DCN: 2013-GEO-011

MUNICIPAL INFRASTRUCTURE AND IDP HOUSING REHABILITATION PROJECT

ENVIRONMENTAL ASSESSMENT ONI WATER SUPPLY

CONTRACT: AID-EDH-I-00-08-00027-00, TASK ORDER: AID-114-TO-11-00002

December 2012

This document was produced for review by the United States Agency for International Development. It was prepared by Tetra Tech for the Municipal Infrastructure and IDP Housing Rehabilitation Project, Task Order number AID-114-TO-11-00002 under the USAID Architectural and Engineering (A&E IQC).

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Environmental Impact Assessment Approval Sheet

Reference IEE: DCN: 2010-GEO-033
Country: GEORGIA
Project Name: Municipal Infrastructure Rehabilitation Project, Oni Water Supply Rehabilitation

Type of document(s):
☒ **Environmental Impact Assessment**

Document Prepared by: Tetra Tech EM, INC.
Document Preparation Date: Dec 2012

Location(s) Covered by this document: Georgia

Environmental Media and/or Human Health Potentially Impacted (check all that applies):
☒ Air ☒ Water ☒ Land ☒ Biodiversity

Introduction:
This document records Mission clearance and Bureau Environmental Officer (BEO) approval of the Environmental Impact Assessment (EIA) for USAID/Caucasus's Municipal Infrastructure Activity, Oni Water Supply Rehabilitation.

Background:
USAID's environmental regulation (22 CFR part 216 or Reg. 216) establishes the conditions and procedures for environmental review of new projects, programs, or activities authorized by USAID. It includes a process for the review of environmental and social impacts to ensure that projects funded by USAID are environmentally sound, designed to operate in compliance with applicable regulatory requirements, and not likely to cause a significant environmental, health or safety hazard.

The Initial Environmental Examination (IEE) for the Municipal Infrastructure Rehabilitation Project was approved by the Europe and Eurasia BEO on July 23, 2010, DCN: 2010-GEO-033 and established the requirement for an EIA. As per the IEE and Regulation 22 CFR part 216, a draft Scoping Statement for the EIA was prepared and approved with comments on September 27, 2012, and the final version is attached to this face sheet package. The EIA was prepared in accordance with the scoping statement.

Action:
We request your approval of the Environmental Impact Assessment for the Municipal Infrastructure Rehabilitation Project, Oni Water Supply Rehabilitation.

Clearance:
Mission Director: _____ Date: 2/13/13
Stephen M. Haykin

Deputy Mission Director: _____ Date: 2/13/2013
Roy Plucknett

Project COR: _____ Date: 7Feb13
Brad Carr

Mission Environmental Officer: Jill Kelly Date: 2/12/13
Jill Kelly

Approval:
Bureau Environmental Officer: Date: Jan 5, 2013
William Gibson

Approved: X Disapproved: _____

DCN: 2013-GEO-011

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DISCLAIMER
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DCN: 2013-GEO-011

18 December 2012

Mr. Bradley Carr
Water Irrigation and Infrastructure Advisor
Office of Economic Growth
US Agency for International Development
11 George Balanchine Street
Tbilisi, 0131
Georgia

Re: Environmental Assessment for Oni Water Supply

Dear Mr. Carr:

This report is being submitted to you in accordance with the requirements of task order no. AID-114-TO-11-00002 of contract AID-EDH-I-00-08-00027-00. It provides Tetra Tech's Environmental Assessment for Oni Water Supply.

We look forward to your review and welcome your comments and suggestions.

Very truly yours,

Jeffrey W. Fredericks, P.E., PhD
Chief of Party
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CC: USAID (George Kokochashvili); MDF (Kartlos Gviniashvili); Tetra Tech (Firouz Rooyani)

Table of Contents

1. Summary 1
1.1 Description of the Project 1
1.2 Project Context 1
1.3 Summary of 22 CFR 216 Requirements, IEE Summary, Scoping Process 1
1.4 Major Conclusions 2
1.5 Areas of Controversy and Issues to be Resolved 3
2. Underlying Purpose and Need to Which Proposed Action is Responding 4
2.1 Project Description 4
2.2 Purpose and Need for the Proposed Action 4
2.3 Status of Environmental Compliance Documentation 5
2.3.1 Summary of 22 CFR 216 Requirements and the IEE for GMIP Component 1 5
2.3.2 Environmental Scoping Statement 5
2.3.3 Stakeholder Engagement and Host Government Consultation 6
2.3.4 Host Country Environmental Context 6
3. Alternatives Including the Proposed Action 8
3.1 Description of Project Alternatives 8
3.1.1 Alternative 1 – Proposed Action 8
3.1.2 Alternative 2– Groundwater Source Water 10
3.1.3 Alternative 3 – No Action Alternative 11
3.2 Alternatives Eliminated from Analysis and Rationale for Eliminating Alternatives ... 11
3.3 Comparison of Environmental Impacts of Program Alternatives 11
3.4 Discussion & Ranking of Alternatives with Respect to Significance of Environmental Impacts of Alternatives 12
4. Affected Environment 13
4.1 Geographic Characteristics 13
4.2 Economy 14
4.3 Water and Air Resources 14
4.4 Environmental Baseline Information 15
4.4.1 Environmental Baseline Information: Hydrology 15
4.4.2 Environmental Baseline Information: Geology and Soils 16
4.4.3 Environmental Baseline Information: Seismicity 17
4.4.4 Environmental Baseline Information: Biodiversity and Habitats 18
4.4.5 Environmental Baseline Information: Archeology and Cultural Heritage 20
4.5 Policy, Legal, Regulatory and Permitting Requirements 21
4.5.1 International Conventions 24
4.5.2 International Standards and Best Practices 25
4.5.3 Relevant and Applicable Permitting Requirements 25
5. Environmental Consequences 27
5.1 Environmental Impacts of the Proposed Action and Alternatives 27
5.1.1 Direct & Indirect Effects and their Significance 27
5.1.2 Issues eliminated from further evaluation 32
5.1.3 Possible Conflicts between Proposed Action and Land Use 33
5.1.4 Possible Conflicts between Proposed Action and Policies and Controls 34
5.2 Energy Requirements of Alternatives 34
5.3 Irreversible and Irretrievable Commitment of Resources 34

5.4 Means to Mitigate Adverse Environmental Impacts 34
6. Environmental Mitigation and Monitoring Plans 35
6.1 Environmental Mitigation and Monitoring Plans 35
7. LIST OF PREPARERS 46
8. APPENDICES 47
Appendix 8.1 Details of Oni Stakeholder Meeting..... 48
Appendix 8.2 Oni Environmental Site Visit Inspection Report 63
Appendix 8.3 Ecological Survey of the Project Area (Biodivesity, Habitat/Ecosystems) 76
Appendix 8.4: Survey of Hydrogeology & Geology of Oni Project Area..... 102
Appendix 8.5: Detailed Design of Oni's Water Supply Scheme..... 106

LIST OF FIGURES AND TABLES

List of Tables

Table 2.1: Potential Required for Local Permits/Licenses/Clearances
Table 3.1: Comparison of Alternatives
Table 4.1: Principal Laws and Regulations Relevant to the Proposed Project
Table 5.1: Concerns that have been Eliminated from Further Evaluation
Table 6.1: EMMP for Construction of Oni Water Supply Improvements
Table 6.2: EMMP for Operation of Oni Water Supply Improvements

List of Figures

Figure 2.1: Schematic Plan for Kvedrula Water Pipeline in Oni
Figure 4.1: Satellite Image of Oni
Figure 4.2: Map of Macroseismicity in Georgia
Figure 4.3: Map of Georgia's Protected Areas

ABBREVIATIONS AND ACRONYMS

ARWR	Actual Renewable Water Resources
BEO	USAID Europe and Eurasia Bureau Environmental Officer
CFR	Code of Federal Regulations
EA	Environmental Assessment
EIA	Environmental Impact Assessment
EMMP	Environmental Mitigation and Monitoring Plan
EPI	Economic Prosperity Initiative (USAID Project)
ESS	Environmental Scoping Statement
Geo	Geo Ltd
GMIP	Municipal Infrastructure And IDP Housing Rehabilitation Project (the project)
GoG	Government of Georgia
IDP	Internally Displaced Persons
IRWR	Internal Renewable Water Resources
KAV	Kavgiprotransi-Mg Ltd
M&E	Monitoring and Evaluation
M&M	Mitigation and Monitoring
MDF	Municipal Development Fund
MEO	USAID/Georgia Mission Environmental Officer
MLHSA	Ministry of Labor Health and Social Affairs
MRA	Ministry of Refugee Affairs
MRDI	Ministry of Regional Development and Infrastructure
NEO	New Economic Opportunities (USAID Project)
NGO	Non-Government Organization
PMP	Performance Monitoring Plan
SOW	Scope of Work
TBD	To Be Determined
TOCOTR	USAID Task Order Cognizant Technical Officer
Tt	Tetra Tech EM Inc.
USAID	United States Agency For International Development
UWSCG	United Water Supply Company of Georgia
USG	U.S. Government
WB	World Bank

1. Summary

Georgia's economic and political stability has been challenged by the 2008 conflict with Russia and the global economic downturn. The conflict, crisis, and subsequent slowdown in economic growth and foreign direct investment have strained Georgia's national budget and its ability to finance core investments in critical regional development initiatives. Many years of decline in the quality, coverage, and maintenance of basic services, including water supply, sewage, local roads, solid waste services, and irrigation systems have dramatically reduced Georgia's quality of life in rural areas and constrained private sector growth. Such degradation and instances of conflict-related damage have resulted in significant constraints to the productive capacity and quality of life of thousands of Georgians, including old and new Internally Displaced Persons (IDPs), rural poor, and persons directly or indirectly affected by the 2008 conflict with Russia.

USAID is providing assistance to the Government of Georgia (GoG) under the Georgia Municipal Infrastructure and IDP Housing Rehabilitation Project (GMIP). GMIP includes three components: Component 1, Municipal Infrastructure; Component 2, Rehabilitation of Irrigation Infrastructure; and Component 3, IDP (Internally Displaced Persons) Durable Housing. This Environmental Assessment (EA) covers one municipal project under GMIP Component 1: Improvements to the Oni Water Supply System.

1.1 Description of the Project

Municipalities impacted by the 2008 conflict were identified by the GoG as priority targets for USAID technical assistance under GMIP Component 1. Oni municipality was invited to submit up to three infrastructure rehabilitation projects for GMIP financial assistance. Each project was expected to show evidence of civic participation, impact on significant municipal population, contribution to economic growth or greater efficiency, government commitment to maintain rehabilitated infrastructure and potential leverage of other donor funding.

Projects were evaluated based on potential for high positive impact and benefits. Two municipal projects were selected for Oni: (1) Improvements to Municipal Roads in Oni; and (2) Improvements to the Oni Municipal Water Supply System. This EA covers one municipal project: Improvements to the Oni Water Supply System. Under this project, USAID will improve the Oni's water treatment plant, adding sand filtration and chlorination disinfection. The project will also include construction of a new water supply storage tank. The project will benefit 2,300 residents in Oni as well as many tourists who come to Oni in the summer.

1.2 Project Context

The 2008 conflict with Russia placed a severe strain on Georgia's national budget and its ability to finance municipal infrastructure investments. Under this project, GMIP will improve the quality and quantity of drinking water provided to the residents of Oni. New treatment will improve water quality and the new water storage tank will provide a continuous supply of water. This infrastructure rehabilitation project will contribute to tourism and economic growth of Oni municipality and improve the social condition of the local population.

1.3 Summary of 22 CFR 216 Requirements, IEE Summary, Scoping Process

USAID's environmental regulations (22 Code of Federal Regulations 216 or Reg. 216) establish the conditions and procedures for environmental review. These procedures apply to new projects, programs, or activities authorized by USAID. Reg. 216 establishes a process for the review of environmental and social impacts; and ensures that projects that are undertaken as part of programs funded under USAID are environmentally sound, are designed to operate in compliance with applicable regulatory requirements, and as required by the legislation are not likely to cause a significant environmental, health or safety hazard.

The Initial Environmental Examination (IEE) for GMIP was drafted and approved by the Europe and Eurasia Bureau Environmental Officer (BEO) on June 23, 2010 (DCN: 2010-GEO-033). Pursuant to Reg. 216 and the IEE's Positive Determination for Component 2, an Environmental Assessment (EA) is required. This EA was prepared to comply with the Positive Determination and is meant to ensure that environmental consequences and their significance are known and clearly identified prior to the approval of the final design and start of construction [216.3 (a) (4)].

The scoping team identified, reviewed, and prioritized environmental issues. An initial public stakeholder scoping meeting was held on July 5, 2011 in Dusheti. A second public stakeholder meeting was held on September 7, 2012 at the Oni municipal Gamgeoba Building. The Scoping Statement was approved by the USAID/Europe & Eurasia Bureau Environmental Officer (BEO).

1.4 Major Conclusions

The EA Team used the potential significant concerns identified in the Environmental Scoping Statement (ESS) and analyzed them in the EA. The concerns evaluated in detail in the EA are shown below:

- Deterioration of upstream ecosystem that could result in contamination of Oni's Karst water source.
- Impacts to threatened, endangered, and protected species. Disruption of sensitive ecological habitats.
- Impacts to cultural resources such as Revaz Japaridze Home-Museum.
- Human health impacts due to poor drinking water quantity or quality.
- Cumulative Impacts: The Environmental Assessment needs to consider the cumulative impacts of water supply activities within the watershed.

In addition to these significant effects, the EA Team identified best practices for a range of potential concerns that were noted in the SS. These concerns were eliminated from further consideration in the EA because they did not require any further assessment; the SS stated that best practices exist that would mitigate impacts.

The EA Team developed mitigations (including best practices) to address impacts associated with the Oni water supply project. EMMPs were developed for construction (Table 6.1) and operation and maintenance (Table 6.2). EMMPs include the identified environmental

impacts, individual mitigation measures, monitoring indicators, monitoring/reporting frequency and responsible party for oversight of EMMP implementation.

1.5 Areas of Controversy and Issues to be Resolved

The EA Team did not identify any remaining areas of controversy, nor issues that need to be resolved.

2. Underlying Purpose and Need to Which Proposed Action is Responding

2.1 Project Description

GMIP addresses needs resulting from Georgia's 2008 conflict with Russia and the global economic downturn that has challenged Georgia's economic stability. Municipal infrastructure improvements were identified by the GoG as priority targets for USAID technical assistance under GMIP Component 1. Oni was one of five municipalities invited to submit up to three infrastructure rehabilitation projects for GMIP financial assistance. Each project was expected to show evidence of civic participation, impact on significant municipal population, contribution to economic growth or greater efficiency, government commitment to maintain rehabilitated infrastructure and potential leverage of other donor funding.

Projects were evaluated based on potential for high impact and benefits. Two municipal projects were selected for Oni: (1) Improvements to Municipal Roads in Oni; and (2) Improvements to the Oni Municipal Water Supply System. This EA covers one municipal project: Improvements to the Oni Water Supply System. Under this project, USAID will improve the Oni's water treatment plant, adding sand filtration and chlorination disinfection. The project will also include construction of a new water supply storage tank. The project will benefit 2,300 residents in Oni as well as many tourists who come to Oni in the summer.

2.2 Purpose and Need for the Proposed Action

The purpose of this project is to improve the quality and quantity of drinking water provided to the residents of Oni. New treatment will improve water quality and the new water storage tank will provide a continuous supply of water. This infrastructure rehabilitation project will contribute to tourism and economic growth of Oni municipality and improve the social condition of the local population.

The Proposed Action includes construction of a new treatment plant and water storage tank. The treatment plant will include a high rate sand filter (reinforced concrete) and concrete chlorination chamber for disinfection. The storage tank will store 1000 m^3 of treated water. The filter will only be used during periods after storms when water turbidity exceeds allowable standards. Excessive turbidity impacts not only the quality of the drinking water but can damage components of the distribution system and mitigating this impact will have a positive effect on both human consumption and the system's service life. The disinfection unit will be operated continuously. The Detailed Design of Oni's water supply scheme is provided in Appendix 8.5. The Detailed Design was prepared by SakTskalProekti (Georgia Water Project) for the United Water Supply Company of Georgia (UWSCG).

The August 2008 conflict with Russia and the global economic downturn have reduced Georgia's ability to finance core investments in critical regional infrastructure rehabilitation. Many years of decline in the quality, coverage and maintenance of municipal infrastructure have dramatically reduced Georgia's quality of life and constrained private sector growth. Such degradation and instances of conflict-related damage have significantly impacted thousands of Georgians. GMIP addresses these needs. Specifically, the proposed project responds to the needs of Oni Municipality. Oni was impacted by the 2008 conflict and identified by the GoG as a priority target for USAID technical assistance to rehabilitate municipal infrastructure.

2.3 Status of Environmental Compliance Documentation

2.3.1 Summary of 22 CFR 216 Requirements and the IEE for GMIP Component 1

USAID's environmental regulations (22 Code of Federal Regulations 216 or Reg. 216) establish the conditions and procedures for environmental review. These procedures apply to new projects, programs, or activities authorized by USAID. Reg. 216 establishes a process for the review of environmental and social impacts; and ensures that projects that are undertaken as part of programs funded under USAID are environmentally sound, are designed to operate in compliance with applicable regulatory requirements, and as required by the legislation are not likely to cause a significant environmental, health or safety hazard.

The Initial Environmental Examination (IEE) for GMIP was approved by the Europe and Eurasia Bureau Environmental Officer (BEO) on June 23, 2010 (DCN: 2010-GEO-033). Pursuant to Reg. 216 and the IEE's Positive Determination for Component 1, an Environmental Assessment (EA) is required. An EA is meant to ensure that environmental consequences and their significance are known and clearly identified prior to the approval of the final design and start of construction [216.3 (a) (4)].

2.3.2 Environmental Scoping Statement

The scoping team identified, reviewed, and prioritized environmental issues. This was accomplished through the following three tasks:

- Identifying and reviewing existing environmental information and studies related to GMIP- Component 1;
- Carrying out site investigations to ascertain any additional environmental issues; and
- Obtaining stakeholder input in an organized meeting to ensure that significant environmental and social issues were identified for evaluation in the EA.

The team held a public stakeholder scoping meeting on July 5, 2011 in Dusheti. The purpose of the meeting was to provide information and get local citizens' views of the proposed action. Twenty-four people attended the meeting. A second public stakeholder meeting was held on September 7, 2012 at the Gamgeoba Building in Oni Municipality. Twenty-eight representatives from Oni Municipality and local stakeholders, United Water Supply Company of Georgia (UWSCG), SakTskalProekti (Georgia Water Project), MDF and TetraTech attended this meeting. The focus of this meeting was to obtain the opinions of those who did not participate in the first meeting. Minutes of the meeting are attached in Appendix 8.1.

The Oni public stakeholder meeting provided a forum for discussions on several issues. The facilitator invited participants to give their feedback on the following discussion issues:

- What are the expected problems associated with the planned rehabilitation?
- What are the benefits to local citizens?

- What impact will the rehabilitation have on surface waters, wetlands and local ecosystems?
- What is happening to the quality of soil and land resources in the area? Would these (and how would these) be affected by water system improvements?
- Are there any current problems with pathogens or water-borne diseases? Would this be affected by water system improvements?
- What are the long-term prospects for maintaining improvements? Who will maintain them and how? Who will pay for maintenance?
- Are there differences in men's and women's roles and relationships that may affect the long-term future of the municipal improvements and the environment?
- What realistically may happen when the project ends? What will the project area look like in 30 years?

The attached minutes also provide the technical description of the project and questions and answers provided by the project team during the meeting. Also, the attachment includes the meeting announcement, agenda, photos and names of participants.

2.3.3 Stakeholder Engagement and Host Government Consultation

GMIP was designed in close coordination with the GoG. GMIP's local partner is the GoG's MDF. As part of feasibility studies, GMIP staff visited Oni and met with stakeholders. Site visits were made to the Oni project site from August 2012 to November 2012. Visits were made to water sources and future sites for the water treatment plant and storage tank. Engineers from the UWSCG, Georgian designers from SakTskalProekti and the Oni Service Center participated in the site visit with Tetra Tech. The Oni Environmental Site Visit Inspection Report is provided in Appendix 8.2.

The initial site visits were followed by more site investigations that focused on terrestrial ecology and hydrogeology, responding to the needs identified in the scoping stage. Findings of these visits are reflected in the EA document, both in the environmental baseline section and in the assessment of potential impacts. These inspection reports are provided in the appendices: Appendix 8.3, Ecological Survey of Biodiversity and Habitat/Ecosystem, and Appendix 8.4, Survey of Hydrogeology and Geology.

Site visits and meetings during the EA process provided insights on the potentially significant issues. The EA Team thinks that the site visits, document reviews and meetings held during the scoping and assessment process identified all potential concerns with the project. GMIP will continue to hold regular consultations during design and construction activities.

2.3.4 Host Country Environmental Context

The projects covered by this EA, rehabilitation of flood protection infrastructure, do not require an Environmental Impact Permit (EIP) or State Ecological Examination under Georgian legislation. Local permits, licenses and clearances may be required. See Table 2.1, below.

Table 2-1: Potential Requirements for Local Permits/Licenses/Clearances

Permit Type	***Comments***
Building/Construction	Permits may be required
Source Material Extraction	Licenses may be required

Waste Disposal	Clearances on disposal sites may be required
Wastewater Discharge	Clearance on disposal may be required
Air	Compliance with air standards
Water Use	Clearances may be required
Historical or Cultural Preservation	Clearances may be required
Water and Wetlands	Water and riverbank protection may be required
Threatened or Endangered Species	Unlikely
Other	UWSCG will operate and maintain the Oni water supply facilities. GMIP will provide an O&M manual for UWSCG. GMIP technical assistance to UWSCG will also be provided.

3. Alternatives Including the Proposed Action

This chapter provides a discussion of the "Project Alternatives" followed by a comparison of the alternatives based on potential significant environmental impacts as identified in the SS and as modified by the EA Team. The EA Team used the alternatives developed by the Scoping Team; no additional feasible alternatives were identified during the EA preparation process. The alternatives considered are: the Proposed Action (Alternative 1); Groundwater Source Water (Alternative 2); and No Action (Alternative 3).

3.1 Description of Project Alternatives

Reasonable alternatives are defined (by the U.S. National Environmental Policy Act) as those alternatives that meet the project purpose and need and address significant issues. This section describes the alternative actions that meet the project's purpose and need. The major purpose of this project, as stated above, is to improve water supply in Oni Municipality. The project need is to improve the quality and quantity of drinking water provided to the residents of Oni. New treatment will improve water quality and the new water storage tank will provide a continuous supply of water. This infrastructure rehabilitation project will contribute to tourism and economic growth of Oni municipality and improve the social condition of the local population.

This section describes three alternatives that meet the project's purpose and need: Alternatives 1 and 2 are considered feasible. Oni Municipality has already evaluated needs and submitted their best selection of infrastructure projects based on available funds and municipal needs. Alternative 3 (No Action) is included to help evaluate the comparative merits of the alternatives.

3.1.1 Alternative 1 – Proposed Action

The purpose of this project is to improve the water supply system for 2,300 residents (and additional tourists) in Oni Municipality. Water is currently obtained from a Karst system that intercepts underground spring water. Millions of people from Austria to Texas live in Karst areas and are supplied with drinking water from these aquifers. The existing Karst water is of good quality but this system, like other Karst aquifers, has temporary turbidity problems caused by heavy rainfall. Rapid fluctuation of raw water quality is common during storms, especially in turbidity and sometimes with elevated concentrations of dissolved organic substances and bacteria.

Oni's Karst water supply system has been in operation since the 1970's. A trapezoidal (7.4 m x 8.2 m) concrete structure collects the Karstic water and feeds it into an intermediate chamber (4.2 m x 3.6 m x 1.6 m) where water overflows into the Kvedrula water pipeline. Water flows by gravity 9.3 km to just outside Oni Municipality. (See Figure 3.1 for schematic of water pipeline.) An old vertical settling basin, low rate filter, chlorination disinfection unit and water storage tank were built but they have not operated for a long time. (They are in such poor condition that they cannot be rehabilitated. For example, the old storage tank has large cracks and its foundation is unstable.) The Karstic water enters the Oni drinking water distribution network which was constructed in 2010.

The Proposed Action includes construction of a new treatment plant and water storage tank. The treatment plant will include a high rate sand filter (reinforced concrete) and concrete chlorination chamber for disinfection. The water storage tank will store 1000 m^3 of treated water. The filter will only be used after storms when water turbidity exceeds allowable standards estimated at two months of the year. Excessive turbidity impacts not only the quality of the drinking water but can damage components of the distribution system and mitigating this impact will have a positive effect on both human consumption and the system's service life. The disinfection unit will be operated continuously. The Detailed Design of Oni's water supply scheme is provided in Appendix 8.5. The Detailed Design was prepared by SakTskalProekti (Georgia Water Project) for the United Water Supply Company of Georgia (UWSCG).

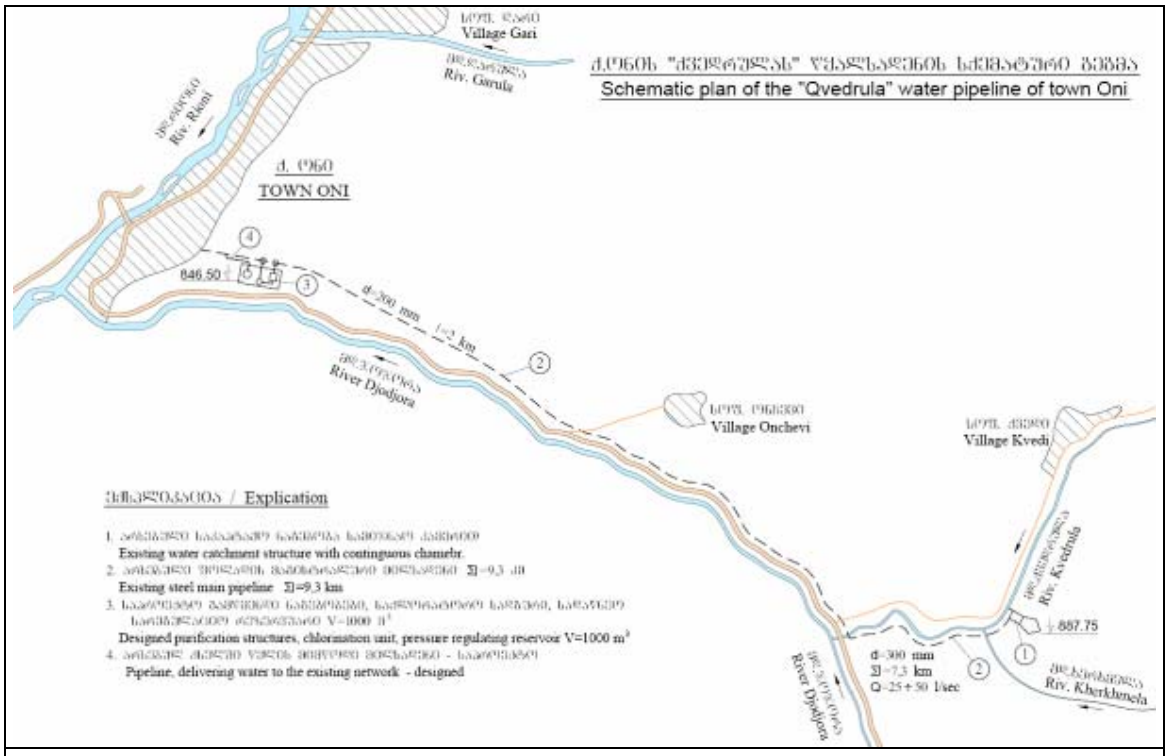


Figure 3.1. Schematic Plan for Kvedrula Water Pipeline in Oni

The design decisions were based on technological materials, Oni master plan, geology and geodetic survey and climatic and geophysical data for Oni. Construction activities include

- Pressure regulator well. The hydrostatic head at the water purification structure in the existing pipeline is 16 atm. The project design includes mounting a pressure regulator in a reinforced concrete well. A water meter will determine the capacity of the water purification structures.

- Settling basin. The cylindrical shape structure is 4.3 m deep. Its height above the ground level is 3.9 m, the underground conical shape part is 2.2 m deep. The structure is made with reinforced concrete with a super plasticizing additive.

- High rate filter. The rectangular structure dimensions are 5 x 6.5 m, depth 3.33 m. The structure is made with reinforced concrete reinforced with a super plasticizing additive.

- Chamber for pumping unit: The pumping unit installation is in a reinforced concrete well. The well is equipped with metal ladder and light-weight cover. From the storage tank to the pumping chamber, water is supplied by a 400 mm diameter pipe equipped with a manually operated control valve. The chamber can be emptied by a discharge pipe and control valve.

- Chlorination unit: Dimensions of structure are: 8.2 x 6.4 m, H=3.3 m. Walls are built with thin concrete blocks and sand cement mortar with plasticizer additive, thickness up to 200 mm. The floor is covered with ceramic tiles and linoleum. Corners are reinforced with fabric and partitions are fixed in walls and the roof slab. The threshold of reinforced concrete and ceiling is made with standard precast reinforced concrete slabs. Ceiling slabs are tightened with mass reinforced concrete. The roof is covered with soft rolled paranite. The gutter is made of sheet steel and the structure is surrounded with a 1.0 m concrete side slope. Construction works will be according to the safety engineering standard III-4-8.

- Storage tank V=1000 m^3 The cylinder shaped storage tank has a diameter of 18.0 m and depth of 4.8 m. The entire structure is made with reinforced concrete with super plasticizer additive. Concrete is reinforced with steel fabric and separate rods. A drainage system is constructed around the storage tank.

Alternative 1 does not include excavation, berms or other structures that would divert or filter runoff (from rain or snowmelt) from entering Karst funnels in the catchment. Removal of old piping or other debris in Karst funnels is not part of this alternative.

Day to day operation and maintenance (O&M) of the new treatment plant and storage tank will be the responsibility of the local Oni Service Center (OSC). OSC is currently operating the existing system and water distribution network. The Proposed Action includes training and assistance with startup and O&M of the new water system.

3.1.2 Alternative 2– Groundwater Source Water

This alternative considers using relatively deep wells to deliver groundwater to Oni. The Proposed Action utilizes underground spring water in a Karst aquifer where extraction is almost at the surface.

Groundwater is used as the drinking water supply in many parts of Georgia. Water wells are typically large, deep with turbine pumps that may be expensive to construct and operate. The system requires electricity, water storage tank, and a distribution system.

The groundwater alternative has several difficulties: (a) deep and limited aquifers; (b) high development cost, particularly for diesel pumps; and (c) need for reliable electric power source. Since existing water supplies in Oni will be adequate after rehabilitation, groundwater development would be more expensive than using the existing Karst water scheme.

3.1.3 Alternative 3 – No Action Alternative

The No Action Alternative means that USAID will not support the water supply improvements in Oni and therefore, residents will continue to live without adequate water quality and quantity and tourism and economic growth would be reduced. This alternative provides a benchmark against which the action alternatives may be evaluated.

Under this No Action Alternative, GoG would be slowed in improving the conditions needed to improve tourism and economic growth in Oni. The employment opportunities that are expected as an indirect effect of rehabilitation are intended to benefit local residents in Oni. Without rehabilitation, employment opportunities will be lost and residents will not be able to improve their living conditions.

3.2 Alternatives Eliminated from Analysis and Rationale for Eliminating Alternatives

The EA Team did not eliminate any of the alternatives proposed during the scoping process. Each alternative was given further consideration during the EA phase and the EA Team thought that each alternative was viable and met the project's purpose and need. Oni was not pressured to accept any specific infrastructure project type and they are expected to meet their responsibility for operation and maintenance of the water supply improvements.

3.3 Comparison of Environmental Impacts of Program Alternatives

As required by 22 CFR 216.6(c)(3), Table 3.1 shows, in comparative form, impacts of the proposed GMIP water supply rehabilitation and its feasible alternatives. As stated in USAID's Environmental Procedures, this section is meant to sharpen the issues, illustrate the comparative merits of each alternative, and provide a clear basis for choice among the options. Section 5, Environmental Consequences, provides the analytic basis of the alternatives comparison. Potential environmental issues are compared in Table 3.1.

