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Report on identification of the volume of sedimentation at the Ruslovoye reservoir of the Tuyamuyun hydro complex

Ministry of Water Resources of the Republic of Uzbekistan
Scientific and Research Institute of Irrigation and Water Problems

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Introduction

The Tuyamuyun Hydro Complex (THC) is located on the boundary between the Amudarya midstream and downstream; its primary purpose is to:

- Regulate seasonal flow of the Amudarya waters for the benefits of all water users in the river downstream including agriculture, municipal and industrial use;
- Provide guaranteed withdrawal of water into irrigation systems and reduce sediment load carried into the right bank and the left bank canals during water withdrawal;
- Store low-mineralized water in the Kaparas reservoir for its subsequent use to meet needs of the downstream population in drinking water.

The THC includes the Channel reservoir and three off-stream reservoirs, i.e. the Kaparas, the Sultansanjar and the Koshbulak reservoirs. Over 40 years of the THC reservoirs operation their design parameters have changed substantially. The quantity of sediments in the Channel reservoir has exceeded the design values. The live storage capacity of the Koshbulak reservoir has been lost because of occurrence of landslides in the connecting canal. Some losses of the Koshbulak + Sultansanjar live storage capacity have been due to seepage of the Sultansanjar reservoir dam; therefore, the design water volume cannot be stored in the reservoir basins. The Kaparas reservoir is primarily used for storing high quality water for drinking purposes, thus imposing certain restrictions on the control regime of all reservoirs. The need to fill the Kaparas reservoir during the water stress period (July-August), especially, in the years with low water, combined with insufficient throughput capacity of the Sultansanjar spillway system, drastically reduces the possibilities for meeting the needs of the downstream in irrigation water.

Besides, there are losses of water from the reservoirs by seepage and evaporation amounting to 1,100 mln m^3/year when the reservoirs are full.

For this reason, especially, during the dry years, the main task of the upstream regulation of the THC reservoirs is to use existing storage capacity for accumulating water resources to the maximum extent possible and allocate these resources efficiently and in proportions during the water stress periods.

On the proposal of the Ministry of Water Resources of the Republic of Uzbekistan (MWR) and the Turkmenistan State Committee for Water Resources (SCWR), at the first meeting of the Regional Steering Committee held on October 27, 2020, the Tuyamuyun Hydro Complex was selected as a demonstration project under the EU project on Central Asian Dialogue to Promote Intersectoral Water-Energy-Food Financing (Phase II).[1] The task of the demonstration project was to estimate sediment build-up in the THC Channel reservoir that led to losses of its live storage capacity. Sediment build-up in the THC Channel reservoir reduces operational capacity of the off-

[1] The EU supports to promote intersectoral Water-Energy-Food in Central Asia (carececo.org)

stream reservoirs (Sultansanjar, Koshbulak and Kaparas) to meet irrigation needs of Uzbekistan and Turkmenistan.

Project objective: to conduct depth measurements and estimate sediment volumes in the THC Channel reservoir, prepare forecast estimates of silting and develop recommendations for optimizing reservoir operation modes with the aim of reducing sediment volumes with application of innovation solutions relating to utilization of removed sediments.

1. Technical performance of the THC reservoirs

The Tuyamuyun Hydro Complex (THC) is located on the boundary between the midstream and the downstream of the Amudarya river in the Tuyamuyun narrow gorge 450 km from the Aral Sea at a tripoint where the borders of Karakalpakstan, Bukhara (Uzbekistan) and Daşoguz (Turkmenistan) meet. The THC main functions are to:

- Regulate seasonal flow of the Amudarya waters for the benefits of all water users in the river downstream including agriculture, municipal and industrial use;
- Provide guaranteed withdrawal of water into irrigation systems and reduce sediment load carried into the right bank and the left bank canals during water withdrawal;
- Store low-mineralized water in the Kaparas reservoir for its subsequent use to meet needs of the downstream population in drinking water.

The THC includes the Channel reservoir and three off-stream reservoirs, i.e. the Kaparas, the Sultansanjar and the Koshbulak reservoirs; their main performance characteristics are provided in Table 1 (Figure 1).

Table 1. Main design characteristics of the THC reservoirs

Characteristics	Unit	Channel reservoir	Kaparas	Sultansanjar	Koshbulak	Total
Water surface area at the normal water surface elevation (NWE)	km^2	303	70	149	128	650
Normal water surface elevation	m	130	130	130	130	130
Dead storage elevation (DSE)	m	120	120	116	120	
Length	km	102	15	24	26	167
Width: maximum	km	11	9	12	11	
mean	km	4	4	8	6	
Depth at the NWE level: mean	m	7,7	13,7	18	14,2	
maximum	m	20	36	38	41	
Depth at the DSE: maximum	m	10	26	28	31	
mean	m	2,8	9,3	10,8	12,7	
Area of shallow waters 2 m deep at the NWE	km^2	93	6	10	7	116
At the dead storage level	km^2	59	4	2	9	74
Reservoir's design life (period after which the live storage capacity of the reservoir will be completely depleted by silting)	year	35-40	100	More than 100		

Figure 1. Schematic plan of the THC structures

The THC complex includes:

1. A concrete spillway dam which is 141 m long. It has nine spans including eight spans with bottom openings and one span with a surface spillway;
2. Earth dam;
3. HPP with capacity of 150,000 kW (six 25,000 kW units) and mean power generation of 480 million kWh;
4. Left bank water diversion facility and the main canal with a capacity of up to 500 m^3/s;
5. Right bank water diversion facility and the main canal with a capacity of up to 200 m^3/s;
6. Sluice with an inverted siphon on the left bank main canal with a capacity of 500 m^3/s;
7. Water diversion facility for filling and drawing down the Sultansanjar reservoir with a discharge rate of 500 m^3/s;
8. Canal for filling and drawing down the Sultansanjar reservoir with a discharge rate of 200 m^3/s;
9. Water diversion facility of clarified water from the Sultansanjar reservoir with a discharge rate of 250 m^3/s;
10. Canal of clarified water from the Sultansanjar reservoir with a discharge rate of 100 m^3/s;

11. Canal for filling and drawing down the Koshbulak reservoir with a discharge rate of 100 m^3/s;
12. Water diversion facility for filling and drawing down the Kaparas reservoir with a discharge rate of up to 400 m^3/s;

All four reservoirs of the hydro complex are interconnected. The Channel reservoir interacts with the Kaparas reservoir via a weir whereas the Sultansanjar reservoir and the Koshbulak reservoirs are interconnected via a specially built canal.

The water flow regulation facilities have been built in such a way that the Channel reservoir and the Kaparas reservoir are filled and emptied independently of each other. Completely empty reservoir basins are filled based on water surface elevations in the following way (according to the technical design documentation):

- Filling of the Channel reservoir begins when the backwater level in the Amudarya stream rises to and above a height of 114 m;
- Water overflows from the Channel reservoir into the Kaparas reservoir across the weir when backwater level rises to and above 117 m;
- Overflow into the Sultansanjar reservoir from a branch at the tail end of the Channel reservoir begins to occur when water rises to a height of 115 m (with shields open);
- Overflow from the Sultansanjar reservoir into the Koshbulak reservoir begins to occur through the entry throat of the Koshbulak area when water rises to a height of 120 m.

The extent to which the reservoirs have been filled and drawn down is recorded by water gages located upstream in front of the Channel reservoir dam, behind the water diversion facilities in the Kaparas and Sultansanjar reservoirs. Water heights in Koshbulak are assumed to be the same as water heights in Sultansanjar.

2. Estimation of sediment volumes in the Channel reservoir

2.1 Tasks and methods of bathymetric surveys

The tasks of field surveys of the Channel reservoir silting included the following:

- To quantify sediments accumulated over all years of its operation upon its commissioning;
- To clarify distribution of the accumulated sediments along the length of the reservoir basin and its elevations;
- To identify impact of sediment load on main performance characteristic of the reservoir, i.e. the elevation-storage curve.

The methodology of field surveys is based on estimation of sediment load by subtracting the volume of water in the reservoir basin at the time of the surveys from the design volume. Volumes have been calculated based on depth soundings taken from a launch/motor boat moving along specially selected and fixed cross sections, with the position of the launch/motor on the reservoir fixed when soundings of depth are taken with position finding by a Garmin/eTrex Vista GPS navigator. The total number of cross sections is 62. They are positioned along the entire length of the Channel reservoir which is 82.49 km long and that is close to the length of the backwater held back by the THC dam.

Given that some cross sections are not parallel to each other in the plan and taking into account local bends of the designed configuration of the reservoir basin, an adjustment coefficient–K=1.07 – was introduced.

When sounding data were processed to determine the areas at the cross-sectional sites, special tables (Annex 1, Annex 2, Annex 4 and Annex 5) were prepared based on depth pre-calculated for the cross-sections.

In 2021 the depth soundings of the THC Channel reservoir were taken from June 14 to June 24 at an elevation of 123,8 m near the dam (on the Turkmenistan side) and from August 5 to August 15 at an elevation of 124,1 m near the dam (on the Uzbekistan side).

The water discharge flowing into the reservoir basin varied from Q=243 m^3/s to Q=361 m^3/s, according to the inflow reference station Darganat.

The sounding results include:

- Boat location identification when soundings of depth are taken as the boat moves along the cross-sections with geo-referenced data (Annex 3 and Annex 5).

- Water depth notes in the equipment monitors measured by soundings with the use of a SONTEC S5 river surveyor (acoustic doppler-profile recorder) (Figure 2) and an HD-MAX echo sounder (Figure 3);
- Level notes on the reservoir rim and the dry area of the reservoir basin with references to the vertical control survey networks by a LEICA 250M digital level (Figure 4).

All these data have been stored in the electronic format in the database of the equipment used, with copies stored in the working PCs.

