



2015 Tbilisi Flood

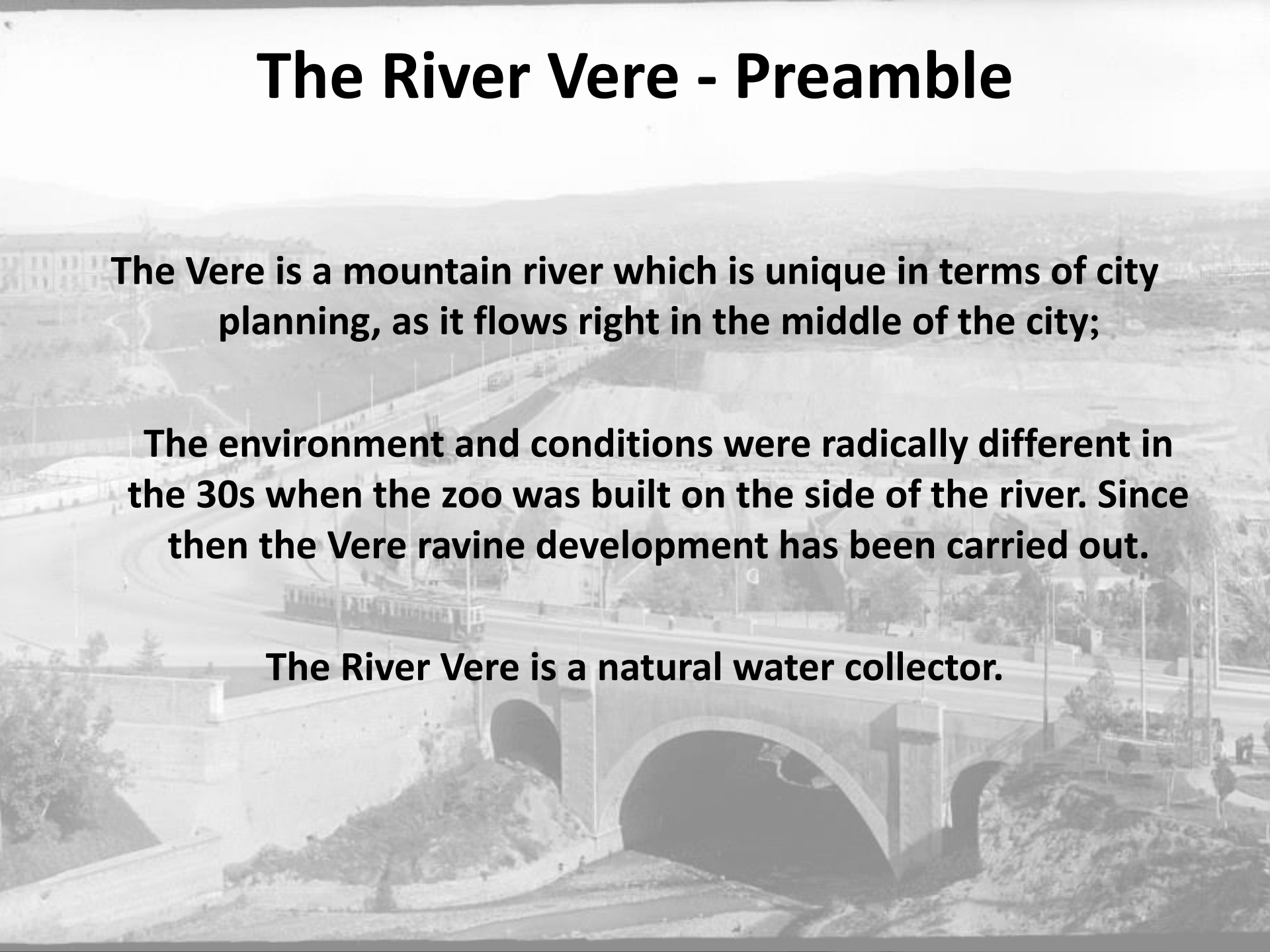
თბილისის მერია
2015 წელი

The River Vere - Preamble

The Vere is a mountain river which is unique in terms of city planning, as it flows right in the middle of the city;

