



Defense against erosion and Torrens

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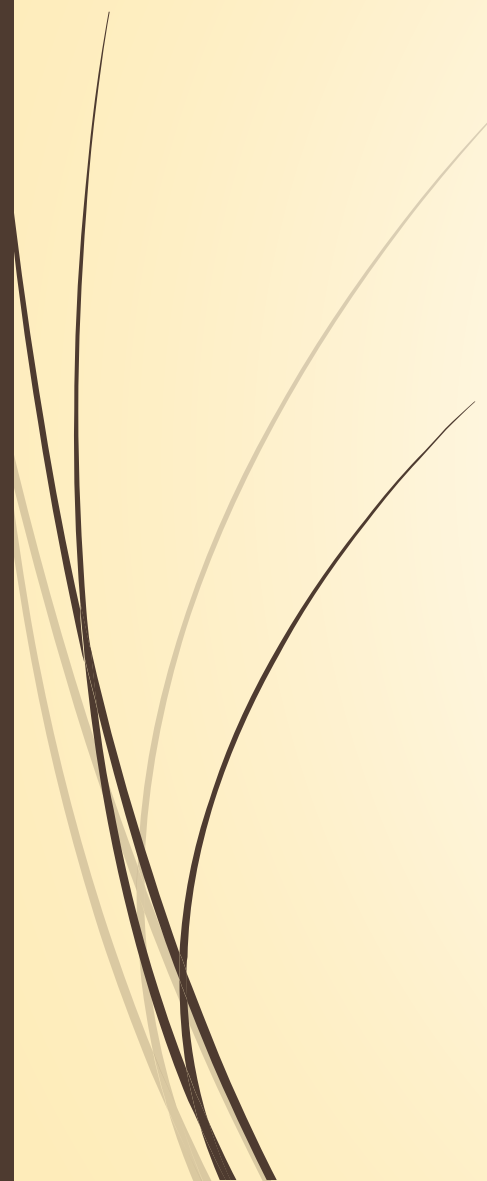
Defense against erosion and Torrens

- ▶ The discipline is included in the curriculum of the specialty Forestry, Bachelor's degree.
- ▶ It is studied in the 6th semester for regular education and the 7th semester for the external degree.
- ▶ The type, of course, is required.

Bachelor's degree	Auditory activity	Extracurricular activity	ESTC
Regular education	3	3.5	6,5
External degree	1.5	5	6,5



Lectures.

- ▶ Erosion;
 - ▶ Torrents;
 - ▶ Hydraulics;
 - ▶ Protective Activities;
 - ▶ Other Denudation Processes.
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Lecture. Erosion.

- ▶ Nature of erosion;
- ▶ Types of erosion;
- ▶ Stages in developing erosional relief forms;
- ▶ Influence of climate, relief, soils, vegetation, and anthropogenic activity on erosion;
- ▶ Methods for determining the degree of land degradation.



Lecture. Torrents.

- ▶ Parts of a torrent catchment and their characteristics;
- ▶ Hydrographic system;
- ▶ Determining the maximum water outflow;
- ▶ Movement and deposition of sediments.



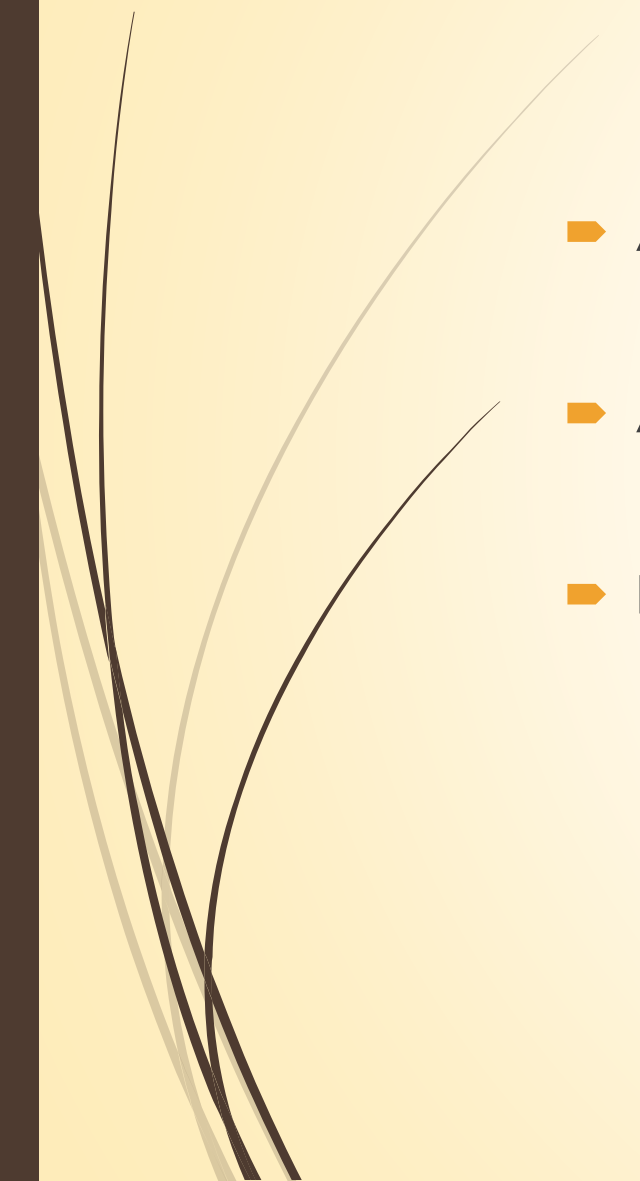
Lecture. Hydraulics.

