Council for Development and Reconstruction (CDR)
Ministry of Energy and Water (MoEW)
Water Establishment Beirut and Mount Lebanon (WEBML)

Federal Institute for Geosciences
and Natural Resources (BGR),
Hannover, Germany

German-Lebanese Technical Cooperation Project

Protection of Jeita Spring

Support by the BGR project to the Wastewater Planning Process in Lebanon

(project component 1)

Final Project Workshop
11 July 2014

Dr. Armin Margane

Planned Project Activities

1. Integration of water resources protection aspects into the investment planning and implementation process in the wastewater sector

- Support of CDR and other institutions concerning the prioritization of wastewater projects as well as the design and site selection for WWTPs, collector lines and effluent discharge locations; ✓
- Support of CDR concerning the preparation of EIAs for wastewater projects, with regards to their impact on the water resources;
- Preparation of best practice guidelines for the implementation of wastewater projects with special consideration of the aspect of ground and surface water protection. ✓

Contamination Risks from Wastewater

Currently wastewater is discharged
- **into injection wells**
- **into open cess pits or**
- **into nearby creeks/rivers/wadis**

residences with no wastewater collection and treatment

Infiltration of untreated wastewater into highly karstified Jurassic limestone (Faitroun)

► microbiological contamination of Jeita spring

Specific Problems concerning Wastewater Treatment

Jeita Catchment

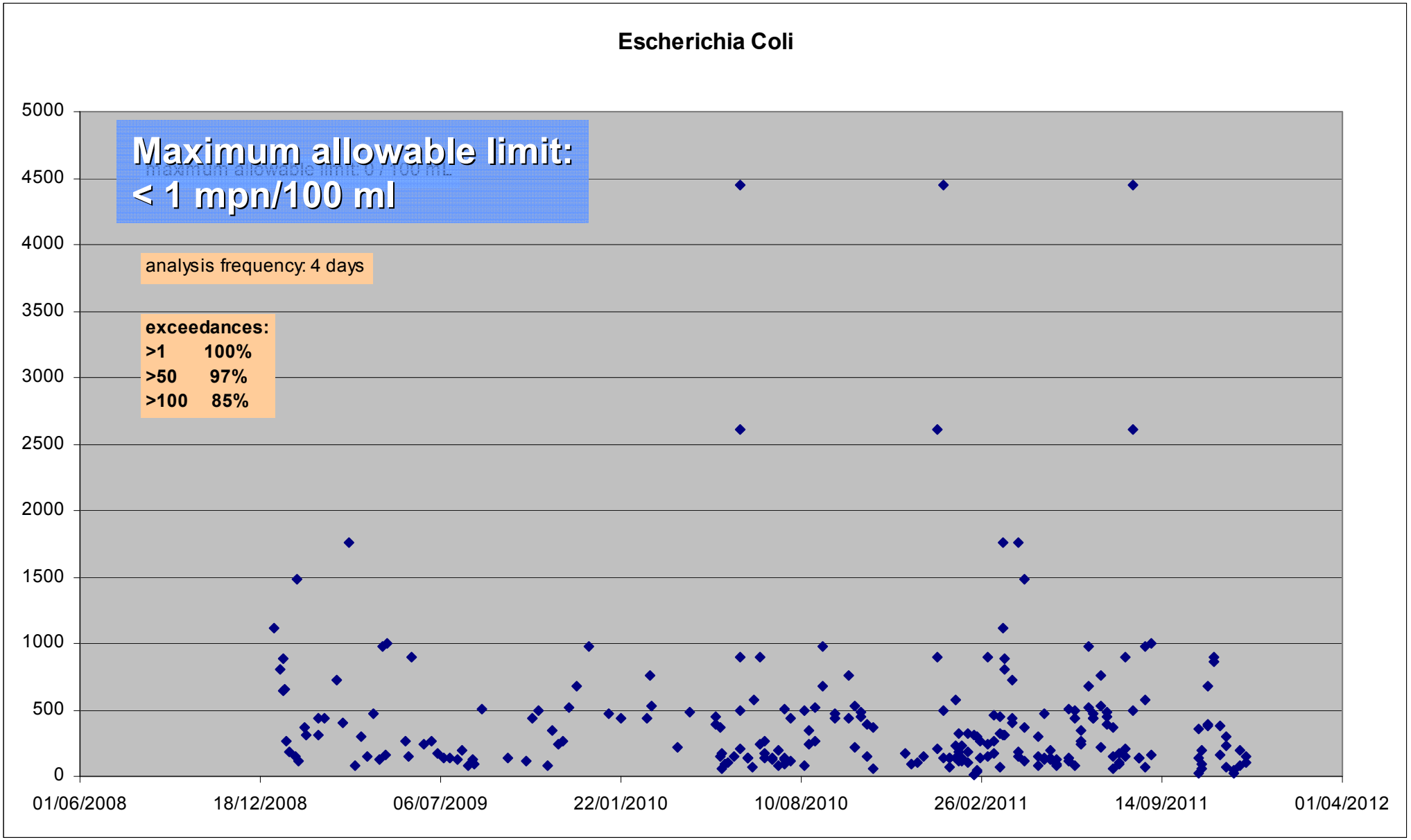
- Topography (WW must be pumped up at several locations; extremely high gradients)
- Electricity not available 24/7 (max 25%)
- Large spacing between residential areas (often only up to 70 % of a village can be serviced by a wastewater scheme)
- Households cannot be forced to connect to WW collector lines
- Municipalities have begun to construct WW collector lines without coordinating with the responsible agencies (aim: divert WW out of the village)
- Their concept, material, etc. does not fit with KfW's/EIBs concept, material, ...

- Geo-risks: karst (sinkholes), tectonics, landslides, rock slides, earthquakes, flooding

► wastewater master plan is urgently needed

Dbayeh raw water (treatment plant)

High and continuous microbiological contamination



Wastewater Planning

Implementation Procedure (how it should be)

In order to establish a wastewater scheme (collection & treatment),

- a Wastewater Master Plan (WMP) has to be developed. This WMP defines the target for a specific planning horizon (e.g. 25 years), i.e. what principally be done to cover a certain area with adequate collection and treatment facilities. The WMP proposes several individual wastewater schemes and gives a rough estimation of costs.
- An initial site investigation for the proposed wastewater treatment plants (WWTP) has to be conducted to determine their suitability (draft environmental impact assessment (EIA), especially on water resources). Based on this draft EIA the update of the WMP is done.
- The agencies responsible for planning in the wastewater sector (here: CDR, MoEW), according to the available funds, define which wastewater schemes will be implemented, what are the exact boundaries of these schemes and what is the time line for implementation.
- The municipalities involved in the proposed wastewater schemes have to agree to the planned wastewater facilities.
- Tender documents are prepared and a consultant is contracted to build the wastewater scheme.
- The detailed site investigation/planning & EIA for the scheme are prepared by the consultant and discussed with all stakeholders (public participation)
- The wastewater facilities are built and transferred to the agency operating it (WEBML)

Site Selection for Wastewater Facilities

criteria catalogue

- General criteria
- Geological/hydrogeological criteria ← BGR
- Financial criteria

ANNEX 1: Criteria for Site Selection and Design of Wastewater Facilities in Lebanon

Criteria	Collector Lines	WWTP Location	WWTP Design	discharge Location	Remarks	Tasks / source
General Criteria						
number of inhabitants to be serviced (capa						
WW indus						
planr /indu plan)						
popu						
planr						
mate appr						
existi mate						
chara inclu						
topo can b have to be wher follov						
land ?)						

