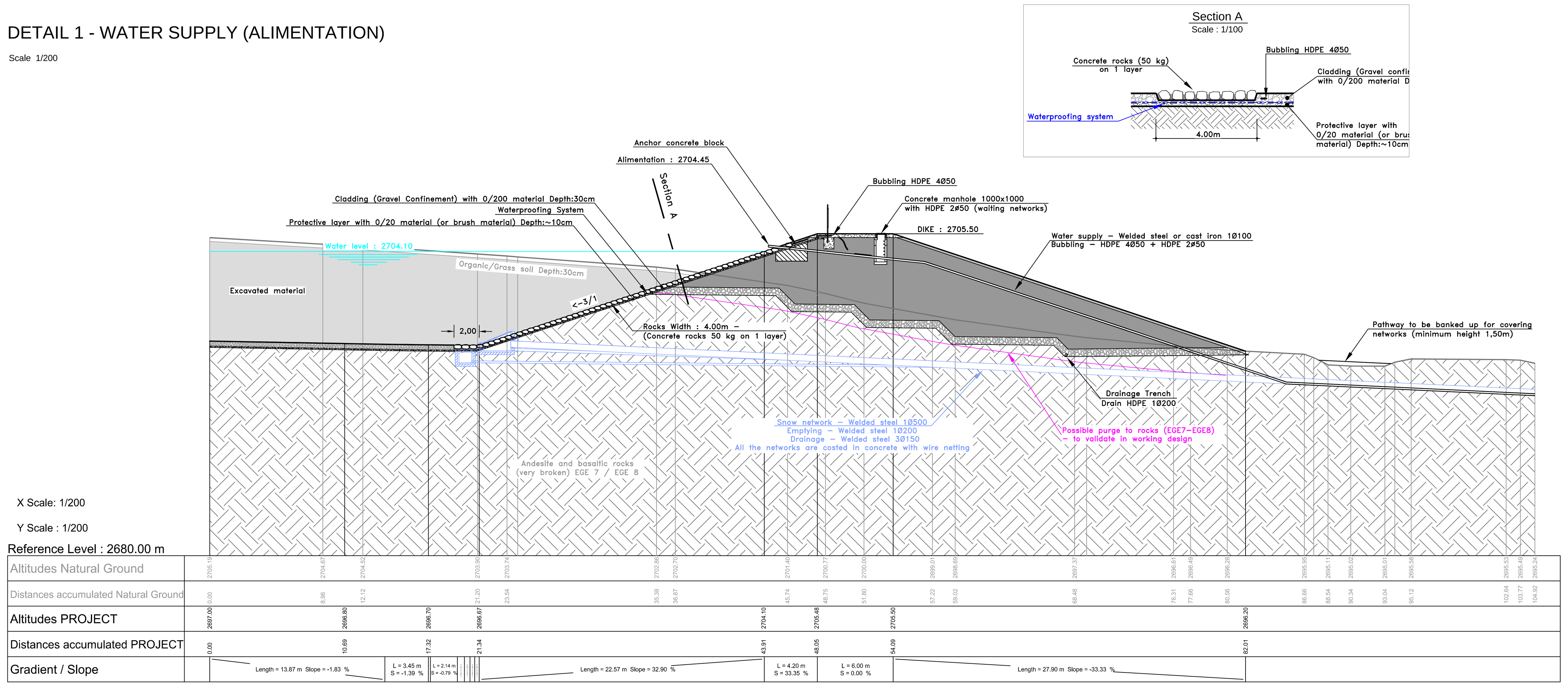
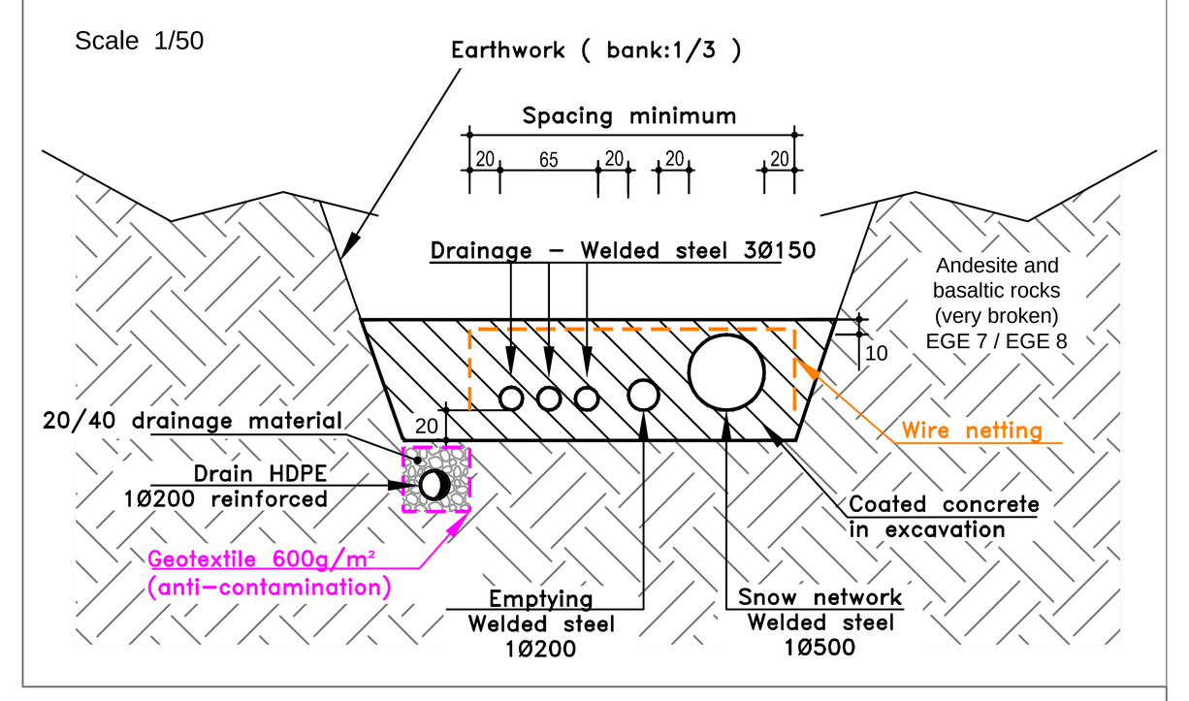
DETAIL 1 - WATER SUPPLY (ALIMENTATION)