Table 3.1: Comparison of Alternatives

(+2) highly positive effect/beneficial; (+1) positive/beneficial; (-2) significant negative effect/highly detrimental; (-1) negative effect/detrimental; (0) remains the same (i.e., no effect or same rate of change versus gets progressively worse or better);

Const refers to the construction stage of project; and Oper refers to the operation and maintenance stage of project.

Potential environmental issues (identified in the Scoping Statement)	Alternative 1: Proposed Action (without mitigation)		Alternative 2: Groundwater Source Water		Alternative 3: No Action	Alternative 1 with mitigation	
	Const	Oper	Const	Oper		Const	Oper
1. Deterioration of upstream ecosystem that could result in contamination of Oni's Karst water source.	0	0	0	0	0	+1	+1
2. Impacts to threatened, endangered and protected species (TES). Disruption of sensitive ecological habitats.	-2	+1	-1	0	0	0	+1
3. Impacts to cultural resources such as Revaz Japaridze Home-Museum.	-1	0	-1	0	0	+1	+1
4. Human health impacts due to poor drinking water quantity or quality.	-1	0	-1	+1	-1	0	+2
5. Cumulative Impacts: The Environmental Assessment needs to consider the cumulative impacts of water supply activities within the watershed.	-1	0	-1	0	0	0	+1

3.4 Discussion & Ranking of Alternatives with Respect to Significance of Environmental Impacts of Alternatives

During construction, Alternative 1 may have some impacts on threatened, endangered and protected species (TES), ecological habitats, cultural resources, human health and watersheds. Construction impacts are greatest under Alternative 1 without mitigations. Under Alternative 1 with mitigations, impacts during operation are positive/beneficial or the same. Benefits are greatest under Alternative 1 with mitigations and there are fewer benefits under Alternative 1 without mitigations. Under Alternative 2, there are impacts during construction and effects are mostly the same during operation. Under the No Action Alternative 3, there are water quality and quantity risks because the water supply system would not be improved and more residents may be impacted due to continued problems with water supply.

4. Affected Environment

This chapter provides a brief description of the human and natural environment in Oni Municipality. This section focuses on the *affected environment* in Oni, and describes the current conditions, including cultural, land uses, soils, geology, biodiversity, and water. As stated in 22 CFR 216, the "affected environment" should be succinctly described and the focus should be on the areas "to be affected or created by the alternatives under consideration. The descriptions shall be no longer than is necessary to understand the effects of the alternatives." In line with this, the baseline description of the affected environment sets the benchmark for the evaluation of the impacts of the proposed action and its alternatives in Chapter 5.

The EA team conducted site visit inspections from August 2012 to November 2012. Visits were made to water sources and future sites for the water treatment plant and storage tank. Engineers from the UWSCG, Georgian designers from SakTskalProekti and the Oni Service Center participated in the site visit with Tetra Tech. The Oni Environmental Site Visit Inspection Report is provided in Appendix 8.2. The initial site visits were followed by more site investigations that focused on terrestrial ecology and hydrogeology, responding to the needs identified in the scoping stage. Findings of these visits are reflected in the EA document, both in the environmental baseline section and in the assessment of potential impacts. These inspection reports are provided in the appendices: Appendix 8.3, Ecological Survey of Biodiversity and Habitat/Ecosystems, and Appendix 8.4, Survey of Hydrogeology and Geology.

Desk studies were also conducted to gather baseline information and available information was collected from published sources including books, periodic publications, scientific journals, etc. This section provides information on surface water and groundwater hydrology, biodiversity, geology and soils, seismic features, archeology and cultural heritage, public health and socio-economic issues.

4.1 Geographic Characteristics

Georgia is a mountainous country covering 70,000 km^2, situated between the south slope of the Caucasus Mountains, the east coast of the Black Sea, and the northern edge of the Turkish Anatolia plain. Georgia has one of the most varied topographies of the former Soviet republics. The country lies mostly in the Caucasus Mountains, and its northern boundary is partly defined by the Greater Caucasus range. The Lesser Caucasus range, which runs parallel to the Turkish and Armenian borders, and the Surami and Imereti ranges, which connect the Greater Caucasus and the Lesser Caucasus, create natural barriers that are partly responsible for cultural and linguistic differences among regions. Earthquakes and landslides in mountainous areas present a significant threat to life and property.

Oni is in the western part of Georgia and is located on both sides of the Rioni River. (See Figure 4.1 for satellite image of Oni.) The elevation is 785-800 mamsl. The climate of Oni region is transitional towards humid subtropical and is characterized by long warm summers, cold winters and two minimums of precipitation. The annual amount of precipitation is 1048 mm. The maximum amount of precipitation comes in spring and at the beginning of summer. Duration of snow cover is 75-100 days per year.

The main economic sectors are agriculture, trade, and services. Oni is fast becoming attractive for tourists due to the potential for mountaineer tourism and alpinism. Other touristic attractions in the Municipality are mineral waters and the climate.

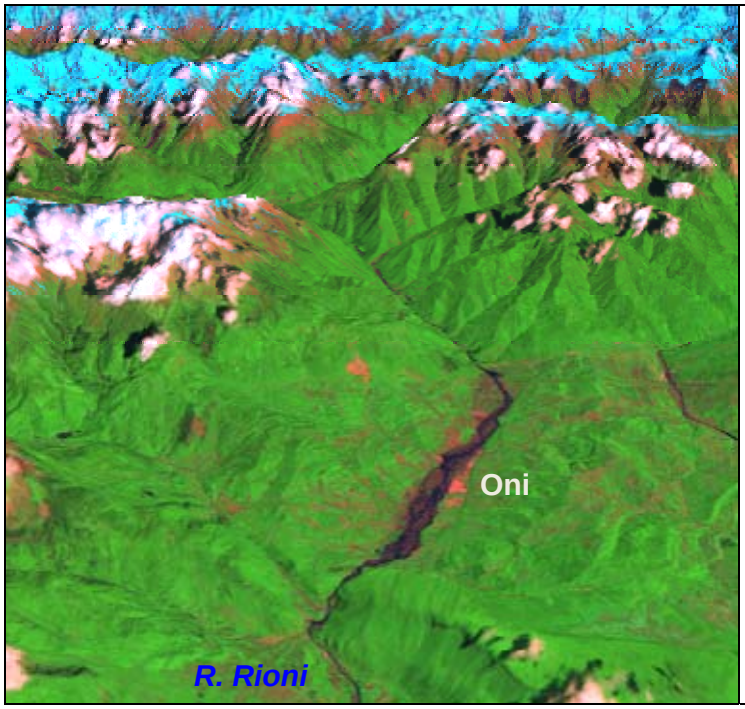


Figure 4.1: Satellite Image of Oni
(source: Landsat 5 TM, June 08, 2011)

4.2 Economy

Employment opportunities in Oni are limited. From a country-wide perspective, economic development has been uneven for the last decade. From 2004 to 2007, the country underwent rapid economic growth ranging between 5.9-12.3 percent per year. Some factors such as armed conflicts and global economic crises severely influenced the country. Post-conflict, growth plummeted to 2.3 percent in 2008 and -3.8 percent in 2009. Perhaps of more concern than actual numbers of employed, is that according to UNDP (HDR, 2010), over 62 percent of employment countrywide is ranked as "vulnerable," or as unpaid family workers or self-employed. Even this data is misleading for Oni. Most economic activity takes place in the capital city, Tbilisi. Smaller municipalities like Oni have suffered more than Tbilisi in the economic downturn. Municipal infrastructure needs, unemployment, and weak employment opportunities are key economic issues for Oni.

4.3 Water and Air Resources

Georgia has about 25,000 rivers, some of which power small hydroelectric stations. Water drainage is into the Black Sea to the west and through Azerbaijan to the Caspian Sea to the east. The largest river is the Mtkvari (known also by its Turkish name, *Kura*, used in Azerbaijan, Turkey and Russia), which flows 1,364 km from northeast Turkey across the plains of eastern Georgia, through the capital, Tbilisi, and into the Caspian Sea. The Rioni River crosses the Oni region from east to west. The Rioni is the largest river in west Georgia and empties into the Black Sea near Poti. The mouth of the river is located on the southern part of the Caucasus Mountain Ridge at the bottom of Mount Hasi. The length of the river is 327 km; average inclination (slope) – 7.2%; and the area of watershed is 13,400 km^2. The

main tributaries of the Rioni River are Jejora (L=30km), Kvirila (L=140km), Khanistskali (57 km), Tskhenistskali (176 km), Noghela (59 km), Tekhuri (101 km) and Tsivi (60 km) – total 370 tributaries. The hydrological network of the basin is quite dense.

Georgia's renewable groundwater resources are estimated at 17.2 km^3/year, of which 16 km^3/year are drained by the surface water network. This is the equivalent of a total of 58.1 km^3/year as internal renewable water resources. The total actual renewable water resources are 63.3 km^3/year.

The monitoring of air pollution is carried out only in the following project cities: Tbilisi, Rustavi and Kutaisi. There is no data on air quality in other parts of the regions/cities. The only available data are those of stationary sources provided by the industry sector to the Ministry of Environment of Georgia.

4.4 Environmental Baseline Information

Environmental baseline information is provided in this section for hydrology, geology and soils, seismicity, biodiversity and habitats, and archeological and cultural heritage resources.

4.4.1 Environmental Baseline Information: Hydrology

The source of Oni's water supply is underground spring Karstic water, located within wider watersheds of the Jejora and Rioni rivers and the nearby Kvedrula stream. Oni's water source is fed by the upstream Karstic system.

The closest surface water system (but not connected with the Karstic system) is the Kvedrula stream. The Kvedrula stream has a deep gorge that varies from 800 - 1500 m deep. The wider/open shape of the gorge at the initial section of the stream was formed by glaciers. The middle section of the Kvedrula gorge is V-shaped and at its lower section, it is a typical limestone canyon. The name of the Karstic water source (Kvedrula) originates from the closest river system and should not be confused with the surface water stream with the same name.

The Karstic source is a geological spring composed of lower cretaceous and upper Jurassic layers of sediments. Upper Jurassic sediments consist of psammitic-aleuric clays (speckling clays), which are gradually change to Arkosic-Greywacke sandstones. The lower cretaceous layer is Karstic limestone sediments of pelitomorphic and brecciated limestone. Karstic waters like the water source for Oni are typical for this region of Georgia.

The Karstic stream comes to the surface 1 km upstream the current collection point at Tskhratava in the mountains and then disappears under the surface until it comes out at the collection source. The Karstic water source flows on the left slope of the Kvedrula stream, about 10-12 m above the stream's level. The outlet of the source is related with the interaction of Neocomian limestone, upper Jurassic Kimmeridge-Tithon speckled clays and clay sandstones. It is composed of thick layers of limestone and flows out of steep slopes with some 20-35 l/sec flowrate. As mentioned above, at about 1 km from the outlet, the Karstic funnels are formed. The radius of the first identified funnel is about 7 m and the slump depth is 5.5 – 6.0 m. Limestone rocks and comparably small pieces of clay and loamy materials are (naturally) in the Karstic funnel. Near this funnel is another one of conical shape, radius about 3-3.5 m and slump depth of 1.6-1.7 m. During heavy rainfall and snowmelt, runoff flows into the funnels filled with clay soils, leaves and branches of trees. No spring outlets have been found along 10-12 km^2 surface run-off catchment area spreading

between the Kvedrula and Skhanari surface water streams, between which the current water collection point and its groundwater catchment is located, meaning that rainfall and snowmelt almost fully flows into this Karstic spring system.

The Oni water source is a typical Karstic spring which is characterized with all the features typical to Karstic springs: stirring up turbidity, drastically changeable regime, etc., but characterized with good drinking quality features, with low mineralization and satisfactory chemical composition. The chemical composition of the spring is hydrocarbonate – calcium – sodium and according the Kurlov formula: $M_{0.253}\frac{HCO3(79)Ca24(21)}{Cl8Na92}$. Spring temperature is 8.5-9°C and the pH is slightly acidic (5.5-6). It can be concluded that the morphological boundary of the Karstic spring feeding area does not match with the water flow formed within it, meaning that tectonic disruptions play a key role in forming the large flow of the spring by diverting groundwaters. The Oni water source is part surface water and part groundwater and the high turbidity and high suspended solids during heavy rainfall are typical of these Karstic water sources.

4.4.2 Environmental Baseline Information: Geology and Soils

The geology of the area is presented by the deposits of the Jurassic, Cretaceous, Paleogenic and Neogenic periods, which are presented by terrigenous, volcanic-terrigenous and carbonate rocks. Magma formations are spread at some places only. The mentioned rocks over the vast areas of the study territory are covered by deluvial, deluvial-proluvial, eluvial and alluvial deposits of the Quaternary Age. The relief of Oni region is mountainous with intervening plains and river terraces. The plains are mainly from Quaternary age alluvial sands, loamy sand and limestone. Tectonically the territory is a part of Lesser Caucasus Mountainous fold system. There are various types of soils spread in the region: weak gray forest and brown earth soils are found on the slopes of the mountains, while the tops of the mountains are covered by greensward and greensward–peaty mountain-meadow soils. Transitional black soils are found in the plains. The soil cover in the upper part of the section is stony. At some places stones dia. 2m can be found. The valley is box-shaped and winding. It is constructed with sand and pebbles and stones. The bottom width of V-shaped valley ranges between 0.1-0.4 km. In the Oni region greensward-carbonate soils are common. In the zone of deciduous and coniferous forests, weak gray forest soils are found. They are formed in the forest zone on the rocks containing calcium carbonate. The zone of greensward-carbonate soils is characterized by erosion processes and landslides.

Geologically, the region includes Lower, Middle Jurassic and Quaternary deposits of the Gagra-Java zone. The Upper Jurassic period is represented with flysch alternation of sandy parts, argillaceous shales and argillites from the Toarcian stage. The Middle Jurasssic period is represented with flysch alternation of sandy and aleurolite parts and pelagic shale argillites from the Aalenian stage. Quaternary rocks are widely spread in the area and they are mostly represented with deluvium and proluvium-alluvium argillaceous coarse deposits. Modern deluvium yellow-grey strong plastic clays are found at the surface. Proluvium-alluvium yellow strong plastic clays with grass and gravel inclusions in the upper and lower zones are found below the surface layer.

The deposits of the Jurassic Age are presented by clays, sandstones, conglomerates (Akarmar stratum); sheet slates, sandstones, clay slates (Dzimuti stratum); tufa-breccia, lava breccia, cover porphyries (middle Bajocian age); tufa-breccia, conglomerates, gravelites, sandstones (Upper Bajocian age). The deposits of the Cretaceous Age are presented by

limestones (Maastrichtian and Denmark layers, Barrem Urgonian stage), slate and clay limestones (lower sub-layer of Barrem layer); marls and rarely tuffas and tuffa-limestones (Turonian and Albian layers). The deposits of the Paleogenic Age are presented by clays, marls, sandstones, conglomerates, marls with sandstones and limestones. The deposits of the Neogenic Age are presented by sandstones, clays, marls, conglomerates, sands and limestones. The cover deposits (of deluvial, deluvial-proluvial, eluvial and alluvial genesis) of the Quaternary Period are presented by clays, loams, rubble, shingle, gravel and sand.

4.4.3 Environmental Baseline Information: Seismicity

The Oni project area has strong differential movements such as the Racha-Lechkhumi syncline where the two structures of opposite directions collide – Kavkasioni (Greater Caucasus Ridge) and Georgian blocks. Tectonic structures are isolated from one another by lines of fault or overfaults. Oni's high relief and steep rock cliffs, its climate and local conditions promote the formation and activation of the whole spectrum of geological processes – landslides, rock avalanches, erosion, mudflows and snowslides. This creates an active seismic zone with strong earthquake events.

The area experienced an almost 9-point intensity earthquake at epicenter in April of 1991 (http://seismo.iliauni.edu.ge/aboutEq/strong_earthquake_in_caucasus.php). Intense rockfalls were observed at the edges of the limestone line of Racha ridge with hundreds of landslides. About 200 persons died, 14,000 buildings were damaged and different types of communications were out of order. The landslide processes totally ruined village Chordi (Oni municipality). Less intense earthquakes are recorded almost every year. The geodynamic changes caused by the earthquakes are most clearly seen in the morphologic-structural blocks located between the tectonic faults, where pulsating (ascending and descending) movements take place.

According to the Order No 1-1/2284 dated 07 October 2009 of the Minister of Economic Development of Georgia on Construction Norms and Rules – "Seismic Resistant Construction" (PN 01.01-09), settled areas of Oni municipality are included in the highest 9 earthquake intensity zone (magnitude 6.9 according to MSK 64 scale). The map in Figure 4.2 depicts the macroseismic zoning of Georgia. The Oni area is attributed the dimensionless coefficient of seismicity 0.36. Seismic resistant construction norms for Magnitude-7 (MSK-64 scale) earthquake threat, in compliance with the above mentioned GoG regulation and best practice, should therefore be applied to the design and construction in this area.

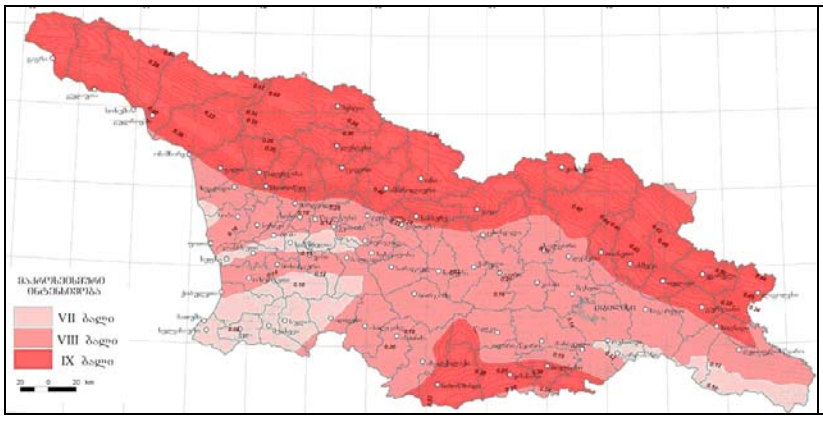


Figure 4.2: Map of Macroseismicity in Georgia
(waiting period 50 years, accidence probability 1%, MSK intensity scale)
Source: http://seismo.iliauni.edu.ge

4.4.4 Environmental Baseline Information: Biodiversity and Habitats

Oni municipality has a rich diversity of plant species. Oni's variable climate, elevations, and soil conditions have produced a set of plant species that change with the elevation of the mountain (300-600 m). Beech and coniferous forests (e.g., silver and green fir-tree, pine-tree and juniper) can be found in the area. However, the project area is highly disturbed and urban/peri-urban type environment. Very little, good quality natural vegetation exists in the affected environment.

Fauna: The fauna in Oni municipality is represented by species from mountainous areas as well as lowland fauna. Within the larger region of Oni, approximately 44 terrestrial mammal species are found, among them are wolf (*Canis lupus),* jackal (*Canis aureus),* fox (*Vulpes vulpes),* brown bear (*Ursus arctos),* badger (*Meles meles),* common marten (*Martes martes),* rock marten (*Martes foina),* wild cat (*Felis silvestris),* and roe-deer (*Capreolus capreolus).* However, due to the highly disturbed nature and the length of time the affected environment has been developed, very few wildlife species are found in the more urbanized areas of the municipality; only those species well-adapted to living near humans are found in the affected environment.

Bats (Order Chiroptera) are commonly found within the project area. Typically, bats are highly vulnerable to environmental change. They are extremely restricted in finding shelters for their breeding colonies. Tree hollows, caves, and abandoned buildings may be used by bats for breeding and roosting. The EA Team directly observed 15 species of bats within the project area and one additional species, the western barbastelle (*Barbastella barbastellus*), is expected to inhabit the project area. Two species of Chiroptera, the Mediterranean (*Rhinolophus Euryale*) and Mehely's horseshoe bat (*Rhinolophus mehelyi*) are expected to inhabit the study area and are included in the Red List of Georgia and in the IUCN Red List under the category of "VU: Vulnerable." Identification of bat roosts and nesting trees is needed to protect these bat species.

There are 243 bird species that may inhabit the Oni area. About 48 breeding bird species are classified as year-round residents and 53 species are migratory summer breeders. Considering all available data on bird conservation, important breeding habitat is uncommon in the project area. Most birds found in the project area are common, widely distributed, and numerous. The dominant group of breeding birds is small forest passerines. The larger Oni area also has breeding sites for the common buzzard (*Buteo buteo)* and the common kestrel (*Falco tinnunculus*), but breeding sites are unlikely to occur in the affected environment around the project area.

Up to 14 species of reptiles were recorded within administrative districts (rayon) of Oni. One rare species, the Caucasian viper (*Vipera kaznakovi*), is listed among them, but is unlikely to occur in the project area. Two reptile species are likely to be found within the project area, the Artvin lizard (*Darevskia derjugini*) and the Meadow lizard (*Darevskia praticola*).

One amphibian species on the Red List of Georgia (also a regional endemic), the Caucasian parsley frog (*Pelodytes caucasicus*), may inhabit the project area. Another regional endemic species, found exclusively in the Caucasus, the Caucasian toad (*Bufo verrucosissimus*), may be found in the project area. Two other regional endemic species of the Middle East are found only in the Caucasus and the northern part of Asia Minor, the southern banded newt (*Triturus vittatus*) and (*Rana macrocnemis*). These species would be sensitive to project activities because of their restricted habitats. Seasonally, during spring migration to

reproduction sites, summer migration to feeding grounds, and during the autumn migration to wintering places, many amphibians perish on the roads. Frogs may even pose a threat to traffic safety.

Due to heavy pressure of humans, the fauna is degraded in the project area. Numbers of species and populations are low. No protected species are recorded in the area of planned construction.

Habitat/Ecosystems: The habitat/ecosystem of the project area is the Colchic middle-mountain erosion-denudation landscapes with beech forests mainly with evergreen understory. The natural vegetation cover near the area planned for construction of new facilities is almost totally destroyed. Most of the site is converted to treeless pasture. Small remnants of forest are under the press of the fuel-wood harvesting, cattle and pig grazing. The water catchment basin is covered with middle-mountain erosion-denudational landscapes with beech forests with rich evergreen underwood. From the north, it is bordered by middle-mountain erosion-denudational landscapes with beech, beech-dark coniferous and dark coniferous forests mainly with evergreen underwood.

Ranges of separate animal species and areas of distribution of species complexes often coincide with borders of biotopes or landscapes. Landscapes are mosaic scattered within each of physical-geographic or zoogeographical regions. The main types of ecosystems are the following:

Industrial and urban areas. Sometimes, nests of birds or significant associations of bats can be found in old industrial buildings - mainly abandoned storehouses, cellars, attics etc. In such a case, it is needed to undertake special measures, to prevent a mass death of them, especially, if these species are protected by law (e.g. are included in the Red List). During ecological site visits, such associations or nesting places of protected species were not found in the abandoned water storage tank or in abandoned buildings on the old water treatment plant at Kvedi village.

River bank ecosystems. Surrounding landscapes differ from other areas in their higher humidity, less developed soil layer, higher density of shelters, more developed bush vegetation and less cover with agricultural landscapes. These ecosystems usually form narrow belts along rivers up to several hundred meters wide. Generally, they are quite diverse in regard of species composition of plants and animals. They are important for many species as shelter and feeding place. Animal communities can be affected if large areas of vegetation are destroyed.

The steel pipe from the water intake structure to the water distribution system of Oni is situated along the Kvedrula stream (about 2 km) and then along the Jejora River (approximately 7 km). The water pipeline in the Jejora gorge is laid along the dirt road running parallel to the Jejora River, thus any construction or repair works will not have adverse impacts on biodiversity.

Freshwater ecosystems. Attention must be paid to fish, association of amphibians and invertebrate species. Such ecosystems are sensitive to the impact of the construction and chlorination systems. These ecosystems can be affected during construction work in case of fuel leakages and turbidity increasing during work within floodplain and river crossing by trucks.

Forest ecosystems. Forests of the area can be divided into different types. Forest near areas of planned construction are low-mountain mixed oak, hornbeam-oak and beech forest. Parts belong to the Colchic region of the Caucasus zoogeographical district. In such forests, among protected by law species, occur seven mammals, one Endangered (Brown Bear - *Ursus arctos)*, and six Vulnerable species (two bats Mehely's Horseshoe Bat - *Rhinolophus mehelyi* and Mediterranean Horseshoe Bat - *Rhinolophus euryale*, rodents Caucasian Squirrel - *Sciurus anomalus,* and, Otter - *Lutra lutra*); 12 birds - one Critically Endangered winterer (Saker Falcon - *Falco cherrug*), four Endangered species (passage visitors: Red-footed Falcon - *Falco vespertinus*, and seven Vulnerable bird species (six passage migrants: Black Stork - *Ciconia nigra,* Long-legged Buzzard - *Buteo rufinus*, one year-round resident Boreal Owl - *Aegolius funereus*, and six species of insects, among them one Endangered species (Death's Head Sphinx - *Manduca atropos* and eight Vulnerable (Small Night Peacock Butterfly - *Eudia pavonia*, Scarlet Tiger - *Callimorpha dominula*, Apollo - *Parnassius apollo*, Caucasian Festoon - *Anthocharis caucasica,* Violet Carpenter bee - *Xylocopa violacea* and one dragonfly: Dark pincertail - *Onychogomphus assimilis* and Vulnerable endemic Colchis crayfish - *Astacus colchicus*.

Most sensitive to human presence and activity impact are: Brown Bear, Otter, Mehely's Horseshoe Bat, all red-listed wintering birds, and, in case of poaching or water pollution - salmon in the Rioni River.

A site visit to the water catchment basin at the village Skhanari showed a smooth valley covered with middle-mountain hornbeam-beech and coniferous forests with evergreen underwoods, blackberry bushes and grasses. The forests are in good condition and there is no regular or commercial tree cutting. Only one family harvests wood for fuel. There is cattle and pig grazing in the area, mostly near Oni. Fauna is degraded, the numbers of species and populations are low and no protected species were found.

4.4.5 Environmental Baseline Information: Archeology and Cultural Heritage

Approximately 8 percent of the country is under protected area status. Figure 3.1 below shows the network of protected areas in Georgia. Preliminary studies indicated that the proposed project to improve the water supply system in Oni would not be carried out within or in proximity to protected areas, and that there were no natural, cultural, and/or archeological monuments within the work areas. In addition, the project's construction activities will be implemented in areas with existing water infrastructure, reducing the chance of finding or impacting archeological monuments.

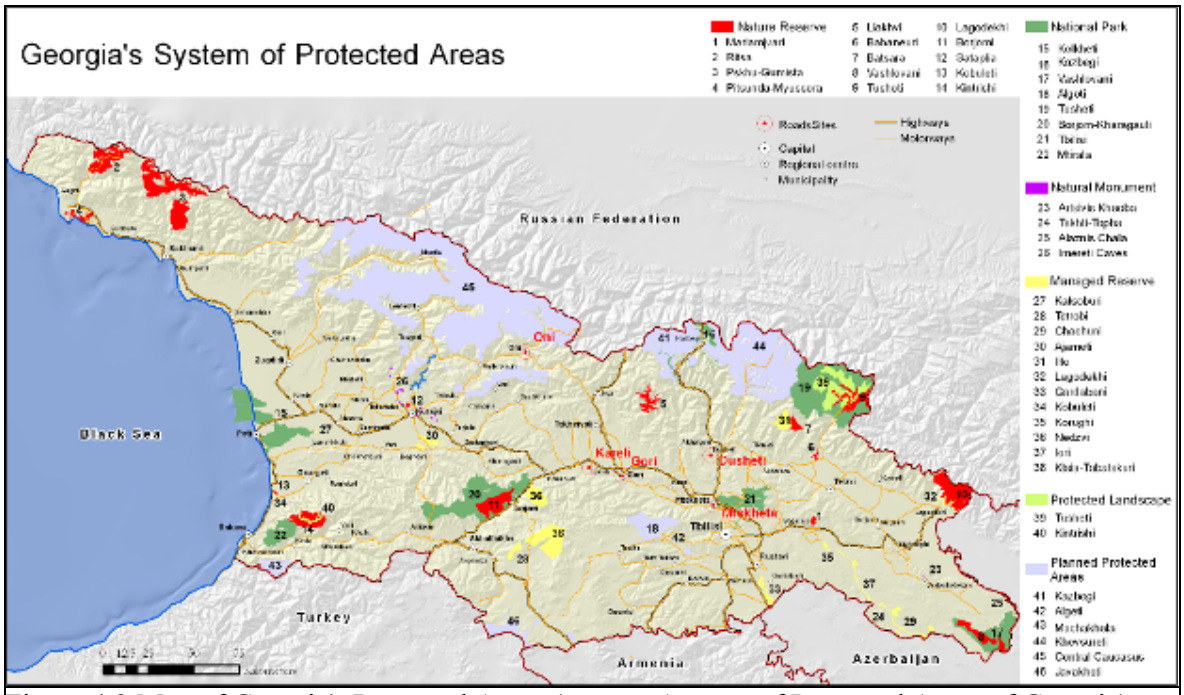
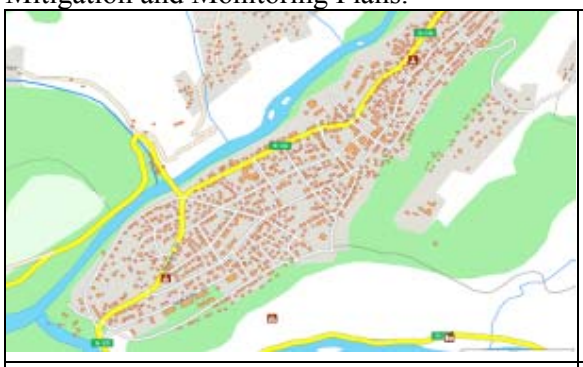


Figure 4.3 Map of Georgia's Protected Areas (source: Agency of Protected Areas of Georgia)

There are a few cultural heritage landmarks in Oni, including the 19th century Oni Synagogue, a church (located on Baratashvili Street), and a theatre (Rustaveli Street). The Oni water supply project activities will not be carried out within or in proximity to these landmarks. The only natural, cultural, and/or archeological monument within the project work area is the Revaz Japaridze Home-Museum located near the water treatment and storage facility construction area. The public stakeholder meeting revealed that the home-museum is not formally registered as the cultural heritage object within the government registry. The affected environment is not in or near other identified monuments. Nevertheless, there may be chance-finds of cultural or archeological resources in proximity to the Oni site and thus, archeology and cultural heritage mitigations will be included in Section 6 Environmental Mitigation and Monitoring Plans.



Distribution of heritage monuments in the central part of Oni (source: mygeorgia.ge)

Traditional wooden houses of Racha-Lechkhumi region (source: GPAP, 2008)

4.5 Policy, Legal, Regulatory and Permitting Requirements

A number of Georgian laws and regulations exist related to environment, social, labor, land, cultural heritage, and other technical issues, which are relevant to this EA.

The Constitution of Georgia sets general regulating principles of environment protection. Namely, Article 37, Clause 3 states that all citizens have the right to live in a healthy environment and use natural and cultural surroundings. In addition, citizens are obliged to protect the natural and cultural surroundings. Below is a list of the principle environmental, social, health care, cultural heritage, and technical laws and regulations.