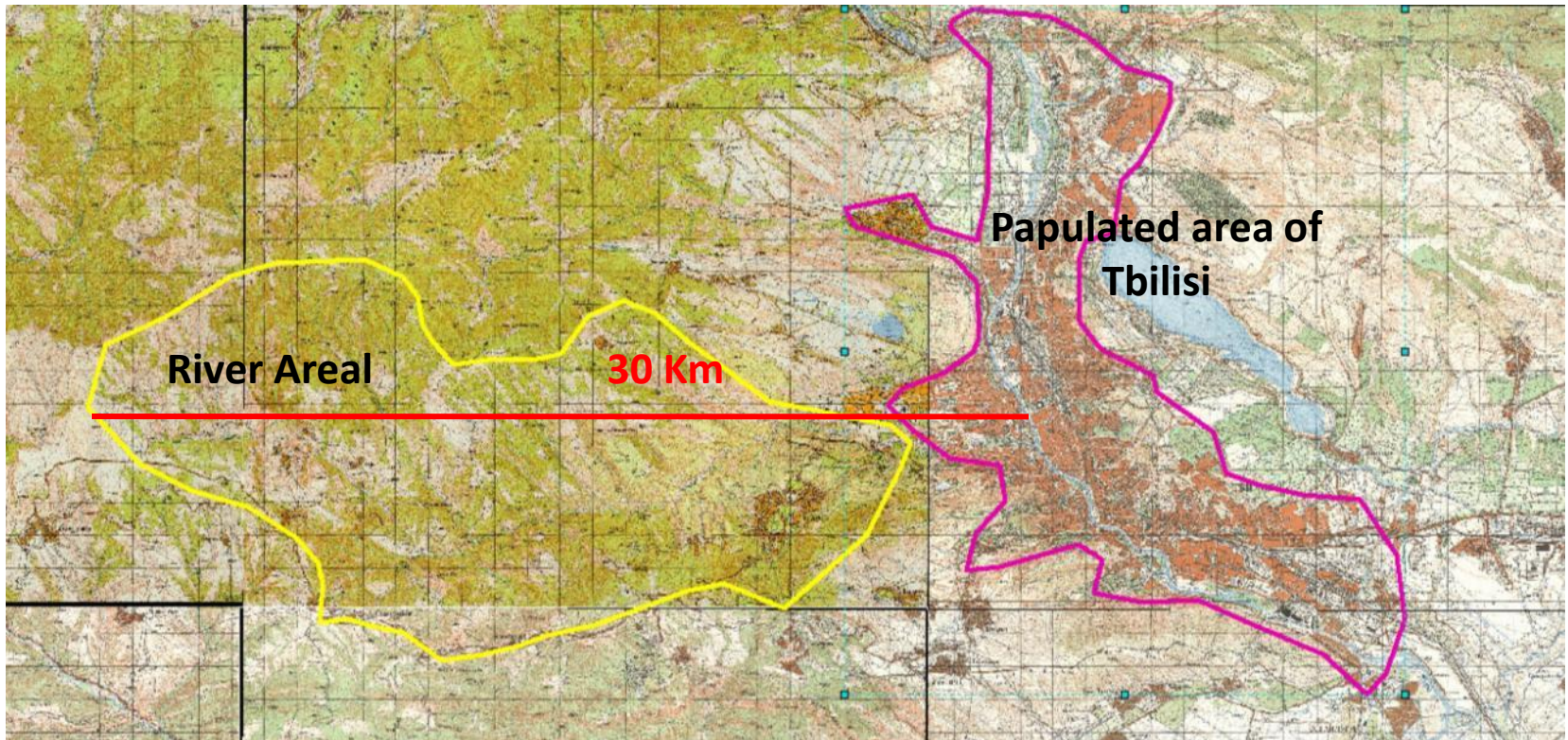
The environment and conditions were radically different in the 30s when the zoo was built on the side of the river. Since then the Vere ravine development has been carried out.

The River Vere is a natural water collector.



River Areal VS Tbilisi

Flowing areal of the river is as large as populated area of the City of Tbilisi.
The river length - 30 Km.



Exciting Risk Factors

- **The risk of devastating Flashflood will always be present without proper mitigation .**
- **The main cause of the city flooding started in mountains, due to massive landslide.**
- **Damage was escalated due to the constructed tunnel under the Vake-Saburtalo road. Landslide clogged the narrow pass of the tunnel.**
- **The tunnel under Heroes' Square bears a great risk also, due to being constricted on lower level of the area.**
- **People's lives are in danger by unregulated massive constructions in the river bank;**
- **For the entire city population the safety issue is an absence of Early Warning System;**

