed in chapter 8. Hauling the sludge in this instance will allow drying the sludge in beds for long period of time under favorable weather conditions. The sludge that will be hauled will be stabilized, on a daily basis with a minimum of 30% dry solids content from all three WWTPs. The estimated number of trips to haul sludge from both Rasht and Anzali is 3 per day in year 2009, and 11 per day at year 2027.

This sludge will be transported from the project area in closed vehicles by the GWWC. Lorries used for the transportation of sludge will be enclosed and leak proof. Each transport lorry will carry an average of 8 dry tons of sludge per trip. It is anticipated that no significant impact will occur on the traffic movement between Qazvin and Gilan provinces.

6.13 Impacts due to Seismic Activities

Rasht and Anzali are located in a seismically active zone, with frequent earthquakes recorded in the area.

In the event of an earthquake, the potential impacts could be grave and have serious repercussions on public health and on the environment. Water retaining structures, such as sewage holding tanks and water reservoirs, can be severely damaged, and thus, result in discharge of their contents in an uncontrolled manner. Sewers can break to discharge the sewage in the soil or groundwater. All these conditions can create health hazards to the public.

Potential impacts from seismic activities can only be mitigated by strict adherence to earthquake codes, which should be implemented under extensive QA/QC procedures during design and construction works. The project will include Iranian Code for Protection against Earthquake and other applicable codes in all tender documents. Furthermore, an earthquake emergency preparedness plan will be developed as discussed in Chapter 9.

6.14 Impacts due to Septage disposal

The project will provide sewer connections to the inhabitants of Rasht and Anzali, and thus will protect the surface and ground water sources from pollution, and in general will lead to improving the environmental conditions within the area. However, the provision of sewage collection and treatment takes place during a number of years, and thus some inhabitants will remain unconnected for several years (100% connection is expected by year 2027). Therefore, a number of dwellings in Rasht and Anzali will continue to rely on percolating pits. Since currently there is no facility for receiving septage, it is frequently discharged to surface water bodies resulting in very high pollutant loads, or disposed on land exposing the public to health hazards. Therefore to mitigate the environmental impacts caused by uncontrolled discharge of septage to the environment, a septage receiving station and treatment facility needs to be included in the WWTPs of Rasht and Anzali. The subject is further discussed in chapter 9.

6.15 Summary of Environmental Impacts

Summary of Environmental Impacts of this project in Rasht and Anzali during Construction and Operational phase are Shown in **Table 6.2 , 6.3 and 6.4.**

Table 6-2: Summary of Environmental Impacts (Part A)

Environmental Sector	Impact	Construction Phase	Operational Phase
Geophysical Environment	Change of Land Use	Slight Negative	None
	Relocation of Population	None	None
	Disturbance to people	Severe negative	None
	Noise	Moderate negative	Insignificant
	Vibration	Moderate negative	None
	Odor	None	Moderate negative at Rasht WWTP Slight negative Elsewhere
	Visual Impact	Moderate negative	Insignificant
	Seismic Activity	Moderate negative	Moderate negative
	Impact on traffic and transportation	Severe negative	Insignificant
Social and Economic Environment	Impact on population levels	None	Slight positive
	Impact on employment	Positive	Positive
Cultural Environment	Impact on historical and cultural sites and buildings	Slight negative	Positive
	Impact on public attitudes	None	None

Table 6-3: Summary of Environmental Impacts (Part B)

Environmental Sector	Impact	Construction Phase	Operational Phase
Surface Waters	Sewer connections	None	Positive
	Egos and canals	None	Positive
	Industrial discharges	None	Positive
	Goharood and Zarjoob water quality	None	Positive
	Goharood and Zarjoob water quantity	None	Slight negative
	Anzali Lagoon	None	Positive
	Water supply	None	Positive
Hydrogeology	Groundwater resources	None	Positive
	Groundwater quality	None	Positive
Agriculture	Crop production	None	Positive
	Soil quality	None	Slight negative
	Crop quality	None	Slight negative
	Impact on agricultural practices	None	Positive
	Impact on agricultural workers	None	Slight negative

Table 6-4: Summary of Environmental Impacts (Part C)

Environmental Sector	Impact	Construction Phase	Operational Phase
Health	General health impacts	None	Positive
	Impact due to WWTP effluent UV disinfection	None	None
	Impact due to STP operation	None	None
	Impact due to water supply chlorination	None	Positive
	Impact due to pests	None	Insignificant
Climate	Impact on local climate	None	Insignificant
	Impact on global climate	None	Insignificant
Biological environmental	Impact on habitats	Insignificant	Positive
	Disturbance to fauna and flora	Insignificant	Positive
	Ecological effects due to improved surface water quality	None	Positive

6.16 Major Adverse Effects of the Project

Drinking Water Quantity and Quality

Treated water quantity and quality should meet water demand as well as allowable drinking water standards set by the Iranian Government and WHO. Among the parameters of concern are the bacteriological contamination of the water, the concentration level of nitrate, the presence of nitrite and concentration of heavy metals. In order to safeguard public health, it is imperative that regular monitoring of raw and treated water at the treatment plant, storage reservoirs, and in the distribution network be implemented to ensure drinking water quality limits are not exceeded.

Effluent Quality

The effluent should be of acceptable quality so that it can be discharged into rivers, Anzali lagoon, and other water bodies. This means that effluent quality should meet Iranian Government quality standards for surface water discharge.

Sludge Quality

Dried sludge for use as soil conditioner or fertilizer. In such a case the sludge quality will have to comply with the FAO, EU and WHO guidelines for the use of sludge in agriculture including the limit of less than one intestinal nematode egg per 100 gm of dry solids and the limits on the concentration of heavy metals. The adopted treatment processes, the one year storage period, and the control of industrial discharges to the sewage system would ensure that the WHO nematode standard and EU and FAO guidelines on the level of toxic substances would not be exceeded for the use of sludge in agriculture.

Health & Safety

During the construction and operational phase, the project will have potential adverse impacts on health and safety of workers and the public. Construction activities, treatment plant operation, chlorination facilities, water supply systems, effluent and sludge disposal can all cause health hazards and accidents. The provision of workers' training in safety procedures, public education, and the development of emergency response procedures will mitigate health and safety impacts.

7 Analysis of Alternatives to the Proposed Project

The analysis of alternatives to the proposed project is addressed separately for the two main components of the project; (1) water supply and (2) wastewater collection and treatment. The alternatives considered for each component of the project are described and compared to each other in terms of capital costs, operational costs, land requirements, length of transmission lines, consumed energy, environmental impacts, management needs, reliability of the process and local conditions.

7.1. Water Supply

Two options have been considered while comparing the proposed water supply system in Rasht and Anzali.

The proposed water supply system is divided into the following three (3) main groups

- Water treatment plant at Sangar Dam
- Water transmission pipe lines
- Water distribution system

7.1.1 Option 1: No Project

The "do nothing" option for water supply system in Rasht and Anzali is that the present water supply system prevails and the system relies on surface water of Sephidrood River, and on Sangar and Lahijan wells. In this case, water will continue to be abstracted from Sangar Dam as presently in practice and the piping system, which has a high leakage rate due to its old age and corroded conditions will still be used. With increasing water demand, this option would entail supplying water to part of the population by provision of day tanks and trucking water. This section compares this option with the proposed project.

7.1.1.1 Water Resources

Due to the old and deteriorating network conditions considerable amount of water (44% in Rasht and 26 % in Anzali of total supply) is lost through damaged and leaking pipes, thus valuable water resources are wasted.

7.1.1.2 Water Supply System Reliability

Due to incomplete network coverage, and leakage caused by pressure build-up in some zones, water pressure is dropping and in many instances, peak water demands cannot be met.

7.1.1.3 Public Health

In such an old distribution network, contaminated ground water and wastewater infiltrates the water distribution network at points of low pressure. This would result in the deterioration of the bacteriological quality of potable water and thus potable water becomes a source for spreading infectious diseases.

7.1.1.4 Indirect Environmental Impacts

The substandard water quality and unreliability of the water supply system may cause distress and frustration among the population. Furthermore, incidents due to waterborne diseases would lead to negative indirect economic effects.

7.1.1.5 Construction Impacts

In the do nothing option, the adverse construction impacts will be avoided such as noise, dust, traffic interruption, public disturbance, etc.

However, water hauling would be necessary, and as development increases, water transportation could cause disturbance due to traffic. It would also cause noise impact associated with water pumping in heavily populated areas.

7.1.1.6 Management and Monitoring

Not constructing the water supply system would result in increased management intervention to address low water quality and poor water distribution problems. Furthermore, it would mean increased monitoring of well water quality, at source and in the distribution system to prevent transmission of non-complying water.

The 'do nothing' alternative would also result in increased public health management to address the increase in water borne disease cases.

7.1.1.7 Economic Analysis

The economic consequences of not implementing the project are associated with the following:

- Cost of medication associated with water borne diseases
- Cost of working days lost due to therapy, which would be paid directly by individuals and indirectly by the economy
- Cost of unaccounted for water, which increases the treatment costs and represents lost revenues

- Indirect loss to the economy associated with limitations on development, and thus affecting internal investments
- Direct costs associated with supplying water on individual basis through the provision of day water tanks and transporting water. These costs can be estimated by the following:
    - Cost of 2 m^3 water tanks is 400,000 Rials. Annual cost of water tank operation and maintenance is 10% of the tank cost
    - Cost of transportation per cubic meter of water is estimated at 7,000 Rials.
    - The demand for water is assumed to be 94 liters per capita per day for the purpose of calculating the costs arising from water supply by trucking water

The indirect costs stated above as well as the positive benefits from implementing the project such as improved water supply quality, and decreased maintenance costs of the water supply system are difficult to quantify; however in order to provide an indication as to the cost of not implementing the project, the cost of trucking water was estimated. Based on the cost figures stated in the preceding paragraph, the net present value of trucking water for the period 2009 to 2027 is 269.5 billion Riyals or US dollars 30.6 million.

7.1.2 Option 2: Proposed Water Supply in Rasht and Anzali cities

This option consists of Extension of Sangar and the Emergency water treatment plants, development of new ground water sources laying of transmission main, construction of reservoirs and water transfer pumping stations, rehabilitation and expansion of the water distribution system.

These components and their impacts are described in chapter three. The main benefits and drawbacks of this option are presented below:

7.1.2.1 Water Resources

The implementation of this project would conserve water resources by reduction of unaccounted for water.

7.1.2.2 Water Supply System Reliability

This option would ensure that adequate water supplies will be available at all times in the network by extending network coverage.

7.1.2.3 Water Supply Quality

The quality of the water supply will improve, since the project will increase water abstraction from the Shahr Bijar River and rehabilitate the old network, thus ensuring good compliant water quality, free of water-borne diseases.

7.1.2.4 Public Health

As a result of the improved water quality, public health is expected to improve due to a considerable decrease in water borne diseases.

7.1.2.5 Construction Impacts

The project will result in adverse construction impacts within the city (such as noise, disturbance, traffic interruption, and dust). However these are of temporary nature, limited to the construction period, and can be reduced by adopting adequate mitigation measures.

7.1.3 Conclusion

The “no project” option would avoid the temporary environmental impacts of installing pipelines and constructing reservoirs, however this option is rejected on the grounds of economic cost and adverse long-term environmental and social impacts. It would mean a whole region with poor water supply quality. Under such conditions considerable adverse environmental impacts such as the pollution and poor health conditions, and the prevailing environmental conditions will further deteriorate.

Moreover, the economic benefits of the proposed project are greater than the cost of not implementing it; taking into account revenues from tariffs for water supply, the cost of the degradation of surface and ground water resources; the cost of treating additional water quantities to compensate for the high unaccounted for water; the high maintenance cost for the aged water supply system; lost woıking days due to water related diseases; cost of medical treatment; and costs of water supply by tankers.

7.2 Waste Collection and Treatment

7.2.1 Option 1: No Project

The "do nothing" option for this Project is that the present practice of using the combined sewer system and discharging the untreated wastewater into surface water bodies in these cities would continue.

7.2.1.1 Surface Water Pollution

Presently, untreated wastewater is being discharged into Zarjoob and Goharood Rivers in Rasht and Anzali lagoon in Anzali. These surface waters will continue to be polluted by the domestic waste coming from Rasht and Anzali in the "do nothing option"

Conditions will deteriorate with the passage of time. The population of both Rasht and Anzali cities is expected to be doubled in the next twenty five (25) years. As such, the amount of wastewater entering rivers will increase in the same proportion which will further deteriorate the surface water bodies.

The Zarjoob and Goharood rivers would continue to be polluted by overflowing sewage and illicit discharges, and contain excessive quantities of pathogenic micro-organisms, organic matter, solids and potentially toxic elements such as heavy metals. It is unlikely that these practices could be eliminated.

The water quality of Anzali Lagoon will continue to deteriorate: increase in nutrient concentrations, organic loads, and other pollutants will accumulate to promote eutrophic conditions and to cause severe damage to the lagoon's ecosystem and its aquatic life. These conditions will further exacerbate the polluted state of the Caspian Sea.

7.2.1.2 Groundwater

The ground water level in both Rasht and Anzali is shallow. The present practice of discharging wastewater into traditional combined sewerage system, which is infiltrating the shallow ground water, is deteriorating both the surface and ground water sources.

7.2.1.3 Agriculture

The continued use of sewage polluted river water in agricultural irrigation on the nearby agricultural lands would pose health hazards to farmers and consumers alike.

7.2.1.4 Health

Medical data on water borne diseases has identified diarrhea and typhoid as major water borne diseases in Rasht and Anzali. This number of cases of water borne diseases could be expected to remain high or even increase as the population increases. The costs of working days lost and remedial drugs consumed would continue to remain high.

7.2.1.5 Construction Impacts

The "Do nothing" option means that no construction activities for the improvement and extension of the sewage collection network will take place nor the construction of wastewater treatment plants in Rasht and Anzali will take place.

This option would save the general public from the adverse construction impacts like change of land use, soil erosion, disturbance to the people, disruption of existing utilities, disruption of traffic, disposal of spoils, dust, air pollution, noise and vibration etc. The WWTP sites would be free for other uses, and the high cost of concrete and steel requirements associated with construction would be avoided.

However, the regular and widespread construction of improper collection and discharge pipes to the Zarjoob and Goharood rivers, the Anzali Lagoon and the Caspian Sea would still continue. This would cause severe localized disturbances, such as emission of noxious odors, contamination and flooding at locations of high water table.

7.2.1.6 Management and Monitoring

Not constructing the wastewater collection and treatment system would result in increased management intervention to address health related issues because of waterborne diseases. Furthermore, it would mean increased monitoring of Anzali Lagoon, Zarjoob and Goharood Rivers to manage the contaminant levels in these surface water bodies.

The no project alternative would also result in increased public health management to address the increase in cases of water borne diseases.

7.2.1.7 Economic Analysis

The economic consequences of not implementing the project are associated with the following:

- Cost of treating illnesses associated with water borne diseases caused by discharge of raw sewage, such as diarrhoea, typhoid, etc
- Cost of working days lost due to therapy, which would be paid directly by individuals and indirectly by the economy.
- Costs of polluting water resources (eventual clean up and monitoring)
- Loss of income generated by tourism in Anzali Lagoon.
- Indirect loss to economy associated with limitations on development, and thus, affecting internal investments.

7.2.1.8 Conclusions

In case of not implementing this project, the entire pollution load in the rivers of Rasht and Anzali will continue to discharge in Anzali Lagoon and its environmental degradation will further increase. Information on the quality of surface waters is presented in chapter 4.

Degradation of Anzali Lagoon will continue and may result in irreversable loss in the ecological conditions of the world famous wetland of international importance. This will not only result in undermining the ecological life in the lagoon , but will have serious repercussions on the tourist activities connected with Anzali lagoon, where about two (2) million people visit the lagoon annually. Due to this effect, local economy will suffer as the tourists spend money on hotels, travel and recreational activities, which boosts the economy of the local inhabitants.

This option cannot be accepted on the grounds of having continuous negative impacts on ground water, surface water and on health. The negative impacts due to construction are short in time, occurring only during the construction phase of the project affecting different people at different times. These could be properly mitigated as suggested in the relevant section of this report.

7.3 Proposed Alternatives for Wastewater Collection, Treatment and Disposal in Rasht and Anzali

In this section the alternative processes investigated in the feasibility study will be discussed. The design performance of the different alternatives investigated by the feasibility study is based on the following design parameters:

<u>Rasht</u>

- Ultimate design capacity of 120,000 m^3/day
- Influent loads concentrations: BOD_5 238 mg/l and TSS 286 mg/l

<u>Anzali</u>

- Ultimate design capacity of 23,000 m^3/day
- Influent loads concentrations: BOD_5 246 mg/l and TSS 295 mg/l

<u>Effluent Quality</u>

- BOD_5 30 mg/l and TSS 40 mg/l
- NO_3 50 mg/l as NO_3
- Total Phosphorus 10 mg/l as phosphorus

7.3.1 Wastewater Treatment Process Alternatives

The Feasibility Consultant conducted a comparative analysis between several treatment processes. The alternatives studied included:

i) Trickling Filter process;

ii) Stabilization Pond process;

iii) Aerated Lagoon process; and

iv) Activated Sludge process.

The different alternatives were evaluated based on several criteria, including: land requirement, energy requirements, process efficiency, operation and maintenance requirement, flexibility for future expansion, construction costs, flexibility to handle various wastewater loads and capability to cope with toxic shocks, and safety factor for treatment efficiency. Table 7-1 summarizes the comparison of various biological treatment processes for wastewater

Table 7-1: Comparison of Treatment Process Alternatives

Parameter	Treatment Process		
	Stabilization Ponds and Aerated Lagoons	Trickling Filters	Activated Sludge
1. Land Acquisition costs	Maximum	Medium	Minimum
2. Need for expert & skilled staff for operation and maintenance	Minimum	Medium	Maximum
3. Energy consumption	Minimum	Medium	Maximum
4. Flexibility for future extension & execution of the plant in stages	Maximum	Minimum	Minimum
5. Costs of plant construction	Minimum	Maximum	Maximum
6. Costs of operation and maintenance and needed expertise	Minimum	Medium	Maximum
7. Foreign Exchange requirements	Minimum	Medium	Maximum
8. Safety factor of treatment efficiency	Medium	Minimum	Maximum
9. Flexibility to wastewater load and toxic shocks	Maximum	Medium	Minimum
10. Odor and other nuisances	Medium	Maximum	Minimum

The investment costs for the various process alternatives were also considered. Tables 7-2 and 7-3 show the comparison of the various cost elements for the treatment alternatives considered for the Rasht and Anzali WWTPs:

Table 7-2: Investment and Operation & Maintenance (O&M) Costs of Rasht WWTP Alternatives (in USD)

Target year	**2027**			
Population (persons)	*575000*			
Total wastewater flow (m^3/d)	*120000*			
Description	**WSP_S**	**AL**	**DPMC**	**BNR-AS**
Initial investment costs	5,760,000	20,130,000	9,620,000	23,000,000
O & M costs	1,430,000	5,030,000	2,160,000	5,750,000
Total investment costs	7,200,000	25,160,000	10,780,000	28,750,000
Cost per capita	12.5	43.75	18.75	50
Cost per m^3 of treated wastewater	60	209.70	89.80	239.60
Total land requirement (ha.)	140	90	35	12
Total cost of land	3,500,000	2,300,000	880,000	300,000

Table 7-3: Investment and Operation & Maintenance (O&M) Costs of Anzali WWTP Alternatives (in USD)

Target year	**2027**			
Population (person)	*113400*			
Total wastewater flow (m^3/d)	*23000*			
Description	**WSP_S**	**AL**	**DPMC**	**BNR-AS**
Initial investment costs	1,140,000	3,970,000	1,700,000	4,530,000
O & M costs	280,000	990,000	420,000	1,130,000
Total investment costs	1,420,000	4,960,000	2,120,000	5,670,000
Cost per capita	12.5	43.75	18.75	50
Cost per m^3 of treated wastewater	60.74	215.65	92.45	246.5
Total land requirement (ha.)	30	20	7	3
Total cost of land	750,000	500,000	180,000	75,000

Note:
WSP_S: Wastewater Stabilization Pond System;
AL: Aerated Lagoons;
DPMC: Dual Power Multicellular Lagoon;
BNR-AS: Biological Nutrient Removal Activated Sludge system
Cost of Land: 2.5 USD/ m^2

The above tables show that the most economical process is the stabilization ponds followed by aerated lagoons and DPMC. The activated sludge process has the highest investment cost. Also the table shows that stabilization ponds have the largest area requirements followed by aerated lagoons and DPMC, and that the activated sludge system has the least area requirements among the alternatives. For this project, the environmental constraints are paramount in the evaluation of the alternatives. It is very clear that the project can not accommodate facilities having large area requirements due to visual impacts, land use change and its economical effects on farmers of the area, or processes with inferior process performance resulting in high potential of odour emissions (as in the case for stabilization ponds) or high level of phosphorus and nitrogen in their effluent. The latter reason is perhaps the most important among all as nutrients are causing eutrophic conditions in Anzali lagoon.

Among all the processes considered, the activated sludge process with biological nutrient removal ranks first in terms of reliability to produce compliant effluent with required nutrient levels and has the least area requirements. Therefore the activated sludge system is the most environmentally sound option and, thus, it is the selected alternative.

7.3.2 Biological Nutrient Removal (BNR) Process Alternatives

Given the need to reduce biological nutrients, notably phosphorus and nitrogen from the treated effluent to reduce eutrophication of Anzali Lagoon, the Feasibility Consultant made a comparative analysis of several BNR systems. The purpose of a BNR System is to increase and improve elimination of organic matters and biomass synthesis. The following systems were investigated in detail by the Feasibility Consultant for their comparative advantage in upgrading the wastewater treatment process with BNR:

i) the A^2O process,

ii) the Bardenpho process,

iii) the UCT process; and

iv) the VIP process.

Criteria used in evaluating these processes included process simplicity; energy requirements; investment, operation and maintenance costs; and total hydraulic retention time.

The A_2O process was proposed for the Rasht and Anzali treatment plants due to its simplicity of operation and treatment reliability.

7.4 Alternative Wastewater Collection and Treatment Schemes

This section considers alternative wastewater management schemes for each city. The management schemes explored would consider different number of collection networks, pumping stations, and treatment plant for each city.

7.4.1 Rasht Wastewater Management Scheme

Rasht City is traversed by the Zarjoob and Goharood Rivers, which divide the city into three drainage zones, Eastern, Central and Western parts. The flow projection and connected population in the three zones of Rasht are summarized in the table below:

Table 7.4: Drainage Zones and Projected Wastewater Flows in Rasht at Year 2029

Drainage Zone	Total wastewater flow (m^3/d)	Population (persons)
Western	69,860	333,300
Eastern	79,200	377,900
Central	51,430	245,400
TOTAL	200,500	956,600

The investigated alternatives comprise the following:

- *Alternative 1. Single wastewater treatment*

  In this alternative, the future flows for phases 3 and 4 generated in all three drainage zones will be conveyed to a single wastewater treatment plant, which is currently under construction to the northwest of Rasht City. The wastewater flows from the eastern and western zones of Rasht will be pumped to the central plant. In this alternative, the capacity of the phase 3 and 4 treatment stream at the currently under construction treatment plant will be 120,000 m^3/day.

- *Alternative 2. Dual treatment plants*

  In this alternative the flows generated in phases 3 and 4 are conveyed to two treatment plants. The flows of the central and eastern zone are conveyed to the currently under construction WWTP, whereas the flows from the western zone will be conveyed to a treatment plant located at the downstream end of that area. In this alternative, the capacity of the phase 3 and 4 treatment stream at the currently under construction treatment plant will be 50,000 m^3/day, and the capacity the treatment plant at the western zone will be 70,000 m^3/day.

7.4.1.1 Comparison of the Alternative Wastewater Treatment Management Schemes

The comparison of the two alternatives is based on capital costs, operating costs, manpower requirements, and land requirements. It should be noted that the components of the alternatives differ only in terms of number of treatment plants and the forcemain conveying the western flows to the currently under construction WWTP. The comparison of the two alternatives is presented in Table 7-5 below:

Table 7-5: Comparison of Alternative Wastewater Management Scheme in Rasht

Description	1 WWTP	2 WWTP	
	Central WWTP	*Eastern + Central WWTP*	*Western WWTP*
Population (persons)	575,000	238,000	333,300
Total wastewater flow (m^3/d)	120,000	50,000	70,000
Cost per capita (USD)	50	62.5	60
Total investment cost (USD)	29,000,000	15,000,000	20,000,000
Total construction cost in USD (50% of total investment cost)	15,000,000	7,500,000	10,000,000
Total land requirement (ha.)	15	Same as alternative 1	9
Total cost in USD of land acquisition (based on 2.5 US$/$m^2$)	Acquired	Acquired	230,000
Man power requirements (persons)	46	20	27
Total cost in USD of operation, maintenance, repair and replacement (about 20% of total investment cost)	5,800,000	3,600,000	4,000,000
Cost in USD of pipeline conveying west wastewater flow to the central plant (with Dia. of 1200mm and length of 1800m)	680,000	---	
Total Cost (USD)	**35,500,000**	**42,900,000**	

The above table indicates that that alternative 2 is 21% more expensive than alternative 1, and that it requires an additional area 9 hectares of land.

7.4.1.2 Environmental Impact Comparison of the Alternative Wastewater Treatment Management Schemes

The environmental impacts with respect to the environmental baseline conditions arising from the implementation of the alternative wastewater management schemes described above were already discussed in Chapter 4. The aim of this section is to provide a comparative analysis of the environmental impacts of the two alternatives, in order to determine which of them is environmentally preferable.

The differences in the impacts on the environment are presented below in accordance with the environmental parameters under consideration:

Water Resources

Both alternatives would lead to the same considerable positive impact on the quality of surface and ground water resources due to the cessation of uncontrolled discharge of raw sewage. The potential risk of groundwater and surface water contamination and the associated impacts on public health due to wastewater conveyance (through force mains or trunk mains) is more for Alternative 1 than for the second alternative, since in the latter case the treatment facilities are nearer to the sources of wastewater generation. Also, since the alternative 2 involves two treatment facilities, it follows suit that in the event of an accidental spill from the treatment plants or breakage in the main conveyance lines, the effect on the environment will be much less for this alternative than for Alternative 1 due to the smaller volumes involved.

In conclusion, Alternative 2 has a less negative effect on water resources than Alternative 1.

Fauna and Flora

The permanent positive impacts on fauna and flora due to the improvement of water quality and other environmental conditions are the same for both schemes. However, as Alternative 2 requires the development of larger areas of land than Alternative 1 due to the additional wastewater treatment plant site, it would therefore cause a larger impact on the flora due to the change in land use.

Noise & Vibration

During construction stage, the negative impacts of noise, vibration and traffic resulting in disturbance to people will be slightly more for Alternative 2 than for Alternative 1, since Alternative 1 requires the development of one treatment facility, whereas the other alternative requires the development of two treatment facilities and more pumping stations.

Public Health

Since the works for Alternative 2 are more than the works for Alternative 1, the risks on public health associated with construction works will be higher for this alternative than for Alternative 1. However, the impact is temporary and, as stated in the paragraph on water resources, the potential health risk during the operation stage due to piping breakage or discharge of non-complaint treated effluent for Alternative 1 is much higher than the potential impact caused by Alternative 2.

Economic Aspects

As the works for Alternatives 2 will be more extensive than the works for Alternative 1 due to the additional wastewater treatment plant, it follows suit that the negative socio-economic impacts due to temporary disturbance will be higher for Alternative 2 than for Alternative 1.

Moreover, it is anticipated that the indirect negative economic impact due to the increased tariffs required to sustain the operation of the facilities will be more for Alternative 2 than for Alternative 1.

Land Use and Visual Impact

Alternative 2 will entail a greater change in land use than Alternative 1 since the additional treatment plant site in this alternative is larger in area than Alternative 1. For the same reason, this alternative will have a greater visual impact than Alternative 1.

To summarize the environmental impact comparison of the two alternatives, it can be concluded that alternative 1 is slightly preferred over alternative 2 due to reduced land use change and visual impacts, reduced economic impacts, reduced construction disturbance, and impacts on fauna and flora.

7.4.1.3 Preferred Alternative Wastewater Scheme

Alternative 1 was selected as the preferred option in comparison with Alternative 2 due to the following reasons:

- The centralization of the treatment operations at one location would result in simpler and more efficient management operations and hence reduced management costs.
- Significant reduction in investment costs in terms of both capital and operation costs.
- Reduced environmental impacts.
- Limited land availability in Rasht makes this alternative easier to implement.

7.4.2 Anzali Wastewater Collection System

Anzali is divided by the Anzali lagoon's outlet to the Caspian Sea into two drainage zones, Eastern and Western zones.

A treatment plant in the western zone is currently under construction at Ilyaran.

The investigated alternatives include the following:

- *Alternative 1: Decentralized plants, one in each drainage zone*

  Wastewater flows from each zone will be treated at two separate plants, one in each zone (Ilyaran in the western zone and Ghazian in the eastern zone)

- *Alternative 2: Centralized treatment plant*

  Wastewater from both the western zone and eastern zones will be pumped to the western treatment plant in Ilyaran, which is currently under construction.

7.4.2.1 Comparison of the Alternative Wastewater Treatment Management Schemes

Based on the natural topography in Anzali, and the division of the city into two separate drainage zones intersected by the Ghazian channel, Anzali Lagoon's outlet to the Caspian Sea, GWWC has considered the construction of separate plants in each of the zones, one in Ilyaran serving the western zone, and another plant proposed for the eastern zone at Talebabad, instead of a centralized plant. This alternative was selected due to the natural drainage of the topography, and the significant constraints ruling out the selection of the alternative scheme, as detailed in the proceeding paragraph.

7.4.2.2 Factors Specific to Anzali's Sites and Land Availability

Other factors which precluded the selection of Alternative 2 (i.e. Centralized Plant at Ilyaran), and taken into consideration by the Feasibility Consultant, included the following:

1. Additional land for expanding the currently under construction plant at Ilyaran to accommodate the flows of Ghazian is not available.
2. To convey the collected wastewater from the eastern zone to the western zone, pumping of the wastewater across the lagoon would be necessary. Taking the minimum width of the lagoon's outlet and the significant limitations for establishing a new pipe bridge across the waterway, such a bridge would require considerable capital investment. As for the execution of such works, there is a severe space limitation for establishing a new pipe bridge in the area, as there are two traffic bridges, harbour facilities, and a gas pipe bridge in the same area.
3. The pumping of the wastewater across the lagoon over Ghazian channel has very serious inherent environmental risks. In the instance of pipe breakage the sewage flows of all of Ghazian area will be discharging at a single point, which includes boating activities and thus would pose high public health risks, as well as the discharge will cause severe damage to the aquatic life in both Anzali Lagoon and the

Caspian Sea. Furthermore, since the flow is pumped across the lagoon, it is very likely that sulphates are generated in the forcemain to be released as H_2S at the point of discharge on the western side of the channel.

4. The water supply network for Anzali city includes water pipes crossing the channel at the existing bridge. Using this bridge to carry a new sewage pipe for conveying the sewage from Ghazian to Anzali would involve placing it in close vicinity to the water supply pipes, which would pose an unacceptable major public health risk.
5. Considerable infrastructure and roads exist on both sides of the waterway, and the potential for disruption of the public utility services would be great for the implementation of this collection scheme.

7.4.2.3 Preferred Alternative Wastewater Management Scheme

Accordingly, due the considerable natural and urban constraints in Anzali, the centralized plant alternative was rejected and Alternative 1 with a treatment plant for each of Anzali's two drainage zones was selected.

7.5 Other Alternatives Explored

A number of other alternatives have been explored. These include:

- On-site sanitation.

This option has been described partly in the 'no project' discussion, but it should be further mentioned that the government has already initiated the construction of wastewater treatment plants at Rasht and Anzali and various sections of the collection and conveyance network are being implemented, which would offer a more feasible and reliable method for sewage disposal to house owners. Furthermore, the performance of such systems has proved to be unsatisfactory due to the resulting contamination of ground water and frequent flooding of cesspits induced by the high water table in the area.

Hence, the option of on-site sanitation is rejected.

- Decentralized treatment

The DOE has set limitations on the construction of treatment plants within the city. Therefore decentralized treatment plants would have to be located outside the city limits. The option of having additional plants to those considered in the alternatives explored earlier in this chapter was rejected based on the following:

- The increased cost of influent trunk mains to each treatment plant
- The increased cost of outfalls from each treatment plant to the end disposal point.
- The prohibitive cost and the difficulty of finding suitable sites for the different decentralized plants.
- The potential adverse impacts associated with development of these facilities.

8 Post Environmental Review of Rasht and West Anzali WWTPs

The purpose of the post environmental review for the current under construction wastewater treatment plants of Rasht and West Anzali is to provide an evaluation of the plants sites, a review of the plants' design basis, an appraisal of the plants' technical and environmental performance, and an assessment of the potential risks associated with their operation.

Rasht WWTP will treat the wastewater flows originating from the three (central, east, and west) drainage zones of Rasht city and is being developed in four phases:

- Phase 1, currently under construction, has a capacity of 80,000 m^3/day and can serve the year 2012 flows generated by a connected population of 384,200
- Phase 2, to be constructed in the year 2010, shall extend the plant's capacity by another 40,000 m^3/day so that the total capacity reached will be 120,000 m^3/day to serve a connected population of 582,000 at year 2017
- Phase 3, to be constructed in the year 2015, shall extend the plant's capacity by another 40,000 m^3/day so that the total capacity reached will be 160,000 m^3/day to serve the year 2022 connected population of 769,300
- Phase 4, to be constructed in the year 2021, shall extend the plant's capacity by another 40,000 m^3/day so that the total capacity reached will be 200,000 m^3/day to serve a connected population of 956,600 at year 2027

Anzali West WWTP at Ilyaran will treat the wastewater flows originating from the west drainage zone of Anzali city and is being developed in two phases:

- Phase 1, currently under construction, has a capacity of 20,000 m^3/day and can serve the year 2015 flows generated by a connected population of 105,000
- Phase 2, to be constructed in the year 2013, shall extend the plant's capacity by another 10,000 m^3/day so that the total capacity reached will be 30,000 m^3/day to serve a connected population of 138,600 at year 2027

8.1 Design Basis

8.1.1 Influent Wastewater Quality

Several measurements on wastewater samples were undertaken in both Rasht and Anzali cities in the year 2003 to characterize the wastewater quality. These measurements proved that the wastewater quality has very weak strength (BOD_5 less than 200 mg/l), which was anticipated as the present sewerage system combines both storm drainage and domestic wastewater. Since this project proposes the separation of the system to two independent networks one for domestic wastewater and one for storm water drainage, these results were discarded as they would not be representative of the future wastewater quality arriving to the treatment plants. Therefore, the design influent wastewater quality adopted by Iranab is based on unit wastewater generation rates.

In accordance with the historical records collected from Tehran and Isfahan cities, and the guidelines issued by the Organization of Planning and Management (ref: Issue 3a Design Criteria of Municipal Wastewater Treatment Plants), a unit waste generation rate for BOD_5 of 50 grams per capita per day and for TSS of 60 grams per capita per day were selected[1]. Based on these unit rates and Iranab's estimate for unit wastewater generation rates for both cities, the wastewater quality was projected in accordance with following table:

Table 8-1: Design Wastewater Quality for Rasht & Anzali

Parameter	BOD_5 unit rate	TSS unit rate	Per capita flow rate	BOD_5 concentration	TSS Concentration
Units	gm/capita/day	gm/capita/day	l/capita/day	mg/l	mg/l
Rasht	50	60	210	238	286
Anzali	50	60	206	246	295

In both cities the projected figures characterize weak sewage, which can be attributed to the high infiltration rates estimated at around 20% of the total generated flows. The high infiltration rates were justified based on the high water table that exists in both Rasht and Anzali.

A concentration of 4.6 mg/l for total phosphorus as phosphate and concentration of 40 mg/l for TKN was adopted in the feasibility report for Rasht and Anzali wastewater treatment plants, however without any justification. Also no analysis was performed for seasonal wastewater quality and quantity changes. Therefore, although the adopted design influent concentrations appear reasonable, nonetheless a full wastewater characterization study needs to be developed once the wastewater system is operational. This issue is accounted for through the monitoring program included in the Environmental Management Plan, and will assist in the adjustment of the plants'

[1] Design Criteria of Municipal Wastewater Treatment Plants, Issue 129-a

operating parameters and any required adjustment in the design of the plants in subsequent phases.

8.1.2 Treated Effluent Quality

The treated effluent quality design criteria are dictated by the final disposal method of the effluent. For this project, the effluent will be disposed to surface water bodies that eventually discharge to Anzali lagoon. For the Anzali West WWTP the effluent will be disposed to Anzali lagoon via a channel of 50 m length and 1.0 m width by 1 m high. For the Rasht WWTP the effluent will be disposed to Saighalan River (local name for Zarjoob River) via an outfall channel 2 m wide and 1 m high and 430 m long.

The disposal to water bodies is governed by the DOE regulations which require the effluent quality limits presented in Table 3-9 of chapter 3, which for discussion purposes require the following limits for the parameters of concern:

Table 8-2: Selected Design Effluent Quality Limits for Rasht & Anzali

Parameter	BOD_5	TSS	COD	DO	Total PO_4 as P	NH_3 as N	NO_3 as N
units	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Required Limits	30	40	60	2	1	2	11

The above table indicates that the quality of the effluent needs to comply with secondary standards. Furthermore, the effluent needs to be nitrified and denitrified for nitrogen control and phosphate level should be controlled to 1 mg/l.

In view of the current pollution levels of Anzali Lagoon, and the necessity to reduce the possibility of the development of eutrophic conditions, the feasibility consultant has adopted as one of the treatment objective, biological nutrient removal which further reduces the nitrogen level. In this instance, the total nitrogen would be less than 10 mg/l. This revision to the treated effluent quality limits as well as other design revisions proposed by the feasibility consultant to improve the plants' performances is discussed in the proceeding sections of this chapter.

8.1.3 Treated Sludge Quality

Similar to the treated effluent, the end disposal method of the sludge generated by the treatment process determines the treatment objectives for the sludge. The sludge disposal methods comprising of application to land for agricultural reuse, application to a sanitary landfill, and sludge incineration have all been explored by the feasibility consultant.

Reuse of the sludge as a fertilizer in agriculture was rejected on the grounds of public opposition due to religious beliefs, public health concerns, and potential impact on the commercial value of rice which is the predominant crop in Gilan province.

As for application in a landfill, the selection of a suitable site for disposal presents the largest hurdle in the implementation of this solution. In accordance with the feasibility study, there are no suitable plots of land within a 150 km radius from the plants' locations.

Therefore considering all these factors, the use of sludge incineration was preferred over the application in a landfill mainly due to economic reasons, where the incinerator net present value (based on actual contract price) represents around 43% of the landfill net present value as calculated by the feasibility consultant.

The residual material resulting from incineration comprises of slag (main components metals, glass, and mineral constituents), boiler and fly ash (mineral particles, inert particles, heavy metals), residues from flue gas treatment, and sludge from the water treatment resulting from flue gas wet treatment. These materials represent around 10% of the original volume applied and 25% of the original weight applied.

Some of these materials are inert whereas others could leach to the ground water, and therefore should be disposed off in a well operated landfill. The subject of environmental impact of the incinerator is addressed separately in the proceeding paragraphs.

8.2 Evaluation of Rasht WWTP Site

The plant is conveniently located downstream of Rasht city at a distance of 4 km to the north west of the city boundary. It can be accessed through a secondary road which leads to Pirbazar (Refer Drawing RSC-PJ-PI-IR-101 & Drawing RWWS-IR-138) in Annex A.

The treatment plant site is situated in an agricultural area growing mostly rice and some vegetables. Individual farm houses are scattered to the east and south of the site at distances of around 300 m. The closest cluster of residential houses is located some 800 m to the south east of the site. (see exhibit 4 in Annex G).

The site presently has a total land area of 19.5 hectares, and 40 additional hectares will be acquired for the subsequent phases of the project. It is bounded from all sides by agricultural fields, some of which are cultivated. The prevailing winds are north and north – easterly. As shown on Drawing RWWS-IR-138, the plot of land has rectangular shape and has a concrete wall along all its boundaries. The total built up area, including the treatment works amount to 8 ha. Saighalan River (local name of Zarjoob River) runs parallel to the site at some 350 m towards the north east (See exhibit 5, Annex G); whereas Siahrood River (local name for Goharood) runs along the west side of the site at some 800 m distance.

Presently the site is under construction. The aeration tanks, primary and secondary clarifiers are already built. The construction of administration building, mechanical plant room, and sludge handling facilities is in progress. The original topographic and site environmental conditions were changed. Nonetheless it is possible to assess the site characteristics from adjacent plot of lands. The site has a flat terrain with a minor slope in the southwest direction. Presently there is no ground cover as the site has been cleared. There is no valuable vegetation or special wildlife habitats on adjacent plot of lands (See exhibit 6 & 7, Annex G). A major disadvantage of the site is that the water table is at less than 2 m below ground level, which makes construction quite difficult.

The advantage of the site is that it is located near the two rivers, thus a receiving water body is available for treated effluent discharge. Evidently, the treated effluent will have an impact on the river which is further investigated in the proceeding paragraphs of this chapter.

The choice of the geographical location of the site was somewhat limited, and GWWC spent a lot of effort to acquire the site as the land for development of such projects is quite difficult to find. Currently GWWC is in the process of acquiring the land immediately adjacent to the site on its northern boundary, for the expansion of the WWTP.

Both plots of land have adequate size, as sufficient space is available for temporary storage of screenings and grit, and for construction of the emergency reservoir.

The environmental impacts to the plant site can be described as minimal to average. The original topographic conditions were to a large degree retained, since the site is relatively flat with a favourable minor gradient. However, since the water table is high, adverse impacts due to construction activities or accidental spills of chemicals might have occurred, or may occur in the future.

The treatment plant will also have a visual impact. The tallest structure at the treatment plant is the anaerobic digester, which is 16 m above ground level. The plant is also enclosed by a perimeter wall. Both of these construction features will be visible from a distance due to the flat, agricultural areas that surround the plant. The colour of the perimeter wall is somewhat intrusive due its contrast with green terrain surrounding the site. However, since the facility will include tree planting around the perimeter walls, the visual impact will be reduced and the aesthetic visual quality of the plant will be improved.

Odours can also be potentially emitted in the plant due to improper operation or septic sewage. In this regard it should be noted that the WWTP receives the raw sewage from three conveyor mains, two of which are forcemains with lengths exceeding 1.5 km. It is well documented that at any time the sewage does not have contact with oxygen for a short period of time sulphides will be generated; and the classic example are sulphides in force mains. Therefore in warm weather, it is envisaged that the sulphides will be generated in increasing concentrations in the forcemains, and will be released as H_2S at the sump of the influent lift station where the force mains discharge. In order to mitigate odour emissions it is imperative that odour control facilities be installed on site to treat any malodorous gases from the influent pumping station and the mechanical screenings room. Furthermore, potential odour emissions could arise from the sludge handling facilities; therefore it is also recommended in this case that the sludge dewatering room be provided with an air extraction and treatment system. In general odour emissions remain localized to the plant and can be mitigated by proper management of the facility; however due to the reasons stated above and the lack of sufficient buffer distance between the plant and the nearest residential community, positive odour control measures will be required.

Noise levels are not expected to cause a significant impact, since the project includes noise levels standards for operating machinery, and furthermore the site is wall bounded and tree bordered, which will reduce noise to insignificant levels.

In summary, visual and noise impacts are minor and localized to the site, and can be mitigated by appropriate measures. With regard to odour emissions, the impact can be significant, and therefore positive odour control measures should be provided on site. The installation and operation of the incineration system will also have a major impact on the site's surrounding as will be discussed in the proceeding paragraphs.

8.3 Rasht Wastewater Treatment Plant Design

The wastewater treatment plant is currently being constructed on a rectangular piece of land having a total area of 19.5 hectares. In order to meet the treated effluent quality presented in Table 8-2 of the preceding section, the plant utilizes biological treatment of the activated sludge technology. The plant facilities for phase 1 are described in the following paragraphs. The reader can refer to the feasibility study [ref 16 Chapter 10] for details of the works for phases 2, 3, and 4.

8.3.1 Process Units

In accordance with feasibility study, the original stage 1 capacity of the plant is 90,000 m^3/day comprising of three independent streams with following components:

Liquid Stream

- Inlet works comprising of mechanical and manual bar screens, and flow measurement system.
- Preliminary treatment works comprising of aerated grit removal chambers.
- Primary sedimentation consisting of three circular clarifiers with a primary sludge pumping station.
- Secondary treatment consisting of three aeration tanks equipped with surface aerators
- Secondary sedimentation consisting of three circular clarifiers with a secondary sludge pumping station. The pumping station will recycle the settled sludge to the aeration tanks, and will pump the excess sludge to the sludge treatment units.
- Chlorination system comprising of chlorine contact tank and a proportional gas chlorination system.

Sludge Stream

- Gravity sludge thickeners
- Two stage mesophilic anaerobic digesters
- Mechanical dewatering of the digested sludge comprising of belt filter presses.
- Sludge incineration plant complete with air pollution equipment. The subject of the incinerator is discussed separately in the proceeding paragraphs.

8.3.2 Treatment Plant Upgrade Proposal

As stated earlier, the feasibility consultant has proposed upgrading the treatment plant process to include for nutrient control in order to reduce the possibility of Anzali Lagoon eutrophication. No doubt that this proposal is environmentally very sound and recommended, due to the importance the lagoon represents in terms of the environmental setting of the area, and the economics of the province as discussed in chapter 4.

In order to include nutrient control in the treatment process, it was proposed to incorporate the biological nutrient removal (BNR) technology within the under construction process units. This would entail the provision of anoxic and anaerobic reactors within the present reactor tanks. Several methods where explored, and the Feasibility Consultant recommended the A_2O process due to its simplicity and ease of incorporation in the exiting tanks. This system is a modified pre-anoxic denitrification system. The inclusion of an anoxic tank which receives the return activated sludge enhances the biological removal of phosphorus in the subsequent stages. The anaerobic tank following the anoxic tank ensures denitrification where no free dissolved oxygen conditions prevail. The last tank, the aeration tank, ensures the nitrification of the ammonia present in the raw sewage.

By incorporating the BNR in the present system, it would be possible to reduce the total nitrogen to 10 mg/l and to eliminate to phosphorus concentrations by 70 to 80%. The inclusion of the reactors, however, results in reduced aeration volumes which reduces the overall capacity of the existing stream from 90,000 m^3/day to 80,000 m^3/day.

Other modifications proposed by the Feasibility Consultant include:

- Replacing chlorine gas disinfection by UV disinfection. UV disinfection has becoming increasingly popular as replacement for chlorination systems. Although gas chlorination is more economical however, it generates harmful by-products, such as trihalomethanes which are potential carcinogens to living organisms and animals. Also chlorine is a very strong oxidant which would result in injury in case of uncontrolled release. Therefore this proposal is warranted and recommended as it would eliminate negative impacts of chlorine usage and helps preserve the aquatic species in Anzali lagoon.

- The study of the load development to the plant indicated that the plant in its initial years of operation would be underloaded. Thus, it would be possible to bypass the primary clarifiers and to operate the activated sludge units in the extended aeration mode. This mode of operation generally results in well stabilized sludge particularly if the sludge retention time is extended, thus there would be no need to operate the anaerobic sludge digesters. Therefore the Consultant has proposed to reschedule the construction of the anaerobic digesters to the year 2012 (see discussion on load progression section.)

- The construction of sludge blending tanks for complete mixing of the sludge ahead of the anaerobic digestion process.

- A one day emergency storage tank is proposed to provide for emergency storage of the raw sewage in case of major repair or breakdown of the main treatment process or in case of toxic spills, etc. The tank shall be constructed in concrete, and shall have a total volume for phase 1 of 80,000 m^3. The provision of emergency raw sewage storage increases the treatment reliability of the WWTP and protects Anzali Lagoon and the Caspian Sea from any major upset in the plant's operation.

8.3.3 Buildings and Other Facilities in the Plant

According to tender documents, the plant includes a number of utility buildings as described hereunder:

Guardhouse

The guardhouse is situated at the entrance of the plant to control entry to and exit of the staff and visitors. This building has an area of 85 m^2, and is furnished with the required accommodation needs.

Administration Building

This building will be used by the plant operators for administrative and monitoring operations. It includes a laboratory, canteen, control room, offices, meeting room etc. The total built up area of the building is 855 m^2.

Power Supply Building

This building houses the emergency diesel power generators, and power transformer. The power supply building has an area of approximately 270 m^2.

The Chlorination Building

This building consists of two adjacent rooms; the first houses the chlorination equipment, and the second is provided for storage of the Calcium Hypochlorite chemical. The building has a total area of 165 m^2. It is expected that this building will house the UV control panels, and UV cleaning equipment and accessories following approval of replacing chlorine with the UV system.

8.3.4 Workshop

This building houses the facilities required for repair and maintenance of the mechanical equipment and electrical switchgear. The total area of the workshop is approximately 270 m^2.

8.3.5 Laboratory

The laboratory is located in the administration building. It has a plan area of 170 m^2, and furnished with the required mechanical and electrical installations. The laboratory includes equipment, tools and reagents for conducting wastewater quality tests.

8.3.6 Landscaping

The plant design includes for landscaped areas that are lawn planted. Furthermore, the design allows for tree planting along the perimeter wall and within the facility grounds. Internal roads and walkways shall be constructed to provide access to all treatment units, and facilities of the site. Parking spaces are provided as necessary for parking vehicles for staff or visitors.

8.3.7 Power Supply & Equipment Controls

The electricity requirements of the plant are supplied by two 20 KV overhead lines. For avoiding power outage due to power cuts, the required number of emergency power generators is provided.

Control Panels and the central control station at the administration building facilitate remote and local monitoring of equipment. Instrumentation for monitoring of process variables is partially provided. The missing instrumentation is identified and discussed in the proceeding paragraphs. Furthermore, it is recommended to include for automatic flow proportional samplers at the inlet and outlet channels of the plant for a more reliable sampling, and better representative wastewater quality characterization.