Table 4.1: Principle Laws and Regulations Relevant to the Proposed Project

Year	Law / Regulation
	Environment
1994	on Soil Protection
1996	on System of Protected Areas
1996	on Protection of Environment
1996	on Mineral Resources
1997	on Wildlife
1997	on Water
1998	on Hazardous Chemicals
1999	on Protection of Ambient Air
1999	Forestry Code of Georgia
1999	on Compensation of Damage from Hazardous Substances
2000	on Regulation and Engineering Protection of Coastline and River Banks of Georgia
2005	on Red List and Red Book of Georgia
2006	on Licenses and Permits
2007	on Status of Protected Areas
2007	on Ecological Examination
2007	on Service of Environmental Protection
2007	on Environmental Impact Permit
2002	Regulation on Environmental Impact Assessment (approved by the Order No. 59 of the Minister of Environment.
	Cultural Heritage
2007	Law on Cultural Heritage
	Social, health and labor issues
2007	Law on Public Health
1997	Law of Georgia on Heath Care
2006	Labor Code of Georgia
1997	Law on Professional Unions
	Land and land ownership
1997	The Civil Code of Georgia
1997	The Civil Procedural Code of Georgia
1996	The Law of Georgia on Ownership of Agricultural Land
2010	Law on State Owned Property
2007	Law of Georgia on Entitlement of Ownership Rights to Lands Possessed

	(Employed) by Physical and Legal Persons of Private Law
1999	The Law on Rules for Expropriation of Ownership for Necessary Public Need
2007	Law on Replacement Cost Reimbursement and Compensation for the Use of Agricultural Land for Non-Agricultural Purposes
2007	Presidential Decree #525 on Rules for Entitlement of Ownership Rights to Lands Possessed (Employed) by Physical and Legal Persons of Private Law and Approval of Ownership Certificate Format

The environmental permitting system in Georgia is regulated by the Law on Environmental Impact Permit, Law on Licenses and Permits, Law on Ecological Assessment, and Law on Licenses and Permits. These laws are described in the section on Relevant and Applicable Permitting Requirements, below.

Law of Georgia on Protection of Environment
This law regulates the legal relationship between the bodies of the state authority and the physical/legal persons regarding environmental protection and use of natural resources on Georgian territory, and defines responsibilities of state institutions. The law gives major principles for environmental management, licensing, standards, EIA, and related issues and describes different aspects of the protection of ecosystems, protected areas, and biodiversity.

Law of Georgia on Natural Resources
The law defines the status of natural resources, describes their use, and sets out the types of licenses and rights and obligations of the users. The law sets responsibilities to preserve lands from contamination and ensures conformity of agricultural activities with relevant legal requirements. It describes economic principles for consumption of natural resources.

Law of Georgia on Soil Protection
The law aims at ensuring preservation of soil integrity and improving its fertility. It defines obligations and responsibilities of land users and the state regarding provision of soil protection conditions and ecologically safe production. The law sets the maximum permissible concentrations of hazardous matter in soil. It also restricts the use of fertile soil for non-agricultural purposes; execution of any activity without stripping and preserving topsoil; open quarry processing without subsequent re-vegetation of the site; terracing without preliminary survey of the area and approved design; overgrazing; wood cutting; damage of soil protection facilities; any activity that would degrade soil quality (e.g., unauthorized chemicals/fertilizers, etc.).

Law of Georgia on Protection of Atmospheric Air
The law regulates protection of atmospheric air from adverse anthropogenic impact within the whole Georgian territory (Part I, Chapter I, Article 1.1). Adverse anthropogenic impact is any human-caused effect on atmospheric air causing or capable of causing negative impacts on human health and the environment (Part II, Chapter IV, Article II.I).

Law of Georgia on System of Protected Areas
The law sets out the categories of protected areas (including national parks, state reserves, managed reserves, etc.) and defines activities allowed in their boundaries.

Law of Georgia on Cultural Heritage
The Law of Georgia on Cultural Heritage among others envisages protection measures for newly identified objects of cultural heritage. In accordance with the legislation the expertise

of the newly identified objects of cultural heritage is the responsibility of the Ministry of Culture and Monument Protection of Georgia. In particular, the Law provides (Volume II, Chapter III, Article 101, Item 1) that if any physical or legal entity reveals or discovers cultural heritage or supposes sufficient justification for the existence of such objects during the activities that may damage, destroy or cause danger to it, the entity who conducts such activities is obliged to immediately suspend activities and inform the Ministry about the reveal or suppositions on existence of cultural heritage and suspension of activities.

Law of Georgia on Water
The law regulates protection and consumption of surface and groundwater, commercial water production, protection of aquatic life, fauna, flora, forest, land and other natural resources. Consistent with the legislation, water within the territory of Georgia is under state ownership.

Law on Rules for Expropriation of Ownership for Necessary Public Needs
The state has the constitutional power to seize any property by means of expropriation for projects of imminent public necessity. The expropriator has to make every reasonable effort to acquire property by negotiation and is required to value the property in accordance with the fair market value before negotiations.

Law on Rules for Expropriation of Ownership for Necessary Public Needs
The state has the constitutional power to seize any property by means of expropriation for projects of imminent public necessity. The expropriator has to make every reasonable effort to acquire property by negotiation and is required to value the property in accordance with the fair market value before negotiations.

Law on Replacement Cost Reimbursement and Compensation for the Use of Agricultural Land for Non-Agricultural Purposes
The law specifies requirements for a land replacement fee (based on location and quality of land) to compensate the government and private landowners/ land users for property loss, plus lost profits by the beneficiary as a result of allocation of agricultural land for nonagricultural purposes.

Labor Code of Georgia
The code regulates labor relations between all workers and employees in Georgia. It supports the realization of human rights and freedoms through fair reimbursement and the creation of safe and healthy working conditions.

4.5.1 International Conventions

The following list gives an overview on Multilateral International Conventions, related to nature conservation and biodiversity protection, enforced in Georgia, which are relevant to this EA:

- Convention on Biological Diversity (CBD), 1992, - accepted at 02/06/1994
- Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention) – ratified at 07/02/1997
- Convention on the Conservation of Natural Habitats and of Wild Fauna and Flora (the Bern Convention) - ratified in 30/12/2008.

- Convention on the Conservation of Migratory Species of Wild Animals (CMS), Bonn, 1979, date of entry into force 01/06/2000.
- Agreement on the Conservation of Bats in Europe (EUROBATS) – ratified at 21/12/2001. This Agreement protects 28 bat species occurring in Georgia.
- Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) - ratified in April 2001. This Agreement increased a number of the bird species that are protected by the law (up to 98 species listed in the Agreement occur in Georgia, most of them are not mentioned in Georgian Red List.

4.5.2 International Standards and Best Practices

International standards that may apply to the project include the ILO core labor standards on:

- Forced labor (C105)
- Child Labor (C182)
- Discrimination (C111)
- Freedom of Association and the Right to Organize (C 87)
- Equal Remuneration (C100)
- Minimum Age (C138)

Georgia is a party to the following environmental conventions and treaties, not all of which will be relevant to the project:

- Ramsar Convention on Wetlands of International Importance, especially as Waterfowl Habitat
- UN Rio de Janeiro Convention on Biological Diversity
- Convention on Migratory Species
- Paris Convention on the Protection of World Culture and Natural Heritage
- Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters
- European Archaeological Heritage Convention
- European Convention on Protection of the Archaeological Heritage (Lavallette, 1992 – 01 – 16) – Georgia joined the convention on February 23, 2000, pursuant to Decree # 158; and
- European Convention on Protection of the Archaeological Heritage (Granada, 1985-10-03) – Georgia joined the convention on February 23, 2000, pursuant to Decree # 157.

4.5.3 Relevant and Applicable Permitting Requirements

In Georgia, projects requiring ecological examination are mainly regulated by the following laws:

Law of Georgia on Environmental Impact Permit
The Law on Environmental Impact Permit contains the list of activities subject to EIA and the related procedures and regulations governing the issuance of environmental impact permits (EIP). Road rehabilitation project does not require an EIP and/or State Ecological Expertise (SEE) under the Georgian legislation, since in accordance with the Article 4 of the

Law of Georgia on Environmental Impact Permits, road rehabilitation is not listed as a type of project subjected to EIP or SEE. Setting norms for maximum permissible levels of air and water emissions specifically for the project is not required either. According to current legislation, water and air emissions during rehabilitation and operation of the project facilities should therefore comply with the existing norms established by the Technical Regulations of the Environmental Protection (Order of the Minister of Environment Protection No. 745, dated 13.11.2008).

Law of Georgia on Ecological Examination
This law makes ecological examination an obligatory step to issue the environmental impact permit or construction permit for certain types of activities.

Law of Georgia on Licenses and Permits
The law regulates the issuance of licenses or permits, gives an exhaustive list of licenses and permits, and sets the rules for issuing, amending, and cancelling permits. The law defines three principles for issuance of the license:

- "One-window" principle – meaning that a licensing administrative body shall ensure the approval of additional licensing conditions by the other administrative bodies.
- "Silence gives consent" – licensing administrative body is obliged to make a decision in due course after the submission of the application. Otherwise, if a decision is not made in the determined time period the license is deemed issued.
- "Umbrella principle" – the holder of the general license is not obliged to apply for specialized licenses.

5. Environmental Consequences

5.1 Environmental Impacts of the Proposed Action and Alternatives

The Oni Water Supply Scoping Statement (SS) provided a framework for analyzing the potentially significant social and environmental impacts. The SS listed the concerns that were generated from document review, scoping meetings, and site visits. The concerns were categorized into potentially significant social and environmental issues for further analysis in the EA. The SS also identified the additional information needed to adequately analyze the issue for the EA.

This chapter evaluates the potentially significant social and environmental issues identified by the Scoping Team.

5.1.1 Direct & Indirect Effects and their Significance

Social & Environmental Concern	Potentially significant issue	EA Requirements/ Work Tasks
1. Deterioration of upstream ecosystem that could result in contamination of Oni's Karst water source.	Construction of villages and/or tourist hotels, deforestation, farming, animal grazing, etc. impact Karst water source.	Identify upstream land use and determine land use requirements.

The source of Oni's water supply is underground spring Karstic water, located within wider watersheds of the Jejora and Rioni rivers and the nearby Kvedrula stream. Oni's water source is fed by the upstream Karstic system. The closest surface water system (but not connected with the Karstic system) is the Kvedrula stream. The Karstic water flows through limestone and other soluble rock creating crevices and channels down to a location known as Tskhratava where the water comes to the surface. From this point, the water flows under the surface for 1 km to the extraction point at Oni. The upstream ecosystem is affected by soil erosion and rock dissolution, leakages from channels and underground reservoirs and collapsing of underground cavities and formation of sinkholes. River flows and infiltration of rainwater and snowmelt recharges the Karst water. It is important to restrict construction of villages and tourists hotels in the Oni Karst ecosystem because these activities may contaminate the Karst aquifer and Oni's water supply. Consider restricting farming, logging and animal grazing as much as possible to reduce the chances of contaminating the water source. Also, consider working with the single Skhanari village resident to restrict tree cutting and animal grazing in very small (1-2 sq km) Karst funnel drainage area (Sanitary Zone).

The Proposed Action Alternative 1 involves drinking water treatment and storage for Oni. The project depends on the high quality of the Karstic water. The Groundwater Alternative 2 has several possible problems, including the need for deep and limited aquifers, difficulty of finding/drilling wells into Karstic waters, higher cost and water source contamination. The No Action Alternative 3 would leave Oni without suitable drinking water especially during heavy rainfall events.

The Proposed Action will not involve activities that would change the Karstic flow or water quantity. The local hydrology is not expected to be affected. Using the Karstic water will

add to the local need for restriction of activities in the ecosystem that could contaminate this important water source. No rivercourse will be diverted nor streambed changed. Structures will not be placed in riverbeds and construction will not affect water quantity or water quality.

These impacts are expected to be limited to the construction period (several months). After construction, water quality should return to pre-construction conditions and may even improve due to cleaning and the improved water flow that will result from the rehabilitation activities. Any erosion or sedimentation should be controlled during construction. Excavation spoils should not be stored in waterways and trench dewatering should not be discharged directly into waterways.

Significance: Impacts from construction and farming/logging/animal grazing should be restricted as much as possible to reduce the chances of contaminating the water source. Impacts from the project's construction activities should not affect the water source. Mitigations and best practices are needed for construction activities under Alternative 1 to minimize potential significant impacts to waters and ecosystems in the area.

Social & Environmental Concern	Potentially significant issue	EA Requirements/ Work Tasks
2. Impacts to Threatened, Endangered, and Protected Species. Disruption of sensitive ecological habitats/ecosystems	Rehabilitation, including construction and operation phases, could impact Threatened, Endangered & Protected Species (TES) and sensitive ecological habitats. This could occur through direct impacts (workers may disrupt habitats without oversight) or indirectly through habitat or ecosystem alterations during construction.	Identify presence of TES and/or sensitive habitats/ecosystems; Determine possible short and long-term habitat or ecosystem alterations.

Oni municipality has a rich diversity of plant species. The project area is highly disturbed and urban/peri-urban type environment. Very little, good quality natural vegetation exists in the affected environment. The fauna in Oni municipality is represented by species from mountainous areas as well as lowland fauna. Within the larger region of Oni, approximately 44 terrestrial mammal species are found, among them are wolf (*Canis lupus),* jackal (*Canis aureus),* fox (*Vulpes vulpes),* brown bear (*Ursus arctos),* badger (*Meles meles),* common marten (*Martes martes),* rock marten (*Martes foina),* wild cat (*Felis silvestris),* and roe-deer (*Capreolus capreolus).* However, due to the highly disturbed nature and the length of time the affected environment has been developed, very few wildlife species are found in the more urbanized areas of the municipality; only those species well-adapted to living near humans are found in the affected environment.

Bats (Order Chiroptera) are commonly found within the project area. Typically, bats are highly vulnerable to environmental change. They are extremely restricted in finding shelters for their breeding colonies. Tree hollows, caves, and abandoned buildings may be used by bats for breeding and roosting. The EA Team directly observed 15 species of bats within the project area and one additional species, the western barbastelle (*Barbastella barbastellus*), is expected to inhabit the project area. Two species of Chiroptera, the Mediterranean (*Rhinolophus Euryale*) and Mehely's horseshoe bat (*Rhinolophus mehelyi*) are expected to inhabit the study area and are included in the Red List of Georgia and in the IUCN Red List

under the category of "VU: Vulnerable." Identification of bat roosts and nesting trees is needed to protect these bat species.

There are 243 bird species that may inhabit the Oni area. Up to 14 species of reptiles were recorded within administrative districts (rayon) of Oni. One amphibian species on the Red List of Georgia (also a regional endemic), the Caucasian parsley frog (*Pelodytes caucasicus*), may inhabit the project area. Another regional endemic species, found exclusively in the Caucasus, the Caucasian toad (*Bufo verrucosissimus*), may be found in the Project area. These species would be sensitive to project activities because of their restricted habitats. Seasonally, during spring migration to reproduction sites, summer migration to feeding grounds, and during the autumn migration to wintering places, many amphibians perish on the roads. Frogs may even pose a threat to traffic safety. Due to heavy pressure of humans, the fauna is degraded in the project area. Numbers of species and populations are low. No protected species are recorded in the area of planned construction.

The habitat/ecosystem of the project area includes industrial and urban areas, river bank ecosystems, freshwater and forest ecosystems. The natural vegetation cover near the area planned for construction of new facilities is almost totally destroyed. Most of the site is converted to treeless pasture. Small remnants of forest are under the press of the fuel-wood harvesting, cattle and pig grazing. The water catchment basin is covered with beech forests with rich evergreen underwood. The main types of ecosystems are the following:

Industrial and urban areas. Sometimes, nests of birds or significant associations of bats can be found in old industrial buildings - mainly abandoned storehouses, cellars, attics etc. In such a case, it is needed to undertake special measures, to prevent a mass death of them, especially, if these species are protected by law (e.g. are included in the Red List). During ecological site visits, we had not find such associations or nesting places of protected species in the abandoned water storage tank or in abandoned buildings on the old water treatment plant at Kvedi village.

River bank ecosystems. Surrounding landscapes differ from other areas in their higher humidity, less developed soil layer, higher density of shelters, more developed bush vegetation and less cover with agricultural landscapes. These ecosystems usually form narrow belts along rivers up to several hundred meters wide. Generally, they are quite diverse in regard of species composition of plants and animals. They are important for many species as shelter and feeding place. Animal communities can be affected if large areas of vegetation are destroyed.

The steel pipe from the water intake structure to the water distribution system of Oni is situated along the Kvedrula stream (about 2 km) and then along the Jejora River (approximately 7 km). The water pipeline in the Jejora gorge is laid along the dirt road running parallel to the Jejora River, thus any construction or repair works will not have adverse impacts on biodiversity.

Freshwater ecosystems. Attention must be paid to fish, association of amphibians and invertebrate species. Such ecosystems are sensitive to the impact of the construction and chlorination systems. These ecosystems can be affected during construction work in case of fuel leakages and turbidity increasing during work within floodplain and river crossing by trucks.

Forest ecosystems. In forest ecosystems near the project site, there are species protected by law, seven mammals, one Endangered (Brown Bear - *Ursus arctos)*, and six Vulnerable species (two bats Mehely's Horseshoe Bat - *Rhinolophus mehelyi* and Mediterranean Horseshoe Bat - *Rhinolophus euryale*, rodents Caucasian Squirrel - *Sciurus anomalus,* and, Otter - *Lutra lutra*); 12 birds - one Critically Endangered winterer (Saker Falcon - *Falco cherrug*), four Endangered species (passage visitors: Red-footed Falcon - *Falco vespertinus*, and seven Vulnerable bird species (six passage migrants: Black Stork - *Ciconia nigra,* Long-legged Buzzard - *Buteo rufinus*, one year-round resident Boreal Owl - *Aegolius funereus*, and six species of insects, among them one Endangered species (Death's Head Sphinx - *Manduca atropos* and eight Vulnerable (Small Night Peacock Butterfly - *Eudia pavonia*, Scarlet Tiger - *Callimorpha dominula*, Apollo - *Parnassius apollo*, Caucasian Festoon - *Anthocharis caucasica,* Violet Carpenter bee - *Xylocopa violacea* and one dragonfly: Dark pincertail - *Onychogomphus assimilis* and Vulnerable endemic Colchis crayfish - *Astacus colchicus*. Most sensitive to human presence and activity impact are: Brown Bear, Otter, Mehely's Horseshoe Bat, all red-listed wintering birds, and, in case of poaching or water pollution - salmon in the Rioni River.

A site visit to the water catchment basin at the village Skhanari showed a smooth valley covered with middle-mountain hornbeam-beech and coniferous forests with evergreen underwoods, blackberry bushes and grasses. The forests are in good condition and there is no regular or commercial tree cutting. Only one family harvests wood for fuel. There is cattle and pig grazing in the area, mostly near Oni. Fauna is degraded near Oni, the numbers of species and populations are low and no protected species were found.

Significance: Most impacts are expected to be limited to the construction period. There are possible impacts from fuels, leaks and spills, dust and noise as well as from construction activities. Mitigations and best practices are needed for Alternative 1 to minimize potential significant impacts. Surveys for bat roosts should be made before construction of trees that need to be removed. Consider sealing old storage tank to provide bat shelter. Construction should be timed to avoid animal disturbance during breeding seasons. Surveys should search for the Red Listed Caucasian parsley frog and Caucasian Toad with mitigations if species are identified.

Social & Environmental Concern	Potentially significant issue	EA Requirements/ Work Tasks
3. Impacts to cultural resources such as Revaz Japaridze Home-Museum.	During the construction phase, cultural resources may be found, disturbed, and/or destroyed.	Identify cultural resources of importance in the vicinity of the projects and as appropriate for the specific resources, measures to remove or protect.

Preliminary studies indicated that the proposed project to improve the water supply system in Oni would not be carried out within or in proximity to protected areas, and that there were no natural, cultural, and/or archeological monuments within the work areas There are a few cultural heritage landmarks in Oni, including the 19th century Oni Synagogue, a church (located on Baratashvili Street), and a theatre (Rustaveli Street). The Oni water supply project activities will not be carried out within or in proximity to these landmarks.

The only natural, cultural, and/or archeological monument within the project work area is the Revaz Japaridze Home-Museum located near the water treatment and storage facility

construction area. The public stakeholder meeting revealed that the home-museum is not formally registered as the cultural heritage object within the government registry. The project area is not in or near other identified monuments.

Significance: The Oni water supply improvements are not in or near natural, cultural or archeological resources/monuments (except Japaridze home-museum). Most impacts are expected to be limited to the construction period. Nevertheless, there may be chance-finds of cultural or archeological resources in proximity to the Oni site and thus, archeology and cultural heritage mitigations will be included in Section 6 Environmental Mitigation and Monitoring Plans. These mitigations and best practices for construction activities will protect against potential significant impacts under Alternative 1.

Social & Environmental Concern	Potentially significant issue	EA Requirements/ Work Tasks
4. Human health impacts due to poor drinking water quantity or quality.	Collect water quality and quantity monitoring data to address the needs of Oni residents	Identify chemical and biological contaminants in water; identify water quantity availability and water needs of Oni.

Water quality testing is conducted for Oni drinking water by the United Water Supply Company of Georgia (UWSCG). Results indicate acceptable water quality except during heavy rainfall events when turbidity increases. High suspended solids and turbidity is often accompanied with increases in pathogen levels. These potential problems should not be significant as the new Oni water supply improvements include filtration to remove turbidity and suspended solids and chlorination to kill pathogens and other microorganisms. During operation, GMIP should insure that regular water quality testing is conducted. Residents should be provided information on their drinking water quality and alerts during any periods when water quality exceeds Georgian standards.

Significance: Water quality testing should be conducted for Oni's drinking water. Residents should be provided information on their drinking water quality and alerts during any periods when water quality exceeds Georgian standards. Mitigations will be included in Section 6 Environmental Mitigation and Monitoring Plans. These mitigations and best practices will protect against potential significant impacts under Alternative 1.

Social & Environmental Concern	Potentially significant issue	EA Requirements/ Work Tasks
5. Cumulative Impacts: The Environmental Assessment needs to consider the cumulative impacts of activities within the watershed.	Cumulative impacts may result from the combination of past, present, proposed, and reasonably foreseeable actions. A cumulative effects analysis is part of EA.	Identify the space, time, and assumptions to predict cumulative impacts.

Cumulative impact is defined by the US Council on Environmental Quality as: …*the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time* (40 CFR 1508.7).

The proposed project (Alternative 1) will provide high quality drinking water to Oni residents. Drinking water will be chlorinated at all times to kill pathogens and problem microorganisms. Filtration will be used to remove suspended solids during periods when heavy rainfall or snowmelt causes high turbidity in the source water. Water quality testing should be conducted for Oni's water source. Residents should be provided information on their drinking water quality and alerts during any periods when water quality exceeds Georgian standards. Day to day operation and maintenance (O&M) of the new treatment plant and storage tank will be the responsibility of the local Oni Service Center (OSC). OSC is currently operating the existing system and water distribution network. The proposed project includes training and assistance with startup and O&M of the new water system.

Best practices are needed to protect Oni during construction. Construction could result in increased erosion and sedimentation, resulting in increased turbidity and decreased water quality. This could affect aquatic resources and vegetation (native flora and fauna and sensitive ecosystems), and could also affect wildlife throughout the food chain, including birds and mammals that rely on aquatic resources. Erosion control measures kept in place throughout the construction phase are expected to mitigate concerns. Best practices associated with heavy equipment should protect water resources. Construction camps should be designed properly and decommissioned with removal of solid waste and buildings.

Excess materials that are not properly disposed of could result in environmental impacts. Liquid and solid waste could degrade water quality, affect aquatic resources (flora and fauna), and terrestrial ecosystems. Water quantity could be affected if trash is left behind to clog waterways. Construction equipment that is left on-site after construction is complete could affect the environment. Fuel and oil leaks, rust from equipment, and equipment parts could degrade water quality, and affect flora and fauna; and could have an impact on hydrology and flood regime (water quantity) if equipment clogs waterways. Decommissioning may require the disposal of solid, hazardous, or special wastes. There could also be public safety risks if people can enter the site to dismantle abandoned equipment.

Without a practical maintenance plan in place, water treatment and storage facilities will degrade. An operation and maintenance (O&M) plan, including training for OSC, is expected to minimize concerns. The Mitigation Plan is intended to minimize any potential adverse environmental and social impacts over the life of the project. The result should be the improved drinking water quality and quantity for residents of Oni and tourists visiting Oni.

Significance: Cumulative impacts from construction and O&M activities under the Proposed Action (Alternative 1) may affect residents of Oni. Cumulative impacts will occur during both the construction and O&M periods. Mitigations and best practices are needed for construction activities under Alternative 1 to minimize potential significant impacts. During the operation period, operation and maintenance needs to be addressed. Without a practical maintenance plan in place, treatment and storage works will degrade, reducing public safety and increasing threats of unsafe drinking water.

5.1.2 Issues eliminated from further evaluation

The SS stated that the concerns in Table 5.1 required mitigation, but no additional investigation and analysis in the EA was needed. Best practices are widely available and can

be easily applied to the GMIP Proposed Action; they are included in Section 6 EMMPs and they will be included in the engineering contracts as well. The concerns that have been eliminated from further evaluation are listed in Table 5.1 along with the reason for elimination.

Table 5.1 Concerns that have been eliminated from further evaluation

Social & Environmental Concern	Reason for Elimination
Water losses due to leaks in Kvedrula water pipeline	Information is sufficient to provide best practices to minimize this concern; BPs to be included in the bidding document. No additional investigation is needed.
Damage caused by constructing temporary staging areas.	Information is sufficient to provide best practices to minimize this concern; BPs to be included in the bidding document. No additional investigation is needed.
Dust generation during rehabilitation; Air pollution from heavy equipment. Noise pollution from heavy machinery.	Information is sufficient to provide best practices to minimize this concern; BPs to be included in the bidding document. No additional investigation is needed.
Noise pollution from construction activities and use of heavy machinery.	Information is sufficient to provide best practices to minimize this concern; BPs to be included in the bidding document. No additional investigation is needed.
Construction camps could result in pollution of surface and groundwater if inadequate sanitary facilities are not provided. Altered landscapes if the site is not returned to previous conditions. Alcohol and socially destructive practices introduced via construction crews.	Information is sufficient to provide best practices to minimize this concern; BPs to be included in the bidding document. No additional investigation is needed. Mitigations to be included in the bidding document.
Contamination from heavy equipment leaks and construction spills.	Information is sufficient to provide best practices to minimize this concern; BPs to be included in the bidding document. No additional investigation is needed.
Lack of environmental co-ordination. Lack of consultation. Participation and transparency. Lack of co-ordination. Inconsistent messages across projects.	Scoping and EA processes are meant to encourage coordination, consultation, participation, and transparency and to provide clear, consistent messages; no further assessment needed.
Project sustainability. Lack of effectiveness. High expectations for project benefits.	The project is designed for sustainability, effectiveness, and to balance expectations with benefits; no further assessment needed.
Lack of understanding of environmental issues	This is an issue nationwide and is beyond the bounds of the project.
Pedestrian and traffic safety. Worker and public health and safety.	Sufficient information is available to develop BPs for inclusion in the bidding document.
Visual impacts due to water supply structures.	Sufficient information is available to develop BPs to minimize this concern.

5.1.3 Possible Conflicts between Proposed Action and Land Use

During construction, raw materials and/or construction wastes may be temporarily stored on private property that is located adjacent to the construction sites. This situation may involve temporary land-take. Construction waste would be removed once the construction is finished

(as required by best practices which are included in the EMMP.) Excavations will be backfilled to original contour after construction is completed.

Some landsites or private property may be affected by the need to excavate beyond the current footprint. GMIP will comply with Georgia's *Law on Rules for Expropriation of Ownership for Necessary Public Needs,* in which the expropriator (USAID-GMIP) has to make every reasonable effort to acquire property by negotiation and is required to value the property in accordance with the fair market value before negotiations. Land use problems are expected to be minor.

5.1.4 Possible Conflicts between Proposed Action and Policies and Controls

As above, GMIP will coordinate with local authorities to ensure that the upgrades and rehabilitation comply with local concerns such as zoning, water use, etc. (See Section 4 for local government requirements).

5.2 Energy Requirements of Alternatives

Energy requirements of Alternative 1 are not significant. Some energy will be needed during construction from equipment used for site preparation and construction. During operation, there is some pumping, but pumping equipment will be efficient and maintenance will insure proper operation and delivery of high quality (and quantity) drinking water.

5.3 Irreversible and Irretrievable Commitment of Resources

Alternative 1 may involve some irreversible or irretrievable commitment of resources. GMIP will implement all reasonable measures to reduce environmental impacts, especially during the construction phase.

5.4 Means to Mitigate Adverse Environmental Impacts

Impacts from construction and operational phases of the project will be minimized with best practices and mitigation measures described in the Section 6 EMMP.

6. Environmental Mitigation and Monitoring Plans

This chapter includes the EMMPs for water supply improvements in Oni Municipality. Table 6.1 covers mitigation and monitoring measures for construction and rehabilitation of water treatment and storage facilities and Table 6.2 covers operation and maintenance of Oni water supply improvements.

6.1 Environmental Mitigation and Monitoring Plans

The Table 6.1 EMMP addresses impacts associated with construction of water supply improvements in Oni Municipality. Identified environmental impacts also include waste management, community impacts and poor sanitation at construction camps, air pollution, noise and visual quality impacts, socio-economic and public health and safety impacts. The Table 6.2 EMMP covers operation and maintenance of the improvements to the Oni water supply system.

Tables 6.1 and 6.2 provide the monitoring indicator(s), monitoring and reporting frequency and GMIP party responsible for monitoring. Monitoring is provided to ensure the effectiveness of mitigation measures.

