JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

STATE COMMITTEE ON ECOLOGY AND NATURE UTILISATION CONTROL
BAKU COMMITTEE ON ECOLOGY AND NATURE UTILISATION CONTROL
AZERBAIJAN REPUBLIC

NO.

THE MASTER PLAN STUDY ON INTEGRATED ENVIRONMENTAL MANAGEMENT IN BAKU CITY IN AZERBAIJAN REPUBLIC

FINAL REPORT
VOLUME III

SUPPORTING REPORT

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The Study on Integrated Environmental Management in Baku City in Azerbaijan Republic

List of Volumes

Volume I	Executive Summary
Volume II	Main Report
Volume III	Supporting Report
Volume IV	Data Book

All the volumes are also available in Russian.

This is the Supporting Report.

In this report, the project cost is estimated by using the price as of the end of October 2000 and the exchange rate of US$ 1.00 = 108.30 Japanese Yen = 4550 Manat.

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LIST OF ABBREVIATIONS

ANASA	Azerbaijan National Aerospace Agency
ARWC	Absheron Regional Water Company
BCE	Baku Committee on Ecology and Nature Utilisation Control
BEP	Baku Executive Power
C/P	Counter Part
CPT	Cleaner Production Technology
DF/R	Draft Final Report
EP	Executive Power
EU	European Union
F/R	Final Report
FSU	Former Soviet Union
GIS	Geographical Information System
GoAz	Government of Azerbiajan
HWM	Hazardous waste management
Hydromet	State Committee for Hydro-meteorology
IC/R	Inception Report
IT/R	Interim Report
JICA	Japan International Cooperation Agency
MOEP	Ministry of Environmental Protection
M/M	Minutes of Meetings
M/P	Master Plan
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
P/R	Progress Report
PPP	Polluters Pay Principle
PVI	Physical Volume Index
S/W	Scope of Work
SCE	State Committee on Ecology and Nature Utilisation Control
SOCAR	State Oil Company of Azerbaijan Republic
Tacis	Technical Assistance programme for the CIS
UEIP	Urgent Environmental Investment Project
UNDP	United Nations Development Programme
VOC	Volatile Organic Compound
WB	The World Bank
WTP	Willingness to Pay

Chapter 1

1 Work Process

The following describes the work process of the study. It is also shown in Figure 1-1.

1.1 Phase 1: Understanding the Current Condition of the Environment

1.1.1 A: Preparatory Work in Japan

A.1 Collection and Review of Existing Information

Information collected by the team and by the JICA's preparatory study mission was studied and other information needed for the study implementation was itemised.

A.2 Re-examination of Study Policies and Study Methods

Study policies and study methods initially considered by the team was re-examined and confirmed by each study member.

A.3 Preparation of the Inception Report (IC/R)

The IC/R was prepared in which study policies and study methods are described. The report summary was translated into Russian.

1.1.2 B: 1st Study Work in Azerbaijan (First Half)

B.1 Presentation and Discussion of Inception Report (IC/R)

Before starting the study in Baku, the team prepared IC/R, in which background, objectives, team members' expertise, methodology and schedule of the study were outlined. The team submitted 30 copies of IC/R (in English and Russian, respectively) to the Government of Azerbaijan (GoAz) and gave a presentation of its contents.

After a series of meetings, the minutes of meetings on IC/R was signed by four representatives from the SCE, BCE, JICA advisory committee and the team. In the minutes, it was agreed that the counterpart and the team would hold weekly meetings on every Monday. The weekly meetings were held, in which the team summarised activities of the previous week and plans for the coming week, and mutual understanding about the study was encouraged.

It was also agreed in the minutes that the study team would hold monthly seminars. They are listed in Table 1-1.

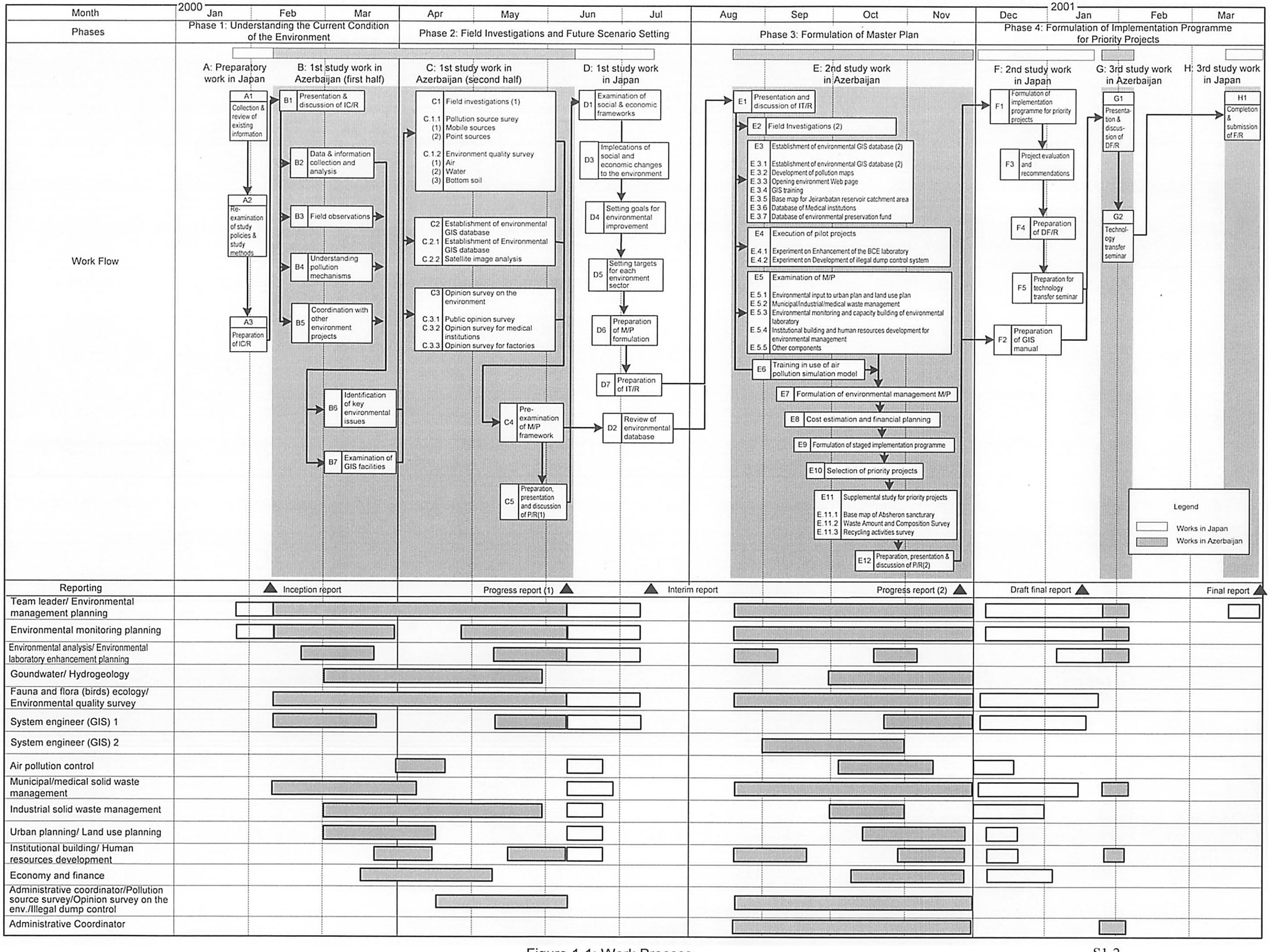


Figure 1-1: Work Process

Table 1-1: Seminars Held by the JICA team

Items / Date	Subjects	Lecturer	Number of Attendants
15 March	Geographic Information System	Mr. Masuda	22
14 April	Air Pollution	Mr. Hawkings	14
12 September	Law Enforcement	Mr. Damazer	35
27 November	Japan's Lessons on Economy and Environment	(Video)	37
27 November	Waste Management	Mr. Shimura	37

B.2 Data and Information Collection and Analysis

In cooperation with the counterpart, the team has collected data and information regarding the following aspects. The team assessed them and some of them were input into the GIS database:

- natural environment;
- social and economic conditions;
- policy, legislation and standards on the environment;
- institutional structures;
- land use;
- social infrastructure;
- environmental quality;
- pollutants and pollution sources;
- activities of other donors for environmental improvement.

B.3 Field Observations

Field observations were carried out for further understanding by supplementing the data and information collected. The following facilities and sites were visited:

- meteorological and hydrological stations;
- monitoring stations;
- laboratories;
- natural reserves, sanctuaries and monuments;
- social infrastructure such as the final disposal sites (including illegal dump sites), city water works, sewerage, wastewater treatment plants, wastewater outfalls, and other pollution-related facilities;
- project sites of other donors for environmental improvement.

B.4 Understanding Pollution Mechanisms

The causes and scale of major pollution problems in Baku and their mechanisms were understood based on the findings of the existing data and information and field observations.

B.5 Coordination with Other Environment Projects

One of the most important objectives of this study is the identification of priority projects, which might be financed by Japanese Government or other international donor agencies after the study, and such projects must not have overlaps with other projects. Therefore coordination with other environment projects is of vital importance in the current study.

As mentioned above, the team had meetings with personnel involved in other environment projects carried out with either local authorities or international organisations, and understood their activities and expected output.

B.6 Identification of Key Environmental Issues

Data review and discussions with various organisations provided the team with basis from which to identify key environmental issues to be focused in the study. Key environmental issues that are either currently significant or anticipated to emerge in future were identified and are presented in Chapter 5 of the Main Report.

B.7 Examination of GIS Facilities

The establishment of an environmental GIS is one of the main components of the study. After reviewing types and volume of available data and other GIS systems established in Azerbaijan, the team examined the database structure and the GIS facility components. JICA procured equipment listed below according to the team's proposal for equipment requirements. The equipment was installed in the office of the BCE.

Table 1-2: List of GIS Equipment Provided by JICA

Item	Quantity
PC for Server DELL Power Edge 2300 Intel Pentium III 500MHz Processor 512Kb secondary cache 512MB ECC EDO DIMMS 4 x 1" LVD 18GB 7200 RPM 80 PIN SCA 3x5.25" external drive bays / 3.5" 1.44 diskette drive Passive Back plane 6 x 1" Non hot-plug Integrated Adaptec 7890 Ultra2/LVD SCSI controller Integrated Adaptec 7860 Ultra/Narrow SCSI controller 4 PCI, 2 PCI/ISA shared slots One parallel port, two serial ports, PS/2 mouse port PV 100T 20GB DDS-4 DAT unit (internal) PCI local bus video 2Mb video memory	1
14/32x Speed SCSI CD-ROM SCSI CD Re-Writer HP Open View Network Node Manager SE Intel Pro 100 Plus PCI TX 15" Dell Monitor Dell performance 105-keyboard Logistic System Mouse 2 button	

PC for Client	
Dell Optiplex Gx1L	2
Intel Pentium Ⅲ 500MHz processor	
512Kb Level 2 cache	
Integrated 3.5” 1.44Mb floppy drive plus one external	
5.25” one internal 3.5” bay	
Three expansion slots (one PCI, one ISA, one shared)	
512Mb SDRAM	
9Gb SCSI Hard Drive	
AHA 29/40 SCSI Controller with SCSI cable	
Integrated 2x AGP with 8mb Video Card	
Integrated 3 Com 10/100 Mbit	
Integrated 16-bit Sound Card	
50 x CD-ROM	
SCSI CD Re-Writer	
ATI Multi-Media Channel port (AMC)	
One parallel, two serial, two USB	
Dell 105-keyboard / Microsoft Mouse	
21” Dell Monitor	
Microsoft Windows 98 pre-installed	
For expansion: 1” LVD 9Gb 7200RPM 68 Pin add	
Network equipment	
Cisco 8 port Micro HUB	1
Jack RJ-45	3
Cable RJ-45 UTP 5 Category	3
Printer	
HP DeskJet 1120C (A3, 600dpi colour, 7ppm)	1
Scanner	
Mustek SCANEXPRESS SCSI	1
Raster to Vector software EASY TRACE 6.0 for Windows	1
Plotter	
HP Design Jet 750C Plus (A0 models)	1
Inkjet cartridge (black & colour)	1
Paper for colour printing	1
Digitizer	
Calcomp Drawing Board Ⅲ 34480-H4 (A0 format)	1
Photocopy Machine	
CANON NP 6416 (A3 format)	1
Sorter and Pedestal	1
ADF	1
Uninterruptible Power Supply	
Inform 1500 King Pro	1
Inform 2000 King Pro	2

Since the GIS will be used and maintained by the BCE after the current study, the BCE must have expertise to operate the GIS. The team commenced a training programme for two BCE personnel.

1.2 Phase 2: Field Investigations and Future Scenario Setting

1.2.1 C: 1st Study Work in Azerbaijan (Second Half)

C.1 Field Investigations (1)

See Chapter 3 of the Main Report and Chapter 3 of the Supporting Report for results and findings from the field investigations (1).

C.1.1 Pollution Source Survey

The Pollution Source Survey looked at mobile sources and point sources (factories). The survey was conducted by a local consultant.

a. Mobile Sources

The purpose of this survey was to obtain the current data of the mobile pollution sources in the study area. The survey consisted of two components; i.e. traffic volume survey and vehicle type analysis.

The objectives of the traffic volume survey were to identify the distribution of traffic in the core area of Baku city, the composition of large vehicles and others, and the traffic volume to and from suburbs. The vehicle type analysis survey was carried out to assess the proportion of large petrol vehicles and large diesel vehicles of the total.

b. Point Sources (Factories)

An environmental passport contains data on pollution caused at the factory in such forms as air, water, solid waste, and energy (i.e. noise and vibration) and it should provide a vital information source for the study. Since the rate of operation of factories in Azerbaijan has dropped due to the depressed economy, it is uncertain whether the data in the environmental passports are still valid to describe the current conditions.

The purpose of this survey was to obtain the current data of the point pollution sources (factories) in the study area. 250 factories were selected for the survey. The survey consisted of two components; i.e. review of environmental passport and opinion survey for factories.

The objective of the environmental passport review was to identify the current status of the point pollution sources (factories) in the study area through a check of the passports submitted. The opinion survey for factories was to understand the opinion of point pollution sources (factories) regarding improvement of the environment, willingness to pay (WTP) for environmental conservation, need for administrative supports, etc.

C.1.2 Environmental Quality Survey

Environmental quality survey consisted of two components: accuracy assessment survey and data verification survey. The work was subcontracted out to a local company.

The purpose of the accuracy assessment survey was to assess the reliability and accuracy of environmental data obtained by the local monitoring organizations. The survey included:

- Air quality regarding SO_2, NO_2, dust, CO, phenol, Hydrocarbons (HC), Hg.
- Water quality on COD, BOD, pH, DO, SS, and heavy metals (Cd, Pb, Zn, Hg, Cr, As) and oil contents.
- Sediment quality regarding heavy metals (Cd, Pb, Zn, Hg, Cr, As), oil contents and oil composition.

The data verification survey was to be carried out to check the environmental data mentioned in the ecology passports in the study area. The survey included:

- Industrial waste (sludge) quality of three selected factories on heavy metals concentration (Cd, Pb, Zn, Hg, Cu, Cr and As).
- Emitted gas quality of three selected factories regarding NOx and CO.
- Wastewater quality of three selected factories on BOD, pH, SS, and heavy metals (Cd, Pb, Zn, Hg, Cr and As).

C.2 Establishment of Environmental GIS Database (1)

C.2.1 Establishment of Environmental GIS Database

An environmental GIS database is to be established to support the BCE as an environment management body to administer and instruct other governmental authorities, which are in charge of urban plans or land use plans, based on a well organized data set in the database. The establishment work of GIS database is being conducted by both the study team and a local consultant and the results of the survey is presented in Chapter 1 of the Data Book.

The data structure is shown in Figure 1-2. As shown, data are categorized into six types.

I. Base Map

II. Natural Conditions

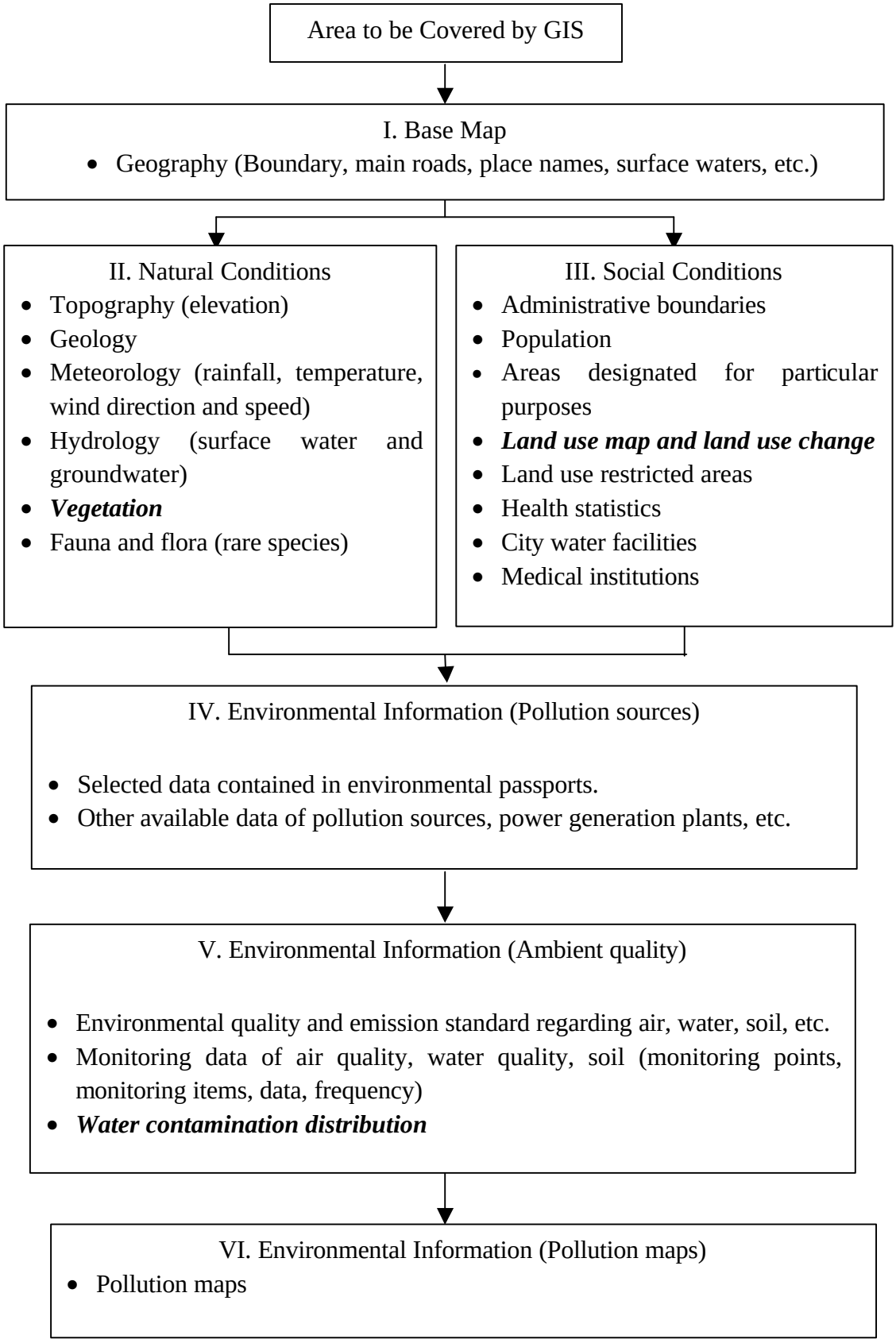
III. Social Conditions

IV. Environmental Information (Pollution sources)

V. Environmental Information (Ambient quality)

VI. Environmental Information (Pollution maps)

The environmental GIS database was established in 2 phases. The 1st Phase of the works was conducted from April to the beginning of June 2000 and 2nd Phase was from September to November 2000. The work distribution of the two phases is presented in Table 1-3.



Bold and italic letters: data obtained from satellite image analysis.

Figure 1-2: Data Structure of Environmental GIS

Table 1-3: Environmental GIS Database Works

Main Category	Sub Category	1st Phase	2nd Phase
Base Map	Geography		
	(1) Boundary (study area)	◎	
	(2) Main roads	◎	
	(3) Place names	◎	
	(4) Surface water	◎	
	(5) Jeiranbatan reservoir and catchment area		◎
Natural conditions	Topography (elevation)	◎	
	Geology	◎	
	Meteorology		
	(1) Rainfall	◎	
	(2) Temperature	◎	
	(3) Wind direction	◎	
	(4) Wind velocity	◎	
	Hydrology		
	(1) Surface water	◎	
	(2) Groundwater	◎	
	Fauna and flora (rare species)		◎
	Vegetation	◎	
Social Conditions	Administrative boundaries	◎	
	Population	◎	
	Areas designated for particular purposes		◎
	Land use	◎	
	Changes in land use	◎	
	Health statistics		◎
	City water facilities	◎	
	Medical institutions		◎
Environmental Information (Pollution sources)	Environmental Passports	◎	
	Power generation plants	◎	
	Oil mining ground	◎	
	Farmland (large-scale farmland)	◎	
	Solid waste treatment/disposal and sewage treatment facilities	◎	
	Environmental protection fund		◎
Environmental Information (Ambient quality)	Environmental quality/emission standards	○	○
	Air quality	○	○
	Water quality	○	○
	Soil quality	○	○
	Water contamination distribution	◎	
Environmental Information	Pollution maps		◎

(Note) ◎ means the works shall be done. ○ means part of the works shall be done.

C.2.2 Satellite Image Analysis

LANDSAT TM data taken on 31 July 1988 and 23 August 1999, which clearly show the Absheron peninsula without clouds, were analysed to establish vegetation maps, land use maps and water contamination distribution maps.

C.3 Opinion Survey on the Environment

Being aware of how much the whole society of Baku is concerned about the environment of Baku and how much it is interested in environmental improvement is fundamental for environmental management planning. In particular, the willingness to pay (WTP) for the environmental improvement has to be understood since WTP is a key element to make the environmental management M/P practicable and financially sound.

Therefore, an opinion survey on the environment was carried out. Its targets were the general public, medical institutions, and factories. An opinion survey for factories was conducted as a point pollution source (factories) survey. A local consultant conducted the survey and the results and findings of the survey are presented in the Chapter 3 of the Supporting Report and Chapter 3 of the Main Report.

C.3.1 Public Opinion Survey

The objective of this survey is to understand how much the whole society of Baku is concerned about the environment of Baku and how much it is interested in environmental improvement.

The number of samples required to obtain a 90% confidence limit is 382 for a population of 100,000 and 384 for a population of 1,000,000. Since the population of Baku is about two million, 400 samples were selected. 400 samples for the POS were chosen so that they well represented the whole city population. 41 items were considered.

C.3.2 Opinion Survey for Medical Institutions

Medical institutions are of interest since they generate not only normal municipal waste but also bio-hazardous, toxic, or dangerous waste. The latter includes used needles, surgical knives, gauze, bandage, expired medicine, removed organs and other infectious material, and requires special attention to avoid risk to humans and the environment.

The opinion survey for medical institutions was carried out in order to understand the amount of medical waste generated and their practices of waste management in terms of segregation, storage, discharge, collection, treatment and final disposal. The results will provide basic information for M/P formulation.

40 medical institutions in the study area were selected for the questionnaire survey to ensure that they represented the current medical waste management in the study area. 43 questions were asked.

C.4 Pre-examination of M/P Framework

Key concepts, principles and goals of the environmental management, which give the framework of the M/P, were pre-examined and presented in the Progress Report (P/R)

(1). Since this was crucial for later stages of the study, the team thoroughly discussed this with the C/P to reach mutual consensus.

C.5 Preparation, Presentation and Discussion of P/R (1)

The team prepared the Progress Report (P/R) (1), which described summary of the findings during the 1st study work in Azerbaijan and issues to be addressed at that stage. The C/P and the team discussed the contents of P/R(1) and signed minutes of meetings (M/M). P/R(1) and M/M were submitted to JICA.

1.2.2 D: 1st Study Work in Japan

D.1 Examination of Social and Economic Frameworks

Social and economic changes can affect environmental status in coming years. The most plausible social and economic scenario was examined.

D.2 Review of Environmental Database

GIS data must be consistent in terms of format and coordinates and errors in typing and categorization must be avoided. Therefore, data digitised by subcontract during the 1st study work in Azerbaijan was reviewed by the team. Database was modified by checking data format, coordinates, raw data and data categorisation.

D.3 Implications of Social and Economic Changes to the Environment

The influences on the environment, which could be given by the socio and economic frameworks, were examined.

D.4 Setting Goals for Environmental Improvement

The period towards the target year 2010 was divided into three and goals of each sub-period were set.

D.5 Setting Targets for Each Environment Sector

Targets that are to be achieved in order to reach to the above goals were set for each environmental sector that is covered by each department of the BCE.

D.6 Preparation of M/P Formulation

Key concepts and issues to be considered in the M/P formulation were clarified. What data and information are necessary in the next phase were examined.

D.7 Preparation of IT/R

The output of the study up to this stage was integrated in IT/R. The summary report was translated into Russian to ensure the understanding of the Azerbaijan side.

1.3 Phase 3: Formulation of Master Plan

1.3.1 E: 2nd Study Work in Azerbaijan

E.1 Presentation and Discussion of IT/R

The IT/R was presented by the study team to the C/P and the steering committee members for discussion to reach a consensus.

E.2 Field Investigations (2)

The field investigations required to formulate an implementation programme for environmental monitoring system development was carried out by local subcontractors. The outline of these investigations is described below.

The results and findings are presented in Chapter 3 of the Supporting Report and Chapter 3 of the Main Report.

E.2.1 Air

(1) Monitoring of Pollution from Vehicular Exhaust

There are nine air monitoring stations in the study area, but only one of these can monitor vehicle exhaust gas pollution. Therefore, the significance of pollution caused by exhaust gas cannot be fully assessed. In order to understand the extent of impacts of vehicular emission and to examine the necessity of monitoring pollution from vehicular exhaust, the following pilot monitoring was executed.

Monitoring point: Two points, one being in the middle of the city and the other east of the city centre. The existing one is in the west of the city centre.

Monitoring period: one whole day (24 hrs).

Monitoring items: SO_2, NO_2, CO, HC, Pb, dust and phenol.

(2) Measurement of Vehicular Emissions

The BCE does not have the equipment to inspect vehicular emissions. Furthermore, the BCE as well as other environment related agencies do not possess data on vehicular emissions upon which the policy for vehicular emission control should be based.