8.3.8 Utility Services

The necessary utility services have been checked and were found to be adequate. These include potable water supply, heating, ventilation, drainage, etc.

8.3.9 Safety and Occupational Health

Provision for fire fighting has been included. The specifications require the installation of fire hydrants. Furthermore, the specifications require installation of safety showers where required. Nonetheless, the plant requires a provision for a first aid room, where medical supplies, medical aid kits, and a stretcher can be housed. It is recommended that appropriate space be allocated for that in the administration building.

8.4 Rasht WWTP Preliminary Design Appraisal

8.4.1 Adequacy of the Rasht Liquid Treatment Stream

The design appraisal in this paragraph will be limited to evaluating the adequacy of the process scheme to produce the required treated effluent quality. It is envisaged that checking and verification of the process units dimensioning has already been conducted by the Supervising Engineer.

The provision of primary and secondary treatment, subject to proper sizing of the process tanks and oxygen supply system, will achieve the desired treated effluent quality of BOD_5 30 mg/l and TSS of 40 mg/l.

Furthermore the proposed inclusion of the BNR system will ensure that total Nitrogen will be less than 10 mg/l which will be in line with revised quality limits specified by the feasibility consultant. With regard to Phosphorus removal, present experience shows that in general 70 to 80% removal by biological means can be expected, depending on the readily biodegradable COD. Therefore the compliance with effluent limit of total phosphate of 1 mg/l is dependent on the influent phosphorus levels. It is recommended that dosing of ferric chloride be added to enhance phosphorus removal in the primary and/or secondary clarifiers. Average dosing of Ferric Chloride ($FeCl_3$) has been estimated about 25 mg/l.

Following a period of operation, the influent phosphorus levels and the plant's phosphorus removal efficiency can be established. It would be possible then to ascertain the need for having tertiary filters to achieve consistent compliance with the 1 mg/l limit. In the mean time, it is recommended that provision of space be made in the design of the WWTP layout for adding the tertiary filters.

8.4.2 Performance throughout Project Period

One of the key questions that need to be addressed, is the plant performance and plant capacity as of commissioning of the project until its target year. Since biological treatment units can operate efficiently within a certain load range of the designed load capacity, it is regular practice to provide multiple process units to have the flexibility of operating the plant at its optimal operating load. It should be noted that the main biological process operate within a range of 30% to 125% of its designed load.

The proposed operating mode of the plant in accordance with projected load progression is summarized by the table below:

Table 8-3: Rasht WWTP Projected Load Progression & Plant Capacity

Year	No. of Operating Modules & Streams	Plant Capacity	Projected Flow	Load as % of capacity
	M: module, S: stream	m^3/day	m^3/day	%
2009	Existing WWTP 2S	53,333	50,860	95%
2010	Existing WWTP 2S	53,333	59,547	112%
2011	Existing WWTP 1M	80,000	68,234	85%
2012	Existing WWTP 1M	80,000	76,920	96%
2013	1M + 1S	90,000	85,496	95%
2014	1M+2S	100,000	94,072	94%
2015	1M+2S	100,000	102,648	103%
2016	1M+3S	110,000	111,224	101%
2017	2M	120,000	119,800	100%
2018	2M + 1S	130,000	127,870	98%
2019	2M+2S	140,000	135,940	97%
2020	2M+2S	140,000	144,010	103%
2021	2M+3S	150,000	152,080	101%
2022	3M	160,000	160,150	100%
2023	3M + 1S	170,000	168,220	99%
2024	3M+2S	180,000	176,290	98%
2025	3M+2S	190,000	184,360	97%
2026	3M+3S	190,000	192,430	101%
2027	4M	200,000	200,500	100%

The above table indicates that due to the large number of streams included in the design, it is always possible to operate at optimal efficiency, which confirms that the design has a high degree of flexibility.

8.4.3 Solids Production and Preliminary Appraisal of the Sludge Treatment Scheme

As discussed in the previous paragraphs, the sludge treatment scheme is comprised of thickening, blending, anaerobic digestion, thickening, dewatering and incineration. As noted before, the digester will only be operated by year 2012 since the plant will be operated in extended aeration mode, wherein the sludge will be aerobically digested. However, by year 2012, it is proposed that the digester be operated as the capacity of the incinerator will be exceeded, thus it will be necessary to reduce the solids load on the incinerator by the digestion process. The description of the operation and appraisal of the incinerator is addressed in the proceeding paragraphs. However, we can note the following concerning the design of the sludge treatment scheme:

- It is preferable not to digest sludge prior to incineration as anaerobic digestion decreases the volatile content of the sludge and consequently increases the requirement for auxiliary fuel for running the incinerator.

- The methane gas generated by the digestion process is flared whereas at this plant capacity, reuse of the gas in generating electrical energy could very well be feasible and therefore a feasibility study should be conducted for reusing of digester gas.

- With regard to the grit and screenings produced at the plant, the feasibility study proposes their incineration with the sludge. The estimated solids production generated by the treatment process can be summarized by the following table:

Table 8-4: Rasht WWTP Solids Production

Phase	Year	Flow	Screenings	Grit	[a] Digested Sludge		Incinerated Solids	
		m^3/d	m^3/d	m^3/d	dry solid tons/year	wet m^3/year	tons/year	m^3/year
1	2009	50,860	1.5	0.76	[b]4900	16334	1225	1361
2	2012	76,920	2.3	1.15	4,621	14,280	1155	1284
3	2017	119,800	3.6	1.8	7,197	24,265	1799	1999
4	2027	200,500	6	3	12,045	40,560	3012	3347

[a] Dewatered to 30% solids

[b] For year 2009, figures are for undigested sludge, as digesters will operate year 2012

8.4.4 Methane Gas Production

The total volumes of methane bio-gas produced if the anaerobic digesters are used will be 8,282 m^3/day for the under construction WWTP and 12,018 m^3/day for the expansion WWTP.

8.5 Rasht WWTP Projected Resource Usage

8.5.1 Power

The total installed power requirement for the Rasht WWTP at end of phase 1 is 20 KVA and at year 2027 is 3.2 MW. Power consumption is estimated to be 870 kW per year at year 2009 and 3100 kW per year at year 2027. There will be one diesel standby generator for giving a total power output of 1.1 MW at year 2009 and two standby generators at year 2027 to provide 2.2 MW, which will be sufficient for operation of the essential plant and equipment and to maintain levels of treatment during any power failures.

8.5.2 Chemical Usage

The chemicals used in the treatment plant and their application rates at year 2009, and 2027 can be summarized in the following table:

Table 8-5: Rasht WWTP Chemical Consumption Rates

Description	Year 2009	Year 2027
Treatment plant flow (m3/day)	50,860	200,500
Sludge Production (tons dry solids/day)	8.4	33
Total Cl_2 requirement at 5 g/m^3 dose (tons/year)	93	366
Total Poly-electrolyte requirement at 5 kg/tons dry solids (tons/year)	16	60
Other Chemicals: Ferric Chloride tons/day	3.2	12.5

The treatment plant includes all the required safety facilities for handling of chemicals such as safety shower, and emergency extraction fans in the chemical storage room.

For all chemicals to be transported or handled on site, provisions for safety standards are included in the tender specifications. These provisions require:

- The posting of information on specifications of the chemical, method of storage, application, and remediation measures in case of emergency conditions due to contact or exposure.
- Installation of safety showers as required
- Wearing of protective clothing
- Emergency plan for serious conditions.

8.5.3 Manpower

The human resources that are envisaged to run the plant at year 2009 and 2027 shall cover all the operation functions required at the facility, which would include: administrative functions, operations functions, and maintenance functions. Therefore it is anticipated that the following resources be allocated at year 2009 and 2027.

Table 8-6: Rasht WWTP Manpower Requirements

Category	**Year 2009**	**Year 2027**
Plant Manager	1	1
Secretary	2	3
Accountant	1	2
Operations Manager	1	1
Senior Operations Engineer	1	1
Operations Engineers	1	3
Maintenance manager	1	1
Senior Maintenance Engineer	1	1
Maintenance Engineer	1	2
Chief Chemist	1	1
Laboratory Technician	1	2
Mechanical Foreman	2	3
Electrical Foreman	2	3
Mechanical Technicians	6	10
Electrical Technicians	6	10
Labour	12	24
TOTAL	**40**	**68**

8.6 Review of Engineering Aspects

Based on the treatment plant's tender documents, and site visits conducted, a number of shortcomings to the plant have been identified. These are summarized by the following:

Instrumentation for Process Control

A number of instruments are required to improve the plant's monitoring and control system. These instruments include: Return activated sludge and Primary sludge density meters, and nitrate sensors in aeration tanks.

Laboratory Equipment and Furnishings

The equipment and instruments required to measure heavy metals in the treated effluent and treated sludge should be furnished. Furthermore, it is proposed to include automatic flow proportional samplers at the inlet and effluent of the plant. An assessment of the laboratory equipment needs for covering all the required tests has been conducted and is included in annex D, complete with cost estimate of the required equipment. These costs estimates have also been included as part of the EMP discussed in chapter 9.

8.7 Incinerator Evaluation

As discussed previously, due to land availability constraints, public resistance to re-use of sludge in agriculture and cost of land filling, sludge disposal by incineration was found to be the most suitable disposal method.

In this method, incineration of sludge will lead to total conversion of organic solids to oxidized end products. The major advantages of this method is: (1) maximum volume reduction of sludge, which reaches 10% of initial volume (2) destruction of pathogens and toxics and (3) energy recovery potential; disadvantages include (1) high capital and operating costs (2) Highly skilled operation and maintenance staff (3) residuals produced (air emissions and ash) may have serious adverse impacts on the environment.

Incineration generates large volumes of flue gases, which carry residues from incomplete combustion and a wide range of harmful pollutants; such as: ash, heavy metals, and a variety of organic and inorganic compounds. These pollutants are present as particles (dust), and gases such as HCL, HF, SO_2, NO_X. These compounds and other harmful ones such as mercury and dioxins can only be removed through advanced and costly chemical treatment technologies. The minimum requirement is for basic emission control, which involves only reduction of particulate matter. At the same time a significant part of the most harmful substances is also retained because dust particles (fly ash) and pollutant adsorbed on the surface of the particles can be removed in efficient dust removal equipment like electrostatic precipitators.

The residues from incineration include mainly bottom slag, and boiler and fly ash, which account for only a small percent of the waste. The bottom slag is stable with only a small amount of organic material. Therefore, it can be reused as road construction material. The boiler and fly ash and other residues will need to be disposed in a well controlled landfill.

The proposed incinerator at Rasht has a capacity of 4 tons/hr and is comprised of the following components:

- Two silos with 100 m^3 capacity.
- Conveyor belt
- One rotary drum furnace with 4 tons/hr capacity
- Dual fuel burner
- Fuel tank
- Air supply system
- Scum and ash disposal system with silo.
- Smoke cooling system capable of maintaining emissions temperatures to less than 300 C and a dust filter to keep the dust particles concentration in the final gas to a level of 150 mg/m^3 level.
- 20 m high stack
- Local control and command unit

Further specifications of the proposed incinerator can be found in the feasibility study reference 16. The key environmental and occupational health standards to be met as required by World Bank guidelines and other international standards are:

1. The flue gas treatment system must be capable of removing dust to less than 30 mg/nm^3.
2. A controlled and well operated landfill must be available for disposal of residues.
3. To avoid noise, dust, and odour in residential areas, incineration plants should be located in land use zones dedicated for medium to heavy industry.
4. The stack height should be at least 70 m high.

For this project, none of the above conditions are satisfied:

1. The flue gas treatment is capable of providing minimum particle concentration levels 5 times the required standard.
2. There is no well controlled landfill in Gilan province suitable for disposal of the harmful residues.
3. The incineration plant is located in an agricultural area with farmer's houses at distances around 300 m.
4. The stack height is 3.5 times shorter than the required height.

Considering all these factors, the provision of the proposed incinerator was discussed between the main parties directly involved in the development of this project notably: the WB project team, Environmental Consultant, Feasibility Consultant, and GWWC. It was decided to explore alternative sludge disposal systems that are more environmentally friendly and compliant with prevailing national and international standards.

8.8 Impact of Effluent Disposal on Zarjoob River

The impact of the project on Zarjoob River has been discussed in Chapter 6, wherein it was shown that the river water quality will markedly improve, when compared to the base line conditions, as raw sewage disposal to the river will be eliminated. As a result, the BOD_5 concentration in the river will drastically drop, the DO levels will increase most likely to their original saturation levels, and other pollutants caused by raw sewage discharge will be eliminated. In this paragraph, the impact of the Rasht WWTP effluent on the Zarjoob River will be evaluated.

In this context, it will be assumed that the river quality prior to disposal will have no pollutants, and that the treated effluent will be compliant with required standards as predicted earlier in this chapter. In terms of quality indicators, the BOD_5 and dissolved oxygen can be used for evaluation of the changes in stream water quality; wherein the stream DO level prior to discharge can be assumed to be 90% of saturation, and the BOD_5 level can be assumed to be 1 mg/l to reflect minor oxygen demand. As for the effluent, it shall be assumed to have a BOD_5 level of 30 mg/l, which is the Iranian standard for discharge and the DO level shall be assumed to be 0.5 mg/l, which is a reasonable level at the discharge point. The evaluation of the effluent discharge on the stream DO level is conducted according to the classic Streeter-Phelps equation. Although the approach is simplified due to the assumptions made, nonetheless the results provide a good assessment of the likely impacts. The results of the calculations, according the Streeter-Phelps model are shown on the table that follows.

The calculations are conducted for the target year of the project, year 2027, which would present the largest impact during the project life time. The calculations indicate that initially, at the discharge point, the dissolved oxygen will drop. This initial drop is termed the initial deficit. Due to the residual BOD level, this initial deficit will continue to increase to reach a maximum, which is termed the critical deficit. Due to reduction in river flow in summer, and reduced DO levels because of temperature, it can be seen that the impact will be greatest during the month of August, where the Streeter-Phelps model and assumptions made predict that DO levels would reach the critical value of 2.1 mg/l after nearly one day of discharge. This deficit, however, would change as soon as Zarjoob meets Goharood River, at about 1 km from discharge point, and both become Pirbazar River as shown on drawing C&EGWSS-IR-101-4. The effect of the effluent discharge on Pirbazar is shown on in Table 8-8.

The calculations indicate that the critical deficit reduces to 4.2 mg/l, and the critical dissolved oxygen level increases to 3.8 mg/l, which is 86% higher than the critical oxygen level of Zarjoob. Eventually as the Pirbazar flow increases due to the discharge of tributary streams, the dissolved oxygen level would increase.

We should bear in mind that this model has limitations, as for instance the BOD_5 of the effluent could well be below 30 mg/l as it very common that well operating plants produce final BOD_5 levels of 20 mg/l, or in case the plant is not performing well, the BOD_5 level can be higher than 30 mg/l. However, in order to avoid the possibility of oxygen depletion in Zarjoob River, particularly as the flows may drop below the monthly average, it is preferable to discharge the effluent in Pirbazar which has a greater absorptive capacity. Therefore, it is recommended to change the routing of the outfall main towards the north. The increased cost due to this change is minimal.

Table 8-7: Zarjoob River DO levels Assessment Following Effluent Discharge

	Units	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
[5]T	°C	7.5	9	13	15	20	23	26	26	21.5	18.5	14	12
[1]$Flow_{stream}$	m^3/s	5.61	6.62	7.17	5.6	5.23	4.82	4.7	4.05	4.01	6.12	6.9	6.62
[2]DO_{stream}	mg/l	10	10	10	10	9	8	8	8	8	9	10	10
[3]$BOD_{5\ stream}$	mg/l	1	1	1	1	1	1	1	1	1	1	1	1
[4]Eff Flow	m^3/s	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31
T_{Eff}	°C	11.5	13.0	17.0	19.0	24.0	27.0	30.0	30.0	25.5	22.5	18.0	16.0
DO_{Eff}	mg/l	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
$BOD_{5\ eff}$	mg/l	30	30	30	30	30	30	30	30	30	30	30	30
$DO_{Mixture}$	mg/l	7.2	7.5	7.7	7.2	6.4	5.6	5.5	5.3	5.3	6.7	7.6	7.5
[5]T_{Mix}	°C	8.7	10.0	14.0	16.2	21.2	24.3	27.3	27.5	23.0	19.6	15.0	13.0
$BOD_{5\ mix}$	mg/l	8.8	7.8	7.3	8.8	9.2	9.7	9.9	10.9	11.0	8.2	7.5	7.8
$D_{initial}$	mg/l	2.77	2.46	2.32	2.78	2.61	2.43	2.47	2.73	2.74	2.33	2.39	2.46
$t_{critical}$	days	3.83	3.50	2.69	2.31	1.62	1.31	1.02	1.01	1.46	1.84	2.51	2.87
$D_{critical}$	mg/l	1.1	1.1	1.5	2.1	3.3	4.2	5.3	5.9	4.4	2.6	1.7	1.5
$DO_{critical}$	mg/l	8.9	8.9	8.5	7.9	5.7	3.8	2.7	2.1	3.6	6.4	8.3	8.5

[1] Based on average of monthly measurements for 23 years
[2] Assumed to be 90% of stream DO saturation level
[3] Assumed
[4] Average yearly at 2027
[5] Based on stream data provided in chapter 4. Temperature of effluent as assumed to be 4 °C higher than that of the river.

Table 8-8: PirBazar River DO levels Assessment Following Effluent Discharge

	Units	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
T	°C	7.5	9	13	15	20	23	26	26	21.5	18.5	14	12
Flow $_{stream}$	m^3/s	10.75	12.25	12.39	9.75	8.13	7.24	6.72	6.49	6.4	8.13	13.22	10.91
DO $_{stream}$	mg/l	10	10	10	10	9	8	8	8	8	9	10	10
$BOD_{5\ stream}$	mg/l	1	1	1	1	1	1	1	1	1	1	1	1
Eff Flow	m^3/s	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31
T_{Eff}	°C	11.50	13.00	17.00	19.00	24.00	27.00	30.00	30.00	25.50	22.50	18.00	16.00
DO_{Eff}	mg/l	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
$BOD_{5\ eff}$	mg/l	30	30	30	30	30	30	30	30	30	30	30	30
$DO_{Mixture}$	mg/l	**8.3**	**8.5**	**8.5**	**8.2**	**7.1**	**6.2**	**6.1**	**6.0**	**6.0**	**7.1**	**8.6**	**8.3**
T_{Mix}	°C	8.2	9.6	13.6	15.8	20.9	24.0	27.0	27.1	22.6	19.4	14.6	12.7
$BOD_{5\ mix}$	mg/l	5.3	4.8	4.7	5.8	6.6	7.3	7.7	7.9	8.0	6.6	4.5	5.3
$L_{0\ mix}$	mg/l	6.8	6.1	6.1	7.4	8.6	9.4	9.9	10.2	10.3	8.6	5.8	6.8
D_{intial}	mg/l	1.68	1.51	1.50	1.82	1.88	1.82	1.92	1.97	1.99	1.88	1.42	1.66
$t_{critical}$	days	3.94	3.60	2.76	2.38	1.67	1.34	1.05	1.05	1.50	1.87	2.58	2.94
$D_{critical}$	mg/l	0.7	0.7	0.9	1.4	2.3	3.1	4.1	4.2	3.1	2.1	1.0	1.0
$DO_{critical}$	mg/l	**9.3**	**9.3**	**9.1**	**8.6**	**6.7**	**4.9**	**3.9**	**3.8**	**4.9**	**6.9**	**9.0**	**9.0**

[1] Based on average of monthly measurements for 23 years
[2] Assumed to be 90% of stream DO saturation level
[3] Assumed
[4] Average yearly at 2027
[5] Based on stream data provided in chapter 4. Temperature of effluent as assumed to be 4 °C higher than that of the river.

8.9 Sludge Disposal by Re-Use in Agriculture

This option was originally discarded due to public opposition specifically since the main crop cultivated is rice, which is the best of its kind in the country. Furthermore, due to the rainy weather and high humidity, which prevail for most of the year, drying the sludge to meet WHO health standards would be very difficult.

However, since incineration proved to be unacceptable, this option was explored again. Other regions where weather and agricultural conditions are more suitable had to be investigated for this application. The preliminary investigations indicate that the aforementioned conditions will be more favourable at the border of Gilan Province with Qazvin or in Qazvin province itself.

The implementation of this solution would entail the following:

1. The provision of sludge digestion at the two Anzali WWTPs to stabilize the sludge prior to further handling
2. Hauling sludge that is stabilized, on a daily basis with a minimum of 30% dry solids content to a location approximately 150 km from the Rasht WWTP. The estimated number of trips to haul sludge from both Rasht and Anzali is 3 per day in year 2009, and 11 per day at year 2027
3. The construction of sludge drying beds with 2.5 hectares area for year 2009 and 10 hectares for year 2027.
4. It is envisaged that sludge could be applied to 1,750 ha/year at year 2027 at an application rate of 8 tons/ha/year.
5. The preliminary net present value calculated by the feasibility consultant for this sludge disposal option over the project period is US$ 1,700,000. This value covers: loading costs at the plant, sludge hauling costs, and construction costs of the sludge drying beds.

At the time of writing this report, this solution had the preliminary approval of all parties concerned. Therefore further studies are currently under way to:

- To identify the final location for developing the sludge drying beds taking into consideration distance from Rasht and distance from land application location.
- To further elaborate the construction and operation requirements by providing preliminary dimensions of drying beds, establishing the equipment and manpower required at the WWTPs sites and sludge drying bed points

- Refining the costs estimates based on above.
- Obtaining the final approval of all concerned.
- Evaluate further the sludge re-use potential in the intended area of application.

Pending the completion of above activities, the environmental assessment report will address the general environmental issues of sludge re-use. These issues are addressed in chapters 6 and 9.

8.10 Evaluation of Anzali WWTP Site

The plant is conveniently located at Ilyaran downstream of the West Anzali drainage area at a distance of 2 km south east of Anzali. It can be accessed through a secondary road which leads to a rural area called Margodeh (Refer Drawing AWWS-IR-17-2). GWWC procured the land from the halfway point of this road for the purpose of reducing the length of the force pipes conveying the sewage from the main pump station to the WWTP. The access road along the force main path is currently under reconstruction by GWWC.

The treatment plant site is situated in an agricultural area growing mostly rice. The site surroundings within a radius of 1 km, comprise of cultivated area and do not include any developments, except for a farm to the east of the site, at a distance of more than 500 m. The closest residential area is located in the Anzali city some 2 km to the north of the plant.

The site has a total land area of 6.4 hectares, and will be expanded to 14 hectares for the remaining phases. The prevailing winds are north and north – easterly. As shown on Drawing No AWWS-IR-17-4-3 the plot of land has irregular shape and has a concrete wall along all its boundaries. The total built up area, including the treatment works amount to 10 ha. Immediately to the south of the site, the land is full of stagnant water, and at a distance of 50 m south of the site, the Basham Rogah runs to the north east to Anzali Lagoon.

Presently the site is under construction. The aeration tanks, and secondary clarifiers are already built. The construction of administration building, mechanical plant room, and sludge handling facilities is in progress. The original topographic and site environmental conditions were changed. Nonetheless it is possible to assess the site characteristics from adjacent plot of lands. The site has a flat terrain with a minor slope in the southeast direction. Presently there is no ground cover as the site has been cleared. There is no valuable vegetation or special wildlife habitats on adjacent plot of lands (See exhibit 8, Annex G).

The advantage of the site is that its geographical location permits gravity conveyance of the West Anzali sewage flows due to the lower elevation of site with respect to the drainage area. Thus investment and operational cost of pumping stations are saved.

The size of the plot is properly chosen, as adequate space is available for the plant's future expansion, and for the short term storage of sludge and temporary storage of screenings and grit.

The environmental impacts to the plant site can be described as minimal. The original topographic conditions were to a large degree retained, since the site is relatively flat with a favourable minor gradient.

The treatment plant will also have a minor visual impact. The tallest structure at the treatment plant is the administration building, which is 10 m above ground level. The plant is also enclosed by a perimeter wall. Both of these construction features will be visible from a distance due to the flat, agricultural areas that surround the plant. The colour of the perimeter wall is somewhat visually intrusive as it contrasts with the greenish background colour of the agricultural fields. Furthermore, since the facility will include tree planting around its perimeter walls the visual impact will be reduced and the aesthetic visual quality of the plant will be improved.

Although the administration building and the perimeter wall will be visible from a distance, the wastewater treatment facilities will have no significant negative visual impact because:

- The development will not reduce the visual quality of the surroundings any further.
- No residential areas have a view of the site.
- The planting of trees around the perimeter wall will allow improvements to be made to the visual quality.

Odours can also be potentially emitted in the plant due to improper operation or septic sewage. However, this impact is localized to the plant and can be mitigated by proper management of the facility. Sufficient buffer distance is available between the plant and the nearest residential community to render the effect of any odour emission insignificant. The existing farm to the east of the plant maybe affected by odours under considerable adverse plant operating conditions, however in general the farm is upwind and separated by a sufficient distance from the plant.

Noise levels are not expected to cause a significant impact, since the project includes noise level standards for operating machinery, and furthermore the site is wall bounded and tree bordered, which will reduce noise to insignificant levels.

In summary, the site is appropriately selected. Its main advantage is that it permits gravity flow to the plant from the city. The visual, odour, and noise impacts are minor and localized to the site. The impact of the treated effluent at the point of application is considered in the proceeding paragraphs.

8.11 West Anzali Wastewater Treatment Plant Design

In order to meet the treated effluent quality presented in Table 8-2 of the preceding section, the plant utilizes biological treatment of the activated sludge technology. The plant facilities for phase 1 are described in the following paragraphs. The reader can refer to the feasibility study [ref 16] for details of the works for the remaining phases.

8.11.1 Process Units

In accordance with feasibility study the original stage 1 capacity of the plant is 20,000 m^3/day comprising of three independent streams with the following components:

Liquid Stream

- Inlet works comprising of mechanical and manual bar screens, and flow measurement system.
- Preliminary treatment works comprising of aerated grit removal chambers.
- Secondary treatment consisting of two aeration tanks equipped with twelve surface aerators in each aeration tank.
- Secondary sedimentation consisting of four circular clarifiers with a secondary sludge pumping station. The pumping station will recycle the settled sludge to the aeration tanks, and will pump the excess sludge to the sludge treatment units.
- UV disinfection system.

Sludge Stream

- Gravity sludge thickeners
- Mechanical dewatering of the thickened sludge comprising of belt filter presses.
- Two Sludge storage ponds

8.11.2 Treatment Plant Upgrade Proposal

Similar to what has been proposed to Rasht WWTP, the feasibility Consultant has proposed to modify the existing extended aeration plant to a BNR activated sludge plant.

This would entail the provision of anoxic and anaerobic reactors within the present reactor tanks. Several methods where explored, and the feasibility Consultant recommended the A_2O process due to its simplicity and ease of incorporation in the exiting tanks. This system is identical to what has been proposed to Rasht, and involves a modified pre-anoxic denitrification system, which incorporates anoxic, anaerobic, and aerobic treatment stages in sequence.

By incorporating the BNR in the present system, it would be possible to reduce the total nitrogen to 10 mg/l and to eliminate to phosphorus concentrations by 70 to 80%. The inclusion of the reactors however, results in reduced aeration volumes which reduces the overall capacity of the plant from 30,000 m^3/day to 28,000 m^3/day.

Other modifications proposed by the feasibility consultant include:

- Reduction in dewatered sludge storage capacity from 3 months to 7 days as the final sludge disposal method will be through incineration at the Rasht WWTP

- Similar to Rasht WWTP, a one day emergency storage tank is proposed to provide for emergency storage of the raw sewage in case of major repair or breakdown of the main treatment process or in case of toxic spills, etc. The tank shall be constructed in concrete. The total volume provided is 30,000 m^3. The provision of emergency raw sewage storage increases the treatment reliability of the WWTP and protects Anzali Lagoon and the Caspian Sea from any major deficiencies in the plant operation.

8.11.3 Buildings and Other Facilities in the Plant

According to tender documents, the plant includes a number of utility buildings as described hereunder:

<u>Guardhouse</u>

The guardhouse is situated at the entrance of the plant to control entry to and exit of the staff and visitors. This building has an area of 85 m^2, and is furnished with the required accommodation needs.

Administration Building

This building will be used by the plant operators for administrative and monitoring operations. It includes a laboratory, canteen, control room, offices, meeting room etc. The total built up area of the building is 750 m^2.

Power Supply Building

This building houses the emergency diesel power generators, and power transformer. The power supply building has an area of approximately 200 m^2.

The UV Disinfection Building

This building consists of two adjacent rooms; the first houses the UV equipment, and the second is provided for storage of spare parts. The building has a total area of 110 m^2.

8.11.4 Workshop

This building houses the facilities required for repair and maintenance of the mechanical equipment and electrical switchgear. The total area of the workshop is approximately 250 m^2.

8.11.5 Laboratory

The laboratory is located in the administration building. It has a plan area of 120 m^2, and furnished with the required mechanical and electrical installations. The laboratory includes equipment, tools and reagents for conducting wastewater quality tests. An assessment of the equipment needs for covering all the required tests has been conducted and is included in annex D, complete with cost estimate of the required equipment. These costs estimates have also been included as part of the EMP discussed in chapter 9.

8.11.6 Landscaping

The plant design includes for landscaped areas that are lawn planted. Furthermore, the facility design allows for trees planting along the perimeter wall and within the facility grounds. Internal roads and walkways shall be constructed to provide access to all treatment units, and facilities of the site. Parking spaces are provided as necessary for parking vehicles for staff or visitors.

8.11.7 Power Supply & Equipment Controls

The electricity requirements of the plant are supplied by two 20 KV overhead lines. For avoiding power outage due to power cuts, the required number of emergency power generators is provided.

Control Panels and the central control station at the administration building facilitate remote and local monitoring of equipment. Instrumentation for monitoring of process variables is partially provided. The missing instrumentation is identified and discussed in the proceeding paragraphs. Furthermore, it is recommended to include for automatic flow proportional samplers at the inlet and outlet channels of the plant for a more reliable sampling, and better representative wastewater quality characterization.

8.11.8 Utility Services

The necessary utility services have been checked and were found to be adequate. These include potable water supply, heating, ventilation, drainage, etc.

8.11.9 Safety and Occupational Health

Provision for fire fighting has been included. The specifications require the installation of fire hydrants. Where required safety showers have been installed. Nonetheless, the plant requires a provision for a first aid room, where medical supplies, medical aid kits, and a stretcher can be housed. It is recommended that appropriate space be allocated for that in the administration building.

8.12 West Anzali WWTP Preliminary Design Appraisal

8.12.1 Adequacy of the West Anzali Liquid Treatment Stream

Similar to the appraisal for Rasht WWTP, the design appraisal in this paragraph will be limited to evaluating the adequacy of the process scheme to produce the required treated effluent quality.

The provision of a secondary treatment, subject to proper sizing of the process tanks and oxygen supply system, will achieve the desired treated effluent quality of BOD_5 30 mg/l and TSS of 40 mg/l.

Furthermore the proposed inclusion of the BNR system will ensure that total Nitrogen will be less than 10 mg/l which will be in line with revised quality limits specified by the feasibility consultant. In this respect, it is worth stating that the omission of primary clarification will result in a more reliable denitrification system, as in this instance, the BOD_5/TN ratio will be higher ensuring sufficient substrate for denitrification to proceed. With regard to Phosphorus removal, present experience shows that in general 70 to 80% removal by biological means can be expected, depending on the readily biodegradable COD. Therefore the compliance with effluent limit of total phosphate of 1 mg/l is dependent on the influent phosphorus levels. It is recommended that dosing of ferric chloride be added to enhance phosphorus removal in the secondary clarifiers. Average dosing of Ferric Chloride ($FeCl_3$) has been estimated at about 25 mg/l.

Following a period of operation, the influent phosphorus levels, and the plant's phosphorus removal efficiency can be established. It would be possible then to ascertain the need for having tertiary filters to achieve consistent compliance with 1 mg/l limit. In the mean time, it is recommended that provision of space be made in the design of the WWTP layout for adding the tertiary filters.

8.12.2 Performance throughout Project Period

Similar to what has been discussed for Rasht WWTP, it is necessary to evaluate the plant performance at different loading conditions, which reflect the build up of the sewage flows arriving to the plant. As the WWTP is comprised of multiple streams, it is possible to control the plant capacity according to the loading rate. As stated earlier, the main biological process operates within a range of 30% to 125% of its designed load. The proposed operating mode of the plant in accordance with projected load progression is summarized by the table below:

Table 8-9: Anzali West WWTP Project Load Progression & Plant Capacity

Year	No. of Operating Modules & Streams	Plant Capacity	Projected Flow	Load as % of capacity
	M: module, S: stream	m^3/day	m^3/day	%
2009	Existing WWTP 2M	18,666	13,560	73%
2010	Existing WWTP 2M	18,666	14,764	79%
2011	Existing WWTP 2M	18,666	15,967	86%
2012	Existing WWTP 2M	18,666	17,170	92%
2013	Existing WWTP 2M	18,666	18,170	97%
2014	Existing WWTP 2M	18,666	19,170	102%
2015	Existing WWTP 2M	18,666	20,170	108%
2016	Existing WWTP 2M	18,666	21,170	113%
2017	Existing WWTP 3M	28,000	22,170	79%
2018	Existing WWTP 3M	28,000	22,767	81%
2019	Existing WWTP 3M	28,000	23,364	83%
2020	Existing WWTP 3M	28,000	23,961	86%
2021	Existing WWTP 3M	28,000	24,558	88%

2022	Existing WWTP 3M	28,000	25,155	89%
2023	Existing WWTP 3M	28,000	25,752	92%
2024	Existing WWTP 3M	28,000	26,349	94%
2025	Existing WWTP 3M	28,000	26,946	96%
2026	Existing WWTP 3M	28,000	27,543	98%
2027	Existing WWTP 3M	28,000	28,140	100.5%

The above table indicates that due to the large number of streams included in the design, it is always possible to operate within the operating range of 30% to 125%, which confirms that the design has a high degree of flexibility.

8.12.3 Solids Production and Preliminary Appraisal of the Sludge Treatment Scheme

As discussed in the previous paragraphs, the sludge treatment scheme is comprised of thickening, dewatering and incineration. As noted before, sludge digestion was not included since the plant will be operated in extended aeration mode, wherein the sludge will be aerobically digested. However, by year 2012, it was proposed that the digester be included and be operated as the capacity of the proposed incinerator will be exceeded, and therefore the digestion process will reduce the solids load on the incinerator. Considering the results of the evaluation of the incinerator presented in the preceding section, sludge digestion should be introduced much earlier, if the incineration option is finally discarded. Similar to what has been discussed for Rasht, a feasibility study should be conducted for re-use of methane gas in generation of electrical power, in case anaerobic digesters will be adopted as the method of digestion.

With regard to the grit and screenings produced at the plant, the feasibility study proposed their incineration with the sludge. The estimated solids production generated by the treatment process can be summarized by the following table:

Table 8-10: Anzali West WWTP Solids Production

Phase	Year	Flow	Screenings	Grit	[2]Dewatered Sludge		Incinerated Solids	
		m^3/d	m^3/d	m^3/d	dry solid tons/year	wet $m^3/year$	tons/year	$m^3/year$
1	2009	13,560	0.40	0.21	119	476	45.75	51
2	2012	17,170	0.51	0.26	151	604	58	64.5
3	2017	22,170	0.66	0.33	195	780	74.75	83
4	2027	28,140	0.84	0.42	245	980	95	105.5

[2]Dewatered to 25% solids

8.12.4 Methane Gas Production

The estimated total volumes of methane bio-gas that will be produced if the anaerobic digesters are used are 388m^3/day for the western WWTP and 2,462 m^3/day for the eastern WWTP.

8.13 Anzali WWTP Projected Resource Usage

8.13.1 Power

The total installed power requirement for the Anzali West WWTP at end of phase 1 is 10 KVA and at year 2027 is 1.2 MW. Power consumption is estimated to be 370 kW per year at year 2009 and 1180 kW per year at year 2027. There will be one standby diesel generators for giving a total power output of 0.5 MW at year 2009 and two standby generators at year 2027 to provide 1.1 MW sufficient for operation of the essential plant and equipment and maintain appropriate levels of treatment during any power failures.

8.13.2 Chemical Usage

The chemicals used in the treatment plant and their application rates at year 2009, and 2027 can be summarized in the following table

Table 8-11: Anzali WWTP Chemical Consumption Rates

Description	Year 2009	Year 2027
Treatment plant flow (m3/day)	13,560	28,140
Sludge Production (tons dry solids/year)	183	380
Total Poly-electrolyte requirement at 5 kg/tons dry solids (tons/year)	0.9	1.9
Other Chemicals, Ferric Chloride (tons/day)	1.5	3.2

The treatment plant includes all the required safety facilities for handling of chemicals such as safety shower, and emergency extraction fans in the chemical storage room.

For all chemicals to be transported or handled on site, provisions for safety standards are included in the tender specifications. These provisions require:

- The posting of information on specifications of chemicals, method of storage, application, and remediation measures in case of emergency conditions due to contact or exposure.
- Installation of safety showers as required
- Wearing of protective clothing
- Emergency plan for serious conditions.

8.13.3 Manpower

The human resources that are envisaged to run the plant at year 2009 and 2027 shall cover all the operation functions required at the facility, which would include: administrative functions, operations functions, and maintenance functions. Therefore it is anticipated that the following resources be allocated at year 2009 and 2027:

Table 8-12: Anzali WWTP Manpower Requirements

category	**Year 2009**	**year 2027**
Plant Manager	1	1
Secretary	1	1
Accountant	1	1
Operations Manager	1	1
Senior Operations Engineer	1	1
Operations Engineers	1	1
Maintenance manager	1	1
Senior Maintenance Engineer	1	1
Maintenance Engineer	1	1
Chief chemist	1	1
Laboratory technician	1	1
Mechanical foreman	1	1
Electrical Foreman	1	1
Mechanical technicians	3	4
Electrical Technicians	2	3
Labour	4	6
TOTAL	**22**	**26**

8.14 Review of Engineering Aspects

Based on the treatment plant's tender documents, and site visits conducted, a number of shortcomings to the plant have been identified. These are summarized by the following:

<u>Instrumentation for Process Control</u>

A number of instruments are required to improve the plant's monitoring and control system. These instruments are as follows:

1. Influent conductivity meter;
2. Effluent flow meter;
3. NO_3 sensors and meters for nitrification tanks;
4. secondary clarifier sludge blanket detectors;
5. Thickened sludge flow meters; and
6. Density meters for return activated sludge, waste activated sludge, thickened sludge, and dewatered sludge.

8.15 Impact of Effluent Discharge At Disposal Point

As stated earlier in this chapter, the effluent outfall is 1 m wide by 1 m high rectangular channel that abruptly ends and discharges in stagnant body of water. In this case, due to nutrient accumulation at the point of discharge it is anticipated that excessive growth of algae will occur, which will cause eutrophic conditions in that area. Furthermore, the continuous application of effluent in a stagnant body of water will eventually cause oxygen depletion and build up of sediments.

These significant adverse impacts, although local to the point of discharge, can be avoided by extending the outfall main some 50 m to the south of the plant to discharge into Anzali Lagoon.

8.16 Effluent Discharge Impact on Anzali Lagoon

The impact of the Anzali West WWTP treated effluent on Anzali Lagoon is considered in chapter 6.

8.17 Summary of Recommended Additional Works

The following table summarizes the additional recommended works resulting from the post environmental review. Also a preliminary cost estimate is provided for budgeting purposes.

Table 8-13: Cost Estimate of additional Works Required at Rasht and Anzali WWTP

Sr.	Description	Cost US$
Rasht WWTP		
1.	Provision of odour control equipment at the inlet pumping station and sludge dewatering building	400,000
2.	Provision of automatic flow proportional samplers	8,000
3.	Provision of ferric chloride dosing equipment for improving TP control	60,000
4.	Change of routing of outfall main to Pirbazar	80,000
5.	Additional instrumentation for monitoring of all variables	8,000
[1]Total cost for additional works at Rasht WWTP		**458,000**
Anzali West WWTP		
1.	Provision of automatic flow proportional samplers	8,000
2.	Provision of ferric chloride dosing equipment for improving TP control	20,000
3.	Provision of digesters for sludge hauling and drying solution	600,000
4.	Additional instrumentation for monitoring of all variables	25,000
Total cost for additional works at Anzali WWTP		**608,000**

[1] Reduction in cost of Emergency Storage tank is not included in above costing, but in main cost estimate of phase 1 works.

9 Environmental Management Plan

9.1 Objectives of the Environmental Management Plan

The objective of this Environmental Management Plan (EMP) is to address all major environmental issues and provide a framework for the implementation of mitigation measures and Environmental Management and Monitoring Program during design, construction and operation of the proposed Project in the cities of Rasht and Anzali. Institutional arrangements shall be described for proper implementation of mitigation measures while responsibilities for operation, supervision, enforcement, monitoring and reporting shall also be defined. It will further be ensured that all the negative environmental impacts identified in the Environmental Assessment Report are properly mitigated, prevented or minimized to an acceptable level and required actions to achieve this objective are successfully implemented by the concerned institutions/regulatory agencies. The EMP will be carefully coordinated with the design and construction program of the Project to ensure that each relevant mitigating measure is implemented at the most appropriate time and that resources are properly allocated to achieve the desired results.

Baseline Information

In order to properly gauge the performance of the project as a whole and to set the future direction of developments, the situation will be fully monitored and compared with the established baseline. Each issue to be affected by the project has been identified and a program of monitoring has been designed to efficiently establish a datum for future changes. Areas of concern will not only include the quality aspects of water and soil, but also social issues, general public health, and the economic well-being of the community.

Monitoring

It is important to realize that while the collection of data is necessary, the information gained must be useful. There is no advantage in collecting a wide range of data, if a use for it has not been defined. Programmes and procedures for monitoring have been developed taking full consideration of economic and physical restrictions and budget allowances.

9.2 Mitigation Measures

The proposed project is anticipated to have serious environmental impacts if various activities are not properly planned and managed to mitigate the negative impacts during design, construction and operation stages of the project, previously identified and discussed in Chapter 6. The following mitigation and environmental protection measures shall be adopted to eliminate adverse environmental impacts or to reduce them to acceptable levels within the prevalent legislative/regulatory framework.

9.2.1 Design Phase

Environmental protection and management measures can be incorporated during the design stage of various project components. Contract Documents for the execution of the Project shall incorporate the suggested mitigation actions and set out the responsibilities at the design stage.

Change of Land Use

The negative environmental impacts related to the change of land use can be effectively minimized while selecting a site for different permanent structures required for the Project. The project components that will require a change in land use for Rasht and Anzali are pump houses, elevated / ground water reservoirs, sewage lift/ pump stations and wastewater treatment plants (WWTPs). Land has already been acquired for construction of WWTPs for both the cities of Rasht and Anzali. The construction of these permanent structures will result in change of land use. This impact shall be catered for at the design stage by making a suitable provision in the Contract Documents requiring plantation of trees and landscaping in the surrounding areas. In addition, special attention shall be given to architectural design of these structures to give them better aesthetic look and to avoid negative impacts. Contractors shall be contractually obliged to adopt similar measures while establishing their construction camps in close interaction with TSU and Gilan Water and Wastewater Company (GWWC).

Relocation of People

The Design Consultant shall ensure that site selection for project components is done wherever the least/no relocation of people is required. In situation where siting of components requiring relocation of people is unavoidable, TSU should ensure that GWWC provides all affected landowners with full and fair compensation in accordance with Iranian law. It is recommended that a written agreement with the landowners be obtained by GWWC prior to the commencement of any construction work.

Disturbance to the People

The Design Consultant shall select appropriate routes for water supply mains and trunk sewers so that these are laid along routes with minimum disturbance to every day life of the people. Use of tunneling/ thrust boring techniques shall be proposed in the design for the deep sewers crossing busy roads and to avoid excessive open excavations. Roads with right of way limitations shall be very carefully examined at the design stage with regard to ease of construction and practical viability for laying of water supply mains and trunk sewers.

Disruption of existing utilities

Since most of the utilities/services like water supply, drainage, telephone, electricity and gas exist in the project area, the alignment of proposed extension of water supply and laying of new sewer lines will be selected in such a way that it causes minimum damage to existing utility services and lines.

Where relocation of existing utility services is unavoidable, new utility lines shall be laid prior to dismantling the old ones to minimize disturbance to the locality using these services. The existing traditional sewerage system shall be ensured to remain functional up to completion of the proposed collection, treatment and disposal system.

Where it is unavoidable to displace existing services, relocation plans for all the service lines shall be prepared in coordination with relevant Utilities Departments such as telephone, gas, and electricity etc. well in advance of start of construction activities. Provision for these measures shall be made in the Contract Documents.

Disruption of traffic & its Management

For Rasht and Anzali, traffic management plans will be required for all primary and secondary roads in the city. Parallel roads in the city will be utilized as diversion roads. However consideration should be given for the provision to the local residents to have access to blocked roads. Similarly, closure of one side of the road could be considered for four (4) or more lanes roads.

Due consideration shall be given at the design stage of the main lines/ trunk sewers, to select routes that involve minimum traffic load and business activities. Traffic diversion/ re-routing plans shall be made with the help of traffic police at different implementation stages of the Project before starting the construction phase of the Project. In addition, use of tunneling/ thrust boring techniques shall also be helpful in order to minimize disruption of traffic on main roads.

The contractor shall prepare and submit all plans to GWWC, traffic department and Municipality and other relevant authorities for approval prior to construction.

Impacts on Water Bodies

The water bodies in the cities of Rasht and Anzali are Zarjoob and Goharood rivers, Anzali lagoon and groundwater wells. The Design Consultant shall select alternate routes for water supply mains and trunk sewers to avoid any negative impact on surface water bodies arising from construction activities. Where it is unavoidable to cross the existing surface water bodies, detailed design shall be prepared to show crossing arrangements so as to avoid any damage to existing water retaining structures.

Contamination of Water Distribution Network

To ensure protection against contamination of potable water, the following mitigation measures shall be incorporated at the design stage:

- Alignment of water supply and sewer lines will be on the opposite sides on single roads.
- Alignment of water supply pipes will be near the property line with suitable spacing from the sewer on dual roads.
- At junctions where water supply and sewerage are crossing each other, the water supply line will be above the sewerage line.
- No water supply line will cross the manholes.
- Continuous supply of drinking water will be ensured to prevent infiltration of contaminants.
- Continuous chlorination of water supply will be done at the source.
- Preparation of a proper closure plan for the existing traditional sewerage system and connection to the new sewerage system will be ensured.
- Provision of Septic Tanks will be made where connection to the public sewer is not possible and disposal is required through absorption wells on exceptional cases depending upon its feasibility
- Provision of interceptors will be made to avoid ingress of grit/ solid waste's entry into the street sewers.

Odor

The Design shall minimize any undesirable impacts caused by odors during design of the WWTP and associated works by:

- Selecting the treatment alternative with minimum odor problem.
- Designing the WWTP to ensure minimum odors at the site by strategically locating the sludge treatment units with reference to the remainder of the WWTP and the neighboring settlements.
- Making provision for proper odor control units in the design.

Improvement in Rasht and Anzali wastewater treatment plants

An emergency plan should be considered for the discharge of treated effluent in case the effluent does not meet the standards.

Table 9-1 shows the environmental mitigation measures during the design phase.

Table 9.1: Environmental Mitigation Measures during the Design Phase

Potential Impacts	Mitigation Measures	Responsible Organization	
		Performing	QA/QC
Change of land use	• Select Site involving least negative impacts due to change in its use • Make provision in Contract Documents for the plantation of trees and landscaping of the surrounding area • Ensure better aesthetic look by giving attention to architectural design of various structures	TSU/GWWC DC	DOE
Relocation of population	• Select site for permanent structures with no/least relocation of population • Determination of land price in consultation with affected community • Payment of full compensation on basis of prevailing market rates, and in accordance with Iranian law • Written agreement with the land owners before commencement of any construction work	DC TSU GWWC	DOE
Disturbance to the people	• Select appropriate routes for water supply mains and trunk sewers so as these are laid on routes with minimum disturbance to every day life of the people • Use of tunneling/ thrust boring techniques shall be proposed in design where deep crossing of	DC	DOE

Potential Impacts	Mitigation Measures	Responsible Organization	
		Performing	QA/QC
	busy roads is required and to avoid excessive open excavations • Roads with right of way limitations shall be very carefully examined with respect to ease of construction		
Disruption of existing utilities	• The alignment of proposed water supply and sewer lines shall be selected in such a way to cause minimum damage to existing utilities. • Relocation plans for all utilities shall be prepared in close coordination with relevant departments/ agencies such as telephone, gas, electricity etc.	DC/MoRA	DOE
Disruption of traffic	• At design stage select routes for main lines having comparatively less traffic load and business/commercial activities. • Traffic diversion/ rerouting plans shall be made by traffic police according to different implementation stages	DC/MoRA	DOE
Impacts on Water bodies	• Select such routes so as to avoid crossing of surface water bodies • Design capacity of Fehlman water wells should not exceed the safe yield of aquifer. • Effluent from WWTP to be according to the assimilative capacity of receiving water body	DC	DOE
Contamination of water distribution network	• Alignment of water supply pipes near the property line with suitable spacing from sewer on dual carriageways. • Preparation of a proper plan for connection to the piped sewerage system. • Provision of interceptors on all houses and septic tanks at isolated locations where	DC	DOE

Potential Impacts	Mitigation Measures	Responsible Organization	
		Performing	QA/QC
	connection to municipal sewer is not feasible. • Preliminary treatment of industrial wastewater before connection to the municipal sewer		
Odor	• Include odor control equipment for Rasht at wet well and sludge handling facilities. • Design all WWTP to minimize odor emissions; such as ensuring proper velocity in influent channels, proper sludge withdrawal		

9.2.2 Construction Phase

During the construction of the project, particularly the sewerage and water supply network, the potential for causing disruption to public activities is the greatest. Monitoring during this stage will need to be continuous and will cover traffic impacts, noise and dust nuisances, disposal of spoil, and safety. Public liaison would have to be maintained.