6.1: Environmental Mitigation and Monitoring Plan for Construction of Oni Water Supply Improveme

ivity	Identified Environmental Impacts	Are Impacts Potentially Significant	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Respons Party(i
e Water provements unicipality	Poorly planned and constructed water system improvements (Human health and other impacts)	N	• Install new water supply treatment plant and water storage tank. • Conduct testing to insure system operates as designed, including sufficient pressures to deliver drinking water throughout distribution network. • Provide residents with guides on conserving water, reducing water usage, routine maintenance, and protections during cold (freezing) weather.	Conformance with design standards Quantity of water (m^3), quality of drinking water, reduction of water usage Number of guides provided to Oni residents Complaints from users Photo log	Inspections at the start of the activity and at least monthly thereafter during construction	Requireme specified in contracts Periodic inspections MDF and GMIP.
	Impact to Threatened, Endangered & Protected Species (TES); Disruption of sensitive ecological habitats/ecosystems	N	• Use biologist experienced with TES and their habitats. • Conduct survey of amphibian crossings in Oni. • Conduct surveys of trees to be removed for bat roosts. • Seal old tank to shelter bats. • Determine breeding seasons for protected species in project area; establish construction schedule to minimize disturbance. • Implement TES protection programs including worker training to identify and	Conformance with TES Program Surveys by TES biologist. Inspections by TES biologist. Number of TES identified. Number of employees trained.	Survey reports for TES/habitat identification and protection. Inspection at the start of the activity and at least monthly thereafter during construction.	Requireme specified in contracts Periodic inspections MDF and GMIP

ivity	Identified Environmental Impacts	Are Impacts Potentially Significant	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Respons Party(i
			protect TES and habitats. • Avoid cutting of matured trees; if unavoidable, plant four trees of same species for each tree that is removed.	Old tank sealed to serve as shelter for bats.		
	High seismic risk, intensity zone 9, magnitude 7 according to MSK 64 scale (Oni is attributed one of the highest dimensionless coefficient of seismicity in the country – 0.36).	N	• Seismic resistant construction norms for Magnitude-7 (MSK-64 scale) earthquake threat is applied, in compliance with the applicable national regulations, such as the Order No 1-1/2284 dated 07 October 2009 of the Minister of Economic Development of Georgia on Construction Norms and Rules – "Seismic Resistant Construction" (PN 01.01-09), and best practice. • Build ancillary structures with wood frames instead of concrete or brick.	Design provides for measures and justifications on compliance with applicable norms. Design is cleared with GoG with regard to seismic risk compliance. Construction is implemented in compliance with seismic resistance requirements.	Check of design documentation. Inspection on compliance during construction and handover.	Requireme specified ir contracts. Periodic inspections MDF and GMIP. Clearance b governmen authority ir charge of monitoring compliance with seismi norms.
	Waste Management from Construction Rehabilitation and Demobilization (Soil and Water Contamination)	N	• Collect/segregate old water system, construction waste, reuse or recycle as possible. • Store materials onsite, protect from storm water runoff or wind until transport for disposal according to local regulations (in landfills). • Remove topsoil from water storage tank excavation site, store and protect onsite, and reapply soil and restore site's	Types of waste and waste quantity (kg (m^3)) Number of Inspections Complaints from nearby residents	Inspections at the start of the activity and at least monthly thereafter during construction	Requireme specified ir contracts Periodic inspections MDF and GMIP

ivity	Identified Environmental Impacts	Are Impacts Potentially Significant	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Respons Party(i
			natural drainage pattern. • Minimize demolition waste (e.g., concrete foundations) and dispose of properly. • Use excavated subsoil on-site to the extent possible, reuse the surplus subsoil in other construction projects. • Restore soils/natural drainage where new pipeline installed. • Proper management of hazardous waste (solvents, adhesives, paint). Store safely (cover) until proper disposal. Prevent leaks, spills or local scavenging.			
	Impacts from lack of environmentally sound facilities or poor sanitation at construction camps (soil and water contamination)	N	• Choose or develop design standards for construction camps • Provide sound temporary sanitation facility • ties (e.g., dry toilets or pit latrines, cleanup of food services, trash/waste collection bins) • Provide off-site housing for workers (if needed) • Use minimum camp size • Remove and restore site after construction is completed. • Provide worker training on minimizing impacts on local habitats	Conformance with design standards Complaints from nearby residents Photo log	Inspections at the start of the activity and at least monthly thereafter during construction	Requireme specified in contracts Inspections MDF and GMIP

ivity	Identified Environmental Impacts	Are Impacts Potentially Significant	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Respons Party(i
	Community impacts from introduction of alcohol and other socially destructive substances via construction crews.	N	• Use local workers • Prohibit alcohol and socially destructive substances in construction camps • Use local or regional labor if possible • Install signs and reminders that alcohol/substances are prohibited	Camp inspections Complaints from nearly residents	Monthly during construction	Requireme specified in contracts Inspections MDF and GMIP
	Impacts from lack of management of construction areas, equipment and materials storage areas (soil and water contamination)	N	• Develop mobilization and demobilization plan • Install fence and signs • Set protocols for storage of materials and wastes • Set protocols for equipment storage and maintenance • Limit onsite equipment maintenance, require most maintenance offsite • Store fuels and lubricants in safe place, provide spill protection, emergency response procedures • Prevent dumping of hazardous materials • Prevent dumping of other non-construction waste • Remove and restore site after construction is completed • Clean wheels and undercarriage of haul trucks prior to leaving construction • Laying of pipeline on steep slope with extreme care not	Conform with mobilization & demobilization plans, fuels and lubricant storage and waste management protocols Inspection of shipping manifests, landfill receipts Complaints from nearby residents Photo log	Inspections at the start of the activity and at least monthly thereafter during construction	Requireme specified in contracts Inspections MDF and GMIP

ivity	Identified Environmental Impacts	Are Impacts Potentially Significant	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Respons Party(i
			to trigger landslide and to preserve vegetation. • No heavy equipment use at source site rehabilitation.			
	Air pollution from construction activity	N	• Use water sprays, covers and containment to control dust and air emissions during construction. • Prevent burning, minimize visible smoke/emissions • Use environmentally acceptable fuels (natural gas if available) for equipment.	Visual inspections Complaints from nearby residents	Monthly during construction	Requireme specified in contracts Inspections MDF and GMIP
	Noise and visual quality impacts	N	• Provide landscaping and traditional wood architecture to screen buildings/facilities. • Schedule trucks carrying construction materials at times during the day to minimize impacts to local communities. • Minimize use of heavy equipment during early morning or nights. • Screen facilities with trees or fencing to control noise and visual impact.	Landscaping and visual impact minimization measures reflected in the design. Visual inspections. Complaints from nearby residents.	Check of design documentation. Monthly during construction	Requireme specified in contracts Inspections MDF and GMIP
	Socioeconomic impacts	N	• Hire local workers. • Develop O&M plan including how to pay for needed O&M services • Community public meetings to share mitigation information.	Number of local workers, when possible Number of public meetings.	One time during construction phase (local workers); Once when O & M plans are complete;	Requireme specified in contracts Inspections MDF and GMIP

ivity	Identified Environmental Impacts	Are Impacts Potentially Significant	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Respons Party(i
			• In the event of chance find of archaeological objects the Contractor shall stop (until further notice to proceed) and shall immediately inform the Client to notify authorities.		Date(s) of community meetings	
	Public health and safety impacts	N	• Documented safety procedures. • Provide workers with protective equipment (e.g., gloves, boots, eyeware). • Maintain regular worker safety training. • Manage construction traffic to protect children and the community. • Signs clearly displayed • Protect public from stored construction materials. • Provide walkways/sheets across trenches, where people or vehicle access required.	Conformance with safety procedures Percent of workers and supervisors with up-to-date training records Number of accidents and injuries. Complaints from nearby residents Photo log	Inspections at the start of the activity and at least monthly thereafter during construction	Requireme specified in contracts Periodic inspections MDF and GMIP
	Potential impact on public health & safety due to contaminated drinking water supply during construction.	Y	• Monitoring of raw drinking water quality at WTP inlet on compliance with applicable standards. • GMIP to provide UWSCG with proper equipment and training if QA/QC capacity is found insufficient. • Providing proper facilities and procedures for handling of chlorine and other	pH, Turbidity, Sulphate, Chlorides, Calcium, Nitrate, Nitrite, Fluoride, Magnesium, Sodium, Zinc, Total coli form, Ecoli, BOD and/or other parameters per applicable standards.	Once before the start of the construction and at completion and handover. Quarterly during Construction. Site visits to check catchment	UWSCG (laboratory with QA/Q system). MDF/GMI (needed lab equipment training). UWSCG /GMIP to c

ivity	Identified Environmental Impacts	Are Impacts Potentially Significant	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Respons Party(i
			hazardous chemicals.	Proper equipment, training and QA/QC capacity at UWSCG lab. Proper facilities and procedures for chlorine handling.	conditions during turbidity events.	for proper chlorine handling. UWSCG /GMIP (observing catchment conditions)
				pH, suspended solids, turbidity, DO.	Daily	UWSCG (laboratory with QA/Q system)

6.2: Environmental Mitigation and Monitoring Plan for Operation of Oni Water Supply Improvements

	Identified Environmental Impacts	Are Impacts Potentially Significant?	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Responsil Party(ies)
ons for ply ents in Oni ity (During Defects	Impacts Include: Water and Soil Contamination, Air Pollution, Waste Generation, Noise/Visual or Socioeconomic Impacts, Public Health and Safety	N	• Use "Defects Liability" to correct defects involving water treatment and water storage tank. • Establish training for inspectors. Provide worker training on water system O&M procedures.	Number of defects corrected Number of inspections Number of complaints	Quarterly for defects liability 1 year period	Requireme specified in contracts Inspections MDF and GMIP
	Enforcement of land use restrictions and catchment management measures to protect watershed and prevent water contamination.	N	• Oni Municipality enforces land management measures in watershed (to control grazing and forest cutting). • New construction not allowed in water catchment area. • Cattle and pig grazing not allowed in areas adjacent to Karstic water source.	Oni Municipality introducing proper land management regulation for the source watershed. Local warden employed by UWSCG in Skhanari village. Number of inspections. Number of enforcement actions. Number of complaints from residents.	Quarterly in first year and annually after first year.	Requireme specified in contracts Periodic inspections MDF and GMIP Enforceme Oni Municipali and UWSC
	Soil, Water and other Environmental Impacts due to weak municipal water supply operation and maintenance (O&M).	N	• Strengthen Oni water supply O&M program. Establish plan for funding water supply O&M. • Organize data collection, identify O&M problems throughout the municipal water distribution network and design solutions	Number of inspections Number of complaints from nearby residents	Quarterly in first year and annually after first year.	Requireme specified in contracts Periodic inspections MDF and GMIP

	Identified Environmental Impacts	Are Impacts Potentially Significant?	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Responsil Party(ies)
			including better operating guidance, preventive maintenance, program schedules and activities, training for stronger management systems for maintenance workers including use of "how-to" guides and information on best practices, and proper facilities and procedures for handling of chlorine and other hazardous chemicals.			UWSCG to maintain ar monitor chlorine handling facilities ar procedures
	Potential impact on public health & safety due to contaminated drinking water supply upon completion of construction and during operation.	Y	• Monitoring of raw drinking water quality at WTP inlet on compliance with applicable standards.	pH, Turbidity, Sulphate, Chlorides, Calcium, Nitrate, Nitrite, Fluoride, Magnesium, Sodium, Zinc, Total coli form, Ecoli, BOD and/or other parameters per applicable standards.	Once after the completion of the construction, at handover. Quarterly during operation.	UWSCG (laboratory with QA/Q system)
				pH, suspended solids, turbidity, DO.	Daily	UWSCG (l with QA/Q system)
			• Monitoring of treated drinking water quality at WTP outlet on compliance with applicable standards.	pH, Turbidity, Sulphate, Chlorides, Calcium, Nitrate, Nitrite, Fluoride, Magnesium, Sodium, Zinc, Total coli form, Ecoli, BOD and/or other parameters per	Once after the completion of the construction, at handover. Quarterly during operation. Site visits to check catchment conditions at	UWSCG (laboratory with QA/Q system) UWSCG (observing catchment conditions)

	Identified Environmental Impacts	Are Impacts Potentially Significant?	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Responsi Party(ies)
				applicable standards.	turbidity events.	

7. LIST OF PREPARERS

Baseline data collection, field studies, alternatives analyses, impact assessment and development of EMMPs and completion of this EA was conducted by a specialized team of scientists and engineers from Tetra Tech. Backgrounds of principal members of the EA Team are highlighted below:

James Gallup, Ph.D., P.E., Team Leader and Environmental Engineer. Dr. Gallup is a senior environmental engineer with over 40 years of international experience, including projects in Georgia. He led a team that prepared a Programmatic Environmental Assessment (PEA) for the USAID AgVANTAGE Project implemented by ACDI/VOCA. He has provided direct technical support to the Europe and Eurasia Bureau Environmental Officer and he designed and implemented USAID's Global Environmental Pollution Prevention Project (EP3). Dr. Gallup, a registered professional engineer, earned his Ph.D. in Environmental Engineering from the University of Oklahoma. He holds a BS in Microbiology and MS in Environmental Engineering.

Mamuka Gvilava, Ph.D., Environmental Specialist. Dr. Gvilava is an environmental specialist with fifteen years experience in field work, project management, environmental policy development and regional cooperation. He has experience with environmental and social impact assessment, remote sensing, GIS and green design. He is the national ICZM focal point to the Black Sea Commission, and served as project director of the World Bank and GEF coastal management project. He has a Ph.D. in physics and math.

Mamuka Shaorshadze, EHS Specialist. Mr. Shaorshadze has 12 years relevant experience, most recently as an environmental supervisor on two Millennium Challenge Georgia (MCG) fund infrastructure programs. He also served as an Environmental Field Officer for the Georgian Oil and Gas Corporation initiatives funded by the MCG. Mr. Shaorshadze earned his Bachelor's Degree in International Economics from Georgian Technical University.

In addition to core team members, additional experts were mobilized to contribute with additional studies identified during scoping. **Omar Gogrichiani, Hydrogeologist** of the National Environmental Agency and **Andrei Kandaurov, Biodiversity Expert** from the Institute of Zoology were involved for EA baseline studies for hydrogeology and biodiversity/habitats and their reports are included as EA appendices. Dr. A. Bukhnikashvili and A. Goderidze assisted Dr. Kandaurov.

8. APPENDICES

Appendix 8.1: Minutes of the Stakeholder Meeting (September 7, 2012)

Appendix 8.2: Oni Environmental Site Visit Inspection Report

Appendix 8.3: Ecological Survey of the Project Area (Biodiversity, Habitat/Ecosystems)

Appendix 8.4: Survey of Hydrogeology & Geology of Oni Project Area

Appendix 8.5: Detailed Design of Oni's Water Supply Scheme

Appendix 8.1 Details of Oni Stakeholder Meeting

This appendix provides the details of the Stakeholder Meeting held in Oni on September 7, 2012. The appendix includes meeting participants, speaker information and opinions, proposals and recommendations, photos, agenda and list of participants.

1.1 Introduction

Municipal Development Fund (MDF) of Georgia and TetraTech, in coordination with the project sponsor USAID-Georgia and project beneficiary United Water Supply Company of Georgia (UWSCG), organized Environmental Scoping Stakeholder Meeting for the proposed Oni Water Supply Improvement Sub-Project under the Municipal Rehabilitation component of the Georgia Municipal infrastructure and IDP housing rehabilitation project (GMIP).

The stakeholder meeting was held on September 07, 2012 at 13:00 at the Gamgeoba Premises, Oni Municipality, Georgia. The aim of the meeting was to provide project stakeholders with the information regarding the sub-project, as well as to explain the technical as well as environmental issues important for the Environmental Assessment (EA) of Oni Water Supply Improvement Sub-Project to be implemented under GMIP.

1.2 Itinerary

Notice about the meeting was posted at the entrance of the Gamgeoba Premises few days before the meeting. Local self-governments' public information board was used to display the announcement informing the public about meeting purpose and location. In addition to this, UWSCG and its Service Center in Oni – the Government owned company in charge of the investment, operation and maintenance of the water supply networks in Georgia (except Tbilisi and Adjara) – the main beneficiary of the project component, were kindly requested to facilitate the invitation and participation of the project stakeholders, including its own staff concerned, as well as the representatives of the local self-government (various services of Oni Gamgeoba) and the local public.

The text of the public notice/announcement is provided in Annex A. Agenda of the meeting is reproduced in Annex B. Some photos documenting the meeting are provided in Annex C. List of invited and attending participants / the registration sheet are provided in Annex D. Copy of the presentation is attached as Annex E.

The meeting, including it question and answer sessions, was recorded in audio and webcam format, which is kept in project files. Presentation facilities at the meeting included overhead projector with PowerPoint file (in Georgian language). The meeting was logistically organized by MDF and TetraTech, while proceeding was facilitated by Mamuka Gvilava, environmental consultant of TetraTech, Georgia.

1.3 Presentations

After the presentation of the agenda and personal introduction of all participants the meeting was addressed on behalf of the project implementer by Mr. Kartlos Gviniashvili, MDF Coordinator for GMIP. He thanked and welcomed participants of the meeting.

With introductory statement the meeting was also addressed by Mr. Jeffrey Fredericks, USAID/TetraTech, GMIP Chief of Party. He described basic parameters of the project with over $50 million allocated by USAID to municipal, IDP and irrigation components of the project, explained rationale behind Oni Water Supply sub-project and the EA requirements due to USAID regulations. He welcomed Oni Municipality, MDF, UWSCG representatives as the participants and beneficiaries of the project, explained the purpose of the environmental meeting and briefly introduced the project organization and its municipal component in particular. Highlighted that GMIP is supporting at least two sub-projects in Oni: rehabilitation of Oni and water supply.

Technical description of the project was presented by Mr. Korneli Darsavelidze, design engineer from Georgia Water Project (GWP), engineering consultant to UWSCG for Oni Water Supply. He mentioned that GWP designed in 2012 Oni Water Supply Improvement sub-project. There are two sources of water supply to Oni, Zhizhoreti and Kvedrula systems. First one is just 20 l/sec flow supply, but is sometimes compromised by suspended particulates during Rioni flooding events. There is separate project for Zhizhoreti elaborated as well, including provision of chlorination, cleaning and covering filtrate manholes with roofs, fencing, guard house, etc. As for Kvedrula system, it entered into operation in 1970-s. Source is Karst waters, 25-40 l/sec, increasing to maximal rates during rainy events & season. Zhizhoreti only supplies lower elevations in Oni, therefore there is a need to improve situation with Kvedrula system. Planned measures include following: clearing water sources and rehabilitation including dealing with leakages. Pipeline of 9.3 km with dia 300 mm and 200 mm is supplied to Oni, without using existing damaged water storage tank. Pipeline is not part of the project as this was not the task of the design ToR. Problem with current system is particulate pollution during rainy events and no capacity of regulation and storage. Existing storage tank is very dangerous and can not be filled with water due to imminent risk to population in case of failure. This storage tank never worked since 1970-s. Part of the proposed design is the water purification system, which would operate during water quality reduction events caused by suspended particulates. In other periods water is clean and no purification is required. Initial design included Finish and German systems, but their maintenance and operation was questionable, therefore simplest possible engineering solutions were advised. Initial idea was to build in the place of existing storage tank, even topography was surveyed in winter time, but after snow melted it became clear that storage tank is unfit and located where there is no place for chlorination and other facilities as well. The option proposed was to build purification infrastructure at the terrace just above Oni. Design includes pressure reduction unit, measurement unit, 2 vertical sedimentation units with 15 l/sec capacity and two rapid filters, with capacity up to 17 l/sec. Design parameters for purification were calculated for 15 l/sec flows and 250 l/day per inhabitant. One filter will work and another will back-up. Purified water enters 1,000 cub. m storage tank and in peak hours 30 l/sec can be supplied. Disinfection is through electrolysis method with active chlorine generation. Once water is clean the main pipeline is directly supplied to storage tank. During turbidity spikes purification system would be switched on. Treated water is supplied to 250 m distance new 300 mm pipeline across the pine forested slope to connect with the

manhole located near old storage tank from this point to connect with water distribution network. The proposed territory for treatment plant has access roads. As for the source water, no rehabilitation or demolition activities were planned there and this infrastructure will remain forever in the exiting location as a kind of 'monument'.

Questions and Answers session followed the technical design presentation.

The following question was asked by Oni municipality representative: at Zhizhoreti is it planned to change asbestos-cement piping system? These asbestos-cement pipes are in bad condition and there are frequent repairs needed and without changing them we will have a problem with supplying water for Oni.

Feedback was provided by the presenter, that asbestos-cement pipes are operating in Zhinvali, in Tbilisi and in many international systems and this is not problematic. Filter is operations at Zhizhoreti and has no problem.

Another question was raised that 15 l/sec is not sufficient for Oni in summer during summer time recreation and holiday visitors, when population of Oni triples, with population number surging up to 10,000.

Response provided by technical expert was that 15 l/sec is only during pollution events; otherwise up to 40-50 l/sec can be supplied to Oni. The Explanatory Note to the design provides that Oni population doubles in summer and we agreed with UWSCG 250 l/day parameter instead of regularly defined 160 l/day elsewhere (for instance in Khashuri and Surami). Chlorination is considered for 50 l /sec capacity. So this is the regular rate of supply and during pollution events only the purification is needed. Increasing this capacity to 30 l/sec would dramatically increase the cost of construction and operation.

UWSCG also responded that during spring and autumn due to suspended particulates water needs purification (some 1 month period), but during August water is clean, therefore visitors will not be affected by water shortage.

Question was again asked whether this is only water purification project and not water source capacity increase project. This could leave the town with future problem of quantity of water rather than quality only.

Presenter clarified that according to terms of reference the task was to purify water from particulates during precipitation events and to provide disinfection as well. Water metering could be the solution for water quantity.

Environmental scoping of the Oni water supply sub-project was presented by Mr. Mamuka Gvilava, Environmental Specialist of TetraTech, Georgia. Substance of the presentation was concerned with scoping issues such as potential project alternatives, key environmental issues of the project component to be considered in EA, etc. Presentation was closely following the PowerPoint file, which is reproduced in Annex E. After the presentation of the environmental scoping issues the presenter invited participants to raise their questions (Q&A session is reproduced in the next subsection). The presenter than facilitated the discussion session with stakeholders to identify and/or confirm key environmental issues. Results of this discussion are reported in the subsequent sub-section further below.

1.4 Questions & Answers

The participants were invited to raise their questions.

Question. *Design engineer commented the need for construction norms and rules which are now missing in Georgia. In 2006 Sanitary Protection Zones were legislated and this resolved many questions. Now we need similar rules and norms for environmental protection. Second issue is related to potential loss of water source; please clarify what is meant under such impact on water supply?*

Response. Presenter responded that potential impact mentioned is of land use nature, not hydrogeological conditions. As for the norms and rules, this is the issue for UWSCG to deal with in future, but EA is the instrument to analyze legal and institutional issues and in case of deficiencies to provide respective plan of action and mitigations both to address construction as well as operation/maintenance periods. EA provisions will be obligatory for contractor as well as operator of the facility. Issues of legislative nature can not be resolved with single project, but UWSCG was urged to work with Ministry of Environment Protection to include water supply projects into the list of project subject to EIA per Georgian legislation – this will only be beneficial for their operations.

Question. *Sanitary zone is or not of the part of the project?*

Response. Design consultant responded that purification systems will be fenced with fences with concrete foundations, and guard house and guard will be provided. Even 'birds' would not be able to penetrate.

Environmental consultant noticed that land use regulations are required to provide for long term sustainability of the water source.

Question. *At Zhizhoreti there is road passing. Currently both cows and people can enter. There is a need of sanitary zone delimitation/enforcement and fencing there.*

Response. Environmental consultant intervened that this project is not concerned with Zhizhoreti, unless there is need for analysis for potential connection with planned activities via indirect impacts. USAID's GMIP is not supporting activities at Zhizhoreti.

Response. Technical design consultant also responded that Zhizhoreti is so called 'reserved' source. There is a separate project of UWSCG which includes sanitary zone, chlorination and fencing including guard's house. UWSCG representative confirmed this and also that this project is not considered under GMIP, rather it is a separate activity of UWSCG. Road relocation is an issue there as well, since sanitary zone will require separate construction of bypass road for population.

This concluded the Q&A session for environmental scoping presentation.

1.5 Discussions

Facilitator of the meeting invited participants to elaborate their opinion with regard to the pre-selected issues displayed on screen using PowerPoint projector.

Discussion issues. *What are the expected problems associated with the planned rehabilitation?*

Feedback of stakeholders. Design consultant mentioned noise and potential spillages and other impacts from heavy construction equipment.

Representative of local heritage society did not exclude the possibility of archeological finding at this proposed territory. Preparedness for archeological chance finds needs to be considered. As for Japaridze museum, it does not have official status.

Discussion issues. *What are the benefits to local citizens?*

Feedback of stakeholders. Better water supply for Oni, employment opportunities. Design consultant was asked to elaborate on planned numbers of employed people and at peak of construction it was agreed that equals up to 50 persons for couple of months. So this project will not solve at large employment problem in Oni. Local workforce maximization was kindly requested, but this is probably up to prospective contractor. During exploitation several personnel would be employed continuously (4-5 persons).

Question. *What impact will the rehabilitation have on surface waters, wetlands, and local ecosystems?*

Feedback of stakeholders. No sensitive ecosystems could be reported in the location. One concern was mentioned the potential leakage from storage tank. No storage tank is free from leakage and if this will be significant, geotechnical instability can be a concern. But design consultant was not concerned with this issue.

Discussion issues. *What is happening to the quality of the soil and land resources in the area? Would these (and how would these) be affected by water system improvements?*

Feedback of stakeholders. No issue was identified by present audience, even with grazing, but environmental consultant mentioned that he witnessed grazing himself during the filed visit to proposed storage tank location. Current and future land uses around the water source catchment areas should be of concern as well.

Discussion issues. *Are there any current problems with pathogens or water-borne diseases? Would this be affected by water system improvements?*

Feedback of stakeholders. Head of Kutaisi/Tskaltubo regional laboratory was not concerned with bacterial pollution. Only nuisance is with turbidity. Oni representatives still considered this as significant nuisance and concern for local population as it is legitimate if they might be suspicious during turbidity events how harmful this water is. Head of laboratory advised to use water for 'technical' purposes during these episodes.

At the initiative of the environmental consultant it was agreed that MDF will officially write to UWSCG requesting available water quality time series and location information, preferably in electronic format.

NB: *MDF should write and submit this letter ASAP.*

NB: *One SC Head was requested to document turbid episodes with photographs.*

Technical design consultant mentioned that according to ToR 90 mg/l turbidity was requested to treat, but in reality design engineers accounted for 250 mg/l initial turbidity, with sedimentation system reducing it to 12 mg/l and after purification filters the water would be just pure. Environmental consultant still kindly asked for monitoring results, so that improvements can be documented and confirmed.

Question. *What are the long-term prospects for maintaining improvements? Who will maintain them and How? Who will pay for maintenance?*

Feedback of stakeholders. UWSCG informed that now land belongs to local authority, but after rehabilitation it will be handed over to UWSCG, which will operate the facility. MDF informed that O&M manual will be produced as part of the project. Design consultant confirmed that it is very important to have proper arrangements for O&M. Oni alone will not be able to operate, so UWSCG support is needed to guarantee O&M with proper funding. UWSCG mentioned that its capacity is improving and doubts are less today than few years ago, but in general no-one is immune from institutional changes.

Discussion issues. *Are there differences in men's and women's roles and relationships that may affect the long-term future of the municipal improvements and the environment?*

Feedback of stakeholders. Women will be clear beneficiaries, because during this 1 month period of turbidity even washing machine can not be operated. It was also mentioned with satisfaction that gender equality was clearly facilitated with equal representation at this consultation meeting.

Discussion issues. *What realistically may happen when the project ends? What will the project area look like in 30 years?*

Feedback of stakeholders. Environmental consultant highlighted importance of this issue considering failure with existing storage tank. UWSCG representative stressed that company is committed to further improve its operations, and looks like from today's perspective the company will be able to properly operate the system.

Design consultant also brought the issue of engineering heritage of Georgia, reminding the example of historical water supply in Vardzia in 11th century. Environmental consultant welcomed such an approach and called for some changes in design so that visual impacts of the proposed project can be mitigated, showing example of simple landscaping tool used in Oni Orion hotel. Another example brought was to use local architecture for ancillary infrastructure, also to provide blending color for fencing.

Last but not least, the consultant highlighted ultimate importance of Heath and Safety issues demonstrating this with the TV media still image taken from recent water supply system visit by high level officials: non of the officials were carrying proper Personal Protective Equipment (PPE), while one high level official indeed was filmed in extremely dangerous situation (sitting on 4-5 m high concrete pouring wooden pile). All stakeholders were strongly urged not to allow site entry without proper safety measures. Situation should not be repeated during USAID funded project as well as for any other UWASG project implementation.

This concluded the discussion session and the meeting. Organizers thanked local stakeholders for active participation in this very informative meeting.

1.6 Conclusions

Meeting lasted from 13:00 to 15:00. It was well attended and organized as planned (with few exceptions) and was very substantive. Participants were represented by various stakeholders, including representatives of operator company, local communities as well as local government authorities. Unfortunately MDF and UWSC environmental management personnel were missing at the meeting despite advanced invitation and confirmed commitment to come. Atmosphere at the meeting was quite relaxed; all those wishing to express their opinion were readily given such an opportunity. Female were at least 30% of participants. Meeting was facilitated by TetraTech environmental specialist, with moderating back-up by MDF GIMP Coordinator. Project management was well represented by TetraTech team and key MDF representative in charge of GMIP. Meeting room was kindly provided by local authority. Due to some construction works in the central square of Oni some noise was clearly the nuisance during the meeting. GMIP project can avoid similar nuisances for population of Oni as much as possible by planning proper mitigation measures throughout EA process.

Annex A. Announcements

Text of the announcement displayed at the entrance of the Oni Gamgeoba Building:

ANNOUNCEMENT

USAID funded GMIP Project, Municipal Component

Oni Water Supply Improvement Project

Stakeholder Meeting (Environmental Scoping)

Municipality Gamgeoba Building, 1, Agmashenebeli Street, Oni

13:00, Friday, 7 September 2012

Municipal Development Fund of Georgia is pleased to announce that the stakeholder meeting to discuss the environmental scoping of the Oni Water Supply Improvement sub-project under the USAID funded Municipal Infrastructure Rehabilitation Project (GMIP) will be held on Friday, 7 September 2011 at 13.00, at the meeting room of the Oni Municipality Gamgeoba, at the address 1, Agmashenebeli Street, Oni.

Proposed GMIP sub-project comprises the construction of the water supply treatment plant and distribution reservoir in Oni. The meeting will discuss the technical aspects, as well as will consult with stakeholders on issues important for environmental scoping of this sub-project. Those interested to participate should contact meeting organizers at the address and contacts indicated below.

Municipal Development Fund of Georgia
Nino Patarashvili, Project Officer
150 Agmashenebeli Ave., 0112, Tbilisi, Georgia
Mobile: +995 (599) 38 22 92
E-mail: npatarashvili@mdf.org.ge

Tetra Tech/USAID - Municipal Infrastructure and IDP Housing Rehabilitation Project
Mamuka Shaorshadze
Environment, Health and Safety Specialist
154, Agmashenebeli Ave., 0112, Tbilisi, Georgia
Mob: +995 (595) 11 60 71
E-mail: mamuka.shaorshadze@tetratech.ge

Annex B. Agenda

AGENDA

USAID funded GMIP Project, Irrigation Component

Oni Water Supply Improvement Project

Stakeholder Meeting (Environmental Scoping)

Municipality Gamgeoba Building, 1, Agmashenebeli Street, Oni

13:00, Friday, 7 September 2012

1. Welcome and meeting objectives, introduction of all participants (Oni Municipality, UWSCG, MDF, USAID/TetraTech)

2. Introduction into technical aspects of Oni Water Supply Improvement Project (Korneli Darsavelidze, Chief Engineer, SakTskalProekti – Georgian Water Project)

3. Environmental scoping of the Oni Water Supply Improvement Project (Mamuka Gvilava, Environmental Specialist, TetraTech, Georgia)

4. Discussion on potential key environmental issues.

5. Conclusions and meeting closure (MDF, USAID/TetraTech)

Annex C. Photos

Annex D. Participants

	Name/Organization	Title	Signature
	USAID		
1	Brad Carr	Water, Irrigation, and Infrastructure Advisor	
2	Maya Chelidze	Acquisition Specialist	
3	George Kokochashvili	Engineering Specialist	
4	Gocha Lobzhanidze	Project Management Specialist	
	Tetra tech		
1	Jeffrey Fredericks	COP	
2	Vasil Apkhazava	QC/QA Specialist	
3	Mamuka Gvilava	Environmental Consultant	
4	Mamuka Shaorshadze	EHS Specialist	
5	Givi Varduashvili	IDP Housing Specialist	
6	Akaki Shubitidze	Road Engineer	
7	Maia Dali	Translator/Interpreter	
8	Anna Urotadze	Document Control Manager	
	[illegible]		
	Oni Municipality		
1	Temur Skhiereli	Chief Specialist, Architects Service	
2	[illegible]	[illegible]	
3	[illegible]	[illegible]	
4			
	Arnabi 21		
1	David Jgenti	Director	
2	Nugzar Mirimanov	Designer	
3	Valeri Garjava	Chief Engineer	
4	Giorgi Lobjanidze	Construction engineer	
5	Ilia Mtskhvetadze	Environmental Specialist	
6		CQ Manager	
	[illegible]		
	MDF		
1	Merab Chivadze	Road Project Manager	
2	Vasil Pekhmashvili	Road Engineer	
3	Devna Gugeshashvili	Supervisor	
4	Kartlos Gviniashvili	Program Manager	
	Total	25 Persons [illegible]	

List of Participants for Stakeholder Meeting Held on Sep 7, 2012 in Oni

	Name/Organization	Title	Signature
	MDF		
1	Kartlos Gviniashvili	Program Manager	
2	Nino Patarashvili	Resettlement and Environment	
	Local Authorities		
3	Giorgi Metreveli	Oni Municipality Envoy	
4	Mikheil Bidzishvili	Oni Acting Gamgebeli	
5	Givi Bendianishvili	Oni Municipality Head of Infrastructure Service	
6	Mamuka Metreveli	Oni Municipality Environmental Protection Service	
7	Makhvala Japaridze	Local NGO Representative	
8	Gia Berishvili	Chief Scientist of R. Japaridze Museum	
	UWSCG		
9	Gogi Andghuladze	Projects Department Chief Specialist	
10	Aleksandre Zabakhidze	Imereti, Racha-Lechkhumi Regional Manager	
11	Tinatin Zhizhilashvili	Resettlement and Environment Division	
12	Khatuna Nebieridze	Laboratory Specialist	
13	Misha Lobzhanidze	Oni Service Center Manager	
14	Zaza Japaridze	Technical Department Head	
	[illegible]	[illegible]	
	Georgia Water Project		
15	Korneli Darsavelidze	Chief Engineer	
	[illegible]	[illegible]	
	Tetra tech		
16	Jeffrey Fredericks	COP	
17	Teimuraz Levanishvili	Housing Rehabilitation Manager	
18	Givi Varduashvili	Civil Engineer	
19	Mamuka Gvilava	Environmental Consultant	
20	Mamuka Shaorshadze	EHS Specialist	
21	Vasil Apkhazava	QA/QC Specialist	
22	Kako Shubitidze	Roads Engineer	
23	Koba Tsiramua	Regional Engineer	
24	Avtandil Baramia	Construction Oversight Engineer	
	[illegible]	[illegible]	
	Total	**Persons 24**	

[illegible]

Annex E. Presentation

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Municipal Infrastructure and IDP Housing Rehabilitation Project (GMIP)

Oni Water Supply Improvement Subproject

Stakeholder Meeting (Environmental Scoping)

September 7, 2010

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Objectives of the meeting:

- Introduction into GIMP
- Technical aspects, Oni water supply project
- Environmental Scoping of Oni water supply
- Discussion on potential key environmental issues to be addressed in the EA

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Municipal Infrastructure and IDP Housing Rehabilitation Project

USAID | GEORGIA

Municipal Infrastructure and IDP Housing Rehabilitation Project

Implementation: Municipal Development Fund

Subproject: United Water Supply Company & Georgia Water Project

Engineering oversight: Tetra Tech

Donor: USAID

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Location: Oni Municipality of Georgia

The purpose of this project is to improve the quality and quantity of drinking water provided to the residents of Oni. New treatment will improve water quality and the new reservoir will provide a continuous supply of water. This infrastructure rehabilitation project will contribute to improve and economic growth of Oni municipality and improve the social condition of the local population.