Criteria	Collector Lines	WWTP Location	WWTP Design	discharge Location	Remarks	Tasks / source
Geological and Hydrogeological Criteria						
geology (rock type, underground as a barrier, dip direction/angle)	xx	xx			if natural geological barrier is existing, it should be used	geological mapping
stability						
landslic effect						
tectoni						
earthqu affect t						
ground velociti						
thickne velocity						
infiltrati						
karst fe						
risk of becom						
distanc (used f						
risk of f						

Criteria	Collector Lines	WWTP Location	WWTP Design	discharge Location	Remarks	Tasks / source
Cost related Criteria						
method of treatment (primary / secondary / tertiary)			xxx	xxx	can existing regulations / guidelines for effluent (reuse) quality be maintained at all times ?	
reliability of treatment			xxx	xxx		
storage capacity (bypass in case of overload ?)		xx	xx	xx	must be large enough to guarantee that bypassing untreated WW will not be necessary	
possibility / need for treated WW reuse		xx	xxx	xxx	discharge location must be high enough to use as little energy as possible for reuse	
sludge management / reuse of (treated) sludge for agriculture		xx	xx	xx	can existing regulations / guidelines for quality of (organic) fertilizer be maintained at all times ?	analysis of sludge content; determine sites for sludge application; determine treatment of sludge and related feasibility
costs for primary collector lines						
costs for secondary collector lines						
costs for household connections						
costs for WWTP construction						
costs for effluent discharge pipeline / canal						
overall costs for construction (available funds)					including equipment, laboratory and staff for continuous monitoring of treated WW quality	
annual costs for maintenance and operation (available budget)					including continuous monitoring of treated WW quality and sludge mgmt.	

xxxx - killing arguments, xxx - very important arguments, xx - important arguments, x - less important arguments

Site Selection

Treatment plant:

Centralized approach:

Because of impact on water resources the treatment location must be outside (downstream) of the GW catchment of drinking water resources

Also the potential impact by geohazards (flooding, active faults, landslides, rockfalls, cave collapse, etc.) must be low.

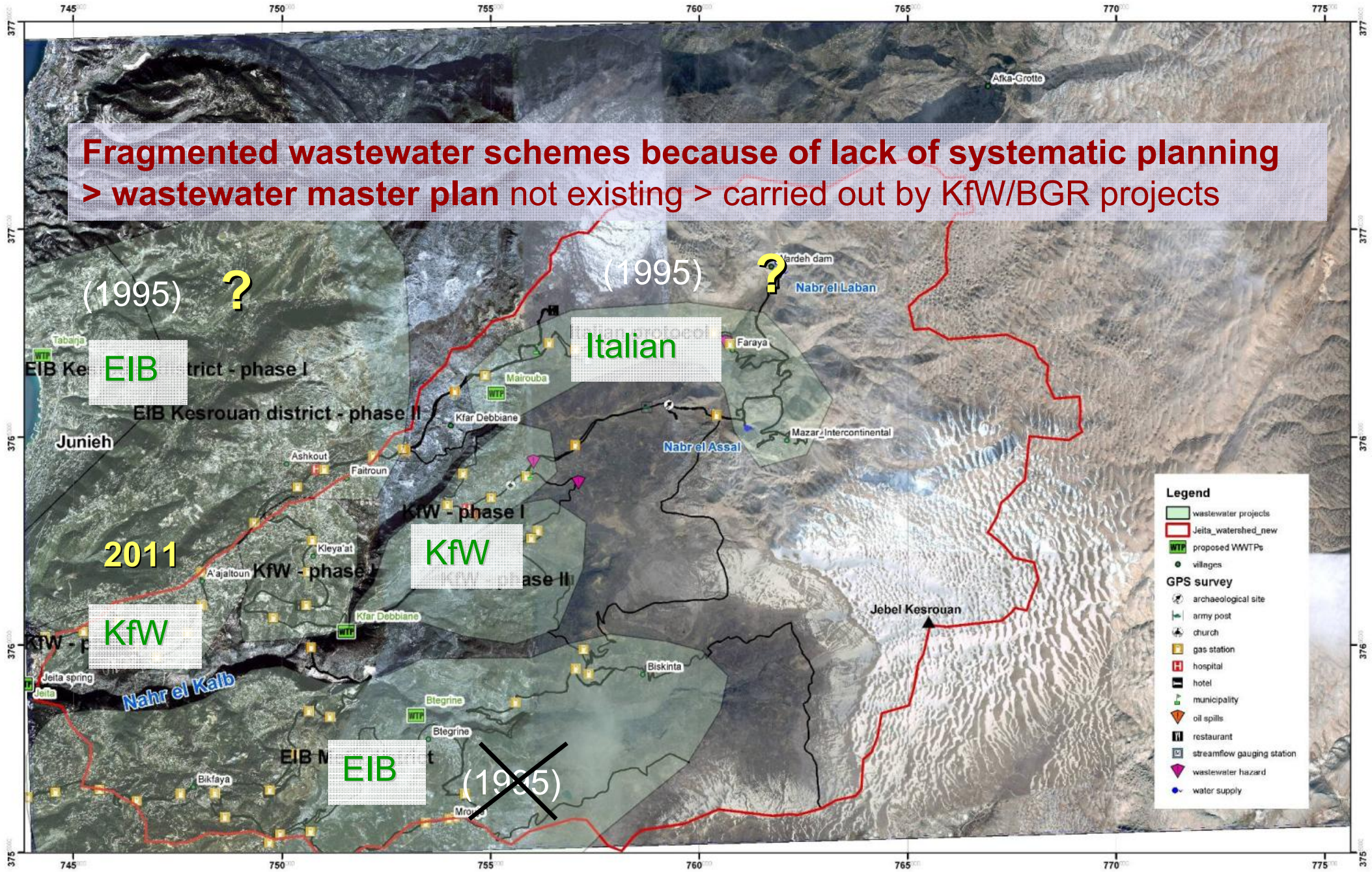
Collector line:

- should collect most wastewater to reduce groundwater pollution
- must avoid pumpage (pollution risk if not operated)
- cannot be along river (too steep, no possibility for maintenance road)