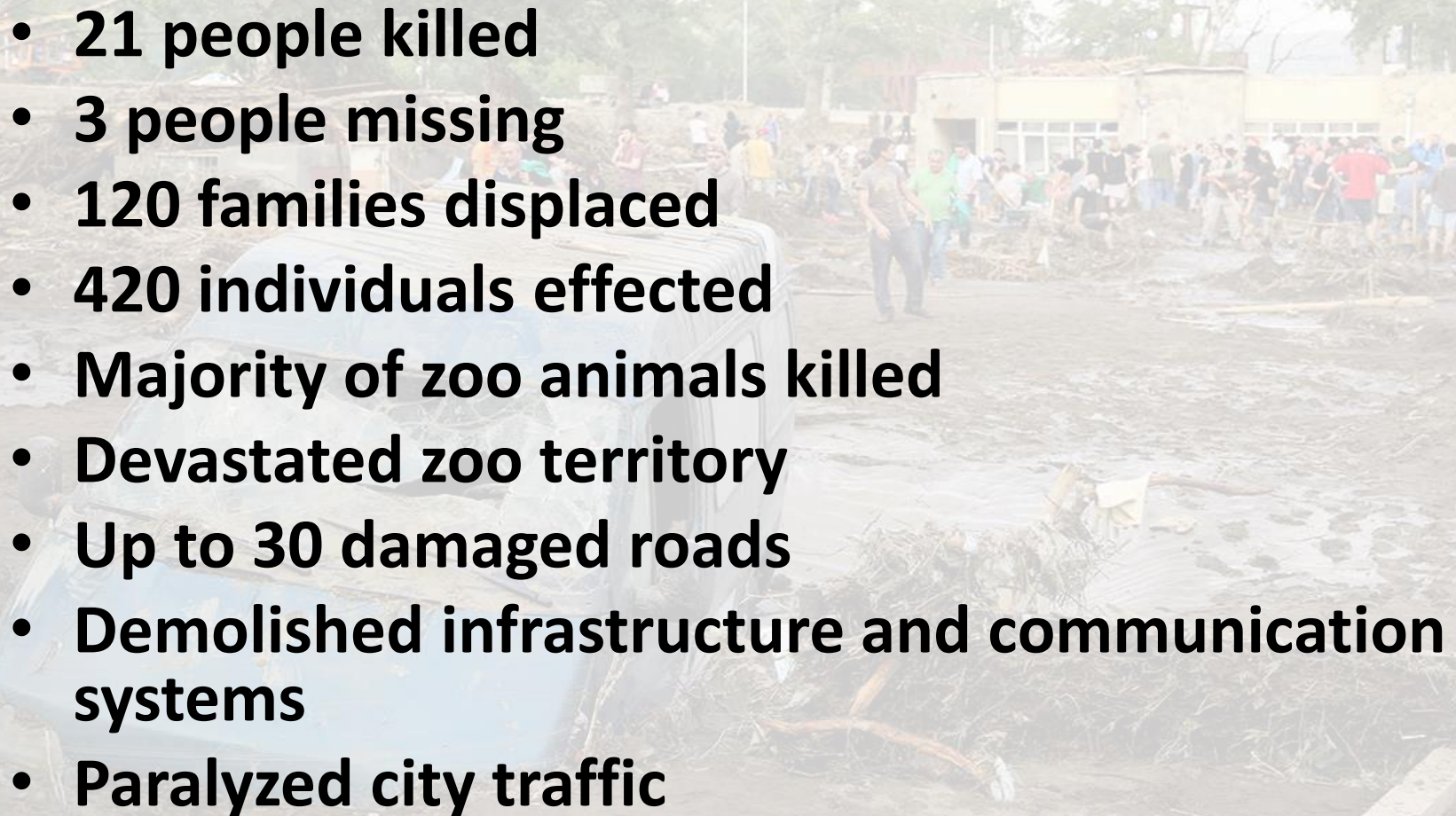
Landslide areas and dangerous unstable mountain zone







Flooding Results

- **21 people killed**
 - **3 people missing**
 - **120 families displaced**
 - **420 individuals effected**
 - **Majority of zoo animals killed**
 - **Devastated zoo territory**
 - **Up to 30 damaged roads**
 - **Demolished infrastructure and communication systems**
 - **Paralyzed city traffic**
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Devastated People, Environment and Helpless Animals

































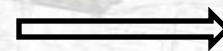
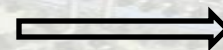
Core Values

- **The maximum safety of people's lives;**
- **Maximum security of highway infrastructures;**
- **River. Vere - integrated space in the city;**

The basic approaches and methods

Approaches:

- The complex analysis of the situation
- Strategic goals and objectives
- The exact identification of the actions needed
- Short, medium and long-term action plans



Methods:

- Research
- Modeling
- Design
- Management

City Short Term Plan

- **Finding missing people;**
- **Provide displaced people with the main necessities;**
- **Cleaning, restoring & opening the main roads;**
- **Managing the paralyzed City traffic;**
- **Reinforcement works for damaged structures;**
- **Finding financial recourses.**
- **Implementing City Early Warning System;**

City Medium Term Plan

- **Feasibility study;**
- **Comprehensive and multidisciplinary study;**
- **Hydrological studies for the territory from the source of the river to the end point.**
- **Creating the master plan of the area;**
- **Defining what outline is best fit for the road (what part of the road is to be cut, maintained or changed)**
- **Housing solutions for the displaced people;**
- **Registration of the territories;**

City Long Term Plan

Implementation of the project identified by the studies:

- **Proper infrastructure rehabilitation;**
- **Master plan and long-term city planning and engineering projects are to be elaborated;**
- **Rehabilitation of damaged roads;**
- **Plan for creating 2 new recreational areas on the sides of the river Vere;**
- **Plan for zoo relocation and repopulation;**
- **Construction of filtration systems;**
- **River reinforcement works for prevention purposes;**
- **Restoring damaged educational and cultural centers.**

Estimated Budget

Short-term actions (1-3 months)

- **Creating early warning system; 1 Million GEL**
- **Relocating people from potential high risk flood-zone; 30 Million GEL**
- **Emergency Rehabilitation of existing engineering structures and spaces; 12 Million GEL**
- **Two stationary radars (for western and eastern Georgia) - 4 Million GEL EUR (est.)**
- **One mobile radar - 350 000 EUR (est.)**

Medium-term actions (2015-2016)

- **Re-planning and construction of highway through the valley; 140 Million GEL**
- **Building Heroes Square Tunnel special protective facilities; 25 Million GEL**
- **Heroes' Square Tunnel Monitoring; 1 Million GEL**
- **Tbilisi Zoo relocation – 30 Million EUR**

Long-term actions (2016-2018)

- **Heroes' Square reconstruction; 40 Million GEL**
- **Development of the special landscape cluster of Vere; 8 Million GEL**
- **Adequate urban planning and control system; 2 Million GEL**
- **Mziuri (78 924 sqm) /old zoo territory (91 740 sqm) recreational space \$20-30 Million**