- ▶ Hydrostatics;
- ▶ Hydrodynamics.





Lecture. Protection activities.

- ▶ Anti-erosion activities in agricultural lands;
 - ▶ Anti-erosion afforestation in torrential water catchment;
 - ▶ Hydro-ameliorative activities.
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Lecture. Other denudation processes.



Land collapses



Landslides



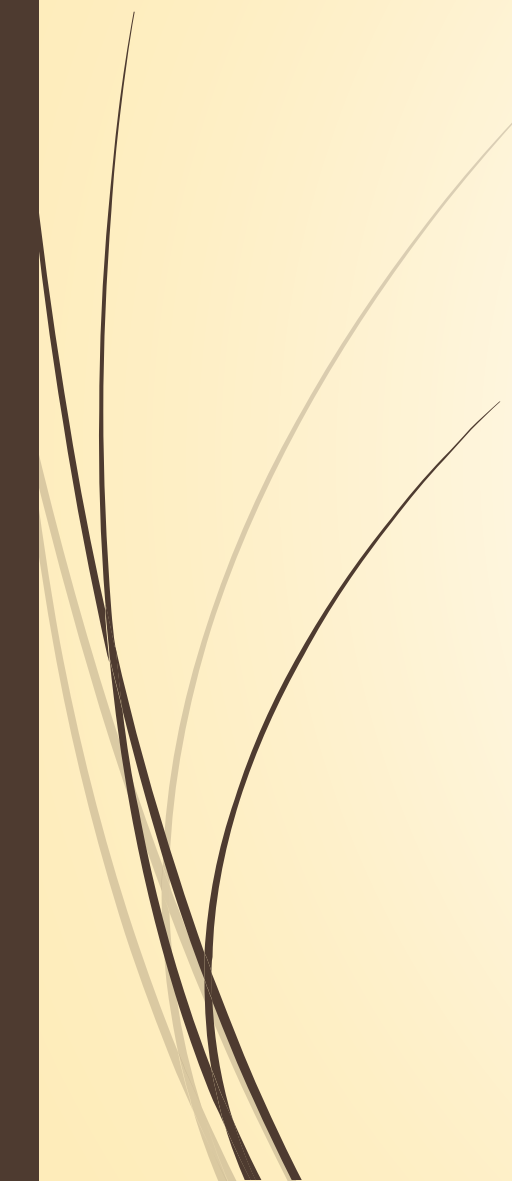
Avalanches;




Deflation.



Practices. Erosion and Floods.

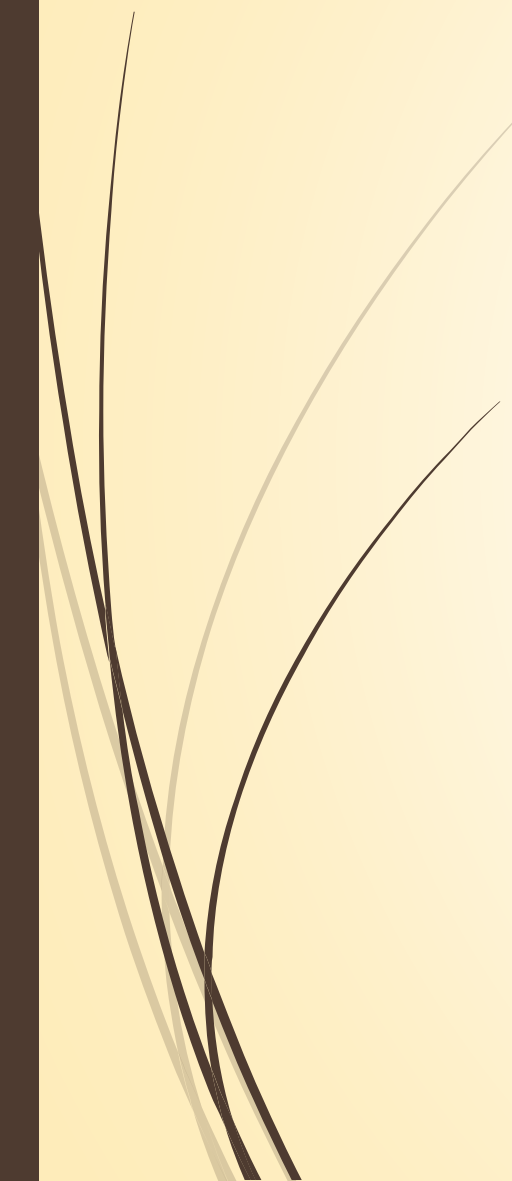
- ▶ The first topic is Remote Erosion Research. Here the erosional relief forms are considered, and the lands are categorized and mapped based on the type of land cover and the extent of erosion.
 - ▶ The second topic is a torrential water catchment. Its boundaries are determined, and geometric and physiographic characteristics are made.
 - ▶ The last topic of this part is the hydrographic system. Here a longitudinal profile of the mainstream is prepared, and the density of the hydrographic system is determined.
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Practices. Hydraulics.