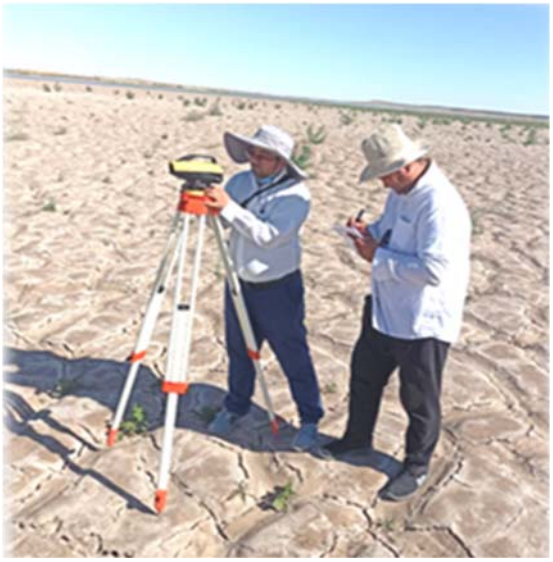
River Surveyor S5

Current velocity measurement:	
• Profiling distance	From 0.06 to 5 m
• Velocity range	+/- 20 m/s
• Precision of measurements	Up to ±0.25% from measured velocity, ±0.2 cm/s
• Resolution	0.001 m/sc
• Number of cells	Up to 128 cells
• Cell size	0.02 m – 0.5 m
Depths at which discharge is measured:	
• In the bottom-tracking mode	From 0.3 m to 5 m
• Mapping GPS unit	From 0.3 m to 15 m

Figure 2. Performance characteristics of a doppler-profile recorder and the process of storage capacity measurement

Frequency, not more than, KHz	20
Maximum transmission, power not more than, W	500
Sound range, m	0,2~300
Sounding accuracy at 1 c resolution, mm	± 10 + 0.1%
Adjustment range, m	0 ~ 15
Range of sound speed adjustment within, m / s	1200 1800
Maximum discretization frequency up to, Hz	30
GPS module: Track not less	14
Signal/Accuracy not more than, m	GPS + beacon/0.5
PC: Dual core processor, at least, GHz	1,6
Memory not less/ Hard disk not less than, GB	2/16
Display resolution not less than, inches	17”
Power supply, V/ consumption less, V	220/30
Temperature, degree	-20~+50℃

Figure 3. An HD-MAX echo sounder with a GPS unit and its performance characteristics



Distance measurement range: 2–100 m
Precision: 0.7 mm with a lined fiberglass rod; 2.5 mm with an engineer's rod
Operating range of the compensator: ±10'
Storage memory: 1000 measurements
Keyboard: 5 keys for interface control and a measurement key
Magnifying power of the telescope: 24x
Display: LCD, 128x104 pixels; direct image
Objective diameter: 36 mm, mirror of universal level
Sensitivity of the universal level: 10'/2mm
Compensator type: magnetic damper
Operating temperature range: from 10°C to +50°C

Figure 4. Performance characteristics of a specialized geodetic equipment – digital LEICA 250M level

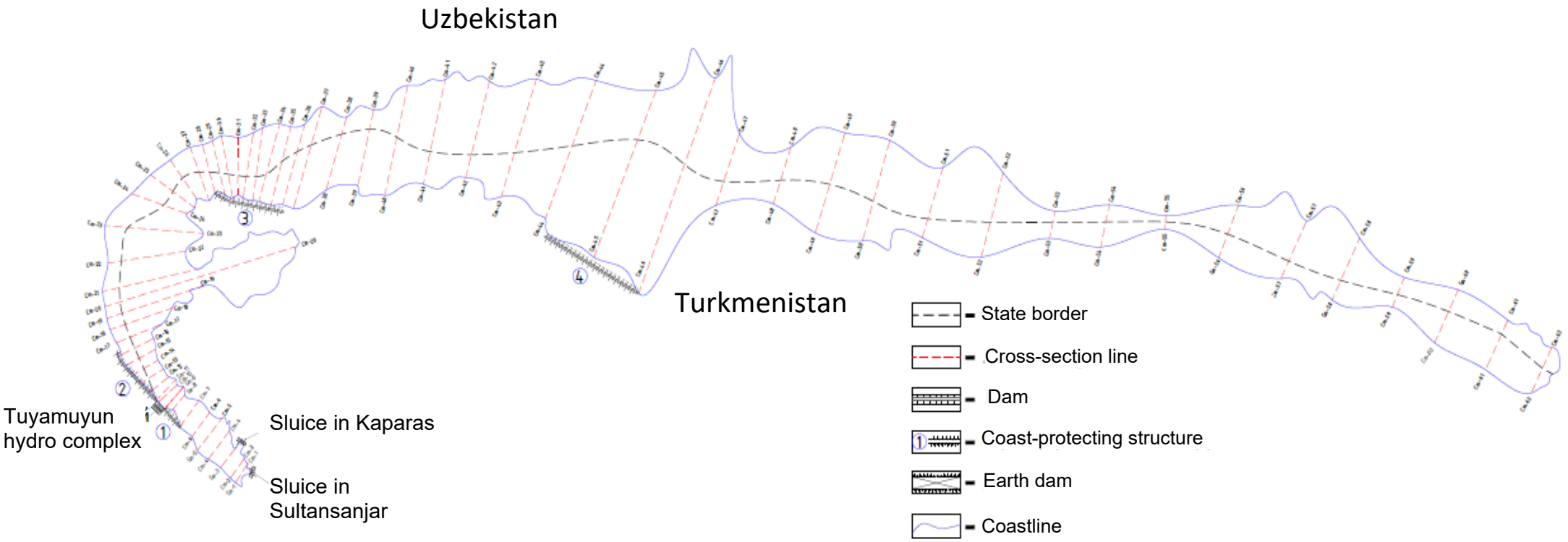


Figure 5. Schematic plan of the Channel reservoir with cross sections of measurements

2.2 Estimation of sediment volumes

Over 40 years of the THC reservoir operation the Channel reservoir performance characteristics have changed substantially due to accumulation of sediments in the reservoir. In the period from the startup of the Channel reservoir operation (1981) to 2002 the sediment volumes in this reservoir were estimated by depth soundings during field surveys taken by the Zhurin Central Asian Research Institute of Irrigation. In 2008 depth soundings were taken by the state unitary enterprise 'The Bathymetric Center' (BM) at the Ministry of Water Resources of the Republic of Uzbekistan. Last soundings were taken under this project in June–August 2021. The calculation results based on depth soundings (Annex 1 and Annex 3) are provided in Table 2.