The team measured vehicular emissions as shown below in order to examine the viability of including vehicular emission measurement in the BCE's monitoring system.

Measured items: CO, SO_2 and NO_x.

Period: Four days.

Measuring sites: Three sites

Number of Vehicles Measured: 300 vehicles in total: 60 ordinary vehicles, 60 microbuses, 60 large buses, 60 trucks and 60 taxis.

Sampling method: 25 vehicles were randomly sampled per measuring site in a day.

25 vehicles x 3 sites x 4 days = 300 vehicles

Method: Portable equipment was used to measure vehicle emission when vehicles were idling.

E.2.2 Sediment

Many lakes in and around the city are severely contaminated due to the discharge of wastewater from households, industries and oil fields. Hydromet regularly monitors

lake water, and it is fortunate that most of those polluted lakes are not used for domestic or agricultural purposes and that there are no reports of major impacts on public health. However, since accumulation of pollutants in lake sediments can cause future incidents, sediment monitoring may be necessary.

Sediment quality measurement was carried out to understand current conditions and decide the necessity of regular sediment monitoring.

Sampling point: Three sampling points each in five lakes (Ganligol, Khojasan, Beyuk Shor, Bul buli and Zykh) and one sampling point each in three lakes (Yashamal 1, Yashamal 2, and Krasnoye).

Number of samples: One for every sampling point; sampling will be done using a sediment collector sunk from a boat.

Measured items: Heavy metals (Cd, Pb, Hg, Methyl-Hg and As), and oil content.

E.2.3 Water

Although the Jeiranbatan reservoir is out of the BCE's area of jurisdiction, the BCE should understand its water quality, considering that the reservoir is a major drinking water source. To obtain base information, water quality measurement was carried out as follows.

Sampling point: Three in the reservoir, one in each of the three ponds in its catchment area and three in the neighbouring water way constructed to prevent wastewater from entering the reservoir.

Measured items: Cd, As, Hg, Pb, CN, Cr^{6+}, PCB and oil content.

Number of samples: One sample per point.

E.2.4 Accuracy Assessment

In order to analyse chemical substances accurately, the whole analytical processes including pre-treatment of samples and reagent preparation must be appropriately carried out.

The team assessed the accuracy of BCE's laboratory works by observing its methods of analysis. The works were carried out as follows.

Measured items: Heavy metals (Cd, Pb, Cr and As) and oil content.

Samples: The same three sediment samples as E.2.2 taken from different lakes and the same three water samples as E.2.3 taken from different places.

Analysis method: Atomic absorption spectrophotometry and gaschromatography.

The assessment was then incorporated into the M/P for laboratory (Section 7.5 of the Main Report) and one of the priority projects (Section 10.3 of the Main Report).

E.3 Establishment of Environmental GIS Database (2)

E.3.1 Establishment of Environmental GIS Database (2)

The data categories for the environmental GIS database, which was established in the 2nd Study Work in Azerbaijan, are shown in Table 1-3. The newly obtained data and information are explained below. See Chapter 1 of the Data Book for details.

(1) Fauna and Flora

The information on sanctuaries and natural monuments was entered onto the GIS.

(2) Areas Designated for Particular Purposes

Some areas may be restricted from particular types of development. These include areas restricted for industrial or residential development, such as national parks. Alternatively, there may be some areas where particular types of development are specially promoted, such as designated industrial zones. However, the appropriate landuse map, which is part of the Baku Devleopment Master Plan, was not available to the team in spite of repeated requests to the city authorities. As stated elsewhere, a valid land use plan, which shows areas designated for particular purposes, does not exist in the city at present.

Accordingly environmental zoning which indicates the areas restricted for developments was proposed by the team as in Section 6.2.4 of the Main Report.

(3) Health Statistics

Health statistics such as mortality rate and morbidity rate were entered as attribute data for each district.

(4) Environmental Quality Standards and Emission Standards

Environmental quality standards and emission standards available in Azerbaijan were entered as attribute data.

(5) Air quality/Water quality/Soil quality

Some information on air, water and soil quality was entered into the GIS database during the 1st study work in Azerbaijan and further information that was acquired on the same issues continued to be entered. Furthermore, data on lake sediment quality were entered into the database.

E.3.2 Development of Pollution Maps

Pollution maps were developed using the GIS functions and the various databases which were established in the present study.

E.3.3 Opening Environment Web Site

Environmental information should be shared among citizens, private enterprises and public agencies as a means of enhancing the public's environmental awareness. Development planning should also take the environment into account, and effective and practical environmental policies should be formulated. The team believes that opening an environment web site using the GIS database developed by this study is a good step for environmental information sharing. The team created html formatted files showing part of the information contained in the GIS database. As agreed in the M/M of P/R(1), the C/P was required to secure appropriate host facilities within the

SCE or GoAz servers. Types of information that were presented in *html* files by the team are as follows:

- general information on the BCE and background of the establishment of the homepage;
- structure of the established database;
- graphical images for each of information shown in Table 1-3;
- hardware and software components of the BCE's GIS.

E.3.4 GIS Training

The JICA team continued to give training on GIS usage to the BCE trainees. An SCE trainee, who received training from IWACO, a Dutch consulting company, within its technical assistance for Baku Bay cleanup project, was also invited to the training. The training inputs contained the following elements:

- creating a database using MS Excel and MS Access;
- opening existing shape files using ArcView;
- saving database as a new project file using ArcView;
- creating a new theme using ArcView;
- editing attribute tables using ArcView;
- creating layouts using ArcView;
- importing a database from external data sources to ArcView;
- exporting attribute tables from ArcView to MS Excel or MS Access;
- hardware and software components.

E.3.5 Base Map for Jeiranbatan Reservoir Catchment Area

Because the study area does not include the Jeiranbatan reservoir and its catchment area, these were excluded from the present GIS. However, considering that the preservation of the reservoir is of great importance to the residents of Baku, the team added a base map of the reservoir and its catchment area to the GIS. The base map contains the following information:

- topography;
- land use;
- vegetation;
- surface water;
- rivers;
- channels;
- buildings;
- roads;
- railway and stations.

E.3.6 Database of Medical Institutions

There are 240 medical institutions in the study area. Due to the significance of medical waste control, their information in terms of the following items was entered to the GIS.

- name, location, address, type and contact numbers;
- private or public;
- total number of beds;

- total number of doctors;
- other.

E.3.7 Database of Environmental Protection Fund

Information on payments record of each factory to the environmental protection fund was entered into the GIS.

E.4 Execution of Pilot Projects

It is expected that the BCE will encounter difficulties when carrying out the proposed priority projects in the future. Pilot projects were, therefore, carried out by the C/P and the JICA team. The pilot projects provided good lessons on likely problems and possible solutions, and a practical baseline for the formulation of the priority project implementation programmes.

E.4.1 Experiment on Enhancement of the BCE Laboratory

The BCE planned to construct a new laboratory with an area of about 500 m^2, but the construction was halted due to shortage of funds from the SCE. The structure was completed but there were no doors, windows or piping.

The BCE's laboratory equipment was stored in the Academy of Science and was not used at all. Without the opportunity to observe the laboratory activities of the BCE, it was impossible for the team to examine its capability of carrying out laboratory analysis, which is necessary for monitoring and inspection.

In this pilot project, the laboratory facility was arranged, the BCE staff actually conducted chemical analysis, and the team assessed their practice, according to the work allocation in Table 1-4. Through the pilot project, the team investigated:

- an enhancement plan for the BCE laboratory organisation;
- laboratory equipment needs;
- a training and instruction plan for analytical skills.

Table 1-4: Descriptions and Responsibilities of the Project

Work Items	Work Responsibilities
1. Internal Finishing	BCE
2. Mechanical and Electrical Work	BCE
3. Lab Furniture Procurement	JICA
4. Installation of Lab Equipment	BCE
5. Training and Instruction for Analysis	JICA
6. Purchase of Reagents	BCE
7. Chemical Analysis	BCE
8. Assessment	JICA

Such investigations were reflected in the M/P for BCE laboratory, and also incorporated in one of the priority projects.

E.4.2 Experiment on Development of Illegal Dump Control System

There are a great number of illegal dumps in Baku city. There is no doubt that illegal dump cleanup is one of the essential tasks to be accomplished for the amenity of the city.

Therefore, a pilot project entailing illegal dump cleanup was planned. The team and the C/P observed a number of illegal dumps in the city and recognised that most of illegal dumps can be categorised into three: i) large dumps - where mainly construction waste and other bulky waste (eg steel pips, cars, etc.) were tipped; ii) small dumps - domestic waste beside waste collection containers for the residents due to their improper regard for waste disposal; and iii) other small dumps due to insufficient waste collection services. Because solving the third type of dumps requires the improvement of collection services and is not a simple question of illegal dumping, this pilot project considered only type I (large dumps) and type II (small dumps).

With regard to the large dumps, the team, the C/P and the BEP selected one behind the Sports Palace. The team arranged heavy machinery for cleanup and cleanup activities were widely publicized on mass media. After the cleanup, the site was developed to a park so that it would not become a dump again.

Solving the problem of small dumps needs cooperation of all the residents. Not only the physical cleanup but also public awareness raising are essential. Therefore the team and the C/P organised a cleanup campaign in which a campaign logo was selected by a public contest, educational tools were printed and distributed, community meetings were held with nearly 200 attendants in total, and a waste dump tour was carried out. During the tour, the participants experienced actual dump cleanup.

For publicity, a series of all those activities was summarised in a 10 to 15-minute video, which was broadcast on TV.

The work demarcations were as in Table 1-5.

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Table 1-5: Descriptions and Responsibilities of the Project

Work Items	Work Responsibilities
1. Selection of an illegal dump to be cleaned up	JICA & C/P
2. Public meetings	C/P & JICA
3. Illegal dump tour	C/P & JICA
4. Advertisement	JICA & C/P
5. Clean-up of illegal dump*	JICA
6. Import fertile soil*	JICA
7. Turfing and planting*	JICA
8. Irrigation work*	C/P
9. Masonry*	C/P
10. Misc. facilities such as benches, etc.*	C/P
11. Public educational tools	JICA & C/P
12. Assessment	JICA

*) At the large dump site.

Refer to chapter 9 of the Main Report or Chapter 4 of the Supporting Report for further details.

E.5 Examination of M/P

Four major components were identified in the S/W. The team examined the M/P with special attention to those and also other issues.

E.5.1 Environmental Input in Urban and Land Use Plans

The team proposed an environmental zoning from the viewpoint of maintaining the current environmental situation in Baku and of securing the safety of the city against environmental hazards.

The environmental zone maps and the current land use map were overlaid on the GIS. Recommendations for current land use from the viewpoint of the environment were made.

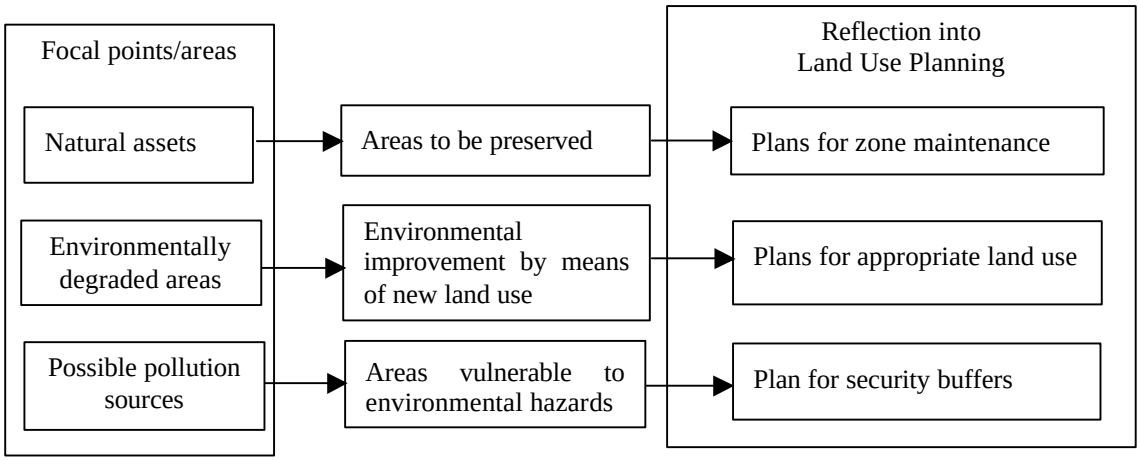


Figure 1-3: Reflection of Environmental Zoning into Land Use

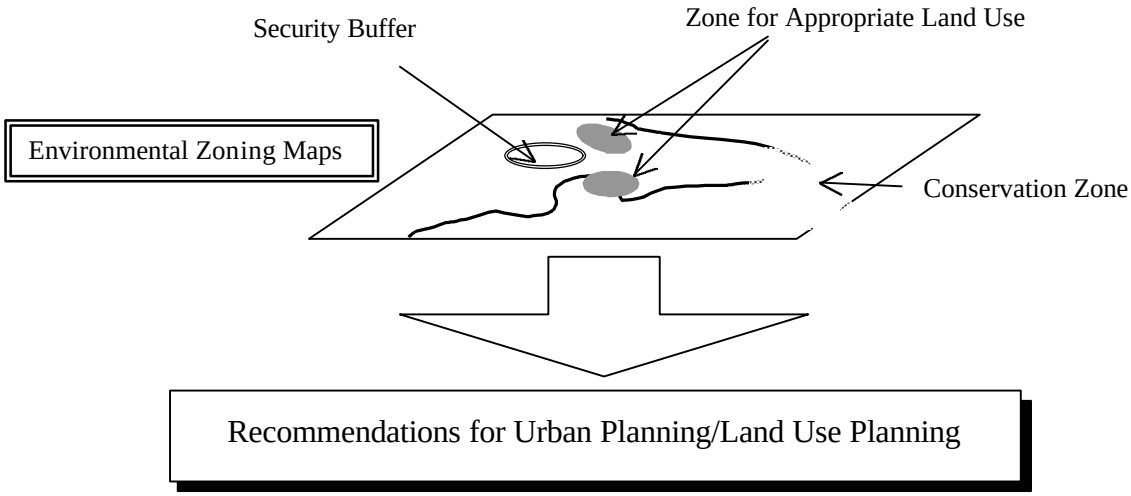


Figure 1-4:Illustrative Environmental Zoning Map

E.5.2 Municipal/Industrial/Medical Waste Management

Municipal Waste: There is an urgent need to develop an M/P for municipal solid waste management (MSWM). The formulation of the M/P rests with the BEP and District EPs, while the BCE/SCE is responsible for encouraging, supervising and supporting the M/P formulation in order to execute their overall responsibility for environmental management. The team attempted to identify necessary steps to be taken by the BCE/SCE for such purposes and to clarify items that must be addressed in the M/P.

Industrial Waste: Industrial waste is of two types: non-hazardous and hazardous industrial wastes. The former should be covered by the MSWM M/P, while the latter is being studied in the sub-component of the UEIP "Development of a Hazardous Waste Management System". The team presented recommendations to the BCE/SCE, which should put the plan into practice.

Medical Waste: A M/P for medical waste management is also urgently needed. The M/P has to be developed by the BEP and Ministry of Health, while the BCE/SCE will be responsible for encouraging, supervising and supporting the M/P formulation in order to execute their overall responsibility for environmental management. The team attempted to identify necessary steps to be taken by the BCE/SCE for such purposes and to clarify items that must be addressed in the M/P.

See Section 7.3 of the Main Report.

E.5.3 Environmental Monitoring and Capacity Building of Environmental Laboratory

The M/P for the improvement of environmental monitoring and capacity building of a BCE laboratory was formulated so that environmental monitoring based on reliable environmental quality data is efficiently integrated into the whole environmental management system. The team assessed the appropriateness of the present monitoring system in terms of monitoring items, methodology, monitoring point allocation, frequency, data usage and cost. The team also considered the cooperative relationships between the BCE and other authorities collecting environmental data, the utilisation of monitoring data for environmental management efficiency review, hardware and software upgrading, staff training programs and other issues. See Section 7.5 of the Main Report.

E.5.4 Institutional Building and Human Resource Development for Environmental Management

Consistent with the WB's UEIP, which considers SCE restructuring, the M/P for BCE's institutional building and human resource development was developed. See Sections 6.2.5 and 7.9 of the Main Report.

E.5.5 Other Components

As for other components, including nature conservation, air quality, water quality, and soil quality, several issues of particular importance for each component were examined and recommended actions were incorporated in the M/P. See relevant sections in Chapter 7 of the main report.

E.6 Training in Use of Air Pollution Simulation Model

Several operating factories, which could have great influences on the environment, were selected to be modelled. Data on SO_2 and NO_x emissions from the factories were integrated together with meteorological data from Mashtaghi (1999). The team trained the BCE personnel in running the AERMOS air pollution simulation model to calculate ground level concentrations and draw diffusion maps. Data were also transferred to the GIS such that maps of pollution could be integrated with other features previously mapped.

The team also instructed the BCE personnel in using the model to apply a diffusion theory to the calculation of the concentration of air pollutants along roads so that the BCE can assess the degree of impact caused by automobile traffic on air quality.

Further details are in Section 6.1 of the Supporting Report

E.7 Formulation of Environmental Management M/P

The environmental management M/P was formulated taking into consideration all findings of the study up to this point and the results of discussions with the C/P.

E.8 Cost Estimation and Financial Planning

The cost for the implementation of each project proposed in the M/P includes costs for material and equipment, construction, operation, and maintenance. Based on the cost estimates, a financial plan for the M/P was examined. Sustainable cost sharing by the community was one of the most critical issues to be considered. The increase of the Environmental Protection Fund charge (which at present does not have any effect on pollution control as the charge is much lower than the pollution control cost) and the appropriate allocation of the national budget, EPF and Oil Fund were examined.

E.9 Formulation of Staged Implementation Programme

The projects in the M/P will be implemented in phases according to the implementation programme to be recommended by the team.

E.10 Selection of Priority Projects

Projects with a high priority were drawn from the M/P. Those are as shown in Table 1-6.

Table 1-6: Priority Projects

Priority projects	Outline
1. Development of environmental data management	Collection of environmental data, improvement of GIS, etc.
2. Institutional capacity building for the BCE	Development of administrative structure, development of law enforcement system, staff training etc.
3. Development of environmental monitoring system	Development of environmental monitoring system, establishment of the BCE laboratory, development of pollution source inspection system, etc.
4. Development of natural conservation system	Improvement of BCE's capacity for the development of Absheron sanctuary.
5. Development of illegal dumping control system	Improvement of BCE's capacity to control illegal dumping, development of control system among the BCE, BEP, District EPs and other relevant organizations, etc.
6. Development of supervision and support system for M/P formulation of MSW and waste recycling	Improvement of BCE's capacity to supervise and support the M/P formulation and recycling plans, development of cooperative system among the BCE, BEP, District EPs and other relevant organizations, etc.

E.11 Supplemental Studies for Priority Projects

To formulate the implementation programmes for some of the priority projects, the following supplemental studies were undertaken. See Chapter 5 of the Supporting Report.

E.11.1 Base Map of Absheron Sanctuary

In order to formulate a nature conservation system (priority project 4), a base map of the Absheron sanctuary at a scale of 1:5000 was be produced using IRS and SPOT images.

E.11.2 Waste Amount and Composition Survey (WACS)

The waste amount and composition survey (WACS) intends to provide an overview of the solid waste generation condition in the study area. Waste generated in households in low income/middle income/high income areas, restaurants, markets, and other commercial units and waste from streets was surveyed.

The survey found out the types, amount and composition of waste generated by each category of waste generators. The results of the survey will be used to understand the waste stream in the study area and to formulate an appropriate solid waste management system by the BEP and district EPs in future.

The number of waste samples for each category are summarised in Table 1-7.

Table 1-7: Number of Waste Sample for Each Category

		Waste Amount				Waste Composition			
Category		Area	Samples per Area	Duration of Survey (days)	Total Samples	Samples per Day	Duration of Survey (days)	Physical composition	Chemical Analysis (C, N)
Household	High Income	4	5	7	140	1	7	7	1
	Middle Income	4	5	7	140	1	7	7	1
	Low Income	4	5	7	140	1	7	7	1
Commercial	Restaurants	1	5	7	35	1	7	7	3
	Others	1	5	7	35	1	7	7	
Markets		2	1	7	14	1	7	7	3
Streets		2	1	7	14	1	7	7	
Total					518			49	9

E.11.3 Survey on Recycling Activities

The survey on recycling activities was carried out by distributing questionnaires to 20 enterprises involved in waste recycling. By analysing the survey result, the team intended to:

- understand the present recycling system;
- understand handling capacity of recyclable materials;
- understand the trends and potential for the demand for recycled materials;
- diagnose the present recycling system;
- obtain basic data to estimate the feasibility of a recycling plant.

E.12 Preparation, Presentation and Discussion of P/R(2)

The Progress Report (2) was prepared and was presented to the C/P for discussion. Based on the discussion with the C/P on the P/R(2), the M/M was signed by both parties.

1.4 Phase 4: Formulation of Implementation Programme for Priority Projects

1.4.1 F: 2nd Study Work in Japan

F.1 Formulation of Implementation Programme for Priority Projects

The implementation programme for the priority projects were formulated as in Chapter 10 in the Main Report. The components to be considered were as follows, although they depended on the project types.

F.1.1 Facilities and Equipment Plan

Outline of necessary facilities and equipment, their specification, operation, maintenance, and other aspects were planned.

F.1.2 Financial Plans

Cost for land, construction, equipment, staffing, operation, maintenance, and other components were estimated and financing plans will be proposed.

F.1.3 Institutional and Legislative Plans

Institutional and legislative arrangements to implement the priority projects were examined. The types of implementation bodies were the most important matter.

F.1.4 Implementation Programmes

The facilities and equipment plans, financial plans and institutional and legislative plans were integrated into the implementation programme, which describes what should be done by whom and when. Yearly financial needs and financial sources were also shown.

F.2 Preparation of GIS Manual

The GIS requires continuous maintenance to be effectively used. A GIS manual was prepared so that the C/P is able to update the database and utilize the GIS according to its own needs. The manual also included technique to open environmental data to the general public by Internet.

F.3 Project Evaluation and Recommendations

The technical, financial, social, economical and environmental soundness of the priority projects were studied. The crucial elements for implementation were identified and recommendations for future actions by the C/P were made.

F.4 Preparation of DF/R

The output of the entire study was compiled into a Draft Final Report (DF/R). The whole volume was written in English but the summary was both in English and Russian to facilitate communication.

F.5 Preparation for Technology Transfer Seminar

The study team prepared materials for the technology transfer seminar to be held during the 3rd study work in Azerbaijan.

1.4.2 G: 3rd Study Work in Azerbaijan

G.1 Presentation and Discussion of DF/R

The DF/R was presented to the C/P and the steering committee and its contents were discussed to reach common understanding.

G.2 Technology Transfer Seminar

The technology transfer seminar was held, encouraging the participation of the C/P as seminar organizer.

1.4.3 H: 3rd Study Work in Japan

H.1 Completion and Submission of F/R

Reflecting the comments from the Azerbaijan side on the DF/R, the Final Report will be completed and submitted. The whole volume will be written in English and Russian to make sure that the study output is fully understood and utilised.

Chapter 2

2 Profile of the Study Area

2.1 Terrestrial Surface Waters

2.1.1 Lakes

Lake Boyuk Shor – located between the settlements Sabunchi, Balakhani, Binagadi and Baladjari, this lake is referred to a the crown of the Baku synclinal plateau. The lake is oval in shape. The southern part of the lake extends in a wide direction – from the northwest to the southeast. Northern-western and eastern stretches of the lake have become marshy.

In terms of geo-morphology, Lake Boyuk Shor is associated with Boyuk Shor kettle, at the southern wing of the Balakhani-Binagadi anticlinal arch encircling the Baku synclinal plateau from the north.

The depth of the kettle is 20-30 m. The depression constitutes of deposits from the Absheron stratum – clay embedded with dusty sand and underlaid with dense limestone-shell stone. The northern shore of the lake is gently sloping and represents the Old Caspian terrace, while the southern shore is precipitous and steep. Both shores constitute of limestone-shell stone. The eastern shore has a tortuous and indented contour, and the ledge is quite abrasive at a height of 1.5 – 3 m and a length of 450 m, constituting Khazar aged arenaceous-argillaceous rocks in the northeast. Since the lake is situated in the area with predominant clay deposits, groundwater flow is not widespread.

Lake Boyuk Shor relates to saline lakes with disrupted recharge regime. Under the natural regime, recharge is mainly derived from atmospheric precipitation, slope run-off and ground water flow. The pressure water from the productive strata, perhaps, played some role in this, as can be seen from the remaining spots eroded with water and deposits of travertine in the northern part of the lake. At the end of the 1980s, some springs could still be found in the area. In the 40-50s, the level of ground water resources was not sufficient enough to nourish lakes, which had a much higher water level. In 1949 and 1950, the huge discharge of water from oilfields provided several viewpoints to establish the relationship between lacustrine and groundwater. Water from lake Boyuk Shor to some extent seeps into permeable rocks of the Absheron stratum towards Baku Bay. Groundwater was also observed to flow along the lake coast at a level lower than the edge of the lake water. Lateral groundwater flow is estimated at 788 thousand m^3/y. At the same time, one can also assume a vertical influx of subterranean water through the bottom of the lake emerging from the deeper strata. K. V. Shishkin (1952) estimated that the lake is recharged by 3.66 million m^3/year of groundwater. E.K. Askerbeyly (1974), who studied Boyuk Shor and its influence on the environment, pointed out that ground water is recharged by lacustrine water.

Lake Boyuk Shor particularly stands out among the lakes in the Absheron Peninsula in terms size, conditions of formation, and recharge conditions under the hubbub of human economic activities.

The natural meteorological condition in Lake Boyuk Shor was significantly affected by the discharge of water from oilfields in the 70s. The lake, in its primordial state,

attracted attention for the extraction of salt, medical mud and rapa. Salt extraction started in 1932, and with this 44 basins belonging to the Trust "Baksol" were constructed in the western part of the lake. Salt reserves at an area of 4.84 km^2 were estimated to amount 0.5 million tons; only 50 % was suitable for exploitation. The salt from the lake was of a low quality. A section of the bottom of Lake Boyuk Shor consists of a 5-8 cm layer of sodium chloride with traces of sulfates, bromide and iodized salts, a 5-25 cm layer of yellow (greasy) clay with rare embeddings of salt crystals, a 5-24 cm layer of black, polished mud gradually shading into greenish-gray clay (medical mud used to be derived from this form). For 90 seasons, the medical mud volume totaled about 0.3-million m^3 but several years of extraction markedly decreased the volume to 600 m^3. One of the reasons for the accelerated deterioration of mud was the fact that starting from 1939 "extraction of medical mud ceased in connection with the inundation of the lake with drilling alkaline water".