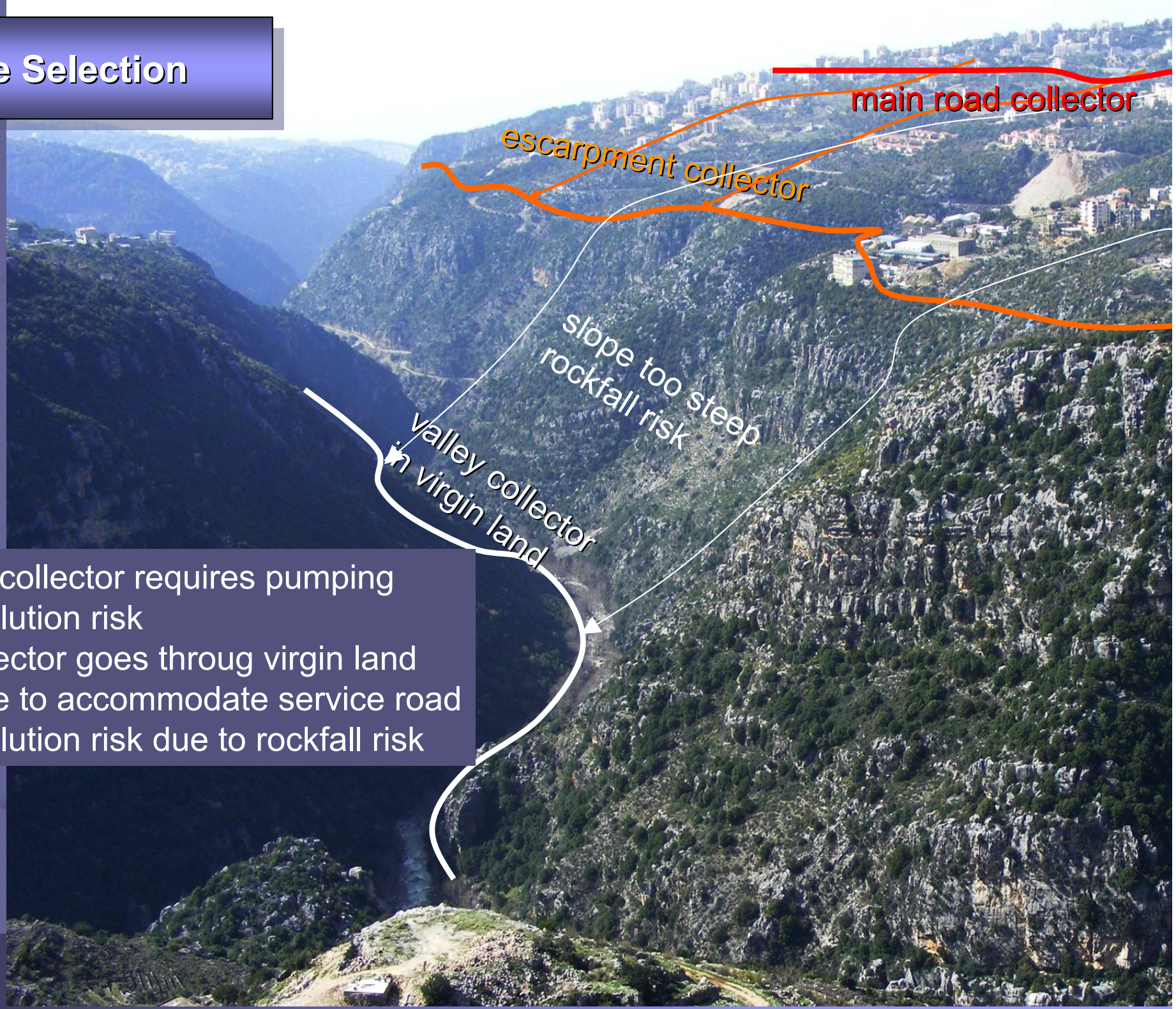
► only possibility: along escarpment

Wastewater Projects North of Beirut

Project Component 1 : Wastewater



Site Selection



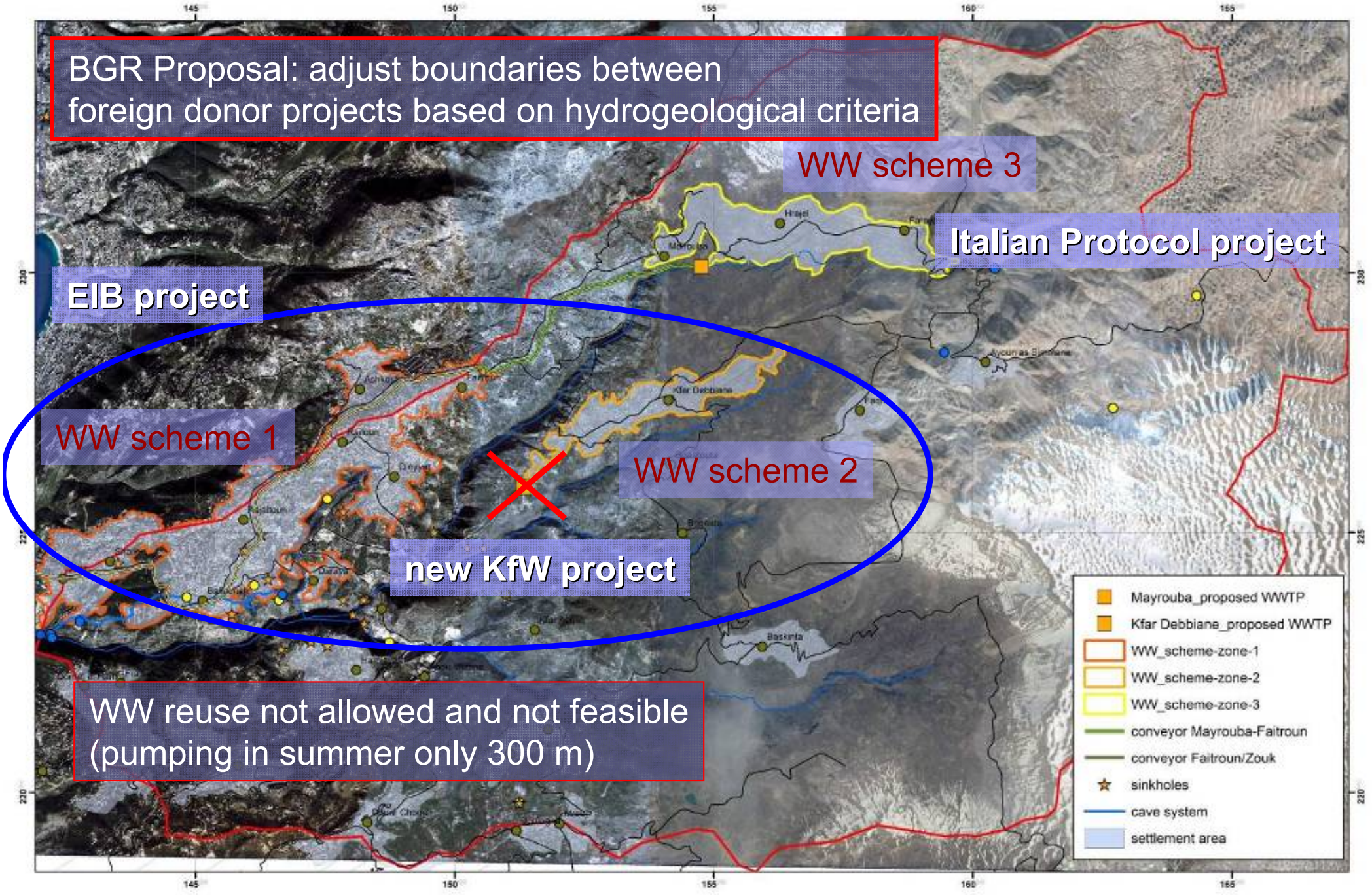
Main road collector requires pumping
► high pollution risk
Valley collector goes throug virgin land
► no place to accommodate service road
► high pollution risk due to rockfall risk

Site Selection

Valley collector not feasible
& environmental objection

Proposed Wastewater Schemes

January 2011



Ranking of Alternatives for WW schemes based on Water Resources Protection Aspects