Scale 1/200



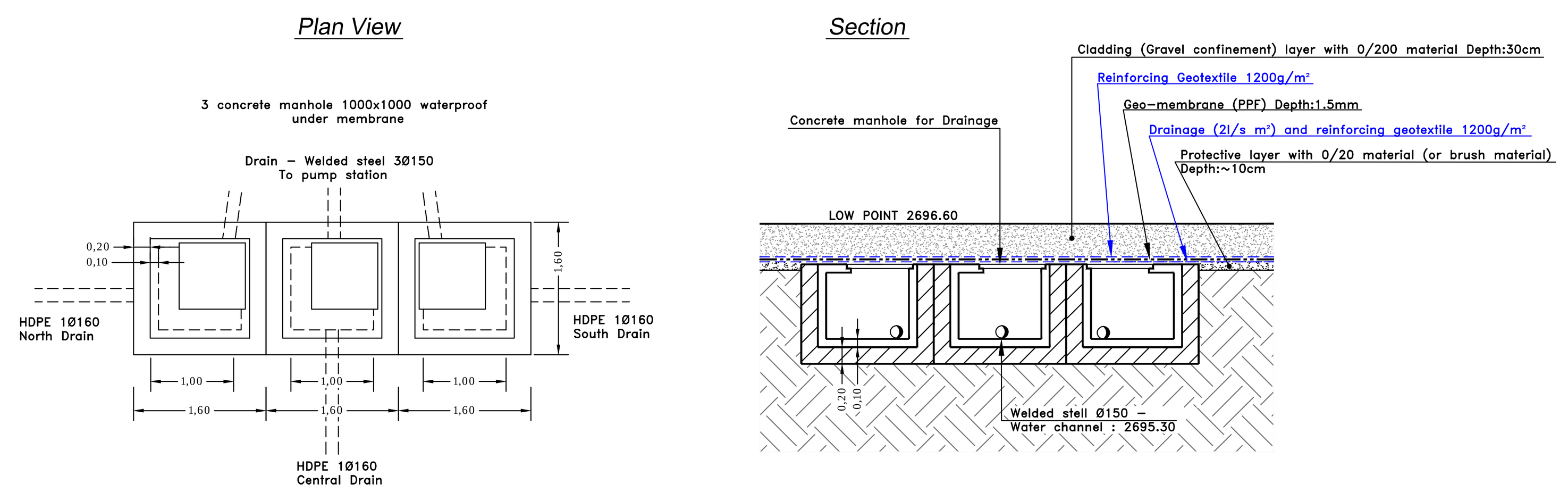
DETAIL 5 - NETWORKS LAYING

Scale 1/50



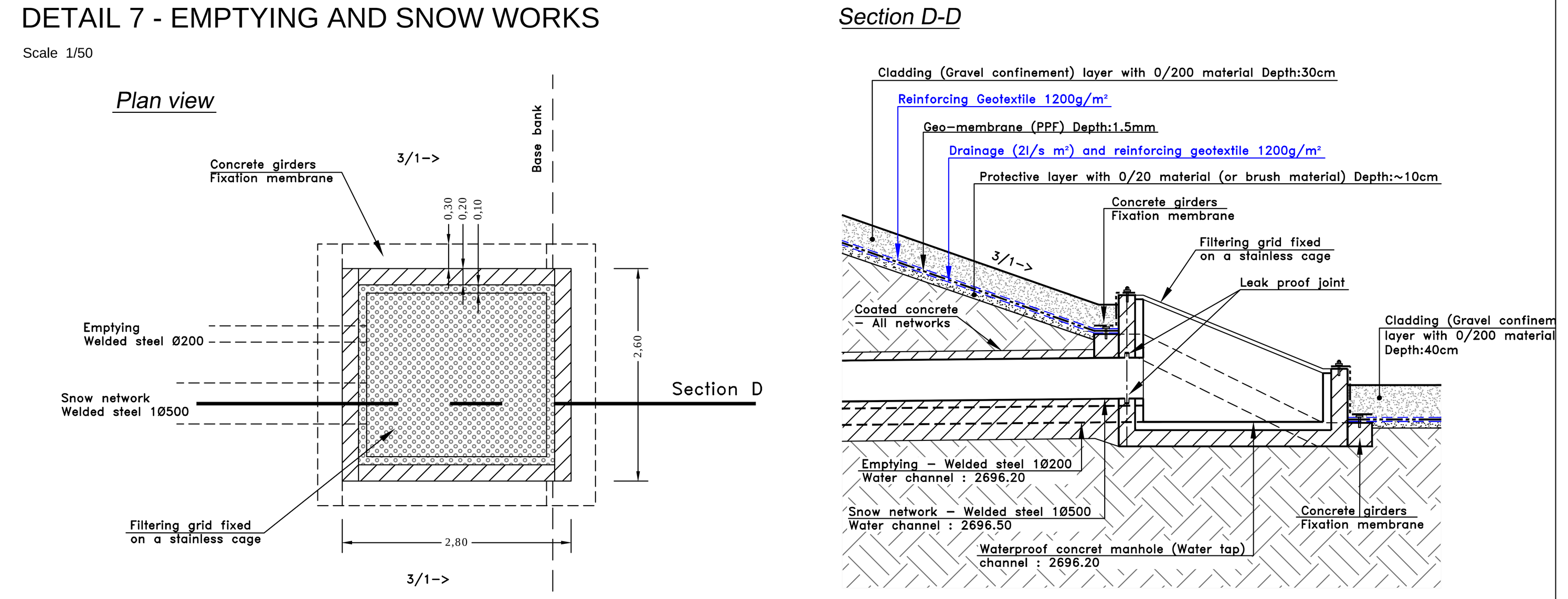
DETAIL 6 - DRAINAGE WORKS

Scale 1/50



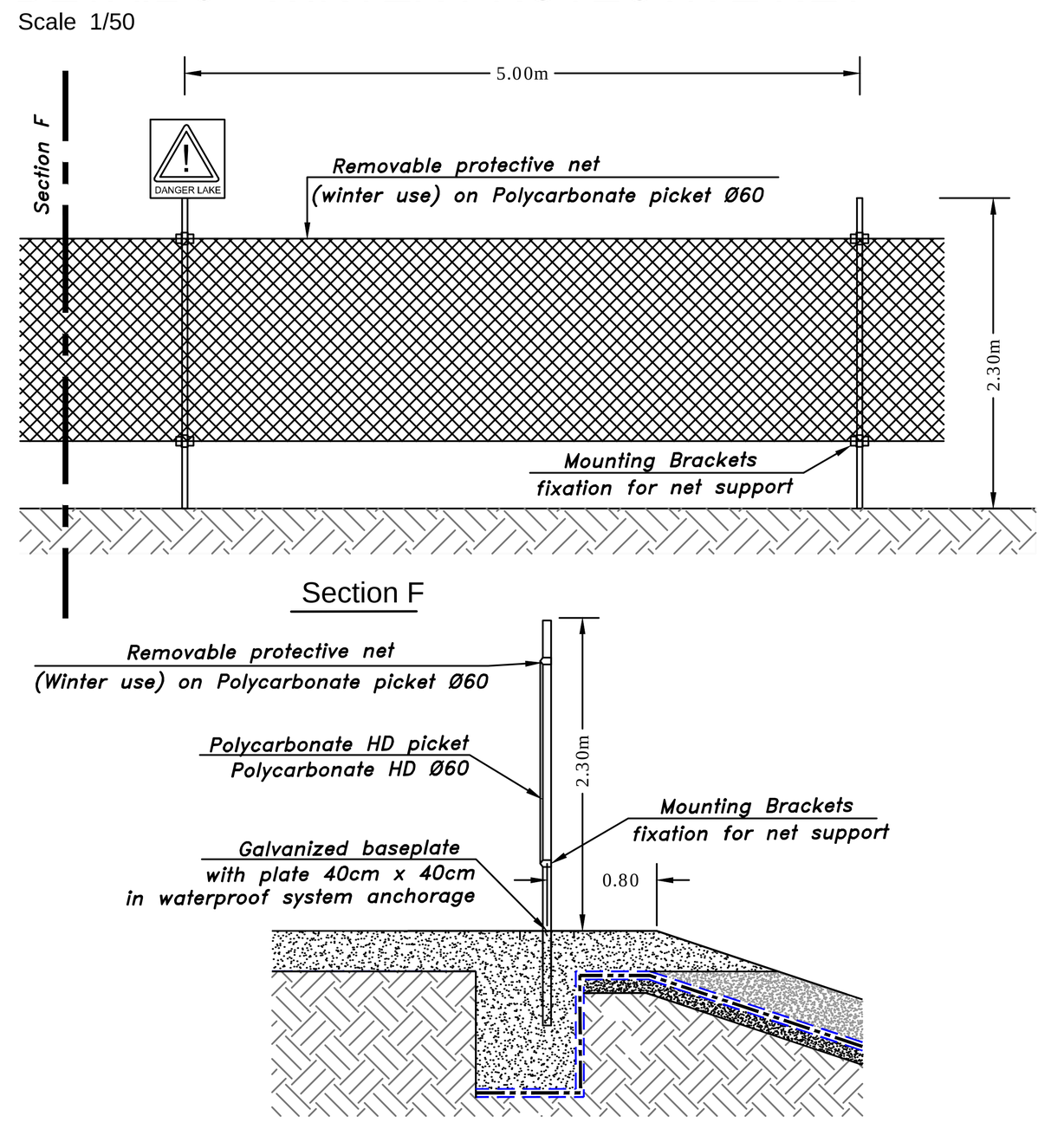
DETAIL 7 - EMPTYING AND SNOW WORKS

Scale 1/50



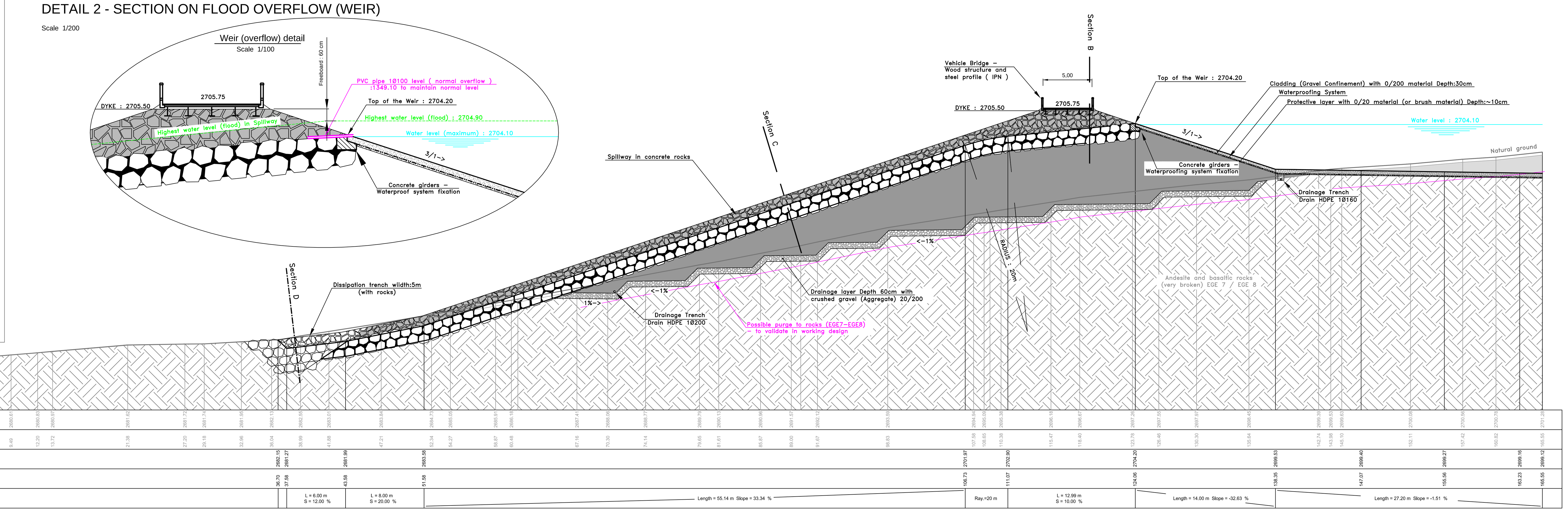
DETAIL 9 - WINTER PROTECTIVE NET

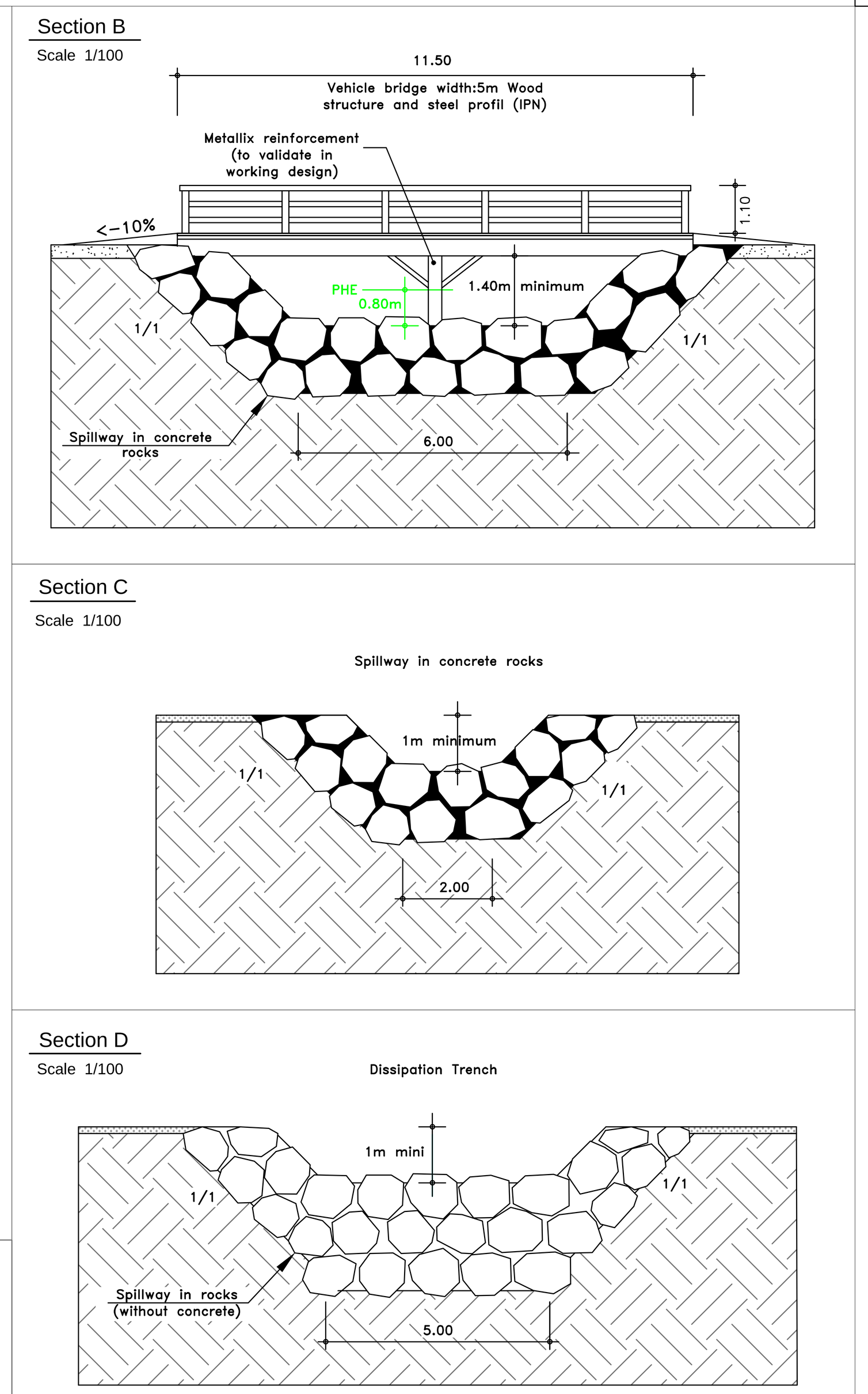
Scale 1/50



DETAIL 2 - SECTION ON FLOOD OVERFLOW (WEIR)