At the beginning of the 20th century, the lake measured a total of 8.97 km^2 with a water volume of 0.5 million.m^3. Up to 7 million.m^3/year of gun barrel water with common salt (6-7%) was discharged into the lake in 1929 and in 1938. Oilfield water was discharged into the lake through 4 ditches, totaling a yearly volume of about 1 million m^3/year. About 60% of this water was used for drilling; the rest is made up of marine water used in fields, discharged through the marine pipeline. About 100 thousand m^3 of industrial wastewater has been discharged into the lake every day since the 70s. The discharge into the lake ranges from the water of Binagady oilfields, household and fecal wastewater, household, domestic and industrial effluents from the steam station of the Azerbaijan Railways, wood working plant, prison, enterprises and buildings near the lake and also repeated discharges from the water supply and sewerage systems.

Household and fecal wastewater is illegally discharged without any treatment into open ditches creating unsanitary conditions over a vast area. According to available information, the volume of industrial effluents accumulating in the lake totals 0.8 million m^3 in summer and 11.7 million m^3 in winter. The surface of the lake is covered with oil film and the shoreline is marked by black bituminous edging.

The discharge of wastewater into Lake Boyuk Shor and the constructions nearby repeatedly affected the lake area. Industrial wastewater discharge from 1899 to 1932, increased the water surface area of the lake by 13.3%. After 1932, the drainage of the western part of the lake for the building of a bulk oil reduced the water surface to 1.67 km^2. The water surface of the southern-western part which is developed for the artificial salt sedimentation basins of the Trust "Baksol" fell to 0.76 km^2. In 1940 the area of the lake basin increased again to 10.29 km^2; true altitude of 10.82 m. In 1942 the water surface area shrank to the level of 1899 when the discharge of oil products had been almost discontinued. In 1951, the marginal south-eastern part of the lake was drained for the construction of a road. The water surface area of the lake was 9.98 km^2 in 1961, 10.75 km^2 in 1966, and more than 12.0 km^2 in 1990.

Lake Zikh – is located east of Baku. It has been formed as a result of erosional, abrasional and deflationary activity. The lake kettle forms a cap with shores at an angle of 45^0. There is a mud volcano crater in the center of the lake, which was created after the deposition of Middle Absheron clay. From the end of the Baku century to the beginning of the Modern one, the depression of Lake Zikh looked like a sea gulf with a tight neck, open to the east – southeast. The strata of Old Caspian deposits lying strictly on the surface of the Absheron clay layer fills the entire basin

of the lake kettle. This strata, however, is absent in the lake trough being stripped as a ledge along the whole coastal line of the lake. The Old Caspian deposits are 16 m thick and the upper section consists of firm and porous limestone and conglomerate. There are no intermediate impermeable layers in the strata of the Old Caspian deposits. Moisture penetrating these layers is therefore concentrated at the bottom and directly on the surface of Absheron clay and flows down into the lake trough. The lake is mainly recharged by atmospheric precipitation. The replenishment of the lake water was not considered in view of the fact that the lake is situated directly above the sea. Lake Zikh is recharged mainly by the water from the productive strata seeping through the crater of a mud volcano. This has been substantiated by the similarities in the properties of the water from the lake and the productive strata. Wastewater generated by drilling work in neighboring oil fields also flow into the lake.

Lake Gala – is situated in a natural kettle with a depth of about 25 m, south of the Gala settlement and an oil field. It is elongated in form, from the northwest to the southeast. The north-eastern, south-western shores of the lake kettle are quite steep.

Before the oil fields were developed in the region of Gala and when the natural regime of the lake was not disrupted by industrial wastewater discharge, the lake used to be full both in winter and springtime. In summer, it used to desiccate and was covered with a salt crust along its shore and in the center – the narrowest place – and this served as a source of salt for local inhabitants. The water used to stay in the basins in the northern and southern parts. At present, the lake is inundated with gun barrel water and is always full.

According to V.V. Veber, the lake depression constitutes deposits from the Absheron stratum and terraces of the Old Caspian. The lake floor is covered with saline deposits. Terrace deposits consist of heterogeneously stratified clay and pebble, detritus dense sand and cemented to sandstone and yellow-layered argillaceous sand in some places. Absheron deposits of black-brown sometimes gray low arenaceous clay outcrop in some places on the western and eastern shores of the lake.

Lake Masazir holds a depression (about 10 km^2) between the Novkhany and Masazir settlements. It corresponds to a synclinal fold from deposits in the upper sector of a productive strata. The deposits constitute of arenaceous clay with rare embedment of sand. Angle of seam inclination is from 20^0 to 52^0. In some places, shell rocks and conglomerates occur horizontally. Recent deposits constitute loamy soil. Southern and western coasts of the lake are orientated by the course of productive strata layers. The south-eastern shore of the lake is steep in some places and strips rocks of productive strata across its course. In some places, the height of the shore reaches 34m. In recent years, the rise in water level has been considered due to the accumulation of wastewater, meteoric precipitation and ground water inflow. Common salt used to be collected from this lake until the last decade, and mud-rapa was used for treatment of skin diseases. The mud used for treatment is 1.5 to 2.0m thick.

Lake Mirzaladi – is located to the east of Lake Masazir in the same synclinal fold. The lake stretches from the northwest to the southeast. The bottom of the lake is located at a true altitude of 10 m.

According to the survey held in 1899, the Mirzaladi, Alibaba Shor and Siyan Shor lakes used to be conjoined, but the lack of outlets after these lakes separated severed the connection between these lakes.

The lake shore is divided into varying extents. The sections that is divided the most are the southern and northern shores. The eastern shore is steep and precipitous, and less divided. The southern shore is divided more than the others, regardless of its gently sloping features. Surface runoff in the surrounding territories was mainly used to divide the coastal slopes. The lake is recharged by atmospheric precipitation and irrigation water.

Lake Hagi-Hasanli occupies the northern part of Yasamal valley, extending towards the meridian.

The shores of the lake constitute Old Caspian deposits. On the western shore the Akchalyg stratum crop out. This stratum consists of clay shale embedded with white volcanic ash-sand and underlain by arenaceous clay with thin interlayers of sandstone and layers of productive strata sand correspondingly embedded with Akchalyg. The northern-western ending of the lake constitutes of top layers of the productive strata, expressed with brown clay embedded with a 2m thick sand layer.

Water from an area of 22 km^2 is discharged into Lake Hagi-Hasanli. Surface run-off from the slopes of the Shabandag ridge, the Zigil-Pir elevation and the Baladjar plateau also flows and accumulates in the area.

At the beginning of this century, lake Hagi-Hasanli started becoming salty after rainfall. The rest of the year, the lake depression becomes waterlogged due to the water sources on the northern-western cone and only during summer when the air is dry.

The surface of the depression used to be covered with insignificant accretion of clay and sand saturated with saline. At present, the lake is constantly filled with water, at a depth of 6-7 m, owing to gun barrel water (waters extracted by oil exploration) from surrounding fields, irrigation water drainage from vegetable plantations, sewage from the Hagi-Hasanli settlement, and of course precipitation.

Rise in the lake water level swamped the territory between this lake and Lake Girmizi. From the 70s, the lake posed a peril to the Baku-Tbilisi railway bed.

Lake Girmizi – is located in the southern part of the Yasamal valley near the coast of the Puta gulf, southeast from Lake Hagi-Hasanli.

The lake is rather young and was probably a part of the Puta gulf that got buried by sand from the Yasamal valley. Having lost its connection with the sea, the lake dried up and only gets periodically filled with water after rainfall. After fields were developed in the Yasamal valley, the lake was inundated with gun barrel water and its borders were significantly enlarged. Today the lake occupies a big area that extends from the Lockbatan settlement to the Cape Puta, and divided by artificial dams and highways. During heavy rain and strong winds, these dams and roads are inundated with water. An annual regime of the water level in the lake shows some shrinking of the lake during July-September.

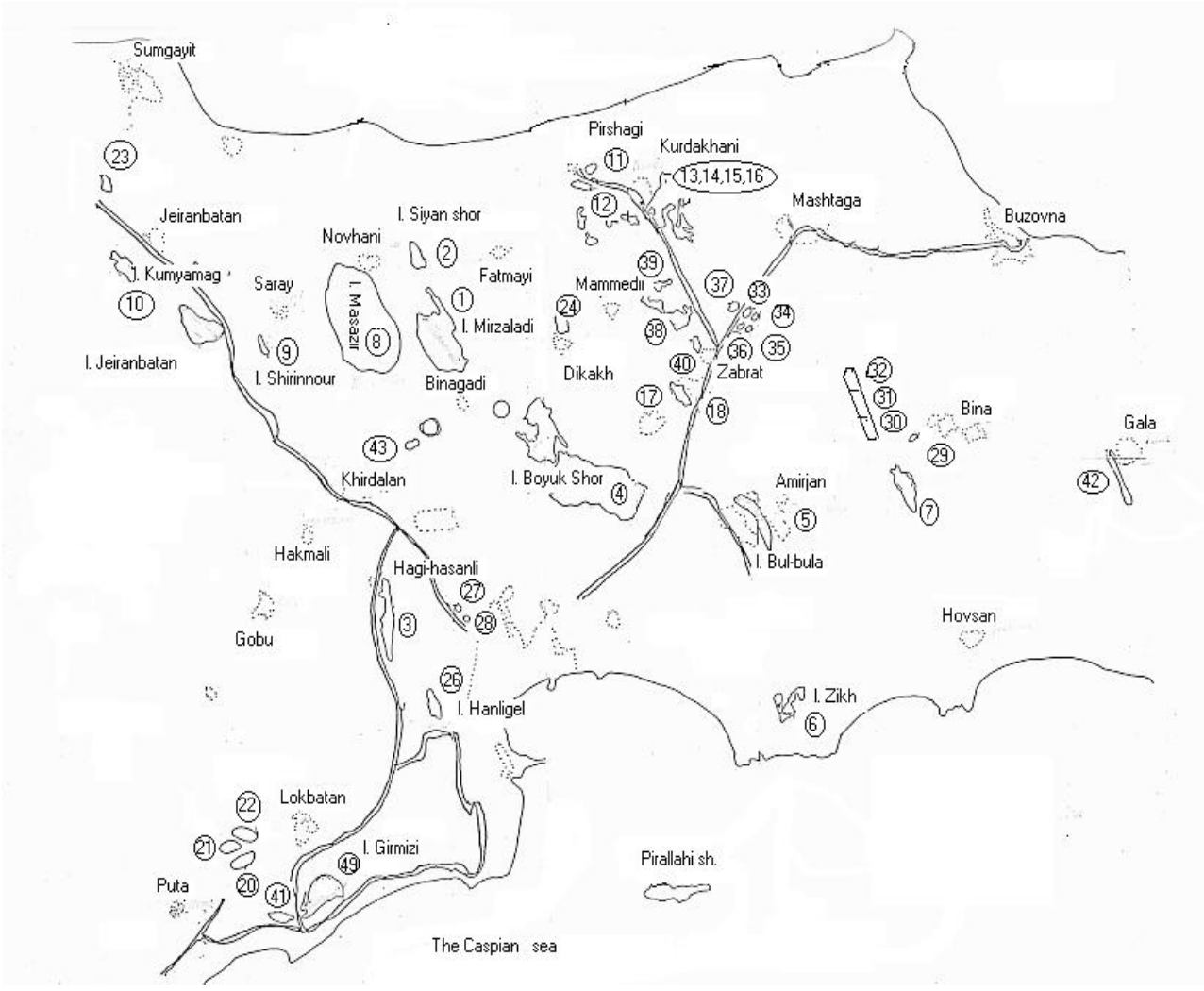
Lake Girmizi, as mentioned above, also receives the flow of Lake Hagi-Hasanli. It is necessary to develop measures that would allow the release of lake water into the sea.

Table 2-1: Water Level of the Lakes in Different Years

	Name of Lake	Area, (km^2)	Average Annual Level (m)							TDS* (g/l)	Chemical Composition
			1956	1987	1988	1989	1990	1991	1996		
1	Mirzaladi	3.7	12.2	11.104	11.434	12.077	12.236	12.089	11.974		
2	Siyan shor	0.3	23.9	23.336	23.618	23.530	23.310	23.25	23.526		
3	Hagi-Hasanli	18	13.7	16.625	16.701	16.819	16.474	16.431	16.142	1.8	Cl-S-Na
4	Boyuk Shor	9.2	11.8	11.359	11.711		11.731	12.321	12.902	8.92	Cl-Na
5	Bul-bul	1.2	7.7	6.788	7.188	6.174	6.722	6.65	5.54		
6	Zikh	1.3	-21.2	24.300	-23.808	-23.607	-24.14	-23.64	-24.142	73.0	Cl-Na I –6 mg/l
7	Yeni Surakhani	0.8	-3.2	-3.192	-3.195	-3.345	-3.419	-3.005	-3.528	69.1	Cl-Na I–9.8mg/l Br-126.7
8	Masazir	8.9	7.9	3.215	3.661	3.783	3.900	4.277	4.008	138.4	Cl-Na I–5.2 mg/l
9	Shirinnour	0.25		38.999	39.851	40.279	40.299	40.487	40.775		
10	Kumyamag	1.0		3.618	3.595	4.103	4.062	4.432	4.450	0.86	Cl-S-Na I–40 mg/l
11	Station Pirshagi	0.2		-4.899	-4.107	-3.566	-4.155	-4.079	-4.811		
12	Pirshagi	0.12		-6.491	-5.968	-6.250	-6.293	-6.177	Dry	83.0	Cl-Na Br-825mg/l
13	Kurdakhani 1		-3.2	-3.986	-3.986	-3.752	-3.805	-3.801	-3.619	87,0	Cl-Na I–1.55 mg/l
14	Kurdakhani 2	3.3	-3.2	-3.899	-3.884	-4.072	-4.086	-3.697	-5.005		
15	Kurdakhani 3		-3.2	-3.701	-3.863	-3.939	-3.844	-3.586	Dry		
16	Kurdakhani 4		-3.2	-4.001	-3.848	-3.945	-3.862	-3.627	Dry		
17	Zabrat 1	0.5		27.600	27.480	27.596	27.482	27.808	27.948		
18	Zabrat 2			26.725	27.782	27.945	27.790	27.761	27.744		
19	Girmizi	2.7		-24.698	-23.875	-24.013	-23.92	-23.79	-23.744	106.8	Cl-Na I–9.72 mg/l
20	Puta 1			-22.667	-23.429	-23.504	-23.09	-21.80	Strewn		
21	Puta 2	2.2		-22.820	-22.572	-22.462	-22.63	-22.32	-21.763		
22	Puta 3			-22.701	-22.991	-23.115	-24.11	-23.09	-22.295		
23	At 29th Km of the road Baku-Guba	0.12		-5.806	-6.665	-6.756	-6.46	-6.42	-6.566		
24	Digakh	0.3		23.743	24.201	24.054	24.105	23.932	23.685		
25	In front of the settlement Nasosny			-11.403	-10.324	-10.128	-10.14	-10.20	-11.126		
26	Ganli-Gel	2.7		105.30	106.45	106.84	105.77	105.45	104.60	1.92	S-Cl Mg-Na J-0 Br-0.25
27	Alatava 1			81.372	81.932	81.900	81.832	81.803	81.508		
28	Alatava 2			81.373	81.931	81.915	91.883	81.829	81.508		
29	Baku-Airport			-8.226	-7.738	-7.905	-8.041	-8.115	-8.10	69.7	Cl-Na I–0.43mg/l
30	In the same area – 200 m from a road			-7.664	-7.512	-7.927	dried	-7.546	-7.114		

	Name of Lake	Area, (km^2)	Average Annual Level (m)							TDS* (g/l)	Chemical Composi-tion
			1956	1987	1988	1989	1990	1991	1996		
31	Near a pump station			-6.739	-6.772	-7.190	-6.916	-7.042	-7.013		
32	The next lake adjoining the pump station			-6.835	-6.494	-7.228	-6.932	-6.51	-7.02		
33	On approach to the settlement Mashtaga 1st Lake			14.286	14.301	14.049	14.038	14.176	14.328		
34	2nd lake	1.0		14.571	14.905	14.852	14.940	15.004	14.973		
35	3rd lake			14.990	15.336	15.091	15.057	15.382	15.004		
36	4rd lake			14.794	15.172	14.707	14.742	15.057	14.998		
37	On the left side of the same road			13.274	13.634	13.295	13.462	13.546	13.353		
38	On the circle Zabrat, Kurdakhani, Mashtaga	0.2		16.178	16.403	Strewn	--"--	--"--	Strewn		
39	The village Mammedli -The lake on the left side of the road Zabrat-Mammedli	0.8		10.853	10.113	10.914	11.046	11.209	11.125	77.6	Cl-Na I–0.2mg/l
40	On the right side of the same road	0.2		9.040	10.074	8.971	9.277	9.815	9.432		Br-80.01
41	On the left side of the road Lockbatan-Gobustan	0.5		-24.868	-23.875	-24.013	-23.85	-23.67			

*) TDS: Total dissolved solids



-- Settlements
-- Lakes
-- Lake number (see table above)

Figure 2-1: Layout of Lakes in Absheron Peninsula

V.V. Veber, who carried out a study on Gala district in 1926, indicates that gas together with hydrogen-sulfide water seeps along the coast of the lake parallel to a fault line. V.V. Veber reckoned that the trough was formed at the bottom of the water basin as a result of subaqueous erosion. He associated the outset of trough shaping with the occurrence of a shift (fracture) at the bottom of the Old Caspian Sea along with a much more intense emission of water and gas, thereby conditioning the shape of salty soil as a narrow trough stretched along a direct line. Erosional and deflationary processes that took place afterwards contributed to the further development of the trough.

Aside from atmospheric precipitation and industrial wastewater flow, groundwater flow plays a significant role in recharging the lake, and this is well reflected on the Hydroisohypse map.

Lake Bul-bul is situated at eastern region of Baku, between the settlements Amiradjany and Bul-bul. It has a prolonged shape, stretched from the northwest to southeast. The lakeshore consists of limestone, clay and sand, and the floor, clay from the Absheron stratum. Environmental conditions in Lake Bul-bul started to deteriorate in the 1940s with the development and operation of the oil fields. Household-fecal wastewater from residential districts are discharged into the lake. At present, the southern shore of the lake has become marshy and inundation is observed at the eastern shore. The construction of dwelling districts in the settlement Bakikhanov settlement in the 70s increased the amount of wastewater discharge into the lake.

Lake Ganli-Gel is situated in the western part of Baku. Its basin consists of deep kettle with the eastern steep and high slope facing Baku. The western part of the lake kettle borders on the steep hillside of the Yasamal valley. The basin and shore of the lake constitute of limestone and clay of the Absheron stratum.

Like all other lakes in the Absheron Peninsula, Lake Ganli-Gel's natural source of recharge is atmospheric precipitation. The lake was formed from the discharge of gun barrel water from fields in the southern part of the lake, wastewaster from the "Azon" plant, domestic effluents from an un-seweraged part of the Musabekov settlement adjacent to the lake.

In 1942 and 1943, the lake area was only 0.18 km^2 and the true water level – 89 m. By 1970 the lake area has increased to 0.43 km^2, and the water level to 94.6 m; the value of water mineralization surpassed 10 g/l. In 1985 the total area of the lake further increased to 2.5-3.0 km^2 and mineralization decreased to 1.2 – 1.5 g/l. At present, the water level in the lake is sustained at 105.8 – 106.8 m.

The lake seriously endangers the city of Baku and it is an important factor behind the negative changes in hydro-geologic conditions at the stretch adjoined from the southeast and east. Peculiarities in the geological composition of the area, limestone deposits and sandy layers in the lake tilting towards the downtown area create conditions whereby lake water flows into the layers. This is confirmed by the fact that the subterranean water at the Musabekov settlement at the section between subway stations "Elmlar Akademiyasy" and "Inshaatchilar" was at a depth below 25m before 1973 – 1974 when the water level in the lake had not exceeded the true altitude of 103 m. In 1980 the water level rose to 105 m and the groundwater level also increased to 2-14 m, i.e. by more than 9 meters. In addition, a pressure water strata also developed at a depth of 28 – 45m with an established piezometric level at a depth of 11m. Experts are currently seriously considering the problem regarding Ganli-Gel – the need to get rid of it and its negative impacts on the environmental conditions in Baku. Several options have been proposed and include the following: to utilize the lake water for Yasamal valley; discharge lake water into the sea; and halt discharge of any effluents into the lake. However we should note that utilizing the water from the lake in various ways is not only restricted by the extremely dangerous bacteriological condition of the water (except for discharge from "Azon" and household-fecal) due to run-off water from the slope area occupied by a cemetery. In spite of this danger, about 7000 m^3/day of water is presently used to irrigate greeneries. It is also inadmissible to discharge unpurified lake water into the sea.

2.1.2 Wetland

There are excessively waterlogged areas, i.e. marshy lands, within the bounds of the Peninsula. These areas cover a vast expanse and seem to continue to spread, unfortunately, owing to manmade activities. They also mainly develop on the cultivated lands of the central and eastern parts of the Peninsula. Marshy patches, small spots not surpassing 0.1-0.5 km^2, are also found in the uninhabited western, northern-western parts of Absheron, and are associated with natural depressions in argillaceous rocks. However, the total area of these spots is significantly inferior to the abovementioned waterlogged area. Swamping here is rather seasonal and areas covered by marshes, in general are constant and not prone to expand.

The vastest marshy lands are situated at the external border of Baku synclinal fold, consisting of a chain of deep, broad flat-bottomed valleys with insignificant tilts predominantly in argillaceous rocks of Neogene. Marshy patches cover up to 12-15 km^2 of the expanse of the valleys encircling the Baku synclinal plateau from the west, north and east: Yasamal, Chakhnaglar-Boyuk shor, Bul-bul-Karachukhur and Zikh.

Big marshy patches have appeared recently in the central and southern parts of the Bina-Hovsan synclinal fold. Marshy patches in the southern-western parts of the Peninsula, at the Lockbatan oil fields, are expanding. In all cases (except for the Bina-Hovsan synclinal fold), the main cause of swamping is the discharge of oily waste, and to a lesser extent – discharge of domestic water from the field.

The marshy patches in the Bina-Hovsan synclinal fold originate mainly from the irrigation of cultivated lands, and to a lesser extent, the discharge of oil waste. Some marshy patches in the western part of the Peninsula are recharged by the water running to local depressions from the numerous mud volcanoes in this region, releasing water as a low-flow rate griffin and salt (mud-volcano).

2.1.3 Natural Saltpans

Natural saltpans at the territory of the Peninsula are significantly widespread and found in different parts. They are in majority small by area (0.5-2.0 km^2) and one-off reaches 10-15 km^2 (Shurezer, Sananapuza). They are usually associated with flat bottoms of the depressions in clayey rocks and originate due to erosional-suffusional processes and deflation. In the rainy season, the troughs are filled with water; water depth is 2m from the surface.

There are constant processes of salt leaching from clayey rocks, constituting the bottom of a depression in the depressions. Evaporation crystallizes the salt and as a result the soil becomes very loose and crumbly, and the horizon of the pans are easily weathered on the surface.

It also should be noted that, argillaceous rocks, constituting saltpans, are highly aggressive for concrete made of regular cement, and corrosive for metal works. Plots with saltpan earth are not fit for construction and agricultural cultivation.

2.1.4 Economic value of the lakes

All lakes in the area are salty and not suitable for economic and land irrigation use. Apart from salinity, the majority are contaminated by wastewater (oil, feces, etc.).

Lakes are recharged by precipitation, underground water (not applicable to all lakes) and wastewater. Huge surface vaporization is also another factor. For these reasons lake water is high in salinity. Boyuk-Shor Lake is used for the mining of Iodum by Baku Iodum Plant.

Table 2-2: Economic value of the lakes

Lake	**Possible economic value of the lakes**
Boyuk-Shor	Balneological, recreational, mineral resources mining (Iodum, Bromine etc).
Amirjan	Recreational
Zikh	Balneological, recreational
Masazir	Balneological, recreational, salt extraction
Girmizi	Salt and other minerals extraction

Salt is being extracted by some individuals from the Masazir and Girmizi lakes. These lakes, however, are contaminated with a foul smell due to the discharge of oil waste.

Because they inundate nearby land and due to the level of eutrophication, most of these lakes (lakes Ganly-Gel, Hagi-Hasanli, Kalinskoye, Pirshagi, and Bina-Hovsan) might be eliminated as they threaten environmental conditions. However, this problem should be solved after examination and with the coordination of local authorities.

The above conditions substantiated the main environmental problems and proposals on underground water of the peninsula in the review.

2.1.5 Other Water Sources

a. Jeiranbatan Reservoir

This artificial reservoir was built in 1956 in place of the existing small saline lake within limits of the Jeiranbatan structure, at an altitude corresponding to +28-70 m. The total area of the reservoir is 11.7 km^2, the expanse by central line length is about 12 km, maximum width is 1.8 km, maximum depth - 19-20 m, maximum capacity - 180 million m^3, and payload capacity - 150 million.m^3. The reservoir source is mainly the Samur River and partially by the rivers Gusarchay, Kudialchay and Velvelychay (via Samur-Absheron channel; flow velocity of 11.6 m^3/s). The main mass of suspended particles precipitates at the upper part of the reservoir. The amount of suspended particles in calm weather conditions in the middle and southern parts of the reservoir varies within 50-115 mg/l. However, sediment concentration sometimes reaches up to 4-10 g/l.

The total mineralisation value fluctuates depending on changes in the water volume in the reservoir. Fluctuation, however, does not exceed 0.6-0.8 g/l.