Alternative	Rank	Main Advantages/Disadvantages
Principally acceptable solutions		
B4b*	1	Lowest pollution risk because no Jeita WWTP – Mokhada bridge collector/conveyor would be required but poor feasibility prospects for coast WWTP
B4a*	2	
A2b	3	Special protective measures in protection zone 2 necessary for escarpment collector and Jeita WWTP – Mokhada bridge conveyor/collector
A2a	4	Special protective measures in protection zone 2 necessary for Jeita WWTP – Mokhada bridge conveyor/collector
A1b	5	Uncertain reuse concept for Kfar Debbiane
A1a	6	
B2b	7	High costs for relatively small Jeita WWTP, poor feasibility prospects for coast WWTP
B1b	8	
B2a	9	
B1a	10	
Objected solutions		
A3a		The Daraya WWTP would be located in open karst where sinkholes are reported which are probably connected with Jeita cave. Discharge of treated effluent under these conditions is problematic.
A3b		
B3a		
B3b		

EIAs for Wastewater Facilities

Proposed EIA Guideline for WW Facilities:

- Standard outline
- Integration of all relevant geoscientific aspects
  - impacts on water resources
  - impacts from geohazards (tectonic movements, earthquakes, landslides, rock falls, rock collapse structures, soil liquefaction, soil stability, flooding)

► Technical Report No. 3

Potential negative impacts on the quality of water resources must be considered separately for all individual components of a proposed wastewater facility or scheme (collector lines, treatment plant, effluent discharge location) and mitigation measures must be proposed for each of those

Standard Outline of EIA for WW Facilities

1	Introduction
2	Legislative and Institutional Frameworks
3	Description of the Project
4	Description of the Environment
5	Impact Identification and Analysis
6	Mitigating Adverse Project Impacts
7	Environmental Management Plan
8	Public Involvement and Participation
9	References

BGR contribution

Annex 1:	Topographic Map of the Study Area
Annex 2:	Geological Map of the Study Area
Annex 3:	Hydrogeological Map of the Study Area
Annex 4:	Map showing all Components of the Proposed Wastewater Facility (overview and detailed views)

Impact on Water Resources

Impacts on water resources might be caused by :

- inadequate site selection
- inadequate design (methods, technology, capacities, diameters, etc.)
- inadequate materials
- mistakes during installation/construction
- mistakes during operation (e.g. inadequate maintenance, monitoring, etc.)
- impacts of geohazards

Impact of Geohazards

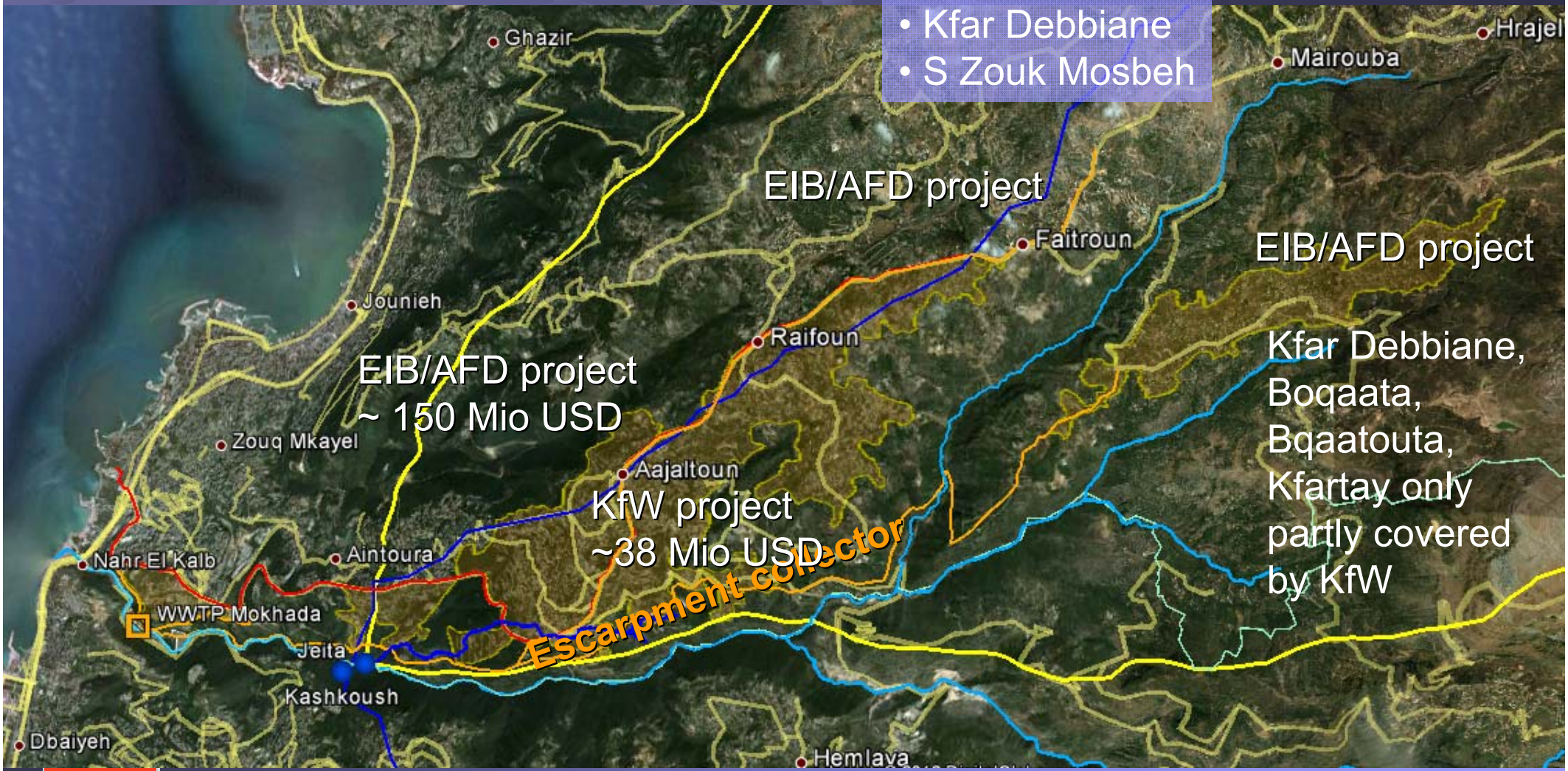
- tectonic movements
- earthquakes
- landslides
- rockfalls
- rock collapse structures (e.g. dolines)
- land subsidence
- soil liquefaction (instable soil)
- flooding

KfW Jeita Project

Without pumpage

Serviced area
- S Jeita
- (S Sheile)
- Ballouneh
- Aajaltoun
- Daraya
- Kfar Debbiane
- S Zouk Mosbeh