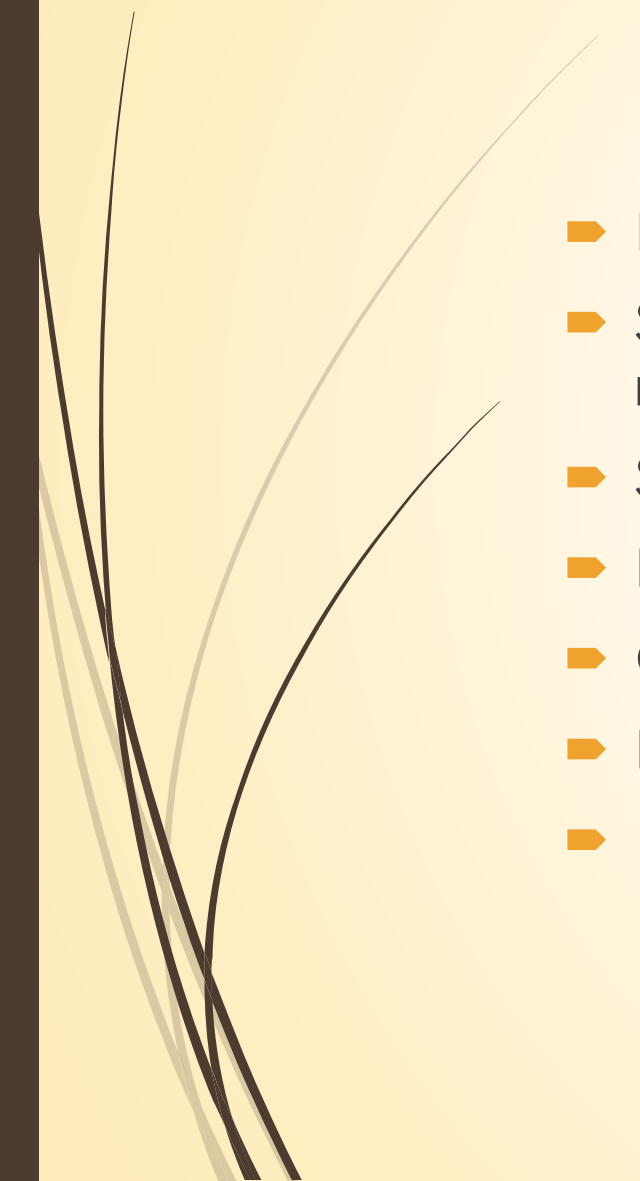
- ▶ Practical problems of hydrostatics and hydrodynamics are solved.

Practices. Projects of facilities.

- ▶ Concerns strengthening the sloping lands and the hydrographic system through terracing and small cross-sectional facilities.
 - ▶ Strengthening the hydrographic system through large-scale transverse fortifications. The rectilinear and curvilinear barrage projects.
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Field practice.

- ▶ Restoration of forest vegetation in flooded terrains;
 - ▶ Strengthening the hydrographic system through transverse facilities - retaining and reinforcing barrages;
 - ▶ Stabilization of landslides through fortification systems.
 - ▶ Land collapses. Protection activities;
 - ▶ Corrective forest belts;
 - ▶ Denudation processes in undermining terrains;
 - ▶ Modern constructions of reinforced concrete barrages;
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Torrential catchment management

