W.A.R.B.O After Life activities

October 14th 2015.

Presentation of W.A.R.B.O. project at :

GWP Georgian Water and Power

33,I Lane, Kostava str. 0179 Tblisi , Georgia

Introduction

In the past 10 years , meaning during the development of CAMI and WARBO projects , EUREKOS has been involved in several hydrogeological project in Georgia and has always been considered a reference points for hydrogeology and the related geophysical investigations.

GWP is the Georgian company in charge of freshwater production and distribution in the Capital and in the major Cities of Georgia and at the same time it generates electricity from several dams, the largest being Zhinvaly dam. 400 long and 101 m tall.

Description of presentation

During summer 2015 GWP has evaluated the possibility to modify the process of treatment of water and energy generation of waters Zhinvali dam to produce more energy without affecting the amount of drinking water delivered to the Capital, by driving an important amount of water to a new power station via a 3 km channel by-passing the river Aragvni.

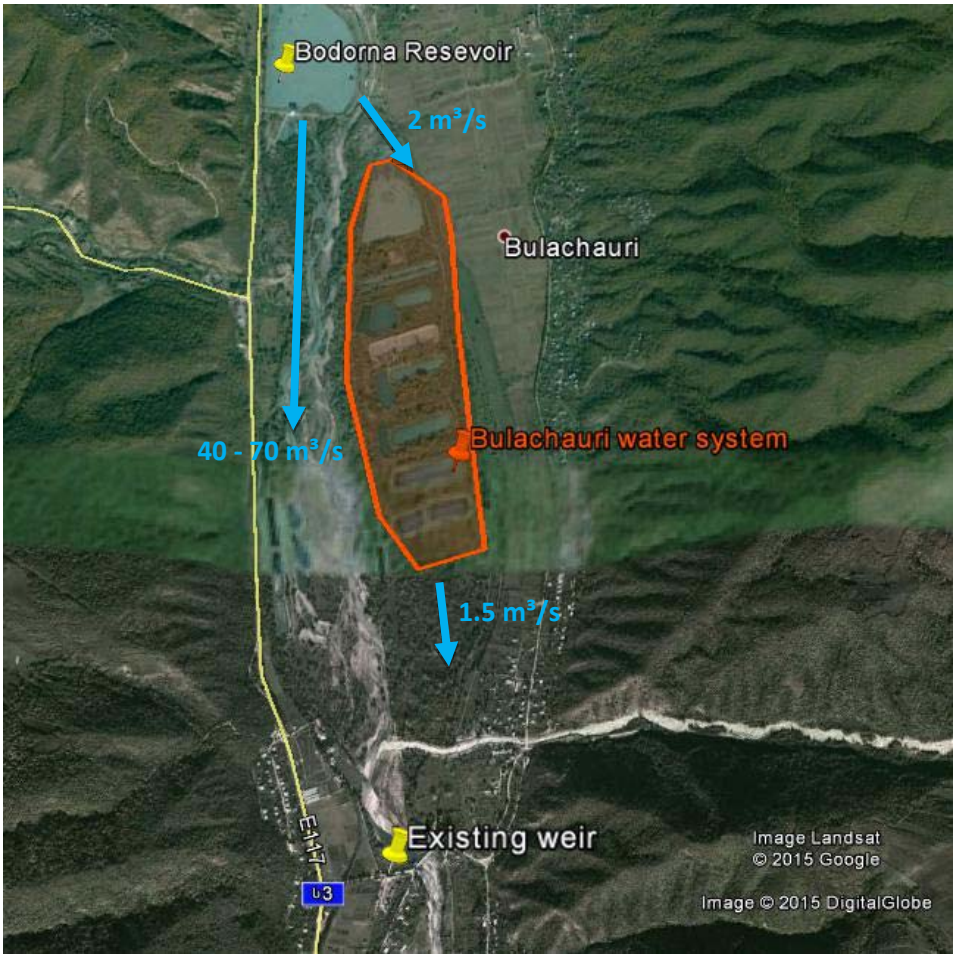
The main concern is the effect of the diversion of 40 m^3/s of water from filtration to the new powerplant instead that delivering that amount to the Aragvni river which is probably the main source of recharge of the groundwater. The diversion will by-pass an area near the village of Natachtari where many water wells are located and where excellent beer and beverages are produced, and for that that area will not benefits of the sub-bottom recharge.