The analysis of the survey results showed the following: at the time of last measurements, full storage capacity of the Channel reservoir was reduced from the design 2,340 mln m^3 to 863 mln m^3; therefore, the surface area of the reservoir at different water levels changed as well, the water surface area at a height of 130 m is 247.8 km^2. Hence, during the THC operation the **live storage capacity of the Channel reservoir** lost **1,477 mln m^3**.

The elevation-storage curve and the area-elevation curve are provided in Figure 6 and Figure 7.

Table 2. Changes over time in the Channel reservoir storage capacity during its operation

Height m	Design storage capacity mln m^3, 1981		BM 2008	**Scientific and Research Institute of Irrigation and Water Problems, 2021**		
	Full storage capacity	Live storage capacity	Water volume	**Water volume**	**Sediment volume**	Surface area km^2
130	2340	2090	1287	**863**	**1477**	247.8
129	1950	1700	994	**539**	**1411**	211.0
128	1640	1390	746	**302**	**1338**	175.2
127	1380	1130	539	**133**	**1247**	134.9
126	1130	880	372	**64**	**1066**	69.7
125	930	680	263	**25**	**905**	8.2
124	740	490	188	**4**	**736**	1.7
123	570	320	129	0	**570**	0
122	450	200	87	0	**450**	0
121	340	90	58	0	**340**	0
120	250	0	36	0	**250**	0
119	190	0	20	0	**190**	0
118	140	0	9	0	**140**	0
117	110	0	3	0	**110**	0

116	80	0	1,6	0	**80**	0
115	50	0	0,5	0	**50**	0
114	30	0	0,1	0	**30**	0
113	10	0	0	0	**10**	0
112	5	0	0	0	**5**	0