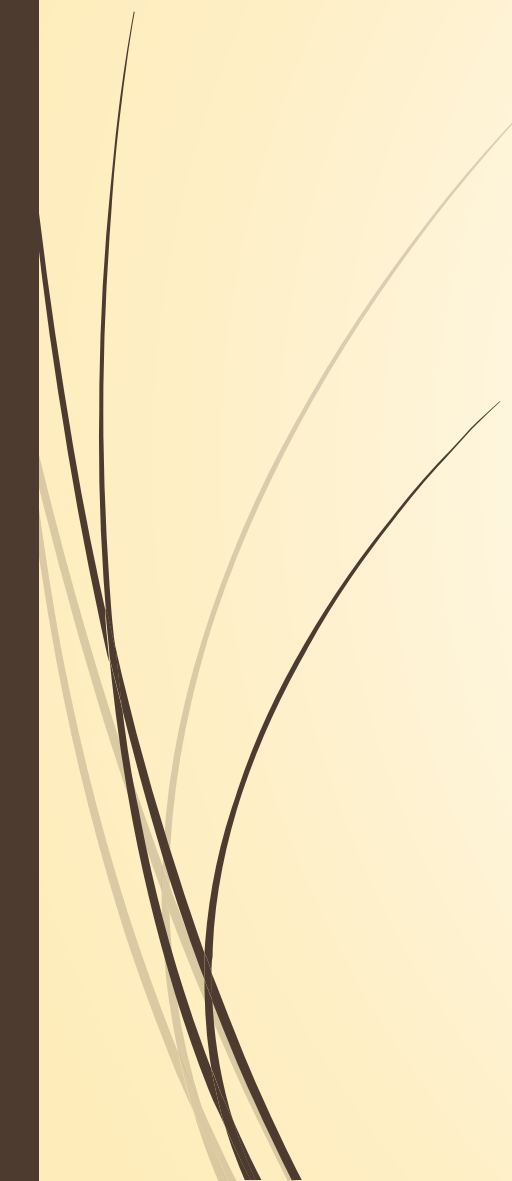
Torrential catchment management.

- The course is included in the specialty Forestry ACS - Master degree.
- The course is an elective for the specialty of Forest Management.
- It is learned in the second semester.

Master degree	Auditory activity	Extracurriculum activity	ESTC
Regular education	2	4	6
External degree	1	5	6



Course aim

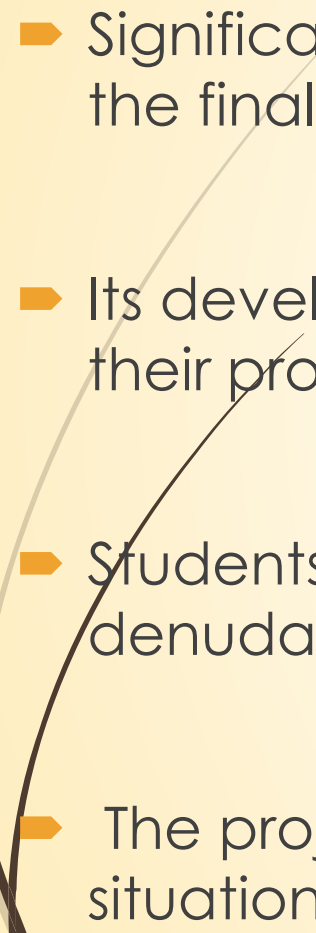
- ▶ The course aims to the broad management principles of torrential water catchment. The following main tasks are solved to achieve it:
 - ▶ - Study the conditions determining the danger of erosion and torrents;
 - ▶ - Determining the state of the lands;
 - ▶ - Analysis of the implemented protective measures and the need to implement new ones;
 - ▶ - Design of additional protective facilities.
 - ▶ The aim is to develop a project for protective activities in torrential water catchments. Teaching methods include lectures, exercises, and seminars. The assessment is performed based on current control, course project, and a written exam.
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Lecture.

- ▶ The problem of the correct regulation of torrential water catchments,
- ▶ The history of the anti-erosion activity in Bulgaria, and the main provisions set in the current legislation are considered.
- ▶ Characterization of the areas threatened by erosion is based on the course's main prerequisites: climate, relief, soils, and vegetation.
- ▶ The catchment area as a geographical unit for anti-erosion activities.
- ▶ The specifics of the denudation processes' manifestation in the torrential water catchment in separate parts are studied.
- ▶ The influence of the types of sloping lands on the image of erosion, depending on their use, is considered.
- ▶ The condition of the hydrographic system is analyzed, and the areas to be strengthened are determined. Priority areas for the design of hydraulic facilities are selected.
- ▶ The effectiveness of the events is assessed.



Practices.

- Significant weight is given to the preparation of the course project when the final grade for the course is formed.
 - Its development requires in-depth knowledge of the discipline and skills for their proper application in practice.
 - Students can choose a concrete water catchment where active denudation processes are available.
 - The project contains a complete description, analysis of the actual situation, and project proposals.
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Practices. Complete description

- ▶ Includes location, boundaries, climate, geological structure, petrographic composition, relief, and vegetation. Maps of every component are prepared. The catchment is mapped based on the degree of soil erosion and vegetation type.