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Map: Schematic Layout of Oni Water Supply

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Main features of Oni Water Supply:

- Sources:
  - Karst spring source at Kvedi (~80%)
  - River Rioni filtrate at Zhizhoreti (~20%)
- Delivery:
  - 9.3 km pipeline from Kvedi to Oni
  - 2 km pipeline from Zhizhoreti to Oni
  - No treatment, no buffering reservoir

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Oni Water Supply: Environmental SCREENING

National environmental requirements:

- EA not required (Law on Env. Impact)

International environmental requirements:

- EA required (US Federal Regulation 216)

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Oni Water Supply: Environmental SCOPING

- Define alternatives
- A determination of the scope and significance of issues to be analyzed in the EA
- Elimination from detailed study of the issues that are not significant
- Establish implementation schedule
- Define EA structure & methodology

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ALTERNATIVES

Alternative 1: no action

- quality of life not improved / lost opportunity

Alternative 2: proposed action

- feasible

Alternative 3: groundwater source

- high cost / reliable electricity

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Map: Planned rehabilitation and construction

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Main activities of Oni water improvement:

- Repair of existing source at Kvedi:
  - Manual repair of trapezoidal structure & chambers
- Build new water treatment plant in Oni:
  - Pressure regulator well (16 am), settling basin (d=4.3m, h=3.9m), high rate filter (5mx6m, d=3.3m), well with pumps, concrete chlorination chamber (8.2mx6.4m, h=3.3m), manholes, pipelines (several hundred m), etc.
- Construct new storage reservoir in Oni:
  - dia=18m, depth=4.8m, volume=1000 m^3

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Potentially significant IMPACTS (both for construction & for operation):

Deterioration of upstream ecosystem that could result in contamination of Oni's Karst water source.

- Identify upstream land use and determine land use requirements.

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Potentially significant IMPACTS (both for construction & for operation):

Impacts to threatened, endangered, and protected species. Disruption of sensitive ecological habitats.

- Identify presence of TES and/or sensitive habitat. Determine possible short and long-term habitat alterations.

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Potentially significant IMPACTS (both for construction & for operation):

Impacts to cultural resources such as Revaz Japaridze Home-Museum.

- Identify cultural resources of importance in the vicinity of the projects and as appropriate for the specific resources, measures to remove or protect.

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Potentially significant IMPACTS (both for construction & for operation):

Human health impacts due to poor drinking water quantity or quality.

- Identify chemical and biological contaminants in water; identify water quantity availability & water needs of Oni.

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Potentially significant IMPACTS (both for construction & for operation):

Visual and landscape impacts due to water supply structures.

- Define visual impact mitigation measures; redesign non-essential facilities of the treatment plant; screening & landscaping.

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Potentially significant IMPACTS (both for construction & for operation):

Cumulative impacts.

- Define and analyze potential for cumulative impacts in space and time.

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MILESTONES:

- Environmental Assessment: October, 2012
- Announcement of bidding: November, 2012
- Start of construction: Spring, 2013
- Completion of construction: 9 months

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CONTACTS:

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QUESTIONS ?

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Potential environmental & social ISSUES

- What are the expected problems associated with the planned rehabilitation?

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Potential environmental & social ISSUES

- What are the benefits to local citizens?

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Potential environmental & social ISSUES

- What impact will the rehabilitation have on surface waters, wetlands, and local ecosystems?

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Potential environmental & social ISSUES

- What is happening to the quality of the soil and land resources in the area? Would these (and how would these) be affected by water system improvements?

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Potential environmental & social ISSUES

- Are there any current problems with pathogens or water-borne diseases? Would this be affected by water system improvements?

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Potential environmental & social ISSUES

- What are the long-term prospects for maintaining improvements?
- Who will maintain them and How?
- Who will pay for maintenance?

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Potential environmental & social ISSUES

- Are there differences in men's and women's roles and relationships that may affect the long-term future of the municipal improvements and the environment?

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Potential environmental & social ISSUES

- What realistically may happen when the project ends? What will the project area look like in 30 years?

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Safety First !..

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Thank you for participation !

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CONTACTS:

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Appendix 8.2 Oni Environmental Site Visit Inspection Report

August 14, 2012

To: Jeff Fredericks, Tetra Tech, GMIP COP

CC: Ilia Eloshvili, Tetra Tech, Deputy COP; Jim Gallup, Environment Team Leader

From: Mamuka Gvilava, Environmental Specialist, Givi Varduashvili, Project Engineer

Subject: GMIP, Environmental and Technical Site Visit Report for Proposed Oni Water Treatment Plant Construction (August 09-10, 2012).

I. Objectives

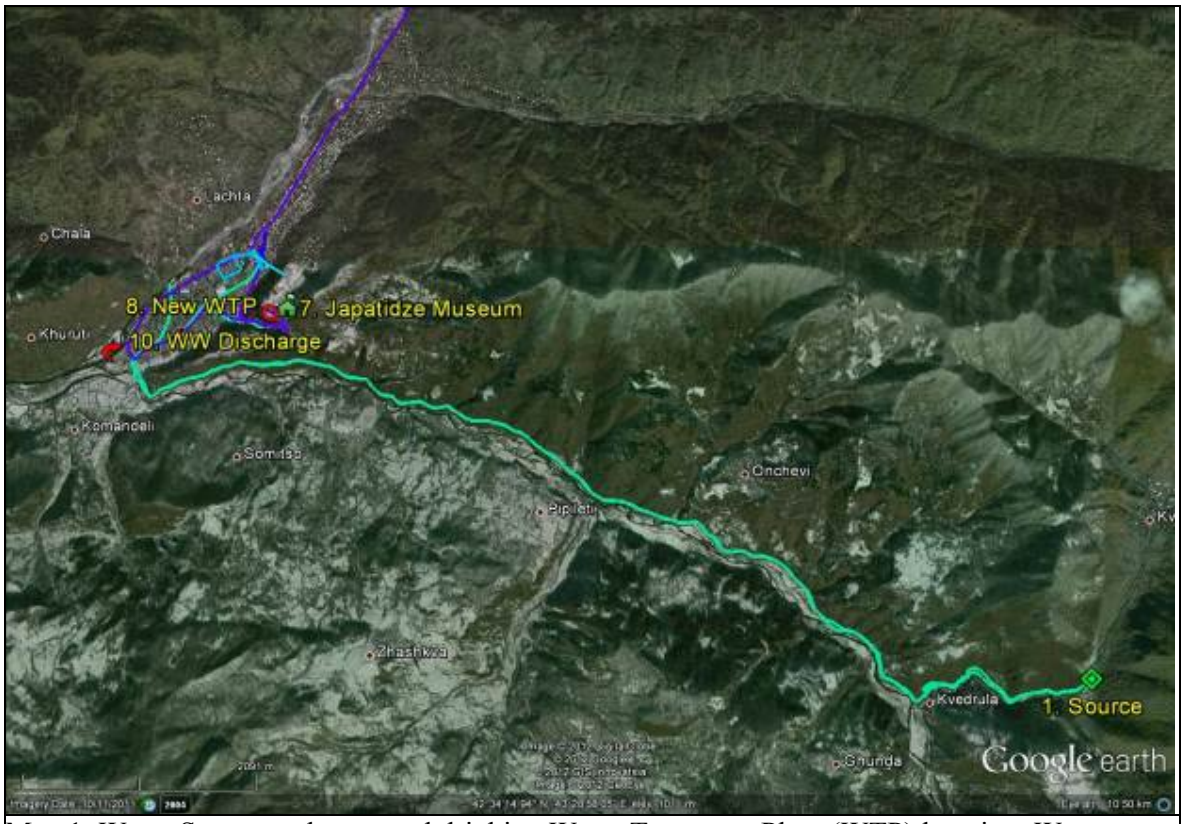
Two day environmental site visit to proposed Oni water supply construction to:
(1) Visually assess and report on site environmental conditions.
(2) Elaborate on regulations with regard to EIA requirements.
(3) Provide initial findings and recommendations on environmental safeguards.

II. Site Visit and Consultation Report

At the request of GIMP COP the environmental and technical inspection was performed by Mamuka Gvilava, Environmental Specialist and Givi Varduashvili, Project Engineer of TetraTech. The duration of the trip was 2 days including approx 2 x 6 hours for driving to and from Oni. One more day was devoted to report writing. On arrival (approx 18:00) Tt team was met by representatives of United Water Supply Company of Georgia (UWSCG), namely Giorgi Andguladze, Giorgi Murghulia (Chief Specialists of Projects Department from Tbilisi), Nodar Chkhikvadze (Technical Manager of Imereti and Racha-Lechkhumi Regional Branch), Michael Lobzhanidze (Head of Oni Service Center) and Korneli Darsavelidze (Chief Engineer of SakTskalProekti – Georgian Water Project), who kindly accompanied us at two sites to jointly visit first water source facility approx. 9 km upstream Jejora River (left tributary of Rioni River) and Kvedrula Stream (right tributary to Jejora) and then to visit proposed location for new water supply plant construction (to host 1,000 cub. m storage tank, filtration and chlorination units and other related facilities). UWSCG team and the design consultant then left for Tbilisi. Next day morning Head of Oni Service Center kindly accompanied us to visit old water supply stoage tank location as well as lead Tt team to show Oni wastewater discharge point to Rioni. On the way back Tt team visited IDP housing construction site in Terjola (see findings separately).

First we report below site visits and on-spot discussions held with UWSCG representatives, then field observations as comments to photo illustration are provided (pictures are available with Tt DCC).

Map 1 depicts the location of Oni water source and proposed drinking water treatment plant. Each site presentation is accompanied by zoomed in Google Earth map as well.



Map 1. Water Source and proposed drinking Water Treatment Plant (WTP) location. Wastewater (WW) discharge point is also shown. Goggle Earth file can be accessed by clicking here: Oni WS.

Kvedrula water supply source (visited 20120809):

- Water is collected from Karst geological layer with trapezoidal abstraction concrete structure with attached distribution building with two chambers (for possibility of maintenance without interruption). As reported by design consultant, it is possible to repair the building/structure by switching waterflow between these two chambers.
- Earlier Karst stream was flowing from the mountain in this spot, with all stream water now being collected for Oni (min 15 l/sec, max 25-30 l/sec). During prolonged precipitation events water is reported to become turbid (probably with Karst limestone particles) so that in some cases turbidity levels are so high that for some time (can be days, even weeks), water reportedly becomes non-potable.
- Proposed rehabilitation works for the abstraction structure (in former Soviet countries referred to with French term 'Captage') are quite minimal and reportedly do not require any heavy equipment; rather hand labor and manual delivery of required materials.
- Initially the source site was provided with entire treatment process (filtration, chlorination, some settlement and storage capacity) but this is not functional for a long time now. The site was and is still protected by the concrete wall along the Kvedrula Stream.
- The Service Center Head informs that Oni does not have lab capacity, and they rely on Ambrolauri service center and Kutaisi regional branch to periodically check water quality.

Map 2. Layout of the water source and initial (now out of function) water treatment facilities (north is tilted). Goggle Earth file can be accessed by clicking here: Oni WS.

Landscape and mountain forest cover of Kvedrula catchment is beautiful.

Layout of headwork from access bridge. Visible also are Kvedrula Stream and its bank protection wall, guard room and old transformer. Other facilities, located just further from transformer, are screened by vegetation.

Filtering facility (cylindrical structure in the background) and settling tank.
(Can these structures be used to house some of the new treatment facilities?)

Chlorination facility at source site

Chlorination and check manhole (water was under good pressure, no noticeable turbidity).

Trapezoidal karst stream water abstractor. Below: reversed views towards the same structure.

Access to source structure
(not visible, it is screened by vegetation).

Access to source facility (no equipment access, only manual labor and had delivery foreseen to rehabilitate the source structure).

Access to chambers and valves (all in need of renewal) through damaged and unsafe ladder.

Typical damage to source building (including leaking). Bottom pipe is the Oni water supply. Spillover pipe also visible behind the ladder.

Pipe with water for Oni.

Spillover pipe.

Inside view of the source building with two chambers and control valves.

Landscape at the source.

Site access bridge, Kvedrula bank protection.

Access roads to source site (in reversed sequence, when leaving the site).
Rock fall is one of the safety hazards.

Bridge across Kvedrula, along the main access road (it goes parallel to Jejora River).
Source site appears to be of hiking interest.

Water pipe crossing under the bridge over Kvedrula (water leak founting under pressure).

Map 3. Proposed WTP location (in proximity with R. Japaridze House-Museum) and location of the old storage tank (north is tilted). Goggle Earth file can be accessed by clicking here: Oni WS

Proposed Water Supply Plant location (visited 20120809):

- New water storage tank (1,000 cub. m) and all related facilities (twin 'fast' treatment filters, pumps for filter cleaning, vertical settler, chlorination unit, control and guard house, fence, various manholes, valves and piping) are proposed in a new location, in place of the former Soviet-style tourist base (so called TurBaza), which were quite low

impact buildings with point and strip foundations, now entirely dismantled to foundations, which remain in place. Name of the tourist base "Bolota" probably comes from Russian Bolota, because this flat terrace has some wetlands characteristics.

- The location is quite picturesque, and despite past impacts from tourism facilities, it can be considered as greenfield area, surrounded by beautiful vistas of mountainous Racha region.
- In addition to beautiful landscape, the site hosts the local heritage, the house-museum of the locally and nationally known contemporary writer Revaz Japaridze. It is quite probable that dwellers and owners of the house-museum may not want to have WTP development in front of their viewscape. In any case, clearance with the national and local authorities likely will be required as part of the construction permit, as well as settlement with house-museum owners.
- The treatment unit would function only during turbidity events. Most of the time water would be directly distributed without treatment. Water storage tank would serve to regulate water supply/storage, considered particularly useful during high demand periods in summer, when population doubles due to summer holiday arrivals.
- Approx. 9 km steel pipe is delivering water to Oni. Despite observed leaks (seen at least one, but there can be many other leaks as well), it seems that due to elevation difference and hence high water pressure, there might be no contamination infiltrating the pipe on the way to Oni. Service Center Head informed that from time to time pipe sections are being repaired. It is laid in the Kvedrula gorge and then along the dirt road running parallel to Jejora River. Would be good to have alignment mapped.
- There is another source for Oni (at Zhizhoreti). There is a potential to explore this source as well, when considering project alternatives (this site was not visited/explored).

R. Japaridze House-Museum (see item 7 on Map 3).

View towards the proposed WTP location (see item 8 on Map 3) from House-Museum point.

Proposed site for new WTP (item 8 on Map 3). Water mains from the WTP will decent few hundred meters through the pine tree slope, to connect with the network.

View towards House-Museum from proposed site for the new WTP.

180° viewscape towards North from proposed WTP site.

One of the most important impacts of New WTP is landscape and visual. This technique, currently applied in Oni (in front of hotel we stayed), can be used to mitigate visual impact. Cover seems fit for service roads on plant site.

Access road to Old WTP. Design engineers as an alternative should analyze whether some WTP facilities can be located in place of the hazardous old storage tank. Similarly, some items could be considered at the water source locale.

Old Water Supply Storage Tank (visited 20120810):

- Storage tank was constructed upstream Oni but it never functioned due to improper geological and geohazard assessment (landslide and subsidence) and poor construction quality.

120° panoramic view of the old WTP storage tank. Photo was taking from the edge of the storage tank, with due care for safe distance from the perimeter, but existing storage tank is clearly fall hazard. New WTP pipeline should descent on this landslide (the slope in the background) to connect.

Wastewater discharge point (visited 20120810):

- Head of Service Center reports that up to 8 km sewers were put in Oni in 2010 and that a water distribution system is also brand new. This makes Oni perfect location for WWTP, while impact of proposed new WTP should be analyzed in terms of potential for increased WW discharge into Rioni River.

Oni Wastewater discharge point (item 10 on Map 3).

Other observations (20120810):

- Currently some contractor is involved in major Oni-Utsera road works (could easily bid for Oni road works with all the equipment in the area). This asphalt plant located just few km south of Oni (near Shardometi Village) is very likely source of asphalt for GMIP road rehabilitation, but plant operation cannot be considered as in compliance with environmental requirements of BATNEEC.

Asphalt plant in few km distance south of Oni, emitting heavy air pollution.

III. National and International EIA Requirements

Georgian Law on Environmental Impact Permit (December 2007) in Article 4 (1) unfortunately does not provide for state ecological expertise and environmental impact assessment preparation for potable water supply. This is clearly omission of the Georgian legislation and USAID is kindly advised to engage with Government of Georgia whenever appropriate to leverage the renewal of national legislation and the list of activities subjected to environmental impact assessment, making it geared towards the recognized best practices.

Per USAID Regulation 216 'Potable water and sewerage projects other than those that are small-scale' require EA. This activity can hardly be considered as small scale, more over that development is planned in essentially the green field area, despite some residual impact from earlier tourism development and the local road.

IV. Findings & recommendations

These are the initial consideration, to be extended during environmental scoping and assessment:

- Georgian environmental impact permit and state ecological expertise legislation is not invoked with the proposed project, while USAID Reg 216 triggers EA preparation.
- USAID is advised to engage with Government of Georgia whenever appropriate to leverage the renewal of national legislation and the list of activities subjected to environmental impact assessment, implementing acceptable best practice.
- Like with many other Georgian utility companies, UWSCG does not have sound environmental and social management plans and practices in place for construction and operation. It is strongly advisable to develop such instruments for UWSCG and to obtain commitment from the UWSCG management that these rules would be institutionalized, including at least the following themes: sound environmental assessment policies, HS plans and procedures, resettlement policies and procedures, set of various environmental plans (such as for reinstatement, pollution prevention and control, waste management, environmental emergency response, landscape protection, cultural heritage &

archaeology). Application of all these instruments would be required from UWSCG and its contractors when implementing this and other similar projects.

- Important impact is likely to be on landscape and visual. Project design, as conceived currently, is not responsive to mitigating these impacts. EA should analyze landscape and viewscape mitigation measures and try to incorporate them at this very late stage of design.
- Potential solutions considered could be total topsoil preservation for revegetation, use of local architecture imitation for guard/control house (so called Oda houses, for instance) and to screen above ground facilities; using permeable structures for on-site service roads instead of gravelling; planting of local evergreen vegetation to shield structures; burying facilities deeper underground; considering some facilities at other locations (source, old storage tank).
- Project idea is not substantiated by time series data on water quality. Water testing should probably be commissioned to collect data documenting before and after project situation. Same applies to monitoring for expected changes in WW flow and quality determinands.
- Water metering on a priority basis should be considered to mitigate wasteful practices such as water leakages and use for irrigation. This could be the condition agreed with UWSCG.
- Impact of proposed new WTP should be analyzed in terms of potential for increased wastewater (WW) discharge from Oni into Rioni River. Scheduling the WW treatment plant construction could also be considered as the condition of the project against the incentive of supporting the drinking water treatment plant.
- Baseline environmental (rapid biological assessment of flora/fauna/landscapes) and technical (soils, geology) studies will be required to inform/complete the EA.
- It appears that water source is not contaminated by human activities. To prevent from future pollution risks it is advisable to connect the project support with conditionality of catchment management measures (through watershed and forest conservation). This is win-win solution.
- There is another source for Oni (at Zhizhoreti). There is a potential to explore this source as well, when considering project alternatives. Design alternatives were not actually analyzed.
- Project design does not contain any environmental considerations, just one general paragraph.
- Potential for problems with EA: design of the WTP and all its facilities and piping is already substantially completed and authors might be reluctant towards significant revision of the design. Beneficiary's commitment is required on substantial upgrade of the design solution, if so identified by the analysis of alternatives in the EA.
- Clearance with the national and local authorities on cultural heritage likely will be required as part of the construction permit, as well as settlement with house-museum owners.
- Old storage tank clearly represents the geotechnical hazard and should be dealt with appropriately.
- Bringing pipeline from proposed location to network connection should be conducted with extreme care and planning not to trigger the landslide and to preserve valuable evergreen vegetation (which, apart from vegetation integrity, protects land from slipping).
- On another note, please note the issue with Oni road rehabilitation and asphalt plant with unacceptable technology.

Appendix 8.3 Ecological Survey of the Project Area

(Biodiversity, Habitat/Ecosystems)

Table of Contents

Acknowledgement **76**
Introduction **77**
Approaches and Methods 77
National Legal framework 78
International Conventions 79
Brief description of the project 79
Project Area Brief Overview 80
Landscape (habitats) of the Project area 81
Ecosystems impacted by Project 81
General Description of Fauna **84**
Mammals 84
Birds 86
Reptiles 87
Amphibians 87
Invertebrates 87
Red Data List of Georgia 88
Endemic species of the Caucasus 89
Results of the Field Survey on 05-06 November 2012 ..... **92**
Survey findings 92
05 November 2012 92
06 November 2012 94
Conclusion **97**
References **98**

Tables

Table 1. Bat species occurring within the Project area 85
Table 2 Some mammal species occurring within the work area 86
Table 3. Vertebrate Species, endemic to the Caucasus, which can be impacted on Project Area 89
Table 4. Animals, included in the Red Data List of Georgia (2006), which can be found within the impact area of the Project. 90

Maps

Map 1 – Landscapes (ecosystems) of the Project area 81
Map 2 – Sites visited during field survey - 5th November 92
Map 3 – Sites visited during field survey - 6th November 94

This report was prepared by Andrei Kandaurov, Biodiversity Expert, with assistance of Dr. A. Bukhnikashvili and A. Goderidze.

Introduction

Key objective of this report is to describe potential impact zone of headwork of water supply system of Oni in terms of conservation of animal diversity.
It was requested to survey three sites of water supply system of Oni:

- New location of water treatment facilities in Oni and old, destroyed water tank
- Old, abandoned water treatment plant in river Kvedrula gorge
- Water catchment area of water supply system of Oni at the village Skhanari

The report is based on review of published scientific data, available collections, experience of an author and findings of field survey conducted on the territory under consideration in 05-06 November 2012.

Approaches and Methods

In preparing this report we are using as a basic principle - necessity of protecting biodiversity of the fauna of Georgia, as our national heritage and source of income and free services for a significant part of the local population (pharmacy, tourism, recreation etc).

For the evaluation of the consequences of the realization of the project and estimation of the impacts on the environmental receptors - all sensitive receptors, which might be affected, should be identified. In the report should be identified ecosystems and habitats, populations of animals that could be, directly or indirectly, affected by the construction and operation of the headwork of water supply system of Oni. Therefore, during the environmental assessment, the possible impacts of the project on all the identified populations of the protected species and all key biotopes and ecosystems, which might be affected by the project, should be considered.

The general principle for species selection is that each species, considered in the report, must have an argument, which allows to include it in the list for consideration, e.g. to be a species that is already protected by law (listed in the national Red Data List, 2006). Construction of the new headwork of water supply system of Oni should not lead to the harm to animals that occur in Georgia, especially, to the endangered species. The extinction of even one species is inadmissible. We have to prevent any harm for these species on Georgian territory pursuant to our international obligations and national interests.

However, all species, which can be included in the list for consideration in this report, should be presumed as the species impacted by the project, especially if a part of population, significant for surviving of a species as a whole on the territory of Georgia, could be adversely affected by the impact factors of the construction and/or operation of the construction of the headwork of water supply system of Oni.

Key-site selection has two aspects. From one hand, should be selected area which is important for the animals as a key-site. That maybe breeding or nesting place, feeding (foraging) site, stop-over site during migration, wintering or hibernation place, etc. From another hand, we should select sites within the area of the Project activity, where an impact of the construction, operation, and repair works will result in harm to fauna.

We need to identify all the influence factors of the Project to evaluate its impact on the fauna. These factors are:

1. Direct and indirect losses of habitats due to unexpected or long-term consequences of construction (e.g. erosion increasing, habitat fragmentation, because of the cutting trees, etc.)
2. Pollution: the soil and the water - by the oil or fuel (diesel) and waste products during construction and operation
3. Noise pollution – both, disturbance during construction, and residual background noise, during operation of headwork of water supply system of Oni
4. An animals disturbance on the key-sites e.g. on breeding (nesting) places during breeding season, on foraging sites and on wintering areas, on migration routes and stopover sites during migration. That will cause number decreasing of a population

All "sensitive" habitats and ecosystems should be noted in the report. All sites, that are requiring extra cares during constructions and/or operations, and all sites, where can arise problems with the biodiversity preservation, and thus mitigation measures are required - must be noted before the construction work will begin.

The report is prepared using the World Bank's Environmental Source book, Operational Directives 4.01 (Environmental Assessment), Operational Polices on Forestry (OP 4.36) and Natural Habitats (OP 4.04); EU EIA Directive 85/337/EEC as amended by 97/11/EC, EU – Guidance on Scoping, 1996 and latter EBRD guidelines.

National Legal framework

Existing nature conservation legislation in Georgia partly corresponds to internationally accepted principles and criteria in the sphere of nature conservation and biodiversity protection and consequently provides an acceptable framework for EIA. The Georgian legislation and international obligations of Georgia, resulting from the signed International Conventions in the field of the Nature Protection, form a legal side of a framework of our examination.

The main laws on nature conservation relevant to this report are:

- the Environmental Protection Law of Georgia (the Frame Law for nature conservation)
- the Wildlife Law of Georgia
- the Law on Red Data List of Georgia
- Decree #303 of May 2, 2006 of the President of Georgia, "On Approval of the Red List of Georgia" (Endangered Species List)

Pursuant to the Georgian legislation, 135 species and 4 sub-species of animals are protected (Red Data list of Georgia, 2006). Taking into consideration the species, which are protected by the International Agreements, the whole number of protected species can reach up to 250. Most of these species are listed in the Red Data List of Georgia, Red Data List of IUCN, and in Attachments to different Conventions.

International Conventions

The following list gives an overview on Multilateral International Conventions, related to nature conservation and biodiversity protection, enforced in Georgia, which are relevant to this report:

- Convention on Biological Diversity (CBD), 1992, - accepted at 02/06/1994.
- Convention on the Conservation of Natural Habitats and of Wild Fauna and Flora (the Bern Convention) - ratified in 30/12/2008.
- Convention on the Conservation of Migratory Species of Wild Animals (CMS), Bonn, 1979, date of entry into force 01/06/2000.
- Agreement on the Conservation of Bats in Europe (EUROBATS) – ratified at 21/12/2001. This Agreement protects 28 bat species occurring in Georgia.

Brief description of the project

According to documents received from Dr. M. Gvilava the whole headwork system of Oni water supply system needs rehabilitation. The design company recommended to rehabilitate the existing intake well but the other facilities: sediment reservoir, filtration and chlorination system, watching cabin and pressure reducing well to be arranged in suburb of Oni on R. Japaridze Street where the old water storage tank with 2000 m^3 capacity exists. This area is a former location of the permanent tourists camping site destroyed in last decades. It is situated in suburb of Oni within the settled area.

New Oni Water Treatment Plant will consist of new water storage tank (1,000 m^3) and all related facilities: treatment filters, pumps for filter cleaning, vertical settler, chlorination unit, control and guard house on the fenced territory. The treatment unit would function only during turbidity events. Most of the time water would be directly distributed without treatment. Storage tank would serve to regulate water supply/storage, considered particularly useful during high demand periods in summer.

The old water storage tank of 2000 m^3 capacity is situated on the slope a little bit below of the R. Japaridze Street and of the proposed location of new facilities. The concrete tank is sunken in the earth. It was destroyed by earthquake and will be not repaired.

The pipeline from the new water treatment plant to join to the Oni water distribution system should descend along the quite steep slope with signs of landslide. Rehabilitation of the pipeline not requires any heavy equipment; rather hand labor and manual delivery of required materials.

Old, abandoned headwork of water supply system of Oni in river Kvedrula gorge. The old headwork of water supply system of Oni is located 14 km away from Oni in a village Kvedi on the river Kvedrula. The site was and is still protected by the concrete wall along the Kvedrula Stream. Initially the source site was provided with entire treatment process (filtration, chlorination etc) but this is not functional for a long time now. The headwork consists of the following facilities: intake structure, sediment reservoir, filtration and chlorination system which are out of order and are not functioning. There is no power supply to the facility, the territory is not lit. There is no power transformer.

Water is collected from karst rock geological layer. The water intake structure – the trapezoidal abstraction concrete structure with attached distribution building with two chambers (for possibility of maintenance without interruption) is only facility proposed to be

repaired on this site. Proposed rehabilitation works for the abstraction structure are quite minimal and do not will require any heavy equipment.

The headwork is connected with the water system of Oni with of the steel pipes, approximately 9 km of length. The pipe is laid in the Kvedrula gorge and then along the dirt road running parallel to Jejora River.

Water catchment area of water supply system of Oni at the village Skhanari is a smoothed dry valley west from the mountain Kldis Dziri (1800 m MSL) between river Kvedrula and stream Skhanarisgele. The area is covered with beech forest with glades covered with scrubs and grasses.

Activities, proposed in the considered Project, can not have an impact on the environmental receptors in this area, if no earth-works will be taken to prevent rain water inflow in the karst cave.

Project Area Brief Overview

Physical-geographic Characteristics of the Project Area

The Project area is situated in the valley of the river Jejora the left-hand tributary of the Rioni River, between Lechkhumi Ridge (north) and Racha Ridge (south), with the Main Ridge of the Greater Caucasus to the north-east; in the West Georgia.

From the physical-geographic point of view, the West Georgia as well as, the Western part of the Transcaucasian depression is covered by the Colchic province (Kolkheti), including two sub-provinces - of Colchic (Kolkheti) lowland and Colchic (Kolkheti) foothills. All rivers and streams here belong to the basin of the river Rioni and to the basin of the Black Sea. The Project area is located in the Colchic (Kolkheti) foothills sub-province of Colchic province.