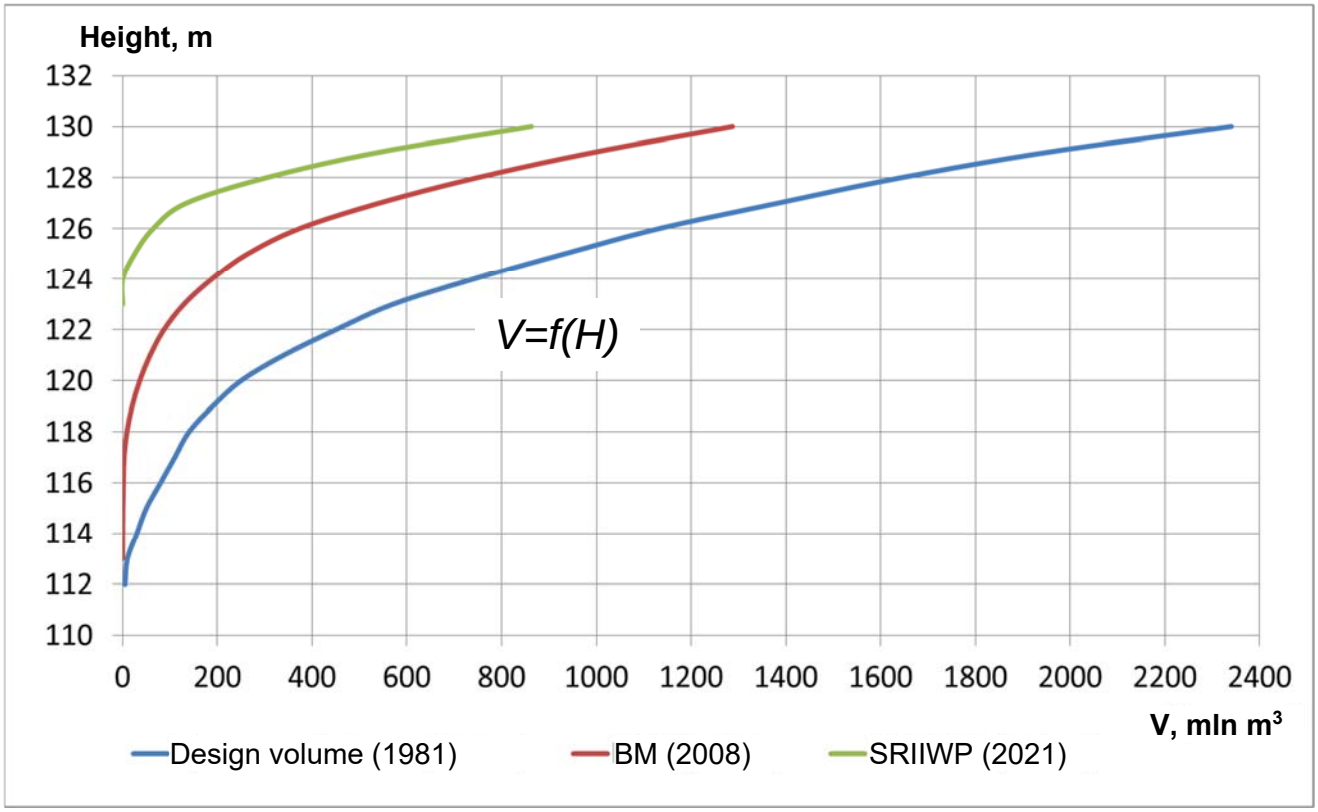


Figure 6. Changes over time in the storage capacity of the Channel reservoir

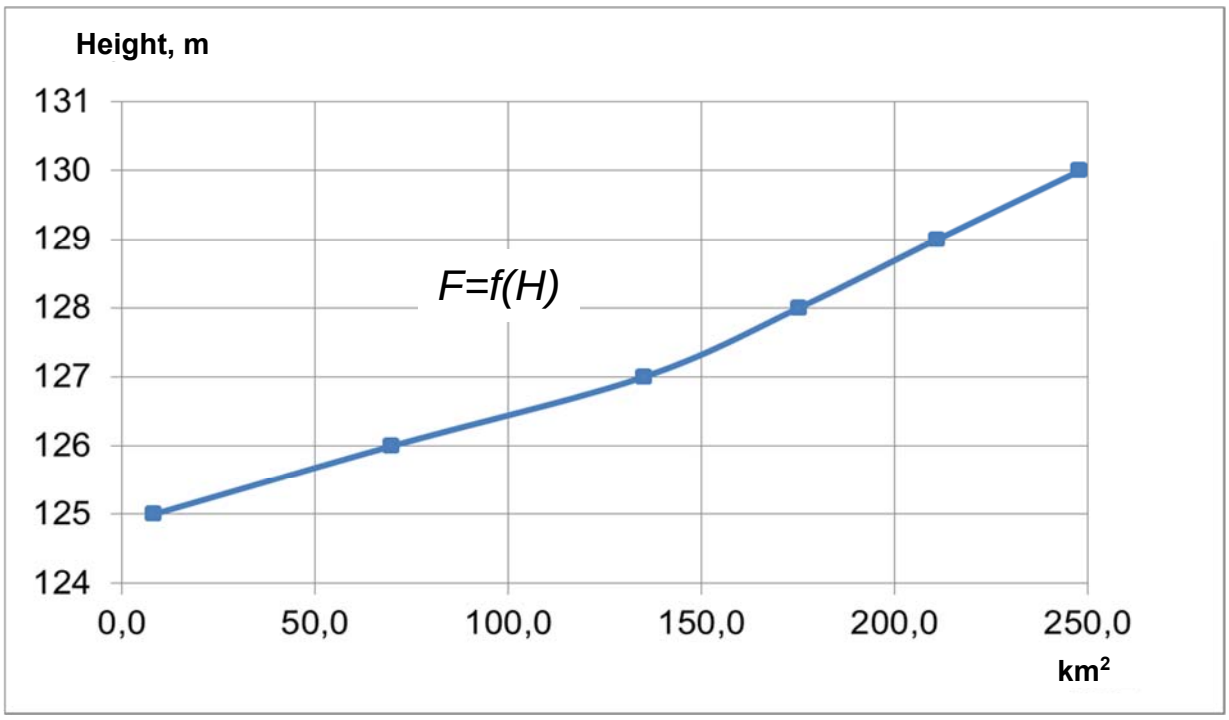


Figure 7. The water surface area at different heights

2.3 Distribution of sediment volume between heights and along the length of the reservoir basin

The analysis of the reservoir basin silting conditions demonstrates that the reservoir is filled up completely by sediments to a height of 125 m, which is 905 mln m^3, or 38.7% of total amount of sediments (Table 3). The remainder of the sediments is distributed as follows:

- 161 mln m^3 (7%) between heights of 125-126 m;
- 314 mln m^3 (13.4%) between heights of 126-127 m;
- 260 mln m^3 (11%) between heights of 127-128 m;
- 310 mln m^3 (12.2%) between heights of 128-129 m;
- 390 mln m^3 (17%) between heights of 129-130 m.

Table 3. Distribution of sediment volume between heights

Height m	Sediment volume mln m^3	%
130	2340	100.0
129	1950	83.3
128	1640	70.1
127	1380	59.0
126	1066	45.6
125	905	38.7

124	736	31.5
123	570	24.4
122	450	42.2
121	340	14.5
120	250	10.7
119	190	8.1
118	140	6.0
117	110	4.7
116	80	3.4
115	50	2.1
114	30	1.3
113	10	0.4
112	5	0.2

Figure 8 contains a curve of sediment volume by height in the Channel reservoir basin. The curve demonstrates that the rate of sedimentation from a height of 112 m to a height of 118 m is not very high, and the sediment volume is 180 mln m^3, whereas the rate of sedimentation from a height of 120 m to a height of 128 m is the highest, and the silt content amounts to 1.05 bln m^3.