Phase I : 45,000 PE
Phase II: 92,000 PE

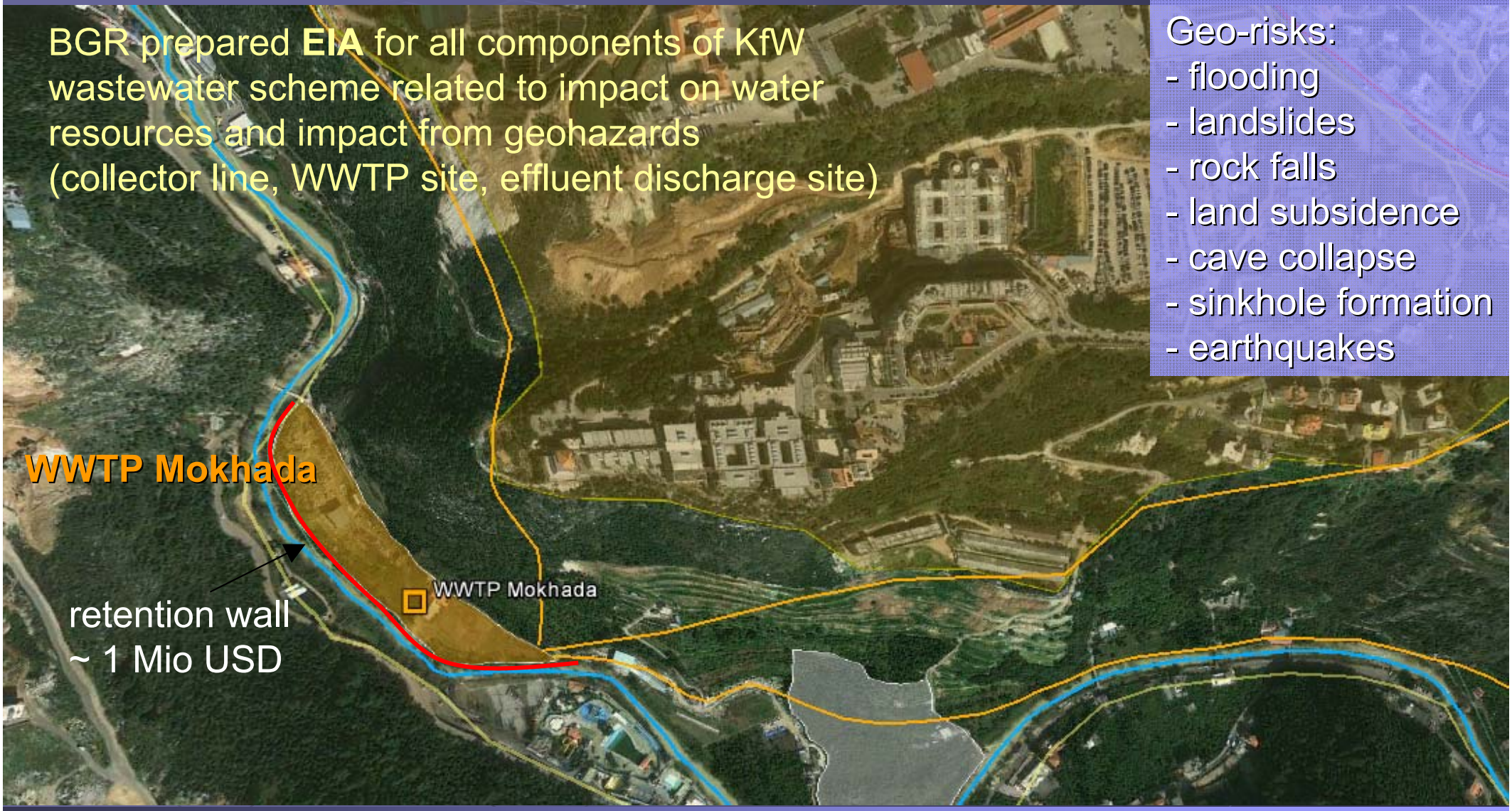


KfW Jeita Project

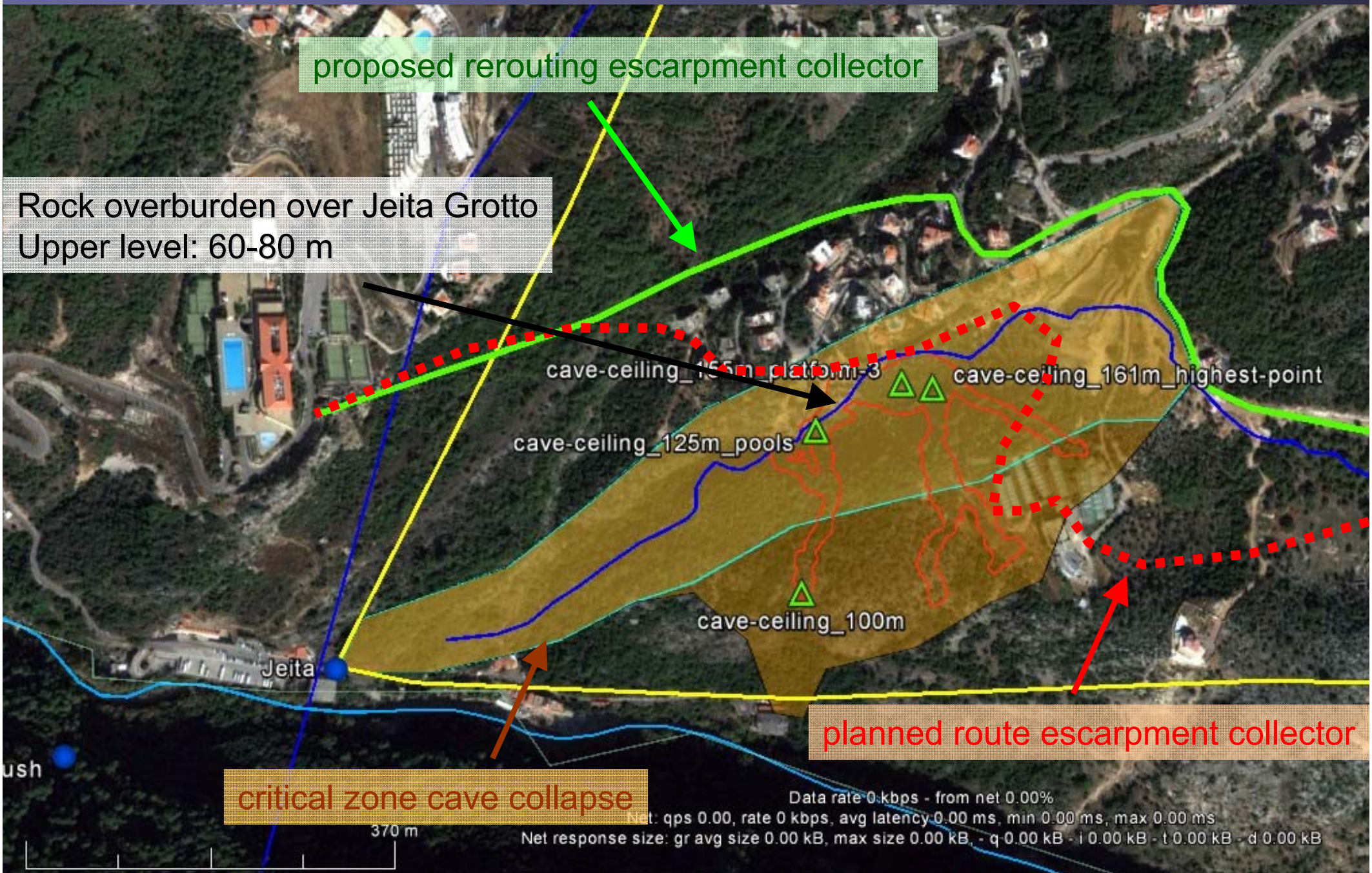
BGR EIA contribution final in June 2013

BGR prepared **EIA** for all components of KfW wastewater scheme related to impact on water resources and impact from geohazards (collector line, WWTP site, effluent discharge site)