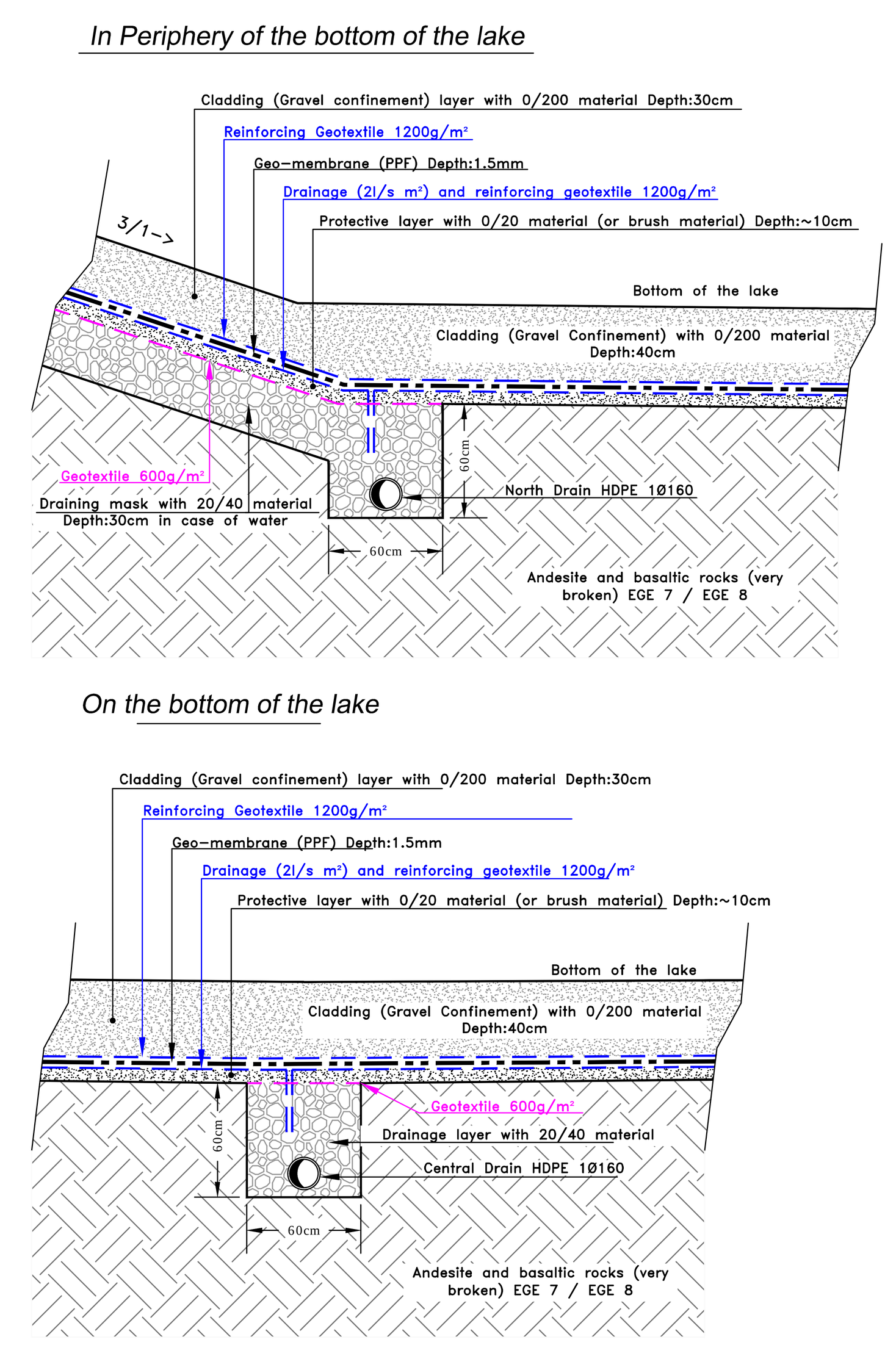
Scale 1/200





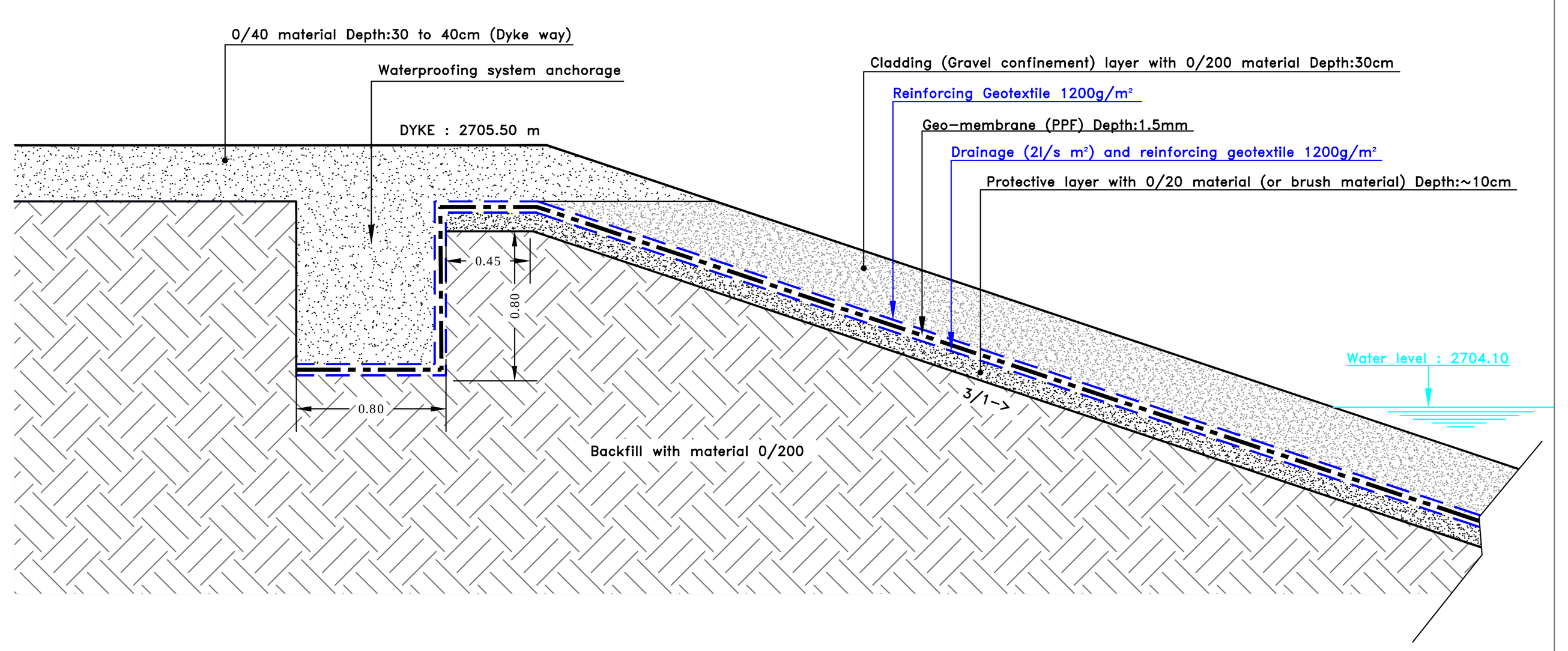
DETAIL 8 - DRAINAGE

Scale 1/25



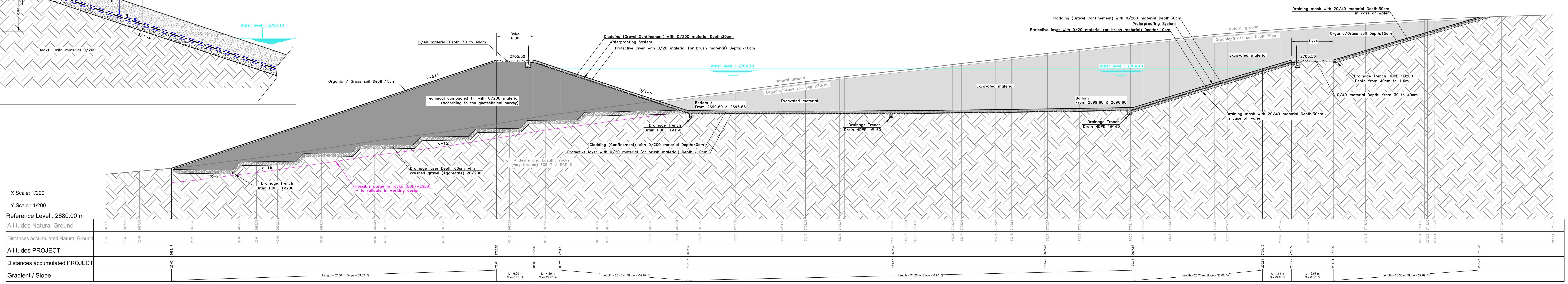
DETAIL 3 - SECTION ON WATERPROOFING ANCHORAGE

Scale 1/25



DETAIL 4 - CROSS - SECTION ON DYKE

Scale 1/200



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-
GEORGIA

SNOW MAKING AND LEISURE LAKE

Resort : GUDAURI Country : GEORGIA

DESIGN PROJECT

1 - Site plan
2 - General drawing
3 - Cross - section
⇨ 4 - Section and detail drawing
5 - Landscape scenery (insertion)

Reference (ABEST) : P:\2014\14-043 Lakes Gudauri\PRO\Gudauri Lake.dwg — SCALE : on plan

INDEX	DATE	EST.	VERIF.	OBSERVATIONS-MODIFICATIONS
0	18-02-15	NP	BB/DL	FIRST DRAWING

6 - values of materials used

Prices are indicative regarding French reference and are including :

Transport of all material and personal on working site;
Supply and installation of the products;
All controls of implementation and welding.

Drainage and reinforced geotextile :	11 €uros/m²
Polypropylene membrane (GUDAURI) :	14 €uros/m²
Reinforcing geotextile :	8 €uros/m²
PVC membrane (BAKURIANI) :	34 €uros/m²

7 - connection pipe

All pipes for :

- Drains under the dam
- Emptying under the dam
- Providing water to the pump station under the dam
- Filling up network from pump station to the top of lake

Will be welding stell.

Minimum thickness :

- Drains under the dam	4 mm
- Emptying under the dam	5 mm
- Providing water to the pump station under the dam	6.3 mm
- Filling up network from pump station to the top of lake	3.6 mm

Classical welding must be done on steel pipes.

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1 - detailed explanatory card

a) General Works

- Studies of details, calculation notes, plans of all of the structures built
- The development of a playground construction and materials sorting installation
- The provision, implementation, maintenance of construction facilities, as well as their evacuation at the end of construction
- The provision and implementation of signals, signs and the protection of the site
- Setting up a fence around the grip of retainer, net and barrier to the right of the main entrance
- The realization of the tests requested
- The creation of the ways of construction and maintenance of these, including geotextile and ballast
- The implementation of all of the work
- The rehabilitation of sites and access.

b) Preparing works

- The realization of ditches and channels of runoff of water collection
- The purge of the materials unsuitable or saturated
- The creation of platform for hanging under the areas to receive the embankments dams, as well as areas of deposits
- The realization of the foundation under embankment spade
- The realization of drainage under embankments (carpet drainage and ditches to drain with manufacture of eyes collection and/or control)
- Stripping of topsoil on the right-of-way of the earthworks with placing in storage outside of the right-of-way of the worksite.

c) General earthwork

- Execution of the general earthworks for altitude withholding planning, routes, tracks
- All earthworks in dredged material necessary for the construction of platforms, including sorting, transport and temporary storage if necessary
- All earthworks as compacted fill necessary for the construction of the platforms after possible crushing and sorting
- The mining, shifting or pneumatic destruction of rocky passages
- The establishment of surplus materials on the trails in order to re - profiling the skiing track
- The upgrading of rocky materials
- The realization of ditches, drains with rejection to the natural environment
- The setting of forms of slope
- The purge and the reinforcement of rock slope anchorage
- The seat of the embankments for anchoring of the dikes
- Methodical put materials in embankment compaction
- The setting, grading, compaction of the bottom of the Lake shape
- Tests, the approval of the supervisor, materials of constitution of embankments as well as boards of trials and the enforcement procedure of the earthworks
- The realization of the tests of compaction and penetrometers

- The realization of a carpet draining into bottom of basin with realization of a peripheral collector
- The implementation of a layer of control and protection in fine materials
- The establishment of a geocomposite drainage and anti-punching under the geomembrane, with receipt of the bracket before installation of the seal
- The tightness of the geomembrane or similar basin including fastening on workpieces
- The implementation of a geotextile anti-punching under the confinement of banks
- The implementation of cladding gravel on all banks
- The realization of the geotextile and geomembrane anchoring trench
- The realization of leak and welding tests
- The implementation of control measures (first fill) and corresponding report
- Development of the overflow system of the lake rockfill, concrete and concrete flood smooth as well as slab stone walling for the water supply
- The bridge construction onto the overflow equipment, for less than 3.5t of vehicule, with wooden fence.

d) Network

- The realization of the tests of each network and/or passage of a camera control
- The realization of necessary trench with topsoil stripping, the opening, making the coating of pipes in sieve materials, filling, delivery in place of topsoil, raking or possible crushing (on request of the supervisor) and the sodding
- The supply and installation of pipes for water and air (bubbling Lake), the sliders and warning screens
- Neat fluid piping flushing and pressure testing
- The switch at the sleeves and all control operations and receipt thereof
- The cleaning and restoration of the land and the paths used after work
- The construction of networks of empying pipe, supply the snow network and drainage welded steel
- These networks in a massive concrete coating
- The making of piece intake water and drain concrete embedded in the slope including supply and sealing of a grille protection in stainless steel and all constraints of attachment of the seal on the concrete
- The network of drainage of the lake and outlet for the natural stream

e) Finishing

- The establishment of the HDPE from the network of bubbling from the pump station to the top of dike in manhole
- Control dams, such as equipment that piezometers, topographic cue
- The realization of two culverts wood for crossing the Weir to the engine room
- Implementation of a visual measurement system of water levels in the lake mounted on water supply channel
- Setting up a mix earth/gravel on dyke road and railways schedule
- The replacement of topsoil and the preparation of soils on the right-of-way of the work of the restraint and deposits areas
- The implementation of a possible jute canvas on the slope before seeding
- The mechanical seeding on all the areas affected by the work.
- Wooden barriers and skiing track net protection.