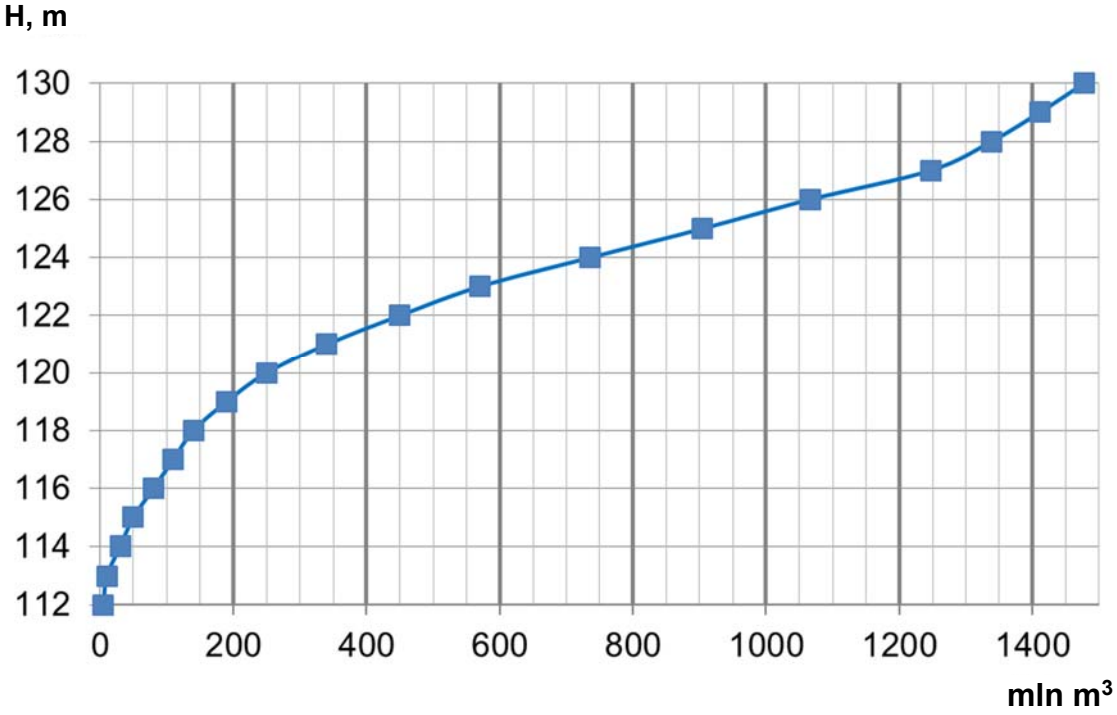


Figure 8. Distribution of sedimentation by reservoir elevations

Figure 9 illustrates sediment volume along the length of the reservoir basin which is 81 km; the basin is divided into 8 sections of the following length:

section 1: 10,380 m; section 2: 10,150 m; section 3: 10,169 m; section 4: 10,321; section 5: 9,610 m; section 6: 11,460 m; section 7: 9,460 m; section 8: 10,940.