Geo-risks:
- flooding
- landslides
- rock falls
- land subsidence
- cave collapse
- sinkhole formation
- earthquakes

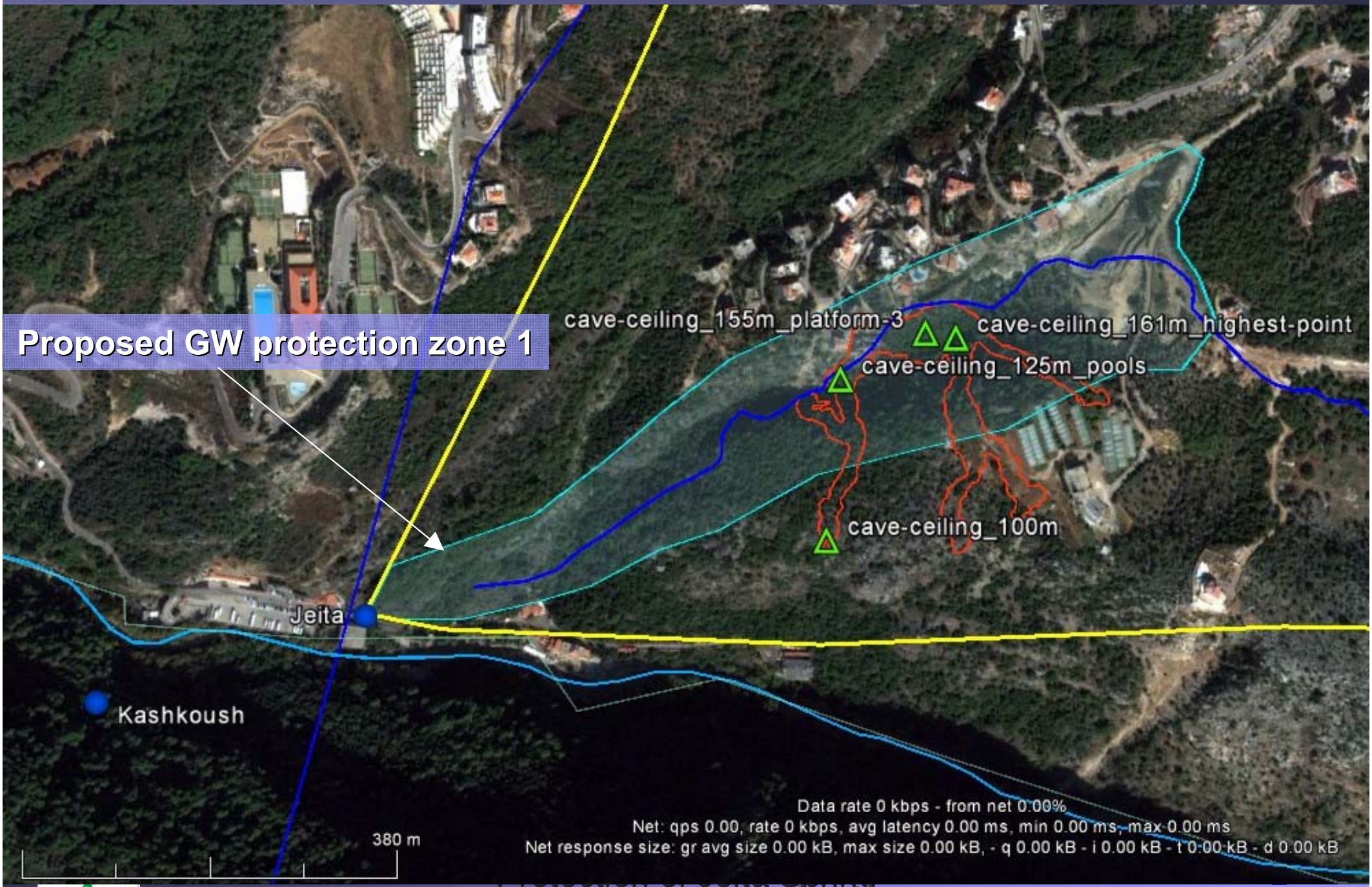


detailed geological mapping at WWTP and collector line

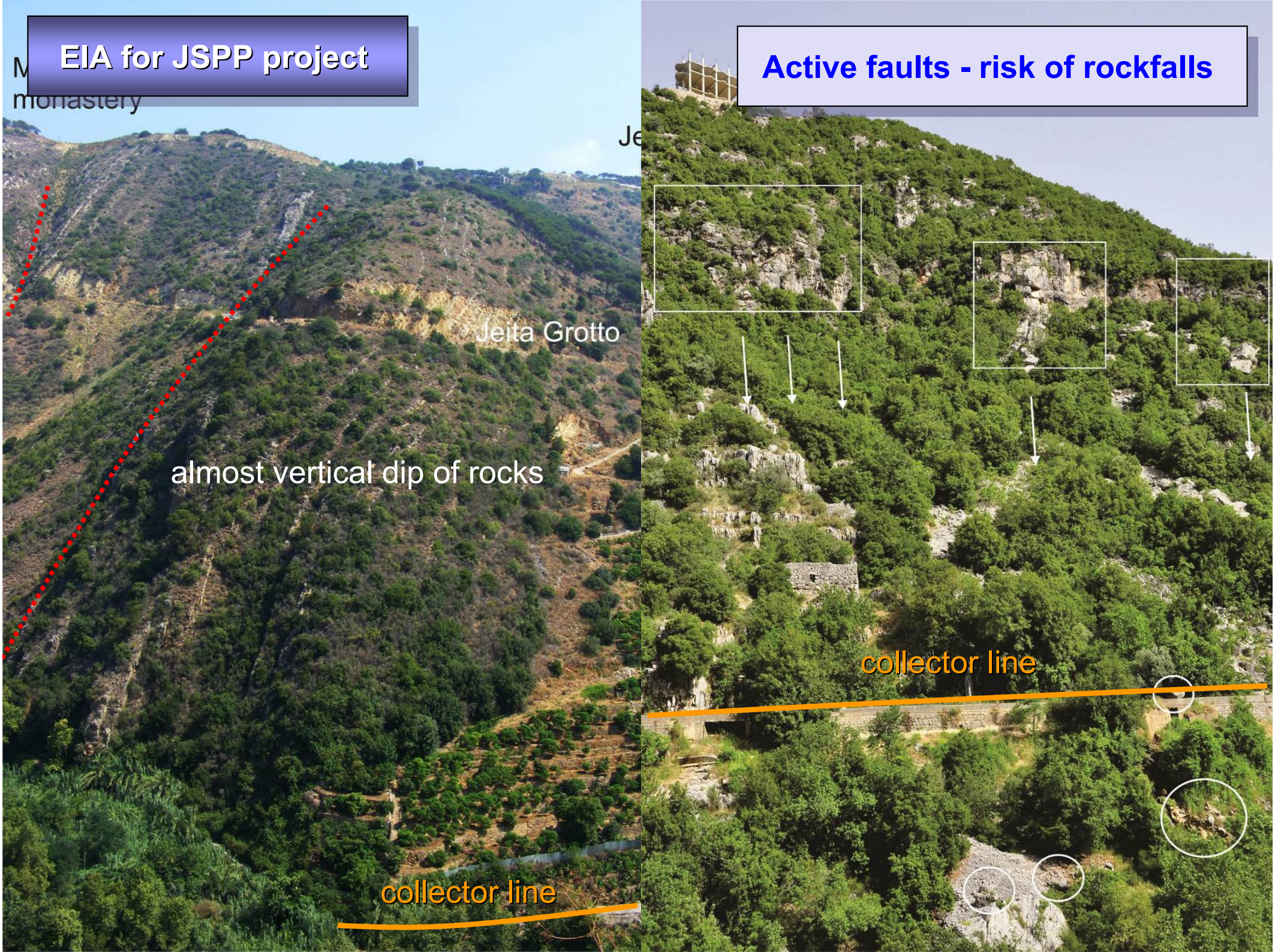

proposed rerouting escarpment collector
Rock overburden over Jeita Grotto
Upper level: 60-80 m
cave-ceiling_161m_highest-point
cave-ceiling_125m_pools
cave-ceiling_100m
Jeita
planned route escarpment collector
critical zone cave collapse
370 m
Data rate 0 kbps - from net 0.00%
Net: qps 0.00, rate 0 kbps, avg latency 0.00 ms, min 0.00 ms, max 0.00 ms
Net response size: gr avg size 0.00 kB, max size 0.00 kB, - q 0.00 kB - i 0.00 kB - t 0.00 kB - d 0.00 kB