1 - detailed explanatory card

a) ***General information***

The evolution of machines will have to be strictly limited to the perimeter of useful work, defined in the beginning of the construction site and being the object of the installation plan.

The protection of flora and fauna will have to be assured and will be the object of a quite particular attention.

The mining and scrapping will be the object of all the useful capacities of safety chargeable to the company.

The company will have at her expense, the application of safety regulations in term of staff and road marking (according to recommendation of the safety coordinator or supervisor) during all time works.

b) ***Excavated material***

The execution mode of the excavations material is left to the choice of the company, as far as it is against the general interests of the construction site.

A procedure of execution will be presented to Mountain Resort Development Company (MRDC) and supervisor, of work during the period of preparation (April and May 2015).

Excavation slopes will carefully be adjusted according to slopes indicated by the cross-section, and on working design plans.

Materials serving to build the dyke must be essentially in good shape (0/200 material). The products of the mining will be used for the greater part on the condition of being of calibre which can be compacted by maximal layer of 50 centimetres. The mining of materials will be executed so as to reused materials in elevation and if necessary materials will be crushed (without valuable capital gain) to be used in backfill material.

The company will have to execute the regulation of the platform according to the excavations: the tolerance of regulation to the prescript quotations will be three centimetres (3 cm) at the end of the works, after well-kept regulation of the shape.

Ditches will be established and maintained during the works to channel and evacuate running water.

All the rolling stones in the excavated material, which could spread outside the influences of the project, will be removed.

Slopes will carefully be drawn up and settled in a way such as they do not present either back of the lap, or irregularity and will be purged of all the elements which risk making it the uncertain stability.

c) ***Soil compaction***

The bottom form will be settled and compacted with, if it turns out to be necessary, the contribution of materials fine as of 0/20 (stemming from the product of the crushing on the site of the materials of clearings).

The platform of collision (anchor), for the construction of the dyke, will be based on a compact ground with a light transverse slope (1 / 2 %). Before any beginning of the elevation, the bottom of earthwork and the prepared soil before embankment will have to be received by the Project manager and the supervisor.

d) ***Drainage***

All means will be taken by the company to assure the natural drainage of the ground, to avoid the training of lands and erosions and to avoid the crushing of drains during the execution of the works.

A control operation of the networks of drainage will be operated before withdrawal of construction work, for possible restoration, included ditches.

A network of drainage will be installed in bottom of the lake and on excavation slopes, completed, if it turns out to be necessary, by draining masks or / and draining spurs on excavation slopes in case of in-rushes water.

Waters intercepted or drained within the framework of the excavations will be evacuated area by area, downstream, in the direction of the existing flood way below. Also, the flows discovered during the excavations of the restraint of height will be inevitably evacuated, after drainage and possible control of drains under the work, towards the existing wet zones and protected in the work zone.

e) ***Backfill material***

Backfill material will be put by layer of 50 centimetres on average, with transverse slope from 1 to 2 %.

Continuous assessment of the compaction in the progress = EV2 > 50 MPa with EV2/EV1 < 2.

Quality controls of the elevations material will be realised, by patches essay and measures of the density and the moisture content according to prescriptions of the geotechnical company.

The company will have to supply all the necessary services for all the controls asked by the project manager.

Trial boards can be asked in prerequisite to the realisation of the dike, without capital gain to the market.
The tolerance of execution of the excavations will be of ± 3 centimetres for the heights and 10 centimetres for the levelness.

Pipes and works (networks), which will have to cross dyke, will be set up after the realisation of the elevations of the dyke or beforehand if these pipes and works are under the basis of the elevations. The backfill material around the coated concrete (envelope of the networks) under dyke will be carefully realised, so as to keep the homogeneity of its body.

The body of dyke in elevation (internal profile according to profile and slope of outside bank 2/1 maximum) must be realised with good materials and validated by the geotechnical company. Beyond the body of dyke banks outer than 20 % at the most can be realised with excavated materials of less good quality.

The phasing and the adopted methodology will have to, in every case, aim at keeping the homogeneity of the body of the dike.

The sorting of materials and their specificity of re-use will respect a rigorous procedure, according to the conclusions of the geotechnical report.

The positive materials essentially clearings in the right of the restraint, will be mainly implemented (operated) on around ski slope, in punctual profiling.

If it's necessary, the elevations of dyke of the restraint will be studded by rocky blocks extracted from the general excavation and stemming from the mining of the rocky imprint : execution of a scour for anchoring blocks put in elevations of materials on hedgehog of blocks. This operation will be integrated into the price of putting in elevations of materials without capital gain.

In order to justify stability under descending earthquake, the following recommendations are to produce :

- ✓ For both lake of Gudauri and Bakuriani :

  A purge of unconsolidated materials of poor quality after analysis at the opening of bottom of excavations at the beginning of work

- ✓ For Bakuriani Lake :

  A strengthening of embankments of dyke by geotextile sheets,
  With the following minimum characteristics :

  - tablecloths of geotextiles spaced 1.00 m
  - T = 330 kN/m
  - Type : geotextile polypropylene anchor of 8 meters within the materials reconstituted
  - on a height equivalent to the lower 2/3 of the dyke.

f) Controls

All control will be realised :

A) On the quality of the bottom of excavation by a visual inspection or possibly by an execution of static or dynamic penetrometer light in the suspect zones. These controls will be realized after compaction and before any elevation

B) Measures of the moisture content will be also made, as well as essays of permeability to the operated materials

C) Before the elevations, the company will have to realise a trial board to verify that their methodology of implementation corresponds well to the requirements of project manager and Geotechnical Company

D) On the sorting of the excavated materials, by a visual permanent control, and possibly the Proctor essay and the moisture content

E) On the good implementation of the elevations, by a visual control

F) On the good compaction of every layer) of elevations, by patch essays following the modus operandi LCPC and its directives. The new layer will be brought only if the previous one is ended and considered satisfactory by the project manager

G) On the holding of the elevations by the implementation of piezometer and topographic points X,Y,Z (during the first filling-up)

H) A daily control of the flows will be made, concerning the drainages and the open ditches.

1 - detailed explanatory card

The reception of platforms, before the implementation of reinforced geotextile and geo-membrane, will make in the presence of the company, of the project manager, the geotechnical company and of the person responsible of the waterproofing system.

A trial board of at least 50 m² will be realised before the realisation of the waterproofing system, to validate the conditions and the modes (implementation) of the constituents of the waterproofing system.

Before, during and after the execution of the waterproofing system, the quality controls of the waterproofing system can concern :

f1) Under waterproofing system

- Control of the geometry of the bottom of the lake by a statement of levelling
- Control of the nature and the quality of the granular materials of the bottom of shape and the layer support
- Control of the implementation of the materials of the layer support and drainage (draining trench, draining mask, drainage geotextile)
- Control of quality and the implementation of the geotextile placed under the geo-membrane (and the drainage geotextile).

f2) Geo-membrane

- Characteristics control of the identification and mechanical / chemical behaviour of the geo-membrane
- Control of the respect for the plan of waterproofing system and the procedure of implementation
- Control of the implementation
- Qualification ASQUAL of the welders, the works foreman and the material
- Control of the coverings of the geo-membrane, the welds, the anchoring, the connecting in the works
- Visual Check of accidental perforing
- Non-destructive testing to estimate the continuity of joints: visual inspection, test in the point (headland) in external edge of joint (simple weld), vacuum bell for the welds by extrusion and the triple points, put in pressure of the central channel for the double welds …
- Destructive Controls to estimate the mechanical resistance of materials in the zone of the joint: taking of sample and essays of drive / coat and drive / cutting.

f3) Protection and confinement

- Control of the quality and the implementation of the reinforced geotextile set up on the geo-membrane
- Control of the protection layer and confinement (cladding)
- Control of the definitive profile of levelling of the work general topographic account (As-built drawings).

During the implementation of the waterproofing system, stop points will be planned. In these points, the company will need the agreement of the project manager of work to continue the works.

Stop points will be the following ones :

- Reception of the support and the draining trench, at the end of the excavation: contradictory reception between the companies of excavation and waterproofness
- Control of the quality and the waterproofness of the geo-membrane before covering (confinement); possibly realised by section not to block the progress of the works

1 - detailed explanatory card

Project manager supervisor of work or the Client (MRDC) can ask at any time for complementary (additional) essays without any payment for the company.

The services of the geotechnical supervisor company taken care by the Client (MRDC) will be:

- Visit of the excavation (at the beginning, current and at the end)
- Validation of the trial results and the re-use of materials (elevation, drainage, confinement)
- Reception of the bottom of the network under the dike
- Visit of reception of the support for the complex of waterproofing system
- Sizing and setting-up of the draining masks and/or the draining trench

All the other works are due to the company.

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DETAILED QUANTITATIVE ESTIMATE

Objet : **GUDAURI SNOW MAKING AND LEISURE LAKE**

Maître d'Ouvrage : **MOUNTAIN RESORT DEVELOPMENT COMPANY**

Devis : **14-043 GUDAURI**

Price number	*Label (works)*	*Unity*	*Planned quantity*	*Unit price (without tax)*	*Amount (without tax)*	*Remarks*
1-Prepatory Work						
1.1	Preparation and site installation, brought and withdrawal of the material (equipment), implantation (setting out)	fixed price	1,00	- €	- €	
1.2	Studies and working drawing	fixed price	1,00	- €	- €	Level of the lake, volume of earthworks
1.3	Geotechnical complementary studies	fixed price	1,00	- €	- €	Material studies, reuse of material
1.4	As-built drawings	fixed price	1,00	- €	- €	At the end of the whole construction
1-Prepatory Work				*TOTAL*	**0,00 €**	
2-General Earthwork						
2.1	Excavated Organic/grass soil	m³	15 500,00	- €	- €	approximately 30 cm
2.2	Excavated material	m³	121 500,00	- €	- €	
2.3	Excavated material (adaptation for balancing material)	m³	10 000,00	- €	- €	To be validated depending of the volume of excavated material and draining material
2.4	Excavated material (possible purge under the dyke)	m³	35 000,00	- €	- €	To validate by a geotechnical company
2.5	Gains scraping (with ripper)	m³	25 000,00	- €	- €	Scraping at the top of the rocks layer (50 cm)
2.6	Gains for explosive mining	m³	89 600,00	- €	- €	Mining or pneumatic equipment
2.7	Backfill material for dyke construction	m³	106 000,00	- €	- €	Reuse of material to be validate by geotechnical survey
2.8	Backfill material for dyke construction (if purge, zone of loan)	m³	35 000,00	- €	- €	
2-General Earthwork				*TOTAL*	**0,00 €**	
3-Waterproofing system (with geo-membrane)						
3.1	Trenching for waterproofing system anchorage	lm	630,00	- €	- €	
3.2	Material for protective layer with 0/20 material (or brush material on site), depth = 10 cm	m³	2 450,00	- €	- €	
3.3	Drainage (2 l/s / m²) and reinforcing geotextile 1200 g/m²	m²	25 750,00	- €	- €	Dimensioning of the waterproofing sytem to be validated on working design
3.4	Reinforcing geotextile 1200 g/m²	m²	25 750,00	- €	- €	
3.5	Geo-membrane (PPF), depth = 1,5 mm	m²	25 750,00	- €	- €	
3.6	Cladding (gravel confinement) layer with 0/200 material, depth = 30 to 40 cm	m³	8 550,00	- €	- €	
3.7	0/40 material, depth = 30 to 40 cm (dyke way)	m³	1 500,00	- €	- €	
3-Waterproofing system (with geo-membrane)				*TOTAL*	**0,00 €**	
4-Flood overflow (weir)						
4.1	Excavated material	m³	1 500,00	- €	- €	
4.2	Gains for explosive mining	m³	1 500,00	- €	- €	
4.3	Weir and Spillway in concrete rocks	m³	950,00	- €	- €	
4.4	Vehicle bridge, wood structure and steel profile (IPN)	m²	65,00	- €	- €	Dimensionning of the bridge, is to adapt of kind of bridge
4.5	Concrete girders (for waterproofing system fixation)	lm	15,00	- €	- €	
4.6	Waterproofing system fixation on concrete girders	lm	15,00	- €	- €	
4.7	Rocks for dissipation trench	m³	125,00	- €	- €	
4-Flood overflow (weir)				*TOTAL*	**0,00 €**	
5-Water supply						
5.1-Alimentation						
5.1.1	Trenching for water supply	m³	150,00	- €	- €	
5.1.2	Gains for rocks on trenching	m³	50,00	- €	- €	
5.1.3	Welded steel or cast iron Ø 100	lm	75,00	- €	- €	Kind of networks
5.1.4	Detectable underground marker tape	lm	75,00	- €	- €	
5.1.5	Protective concrete (concrete fill)	m³	10,00	- €	- €	