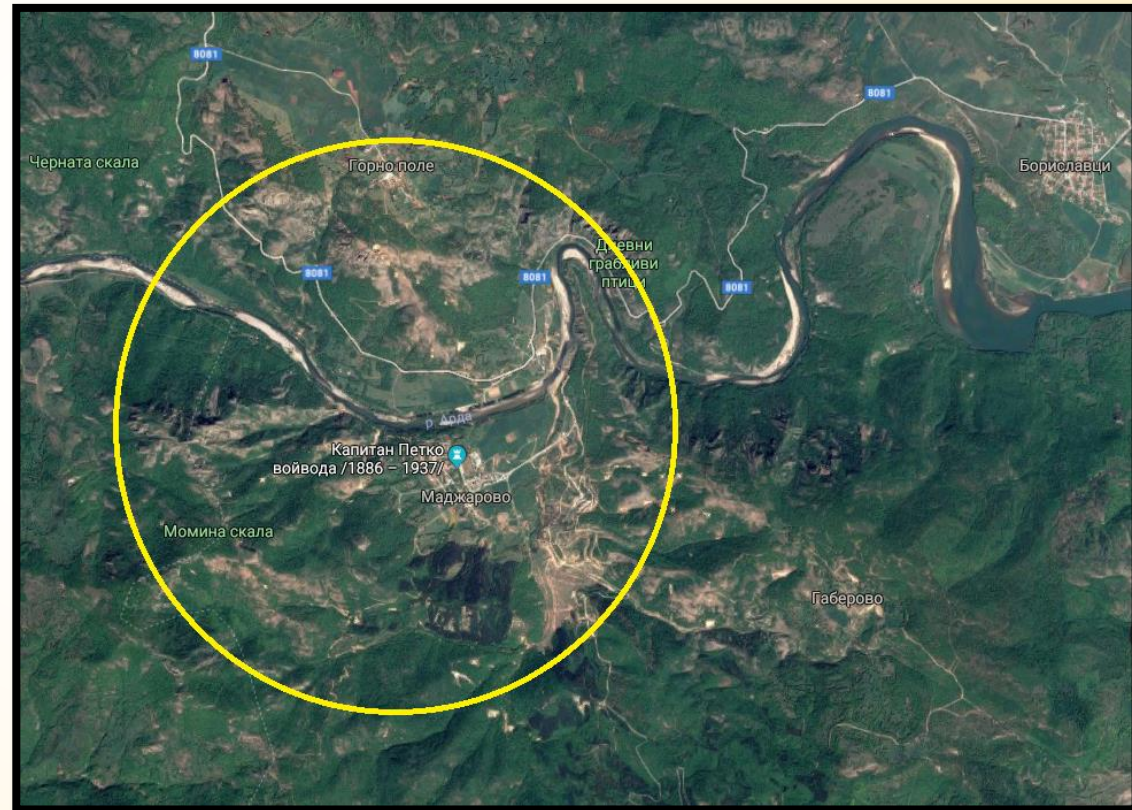
Practices. Analysis of the actual situation

- ▶ It analyzes the, and hydro-ameliorative measures carried out in the water catchment. The necessity of design of new ones is argued.

Practices. Project proposals

- ▶ a longitudinal profile of proposals for strengthening the section is made. The condition and a recommendation for the design of hydro facilities are completed

Thesis Design of anti-erosion activities on the territory of the Madjarovo Caldera





Prerequisite for erosion.

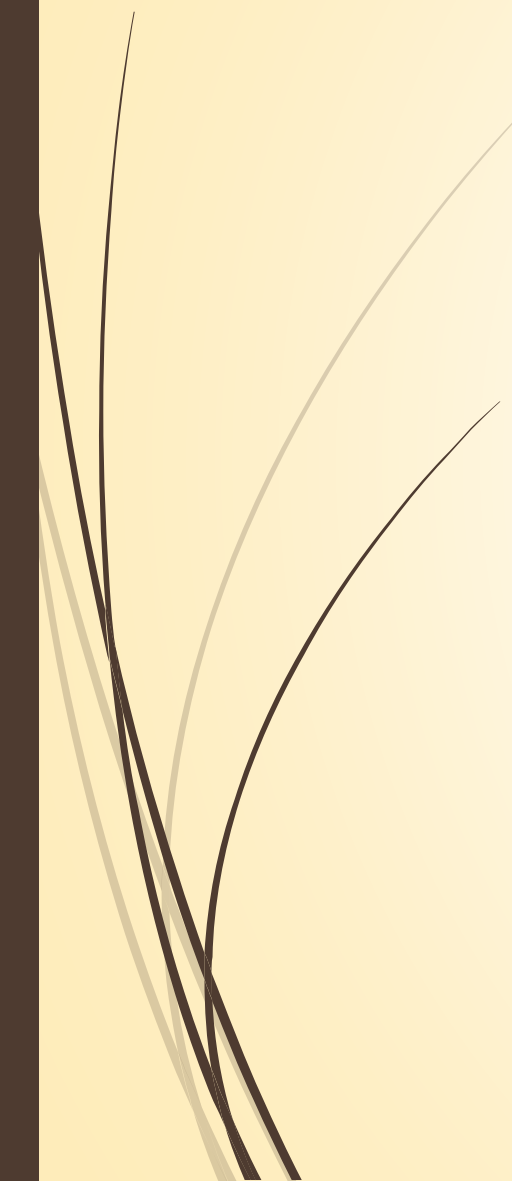
A significant prerequisite for erosion in the area is the combination of the:

- climatic regime;
- characteristics of the lithologic base]
- the action in the past mining activity.

Arda river's catchment area is among the most severely affected by denudation in Bulgaria. The scientific interest in the partial catchments of the river is provoked by the three major dams along its stream - Kardzhali, Studen Kladenets, and Ivaylovgrad.

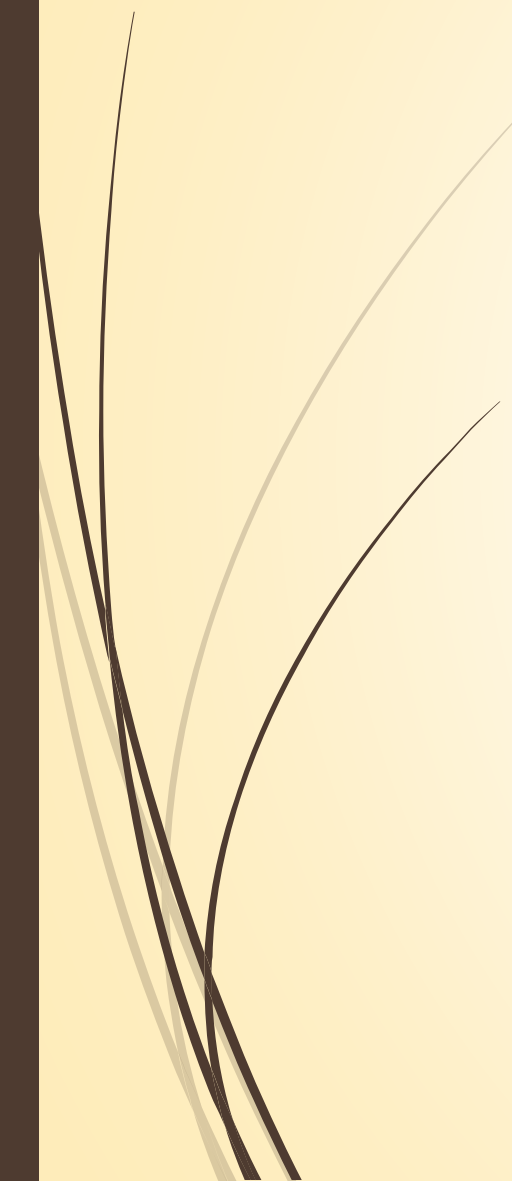


Methodology.

- ▶ The area of the Madzharovo caldera is 676.7 ha. The territory is divided into 158 parts. Their site is from 0.5 to 25 ha. According to data from the Forestry Land Management Project of Madzharovo, the information on each of them was obtained for the type of land cover, the relief elements (slope, exposition, altitude), occupied part of the slope, and the condition of the soil, and the type of vegetation.
 - ▶ The main task in developing the methodology was the correct selection of representative sections for the study. The categorization of land by type of land cover and extent of erosion was carried out.
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The categorization of land by type of land cover

- ▶ rocky landscapes with bare surfaces above 50 %;
 - ▶ forestry landscapes which are covered with forest vegetation over 30 %;
 - ▶ anthropogenic landscapes.
- 



Extent of erosion


- ▶ slight erosion with plant coverage over 71 %;
 - ▶ average erosion with plant coverage between 51 - 70 %;
 - ▶ severe erosion with plant coverage between 31 - 50 %.
 - ▶ extreme erosion with plant coverage below 30 %.
- 



Lands categorization



- ▶ rocky landscapes with extreme erosion;
- ▶ forestry landscapes with low erosion;
- ▶ anthropogenic landscapes with extreme erosion.