The conditions of the contracts will include requirements for the work to be performed as per international specifications. If the contracts are properly prepared and supervised, then disturbance will be minimized. Monitoring of the impacts during construction will be undertaken by the Environment and Safety Officer (ESO) in the Technical Support Unit as part of their contract supervisory duties, and Department of Environment. Dedicated and fully trained personnel will be appointed to carry out this monitoring.

Monthly reports will be submitted to the GWWC on the environmental impacts of construction with recommendations for dealing with any problems including corrective actions that should be taken.

Noise

Noise from construction activities will be mainly from the operation of equipment. All mitigation measures mentioned below will be undertaken in order to minimize the impacts of noise on the community. These measures will include:

- Selection of up to date and well-maintained plant or equipment with reduced noise levels ensured by suitable in built damping techniques or with appropriate muffling devices.
- Providing residents with advance warning of construction activities.
- Confining noisy work to normal working hours in a day, wherever possible.
- Providing the construction workers with suitable hearing protection devices like ear cap, or earmuff and training them on its use.
- Restricting construction vehicles movements during nighttime.

These measures will also be included in the Contract Documents and will be undertaken by the Contractor. The TSU will ensure that these measures are carried out as part of its contract supervision function.

Vibration

Vibration impacts from the construction phase will be mitigated by the following measures:

- The use of modern and well maintained equipment.
- Limiting the use of percussion equipment for the excavation of water supply, sewer trenches and tunnel shafts.
- The use of dead weight rather than vibration compaction plant when compacting trenches close to buildings.
- Providing supports for existing buildings that are likely to be disturbed or damaged; and
- The location of works away from sensitive buildings.

These measures will be included in the contract documents and undertaken by the contractor. The TSU will ensure that they are carried out as part of its contract supervision functions.

As a precaution against excessive compensation claims for damage to property caused by vibration, a program of pre-construction audits will be developed well in advance of the construction program by the TSU's site supervisory staff. This program will involve the detailed inspection of all structures likely to be affected by the project, in order to establish a baseline for defense or the minimization of claims. Particularly susceptible buildings will be carefully surveyed to determine support requirements for the prevention of damage.

Dust

The majority of dust problems caused by the construction of the project will be mitigated by the implementation by the contractor of a few simple procedures:

- Unsealed routes (used for earthmoving equipment and general transport) will be regularly sprayed with water during dry weather.
- Excavation work will be sprayed with water.
- Construction activities causing dust will not be carried out on excessively windy days.
- Stockpiles of excavated material will be covered with tarpaulins or sprayed with water during dry weather.
- Construction workers will be provided with masks for protection against the inhalation of dust and be trained for its use.

These measures will be suitably provided in the Contract Documents and will be undertaken by the Contractor. The TSU will ensure that these are carried out as part of its contract supervision function. **Table 9.2** below provides limits for dust and solid particles.

Table 9.2: Dust and Solid Particle Limits

Source	Standard A gm/Nm^3	Standard B gm/Nm^3	Standard C gm/Nm^3
Stationary plant	0.5	0.4	0.3
Mobile plant	0.7	0.7	0.4

- A mobile plant is defined as a plant that operates for a period not exceeding 24 months and which has a rated production capacity not exceeding 60 tons per hour.
- Standard C is applicable to all new premises or facilities.

Disruption

During the construction phase of the Project, close coordination with departments providing different utility services shall be maintained. Mitigation measures described under the design stage of the Project shall be implemented and monitored in the construction stage. Disruption impacts will be mitigated by the following measures:

- There will be liaison between the TSU and the transport, police, electricity, telephone and water supply authorities at an early stage;
- There will be coordinated planning of traffic diversions by the TSU, police and transport authorities and restrictions in accordance with the construction program, with advance warning to the affected residents and road users;
- The continual services of the police will be used in the diversion and control of traffic;
- The TSU will coordinate the planning and construction of the water supply and sanitation system with the construction of any other planned construction activities, in order to achieve efficiency of progress;
- Under the supervision of the TSU, the contractor will restrict the length of open trenches and the amount of materials stored adjacent to the excavation works to that necessary for construction.

Community Relations

Before start of construction activities in a residential area, the TSU in coordination with GWWC will inform residents of the area about details of the work, likely disturbances and duration, and to whom they should address their complaints. Although these disruptions will have short-term impacts, they may become severe in nature if not addressed properly.

By providing advance publicity on the work program and through the establishment of liaison arrangements between members of the public, contractors and the project team, any adverse public reaction to project nuisance can be minimized. A procedure will be established to enable the public to complain about excessive nuisance, disruption or disturbance due to the Project. The public should be able to do so via both the Public Relations Unit of GWWC and the DOE-Gilan.

By establishing good community relationship, any disruption experienced by the community shall quickly become apparent and consequently be resolved with due consideration to the community's needs.

Air Pollution

Apart from dust, some gaseous emissions are also envisaged as a result of use of vehicles, machinery etc. during construction activities. The following mitigation measures shall be taken into account in order to combat this problem:

- All vehicles, machinery, equipment and generators used during construction activities shall be in good condition and shall be properly tuned and maintained in good working conditions in order to minimize exhaust emission.

- Open burning of solid waste from Contractor's camps shall be strictly banned.

Water Pollution

Construction activities can generate runoff, which would end in surface water bodies or in underground water. The latter is likely to occur due to dewatering operations because of the high water table. Negative impacts on the surface and groundwater bodies shall be minimized by adopting the following measures:

- The Contractor shall ensure proper control of fuel and oil spillage.
- Untreated effluents from Contractor's campsite shall not be allowed to be directly disposed off into water bodies.
- Unauthorized bore wells shall not be allowed.
- Waste solvents, petroleum products, toxic chemicals or harmful solutions shall not be disposed in the city's drainage system watercourse, or the rivers. Solid waste refuse shall be disposed off at landfill or at other approved designated areas. Construction sites shall be maintained in a sanitary condition at all times; rubbish, surplus spills, and litter shall be disposed off in a controlled and prompt manner.
- Septage recovered from percolation pits shall not be disposed to natural water bodies or overland in uncontrolled manner. Septage shall be hauled by special trucks having vacuum pumping system and leak proof tanks. The trucks shall dispose the septage at a septage receiving facility at the central WWTP, whereby the septage shall be introduced in a controlled manner to the liquid treatment system for co-treatment with raw sewage collected by the network.
- The Contractor shall dispose of all fluids and test pumping discharges in a manner that does not cause contamination or nuisance. He shall also be responsible to control all run-offs, erosion, etc. Water pumped from the construction site should be disposed of in an appropriate manner so as not cause nuisance or flooding to surrounding properties.
- Works affecting surface water channels shall allow for the continuous supply of water to existing users. The Contractor shall take all reasonable measures to maintain outflow and to avoid discoloration.
- Where a temporary reduction in downstream flow or discoloration by suspended solids from excavation works is in the opinion of GWWC unavoidable, the Contractor shall make alternative arrangements for supplying water to all affected users throughout the period of flow reduction or discoloration.

- Where dewatering of trenches is to occur, care should be taken to ensure that bank collapses do not occur so as to safeguard workers, the public, and to prevent structural damage to properties.

Accidents and Emergency Cases

Potential accidents during construction can be mitigated by adopting the following measures:

- The Contractor will ensure that construction employees are trained in safety procedures for all relevant aspects of construction.
- The TSU in coordination with GWWC will make regular checks that the Contractor is following safe practices.
- In order to ensure that all work is carried out safely, every team employed by the contractor will be headed by a fully trained supervisor with easy access to emergency services. In addition, an appropriate number of site personnel will be trained in First Aid.
- On all construction sites, first aid facilities will be provided in an accessible location. The tender documents will include this provision, which will be implemented by the Contractor. The TSU will make regular checks on all sites to verify this provision.
- In order to ensure that all work is carried out safely, the contractor should have the proper staff fully trained to handle emergencies. Formal emergency procedures will be developed for each construction site in the event of an accident.
- The Contractor will ensure that the public is aware of the site of construction works. The safety of the public at all stages of the construction will be ensured by appropriate public education and safety measures such as use of barriers, warning tape, and flags etc.
- Public access to the construction sites will be restricted. For this purpose, the sites will be fenced where possible. Security guards will prevent unauthorized entry to these sites.

These measures will be included in contract documents, and as such will be the responsibility of the contractor. The TSU will ensure that these activities are undertaken as part of their supervisory function.

Traffic and Accessibility

Many activities such as digging, excavating, pipe laying, and transportation of primary materials, cause traffic disruption, and some severance of pedestrian movement (particularly on footpaths) may limit access to shops, businesses, factories, etc. The following measures will mitigate such potentially disruptive impacts:

- The closure or partial closure of roads, walkways and other public areas will only be permitted if approved by the relevant authorities and the closure permit has been issued. The Contractor shall detail for each closure the extent of area to be closed, the reasons and duration of the closure, and, where appropriate, proposed diversion route. The Contractor shall exhibit the Closure Permit for inspection by GWWC if requested. The GWWC shall have the right to order suspension of the relevant works if the Contractor does not produce a Closure Permit.
- There will be coordinated planning of traffic diversions by the TSU, GWWC, police and the transport authorities. Restrictions on construction traffic will be in accordance with the construction program with advance warnings to the affected residents and road users.
- The contractor will provide a comprehensive program well in advance for his proposed transportation activities, type of vehicles to be used and number of trips. The timing of vehicles shall be fully coordinated with the concerned traffic departments.
- A plan should be submitted by the contractor to the executive authorities for approval, prior to commencement of the Project. This plan will include the following:
    - Required additional traffic control measures e.g. installation of temporary traffic or warning lights
    - Location of proposed contractor's camps, entry and access points to the camp and points to access primary road network
    - Traffic sign proposals where required
    - Time required to use the proposed access points
- The approved access routes should be defined in a plan as well as on the ground with the outlines as follows:
    - Vehicle type to be used on the route
    - Time of use of the route

- Speed limit
- Parking, loading and unloading locations/ areas.

- On the construction site, proper signs will be installed showing clearly the approved roads. All drivers will be trained on the use of traffic plan and will be advised on the implications of ignoring the plan.
- Continual services of the police will be used in the diversion and control of traffic.
- There will be liaison between the TSU, GWWC, transport authorities and police at the early stages of the Project.
- Transportation of materials to and from construction sites will not be scheduled during peak commuting hours, whenever possible. In the case where abnormal loads are to be transported, during construction, they should be transported during the early hours of the morning. Appropriate times of transportation would be from mid night to at least 2 hours before the normal city traffic timings in the morning.

Soil

Activities such as excavation, landscaping, demolition, temporary storage of materials and the clearing of the sites for the treatment plants can cause soil instability and erosion problems or soil contamination. The following measures will be taken by the contractor to mitigate the potentially negative impacts of construction activities on soil quality:

- The length of the excavated trenches should be controlled to some limits and gradually filled as the pipes are laid and tested. The soil disturbed during excavation will be stabilized using compaction techniques.
- Care will be taken along the excavated trenches for sewage lines during rainy days when water enters into empty spaces between soils and reduces friction between them, increasing fear of soil sliding.
- Contaminated soil should be removed from the construction site to proper landfill centers and not used as fill or cover at the construction sites.
- Vegetation clearance will be kept to a minimum at wastewater treatment sites.
- Trees and plants will be planted at WWTP sites.
- Soil transport will be kept to a minimum.
- All excavated sites should be carefully restored after completion of construction activities.

The TSU will regularly check the implementation of these measures.

Seismic Activity

The potential impacts due to seismic activities are discussed in chapter four. The destructive effects of earthquakes can be avoided at the planning phase and construction phase of the project.

During the design phase, all structures, pipe work, and other works that are subject to damage as a result of an earthquake, shall be designed to the Iranian seismic design code and other complementary international design codes. All tender documents for the design and construction works shall include this provision. Tender specifications shall include QA/QC procedures for implementation during design and construction of all works in compliance with applicable seismic codes.

During construction phase, the Contractor shall comply with provisions of the design specifications and the code requirements. All structures and piping shall be constructed in strict adherence with Iranian code and the tender and design specifications. The TSU will implement an extensive inspection procedure to verify the compliance.

Solid Waste Disposal

Solid waste generated during construction consists mainly of demolition and building rubble, chemicals and road building material, containers and packaging for building materials as well as refuse material from site offices.

All solid wastes shall be temporarily stored at designated locations on the construction sites. Appropriate sealed containers shall be used for storage whenever this is required. Solid waste materials shall be covered during transportation to the disposal facility. The disposal facility shall be approved by TSU prior to any disposal.

Domestic and biodegradable waste shall be removed daily from the Site. Toxic and hazardous wastes shall be collected separately and be disposed of in accordance with current regulations.

Recyclable materials such as oils and metals will be collected and delivered to an appropriate sorting facility. The TSU will specify the location of this facility in the tender documents.

Comprehensive procedures will be included in the construction tender documents to ensure that safe and environmentally sound practices are followed by the contractor. The ESO will supervise the contractors' activities.

TSU will prepare a detailed plan to manage waste and soil spoil. The plan will include procedures of recording, reporting and interpretation of data in details. DOE will supervise the implementation of the plan.

Spoil Material

The amount of spoil generated in Rasht and Anzali will be about 3,102,750 m^3 and 974,925 m^3 respectively. This material will have to be disposed of in an environmentally acceptable manner as described in spoil management plan.

General Housekeeping:

- The Contractor shall maintain the Site and any ancillary areas used and occupied for performance of the Works in a clean, tidy and rubbish-free condition at all times.
- Upon the issuance of any Taking-Over Certificate, the Contractor shall clear away and remove from the Site the Contractors' Equipment, surplus material, rubbish and temporary works of any kind, and shall leave the Site in a clean condition to the satisfaction of GWWC.

Visual Amenity

Activities such as excavation, pipe laying, storage of construction materials and debris, workshops, and general activities on construction sites can cause a significant visual impact. To mitigate potential impacts, the following measures will be followed:

- Fences of workshops and construction facilities shall be built with appropriate materials that blend with the surrounding environment;
- Immediately removing waste and construction debris and soil wastes from the works site.
- Planting suitable trees and plants during the construction phase at the treatment plants sites, water tanks and where appropriate within a 500 m buffer distance of those sites to create a green belt. This will not only obscure construction activities but will also be a permanent landscape feature that will add visual aesthetic value to the facility.

These measures will be included in the contract documents and as such will be the responsibility of the contractor. The TSU will ensure these activities are undertaken as part of their supervisory function.

Archeology and Chance Finds

The implementation of the water and sanitation project will not require the demolition of any known historical sites, nor will it affect any known archeological sites. During final design stages, further site inspections will be conducted by surveyors and archeologist to check the construction drawings in the field.

Furthermore, pre-tender conferences will be held to brief pr-qualified contractors on the effective implementation of mitigation measures. The contractors will be briefed on (i) chance find procedures, (ii) special procedures to be adopted in the vicinity of sites defined as requiring protection, (iii) penalties for non-compliance, and (iv) coordination with concerned authorities.

During the construction phase, the following mitigation measures shall be implemented:

- An archaeologist should always be present in the areas of archeological significance throughout the construction period for delicate observation.
- A group of competent archaeologists in collaboration with the Cultural Heritage Organization should be ready at all times for rescue excavations, so as not to delay the construction process and to save and take control over all archeological findings
- Any finding should be directly reported by the supervisor (Archeologist-Forman to the responsible official authorities or the Cultural Heritage Organization
- Construction work should be performed with suitable equipment. Use of explosives should be prohibited. Moreover, excavation should be monitored especially in delicate areas.
- To avoid extensive delays in an area with a high archeological findings potential, it is highly recommended to perform several sounding (1m x 2m to the needed depth) supervised by an experienced archeologist enabling clearer perspectives of the archeological sites.
- If an archeological site or irremovable remains is discovered, project activities should be suspended and possible adjustments to the project design discussed and implemented in order to prevent any loss of archeological and cultural remains.

The following "chance finding procedures" were developed in coordination with the official representative of the Cultural Heritage Organization and in compliance with the Iranian regulations, and the World Bank Operational Policy on Cultural Property. The procedures should be included as standard provisions in construction contracts to ensure the protection of cultural heritages. In any chance find, the procedures should be directly executed. Chance find includes new archeological remains, antiquity or any other object of cultural or archeological importance, which is encountered during the project construction:

1. Stop construction activities
2. Delineate the discovered site or area

3. Secure the site to prevent any damage or loss of removable objects. In case of removable antiquities or sensitive remains, a night guard should be present until the responsible authorities take over
4. Notify responsible foreman/archeologist, who in turn should notify the responsible authorities, the Cultural Heritage Organization and the local authorities immediately (less than 24 hours)
5. Responsible authorities will be in charge of protecting and preserving the site before deciding on the proper procedures to be carried out. This would require an evaluation of the finding, which should be performed by the Cultural Heritage Organization. The significance and importance of the findings should be assessed according to various criteria relevant to cultural heritage; those include the aesthetic, historic, scientific or research, social and economic values.
6. Decision on how to handle the finding should be reached, that could include changes in the project layout) such as when finding and irremovable remain of cultural or archeological importance), conservation, preservation, restoration, or salvage.
7. Implementation of the authority decision concerning the management of the finding.
8. Construction work should resume only when permission is given from the Cultural Heritage Organization after the decision concerning the safeguard of the heritage is fully executed.

The environmental mitigation measures discussed in the preceding sections are summarized in table 9.3.

Table 9.3: Environmental Mitigation Measures during the Construction Phase

Potential Impacts	Mitigation Measures	Responsible Organization	
		Performing	QA/QC
Noise generation	• Selection of up to date, well maintained plant with reduced noise levels ensured by suitable in built damping techniques. • Confining noisy work to normal working hours in the day. • Providing the construction workers with suitable hearing protection and training them in its use. • Restricting construction traffic movements during the night time.	DC/TSU	DOE
Generation of dust	• Construction activities causing dust will not be carried out on excessively windy days. • Excavation work will be sprayed with water • Cover stockpiles of excavated material with tarpaulins • Provide construction workers with masks and train them for their use	CC	DOE
Traffic congestion	• Advance warnings to the affected residents and road users • Advance programme for proposed transportation activities, type of vehicles and number of trips. • Continual services of the police for the diversion and control of traffic	MoRA CC	DOE
Damage to access roads and streets	Site access roads will be inspected regularly and repairs made where necessary; All roads and streets used for laying pipes will be covered and paved.	CC	DOE

Potential Impacts	**Mitigation Measures**	**Responsible Organization**	
		Performing	**QA/QC**
Water pollution	• Ensure proper control on fuel and oil spillage. • Unauthorized bore wells shall not be allowed • Untreated effluents shall not be allowed to be directly disposed of in water bodies • Septage shall be hauled in a controlled manner and disposed in a septage receiving facility to be treated at the WWTP	CC RWB DoEG	DOE
Public safety and site security	• Construction employees shall be trained in safety procedures for all relevant aspects of construction • Training of appropriate number of site personnel in first aid • Development of formal emergency procedures for each construction site required in the event of an accident • Appropriate public education regarding health and safety • To adopt safety measures like flags, warning tapes and barriers	TSU/GWWC CC	DOE
Air pollution	• Wastes are not to be burnt on site • Construction machinery, vehicles and generators to minimize exhaust emissions by properly maintaining and tuning them.	CC	DOE
Generation of wastes and spoil disposal	• Minimize wastes generated during construction and reuse construction wastes where practicable; • Use appropriate methods for the storage of waste materials; • Dispose of wastes to an appropriate site. • Transporting spoil in closed containers	CC/TSU	DOE

Potential Impacts	Mitigation Measures	Responsible Organization	
		Performing	QA/QC
	• The spoil material should be filled in layers and properly rolled and sprinkled to avoid any negative environmental impacts.		

CC	Construction Contractor
DC	Design Consultants
DoEG	Department of Environment Gilan
JEK	Jihad-e-Keshavarzi
MoRA	Municipalities of Rasht and Anzali
GWWC	Gilan Water and Wastewater Company
TSU	Technical Support Unit
RWB	Regional Water Board
WWTP	Wastewater Treatment Plant

9.2.3 Operation Phase

During the operation of the project, different mitigation measures for each project component will be required on an on-going basis. A Committee will be formed by the GWWC, comprising of its staff who have experience with water testing laboratories and the environment. This Committee will check regularly on the water supply state. The operation mitigation measures are outlined below.

9.2.3.1 Water Project

Responsibility for undertaking mitigation measures during the operation will reside with the water facilities operator under the supervision of the GWWC.

Seismic Activity

Critical mitigation measures are undertaken during the design and construction phase. The Safety and Environment officer will provide the needed procedures, as discussed in the next paragraph, to face the accidents in water facilities in case of an earthquake. Furthermore, monitoring of earthquake occurrence and intensity will be conducted by the TSU, the WTO and WWTO by reviewing the data acquired at the earthquake monitoring station at Sangar Dam and other close centers for evaluation of the resulting impacts.

Incidents and Emergency Cases

Incidents during operation can involve accidental toxic gas emissions, pipe bursts, tank leakages, occupational hazards, all of which can lead to serious health risks if not addressed and dealt with in an appropriate manner.

To ensure incidents and emergency cases are dealt with efficiently, the following mitigation measures will be implemented:

- GWWC will organize and mobilize rescue teams to respond to emergency incidents in a timely and effective manner. Communication with the rescue team must be reliable, manageable and available at all times. The rescue teams should be located in close proximity to the water chlorination and storage facilities and be able to attend the sites of an incident within the City in the shortest possible time period.
- Well equipped rescue teams with appropriate equipment will undertake periodic inspections of the systems so as to troubleshoot defects before an incident occurs.
- Training of professional staff in the fields of health and safety will take place before they commence work or operations. This would minimize the effects of health and safety incidents.
- Public accessibility to the water supply facilities should be restricted. For this purpose, water supply facilities especially storage reservoirs will be under the supervision of GWWC guards.
- Both the operator and GWWC shall ensure that training in basic operational procedures is fulfilled by the concerned staff. Training will be conducted on an on-going basis so as to ensure that staff is aware of best practice procedures, of changes to technology, and of emergency procedures that may occur throughout the lifetime of the project.
- To assure proper safety procedures are followed, any subcontractor of the operator or GWWC should be supervised by a well-trained supervisor who is knowledgeable of and have easy access to emergency services and rescue teams.
- All staff shall be provided with basic training in first aid procedures. The operator will appoint a health and Safety Officer who will have in depth knowledge of first aid procedures.
- Formal procedures on how to respond to emergency cases for facilities should be prepared in the case of incidents. Summaries of these procedures should be displayed in key locations and near telephones so that immediate actions are targeted for obtaining correct assistance in a timely manner. Co-ordination with fire services and hospital services should take place so that the information is kept up to date.
- A formal emergency preparedness plan against earthquakes should be prepared in consultation with the MOHME, the Iranian Civil Defense and other concerned relief agencies. This plan should address the emergency response procedures to be followed by the water system operators and officials of GWWC in case of an

earthquake. The plan shall detail the procedures before, during, and after the earthquake, and shall elaborate on preparedness measures such as availability of survival kits, fire extinguishers, securing of heavy items, power shutdown and gas isolation, safety measures, response of individuals, communications with other colleagues and relief centers, and routine drills for emergency situations. All the treatment plant staff shall be provided with a one day training workshop in earthquake emergency preparedness procedures.

- GWWC will assure that all operation and maintenance staff at the water supply facilities are well informed of the risks in operating the system and machinery. All staff must be trained in avoiding contamination of hygienic areas inside and outside the facilities. Training is also vital to ensure that contamination of water does not take place. All staff will be vaccinated by health officials to protect them against infectious diseases.
- Emergency procedures, especially for accidents involving emissions of chlorine gas will be provided to the operator staff and be presented on the displayed emergency procedures cards. A chlorine gas warning device will be provided wherever chlorine gas is used, chlorine storage rooms shall be equipped with automatic exhaust ventilators discharging gas in a suitable location, emergency showers shall be installed outside rooms for emergency wash.

Water Quantity

The provision of adequate water supply quantities is one of the main objectives of the project. To this end, adequate water supply quantities have been addressed at the planning level, wherein the water supply components to be developed under the project will meet the water demand up to the year 2027. In fact the feasibility study projects that the water supply from well and surface water sources will exceed the demand by 1,700 m^3/day at year 2027. Furthermore, the water supply facilities will include adequate storage facilities that are capable of meeting seasonal, daily, and peak hourly demand. The supply network will be sized to provide the peak hourly rate required by various consumers.

Mitigation measures during the operational phase will include:

- Responding to emergency leakage situations through an established procedure as discussed in the previous section.
- Reducing unaccounted for losses through a comprehensive monitoring plan, that will be discussed in the proceeding section. These monitoring programs will prohibit illegal connections to the water supply network and prevent system leakages.

- The operator of the treatment plant, chlorination, and pumping facilities will adhere to the O&M maintenance procedures and manuals, and will conduct regular maintenance and monitoring to ensure that adequate output is maintained from these facilities. The TSU will check the plant's records and verify that proper O&M operations are being undertaken

In all instances, GWWC will establish an emergency response program to address citizens' complaints in the shortest possible time. These complaints shall be attended, and appropriate mitigation actions will be taken to restore water quantity. A report will be generated to document such incidents, and will be forwarded to GWWC management for review and evaluation of future required action.

Water Quality

The provision of safe and compliant water supply quality is one of the main objectives of the project. To this end, the water quality of available resources (well and surface resources) have been evaluated and were found to be in compliance with WHO and Iranian drinking water quality standards after appropriate treatment.

The surface water treatment process will ensure the elimination of bacteriological contamination, and the removal of turbidity and ground water will be chlorinated to eliminate any microbial concentration. During project implementation, a continuous monitoring program will be implemented at the treatment plant, water reservoir, and supply network to ensure that treated water will always meet the required standards. The monitoring program, discussed in the proceeding sections, will cover biological and physical parameters as well as heavy metals and pesticides residues.

Furthermore proper operation and maintenance of the treatment and chlorination facilities will be performed as discussed in the previous paragraph. Routine inspections of the network will be required to ensure that no cross contamination by a broken sewer line is taking place.

Table 9.4 below provides a summary of the required mitigation measures.

Table 9.4: Environmental Mitigation Measures during the Operation Phase of Water Supply System

Potential Impacts	Mitigation Measures	Responsible Organization	
		Performing	QA/QC
Degradation of water quality	▪ Ensure proper operation and maintenance of the water treatment plant. ▪ Continuous monitoring of raw water and treated water as well as water quality at various locations within the water supply system; avoid cross contamination with sewage; ▪ Chlorination should be monitored and controlled so that contaminant free water is available to consumers without excessive amount of chlorine.	GWWC	DOE
Reduction in available water supply	▪ Provide metered connections ▪ Prohibit illegal connections to the network; avoid leakage in the network; ensure proper maintenance of the system including treatment plant, pumping stations, pipelines and house connections.	GWWC	DOE
Health and Safety	▪ Maintain hygiene and have medical surveillance; maintain showers and sanitary facilities; provide first aid and have an emergency response plan. ▪ Capacity building and training in occupational health, safety and earthquake emergency preparedness procedures and in operation and maintenance of treatment plants.	GWWC	DOE

9.2.3.2 Wastewater Project

Mitigation measures outlined within this plan will be the responsibility of the operators of the wastewater installations. GWWC will supervise the appropriate implementation of these mitigation measures. Key measures to include:

Seismic Activity

Critical mitigation measures are undertaken during the construction phase. The Safety and Environment Officer should provide the needed emergency preparedness procedures to face the accidents in wastewater facilities in case of an earthquake, as discussed in section 9.2.3.1 Also the wastewater treatment plant staff should attend a one day training workshop on the implementation of these procedures.

Noise

Noise impacts during the operation of the Project will be confined to the use of few equipments in the wastewater treatment plant. These are expected to be:

- Compressors
- Pumps
- Stand-by Generators

There will also be some noise from the movement of vehicles. By specifying appropriate silencers on the equipment and screening the noisier areas of the WWTP with structures, there will be significant relief for farmers working around the site of WWTP sites of Rasht and Anzali. Traffic will be routed to keep this nuisance to a minimum. Impacts on the WWTP employees will be further reduced as they will be provided with hearing protection equipment by GWWC and trained on its use. In addition, all plant equipment will be well maintained to maintain their efficiency and noise levels.

A formal maintenance program will be established by the wastewater treatment plant operator (WWTO) on the WWTP site and elsewhere where plant is located. Noise levels will be regularly monitored within this program and any defective equipment will be promptly dispatched for maintenance by WWTO.

It is recommended that land use within 300 meters of the WWTPs be formally allocated as a green/agricultural area. This will restrict the development of housing towards the site and consequently avoid complaints regarding noise in the short or long term.

Odor

The WWTO will have a regular check to minimize any problems caused by odors during operation of the WWTP, pumping stations, and associated works by:

- Install odor removal equipment at Rasht WWTP at the inlet works and at the sludge handling area. Maintain odor removal equipment in good operating condition and monitor treatment efficiency of odor control equipment
- Allocate necessary funds, and make space, power, and mechanical connection

provision for installation of odor removal equipment at the five sensitive locations in Rasht and six sensitive locations in Anzali. Following a short period of operation install odour removal equipment for these sites as necessary.

- Careful planning and implementation of the WWTP operation and maintenance to prevent the formation and liberation of odors.
- Providing covers to containers and equipment likely to cause an odor nuisance and scrubbing of mal-odorous vapors.
- Designating the area around the site as a green belt, thus restricting future development towards the site.

Septage Handling

As discussed for the mitigation measures during construction phase, septage disposal prior to connection of all percolation pit owners, shall be hauled in trucks with leak proof tanks. The trucks shall dispose their contents in a septage handling facility at the central WWTP for treatment with domestic sewage collected from the network.

Screenings Disposal

The screenings from the treatment plants will be disposed of by the WWTO in an environmentally acceptable manner by transporting in enclosed containers and burying in a municipal landfill. Disposal in the landfill has been designed to ensure that groundwater or surface runoff from the site will not be contaminated.

Treated Effluents

In order to assess the performance of Rasht and Anzali wastewater treatment plants and the compliance with the required standards, raw sewage arriving at the WWTP and the final effluent will be regularly monitored by the GWWC for BOD_5, suspended solids, total nitrogen, fecal coliforms, and intestinal nematode eggs to ensure disposal of treated water in the river and Anzali lagoon respectively, without causing negative impacts on receiving soil or water body. Spot samples should be taken once a day so that the operators can respond to any irregularities. The impacts on aquatic life shall also be monitored by DoEG.

The WWTO will also monitor particular units within the treatment works such as the primary sedimentation tanks and aeration tanks to assess their performance. Knowledge of the concentration of mixed liquor suspended solids within the aeration tanks and the settleability of the activated sludge will allow optimization of operation.

The quality of the treated effluent will be carefully controlled at the WWTP to the required limits, through efficient and up to date methods, using accurate analytical procedures. All discrepancies detected will be immediately notified to those concerned, and the problem promptly dealt with at source. A suitable response system will be developed at the WWTP, in the event that problems develop, and all relevant staff will be fully trained in the corrective measures to be taken.

Particular attention will be paid by the WWTO to review the performance of WWTP in removing nitrogen and phosphorus. If the effluent quality data shows that the total nitrogen and total phosphorus concentrations are non-compliant with required standards of the project, then the WWTO will review the treatment process and operations to ensure compliance with the Iranian guidelines for discharge to surface waters. The ESO will supervise all these monitoring operations to ensure that the operator is conducting all the required checks, and that samples are being tested to the correct standard procedures.

Provision will be made for the diversion of non-complying WWTP discharges to the emergency storage tank, thereby preventing its discharge into the river. The stored non-compliant effluent will be re-treated, and once it meets the required standards it will be discharged to the River. Discharges into the final outfall canal leading to the river will take place in accordance with established procedures which will take account of physical and chemical effects on the river having regard to the particular hydraulic and environmental circumstances prevailing at the time.

Sludge Application as a Fertilizer

The reuse of sludge in agricultural applications entails potential adverse impacts due to microbial presence, and heavy metal content. These parameters can cause serious health effects on farmers, agricultural consumers, and the environment through soil contamination, build up in crops, and ground water contamination. The following mitigation measures will be implemented:

- For the use of treated sludge as soil conditioner, compliance with the European Union (EU), Food and Agriculture Organization (FAO), and WHO Guidelines (including the limit of less than 1 intestinal nematode egg per 100 gms of dry solids) will be ensured by providing adequate treatment including a drying period of one year. Sludge drying beds are already incorporated in the design of the treatment facility, and the WWTO will be responsible for application of sludge onto the beds for drying, under the supervision of the ESO.
- Treated sludge disposed of to agricultural land for use as a fertilizer will be monitored for compliance with the standards for metals in sludge and application rates described in the 1986 EC directive on the use of sewage sludge in agriculture (cadmium, chromium, copper, nickel, lead, mercy and zinc). Several spot samples will be taken from each batch of stored sludge taken to the agricultural lands near

the WWTP. It will also be necessary to measure sludge moisture content to calculate the above. These figures and sludge application rates will allow estimation of future compliance with limit values for accumulated metals in soils. In the instance that the treated sludge is not compliant with the applicable regulations, it will be hauled and disposed to the nearest landfill to the sludge drying beds at designated separate cells having clear signage to indicate the cell's content. In a similar manner the sludge from the water treatment plant operations will also be disposed off in separate cells at the landfill.

- Soil in areas where effluent or sludge is used in agriculture will be monitored for the above metals to ensure compliance with the 1986 EC directive on the use of sewage sludge in agriculture. Concentrations will be measured before any application takes place (baseline) and after each year of application, so each area will be monitored every 2.5 years. It will also be necessary to measure soil pH. Ministry of Agriculture Jihad will monitor soil quality and the crops of the lands fertilized by sludge. DOE will be responsible for QA/QC.
- Sludge shall be transported by trucks in closed containers. Truck drivers should be well trained and be aware of the health risks of sludge transportation. The operator of the wastewater treatment plants will be responsible for their training under the supervision of ESO (Environment and Safety Officer).
- Prior to any sludge application program, farmers will be trained in appropriate procedures for sludge application, crops that can be cultivated in sludge conditioned land, application rates, and health and safety matters. Ministry of Agriculture Jihad will be responsible for farmers' training.
- DOE will monitor groundwater to assess the effect of sludge application on groundwater quality.
- Heavy metals content of industrial discharges to sewers will accumulate in sludge. Therefore wastewaters with heavy metals content will have to be pretreated to meet the DOE industrial discharges criteria. The project will only provide connections to those industries that do not discharge toxics that affect the performance of the wastewater treatment plants. The discharge of industrial effluents will be subject to the approval of both the Director of the treatment plant and the director of the DOE. For those industries for which their industrial effluents will not be pre-treated, and/or will not be connected to the network, the GWWC and DOE will require that each polluting industrial establishment will prepare a compliance action plan (CAP), which will address the pollutants of concern, the type of pre-treatment required and the investments and monitoring costs of the pre-treatment facility. Operational permits for these industries will be subject to the implementation of the CAP as yearly monitored by the GWWC and enforced by the DOE.

- TSU and Ministry of Agriculture Jihad will prepare a detailed sludge management plan. The effects of regular application of sludge and its accumulation in soil will be fully considered in the plan. Also, the plan will include procedures for recording, reporting and interpretation of data in detail.

Health and Safety of the Employees

The following mitigation measures will be undertaken to safeguard public health due to the operation of the wastewater system:

- The concerned officials of the WWTP (a Committee in GWWC) will ensure that operation and maintenance personnel of the WWTP are fully aware of the hazards involved in the running of a system of this nature.
- All site employees will be trained in hygienic procedures designed to avoid infection from wastewater and sludge.
- Workers will be educated about the dangers of leptospirosis and provided with documentation to alert medical practitioners about the possibility of such an infection during diagnosis.
- Workers will also be inoculated against infectious diseases such as polio and tetanus, and kept under medical surveillance.
- Formal emergency procedures will be developed by the concerned officials of GWWC in collaboration with WWTP authorities for dealing with accidents. These procedures will involve coordination of emergency services such as the fire brigade and health services.
- Public health and safety will be specially taken care of while preparing these procedures

Increase in per Capita Water Consumption

With increase in level of service and continuous availability of potable water, there shall be tendency of increase in the per capita water consumption resulting in additional need for drinking water, which may exceed the projected demands. The following measures are recommended to mitigate this impact:

- Continue providing metered connections in Rasht and Anzali.
- Higher billing rates for consumers with more water consumption.
- Educate people about water use (water literacy).

Additional Loads on Treatment Facilities

As a result of increase in per capita water consumption, there will be more sewage generation from the area, which may entail serious environmental impacts, thereby reducing the efficiency of the proposed WWTP. Therefore, in addition to adopting water conservation strategies, the design of WWTP should be made flexible enough to take additional loads.

Table 9.5 provides a summary of the mitigation measures during the operation phase of the wastewater system.

Table 9.5: Environmental Mitigation Measures during the Operation Phase of Wastewater System

Potential Impacts	Mitigation Measures	Responsible Organization	
		Performing	QA/QC
Health and environmental risks associated with discharge of treated effluent	• Regular monitoring of effluent quality discharging from the WWTP • Untreated effluents shall be treated before disposing off into river • Aquatic life shall be monitored regularly • Dispose of wastewater into rivers after proper treatment	GWWC/DoEG	DOE
Sludge quality and the risk of public and farmers acquiring infection	• Drying beds for one-year storage will be provided to dry and store sludge following de-watering and digestion. • Monitoring of nematodes, coliforms and heavy metal content of treated sludge. • Transportation of treated sludge in closed containers. • Capacity building, training and awareness.	GWWC	DOE
Odor generation from the wastewater treatment plant	• Careful planning and implementation of operation and maintenance. • Providing covers to equipments and containers that are likely to cause odor nuisance. • Providing odor control equipment at Rasht WWTP • Providing allowance for installation of odor control equipment at sensitive locations for pumping stations	GWWC	DOE
Health and environmental risks associated with disposal of septage	Septage shall be hauled in a controlled manner and disposed in a septage receiving facility to be treated at the WWTP	GWWC	DOE

Potential Impacts	Mitigation Measures	Responsible Organization	
		Performing	QA/QC
Health and Safety	• Train the concerned officials of the WWTP about health and safety procedures. • Ensure that operation and maintenance personnel of the WWTP are fully aware of the hazards involved in the running of a system of this nature. • All site employees will be trained in hygienic procedures designed to avoid infection from wastewaters and sludge. • Emergency procedures will be developed in the event of the release of chlorine gas. • Workers will also be inoculated against infectious diseases and be under medical surveillance	GWWC	DOE

9.3 Monitoring Program

To ensure the performance, efficiency, and effectiveness of environmental mitigation measures programs, it is necessary that these activities be monitored. Monitoring programs will be necessary for noise, air quality, and dust during the construction phase. During the operation effluent, sludge, noise, and odor will be required to be monitored by the Environment and Safety Officer within GWWC. Water quality monitoring in Zarjoob, Goharood rivers and Anzali lagoon will include data on BOD, suspended solids, pH, phosphates, nitrates, salinity, and heavy metals, and will be conducted by the DOE. Quality Control and Quality Assurance (QC/QA) of the monitoring program at the construction and operation phases of wastewater system are the responsibility of Department of Environment (DOE). Quality Control and Quality Assurance (QC/QA) of drinking water is the responsibility of Ministry of Health and Medical Education.

The Technical Support Unit is to provide an executive environmental program with complete details of mitigation measures; so that all those with environmental monitoring responsibilities are clear on their role, the frequency of their inputs and lines of reporting.

If significant adverse impacts by any responsible organizations are identified, appropriate mitigation measures will be taken and arrangements for amendments of the environmental management plan will be made. The Ministry of Energy will have the overall responsibility to ensure that adverse impacts are maintained to acceptable levels and corrective actions are taken when required.

A project monitoring report will be prepared on the effectiveness of the EMP once every 6 months and will be sent to the World Bank after review and approval of DOE.

The executive monitoring program for the various phases of the project including monitoring parameters, location, frequency, and the responsible organization are listed in Tables 9-6 through 9-10.

9.3.1 Construction Phase

Table 9-6: Environmental Monitoring Program for the Construction Phase

Environmental Parameter to be monitored	Monitoring Location	Frequency	Standard	Responsible Organization	
				Performing	QA/QC
Noise	At construction Sites and Surroundings	Weekly	70 dB (A)	Supervision Engineer monitored by ESO	DOE
Air Quality and Dust	At construction Sites and Surroundings	Weekly	150 µg/m^3	Supervision Engineer monitored by ESO	DOE

9.3.2 Operation Phase

9.3.2.1 Water Supply System

The quality of the fresh water and water in the distribution system and storage reservoirs will be monitored by the operator of the system continuously. GWWC will supervise the performance of the operator. Quality Control and Quality Assurance will be the responsibility of Ministry of Health and Medical Education. Monitoring is presented in Table 9-7.

Table 9-7: Environmental Monitoring Program during the Operation Phase of the Water Supply System

Environmental Parameter to be monitored	Monitoring Location	Frequency	Standard	Responsible Organization	
				Performing	QA/QC
pH Turbidity Coliforms Fecal coliforms Fecal Streptocoques	At Water Sources (Treatment plant, dam and wells)	Daily	6.5 – 8.5 5 NTU 0/100 ml 0/100 ml 0/100 ml	WSFO supervised by ESO	MHME
Conductivity Ammonium Nitrates Nitrites Chlorides Phosphates Calcium Magnesium Sodium Potassium Sulfates Iron	At Water Sources (Treatment plant, dam and wells)	Weekly	400 µS/cm 0.05 – 0.5 mg/l 0 - 45 mg/l 3 mg/l 25 – 200 mg/l 1.0 mg/l 100 mg/l 30 – 50 mg/l 20 – 150 mg/l 10 –12 mg/l 250 mg/l 50 – 200 mg/l	WSFO supervised by ESO	MHME
Herbicide and Pesticides Ni Cr Zn Cd Pb Hg	At Water Sources (treatment plant, dam and wells)	Monthly	0.1 µg/l 0.02 mg/l 0.05 mg/l 3 mg/l 0.003 mg/l 0.01 mg/l 0.001 mg/l	WSFO supervised by ESO	MHME
Ammonium Phosphates Nitrites Chlorides Total coliforms Fecal coliforms Fecal streptocoques Residual chlorine	At Water Reservoirs	Daily	0.05 – 0.5 mg/l 1.0 mg/l 0 mg/l 25 – 200 mg/l 0/100 ml 0/100 ml 0/100 ml 0.2-0.8 mg/l	WSFO supervised by ESO	MHME
Total coliforms Fecal coliforms Fecal streptocoques Residual chlorine	At Distribution Network	Every day	0/100 ml 0/100 ml 0/100 ml 0.2-0.8 mg/l	WSFO supervised by ESO	MHME

WSFO: Water Supply Facilities Operator

MHME: Ministry of Health and Medical Education

9.3.2.2 Wastewater Systems

Responsibility for implementing environmental monitoring program in order to control the probable adverse impacts during the operation of the wastewater system is the responsibility of the operator. The GWWC will supervise its performance. Quality

Control and Quality Assurance (QC/QA) is the responsibility of the Department of Environment (DOE). Monitoring of odors is set out in Table 9-8.

Table 9-8: Environmental Monitoring Program of odor at the Wastewater Treatment Centre at the Operation Phase

Disarrangement	Parameter	Monitoring Location	Frequency	Responsible organization	
				Performing	QA/QC
Odor	Gases emitting odor Mercaptans Hydrogen Sulphide Ammoniac	Around wastewater treatment plants & at Pumping Stations	Weekly	WWTO/GWWC	DOE

WWTO: Wastewater Treatment Operator

DOE: Department of Environment

Monitoring of treated effluent and resulting sludge will be the responsibility of the operator and the GWWC will supervises its performance. Quality Control and Quality Assurance of the monitoring program will be the responsibility of Department of Environment (DOE). The monitoring program for treated effluent and treated sludge are shown in Table 9-9 and Table 9-10 respectively.

Table 9-9: Environmental Monitoring Program for the Treated Effluent

Environmental Parameter to be monitored	Monitoring Location	Frequency	Standard	Responsible Organization	
				Performing	QA/QC
BOD COD PH Oil and grease TSS Total Phosphorus Total Nitrogen Nematode eggs Fecal coliform.	At WWTP site	Every day	30 mg/l 125 mg/l 6 – 9 10 mg/l 40 mg/l 1 mg as P/l 10 mg as N/l ≤1 egg/liter 200 MPN/100 ml	WWTO supervised by ESO	DOE
Heavy metals Phosphate Ammonia Nitrate Fluoride Sulfate Sulfide DO Phenols TDS	At Wastewater Plants and in river after discharge	Weekly	10 mg/l 5 mg/l 2.5 mg/l 50 mg/l 20 mg/l 500 mg/l 1 mg/l	WWTO supervised by ESO	DOE
Cadmium Chromium Copper Iron Lead Selenium Silver Zinc	At Wastewater Plants and in river after discharge	Monthly	0.1 mg/l 0.1 mg/l 0.5 mg/l 3.5 mg/l 0.1 mg/l 0.1 mg/l 0.5 mg/l 2.0 mg/l	WWTO supervised by ESO	DOE
[1]Chlorine	At the discharge from the outfall or at 1 km from the WWTP	Weekly	0.2 mg/l	WWTO supervised by ESO	DOE

WWTO: Wastewater Treatment Operator
ESO: Environment and Safety Officer
DOE: Department of Environment
[1] If chlorination is used

Table 9-10: Environmental Monitoring Program for the Treated Sludge

Environmental Parameter to be Monitored	Monitoring Location	Frequency	Standard	Responsible Organization	
				Performing	QA/QC
Nematode eggs (egg/100gm solids)	At Wastewater Plants	Every Batch	<1	WWTO supervised by ESO	DOE
Heavy Metals (mg/kg sludge): Cd Cu Ni Pb Zn Cr	At Wastewater Plants	Every Batch	20 – 40 1000 – 1750 300 – 400 750 – 1200 2500 – 4000 16-25	WWTO supervised by ESO	DOE

9.4 Management Requirements

A comprehensive management plan is required to effectively perform water and wastewater projects mitigation measures. In this plan, goals, activities, and responsibilities of different agencies according to their legal responsibilities, working flow diagrams and reporting will be outlined.

9.4.1 Overview of Responsibilities

There are many different aspects to the administration of the project. The organization's structure must have minimal complexity and have clear lines of communication. It is also essential that the annual budget attached to each relevant department or unit truly reflects its responsibilities.

The GWWC is to be responsible for the implementation of the Rasht and Anzali water and wastewater project, which includes the design of works, supervision of contractors' operation of the plants and ensuring that measures to mitigate adverse environmental impacts will be carried out. It will regulate discharges to the sewerage system and it will charge for them. It will inform the public on the use of the sewerage system. It is to establish a Technical Support Unit (TSU) to implement the project. In close coordination with DOE, the TSU will set standards for effluent discharges to the sewerage network from domestic and industrial sources and prohibiting those that exceed the standards. It will also monitor and regulate effluent and sludge from the wastewater treatment plants.

The DOE is to monitor the project impacts during the construction and operation phases.

The Ministry of Agriculture Jihad is to supervise and regulate the re-use of treated effluent and sludge. It will monitor crop quality and production. It will inform the farmers about safe and productive methods of re-use of effluent and sludge. It is recommended that the Ministry of Agriculture Jihad establish a unit to manage irrigation with treated effluent and sludge application properly; to ensure the correct and safe application of effluent and sludge; to monitor soil and produce; and to provide advice to farmers in order to realize the full potential of the scheme.

The Ministry of Health and Medical Education is to conduct an education campaign to inform the public about general aspects of public health relating to sanitation hygiene and to ensure that drinking water quality is in conformity with the standards.

Involvement of the GWWC

The role of GWWC has been described in Chapter 3.

9.4.2 Technical Support Unit

The structure of the TSU will include the following functions:

Design and Procurement

Provide detailed design and issue contracts for the projects.

Implementation

Ensure that the works are implemented satisfactorily, on schedule and within the allocated budget.

Environmental

Implement the Environmental Action Plan including the specific mitigation measures and monitoring for the parameters listed.

The TSU may perform the above activities itself or employ other agencies to undertake them.

Operations

Ensure adequate operation and maintenance of the water supply and sanitation facilities.

Establishment of a Project Liaison Committee

The effective implementation of the project and associated health protection measures requires the involvement of several Governmental agencies and Ministries. The Ministry of Energy will establish a Gilan Project Liaison Committee. The chair of the Committee is to be the Deputy Minister of Municipal Water and Sewerage Affairs in the Ministry of Energy. Its members will be representatives of the following organizations:

- The Technical Support Unit
- Gilan Water and Wastewater Company;
- The Ministry of Energy;
- The Department of Environment - Gilan;
- The Regional Water Organization;
- Rasht and Anzali Municipalities
- The Ministry of Science, Research and Technology
- The Ministry of Health and Medical Education
- The Ministry of Housing
- The Ministry of Industries and Mining
- The Ministry of Labor and Social Affairs
- The Ministry of Post and Telephone
- The Ministry of Roads and Transportation
- The Management and Planning Organization
- Electricity Board
- Traffic Police

The function of the Liaison Committee will be to minimize adverse impacts of the project on other services and the public. This will minimize interference with the project's progress due to external factors. The Committee will be responsible for project coordination. The full committee will meet at least once every 6 months; most liaisons will take place through several sub-committees, each dealing with a major aspect of the project.

TSU will have among its staff members an Environment and Safety Officer (ESO) to carry out monitoring. ESO will be responsible of supervising monitoring activities during both the construction and operation phases of the water supply and sanitation project. ESO will submit its activities report to TSU on monthly basis.

The water operator will be responsible for monitoring water quality while WWTP operators will be responsible to monitor treated wastewater and sludge. ESO will supervise their monitoring activities.

Ministry of Agriculture Jihad will be responsible to monitor soil and crops. While DOE will be responsible for QA/QC of treated wastewater, sludge, soil, surface water and ground water.

Ministry of Health and Medical Education will be responsible for QA/QC of drinking water as part of its legal responsibilities.

9.5 Institutional Strengthening

A training program is defined in order to increase the capability of different organizations' staff to carry out Rasht and Anzali's water and wastewater projects' mitigation measures. It should be noted that many water supply and wastewater treatment plants do not operate to their full capacity or to prevailing environmental standards due to poor maintenance and lack of suitably qualified staff. Training is thus vital if this project is to achieve its environmental and social development aims.