Cleaning Works

City's Most effected areas:

- **Connecting roads to Tskneti-Betania**
- **Vere ravine and surrounding territories filled with silt (Vake-Saburtalo Road, tunnels, Mziuri territory, Heroes' Square, Zoo, right bank).**
- **Svanidze Street for removal of construction waste and excess soil.**

Reconstruction works

- **Tksneti-Betania connecting road;**
- **Vere Ravine;**
- **Right Bank of Mtkvari, near the ramps of Laguna Vere, damaged dikes;**
- **Right Bank of Mtkvari, from Laguna Vere ramps to Marjanishvili Bridge;**
- **Damaged infrastructure on the Zoo territory;**
- **Damaged infrastructure on Svanidze Street, demolition of damaged buildings;**
- **River bank reinforcement works on Tskneti Street, demolition of under risk buildings;**
- **Connecting road to Napetvrebi settlement;**
- **Connecting road to Akhaldaba Village.**

Restoration plan for the territory damaged by floods

Additional primary works:

- **Removal of the party of cliff and cleaning works near 83 Chavchavadze street;**
- **Cleaning works on the collector on Vaso Abashidze Street;**
- **Cleaning works on Uchaneishvili Street for current ravine soil that came apart;**
- **Demolition of the building on 42 Chavchavadze Street;**
- **Cleaning works on Tamarashvili Street for cliff fragments that fell off;**
- **Cleaning works on 15 Tsagareli Street for water collectors;**
- **Restoration of road on Saakadze Square;**
- **Cleaning works on Bakhtrioni Street;**
- **Cleaning works on the road connecting Saburtalo to Vake (Khiliani street).**

Restoration plan for the territory damaged by floods

Restoration of roads:

- **Uchaneishvili Street asphalt overhaul;**
- **Damaged collector and road on Melikishvili Street;**
- **19 Chavchavadze avenue, near Pixel building;**
- **Chikobava avenue in Chughureti district;**
- **Vakhushti Bagrationi street in Didube district;**
- **Nakashidze street in Krtsanisi district;**
- **Chitaia street in Chughureti district;**
- **Khoshtaria street in Mtsatsminda and Vera district;**
- **Lori street in Isani district;**
- **84 Javakhishvili street;**
- **University street and Saburtalo cemetery;**
- **Shatberashvili Street;**
- **Ialbuzi Street.**

Infrastructure

- **Cleaning works in the Vere ravine (from Tksneti-Betania to Tbilisi) – 1 000 000 GEL**
- **Investigation of damaged roads in the Vere ravine and repair works (or construction of new roads) – 15 000 000 GEL**
- **Rehabilitation of road infrastructure damaged by the flood – 90 000 000 GEL**
- **Restoration of drainage and other municipal infrastructure – 5 500 000 GEL**
- **Geological study of the surroundings of Tbilisi and defining high risk zones – GEL 1 000 000**

Connections between rivers, floodplains and wetlands

Hydrological studies

- Hydrological studies (for a 5-year period) to define territories unfit for construction.

- Hydrological studies to make a 50-year forecast of the territory.

Floodplains and wetlands require flooding at different times to maintain the health of the various plants and animals that live there. They also need periods with lower water levels.

Black box community

River levels are measured at flow gauges, some of which have been used in the method as hydrologic indicator sites

Flow is regulated downstream of dams

Unregulated rivers are not affected by large dams or weirs but may be affected by local water extraction and land use changes

Flows from rivers move through wetlands

River flows within the channel

River channel

Freshes

Low flows

Connections along rivers

The method considers the sequence of flows between the hydrologic indicator sites

Habitats requiring frequent flooding

Habitats requiring periodic flooding

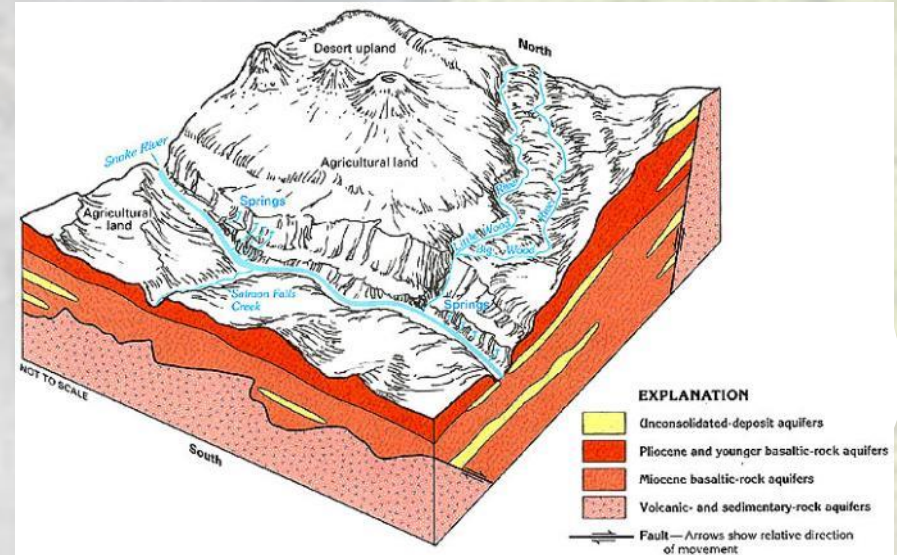
Habitats requiring infrequent flooding

Different river flows such as freshes and low flows provide cues for migration as well as transport of nutrients, salt, carbon and sediment and refuge for plants and animals in dry times

A fresh is a pulse of water which travels down the river and is usually caused by intensive rainfall

Geological studies

- Geological studies to define landslide territories.
- Defining buffer areas of the river, taking into account the river groves and dikes.