The reservoir does not receive any groundwater flow; however, atmospheric precipitation washes off clayey deposits, especially on the side of the Yeni Guzdek settlement. Wastewater from the Khirdalan settlement, a poultry farm and a pipeline lying on the eastern border at a short distance seriously threatens the quality of the water in the reservoir. Oil contamination as a result of a pipeline accident, which was disclosed on 23.11.96, and wastewater constantly jeopardize the quality of the water in the reservoir, especially as the slope directs the flow toward the reservoir and

wastewater accumulates in a pool nearby. There is a dam between the pool and reservoir and water accumulated in the dam tends to overflow. Rocks in the region where wastewater accumulates do not prevent wastewater flow into the reservoir. Jeiranbatan water storage basin is the source of the water supply system of Baku and Sumgayit, and water is conveyed (9.2 m^3/s) to the supply systems through the Samur-Absheron Channel. Samur - Absheron Channel is 180 km long, 73 km of which is within the Absheron Peninsula. Channel outflow is 25 m^3/s, and the outflow in Absheron is 17,6 m^3/s. The channel receives water from Samur River near the boundary with Dagestan as well as some of the flow of the Gusarchai, Kudialchai and Velvelichai rivers. Water (8.4 m^3/s) in the channel is used for irrigation.

b. Sumgayitchai

Sumgayitchai flows almost on the northern boundary of Absheron and is not used for water supply as its surface flow is intermittent (almost dries up in summer time). The water exceeds 1.5 – 2.0 g/l and is very high in sulphate-hydrocarbon-chlorine-sodium. Sumgayitchai is 155 km long with a catchment area of 1751 km^2. The absolute level of the source is 2400 m, and - minus 27 m at the river mouth. The river water is also used for irrigation and other purposes in Gobustan.

2.1.6 Hydro-geological Conditions

The Absheron peninsula constitutes southern-western continuations (about 2000km^2) of the Great Caucasus. The eastern part protrudes deeply into the Caspian Sea. In the west, the border lies along the meridian of promontories Kilazinskaya spit (in the north) and Sangachal (in the south), where it merges with the low section of the Gobustan foothills.

Orographically, the territory of the Peninsula can be divided into the following: north-western and south-western lowland, northern (hilly-ridgeline plain) and eastern plains.

Numerous saline lakes and salinas are a distinctive feature of the landscape.

The biggest lakes are situated in the northern part of the Peninsula (e.g. Masazir Lake - 10 km^2). These lakes are mainly recharged by precipitation and partially by ground water. A large amount of wastewater (oil) also flows into most of these lakes, drastically changing the regime of a number of lakes (Zikh, Girmizi, Boyuk Shor, etc.) in return.

Seepage from the Absheron canal, artificial lakes and wastewater reservoirs has also expanded the area occupied by salinas. The general mineralization in lakes fluctuates from 2-10 to 100 g/l, although in certain cases it reaches 300 g/l and more.

The water of these lakes is usually chloric-sulphurous, sodium-magnesium, considerably rarely sodium-calcium. Some lakes, including Boyuk Shor and Ganli-Gel, are a serious threat to the area not only in terms of its effects on the environment but because it also inundates the surrounding land.

Lake Boyuk Shor is a serious threat to the highway Baku-Airport, Bakikhanov settlement and Bul-bul settlement, and lake Ganli-Gel imperils Baku. The lakes located at the territory of Baku airport jeopardises the airport, highway Baku-Airport, Surakhani settlement, etc.

In general, the problems of the Absheron Peninsula represent a special environmental issue.

After investigations and special researches, it would be necessary to decide to drain these lakes, cease wastewater discharge, regulate water regime and so on. Hydro-geologists, hydrologists, ecologists, biologists and town planners, should participate in the assessment of the existing situation, take necessary decisions and forecast further ramifications. We should take into consideration the fact that the Caspian Sea level fluctuation does not directly influence the aqueous-saline regime of lakes. In this report, this issue is considered in connection with the ground water regime.

a. Hydrological Conditions of Absheron Peninsular

Indigenous rocks relating to the Molassa formation are widespread at the Peninsula. Superficial deposits form mountain slopes, mud volcano and marine transgressions of the Caspian.

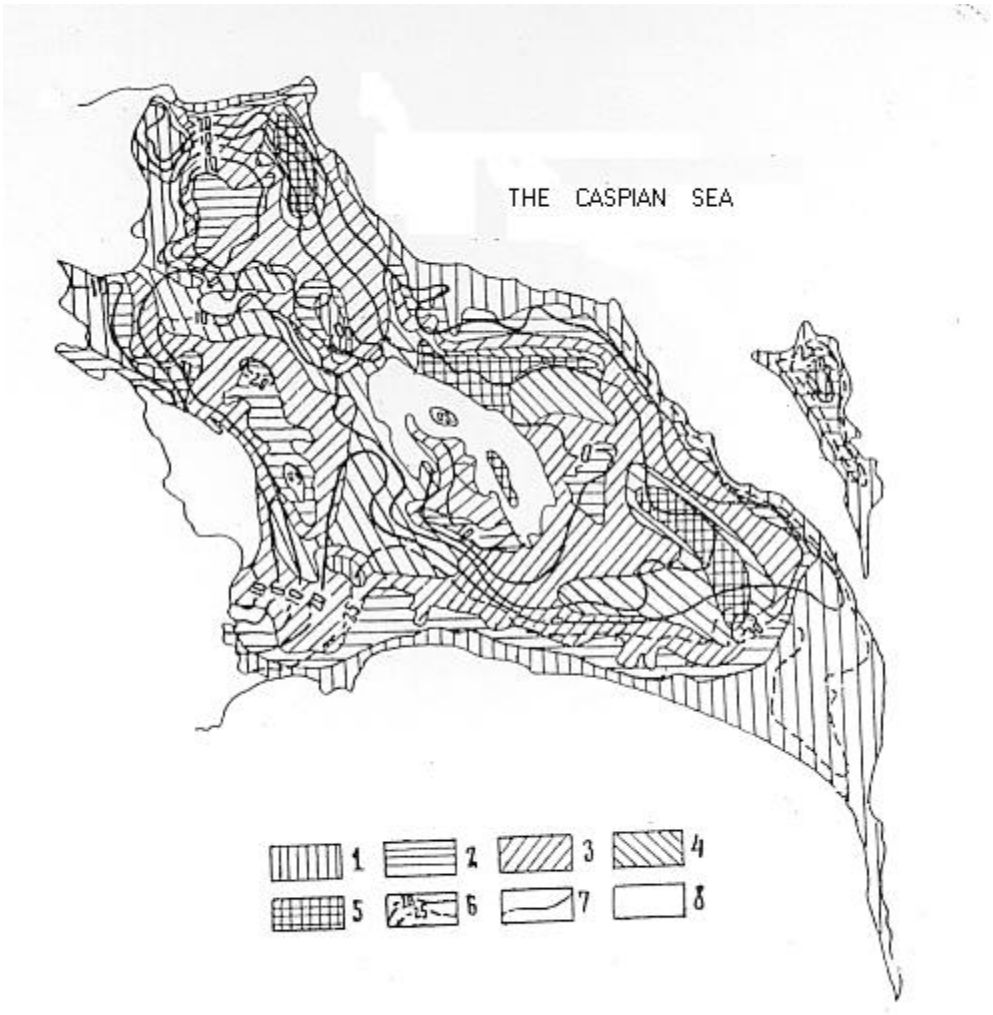
Hydrologically, the Absheron Peninsula is distinctly divided into two parts (western and eastern Absheron) separated by an area that lies from the Nardaran settlement at the northern waterfront of the Peninsula to the Hovsan promontory in the south.

Western Absheron is mainly characterized by the development of clayey rocks of the Pre-Quaternary age. Ground water in this area is connected with the development of sand deposits of the Upper Pliocene and Quaternary periods, and is distributed sporadically with increasing or a high degree of mineralisation.

The pressure water is in the layer of Lower Quaternary and Neogene deposits. The expansion range is unstable depending on their quality and quantity. Although, fresh and poorly mineralised pressure waters are found in layers of deposits of the lower Quaternary system and Absheron stratum, the water from the water bearing horizon of a pay section is highly mineralised and was found to be affected by oil and gas fields, as it is high in iodine, bromine, lithium and other trace elements.

Eastern Absheron is characterised by an almost all-around distribution of ground water and coincides with the layer of the Upper Absheron and Quaternary sedimentary deposits. The depth of occurrence depending on true altitude of the relief varies from fractions of a meter to 20 meters and more and the hypsometric position ranging from 30 meters to minus 31 meters. The direction of the ground water streams is radial from the central parts of the Peninsula toward the Caspian shores.

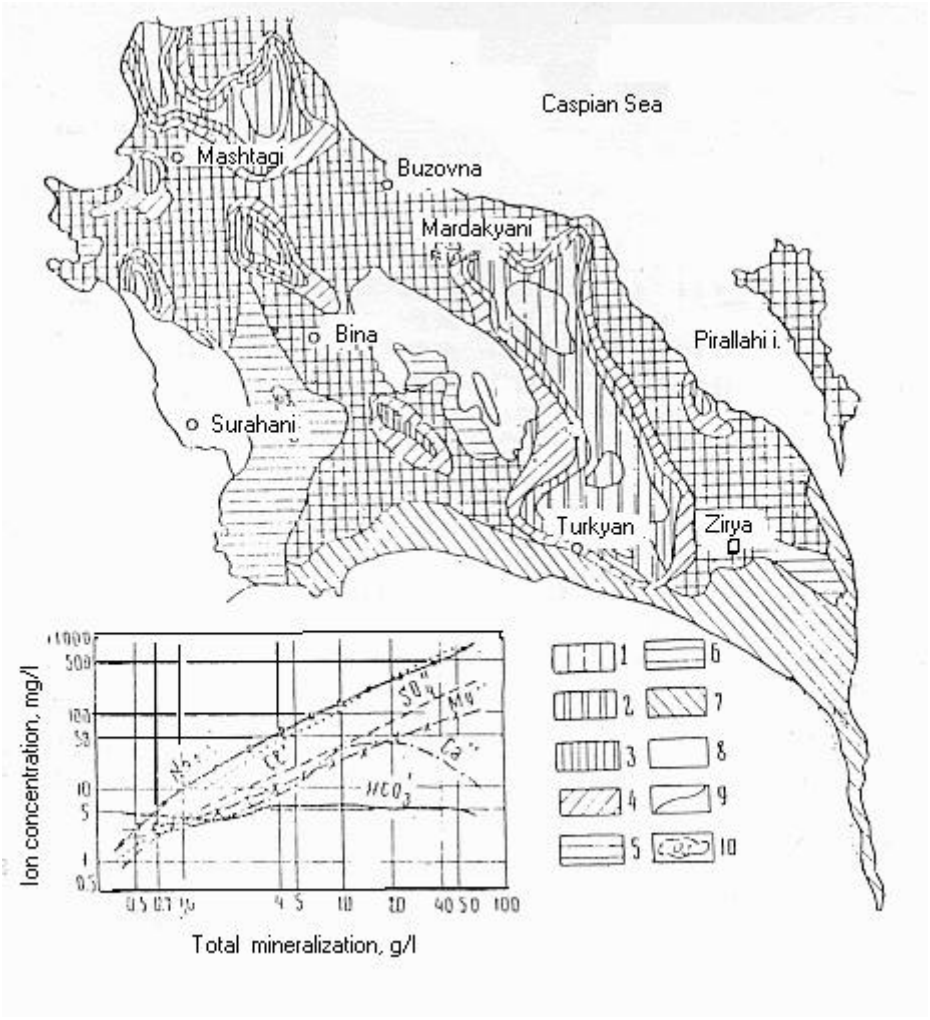
Mineralisation and chemical composition are variegated; these were observed in waters from fresh hydro carbonate calcium to chloric sodium-magnesium brines. The latter is found in regions where wastewater (oil) infiltrates ground water resources (Bina-Hovsan syncline, etc.), the remaining area marked with brackish and saline water (Figure 2-2 and Figure 2-3).



1) less than 5m; 2) from 5 to 10m;3) from 10 to 15m; 4) from 15 to 20m; 5) more than 20m; 6) hydro-iso0hypsographs of ground water; 7) borders of areas where groundwater occurs at different depths; 8) area without ground water.

Figure 2-2: Hydro-iso-hypse and depths of ground water occurrence of eastern part of the Absheron Peninsula

(Areas with depth of water occurrence)



1 – HCO_3 Ca-Mg with general mineralisation up to 0.5;
2 – HCO_3 Ca-Na with mineralisation of 0.5-0.6;
3 – HCO_3-Cl Na-Ca with mineralisation of 0.6-0.8;
4 – Cl-HCO_3 Na with mineralisation of 0.8-1.1;
5 – Cl-SO_4 Na with mineralisation of 1.1-10;
6 – Cl Na with mineralisation more than 10 g/l;
7 – Areas with distribution of lentils (small areas) of fresh water HCO_3-Cl Na-Ca. lying over saline Cl-SO_4 Na-Mg ground water;
8 – areas without ground water;
9 – border of areas with different hydro-chemical characteristic of ground water;
10 – salty lakes

Figure 2-3: Mineralization and prevailing chemical composition of ground waters in eastern part of the Absheron Peninsula

Source: A.G. Askerov and V.A. Listengarten

Other sources of ground water contamination are household, industrial and construction waste dumps, which, in principle, are not designated dumpsites.

The pressure water from the Upper Pliocene and Quaternary deposit layer is usually fresh and poorly mineralised; pressure water from the pay section is highly mineralised and oily.

Ground water formation in the Peninsula takes place under a set of natural and artificial factors. The natural – geological and morphological are relatively constant ones and as with lithofacies, the influence of the relief is significant.

Areas most favourable for the accumulation of precipitation and other surface waters are hollows, ravines and other lowering of the relief.

The main natural type of ground water recharge sources are precipitation and water vapour condensation.

The artificial factors (resulting from manmade activities) are: leakage from water mains and sewerage systems, infiltration from the Absheron canal and watering, including local subterranean water, wastewater (oil and industrial).

Resources of local subsurface water are very restricted and the quality doesn't meet the standards for household and drinking water. Its estimated exploitable reserves amount to 243 thousand m^3/d or 2.81 m^3/s.

Extraction from boreholes (more than 25 thousand) and wells (more than 6 thousand) makes 18.2% of the total resources. Freshwater, 27 m^3/s, is delivered to the territory of the Peninsula from different sources: the Samur-Absheron canal (11.65 m^3/s), the 1st and 2nd Baku Water Mains (3.9 m^3/s) and the Kura Water main (11.72 m^3/s).

According to our calculations and the estimations of other experts, more than 50% of this water is lost in the course of conveyance, an occurrence that fosters rising of ground water level. The level of intensity of this process varies depending on the properties of rocks constituting a collector in the aeration zone, the infiltration rate, and conditions of natural drainage and so on. As mentioned above, there is a common regularity in the flow of ground water streams. Directed in a regional scale, the flow moves toward the Caspian Sea, which on one hand is a regional drainage and on the other hand serves as a positive head for the flow. Some reduction in the ground water level in coastal regions was observed after the Caspian Sea level declined in 1978. However, a slight rise in ground water level was observed in the central part of the Peninsula, at the territory of Baku and Sumgayit (Figure 2-4).

The Buzovna settlement was repeatedly inundated as a result of water injection into oil wells (1973 and 1995); ground water level increase also occurred in other parts of the Peninsula and continues to this day.

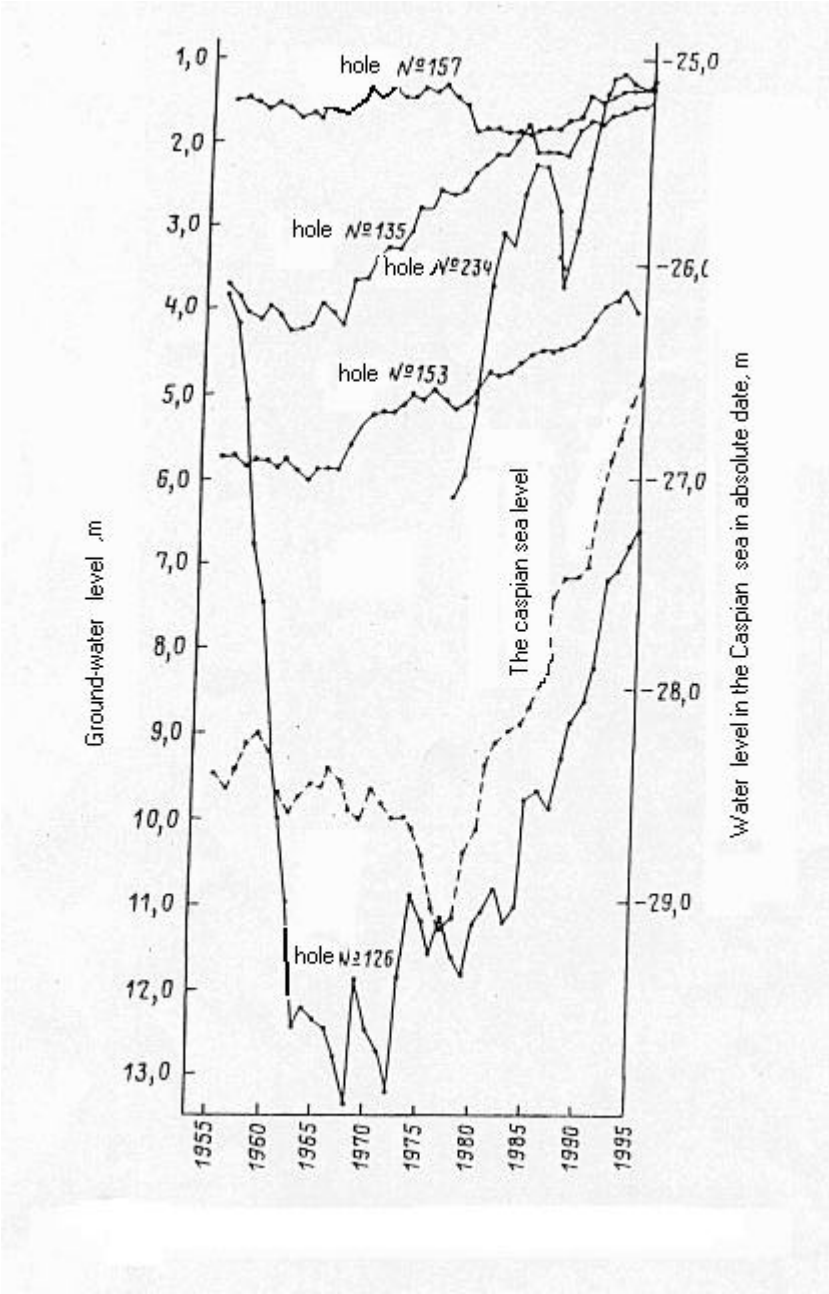


Figure 2-4: Dynamics of ground water level regime in the Caspian Sea

Ground water is spread all over within the limits of Great Baku and coincides with marine sedimentary deposits of the Neogene – pay section, Akchalyg and Absheron strata and rocks of the Quaternary system. Lithologically, they are predominantly represented by middle size sand, loam, and sandy loam and in local areas, by limestone. Three hydro-geological zones are established at the territory of Great Baku in compliance with ground water formation conditions and the depth of occurrence. The first one comprises areas of ground water distribution with relatively deep occurrence (10-51m) – the territory of the synclinal plateau and rim-side part of Baku amphitheatre. Streams of the ground water have a radial character and are directed toward the central part of the Baku synclinal fold and then the Caspian Sea. In

comparison with the second zone, there are better conditions present for water exchange – rainwater infiltration and irrigation, leakage from communication systems. Owing to this, an intense ground water level rise at a velocity of 1.5-3.5 m/year was observed after the communities in the area were opened; this in turn fostered inundation of basement premises. The seasonal drop in ground water level (GWL) was observed at certain areas, where underground water intake is carried out for the technical needs of enterprises and the irrigation of tree and shrub plantations. This process was also noticed at particular areas along a subway line with a direction parallel to or coinciding with the groundwater flow (GW). The positive head, which encourages increase in GWL (the area of the station Kishly-Tovarny), occurs when a metro line intersects the GW flow direction.

In observation well #92, situated in a yard of a dwelling house at Nagorny 6 Street, the GWL from 1955 to 1969 was at a depth lower than 28 meters, with a fluctuation amplitude of 0.32 meters and water mineralisation of 1.62-2.2 g/l. During the period from 1960 to 1963, the GWL rose to a depth of 26 meters, i.e. for 2 meters with the speed of 1-0.5 m/year. At present, the GWL is at 2.8 meters deep and the total value for the increase in depth within a number of years is 25.2 meters (Figure 2-5).

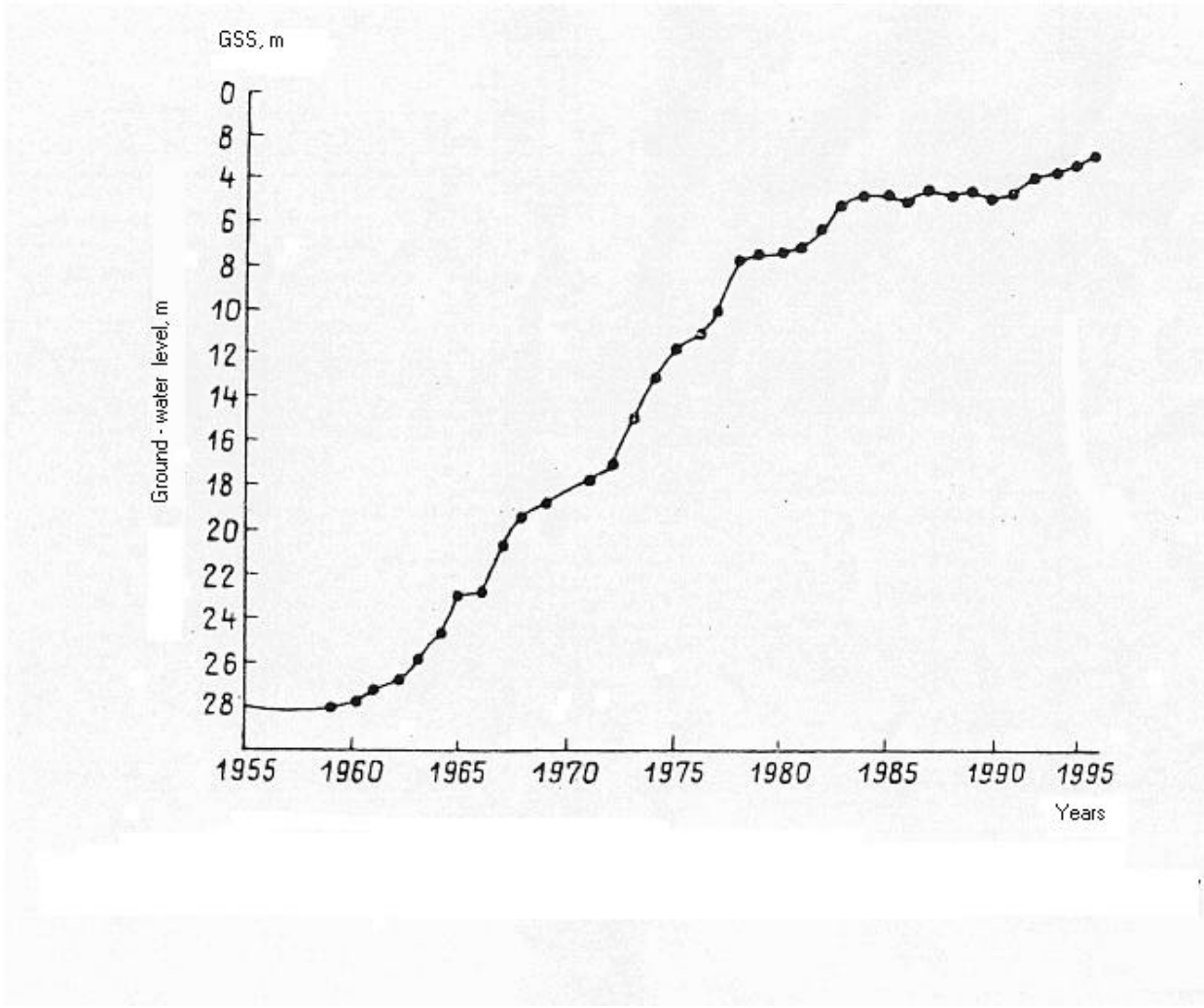


Figure 2-5: Dynamics of ground water level at the territory of Baku

In observation well #220, situated on the hillside section of Baku at the garden of the Academician campus, the initial depth of the GWL in 1969 was 11.3 meters. In 1974, however, the depth was 4.3 meters i.e. it increased for 7 meters at a speed of 1.4 m/year. In 1975, a well for watering was drilled; water extraction shrank the GWL by 12.7 meters (down to 17 m) and at present, it lies at a depth of 15.61 m. The GWL in wells #109 located in the Zabrat settlement and #15 in the settlement 8th km rise every year of the GWL, accordingly more than 9 and 11 meters, respectively.

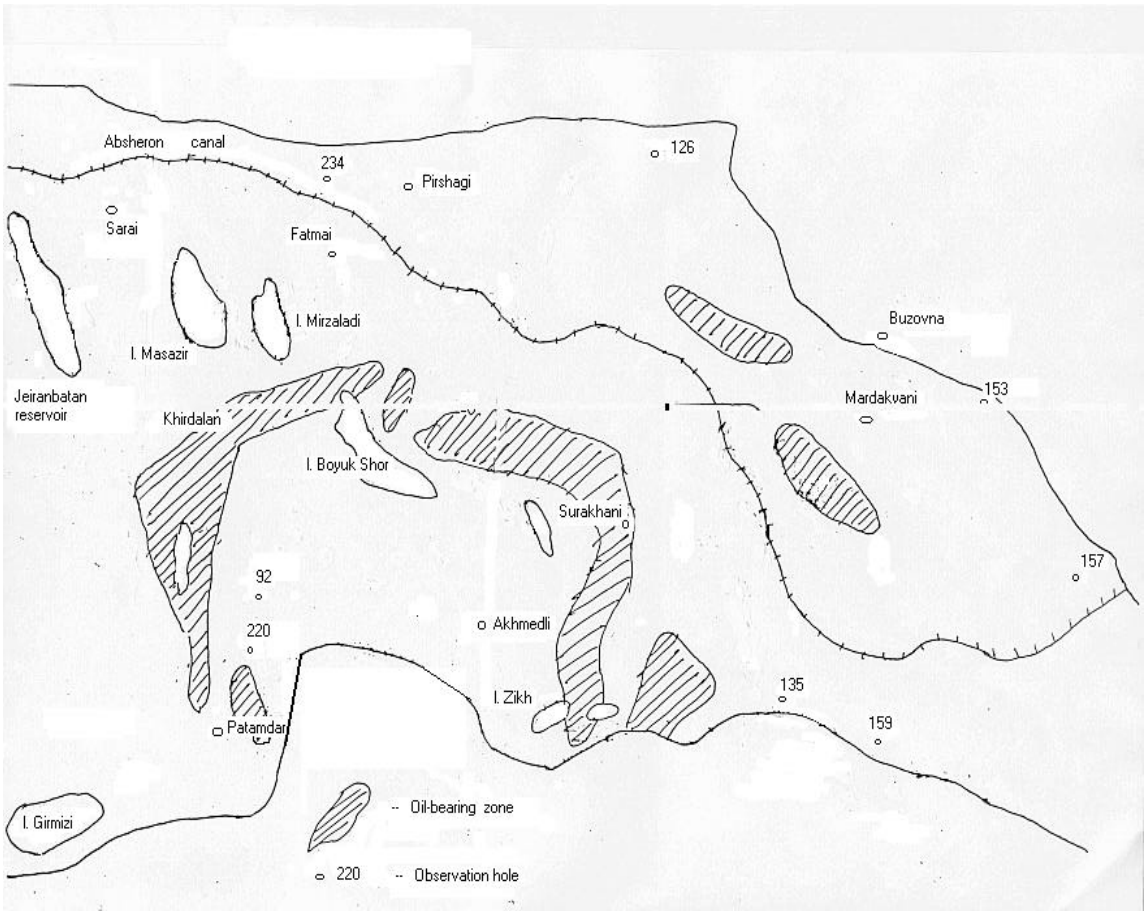


Figure 2-6: Location of Observation Well and Oil Bearing Zone

Oil-Bearing Zone

220 Observation Well

A regular increase in GWL takes place in the areas where new settlements and communities are established – Akhmedly, Zikh, Musabekova, Patamdar, etc. – owing to water loss from the communication systems. Areas with artificial lakes can serve as an example for the development of these processes. The GW in the region of Ganli-Gel Lake, before the Musabekov settlement was established and plant "Azon" (effluent capacity: 3456 m^3/day) was introduced, was at a level of more than 25 meters. Soon, due to infiltration, the GWL rose to a depth of 2-14 meters and the lake

area significantly increased; this in turn led to inundation of the adjacent municipal cemetery.