Training programs will be designed and implemented with the assistance of local and international experts and will include:

- *GWWC, Treatment Plant Operators, Rasht and Anzali Municipalities and Gilan DOE:* At the initiation of the project, a training workshop will be provided to the staff of the GWWC, Ministry of Energy, Rasht and Anzali Municipalities and DOE to raise environmental awareness and clarify the specific environmental requirements related to the project. A two-day workshop will then be provided and will cover the following topics:
  - Effective implementation and mitigation measures
  - Project supervision
  - Sampling and analysis
  - Monitoring and evaluation
- *GWWC, Municipalities, Gilan DOE and Line Ministries:* A two-day workshop will be provided to the staff of GWWC, Municipalities, and representatives of line ministries to strengthen capacities in the application of treated effluent and sludge re-use.
- *Laboratory Staff of Water and Wastewater Treatment Plants:* A one-week training workshop will be provided to strengthen capacities in sampling and analysis methods, environmental monitoring, quality assurance and quality control, as well as safety procedures.

- *Staff at Water and Wastewater Treatment Plants:* A one-day training workshop on occupational health, safety, and emergency response procedures against earthquakes will be provided.

Workshops and awareness campaigns will also be implemented to raise awareness of farmers, NGOs, and residents of Rasht and Anzali, these would include:

- *Local NGOs, communities and farmers:* Training will be provided through one- or two-day workshops for local NGOs, communities and farmers, focusing on public awareness and on re-use of treated wastewater and sludge for agricultural purposes.
- *Awareness campaigns and pamphlets:* Two awareness campaigns will be conducted; pamphlets in Farsi will be distributed to all farmers highlighting the adverse health and public safety impacts resulting from the use of untreated effluent; and measures to be taken when using treated effluent and sludge. Public hygiene education campaigns will also be conducted by the Ministry of Education.

An assessment of analytical capacities of the laboratories at the GWWC and at the Rasht and West Anzali wastewater treatment plant has been conducted (ref. Annex D); additional required equipment was also identified and will be supplied as part of the proposed project. For the East Anzali Wastewater Treatment Plant, a fully equipped laboratory will be provided as part of the construction contract.

Technical assistance will be provided to the DOE to set up baseline data on existing environmental conditions and to develop a quality assurance and a quality monitoring program as well as an enforcement program for industrial discharges. Similarly, technical assistance will be provided to the Ministry of Health and Medical Education to set up baseline data on the occurrence of water born diseases and to develop a monitoring program for the occurrence

Cost Estimate

The cost of the Environmental Management Plan during construction (mitigation measures including additional treatment and monitoring) will be borne mostly by the contractor (construction phase) and the Supervision Engineer who will make the necessary provision as part of their contracts for this project.

During the operation phase, mitigation measures and monitoring activities will be implemented by the operator of each plant. Sangar existing water treatment plant and the emergency water treatment plant will be operated by GWWC. Hence, the required mitigation measures and monitoring activities will be implemented by GWWC as part of their mandates. Similarly for the Rasht and Ilyaran wastewater treatment plants, both of which will be operated by GWWC with one year supervision by the

Contractor, hence the cost of mitigation measures and monitoring requirements will be borne by GWWC.

A total amount of 1,804,000 dollars will be allocated for the implementation of the environmental management plan as detailed in Table 9-11 and will be included in the project cost. It should be noted that the total cost does not include the following:

- Cost of additional treatment incorporated in the design of the project;
- Cost of mitigating negative construction impacts (included in the construction contract cost);
- Cost of mitigation measures and environmental monitoring of the East Anzali WWTP (included in the construction and operation and maintenance contract cost);
- Cost of setting up a new laboratory at the East Anzali wastewater treatment plant (included in construction cost).
- Cost of Environment and Safety Officer at TSU (included in TSU cost).

Table 9-11: Cost Estimate of Environmental Management Plan

Component	Quantity	Unit rate in 1000 US$	Total Cost in 1000 US$	
			Rasht	Anzali
GWWC International environmental consultant to provide technical assistance to GWWC	14 months	12 /month	84	84
Environmental Monitoring Program for Water Supply System	5 years	30/year for R 15/year for A	150	75
Environmental Monitoring Program for WWTP	4 years	75/year for R 50/year for A	300	200
Subtotal			**534**	**359**
Studies, Training and Awareness Development of baseline data on water related diseases and a monitoring program for the occurrence of these diseases			25	25
Development and implementation of a QA/QC monitoring program for the proposed project to be implemented by DOEG			30	30
Development of earthquake emergency preparedness plan			6	6
Development of Compliance Action Plan (CAP)	11 CAPs	4/CAP	28	16
Two days workshop to GWWC, Treatment Plant Operators, Rasht and Anzali Municipality and DOEG on environmental management, monitoring, analysis and evaluation	2 workshop	7/workshop	7	7
Two days workshops for GWWC, Municipality, DOEG and Line Ministries on treated sludge re-use	2 workshop	7/workshop	7	7
One week training workshop to Staff of Water and Wastewater Treatment Plants on laboratory sampling, analysis, environment monitoring and QA/QC	4 workshop	4/workshop	8	8

Table 9-11: Cost Estimate of Environmental Management Plan-Continued

Component	Quantity	Unit rate in 1000 US$	Total Cost in 1000 US$	
			Rasht	Anzali
Studies, Training and Awareness One day training workshop on occupational health and safety to staff at Water and Wastewater Treatment Plants	4 workshop	1/workshop	2	2
One day workshop for local NGOs, communities and farmers, focusing on public awareness and on re-use of treated sludge for agricultural purposes.	4 workshop	1/workshop	2	2
Awareness campaigns and pamphlets			25	25
Subtotal			**140**	**140**
Laboratory Equipment **GWWC**			171.5	171.5
Rasht WWTP			148.6	
West Anzali WWT				115.4
Subtotal			**320.1**	**286.9**
Monitoring and Evaluation at the project level	2 MM	12	12	12
Subtotal Per City			1,006	798
Total			**1,804**	

10. LIST OF REFERENCES

1. Report on Geology of Rasht and Anzali from Central Geological Department, Tehran.
2. First Phase Study for Water Distribution Network Extension for Anzali By Pars Jooyab Consultants- 1998
3. Department of Environment, Gilan Province.
4. The Birds of Iran, Firooz .E; 1976; Department of the Environment
5. Progress Report on Feasibility Studies for Water Supply and Wastewater Collection and Disposal Facilities for Rasht and Anzali Cities by Iranab Consulting Engineers- November, 2002.
6. Rasht/ Anzali Water Supply and Wastewater Collection and Disposal - Progress Report no. 1-3 and 1-4 - November, 2002.
7. Gilan Central Department of Education- 2001
8. Studies on Population in Design report of Rasht Wastewater Network by Iran Ab Consultants.
9. Rasht Region Population Census - 1995 issued by Iran Census Centre
10. General Census of People and Houses; Iran Census Centre; 1996.
11. Design Criteria of Municipal Wastewater Treatment Plants, Issue 129-a, Organization of Management and Planning
12. Gilan Province Census 2000-2001 and Cultural and Heritage Department, Tehran
13. Fisheries and Marine Research Institute-Anzali.
14. Report of Amendment approved by the Council of Ministers on 19.04.1995.
15. Institute of Standards and Industrial Research of Iran (ISIRI).
16. Feasibility Study for Water Supply and Wastewater Collection Treatment and Disposal Facilities for City of Rasht and Anzali, Iranab Consulting Engineers, 2004.
17. Environmental Review of Baalbek Water and Wastewater System, BTD, Beirut, Lebanon.
18. Draft Report Feasibility Study for Water Supply and Wastewater Collection Treatment and Disposal Facilities for City of Tehran, Aser Consulting Engineers, 2000.

19. Final Report on Feasibility Studies for Water Supply and Wastewater Collection and Disposal Facilities for Rasht and Anzali Cities by Iranab Consulting Engineers- 2004.

20. Water Supply Studies for Anzali City- Pars Consult -1996

21. Primary Study on Anzali Wastewater Treatment Plants - Pars Consult -1993

22. Operational Policies of the World Bank -2001

23. Source Book 1999

24. Environmental Code of Iran-2000

25. Pollution Prevention and Abatement Hand Book

26. Japan International Cooperation Agency (JICA)-Study on the Integrated 27. 27. Management for the Ecosystem Conservation of Anzali Wetland, Final Progress Report, February 2004, Nippon Koei Co., Ltd.

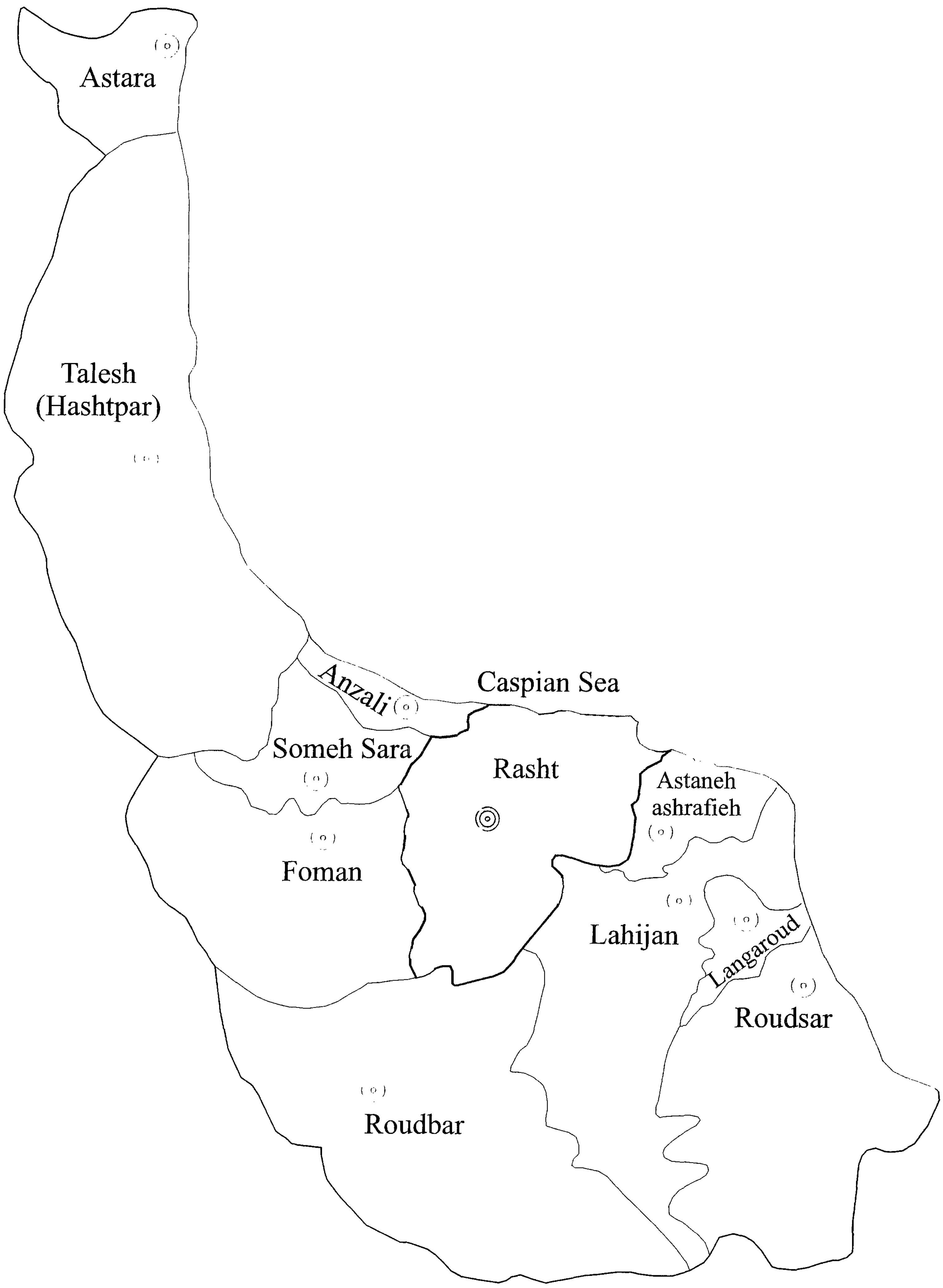
LIST OF ANNEXES

ANNEX A

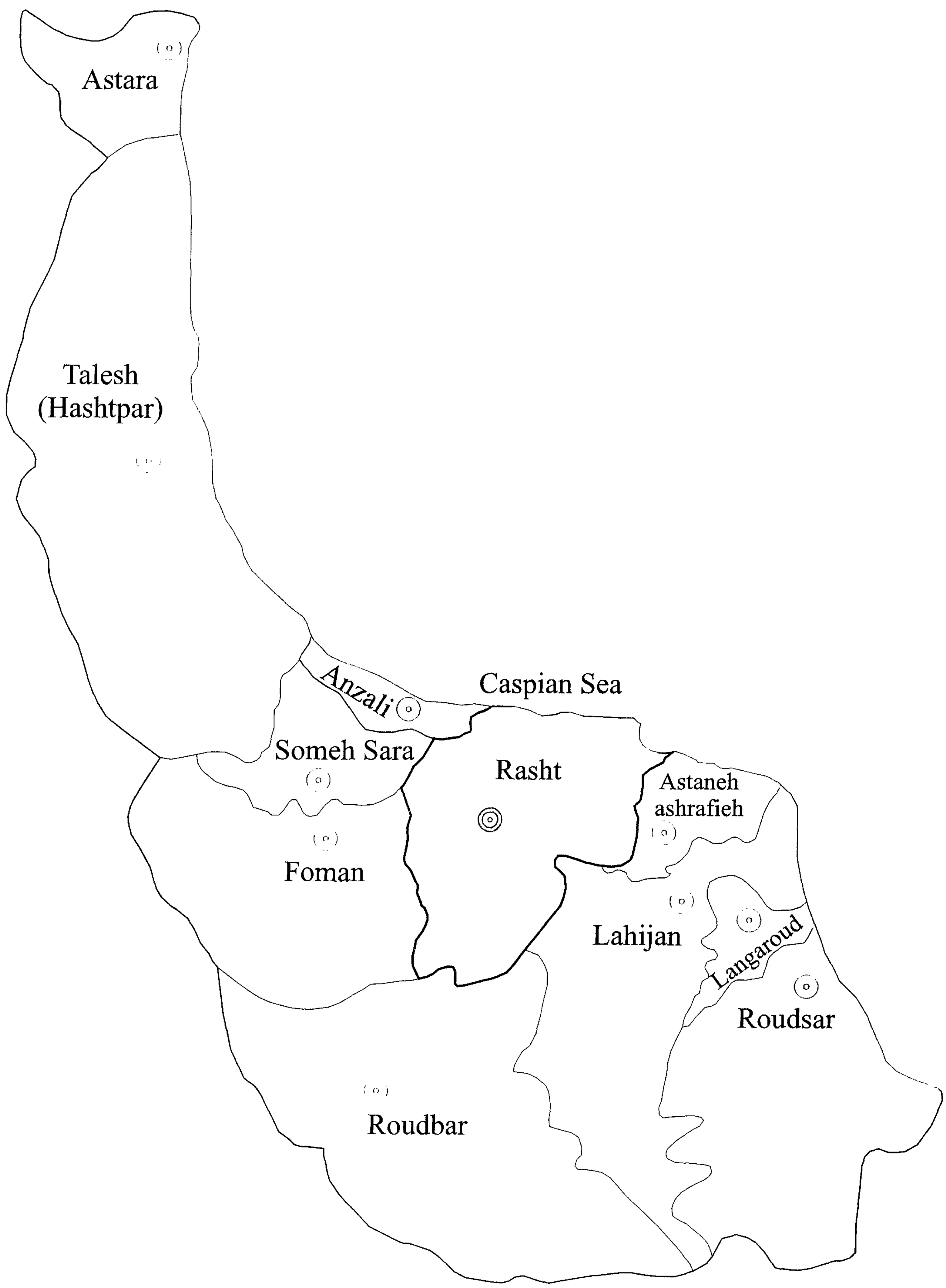
Maps and Drawings

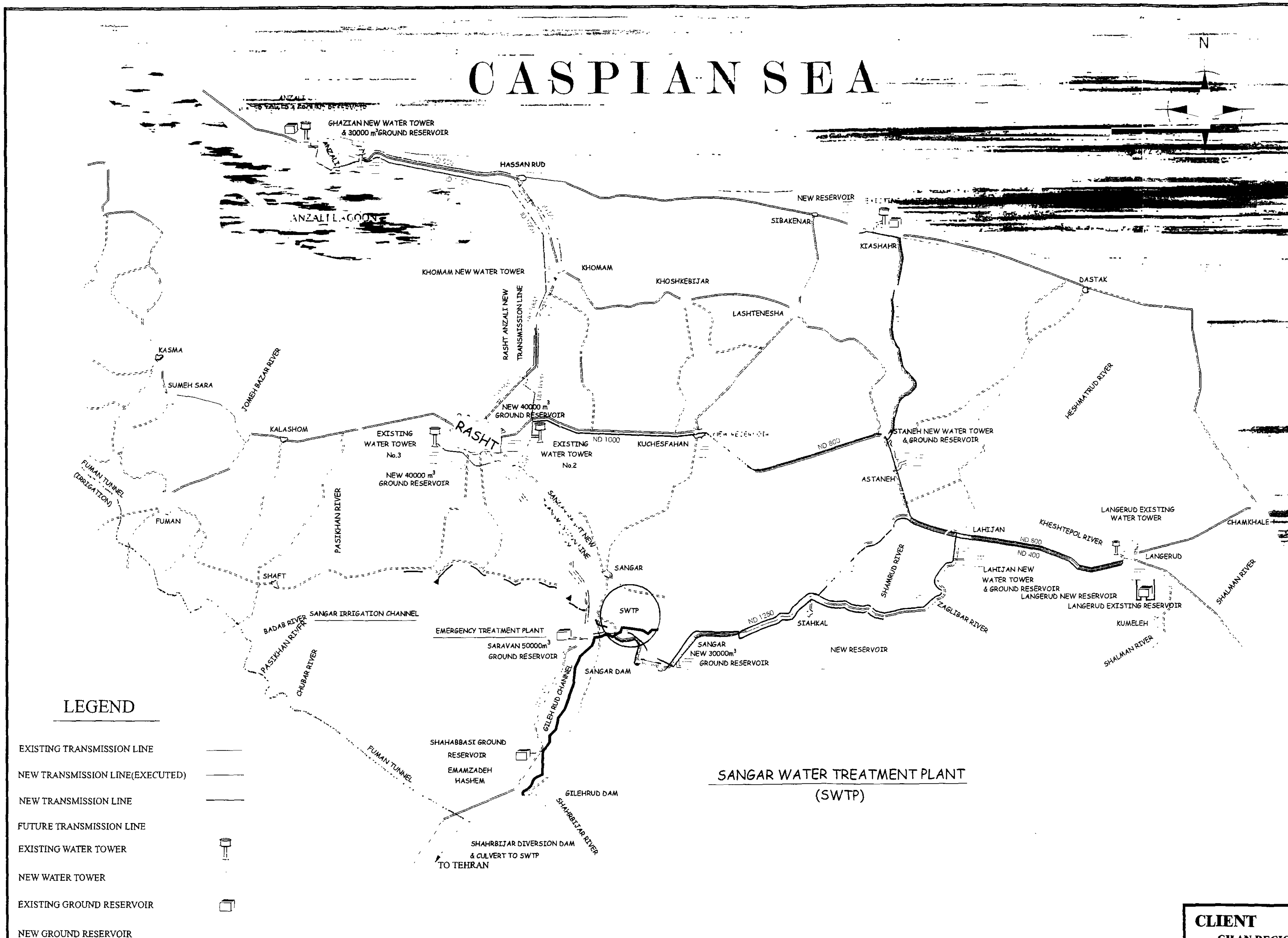
ANNEX A – Maps and Drawings

Map2 - Gilan province & small provinces



Map 2 : Gilan province & small provinces



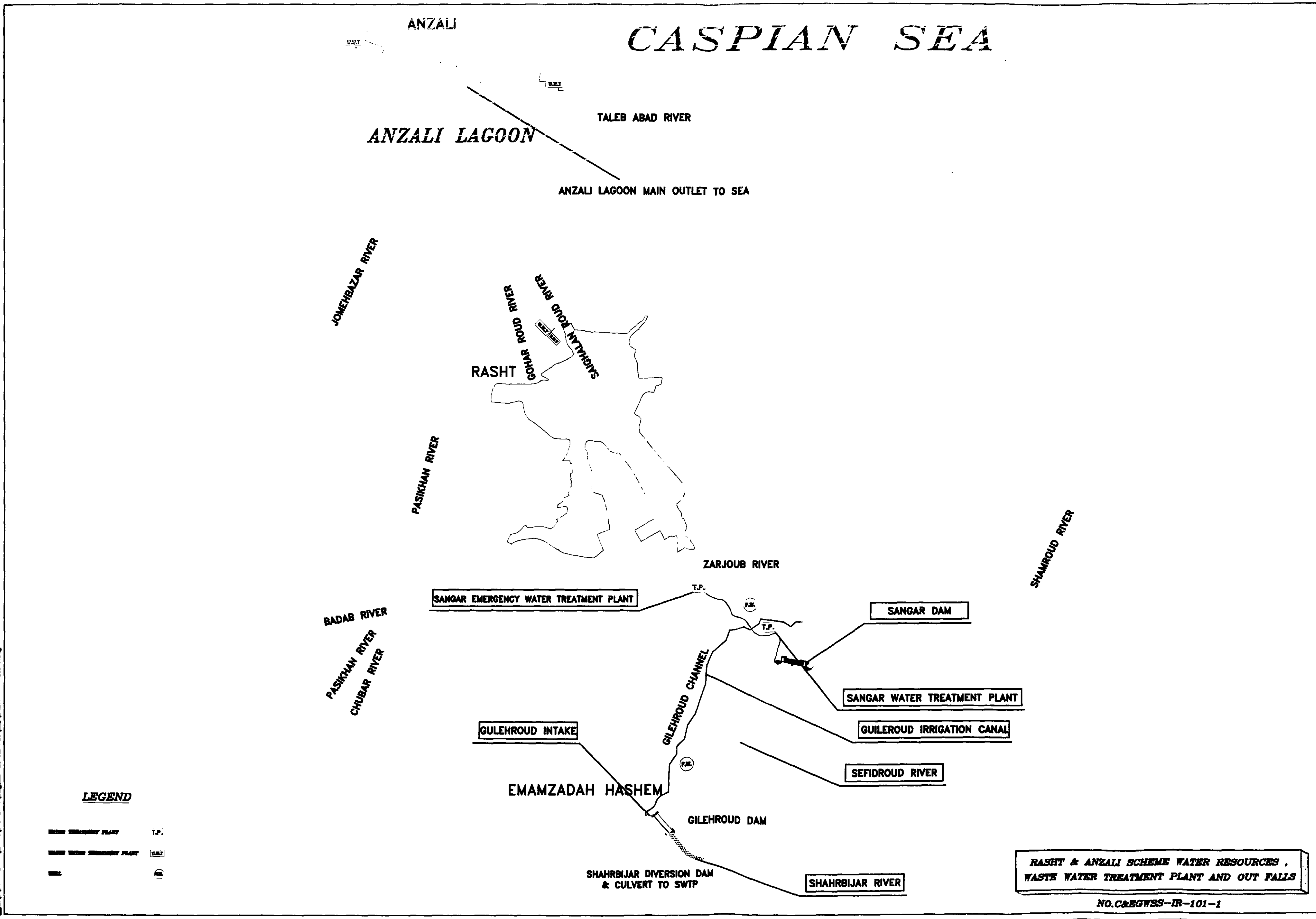


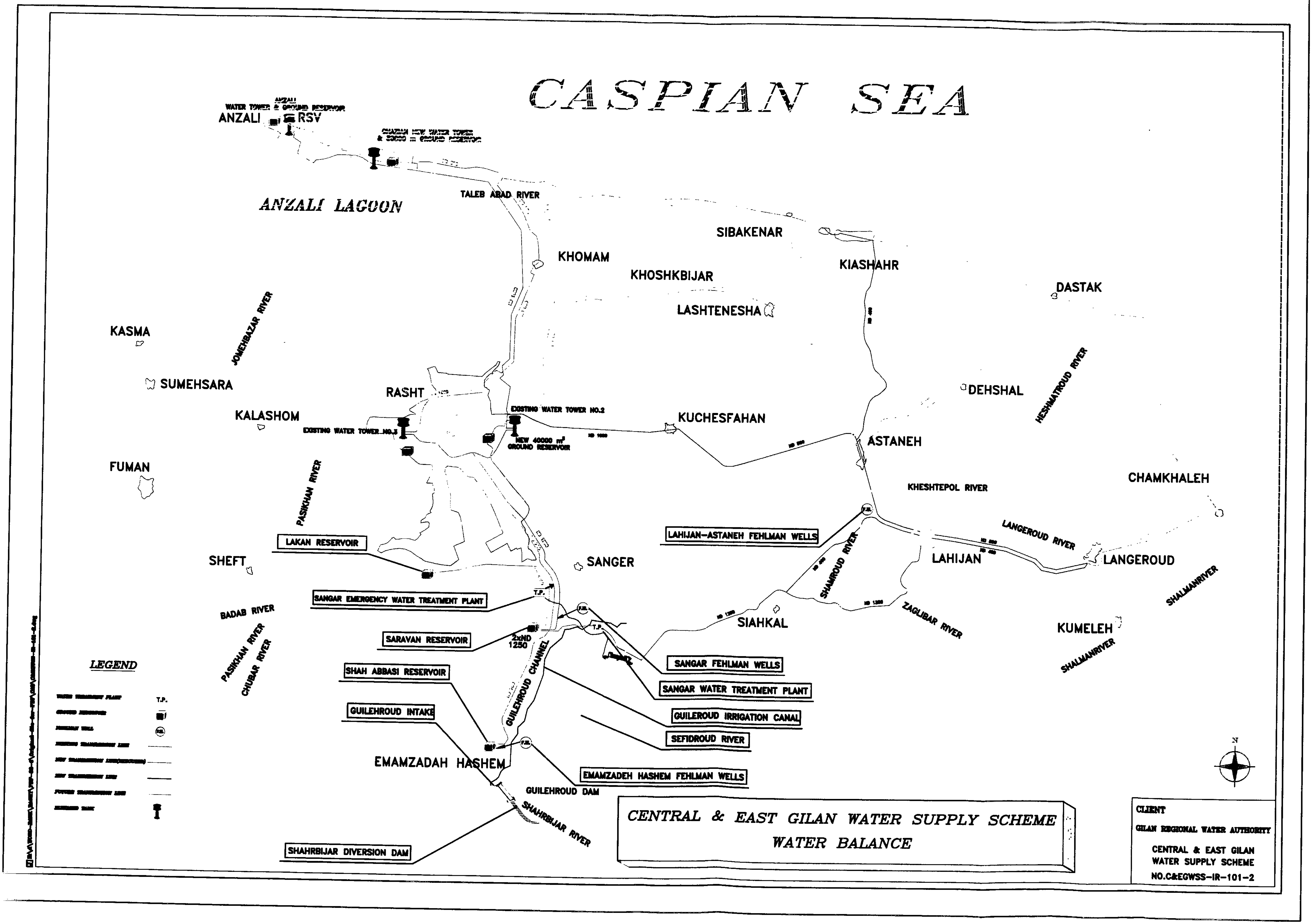
CENTRAL & EAST GILAN WATER SUPPLY SCHEME
TRANSMISSION LINES AND RESERVOIRS

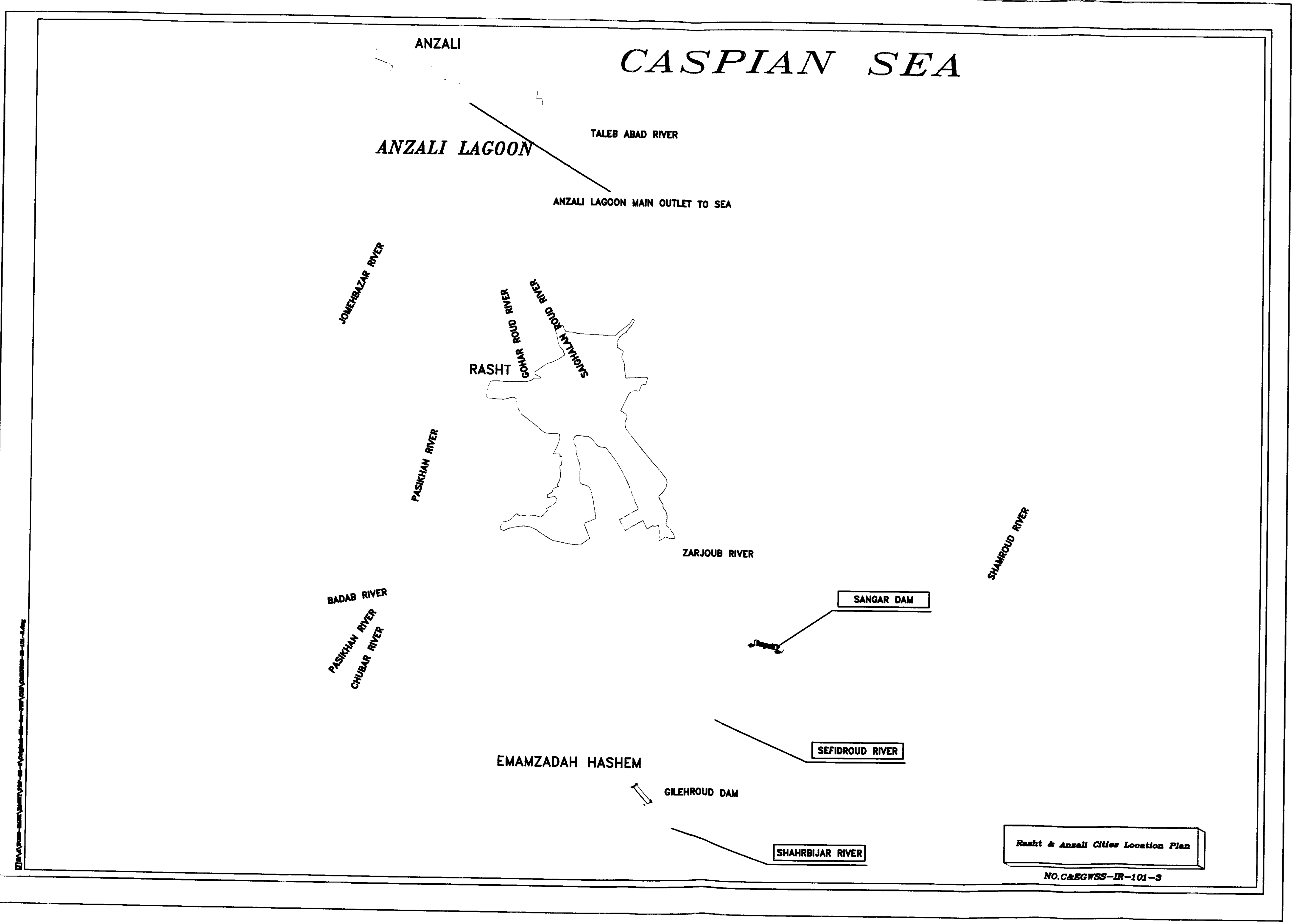
CLIENT
GILAN REGIONAL WATER AUTHORITY
CENTRAL & EAST GILAN
WATER SUPPLY SCHEME
TRANSMISSION LINES & RESERVOIRS

C&EGWSS-IR-100

K-E\RAHMANI\W-BANK\RASHT\82-5\COREL\100.CDR

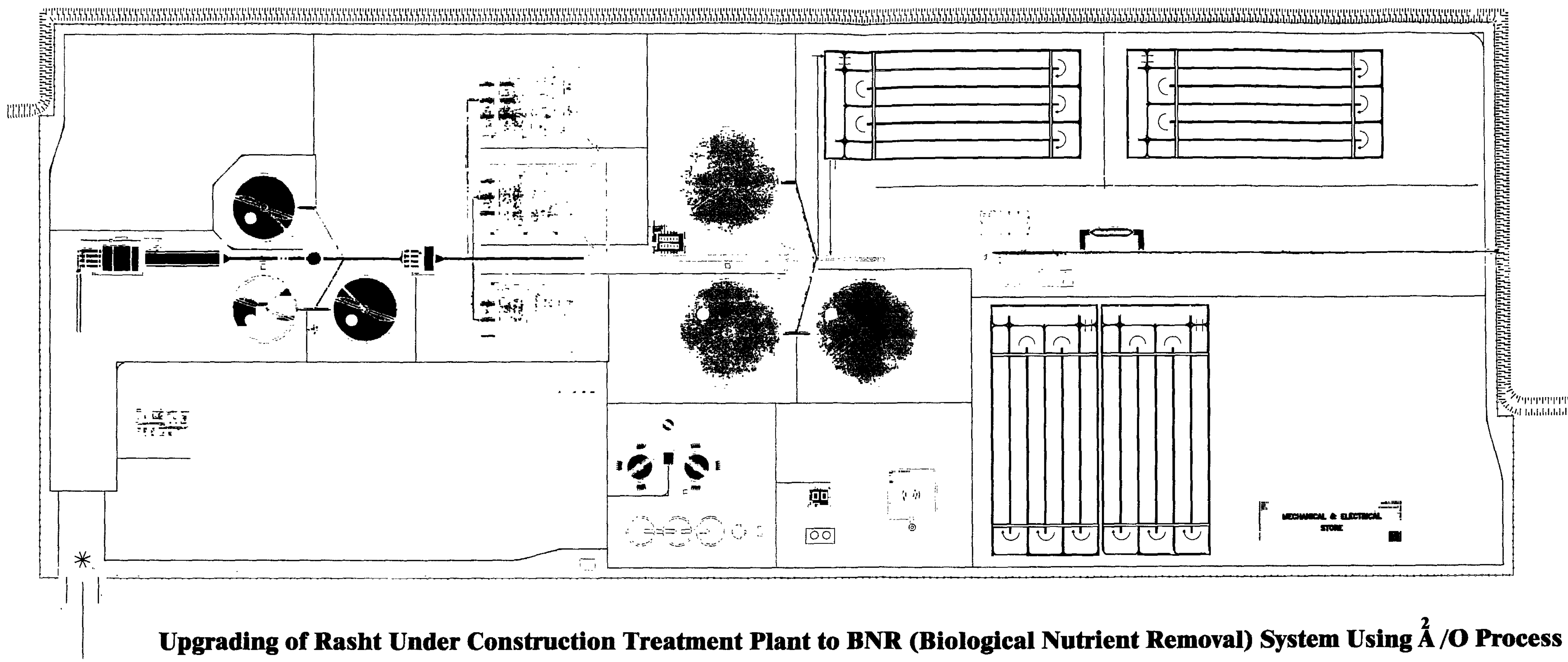

CASPIAN SEA
ANZALI
TALEB ABAD RIVER
ANZALI LAGOON
ANZALI LAGOON MAIN OUTLET TO SEA
JOMEHBAZAR RIVER
GOHAR ROUD RIVER
SAGHIAN ROUD RIVER
RASHT
PASIKHAN RIVER
SHAMROUD RIVER
ZARJOUB RIVER
T.P.
SANGAR EMERGENCY WATER TREATMENT PLANT
SANGAR DAM
T.P.
BADAB RIVER
PASIKHAN RIVER
CHUBAR RIVER
SANGAR WATER TREATMENT PLANT
GILEHROUD CHANNEL
GUILEROUD IRRIGATION CANAL
GULEHROUD INTAKE
SEFIDROUD RIVER
EMAMZADAH HASHEM
GILEHROUD DAM
SHAHRBIJAR DIVERSION DAM
& CULVERT TO SWTP
SHAHRBIJAR RIVER
LEGEND
T.P.
RASHT & ANZALI SCHEME WATER RESOURCES ,
WASTE WATER TREATMENT PLANT AND OUT FALLS
NO.C&EGWSS-IR-101-1


CASPIAN SEA
ANZALI WATER TOWER & GROUND RESERVOIR
ANZALI
RSV
ANZALI LAGOON
TALEB ABAD RIVER
KHOMAM
KHOSHKBIJAR
SIBAKENAR
KIASHAHR
LASHTENESHA
DASTAK
KASMA
JOMEHBAZAR RIVER
SUMEHSARA
RASHT
EXISTING WATER TOWER NO.2
NEW 40000 m³ GROUND RESERVOIR
EXISTING WATER TOWER NO.3
KALASHOM
KUCHESFAHAN
ASTANEH
DEHSHAL
HESHMATROUD RIVER
FUMAN
PASIKHAN RIVER
KHESHTEPOL RIVER
CHAMKHALEH
LAKAN RESERVOIR
LAHIJAN-ASTANEH FEHLMAN WELLS
LANGEROUD RIVER
SHEFT
SANGER
SHAMROUD RIVER
LAHIJAN
LANGEROUD
SANGAR EMERGENCY WATER TREATMENT PLANT
T.P.
SHALMANRIVER
BADAB RIVER
SIAHKAL
ZAGLIBAR RIVER
KUMELEH
SARAVAN RESERVOIR
2xND 1250
SANGAR FEHLMAN WELLS
SANGAR WATER TREATMENT PLANT
PASIKHAN RIVER
CHUBAR RIVER
LEGEND
SHAH ABBASI RESERVOIR
GUILEROUD CHANNEL
GUILEROUD IRRIGATION CANAL
GUILEHROUD INTAKE
SEFIDROUD RIVER
EMAMZADAH HASHEM
EMAMZADEH HASHEM FEHLMAN WELLS
GUILEHROUD DAM
SHAHRBIJAR RIVER
SHAHRBIJAR DIVERSION DAM
N
CENTRAL & EAST GILAN WATER SUPPLY SCHEME
WATER BALANCE
CLIENT
GILAN REGIONAL WATER AUTHORITY
CENTRAL & EAST GILAN
WATER SUPPLY SCHEME
NO.C&EGWSS-IR-101-2


ANZALI
CASPIAN SEA
TALEB ABAD RIVER
ANZALI LAGOON
ANZALI LAGOON MAIN OUTLET TO SEA
JOMEHBAZAR RIVER
GOHAR ROUD RIVER
SAIGHALAN ROUD RIVER
RASHT
PASIKHAN RIVER
ZARJOUB RIVER
SHAMROUD RIVER
SANGAR DAM
BADAB RIVER
PASIKHAN RIVER
CHUBAR RIVER
SEFIDROUD RIVER
EMAMZADAH HASHEM
GILEHROUD DAM
SHAHRBIJAR RIVER
Rasht & Anzali Cities Location Plan
NO.C&EGWSS-IR-101-3

MODIFIED UNDER CONSTRUCTION WWTP

GENERAL LAYOUT



Upgrading of Rasht Under Construction Treatment Plant to BNR (Biological Nutrient Removal) System Using A²/O Process

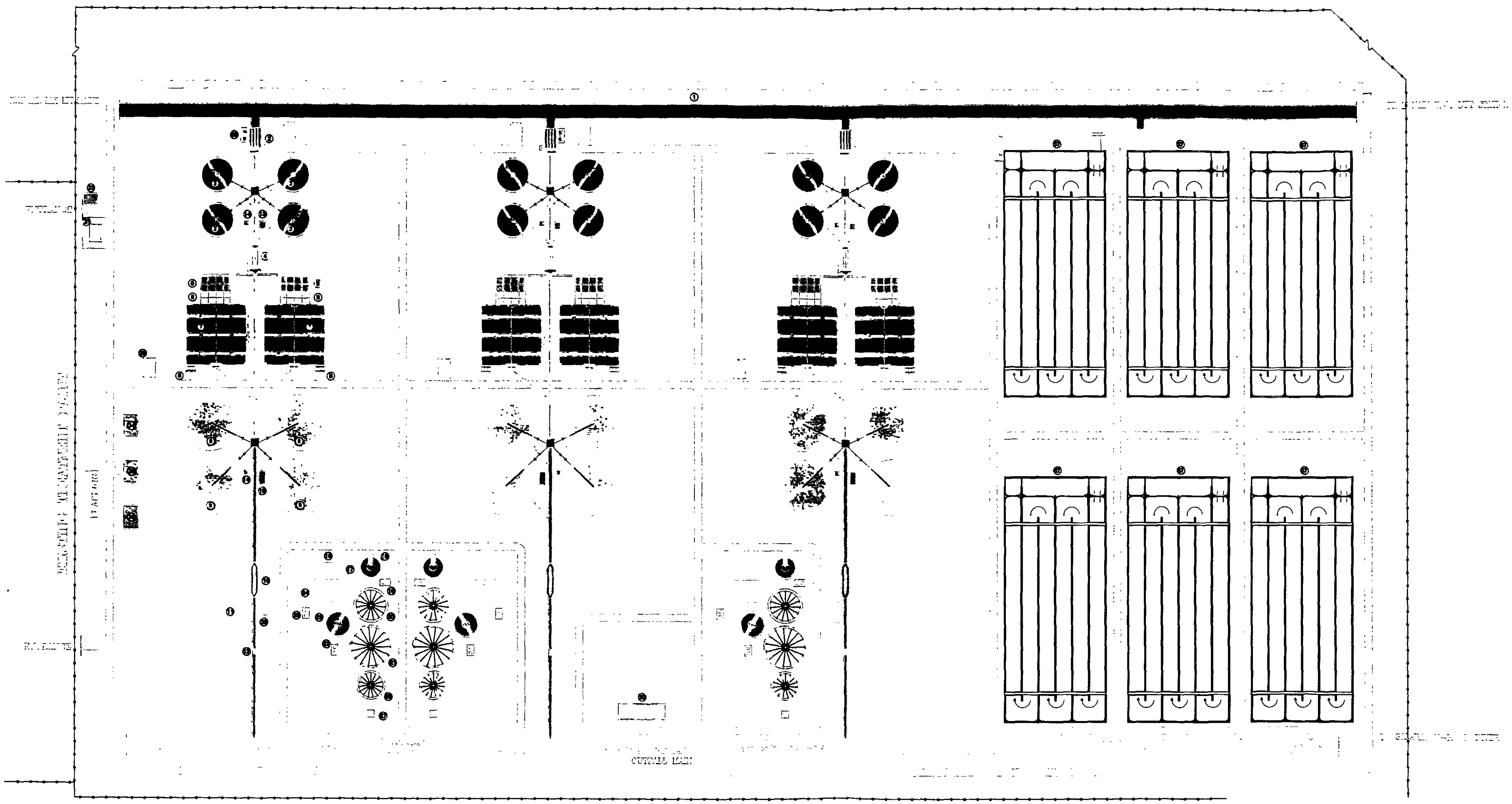
LEGEND

1 [illegible]
2 [illegible]
3 [illegible]
4 [illegible]
5 VENTURI FLUME
6 PRIMARY SETTLING TANKS
7 MIDDLE PUMP STATION
8 ANAEROBIC ZONES
9 ANOXIC ZONES
10 AERATION TANKS
11 INTERNAL RECYCLE PUMP STATIONS
12 SECONDARY SETTLING TANKS
13 [illegible]
14 TREATED EFFLUENT FOR DISPOSAL TO RIVER
15 SLUDGE PUMP STATION TO THICKENERS
16 RETURN & EXCESS SLUDGE PUMP STATION
17 SLUDGE BLENDING TANK
18 SLUDGE THICKENING TANKS
19 THICKENED SLUDGE PUMP STATION
20 SLUDGE DIGESTERS
21 BIOGAS STORAGE TANK
22 GAS FLARE
23 SLUDGE CONDITIONING & DEWATERING UNIT
24 [illegible]
25 FERRIC CHLORIDE STORAGE TANK
26 CHLORINATION BLDG.
27 GUARD HOUSE
28 ADMINISTRATION BUILDING
29 TRANSFORMER,EMERGENCY POWER PLANT & MAIN [illegible] – DISTRIBUTION PANEL BUILDING
30 DILUTION WATER PUMP STATION
31 [illegible] STATION
32 UV DISINFECTION UNIT(ALTERNATIVE)
33 [illegible] WASTEWATER EMERGENCY STORAGE BASIN
D [illegible] DISTRIBUTION CHAMBERS

[illegible]	DATE	[illegible]	DATE	DESCRIPTION	REV.
APPROVED		CHECKED			

F. PROJ. No.			CLIENT: GILAN WATER & WASTEWATER COMPANY	
T. PROJ. No.				
	SIGNATURE	DATE	IRANAB CONSULTING-ENGINEERS	
DESIGNED BY.	M.ABBASI	2004		
DRAWN BY.	COMPUTER CENTER	2004	RASHT WASTEWATER PROJECT COLLECTION SYSTEM UPGRADING OF RASHT UNDER CONSTRUCTION WWTP TO BNR SYSTEM	SCALE N.T.S
CHECKED BY.	M.ABBASI	2004		
APPROVED BY.	TOOTOONCHI	2004		UNIT
FIELD	SEWAGE		DWG. No.RWWS–IR–141	

GENERAL LAYOUT

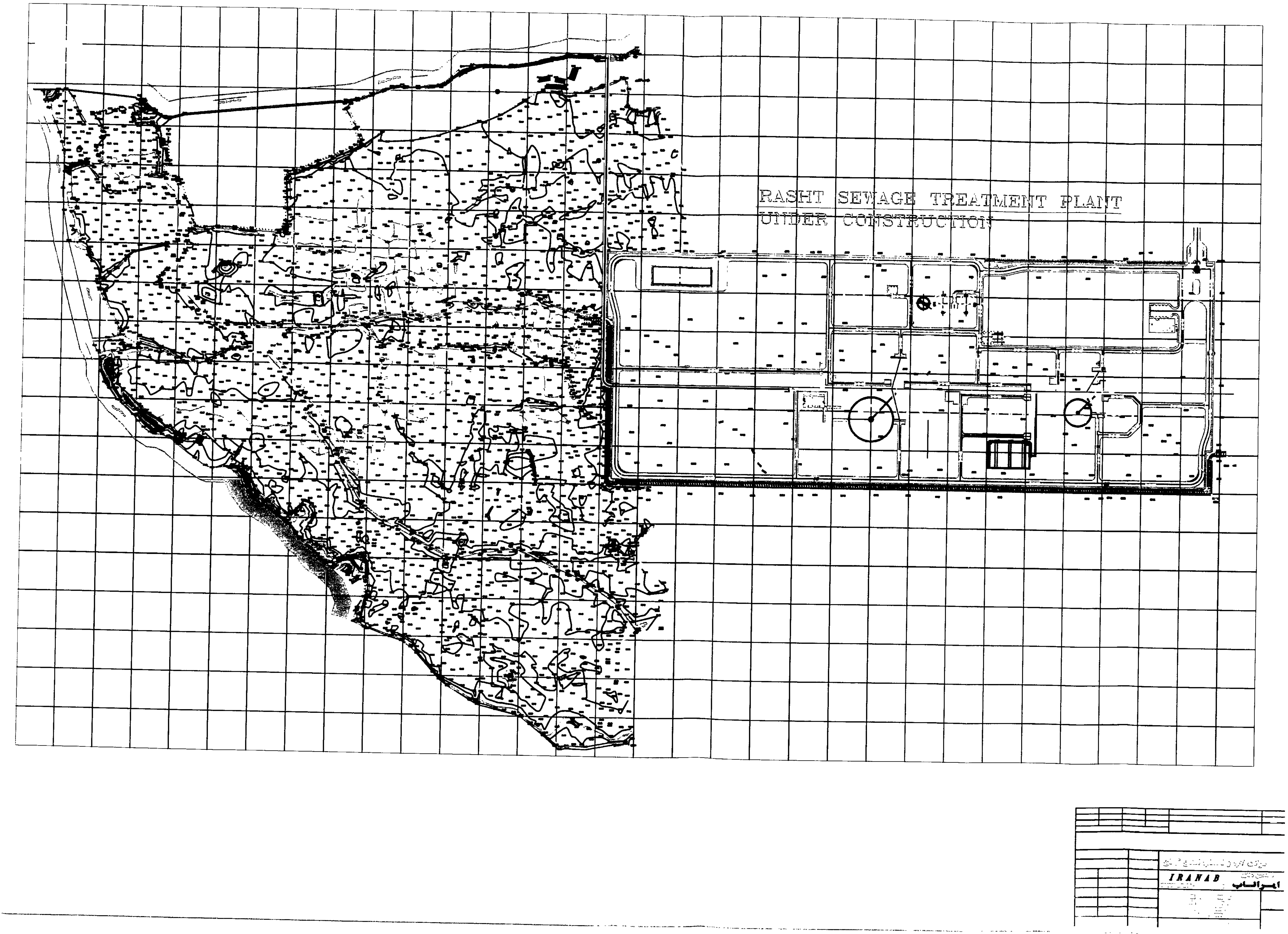


LEGEND

1. DISTRIBUTION CHANNEL
2. AERATED GRIT & GREASE CHAMBER
3. PRIMARY SETTLING TANKS
4. MIDDLE LIFT STATION
5. ANAEROBIC ZONES
6. ANOXIC ZONES
7. AERATION TANKS
8. INTERNAL RECYCLE PUMP STATIONS
9. FINAL SETTLING TANKS
10. UV DISINFECTION CHANNEL
11. UV GENERATION BUILDING
12. PARSHALL FLUME
13. PRIMARY SLUDGE PUMP STATION
14. SCUM SLUDGE PUMP STATIONS
15. RETURN & EXCESS SLUDGE PUMP STATION
16. GRAVITY BELT THICKENER(GBT)
17. THICKENED SLUDGE PUMP STATION
18. SLUDGE BLENDING TANK
19. BLENDED SLUDGE PUMP STATION
20. THERMOPHILIC DIGESTER
21. MESOPHILIC DIGESTER
22. DIGESTED SLUDGE THICKENER
23. DIGESTED SLUDGE PUMP STATION
24. SLUDGE CONDITIONING & DEWATERING UNIT(BFP)
25. THICKENER & FILTER PRESS OVERFLOW PUMP STATION
26. BIOGAS STORAGE TANK
27. FLARE SYSTEM
28. BLOWERS
29. TRANSFORMER , EMERGENCY POWER PLANT & MAIN HV & LV DISTRIBUTION PANEL BUILDING
30. POWER DISTRIBUTION BUILDING
31. PASSAGE STATION
32. FILTER PRESS WASH WATER PUMP STATION
33. GUARD ROOM
34. ADMINISTRATION BUILDING
35. CANTEEN
36. STORE & WORKSHOP
37. RAW WASTEWATER EMERGENCY STORAGE BASINS

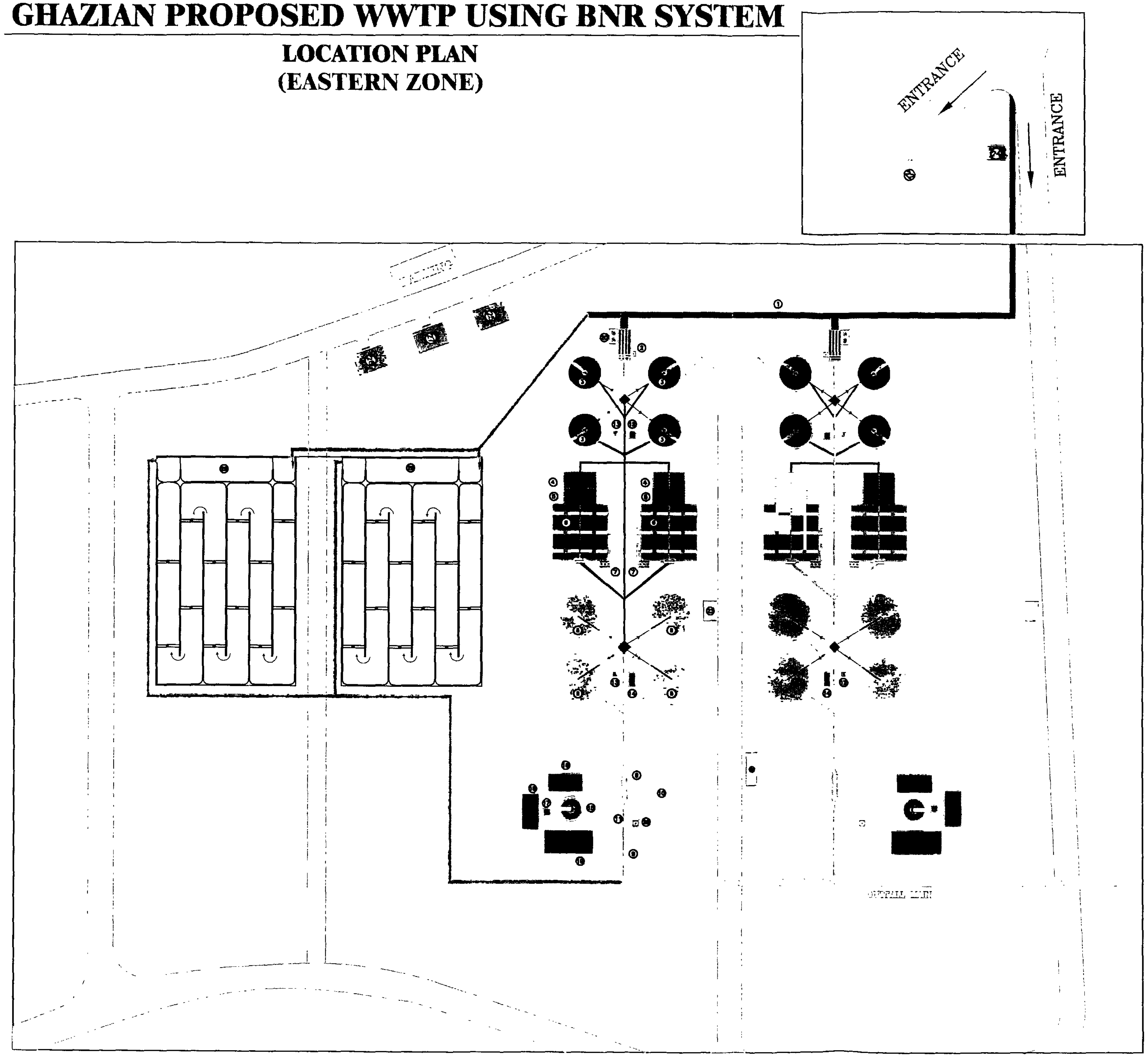
DESIG.	DATE	DRAW	DATE	DESCRIPTION	REV.
APPROVED		CHECKED			

F. PROJ. No.			CLIENT: GILAN WATER & WASTEWATER COMPANY	
T. PROJ. No.				
	SIGNATURE	DATE	IRANAB CONSULTING-ENGINEERS	
DESIGNED BY.	M.ABBASI	2004		
DRAWN BY.	COMPUTER CENTER	2004	RASHT WASTEWATER PROJECT COLLECTION SYSTEM	SCALE N.T.S.
CHECKED BY.	M.ABBASI	2004		
APPROVED BY.	TOOTOONCHI	2004	PROPOSED RASHT WWTP USING BNR SYSTEM	UNIT
FIELD	SEWAGE		DWG. No.RWWS-IR-142	


RASHT SEWAGE TREATMENT PLANT
UNDER CONSTRUCTION
IRANAB
ایرانآب

GHAZIAN PROPOSED WWTP USING BNR SYSTEM

LOCATION PLAN
(EASTERN ZONE)



LEGEND

1. DISTRIBUTION CHANNEL
2. AERATED GRIT CHAMBER
3. PRIMARY SETTLING TANKS
4. ANAEROBIC ZONE
5. ANOXIC ZONE
6. AERATION TANKS
7. INTERNAL RECYCLE PUMP STATIONS
8. FINAL SETTLING TANKS
9. UV DISINFECTION CHANEL
10. UV GENERATION BUILDING
11. PARSHALL FLUME
12. PRIMARY SLUDGE PUMP STATION
13. SCUM SLUDGE PUMP STATION
14. RETURN & EXCESS SLUDGE PUMP STATION
15. SLUDGE BLENDING TANK
16. GRAVITY BELT THICKENERS (GBT)
17. THICKENED SLUDGE PUMP STATION
18. SLUDGE CONDITIONING & DEWATERING
19. DEWATERED SLUDGE STORAGE BASIN
20. BLOWERS
21. POWER DISTRIBUTION BUILDING
22. PASSAGE STATION
23. TRANSFORMER , EMERGENCY POWER PLANT & MAIN HV & LV DISTRIBUTION PANEL BUILDING
24. GUARD ROOM
25. ADMINISTRATION BUILDING
26. STORE & WORKSHOP
27. CANTEEN
28. DILUTION WATER PUMP STATION
29. RAW WASTEWATER EMERGENCY STORAGE BASINS

				DESCRIPTION	REV.