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- Characterization of soils, relief and vegetation in the affected catchments has been made.
 - The object of the study is the water catchments of two actively growing gullies located in anthropogenic landscapes with extreme erosion. Both water catchments belong to the category of very harmful torrents.
 - **Gully "The Ditch"** threatens to destroy a second-class road, which is the shortest distance between the town of Madzharovo and the western village of Bryagovets (about 6 km). The bypass route, located north of the Arda River, extends the road by more than 30 km. The section is vital given the shortest distance to the town of Krumovgrad.
 - Below the water catchment **"Acacia"** is a production workshop threatened by flooding and backfilling with sediments carried by water currents.

Characteristic of the water catchments

- ▶ The water catchments of Ditch and Acacia are located in the territory of the Madzharovo volcanogenic dome morphological structure.
- ▶ Their area is 80.7 ha and 34.7 ha, respectively.
- ▶ The forest cover is 74 % and 93 %.
- ▶ The areas with a tilt between 45-65 % in the Acacia and those over 65 % in the Ditch predominate.
- ▶ The forest vegetation in the water catchments has a low site index but has a significant role in reducing erosion.
- ▶ Held mass anti-erosion activities, which began in the 60s of the last century, had a positive for reducing erosion. The crops are mainly from *Quercus frainetto* Ten., *Quercus cerris* L., and *Quercus pubescens* Willd.

Gully "The Ditch"



Gully "Acacia"



The intensity of erosion in The Ditch gully

Number of benchmarks	Month/year					Total for the period, m
	04/2018	06/2018	10/2018	04/2019	10/2019	
	Distance (m) from the edge of the gully to benchmark in the Ditch object					
1	1.05	1.05	1.05	0.87	0.87	0.18
2	1.95	1.95	1.95	1.73	1.73	0.22
3	<u>1.00</u>	<u>1.00</u>	<u>1.00</u>	<u>0.93</u>	<u>0.93</u>	<u>0.07</u>
4	1.00	1.00	1.00	0.90	0.90	0.10
5	1.50	1.40	1.40	1.30	1.30	0.20
6	1.50	1.50	1.50	0.92	0.92	0.58
7	<u>2.85</u>	<u>2.85</u>	<u>2.75</u>	-	-	<u>2.85</u>
8	2.05	1.95	0.95	-	-	2.05
9	2.05	1.95	0.95	0.95	0.92	1.13
10	1.00	1.00	1.00	0.90	0.90	0.10

	Distance (m) from the edge of the gully to benchmark (m) in the Acacia object					
1	0.50	0.46	0.30	-	-	0.50
2	1.50	1.30	1.09	1.02	0.97	0.53
3	<u>1.50</u>	<u>1.44</u>	<u>1.37</u>	<u>1.37</u>	<u>1.35</u>	<u>0.15</u>
4	1.50	1.48	1.48	1.04	0.98	0.52
5	0.00	0.00	0.00	0.00	0.00	0.00
6	1.50	1.47	1.36	1.34	1.26	0.24
7	<u>1.50</u>	<u>1.45</u>	<u>1.33</u>	<u>0.65</u>	<u>0.34</u>	<u>1.16</u>
8	1.50	1.50	1.45	1.41	1.31	0.19

Condition of the protective facilities in the Ditch gully .



Condition of the protective facilities in the Ditch gully .