Urban Development

Urban face of districts in the central part of the City has been changed

For detailed evaluation of the situation and proper planning of works we need:

**New aerial ledaral shooting and Digital Orthophoto
Estimated budget cost ranges from 600 00 to
800 000 GEL**

Flood effected areas

Svanidze street Totally

Lots- 49

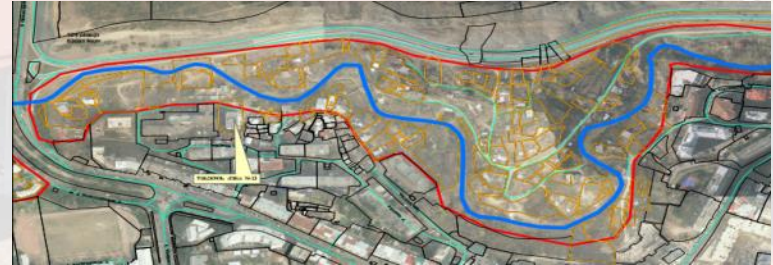
Flooded area- 66 523 sq. m.



Tskneti Street

Lots - 124

Flooded area - 83 691 sq. m.



Chikovani street

Lots - 29

Flooded area - 188 817 sq. m.



Zoo Territory

Lots - 16

Flooded area - 143 680 sq. m.



Future risk-zones

- Svanidze street
- Tskneti street,
- Chiqovani street,
- Dolidze street,
- Khipshidze street near the grove

Total 60 Ha

300 lots

**Resettlement Action Plan
RAP**

60 Ha - 70 000 GEL

**Resettlement Implementation Plan
RIP**

300 lots - 300 000 GEL

**Total could be up to
250 000 000 GEL**

Victim families are in need of:

- **Housing**
- **Basic furniture**
- **Basic appliances**
- **Domestic items (Utensils and dishes, linen, detergents and cleansers, others)**
- **Essential items (personal hygiene items, first aid kits)**
- **Items For children under 5 y.o.**

Housing for the victims

	Number of families	Necessary living space
• Families with 1-2 members	47	45 sq. m.
• Families with 3-4 members	38	65 sq. m.
• Families with 5-6 members	5	90 sq. m.
• Families with 7-8 members	2	110 sq. m.

Housing cost for the victims

Number of families

Necessary living space

47

45 sq. m.

Rent - 900 GEL
Total - 42 300 GEL

Buy - \$45 000

38

65 sq. m.

Rent - 1300 GEL
Total - 49 400 GEL

Buy - \$65 000

5

90 sq. m.

Rent - 1800 GEL
Total - 9 000 GEL

Buy - \$90 000

2

110 sq. m.

Rent - 2200 GEL
Total - 4 400 GEL

Buy - \$110 000

Total - 92
Families

Total - 105 100 GEL per
month
Total - 1 261 200 GEL
per year

Total price cost:
\$2 115 000
\$2 470 000
\$450 000
\$220 000
Total cost \$5 255 000

Healthcare

- **105 children are effected by the disaster**

Rehabilitation activities - 80 000 - 100 000 GEL

Items for families with 2 members

Home appliances

- Washing Machine
- Gas appliance
- Refrigerator
- Water/gas heater
- Computer
- Air-conditioning
- Vacuum cleaner
- Iron / Iron board
- TV
- Hair dryer
- Blender

4 000 GEL

furniture

- Kitchen furniture (cabinet, table, chairs)
- Bedroom furniture (bed, mattress, closet, bed-side table)
- Living-room furniture (sofa, armchairs, coffee table, cupboard)
- Separate Bed
- Dining table

4 100 GEL

Other domestic items

- Dishes – 6 items each: plate, bowl, glass, knife, fork, spoon (tea, table), cup,
- 2 each - knife, boiler, frying-pan, bowl, 1 tea-kettle
- Linen set, towel set (large, small), mattress, blanket, bedspread, pillow
- Detergents/cleansers/cleaning appliances - broom, dustpan, dust mop, wipes, sponge, scrubbers, brush, detergents, laundry pins, buckets, jug
- Misc. - clock (wall), lamp (5 items), duct tape, push pins, extender

810 GEL

Essential items

- Personal hygiene items- shampoo, soap, toothbrush/paste, antiperspirant, cotton wool discs, cotton buds/ items of personal use, comb, scissors
- First aid kit

160 GEL

For children under 5

- bed
- stroller
- Bathroom items
- Wet wipes, diapers, shampoo, soaps, baby oils/powder, cotton wool buds, scissors, comb
- inhaler

930 GEL

Total: 9 070 GEL

Items for families with 3 members

Home appliances

- Washing Machine
- Gas appliance
- Refrigerator
- Water/gas heater
- Computer
- Air-conditioning
- Vacuum cleaner
- Iron / Iron board
- TV
- Hair dryer
- Blender