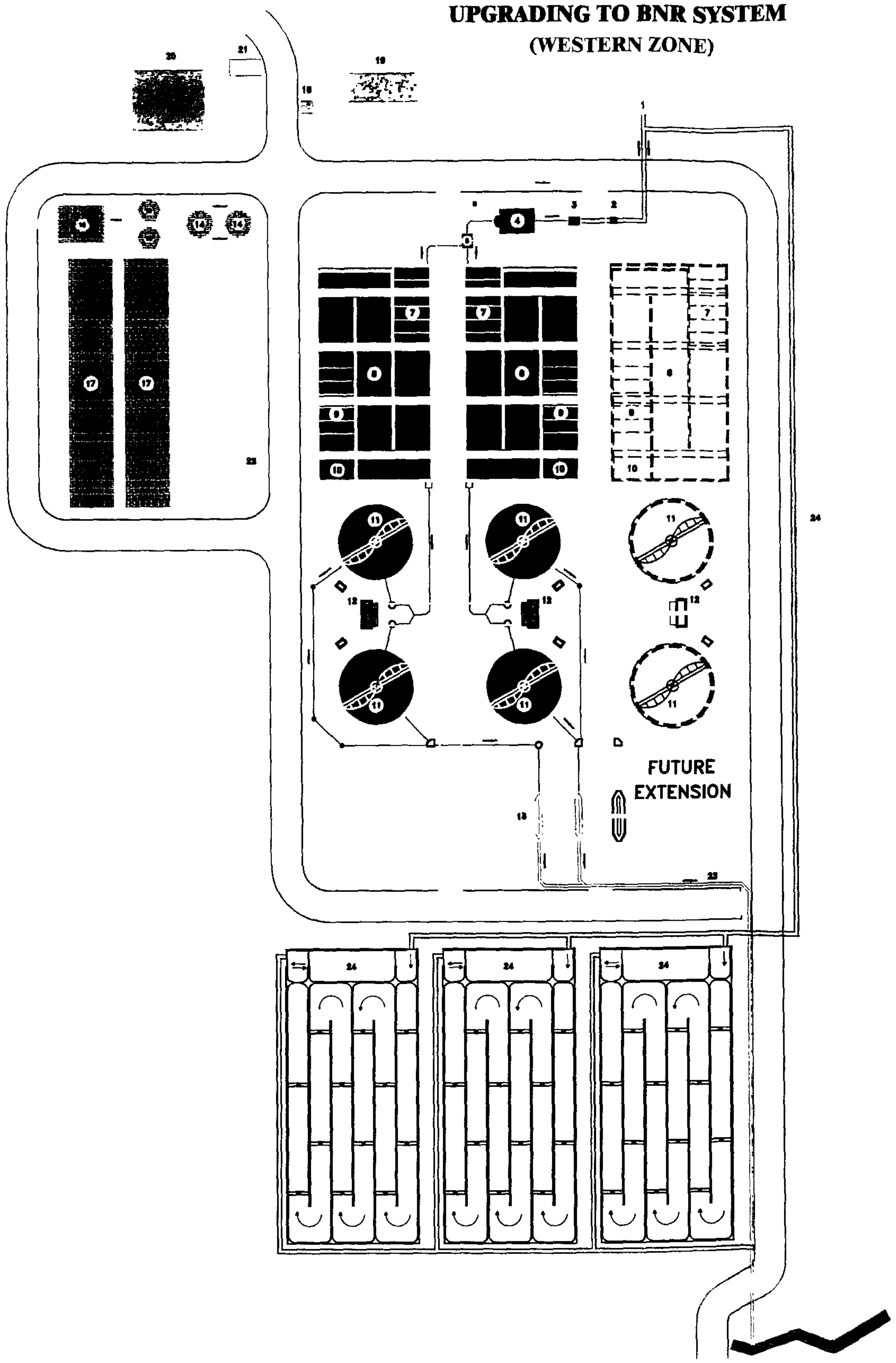
	SIGNATURE	DATE	CLIENT: GILAN WATER & WASTEWATER COMPANY
	M.LASHANI	2004	*IRANAB* CONSULTING-ENGINEERS
	COMPUTER CENTER	2004	
	M.LASHANI	2004	SCALE N.T.S.
	TOOTOONCHI	2004	
FIELD	WASTEWATER		DWG. No.AWWS-IR-17-5-2

D:\ANZALI\AWWS-IR-17-5-2.DWG

GENERAL LAYOUT

UNDER CONSTRUCTION TREATMENT PLANT UPGRADING TO BNR SYSTEM

(WESTERN ZONE)



LEGEND

1 INLET PIPE LINE
2 FLOW MEASUREMENT
3 RAW WASTEWATER RECEIVING BOX
4 AERATED GRIT & GREASE UNIT
5 AIR BLOWER BUILDING
6 WASTEWATER DISTRIBUTION BOX
7 ANAEROBIC ZONE
8 AEROBIC ZONE
9 ANOXIC ZONE
10 AEROBIC ZONE
11 SEDIMENTATION TANKS
12 RETURN & EXCESS SLUDGE PUMP STATIONS
13 EFFLUENT DISINFECTION UNIT USING UV SYSTEM
14 EXECSS SLUDGE STORAGE TANKS
15 SLUDGE THICKENING TANKS
16 MECHANICAL SLUDGE DEWATERING UNIT
17 DEWATERED SLUDGE STORAGE PONDS
18 GUARD HOUSE
19 ADMINISTRATION BUILDING
20 STORE & WORKSHOP
21 PASSAGE STATION
22 TRANSFORMER , EMERGENCY POWER PLANT & MAIN HV & LV DISTRIBUTION PANEL BUILDING
23 EFFLUENT TO ANZALI LAGOON
24 RAW WASTEWATER EMERGENCY STORAGE BASINS
25 BYPASS CHANNEL

DESN.	DATE	SIGN	DATE	DESCRIPTION	REV.
APPROVED		CHECKED			

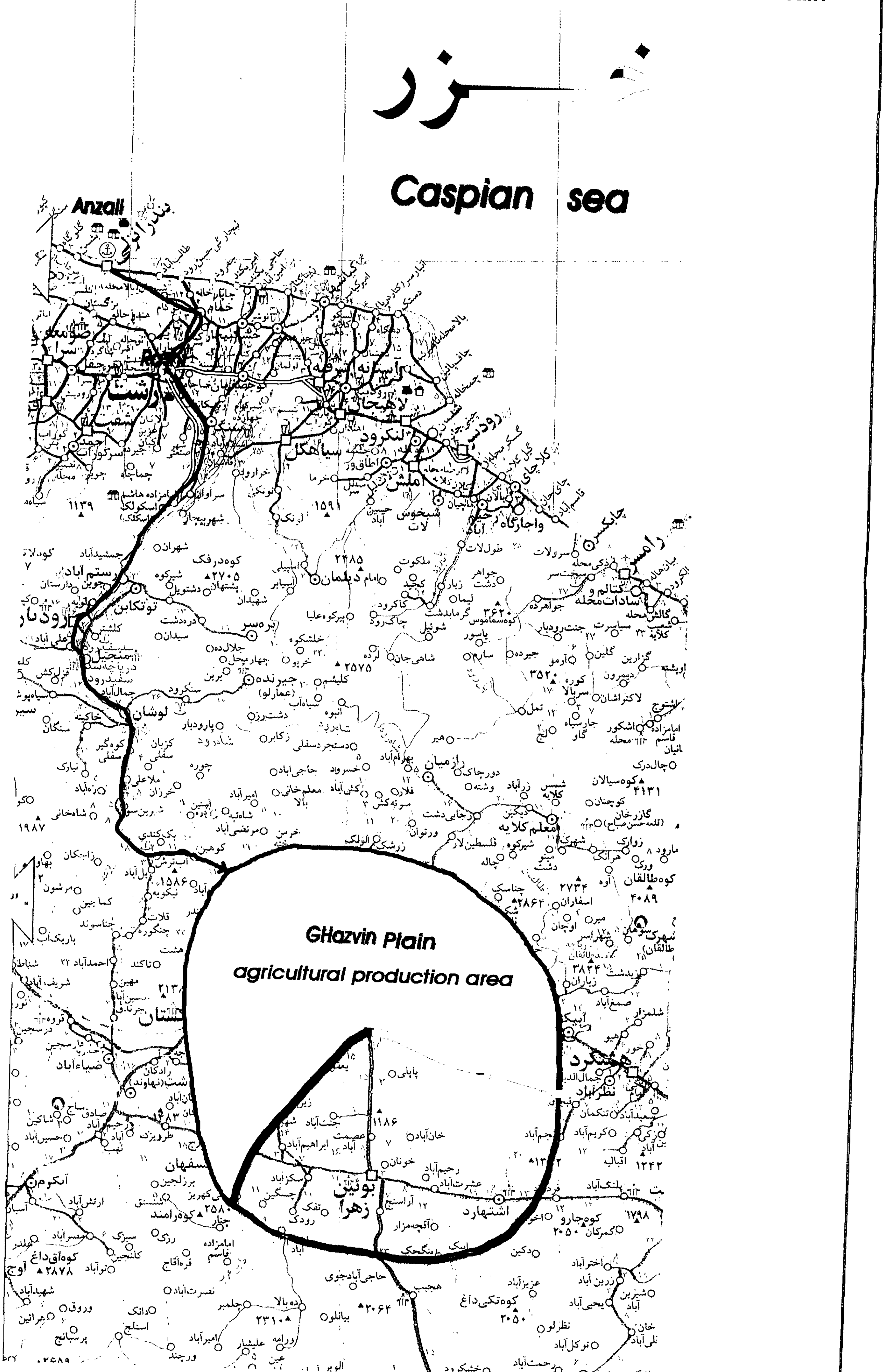
F. PROJ. No.			CLIENT: GILAN WATER & WASTEWATER COMPANY
T. PROJ. No.			
	SIGNATURE	DATE	IRANAB CONSULTING-ENGINEERS
DESIGNED BY.	M.ABBASI	2004	
DRAWN BY.	COMPUTER CENTER	2004	SCALE N.T.S.
CHECKED BY.	M.ABBASI	2004	
APPROVED BY.	TOOTOONCHI	2004	UNIT
FIELD	SEWAGE		DWG. No. AWWS-IR-17-4-4

Area of influence for Rasht and Anzali Project

F:\Sarah\mr.jafari\mr.j1.dwg No\R2A - EIA - IR - L

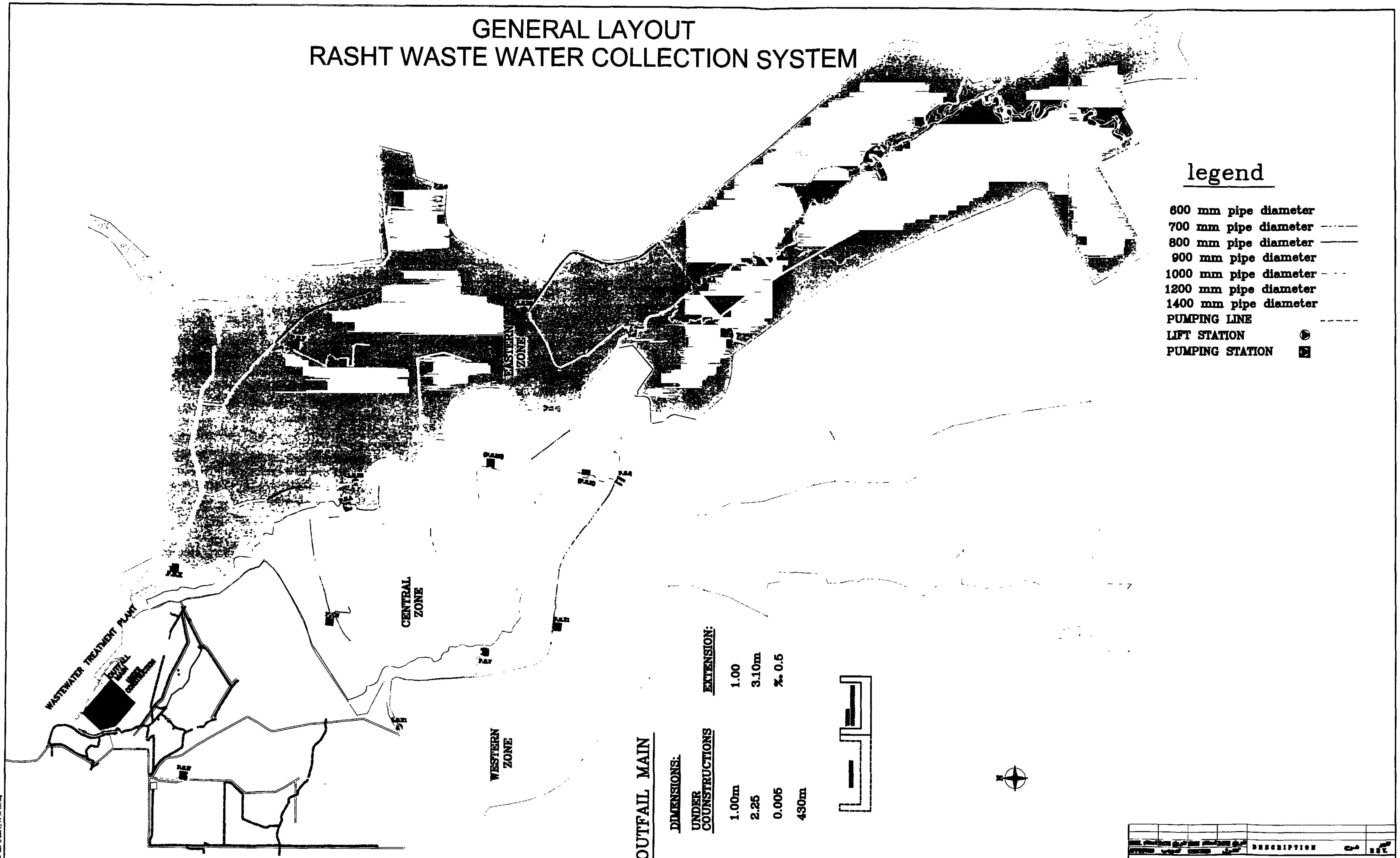
Length :260 km **Width (Max) : 75 km** **Area : 1212 km^2**

Rasht and Anzali treated sludge Storage and application area at GHazvin Plain



n f:\mr.jafari\rasht sludge - t.a\IRANAB

GENERAL LAYOUT
RASHT WASTE WATER COLLECTION SYSTEM



OUTFAIL MAIN

DIMENSIONS:

DESCRIPTION	UNDER COUNSTRUCTIONS	EXTENSION:
Height:	1.00m	1.00
Width:	2.25	3.10m
slope:	0.005	%. 0.5
length:	430m	
SECTION:		

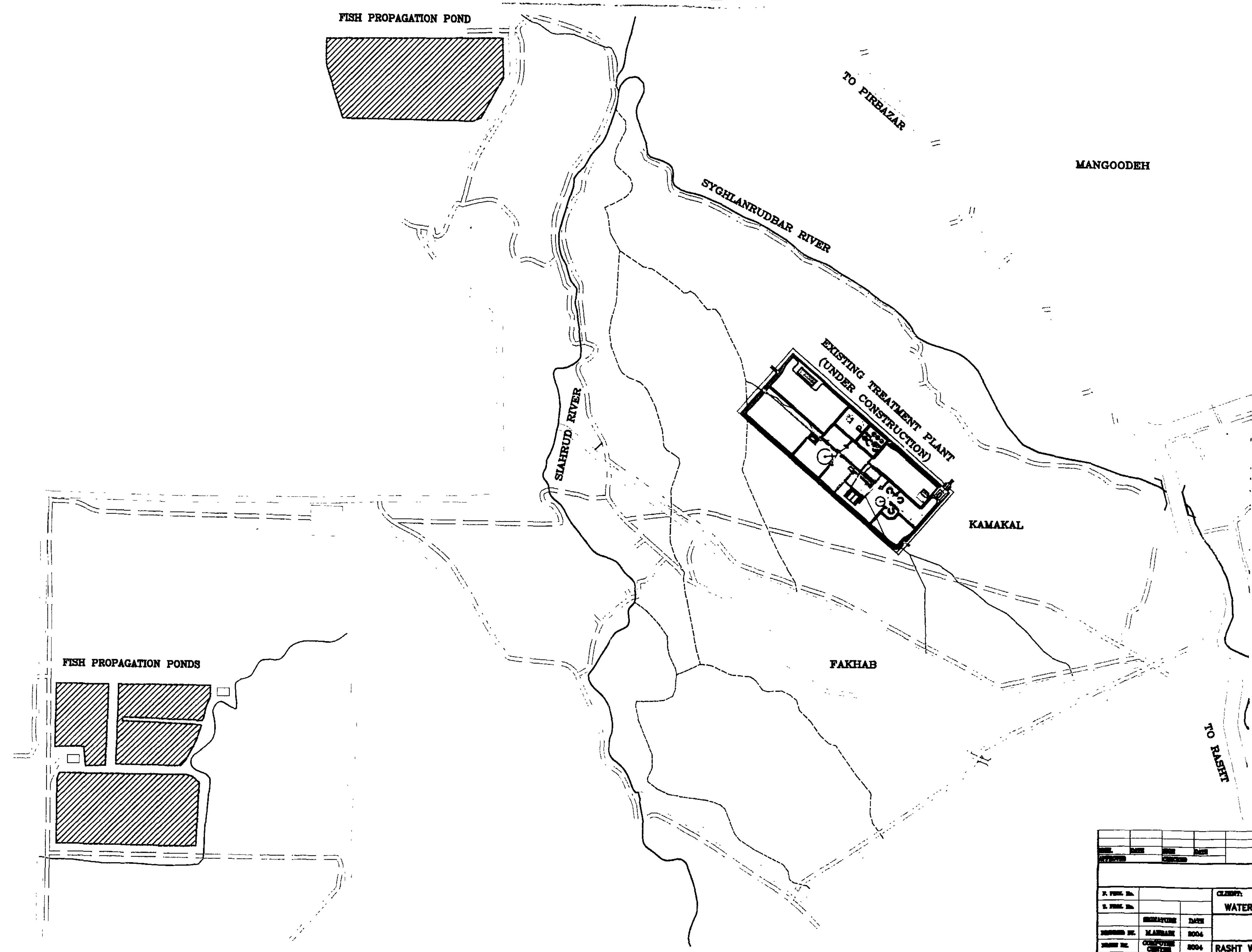
DESCRIPTION

IRANAB CONSULTING-ENGINEERS

RASHT

RASHT SEWAGE COLLECTION SYSTEM

GENERAL LAYOUT



				DESCRIPTION	REV.
		CLIENT: GILAN WATER & WASTEWATER COMPANY			
	SIGNATURE	DATE	IRANAB CONSULTING-ENGINEERS		
DESIGNED BY.	M.ABBASI	2004			
DRAWN BY.	COMPUTER CENTER	2004	RASHT WASTEWATER PROJECT COLLECTION SYSTEM UNDER CONSTRUCTION TREATMENT PLANT LOCATION PLAN		SCALE N.T.S.
CHECKED BY.	M.ABBASI	2004			
APPROVED BY.	TOOTOONCHI	2004			UNIT
FIELD	SEWAGE		DWG. No.RWWS-IR-138		

ANNEX B

Review of Policy, Legal and Environmental Regulations

Annex B-I: List of Existing Environmental Laws and Legislation

1. Environmental & natural resources management and general land use

Document	Date	Subject	Responsible bodies
Law	06.06.1967	Game and Fish	DOE
Law	20.01.1974	Amendment to Game and Fish	DOE
Law	16.12.1996	Amendment to Game and Fish	DOE
Regulation	30.11.1967	Regulation of Game and Fish law (1967)	DOE
Regulation	19.04.1995	Amendment to regulation of Game and Fish law (1967&1994)	DOE
Law, article 4	01.01.1972	Restructuring of Ministry of agriculture, establishing DOE and EHC	DOE
Law	18.06.1974	Environmental Protection and Enhancement Act	DOE
Law	15.11.1992	Amendment to Environmental Protection and Enhancement Act	DOE
Law	05.09.1995	Protection of bio-resources	DOE&FC (MOJA)
Law	02.07.1975	Coastal created properties act	MOJA, MOE
Law	21.08.1967	Protection and utilization of forest and rangeland	
Law, article 56	13.09.1989	Amendment to Protection and utilization Forest and rangeland	MOJA
Law	27.09.1992	Preservation and protection of Natural resources and Forest reserve	MOJA
Law, article 24	27.05.1998	Measures and permission procedures for mining	DOE&MOJA
Law	31.07.1991	Natural disaster impact reduction committee	MOI
Regulation	02.05.1993	Natural disaster impact reduction commission	MOI
Regulation	06.03.2000	Regulation on industrial siting criteria	DOE
Regulation	25.04.1999	Regulation of bio resources protection law	FC (MOJA) &DOE
Regulation	13.08.2000	Industrial siting Criteria in Guilan and Mazanderan provinces (Caspian Coastal Plain)	DOE
Law	20.04.1993	Marine territorial waters &EEZ in Persian Gulf and Oman Sea	DOE and PSO
Regulation	07.11.1994	Land use concerning Forest and rangeland law	MOJA
Regulation	10.021999	Mining	MOIM
Regulation	20.12.1992	Working in hard working environment/condition	MOW
Regulation	29.07.1984	Regulation on Note 66 of the budget law for gravelling	Province governor
Law	14.02.1992	Responsibilities of Institute of Standards and Industrial Research of Iran	MOIM
Law	03.05.1997	Amended to Responsibilities of Institute of Standards and Industrial Research of Iran	MOIM

2. Urban development, services and land use

Document	Date	Subject	Responsible bodies
Law, article 686	23.05.1996	Islamic penal code, trees cutting	DOE&MOH
Law	21.06.1995	Protection of Land use of farmland and Garden	MOJA
Regulation	14.01.1996	Protection of land use of farmland and garden	MOJH
Regulation	10.04.1980	Land use and development	MOJA
Law, rule 30	1949	Budget law of 1949 on displacement of workshops with adverse impact feom cities	MOI
Law, article 55	08.08.1973	Amended (municipalities law 1955), displacement of workshops with adverse impact	MUNS
Law	13.03.1973	Establishment of Urban planning and archeological high council	MOHUD
Law	06.04.1997	Amendment to Urban planning and archeological high council	MOHUD
Law	27.02.1993	High council for traffic in cities	MOI
Regulation	02.10.2000	Regulation on Surface water bodies buffer zone (article 51 of fair water act 1982)	MOE
Regulation	17.05.1976	Regulation on land use beyond cities border	MOJA, MUNS
Regulation	22.01.1995	Regulation on land use beyond cities border	MOJA, MUNS
Regulation	28.11.1994	Regional planning of Guilan and Mazanderan (Caspian Coastal Plain)	MOHUD
Law	02.05.1955	Municipalities organization and responsibilities	MUNS
Law	28.11.1968	Urban renovation and development, amended several times	MOHUD
Regulation	21.01.1988	Coordination of the activities among bodies providing cities services (digging public area)	MUNS
Law	24.05.1380	Protection and development of green area of the cities	MUNS

3. Protected areas

Document	Date	Subject	Responsible bodies
Law, article 31	04.05.1975	Amendment to protection and utilization of forest and rangeland on protected area	DOE
Regulation	22.02.1976	Chapter 1 and 2 on Protected area (for Environmental and Enhancement Act 1974)	DOE
Regulation	23.05.1990	Amended, Protected area (on Environmental and Enhancement Act 1974)	DOE
Regulation	19.04.1995	Amended Protected area (on Environmental and Enhancement Act 1974)	DOE
Rule 164 EHC	13.01.1992	Allocation of 10% of country's forest land for protected area	DOE

4. Environmental Assessment

Document	Date	Subject	Responsible bodies
Law, rule 105	**06.04.2000**	**Third five year plan on EA**	**DOE**
Law, rule 82	**10.01.1995**	**Second five year plan on EA**	**DOE**
Regulation	**30.09.1998**	**Regulation of EIA on rule 82 of second national plan**	**DOE**
Rules 138, 156 EHC	**12.04.1994**	**EIA rules**	**DOE**
Rule 166 EHC	**25.08.1999**	**EIA for Agro-industries over than 5000 hectares**	

5. Water management, air, water, soil and noise pollution

Document	Date	Subject	Responsible bodies
Law	22.05.1966	Protection and preservation of Ground water	MOE
Law	18.07.1968	Water act and nationalization of water resources	MOE
Regulation	0.8.05.1994	Regulations on water pollution prevention	DOE
Article 5	0.8.05.1994	Effluent standards Regulations on water pollution prevention	
Law	01.12.1990	Establishment of water and wastewater company	MOE
Law	02.01.1996	Establishment of Rural water and wastewater company	MOJA
Law	24.01.1976	Marine and River Oil pollution abatement	PSO (MORT)
Law, article 688	30.07.1997	Islamic penal code, pollution penalty	DOE and MOH
Law, article 690	30.07.1997	Islamic penal code, Destruction of the environment penalty	DOE
Law	23.04.1995	Air Pollution Abatement Act	DOE
Regulation	07.09.2000	Regulation on air pollution abatement	DOE
Regulation	22.02.1976	Chapter 3 on pollution prevention and abatement act	DOE
Regulation	09.06.1999	Regulation on noise pollution abatement	DOE
Law	08.05.1967	Plant protection/ Agrochemical application	PPO (MOJA)
Law	28.06.1970	Road and railway security	MORT
Law, article 6	04.01.2000	Amendment to Road and railway on measures for environmental protection	MORT
Law, article 1	04.01.1977	Amended for (law of MOH responsibilities1988) pesticides and chemical application	MOH
Law, article 7	01.10.1987	Oil law on protection of the environment	MOO
Regulation	15.04.1996	Commission on health of cities	MOH
Regulation	15.07.1992	Environmental Heath	MOH
Regulation	05.09.1999	Control and inspection of pesticides and chemicals	MOH
Regulation	22.04.1980	Protection against radiation	AEOI
Law	10.04.1984	Protection against radiation	AEOI
Law, article 85	29.08.1369	Law of work on occupational health	MOH
Regulation	19.11.2000	Standards of industrial emission	DOE

6. Protection of Historical sites in the cities

Document	Date	Subject	Responsible bodies
Law, article 9	**13.09.1987**	**Protection of national heritage and historical site in urban area**	**NHO&MOHUD**
Law, article 55	**02.05.1955**	**Municipalities law, protection of historical sites in the cities**	**NHO&MUNS**
Law, article 102	**02.05.1955**	**Municipalities law, protection of historical sites in the cities**	**NHO&MUNS**

Annex B-II: The Regulations for the Prevention of Water Pollution (Ratified on 7th May, 1994)

Article 1: The terms and expressions used in these regulations have the following meanings:

1. Department: The Department of Environment.
2. High Commission: The Environmental High Council.
3. Water Pollution: It refers to changes in the amount of dissolved or suspending materials, temperature, and other physical, chemical, and biological features of the water to the extent that the water becomes hazardous or unsuitable for its usual type of consumption.
4. Water Polluting Materials (Pollutant): Any type of material, or physical, chemical, and biological factor that causes water pollution or intensifies the existing pollution.
5. Sources Producing Water Pollution (Sources of Pollution): Any source whose activity or its utilization results in water pollution.
6. Sewage: It refers to any kind of liquid waste material produced by animal husbandry, industrial, agricultural, or residential, as well as other waste streams generated in hospitals and laboratories.
7. Solid Waste Materials: It refers to any solid material conventionally considered as waste and unwanted, such as garbage, trash, litter, ash, animal corpses, domestic and industrial unwanted materials, physical and chemical remains of the refineries, as well as human and animal excrements, the unwanted waste materials of hospitals and etc.
8. Receiving Waters: It refers to all kinds of surface and ground waters, including subterranean canals, wells, subterranean water sources, springs, and lakes, as well as the seas, rivers, streams, pools, and ponds into which the sewage and solid waste materials penetrate or are disposed.
9. Iran's Waters: It refers to all the internal and coastal and sea-border waters that are under the possession of the government of Islamic Republic of Iran.
10. Diluting: It refers to the reduction of the polluting materials in the sewage by mixing them with water or with the accepting water.
11. Proper Equipment and Methods: It refers to the best methods and equipment available, most fit to the local conditions that are using advance technologies, having scientific and technical potentials and through their

utilization the total elimination or considerable reduction of pollution would be possible.

12. Criterion (Standard): The permissible limits and specific characteristics that are prepared and fixed for the polluting factors and are set for the prevention of water pollution with respect to the principles of protecting and improving the condition of environment.
13. Responsible Person: It refers to a real person, who has the responsibility of managing or coordinating a source of pollution, such as a factory, workshop, or any other industrial establishment either for himself or as the representative of other real or legal person or persons.
14. Dangerous and Poisonous waste materials: It refers to any polluting waste material or any compound of unwanted materials which possesses great potentials for endangering human health or the health and well being of other living creatures or birds, creates negative impacts on them after repeated contact, or pollutes the water.

Article 2: Conducting any activity that may cause water pollution is strictly forbidden.

Article 3: The Department in collaboration with the ministries of Power, Agriculture Jihad, Health, and Medical Education, and other ministries and related organizations, which may get involved depending to the case, will take measures for the examination of the quality of Iran's water resources in order to determine the degree of their pollution.

Note 1: The Ministry of Hygiene, Health, and Medical Education will act according to its own rules and regulations for the control of the water resources that are bigger than small ponds.

Note 2: Regarding the pollution of the seas, rivers, and lakes, as well as the Border Rivers being polluted with oil substances, the regulations related to Protecting the Border Seas and Rivers from the oil pollution sources will be mentioned.

Article 4: The Department is obliged to take proper measures in identifying the various sources of water pollution. The responsible persons are obliged to provide the Department with the required information and documents whenever the Department demands them.

Note 1: The Ministries of Interior Affairs, Hygiene, Health, and Medical Education, Power, Agriculture Jihad, Industries and Mines, and if needed other related institutions will collaborate with the Department for the execution of the content of this article.

Note 2: The information and documents that are confidential and of security importance are nevertheless given to the Department, but will be considered confidential and will not be used other than the legal issues.

Article 5: The standards related to water pollution along with a description of the methods of measurement and other related regulations will be prepared and put into execution by the Department in collaboration with the ministries and institutions mentioned in article (3) of the present paper of regulations.

Note: With respect to the regulations concerned about the disposal of any kind of sewage into the public system of city sewer and the collection, maintaining, and transportation of unwanted solid materials, a permanent committee consisting of the authorized representatives of the Ministries of Interior Affairs, Hygiene, Health, and Medical Education, Power, Agriculture Jihad, Industries, Mines and Metals, the Department of Environment, and other organizations responsible for the water and sewage issues of the city will be held in the Ministry of Interior Affairs and the decisions made will be put into execution.

Article 6: The gradual classification of the accepting waters, including the surface and ground waters, as well as lakes and coastal waters on the base of their natural capacities for accepting and purifying the polluting factors will be carried out with respect to the priorities defined by the Department in collaboration with the ministries and institutions mentioned in article 3 of the present paper of regulations.

Article 7

The Department of Environment is obliged to collect samples of the sewage and the solid waste materials, according to the previously prepared program, in order to determine the kind and the rate of pollution related to each source. If the severity of pollution in any of these sources of pollution exceeds the standard limits of article (5) of the present paper of regulations, the Department will warn the responsible person to take measures in stopping the pollution. In this warning, the type of pollution and its rate will be specified, and with respect to the potentials and equipment available, the deadline to prevent from spreading the pollution will be determined and directly stated.

Note: Considering the industrial complexes and towns which possess their ow sewer system, the Department will collect samples from the sewers industrial and non-industrial parts of the towns and complexes and will t appropriate measures in stopping the pollution with the responsibility company or complex.

If the units established in these towns and complexes have industrial s containing poisonous substances of heavy metals, which cannot be controlled tl the municipal sewer system, according to the decision of the Departm Environment, that unit will be asked to construct a system of sewage works.

Article 8: The responsible persons are obliged to take measures for stoppin pollution according to the standards before the deadline specified in the wa otherwise, according to the article (11) of the law of Protecting and Improvin Environment, the activities or the utilization of the polluting source will have stopped until the problem of the pollution is solved.

Article 9: If the person responsible for the source of pollution present accept reasons and evidences to prove that stopping the pollution within the limits of deadline given in the warning is practically impossible, the Department is allowe give another respite to the polluting source, provided that the continuation of pollution does not pose a high risk for the human health and the well-being of o living creatures.

Article 10: In fulfilling its legal duties, the Department is allowed to inspect all sources of pollution by its agents. In case the inspection of any of these sourc according to another law, requires a search warrant issued by

the district attorney, measures will be taken for the agents to act as the representati of the district attorney.

Note: The authorities are legally required to cooperate with the agents of tl Department in the execution of the content of the present law.

Article 11: When issuing licenses for the expansion or the construction of industria mining, and agricultural establishments or animal husbandry, chicken breedin centers, and slaughterhouses the Ministries of Industries, Interior Affairs, Agricultur Jihad, and other authorized institutions, involved in similar activities, are required to notify the applicants of the indispensable standards and regulations referred to in the article (5) of the present regulations.

The permissions to be given for the utilization of the mentioned units are depending on the observation of the above-mentioned standards and regulations.

Article 12: The related authorities will send a copy of their permits of the establishment and utilization of their units (referred to in the article 11) to the Department.

Article 13: When preparing the comprehensive directing plans of the cities, towns, residential complexes, and health constructions the Ministries of Housing and Urban Development and Interior Affairs, and the municipalities, related organizations and their dependent units must notify the designers and executors of the standards and regulations mentioned in the article (5) of the present regulations. The municipalities are also required to do the same when issuing construction permits in the cities.

Article 14: The disposal and transference of the sewage or any other polluting material from different sources to accepting waters, more than the standard limits are strictly forbidden. The Department in collaboration with the related ministries and institutions will determine the classification of the types of pollutions and different unwanted materials.

Article 15: Based on sufficient reasons, if the Department concludes that the reduction or the elimination of the pollution caused by the sources of pollution is not possible by any way, other than transferring them to another place, it prepares a plan in collaboration with the Ministries of Agriculture Jihad, Industries, Housing and Urban Development, Power, and Employment and Social Services and after its ratification by the Ministers' Committee, puts it into execution.

Article 16: If necessary, the Department is allowed to install the appropriate equipment and methods for the unregistered or small sources of pollution.

Article 17: Dilution of the sewage in its disposal stage as a purification step is forbidden, unless in special cases when according to the examinations of the Department, it does not pose any risk for the polluting the environment.

Article 18: The responsible persons are obliged to take preparatory measures for the emergency situations when the purification of the sewage is stopped for any reason.

The measures must be taken in order to avoid disposing the untreated sewage into the accepting water.

Article 19: When, according to the article (11) of the law of Protection and Improvement of the Environment and its comment, the warrant for stopping the activities of a factory or a workshop is issued, the district attorney of the local jurisdiction will be informed so that the required orders are communicated.

Article20: In order to prevent water pollution and to encourage all the responsible persons to stop the pollution in the sources of pollution, and to motivate them to find appropriate equipment and methods and conduct research studies for the fulfillment of the purpose the Department develops the necessary plans and puts them into execution.

Article 21: The formalities of communicating the warning of the Department to the sources of pollution follow the procedures of the law of civil adjudication.

Article 22: If violation of the present regulations results in any damage to the environment of the aquatic creatures or natural resources, in response to the Department's demand, the court will sentence the responsible persons to paying some fines and compensating the damage.

The regulations for preventing water pollution (the subject of ratification paper of 90302 on November 29th, 1985) is hereby canceled.

Note: Until the expert companies, scientific centers, and expert persons are formed or educated; the Organization of Planning and Budget, in collaboration with the Department of Environment, will publish a preliminary list.

Article7: The environmental impact assessment will be carried out for the two separated stages of construction and utilization with clarified references to the main activities. The experts preparing the report will also introduce the main activities to be carried out in order to reduce the negative environmental impacts and their expenses.

Article 8: The experts preparing the report on the environmental impact assessment will express their advice at the conclusion of the report in one of the following three ways:

A) Due to the severity and the wide extent of its unfavorable impacts on the environment, the execution of the project is not advised.

B) If certain precautions and activities are considered and put into execution to reduce the unfavorable environmental impacts, the execution of the project is permissible (expenses of the activities included).

C) The project can be executed without extensive precautions and activities for the reduction of negative environmental impacts.

Article 9: The Department of the Environment, on the bases of the communicated regulations, announces its final opinion in less than three month.

Note 1: A scientific meeting for the environmental impact assessment, including the experts and academic authorities on the subject, is held under the supervision of the head of the Department of Environment in order to coordinate the affairs related to the environmental impact assessment. The committee will be held with the following members and will be responsible for the scientific affairs related to the assessments.

- The head of the Department of Environment as the chairperson of the committee.
- Five experts chosen by the head of the Department form among the experts and academic authorities on the subject.
- The representative of the Organization of Planning and Budget.
- The representative of the Organization of the Forests and Pastures of the Country.

- The representative of Iran's Institution of Standard and Industrial Research.
- The representative of the ministry or the organization presenting the evaluated reject.

Note 2: When, according to the environmental assessment and based on the laws and regulations for the protection of environment, it is clear that the execution or the utilization of any of the constructional and developmental projects will have unfavorable impacts on the environment, the Department will communicate the case to the planning ministry or the institution so that it can revise the project, and remove the obstacles in collaboration with the related organizations. If there is disagreement over the points, the final decision is made by the president.

Article 10: After the examinations related to the current environmental conditions of the location are done, the other aspects examined for determining the environmental impacts in all the seven types of plans and projects are subdivided into the following four parts:

A) The environmental impacts on the physical environment.

1. Impacts on soil: Morphological and Qualitative.
2. Impacts on water: The quality and the quantity.
3. Impacts on the climate, air, and sounds: The changes in the air, rainfall, and the quality of the air.
4. The secondary impacts on soil, water, and air.

B) The environmental impacts on the natural environment.

1. Impacts on the Flora
2. Impacts on the Fauna
3. Impacts on the locations of living creatures, landscapes, and the routes of migratory birds.

C) The environmental impacts on the cultural and social environment.

1. Impacts on the human health and hygienic environment.
2. Impacts on the social environment: Employment, housing and education.
3. Impacts on the cultural environment: Cultural heritage and religious beliefs.

D) The environmental impacts on the development projects.

1. Impacts on other agricultural, industrial, and social service plans for the development of the region.
2. Impacts on the logistic plans of the region.
3. Impacts on the practical uses of the lands of the region.

The Environmental High Council, in the meeting held on 22nd December 1997, ratified the present pattern, including ten articles and eight comments.

Annex B-IV: Environmental Standards

(According to article 5 of the regulations for the prevention of water pollution)

Introduction and Definitions:

These standards are prepared according to the articles 3 and 5 of the regulations concerning the prevention of water pollution (1994), in collaboration with the Ministries of Hygiene, Health and Medical Education, Power *(presently Ministry of Energy)*, Industries, Mines and Metals, Interior Affairs, and Agriculture Jihad by the Department of Environment.

In this paper of standards, the following definitions and expressions are used:

Surface Water: It refers to the seasonal or permanent waters, natural or artificial lakes, and ponds.

Absorbing Well: It refers to a hole or ditch that is capable of absorbing water and its bottom is at least three meters above the ground water table.

Absorbing Trench: It refers to a system of horizontal canals into which sewage is directed in order to be absorbed into the ground and the distance between its bottom and the Ground water table is at least three meters.

Bypass: It refers to a canal that leads the sewage from one part to another or to an exit canal without passing form one part or all the parts of the sewage treatment plant.

The Composite Sample: It refers to a 24-hour sample from the samples that are collected in intervals of at most 4 hours.

General Considerations:

1. The discharging of the sewage must be done according to the standards that specify the maximum density of the polluting factors and the observation of the limits set by these standards must be supervised by the Department of Environment.
2. The authorities of the sources of pollution must purify the produced sewage to the limits of the safe standards with appropriate and economical technology and by expert examiners.
3. The act of measuring the density of the polluting materials and the amount of the flow in the sewers must be carried out immediately after the flow passes the final unit of the sewage treatment plant and before it is discharged into the environment.
4. The act of measuring for the purpose of comparing the densities with the established standards before the sewage works must be done by the use of

compound samples. In systems with disconnected disposal, the measuring carried out at the time of disposing is valid and proper to be examined.

5. The sludge or the other solid materials produced by the sewage works must be properly purified before their final disposal and the final disposal of these materials must not cause any pollution in the environment.
6. The treated effluent must be disposed of in the receiving water gradually and in a way that the maximum amount of dilution will take place.
7. The exiting sewage must not have a disagreeable odor or contain scum and floating substances.
8. The color and the turbidity of the effluent must not noticeably change the appearance of the accepting water and the place of disposal.
9. The methods used for measuring the pollutants will be based on the methods mentioned in" Standard Methods for the Examination of Water and Waste Water .
10. Making use of Septic Tank and Imhoof Tank systems with using absorbing wells and trenches in the areas that the distance between the bottom of the well or the trench and the surface of the subterranean waters is less than 3 meters is forbidden.
11. In addition to the necessity of observing the related standards, the effluent must not affect the quality of the water for the purposes for which it is used.
12. It is not acceptable to dilute the purified sewage to reduce the amount of the polluting factors to the established standard levels.
13. Making use of methods of vaporizing the sewage is allowed, provided that the Department of Environment issues the permit.
14. Making use of side passages is forbidden, but those side passages, which are used just for eliminating the defects of the treatment plant units or are used for mixed collecting of the city sewage and rainwater can be used.
15. The sewage works must be planned, constructed, and utilized in such a way that, they contain the required preparations for minimizing the pollution to the least amount during emergencies such as unfavorable and adverse whether conditions, the disconnection of electricity, the defects of the mechanical equipment. Those kinds of industrial wastewaters whose pollution does not exceed the standard limits, can be disposed without treatment, provided that the Department of Environment grants the permit.

Note 1: The disposal with a density higher than the standards given, will be allowed, provided that the exiting hogwash does not increase more than 10% the density of Chloride, Sulfate, and dissolved materials of the accepting source in the radius of 200 meters.

Note 2: The disposal with a density higher than the standards given, will be allowed, provided that the density of Chloride, Sulfate, and dissolved materials of the exiting hogwash does not exceed those of the consumed water by 10%.

Note 3: The existing industries will be allowed to reduce the BOD and COD by at least 90%.

Note 4: The magnitude of the temperature must be controlled so that it does not increase or decrease the temperature of the accepting source in the radius of 200 meters from the exit more than 3 degrees centigrade.

Note 5: If it is used for the irrigation of the produce consumed uncooked, the number of the parasite larva in the purified sewage of the city must not be more than one in one liter.