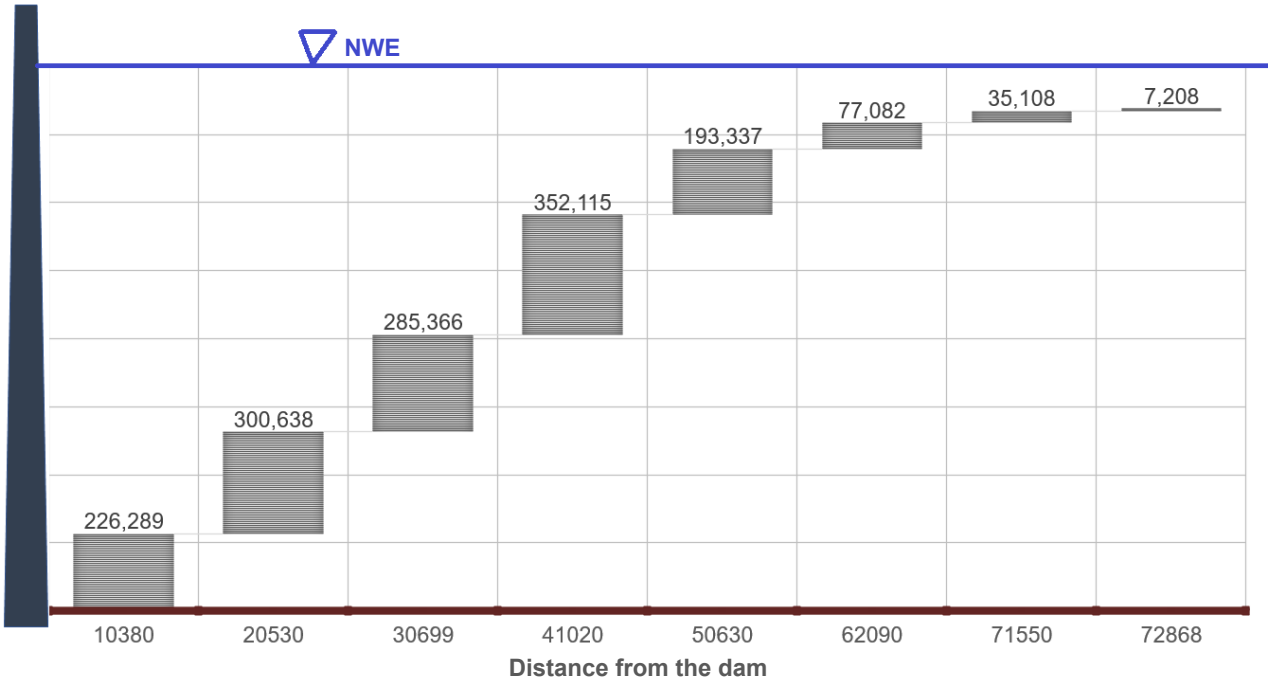
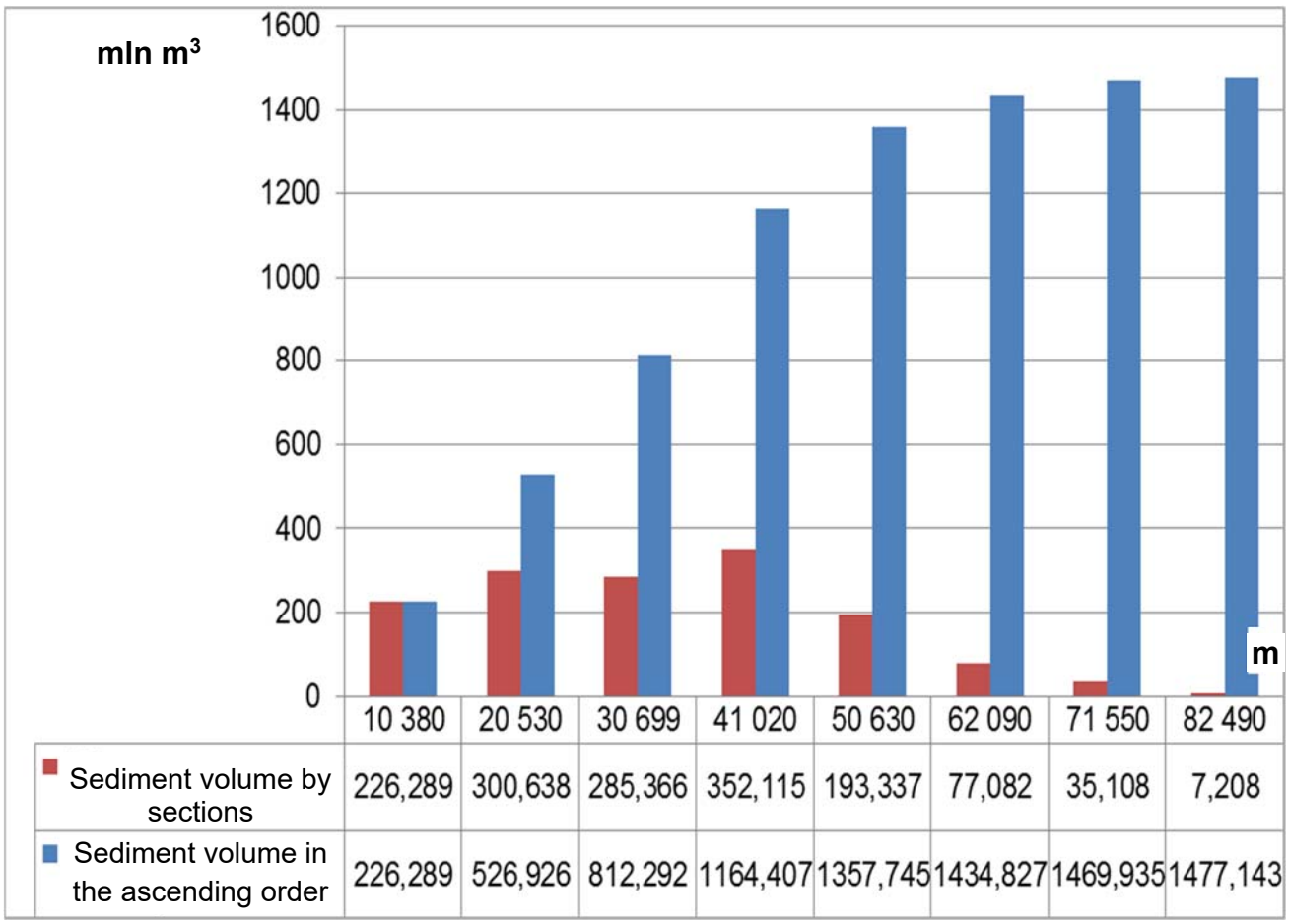


Figure 9. Accumulated sediments by sections

Figure 10 contains data on accumulated volumes of sediments by sections in ascending order which total 1,477 mln m^3. It should be noted that:

Section 1 is located near the dam and is 10.4 km long; the volume of accumulated sediments is 226.4 mln m^3;
Section 2 is 10.2 km long; the volume of accumulated sediments is 301 mln m^3;
Section 3 is 10.2 km long; the volume of accumulated sediments is 285 mln m^3;
Section 4 is 10.3 km long; the volume of accumulated sediments is 352 mln m^3;
Section 5 is 9.6 km long; the volume of accumulated sediments is 193 mln m^3;
Section 6 is 11.5 km long; the volume of accumulated sediments is 77 mln m^3;
Section 8 is 11 km long; the volume of accumulated sediments is 7 mln m^3.

Most sediments in the amount of 1,164 mln m^3 (79%) have accumulated along the length of the reservoir in the section extending 40 km from the dam, the remainder sediments in the amount of 312 mln m^3 (21%) have accumulated in the next 40 km long section.