4 000 GEL

furniture

- Kitchen furniture (cabinet, table, chairs)
- Bedroom furniture (bed, mattress, closet, bed-side table)
- Living-room furniture (sofa, armchairs, coffee table, cupboard)
- Separate Bed
- Dining table

4 350 GEL

Other domestic items

- Dishes – 6 items each: plate, bowl, glass, knife, fork, spoon (tea, table), cup,
- 2 each - knife, boiler, frying-pan, bowl, 1 tea-kettle
- Linen set, towel set (large, small), mattress, blanket, bedspread, pillow
- Detergents/cleansers/cleaning appliances - broom, dustpan, dust mop, wipes, sponge, scrubbers, brush, detergents, laundry pins, buckets, jug
- Misc. - clock (wall), lamp (5 items), duct tape, push pins, extender

960 GEL

Essential items

- Personal hygiene items- shampoo, soap, toothbrush/paste, antiperspirant, cotton wool discs, cotton buds/ items of personal use, comb, scissors
- First aid kit

160 GEL

For children under 5

- bed
- stroller
- Bathroom items
- Wet wipes, diapers, shampoo, soaps, baby oils/powder, cotton wool buds, scissors, comb
- inhaler

930 GEL

Total: 9 470 GEL

Items for families with 4-5 members

Home appliances

- Washing Machine
- Gas appliance
- Refrigerator
- Water/gas heater
- Computer
- Air-conditioning
- Vacuum cleaner
- Iron / Iron board
- TV
- Hair dryer
- Blender

4 000 GEL

furniture

- Kitchen furniture (cabinet, table, chairs)
- Bedroom furniture (bed, mattress, closet, bed-side table)
- Living-room furniture (sofa, armchairs, coffee table, cupboard)
- Separate Bed
- Dining table

5 700 GEL

Other domestic items

- Dishes – 6 items each: plate, bowl, glass, knife, fork, spoon (tea, table), cup,
- 2 each - knife, boiler, frying-pan, bowl, 1 tea-kettle
- Linen set, towel set (large, small), mattress, blanket, bedspread, pillow
- Detergents/cleansers/cleaning appliances - broom, dustpan, dust mop, wipes, sponge, scrubbers, brush, detergents, laundry pins, buckets, jug
- Misc. - clock (wall), lamp (5 items), duct tape, push pins, extender

1 160 GEL

Essential items

- Personal hygiene items- shampoo, soap, toothbrush/paste, antiperspirant, cotton wool discs, cotton buds/ items of personal use, comb, scissors
- First aid kit

160 GEL

For children under 5

- bed
- stroller
- Bathroom items
- Wet wipes, diapers, shampoo, soaps, baby oils/powder, cotton wool buds, scissors, comb
- inhaler

930 GEL

Total: 11 020GEL

Readiness for emergency situations (1)

Heavy Equipment:

- Tracked excavator 20 tons - 1 unit;
- Tracked excavator 30 tons - 2 units;
- 20 ton crane - 2 units;
- 25-ton bulldozer - 2 units;
- Rescue vehicles off-road 4X4 - 35 units;
- A fire vehicles 4X4 and 4X2 3-5-7 ton - 50 units;
- Bronto-elevator for 70 m. height (ladder basket) - 1 unit;
- Silt extractor - 2 units.

Readiness for emergency situations (2)

Equipment for emergency rescue operations in water and debris:

- **Equipment for operations in debris:**
- **Video Camera - 1 unit;**
- **Seismic-acoustic device - 1 unit;**
- **Water jet engine boats 2 units;**
- **High performance contaminated water pump - 30 units;**
- **Water Pump Honda GX 200 -20 units (estimated cost of one unit 800 USD);**
- **Silt extractor pump - 5 units;**
- **Underwater search machine (echolot) - 2 units.**

Readiness for emergency situations (3)

Equipment for emergency-rescue works:

- Hydraulic cutting set – 20 units;
- Cargo lifting pneumatic pillow – 10 units
- Cargo lifting mechanical jacks – 10 units
- 2kw portable lights – 20 units;
- 2-3-5-20 kw Generators – 50 units;
- Mechanical manual winch 3,2 tone – 20 units;
- Internal combustion engine winch 1,6 tone – 20 units;
- 5 tone rope wear protector - 40 units;
- Fire hearth detection device – 4 units;
- Metal mechanical cutter – 32 units;
- Metal electric cutter – 20 units;
- Reinforced concrete cutting machine – 4 units;
- Combustion engine saw – 30 units;
- Perforator – 10 units;
- Plastic pipes connecting iron – 10 units;

Readiness for emergency situations (4)

The technology-equipment for reaction of chemical incidents:

- **Mobile Chemical Lab 1 unit;**
- **Industrial chemical toxic substance detection Detector 4 units;**
- **Decontamination shower - 2 units.**
- **In addition, for the improvement of the quality of the operations and achievement of better coordination between relevant units of the MoIA, it is recommended to use the best international practice, target-oriented consultations and conduct specific trainings.**

Readiness for emergency situations (5)