Zoogeographic Characteristics of the Project Area

From the zoogeography stand point, the Project area is entirely situated within the limits of the Colchic zoogeographic region of Caucasus district. The most part of this region is lying in the Western Georgia. Its conditional borders are: on the north and north-east - the western part of Great Caucasus mountain ridge, on the east – Surami ridge and southern offspur of Great Caucasus, on the south-east and south - Meskheti Mountain ridge, on the west – Black Sea. Typical "Colchic" landscapes unify foothill and lowland subtropical forests with plenty of evergreen plants. Colchic communities are attached to the region with mild climate (usually positive January temperature) and high level of annual precipitation (1,000mm and more).

The entire Caucasus is located in the Holarctic or Palaearctic kingdom or zone, depending on the terminology used by experts in zoogeographic zoning. One can outline, throughout territory of Georgia two areas with important landscape differences. The first - Caucasus district, including Colchic and Caucasus regions, unify forest landscapes with plenty of autochthonous animals and representatives of European fauna. The second - the Mediterranean sub-zone with highlands of Lesser Caucasus and arid, semi-dessert landscapes in Kura valley. Significant part of Georgia is occupied with communities of mixed origin, which could not be unified with any enumerated districts. Relief causes relatively clear borders between some biogeographic districts, but these borders remain conditional.

But, animals' communities of the Project area near the Oni are quite degraded in result of usage of this territory by local human population (as settled area and pasture for cattle and pigs for a long time. The area of the Project is very small. This territory is, actually, on lesser importance from the standpoint of the animal biodiversity conservation.

Landscape (habitats) of the Project area

The natural type of the vegetation within the Project area is the Colchic middle-mountain erosion-denudation landscapes witch beech forests mainly with evergreen understory. It should be noted that natural vegetation cover, within the area of construction of new facilities, is destroyed almost totally. Largest part of the site is converted to treeless pasture. Small remnants of forest are under the press of the fuel-wood harvesting, cattle and pig grazing. Water catchment basin is covered with middle-mountain erosion-denudational landscapes with beech forests with rich evergreen underwood, from the north it is bordered by middle-mountain erosion-denudational landscapes with beech, beech-dark coniferous and dark coniferous forests mainly with evergreen underwood.

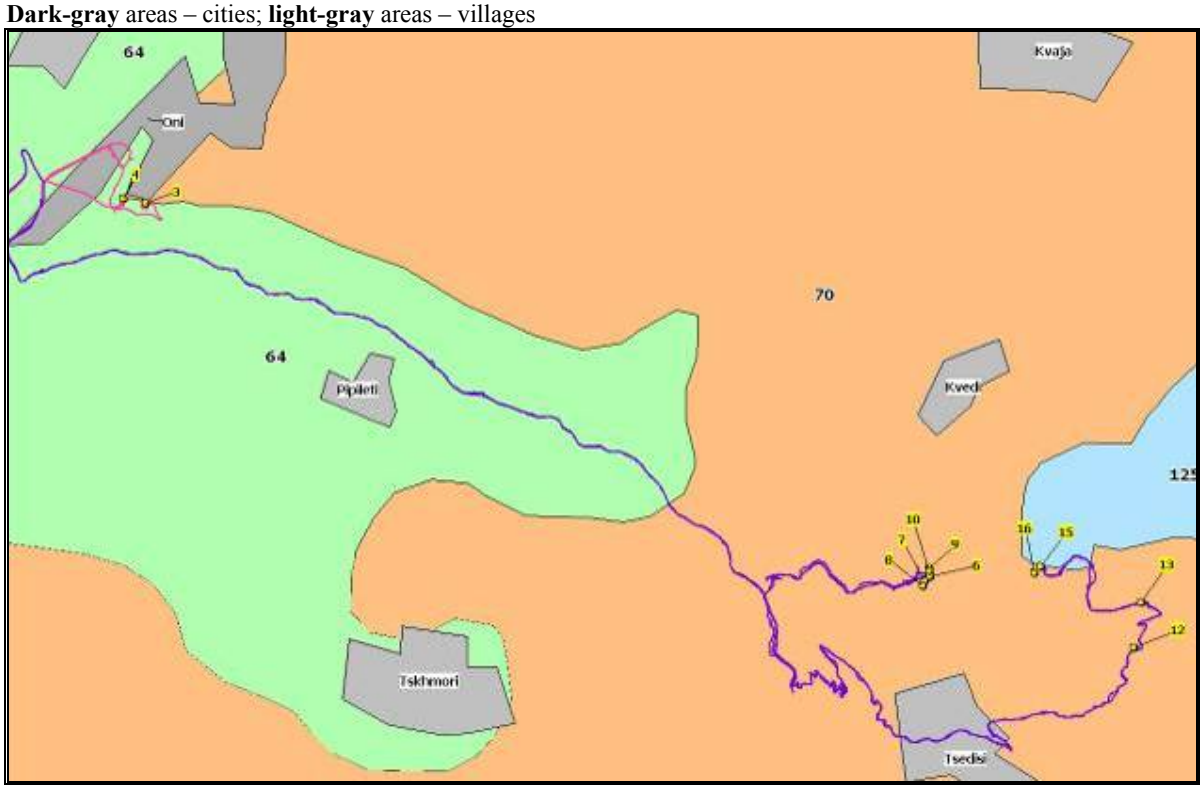
Map 1 – Landscapes (ecosystems) of the Project area

64 - Colchic low-mountain erosion-accumulative landscapes witch mixed oak-, hornbeam- and beech- forests (partly with evergreen understory)

70 - Colchic middle-mountain erosion-denudation landscapes witch beech forests mainly with evergreen understory

125 - Caucasian middle-mountain erosion-denudation landscapes witch beech-dark coniferous and dark coniferous (spruce-fir) forests, partly with evergreen underwood

Dark-gray areas – cities; **light-gray** areas – villages



Ecosystems impacted by Project

Ranges of separate animal species and areas of distribution of species complexes often coincide with borders of biotopes or landscapes. Landscapes are mosaic scattered within each of physical-geographic or zoogeographical regions. Best systems of division of landscapes of the Caucasus, and in particular of the Georgia, are given By Ketskhoveli (1957, 1973),

Gulisashvili et al. (1975), Berouchashvili N., (1995), Sokolov and Tembotov (1989). However we can accept here the simplified scheme, more appropriate from zoological point of view.

The main types of ecosystems are the following:

Industrial and urban areas. Sometimes, nests of birds or significant associations of bats can be found in old industrial buildings - mainly abandoned storehouses, cellars, attics etc. In such a case, it is needed to undertake special measures, to prevent a mass death of them, especially, if these species are protected by law (e.g. are included in the Red Data List). We had not recorded such associations or nesting places of protected species in old abandoned tank for water at Oni or abandoned buildings on former water treatment plant at Kvedi village, inspected during the short field-survey (5-6 November).

River bank ecosystems, usually differing from surrounding landscapes by the higher humidity, less developed soil layer, sometimes – the higher density of shelters, more developed bush vegetation and less covered with agricultural landscapes. These ecosystems usually form narrow belts along rivers up to several hundred meters wide. Generally, they are quite diverse in regard of species composition of plants and animals. They are important for many species as shelter and feeding place. Animal community of these ecosystems can be affected if large part of the vegetation will be destroyed.

The steel pipe from water intake structure to the water distribution system of Oni is situated along the river Kvedrula (about 2 km) and then along the river Jejora (approximately 7 km). In case of incident on the old chlorination unit poison pollution was able reach Kvedrula river water and following Jejora and Rioni. Translocation of the Water Treatment Plant on the new place will solve this problem. The pipe in the Jejora river gorge is laid along the dirt road running parallel to Jejora River, thus any repair works will have not adverse impact on biodiversity.

Freshwater ecosystems. Attention must be paid to fish, association of amphibians and invertebrate species. Such ecosystems are sensitive to the impact of the construction and operation of chlorination. These ecosystems can be affected during construction work in case of fuel leakages and turbidity increasing during work within floodplain and river crossing by trucks.

Forest ecosystems. Forests of the area can be divided in to different types.

Forest on the area of construction site is, generally, low-mountain mixed oak, hornbeam-oak and beech forest. Larger part of area of such forest in the Country can be considered as belonging to the Colchic region of the Caucasus zoogeographical district. In such forests, among protected by law species, occur seven mammals, one Endangered (Brown Bear - *Ursus arctos)*, and six Vulnerable species (two bats Mehely's Horseshoe Bat - *Rhinolophus mehelyi* and Mediterranean Horseshoe Bat - *Rhinolophus euryale*, rodents Caucasian Squirrel - *Sciurus anomalus,* and, Otter - *Lutra lutra*); 12 birds - one Critically Endangered winterer (Saker Falcon - *Falco cherrug*), four Endangered species (passage visitors: Red-footed Falcon - *Falco vespertinus*, and seven Vulnerable bird species (six passage migrants: Black Stork - *Ciconia nigra,* Long-legged Buzzard - *Buteo rufinus*, one year-round resident Boreal Owl - *Aegolius funereus*, and six species of insects, among them one Endangered species (Death's Head Sphinx - *Manduca atropos* and eight Vulnerable (Small Night Peacock

Butterfly - *Eudia pavonia*, Scarlet Tiger - *Callimorpha dominula*, Apollo - *Parnassius apollo*, Caucasian Festoon - *Anthocharis caucasica,* Violet Carpenter bee - *Xylocopa violacea* and one dragonfly: Dark pincertail - *Onychogomphus assimilis* and Vulnerable endemic Colchis crayfish - *Astacus colchicus*.

Most sensitive to human presence and activity impact are: Brown Bear, Otter, Mehely's Horseshoe Bat, all redlisted wintering birds, and, in case of poaching or water pollution - salmon in the Rioni river.

Due to heavy pressure of humans, fauna is degraded on large area. Numbers of species and populations are low. Exactly within the area of construction no any protected species can be recorded.

Forest within the water catchment basin is Colchic middle-mountain beech forests with rich evergreen underwood, bordered from the north by middle-mountain beech, beech-dark coniferous forests mainly with evergreen underwood. Generally, middle-mountain forest have sustainable and certainly rich complex of animals, with number of endemic to Caucasus species and species included in the Red Data List of Georgia and number of sensitive to anthropogenic impact ecosystems and species. The most vulnerable ecosystems are beech and chestnut forests.

Within the water catchment basin, among protected by law species there are seven mammals, one of them is Critically Endangered (Eurasian Lynx - *Lynx lynx*), one species Endangered (Brown Bear - *Ursus arctos*), and two Vulnerable species (rodent Caucasian Squirrel - *Sciurus anomalus,* bat Western Barbastelle - *Barbastella barbastellus*); three Vulnerable bird species (Black Stork - *Ciconia nigra*, Golden Eagle - *Aquila chrysaetos* and Boreal Owl - *Aegolius funereus)*; one Vulnerable fish - Brook Trout (*Salmo fario*); among insects are Vulnerable species (Small Night Peacock Butterfly - *Eudia pavonia*, Scarlet Tiger - *Callimorpha dominula*, Apollo - *Parnassius apollo*, Meleager's Blue - *Polyommatus daphnis*).

Most sensitive to human presence and activity impact are: Lynx, Black Stork, and, in case of poaching or water pollution - Brook Trout.

Within frame of the Project this complex could be affected in case of earthworks on the territory of the water catchment basin.

Forest in the catchment basin	Forest in the catchment basin

General Description of Fauna

Mammals

108 species of mammals occur in Georgia. These species are associated in 64 genera of 28 families that belong to 7 orders. From this amount 4 species, probably, do not meet any more in wild nature of Georgia. Seven species were acclimatized in Georgia or have penetrated after acclimatization on adjacent territories (Bukhnikashvili, Kandaurov 1997, 2002; Gurielidze, 1997). Within the impact area of the Project are lying ranges of distribution of 46-47 terrestrial mammal species. Three more species are also recorded within the administrative districts of Oni. Nowadays, occurring of these species within the Construction Area is unlikely, but penetration of some individuals of Wild Boar (*Sus scrofa*) cannot be excluded. Taken into the consideration the habitat features, the presence of one species of bats - Western Barbastelle (*Barbastella barbastellus*) on this territory can be expected. Totally, about 50 species of mammals can be expected on the study territory. There are not large areas of the key-habitats of the endangered mammals within the Project Area itself. Parts of populations or some individuals of the protected by law species can be affected during construction and operation of the Project.

All bats that occur in Georgia are included in the Appendix II of Bonn Convention and protected under EUROBATS Agreement. Within the construction area presence of the 19 bat species is confirmed. Four species of Chiroptera - Mediterranean (*Rhinolophus euryale*), Mehely's (*Rhinolophus mehelyi*) Horseshoe Bats, Geoffrey's Bat (*Myotis emarginatus*) and Western Barbastelle (*Barbastella barbastellus*) which are found within the area of construction, are included in the Georgian Red Data list and in the IUCN Red List under the category vulnerable (The Atlas of European Mammals, 1999; The Red List of Threatened Animals IUCN, 1994, 2003). Bats are extremely restricted in finding shelters for breeding colonies. Suitable for the roosting shelters – trees hollows, caves and abandoned buildings are of great importance for their wellbeing. Wintering and maternity roost can be destroyed if some trees with hollows will be cut during the clearing works (tree cutting before dam construction) or if bridges and other old buildings along the banks of future reservoirs will be destroyed during preparation works in not proper time. In addition, a spill of a fuel in wetlands on the floodplain can destroy the food resource of the maternal colony, which will substantially reduce number of young. Evaluation of impacts related with construction and

operation of Water Treatment Plant require surveys of summer colonies (nursing and maternal) and winter roosts of bats. Table 1 below provides a list of the bat species, status and preferred shelter type for colonies (tree hollows or structures / buildings).

Table 1. Bat species occurring within the Project area

№	Species - *Latin name*	Common English name	Georgian name	Tree Hollows	Buildings	IUCN and GRDL
1.	*Rhinolophus ferrumequinum*	Greater Horseshoe Bat	დიდი ცხვირნალა		+	LC
2.	*Rhinolophus hipposideros*	Lesser Horseshoe Bat	მცირე ცხვირნალა		+	LC
3.	*Rhinolophus euryale*	Mediterranean Horseshoe Bat	სამხრეთული ცხვირნალა		+	**VU**
4.	*Rhinolophus mehelyi*	Mehely's Horseshoe Bat	მეჰელის ცხვირნალა		+	**VU**
5.	*Myotis blythii*	Lesser Mouse-eared Bat	ყურწვეტა მღამიობი		+	LC
6.	*Myotis nattereri*	Natterer's Bat	ნატერერის მღამიობი	+	+	LC
7.	*Myotis emarginatus*	Geoffrey's Bat	სამფეროვანი მღამიობი		+	**VU**
8.	*Myotis mystacinus*	Whiskered Bat	ულვაშა მღამიობი		+	LC
9.	Myotis brandtii	Brandt's Bat	ბრანტის მღამიობი		+	LC
10.	Myotis daubentonii	Daubenton's Bat	წყლის მღამიობი	+		LC
11.	*Eptesicus serotinus*	Serotine Bat	მეგვიანე ღამურა		+	LC
12.	*Nyctalus leisleri*	Lesser Noctule Bat	მცირე მეღამურა	+		NT
13.	*Nyctalus noctula*	Common Noctule Bat	მეღამურა	+	+	LC
14.	*Pipistrellus nathusii*	Nathusius's Pipistrelle	ტყის ღამორი	+	+	LC
15.	*Pipistrellus pipistrellus*	Common Pipistrelle	ჯუჯა ღამორი	+	+	LC
16.	Pipistrellus pygmaeus	Soprano Pipistrelle	პაწია ღამორი	+	+	LC
17.	*Barbastella barbastellus*	Western Barbastelle	ევროპული მაჩქათელა	+		**VU**
18.	*Plecotus auritus*	Brown Big-eared Bat	რუხი ყურა		+	LC
19.	*Miniopterus schreibersii*	Long-Winged Bat	გრძელფრთიანი ღამურა		+	LC
	Species protected by law					
	Total					

Bats are strongly dependent on existing shelters and areas for propagation and wintering. Their disturbance in May-June or December-February may result in high mortality of these animals. The strong negative impact can be caused by cutting down mature trees with hollows. Fortunately, we had not found trees with hollows within the proposed construction area. The old destroyed underground reservoir can contain bats roost. The preconstruction survey of this reservoir is needed in case of any works related to it.

In additional it should be noted that the Project area lies within the ranges of distribution of some species, which are of community interest. Of course, they could not be seen on the site of construction of the new Water Treatment Plant on the R. Japaridze Street in suburb of the Oni. The game species and species attractive for tourists occur within the area of the water catchment basin at the village Skhanari and old intake structure in the gorge of the river Kvedrula. Among them are 10 mammals, of middle and large size, which are listed in the Table 2.

Table 2 Some mammal species occurring within the work area

	Latin name	English name	Georgian name	Status of presence	IUCN and RDL
1	*Canis lupus*	Wolf	მგელი	Autumn &Winter visitor	
2	*Canis aureus*	Jackal	ტურა	Resident	
3	*Vulpes vulpes*	Fox	მელა	Resident	
4	*Ursus arctos*	Brown Bear	მურა დათვი	Regular Autumn &Winter visitor	EN
5	*Felis silvestris*	Wild Cat	ტყის კატა	Resident	
6	*Lynx lynx*	Lynx	ფოწხვერი	Possible irregular visitor	CR
7	*Lutra lutra*	Common Otter	ცავი	Rare, regular Summer and Autumn visitor	VU
8	*Meles meles*	Badger	მაჩვი	Resident	
9	*Martes martes*	Common Marten	ყვითელყელა (ტყის) კვერნა	Resident	
10	*Capreolus capreolus*	Roe-deer	ევროპული შველი	Resident	

According to interview with local people – Wolf, Brown Bear and Lynx occur within the area under consideration in autumn and winter. Otter visits this area since end of July till October (Bukhnikashvili, Natradze, Kandaurov, 2007).

During field excursions or in result of an analysis of the published issues (literature data) and of interview with locals, no sites, which can be considered as those having an important significance from the mammals' biodiversity preservation standpoint, were not defined within the impact area of the Project activity.

Birds

There are approximately 390 bird species recorded for Georgian avifauna. (Abuladze, 1997, Boehme Et Al., 1987; Zhordania R.G., 1979). More than 220 of these species breed regularly or incidentally in Georgia, others appear in the country during migrations or in wintertime (Abuladze 1997).

Territory of Georgia is important to Western Palaearctic birds' migration. Diversity of the bird species and numbers of each species greatly increase in spring and in autumn during seasonal transit migrations and in winter.
However, large concentrations of birds for a long time on the Project area are unknown.

Georgia is an important wintering area for waterfowl, waders, some passerines and for birds of prey. Significance of Georgian wintering places is increasing when unfavorable weather conditions take place in northward regions (Azov Sea, south of Russia, Front-Caucasian area). The Project area has an importance for a various species of birds-of-prey and passerines as a stopover site on passage and, in lesser extent, as a wintering habitat.

At least of 243 bird species were recorded in the Racha region and thus could be also recorded within the Project area (Dr. A. Abuladze personal communication). Among them about 45 breeding bird species are classified as year-round residents; about 50 are migratory summer breeders, and about 170 species are recorded (regularly or irregularly) during seasonal migrations in spring and autumn, from which at least 77 species were recorded only during passage. Winter avifauna is presented of about 45 year-round resident bird species and more than 50 species winter visitors and occasional visitors.

Based on all available data and taking into account the viewpoint of bird conservation, it can be concluded that breeding avifauna of the impact zone can be classified as a poor by breeding species and is presented in general by common, widely distributed and numerous bird species. The dominate group of breeding birds are small forest passerines. Noteworthy is a fact that this area contains a breeding sites of Common Buzzard (*Buteo buteo*), Common Kestrel (*Falco tinnunculus*) and, probably, of the Golden Eagle (*Aquila chrysaetos)* – rare year-round resident with local seasonal vertical movements (Dr. A. Abuladze, personal communication, 2010), as well as, the feeding grounds of some species of large raptor birds and scavengers.

No one species can be assumed as being under special impact of the Project.

Reptiles

54 species of reptiles were ever recorded for Georgia (Bakradze & Chkhikvadze, 1992; Tarkhnishvili et al., 2002 for the most recent review). The major part of reptile species is restricted in their distribution in the south-eastern part of Georgia, and can not be affected by the construction. About 10 species of reptiles are recorded for administrative districts (rayon) of Oni. Two species are presumed to occur within the area of the proposed Project: the Artvin Lizard (*Darevskia derjugini*) and the Meadow lizard (*Darevskia praticola*).

Fauna of reptiles contains number of species which are endemic to Caucasus. There are one regional endemic of the Middle East that is found only in the Caucasus and the northern part of the Asia Minor (Georgian or Spiny-Tailed Lizard - *Darevskia rudis*) and one species - found exclusively in the Caucasus (Artwin Lizard - *Darevskia derjugini).*

The rock lizards are very much depended on specific places of dwelling - rocks rich with insects. Therefore, they meet in a plenty on a few sites removed from each other. Destruction of such sites can strongly reduce a population or even to threaten to population of some species in Georgia. It can happen, during the construction, if rocks, on which they today live, will be blown up during the construction.

Amphibians

There are 12 species of amphibians found in Georgia (Tarkhnishvili, 1995, 1996). As little as 5-6 species of amphibians are recorded for the administrative districts (rayon) of Oni. Within the area of the proposed Project there is not recorded amphibian species protected by Georgian legislation.

Among amphibians that are or can be found within the Construction area, one species is regional endemic found exclusively in the Caucasus - Caucasian Toad (*Bufo verrucosissimus*), most of its habitat ranges lay in Georgia. Two regional endemic species of the Middle East are found only in the Caucasus and the northern part of the Asia Minor (*Ommatotriton ophryticus, Rana macrocnemis*). Certainly, species that belong to the later two groups desire an especial attention from the conservation point of view.

All amphibian species are in need of stagnant, or of very slowly current, fresh water – pools and oxbows on the flat floodplain and in the forest (e.g. on the forest roads).

Invertebrates

Invertebrate species are less well known in Georgia, but those that have been catalogued include more than 26,000 species, many of them arthropods and mollusks. Moths and butterflies are among the most studied invertebrate groups in Georgia, and of the more than 500 species described, about a third of them are endemic or relict species.

Thousands of invertebrates species occurs in Georgia and most of them are very poorly studied. Conservation status of the most of species can be characterized as DD (Data deficient), except narrow-ranged forms, which are a priori threatened. Numerous (hundreds of species) invertebrate animals - endemics of Caucasus, species included in the Red Lists or important for human health or economy - require extra surveys, first of all, as indicators of general status of ecosystems. Specialist input is also necessary to evaluate dam-related effects on invertebrates.

It is supposed that invertebrate species hardly could be affected by the construction of the Water Plant on a population level or on a species level. The extent and power of the impact factors of the Project are not evaluated yet. That's why we do not describe here invertebrate species occurring within the area of interests. Invertebrate species listed in the Red Data List of Georgia will be noted below in the **Table 3.**

One of the most related with the water ecosystem of the Rioni River, and thus probably can be considered as remote receptor, species of the redlisted invertebrates is a Noble (Colchic) crayfish (*Astacus colchicus).* The wellbeing of this species is depended on clear water. Situation with this species is unclear. It seems that the Project can not be considered as one which will have significant adverse impact on this species.

Red Data List of Georgia

The Red data List of Georgia is an only legal issue to protect species according to law. 30 redlisted terrestrial species are recorded within the Project Area. According to Criteria of Georgian Red List out of six mammals - four species are Vulnerable (VU), one Endangered (EN) and one Critical Endangered (CR); among 12 bird species one is Critical Endangered, two are Endangered and nine are – Vulnerable; no one reptile and amphibian species is recorded on the area under impact of the Project; among 11 invertebrates are two are Endangered and nine - Vulnerable species. Among all the redlisted species, 20 have their home-ranges within the territory of administrative districts of Oni (occurrence of three of those – presumed), 9 species are regular migrants (three of them rare) through the area. The species listed in the Red Data List of Georgia, which can be seen within the area of the Project, are presented in the **Table 3.**

Among the six mammals there are three (two bats and Caucasian squirrel) that use the part of the work area as a home ranges and feeding grounds. As it is stated above, the otter - occupies banks of the rivers in this area since the end of July till October (Bukhnikashvili, Natradze, Kandaurov, 2007). Otter could not be affected during works. Other two species - lynx and brown bear are visitors in the area of water supply in the Kvedrula river valley. Bats can be suffered if some roosts in the trees with hollows will be destroyed during the clearing works (tree cutting before construction) or in old water tank at Oni.

The area is of importance for two-three redlisted bird species. Two of them could be considered as a potential breeder within this area (Golden Eagle and Boreal Owl), and one species is regular migrant during passage (Long-legged Buzzard). All other are rare passage

migrants, visitors or even rare visitors during autumn or spring migration or in winter. For many others not protected by law birds this area is a flyway and stop-over site during passage. The Rioni River valley is of importance for migrating birds, especially during worse weather conditions on Russian part of Caucasus in the winter, when large amount of birds find there flyway, shelter and feeding ground. Fortunately, it could be excluded that within the area of water catchment basin construction will fall nest of any raptor bird, which should be protected from disturbance.

Endemic species of the Caucasus

Among the vertebrate species three species, which are endemic to Caucasus, can be found within the area of Project. Below, in the Table 4, one can see their names (scientific and common); our assessment of extent of possibility that these species would be impacted during construction works or during the normal operation of the facilities; and preferred biotopes for these species.

Table 3. Vertebrate Species, endemic to the Caucasus, which can be impacted on the Project Area

	Common name	Latin name	Possibility of impact on the species	Biotopes and range of occurrence
1	Caucasian mole	*Talpa caucasica*	Low	Forest
2	Radde's shrew	*Sorex raddei*	Low	Forest
3	Caucasian mouse	*Apodemus ponticus*	Low	Forest

Animals, included in the Red Data List of Georgia (2006), which can be found within the impact area of the Project.
rrence of the species confirmed in publications; ? - occurrence of the species suspected; H – home range of the species lies with
f the Project Impact area; V – the species is a visitor within the Project area; M – regular migrant.

Latin name	English name	Georgian name	National status	Studied area	Type of occurrence	Co
	Mammals	**ძუძუმწოვრები**				
inolophus euryale	Mediterranean Horseshoe Bat	სამხრეთული ცხვირნალა	VU	Y	H	
inolophus mehelyi	Mehely's Horseshoe Bat	მეჰელის ცხვირნალა	VU	Y	H	
urus anomalus	Persian Squirrel	კავკასიური ციყვი	VU	Y	H	
nx lynx	Lynx	ფოცხვერი	CR	?	V	
tra lutra	Otter	წავი	VU	?	H;V	
sus arctos	Brown Bear	მური დათთვი	EN	?	V	
	Birds	**ფრინველები**				
conia nigra	Black Stork	ყარყატი	VU	Y	M	
teo rufinus	Long-legged Buzzard	ველის კაკაჩა	VU	Y	M	
uila heliaca	Imperial Eagle	ბეგობის არწივი	VU	Y	M	
uila clanga	Greater Spotted Eagle	მყივანი არწივი	VU	Y	M	
uila chrysaetos	Golden Eagle	მთის არწივი	VU	Y	H	local seaso movement
ophron percnopterus	Egyptian Vulture	ფასკუნჯი	VU	Y	M	probably v breeder at
gypius monachus	Cinereous Vulture	სვავი	EN	Y	V	
ps fulvus	Eurasian Griffon	ორბი	VU	Y	V	probably f
lco cherrug	Sacker	გავაზი	CR	Y	M	
lco vespertinus	Red-footed Falcon	თვალშავი	EN	Y	M	
lco naumanni	Lesser Kestrel	ველის კირკიტა	CR	Y	M	
golius funereus	Tengmalm's Owl	ბუკიოტი	VU	Y	H?	very rare y resident in
	Fish	**თევზები**				
lmo fario	Brook Trout	მდინარის კალმის	VU	?	H	
	Invertebrates	**უხერხემლოები**				

Latin name	English name	Georgian name	National status	Studied area	Type of occurrence	Co
	Insects	**მწერები**				
assus schamyl	Schamyl's Ghost Moth	კავკასიური წმინდადგახვიარა	EN	?	H	endemic
dia pavonia	Small Night Peacock Butterfly	ღამის მცირე ფარშევანგთვალა	VU	?	H	
nduca atropos	Death's Head Sphinx	სფინქსი მკვდართავა	EN	Y	H	
llimorpha dominula	Tiger Moth	დათუნელა ჰერა	VU	Y	H	
rnassius apollo	Apollo	აპოლონი	VU	?	H	
lancastria caucasica	Caucasian Festoon	კავკასიური ზარინთია	VU	?	H	
lyommatus daphnis	Meleager's Blue	ცისფერა მელიაგრი	VU	Y	H	
locopa violacea	Violet Carpenter bee	იისფერი ქსილოკოპა	VU	Y	H	
ychogomphus assimilis	Dark Pincertail	მსგავსი ნემსიყლაპია	VU	Y	H	
	Crustaceans	**კიბოსნაირები**				
tacus colchicus	Colchis crayfish	კოლხური ფართოფეხა კიბო	VU	?	H	
	Mollusks	**მოლუსკები**				
lix buchi	Beech Snail	ბუხის ლოკოკინა	VU	?	H	
OTAL =30 species		**ძუძუმწოვრები**	**22VU+5 EN+3CR**	**22y+8?**	**17H;8M;5V ; 2H?**	

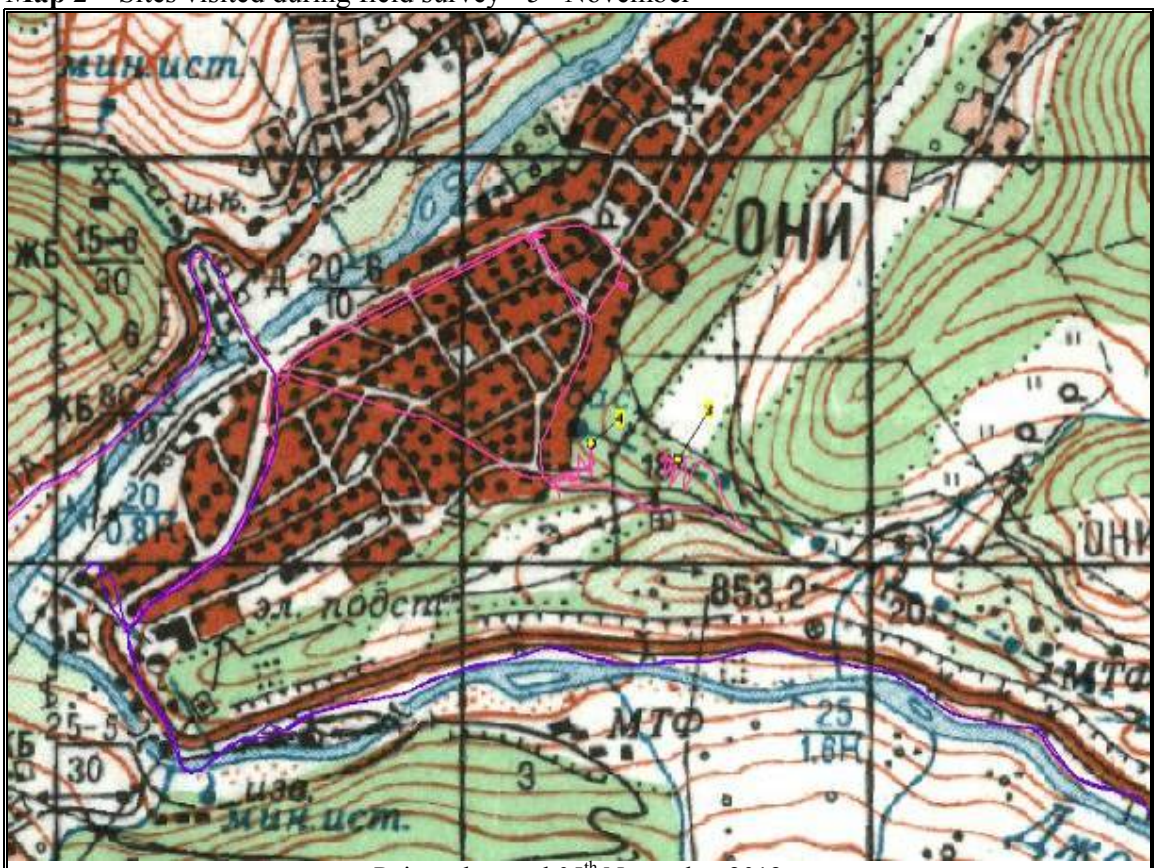
Results of the Field Survey on 05-06 November 2012

During our field survey on 05-06 November 2012 we visited the all three sites. Short survey on foot was executed. The zoological observations were carried out in favorable weather conditions. During the working hours weather was sunny, windless and quite optimal and favorable for direct visual observations of birds and reptiles. During the fieldwork were recorded: tracks of 2 species of mammals, 10 bird species, none reptiles and amphibian species and none species of protected by law invertebrates. The results of observations (sites, data/time, GPS-data, elevation, number of animal species, with some short descriptions of visited locations, comments, etc.) are noted in the field diary. The summary of the field observation are presented below. The terrain altitudes and coordinates of each observation point (longitude/latitude) are taken by the GPS Garmin Ventura. The coordinates are given in the projection: UTM, WGS 84 for zone 38 of Northern hemisphere in "degrees decimal" mode. Time – shows the moment of the observation start on the point.