The water level mark of Ganli-Gel lake in 1954 was 90.9 meters (water area 42.9 hectares). In 1993-1994 the water level of the lake rose to 106 meters (water area more than 130 hectares) – the rise was more than 15-16 meters consequently expanding the area threefold. Mineralisation of water in the lake was more than 10 g/l in 1970, and 1.2-1.5 g/l at present.

The area next to the Airport Bina is one of the most environmentally endangered areas in the Absheron Peninsula. There are a lot of ground and pressure water-bearing horizons. The depth of occurrence of the ground water varies at the range of 0-1 to 10-20. Directly at the airport, these water resources lie at a depth from fractions of a meter to 1-2 meter. The depth of occurrence increases as the flow moves to the eastern and western directions, i.e. towards an elevated relief.

The ground water stream direction is N-S-SE, therefore, the western edge of the airport area regularly becomes inundated; the whole territory is practically waterlogged. Considering that the airport area has a minus mark of the relief, the surface and underground water move in the southern and southern-eastern directions, flowing towards the settlements of Pirshagi, Kurdakhani, Zabrat and then Yeni Surakhani. These waters recharge the lakes located near the airport and persistently pose a threat to the landing strip and the highway connecting Baku with other settlements and villages in the Peninsula. It is necessary to build at least an autonomous drainage system for the melioration of the land.

In the wells located in the second zone, i.e. the central part of the Baku synclinal fold, the GWL, which traditionally lies relatively not too deep (2-5 meters), rose insignificantly due to regular pumping of water from basements. Although the water level increases at a quick pace and was found to reach almost 0.5 to 1m on one day, fluctuation was small especially as basement groundwater pumping has been carried out on a daily basis (more than 20-25 thousand m^3/day) in recent years. Generally, groundwater flows into the Caspian Sea and increases the sea water level. This increase further aggravates conditions and mochezinas (permanent wetlands that develop due to underground water outflow) were observed at certain areas – in the area of the plant, “Paris Commune”, and in Neftchilar Ave. beneath the park named after Nizami, in the vicinity of the Zikh settlement.

The Baku communal system, especially the second zone, has been in use for 50-100 years but the sewerage cannot accommodate household wastewater resulting in frequent overflows from manholes. This increases the GWL, which contaminates the environment and creates serious environmental problems.

A similar situation is observed at the territory of Sumgayit, where the GWL varies at a depth of 1-2 meters. This city is imperiled not only by leakage from its system, but also by the infiltration of water from the Samur-Absheron canal, the Jeyranbatan Reservoir, and the rise of the Caspian seawater level.

It is necessary to discharge communal and industrial effluents (loss by infiltration) only after treatment is completed; to forbid discharge of sewage and other waters to the sea and lakes, especially Ganli-Gel, Hagi-hasanli, Alatava, Boyuk Shor, Masazir etc. It is also important to set up a special drainage system in certain places to regulate the GWL regime of municipal and adjacent territories.

A similar difficult situation occurred in the coastal zone of the Peninsula in connection with a rise in the water level of the Caspian Sea, which led to the establishment of an additional positive head for ground water outfall. This process may have various characters depending on the true altitude and the slopes. In areas that are comparatively flat and where the GWL slightly tilts toward the Caspian, waterlogged conditions, except for common inundation, were also observed in the northern and northern-eastern shores (Sumgayit, Jorat, Pirshagi, beach area of the settlement Fatmai, Bilgakh, Buzovna, Gurgan etc.), the south of Baku and Bayil Bays, the recreation zone (Shykh), waterfronts of the Sahil settlements, etc.

The GWL of the coastal zones of the Absheron Peninsula lies at a relatively shallow depth (2-5 meters). An increase in the underground runoff when the Caspian shrank before 1978 resulted in a certain decrease in the GWL in some places. However, the water level elevation in the Caspian compelled the annual rise of the GWL in coastal zones under a different intensity.

As shown in Table 2-3, the GWL rise in wells may have a different value and speed because of other factors as well as the fact that the lithofacial, geomorphologic and other conditions are not identical. However, the general picture is outlined in Figure 2-4.

Table 2-3: Dynamics of ground water regime in observation wells located in the coastal zone of the Caspian

Years	Yearly Well Water Levels in the Caspian					
	In a well. at the depth of 1 m from the earth's surface					In the Caspian with true altitude (minus)
	126	135	157	159	234	
1978	11.63	2.37	1.90	5.11	5.96	29.08
1979	11.86	2.32	1.84	4.92	5.13	28.77
1980	11.25	2.17	1.85	4.74	3.70	28.63
1981	11.12	2.18	1.82	4.79	3.10	28.35
1982	10.84	1.99	1.91	4.74	3.29	28.25
1983	11.23	1.81	1.90	4.65	2.62	28.19
1984	11.05	2.14	1.87	4.54	2.27	28.17
1985	9.82	2.13	1.83	4.48	2.30	28.09
1986	9.71	2.15	1.83	4.48	2.84	27.96
1987	9.10	2.18	1.73	4.44	3.77	27.56
1988	9.31	1.85	1.71	4.41	3.10	27.48
1989	8.87	1.75	1.46	4.34	2.32	27.48
1990	8.63	1.78	1.54	4.13	1.65	27.42
1991	8.27	1.69	1.45	3.97	1.27	27.10
1992	7.19	1.65	1.39	3.88	1.22	26.91
1993	7.09	1.58	1.37	3.81	1.31	26.82
1994	6.79	1.58	1.37	4.04	1.34	26.65
1995	6.61	1.49	1.28	4.05	1.35	26.52
1996	6.60	1.41	1.29	4.02	1.31	26.62
1997	6.64	1.55	1.33	4.06	1.26	27.72
1998	6.94	1.81	1.69	4.14	1.43	27.03
1999	7.14	2.00	2.00	4.24	1.48	27.03
Well altitude	-17.77	-23.45	-24.43	-21.82	-5.50	

b. Underground Water Use

Fresh and poorly mineralized waters (dry residue 1-3 g/l) are sporadically distributed in the Peninsula. According to preliminary calculations its resources constitute 241

thousand m^3/day. Due to the lack of fresh surface water sources, the local population has been using underground water from ancient times, even though in some places the dry residue amounts to 3-5 g/l. In the past 30-40 years, water from wells (5-15m deep) was extracted using buckets. Numerous boreholes with a depth of 30-70 m have been drilled and water is extracted using a swing lever or a submersible motor pump. The number of wells and boreholes total 10-12 thousand and up to 15 thousand, respectively. Relatively watery areas are mainly found in Eastern Absheron and the Baku synclinal fold. Water is used for drinking, industrial and irrigation purposes. The centralized water intake points are located in the village of Zirya and the settlements of Shuvelan, Buzovna, Bina and Novaya Gala.

The water intake in the settlement of Shuvelan consists of 15 boreholes (depth: 50-51m) and a well (13m). The limestone and sand of the Absheron age are water-bearing rocks. A water volume of 300-445 thousand m^3 is supplied to the settlement near the Hydroelectric Power Station, "Severny".

Mineralisation value by water intake wells varies from 0.5 to 1.7 g/l and the type of water is mixed (HCO_3-SO_4-CL, Na-Mg-Ca).

The water intake point in the village Zirya is situated to the west of the village and consists of 30 boreholes with a depth from 23 to 51 m, over an area of 170 ha. The limestone and sands of the Quaternary age are the water bearing rocks. Water intake amounts to 1200-1400 thousand m^3. The water is slightly brackish (1.0-1.9 g/l); sulfate-bicarbonate with displaced cation content.

The water intake point in the settlement Novaya Gala is situated to the east of the settlement and consists of 5 wells that has boreholes drilled from the bottom, and 2 boreholes. The depth of the boreholes is from 25 to 65 m. The limestone-coquina and fine sand of the Absheron age are the water bearing rocks. Total water intake amounts to 150-180 thousand m^3. The water is fresh (0.5-0.9 g/l); bicarbonate-sulfate-chloride.

The water intake point in the settlement Buzovna is located north-west of the settlement and used to consist of 37 boreholes (43-70 m). The water bearing rocks are represented by the Upper Absheron limestone and fine sand layers. Total output is 400-475 thousand m^3. The water is slightly brackish with dry residue of 1.2-2.4 g/l; sulfate-bicarbonate-chloride with mixed cation content.

The water intake point in the Bina settlement is located approximately 2 km southeast from Novaya Bina and consists of 16 wells and 14 boreholes. Water is extracted from wells with a depth of 16-22 m and boreholes drilled all the way to relatively deep (up to 50 m) horizons of the Low Quaternary age. The total output is about 700-750 thousand m^3/day. The water is brackish with dry residue of 1.1-3.4 g/l; sulfate-bicarbonate-chloride sodium-calcium-magnesium.

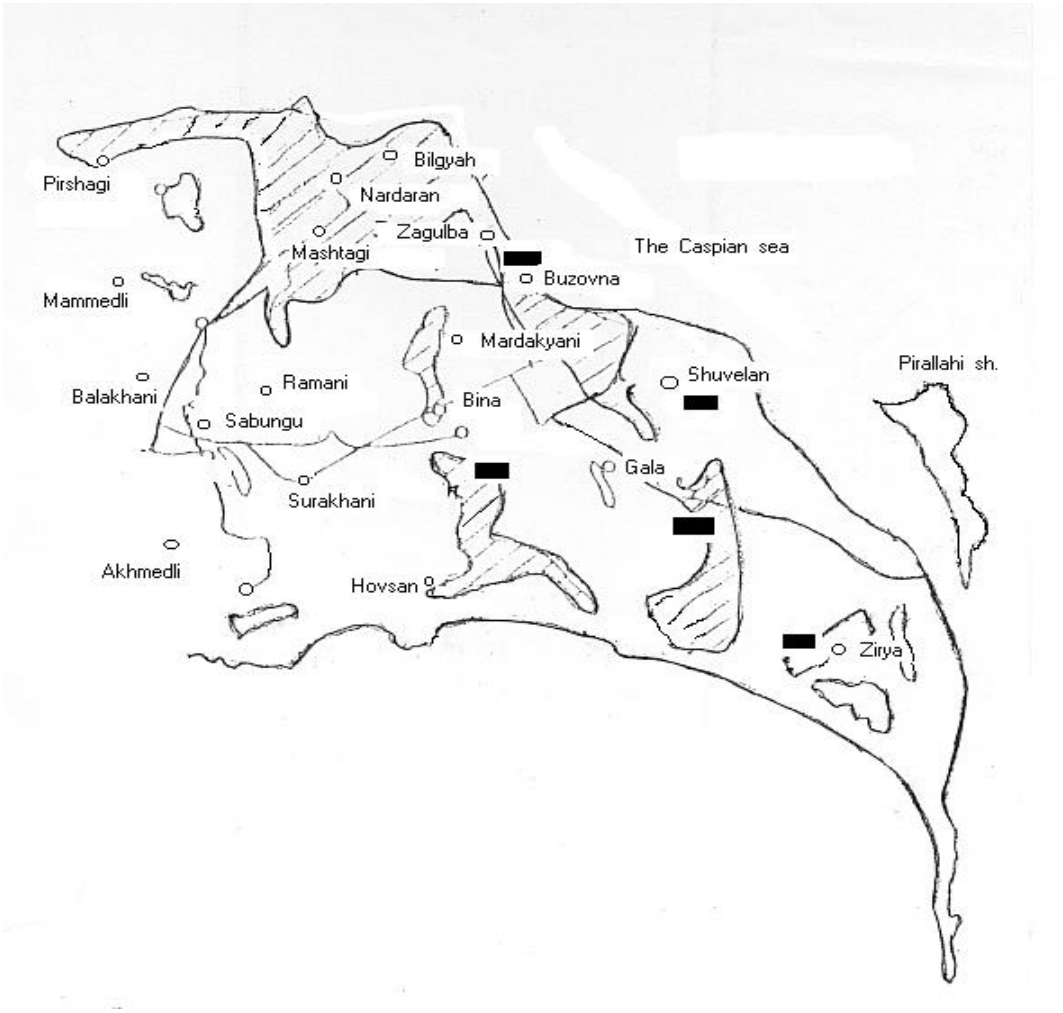


Figure 2-7: Schematic map of areas in the Absheron Peninsula where underground water use is intense

: Areas where underground water use is intense

: Single point water intake

It is difficult to keep a record of the volume of extracted water at the territory of the Absheron Peninsula, as there are no flow meters on wells. The water intake volume is therefore estimated at 70-75 thousand m^3/day.

The main source of water contamination is household wastewater, because most villages and cottage areas have no sewerage systems. Oil seepage is also another contaminant.

Aside from the economic and social problems involved, inundation and water logging of areas at the Caspian coast of the Absheron Peninsula expose neighboring areas, that are being developed for oil production, to environmental hazards.

2.1.7 Ecological Problems in Absheron Peninsula

The water level rise of the Caspian sea is associated with the increased abrasion of shores at the north-eastern coast of Absheron. This also sets conditions favorable for

strengthening accumulative processes and results in the raising of shores due to the accumulation of drift masses at the waterfront (e.g., Geradil-Pirshagi beachfronts). The coastline in the Bibi-Heybat oil-field zone is more endangered. The contaminated soil (900 m^3) is washed out in one day due to waves brought about by a northern storm with a wind force of 8-9. Correspondingly, a great amount of oil products gets into water causing extensive contamination. Further, oil products consisting of naphtha and asphalt-bitumen fractions settle at the bottom and mixes with underwater streams along the shore, devastating fauna and flora. Of course, these issues require a supplementary investigations and study of each factor and object at risk along with damage assessment. However, at present the implementation of coast protection measures is a necessity in the city of Sumgayit, the beachfronts within limits of the city of Baku and Bayil Bay, and the Sahil settlement (Figure 2-8).

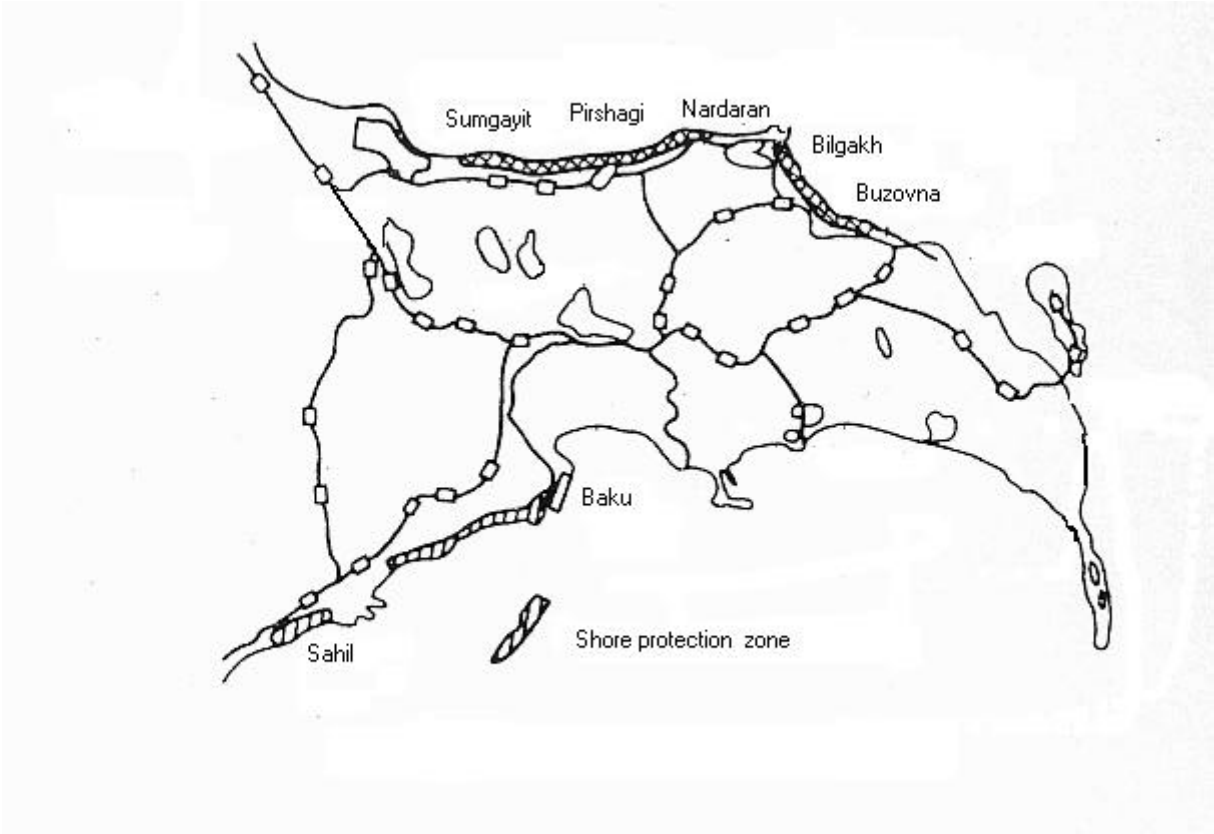


Figure 2-8: Shore protection zone in Absheron Peninsula

The industrial section of the Absheron region constitutes a territorial-production complex (TPC), which includes big industrial centers populated by more than 2.4 million people (excluding refugees). Baku City (with the satellite city, Sumgayit) is located at the center of the TPC.

The TPC implies that the leading industries are mainly into the utilization of local natural resources, such as oil and gas, and their processing.

The Absheron region is only 7% of the Republic but is the major oil producing area in Azerbaijan. The establishment of the oil industry began in the 1970s (although, oil

fields have been developed from ancient times) and immediately determined the economic profile of the region.

Oil gases are also extracted from Absheron and used by petrochemical and chemical industries and for communal utilities. Oil gas reserves are divided into free gas from gas fields (Karadagh. Zirya. Yuzjnaya. Bahar, etc.) and associated (dissolved) gas obtained in the course of oil extraction.

The cities of the Absheron Peninsula – Baku and Sumgayit are the main contributors to the petro-chemical industry which significantly developed in the Republic on the basis of oil and gas processing. 98% of the chemical industry is also located in this region, and focuses on oil and gas processing as well.

The Absheron TPC has a developed railway network, which carries out about 50% of the freight turnover nationwide and more than 73% of the passenger transport. From the region, the railways go west (Tbilisi-Batumi), northwest (Derbent-Rostov), southeast (Djulfa-Nakhichevan) and south (Astara).

The Absheron Region, according to the information provided by the Land Fund, covers an area of 156,067ha, 82,592ha of which are farmlands. Perennial crops hold an area of 4,326 ha (mainly vineyards and orchards). The fallow land, hay field and pasture retain 62,737ha of this 9.1 thousand ha. Yards occupy 2,141 ha.

The smallest territory is occupied by forests and shrubs (10.1 thousand ha) and is situated mainly in the sub-mountainous belt of the region. Household construction and industrial waste dumps occupying vast areas in industrial and residential districts are significantly damaging the environment. The total number of dumps is more than 20 though only one municipal dump for household waste, another one for municipal industrial waste, and a special trash pit for liquid oil products, are legally authorized dumpsites. At present, the municipal dump occupies a vast territory, beginning from the highway Baku-Khachmas at the territory of Sumgayit. This household construction and industrial waste dump doesn't have a definite border. Industrial waste including flammable waste materials are often disposed of at the dumpsite for household waste. A spontaneous ignition of sulfur occurs frequently, and at the same time an open oil pipeline lies near the dumpsite; oil leakage happens frequently and this in turn intensifies the fire. Oxygen bottles that break during fire outbreaks are often disposed of in the dumpsite.

A lot of waste generated by production activities disposed of in the dumpsite are recyclable. For instance, the Production Amalgamation, "Orgsyntez", scraps about 50 thousand tonnes of limestone waste yearly; this can be recycled into construction materials. A great amount of oil products are poured out into a special overfilled pit situated near a timber warehouse. At the same time, a water supply pipeline (Shollar) is adjoined to the pit. In case of leakage (frequent occurrence), a water torrent flows through this formed oil lake and then, along with some oil products, moves to the River Sumgayit-chay and further to the Caspian.

2.1.8 Oil polluted territories

There are more than 10 thousand ha of land contaminated with oil and oil products at the Absheron Peninsula. Every year, 15 thousand tons of oil and oil products, along with the effluents from oil fields and oil refining plants are discharged in the area, resulting in the significant contamination of the Caspian Sea and inland reservoirs. At

the same time, more than 64.2 million m^3 of sediments which is 2 to 40% organic oil have accumulated in the Baku Bay. The intense development of oil and gas fields at the Caspian shelf will aggravate the environmental conditions in view of the real threat of emergency blowouts from oil and dumping into the sea of oil-contaminated residues.

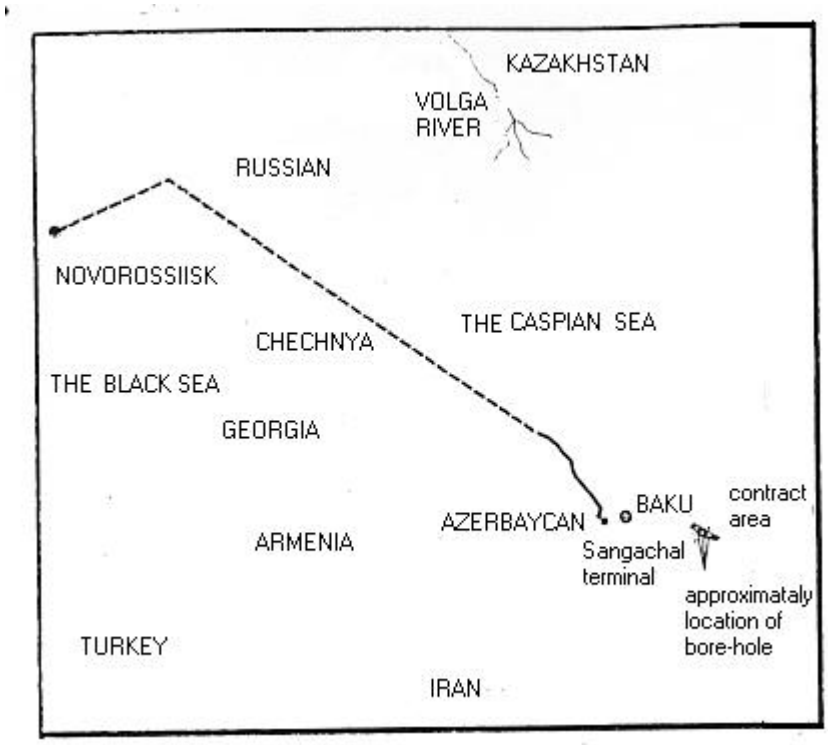


Figure 2-9: Approximate route of oil pipeline

---------- Shows the approximate route of a pipeline through the Russian Federation
_____ Shows the route of Northern Route Export Pipeline in Azerbaijan

A factor that is considered to likely aggravate environment pollution is the transportation of oil by railway and trunk mains. So far, there have been no catastrophic oil spills cases at railways.

Ground water along the highway Dubendi-Gala lies at a depth of 10-20 meters. It is from 5-10 to 1-5 meters in Gala-Surakhani and 5-10 meters in Surakhani-Sabunchi. Pollution due to oil spills occurred in 1987 from oil pipelines from the Baku Oil Refining Plant "Azerneftyanajag" to the subway station "Azizbekov". The oil products covered an area of 90 000 m^2 near the subway station "Neftchilar" and 300 m^2 near the subway station "Azizbekov", seeping into the subway tunnels, still does to this very day, regularly creating an explosive situation. The oil content in the ground water is 12-216 mg/l.

There were several oil spills during the Caspian oil transport from the Sangachal terminal, at the northern route of the export pipeline near the settlement named after Z.Tagiyev, the city of Devichy and the Shirvanovka settlement.

The rehabilitation of oil polluted lands and the treatment of sewage containing oil will improve the environmental conditions in the area targeted for future social and

economic development and would be favorable for the implementation of big investment projects.