- Chainsaw 660 – 20 units
- Water pump– 3 unit (1 hour 1200 liters capacity)
- Water pump – 5 units (1 hour 800 liters capacity)
- Winch – 2 units
- Projectors with powerful independent battery – 30 units

#	Description	Quantity
1	Replace of the vehicles of low cross-country ability with the 4X4 crossover-type vehicles to move the large amount of forensic equipment to the scene	Substitution of 22 vehicles (throughout the country)
2	Wireless floodlights of great capacity for illumination of the scene	80 items (throughout the country)
3	3D scanning system for air (quadrocopter) and infantry detailed laser scanning of the scene	2 systems (throughout the country)
4	Thermal imager with images storage function	10 items (throughout the country)

Readiness for emergency situations (6)

Needs of the LEPL 112

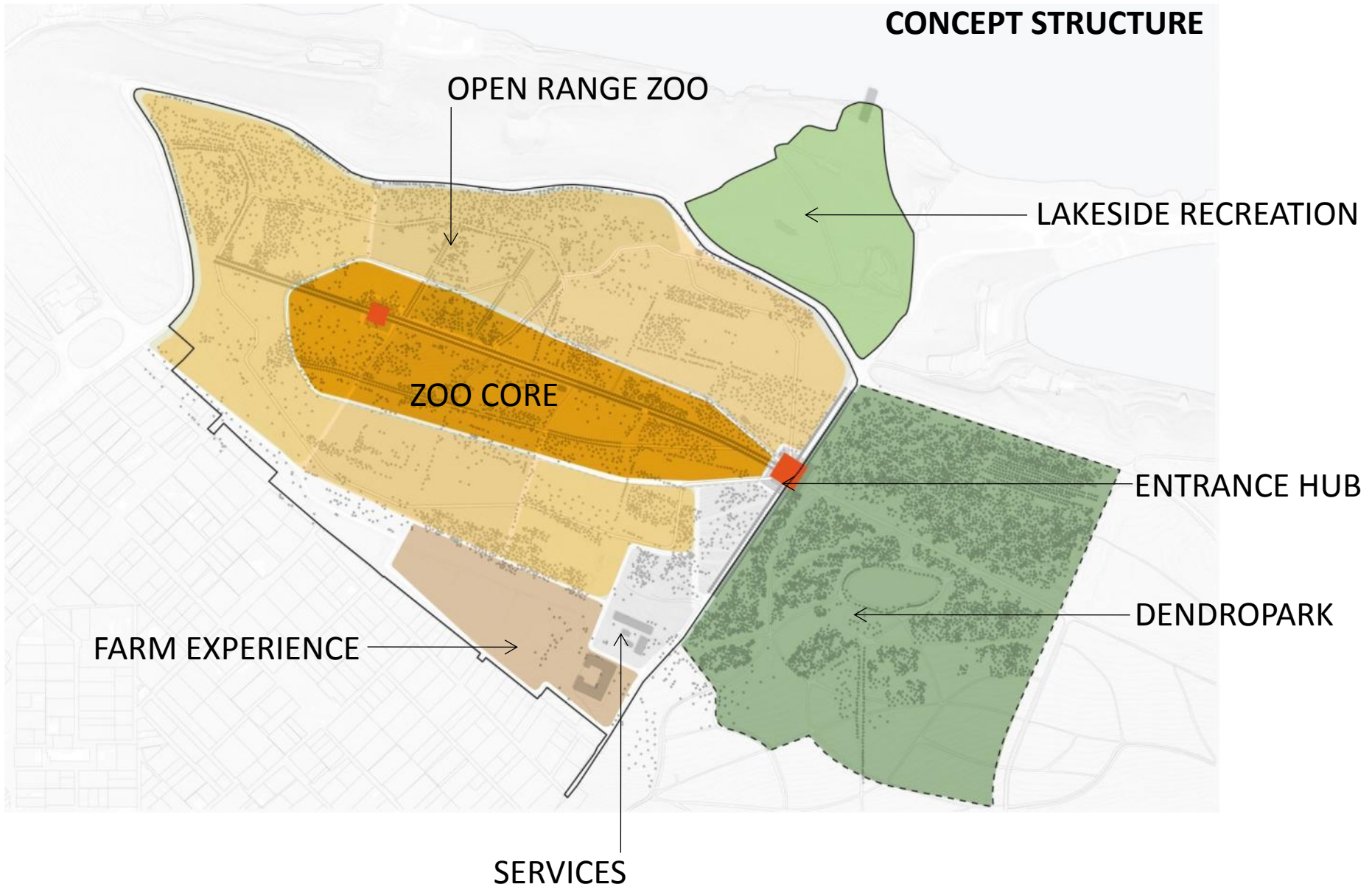
- - Organization of training for the “112” operators/dispatchers on reports management specifics during a large-scale emergency situation;
- - Operation of relevant application for transfer of the information in visual form to the "112" by civilians;
- - Creation of necessary infrastructure for automatic determination of the exact location of the report initiator;
- - Creation of an alternative Data Center in order to protect the infrastructure (fiber optic network) necessary for reception of reports in case of force majeure and insurance of such Data Center;
- - Creation of the “112” alternate center to ensure the mobilization of the required number of primary and standby shifts in case of large-scale emergencies at the same occasion, within the term of sharp increase of the repetitive messages of identical nature and its equipping with computers and relevant technique;
- - Enactment of so called "Mobile Center" in case of large-scale emergencies that means purchase of relevantly equipped bus for mobilization of primary and standby shifts where in transportation mode operators shall continuously receive reports, process and further forward the information to the relevant authorized services.