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DETAILED QUANTITATIVE ESTIMATE

Objet : **GUDAURI SNOW MAKING AND LEISURE LAKE**

Maître d'Ouvrage : **MOUNTAIN RESORT DEVELOPMENT COMPANY**

Devis : **14-043 GUDAURI**

Price number	*Label (works)*	*Unity*	*Planned quantity*	*Unit price (without tax)*	*Amount (without tax)*	*Remarks*
5.1.6	Anchor concrete block (for alimentation)	unit	1,00	- €	- €	
5.1.7	Base slab in concrete rocks	m²	125,00	- €	- €	
5.1-Alimentation				*TOTAL*	**0,00 €**	
5.2-Bubbling						
5.2.1	Polyethylene pipe - HDPE Ø 50	lm	300,00	- €	- €	
5.2.2	Detectable underground marker tape	lm	75,00	- €	- €	To be validated by the snow making process company
5.2.3	Concrete manhole 1000 x 1000	unit	1,00	- €	- €	
5.2-Bubbling				*TOTAL*	**0,00 €**	
5.3-Waiting networks						
5.3.1	Polyethylene pipe - HDPE Ø 50	lm	150,00	- €	- €	
5.3-Waiting networks				*TOTAL*	**0,00 €**	
5-Water supply				*TOTAL*	**0,00 €**	
6-Drainage						
6.1-Drainage (On the bottom of the lake)						
6.1.1	Drainage trench 1,00 m (depth) x 0,60 m (width) with drain HDPE Ø160	lm	590,00	- €	- €	
6.1.2	Gains for rocks on trenching	m³	350,00	- €	- €	
6.1.3	20/40 drainage material	m³	355,00	- €	- €	
6.1.4	Geotextile for drain (600 g/m²)	m²	1 900,00	- €	- €	
6.1-Drainage (On the bottom of the lake)				*TOTAL*	**0,00 €**	
6.2-Drainage (Excavated bank)						
6.2.1	Geotextile for drain (600 g/m²)	m²	8 000,00	- €	- €	
6.2.2	Draining mask with 20/40 material, depth = 30 cm	m³	2 400,00	- €	- €	
6.2.3	20/40 drainage material	m³	250,00	- €	- €	
6.2.4	40/80 drainage material	m³	250,00	- €	- €	
6.2-Drainage (Excavated bank)				*TOTAL*	**0,00 €**	
6.3-Drainage (Under dyke)						
6.3.1	Drainage trench 1,00 m (depth) x 0,60 m (width) with drain HDPE Ø200	lm	575,00	- €	- €	
6.3.2	20/200 drainage material for drainage layer, depth = 60 cm	m³	16 600,00	- €	- €	
6.3.3	Ditch creation	lm	585,00	- €	- €	
6.3.4	Concrete manhole 1000 x 1000	unit	3,00	- €	- €	
6.3-Drainage (Under dyke)				*TOTAL*	**0,00 €**	
6.4-Drainage (Upstream bank)						
6.4.1	Geotextile for drain (600 g/m²)	m²	4 100,00	- €	- €	In case of water, to be validate at the beginning
6.4.2	Draining mask with 20/40 material, depth = 30 cm	m³	1 230,00	- €	- €	
6.4.3	Drainage trench 0,60 m (depth) x 0,60 m (width) with drain HDPE Ø200	lm	80,00	- €	- €	
6.4.4	Drainage trench 1,00 m (depth) x 0,60 m (width) with drain HDPE Ø200	lm	100,00	- €	- €	
6.4.5	Drainage trench 1,60 m (depth) x 0,60 m (width) with drain HDPE Ø200	lm	120,00	- €	- €	
6.4.6	Ditch creation	ml	300,00	- €	- €	
6.4.7	Concrete manhole 1000 x 1000	unit	2,00	- €	- €	
6.4.8	Rocks for protection against erosion	m³	300,00	- €	- €	rocks or networks!
6.4-Drainage (Upstream bank)				*TOTAL*	**0,00 €**	
6-Drainage				*TOTAL*	**0,00 €**	
7-Link (networks) between lake to pump station						
7.1-Earhtwork						
7.1.1	Excavated material	m³	1 750,00	- €	- €	

ABEST Ingénierie

DETAILED QUANTITATIVE ESTIMATE

Objet : **GUDAURI SNOW MAKING AND LEISURE LAKE**

Maître d'Ouvrage : **MOUNTAIN RESORT DEVELOPMENT COMPANY**

Devis : **14-043 GUDAURI**

Price number	*Label (works)*	*Unity*	*Planned quantity*	*Unit price (without tax)*	*Amount (without tax)*	*Remarks*
7.1.2	Gains for explosive mining	m³	1 750,00	- €	- €	
7.1.2	Backfill material for dyke construction	m³	1 750,00	- €	- €	
7.1-Earhtwork				*TOTAL*	**0,00 €**	
7.2-Concrete works						
7.2.1	Solid block of reinforced concrete for coated network under the dyke	m³	220,00	- €	- €	
7.2.2	Emptying and snow works	fixed price	1,00	- €	- €	
7.2.3	Waterproofing system fixation on concrete girders	lm	15,00	- €	- €	
7.2.4	Protective concrete (concrete fill)	m³	10,00	- €	- €	
7.2.5	Concrete manhole 1600 x 1600 (drainage works)	unit	3,00	- €	- €	
7.2-Concrete works				*TOTAL*	**0,00 €**	
7.3-Drainage						
7.3.1	Welded steel pipe Ø 150	lm	285,00	- €	- €	
7.3.2	Reinforcing HDPE pipe Ø 200	lm	95,00	- €	- €	
7.3.3	Geotextile for drain (600 g/m²)	m²	200,00	- €	- €	
7.3.4	20/40 drainage material	m³	50,00	- €	- €	
7.3-Drainage				*TOTAL*	**0,00 €**	
7.4-Emptying						
7.4.1	Welded steel pipe Ø 200	ml	90,00	- €	- €	
7.4-Emptying				*TOTAL*	**0,00 €**	
7.5-Snow network						
7.5.1	Welded steel pipe Ø 500	ml	90,00	- €	- €	
7.5.2	Filtering grid (fixed on a stainless cage)	fixed price	1,00	- €	- €	
7.5-Réseau neige				*TOTAL*	**0,00 €**	
7-Link (networks) between lake to pump station				*TOTAL*	**0,00 €**	
8-Lake emptying						
8.1	Trenching for emptying	m³	750,00	- €	- €	
8.2	Gains for rocks on trenching	m³	250,00	- €	- €	Position to be validated, outlet, concrete manhole, kind of networs, dimensioning
8.3	Ringed HDPE pipe Ø 400 Nominale Pressure NP10	lm	500,00	- €	- €	
8.4	Envelope of pipes in riddled materials	lm	500,00	- €	- €	
8.5	Concrete manhole 1200 x 1200	unit	5,00	- €	- €	
8-Lake emptying				*TOTAL*	**0,00 €**	
9-Secondary works and finishes (surface treatment)						
9.1-Winter protective net						
9.1.1	Galvanized baseplate (with plate 40 cm x 40 cm) put in the waterproof system anchorage	unit	140,00	- €	- €	
9.1.2	0/40 material	m³	50,00	- €	- €	
9.1.3	Polycarbonate HD picket Ø60, height = 2,30 m	unit	140,00	- €	- €	Wood barrier or only winter protective net to be validated
9.1.4	Mounting brackets (fixation for net support)	unit	280,00	- €	- €	
9.1.5	Removable protective net	m²	1 000,00	- €	- €	
9.1-Winter protective net				*TOTAL*	**0,00 €**	
9.2-Finishes (surface treatment)						
9.2.1	Backfill Organic/grass soil	m³	7 500,00	- €	- €	
9.2.2	Rocks	m³	50,00	- €	- €	
9.2.3	Backfill material for covering networks	m³	600,00	- €	- €	To be validate with the level of the pump station
9.2.4	Panel "danger"	unit	12,00	- €	- €	
9.2.5	Lifesaver (safety buoy)	unit	6,00	- €	- €	

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DETAILED QUANTITATIVE ESTIMATE

Objet : **GUDAURI SNOW MAKING AND LEISURE LAKE**

Maître d'Ouvrage : **MOUNTAIN RESORT DEVELOPMENT COMPANY**

Devis : **14-043 GUDAURI**

Price number	*Label (works)*	*Unity*	*Planned quantity*	*Unit price (without tax)*	*Amount (without tax)*	*Remarks*
9.2.6	0/40 material	m³	50,00	- €	- €	
9.2.7	Wood table (1,50 m x 2,50 m)	unit	4,00	- €	- €	
9.2-Finishes (surface treatment)				*TOTAL*	**0,00 €**	
9.3-Control instruments						
9.3.1	Piezometer	unit	8,00	- €	- €	Location to be validated
9.3.2	Piezometric probe	unit	1,00	- €	- €	
9.3.3	Scale level (with a step of 25 cm)	fixed price	1,00	- €	- €	
9.3.4	Topographic point	unit	8,00	- €	- €	Location to be validated
9.3.5	Reference station (topographic)	unit	2,00	- €	- €	Location to be validated
9.3-Control instruments				*TOTAL*	**0,00 €**	
9-Secondary works and finishes (surface treatment)				*TOTAL*	**0,00 €**	

C U M U L S		
Montant H.T.		**0,00 €**
Montant T.V.A.	19,600%	0,00 €
Montant T.T.C.		**0,00 €**

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EARTHWORK VOLUMES - GUDAURI			
Excavated material		**Backfill material**	
Organic / grass soil	15 500,00	Draining Layer (under the dyke)	16 600,00
Gravel in crushed stone	31 900,00	Draining mask (in case of water)	3 680,00
Rocks	89 600,00	Dyke construction	107 750,00
Possible purge (under the dyke)	35 000,00	Dyke construction (if purge)	35 000,00
Flood overflow	1 500,00	Protective layer (0/20)	2 450,00
Link between lake and pump station	1 750,00	Cladding layer (0/200)	8 550,00
Adaptation for balancing material	10 000,00	Dyke way (0/40)	1 500,00
		Draining material (in case of water)	500,00
		Weir and spillway rocks	1 075,00
		Rocks for protection	350,00
		Organic / grass soil	7 500,00
		Covering networks	600,00
TOTAL =	**185 250,00**	**TOTAL =**	**185 555,00**

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2 - specification of the materials

Drainage and reinforced geotextile :

Density :	1250	g/m²
Tensile strength :	23	kN/m
Puncture resistance :	5.8	kN
Drainage :	2	l/s/m²
Permeability :	0.055	ms^{-1}

Polypropylene membrane (GUDAURI) :

Density :	0.9	g/cm^3	
Thickness :	1.5	mm	
Breakage resistance :	23	N/mm	800%
Puncture resistance :	1.1	kN	
Steam permeability :	$<1.10^{-6}$	$m^3/m^2.day$	

Reinforcing geotextile :

Density :	1200	g/m²
Tensile strength :	22	kN/m
Puncture resistance :	5.8	kN

Global calculation of stability of the waterproof complex must be provided by the company, with its offer :

Specific weight of cladding layer : 25 KN/m^3

Including if necessary all the additional net and gravel retention grilling to justify the full stability of the complex;
Including the internal friction angle of each product justification;
Including the slip angle coefficient security of the complex;
Including the anchorage trench calculation, regarding the complex composition proposed;
Global security coefficient might be more than 1.35.

PVC membrane (BAKURIANI) :

Thickness : 3 mm

Armed with frame of polyester, 65kN of minimum resistance

Ski resorts of GUDAURI – STEPANTSMINDA - GEORGIA

GUDAURI LAKE PROJECT

This report concerning the Gudauri lake project (for snowmaking and Leisure Lake) will include all the information about the conception of the lake.