There is a huge amount of pressure on the current state of the environment in the region. This is evidenced in the pollution in the air, the state of the coastal water, the sediments, soil, etc. The following tasks should be carried out for the abatement of environmental pressure and the improvement of the environment in the region:

1. Comprehensive study, assessment and prognosis of anthropogenic impacts on the environment and measures for environmental protection.
2. Determination of impact of the polluted environment on man, animals and plants, buildings, construction, machines and equipment.
3. Scientific and technical prognosis of environmental pollution in the following 10-15 years based on materials on prospective development and siting of production plants.
4. To develop an automated control system for environmental monitoring especially in municipal areas.
5. To assess economic, social and environmental efficiency through the introduction of an environmental protection scheme.
6. Comprehensive study of water resources, anthropogenic impacts, pollution prediction and control measures.
7. To clean up landlocked natural reservoirs (lakes) at the Absheron region to cease discharge of raw sewage and to turn these areas into recreation zones.
8. To produce passports for all the biggest lakes especially those posing as environmental and economic threats.
9. To study lake recharge sources and to determine wastewater quantity and quality.
10. To erect a zone for sanitary protection around the Geyranbatan reservoir in view of its importance as the source of water supply for the population of Baku and Sumgayit cities.
11. To stop discharge of wastewater into lakes – particularly into Boyuk Shor, Ganligel, Girmizi, Hagi-Hasanli, lakes that are significant sources for the extraction of salt and treatment mud – which also threatens the environment.
12. To develop a special program to protect areas from salinization and becoming marshy, especially in the area of Pirshagi-Kurdakhani-Mammedli, Zabrat 1-Mashtaga-Bina-Gala 2.
13. To carry out measures that would organise the oil field economy to reduce, where possible, the practice of secondary treatment of a formation at Absheron. and to dismantle unusable drilling installations and communications systems:
14. To rehabilitate oil-polluted lands in the Peninsula.
15. To take necessary actions to organise a collection-drainage network in the oil fields, to prevent accumulation and discharge of drilled water into the lakes at the Peninsula.

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2.2 Oil Contaminated Land

2.2.1 State of Oil Contaminated Territories

Commercial production of oil on land of the Azerbaijan Republic began in 1871 in the Balakhani-Sabunchi-Ramana oil field, the biggest one by the reserves of hydrocarbons and situated on the Absheron peninsula. Gradually, other new oil fields were brought under development and intensively exploited on the Absheron peninsula and in the other parts of the territory.

The oil fields exploited by the Production Association on Oil and Gas Extraction on land (the successor of the "Azneft" association) are at the last stage of development and characterized by a wide range of mining and geological conditions (multipay deposits, their type and regime, degree of heterogeneity of productive horizons, physical and chemical properties of saturating them formation fluids, duration of development, degree of depletion of oil reserves, water cutting of well output, etc). The technical condition of more than 70% of the operating well stock is unsatisfactory, about 65% of wells have been operated for more than 50 years, that is they are almost non-operable and have become a potential source of environmental pollution.

During last 2-3 years oil production has been stabilized at the level of 1,500,000 t/y. About 20,000,000 m^3 of formation waters are extracted together with oil being further used for technical needs, and also having been purified to a certain standard, they are injected into the underground horizons for reservoir pressure maintenance (RPM) and

utilization. The normative requirements to the quality of water injected in to the beds are determined by fluid conductivity of collectors and volume of oil and foreign solids not exceeding 25-30 mg/l.

The ecological approach to the problems of nature management, first of all, presupposes the study of impact of the anthropogenic activity on the ecosystem. In this regard, the territory of the Absheron peninsula contaminated with oil, drilling mud, formation sewage waters, oil refining and household wastes is extremely problematic.

As it is known, at the initial period of oil and gas production only primitive technical facilities and methods were applied. The oil fields were intensively operated, but without proper construction and observance of elementary requirements for environmental protection. It is suffice to say that at that period the gathering and transportation of well output were carried out by the cut and cover method, which is based on discharge of the extracted oil into the earth reservoirs, that is oil is gathered in the open air and then is transported.

Washing of oil containing formation waters was carried out by means of gradual setting in sludge samplers, that is separation of oil from formation waters is carried out in the earth reservoirs. Then oil is gathered from the surface, but formation waters are left. Non-observance of the technological regime in the process of drilling, repair and operation of wells caused continuous open flows bringing on to the surface oil, gas, heavily mineralised formation waters and drilled solids. All that resulted in heavy contamination of a considerable part of the territory allocated for oil and gas extraction.

An especially big harm has been done to the land of the Absheron peninsula. Here 7,400 ha of fertile land, where used to grow wheat, vine, fig and other agricultural products, have been completely contaminated. By drilling shallow wells in 1989 it was revealed that oil penetrated into the soil for more than 3 m. This process made a negative impact on ground waters resulting in a considerable increase of their level.

The situation is getting even worse, by fact, that the local sites contaminated with radio nuclides, where the intensity of the exposure dose of gamma radiation considerably exceeds the normative level (15-25 mr/h) and reaches (400-1200 mr/h), have been found on the territory of most of the oil fields.

The land of the Absheron peninsula has also been contaminated by oil refining plants, as their wastes are not completely utilized, but are discharged at the area around them. Besides, the land around the plants has been contaminated also as a result of a continuous uncontrolled leakage of oil products (once-run gasoline, diesel fuel, etc) from the non-hermetic earth reservoirs and underground pipelines. The local sites with increased radioactivity can also be found on the territory of oil refining plants.

It must be noted that oil and gas production administrations and oil refining plants are also one of the main sources polluting the industrial environment of Baku. Despite of reduction in the volume of production and refining of oil for last 10 years and implementation of a range of technical measures by structural subdivisions of SOÑAR, about 250,000 t/y of pollutants are emitted into the atmosphere, including more than 212,000 t of hydrocarbons. It must be noted that a considerable part of hydrocarbons falls to the share of oil evaporation from the surface of artificial lakes. All these aforesaid factors negatively influence health of people of near-by

settlements. The situation is allayed by meteorological conditions. In Baku winds blow with velocity of 15m/s and more, thus, promoting a quick dispersion of pollutants.

All the above given data show the seriousness of the ecological situation and point out the need for an urgent rehabilitation of soil and its further use for agricultural needs. However, soil rehabilitation and its further transfer to the main users requires colossal finances and time. According to the techno-economic estimate made by the institute "Azgiprovodkhoz" in 1989, it is necessary to allot 350,000,000 rubles for this purpose. Taking into account the changes that had taken place during last years and the difference between ruble and dollar rates at that period, now this sum makes up more than 500,000,000 US dollars, and as SOÑAR does not dispose of the necessary finances, it was decided to involve foreign companies for the clean up of the contaminated soil on the compensatory base, that is rehabilitation expenses must be covered by the refining and realization of oil gathered from the surface of reservoirs and extracted from soil. At present, contracts of that kind have been concluded with Solvalub Ltd. and OMNE RE S.A. for the clean up of the territories of the G.Z. Tagiev and "Balakhanioil" OGPAs (Oil and Gas Production Administrations).

Taking into account the continuation of operation of oil fields by out of date and worn out equipment being a source of environmental pollution, it is envisaged to carry out rehabilitation process in 2 stages. At the first stage, those sites where the development of oil deposits has already been completed will be rehabilitated.

The total area of these sites is about 2,800 ha. The sites allocated for crops and pastures will undergo both technical and biological remediation, but the sites allocated for house building, construction of plant facilities and sports grounds will undergo only technical remediation, that is drainage of artificial lakes and swamps, land flattening, and clean up of household wastes. It must be noted that more than in 700 ha of the territory of the G.Z.Tagiev, "Binagadioil", "Surakhanioil" and "Balakhanioil", OGPAs were rehabilitated, with further use mainly for house building (Figure 2-13).

The data given below characterize the ecological situation on the territory of oil and gas production administrations situated on the Absheron peninsula.

a. The "Balakhanioil" OGPA

This OGPA is situated on the Absheron peninsula in the north-eastern part of Baku at the distance of about 16 km where the Balakhani-Sabunchi-Ramana oil field, the biggest one in Azerbaijan, was brought under development in 1871.

At present, oil and gas production in the "Balakhanioil" OGPA is carried out in the 7 plants by application of the pumping and compression methods. In 1994 on the basis of the 7th plant the J.V. "AzGeroil" was created jointly with German firms.

Among 1,668 wells of the oil field, 1,157 are operating. From the very beginning of development there have been drilled more than 11,000 wells. At the initial period of operation well yield was very high, but as a result of reservoir energy depletion the oil production rate intensively decreased, and now makes up 600 t/d On account of a considerable well drowning more than 4.500,000 m^3/y of formation waters are extracted together with oil.

Well stream operation is carried out by means of the ascending single pipe method. The essence of that method is that the main volume of formation waters is separated from oil at the oil-gathering stations (OGS), and having undergone preliminary purification from oil and foreign solids in oil traps, is transported by the two main canals, North and South, to the water purification plant (WPP), which was put into operation in 1978, and now consists of 4 settling-tanks with capacity of 5,000 m^3 and a sludge-catchment basin with capacity of 20,000 m^3. After the twelve hour setting in these reservoirs, formation waters containing oil products and foreign solids, correspondingly, 55.0 and 48.6 mg/l in the volume of 6,400 m^3/d. are injected into the beds for reservoir pressure maintenance, and in the volume of 6,050 m^3/d. are used for technical needs of the fields.

Household sewage of the OGPA and near-by housing units in the volume of 4,230 m^3/d is discharged into the sewer, but in the volume of 2,530 m^3/d after purification in the South station is discharged into the Hovsan canal, and then flows into the Caspian Sea.

The production activity of the "Balakhanioil" OGPA is carried out on the territory of 2,865 ha, with 2,155 ha contaminated with oil, field-waste water, drilling mud and other field and household wastes, as a result of a continuous and intensive exploitation of the oil field. The first stage of rehabilitation works will be carried out on the territory of 383.5 ha where the development has already been completed, and this land will be returned to land users.

b. The A.D.Amirov OGPA

The A.D.Amirov OGPA is situated in the south-western part of the Absheron peninsula on the outskirts of the Lokbatan settlement at the distance of 16-20 km from Baku. Here the oil fields are: Lokbatan-Puta-Kushkhana, Shabandag-Shubani-Yasamal valley-Ateshkyah, Kara-Eybat, Guzdek, Karadag, Dashgil, South Adjeveli, Pirsagat, Kalmas, Kergez-Kiziltepe-Shongar, Umbaki. The biggest of them is Lokbatan-Puta-Kushkhana, put into operation in1927.

The earliest oil production began in the Shabandag-Shubani-Yasamal valley-Ateshkyah oil fields, brought under development in 1908.

The oil production in this OGPA is carried out in the 4 OGPP(Oil and Gas Production Plants) by the mechanized depth pump method. The number of oil wells in the field is 727, 417 of them are operating. The average daily well output makes up 800 t/d. There can also be found two gas wells with the average daily output of 36,000 m^3 each.

About 1,129,000 m^3/y of formation waters are extracted together with oil. The formation waters, having been separated from oil at the oil-gathering stations, are transported for the final purification to the Lokbatan oil refining plant by the system of field canals. In the somewhat remote oil fields formation waters are gathered from the field lake, with further use for technical needs.

The central water treating facility of the OGPA – the Lokbatan oil trap was put into operation in 1955. Its capacity is 5,000 m^3/d. and the concentration of oil and foreign solids in the formation waters, having passed through this facility, makes up 23.0 and 38.6 mg/l. All formation waters of the OGPA are used for technical needs.

Household sewage of the OGPA and near-by settlements in the volume of 5,700 m^3/d is discharged into the municipal sewerage system and partly into the sewer.

The production activity of the A.D.Amirov OGPA is carried out on lands of constant use with the total area of 2050.4 ha, among which about 630 ha are contaminated with oil and oil products and swamped by oil field sewage. In the first place, works for soil rehabilitation and its transfer to land users will be carried out on the territory of the Ateshkyah-Lokbatan-Puta oil fields, with the total area of 246.2 ha where the development has already been completed.

c. The "Bibi-Eybat" OGPA

The"Bibi-Eybatoil" OGPA develops an oil field of the same name put into operation in 1873 and situated at the distance of 3-5 km from Baku, in the south-western part of it. A distinctive feature of this multipay oil field (its 29 horizons have already been developed) is its partial situation in that part of the Baku Bay, covered with earth in 1923, therefore, being full of water-logged grounds and drowned swamps.

The oil and gas production in the OGPA is carried out by application of the pumping method in the 4 OGPPs.

The oil field comprises 1,131 wells, among which 572 are operating, 18 wells are operated by the compression method. The average daily output of all well categories makes up 650 t/d.

About 2,247,500 m^3/y of formation waters are extracted together with oil from the operating wells. The gathering of formation waters is realized by the system of subsidiary and main canals, with the help of which the formation waters are transported to the oil refining plants ¹6 and "Scoop". The final stage of purification is carried out in a setting and sludge-sampling tank with 9 sections and with capacity of 24,000 m^3/d, put into operation in 1976.

Finally, having been released from the main mass of polluting ingredients, formation waters with the concentration of oil products and foreign solids, correspondingly, 5.55 and 26.4 mg/l, through the unit-group pumping stations (UGPS), are injected into the beds in the volume of 2,570 m^3/d with the purpose of RPM, and in the volume of 2,190 m^3/d are used for technical needs. Excess of the formation waters in the volume of 1,400 m^3/d is utilized by discharge into the lost circulation horizons.

Household sewage of the OGPA in the volume of 1,050 m^3/d is discharged into the Caspian Sea by the special 32nd canal. For cooling of compressors the OGPA makes a diversion flow of 200 m^3 of seawater from the Caspian Sea every day.

The production activity of the OGPA is carried out on lands of constant use with the total area of 817 ha, among which 48.6 ha are to be rehabilitated in the first place.

Almost all territory of the OGPA is polluted and swamped, as a result of a continuous operation of wells. However, taking into account the "backing" character of the field territory, it is to be rehabilitated first of all.

d. The "Binagadioil" OGPA

The "Binagadioil" OGPA is situated on the Absheron peninsula in the north-western part of Baku at the distance of 8-10 km from it.

Here the developed oil fields are: Binagadi (1898), Chakhnaglar (1932), Sulu-tepe (1920), Zigil-piri, Masazir (1989), and Fatmayi, Syanshor (1973), Kirmaki (1950).

The oil and gas production in the OGPA is carried out by means of the pumping and compression methods in the 4 OGPPs. The operating well fund comprises 720 wells, as well as, 6 compression wells. In the operation there are altogether 1,524 wells.

The average daily well output makes up 500 t/d.

On account of a considerable water cutting of well output, 1.092,500 m^3/y of formation waters are extracted from the wells together with oil. Then the formation waters, having been separated from oil at the oil-gathering stations by the system of subsidiary and main canals, are transported for purification to the hydro station ¹3, which is an engineering construction with an oil trap and a regulating reservoir. Having been released from the main mass of pollutants, formation waters are pumped over by a pump station to the central water purification plant with capacity of 9,000 m^3/d for the final purification. This plant, put into operation in 1977, consists of 4 reservoirs for purification of water in the volume of 30,000 m^3 and 2 reservoirs with the volume of 1,500 m^3. After the twelve hour setting in these reservoirs, formation waters in the volume of 1,280 m^3/d. are pumped into the beds with the purpose of RPM, and in the volume of 1,710 m^3/d. are used for technical needs.

The concentration of oil products and foreign solids in the water, having passed through the water purification plant, is 37.0 and 77.7 mg/l.

Household sewage of settlements and the OGPA in the volume of 1,190 m^3/d is discharged into the sewer.

For cooling of compressors the OGPA makes a diversion flow from Lake Hadji-Hasanli in the volume of 600 m^3/d.

The production activity of the OGPA is carried out on lands of constant use with the total area of 3,151 ha, among which 1,129 ha are contaminated with residual oil. In the first place, the developed lands, with the area of 364.0 ha, are meant for rehabilitation and transfer to landusers. Among these 364.0 ha, 179.0 ha are in the Sulutepe oil field, 145.5 ha in the Kirmaki oil field and 39.5 ha in the Binagadi oil field.

e. The"Surakhanioil" OGPA

The "Surakhanioil" OGPA is situated in the north-eastern direction of the Absheron peninsula at the distance of 14-16 km from Baku. Here the developed oil fields are: Surakhani, put into operation in 1904, and Karachukhur, whose operation began in 1928.

The oil and gas extraction is carried out in the 4 OGPPs by means of the pumping and compression methods.

The number of oil wells in the fields is 622, among them 287 are operating wells. The number of compression wells makes up 20.

At the initial period of operation the wells had a high productivity, but further, on account of the bed pressure fall the oil output intensively decreased, and at present makes up in average1,200 t/d.

On account of a high well drowning of beds, 5.604,000 m^3/y of formation waters are extracted from wells together with oil. The gathering of formation waters is realized by the system of subsidiary and main canals and also pipelines, with the help of which the formation waters are transported to the places of their purification. The oil-catching stations found an application to the latter. In particular, the central water purification plant is a gravitational setting tank, which is constructively built as an oil-catching station №7. This station was put into operation in1953 and has a rated capacity of 20,000 m^3.

After the purification in the mentioned plant, the formation waters of the OGPA in the volume of 3,330 m^3/d are pumped into the beds with the purpose of RPM and are used for technical needs in the volume of 10,250 m^3/d. The concentration of oil products and foreign solids in the purified water is, correspondingly, 8 and 32 mg/l.

The hydroeconomic activity of the OGPA is also connected with the Baku Iodine Plant, to whom the OGPA gives 1,770 m^3 of hard formation water every day. It should be noted that a number of production associations of the Absheron peninsula realizes the discharge of sewage transported by the Hovsan Canal into the Caspian Sea through the oil station №10 in direct closeness from the oil station №7. This canal, with the oil-catching station №10, was built in 1955-1958, and now is transferred to the balance of the "Surakhanioil" OGPA. Its rated capacity was 45,000 m^3/d.

At present more than 70,000 m^3/d of sewage are discharged through this oil station and this considerably abates the degree of purification.

Household sewage of the OGPA and near-by settlements is discharged into the Caspian Sea through the Govsan Canal in the volume of 440 m^3/d.

For cooling of compressor plants the OGPA makes a diversion flow of 2,820 m^3 of seawater from the Caspian Sea every day.

The production activity of the OGPA is carried out on lands of constant use with the total area of 1,766 ha, among which 905.1 ha are contaminated with oil and oil products and swamped by oil field sewage.

f. The G.Z.Tagiev OGPA

The G.Z.Tagiev OGPA is situated in the north-eastern part of the Absheron peninsula at the distance of 40 km from Baku.

Here the developed oil fields are: Gala, Buzovna-Mashtaga and Zirya, put into operation in 1932, 1940 and 1956. Unlike the first two oil-gas wells, Zirya is a gas field.

The oil and gas production in this OGPA is carried out in the 2 OGPPs by means of the pumping and compression methods.

In the operational fund there are 393 wells, among them 180 are operating, and 11 wells are operated by means of the compression method. There is also a gas field, with the output of 27,000 m^3/d. The average daily oil production by all well categories makes up 1,300 t.

Together with oil 784,300 m^3/y of formation waters are extracted from the wells. The purification system of formation waters appears in the following way. The formation

waters of the Gala oil-gas field, having passed through the oil trap, are concentrated in Lake Japaridze (is absent on the lay-out because of the small area), and then are transported for setting to the reservoir with capacity of 20,000 m^3. The water from this reservoir is used for technical needs by the pump station. The concentration of oil and foreign solids in the purified water is 67.3 and 109.4 mg/lt. The formation waters of the Buzovna-Mashtaga oil-gas field are transported to the Mashtaga oil trap by the main canal, and then after the setting in Lake Chukhur-dere are used for technical needs. After the purification in the earth reservoir, the formation waters of the Zirya oil-gas field are used for technical needs, with the concentration of oil and foreign solids, correspondingly, 6.4 and 38.2 mg/l.

Household sewage of the OGPA and near-by settlements in the volume of 1,870 m^3/d is discharged into the municipal sewerage system.

The production activity of the OGPA is carried out on lands of constant use with total area of 1,872 ha, among which 1645.45 ha of the Gala oil field territory, 72.35 ha of the Buzovna-Mashtaga oil field territory and 164.0 ha of the Zirya oil field territory are in the first place for rehabilitation and further transfer to land users.

2.2.2 Rehabilitation of oil contaminated lands financed by the World Bank and TACIS

As it is known, emissions into the atmosphere from oil-contaminated lands have an appreciable impact on the environment and man's health. Therefore, the clean up and rehabilitation of the lands of the Absheron peninsula were included into the National Operation Plan for Environmental Protection, worked out jointly with the World Bank. The latter has allocated 5,000,000 US dollars for elaboration of a pilot project, the first stage of which has already been completed. So, a site with the total area of about 15 ha, which has been used as an oil reservoir before, is allocated at the territory of the G.Z.Tagiev OGPA.

One of the local consultant, being a winner of the competition announced by SOÑAR, has drilled 9 wells at an equal distance from one another. The depths of wells were determined taking into account the results of the ground digging by 2 meters below the oil contaminated layer. The numerous rock samples were taken and the corresponding analysis on defining the concentration of hydrocarbons and granulometric composition were carried out. The maximum depth of oil products penetration was 5.2 m and the concentration of hydrocarbons was 37 g/kg, which by far exceeds the maximum permissible concentration 2 g/kg fixed by he State Committee on Ecology.

The Company has given a report to the World Bank on the accomplished work illustrated by a great number of cartographic materials. The accepted data will be used for defining the most effective rehabilitation method and for selecting the technological equipment.

a. Method of rehabilitation

Recently, SOÑAR has announced a tender, in which interested companies has to propose 3 methods for treatment of oil-contaminated soil. They are the following:

- Biological treatment
- Thermal treatment

- Mechanical washing

a.1 Biological Treatment

The biological treatment is based on the bioconversion of oil contaminated soil under oxidative conditions. The enhanced degradation is carried out by the carefully selective addition of specially blended pre-conditioned substrates and a perfected mechanical soil processing technique adapted to the degradation phases. The treatment enables the step-by-step transformation of the hydrocarbons to the end products CO2 and water.

The sorted and classified soils are subsequently conditioned for the cleaning process. Large pieces of stone and concrete are hereby broken and substrates which have been specially adapted to the soil structure (compost, straw, etc.) are added to improve the soil matrix.

Mineral nutrients (balanced nitrogen-phosphor ratio) are admixed to supply the micro organisms; adapted bacteria and fungi are enriched in the soil and the soil is provided with an optimum supply of oxygen.(refer to Figure 2-10)

a.2 Thermal Treatment

The thermal method consists of several phases. The process receives screened oil mud and oil mud cuttings from drilling operations and treats these in a sealed chamber. Sufficient heat (250-270 C) is generated to flash evaporate both oil and water content leaving the dry oil free powder to discharge through a valve at the end of the chamber. The vapour stream passes through a cyclone where remaining powders carried over by the vapour are separated out and collected along with the discharged powder from the chamber. Thereafter, the vapour is condensed in two stages so that oil and water can be collected, for re-use and discharge respectively.

The Drill Cuttings are recycled into three separate products:

- Water suitable for discharge to sewer /out-fall or re-use in industry
- Oil for re-use by operator or as low grade fuel
- Dry, Inert Rock Powder with a Hydrocarbon content of less than 0.1%, classified as “Inert” and suitable for re-use in industry as a bulking material of filler. The material is also suitable for landfill as an inert material or as a Landfill Engineering product. (refer to Figure 2-11)

a.3 Mechanical Washing

The essence of the method of mechanical washing is the treatment of oil contaminated soil by dissolvent vapours, and as a result of it oil products in the form of the liquid phase passes into the reservoir together with the dissolvent. Then the dissolvent is separated from oil products and re-used. The advantage of this method is the collection of oil products for re-use. (refer to Figure 2-12)

b. Other Information

There is also a site allocated for the project of TACIS, as it is going to test the technologies and technical facilities for rehabilitation of oil contaminated lands. Unlike the World Bank’s project, the TACIS project envisages to use only local technologies and technical facilities.

Only 3 organizations were chosen for testing: the Åxperimental -Production Department of the Academy of Sciences of the Azerbaijan Republic on the Complex Mineral Stuff Processing, Azpetrocom and Azpromstroy. TACIS will also provide means for equipping laboratories for the concentration analysis of hydrocarbons, heavy metals and the size of sediments by the world standards level, which will be transferred to the State Committee on Ecology when completed.

Time for the realization of these projects depends upon the support of sponsors, but the effect from accomplishing the projects is indubitable in ecological and economic respects. Therefore, for accelerating the rehabilitation process of oil contaminated lands and their use in agriculture a part of finances of the newly created Oil Fund may be further used.

The layout (refer to Figure 2-13) shows the location of oil contaminated lands on the Absheron peninsula. The layout was constructed on the basis of the information obtained by SOCAR from the Oil and Gas Production Administrations. The whole oil contaminated land is marked on the layout by green and yellow colours. The land marked by green colour, having passed all phases of the clean up process, can further be used in agriculture. However, the land marked by yellow colour, in the expert's opinion, being completely exhausted, can only be used for Industries.

2.2.3 The Survey of Perspectives of Carrying Out the Clean Up of Oil Contaminated Lands

The clean up of oil contaminated lands had been realized beginning with the 90-ties and continued during a short period. For the lack of finances biological remediation was not carried out, only mechanical remediation was realized, i.e. transportation of the contaminated soil, drainage of artificial lakes and swamps, land flattening, cleaning of household rubbish and other wastes. More than 700 ha of land were rehabilitated by means of this method on the territories of the "Binagadioil" named after G.Z.Tagiev, "Surakhanioil"and "Balakhanioil" OGPAs, which were mainly used for house building by the oil industry workers, partially for plant building.

It should be noted that despite the necessity of enormous finances, the rehabilitation of oil contaminated lands is greatly profitable in ecological and economic respects. So, according to the technico-economic estimates, made on the request of the "Azneft" association (the predecessor of the association on the oil and gas production on land) in 1990, all rehabilitation expenses are to be covered during 14 years owing to the realization of the gathered oil, introduction of the rehabilitated lands into agriculture.

SOCAR has concluded a contract with Solvalub Ltd. Company and OMNE RE S.A. on rehabilitation of the territories of the G.Z.Tagiev and "Binagadioil" OGPAs. This contract envisages that Solvalub Ltd. will carry out the clean up of oil contaminated territory only by application of its own funds and facilities. The expenses are to be covered by realization of the gathered oil. The mechanical washing technology, proposed by the mentioned firms, provides oil extraction from the soil at 98%, i.e. as it is required by the SCE.

2.2.4 Information on the Mercury Clean up Project in Sumgait

The Mercury Clean-Up Project in Sumgait is addressing one of the three most urgent issues that were identified in the National Environmental Action Plan of the Azerbaijan Republic.

Sumgait was a major centre of chemical production in the former Soviet Union. On one factory site, a chlorine-alkali plant has been manufacturing chlorine and caustic soda since 1958. The process has consumed a large quantity of mercury, much of which is present in the soil beneath the plant or in the waste sludge lagoons.

The site is located close to the Caspian Sea. Migration of the mercury contamination into the sea will threaten the ecosystem and human food sources, including the internationally important fisheries.

This project is financed by the World Bank at the rate of 1,700,000 US dollars and has been commenced in the middle of 2000 and will continue till September 2002. This project envisages construction of a landfill in the western direction from Sumgayit, on the territory of the Perekishkyul settlement with the area of 50 ha. Later on, the World Bank will allocate additional funds for construction of the landfill.