Annex B-IV-1: Drinking Water Standard

(Institute of Standards and Industrial Research of Iran ISIRI)

1- Physical properties

No	Parameter	Maximum Permissible Level	Desirable
1	Turbidity	5 NTU (Nephelometric Turbidity Unit)	1=>
2	Color	20 T.C.U (True Color Unit)	1=>
3	Odor	2 at 12 and 3 at 25 degree Celsius	0
4	pH	6.5-9	7- 8.5
5	Taste	Acceptable to public , no objection of public	-
6	Oil	Not visible	-

2- Toxic metals

No	Parameters	Maximum Permissible mg/l
1	As	0.05
2	Pb	0.05
3	Cr	0.05
4	Se	0.01
5	Cd	0.005
6	Sb	0.005
7	Hg	0.001
8	Mo	0.07
9	CN	0.07
10	V	0.1

3- Toxic Organic Substances

No	Parameter	Maximum permissible microgram/l
1	Aldrin-dialdrin	0.03
2	Chlordane	0.2
3	2-4Dichlorophonexy acetic acid	30
4	DDT (Dichloro Diphenyl Trichloro ethan)	2
5	1,2-dichloroethane	30
6	1,2-dichloroethene	50
7	Heptachlor and heptachlor epoxide	0.03
8	Hexachloro benzene	1
9	Lındane	2
10	Methoxychlor	20
11	P.A.H (Poly Nuclear Aromatic Hydrocarbons)	0.2
12	Alachlor	20
13	aldicrab	10
14	Atrazine	2
15	Bentazone	30
16	Carbfuran	5
17	Chlorotoluron	30
18	1,2-dibromo 3-chloropropane	1
19	1,2-dichloropropane	20
20	THM'S	
• Chloroform		200
• Bromoform		100
• Bromodichloromethane		60
• Dibromochloromethane		100

No	Parameter	Maximum permissible microgram/l
21	Isoproturon	9
22	2methyl 4 chloro phenoxy Acetic Acid MCPA	2
23	Metolachlor	10
24	Molinate	6
25	Pendimethalin	20
26	Pentachloro phenol	9
27	Permethrin	20
28	Propanil	20
29	Pyrodate	100
30	Simazine	2
31	Trifluralin	20
32	Dichloroprop	100
33	Fenoprop	9
34	2-4-5 Trichlorophenoxiprpopenic Acid	9
35	Surfactant	200
36	Phenol Index	0.5
37	Residual pesticides (Used in the region)	WHO standards

4- Inorganic substances

No	Parameter	Maximum permissible mg/l
1	(TDS)	1500(1)
2	CaCO3	500(2)
3	Cl	400
4	So4	400
5	H2S	0.05
6	Fe	0.3
7	Mn	0.5
8	Al	0.2
9	Zn	3
10	Cu	1
11	NO3	50 (3)
12	NO2	3 (3)
13	Ca	250
14	Mg	50
15	NH3	1.5
16	Na	200 (4)

1. In specific condition up to 2,000 mg/l
2. Suggested according to technical and economical condition of Iran
3. Total of nitrite and nitrate should be less than one mg/l
4. In specific condition with sever shortage of water up to 250mg/l

5- Microbial parameters

No	Parameter	Level
1	Microbial parameters	WHO standard

Annex B-IV-2: Sewage Effluent Standard

(Department of the Environment)

No	Contaminants	Discharges into surface water mg/l	Absorbing Wells mg/l	Agriculture and Irrigation use mg/l
1	Ag	1	0.1	0.1
2	Al	5	5	5
3	As	0.1	0.1	.01
4	B	2	1	1
5	Br	5	1	1
6	Be	0.1	1	0.5
7	Ca	75	-	-
8	Cd	0.1	0.1	0.05
9	Cl	1	1	0.2
10	Cl-	600 (Note 1)	600 (Note 2)	600
11	CH2O	1	1	1
12	C6H5OH	1	Very low	1
13	CN	0.5	0.1	0.1
14	Co	1	1	0.5
15	Cr+6	0.5	1	1
16	Cr+3	2	2	2
17	Cu	1	1	0.2
18	F	2.5	2	2
19	Fe	3	3	3
20	Hg	Very low	Very low	Very low
21	Li	2.5	2.5	2.5
22	Mg	100	100	100
23	Mn	1	1	1
24	Mo	0.01	0.01	0.1
25	Ni	2	2	2
26	NH4	2.5	1	-
27	NO2	10	10	-
28	NO3	50	10	-
29	P-PO4	6	6	-
30	Pb	1	1	1
31	Se	1	0.1	.01
32	SH2	3	3	3
33	SO3	1	1	1
34	SO4	400 (Note 1)	400 (Note 2)	500
35	V	0.1	0.1	0.1
36	Zn	2	2	2
37	Oil (lipid)	10	10	10
38	ABS-Detergents	1.5	0.5	0.5
39	BOD_5*	30	30	100
40	COD*	60	60	200
41	DO	2	-	2
42	TDS	Note 1	Note 2	-
43	TSS	40 instant	-	100
44	SS	0	-	-
45	pH	6.5-8.5	5-9	6-8.5
46	Radioactive substances	0	0	0
47	Turbidity Turbidity unit	50	-	50

No	Contaminants	Discharges into surface water mg/l	Absorbing Wells mg/l	Agriculture and Irrigation use mg/l
48	Color (color unit)	75	75	75
49	Temperature-C	Note 3	-	-
50	Fecal Coliform NO/100ml	400	400	400
51	Total Coliform NO/100ml (MPN)	1000	1000	1000
52	Nematode egg	-	-	<1 per 1000 ml

Note 1: Discharges of higher concentration than mentioned in table will only be allowed when the effluents do not increase the Chloride, Sulfate and dissolved solids concentration in admitting water by over 10 percent in a radius of 200 m.

Note 2: Discharges of higher concentration than mentioned in table will only be allowed when the increase of Chloride, Sulfate and dissolved solids concentration in effluents in relation to used water does not exceed 10 percent.

Note 3: Temperature should not increase or reduce temperature of receiving water more than 3 centigrade, in a radius of 200 meters.

* Industries should reduce BOD_5 & COD by at least 90%.

Annex B-IV-3: Industrial Discharge Into Sewage Collection System Standard (Ministry of Industry)

Industries, which discharge their effluent into sewage collection system, should pre-treat the effluent up to the levels set by the Ministry of Industry. These are summarized in the Table below.

Industrial Effluent Quality for Discharge into Collection System

Item	Parameter		Value
1	Temperature	°C	43
2	pH		6.5-9
3	Total oil & grease	*mg/l*	50
4	Sulphates	*mg/l-*So_4^{-2}	400
5	Suspended solids (SS)	*mg/l*	350
6	BOD_5	*mg/l-*O_2	280
7	Phenol and creosol	*mg/l*	5
8	Copper	*mg/l-Cu*	1
9	Zinc	*mg/l-Zn*	1
10	Nickle	*mg/l-Ni*	2
11	Silver	*mg/l-Ag*	0.1
12	Mercury	*mg/l-Hg*	0.1
13	Lead	*mg/l-pb*	1
14	Cadmium	*mg/l-cd*	1
15	Cromium	*mg/l-*cr^{6+}	2
16	Cromium	*mg/l-*cr^{3+}	6
17	Iron	*mg/l-*Fe^{3+}	10
18	Beryllium	*mg/l-Be*	1
19	Cyanide	*mg/l-CN*	0.5
20	Arsenic	*mg/l-AS*	1
21	Radioactivity	*mci/cm3*	10^{-7}

Annex B-IV-4: Outdoors Noise Standard

(Department of the Environment)

Type of area	Day time (07-22 hours)	Night time (22-07 hours)
Residential area	50dB	30dB
Residential- commercial area	60dB	50dB
Commercial area	65dB	55dB
Residential-Industrial area	70dB	60dB
Industrial area	75dB	65dB

Annex B-IV-5: Air Pollution Standard

(Department of the Environment)

Full long list of emission standards for various point sources are available in DOE air pollution standards published by DOE (in Persian).

The ambient air quality standard is presented in the table below.

Ambient Air Quality Standard

Pollutant	Primary		Secondary	
	mg/m^3	ppm	mg/m^3	ppm
Carbon Monoxide Maximum8-hour concentration Maximum1-hour concentration	 10000 40000	 9 35	 10000 40000	 9 35
Sulfur Dioxide Annual average Maximum24-hour concentration Maximum3-hour concentration	80 365 -	0.03 0.14 -	60 260 1300	0.02 0.1 0.5
Non-Methane Hydrocarbons Maximum3-hourConcertration (6-9Am)	160	0/24	160	0.24
Nitrogen Dioxide Annual Average Concentration	100	0/05	100	0.05
SPM Annual Average Maximum24-hourAverage	 75 260		 60 150	
Photochemical Oxidants Maximum1-hour	160	0.08	160	0.08

Annex B-IV-6: Japanese Water Related Standards

Standards Related to the Conservation of the Living Environment in Rivers

Class	Item	Standard value				
	Water use	PH	BOD	SS	DO	Total coliform
AA	Water supply class 1, conservation of natural environment and uses listed in A-E	6.5-8.5	1 mg/l or less	25 mg/l or less	7.5 mg/l or more	50 MPN/100ml or less
A	Water supply class 2, fishery class 1, bathing and uses listed in B-E	6.5-8.5	2 mg/l or less	25 mg/l or less	7.5 mg/l or more	1000 MPN/100ml or less
B	Water supply class 3, fisheryclass 2. and uses listed in C-E	6.5-8.5	3 mg/l or less	25 mg/l or less	5 mg/l or more	5000 MPN/100ml or less
C	Fishery class 3, Industrial water class 1 and uses listed in D-E	6.5-8.5	5 mg/l or less	50 mg/l or less	5 mg/l or more	-
D	Industrial water class 2, agricultural water and uses listed in E	6.0-8.5	8 mg/l or less	100 mg/l or less	2 mg/l or more	-
E	Industry water class 3, and conservation of environment	6.0-8.5	10 mg/l or less	Floating Matter such as garbage should not be observed	2 mg/l or more	-

Ref: Japan standard, 2000.

(BOD : Biochemical Oxygen Demand, SS : Suspended Solids, DO : Dissolved Oxygen)

Notes :

1. The standard value is based on the daily average value. (The same applies to the standard values of lakes and coastal waters.)
2. At intake for agriculture, pH shall be between 6.0 and 7.5 and DO shall be more than 5mg/l the same applies to the standard values of lakes.

Standards Related to the various uses of Rivers

Class	Item	Standard value	
	Water use	Total nitrogen	Total phosphorus
I	Conservation of the natural environment and uses listed in II-IV (except fishery classes 2 and 3)	0.2 mg/l or less	0.02 mg/l or less
II	Fishery class 1, bathing and the uses listed in III-IV (except fishery class 2 and 3)	0.3 mg/l or less	0.03 mg/l or less
III	Fishery class 2 and the uses listed in IV (except fishery class 3)	0.6 mg/l or less	0.05 mg/l or less
IV	Fishery class 3, industrial water, and conservation of habitable environments for marine biota	1 mg/l or less	0.09 mg/l or less

Note:

1- Standard values are set in terms of annual averages.
2- Standard values are applicable only to marine areas where marine phytoplankton blooms may occur.

Environmental Quality Standards for Water Pollutants Regarding Human Health

Item	Standard Values
cadmium	0.01 mg/liter or less
total cyanogen	0.01 mg/liter or less
lead	0.01 mg/liter or less
chromium (VI)	0.05 mg/liter or less
arsenic	0.01 mg/liter or less
Total mercury	0.0005 mg/liter or less
alkyl mercury	not detectable
PCBs	not detectable
dichloromethane	0.02 mg/liter or less
carbon tetrachloride	0.002 mg/liter or less
1, 2-dichloroethane	0.004 mg/liter or less
1, 1-dichloroethylene	0.02 mg/liter or less
cis 1, 2-dichloroethylene	0.04 mg/liter or less
1, 1, 1-trichloroethane	1.0 mg/liter or less
1, 1, 2-trichloroethane	0.006 mg/liter or less
trichloroethylene	0.03 mg/liter or less
tetrachloroethylene	0.01 mg/liter or less
1, 3-dichloropropene	0.002 mg/liter or less
thiram	0.006 mg/liter or less
simazine	0.003 mg/liter or less
thiobencarb	0.02 mg/liter or less
benzene	0.01 mg/liter or less
selenium	0.01 mg/liter or less

***Source:** Environment Agency of Japan.*

Notes:

1. Standard values are the annual mean.
2. The value for total CN is the maximum value.

Monitoring Substances and Guideline Values

Categories	Guideline Values
chloroform	0.06 mg/liter or less
trans 1, 2-dichloroethylene	0.04 mg/liter or less
l, 2-dichlorpropane	0.06 mg/liter or less
p-dichlorobenzene	0.3 mg/liter or less
isoxathion	0.008 mg/liter or less
diazinon	0.005 mg/liter or less
fenitrothion	0.003 mg/liter or less
isoprothiolane	0.04 mg/liter or less
oxine	0.04 mg/liter or less
copper	0.04 mg/liter or less
chlorothaloni	0.008 mg/liter or less
propyzamide	0.006 mg/liter or less
EPN	0.01 mg/liter or less
dichlorvos	0.02 mg/liter or less
fenobucarb	0.008 mg/liter or less
IBP	-
CNP	0.6 mg/liter or less
toluene	0.4 mg/liter or less
xylene di (2-ethylhexyl) phtalate	0.06 mg/liter or less
boron	0.2 mg/liter or less
fluoride	0.8 mg/liter or less
nickel	0.01 mg/liter or less
molybdenum	0.07 mg/liter or less
antimony	0.002 mg/liter or less
Nitrat e-N and nitrite-N	10 mg/liter or less

Source: Environment Agency of Japan.

Irrigation Water Quality Standards

Quality Classification of Water for Irrigation (after Wilcox)

Water Class	Percent Sodium	Specific Conductance, µS/cm	Boron, mg/l		
			Sensitive Crops	Semitolerant Crops	Tolerant Crops
Excellent	<20	<250	<0.33	<0.67	<1.00
Good	20-40	250-750	0.33-0.67	0.67-1.33	1.00-2.00
Permissible	40-60	750-2000	0.67-1.00	1.33-2.00	2.00-3.00
Doubtful	60-80	2000-3000	1.00-1.25	2.00-2.50	3.00-3.75
Unsuitable	>80	>3000	>80	>2.50	>3.75

Chemical Analysis and Classifications of Selected Ground waters in California (after Donnen, L.D., Calif. Agric., v. 4, no. 11, 1950)

Number	Specific Conductance, µS/cm	B, mg/l	Major Constituents, meg/l						Percent Na	Wat Clas
			Ca	Mg	Na	CO_3 $+HCO_3$	Cl	SO_4		
1.	260[b]	0.13	1.41	0.44	0.89	1.88	0.34	0.33	32	Good
2.	270	0.10	0.21	0.05	2.42	1.20	0.68	0.67	90	Unsuit
3.	790	6.90	0.24	0.02	7.28	2.39	2.47	2.48	96	Unsuit
4.	900	0.51	2.49	5.81	2.83	8.87	1.13	1.02	25	Permis
5.	1090	...	1.20	2.00	8.10	8.10	1.00	2.60	72	Doubtf
6.	1370	0.25	8.30	0.75	3.96	2.46	2.73	4.47	30	Permis
7.	1740	0.71	2.14	0.08	12.67	1.02	12.04	1.80	85	Unsuit
8.	2550	0.50	11.40	5.70	12.90	2.80	2.80	23.00	45	Doubtf
9.	4330	1.63	12.37	16.71	27.39	2.75	8.55	41.74	49	Unsuit

[a] Based on above table
[b] Underlined values determine water class

Annex B-IV-7: FAO Guidelines

F.A.O. Guideline for Maximum Permissible Concentration of Elements in Water Used for Irrigation

Item	Contaminants		For waters that are used continuously for all kind of soils	For use up to 20 years in soil with fine structure and PH = 6.5-8.5
1	Aluminum	*mg/l-Al*	5	20
2	Arsenic	*mg/l-As*	0.1	2
3	Beryllium	*mg/l-Be*	0.1	2.5
4	Born	*mg/l-B*	0.75	2
5	Cadmium	*mg/l-cd*	0.01	2.5
6	Chromium	*mg/l-cr*	0.1	1
7	Cobalt	*mg/l-co*	0.05	5
8	Copper	*mg/l-cu*	0.2	5
9	Fluoride	*mg/l-F*	1	15
10	Iron	*mg/l-Fe*	5	20
11	Lead	*mg/l-pb*	5	10
12	Lithium	*mg/l-Li*	0.075	0.075
13	Manganese	*mg/l-Mn*	0.2	100
14	Molybdenu	*mg/l-Mo*	0.01	0.05
15	Nickel	*mg/l-Ni*	2	2
16	Silica	*mg/l-Si*	0.02	0.02
17	Vanadium	*mg/l-V*	0.1	1
18	Zinc	*mg/l-Zn*	2	10

Annex B-IV-8: WHO Guidelines

Recommended Microbiological Quality Guidelines for Wastewater Use in Agriculture (WHO 1989)[1]

Category	Re-Use Conditions	Exposed Group	Intestinal Nematodes (arithmetic mean of eggs per 100ml)[2]	Fecal Coliforms (geometric mean no. per 100ml)[3]	Wastewater treatment expec to achieve the required microbiological quantity
A	*Irrigation of crops likely to be eaten uncooked sports fields public parks*[4]	Workers, consumers, public	<1	<1000	*A series of stabilization pon designed to achieve the microbiological quality indicated or equivalent treatment*
B	*Irrigation of cereal crops, industrial crops, fodder crops, pasture and trees*[5]	Workers	<1	No standard recommended	*Retention in stabilization po for 8-10 days or equivalent helminth and faecal coliform removal*
C	*Localized irrigation of crops in category B if exposure of workers and the public does not occur.*	None	Not applicable	Not applicable	*Pre-treatment as required b the irrigation technology, bu not less than primary sedimentation*

Source: WHO, 1989

[1] In specific cases, local epidemiological, socio-cultural and environmental factors should be taken into account and the guidelines modified accordingly.

[2] Ascaris .Trichuirs and hookworms.

[3] During the irrigation period.

[4] A more stringent guideline (<200faecal coliforms /100ml) is appropriate for public lawns, such as hotel lawns. with which the public may have direct contact.

[5] In the case of fruit trees. Irrigation should cease two weeks before fruit is picked ,and no fruit should be picked off the ground. Sprinkler irrigation should not be used.

Annex B-IV-9: European Directive for Maximum Permissible Concentration Limits of PTEs in Sludge and Soil

Maximum Permissible Concentration Limits of PTEs in Sludge and Soil (mg/kg DS) and Addition Rates (kg/ha per year)

Parameter	Sludge	Soil	Addition rate*
Cd	20 – 40	1 – 3	0.15
Cu	1000 – 1750	50 – 140	12
Ni	300 – 400	30 – 75	3
Pb	750 – 1200	50 – 300	15
Zn	2500 – 4000	150 – 300	30
Hg	16 – 25	1 - 1.5	0.1

Ref.: Directive 86/278/EEC)

* maximum permissible average annual rate of PTE addition over a 10 year period

ANNEX C

Baseline Environmental Data

ANNEX C
BASELINE ENVIRONMENTAL DATA

Annex C-I:
A) Flora:

Water and Water Border Flora around Goharood and Zarjoob Rivers

Sr. No.	Science Name	Family Name
1	Alnus glutinosa	Betulacea
2	Salix alba	Salicaceae
3	Ficus carica	Ficusiae
4	Sparganium erectum	Sparganiacae
5	Lemna minor	Lemnaceae
6	Potamogeton pectinatus	Potamogetonaceae
7	Typha australis	Typhaceae
8	Cyperus Sp.	Cyperaceae
9	Scrpus Sp.	Cyperaceae
10	Paspalidum disticum	Gramineae
11	Phragmites communis	Gramineae
12	Phragmites australis	Gramineae
13	Juncus Sp.	Juncaceae
14	Rubus persicus	Rosaceae
15	Polygonum Sp.	Polygonaceae

Pasture Flora of Rasht and Anzali Cities

Sr. No	Science Name	Family Name
1	Festuca ovina	Graminae
2	Festuca arandica	Graminae
3	Hordeum Sp.	Graminae
4	Agropyron elengatum	Graminae
5	Amaranthus viridis	Graminae
6	Rumex Sp.	Polygonaceae
7	Trifolium Sp.	Legominaceae
8	Cynodon dactylon	Graminae
9	Bromus tementolus	Graminae
10	Onobrychys Sp.	Legominaceae
11	Medicago Sp.	Legominaceae
12	Poa bulbosa	Graminae
13	Polypogon Sp.	Graminae
14	Lolium rigidum	Graminae
15	Avena Sp.	Graminae
16	Centaurea Sp.	Graminae
17	Cotoneaster Sp.	Legominaceae
18	Teurim polium	Legominaceae
19	Chenopodium albaum	Chenopodiaceae

Forest Flora of Rasht and Anzali Cities

Sr. No	Science Name	Family Name
1	Carpinus	-
2	Quercus castaueifolia	-
3	Carpinus orientalist	-
4	Acer plauanoides	-
5	Alnus glutinous	-
6	Zelkova carpinifolia	-
7	Gleditschiu caspica	-
8	Mespilus Sp.	-
9	Prunus Sp.	-
10	Albizia julibrrissin	-
11	Pterocaria froxinifolia	-
12	Fraxinus excelisio	-
13	Palurus spina-christi	-
14	Cratuegus Sp.	-
15	Punica Granutum	-
16	Tamarix ramossima	-
17	Ficus carica	-

Water and Water Border Flora in Anzali lagoon

Sr. No.	Science name	Emerged plants	Floating	Immerse	Sensitive value
1	Azolla filiculoides	-	+	-	???
2	Alisma plantago-aquatica	+	-	-	??
3	Apium graveolens	+	-	-	???
4	Berula angustifolia	+	-	-	???
5	Bidens tripartita	+	-	-	???
6	Butomus umbellatus	+	-	-	??
7	Callitriche brutia	-	+	-	??
8	Carex sp	+	-	-	???
9	Catabursa aquatica	+	-	-	???
10	Ceratophyllum demersum	-	-	+	???
11	Cara fragilis	-	-	+	??
12	Cyperus glabra	+	-	-	???
13	Cyperus Longiflia	+	-	-	???
14	Echinocloa crus-galli	+	-	-	???
15	Epilobium hirsutum	+	-	-	???
16	Eragrostis sp	+	-	-	???
17	Galium gilanicum	+	-	-	??
18	Hydrilla verticillata	-	-	+	?
19	Hydrocharis morsus-rana	-	+	-	??
20	Hydrocotyle ranuncoloides	-	+	-	???
21	Iris pseudoacorus	+	-	-	???
22	Juncus bofonicus	+	-	-	???
23	Juncus littoralia	+	-	-	???

Sr. No.	Science name	Emerged plants	Floating	Immerse	Sensitive value
24	Lemna minor	-	+	-	???
25	Lemna trisulcu	-	+	-	???
26	Ludwigia palutris	+	-	-	??
27	Lythrum salicaria	+	-	-	???
28	Marsilea Qudrifolia	+	-	-	??
29	Mentha aquatia	+	-	-	???
30	Mentha pulegium	+	-	-	???
31	Myostis palustris	+	-	-	??
32	Myriophyllum verrticilata	-	-	+	??
33	Myriophyllum spicatum	-	-	+	???
34	Nastrium officinalis	+	-	-	?
35	Nelumbium caspicum	-	+	-	?
36	Nympha alba	-	+	-	??
37	Nymphoeides indicum	-	+	-	?
38	Oenanthe aquatica	+	-	-	???
39	Oenanthe biennis	+	-	-	???
40	Paspalum disticum	+	-	-	???
41	Paspalum paspaloeides	+	-	-	???
42	Phragmites australis	+	-	-	???
43	Polygonum hydropiper	+	-	-	??
44	Potamogeton crispus	-	-	+	???
45	Potamogeton lucens	-	+	-	???
46	Potamogeton nodusus	-	+	-	???
47	Potamogeton pectinatus	-	-	+	???

Water and Water Border Flora in Anzali Lagoon

Sr. No.	Science name	Emerged plants	Floating	Immerse	Sensitive value
48	Potamogeton perfoliatus	-	-	+	?
49	Ranunculus cicutarius	-	-	+	??
50	Ranunculus muricatus	+	-	-	??
51	Ranuncullus opioglossifolium	+	-	-	??
52	Ranunculus scleratus	+	-	-	??
53	Ranuncuius tricophyllum	-	-	+	??
54	Rorippa islandica	-	-	+	??
55	Rorippa silvestris	+	-	-	??
56	Sagitaria trifoliata	+	-	-	?
57	Sagitaria satifolia	+	-	-	?
58	Salvinia natans	-	+	-	???
59	Samulus valerandi	+	-	-	?
60	Scirpus lacustris	+	-	-	??
61	Solanum dulcamara	+	-	-	??
62	Sparganium neglectum	+	-	-	???
63	Spirodella polyrhyhiza	-	+	-	???
64	Teucrium hyrcanicum	+	-	-	??
65	Trapa natans	-	+	-	?
66	Thypha ssp	+	-	-	???
67	Valizneria spiralis	-	-	+	?
68	Veronica anagalis-aquatica	+	-	-	??
69	Wolffia arrhiza	-	+	-	???
70	Zostera noltii	-	-	+	???
71	Utricularia neglecta	-	-	+	?

I: Sensitive Flora
II: Semi Sensitive Flora
III: Residence Flora

B) Fauna:

List of Mammalians in Rasht and Anzali Areas

Sr. No.	Science name	Family
1.	Felis chaus	FELIDAE
2.	C. aureus	CANIDAE
3.	Vulpes vulpes	CANIDAE
4.	Sus scrofa	SUIDAE
5.	Glis glis	GLIRIDAE
6.	Lutra lutra	MUSTELIDAE
7.	Phoca caspica	PHOCIDAE
8.	Hystrix indica	HYSTRIDAE
9.	Lepus capensis	LEPORIDAE
10.	Rhinolophis hyposideros	RHINOLOPHIDAE
11.	Mythis blytha	RHINOLOPHIDAE
12.	Rattus rattus	MURIDAE
13.	Rattus norvegicus	MURIDAE
14.	Mus musculus	MURIDAE

Annex C-II: List of Birds in Rasht and Anzali

Serial No.	The scientific name of species	The scientific name of family	Endemic	Migrant	
				Passenger	Wintering
1.	Podiceps (Tachybsbtus) ruficollis	PODICEPCIDAE	+		+
2.	Cristatus Podiceps	PODICEPCIDAE			+
3.	Podiceps nigricolis	PODICEPCIDAE			+
4.	Policeps auritus	PODICEPCIDAE			+
5.	Podiceps auritus	PODICEPCIDAE			+
6.	Podiceps grisegena	PHALACROCORAX			+
7.	Phalacrocorax carbo	PHALACROCORAX			+
8.	Phalacrocorax pygmaeus	ARDEIDAE		+	
9.	Botaurus stellaris	ARDEIDAE		+	
10.	Nycticorax nycticorax	ARDEIDAE		+	
11.	Egretta alba	ARDEIDAE		+	+
12.	Egretta garzetta	ARDEIDAE		+	+
13.	Ardea cinerea	ARDEIDAE		+	+

List of Birds in Rasht and Anzali

Serial No.	The scientific name of specie	The scientific name of family	Endemic	Migrant		
				Passenger	Wintering	Catching
14.	Ardea purpurea	ARDEIDAE		+	+	
15.	Anser erythropus	ARDEIDAE			+	
16.	Anser anser	ARDEIDAE			+	
17.	Anser albifronns	ARDEIDAE			+	
18.	Tadorna tadorna	ARDEIDAE			+	
19.	Tadorna feruginea	ARDEIDAE			+	
20.	Sygnus	ARDEIDAE			+	
21.	Sygnus sygnus	ARDEIDAE			+	
22.	Anas plathyrhynchos	ARDEIDAE			+	
23.	Anas creca	ARDEIDAE		+	+	
24.	Anas sterepra	ARDEIDAE		+	+	
25.	Anas penelop	ARDEIDAE		+	+	

List of Birds in Rasht and Anzali

Serial No.	The scientific name of specie	The scientific name of family	Endemic	Migrant	
				Passenger	Wintering
26.	Anas acutea	ANATIDAE			+
27.	Anas clyptea	ANATIDAE			+
28.	Aythya ferina	ANATIDAE			+
29.	Aythya marila	ANATIDAE			+
30.	Aythya fuligula	ANATIDAE			+
31.	Anas querquedula	ANATIDAE		+	
32.	Netta rufina	ANATIDAE			+
33.	Aythya nyroca	ANATIDAE			+
34.	Bucephala clangula	ANATIDAE			+
35.	Mergus albelus	ANATIDAE			+
36.	Mergus merganser	ANATIDAE			+
37.	Mergus senator	ANATIDAE			+

List of Birds in Rasht and Anzali

Serial No.	The scientific name of specie	The scientific name of family	Endemic	Migrant		
				Passenger	Wintering	Catching
38.	Oxyura leucocephalus	ANATIDAE			+	
39.	Rallus aquaticcus	RALLIDAE	+		+	
40.	Gallinula chloropus	RALLIDAE			+	+
41.	Porhyrio porhyrio	RALLIDAE			+	
42.	Fulica atra	RALLIDAE			+	
43.	Platalea leucorodia	THRESKIORNLTHIDAE		+		
44.	Plegadis falcinellus	THRESKIORNLTHIDAE		+		
45.	Himantopus himantopus	RECURVIROSTRIDAE		+		+
46.	Recorvirostra aosetta	RECURVIROSTRIDAE		+		+
47.	Vanelus vanelus	CHARADRIIDAE		+		+
48.	Vanelus leucovus	CHARADRIIDAE		+		+
49.	Charadrius hiaricula	CHARADRIIDAE	+			

List of Birds in Rasht and Anzali

Serial No.	The scientific name of specie	The scientific name of family	Endemic	Migrant		
				Passenger	Wintering	
50.	Charadrius dubius	CHARADRIIDAE		+		
51.	Charadrius alexandrius	CHARADRIIDAE		+		
52.	Pluvialis apricaria	CHARADRIIDAE		+		
53.	Piuvialis squatarola	CHARADRIIDAE		+		
54.	Araria interpre	CHARADRIIDAE		+		
55.	Charadrius asialius	CHARADRIIDAE		+		
56.	Limosa limosa	CHARADRIIDAE		+		
57.	Limosa lapponica	CHARADRIIDAE		+		
58.	Numenius phoeopus	CHARADRIIDAE		+		
59.	Numenius arquata	CHARADRIIDAE		+		
60.	Tringa totanus	CHARADRIIDAE		+		
61.	Tringa erythropus	CHARADRIIDAE		+		

List of Birds in Rasht and Anzali

Serial No.	The scientific name of specie	The scientific name of family	Endemic	Migrant		
				Passenger	WInterinNG	Catching
62	Tringa stagnatilis	SCOLOPACIDAE		+		
63	Tringa nebulari	SCOLOPACIDAE		+		
64	Tringa glareola	SCOLOPACIDAE		+		
65	Tringa hypoleocus	SCOLOPACIDAE		+		
66	Scolopax rusticola	SCOLOPACIDAE			+	
67	Gallinago galinago	SCOLOPACIDAE		+		
68	Lymnocryptes minimus	SCOLOPACIDAE		+		
69	Gallinago media	SCOLOPACIDAE		+		
70	Calidris minuta	SCOLOPACIDAE		+		

List of Birds in Rasht and Anzali

Serial No.	The scientific name of specie	The scientific name of family	Endemic	Migrant	
				Passenger	WInterinNG
71	Calidris alba	SCOLOPACIDAE		+	
72	Calidris temmenckii	SCOLOPACIDAE		+	
73	Calidris alpina	SCOLOPACIDAE		+	
74	Calidris ferruginea	SCOLOPACIDAE		+	
75	Limicola falcinellus	SCOLOPACIDAE		+	
76	Philomachus pugnax	SCOLOPACIDAE		+	
77	Larus canus	LARIDAE			+
78	Larus argentatus	LARIDAE			+
79	Larus ridibundus	LARIDAE			+
80	Larus genei	LARIDAE			+
81	Larus minutus	LARIDAE			+

List of Birds in Rasht and Anzali

Serial No.	The scientific name of specie	The scientific name of family	Endemic	Migrant		
				Passenger	WInterinNG	Catching
82	Larus ichthyaetus	LARIDAE			+	
83	Stema hirundo	LARIDAE			+	
84	Stema albitrons	LARIDAE			+	
85	Chlidonias hybrida	LARIDAE			+	+
86	Chlidonias teucoptorus	LARIDAE			+	+
87	Columba palumbus	COLUMBIDAE		+		+
88	Columba oenas	COLUMBIDAE	+			
89	Columba livia	COLUMBIDAE	+			
90	Streptopelia turtur	COLUMBIDAE	+			
91	Cuculus canorus	CUCULIDAE				+
92	Asio flammeus	CUCULIDAE	+			
93	Otus scop	CUCULIDAE	+			

List of Birds in Rasht and Anzali

Serial No.	The scientific name of specie	The scientific name of family	Endemic	Migrant	
				Passenger	Wintering
94	Athene noctua	CUCUIIDAE	+		
95	Apus apus	APODIDAE		+	
96	Coracias garrulus	CORACLIDAE	+		
97	Aicedo athis	ALCEDINIDAE	+		
98	Merops apiester	MEROPIDAE		+	
99	Upupa epops	UPUPIDAE	+		
100	Lanius collurio	LANIDAE		+	
101	Lanius minor	LANIDAE		+	
102	Lanius excobitor	LANIDAE		+	
103	Oriolus oriolus	ORIOLIDAE		+	
104	Stumus vulgaris	STURNIDAE	+		
105	Stumus roseus	STURNIDAE		+	

List of Birds in Rasht and Anzali

Serial No.	The scientific name of specie	The scientific name of family	Endemic	Migrant		
				Passenger	Wintering	Catching
106	Pica pica	CORVIDAE	+			
107	Corvus frugilegus	CORVIDAE	+			
108	Corvus corone	CORVIDAE	+			
109	Corvus minor	PICIDAE	+			
110	Riparia riparia	HIRUNDONIDAE		+		
111	Hirumdo rustica	HIRUNDONIDAE		+		+
112	A. spinoletta	HIRUNDONIDAE		+		
113	Motacllia flava	HIRUNDONIDAE	+			
114	Motacllia cinerea	HIRUNDONIDAE	+			
115	Motacllia alba	HIRUNDONIDAE	+			
116	Cinculus ciculus	CINDIDAE	+			
117	Cettia cetti	SYLVIDAE				+

List of Birds in Rasht and Anzali

Serial No.	The scientific name of specie	The scientific name of family	Endemic	Migrant		
				Passenger	Wintering	Catching
118	Acrrocephalus palustis	SYLVIDAE		+		
119	Acrocephalus scirpaceus	SYLVIDAE		+		
120	Acrocephalus arundinaceus	SYLVIDAE		+		
121	Phyloscopus callybita	SYLVIDAE		+		
122	Erithacus rubecula	SYLVIDAE		+		
123	Luscinia megarthynchos	TURDIDAE		+		
124	Turdus merula	TURDIDAE	+			
125	Turdus ohilumelos	TURDIDAE	+			
126	Turdus viscivorus	TURDIDAE	+			
127	Parus lugubris	PARIDAE	+			
128	Parus ater	PARIDAE	+			
129	Parus caeruleus	PARIDAE	+			

List of Birds in Rasht and Anzali

Serial No.	The scientific name of specie	The scientific name of family	Endemic	Migrant		
				Passenger	Wintering	Catching
130	Parus major	PARIDAE	+			
131	Passer domesticus	PLOCIDAE	+			
132	Passer hispanioiensis	PLOCIDAE		+		
133	Passer monthanus	PLOCIDAE	+			
134	Fringilla coelebs	FRINGILLIDAE		+		+
135	Fringilla montifringilla	FRINGILLIDAE		+		
136	Carduelis carduelis	FRINGILLIDAE		+		
137	Emberiza calandra	EMBRIZIDAE		+		
138	Emberiza melanocephala	EMBRIZIDAE		+		+
139	Milus migrans	ACCIPITERIDAE	+			
140	Buteo buteo	ACCIPITERIDAE	+			
141	Circus aeruginosus	ACCIPITERIDAE	+			

List of Birds in Rasht and Anzali

Serial No.	The scientific name of specie	The scientific name of family	Endemic	Migrant		
				Passenger	Wintering	Catching
142	Aquila clanga	ACCIPITERIDAE		+		
143	Aquila pomarina	ACCIPITERIDAE		+		
144	Acclipter nisus	ACCIPITERIDAE		+		
145	Falco subbuteo	FALCONIDAE		+		
146	Falco tinunculus	FALCONIDAE	+			
147	Falco columbarius	FALCONIDAE	+			
148	Pandion hallaetus	PANDIONIDAE		+		

Annex CIII: List of fish in Anzali lagoon, Goharood and Zarjoob Rivers

List of Fish in Anzali lagoon

Sr. no.	Science name	Semi migrate	migrate	Without migrate	Native
1	Rutilus frisi kutum	+			+
2	Rutilus rutilus	+			+
3	Cyprinus carpio	+			+
4	Abramis brama	+			
5	Abramis brama cy:	+			+
6	Barbus barbus		+		+
7	Vimba vimba	+	+		+
8	Chalcalburnus chalcoides				
9	Tinca tinca				+
10	Aspius aspius	+			+
11	Carassius auratus				+
12	Hypophthaimichthys nobilis				
13	Hypophthalmichthys militrix			+	
14	Ctenopharyngdon idella			+	
15	Varicorginus capoeta			+	
16	Gobiogobio				+
17	Chohdrostoma agassiz			+	+
18	Neogobius sp.			+	+
19	Neogobius melanostomus			+	+
20	Neogobius sp.			+	+
21	Blicca bjoercna			+	+
22	Lucioprca Iucioperca			+	+
23	Perca fluviatilis				+
24	Silurus glanis			+	+
25	Esox iucius				
26	Syngnathus nigrolineatus	+		+	
27	Gambusia affinis				
28	Mugil cephalus			+	

List of fish in Goharood and Zarjoob Rivers

Sr. No.	Science name
1	Barbus barbus
2	Barbus capito
3	Barbus mursa
4	Capoeta capoeta
5	Luciscus cephalus
6	Alburnoides bipuhctatus
7	Neogobius melanostomus
8	Neogobius caspius
9	Neogobius fluvialitis
10	Neomachhilus bergianus
11	Neomachilus malapterus
12	Gambusia offinis
13	Cyprinus carpio
14	Vimba vimba
15	Tinca tinca
16	Abramis brama
17	Perca fluviatilis

List of Reptiles in Rasht and Anzali Areas

Sr. No	Science Name	Family	Population		Poison		
			Rare	Many	VENOMOUS	OPISTHOGLYPHA	AGLYPHA
1	Coluber ravergieri	COLUBRIDAE		+	+		
2	Elaphe dione	COLUBRIDAE		+	+		
3	Malpolon monspessulanus	COLUBRIDAE		+		+	
4	Psammophis schokari	COLUBRIDAE		+		+	
5	Psammophis lineolatum	COLUBRIDAE		+	+		
6	Coluber karelini	COLUBRIDAE		+	+		
7	Natrix natrix persa	COLUBRIDAE		+	+		
8	Oligodon taeniolatus	COLUBRIDAE		+	+		
9	Eryx milliaris	BOIDAE		+	+		
10	Cyrtodactylus caspius	GEKKORIDAE		+	+		
11	Agama agillis	AGAMIDAE		+	+		
12	Typhlops vermicularis	TYPHLOPIDAE		+	+		
13	Eremias velox velox	LACERTIDAE		+	+		
14	Eremias nigrocelleata	LACERTIDAE		+	+		
15	Lacerta steigata	LACERTIDAE		+	+		
16	Lacerta saxicola	LACERTIDAE		+	+		
17	Mauremys caspica caspica	TESTUDINDAE		+	+		
18	Emys orbicularis	TESTUDINDAE		+	+		
19	Testudo gracia iberica	TESTUDINDAE		+	+		
20	Varanus caspius	VARANIDAE		+	+		
21	Lacerta chlorogaster	LACERTIDAE		+	+		
22	Mesalina guttlata	LACERTIDAE		+	+		
23	Hyla arborea savignye	HYLIDAE		+	+		
24	Bufo virdis jaurenti	BUFONIDAE		+	+		
25	Bufo bufo lineatus	BUFONIDAE		+	+		
26	Rana camarani	RANIDAE		+	+		
27	Rana macrocnemia	RANIDAE		+	+		
28	R m pseudodalmantina	RANIDAE		+	+		
29	Rana ridibunda	RANIDAE		+	+		
30	R. r. ridibunda	RANIDAE		+	+		

ANNEX D

Institutional Capacities

ANNEX D : Institutional Capacities and Needs

Capacities

Guilan Water and Wastewater Company

Currently, GWWC has a central laboratory at Rasht for conducting water and wastewater analysis. The lab is run by a laboratory manager, 3 chemists, 4 laboratory technicians, and 1 helper. The available equipment is listed below:

Table D-1: Available Equipment at GWWC Laboratory

Equipment	Quantity
Flame photometer	1
Spectrophotometer	1
BOD meter	1
COD reactor	1
Furnace	1
pH meter	1
Microscope	1
Incubator	4
Oven	2
EC meter	1
Dissolved Oxygen Meter	1
Autoclave	1
Digital balance	2
Distillated Water Unit	1
Turbidity meter	1
Vacuum Pump	1
Hot Plate	4
Refrigerator	2
Water bath	1
Colony Counter	1

Guilan Water and Wastewater Company- Rasht Emergency WTP

The Emergency WTP at Rasht has a laboratory for conducting water quality analysis. The lab is run by a laboratory manager, 2 chemists, and 1 helper. The available equipment is listed below:

Table D-2: Available Equipment at Rasht Emergency WTP

Equipment	Quantity
Flame photometer	1
Spectrophotometer	1
pH meter	1
Microscope	1
Incubator	4
Oven	2
EC meter	1
Autoclave	1
Digital balance	2
Distillated Water Unit	1
Turbidity meter	1
Vacuum Pump	1
Hot Plate	4
Refrigerator	1
Water bath	1
Colony Counter	1
Jar Test unit	1

Guilan Water and Wastewater Company- Sangar WTP

The Sangar main WTP at Rasht has a laboratory for conducting water quality analysis. The lab is run by laboratory manager, 2 chemists, 1 technician. The available equipment is listed below:

Table D-3: Available Equipment at Sangar WTP

Equipment	Quantity
Flame photometer	1
Spectrophotometer	2
pH meter	1
Microscope	1
Incubator	4
Oven	2
EC meter	1
Dissolved Oxygen Meter	1
Autoclave	1
Digital balance	2
Distillated Water Unit	2
Turbidity meter	1
Vacuum Pump	1
Hot Plate	4
Refrigerator	2
Water bath	1
Colony Counter	1
Jar Test unit	1

Guilan Water and Wastewater Company-Rural Laboratory

Currently, GWWC has one laboratory, located in a rural area of Guilan, for conducting water and wastewater analysis. The lab is run by 2 chemists. The available equipment is listed below:

Table D-4: Available Equipment at GWWC Rural Laboratory

Equipment	Quantity
Flame photometer	1
Spectrophotometer	1
BOD meter	1
COD reactor	1
Furnace	1
pH meter	1
Microscope	1
Incubator	4
Oven	1
EC meter	1
Dissolved Oxygen Meter	1
Autoclave	1
Digital balance	2
Distillated Water Unit	1
Turbidity meter	2
Hot Plate	1
Refrigerator	1
Centrifuge	1

Guilan Department of Environment

The DoEG has a laboratory which can measure water, wastewater, soil, and air quality parameters. The laboratory is staffed with 8 specialists and 1 helper. The available equipment and apparatus for conducting the various tests are listed below.

Table D-5: Available Equipment at DoEG Laboratory

Equipment	Quantity
Flame photometer	1
Spectrophotometer	2
BOD meter	2
COD reactor	1
Furnace	1
pH meter	1
Microscope	1
Incubator	2
Oven	1
EC meter	1
TOC Analyzer	1
Autoclave	2
Digital balance	1
Distillated Water Unit	2
Hot Plate	2
Refrigerator	2
Water bath	1
Centrifuge	1
Jar Test Unit	1
GC	1

Ministry of Health and Medical Science Education

The MoHME at Guilan has a laboratory which can measure water quality parameters. The laboratory is run by 3 specialists. The available equipment and apparatus for conducting the various tests are listed below.

Table D-6: Available Equipment at MoHME Guilan Laboratory

Equipment	Quantity
Flame photometer	1
Spectrophotometer	1
BOD meter	1
COD reactor	1
Furnace	1
pH meter	2
Microscope	5
Incubator	5
Oven	2
EC meter	1
Dissolved Oxygen Meter	1
Autoclave	2
Digital balance	2
Distillated Water Unit	2
Turbidity meter	1
Hot Plate	1
Refrigerator	4
Water bath	5

Ministry of Agricultural Jihad

The MoAJ at Guilan has a laboratory which can measure water, wastewater, and soil quality parameters. The laboratory is run by 4 specialists, 3 technicians, and 2 helpers. The available equipment and apparatus for conducting the various tests are listed below.

Table D-7 Available Equipment at MoAJ Guilan Laboratory

Equipment	Quantity
Flame photometer	1
Spectrophotometer	1
pH meter	1
Microscope	1
Incubator	1
Oven	1
EC meter	1
Digital balance	1
Distillated Water Unit	1
Refrigerator	2
Atomic Absorption	1
Voltmeter	1

Needs

The institutional needs for conducting the environmental monitoring and mitigation measures of this project have been assessed in terms of laboratory equipment and human resources of the various agencies involved in the EMP. These needs were assessed for a five year period, and should be reevaluated at the end of this period for the next five years. The cost estimate of these needs are also included and are based on the prevailing price rates and salaries in the Islamic republic of Iran.

Environment and safety officer (ESO)

Equipment	Quantity	Price US ($)
Data Logging noise analyzer	2	3000
Total		**6000**

Guilan Water and Wastewater Company

This laboratory can be used as the central laboratory for water and wastewater analysis in Guilan. In addition to this laboratory, Rasht WWTP and the two WWTPs at Anzali will have their own laboratory for conducting routine wastewater and sludge analyses for the samples collected at the treatment facilities. Also the Emergency WTP at Rasht and the Sangar main WTP will also have their own laboratory for testing water quality.

Table D-8: Equipment Needs at GWWC Laboratory

Equipment	Quantity	Price ($)
BOD meter	1	2,000
COD reactor	1	6,000
Atomic absorption	1	90,000
DO meter	1	1,500
Mass Gas Chromatograph (GC/MS)	1	130,000
Ion meter with Ammonium, Nitrate, Nitrite, Chloride, Fluoride, Phosphate, Sulfate probes and standards	1	19,000
HPLC	1	50,000
Spectrophotometer	1	10,000
Flame Photometer	1	5,000
Polarograph	1	10,000
pH meter	1	1,500
TOC analyzer	1	10,000
Centrifuge	1	1,000
Water bath	1	1000
Turbidity meter	1	1,000
Autoclave	1	1,000
Incubator	1	1,000
Oven	1	1,000
Hot plates	2	1,000
EC meter	1	1,000
Total		**343,000**

Guilan Water and Wastewater Company- Sangar WTP

The main WTP at Rasht requires additional equipment is listed below:

Table D-9: Equipment Needs at Sangar WTP

Equipment	Quantity	Price ($)
BOD meter	1	2,000
COD reactor	1	6,000
TOC analyzer	1	10,000
Water bath	1	700
Hot plates	2	1,000
On-line oil detector in water	1	50,000
Total		**69,700**

Table D-10: Equipment Needs at GWWC Rural Laboratory

Equipment	Quantity	Price ($)
Atomic absorption	1	90,000
Mass Gas Chromatograph (GC/MS)	1	130,000
HPLC	1	50,000
Spectrophotometer	1	10,000
Refract Meter	1	10,000
Distilled Water Unit	1	3,000
Total		**293,00**

Table D-11: Rasht WWTP Laboratory Needs

Equipment	Quantity	Price ($)
Atomic Absorption	1	90,000
Ion meter with Ammonium, Nitrate, Nitrite, Chloride, Fluoride, Phosphate, Sulfate probes and standards	1	19,000
Spectrophotometer and COD reactor	1	6,000
Water bath	1	800
Auto Clave	1	1,000
Refrigerator	1	300
Digital balance, 0.0001 g	1	3,000
BOD meter	4	8,000
Distillated Water Unit	1	3,000
Oven	1	1,000
Hot plates	3	1,500
Laboratory Glasses	-	15,000
Total		**148,600**

Table D-12: Anzali West WWTP Laboratory Needs

Equipment	Quantity	Price ($)
Ion meter with Ammonium, Nitrate, Nitrite, Chloride, Fluoride, Phosphate, Sulfate probes and standards	1	19,000
EC meter	1	1,000
Spectrophotometer and COD reactor	1	6,000
Water bath	1	800
Auto Clave	1	1,000
Furnace	1	500
Refrigerator	2	600
Digital balance, 0.0001 g	1	3,000
Incubator	2	2,000
BOD meter	4	8,000
Distillated Water Unit	1	3,000
pH meter	1	1,000
Turbidity meter	1	1,000
Oven	1	1,000
Centrifuge	1	1,000
Hot plates	3	1,500
Chemicals	-	5,0000
Laboratory Glasses	-	15,000
Total		**115,400**

Health and Medical Science Education Ministry

Table D-13: Equipment Needs at MoHME Guilan Laboratory

Equipment	Quantity	Price ($)
Atomic absorption	1	90,000
Mass Gas Chromatograph (GC/MS)	1	130,000
HPLC	1	50,000
Spectrophotometer	1	10,000
Flame Photometer	1	5,000
Turbidity meter	1	1,000
Distilled water unit	1	3,000
Total		**289,000**

Guilan Department of Environment

Table D-14: Equipment Needs at DoEG Laboratory

Equipment	Quantity	Price ($)
Atomic absorption	1	90,000
Microscope	1	5,000
HPLC	1	50,000
Micro Kjeldahl Unit	1	5,000
Ion meter with Ammonium, Nitrate, Nitrite, Chloride, Fluoride, Phosphate, Sulfate probes and standards	1	19,000
Flame Photometer	1	5,000
Spectrophotometer	1	10,000
Distilled Water Unit	2	6,000
BOD meter	2	4,000
pH meter	2	2,000
Furnace	1	500
Digital Balance	2	6,000
Colony Counter	1	500
Polarograph	1	10,000
Hot plates	1	500
Water bath	1	700
Turbidity meter	1	1,000
EC meter	2	2,000
Dissolved Oxygen meter	1	1,500
Automatic Titrater	4	2,000
Total		**220,700**

Agricultural Jihad Ministry

Table D-15: Equipment Needs at MoAJ Laboratory

Equipment	Quantity	Price ($)
GC/MS with accessories for 5 years	1	130,000
Ion meter with Ammonium, Nitrate, Nitrite, Chloride, Fluoride, Phosphate, Sulfate probes and standards	1	19,000
HPLC	1	50,000
Polar Graph	1	20,000
Total		**219,000**

Staff Needs and Costs

Table D-16: Staff Requirements & Costs

Organization	Needs	Annual costs ($)	Five years costs ($)
ESO	2 specialist 2 technicians 1 officer 1 worker	2*6,000 2*4,200 1*3,000 1*2,400	129,000
GWWC central lab	2 specialists	2*6000	60,000
*Rasht WWTP lab	1 specialist 2 technicians 1 worker	1*6000 2*4200 1*2400	67,200
*West Anzali WWTP lab	1 specialist 2 technicians 1 worker	1*6000 2*4200 1*2400	67,200
DOE	-	-	-
MHME	2 technicians 1 worker	2*4200 1*2400	84,000
MAJ	-	-	-

* Costs are for four years only

ANNEX E

List of EA Preparers

ANNEX – E

ENVIRONMENTAL AND SOCIAL ASSESSMENT FOR THE PROJECT AREAS IN THE CITIES OF RASHT, ANZALI, SARI AND BABOL

List of EA Preparers

SL No	Name	Position
Nespak		
	Mr. M.P. Aftab	Project Advisor
	Mr. T. Qamar	Project Manager/Civil Engineer (Local)
	Syed Ahmad Zaidi	Project Manager/Civil Engineer (Local)
	Dr. Philip Hughes	Environmental Expert (International)
	Mr. Muhammad Iqbal Saif	Sociologist Expert
	Mr. Qasim Ali Qasim	Natural Resource Expert/Archeologist
	Mr. Javed Anwar Chaudhry	Economist
	Mr. Anwar Hussain Mujahid	Institutional Expert
	Mr. Anwar Kamal	Legal Advisor
	Mr. Qaiser Javed	Senior Water Supply & Wastewater Engineer
	Mr. Muhammad Zaheer	Senior Environmental Engineer/Team Leader
	Mr. Haroon Nawaz	Environmental Engineer
	Mr. Abdul Rehman	Sociologist
	Mr. Rana Sarwar	Sociologist
Pars Ab Tadbir		
	Mr. F. Ghodani (M.S)	Project Manager
	Mr. M. Rezaei (Ph D)	Social Science
	Mr. M. Nasehi (M. S)	Public Consultation/Participation
	Mr. A. Arabi (M. S)	Economics

SL No	Name	Position
	Mr. M. Pirsaheb (PhD)	Public Health
	Mr. E. Safari (PhD)	Environmental Planning Management
	Mr. S. Shahooei (M.S)	Water Resources management-Ground Surface Water
	Mr. B. Javaheri (M.S)	Water/Wastewater Infrastructure design
	Mrs. G. Golshani (M.S)	Environmental Engineer
	Mrs. M. Fallah (M.S)	Environmental Engineer
	Mrs. A. Ahmadi (M.S)	Environmental Engineer
	Mrs. Z. Satari (M.S)	Environmental Engineer
	Mrs. Gh. Mahjobiyan (M.S)	Computer Engineer
	Mr. M.R. Eghtesadian (M.S)	Economic
	Mr. H. Hashemi (PhD)	Environmental Engineer
International Expert		
	Mr. Omar Hindi	Environmental Consultant

ANNEX F

Public Consultations

Annex F

Public Consultation

Annex F-1	Minutes of the Public Forum Meetings in Rasht and Anzali
Annex F-2	List of Participants in the Rasht Meeting on 12th January 2005
Annex F-3	List of Participants in the Anzali Meeting on 13th January 2005
Annex F-4	Official Invitation to Attend the Public Forum Meeting in Rasht
Annex F-5	Rasht Public Forum Announcement
Annex F-6	Anzali Public Forum Announcement
Annex F-7	Newspaper Coverage of the Public Forum Meeting
Annex F-8	Question Form Distributed During Public Forum Meetings
Annex F-9	Review of Background Meetings with Project Stakeholders

Annex F-1

Minutes of the Public Forum Meetings on the Environmental Impact of Water and Wastewater Projects in Rasht and Anzali

Background of public participation

Since the start of the project in 2002, the Gilan Water and Wastewater Company (Client) initiated a Public involvement programme, which initially consisted of informing the public and major stakeholders through means such as newsletters, bulletins, etc of the project objectives and components. The major stakeholders include:

- Gilan Provincial Water and Wastewater companies
- General Public
- Regional governmental institutions
- Representatives of Rasht and Anzali in the National Parliament
- Relevant industrial institutions
- The Municipalities of Rasht and Anzali
- The City Councils
- The Department of the Environment
- The Ministry of Health and Medical Education
- The Ministry of Agricultural Jihad
- The Cultural Heritage Organization
- Universities
- Professional Associations (such as the Gilan Order of Building Engineers)
- Private Sector companies
- NGO's (such as the Green Association)
- Farmers.