EIA for JSPP project

groundwater protection zones

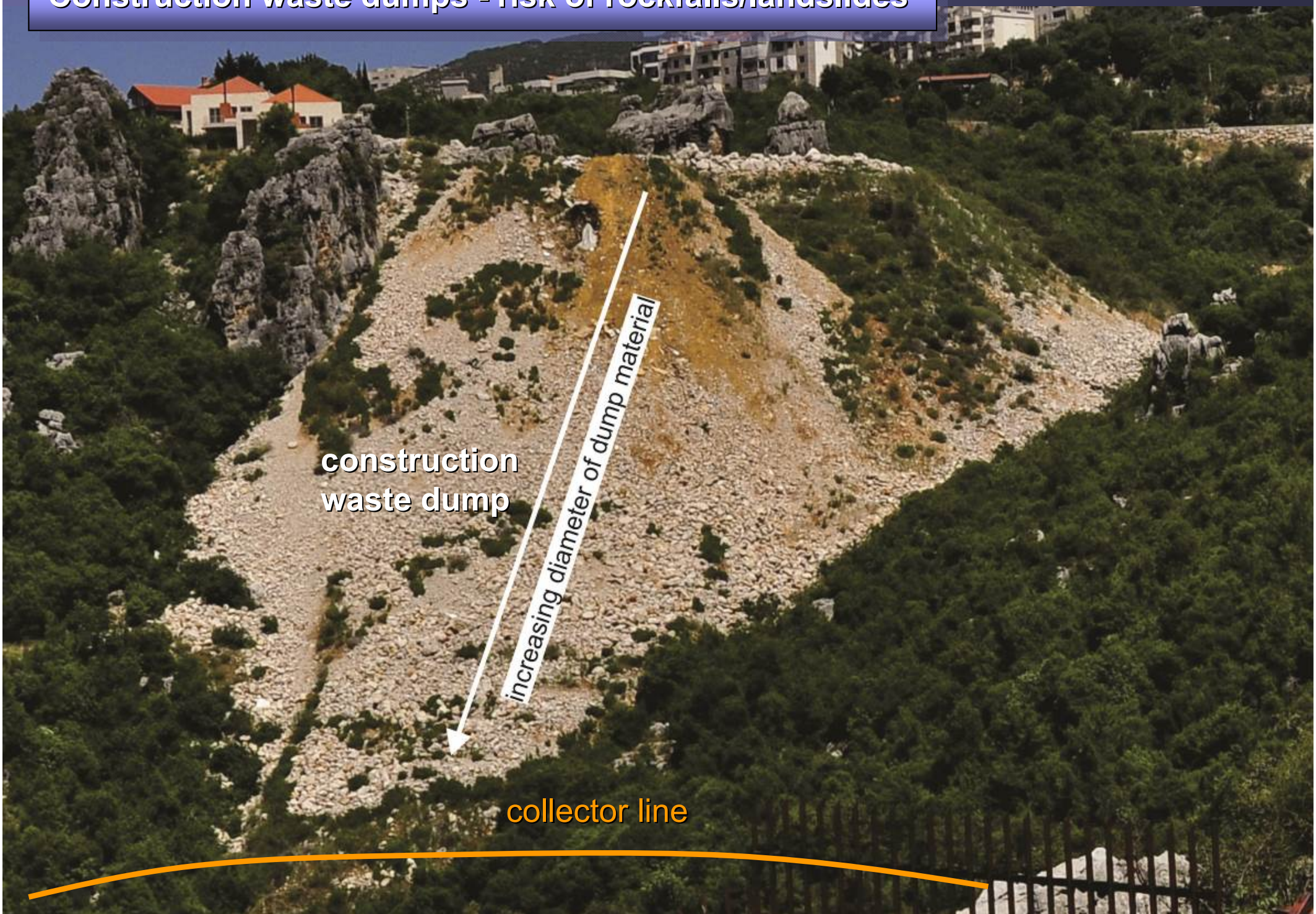


EIA for JSPP project

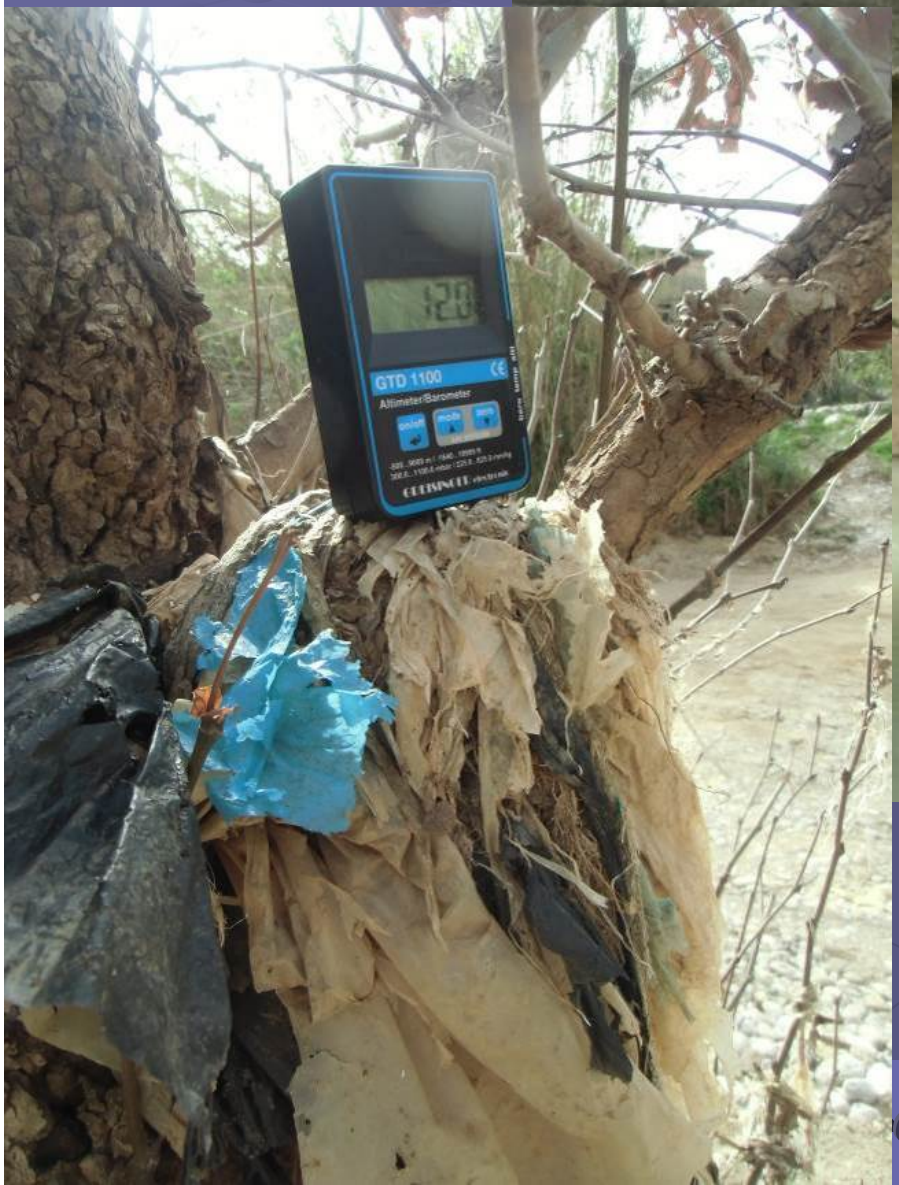


Active faults - risk of rockfalls

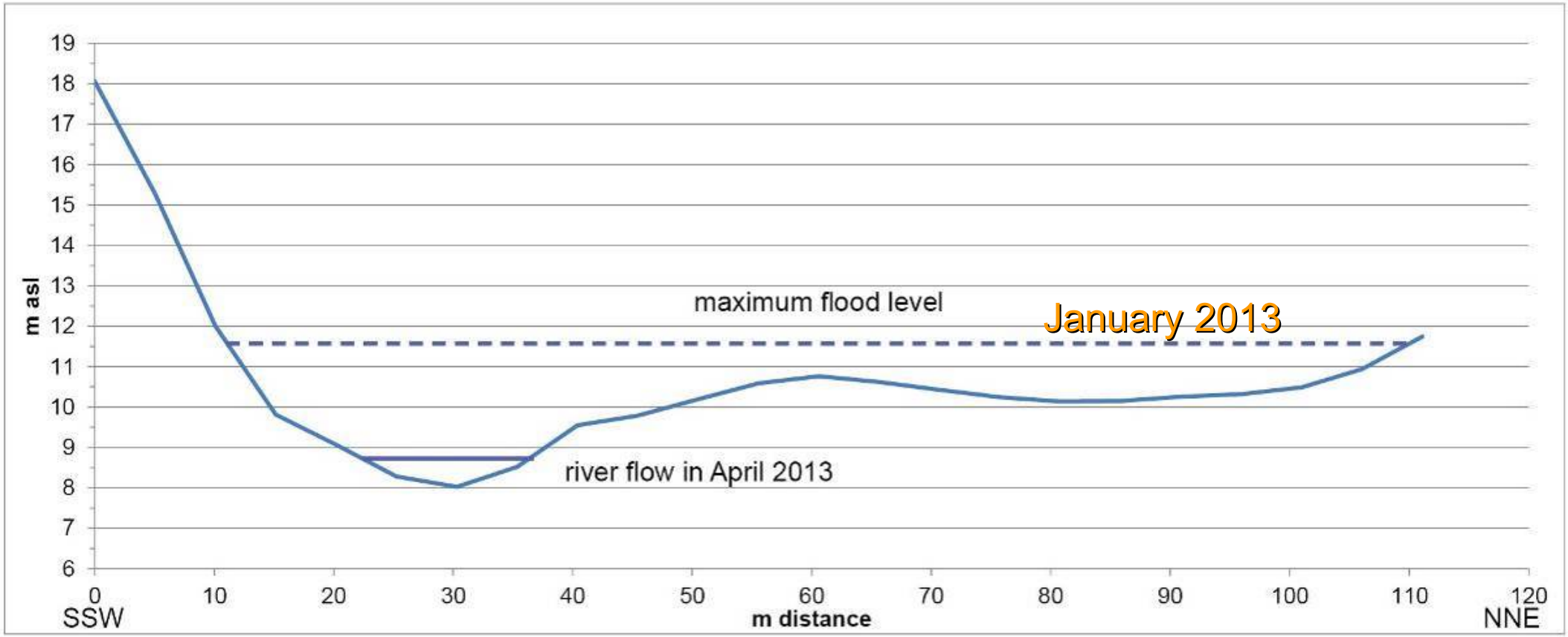
Construction waste dumps - risk of rockfalls/landslides



Risk of flodding



Risk of flodding



Best Management Practice Guideline

The guideline gives recommendations on the potential impact on water resources with regards to:

- site selection and design process for wastewater treatment plants, collector lines and effluent discharge points
- selection of the optimal treatment method
- criteria for treated wastewater reuse
- criteria for sludge management
- proposal for monitoring of the treated wastewater effluent, sludge quality and effects of wastewater reuse and sludge application

► **Technical Report No. 2**

Proposed Standard for Treated WW Reuse

Recommendations:

• Treated industrial wastewater and treated domestic wastewater containing a large share (> 10%) of industrial or commercial wastewater, should not be reused for irrigation.

• Domestic wastewater reuse classes should be based on health concerns, hydrogeological criteria and soil characteristics of the area.
Groundwater vulnerability maps should be used to decide where reuse can be allowed.

• The concept for treated wastewater reuse must be agreed upon with the potential users before the planning of a wastewater facility. Treated wastewater will often have to be pumped to the irrigation area so that treatment for reuse in agriculture will be significantly more costly.

• Public awareness for farmers is needed in order to provide an agricultural production which is safe for human consumption. Moreover the safety of farm workers and local population around farms needs to be taken into consideration.