GWP has contacted EUREKOS to have a presentation of WARBO project with special interest to groundwater modeling and methodology of recharge.

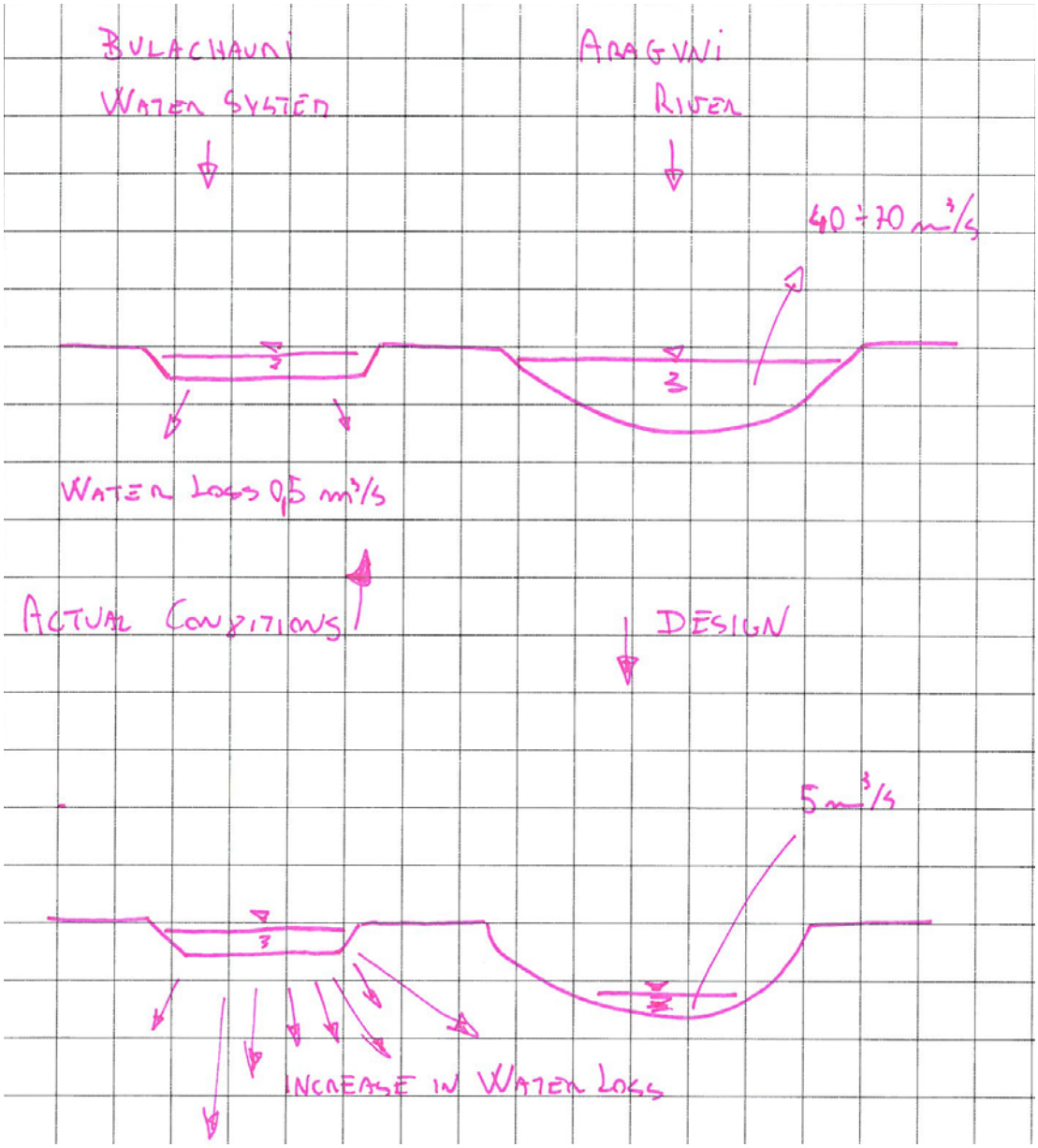
HYDROGEOLOGICAL SITUATION

EUREKOS has spent some days analyzing the available data regarding the Aragvni river basin, the riverbed and the nearby reliefs downstream Zhinvali dam. The main interest is to evaluate if the techniques and modeling procedures applied in WARBO could be used to evaluate the possible effects on the aquifer due