1. General dimension

a) General hypothesis

Regarding our last 30 years of experience in the Alps for managing snowmaking project, water and energy resources, and the following hypothesis could be taken into consideration:

- The average global need for one season is around 90 cm, considering the alteration of snow and usury
- Possibility to produce snow and open the skiing tracks within 5 nights (60 hour) of cold (minus 2.5°c or less) for approximately 50 cm, before Christmas holiday period (50 to 60% of the full season)
- Generation of snow to ameliorate the quality of slopes and finalize the winter season in security (20/25% before the end of January and 2 times 10/15% after).

The importance and requirement of building some lakes are about 4 major points:

- The necessity to dispose the maximum debit to insure the opening of the ski resort after the first week of effective cold
- The limitation of energy consumption during the producing of snow, if the lake is situated at an upper altitude points from the ski track (between 2 and 3 times less electrical power needed)
- The insurance of the water quality, regarding the possibilities of filtration and settling of sediments
- The tourist possibilities opportunities around the lake, the building, shops and lift station around) and the unique landscape opened: walking, picnic, fishing, splashing, nautical ski, …

Projecting a lake means also to secured the situation of water reserve and protect the bottom of the lake, in anticipation of any hazard. This can be traduced by the maintaining of about 20/30% of the global capacity at each time.

Venues of Lake Project need to be analysed scrupulously, as such an infrastructure is liable to natural risk and could drive so irreversible damage for goods and lethal trouble after an eventual dam breaking facing:

- *Snow avalanche (not considered along the actual venues studied)*
- Hydrological water flow
- Wind waves
- Geotechnical stability and foundation
- Seismicity resistance
- Overflow channel
- Waterproof guarantee
- Topographic and landscape optimizing
- Adaptation with the pump station implantation
- Possibilities of filling up

Filling-up

b) <u>Gudauri needs</u>

The same hypothesis than before lead to the following characteristic:

- 117 000 m3 for the all winter season

- 1 100 m3/h (300 l/s) of debit before the opening season.

The board below shows the evolution of the resources and the quantities of available water for the snowmaking system during winter period:

Winter season period	initial lake volume	snow producing	possible fill up (20 l/s)
01-05 december	80 000	64 350	3 600
05-31 december	19 250		36 000
01-15 january	55 250		21 600
15-25 january	76 850	29 250	14 400
25-31 january	62 000		3 600
01-22 february	65 600	11 700	28 800
22-28 february	80 000		3 600
01-15 march	80 000	11 700	21 600
	80 000	117 000	133 200

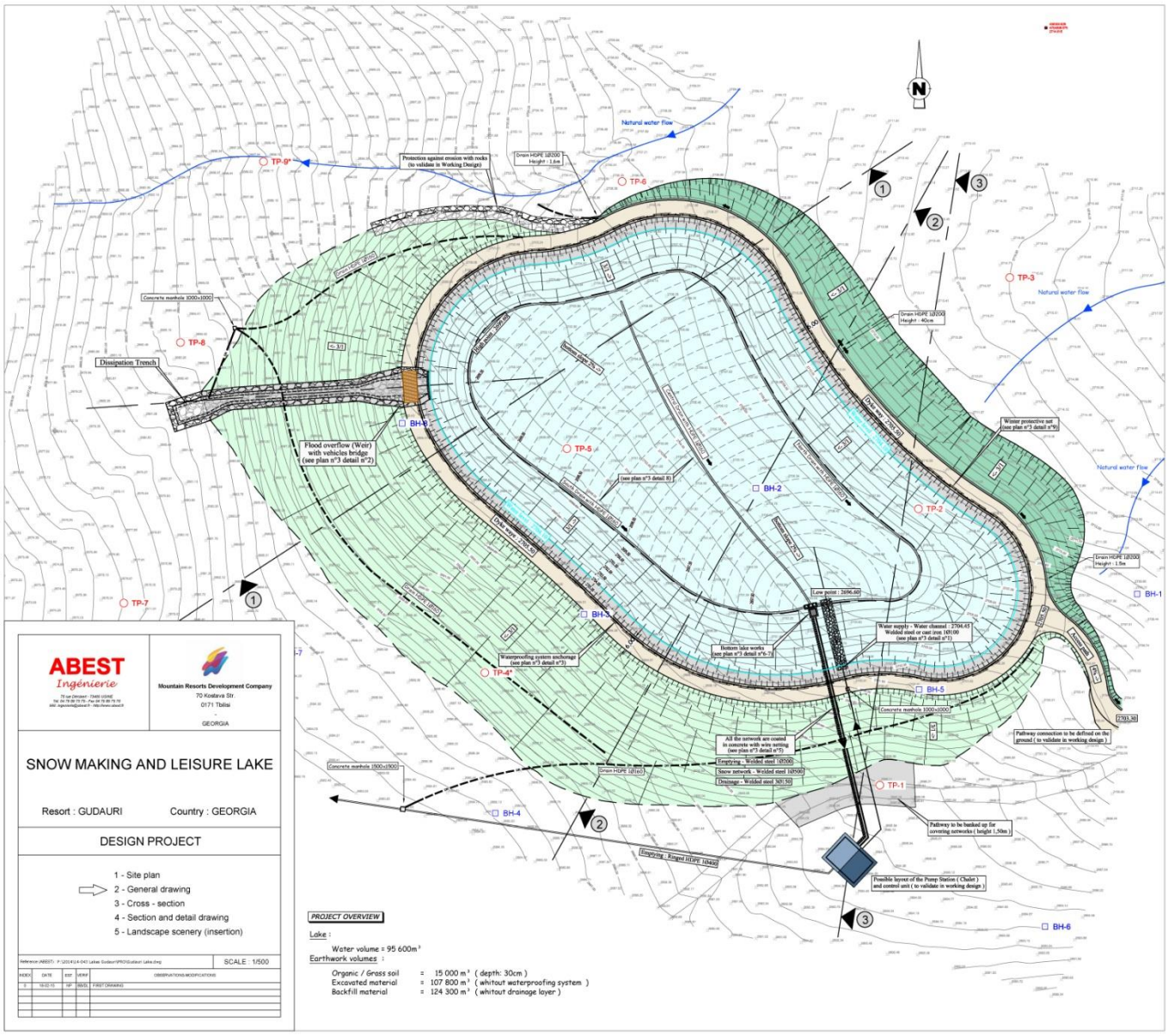
The minimum of water stock appears to be 80 000 m³.

To insure the medium term future equipment of snowmaking, along the top beginner ski lift per example, and according the large possibilities of the venue near the top gondola station that could receive the lake, volume could be projected to 100 000 m³ (6ha of snowmaking more).

We have also considered that in Georgia, the administrative and reglementary constraint are harder with à lake further more than 100 000 m³.

The volume of the Gudauri Lake project is 95 600 m³ of water.

Finally, the setting-up of the lake in was defines between the existing pathway (south side) and the natural water flow (north side).



2. Stability of the lake

The stability of the lake was calculated with the GVIRGVINI Ltd study (conducted in November and December 2014) conclusion.

This conclusion (Borehole and pit) was interpreted to design the stability of the lake.

The conclusions have allowed showing the different geological layers (see the map 3 – Cross-section):

- Organic / Grass soil on approximately 30 cm – EGE1;
- Sandy and Clay soil with gravel and crushed stone until 1,0 m to 2,1 m depth – EGE2 / EGE3;

- Gravel in crushed stone clayey until 1,0 to 3,5 m depth (and until 6,0 to borehole BH-1) – EGE4 to EGE6;
- Andesite and basaltic rocks (very broken) until 30 m – EGE7 / EGE8;

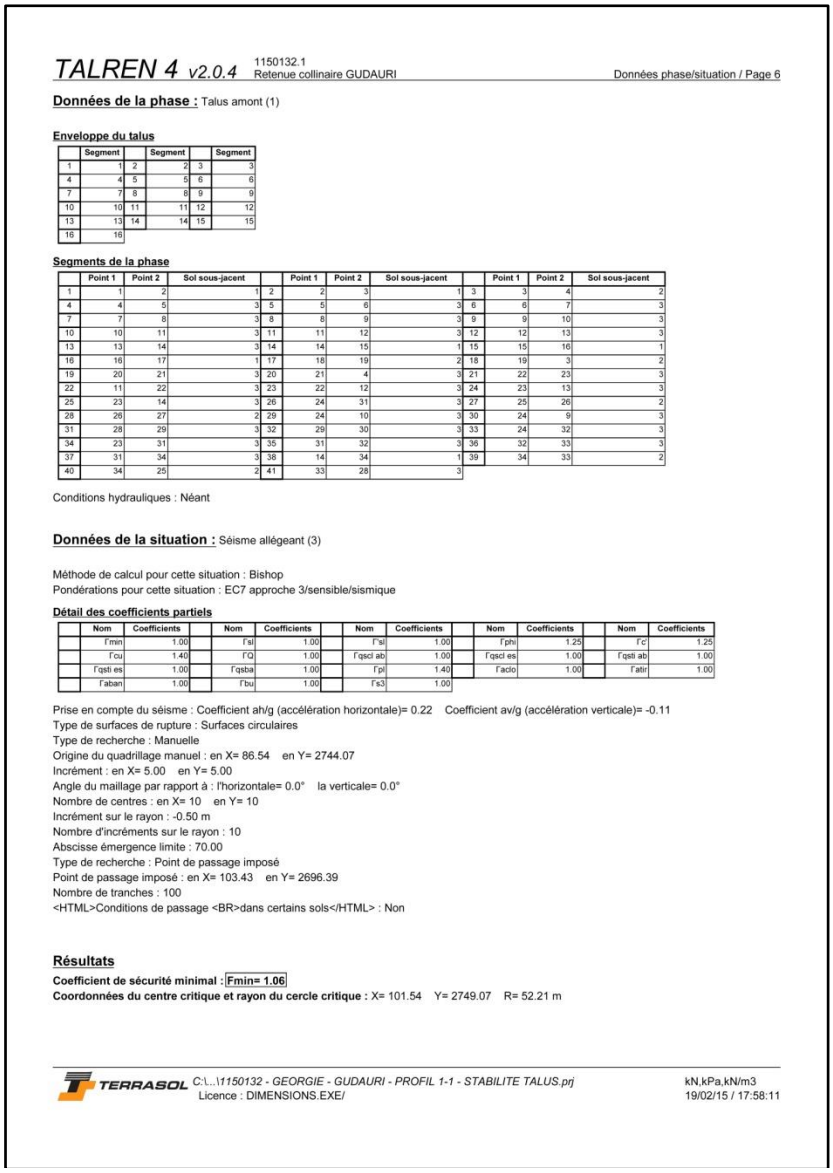
This conclusion shows that there are 3 geological layers (Organic / grass soil with sandy and clay layer, Gravel in crushed stone layer and andesite and basaltic rocks layer).

The study does not show subterranean water circulation but with our visit has us allowed to notice in-rushes of water.

The seismic calculations were realized with as data:

- Magnitude = 9
- Acceleration = 0.31

All of this information allows us to do the stability calculation with TALREN software. TALREN allows the check of the stability of the geotechnical works, with or without strengthening: bank natures, elevations, dams and dikes works.