Proposed Standard for Treated WW Reuse

continued

Recommendations:

• Monitoring of treated wastewater quality is very important in order to provide that no pollution will occur. Monitoring will require a massive increase in laboratory capacities, which needs to be planned for now.

- where to monitor
- what to monitor
- how often to monitor

• The government agency responsible for the operation of the treatment plant should also be responsible for the monitoring of treated wastewater reuse. All impacts of treated domestic wastewater reuse for irrigation on soil, groundwater and humans have to be monitored regularly.

► **Special Report No. 4**

Reports for Project Component 1

Integration of Water Resources Protection Aspects into the Investment Planning and Implementation Process in the Wastewater Sector

Technical Report 1: **Site Selection** for Wastewater Facilities in the Nahr el Kalb Catchment (January 2011) ✓

Technical Report 2: **Best Management Practice Guideline** for Wastewater Facilites in Karstic Areas of Lebanon (March 2011) ✓

Technical Report 3: Guideline for **Environmental Impact Assessments** related to Wastewater Facilities (draft) ✓

Special Report 4: Proposed **National Standard for Treated Domestic Wastewater Reuse for Irrigation** ✓

www.bgr.bund.de/jeita

Reports for Project Component 1

Reports prepared with GITEC

GITEC & BGR: Regional Sewage Plan (October 2011) ✓

LibanConsult & BGR: Environmental Impact Assessment for the Proposed CDR/KfW Wastewater Scheme in the Lower Nahr el Kalb Catchment (~ June 2013)

Thank you for your kind attention

www.bgr.bund.de/jeita

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