Survey findings

05 November 2012

Map 2 – Sites visited during field survey - 5th November



Points observed 05th November 2012

<u>1 Site name and brief description:</u> This site is a former location of the permanent tourists camping site destroyed in last decades. It is situated in suburb of Oni within the populated

area. The building is already entirely dismantled to foundations, which remain in place. The site is treeless with sparse bushes. Cattle and pigs are grazing everywhere. Remnants of the low-mountain mixed hornbeam-oak forest are out of the construction site and on the slope.

Observation points:

LABEL	LATITUDE	LONGITUDE	ELEV	Time	Description	
3	42.579363° N	43.445992° E	908	17:23	New location of the Water Treatment Plant of Oni	Oni\20121105\RIMG3320.JPG; Oni\20121105\RIMG3321.JPG; Oni\20121105\RIMG3322.JPG; Oni\20121105\RIMG3323.JPG; Oni\20121105\RIMG3325.JPG; Oni\20121105\RIMG3326.JPG; Oni\20121105\RIMG3328.JPG; Oni\20121105\RIMG3329.JPG; Oni\20121105\RIMG3330.JPG; Oni\20121105\RIMG3331.JPG
4	42.579692° N	43.443396° E	856	17:38	Location of old water storage tank	Oni\20121105\RIMG3332.JPG; Oni\20121105\RIMG3333.JPG; Oni\20121105\RIMG3334.JPG; Oni\20121105\RIMG3335.JPG; Oni\20121105\RIMG3336.JPG; Oni\20121105\RIMG3337.JPG; Oni\20121105\RIMG3338.JPG; Oni\20121105\RIMG3340.JPG

Animals: goldfinches, house sparrow, crows. Marsh frogs (*Rana ridibunda*); no evidence of presence of other species.

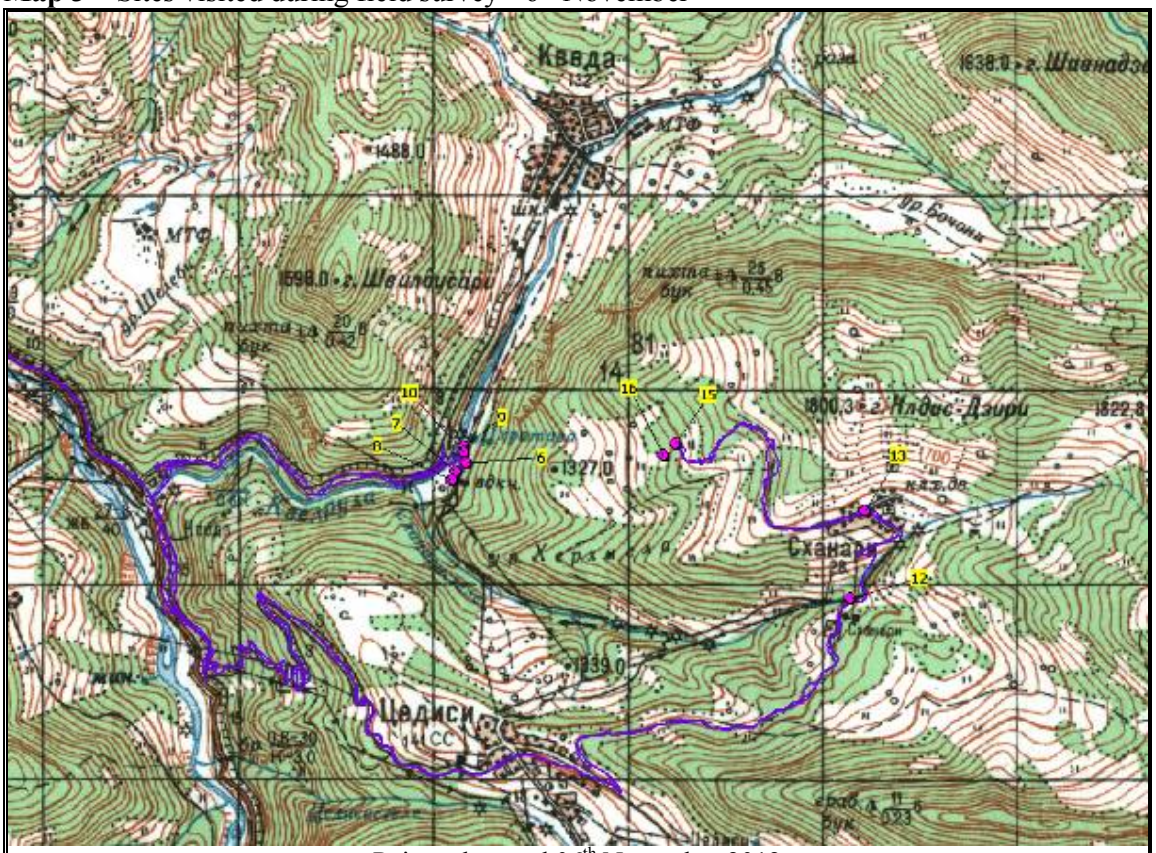
Construction site of new WTP

Suburb of Oni - construction site

Old reservoir	Old reservoir

06 November 2012

Map 3 – Sites visited during field survey - 6th November



Points observed 06th November 2012

2 Site name and brief description: The old headwork of water supply system of Oni located on the bank of the river Kvedrula. The site is protected by the concrete wall along the Kvedrula. All facilities, except water intact construction, are abandoned and partly destroyed (treatment filters, sediment reservoirs, chlorination unit, and guard house). There is no power supply to the facility, the territory is not lit. There is no power transformer. Floodplain of

river covered with degraded riparian forest. The site is surrounded with middle-mountain beech forests with rich evergreen underwood. Tracks of cattle and pigs everywhere.

Observation points:

Label	Latitude	Longitude	Elev	Time	Description	Photos
6	42.547860° N	43.539747° E	1083	9:57	Entrance	Oni\20121106\RIMG3363.JPG; Oni\20121106\RIMG3365.JPG; Oni\20121106\RIMG3366.JPG
7	42.547484° N	43.539074° E	1071	10:03	Filtration reservoir	Oni\20121106\RIMG3367.JPG; Oni\20121106\RIMG3369.JPG; Oni\20121106\RIMG3370.JPG; Oni\20121106\RIMG3371.JPG; Oni\20121106\RIMG3372.JPG; Oni\20121106\RIMG3373.JPG
8	42.547093° N	43.538870° E	1054	10:14	Chlorination	Oni\20121106\RIMG3375.JPG; Oni\20121106\RIMG3376.JPG; Oni\20121106\RIMG3377.JPG; Oni\20121106\RIMG3378.JPG Oni\20121106\RIMG3379.JPG; Oni\20121106\RIMG3380.JPG; Oni\20121106\RIMG3381.JPG; Oni\20121106\RIMG3382.JPG; Oni\20121106\RIMG3383.JPG
9	42.548623° N	43.539630° E	1053	10:28	Water input facility inside	Oni\20121106\RIMG3384.JPG; Oni\20121106\RIMG3385.JPG; Oni\20121106\RIMG3386.JPG; Oni\20121106\RIMG3387.JPG
10	42.548381° N	43.539632° E	1045	10:30	Water input facility outside Valley of the river Jejora	Oni\20121106\RIMG3388.JPG; Oni\20121106\RIMG3389.JPG Oni\20121106\RIMG3390.JPG; Oni\20121106\RIMG3391.JPG; Oni\20121106\RIMG3392.JPG; Oni\20121106\RIMG3393.JPG

Animals: jay, blackbird, chaffinch, Great Tit (*Parus major*), European Robin (*Erithacus rubecula*), Marsh frogs (*Rana ridibunda*); no evidence of presence of Common Otter (*Lutra lutra*) and of presence of other animals were found. According to local man – Alexandre Maisuradze – brown bear, wolf, red fox, hare and roe deer occur here.

Old headworks site

Old headworks – sediment reservoir

3 Site name and brief description: the water catchment basin at the village Skhanari. Smoothed dry valley between river Kvedrula and stream Skhanarisgele is covered with middle-mountain hornbeam-beech forests with rich evergreen underwood, on the glades - blackberry bushes and grasses. Two big sluggy (the observation points ## 15 and 16) were surveyed within the hornbeam-beech forest. The remnants of concrete pipes and track of earthworks are found in lower one. Forest is in quite good condition. According to Dianoz Maysuradze there are not regular or commercial tree cutting. Fuel harvesting is limited in amount needed for one family.

Observation points:

Label	Latitude	Longitude	Elev	Time	Description	Photos
12	42.541934° N	43.563911° E	1471	11:37	river Skhanarisgele	Oni\20121106\RIMG3399.JPG Oni\20121106\RIMG3406.JPG; Oni\20121106\RIMG3407.JPG
13	42.545964° N	43.564749° E	1572	11:56	Village Skhanari Landscape of catchment basin	Oni\20121106\RIMG3408.JPG; Oni\20121106\RIMG3409.JPG Oni\20121106\RIMG3411.JPG; Oni\20121106\RIMG3412.JPG; Oni\20121106\RIMG3414.JPG; Oni\20121106\RIMG3426.JPG; Oni\20121106\RIMG3427.JPG; Oni\20121106\RIMG3434.JPG
15	42.548936° N	43.552824° E	1497	13:21	Upper karst sluggy Dianoz Maysuradze	Oni\20121106\RIMG3415.JPG; Oni\20121106\RIMG3416.JPG; Oni\20121106\RIMG3417.JPG; Oni\20121106\RIMG3418.JPG; Oni\20121106\RIMG3418.JPG; Oni\20121106\RIMG3419.JPG Oni\20121106\RIMG3420.JPG; Oni\20121106\RIMG3430.JPG
16	42.548372° N	43.552081° E	1467	13:36	Lower karst sluggy	Oni\20121106\RIMG3421.JPG; Oni\20121106\RIMG3422.JPG; Oni\20121106\RIMG3423.JPG; Oni\20121106\RIMG3424.JPG; Oni\20121106\RIMG3425.JPG

Animals: sparrow hawk (*Accipiter nisus*), Buzzards (*Buteo buteo*), crow, jay, blackbird, goldfinch, chaffinch, winter wren (*Troglodytes troglodytes*), Great Tit, European Robin. Tracks of Caucasian mole and burrows of voles recorded on glade. No reptiles were fixed.

According to Dianoz Maysuradze there are: Lynx, brown bear, wolf, red fox, badger, marten, weasel, hare, and roe deer. There are not squirrels (*Sciurus anomalus*)

Activities, proposed in the considered Project, cannot have an impact on the environmental receptors in this area, if no earth-works will be taken to prevent rain water inflow in the karst cave.

Upper sluggy

Lower sluggy with pipes

Glade in the forest in the catchment basin

View on the catchment basin

Conclusion

This chapter provides brief list of impacts and proposed mitigation measures according to key ecological receptors (faunal component only).

Based on the review of available data, it can be stated that there are no problems related to the conservation of animal biodiversity, which cannot be resolved and / or mitigated at a reasonable cost.

List of possible impacts includes:

- Destroying of shelters and nests during the preconstruction clearings (cutting trees etc). Ecological receptors birds (mainly not protected by law passerines) and bats (one species of which is redlisted).
- Animals disturbance during breeding season (some birds will abandon their nests, even with nestlings).

Mitigation measures are detailed below.

General recommendations:

- To take measures to reduce amount of dust emission
- To take measures to reduce level of noise during construction works
- To clean the work area and its surroundings from household solid waste and building waste: do not dispose it on the open temporal dumps and do not throw out it in the river valley or into the water
- Prevent fuel and mineral oil leakage on the soil
- Open holes, trenches and precipices should be fenced with something from falling of animals: for the large species it could be a bright tape, for the small animals it is possible to use any flat material (a tin or a polyethylene film), in trenches and holes at the night could be putted boards or large branches (with one end) to allow the fallen small animals to leave it. The holes and trenches should be checked before fulfilling.

Specific recommendation:

- Pre-construction surveys of all mature trees planned to be removed to verify presence / absence of bat roosts. Results of field survey shows that there are no such trees.

In conclusion we can say:

There are no species that should be presumed as the species impacted by the project on a population level and adversely affected by the impact factors of the construction and/or operation of the new Oni Water Treatment Plant.

The construction site is not a place which is important for the animals as a key-site (breeding or nesting place, feeding (foraging) site, stop-over site during migration, wintering or hibernation place) on which the Project activity will result in harm to fauna.

- Direct and indirect losses of habitats due to habitat fragmentation will be not large and can be neglect, because of proximity of human populated area
- Soil contamination by the oil or fuel (diesel) and waste products during construction and operation can be easily monitored and mitigated
- Noise pollution – both, disturbance during construction, and residual background noise, during operation will be temporary
- An animals disturbance on the key-sites will not take place

The area of the water catchment basin is definitely of importance for the biodiversity preservation in the region. The earth-works to prevent rain-water inflow in the karst cave can have adverse impact on fauna. In case such works will be considered as an essential need, a new impact assessment and field survey must be done by experts in theriology and ornithology in proper season.

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Appendix 8.4: Survey of Hydrogeology & Geology of Oni Project Area

This report was prepared by Hydrologist O. Gogrichiani from National Environmental Agency.

Geologically outflow point of the spring/source and adjacent area is composed of Lower Cretaceous and Upper Jurassic (so called "Geske") series of sediments. Upper Jurassic sediments are represented by Psammitic-Aleuritic clays (speckled clays), which in cross-section are gradually transferred into Arkosic-Greywacke sandstones. As for Lower Cretaceous easily karstifiable limestone sediments, these are represented by Pelitomorphic and sometimes by Brecciated limestones.

According to tectonic characterization scheme of Georgia (E. Gamkrelidze, 2000), source outflow site and adjacent areas belong to Gagra-Java ridge zone, which includes high mountainous undulated topography, developed on Upper Jurassic Lower Cretaceous substrata sediments. Spring outlet and nearby area is fed by surrounding areas with large amplitude tectonic faults on the north, south and south-east sides. Among these tectonic faults the 'Skhanari' syncline is spreading from south-east to north-western direction and the north-western side of this syncline, composed of Jurassic age sediments, is sloping down into the bed of river Kvedrula with 70°-72° inclination.

Morphologically the study area represents the southern slope of the eastern end of the Shoda-Kedela ridge. Its landform is the typical combination of mountain and gorge topography, developed in Cretaceous Carbonate sediments. The topography is characterized by deep cut in gorges/canyons.

River Kvedrula has developed a deep cut gorge and the depth of the canyon varies within the range of 800-1500 m. The wider/open shape of the gorge at the source section of the stream is influenced by the glaciers. In the middle section the river gorge has a V-type shape and at the lower section, in limestone sediments, the gorge is a typical canyon.

Hydrogeologic Conditions

According to Hydrogeologic characterization of Georgia (I.M. Buachidze, 1970) the study area belongs to north-east ending of artesian and non-artesian water systems of Racha-Lechkhumi syncline. Character if groundwater systems of both intense and constrained circulation are widely spread in this region, represented by groundwaters of karstic, crevice-karstic, crevice and crevice-porous origin.

Many water carrying complexes and horizons are spread in the study site and adjacent areas, among which we consider groundwaters formed in sediments of Lower Cretaceous (Neocom) and Upper Jurassic periods, as in this particular case we are interested in the visual evaluation of hydrological conditions of 'Tskhratava' source area feeding the Oni water supply.

Above mentioned spring sources flows out on the left slope of the river Kvedrula at some 10-12 elevation above the river level. Spring source is formed in the combination of layers of Neocomian limestone, Upper Jurassic Kimmeridge-Tithon speckled clays and clay sandstones. The spring outlet is covered with particles of limestone materials. The spring is of downflow character, with some 20-35 l/sec flowrate. To the east of the spring source outflow

site steep slope is located, which is descending towards the river gorge with inclination of some 35-40°. Geologically it is composed of easily karstifiable thick layers of limestone. At the north-east side the karstic funnel is developed at some 0.9-1.0 km distance from the spring outlet. The radius of the funnel is 6.5-7 m and the depth of the slump is 5.5-6.0 m. Deposits of limestone rocks and comparably small pieces of clay and loamy materials are (naturally) occurring inside the karstic funnel. For some unidentified reason (probably to divert the precipitation surface run-off from entering the karst funnel) quite large diameter asbestos-cement pipes (apparently accidentally) were observed as slid into the funnel (see figures 1-2). The ditch for surface water was apparently arranged on the south-east side of the funnel, but is not functional at present.

Fig. 1

Fig. 2

Another karstic funnel with conical shape is developed on the north-east side of the above mentioned karstic funnel (figure 3). The radius of the funnel is 3-3.5 m. The depth of the slump is 1.6-1.7 m at present. It appear that slump depth was deeper in the past (probably approximately the same depth and shape as above described karstic form). Though, the karst is filled artificially with clay-loamy materials and apparently there was an attempt to divert surface flow from the open karst. There used to be ditch for diverting surface flows from entering the karst, but this is not functional at present either. In this karstic body the clay bottom appears subsided and the well of cylinder shape developed, where surface water runoff apparently enters during the heavy rainfall and snowmelt events. As mentioned above, branches of trees, leaves and clay soils are dumped in this karst space.

Fig. 3

Local anecdotal evidence indicates that in the past, in order to test that above mentioned karstic slumps are indeed connected with the groundwater flow and ultimately the downstream spring source, grinned chaff were introduced as test samples into the karstic funnel and it was observed that these samples indeed surfaced in the karst outflow waters downstream.

In general, Lower Cretaceous sediments (Neocomian) are characterized with abundant water resources. Springs usually flow out at the level of local erosion base or at a bit upper area. Flowrates of such springs are usually dozens of litters per second. The same is the case with this particular 'Tskhratava' spring as well. The Lower Cretaceous (Neocomian) limestone is laid over the substrate watertight Kimmeridge-Tithon speckled clays of upper Jurassic age, which form impermeable layer forcing the water flow to surface at the local erosion base level. It should also be mentioned that morphologically the catchment area of the subject water source constitutes approximately 2-2.5 km^2. Observed flowrates at source are unrealistic to expect form indicated catchment area, therefore we can speculate that tectonic disruptions which are spread in the spring feeding area play the key role in feeding the spring. These tectonic disruptions divert groundwaters from tectonically active zones into above described open and sealed karstic spaces. It should also be highlighted, that within the Tskhratava source area no other spring outflows with significant flowrates can be found within the entire 10-12 km^2 catchment area, located between the river Kvedrula and its nearby tributary Skhanari stream. This clearly indicates that most atmospheric precipitation and snowmelt run-off waters are ultimately emptied into this karstic system.

It can therefore be concluded, that spring source is of is a typical karstic origin, with all its characteristic features, such as occasional turbidity, highly variable regime and discharge rates, etc., at the same time, though, characterized with good drinking qualities, low mineralization and satisfactory chemical composition. Based on results of earlier hydrogeologic studies, the chemical characterization of the spring source is of hydrocarbonate-calcium-sodium type and according the Kurlov formula: $M_{0.253}\frac{HCO_3(75)SO_4(21)}{Ca(70)Na(30)}$; source water temperature is in the range of 8.5-9°C, pH – 5.5-6.

Taking all the above mentioned into consideration, we can consider following conclusions:

1. It is a typical karstic spring water source;
2. Morphological boundary of spring catchment area is not compatible with observed spring source water flowrates;
3. Tectonic faults play a key role in contributing into the large flowrates of the spring source, by diverting ground waters, formed above the erosion base, into the karstic system;
4. The reason for turbidity observed in the water source is the due to flushing of the Kimmeridge-Tithon speckled clay layers and the mobilization of solid sediments with subsequent withdrawal through karstic spring source;
5. Surface run-off water inputs discharged into the above described karstic voids provide important but non-decisive contribution in the turbidity of the spring waters;
6. Open karstic voids create precondition for polluting the spring water and therefore, their isolation is indeed required. It is also necessary to remove asbestos-cement pipes from karstic funnels.

Hydrogeologist: O. Gogrichiani
05.11.2012

Appendix 8.5: Detailed Design of Oni's Water Supply Scheme

Improvement of Oni town water supply scheme
Detail Design
JSC "Saktskalproekti"
General Explanatory Note

JSC GEORGIAN WATER PROJECT

Improvement of Oni town water supply scheme

DETAILED PROJECT

VOLUME 1

GENERAL EXPLANATORY NOTE

General Director	N. Palavandishvili
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Tbilisi
2012

PROJECT DESCRIPTION

1	GENERAL EXPLANATORY NOTE	Volume 1
2	CONFIDENTIAL COST ESTIMATES	Volume 2
3	DRAWINGS	Volume 3
4	ELECTROTECHNICAL PART. EXPLANATORY NOTE AND DRAWINGS	Volume 4

1. Introduction

In compliance with the agreement with JSC "United Water Supply Company of Georgia", JSC "Saktskalproekti" was commissioned with improvement of water supply scheme of Oni town in 2012.

Population of Oni is provided with running water via two water-piping schemes: "Zhizhoreti" and "Kvedrula", up to 20 and 80% of users, respectively.

The basic water supply source is "Kvedrula" piping network with capacity 25-45l/sec.

"Kvedrula" water-piping scheme is under operation since the 70-ies of last century. According to information of local specialists and users the debit of "Kvedrula"is rising up to 50l/sec during heavy precipitations fall which causes water turbidity. In consequence, its quality does not meet requirements of potable water state standards and it is not used for drinking.

On that basis the vertical settling basin, low rate filter, chlorinating unit for water disinfection and 2000m^3 capacity power regulating reservoir were built at the catchment structure territory. However, these structures cannot be restored today.

Trapezoidal shape (7.4 x 8.2)m structure is used to intake karst water which is fed to intermediate chamber (4.2 x 3.6 x 1.6)m (Drg. N8), equipped with excess water discharger, water feeder to the scheme, discharging and flushing pipelines with depreciated valves.

Since the chlorinating unit is inoperative water is not disinfected at all.

To provide population with potable water corresponding to the state standard quality, Finnish make FENNO NATERON Ltd purification structure's design has been worked out and handed over to the customer according to the technical assignment of Contract N02-01337 with "United Water Supply Company of Georgia" in 2012. JSC "Construction Systems" has recommended to replace this water purification structure with comparatively simpler German make double block 24 moduli dirre 2.0 x L 1.5 MB40 purification units to be designed at the territory of V=2000m^3 capacity power regulating reservoir according to technical assignment of the additional agreement.

Topo-geodetic survey and engineering-geological study of the said territory as well as poor technical state of the reservoir all indicate to the developed landsliding phenomena there. It must be noted that since the day of its commissioning in the 70-ies of last century the reservoir never worked because of strong leakages of water and cracked structures.

After consideration of the said data with foreign experts it has been decided that construction of new purification structure and restoration of reservoir at the old site shall be cancelled.

That is why the experts of design organizations with the representatives of local municipality have chosen new construction site for purification structure and reservoir. According to recommendation of Mr. G. Soselia and Mr. L. Gabunia the experts of "United Water Supply Company of Georgia", it has been decided to design and build high rate filters already tested practically and similar to Anaklia-Ganmukhuri water supply scheme instead of German complex units.

2. Topo-geodetic substantiation

Topo-geodetic survey works for development of Oni town water supply scheme were fulfilled in compliance with the technical assignment coordinated with the customer.

According to the technical assignment the following types and scope of topo-geodetic works were fulfilled at the site:

Planning of existing and design reservoirs sites, scale 1:200, relief section 0.5m, at 1.7 ha area. Topographic works at the site were done by means of electronic tachometer, TPS series, TCR-407 power model. Its laser distance meter without reflector can be used for measurements up to 200-400m with 2-5 mm precision, while with reflector (standard prism GPR-111) up to 1800-3500 mm with precision 2-5 mm. The range of measurements depends on the air transparency and weather conditions..

During works measurements with EDM IR reflector and without RL reflector were done. The standard GPR-111 prism was used as a reflector.

Topo-geodetic works were fulfilled in the WGS-84 System of coordinates.

To establish position and elevations of planning network points theodolite traverses and levelling lines were done by electronic tachometer TCR-407 power model which are represented as closed polygons.

Quality indices of the said traverses and levelling lines are as follows:

Length of a traverse L=640m.
Absolute linear error fs=0.20
Relative linear error fs/L=1/3200
Levelling line discrepancy, accepted fh=+17 mm.
Levelling line discrepancy, assumed fh= ±24 mm.

According to the above, the quality and parameters of theodolite traverses and levelling lines meet requirements of topo-geodetic survey instructions.

The assumed errors in levelling lines are calculated by formula::

$$fh= \pm 30\sqrt{L}$$

where L is the length of levelling line in km.

In levelling lines the errors were distributed in proportion with the length of their sides.

The results of all measurements (names of points, codes, altitudes, coordinates) were recorded in the instrument job file similar to computer directions, transferred into computer by LGO tools program, processed in AUTO CAD 2007 System DWG format and handed over to the design department.

3. Engineering geology

3.1. Introduction

The existing water supply network of Oni town was commissioned in the 70-ies of XX century. Under testing water losses from regulation reservoir exceeded permissible volumes considerably and till today water is supplied to the users without reservoir.

It is believed that poor technical state of existing reservoir is caused by heterogeneity of ground under its foundation that cannot be remedied today. That is why it is decided to demolish the old and build new reservoir nearby.

3.2 General physical-geological description of the region

From the point of view of physical geography (by L. Maruashvili) Oni is located in the valley of river Rioni within the boundaries of Great Caucasus Range in the Upper Ratcha depression between Pasis Mta-Zekari, Lechkhumi and Ratcha Ranges. The depression is surrounded with Pasis-Mta-Kazikhokh section of the main range and Shoda-Kedela ranges.

Morphologically (by A. Javakhishvili, L. Maruashvili) the territory is attributed to intermontane zone of the Great Caucasus mountainous system southern slope – the Ratcha-Letchkhumi synclinal depression which is characterized with rocky, mountainous relief dissected with deep transversal gorges.

Climatically (construction climatology PN 01.05-08) the territory is attributed to the marine, humid subtropical zone with considerably humid climate, moderately cold winter and long warm summer.

The mean annual temperature of air is 10^0 C, negative temperatures are observed in January (-1.0^0C) and December (-0.8^0C). The maximum temperatures are in July ($+20.4^0$C) and August ($+20.5^0$C). The absolute minimum temperature is -27^0C and the maximum one $+38^0$C.

- The period without frosts is 200 days per year;
- The maximum freezing depth for the following soil is as follows:
- clay-argillaceous soil – 23 cm;
- sand-sandy soil – 28 cm;
- gravel-cobbly soil – 30 cm;
- coarse-detrital soil – 34 cm.

The annual sum of precipitations is 1048 mm, where during cold season (XI-III months) -420 mm, and warm season (IV-X months) -628 mm. Duration of snow cover is 75-100 days per year.

Tectonically (by P.Gamkrelidze) the territory is located within the boundaries of Great Caucasus southern slope folding system, porphyritic- jurrasic northern sub-zone of Gagra-Java zone.

From the point of view of seismic civil engineering (PN 01.01-09) the territory is attributed to the 9th point zone of seismic intensities (MSK scale), the non-dimensional coefficient of seismicity is 0.38.

Geologically (by P.Gamkrelidze) the Lower, Middle Jurassic and Quaternary deposits of Gagra-Java zone are spread in the region.

The Upper Jurassic period (J_1t) is represented with flysch alternation of sandy turbidits, argillaceous shales and argillites of Toarcian stage.

The Middle Jurasssic (J_2a) period is represented with flysch alternation of sandy and aleurolite turbidits and pelagic shale argillites of Aalenian stage. These rocks are widely spread in the vicinity of Oni.

Quaternary rocks (Q) are mostly represented with deluvium and proluvium-alluvium argillaceous coarse deposits.

At the surface modern deluvium (dQ_4) yellow-grey strong plastic clays are spread. Below proluvium-alluvium (paQ_4) yellow strong plastic clays with gruss and gravel inclusions in the upper and lower zones correspondingly are spread.

3.3 The state of existing reservoir

The existing reinforced concrete cylindrical reservoir, diameter 24m, height 4.4m, capacity 200m^3 is hypsometrically located above Oni.

River Jejora, water abundant tributary of Rioni river flows along the south-east side of the reservoir site.

The territory of existing reservoir site is lithologically composed with Quaternary alluvium-proluvium and deluvium boulders, pebbles, rubble and gruss. The coarse fraction diameter often exceeds 1 m. That material is filled with clay, argillaceous and coarse sand.

The presence of alluvial deposits at the steep slope is associated with old river beds of Jejora and its right tributary Tsiliskhevi. According to L.Maruashvili (The Geomorphology of Georgia) Tsiliskhevi river was a tributary of Rioni river in the vicinity of Oni at village Tsola where about one km long dry river bed still exists at 50-75 elevation mark above the thalweg of Jejora and Rioni rivers.

The southern slope at reservoir site is unstable with small and medium size landslide hillocks and negative topography sections. Dense forest growing at the slope prevents development of active landslide processes, otherwise it local soils could be moved by gravitation towards the slope bottom, i.e. to the reservoir.

Technical state of existing reservoir is not satisfactory today. There are cracks at 4.9m high circular wall at the northern (settlement) side and water leaks at its bottom. Cracks are not excluded at its southern wall which is entirely covered with soil and the bottom as well.

The existing cracks and deformations indicate to the settling of structure in grounds of different resistance that is prohibited by construction norms and rules. The above defects were detected under testing of reservoir that is why it was not operating since the day of its construction. Even in case of its filling with water after rehabilitation it is extremely difficult to predict the expected results.

3.4 Engineering geology of design reservoir, chlorinating and water –purification structures.

The site of said structures is located to the South of Oni, within 1 km distance from village Tsmendauri, in the vicinity of former tourists base “Bolotha” which does not exist today and only some 0.5m high concrete supports indicate to its former area.

The absolute elevation mark of reservoir is between 845.25-845.30 m.

The both chlorinating and water purification structures will be located to the East from reservoir. The chlorinating unit within 20 m distance at 845.00 m elevation, while water purification unit within 40 m from chlorinating unit.

The sites of all three structures are at the western end of ridge between Rioni and its left tributary Jejora river, gently sloping from West to East, i=0.025(1.5^0).

Geological workings were excavated at the site of each structure. Working N1 at reservoir site, working N2 at chlorinating unit site and working N3 at water purification unit site. N1 and N2 workings are 5.0 m deep while N3 is 3.0 m deep.

Lithological composition of the structures site (see appendix) is as follows:

- Modern deluvium (dQ_4) yellow-grey strong plastic clays are spread from 0.0 to 1.5-1.7 m depth;
- Proluvium-alluvium (paQ_4) yellow strong plastic clays with gruss inclusions in the upper and gravel inclusions in the lower zones are spread from 1.5-1.7 m to 3.0-5.0 m depth.

Under the above said conditions foundations of structures will be deepened at least up to 1.5-2.0 m to rest on proluvium-alluvium soils strata.

Characteristics of soils are given according to the existing materials and documents.