TALREN 4 v2.0.4 1150132.1 Retenue collinaire GUDAURI — Données phase/situation / Page 6

Données de la phase : Talus amont (1)

Enveloppe du talus

	Segment		Segment		Segment
1	1	2	2	3	3
4	4	5	5	6	6
7	7	8	8	9	9
10	10	11	11	12	12
13	13	14	14	15	15
16	16				

Segments de la phase

	Point 1	Point 2	Sol sous-jacent		Point 1	Point 2	Sol sous-jacent		Point 1	Point 2	Sol sous-jacent
1	1	2	1	2	2	3	1	3	3	4	2
4	4	5	3	5	5	6	3	6	6	7	3
7	7	8	3	8	8	9	3	9	9	10	3
10	10	11	3	11	11	12	3	12	12	13	3
13	13	14	3	14	14	15	1	15	15	16	1
16	16	17	1	17	18	19	2	18	19	3	2
19	20	21	3	20	21	4	3	21	22	23	3
22	11	22	3	23	22	12	3	24	23	13	3
25	23	14	3	26	24	31	3	27	25	26	2
28	26	27	2	29	24	10	3	30	24	9	3
31	28	29	3	32	29	30	3	33	24	32	3
34	23	31	3	35	31	32	3	36	32	33	3
37	31	34	3	38	14	34	1	39	34	33	2
40	34	25	2	41	33	28	3				

Conditions hydrauliques : Néant

Données de la situation : Séisme allégeant (3)

Méthode de calcul pour cette situation : Bishop
Pondérations pour cette situation : EC7 approche 3/sensible/sismique

Détail des coefficients partiels

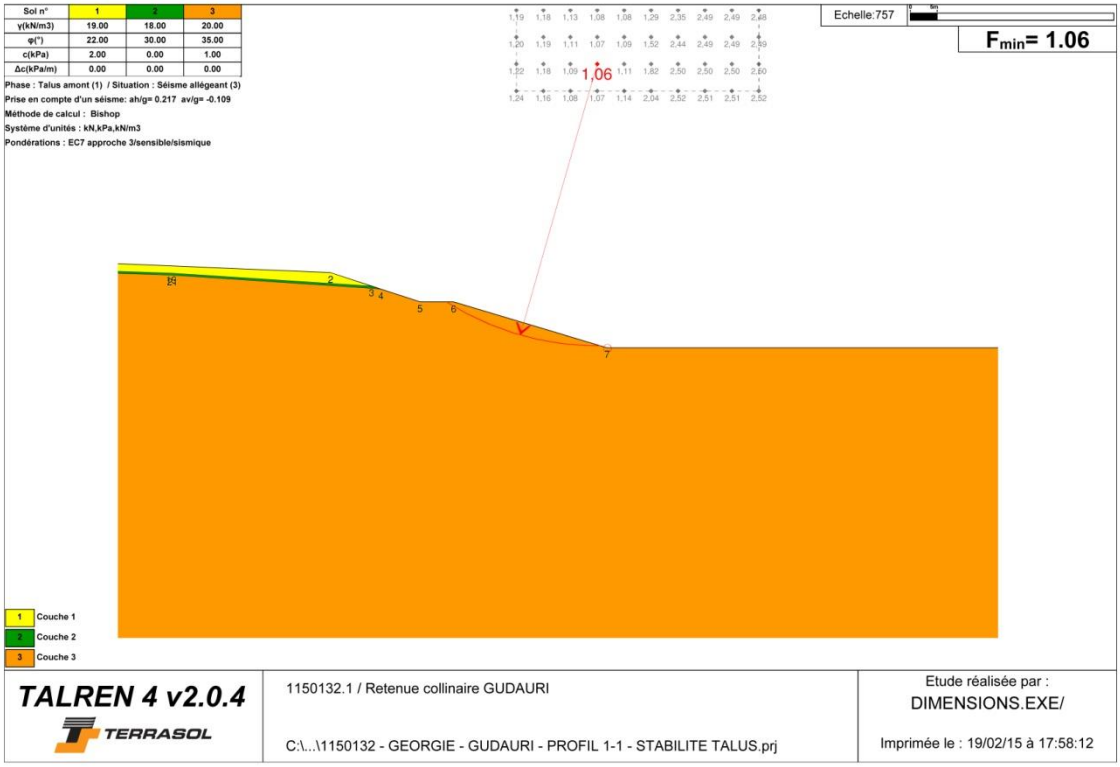
Nom	Coefficients	Nom	Coefficients	Nom	Coefficients	Nom	Coefficients	Nom	Coefficients
Γmin	1.00	Γsl	1.00	Γ'sl	1.00	Γphi	1.25	Γc'	1.25
Γcu	1.40	ΓQ	1.00	Γqscl ab	1.00	Γqscl es	1.00	Γqsti ab	1.00
Γqsti es	1.00	Γqsba	1.00	Γpl	1.40	Γaclo	1.00	Γatir	1.00
Γaban	1.00	Γbu	1.00	Γs3	1.00				

Prise en compte du séisme : Coefficient ah/g (accélération horizontale)= 0.22 Coefficient av/g (accélération verticale)= -0.11
Type de surfaces de rupture : Surfaces circulaires
Type de recherche : Manuelle
Origine du quadrillage manuel : en X= 86.54 en Y= 2744.07
Incrément : en X= 5.00 en Y= 5.00
Angle du maillage par rapport à : l'horizontale= 0.0° la verticale= 0.0°
Nombre de centres : en X= 10 en Y= 10
Incrément sur le rayon : -0.50 m
Nombre d'incréments sur le rayon : 10
Abscisse émergence limite : 70.00
Type de recherche : Point de passage imposé
Point de passage imposé : en X= 103.43 en Y= 2696.39
Nombre de tranches : 100
<HTML>Conditions de passage
dans certains sols</HTML> : Non

Résultats

Coefficient de sécurité minimal : Fmin= 1.06
Coordonnées du centre critique et rayon du cercle critique : X= 101.54 Y= 2749.07 R= 52.21 m

TERRASOL C:\..\1150132 - GEORGIE - GUDAURI - PROFIL 1-1 - STABILITE TALUS.prj — kN,kPa,kN/m3
Licence : DIMENSIONS.EXE/ — 19/02/15 / 17:58:11



Conclusion of the stability study:

- Elevation of dike with materials stemming from the excavation material (with EGE7/EGE8 material);
- Possible purge if unfit materials;
- Bank slope = 3/1 (inside and outside ok the lake);
- Consideration of the seismicity with safety factors of 1 minimum;

3. Hydraulic design

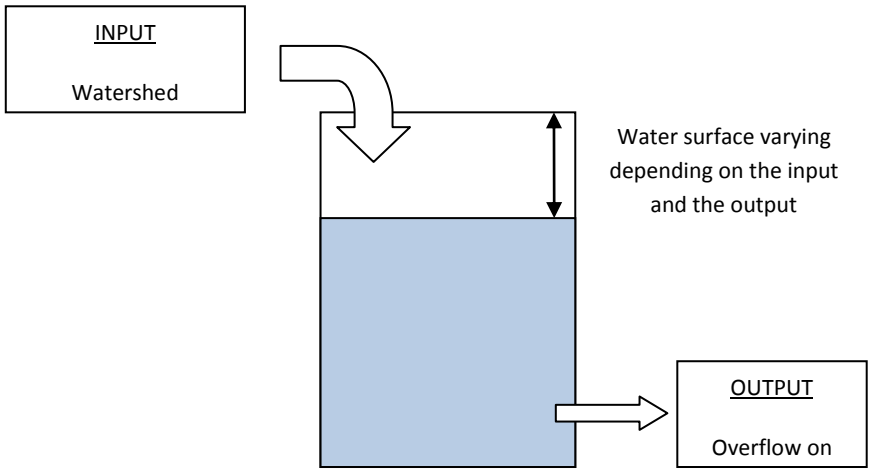
A spillway is planned for the Gudauri Lake. This structure will provide the project with the ability to release excess or flood water to ensure the safety of the lake.

This technical note aims to present the hydraulic design of spillway which includes a weir, an open channel spillway and a plunge pool energy dissipater (dissipation Trench).

a) Methodology

The weir is calculated for an extreme flood. According to French legislation, the choice of the return period to consider for the design depends on the maximum head and the volume of the dam. A freeboard (revenge) of 60 cm and a 1 000 year event are considered.

The structure is designed for a 1 000 year flood in the lake's watershed and a water surface in the lake at 2704.20 m (crest weir elevation). A model is built considering at the same time the flow coming for the watershed, the lake itself and the overflow in the weir. The schema model is the following:



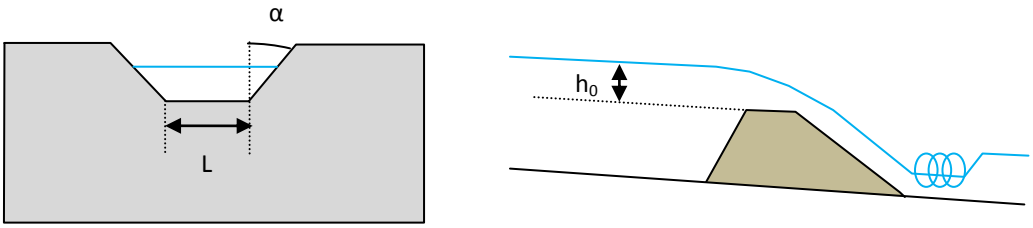
Schema of the model built for the design of the weir

b) Calculation of a 1000 year flood

The 1 000 year peak discharge of Gudauri basin is evaluated to 10.92 m^3/s with the rational method.

Guduari's watershed :		
Q10	Q100	Q1000
2.89 m^3/s	7.18 m^3/s	10.92 m^3/s

A trapezoidal weir is planned.



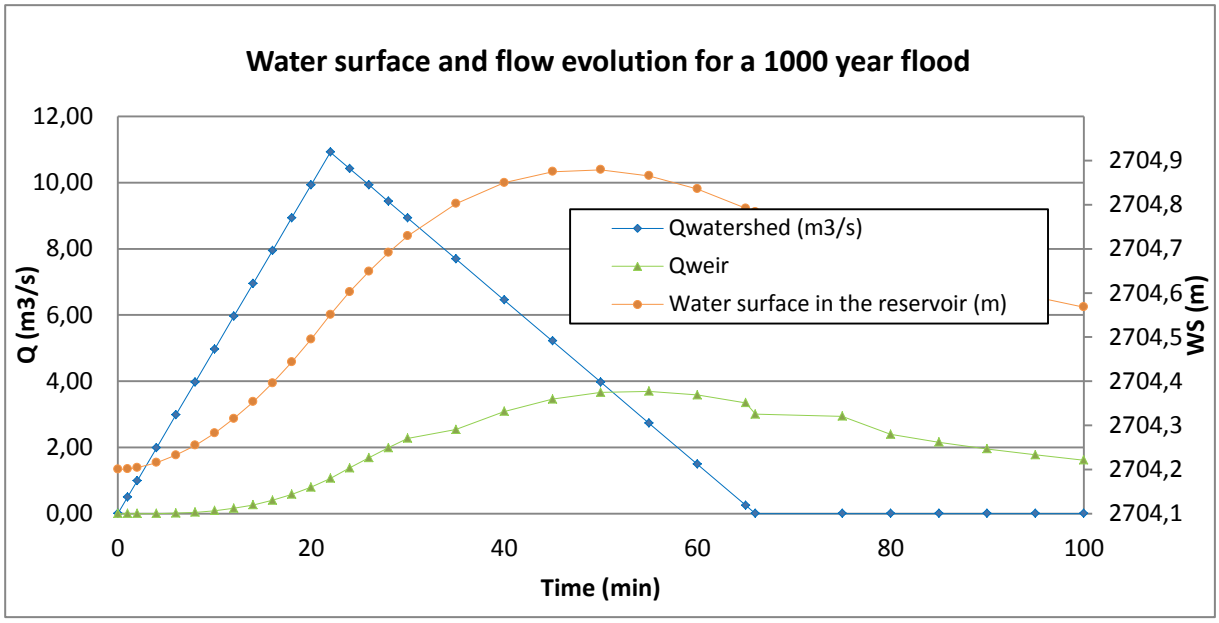
Weir schema

A multiplicative coefficient of 0.6 is added to compute the discharge over the weir to consider the roughness of the weir and the potential ice which can reduce the weir's efficiency.

c) Results

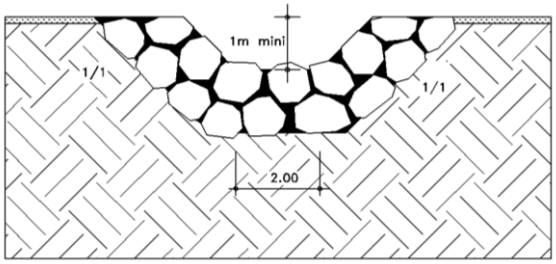
A Trapezoidal weir with a length of 6 m can evacuate a 1000 year flood. The head water on the weir is 0.68 m (highest water level at 2704.88 m).

The lake enables to reduce the peak of the flood of 60 percent: 3.70 m^3/s instead of 10.92 m^3/s.



The maximum storage in the lake is around 14 000 m^3.

d) Design of the open channel spillway



An open channel with the following size and a slope of 33 % is planned:

The capacity of this channel is estimated using the Manning-Strickler equation.