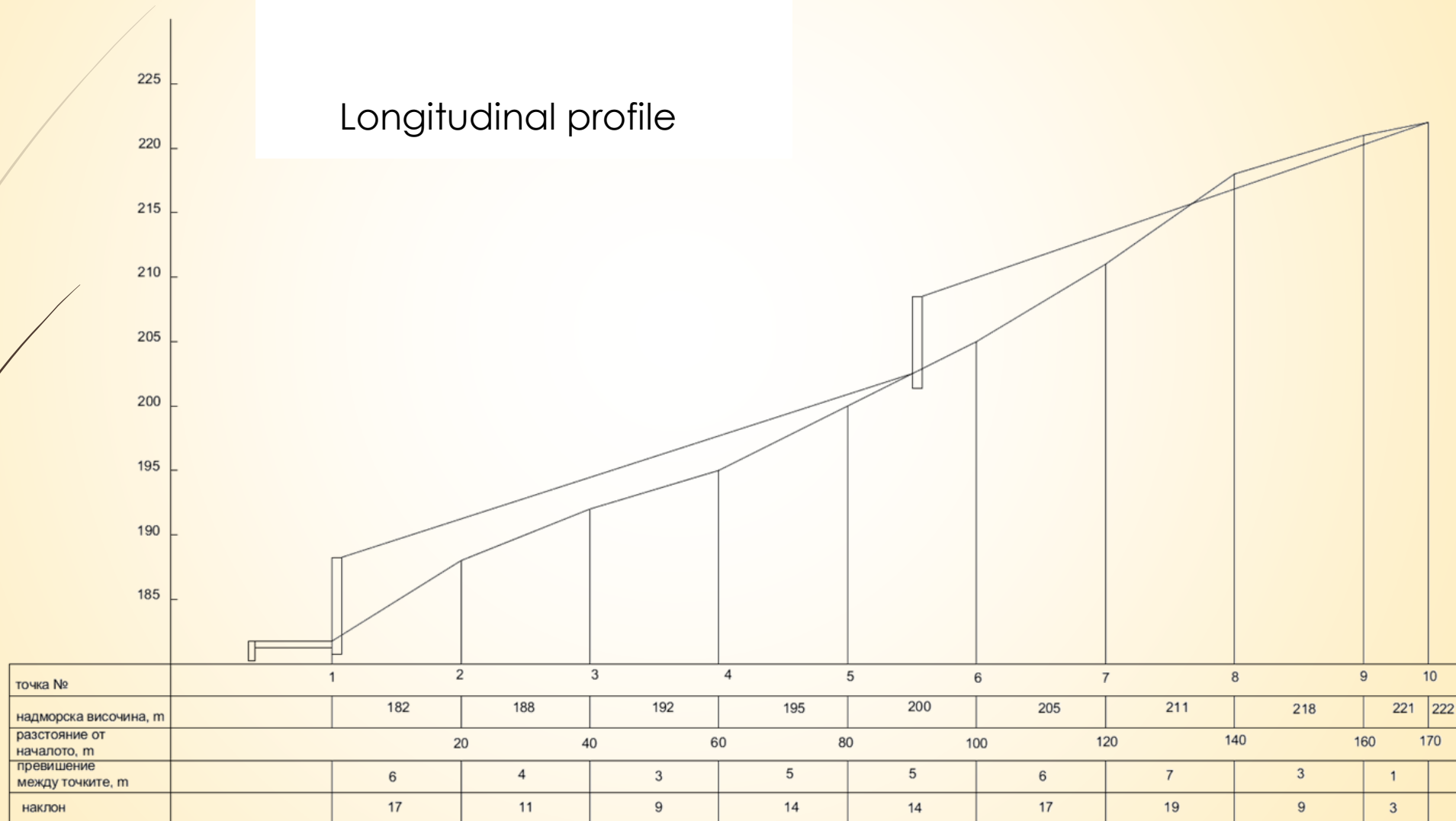


Project for protective facilities

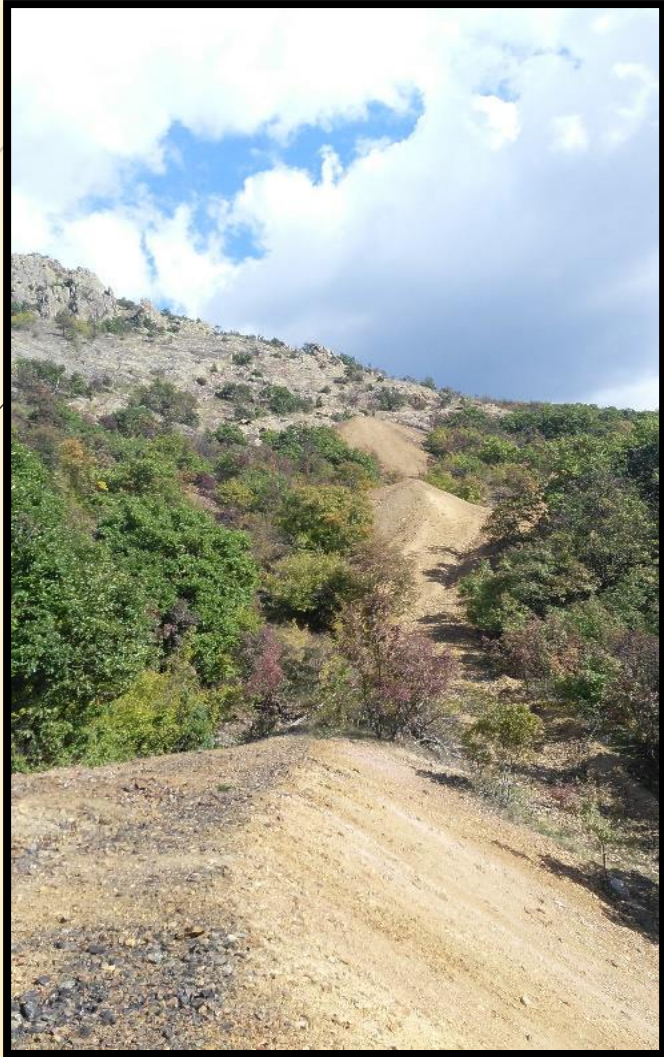


Project for protective facilities.

Longitudinal profile



Condition of the Gully Acacia.





Thanks for your attention