Description of soil	Density kg/m^3	Processing group and category	DDeformation modulus, MPa	Internal friction angle, degree	Viscosity, KPa	Design resistance, KPa	Temporary slope of depression side up to 3m denth	Aggressiion of soils agains reinforced concrete	Seismicity of soil group	Maximum freezing depth
Deluvium, yellow-grey, strong plastic clay	1900	$ 8-v III	12	15	50	200	1:0,25	Not agressive	II	23
Proluvium-alluvium yellow strong plastic clay with gruss in the upper and gravel inclusions in the lower zone.	1950	$ 8-g III	20	18	50	300	1:0,25		II	23

Head pf the Eng. geological Dept.: **G.Margishvili**

Head of geological team: **J. Kvirkvelia**

4. Present conditions

It has been said above that "Kvedrula" scheme is supplied with karst water that is received in trapezoidal shape reinforced concrete catchment structure while water is regulated in intermediate chamber by means of technological pipelines and valves.

An inspection of catchment structure sections revealed the following defects:

The structure and intermediate chamber walls are cracked here and there, water leaks, bottom has hollows, valves are in poor repair and must be replaced, walls in the top part of the chamber, roof, floor, doors and windows, iron staircase and handrails need restoration.

At the purification structure: settling tank, low-rate filter, main wells, regulating reservoir, chlorinating unit building are destroyed and cannot be restored. Moreover, technological conditions of purification structure do not meet rate and high-quality water purification requirements of today.

Since in the main pipeline at the territory of design purification structures water pressure is above 16 atm., it is envisaged to arrange at the purification structures supply branch water pressure regulator and water meter q=15-17l/sec wells (Drg N1-1, 2-1, 2-3).

5. Design arrangements

According to the technical assignment, it is envisaged in the design to improve potable water quality received from the existing "Kvedrula" scheme according to the state standard requirements.

However, since disinfection and turbid water (caused by heavy precipitations) purification units do not operate in the supply scheme, water quality is poor and it cannot be used for drinking.

It must be taken into account that because of poor technical state of water intake catchment structure creation of additional contamination sources is expected. Besides, considerable volumes of water are lost from damaged parts of catchment structure. Because of the said reasons it is envisaged in the design to carry out rehabilitation works at the site (Fig. N8).

Works connected with the improvement of water quality will be basically realized at water purification structures and water chlorinating unit in the following scheme:

At the 9th km of existing d=200 mm pipeline supplying water from the catchment structure to the damaged 2000m^3 capacity reservoir design and construction works of the following structures and units are envisaged: the complex of water purification structures, V=1000m^3 capacity head-regulating reservoir, chlorinating unit, high rate filter flushing pumping station, water pressure regulator and water meter wells, elevated water tank, various underground pipelines at the site, sentry box, sanitary zone protecting fence, etc (Drg 1-1).

It must be mentioned that the main pipeline - d=300 mm L=7,3 km.; d=200 mm L=2,0 km., from the water catchment structure to the water distributing network of the town is arranged by steel pipelines. Also the technological pipelines of the flushing structure, high velocity filter, drainage scheme and collectors, vertical settling basin and reservoir, most of regulating equipment, are made from steel. It is envisaged to arrange the main pipeline, from the site of designed purification structure and reservoir, to the now abandoned v=2000 m^3 reservoir (To the existing, d=300 mm, steel main pipeline), passing the complicated terrain, on the mountain slope, by steel pipes.

Taking into account the above mentioned factors, for simplifying the conditions of construction and maintenance, and also for ensureing the reliability and stability of the water supplying scheme, the arrangement of all designed underground communications is

envisaged by steel pipes. (In the design are used the following dimensions of the pipeline. As example: d=150 – conditional internal diameter; d=159 mm – outer diameter, d=159x5 mm – outer diameter with wall thickness – 5 mm and so on.

For preparing the disinfecting solution in the chlorination unit, for cleaning the floor of the building, for washing the equipment , for the personnel's higienic purposes and so on the special water pressure tank is envisaged. To this reservoir water will be suupplied from the existing main pipeline, and in exsceptional cases, when water from the headwork is very turbid, the tank will be filled from the reservoir, by pump and pressure pipeline (see dr. No 1-1)

The pessonel, for drinking will use, delivered from the reservoir water.

Under operation of water purification structures d=150 mm valve is opened in the main well N1 while the valve supplying clean water to reservoir is closed in the well N19.

As water purification structures are operating periodically they are mostly closed and clean water is supplied to the reservoir by the existing main pipeline and control valves in main wells N13 and N19. At that time water supplying valve in the main well N1 at purification structures is closed, etc (see Dr. 1-1 and table No3).

6. Designed discharge of water

It has been said above that Oni town is supplied with water by “Zhizhoreti” (20 l/sec) and “Kvedrula” (25-45 l/sec) schemes. The latter provides mostly so-called “upper zone” users. It must be mentioned that the debit of both schemes varies sharply so “Kvedrula” scheme is considered as the basic water supply source of the town while “Zhizhoreti” is the reserve one.

Hence the total demand of the town is calculated according to the volumes received from “Kvedrula” scheme.

According to technical assignment population of Oni is 2300 persons in total, that under consideration of the coefficient of growth 1.25 is 2875 persons.

It is assumed that the daily water requirement norm is 250 l per capita. It has been calculated on the basis of JSC “United Water Supply Company of Georgia” and the “European Investment Bank” water requirements typical forecast data form for the existing networks (Table N1) thatdesigned discharge of water from the source will be 15,06 l/sec while in peak hours q_{max}=29.25 l/sec (Table N2) that will be received by a user from regulated water reserve in reservoir in case of need.

The said will take place when water is turbid and according to the capacity of purification structures 15 l/sec volume is supplied to the reservoir. Otherwise, except the period of intense and long precipitations 30-40 l/sec clean water will be supplied directly into the reservoir.

Table 1

Projects of the United Water Supply Company of Georgia and European Investment Bank
Future water requirements typical forecast data for existing projects

Distribution scheme		Presumable, future state after rehabilitation works				
Group of users	Population	Unit requirement	Average daily requirements		Maximum da requirements	
Predesigned water discharge data	Forecasted number of water provided population	Day/per capita m^3	Predesigned requirement m^3/day	Average designed l/sec*** supply	Predesigned requirement m^3/day	Ma de l/s su
Household requirements	2875	0.25	718.75	8.32	862.5	
mall commercial/industrial requirements**	% Of the above	10%	71.9	0.83	71.9	
rs (big volume supply + 10 to20% to existing data)	-	-	-	-	-	
New water requirements in distribution scheme			790.65	9.15	934.4	1
vident losses (% of net requirements ****		6.0%	47.4	0.55	47.4	
Real losses (leakages)	(% of net requirement)****	40.0%	316.26	3.7	316.26	
Total design requirement for distribution scheme			1154.31	13.4	1298.1	1
seasonal factor for the maximum daily requirements 1.2 calculated for requirements and not for leakage		1.20				

** When meter data is available, is added 10-20% to the actually used volume

*** Without the factor of peak/hour

Vhen there is no extraordinary situation in the town the following percentage values are used: fro evident losses 4% of total demand or 6% o
l; For real losses (leakage 27% of total demand or 40% of net demand; For losses in the main pipelines 4% of total demand or 5% of net der

***** Technical water for services 8^ of total demand or 9% of net demand, losses inclusive.

Total water discharge of "Kvedrula" scheme

T

ector name	Population number	Total average discharge l/sec	αmax.	βmax.	Kmax.	Total discharge l/sec	Max discharge l/sec for Sectors	Fire fighting discharge l/sec	Max. discharge fire purposes inclusive l/sec	Water supply source	Not
2	3	4	5	6	7	8	9	10	11	12	
Kvedrula" cheme, Oni	2875	15.06	1.3	1.5	1.95	29.52	-	-	-	"Kvedrula" karst water	

7. Water purification structures

Since the standard three years observation cycle on "Kvedrula" water quality (turbidity) does not exist and to avoid higher costs and complexity of operations it is envisaged to purify water without reagents. That is why according to the standard 2.04.2012-84 water turbidity supplied to the filter for purification must be preliminarily reduced to 8-12 mg/l in the settler. Thus, construction of vertical settling basin is envisaged in the design.

- Calculation of vertical settling basin Q_{calc}=1298m^3/day =54m^3/hr =15 l/sec

by settling zone area $F = \frac{Q_{calc}}{3.6 \times V_{av} \times N}$ m^2, where V_{av}=0.5÷0.6 mm/sec is the stream upward velocity in settling zone mm/sec. N is the number of settling tanks and we need two units. Substituting the values into formula $F = \frac{54}{3.6 \times 0.6 \times 2} = 12.5$ m^2, chamber area $f_{k.x.} = \frac{q \times t}{60 H_1 \times 2}$, where $f_{k.x.}$ is the chamber area m^2, t is the delay time of stream in chamber t=15 min, H_1 is the height of chamber in m, H_1= $H_{settl.x0.8}$, where H=3.5m, the height of settling tank from water surface up to conical part, then H_1=3.5 x 0.8=2.8m. N=2. Substituting the values into formula

$$f_{k.x.} = \frac{54 \times 15}{60 \times 2.8 \times 2} = 2.4 \text{ m}^2.$$

Diameter of settling basin $D_s = \sqrt{\frac{\sum F \times 4}{\pi}} = \sqrt{\frac{12.5 + 2.4 \times 4}{3.14}} = 4.3$ m.

d:H=4.3:3.5=1.23<1.5. the height and diameter ratio is observed.

Diameter of chamber $D_{ch} = \sqrt{\frac{D_{ch} \times 4}{\pi}} = \sqrt{\frac{2.4 \times 4}{3.14}} = 1.8$ m.

To make the structure simpler it is envisaged to replace reinforced concrete chamber with plastic one.

Vertical settling basin is equipped with supply, discharge, flushingand excess water discharging pipelines and control valves. There are two operating and reserve structures (Fig. 4.1).

- High rate filter (Drg. 5.1÷5.8).

Q_{calc}=1298 m^3/day =54m^3/hr=15l/sec.

According to the state standard for purification structures use 10-14% are assumed. Then

Q_{calc}=Q_{day} .x 1.14=1298x1.14=1479m^3/day=62m^3/hr=17 l/sec.

High rate filter area $F = \frac{Q_{calc}}{T_{vp \cdot H} - 3.6nwt_1 - nt_2 vp \cdot H}$,

where

T – operation time of filer during 24 hrs;

$V_{l.H}$=5-6 filtration velocity m^3/hr;

n – number of filter flushings 2-3 times/day depending on water turbidity;

w – intensity of filter flushings l/sec/m^2=12;

t_1- duration of filter flushing 0.1 hr;

t_2 – delay of filter operation under flushing – 0.33 hr;

Substituting the said values in formula the area of high rate filter is

$$F = \frac{1479}{24x6 - 36x3x12x0.1 - 3x0.33x6} = \frac{1479}{125.1} = 11.8 \text{ m}^2$$

The number of filter sections $NF_F = 0.5\sqrt{11.8} = 1.72$. Double section is accepted in the design with total area $\sum F \cong 12x2 = 24$ m^2, section dimensions l=4m, b=3m, h=3.33m (Drg N5-1 ÷ 5-8)

8. Head-regulating reservoir

It has been mentioned above that the existing reservoir (V=2000m^3) is so damaged that it cannot be restored and engineering-geological conditions of the site are not reliable. That is why it was envisaged in the design to build new reservoir at water purification structures site.

According to the state standards it is envisaged to build head-regulating reservoir.

The total volume of reservoir contains regulation, emergency and fire-fighting water storages.

$\Sigma w = w_{reg} + w_{em.} + w_{ff.}$ Q=1298m

It is assumed that regulation storage equals to 30% of the maximum daily discharge, then

w_{reg}=1298 x -0/3=389m3

$W_{em.}$ – An emergency storage is assumed for elimination of an accident during 8 hours with reduction of the maximum water use by 28%. Then W_{em}=1298:24 x 8=433m^3.

$W_{f.f.}$-fire-fighting storage is determined by the number of population and the number of building floors. It is assumed for indoor and outdoor fire-fighting cases as 15 l/sec during 3 hours. Then $W_{f.f.}$=15 x 3.6 x 3=162m^3.

In total $\Sigma w = w_{reg} + w_{em.} + w_{ff.}$=389+433+162 =984m^3

It is envisaged in the design to build one round shape reservoir (d=18m, h=4.4m, h_t=4.8m) with specific volume 1000m^3 according to the typical 901-4-2c design and corresponding remaking of the Construction part.

The reservoir will be built at the site of purification buildings with its bottom at 842.20 absolute elevation. It will be equipped with water inlet from the source, excess water discharger, regulating emergency and fire-fighting outlets, flushing and discharging technological pipelines and main wells with their control valves (Drg.1-1, 9-1 and 9-2).

Fire-fighting, emergency and flushing pipeline valves are closed usually and will be opened in case of need only.

The reservoir will be located in a hollow with 0.5m thick earth embankment on the roof to preserve needed temperature of water (See Drg N9-1, 9-2).

9.Disinfection of water

By the coefficient of growth the number of Oni population is 2875 persons.

According to the technical assignment daily consumption rate is 25 l per person or 15 l/sec.

That volume is calculated for a case when water becomes turbid and it is necessary to purify it which happens during intense precipitations only. Thus the capacity and construction cost of water purification structure depend on the volume of water to be purified or the capacity of 15 l/sec. Usually, there is no need to purify water and its discharge from the catchment basin is rising above 30-35 l that is supplied to reservoir and further to the users.

In such cases one person can use 400-500 liters of water daily. It must be taken into consideration that considerable part of Racha population live in big cities all the year round and go to their native villages or towns in summer time only. During that season the number of water users is more than double and so water requirements sharply increase.

That is why it is envisaged in the design to disinfect 45-50 l/sec water discharged from the reservoir during peak hours for drinking and household purposes.

Thus for disinfection of the above said water volumes two sets of anolyte type production units are envisaged in the design – one unit with capacity 100 m^3/hr during peak hours. According to the given scheme and the required water discharge the units will be on /off automatically to supply water from reservoir to network by valves mounted on pipeline in wells N1 and N2 (Drg.1-1).

Calculation of oxidants for water purification network received by electrolysis from table salt water solution is given in the explanatory note of chlorinating unit.

10. Construction part

1. The design decisions are based on:
   - Technological materials;
   - Master plan of design object;
   - Topo-geodetic survey materials;
   - Engineering-geology study materials;
   - Climatic and geophysical data of the area.
2. According to "Collection of climatic and geophysical data for construction design at the territory of Georgia" published in 2008 by the Ministry of Economic Development of Georgia the following loads are assumed for construction sites:
   - Wind velocity rated head 35 kg/m^2;
   - Snow cover rated weight 85 kg/m^2;
   - Ground freezing rated depth 37 cm;
   - Winter design temperature -15^{0}C;
   - Summer design temperature +28^{0}C;
   - Region design seismicity 9.
3. Foundation base is yellow-gray strong plastic clay i=1900 kg/m^3; E=12 mPa; φ=15^0; C=50KPa; R=300KPe;

<u>Pressure regulator well</u>

Since in the existing pipeline at purification structure the hydrostatics head value is 16 atm it is envisaged in the design to mount pressure regulator in the reinforced concrete well (3.4 x 2.2. x 2.32)m.

<u>Water meter well</u>

Capacity of water purification structures is 15 l/sec that will be determined by water meter mounted in reinforced concrete well (2.2 x 1.5 x 2.4)m.

Vertical settling basin

The cylindrical shape structure d=4.3 m. Its height above the ground level H=3.9 m, the underground conical shape part H=2.21 m deep. The structure is made with reinforced concrete (concrete brand 25(m-325) class W-6, F=100 reinforcement A=III, A-I) with super plasticizing agent additive. At 2.9 m depth quality embankment is made around high rate filter and vertical settlers.

High rate filter

The rectangular structure dimensions are 5 x 6.5 m, depth H=3.33. It is made the structure is made with reinforced concrete (concrete brand 25(m-325) class W-6, F=100 reinforcement A=III, A-I) with super plasticizing agent additive.

Chamber for pumping unit

The pumping units installation is envisaged in reinforced concrete well (3x4)m, h=4.3 (Drg.6-1, m-1, m-2). Its bottom elevation mark is 842.16 while that of roof – 846.16.

The well is equipped with metal ladder and light-weight raising cover made of sheet iron.

From reservoir to pumping units chamber water is supplied by d=400 mm pipe equipped with manually operated control valve. The chamber can be emptied by d=32 mm discharge pipeline with control valve.

It is envisaged to switch over the head pipeline of two simultaneously operating pumping units to the mass concrete slide gate chamber (Drg.m-1) From the chamber water is supplied to the filter by pipeline d=300 mm, l=54 m (Drg.6-3).

Two pumps are mounted in the well with total discharge capacity q_t=144 l/sec, pumping lift H=18 m, power N_t=25 x 2=50 kwt.

Chlorination unit

- Dimensions of structure (8.2 x 6.4)m, H=3.3 m;
- Reinforcement of strip foundation;
- Walls are built with thin m-50 concrete blocks with m-50 sand cement mortar with plasticizer additive, thickness up to 200 mm, floor is covered with ceramic tiles and linoleum;
- Corners are reinforced with fabric from top to bottom with 600 mm pitch;
- Partitions are fixed in walls and roof slab;
- Threshold of reinforced mass concrete;
- Ceiling is made with standard precast reinforced concrete slabs;
- Ceiling slabs are tightened with mass reinforced concrete;
- Roof is covered with soft rolled paranite H=40 cm;
- Gutter of sheet steel;
- Structure is surrounded with concrete side slope b=1.0 m;
- Construction works should be realized according to the safety engineering standard III-4-8- at construction site.

Reservoir W=1000 m^3

The cylinder shape reservoir d=18.0 m, depth H=4.8 m. The entire structure is made with reinforced mass concrete, brand 25(m-325) with super plasticizer additive. Concrete is reinforced with steel fabric and separate rods brand A-III, A-1 W-6, F-100. Drainage system is made around the reservoir.

Potable water supply to the design object

To regulate and supply water to the design object and chlorination unit it is envisaged to install elevated water tank made of steel pipe d=800 mm, height – 3.5 m (Drg. 6-4) capacity 1.8 m^3

The tank will be equipped with supplying, discharging and emptying pipelines with corresponding valves.

From the tank water will be supplied to chlorination unit (Drg. 1-1) and the personnel users.

The tank will be filled with water in two cases.

When water is clean in the source d=150 mm valves in the main N1 and N20 wells will open. At that time the valves in N18 and N13 main wells are closed and water is supplied into the tank until the excess water begins to flow from its discharging pipeline. At that time d=150 mm valve in well N1 will close, etc..

To supply water to chlorination unit it is necessary to open d=400 mm valve in N18 well and to close d=100 mm valve. Water is supplied in the said way until it flows clean through the main pipeline from the source.

When water becomes turbid at the source the purification structures are started and d=150 mm valve in N20 main well is closed.

Sentry box

- Dimensions of structure 4.0 x 3.0 m;
- Height H=2.85 m;
- Strip foundation of mass concrete B-15 (M-500), bottom reinforced;
- walls are built with thin hollow up 25% concrete blocks brand n-50, sand cement m-25 with plasticizer additive;
- Corners are reinforced with fabric from top to bottom with 600 mm pitch;
- Threshold of reinforced mass concrete;
- Floor concrete with planching;
- Doors and windows metal laminated;
- Roof reinforced mass concrete brand m-200;
- Structure is surrounded with concrete side slope 0.8 m wide.

Toilet with cesspit

- Dimensions of structure 3.3 x 1.1.m;
- Height H=2.45 m;
- Walls and ceiling wooden with sheet metal roof, cesspit of mass concrete.

Selection of filter flushing pumps

According to the state standard filters must be flushed with clean potable water. It is assumed that for $1m^2$ filter flushing 12 l/sec of water are required during 6 minutes. When it is envisaged to flush one $F=12\ m^2$ area filter the total volume of water consumption will be q_f=12 x 12 144 l/sec.

In the head pipeline: d=300 mm, l=54 m, q=144 l/sec the quantity of longitudinal losses Σh_l=l x 1000 I x 1.1=0.054 x 17.6 x 1.1=1.05 m, where 1.1 is value of local pressure losses in the pipeline; In filter distribution system h_l= 4m, the value of pressure losses in filter h_l=0.70 m; in gravel trapping layer h_l=0.4 m; under simultaneous operation of two pumps h_l=0.5 m; in valves (5 pcs) h_l=0.75 m. In total pressure losses Σh_l=l.05 + 4 +0.7 + 0.5 + 0.5 + 0.75 =7.4 m. The pumping lift geometrical difference value h_g=849.32 – 843.04 =6.28 m. Total height of the pumping lift $h_t=h_g+ \Sigma h_l + h_f$ = 6.3 + 7.4 +2 = 15.7 m where h_f=2 m that is the value of free pressure at the filter at the end of head pipeline.

We choose S type submerged pump for clean water, capacity q = 72 l/sec, pumping height 18 m; pressure will be controlled by valves (when needed).

It is envisaged in the design to mount two pumping units operating simultaneously with total capacity 72 x 2 =144 l/sec (Drg.m-1).

11. Measures of Environment Protection

Under improvement of Oni town water supply scheme and in particular in case of water turbidity caused by heavy precipitations in the existing "Kvedula" water supply scheme it is envisaged to build water purification structures, disinfection-chlorination unit and v=1000 m^3 capacity power-regulating reservoir.

Under realization of the said works negative impact on the environment will certainly take place. However, because of low intensity of transport operations it will be insignificant and will not exceed the valid norms.

The contractor organization should pay due attention to normal operation of transportation and mechanical machinery with a view to minimize contamination of the area with fuel and lubricants. However, if that happens the contaminated site must be immediately localized, dirty boil must be removed and dumped at the site indicated by the regional environment protection service personnel under strictly observed rules of environment protection.

12. Organization of construction

Flushing structures, pressure-regulating reservoir and under ground communications placement site, F=0,47 ha is situated in the suburbs of town Oni, on unpopulated area, in 100 m. distance from the existing road. According to this, during arrangement of the trench and foundation pit, the security measures are not so strict, as for construction in condiytions of towns and settlements populated areas.

On the construction site, during underground arrangement of the pipelines, the average depth of the trenches is 1,0÷3,0 m. So the arrangement of the ytemporary trenches is envisaged without protecting of the trench slopes, according to the natural slope characteristics of the soils.

Notwithstanding of above mentioned, according to the existed rules, the special warning sign's should be installed around the provided earth excavation site. If earthworks will be provided at night, the contractor should provide the lighting of the trenches.

According to the recomendations of T_t, for avoiding the additional damages during arrangement of the foundation pits for repairing the pipelines after the incidents, the special humid resistant coloured strip should be placed, during backfilling the pipeline trenches, on 60 cm. height over the pipeline, before backfilling the trench up to designed elevation.

All above mentioned measures should be provided by winner in the tender firm.

Concreting of the structures with reinforcement framework, arranged accprding the relevant drawings, should be provided continously. The quality of the concrete should be controlled by concrete works quality sertificates, issued by specialized laboratory, according to the existing rules and in agreed intervals.

The total period of construction works envisaged to the improvement of Oni population water supply is 4 months that account for 122 calendar or 100 working days inclusive preliminary and contractor's mobilization periods – 17 days and the main working 83 days.

The standard working regime is assumed for execution of works: 25 eight-hour working days a month.

The total cost of construction works is 976.37 thousand GEL. The maximum number of personnel proceeding from the calendar schedule of construction is 43 persons (Table 12.1)

Labour consumption for execution of construction and erection works is 2723 man/day (Table 12.2).

Demand for technical resources is given in Table 12.3.

Chief specialist **B. Maglaperidze**

13. Rules of purification structures control

Karts waters are the source of "Kvedrula" scheme which supplies potable water to Oni population..

The debit of "Kvedrula" karst water source varies sharply within the range of - 25÷50 l/sec that is caused by heavy precipitations fall when water becomes turbid and useless for drinking.

With a view to avoid the said problem it is envisaged in the design to build water purification structures, such as the vertical settling tank and high-rate filter which will operate in case of water turbidity.

Prior to operation of purification structures under clean water supply from catchment structure D15NP type pressure regulator with 16 bar input and 1.0÷1.5 bar output pressures must be prepared and calibrated. The water meter capacity range Q=15 l/sec, which will not be changed for a long time, will be determined by means of control values in the main N1 well – d=200 mm and d=150 mm and water meter well d=150 mm.

The sequence of purification structures operations beginning and termination (one filter and one vertical settler are working, the second one is in reserve):

Since the distance between purification and catchment structures is 9 km the operator in catchment structure chamber is permanently testing water quality samples during atmospheric precipitations (in a special transparent glass flask) and as soon as water colour is changed informs the purification structure operator.

The purification structure operator, accorsing to the table No 3, immediately closes in main well N19 clean water valve, supplying water to the reservoir and opens d=200 mm calve on – 15 - pipeline in the same well. Simultaneously in the main well N 13 the valve is closed on the pipeline – 7 – supplying clean water from the source and the valve on pipeline – 1 – supplying clean water from purification structure to reservoir is opened.

Then in the main well N1, d=150 mm valve is opened on – 4 – pipeline (according to the preliminary control data). In pressure control N2 and N 3 main wells valves d=150 mm on – 4 - pipelines are opened (depending on which vertical settler and filter are operating).

From vertical settler water is automatically supplied to the corresponding high-rate filter by – 4 – pipeline.

Water cleaned in the high-rate filter is supplied to reservoir. At that time d=150 mm valves in the main wells (N9 and N10 are opened depending on which filter is working, while in the wells N8, N11 and N12 the valves are closed (See table No 3).

From reservoir the controlled volumes of water are supplied to the scheme according to the corresponding demands by means of valves on regulating, accident and fire fighting pipelines.

At the beginning of the above said cycle in the main well N1 the valve opened according to the preliminary determined degree supplies excess water to existing pipeline – 15 -, etc.

Operation of valves in the main well N18 does not depend on purification structures operation or inoperation. Valve d=100 mm will open when water is turbid and its supply for

drinking or chlorination unit needs is impossible. To supply clean water from reservoir to tank the pump will be started for a short period. At that time in the same well valve d=40 mm on – 29 – pipeline as well as valves 2d=300 mm in N8 and N12 wells must be closed without fail. In the main well N18, d=100 mm valve is opened and as soon as the tank is filled and excess water starts to run from its overflow drain the pump is switched off, valve d=100 mm in N18 well is closed and valve d=40 mm is opened.

Under supply of clean and turbid water from the source – catchment structure and flushing of high-rate filter the full cycle of valves control and regulation sequence at corresponding technological pipelines is given in Table N3.

Tal

Control - regulation sequence of technological pipelines and valves on the purification structure's territory

Purification structures						
Isn't in working condition			In working condition			
eline No and d mm	Gate valve d mm		Pipeline No dmm	Gate valve dmm		Note
	Open	Closed		Open	Closed	
2	3	4	5	6	7	8
-15- 200 -4- 150	200 150	–	-15- 200 -4- 150	200 150	–	Is regulating according to demand
-14- 50	50	–	-14- 50	–	50	Is allways in open position during suppling of clea from water catchment structure
- 150	–	2d=150	- 150	2d=150	–	According to which high rate filter is operating. filters are operating, the valves 2-3 are in open po
-5- 150	–	2d=150	-5- 150	–	2d=150	Is open position during emptying and flushing of settling structurres
-1- 150	–	2d=150	-1- 150	2d=150	–	According to which high rate filter will in opera
80	–	2d=80	80	–	2d=80	During washing of filter is opening the accordin valve, and closed after pouring of used for flu water and initial filtrates.
-2- 300	–	2d=300	-2- 300	–	2d=300	During flushing of the high rate filter, will be ope according gate valve

-1- 200 -7- 200	- - - 200	200 –	-1- 200 -7- 200	- 200 – -	- - - 200	
-7- 200 -15- 200	200 –	200	-7- 200 -15- 200	–	200	-15- gate valve is regulated

2	3	4	5	6	7	8
-2- -100- -29- 40	_40	100_	-2- -100- -29- 40	—		The gate valves should be opened and closed, acco the filling by water and water use of water pressu according to the demand
-3- 300 -3- 300	– –	300 - 300	-3- 300 -3- 300	– –	300-300	Will be opened only during the flushing of the re filter
-9- -10- -11- -12-	Reservoir's gate valves are regulated according to its nomination and demand					

Washing of the filter

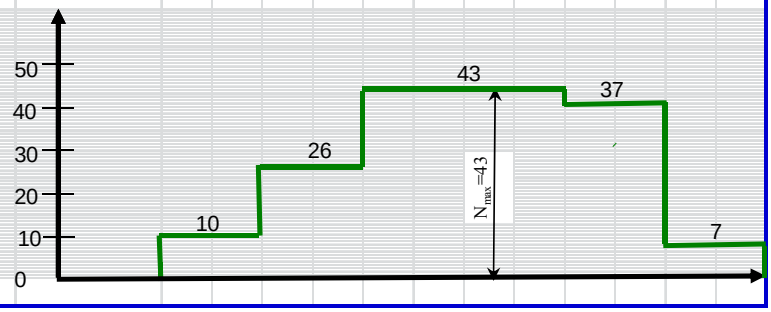
-3- 2d= 300	300	–	-3-	-	300	Will be opened that gate valve, which filter is flu

-1- 2d=150	150	-	-	-	150	Will be closed that gate valve, which filter is flu
-2- 2d=300	300	–	-2-	-	300	Will be opened that gate valve, which filter is flu
80	–	2d=80	-	-	2d=80	After finishing and washing of the filter, will be the according gate valve for removal of dirty wat initial filtrates
-2- 2d=300	2d=300	–	-	2d=300	-	The both gate valves should be opened, durin flushing of any filter
-5- 2d=150	–	2d=150	-	-	-	Should be opened, during flushing-emptying o relevant vertical settling basin
	2d=300	-	-	2d=300	-	Afrer 6 min. working will be stopped the pump, 2d=80 mm gate valve in the No 11 well and pou dirty, used for flushing water and initial filtrates these, all gate valves, opened for flushing should b all closed gate valves should be opened and so according to the necessity

Calendar Schedule of construction

Table 12.1

#	Description of works	labour input workday unit.	Months and decades											
			I			II			III			IV		
			I	II	III	I	II	III	I	II	III	I	II	III
1	Contractors mobilization and preparatory period	166	10											
2	Headwork of "Kvedrula" water scheme	99			6									
3	Purification structures with service network	762								15				
4	Reservoir and chlorination unit	900								14				
5	Pumping station with head pipeline	276						6						
6	Organization of territory	455							8				3	
7	Electric-technical part	66											4	



Calendar Schedule of Man-power Resources
Table 12.2

#	Description of works	labour input workday unit.	Months and decades											
			I			II			III			IV		
			I	II	III	I	II	III	I	II	III	I	II	III
1	Contractors mobilization and preparatory period	1328	1328											
2	Headwork of "Kvedrula" water scheme	792				792								
3	Purification structures with service network	6093						4062			2031			
4	Reservoir and chlorination unit	7196			1799			3598			1799			
5	Pumping station with head pipeline	2208				736			1472					
6	Organization of territory	3639							2135		1065		439	
7	Electric-technical part	528												528
8	Total labour consumption	21784		1328		3327			11267		4895		967	
9	Man/day			10		26			43		37		7	

The bill of technical resources

Table12.3

No	Description of Technical Resources	Meas.	Quantity
1	2	3	4
I	Labour consumption		
1-1	Labour consumption of personnel	man/day	2723
II	Construction machiney		
2-1	Excavator with 0.65 m3 bucket	unit	3
2-2	. Excavator with 0.25 m3 bucket	unit	1
2-3	Bulldozer 130 hp.	unit	3
2-4	Bulldozer 80 hp.	unit	1
2-5	Lorry up to 10 t.	unit	1
2-6	Truck crane up to 10 t.	unit	2
2-7	Travelling electric generator	unit	1
2-8	Welding	unit	4
2-9	Concrete mixer	unit	1

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