It appears that the capacity is higher than the flood over the weir in the 1000 year event case.

e) Design of an energy dissipater structure

At the end of the open channel spillway a plunge pools is planned as energy dissipater structure. This structure is necessary to avoid erosion downstream the open channel.

Before the structure, the channel area is widened to reduce the velocity flow.

4. Control unit

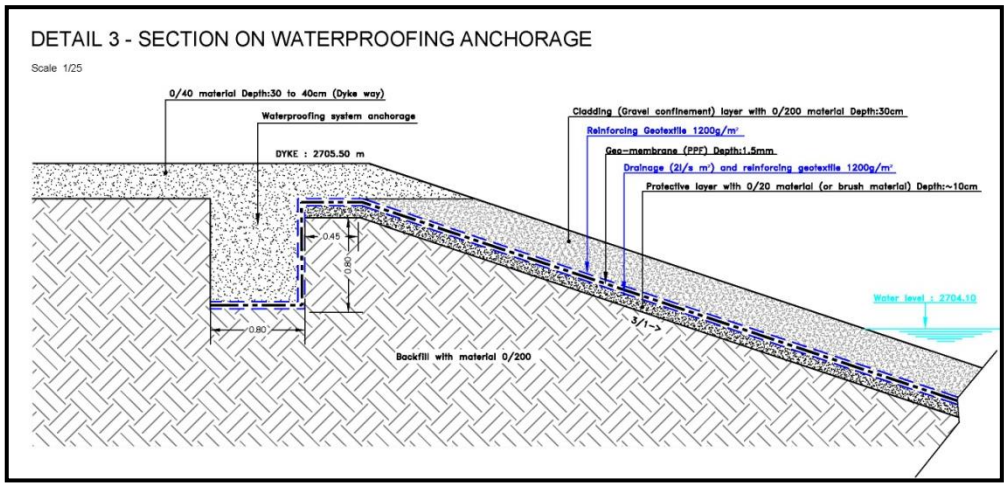
On a lake of this size, several elements of surveillance are necessary to assure the safety for the downstream but also the sustainability of the lake:

- Drainage trench at the bottom of the lake (3 for this lake, north, south and central) to collect water under waterproof system. These drainage trenches are returned to the pump station to be verified. This control permit to see possible leaks. This control must be collect also by an alarm if there a big quantity of water arrived on the pump station.
- Drainage layer under dyke, with 20/200 material, allows to assure the basis of the dike and to collect possible in-rushes of water.
- Monthly control of the weir overflow to be sure that there is no problem on it (ice, rocks, cracks…).
- To be sure there is no presence of water on the dike, the installation of piezometer is essential (position to be validated in working design).
- It's also necessary to have some topographic point all around the lake (on concrete block) to assure a control of the stability of the lake during the year.

Piezometer

5. Waterproofing system

The waterproofing system was dimensioned with the kind of material on the site, the possible presence of water and the slope of the bank.



The waterproofing system will include:

Waterproof system

- One protective layer (10 cm depth) with 0/20 material or with brush material on the site;
- One drainage (minimum of 1,00 l/s/m according to the French norm) and reinforcing geotextile 1200 gr/m²;
- One geo-membrane (PPF, flexible polypropylene) 1,5 mm depth;
- One reinforcing geotextile 1200 gr/m² to protect the geo-membrane;
- One cladding (gravel confinement) layer with 0/200 material (from excavated material, 30 cm to 40 cm;

This kind of waterproofing system allows an easy fixation on concrete works and assures a perfect waterproofness.

6. Volume of earthworks

The balance sheets of the earthworks of the project are:

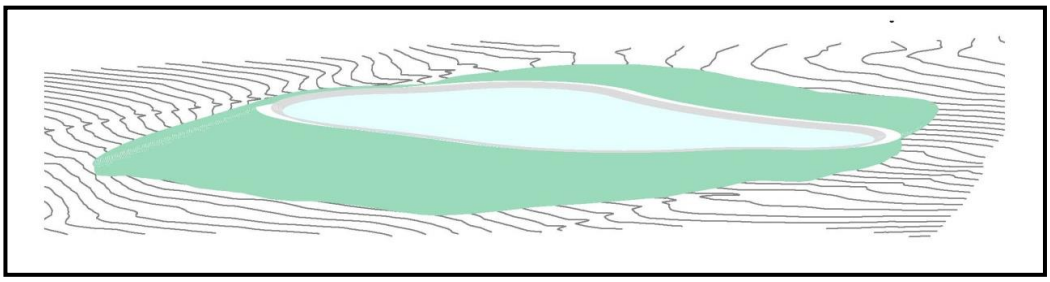
- Organic / grass soil, surface 5 hectares by 30 cm = 15 000 m³;
- Excavated material (without waterproofing system) = 107 800 m³;
- Excavated material for the waterproofing system = 10 000 m³;

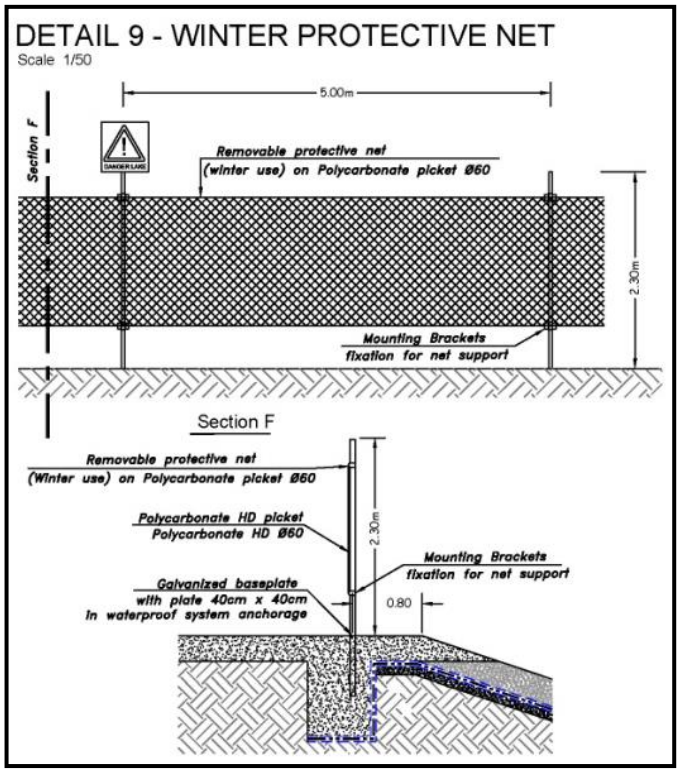
- Purge = 5 000 to 10 000 m³;
- Excavated material total (without purge) = 132 800 m³;
- Backfill material (without drainage) = 124 300 m³;
- Backfill material for drainage = approximately 10 000 m³;

The Gudauri site project allows re-using a maximum of the excavated material for the technical compacted fill of the dyke with 0/200 material.

7. Environment (insertion)

The setting-up of the lake was thought so as to become integrated as much as possible into the environment of the existing site (with the existing pathway, the ski slope, the natural flood water …).





In winter period we suggest setting up a protective net to forbid the skiers to come down (to fall down!) in the lake and to indicate it in case of bad weather

Winter protective net

The existing site is provided with a lot of quantities of organic/grass soil and will allow a backfill on all the banks, allowing better one regreening by the local vegetation.

The carbon balance of this lake will be better than another lake with poor material because in this site we can re-use a lot of material instead of bringing it from the valley.

8. Economical quote

The estimated price of building the Gudauri lake without working design studies, supervising of work and snowmaking pump station are approximately 2 500 000 €.

This price can be decomposed by kind of works:

- General earthworks = 950 000 €;
- Waterproofing system = 950 000 €;
- Networks (under dyke, emptying, snow networks, drainage, water supply …) = 300 000 €;
- Concrete works (snow and emptying works at the bottom of the lake, concrete manhole, drainage, overflow, spillway …) = 150 000 €;
- Surface treatment, net and fence = 150 000 €;

These prices were calculated on valuable French bases and can be adapted we Georgian company.

9. General schedule

The delivery time for the building of a lake such as 100 000 m^3 can be defined by:

- General earthworks = 4 month;
- Waterproofing system = 3 month;
- Networks = 1 month;
- Concrete works (overflow, drainage works …) = 1,5 month;
- Surface treatment = 1 month;
- Filling up = 2 month

This schedule (1 year), can be reduce if you superpose works or by anticipating a maximum of works and by defining exactly each link between works (networks and pump station, earthworks and waterproofing system …).

10. Particular point to validate in working design

After the realization of the Gudauri lake project, several points are to validate and to defined in working design (execution phase):

- Kind of networks (concrete, welded steel, coast iron…) for the emptying from the pump station.
- Dimensioning of the emptying networks from the pump station.
- Concrete manhole dimensions.
- Calculation (validation) of the water channel of the networks.
- Dimensioning of the waterproofing system anchorage (depending on the membrane and geotextile).
- Characteristics of the waterproofing system.
- Layout of the pump station (according to the networks).
- Dimensioning of the pump station (size, interior design).
- Dimensioning of the vehicle bridge under the weir.
- Setting up the winter protective net or wood barrier.
- Evacuation of the drainage trench.
- Covering networks (1, 5 meter minimum!).
- Protection against erosion in case of water.
- Possible purge under the dyke to the rocks.
- Draining mask under waterproof system in case of water presence.

Possible pump station

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GUDAURI WORKING PLANNING - YEAR 2015

	MAY					JUNE					JULY				AUGUST				SEPTEMBER				OCTOBER					NOVEMBER				DECEMBER				
	Weeks																																		
Works	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
Working Design																																				
Excavated grass soil																																				
General earthwork																																				
Link between lake and pump station																																				
Drainage																																				
Flood overflow (and spillway)																																				
Concrete works																																				
Water supply (alimentation)																																				
Waterproofing system (with confinement)																																				
Lake emptying																																				
Finishes																																				
Winter protective net																																				
lake filling up																																				

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EARTHWORK VOLUMES - GUDAURI

Excavated material			Backfill material	
Organic / grass soil	15 500,00		Draining Layer (under the dyke)	16 600,00
Gravel in crushed stone	31 900,00		Draining mask (in case of water)	3 680,00
Rocks	89 600,00		Dyke construction	107 750,00
Possible purge (under the dyke)	35 000,00		Dyke construction (if purge)	35 000,00
Flood overflow	1 500,00		Protective layer (0/20)	2 450,00
Link between lake and pump station	1 750,00		Cladding layer (0/200)	8 550,00
Adaptation for balancing material	10 305,00		Dyke way (0/40)	1 500,00
			Draining material (in case of water)	500,00
			Weir and spillway rocks	1 075,00
			Rocks for protection	350,00
			Organic / grass soil	7 500,00
			Covering networks	600,00
TOTAL =	**185 555,00**		**TOTAL =**	**185 555,00**

EARTHWORK VOLUMES MOVEMENT - GUDAURI

Organic / grass soil (30 cm)	15 500,00	→	Organic / grass soil	7 500,00
			Dyke construction (not technical)	8 000,00
			Total =	15 500,00
Gravel in crushed stone	31 900,00	→	Dyke construction (not technical)	27 350,00
			Dyke way	1 500,00
			Covering networks	600,00
			Protective layer	2 450,00
			Total =	31 900,00
Rocks	89 600,00	→	Draining layer	16 600,00
			Draining mask	3 680,00
			Cladding layer	8 550,00
			Draining material (in case of water)	500,00
			Weir and spillway rocks	1 075,00
			Rocks for protection	350,00
			Dyke construction (technical)	58 845,00
			Total =	89 600,00
Purge (Gravel in crushed stone)	35 000,00	→	Dyke construction (after purge)	35 000,00
			Total =	35 000,00
Flood overflow (weir - spillway)	1 500,00	→	Dyke construction (technical)	1 500,00
			Total =	1 500,00
Link between lake and pump station (rocks)	1 750,00	→	Dyke construction (tecnical)	1 750,00
			Total =	1 750,00
Adaptation for balancing material (Rocks) - Minimum	10 305,00	→	Dyke construction (technical)	10 305,00
			Total =	10 305,00
TOTAL =	**185 555,00**		**TOTAL =**	**185 555,00**