Furthermore while conducting social studies, a considerable number of questionnaires were distributed to the above stakeholders. Also numerous group discussions were held to obtain public opinion on the proposed plan.

The Public Meetings

- The PMU representing Gilan Water and Wastewater Company (GWWC), organized two one-day Meetings to review the environmental impacts of Water and Wastewater project in Rasht and in Anzali.

- The event in Rasht was held from 08:30 to 14:30 on the12th of January, 2005 in the Meeting Hall of Saderat Bank in Rasht, which has a seating capacity of 300 persons. Despite the fact that the meeting was scheduled during normal working hours of the day, the Hall was filled to near capacity.

- The event in Anzali was held from 08:30 to 14:30 on the 13th of January, 2005.

- During the month leading to the schedule date of the Meetings, GWWC publicized the event through newspaper advertisements, billboards in public places, and finally over 200 direct invitation letters, to which a Farsi translation of the executive summary was attached, were sent to major stakeholders (as per the attached list of participants).

- The Meeting was conducted by the client's Project Management Unit (PMU), Iranab Consulting Engineers (feasibility studies) as well as Parsab Tadbir Consulting Engineers (environmental assessment study).

- This Meeting was organized with the objective of informing the public and getting a feedback on the status of Gilan Water and Wastewater project, as well as obtaining the stakeholders' opinions on the project itself.

- The event was fully covered by the local Radio / TV station and newspapers.

- The Meeting's programme included:
    - Recitation from the Holy Koran;
    - An introductory speech by the Director of PMU;
    - A report on feasibility studies presented by the Consultant (Iran Ab);
    - The environmental assessment report presented by the Consultant (Pars Ab Tadbir);
    - A short film on the present water and wastewater conditions in each of Rasht and Anzali cities; and finally
    - A Question and Answer Session.

- The speakers discussed their reports using the following presentation aids:
    - Power Point
    - Audio-visual aids
    - Graphs.

Speech of the Client Representative

After presenting a brief status report on the current urban water and wastewater system conditions, Mr. Mehdizadeh, the Managing Director of GWWC provided a general presentation of the water and wastewater projects in Rasht and Anzali, and stated that one of the most urgent problems is related to proper wastewater collection and disposal, and that limited financial resources are affecting the project implementation. He said that the pros and cons of the proposed plan would be explained in details by the consultants. He then described the stages of loan application from the World Bank (WB) and explained each in details. He stressed that a WB loan would greatly accelerate the implementation of related plans to resolve the present problems. He concluded that G*WWC could not complete its projects neither in the short nor the middle terms through the present Government credits alone, and therefore the use of other financial resources, the most preferable of which is a WB loan, were necessary.*

The Feasibility Studies

The Project's Consulting Engineer and Project Manager for Studies (Mr. Tootoonchi) began his Power Point presentation with a report on the current conditions of water supply, the shortages and the problems faced by the sector; saying that Rasht and Anzali's water is supplied from the two resources of surface and ground waters. The surface water is supplied from the treatment plant in the Sangar Dam, while the

Fehlman wells comprised the ground water resources. He further stated that the lack of sufficient number of reservoirs has resulted in water being pumped directly to the network, creating many problems.

He then described the development of the Water Scheme of Central and East Gilan, which will last for a period of 25 years, divided into four phases. He estimated the cost of the project during the first phase (5 years) at 62 million USD for Rasht and 11.4 million USD for Anzali (present values). The main works involved in this period consist mostly of upgrading and rehabilitation of the system to ensure a reliable water supply.

He stated that the proposed plan shall end the direct pumping of water to the network through the construction of new reservoirs, as well as the repair of existing elevated storage tanks. According to the feasibility study a total of 152 million USD would be needed (at present values) to develop the entire project.

He concluded by stating that through development of surface and ground resource, *water of adequate quantity and quality would be available for 100% population coverage in the cities of Rasht and Anzali.*

During the second part of his presentation, Mr. Tootoonchi described the present wastewater situation in Rasht and in Anzali. He stated that the current population in Rasht is 500,000 and that of Anzali is 120,000, and the current wastewater disposal is through discharge into the local rivers, which eventually flow into Anzali Lagoon and the Caspian Sea, and is causing environmental pollution to these water bodies. He added that the construction of one treatment plant in Rasht and another one in Anzali and some of the trunk mains are currently under way.

Explaining the proposed plan in this sector, he remarked that during the first phase of implementation all the main trunks will be installed while house connections will be constructed gradually. He stated that one wastewater treatment plant was proposed in Rasht, which is currently under construction, and two treatment plants were proposed for Anzali, of which the first is currently under construction at Ilyaran. The second is proposed for Ghazian in the eastern zone of Anzali.

He pointed out that the wastewater project cost estimates for Rasht amount to 106.6 million USD (current value) for the first phase and a total of 275 million USD by 2027. Furthermore, he stated that the total cost estimate for Anzali's wastewater project (by 2027) will be 88.5 million USD, of which about 55 million USD is for the first phase.

In conclusion he expressed hope that by 2027, all the projected population of 956,000 of Rasht and 252,000 of Anzali would be served by a wastewater collection and treatment system.

Documentary Film

A short documentary film was screened after Mr. Tootoonchi's speech. It showed the present water and wastewater conditions in the Cities of Rasht and Anzali and some of the on-going works.

The Environmental Issues

Representing the Environmental Consultants commissioned to prepare the EA Report, Miss Sattari began her presentation by describing the environmental problems of the region caused by the lack of appropriate systems for water supply and collection and treatment for wastewater. These problems include the pollution of surface and ground resources and related health issues, the high level of Unaccounted for Water (UFW), and a higher demand for quality water by the increasing population. Moreover, the pollution resulting from the discharge of untreated wastewater into the rivers and Anzali lagoon are affecting the environment and the flora and fauna of the area, as well as that of the Caspian Sea.

She added that the most important positive impacts of the project would be the improvement of public health, reduction of environmental pollution, especially in surface and ground resources, the possibility of using the treated effluents in farm irrigation and applying the treated sludge as a fertilizer and soil conditioning. The treated wastewater would improve the condition of the local rivers, Anzali Lagoon, and the Caspian Sea. She also stressed the need for cooperation with the Ministry of Agricultural Jihad to train farmers on the benefits, proper procedures and the constraints of using the treated effluent and sludge for irrigation and conditioning the soil.

Referring to the short-term environmental impacts of the plan, Miss Sattari said that the considerable volume of works involved could create employment for many people and become a great source of income for the region. Although the construction works can also lead to problems such as traffic congestions, dust and noise, they are however, temporary in nature and can be reduced to an acceptable limit by taking appropriate measures. She stressed that in addition to mitigating the negative impacts; the Environment Management Programme would include monitoring and capacity building to ensure the proper implementation of plans. To this end, the Gilan WWC will be strengthened as far as manpower and equipment are concerned, to be able to provide the necessary technical assistance to other concerned organizations in carrying out their legal duties.

Miss Sattari reaffirmed that the mitigating measures would be implemented by the contractor during the construction phase and by the operator during the operation phase of the plan. Throughout all phases GWWC will monitor the actions of the contractors and operators. Moreover the Department of Environment, the Cultural Heritage Organization and the Ministry of Health and Medical Education will control and ensure the quality of the aforementioned mitigating measures. Miss Sattari ended by stating that the Environment Management Programme would cost 1.086 million USD for Rasht and 911,000 USD for Anzali, and these figures were included in the total costs of the project.

She concluded by saying that the collection, treatment and sanitary discharge of wastewater will improve the people's health and well-being, reduce the level of pollution particularly in Zarjoob and Goharood Rivers and Anzali Lagoon and ground resources, and finally improve the environmental conditions of Rasht and Anzali.

Question and Answers:

At the start of the Meetings, question forms were distributed to participants to solicit questions and feedback for the panel. After the above presentations, participants at the meetings raised a number of questions which were responded to by the panel consisting of Mr. Mehdizadeh, the Client's Managing Director, Mr. Momenpour, Client's PMU Director, Mr. Tootoonchi, Managing Director of Iranab, the consultant of the feasibility studies and Miss Sattari, the environmental specialist for Pars Ab Tadbir Consultants, and technical personnel from GWWC and Iranab. The following are some of the important questions raised and the corresponding answers.

1- Q by a staff of Iranab consulting engineers:
There are several cities which are located in the vicinity of the main Rivers of Gilan, such as Sephidroud and Shahroud, and these cities discharge most of their wastewater, directly or indirectly into these rivers, which changes the beautiful scenery of the rivers to an unsightly one, therefore the wastewater collection system for these cities should also be considered as a priority.

A: There are several priorities according to GWWC policy, one priority refers to those cities which discharge their wastewater to Anzali lagoon, and the second priority is for those cities discharging to the mentioned rivers, which are the sources of raw water for water treatments plants. The wastewater collection system for this second group of cities is under study or construction and all the studied projects should be implemented during next five years.

2- Q by the head of UFW Department, GWWC:
The Iranab Manager said that the reduction of high rate of UFW is also considered in the projected plan. Could you please outline the proposed steps for UFW reduction?

A: The water distribution system of Rasht is an old one which was executed in 1960 according to requirements at the time and, in most cases, without any specific long term design. The pipes are old and the high humidity caused early corrosion of the buried pipes resulting in high leakage rate. Therefore, all the old pipes are subject to replacement and the main portion of pipes in the city's central zone will be replaced during the first phase with new pipes of more durable material. This will improve the reliability of the distribution network and reduce UFW rates.

3- Q by a Scientific Board member of Tehran Medical Science University:
The environmental impacts on Rasht's rivers, Anzali Lagoon and Caspian Sea resulting from implementation of the projects, were not addressed. Also the impacts from the Socio- Economic aspect were not addressed. Would you please explain?

A: Two Important rivers of Rasht, Zarjoob and Goharoud, were assessed in detail in the report and you can refer to the findings therein. The Anzali Lagoon has been assessed as a separate ecosystem which will be explained during the meeting of January 13 in Anzali. The social assessment report has been completed in the report based on the TOR of World Bank and four check lists have also been provided in the environmental report as: 1) Negative impacts, 2) Positive impacts,

3) No project option and 4) Important impacts during construction and operation phases.

4- Q by a technical expert of GWWC:
What is your plan for the sludge that will be produced in wastewater treatment plant?

A: The different methods of sludge disposal have been assessed in feasibility studies, for example: the sludge can't be used in agricultural areas since the predominant cultivation in the area is rice which is planted by hand. Initially the sludge incineration plant had been considered as the best solution, but due to W.B. standards, its stack should be heightened, the gas emission system should be upgraded and a standby system should be provided which would cause this alternative to no longer be feasible, compared to the others. Therefore according to latest economical evaluations, the most feasible alternative selected is the one year storage of digested and dewatered sludge, in accordance with applicable standards. The proposed location is in a dry area far from Rasht.

5- Q by Development Deputy of Anzali Municipality:
The wastewater collection system of the western part of the city is under construction to some extent, but there is no activity in the eastern part (Ghazian). Therefore, since this area suffers from lack of even the traditional sewage collection system, please describe how your plan addresses this issue.

A: Construction of waste water collection system in both parts of the city needs a lot of investment and our funds are limited, therefore since three years ago when the loan from World Bank has been set forth for discussion, we concentrated our works in one part of the city. The other part will be started once the loan becomes effective.

6- Q by an expert of Anzali WWC:
The wastewater treatment plant of Anzali will go into operation in few months. What are the provisions for eliminating nutrients such as phosphorous and nitrogen which will result in algae growth and consequently, adverse impacts on the aquatic environment?

A: This problem has been mentioned by the World Bank experts and was studied by the feasibility consultant. The proposed system for eliminating the nutrients is Biological Nutrient Removal by using the SBR process.

7- Q by an independent engineer:
a) What is your justification for describing the application method for treated wastewater and sludge while there is no use for them in this province?
b) Since some types of nematode eggs will live more than one year in humid areas, how did you specify the sludge storage duration as one year?
c) What is your plan for soliciting the co-operation and contribution in environmental activities of local NGOs?

A: a) The specified duration of one year for sludge storage for nematode eggs is in accordance with the relevant international standards and followed by the World Bank.

b) The NGOs have a high potential to contribute in Environmental activities since they have a good knowledge in this field and can assist in advising concerned people and also act as a supervisory body during and after implementation of the projects.

8- Q by an independent engineer:
How much is the rate of pollution which enters into Anzali lagoon and how do you evaluate the capacity of the lagoon's self purification?

A: There is no specified figure for influent pollution into the lagoon due to numerous and different inlet sources, but as a figure, the BOD for Pirbazar river which is formed from Zarjoob and Goharoud rivers passing trough Rasht city, is reported as 30 mg/l which is similar to that we normally consider for treated waste water as a standard. Regarding self purification of Anzali lagoon, we should say that it is quite limited, because the oxygen mixing ratio is too low due to the stagnant state of the lagoon and high rate of influent pollution.

Conclusion:

At the end Public Consultation Meetings, Mr. Momenpour, PMU Director, thanked the active participation of all project stakeholders in preparation of these urgent projects and wished that this support would continue during the project implementation.

Annex F-2

List of Participants in the Rasht Meeting on 12th January 2005

No.	Name	Family Name	Organization	Position
1	Aslan	Sabere Naeemi	IRANAB Consult	Inspector
2	Aliakbar	Rajabi	RASTAB Consult	Project Supervisor
3	Hasan	Jafari	Reporter	Information newspaper
4	Parviz	Fatohi	Economic newspaper	Manager
5	Masood	Nicchehreh	GWWC	Managing Director Advisor
6	Gholam Reza	Moghasddasi	GWWC	Inspector
7	Mohsen	Arbabi	IRANAB	Process Manager
8	Mohammad Sadegh	Baradarane nqviri	Gilan governorship	Civil Inspector
9	Mohammad Hossien	Mehdizadeh	GWWC	Managing Director and Chairman of Board
10	Hadi	Nayzehbaz	GWWC	Deputy of Technical Affairs
11	Maziyar	Alipoor	GWWC	Deputy of Customer and Revenue
12	Morteza	Ghanbar niya	GWWC	Rasht WWC Manager
13	Sayyed mohsen	Hossieni	Astara WWC	Astara WWC Manager
14	Sayyed mohammad taghi	Alavi	GWWC	Managing Director Advisor
15	Hamid	Armat	Operation	Technical
16	Masood	Rasoli	Kochesfehan WWC	Office Manager
17	Mahmood	Bamdadi	Khoshkebijar WWC	Office Manager
18	Gholam Ali	Bagheri	Lashte nesha WWC	Office Manager
19	Hadi	Yahyaee	Khomnam	Office Manager
20	Azar	Babaee hemmati	Green Group NGO	Member
21	Nasim	Tavaf zadeh haghi	Gilan Green Institute NGO	Board Member
22	Golnosah	Rezaee pour	Gilan Green Institute NGO	Member
23	Farahnaz	Movaghare hossieni	GWWC	UFW Sector Manager
24	Mozhgan	Farzin	GWWC	Technical Inspector
25	Jamshid	Boka	GWWC	Staff
26	Mehran	Sami	GWWC	Farhang branch
27	Jalil	Yahyaee	GWWC	Confidential sector manager
28	Homayoon	Rahnama	GWWC	Staff
29	Mostafa	Saberpour	GWWC	Staff
30	Naser		Iranab	Staff
31	Davood	Ali niya	Iranab	Staff
32	Mostafa	Jonomi	Saderat bank	Saderat Bank branch
33	Ataolah	Ahmadi	GWWC	Operation
34	Rahim		T.V	Local T.V
35	Azardokht	Movahedi	GWWC	Staff
36	Samira	Yahyaeezadeh	GWWC	Software Technical

No.	Name	Family Name	Organization	Position
37	Maryam	Amjadi	GWWC	Office of Planning Department
38	Sohail	Ebrahim nezhad	GWWC	Connection Sector
39	Siyavash	Zahmatkesh	GWWC	Inspector
40	Iraj	Mirboloki	GWWC	Sport sector manage
41	Seyyed reza	Mir haydari	Iranab consulting co	Control
42	Farshad	Fayaze roohi	Iranab Consulting Co.	Control
43	Sohrab	Abotalebi	GWWC	Inspector
44	Asghar	Ghanbari	GWWC	Water Control Sector
45	Ghorban ali	Bagheri niya	GWWC	Water Control Sector
46	Mohammad ali	Zat darvish	GWWC	Water Control Sector
47	Fereydoon	mazhari	Saderat Bank	Inspector
48	Mohammad	Ashorpour	GWWC	Manager
49	Zabihollah	Momeni	GWWC	Water Sale manager
50	Gol mohammad	Nateghi	GWWC	Confidential Sector
51	Mohammad	Nikoee	GWWC	Staff
52	Ahmad reza	Maarefi	GWWC	Research Control
53	Ali reza	Gholami	Governor ship	Economic Affairs Director General
54	Mohammad reza	Balazade	Iranab	Projects Manager
55	Ghaysar	Mosa zade	NGO	Member
56	Mohammad ali	Beheshti	Consultant	Projects Manager
57	Mohammad hossien	Khosh andam	Previce engin'g building	Board Member
58	Daryosh	Khanjani	Rastab Consult	Projects Manager
59	Zohreh	Abdi	GWWC	Inspector
60	Havva	Abas ali zadeh	GWWC	Inspector
61	Ramin	Darvish pour	Iranab	Inspector
62	Ali reza	Rastgo	GWWC	Inspector
63	Abbas	Fakori	GWWC	Inspector
64	Abolhasan	Yosefi	Order of Engineers	Vice-President
65	Reza		Order of Engineers	Vice-President
66	Kamran	Pour taghi	Iranab	Control Supervisor
67	Javad	Delbari	Iranab	Inspector
68	Esmaeel	Cheraghi	GWWC	Inspector
69	Aazam	Atefi	GWWC	Human resource manager
70	Hajar	Behboodi	GWWC	Inspector
71	Khosro	Kamran	NWWEC	Lead Specialist
72	Pezhman	Pezhom	Iranab	Inspector
73	Hamid reza	Divareh	Iranab	Controller
74	Mohammad hasan	Aghel manesh	City Council	President
75	Mohammad hasan	Sabet ghadam	Municipality	Deputy of Technical Affairs
76	Mohsen	Tarabi	GWWC	Service sector
77	Siyavash	Refahi	GWWC	Service sector
78	Ramezan	Tarabi	GWWC	Service sector
79	Mojtaba	Shafiee	GWWC	General Relations

No.	Name	Family Name	Organization	Position
80	Faramarz	Yaghobi	GWWC	Sewage Projects Manager
81	Robaik	Sarkhishan	Iranab	Projects manager
82	Nematollah	Danesh mir kohan	GWWC	Executive Representative
83	Asadollah	Saffari	GWWC	Inspector
84	Roshan	Babaee Ghesmati	Tourism and Cultural Heritage Org.	Inspector
85	Farshid	Hatami	Iranab	Projects Controller
86	Maziyar	Pour Ebrahimi	Microtunneling Projects	Supervisor
87	Hasan	Fro dastan	Pars Joyab co	Technical Manager
88	Fateme	Zare fekri	GWWC	Laboratory Inspector
89	Seyed hasan	Shafavi moghadam	GWWC	Technical Inspector
90	Mohammad ali	Pour jafari	GWWC	Technical Advisor
91	Kaveh	Hariry	GWWC	Research Manager
92	Faramarz	Hafgiri niya	Governorship	Technical
93	Mohammad	Mirnasrollahi	GWWC	Quality control unit
94	Zohreh	Shemshadi	Women's NGO	Inspector
95	Naser	Ramezani	Melli Bank	Inspector
96	Ali reza	Ghiyasi	GWWC	Sewage sector manager
97	Seyyed abdolghadir	Noghabaee	GWWC	Inspector
98	Ghasem	Hossieni pour	GWWC	Personnel manager
99		Pairo	Sefid rood consultant	Managing Director
100	Zahra	Godazgar	Sefid rood consultant	Inspector
101	Farzin	Farrokhi	GWWC	Rodsar WWC
102	Adib	Sohaili	GWWC	Customer section
103	Naser	Meraji	GWWC	Customer section
104	Seyyed rasool	Abti	Pars joyab consultant	Rural WWC
105	Mohammad reza	Seddigh	Saderat Bank	Rural WWC
106	Seyyed parviz	Hossieni	Saderat Bank	Rural WWC
107	Bahram	Nezhad hasan pakdel	GWWC	Inspector
108	Majid	Tavana	GWWC	Inspector
109	Seyyed abbas	Asadi	GWWC	Inspector
110	Mohammad reza	Ahmadi	GWWC	Finance Deputy
111	Seyyed ziyaa	Jalali masooleh	GWWC	Information sector manager
112	Masood	Soodi	GWWC	Inspector
113	Hossien	Safdel	GWWC	Researcher
114	Mohammad ali	Servati	GWWC	Inspector
115	Mohammad taghi	Ghaheri	GWWC	Quality Control Manager
116	Mahdi	Daniyali	GWWC	Inspector
117	Parva	Hossien ali zadeh	National Department	National Department Representative Advisor
118	Shirin	Khoshfekr	Iranab	Inspector
119	Zarrin	Khaleghdoost	GWWC	Inspector
120	Masood	Akhavane azari	Sefid rood consultant	Manager
121	Aydin	Parsa	Iranab	Supervisor
122	Ali reza	Sobhani	Iranab	Supervisor

No.	Name	Family Name	Organization	Position
123	Rahim	Khorasani	RWB	Quality Protection Office manager
124	Ardeshir	Rastgar	Rastab co consultant	Manager
125	Hamid	Gholami	Research control	Researcher
126	Maziyar	Akbari	GWWC	Manager
127	Farkhondeh	Akbari	GWWC	Manager
128	Shole	Dost abbasi	GWWC	Quality Inspector
129	Farnaz	Ebadi	GWWC	Quality Inspector
130	Sahar	Bazargan	GWWC	Quality Inspector
131	Delaram	Haghighi	Leading Ttechnical Org	Quality Inspector
132	Kazem	Sedghi nezhad	Lushan Microtunnelling	Managing Director
133	Nader		Iranab	Supervisor
134	Mahmood	Firozi	GWWC	Deputy of Operations
135	Mahdi	Sahmani	GWWC	Project Manager
136	Ahmad	Golbaghi	GWWC	Inspector
137	Mohammad	Rajabi	GWWC	Technical Office Manager
138	Mohammad	Totkare bidarigh	GWWC	Inspector
139	Ali reza	Mashayekh	GWWC	Inspector
140	Khashayar	Yas yasaman	GWWC	Inspector
141	Ali asghar	Moradi	Iranab	Inspector
142	Haman	Osooli	Iranab	Supervisor
143	Shahryar	Bagher pour	Iranab	Supervisor
144	Javad	Ferdosi	GWWC	Inspector
145	Mohammad reza	Hadalle	GWWC	Inspector
146	Sohayla	Mohammad salehi	NGO	Member
147	Shaghayegh	Ghiyasi	NGO	Member
148	Sedigheh	Sofi	NGO	Member
149	Fatemeh	Agha goli	NGO	Member
150	Hossien	Pour vahedi	GWWC	Contracts Department Manager
151	Gholam reza	Arab	GWWC	UFW Sector Inspector
152	Javad	Jahanfar	GWWC	Operational sector Inspector
153	Zolfaghgtr	Chegini	GWWC	Operational sector Inspector
154	Farhad	Panahi	GWWC	Operational sector Inspector
155	Hamid reza	Jafari	GWWC	Operational sector Inspector
156	Yadollah	Hasan zadeh	Iranab	Inspector
157	Seyyed majid	Vashtani	GWWC	Somea Sara WWC Manager
158	Saeed	Alijani	GWWC	Inspector
159	Tabassom	Kazem zadeh	Newspaper	Reporter
160	Abdolmahommad	Maboodi	GWWC	Inspector
170	Hasan	Karim pour	RWWC	Project Manager
171	Esfand	Shaydaee	RWWC	Project Manager
172	Mohammad reza	Zafar yabi	GWWC	Inspector
173	Seyyed ali	Mozaffar zadeh	Contractor co	Managing Director
174	Parisa	safarye yekrang	Gilan University	Water Sector Inspector

No.	Name	Family Name	Organization	Position
175	Tahereh	Mohseni zadeh	NGO women population	Member
176	Amin	Ebrahimi	Iranab	Supervisor
177	Kayvan	Shakori	GWWC	Laws Inspector
178	Ghasem	Babaee	GWWC	Laws Inspector
179	Toraj	Rajabi nezhad	GWWC	Staff
180	Masood	Mortazavi	GWWC	Inspector

Annex F-3

List of Participants in the Anzali Meeting on 13th January 2005

No.	Name	Family	Organization	Position
1	Reza	Porshaban	Anzali Water	Manager
2	Esmaeil	Pasandedeh	Rasht Governorship	Deputy Governor
3	Massoad	Nikchehreh	GWWC	Technical Advisor
4		Hagh chenass	National Parliament	People's Representative
5	Seyyed Ali	Aghazadeh	Governorship	Governor
6	Mahmood	Firozi	GWWC	Deputy of Operations
7	Parviz	Varzachany	Pars consult Consultant	Supervisor of Project
8	Aslan	Sabernaaimy	IRANAB Consultant	Specialist
9	Jalil	Yahyayi	GWWC	GWWC Confidential Affairs Manager
10	Bahram	Mosleh	Anzali Municipality	Deputy of Technical Affairs
11	Mohamad Mehdi	Yosefizadeh	GWWC	Public Relations Sector
12	Zahra	Sattari	Parsab Tadbir	Lead specialist
13	Arezo	Ahmadi	Parsab Tadbir	Lead specialist
14	Azar	Babaai hemati	Ngo(Green Group)	Member
15	Nasim	Tarafzadeh	Ngo(Green Group)	Member
16	Ameneh	Mohamadi	Gilan Today Newspaper	Reporter
17	Ahmad	Eskandardost	GWWC	Information Sector
18	Kazem	Mahjob	Anzali WWC Office	Specialist
19	Syyedzia	Jallali	GWWC	Information Sector Manager
20	Mahmod	Ammiry	Anzali GWWC	Operation
21	Mohammadseadat	Baradaran noveri	Governorship	Civil Specialist
22	Mohsen	Arbabi	IRANAB Consultiy	Process Engineering Unit Manager
23	Robic	Sarkhosion	IRANAB	Project Manager
24	Seyyed taghi	Jaddi	IRANAB	Local Controller
25	Javad	Labeei	IRANAB	Control Manager
26	Alireza	Saber nayimi	IRANAB	Local Control
27	Saeed	Saber nayimi	IRANAB	Technical Office
28	Abbas	Najafi fard	Local T.V	Reporter
29	Farhad	Nazarpoor	Anzali Islamic of Republic T.V	Reporter
30	Majid	Hossieni	General Public	
31	Mohammad	Esmali Naddafi	General Public	
32	Zarrin	Khaleghdost	GWWC	Specialist
33	Vida	Mahmodi	GWWC	Specialist
34	Habibeh	Bahrehmand	Anzali WWC Office	Specialist
35	Zahra	Nejati	WWC	Revenue Section
36	Mitra	Pirkha	AWWC	Quality control
37	Helen	Mehri	AWWC	Quality control

No.	Name	Family	Organization	Position
38	Shiva	Porvahedi	AWWC	Customer operator
39	Tahereh	Tongho	AWWC	Customer operator
40	Nasim	Saber moash	DOE	Specialist
41	Fatemeh	Amin	AWWC	Technical
42	Zolakha	Rahnama	AWWC	Operation sector
43	Zahra	Safaee	City Council	Member
44	Mohammad	Mirzajani	Newspaper	GWWC
45	Jalil	Asgharzad	Sontage mehr co	Vice President board
46	Khosro	Kamran	NWWEC	Load Specialist
47	Mohammad	Totkar	GWWC	Specialist
48	Babak	Bapiroshi	Pars Consult Co	Local Supervisor
49	Faramarz	Farhar	Lushan Pipe-laying Co	Supervisor
50	Kazem	Sedghi nezhad	Lushan Pipe-laying Co	Managing Director
51	Mohammad ali	Pour jafari	GWWC	Technical advisor
52	Ahmad reza	Maarefi	GWWC	Specialist
53	Seyyed mahmood	Miri	Anzali Military Representative	Technical Affairs Deputy
54	Bahram	Taleb niya	Business Co	Business
55	Kazem	Minaee	City Council	Member
56	Mahyar	Sakari	DOE	Deputy
57	Ahmad ali	Yaghobiyr moghadam	Information newspaper	Reporter
58	Seyyed abolhasan	Hossieni	GWWC	Quality Control Specialist
59	Mahdi	Daniyali	GWWC	Quality Control Specialist
60	Seyyed mohammad	Mir nasrollahi	GWWC	Quality Control Specialist
61	Mohammad	Moghaddam	GWWC	Quality Control Specialist
62	Ghasem	Mohammad khah	GWWC	Quality Control Specialist
63	Shahram	Nori	City Council	Quality Control Specialist
64	Hojjat	Arshid	Contractor	Contractor
65	Mahmood	Armodeli	AWWC	Auditor
66	Sadegh	Falahatgar	AWWC	Procurement
67	Javad	Samiee	City Council	General Relations Manager
68	Rasool	Sharif zadeh	AWWC	Confidential Affairs
69	Ali	Karimi	Newspaper (Etemad)	Reporter
70	Mohammad reza	Afrangeh	AWWC	Staff

Annex F-4

Official Invitation to Attend the Public Participation Meeting in Rasht

Invitation Letter

شرکت آب و فاضلاب گیلان

جناب آقای : آخوندزاده... مشاور محترم دستیار مدیر امور بین الملل

احتراماً بدینوسیله باستحضار می رساند بمنظور مشاوره عمومی بررسی مطالعات فنی، اجرائی و تأثیرات زیست محیطی، طرحهای آب و فاضلاب شهر رشت، جلسه ای با حضور مقامات استان گیلان و با همکاری مجریان و مشاوران طرح ، معاونت امور آب و فاضلاب وزارت نیرو ، شرکت آب و فاضلاب گیلان و مهندسین مشاور ایراناب و پارس آب تدبیر برگزار می گردد.

بدینوسیله از جنابعالی و کارشناسان آشنا با اینگونه طرح ها در آن سازمان محترم جهت شرکت در این گرد همایی دعوت بعمل می آید. قطعا حضور جنابعالی در این همایش، اثر بخش خواهد بود.

اهداف جلسه مذکور به شرح زیر می باشد:

۱- معرفی طرحهای آب و فاضلاب شهر رشت.

۲- ارائه مهمترین اثرات زیست محیطی و پیش بینی راه حل های مناسب جهت به حداقل رساندن اثرات منفی طرح .

۳- بررسی و دریافت نظرات شرکت کنندگان در جلسه و پیشنهاداتی که در رابطه با اجرا و راه اندازی و بهره برداری طرحهای آب و فاضلاب شهر رشت ارائه خواهد شد.

زمان : روز چهارشنبه مورخ ۸۳/۱۰/۲۳ ساعت ۸:۳۰ صبح

مکان: رشت ، خیابان امام ، سالن بانک صادرات

لطفاً مشخصات افراد شرکت کننده در جلسه را تا تاریخ ۸۳/۱۰/۲۱ به شماره فاکس ۳۲۲۵۰۲۰ دفتر روابط عمومی شرکت آب و فاضلاب گیلان، دفتر همایش اعلام نمائید.

ضمناً به پیوست یک نسخه از خلاصه گزارشات زیست محیطی جهت مطالعه به حضورتان ارسال می گردد.

محمدحسین مهدیزاده

رئیس هیأت مدیره و مدیر عامل

Annex F-5

Rasht Public Forum Announcement

شرکت آب و فاضلاب گیلان
(سهامی خاص)

همایش آب و فاضلاب رشت

Rasht Water Supply and Sanitation

Project Forum

Annex F-6

Anzali Public Forum Announcement

شرکت آب و فاضلاب انزلی

(سهامی خاص)

همایش آب و فاضلاب انزلی

Anzali Water Supply and Sanitation

Project Forum

Annex F-7

Newspaper Coverage of the Public Forum Meeting

Public Participation Report in Newspaper (Guilan Today

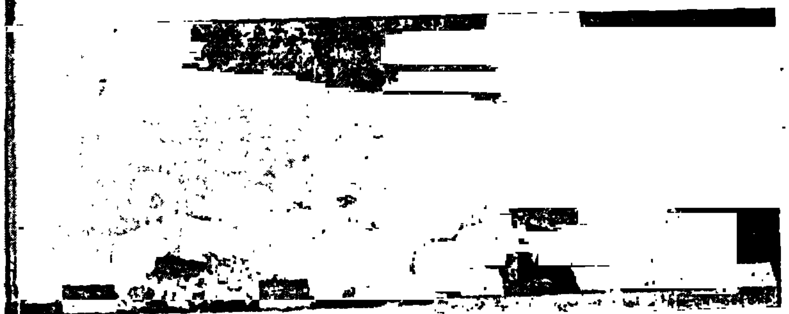
پنجشنبه ۱ بهمن ماه

گیلانشهر

توسط مهندس «مهدی زاده» مدیرعامل آبفای گیلان در سمینار بررسی مطالعات فنی اجرایی، زیست محیطی طرح آب و فاضلاب عنوان شد

توسعه شهرنشینی افزایش اعتبارات آب و فاضلاب را ضروری کرده است

◄ اگر توسعه شهرنشینی با خدمات رسانی در امور آب هماهنگ نباشد جنگ آینده جنگ آب خواهد بود



Report related to public participataion

in Rasht Dynamic Economy newspaper

همایش مشاوره مردمی طرح‌های آب و فاضلاب گیلان با همکاری بانک جهانی در رشت برگزار شد

Annex F-8

Question Form Distributed During Public Forum Meetings

This paper prepared for questions & proposal

بسمه تعالی

با سلام و خیر مقدم به میهمانان محترم

خواهشمند است سوالات خود را در این صفحه یادداشت و تحویل همکار ما فرمایند تا توسط اعضاء حاضر در پانل، پاسخ داده شود.

نام و نام خانوادگی	سمت	محل کار

۱.

۲.

۳.

۴.

۵.

۶.

۷.

۸.

۹.

۱۰.

با تشکر

مهدیزاده

Annex F-9

Review of Background Meetings with Stakeholders for Information Solicitation and Public Consultation

➢ GWWC

Venue: Office of the Gilan Water and Wastewater Company, Rasht
Date: December 17, 2002.
Participants:

- Mr. Momenpur (Deputy Regional PMU)
- Mr. Rana M. Sarwar (Social Assessment Specialist)
- Mr. Qaisar Javed (Environmental Specialist)
- Ms. Fallah Mehrzad (Environmentalist)

Discussion

The participants were briefed about the water and wastewater project- Rasht and Anzali.

Consultation with the participants covered the following issues:

- Very high water table in Rasht and Anzali. In Anzali it is even up to – 2.5m to – 0.5 m.
- Sangar water treatment plant at Sangar dam is the source for supplying water to both the cities of Rasht and Anzali.
- The drinking water quality at the treatment plant is good, however, water distribution networks in the cities are old and need to be replaced.
- The absence of a proper sewerage system in the two cities. The sewage is contaminating the ground water. As the water distribution system is old, sewage also enters the water distribution network.
- Inhabitants complain of rust in the drinking water in some areas of the cities.
- The need to improve the quality of water at the Sangar Dam as there is no problem in the quantity of potable water n the cities of Rasht and Anzali.
- The presence of 30 different committees in the office of Gilan Water and Wastewater Company, Rasht.
- The National Water and Wastewater Company is a policy maker for the Regional Water and Wastewater Companies.
- After treatment, sewage in Rasht and Anzali will be disposed to the river and the lagoon respectively and ultimately discharge into the Caspian Sea.
- The treated sewage will not be used for agricultural purposes in the city of Rasht and Anzali.
- The sludge produced from the wastewater treatment plants in Rasht and Anzali will be burnt in the incinerator plant. One incinerator plant is proposed in Rasht wastewater treatment plant which is under construction.
- The presence of few potable water testing laboratories in Rasht and Anzali working under the Guilan Water and Wastewater Company. There is no laboratory in GWWC, however, there is one in the Department of Environment in Rasht.
- GWWC will be responsible for all the components of water and wastewater project including the treatment plants, water and wastewater testing laboratories, water and sewage house connections etc. and as such there will be limited role for the Municipality or DoE in this project.

➢ Regional Water Board (RWB)

Venue: Office of the Regional Water Board Gilan, Rasht
Date: December 18, 2002.
Participants:
- Mr. Momenpur (Deputy Regional PMU)
  - Mr. Mohseni (Deputy Finance, Regional Water Board- Guilan)
  - Mr. Rana M. Sarwar (Social Assessment Specialist)
  - Mr. Qaisar Javed (Environmental Specialist)
  - Ms. Fallah Mehrzad (Environmentalist)

Discussion
The following points were mentioned in the meeting:

- The Regional Water Board (RWB) was established in 1962 and is controlled by the central government through the Ministry of Energy.
- There are about 700 employees in the RWB- Guilan.
- The RWB coordinates with the Regional Water and Wastewater Companies for financing the water supply projects.
- The RWB is working for the provincial water resources. Transmission of water for agricultural and industrial use as well as for Guilan Water and Wastewater Company is the responsibility of the Regional Water Board. As rice is the major crop growing in the vicinity of Rasht, RWB is responsible for providing raw water for its irrigation
- The Gilan Water and Wastewater Company is responsible for the distribution networks in the cities of Gilan.
- Water treatment plant at Sangar is constructed by the RWB and is operated by the Guilan Water and Wastewater Company.
- Gilan Water and Wastewater Company is a private company. Different share holders of the company and their shares are as follows:
  - Municipality 49 %
  - National Water and Wastewater Company 10 %
  - Water and Wastewater Companies of other provinces 6 %
  - Regional Water Board 35 %

  Total: 100 %
- There are 16 municipalities in Guilan province.
- Regional Water Board is charging the Guilan Water and Wastewater Company for the raw water supplied to the company. The rates for supplying raw water are as follows:
  - Underground water Rials 20 / m^3
  - Surface water Rials 90 / m^3
  - Drinking water well (Felman's well) Rials 50 / m^3
- Presently, Sangar water treatment plant is producing 3 m^3/sec of potable water and production is estimated to be 6 m^3/sec by the year 2025. The construction cost of this treatment plant was 15 billion Tomans.

➢ Department of Environment

Venue: Office of Department of Environment (DoE), Rasht
Date: December 18, 2002.
Participants:
- Mr. Sakari (Director Provincial DoE, Rasht)
- Mr. Momenpur (Deputy Regional PMU)
- Mr. Rana M. Sarwar (Social Assessment Specialist)

- Mr. Qaisar Javed (Environmental Specialist)
- Ms. Fallah Mehrzad (Environmentalist).

Discussion

The following points were particularly mentioned in the meeting;

- The DoE was established in Rasht in 1972.
- The jurisdiction of Regional DoE is the Gilan Province. For the local offices of DoE working in different cities of Gilan Province, the jurisdiction of these offices is the boundary of the respective city.
- The provincial DoE is working under the central DoE, Tehran.
- Regarding Anzali lagoons, about 50,000 migratory birds visit it every year.
- Information regarding Anzali lagoon and biodiversity of Gilan province is also available at the web site www.biodiversity.ir.
- The provincial government contacts DoEG, which works under the authority of the central DoE in Tehran.
- DoEG has professional relations with other ministries and departments in the region such as Ministries of Fisheries, Industries and Mines, Agriculture etc. as well as with pubic sector departments such as the Water and Wastewater Company, Gilan.
- There is one central public relation office in Rasht. The rest are in the cities of the Gilan province.
- The Islamic Republic of Iran prepares its 5 year plan. Based on this plan, DoEG prepares its plan and forwards it to the DoE in Tehran office where it is reviewed by the Environmental Protection High Council and after approval of the Parliament, the plan is forwarded back to the DoEG for implementation.
- The DoEG is also responsible for following up with the planning of other ministries like the Ministry of Energy, Industries and Mines, Fisheries, Agriculture, etc. whose works have effects on the environment.
- The DoEG is responsible for increasing people's awareness regarding environmental issue directly and through NGOs.
- Around one million people contribute to the generation of waste which is discharged into rivers, lagoons and ultimately to the Caspian Sea. Rasht and Anzali are the biggest polluters as they are inhabited by approximately half a million. The rest of the population live in towns and villages where the effluent is discharged into rivers and then to Anzali lagoons.
- The DoEG is giving due importance to Anzali lagoon to improve its environmental state. Another project parallel to this project is the improvement of solid waste in the city of Ramsar.
- The role of DoEG is very important in the development of Gilan Province. Presently the DoE proposed that the Ministry of Energy implements a proper sewerage system and wastewater treatment plant especially for the cities of Sari, Babol, Rasht and Anzali.
- The department is also concerned about combating deforestation, improving solid waste disposal sites, reducing the pollution of rivers, lagoons, port and Caspian Sea. In addition, reducing industrial pollution by suggesting to industries to have a proper treatment of their effluent.
- DoEG has turned about 14 to 15% of the forests in the North to protected areas.
- About 30% of Anzali lagoon is protected by the DoE from hunting, swimming and any activity causing damage to the environment.

- DoEG is planning against the flooding of Anzali lagoon from the agricultural land around it. Sometimes the water level in the lagoon becomes so high that crops are damaged and pesticides are discharged in the lagoon.
- One of the permanent members of the Water and Wastewater Company of Gilan works at the DoE. This member attends the important decision making meetings of the Company.
- Regarding future development plans of DoEG, the following are their priorities
  - o Sewerage system for the city of Rasht and Anzali
  - o Wastewater treatment plants for the above cities.
  - o Air pollution
  - o Solid waste management.

➢ **Fisheries and Marine Research Institute**

Venue: Office of Fisheries and Marine Research Institute, Anzali

Date: December 19, 2002.

Participants:

- Mr. Rezaikha (Head Fisheries and Marine Research Institute, Anzali)
- Mr. Karimpur (Research Member)
- Mr. Noor Adin Hoseinpur (Advisor)
- Mr. Mohammad Reza Rezaie (Deputy Director)
- Mr. Davood Moghani nejad (Chief of Resource Management Office)
- Mr. Soheil Mohammadi (Advisor)
- Mr. Ali Reza Vallipur (Chief Planning)
- Mr. Ali Reza Mirzajani (Chief ecology of water resources office)
- Mr. Ali Danesh khosh asl (Assistant Research Centre)
- Mr. Momanpur (Deputy of Planning & Mgmt Improvement and Reg. Director PMU)
- Mr. Rana M. Sarwar (Social Assessment Specialist)
- Mr. Qaisar Javed (Environmental Specialist)
- Ms. Fallah Mehrzad (Environmentalist)

Discussion

Participants were briefed about the water and wastewater project in Anzali and the following points were discussed.

- This centre is one of the old centres in Iran and conducts a lot of research on fisheries and Marine life.
- Participants had the opinion that the project will not only benefit the local population, but also the aquatic life in the rivers, Anzali lagoon and the Caspian Sea.
- There is no system in the institute for measuring Dissolved Oxygen in Anzali lagoon.
- Based on the latest data, 47 fish species live in Anzali lagoon and are divided into two groups; regional (indigenous) and migratory fish.
- The present area of the lagoons is 80 sq. Km.
- Total fish production from the lagoon has decreased from 2300 tons / sq. km about 68 years ago to only 300- 350 tons/ sq. km nowadays.
- In addition to Anzali lagoon, there are three small lagoons inside Anzali which are Siah Keshim, Ab Kenar and Shei Jan.
- There are five (5) Rogahes (a small river that discharges flow from the Anzali city to the lagoon). These Rogahes from East to West are:

   - Sosar Rogah (Wastwater from Rasht and Ghazian discharge into this Rogah)
   - Pir Bazar Rogah (wastewater from Rasht discharge to Shayjan lagoons and then to Anzali lagoons)
   - Rasteh Khaleh Rogah
   - Nahang Rogah
   - Anzali Rogah (Wastewater from Anzali discharges to this Rogah)
- In addition to these Rogah, there are some secondary Rogahs in the city e.g. Basham Rogah which is the closest to the wastewater treatment plant.
- From October to March, catching fish is not allowed since these are the spawning months for the fish.
- Fish species called "Mahi Azad" was once spawning in Siah Darvishan and Pasi Khan Rivers and is now no longer breeding there.

➢ **The Chief of DoE**

Venue: Office of the Department of Environment, Anzali

Date: December 19, 2002.

Participants:

- Mr. Nezami (Head of Department of Environment, Guilan)
- Mr. Momenpur (Deputy of Planning & Mgmt Improvement and Regional PMU)
- Mr. Rana M. Sarwar (Social Assessment Specialist)
- Mr. Qaisar Javed (Environmental Specialist)
- Ms. Fallah Mehrzad (Environmentalist)

Discussion

Mr. Nezami expressed his support for the project since it will exert positive environmental and social impacts on the cities of Rasht and Anzali. The following are the major findings as per the discussion:

- The importance of having a wastewater treatment for the city of Rasht as it is the capital of the Gilan province and has the highest population density of about 420,000 inhabitants.
- The lack of a treatment plant in the Gilan province which is causing a major problem of pollution in Anzali lagoon. By treating the wastewater in Rasht, there will be a major relief for Anzali Lagoon.
- The contaminated water of Anzali Lagoon and the bad odour especially in the summer has caused local people as well as visitors coming to Anzali lagoon for recreational purposes to refrain from coming due to the spread of diseases.
- The authorities should consider the reduction of Phosphorous and Nitrogen from the wastewater so that the problem of eutrophication could be minimized from the lagoon.

➢ **Site Visit to Anzali city and Lagoons**

Venue: Anzali city and Lagoons

Date: December 19, 2002.