The objectives of this project are:

- Assess the extent of mercury accumulation in the environment and human exposure in the Sumgayit area
- Clean up the mercury contamination
- Provide safe and sustainable disposal of the sludge

This is a demonstration project and thus a strong emphasis will be placed on training in the technical, health and safety elements of the project.

The client for this project is the Government of Azerbaijan, represented by the Project Implementation Unit of the Azerbaijan State Committee on Ecology. The project is financed by a credit from the World Bank Group, under the Urgent Environmental Investment Program.

The Management Contractor is an association of Containment Quality Associates Ltd and Curry & Brown (both UK firms), together with the Azerbaijan Environment and Technology Centre and Woodward Clyde.

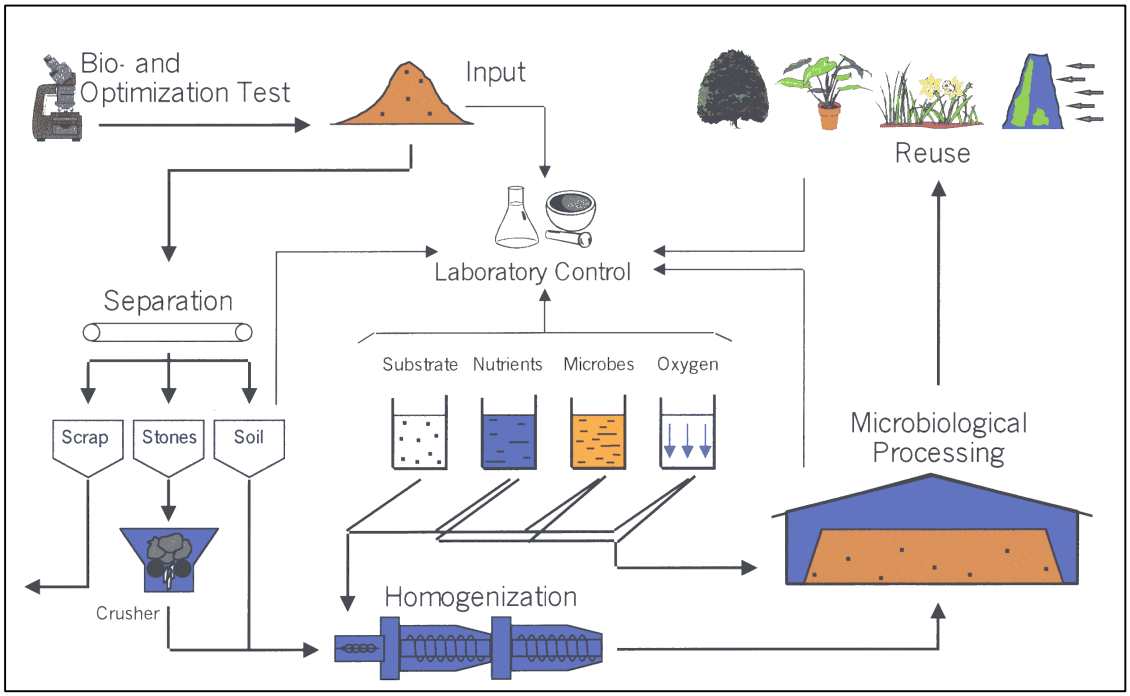

Figure 2-10: Biological Treatment

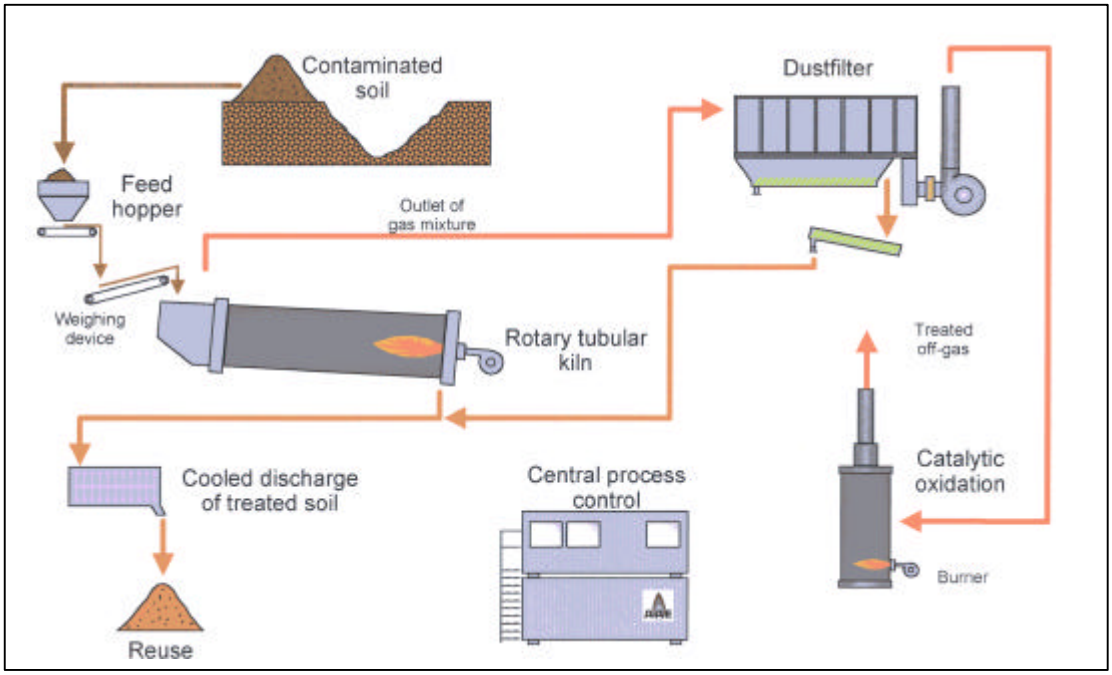

Figure 2-11: Thermal Treatment

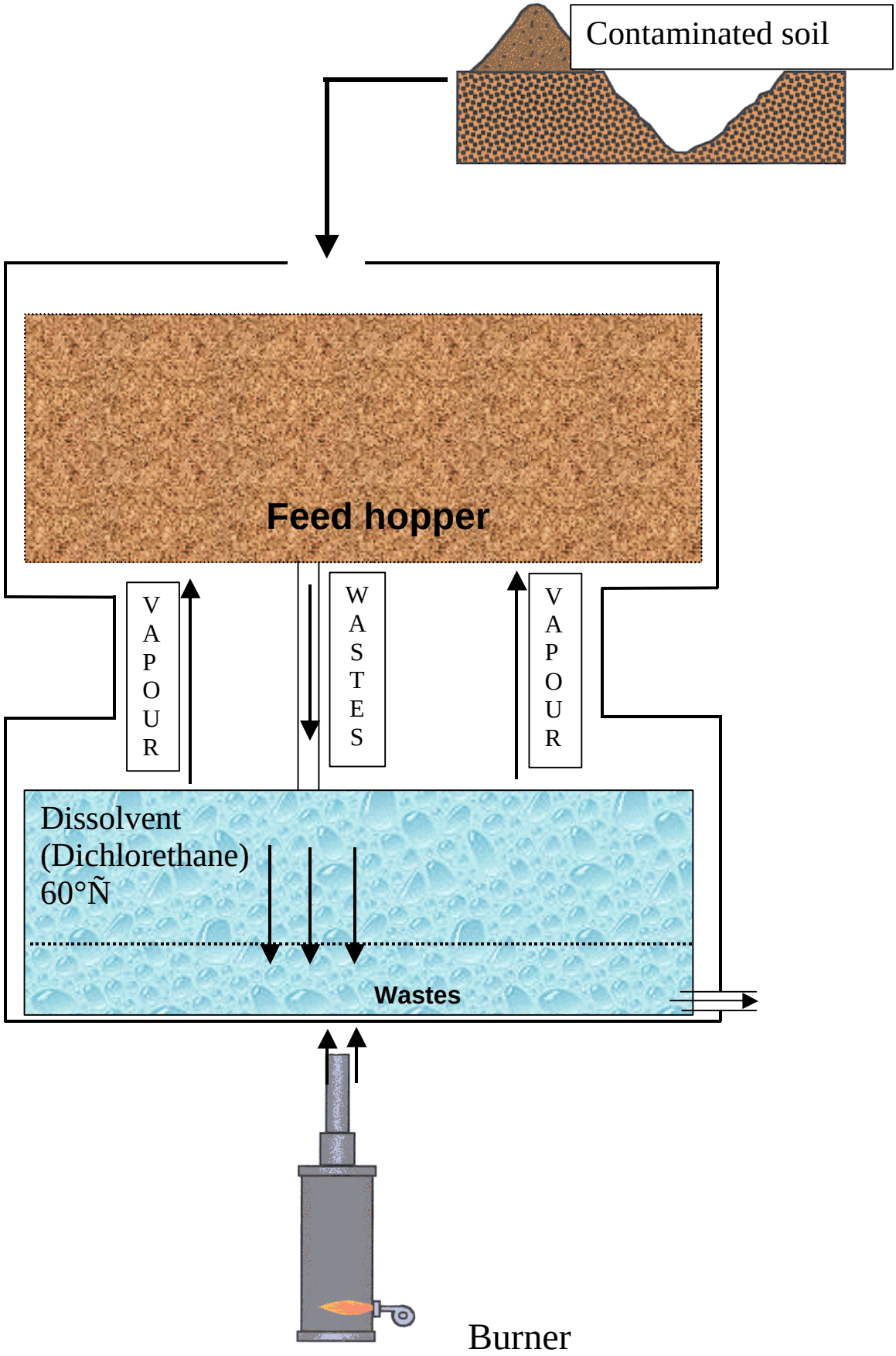

Figure 2-12: Mechanical Treatment

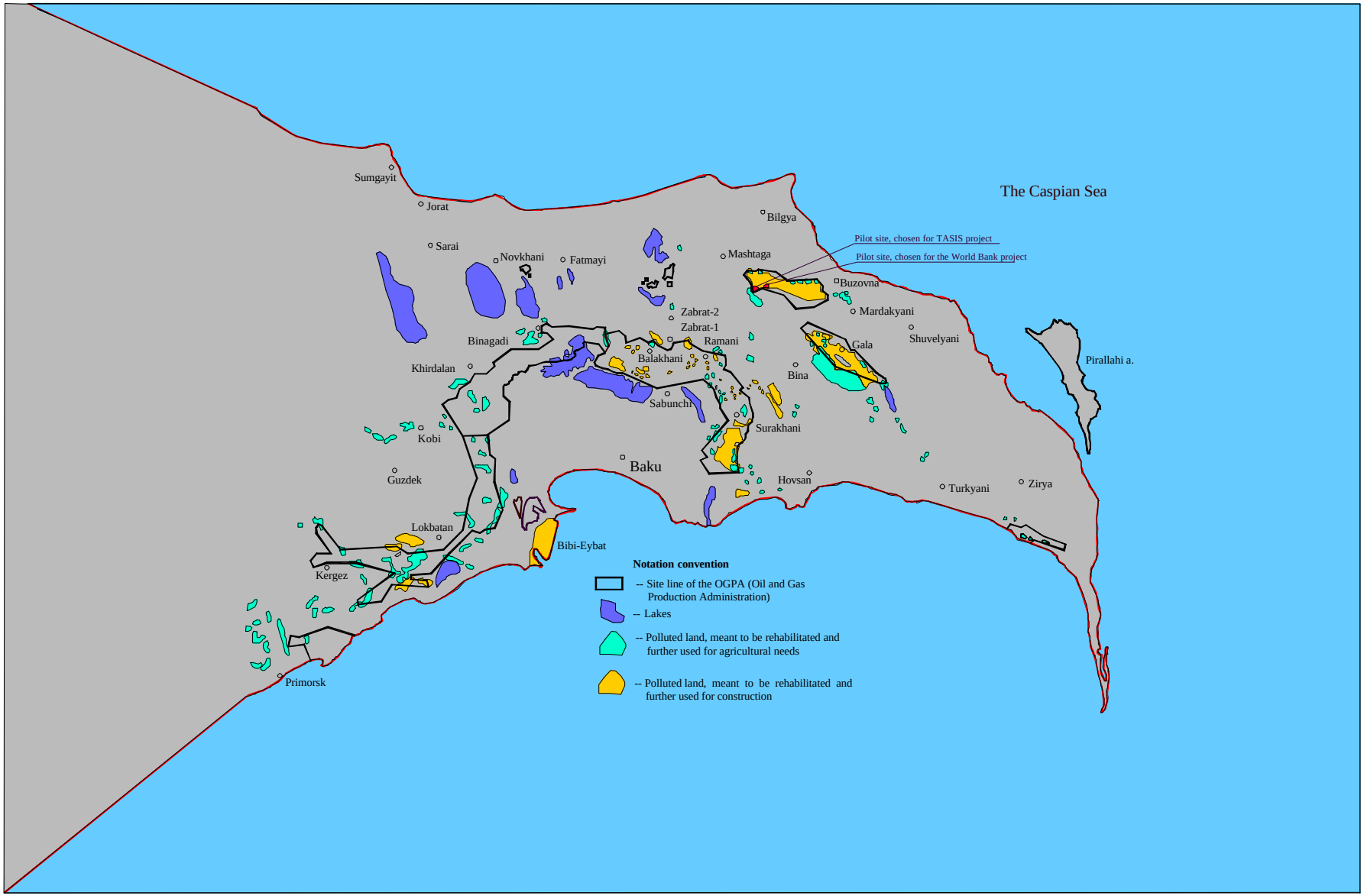

Figure 2-13: Location of the Oil Contaminated Land

2.3 Fauna on the Absheron Peninsula

2.3.1 Ichtiofauna

A list of fishes of Azerbaijan includs 78 species. 41 species from 5 orders (Acipenseriformes – 4 species, Clupeiformes – 9, Cypriniformes – 10, Mugiliformes – 2, Perciformes – 16) can be found on Absheron peninsula (Àáäóðàõìàíîâ, 1966). Most species from this list occur in Caspian Sea and along the coastline of the Absheron. The sea fishes distribute vertically (from surface to deep strata of water). Main masses of fishes occur as deep as 50 – 75 m, where water temperature and oxygen content are more, and where many water invertebrates, the main food for fishes, occur. But some species prefer more deep water. For example, representatives of genus Alosa sometimes meet at the depth of 100 m, and some sprats (*Clupeonella grimmi & Clupeonella engrauliformes*) occur at the depth of 120 m.

All fishes was classified into the next categories: sea fishes (they live in the sea during all their lives and never go away from its border), river fishes (they live in the fresh water during all their lives), passer fishes (they live in the sea till the breeding season, after that they migrate to rivers, usually far from the mouth), and semi-passer fishes (they live in the freshe part of the sea, and for breeding they migrate to rivers, usually not far from the mouth). But some species are difficult to apply this classification. For example, *Clupeonella delicatula* and *Alosa caspica caspica* have migrations to the North Caspian, where they breed in the shale water. But some part of these fishes goes to the mouth of River Volga and river zones near the mouth for spawn. Some representative of genus Gobius and Proterorhinus (as rule they occur in the seawater) occur in fresh water.

One of the common species in the Caspian Sea is sprat (*Clupeonella grimmi & Clupeonella engrauciformis*). They appear in the deep water (not near the surface), where water regime is more stable, which make them less vulnerable (Êàçàí÷åâ, 1981). Representatives of genius Gobius (*Gobius melanostomus & Gobius caspius*) also meet in multitude. One of the main producers' fishes is the representatives of family Sturgeons (*Huso huso, Acipenser guldenstadti & Acipiter stellatus*; Êàñûìîâ, 1987).

The Red Book of Azerbaijan includs 5 species of fishes. Two of them appear around the Absheron peninsula – *Abramis sapa (Þ æ í îê àñïèéñêàÿ áåëîãëàçêà) & Lucioperca marina (Ìîðñêîé ñóäàê)*.

2.3.2 Herpethofauna

Sixty-three species of Amphibia and Reptilia occur in Azerbaijan.

Herpethofauna on the Absheron peninsula includes 25 species. Only two species are from Amphibia (*Bufo viridis* and *Rana ridibunda*). The others 23 species are from Reptilia. Reptilia includes two subclasses – Squamata and Testudines and three orders – Cryptodira (3 species), Sauria (10 species) and Serpentes (10 species).

This high diversity of reptile species on the Absheron peninsula (39 % of all species in the country) is explained by long warm seasons of year, by rich sources of forage and by the diversity of habitats. Most typical species and subspecies on this territory are: *Testudo graeca, Gymnodactylus caspicus, Agama caucasica, Phrynocephalus*

helioscopus persicus, Eumeces schneideri princeps, Ophisops elegans, Eremias arguata transcaucasica, Eremias velox caucasica, Natrix tesselata, Typhlops vermicularis, Eryx jaculus familiaris, Columber jugularis erythrogaster, Columber ravergieri, Eirenis collaris, Malpolon monspessulanuso and *Vipera lebetina obtusa* (see map "Distribution of reptile"; Àëåêïåðîâ, 1978).

The following species are also numerous species: *Testudo graeca, Agama caucasica, Ophisops elegans, Eremias velox, Eremias arguata, Natrix tesselata, Columber jugularis, Eirenis collaris, Malpolon monspessulanuso* and *Vipera lebetina.*

The following species are rare on the Absheron peninsula: *Clemmus caspica, Ophisaurus apodus, Coluber ravergieri, Phrynocephalus mystaceus.*

Besides, one species, which occurs on the territory of Absheron peninsula, is endemic of Caucasus – *Eirenis collaris.*

Most species of reptile from order Sauria and Criptodira appear from the beginning of March until October-November (it depends from the conditions of temperature of the year). Species from order Serpentes usually occur from the end of March or April till October. The exception is *Vipera lebetina*, which may not have hibernation (this species can be found throughout the year). Representatives of Amphibia may also occur during all the year (in suitable weather conditions), but the period of activity of these species (when they occur in high number) is from March to November.

Thirteen species of reptile are included in the Red Book of Azerbaijan. Two species out of them occur on the Absheron peninsula: *Testudo graeca* (Ñðåäèçåìíîìîðñêàÿ ÷åðåïàõà) & *Phrynocephalus helioscopus* (Òàêûðíàÿ êðóãëîãîëîâêà).

2.3.3 Theriofauna

One hundred species of mammals occur in the Republic. Teriofauna of Absheron peninsula includes 35 species, which are from 7 orders: Insectivora – 6, Chiroptera – 6, Lagomorpha – 2, Rodentia – 10, Carnivora – 9, Pinnipedia – 1 and Artiodactyla – 1 (Âåðåùàãèí, 1938, 1959; Àëåêïåðîâ, Ðàõìàòóëèíà, 1975; Ðàõìóëèíà, 1995). Two species (*Oryctolagus cuniculus* and *Sciurus vulgaris)* were introduced in this fauna. Rodents and beasts of prey are dominates on this territory. The most typical and numerous species are *Rattus norvegicus, Mus musculus, Meriones erythrourus, Pipistrellus kuhl, Vulpes vulpes, Oryctolagus cuniculus, Sciurus vulgaris* and *Pipistrellus kuhli*.

The numbers of rodents increased in last years, because the necessary sanitary control to regulate their number is absent. *Rattus norvegicus* & *Mus musculus* occur and are active throughout the year and are typical human vermin.

The number of *Pipistrellus kuhli* increased during the second part of the 20th century after the urbanization of the Absheron. This species finds its shelter in aired landscapes and is widespread in different settlements. *Pipistrellus kuhli* occurs in all seasons of the year (usually in winter it appears on warm days) in the twilight. This species meets in settlements, in the center of cities and on the open places during feeding (Ðàõìàòóëèíà, 1983). In average, more than 10 individuals exist in one ha on this territory.

On Absheron peninsula *Meriones erythrourus* is dominant in open areas of semi-deserts and on agriculture lands. In the first half of the 20th century it was found

in a mass (more than 100 individuals was counted in one ha). In the second half of this century, as a result of urbanization of districts, development of national economy and oil industry and change of water regime, the numbers of this species is significantly declined and now there are no more than 18 – 20 individuals in 1 ha (Ðÿùìÿòóëèíà, Ùÿñÿíîâ, 1999).

Last decades, *Vulpes vulpes* was most widespread species on the territory of the peninsula. Its burrows were found on open part of semi-desert and near the settlement. The main diet for this species is rodents. Now, this species often occurs on rubbish heaps and feeds also there. In average, one individual is found in one ha.

The following five species, in some habitats, appear a little less than one individual in one ha: *Crocidura guldenstaedti* (on wetlands), *Allactaga williamsi* and *Allactaga elater* (on virgin soil, near settlements and along different roads), *Apodemus sylviaticus* (on wetlands with vegetation, on agriculture lands, in buildings), *Microtus socialis* (on wet meadows, on open places of semi-deserts).

There are 14 species from mammalian included in the Red Book of Azerbaijan. The following four species from this list occur on the territory of the Absheron peninsula: *Hyaena hyaena* (Ãèåíà), *Vormela peregusna* (Ïåðåâÿçêà), *Panthera pardus* (Ëåîïàðä), and *Gazella subgutturosa* (Äæåéðàí).

2.3.4 Ornithofauna

A list of fauna of Azerbaijan includes 366 species of birds. According to different sources of literature (Ãàìáàðîâ è äð., 1958; Ãàìáàðîâ, 1960; Ìóñòàôàåâ è äð., 1968; Ïàòðèêååâ, 1991 à, á; Àãàåâà, Ñóëòàíîâ, 1999) and new investigation, 231 species from 21 orders (Gaviae – 1 species, Podicipites – 4, Steganopodes – 4, Gressores – 13, Phoenicopteri – 1, Anseres – 25, Accipitres – 17, Tetraonidae – 2, Otides – 2, Ralli – 7, Limicolae – 35, Lari – 13, Pterocletes – 1, Columbae – 6, Cuculi – 1, Striges – 3, Caprimulgidae – 1, Macrochires – 1, Coraciiformes – 5, Picaridae – 1 & Passeres – 88) occur on the territory of the Absheron peninsula. However, it can not be said that this list is complete, because it is always supplemented. This high diversity of species can be explained by the fact that a major migration way of waterbirds and other species crosses over the peninsula. That is why 97 species (41 %) meets on this territory in migration season only. 38 % of species are wintering birds, 29 % are breeding, and 4 % are accidental visitors. Only small percent (about 10 %) of the species are really sedentary on the Absheron, and all the other birds are wintering-migration or breeding-migration.

Major wintering and breeding sites on the Absheron peninsula are indicated in Figure 2-14.

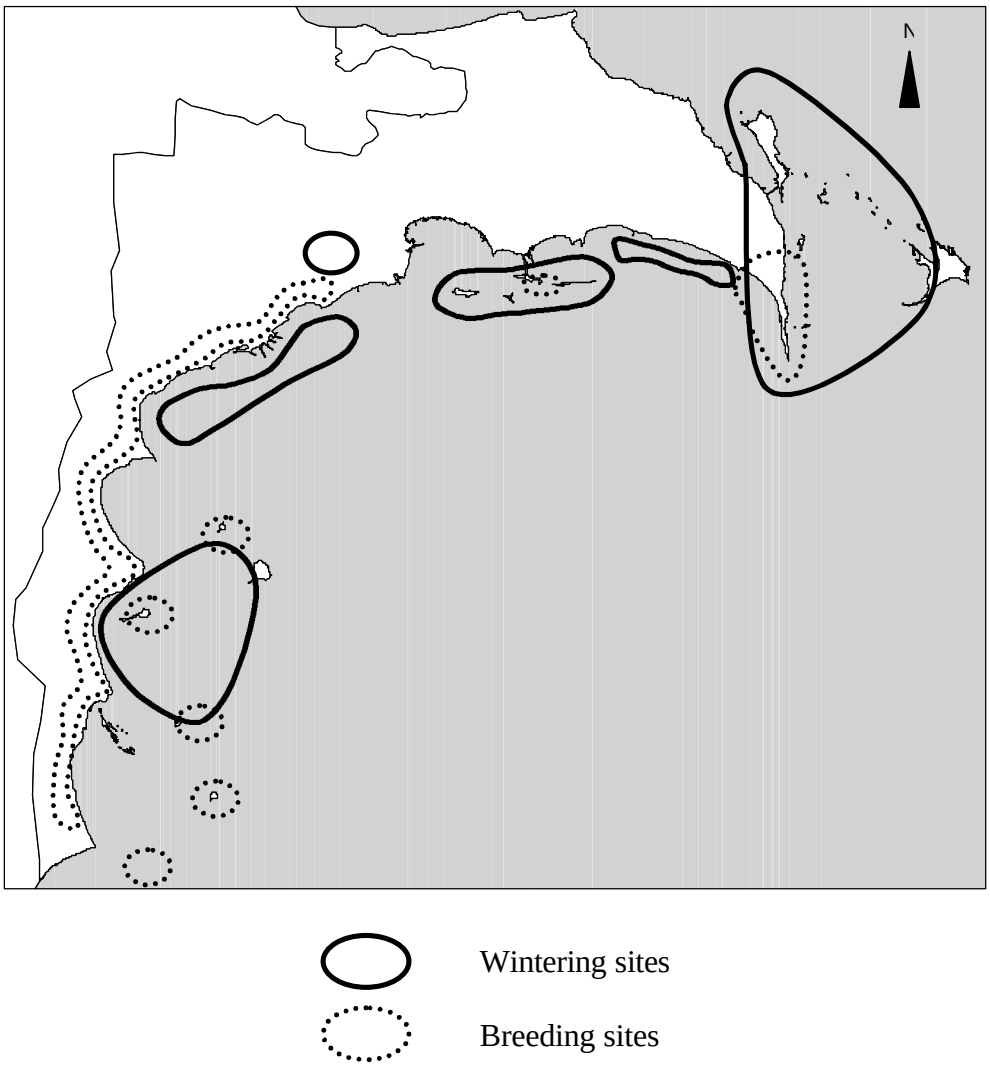

Figure 2-14: Major Wintering and Breeding Sites

The composition of the species of birds has strong fluctuation during seasons of the year: it is maximal in migration season (up to 50 species a day), in wintering season it is minimal (usually 13 – 15 species a day). However, it does not correspond to numbers of birds: in winter the number of birds is the highest, while during migration the number can strongly change (it depends on weather conditions and the intensity of migration).