to the diversion of water from Aragvni river from the Bodorna reservoir to the existing weir 3.5 km downstream for hydropower energy production. Main outflow for Bodorna reservoir into Aragvni ranges form 40 to 70 m^3/s, Bodorna reservoir is also connected by two pipes (800 mm e 1200 mm) to Bulachauri water system connected to the Tblisi water supply system. Bulachauri water system inflow from Bodorna is 2 m^3/s and outflow, after filtration process, to Tblisi water supply system is 1.5 m^3/s.



The main issue is to evaluate the possible effect on the Bulachauri water system due to the lowering of water level in the Aragvni river, according to environmental flow (5 m^3/s), as this condition may increase the hydraulic gradient and the rate of water loss in the Bulachauri water system actually estimated 0.5 m^3/s. In a very simplified way the possible effect of water diversion is shown in the following figure.



Application of WARBO techniques and procedures

This study requires to develop two significant models:

1. hydraulic model of the river between Bodorna and the existing weir to estimate water level in actual and design conditions;
2. groundwater model to investigate the local aquifer system:
   - water losses-recharge from the sedimentation basins
   - lateral recharge from the hills forming the river
   - contribution of the river to the groundwater recharge
   - other sources of recharge

and the possible effect of water diversion on the Bulachauri water system.

According to WARBO protocols , to develop these models the following data are necessary:

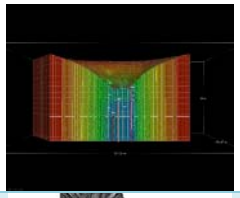
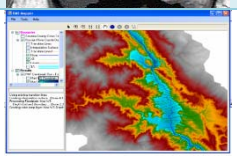
- flows data from Bodorna reservoir (daily flow discharge, for a period of some years, following the operating rules);
- at least 8 river topographical cross section (bathymetry included) from Bodorna reservoir to the existing weir;
- general topographic information of the area: digital elevation models, set of points with known elevation, Bulachauri basins levels and location, topographic description of the existing weirs including levels etc.;
- hydrogeological information of the area (soil type, bedrock depth, permeability of soils, groundwater levels)
- hydrological data (daily rainfall, temperature etc. for a period of some years)
- topographical survey (river cross sections and main levels)
- geotechnical hydrogeological investigation (4 boreholes with in situ permeability test and water level measurement)
- electric tomography- geoeletrical investigation:
- to verify Bulachauri basins leakage with investigation of the infiltration plume;
- to evaluate infiltration process provided by the river
- to define groundwater level

EUREKOS has confirmed that WARBO team has a sounding experience in groundwater investigation and modeling on the basis of the experience collected during the EU CAMI-LIFE and WARBO projects for the study and characterization of aquifers.
(http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=2767&docType=pdf)

CONCLUSION

GWP management has expressed its very high appreciation for the WARBO project and has kindly asked to organize a larger presentation of possible application of WARBO protocols in the Argavni river for a precise monitoring and modeling and to activate , if needed, groundwater recharge procedures.

SOFTWARE

Feflow	3D FEM code for underground flow analysis	
Hec - GeoRAS	HEC-GeoRAS is a set of procedures, tools, and utilities for processing geospatial data in ArcGIS using a graphical user interface (GUI)	
HEC-Ras	HEC-RAS performs one-dimensional steady flow, unsteady flow, sediment transport/mobile bed computations, and water temperature modeling	
FLO-2D	2D flood routing model. It simulates channel flow, unconfined overland flow and street flow over complex topography.	
GMS	Groundwater and subsurface simulations in a 3D environment.