The list of special equipment needed for emergency situations

№	a/machine (mechanisme) type	General Technical Specifications	Quantity	Comments
1	Backhoe Loader	operation waight: 8000 kg. front concrete mixer, Back excavating shovel.	2	
2	Skid steer loader	operation waight: 3-4000kg. bobcat type,	4	
3	Wheeled Excavator	operation waight: 18-20 000 kg, concrete mixer capacity 0.8 m ³	1	
4	Light trailer	load capacity: 6-8 000 kg	4	
5	Tractor truck	operation waight: 26-30 000 kg, power: 500 Gb.d	1	
6	Loader	load capacity: 40-50 000 kg	1	
7	Dump track	capacity: 15-20 m ³	2	
8	Mobile crane	crane loading capacity: 2000-2500 kg. body lenght: 5-6m.	2	
9	Lifting	loading capacity: 15-20T.	1	
10	Truck with lifting container 7-10 m ³ capacity	operation waight: 18-20 000 kg. Skiploader	2	
11	7-10 m ³ capacity container for construction waste	capacity: 7-10 m ³	20	
12	Snow plow, with various attachable gadgets	winter equipment: Snow blade (plow), Groove, salt spreader, Summer equipment: Street sweeper, curb and sidewalk washers, cistern, pressure washer, tree trimmer, lawn mower	4	
13	Small silt Sucker Machine	capacity: 3-4000 l. removal depth: 8-10m.	3	
14	Huge silt Sucker Machine	capacity:: 6-8000 l. Removal depth: 18-20m.	2	
15	Dump truck with double cab	body capacity: 8-10m ³	2	
16	Motopompa(for poluted water)	rate of flow: 50-80 000 liters per hour.	2	
17	Bobcat	operation waight: 16-18 000kg, concrete mixer capacity 1.5-2.0 m ³	1	
18	Mini bus (for labour force transfer)	passenger place numbers 15-18	2	
			56	

Zoo relocation to Tbilisi Sea

CONCEPT STRUCTURE



ENVISAGED ZOO DEVELOPMENT PHASES

Phase 1

- Secure main site with Bio-Security fence.
- Secure open range areas.
- Construct main vehicular and pedestrian routes in open range areas.
- Service buildings and services.
- Construct staff accommodation.
- Deployment of underground services/utilities ('utilidor').
- Tree planting works including irrigation system.

Phase 2

- Relocate open range animals to site establishing early populations.
- Construct display enclosures to accommodate existing species.
- Upgrade main access junction and services access.
- Construct entry building and hub.
- Construct boulevard.
- Complete pedestrian circulation.
- Construct main car park.

Phase 6

- Construct tunnelled road crossing to lake side recreation
- Construct bird show amphitheatre and associated landscaping.
- Tender expressions of interest for design/construct and management of an Aquarium attraction.

Phase 3

- Relocate species.
- Close City Zoo.
- Construct first phase of concessions and restaurants.
- Construct display/outdoor classroom area.
- **Open Zoo to public.**

Phase 4

- Confirm program for new zoo species procurement.
- Construct Secondary hub and reptile house.
- Upgrade Dendropark portion of zoo.

Phase 5

- Construct new displays / exhibits for new major attraction species
- Second phase of concessions / restaurants.
- Construct research / lab building.

Phase 7

- Construct Aquarium attraction.
- Complete final phase of zoo concessions

Additional Long Term Plans and Needs

For the future we need to think about public transport plan and other necessary plans for safe livable space.

- Public transport plan implementation period is estimated for 1-5 years.**
- Complex Public Transport system cost – 399 500 000 Million EUR**
- 7000 Hazard buildings that need reinforcement or demolition.**

Transport Systems

- The June 13th flood in Tbilisi showed us that in Tbilisi the public transport system is not adequate to the needs of Tbilisi inhabitants.
- After the disaster, the problem of transportation was not only due to the damaged infrastructure but also due to the absence or underdevelopment of the multimodal transport network.
- Two main means of public transport in the city are: buses and metro. The former needs to be developed both in quantity and quality and the latter needs expansion and overhaul repair.
- Cableway and tramway transport networks are to be added to the public transport system.
- The development of the public transport will result in the decreased use of private vehicles.

Bus parking and infrastructure	Cost (In EUR)	Implementation period
Purchase of 700 units of buses	154 000 000	5 years
Operational buildings of bus parking	20 000 000	1 year
Modernisation/capital repair of metro wagons	25 000 000	5 years
Cableway development project	5 00 000	1 year
Metro network expansion project	2 000 000	1 year
University-Ortachala tramway network construction	150 000 000	3 years
Cableway construction University-Bagebi-Tskneti	32 000 000	2 years
Cableway construction Samgori-Vazisubani	16 000 000	2 years

Conclusion

Rapid Damaged and Needs Assessment will start on June 18 and is expected to take 2-3 weeks.

A refined presentation including a more detailed cost estimation will be circulated once the assessment is completed.

Thank You!