50 % of breeding species of birds are from Passeres order (33 species). In other orders breeding can be found for the following species: Cormorant, Gray heron, Purple heron, Shelduck, Ruddy shelduck, Red-crested pochard, White-tailed eagle, Kestrel, Lesser kestrel, Lanner, Rock partridge, Coot, Moorhen, Purple gallinule, Black-winged stilt, Collared pratincole, Little ringed plover, Kentish plover, Herring gull, Mediterranean gull, Common tern, Little tern, Sandwich tern, Rock dove, Collared dove, Turtle dove, Palm dove, Cuckoo, Little owl, Swift, Roller, Bee-eater and Hoopoe. Besides that, it is assume, that the next species can nest on peninsula: Little grebe, Little bittern, Marsh harrier, Stone curlew, Greater sandplover, Green

sandpiper, Black-bellied sandgrouse, Blue-cheeked bee-eater, Yellow wagtail and Rufous bushchat.

The main places of birds' nesting are islands of Baku archipelago, where were found greater colonies of Herring gulls (Gil, Zenbil and Garasu islands), Mediterranean gulls (Babur Island), Sandwich terns (Garasu Island) and nesting of some species of ducks (for example Shelduck and Ruddy shelduck), terns (common and little) and waders (Collared pratincole, plovers & etc.). For example, in 1996 more than 5,000 pairs of Sandwich tern and nearly 1,000 pairs of Herring gulls were counted on Garasu Island. Gulls and doves nest on many-neglected bore-platform in the sea cormorants. In July of 1996, on islands of Pirsagat ridge more than 600 breeding pairs of cormorants were noted, 400 pairs from which were found on bore-platforms of Sangi-Mugan Island (Sultanov, Haddow, 1997; Ñóëòàíîâ, Êåðèîâ,1998; Musayev, Sultanov, 1999; Ñóëòàíîâ, Êåðèîâ,1999; Sultanov, Kerimov, in print).

It is necessary to mention about nesting on Shah Dili spit, where is the overgrowth of reed and different species of herons, Marsh harriers, Moorhens, Coots, Purple gallinules, waders, gulls and terns can find the concealed nests. But nesting is only single here and the colonies were not found. Besides, single nesting of these species is noted (in suitable habitat) along most part of coastal zone of Absheron peninsula.

There are Passeres, Accipitres and Coraciiformes who nest in mountainous and semi-desert zones of districts. The following species are more spread on semi-desert zone: Bee-eater, Crested lark, Isabelline wheatear, Starling, Hooded crow and others. The Lesser kestrel, Lanner, Rock partridge, Stone curlew, Black-bellied sandgrouse, Crested lark, Isabelline wheatear, Chough and other species nest in a mountain zone.

In last years many species of birds get used to live in towns and settlements and have regular nesting here. Those are Little owl, Swift, Hoopoe, House martin, Swallow, Blackbird, Red-backed shrike, House sparrow, Tree sparrow, Greenfinch etc.

During wintering season 90 species of birds are noted on the Absheron peninsula (Àãàåâà, Ñóëòàíîâ, 1998; Ãóìáàòîâà, 1999). 50 species are waterbirds (18 – Anseres (20%), 10 – Limicolae (11%), 22 – other species (25%) (Red-throated diver, Great crested grebe, Red-necked grebe, Black-necked grebe, Little grebe, Pelican sp., Cormorant, Pygmy cormorant, Bittern, Great white egret, Little white egret, Grey heron, Water rail, Moorhen, Purple gallinule, Coot, Herring gull, Slender-billed gull, Common gull, Black-headed gull and Kingfisher), 34 – Passeres (38%), 4 – Accipitres (4%) and Little bustard & Rock dove. Thus, in breeding season most numbers of species (73%) are birds of land, so in winter season waterbirds are dominants (56%).

Wintering population of birds in Azerbaijan is one of the biggest ones in western Palearctic (Ñóëòàíîâ, 1994). During winter, the most number of birds are found from the end of December till the middle of February. January and February is time of stable wintering, when migration is absent almost. The main concentration of waterbirds records along the coast of sea in this period.

According to data of "Results of winter survey of birds in Azerbaijan" (Ñóëòàíîâ, Ì óñòàôàåâ, 1994; Ñóëòàíîâ, 1997), the maximal density on line was noted along the cost of Absheron (174 individuals on 1 km of way), and the biggest concentrations were found in zone of north part from Absheron peninsula to the Pirallahi island,

around Shah Dili spit, on the section from Zira to Hovsan, around Sahil settlement and on section from Sangachal to Gobustan.

New investigations (Àãàåâà, Ñóëòàíîâ, 1998; Ãóìáàòîâà, 1999) show that in January density on line from Shih cape to Pirsagat cape is 668 individuals on 1 km. The most considerable concentrations of birds were counted in a triangle zone – Pirallahi Island –Boyuk Tava Island – Shah Dili spit, along the coast from Shih cape to Sangachal cape and from Alyat cape to Pirsagat cape. Besides, it is necessary to note about Krasnoye Lake, which is located near the Lokbatan settlement and where waterbirds (geese, ducks, and grebes) are hibernate. It is important that regular wintering of White-headed duck was found in this lake (globally threatened species).

During the winter season the Red-crested pochard, Tufted duck, Pochard and Coot are dominants in number with different prevalence in different places.

One of the main migrations ways passes along the coast of the Caspian Sea. Annually about 10 millions of birds migrate across the territory of Azerbaijan (Òóàåâ, Êàðàáàíîâà, Êóðáàíîâ, 1983). Autumn migration begins from the end of March (songbirds, waders and other small birds) and became a mass from the middle of October. At this time many birds migrate to the South from Northeast Europe and west Siberia.

Some of birds are standing along the sea cost of Azerbaijan for wintering, and some pass to south, to the coast of Iran and farther – to Africa and to Middle East. As a rule, the autumn migration continues until the January, but some times individual passage flocks (for ex. of Cormorant) can be noted during wintering (January & February; Àãàåâà, Ñóëòàíîâ, 1998).

Most of migration birds (grebes, cormorants, geese, ducks, gulls and terns) pass over the sea, and some times in several kilometers far from the coast. The herons, rails and waders prefer a littoral zone. Passage of bustards, doves, bee-eaters and songbirds usually mark over the territory of semi-desert. The birds of prey, as a rule, fly near the mountains. Usually spring migrations begin from the middle or the end of February and can continue until the May (it depends on weather conditions).

Investigation of the migration of birds in Azerbaijan (Êàðàáàíîâà, 1990 à; 1991 à, á, â) identified that in period of spring migrations over the Absheron peninsula 75.3 % of birds pass to northeast direction, 13.4 % to northwest, and 11.3 % to north. It shows that most migration flocks turn round the peninsula and move along the coast of Caspian Sea through Transcaspian route. During autumn migration the main number of birds select a south direction (51.4%), 36.6 % of birds move to southwest direction and 12 % pass to south (see Figure 2-15).

The most characteristic species on the Absheron peninsula is Coot. This species can be found during all seasons of the year here. It is common in summer and numerous in winter. In the breeding season it occurs on flood with shallow water and with vegetation around it. Coot builds a nest in reed near the water. The material for nests are stems and leafs of reed and sedge. Coot lays eggs (usually 7-10) from the beginning of April. The nesting is seen from the end of May. October and November is time of autumn migration of Coots. From the middle of November migration population is arriving here. The Coot is one of numerous birds in wintering season here, but with the development of oil industry the coots became one of vulnerable

species (Âåðåùàãèí, 1945;Ñóëòàíîâ, 1991; Ñóëòàíîâ è äð., 1998; Sultanov, 1998; Ñóëòàíîâ, 1999; Ñóëòàíîâ è äð. 1999).

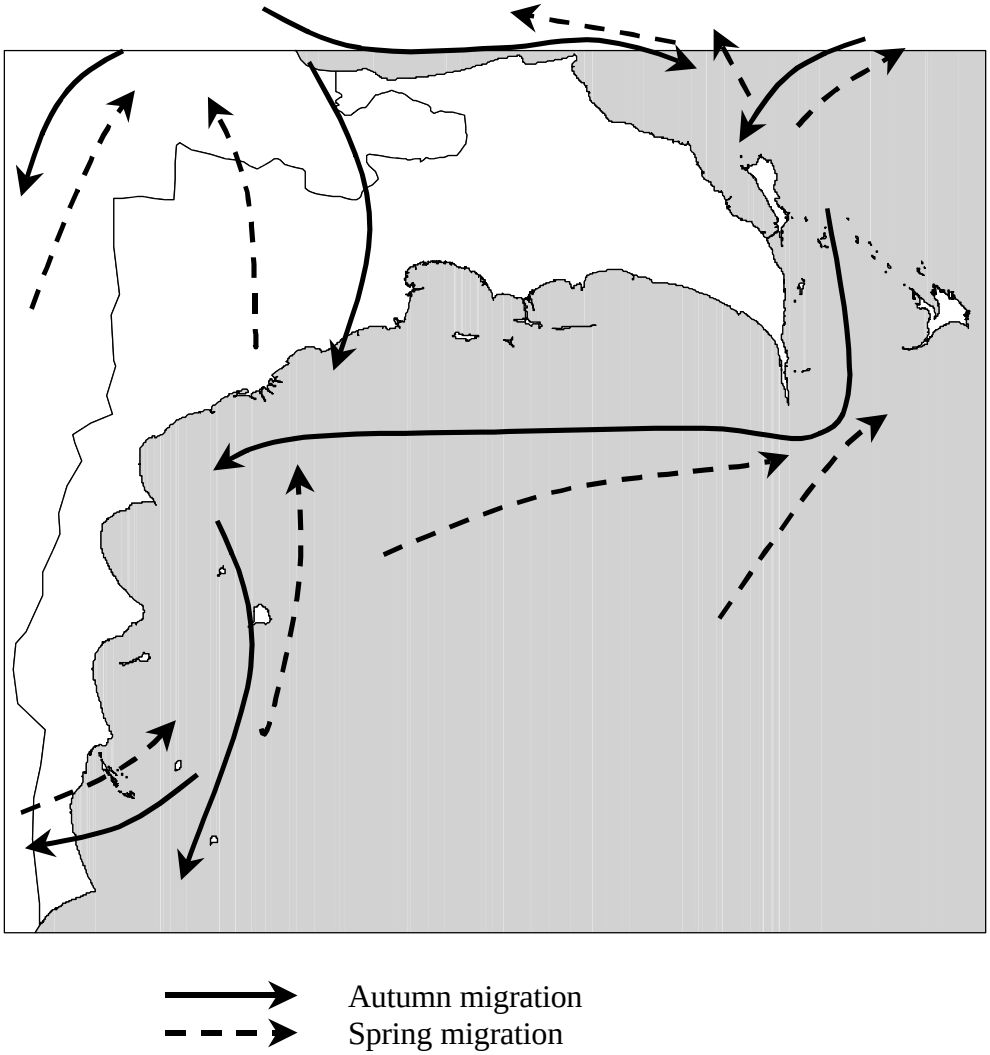

Figure 2-15: Migration Routes

The next important species on the Absheron peninsula is Herring gull. It is a settled species on this territory. In summer it is numerous species, especially on islands and on bore-platforms. In winter it is common birds. In migration season these gulls can be found in big concentrations. They breed on islands of Baku archipelago and on old bore-platforms in the sea some times in big colony. The breeding is beginning from the end of March. It builds a nest on ground. Usually, Herring gull lays 2-3 eggs. After breeding they widespread along a coast of sea. Last time the biggest colony of Herring gulls was on islands of Baku archipelago. A colony on Gil island composes 5-7 thousands of birds. In May of 1996 on this island were found 6300 Herring gulls, in June of same year (after fire) only 2120 adult and 150young, in summer of 1998 –2300 (Ñóëòàíîâ, Êåðèìîâ, 1998), in 1999 – 1500 and only about 1000 in this year. The cause of destruction of this population is disturbance from the local people (collection of eggs, fire, supplying the cats and dogs etc.) and oil pollution in the sea.

One of interesting species on Absheron peninsula is Purple gallinule. This important bird (included in Red Book of Azerbaijan) has nesting on this territory. The main place for nesting of this species is Shah Dili spit, but it may meets in other places (where overgrowth has place). Breeding begins in April, when one can listen to voice of sings of mails. Purple gallinule builds nests in deep of reed, on hillocks and on submerges reed. The material for nests are stems and leafs of old reed. Usually it has 3-5 eggs (Òóâåâ, 1996). The nestling meet in June (Ñóëòàíîâ, Àãàåâà, Ìàìåäîâà, 1997). This species is vulnerable because it is not careful and often is caught by local people. Besides, mass mortality is noted in cold winters.

37 species of birds are included in Red Book of Azerbaijan. 17 species from this list occur on the Absheron peninsula (see Table). 93 species of Absheron peninsula have European conservation status (I category – 9species (Pelecanus crispus, Anser erythropus, Aythya nyroca, Oxyura leucocephala, Aquila clanga, Falco naumanni, Crex crex, Otis tarda, Chettusia gregaria), II – 16, III – 68; Tucker, Heath, 1994).

Table 2-4: Status of Birds

	Species	Conservation category and status	Red Book	Migration status	Habitat
1	*Phalacrocorax pygmeus* (Pygmy cormorant, Ìàëûé áàêëàí)	2 vulnerable		Wintering Migration	Along the coastal zone of Absheron (Factory of Deep Water Platform)
2	*Pelecanus onocrotalus* (White pelican, Ðîçîâûé ïåëèêàí)	3 rare	+	Wintering Migration	"----------" (Alyat)
3	*Pelecanus crispus* (Dalmatian pelican, Êóäðÿâûé ïåëèêàí)	1 vulnerable	+	Wintering Migration	"----------" (Alyat)
4	*Botaurus stellaris* (Bittern, Âûïü)	3 vulnerable		Migration Wintering	"----------" (Lagoons with reed)
5	*Ixobrychus minutus* (Little bittern, Âîë÷åê)	3 vulnerable		Migration Breeding	"----------" (Sangachal)
6	*Nycticorax nycticorax* (Night heron, Êâàêâà)	3 declining		Migration	"----------" (Lagoons with reed)
7	*Ardeola ralloides* (Squacco heron, Æåëòàÿ öàïëÿ)	3 vulnerable		Migration	"----------" (Lagoons with reed)
8	*Ardea purpurea* (Purple heron, Ðûæàÿ öàïëÿ)	3 vulnerable		Migration Breeding	"----------" In reed (Shah Dili, Sangachal)
9	*Ciconia ciconia* (White stork, Áåëûé àèñò)	2 vulnerable		Migration	"----------"
10	*Plegadis falcinellus* (Glossy ibis, Êàðàâàéêà)	3 declining		Migration	"----------"
11	*Platalea leucorodia* (Spoonbill, Êîëïèöà)	2 endangered	+	Migration	"----------"
12	*Phoenicopterus ruber* (Greater flamingo, Ôëàìèíãî)	3 localized	+	Migration Wintering	"----------"
13	*Cygnus olor* (Mute swan, Ëåáåäü-øèïóí)		+	Wintering Migration	"----------" (North-east part of coast, Alyat)

14	*Anser erythropus* (Lesser whitefront, Ïèñêóëüêà)	1 vulnerable		Migration	"----------"
15	*Tadorna ferruginea* (Ruddy shelduck, Îãàðü)	3 vulnerable		Breeding Migration	"----------" (Sangachal, islands of Baku archipelago)
16	*Anas strepera* (Gadwall, Ñåðàÿ óòêà)	3 vulnerable		Migration	"----------"
17	*Anas acuta* (Pintail, Øèëîõâîñòü)	3 vulnerable		Migration	"----------"
18	*Anas querquedula* (Garganey, ×èðîê-òðåñêóíîê)	3 vulnerable		Migration	"----------"
19	*Netta rufina* (Red-crested pochard, Êðàñíîíîñûé íûðîê)	3 declining		Breeding Wintering	"----------" (Factory of Deep water 209platforms, Sangachal, Alyat)
20	*Aythya nyroca* (Ferruginous duck, Áåëîãëàçûé íûðîê)	1 vulnerable		Migration	"----------"
21	*Aythya marila* (Scaup, Ìîðñêàÿ ÷åðíåòü)	3 localized		Wintering	"----------"
22	*Melanitta fusca* (Velvet scoter, Òóðïàí)	3 localized		Accidental visitor	
23	*Mergus albellus* (Smew, Ëóòîê)	3 vulnerable		Wintering	"----------"
24	*Oxyura leucocephala* (White-headed duck, Ñàâêà)	1 endangered		Wintering Migration	Red lake
25	*Milvus migrans* (Black kite, ×åðíûé êîðøóí)	3 vulnerable		Migration	"----------"
26	*Haliaetus albicilla* (White-tailed eagle, Îðëàí-áåëîõâîñò)	3 rare	+	Settled	Gobustan, Alyat cape
27	*Neophron percnopterus* (Egyptian vulture, Ñòåðâÿòíèê)	3 endangered		Accidental visitor	Foothills & mountain zones of region
28	*Gyps fulvus* (Griffon vulture, Áåëîãîëîâûé ñèï)	3 rare		Accidental visitor	Mountain zones of region
29	*Circus cyaneus* (Hen harrier, ÏîëåâîÉ ëóíü)	3 vulnerable		Migration Wintering	"----------" (In semi-desert)
30	*Accipiter gentilis* (Goshawk, Òåòåðåâÿòíèê)		+	Migration	"----------" (In semi-desert)
31	*Aquila clanga* (Spotted eagle, Áîëüøîé ïîäîðëèê)	1 endangered		Migration	"----------" (In semi-desert)
32	*Aquila nipalensis* (Towny eagle, Ñòåïíîé îðåë)	3 vulnerable	+	Migration	"----------" (In semi-desert)
33	*Aquila chrysaetos* (Golden eagle, Áåðêóò)	3 rare	+	Migration	"----------" (In semi-desert)
34	*Falco naumanni* (Lesser kestrel, Ñòåïíàÿ ïóñòåëüãà)	1 vulnerable		Breeding Migration	"----------" (In semi-desert, foothills & mountain zones of region)
35	*Falco tinnunculus* (Kestrel, Îáûêíîâåííàÿ ïóñòåëüãà)	3 decining		Settled	Semi-desert, coastal zone, cities & settlements
36	*Falco biarmicus* (Lanner, Ñðåäèçåìíîìîðñêèé ñîêîë)	3 endangered		Breeding	Gobustan
37	*Falco cherrug* (Saker,	3	+	Migration	"----------"

	Áàëîáàí)	endangered			
38	*Falco peregrinus* (Peregrine, Ñàïñàí)	3 rare	+	Migration	"----------"
39	*Alectoris graeca* (Rock partridge, Êåêëèê)	2 vulnerable		Breeding	Mountain zone of Gobustan
40	*Coturnix coturnix* (Quail, Ïåðåïåë)	3 vulnerable		Migration	"----------" (Semi-desert & mountain zones)
41	*Crex crex* (Corncrake, Êîðîñòåëü)	1 vulnerable		Migration	"----------"
42	*Porphyrio porphyrio* (Purple gallinule, Ñóëòàíêà)	3 rare	+	Breeding	"----------" (Shah Dili, Sangachal)
43	*Tetrax tetrax* (Little bustard, Ñòðåïåò)	2 vulnerable	+	Migration	"----------" (In semi-desert)
44	*Otis tarda* (Great bustard, Äðîôà)	1 declining	+	Migration	"----------" (In semi-desert)
45	*Recurvirostra avosetta* (Avocet, Øèëîêëþâêà)	3 localized		Migration Wintering	"----------"
46	*Burhinus oedicnemus* (Stone curlew, Àâäîòêà)	3 vulnerable		Breeding Migration	"----------", mountain zone of Sangachal and Gobustan
47	*Glareola pratincola* (Collared pratincole, Ëóãîâàÿ òèðêóøêà)	3 endangered		Breeding	"----------", islands
48	*Glareola nordmanni* (Black-winged pratincole, Ñòåïíàÿ òèðêóøêà)	3 rare	+	Breeding Wintering	"----------", islands
49	*Charadrius alexandrinus* (Kentish plover, Ìîðñêîé çóåê)	3 declining		Settled	"----------", islands
50	*Charadrius leschenaulti* (Greater sandplover, Òîëñòîêëþâûé çóåê)	3 endangered		Breeding	"----------"
51	*Chettusia gregaria* (Sociable plover, Êðå÷åòêà)	1 endangered	+	Migration	"----------"
52	*Calidris alpina* (Dunlin, ×åðíîçîáèê)	3 vulnerable		Migration	"----------"
53	*Limicola falcinellus* (Broad-billed sandpiper, Ãðÿçîâèê)	3 vulnerable		Migration	"----------"
54	*Lymnocryptes minutus* (Jack snipe, Ãàðøíåï)	3 vulnerable		Migration Wintering	"----------"
55	*Scolopax rusticola* (Woodcock, Âàëüäøíåï)	3 vulnerable		Migration	"----------"
56	*Limosa limosa* (Black-tailed godwit, Áîëüøîé âåðåòåíèê)	2 vulnerable		Migration	"----------"
57	*Numenius arquata* (Curlew, Áîëüøîé êðîøíåï)	3 declining		Migration	"----------"
58	*Tringa totanus* (Redshank, Òðàâíèê)	2 declining		Wintering Migration	"----------"
59	*Tringa glareola* (Wood sandpiper, Ôèôè)	3 declining		Migration	"----------"
60	*Larus minutus* (Little gull, Ìàëàÿ ÷àéêà)	3 declining		Migration	"----------"
61	*Larus canus* (Common gull, Ñèçàÿ ÷àéêà)	2 declining		Wintering Migration	"----------"

62	*Sterna caspia* (Caspian tern, ×åãðàâà)	3 endangered		Migration	"----------"
63	*Sterna sandvicensis* (Sandwich tern, Ïåñòðîíîñàÿ êðà÷êà)	2 declining		Breeding Migration	"----------", islands
64	*Sterna albifrons* (Little tern, Ìàëàÿ êðà÷êà)	3 declining		Breeding	"----------" (Sangachal), islands
65	*Chlidonias hybridus* (Whiskered tern, Áåëîùåêàÿ êðà÷êà)	3 declining		Migration Breeding	"----------"
66	*Chlidonias niger* (Black tern, ×åðíàÿ êðà÷êà)	3 declining		Migration	"----------"
67	*Pterocles orientalis* (Black-bellied sandgrouse, ×åðíîáðþõèé ðÿáîê)	3 vulnerable	+	Breeding	Semi-desert, foothills and mountain zones
68	*Streptopelia turtur* (Turtle dove, Îáûêíîâåííàÿ ãîðëèöà)	3 declining		Breeding	Gardens & vine-yards
69	*Otus scops* (Scops owl, Ñîïþøêà)	2 declining		Migration	"----------"
70	*Athene noctua* (Little owl, Äîìîâûé ñû÷)	3 declining		Settled	In cities, settlements or near from its
71	*Asio flameus* (Short-eared owl, Áîëòíàÿ ñîâà)	3 vulnerable		Migration Wintering	"----------"
72	*Caprimulgus eurapeus* (Nightjar, Êîçîäîé)	2 declining		Migration	"----------"
73	*Alcedo atthis* (Kingfisher, Çèìîðîäîê)	3 declining		Breeding Wintering	"----------", near floods, rivers & lakes
74	*Merops apiaster* (Bee-eater, Çîëîòèñòàÿ ùóðêà)	3 declining		Breeding Migration	All territory
75	*Coracias garrulus* (Roller, Ñèçîâîðîíêà)	2 declining		Breeding	Semi-desert
76	*Jynx torquilla* (Wryneck, Âåðòèøåéêà)	3 declining		Migration	"----------"
77	*Melanocorypha calandra* (Calandra lark, Ñòåïíîé æàâîðîíîê)	3 declining		Settled	Semi-desert
78	*Calandrella brachydactyla* (Short-toed lark, Ñðåäíé æàâîðîíîê)	3 vulnerable		Breeding	Semi-desert
79	*Calandrella rufescens* (Lesser short-toed lark, Ìàëûé æàâîðîíîê)	3 vulnerable		Breeding	Semi-desert
80	*Galerida cristata* (Crested lark, Õîõëàòûé æàâîðîíîê)	3 declining		Settled	All territory
81	*Alauda arvensis* (Slylark, Ïîëåâîé æàâîðîíîê)	3 vulnerable		Migration	"----------"
82	*Riparia riparia* (Sand martin, Áåðåãîâóøêà)	3 declining		Migration	"----------"
83	*Hirundo rustica* (Swallow, Äåðåâåíñêàÿ ëàñòî÷êà)	3 declining		Breeding Migration	In cities, settlements or near from its
84	*Anthus campestris* (Tawny pipit, Ïîëåâîé êîíåê)	3 vulnerable		Migration	"----------"
85	*Phoenicurus phoenicurus* (Redstart,	2 vulnerable		Migration	"----------"

	Ãîðèõâîñòêà-ëûñóøêà)				
86	*Saxicola torquata* (Stonechat, ×åðíîãîëîâûé ÷åêàí)	3 declining		Migration	"----------"
87	*Monticola saxatilis* (Rock thrush, Ïåñòðûé êàìåííûé äðîçä)	3 declining		Migration	"----------", semi-desert
88	*Hippolais pallida* (Olivaceous warbler, Áëåäíàÿ ïåðåñìåøêà)	3 vulnerable		Migration	"----------"
89	*Sylvia hortensis* (Orphean warbler, Ïåâ÷àÿ ñëàâêà)	3 vulnerable		Migration	"----------"
90	*Muscicapa striata* (Spotted flycatcher, Ñåðàÿ ìóõîëîâêà)	3 declining		Breeding	Gardens
91	*Lanius collurio* (Rer-backed shrike, Æóëàí)	3 declining		Breeding	Gardens
92	*Lanius minor* (Lesser grey shrike, ×åðíîëîáûé ñîðîêîïóò)	2 declining		Breeding	Gardens & vine-yards
93	*Lanius senator* (Woodchat shrike, Êðàñíîãîëîâûé ñîðîêîïóò)	2 vulnerable		Breeding	"----------"
94	*Pyrrocorax pyrrocorax* (Chough, Êëóøêöà)	3 vulnerable		Settled	Foothills and mountain zones
95	*Emberiza melanocephala* (Black-headed bunting, ×åðíîãîëîâàÿ îâñÿíêà)	2 vulnerable		Breeding	"----------", gardens & vine-yards

1,2 & 3 – it is category of Species of European Conservation Concern

1- Species of global conservation concern
2- Unfavorable Conservation Status, and concentrated in Europe
3- Unfavorable Conservation Status, and not concentrated in Europe

\+ - species included in Red Book of Azerbaijan

"----------" – along the coastal zone of Absheron peninsula

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