Participants:

- Mr. Momenpur (Deputy of Planning & Mgmt Improvement and Reg. Director PMU).
- Mr. Rana M. Sarwar (Social Assessment Specialist)
- Mr. Qaisar Javed (Environmental Specialist)

- Ms. Fallah Mehrzad (Environmentalist)

Discussion

A site visit in the city of Anzali and to the Lagoons was made by the participants. The following were observed and briefed:

- Water transmission main from Sangar water treatment plant transmits water to Rasht and then through the same transmission line to Anzali City.
- There are two drainage zones in Anzali city due to the outlet of Anzali lagoon to the Caspian Sea.
- The environmental impacts of the local sewerage system and the disposal of sewers in Anzali lagoon were examined.
- A storm water drain was under construction. It was briefed that both the sewerage system and the storm water drainage system ultimately discharge into the lagoon.
- It was informed that a trunk sewer line of 600 mm diameter was under construction. This trunk sewer is 6.1 km. from Anzali to the West wastewater treatment plant (Ilyáran). About 5.5 Km. sewer has been already laid and 600 meters are in the process.
- It was pointed out that there is a bad odour in the summer around the lagoon which causes nuisance for the local inhabitants and for visitors. Thus, there is a great necessity for the implementation of this project.
- There is no dumping site for solid waste in Anzali and thus solid waste dumping could be seen around Anzali lagoon.

➢ **Site visit to Rasht Wastewater Treatment Plant**

Venue: Rasht WWTP.

Date: December 20, 2002.

Participants:

- Mr. Momanpur (Deputy of Planning & Mgmt Improvement and Regional PMU)
- Mr. Rana M. Sarwar (Social Assessment Specialist)
- Mr. Qaisar Javed (Environmental Specialist)
- Ms. Fallah Mehrzad (Environmentalist)

Discussion

A site visit to the wastewater treatment plant (central phase) was made by the participants. The following were observed and noted:

- For the central phase treatment plant, a land of 25 hectare has been acquired in Rasht and the treatment plant is under construction.
- For the further extension of the present treatment plant up to year 2027, about 40 hectare land is further required. Purchase of this land is in process. By acquiring this land, a total of 65 hectare of land will be available for the treatment plant for the design period of 25 years.
- The treatment plant is located about 8 Km. away in the North of Rasht in Pir Bazar village close to Zarjoob river.
- The treatment plant is designed by Iran Ab and is being constructed by Set Construction Company.
- Solid waste could be seen spread and dumped along the Zarjoob river.
- Small pumping stations can be seen on the bank of Zarjoob River on the way. These pumps are used for pumping the river water to the private agricultural lands by the farmers.

➢ Visit to Anzali city and Wastewater Treatment Plant

Venue: Anzali city and Ilyaran.WWTP
Date: December 20, 2002.
Participants:

- Mr. Momenpur (Deputy of Planning & Mgmt Improvement and Regional PMU)
- Mr. Bagheri from WWC, Anzali
- Mr. Rana M. Sarwar (Social Assessment Specialist)
- Mr. Qaisar Javed (Environmental Specialist)
- Ms. Fallah Mehrzad (Environmentalist)

Discussion
A site visit to Anzali city was made in order to check the existing water supply and sewerage of the city. In addition, the West Wastewater Treatment Plant at Ilyaran was also visited.
The following were observed and noted concerning the city of Anzali:

- An asbestos cement pipe is being used for the trunk sewer.
- There are two outlets for the sewerage system directly disposing off the sewage into the Caspian Sea. Sometimes, sea water level becomes high and the sewage floods into the streets creating a problem for the people living around.
- The industrial effluent will not be combined with domestic wastewater in both Rasht and Anzali. There are industrial zones in Rasht and Anzali and DoE is responsible for the industrial effluent from these zones entering into the receiving bodies.
- One incinerator has been planned for Rasht Wastewater Treatment Plant and may be the same will be utilized for the sludge produced from the Wastewater Treatment Plants in Anzali. This is under study by the Feasibility Study Consultants.
- As the water table is very high in Anzali, the Absorption Wells in the houses normally require cleaning after 8 months. The cost of cleaning an absorption well is Rials 200,000. Consequently, this project will save money allocated for cleaning the wells.

The Western Wastewater Treatment Plant in Ilyaran was visited. The following is the information gathered by this site visit.

- The treatment plant is under construction on a 14 hectare piece of land. Iran Ab is the Consultants for this project.
- The total land required for the Western Wastewater Treatment Plant in Ilyaran is 50 hectares, out of which a 14 hectare land is available. The purchase of the remaining land is in process by the Water and Wastewater Company, Gilan.
- This treatment plant is located at Margodeh. The effluent disposal is planned to discharge into Basham Rogah from where it will enter to the lagoons and to the Caspian Sea.

ANNEX G

Exhibits

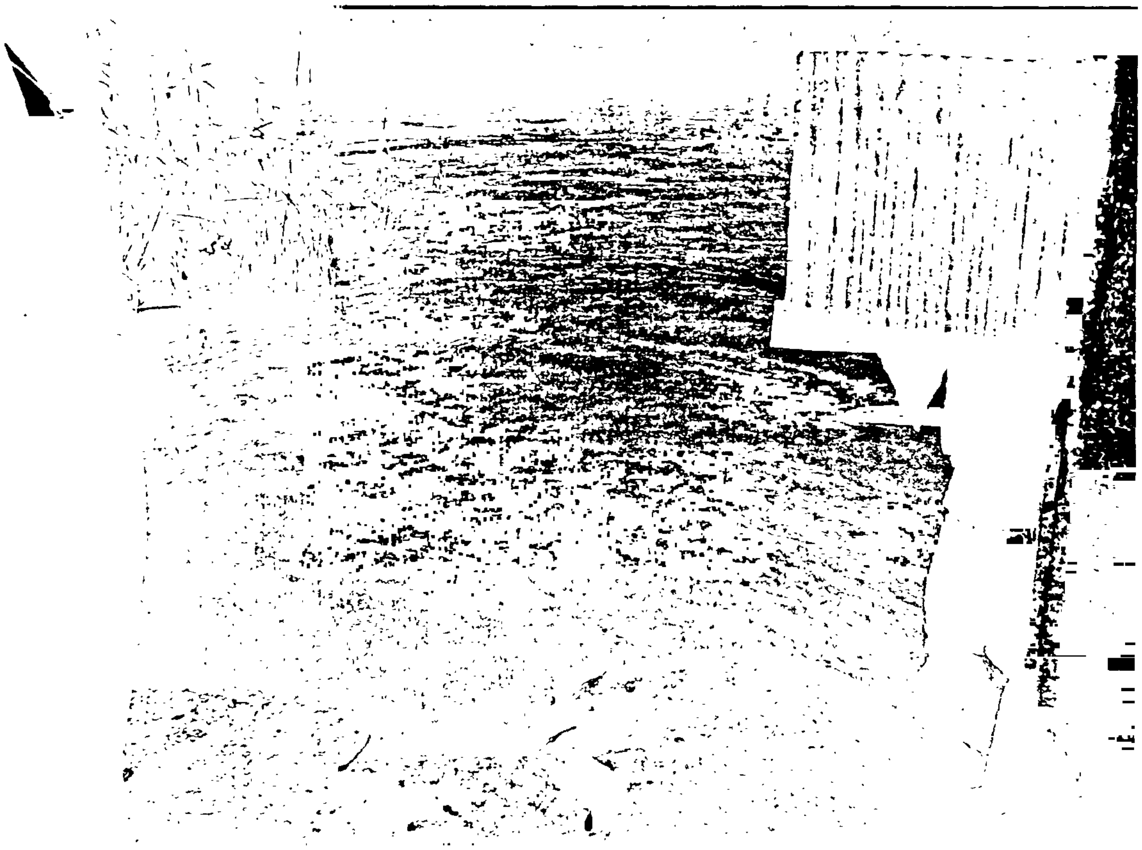


Exhibit 1: Outfall from Anzali directly to Anzali Lagoon

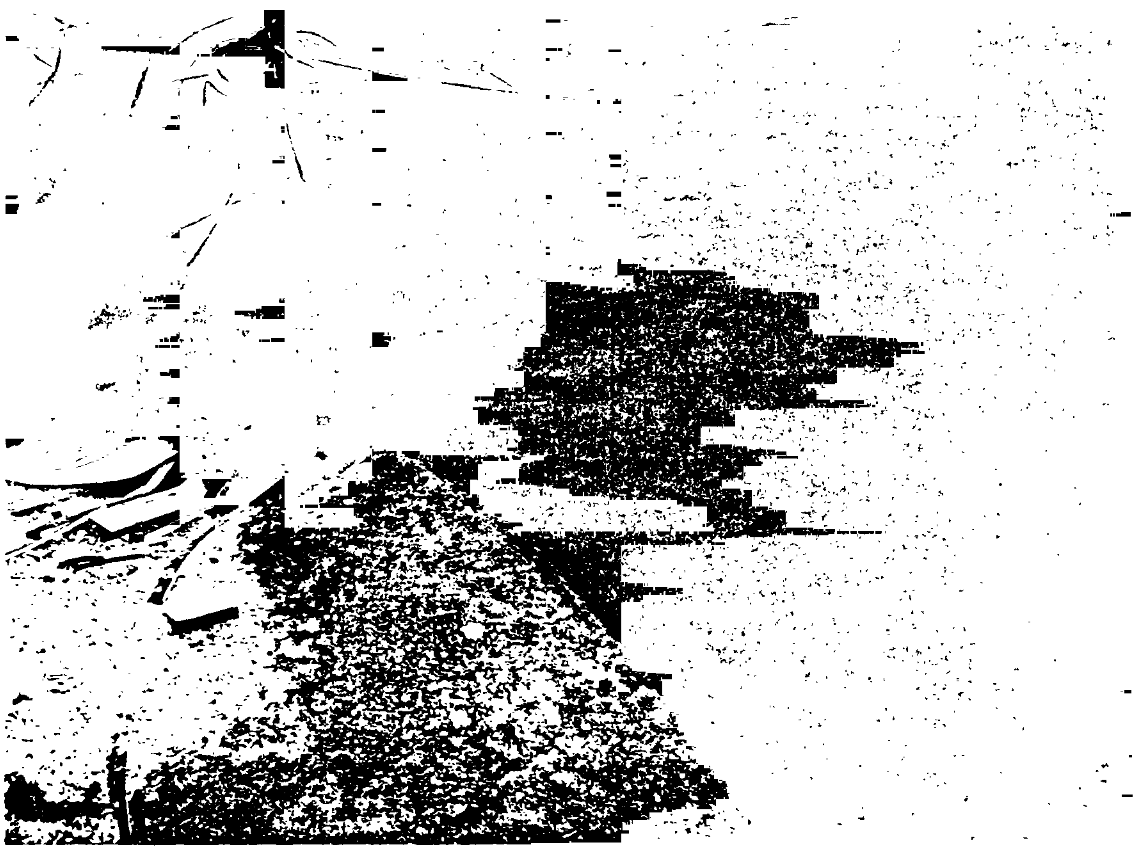


Exhibit 2: Outfall from Ghazian directly to Anzali Lagoon

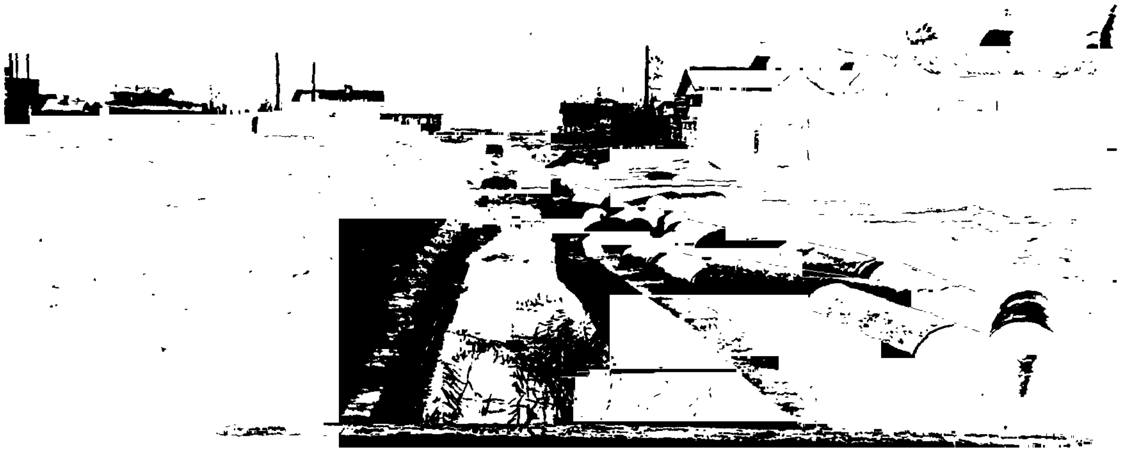


Exhibit 3: Outfall from Anzali directly to Caspian

Exhibit 4: Residential Clusters Close to Rasht WWTP

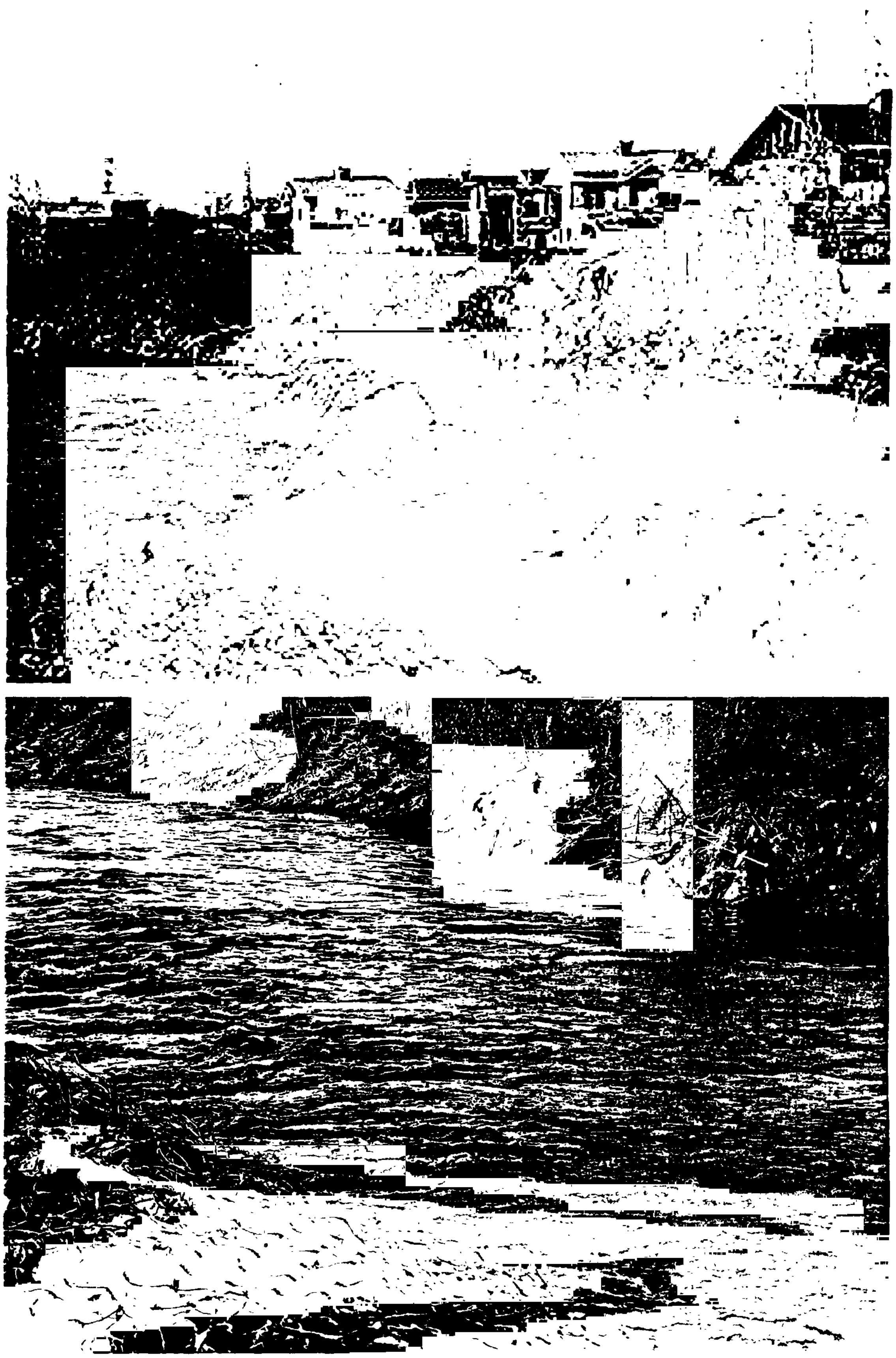


Exhibit 5: Zarjoob River Close to Rasht WWTP

Exhibit 6: Area Adjacent to Rasht WWTP

Exhibit 7: Area Adjacent to Rasht WWTP

Exhibit 8: Land Adjacent to Anzali WWTP

Exhibit 9: Outfall of Existing Anzali WWTP

ANNEX H

JICA Study

ANNEX H

Japan International Cooperation Agency (JICA): *Study on the Integrated Management for the Ecosystem Conservation of Anzali Wetland, Final Progress Report, February 2004, Nippon Koei, Ltd..*

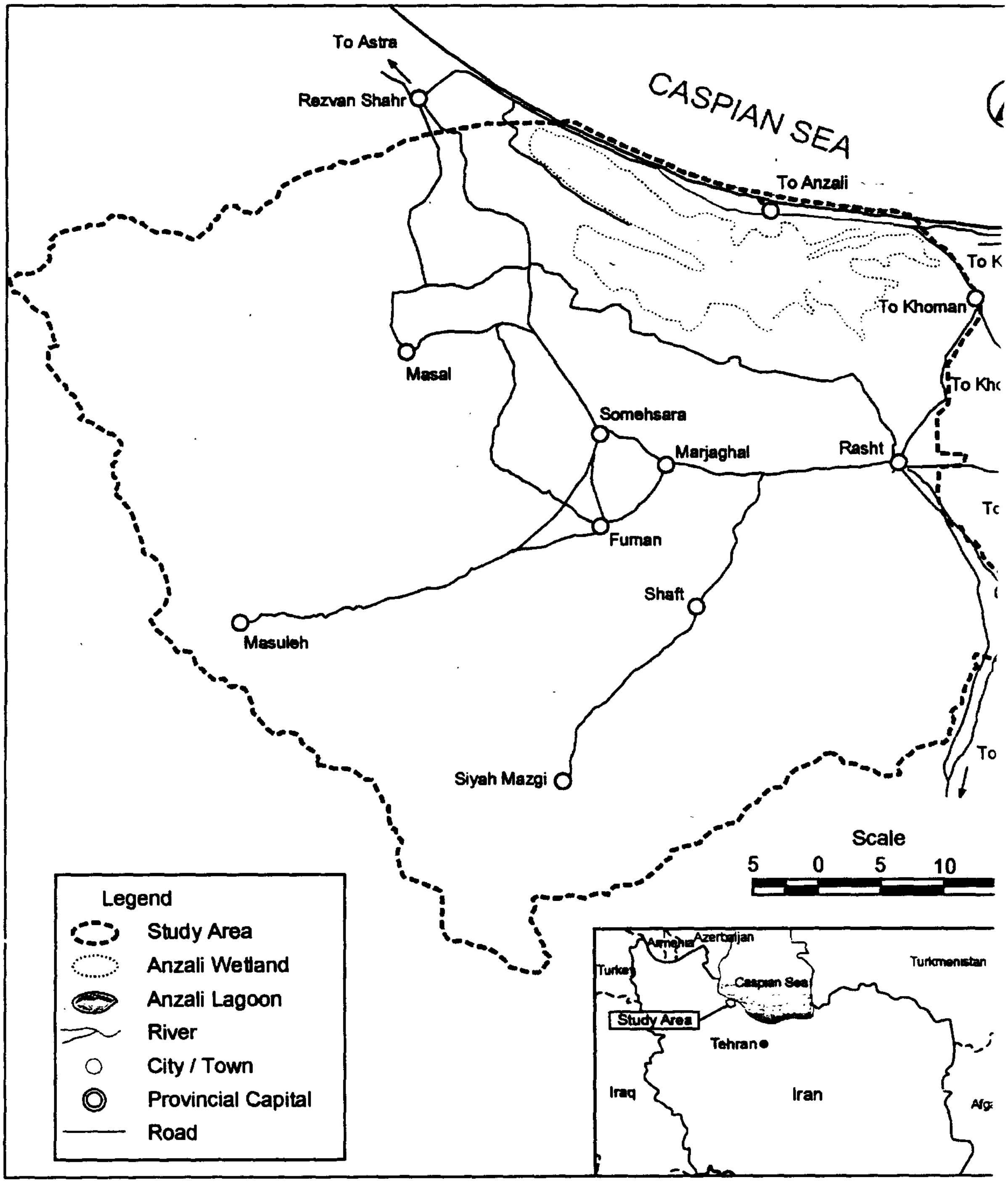


Figure H-1. Location Map of Anzali Lagoon and JICA Study Area

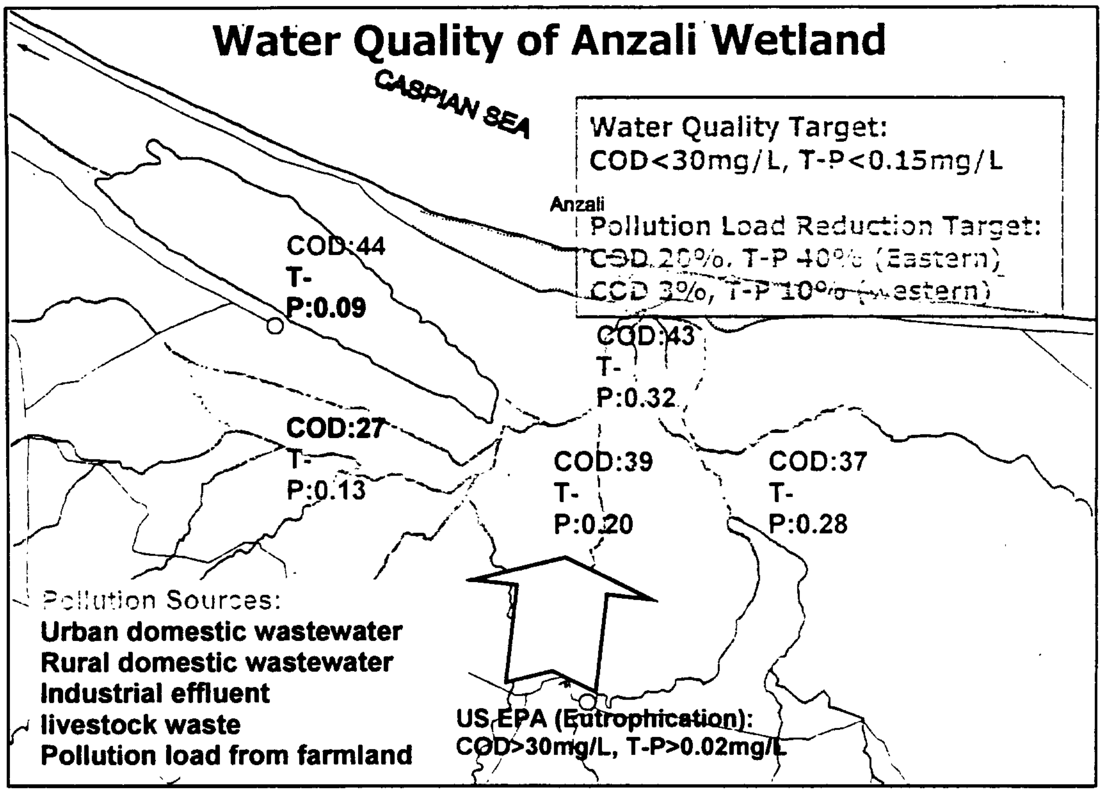


Figure H-2: Water Quality of Anzali Lagoon: Sample Locations and Test Results

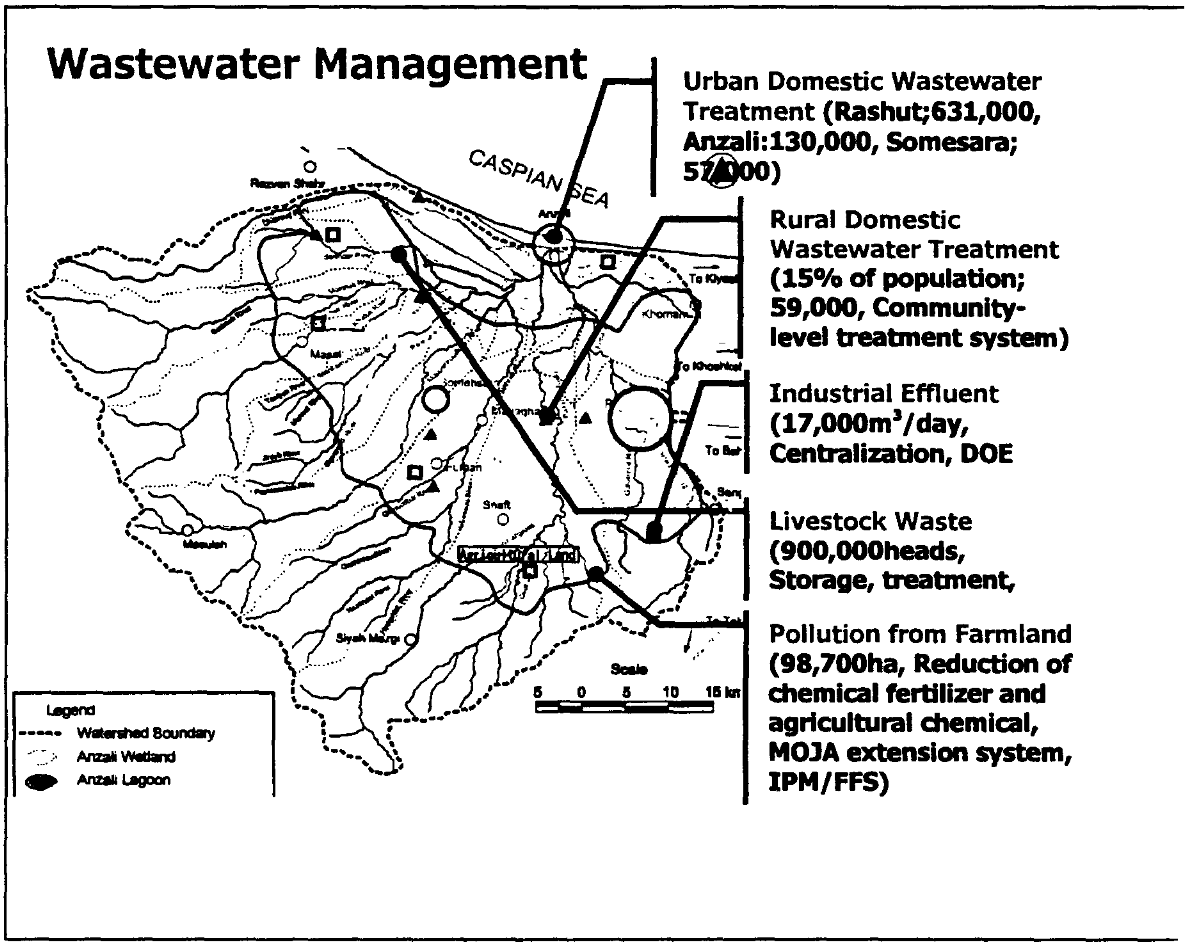


Figure H-3: Sources of Wastewater Pollution in Anzali Lagoon

Water Quality In Anzali Wetland

Excerpts from the JICA Study on the Integrated Management for the Ecosystem Conservation of Anzali Wetland, Final Progress Report, February 2004, Nippon Koei, Ltd.

1 Water Degradation in Anzali Wetland

It is generally believed that large pollution loads impact upon the ecosystem of Anzali Wetland. Certain phenomena in the wetland are reported, such as excessive growth of *Azolla* and *Phragmites*, and anaerobic conditions on the bed of the wetland. These phenomena may be related to the inflow of excessive amounts of COD, T-N and T-P. The mechanism of water quality degradation in the wetland is shown in Figure H-4.

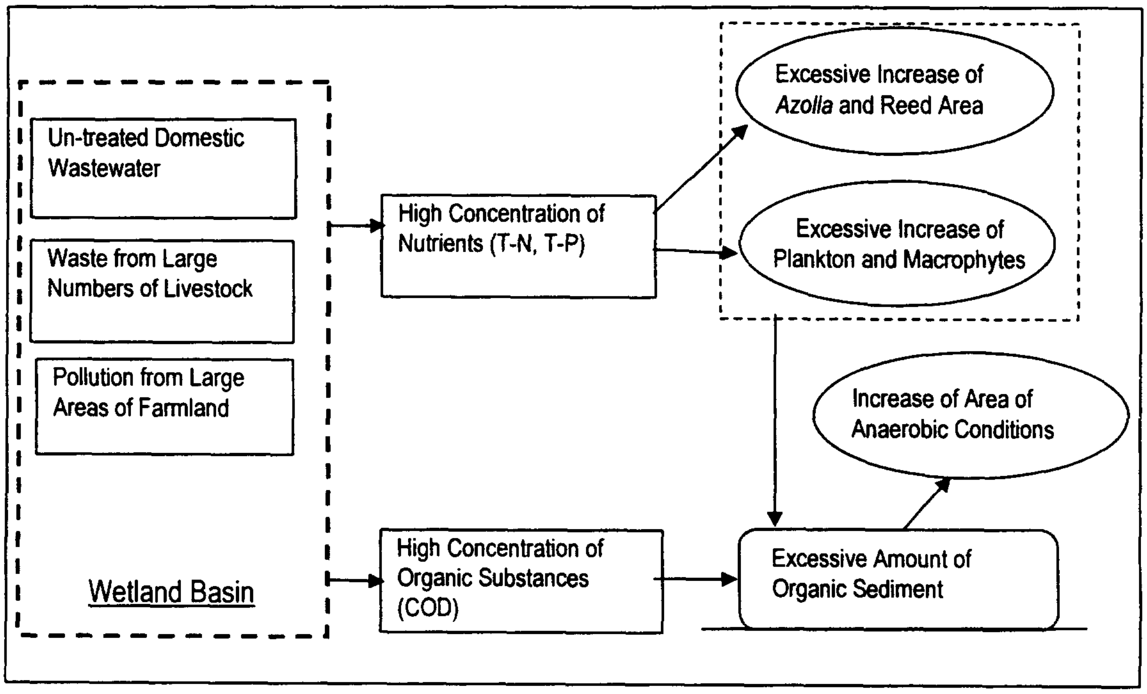


Figure H-4. Mechanisms of Water Quality Deterioration and Ecosystem Degradation

(1) Cause of High Concentration of Nutrient

Comparing the concentrations of nutrients (T-N and T-P) with several eutrophication criteria, it can be said that water quality in Anzali Wetland is between the upper limit of the mesotrophic condition and the eutrophic condition. One of the potential problems associated with eutrophic conditions is the excessive growth of specific plankton and/or macrophytes. The recent spreading of *Azolla* and the luxuriant growth of reeds may be related to the eutrophication of the water.

(2) Causes of High Concentration of Organic Pollution

COD is an indicator of organic pollution, which is caused by the inflow of organic pollutants, and results in the excessive growth of plants. The US EPA water quality guidelines, indicates highly eutrophic conditions, or in this case, high organic pollution, with more than 30 mg/L of COD (see Table 1 below). As the organic pollution progresses, the level of dissolved oxygen generally decreases, and anaerobic conditions in the bottom water are reported in Siakisim, Anzali Port and downstream of Pirbazar River.

2 Water Pollution Sources in the Basin

(1) Characteristics of Pollution Source

The wastewaters discharged to the wetland are generated in the basin of the wetland. There are various kinds of pollution source in the basin. Major water pollution sources are the human population (c. 1,156,000), industrial factories, livestock (> 900,000 head) and farmland (c. 98,000 ha). The present condition of each pollution source is summarized below.

1) Point sources

Urban Population: It is estimated about 762,000 people live in the urban areas of the basin. Most of the households in the urban area connected to traditional sewerage systems and discharge wastewater to river without any treatment.

Rural Population: It is estimated about 394,000 people live in the rural areas of the basin. Most of the households in the rural area have absorption wells.

Industrial Factories: There is large number of small-scale factories in the basin. However, the total quantity of industrial effluent amount is estimated to be about 3% of the domestic wastewater. In addition, the industrial effluent is strictly controlled by DOE.

Livestock: More than 900,000 head of livestock live in the basin. The livestock include about 309,000 cows, 417,000 sheep, 120,000 goats, 17,000 buffaloes and 47,000 horses & donkeys. Livestock waste is spread on farmland or grazing land, and discharged into rivers.

2) Non-point sources

Farmland: There is 98,000 ha of farmland. Every year these lands receive fertilizer which contains nitrogen and phosphorus, part of which will be leached into rivers.

Forest/Grasslands: There is about 199,000 ha of forest and grassland in the basin. Even such natural land will generate some organic and nutrient run-off, even without any human activity.

3 Pollution Load Discharged into Anzali Wetland

Water Flows in Anzali Wetland

The mechanism of water flow in the wetland is considered to be as shown in Figure H-5. This shows that the pollution load comes from five different sub-basins, and that Anzali Wetland can be divided into several areas including five protected areas (Siahkesim Protected Area, Sorkhankol Wildlife Refuge, Selke Wildlife Refuge, Hosein Bekandeh Non-hunting Area and Chokam Non-hunting Area)

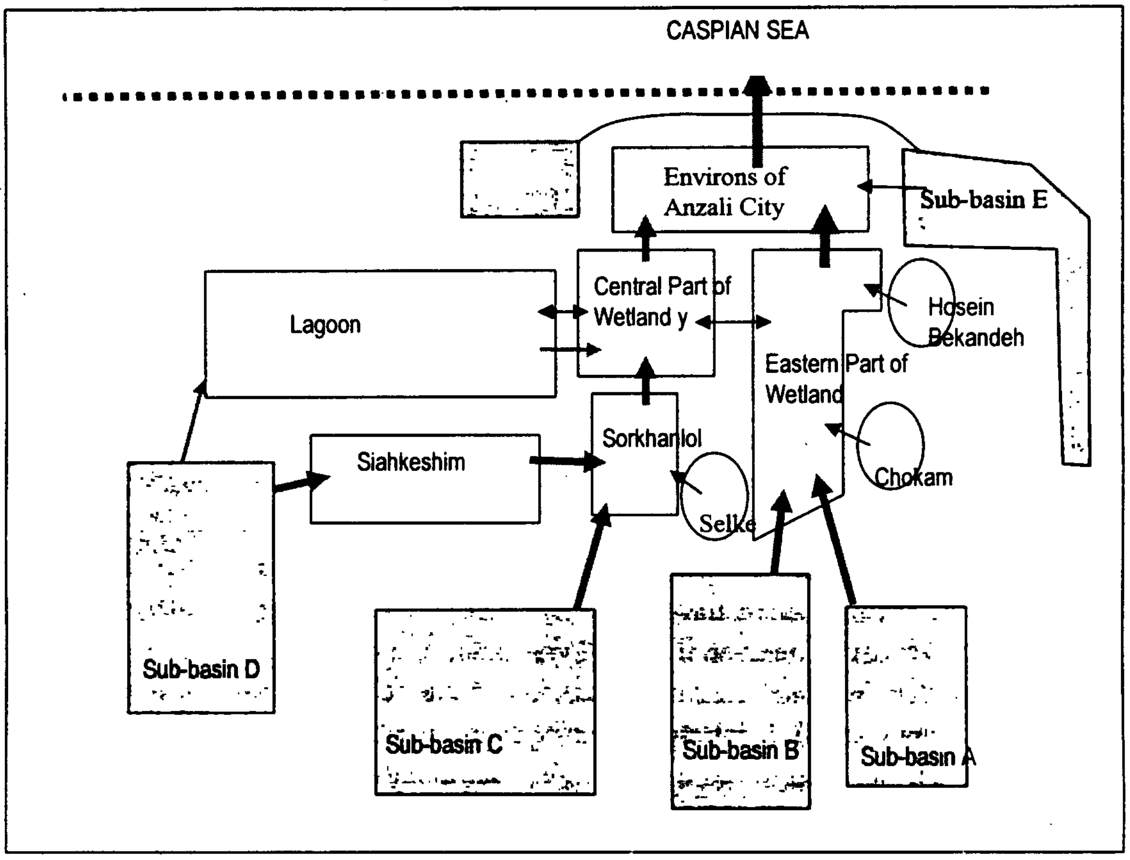


Figure H-5. Pollution Load Discharged Mechanism in Anzali Wetland

Pollution loads generated in the basin are discharged into the wetland through the nine rivers and drains. For the study on pollution load analysis, the basin of the wetland is divided into the five sub-basins shown in Figure H-6.

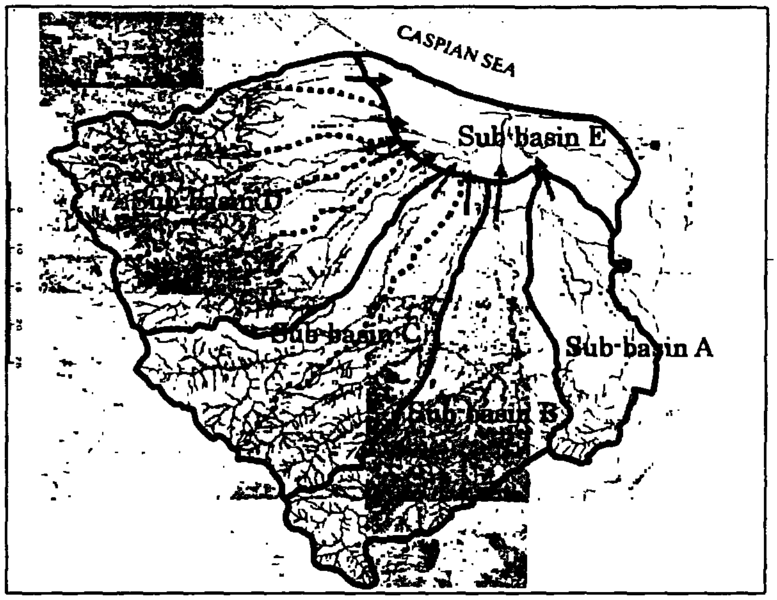


Figure H-6. Sub-Basins

The characteristics of each sub-basin are described below.

- Sub-basin A includes the most urbanized area, the biggest city, Rasht, and several factories. More than half of the population (i.e. 569,697 people) of the basin live in this sub-basin.
- Sub-basin B also discharges river water to the eastern part of the wetland. Only one small urban area, Shaft, and a large forest area are located in the basin. Only 10% of the total population lives in this sub-basin.
- It is estimated that more than half of the pollution load in the basin is discharged from sub-basins A & B through the eastern part of the wetland to the northern part of the wetland. Anaerobic zones at the bottom are found at several points in the eastern part. Hosein Bekandeh Non-hunting Area and Chokam Non-hunting Area are located in eastern part of the wetland.
- Urban area, Fuman and Somehsara are located in sub-basin C. It is estimated that 20 % of the residents and 28% of the livestock live in this sub-basin. The pollution load from sub-basin C is discharged directly to Sorkhankol Wildlife Refuge. Selke Wildlife Refuge is located near Sorkhankol Wildlife Refuge. Large amounts of *Azolla* occur in Selke all year.
- Sub-basin D has only one small urban area, Masal. Most of the population lives in the rural areas. The number of livestock is greater than the human population of the sub-basin. The pollution load from sub-basin D is estimated to be about 20% of total pollution load. Most of the pollution load is discharged directly to Siahkesim Protected Area. It is reported that anaerobic conditions are found in several parts of Siahkesim Protected Area. Only one small river in sub-basin D, the Chafrud River, discharges into the "Lagoon". The lagoon seems to have a

long water retention time.

- Sub-basin E includes the second biggest city, Bandar Anzali. There is only a small land area in this sub-basin. Wastewater generated in Anzali city is discharged into the wetland or the Caspian Sea through drains. Owing to the direct discharge of untreated wastewater from Anzali, the water near Anzali Port is recognized as one of most polluted areas in the wetland.

The major pollution sources in each sub-basin are described in Table H-1.

Table H-1. Pollution Sources (No.) in Each Basin in 2004

			A	B	C	D	E	Total
Population	Urban	Person	515,012	7,673	82,188	18,076	119,870	742,819
	Rural	Person	66,541	94,992	111,374	73,870	47,522	394,300
Livestock	Cow, Buffalo	Head	40,216	63,170	107,711	103,234	10,496	324,827
	Sheep & Goat	Head	311	100,820	191,966	243,204	960	537,261
Land Use	Farming Land	ha	19,868	17,988	32,239	23,430	5,186	98,711
	Forest/Grass Land	ha	29,700	63,360	43,560	59,400	1,980	198,000

The pollution load to the wetland has been calculated, based on the above data. The results for COD, T-N and T-P are shown in Tables H-2 to H-4, respectively.

Table H-2. COD Pollution Load discharged to Wetland

(Unit: ton/year)

COD Load	Sub-Basin					Total
	A	B	C	D	E	
Domestic Urban	26,317	392	4,200	924	6,125	37,958
Domestic Rural	1,360	1,942	2,276	1,510	971	8,059
Livestock	779	1,710	3,012	3,173	208	8,882
Farming Land	4,272	3,867	6,931	5,037	1,115	21,223
Natural Env.	2,792	5,956	4,095	5,584	186	18,612
Total	35,520	13,867	20,514	16,228	8,606	94,734

Table H-3. T-N Pollution Load discharged to Wetland

(Unit: ton/year)

T-N Load	A	B	C	D	E	Total
Domestic Urban	2,255.8	33.6	360.0	79.2	525.0	3,253.5
Domestic Rural	116.6	166.4	195.1	129.4	83.3	690.8
Livestock	85.3	187.1	329.6	347.3	22.7	972.0
Farming Land	284.1	257.2	461.0	335.0	74.2	1,411.6
Natural Env.	112.9	240.8	165.5	225.7	7.5	752.4
Total	2,854.6	885.1	1,511.3	1,116.6	712.7	7,080.3

Table H-4. T-P Pollution Load discharged to Wetland

(Unit: ton/year)

T-P Load	A	B	C	D	E	Total
Domestic Urban	338.4	5.0	54.0	11.9	78.8	488.0
Domestic Rural	17.5	25.0	29.3	19.4	12.5	103.6
Livestock	14.7	32.3	56.8	59.9	3.9	167.6
Farming Land	19.5	17.6	31.6	23.0	5.1	96.7
Natural Env.	8.9	19.0	13.1	17.8	0.6	59.4
Total	398.9	98.9	184.8	131.9	100.8	915.4

4 Water Quality in Anzali Wetland

(1) COD, T-N and T-P

Water quality surveys conducted in the wetland three times between September and December, 2003, indicate the distribution of COD, T-N and T-P concentrations shown in Figure H-7.

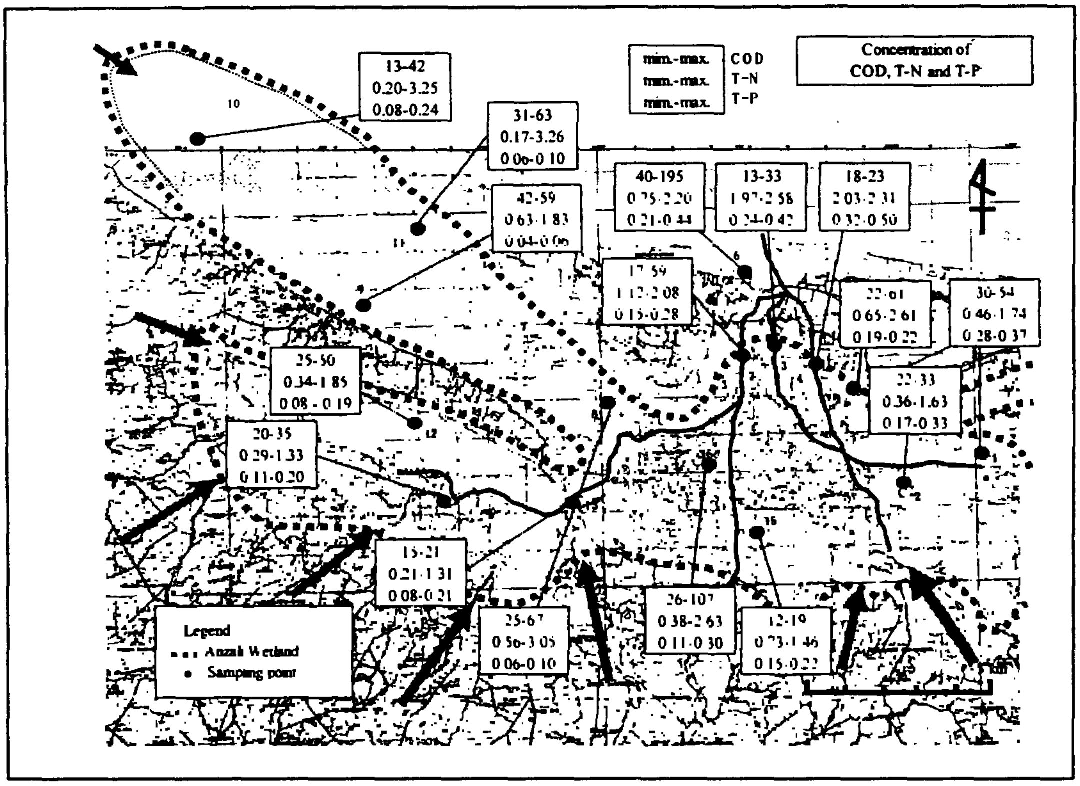


Figure H-7. COD, T-N and T-P Concentrations (mg/l) in Wetland Water

High values of COD, T-N and T-P are recorded throughout the wetland, although the recorded values differ from point to point.

(a) Organic Pollution

Table 2.2.5 shows the distribution of COD concentrations in the wetland, and US EPA eutrophication criteria for comparison. According to the criteria, most of the wetland except for Siahkesim can be classified as highly polluted water.

Table H-5. Distribution of COD Concentrations in the Wetland

(Unit: mg/L)

Area	Eastern part of wetland	Central Part of wetland	Environs of Anzali city	Siahkeshim	Lagoon area	Average
Average	37	39	43	27	44	38
Range	22 - 61	12 - 107	13 - 195	15 - 50	13 - 67	12.9 – 67.2
Criteria of Eutrophic Condition (US EPA)	High: COD >30 mg/L, Moderate: COD 20 -30 mg/L Slight: COD 10 – 20 mg/L, Minimal: COD <10 mg/L					

About half of the organic (COD) pollution load is discharged from sub-basins A & B through the eastern part of the wetland to the Caspian Sea. High COD values are recorded in the eastern part and in the environs of Anzali city, which have the highest recorded COD concentrations. This area receives pollution loads from sub-basin E, which also includes untreated wastewater from the second biggest city, Anzali.

According to DOE officials, there is an anaerobic zone at the bottom of Siahkesim, although the average recorded COD is relatively low.

(b) Nutrients

Table 6. shows the distribution of T-P concentrations in the wetland, and three international eutrophication criteria for comparison. According to these criteria, the wetland is classified as completely eutrophic throughout the wetland.

Table H-6. Total Phosphate Concentrations in Wetland Water

(Unit: mg/L)

Area		Eastern part of wetland	Central Part of wetland	Environs of Anzali city	Siahkeshim	Lagoon area	Average
Average		0.28	0.20	0.32	0.13	0.09	0.20
Range		0.17 – 0.42	0.11 – 0.30	0.16 – 0.50	0.08 – 0.29	0.04 – 0.29	0.04 – 0.50
Criteria of Eutrophic Condition	Vollenweider	0.03 – 0.1 mg/L					
	US EPA	> 0.02 mg/L					
	OECD[1]	0.035 – 0.1 mg/L					

About 57 % of the T-P pollution load is discharged to the eastern part of the wetland and the environs of Anzali city, and about 10% of the pollution load is discharged from sub-basin E to the environs of Anzali city. The environs of Anzali city are recorded as having the highest T-P values. The T-P concentrations in the western part are also high, whilst the values in Siahkesim and the Lagoon are recorded as being relatively low.

(2) Heavy Metal and Other Toxic Materials

(a) Heavy Metals in Sediment

There is no significant difference in the concentrations of heavy metals in the sediments of the wetland and of the rivers, and those values are less than the international standards shown in Table 7. This means that there is not a heavy metal pollution problem in the wetland.

Table H-7. Analytical Result of Heavy Metals in Sediment

(Unit: mg/kg)

Area	Cd	Pb	Cr^{6+}	As	Cu	Zn
Wetland	n.d. - 0.2	n.d. - 50.9	4.3. - 40.6	0.002 – 0.102	18.8 - 86.4	31.9 - 221.5
River	n.d. - 0.2	11.2 - 43.4	3.2. - 39.0	0.012 – 0.257	36.4 - 63.8	49.3 - 144.8
Canadian Criteria for aquatic life*	3.5	913.0	90.0	17.0	197.0	315.0

* : Probable Effect Level, Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, 1999

[1] Fixed Boundary System, OECD Trophic Terminology and Prediction, see http://lakes.chebuoto.org/TPMODELS/OECD/trophic.htm

(b) Pesticide and Herbicide

Pesticides and herbicides, such as diazinon and paraquat, are widely used in the basin, though little is known about their environmental impacts. Apparently birds and fish are quite susceptible to diazinon[2], while the concentrations of diazinon at 16 points in the wetland were recorded as between 14 and 143 μg/L in the water quality survey of September, 2003. Paraquat is moderately toxic to birds and fish[3], and the concentration of paraquat was recorded as between 18 and 199 μg/L at the same points and time. The field survey results must therefore be suspect. It is not clear whether this is due to point sources of pollution or other reasons, such as analytical and reporting errors. Evaluation of the pesticide and herbicide results is still on-going. Meanwhile, a detailed monitoring of agricultural chemical use and environmental concentrations of such chemicals, both with chemical analysis of biological assay, should be established.

[2] Reported LD50 (lethal doze) of diazinon for birds rages of 2.8-41 mg/kg, and the reported LC50 (lethal concentration in water) for fish are 80-3,200 μg/L for rainbow trout, 52 μg/L for bluegill, 30 μg/L for loach (EXTOXNET, 1996; Kyoto Univ., 1997).

[3] Reported LD50 of paraquat for birds is 970-981 mg/kg (bobwhite, Japanese quail), and the LC50 for trout is 13-32 mg/L (EXTOXNET, 1996).