	10 380	20 530	30 699	41 020	50 630	62 090	71 550	82 490
Sediment volume by sections	226,289	300,638	285,366	352,115	193,337	77,082	35,108	7,208
Sediment volume in the ascending order	226,289	526,926	812,292	1164,407	1357,745	1434,827	1469,935	1477,143

Figure 10. Sediment distribution pattern along the reservoir basin

Based on the measurements, the mean bed slope of the Channel reservoir basin is *i=0.00004* against the design value of *i=0.0002,* which means that the deposits accumulated during the initial stage (the first 10 year) of the reservoir operation were gradually transported downstream to the dam (Figure 11).

The Figure compares the reservoir bed elevations, both design and measured, where abrupt changes in the reservoir bed elevations were observed in the section near the dam within 3-5 m and further at the section located at a distance of 30 km.

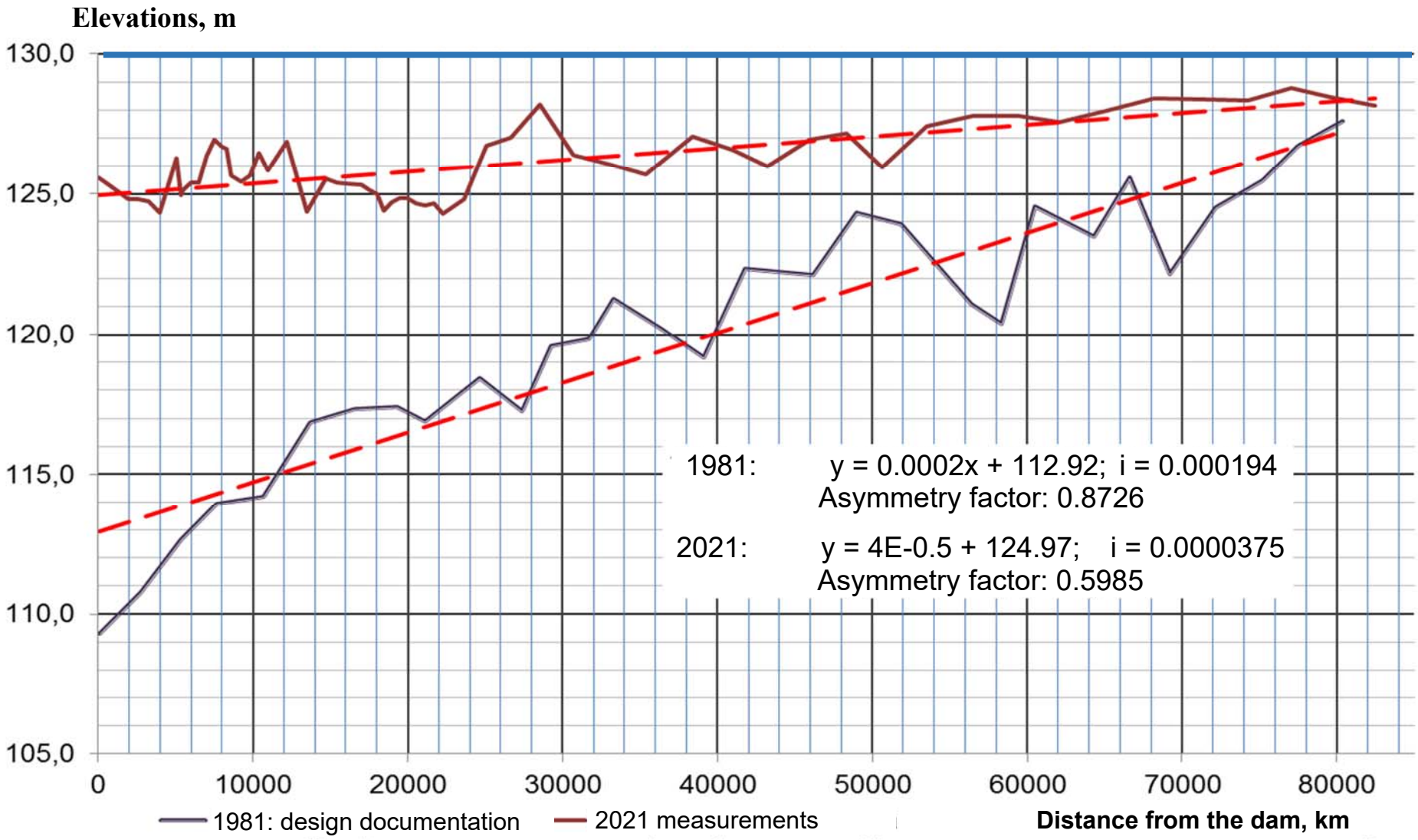


Figure 11. Longitudinal profile of the Channel reservoir bed

2.4 The morphological picture (sediment erosion/deposition) of the upstream section of the THC dam inlet

The schematic plan with mean bed elevations by cross-sections and the cross section lines in the section near the Channel reservoir dam demonstrated that mean bed elevations vary within 124-126 m (Figures 12 and 13). At the same time, elevations of the dam are rather high, which means that despite water discharge/release downstream, sediment/silt deposition and erosion by water flow is not very strong. At this section maximum depth at cross sections 11-16 is around 118 m. The depth at cross sections 7-9 reaches 120 m despite the flow running towards the regulation structures of the Kaparas and Sultansanjar reservoirs. It means that the density of sedimentation in these sections is very high and sediments cannot be removed hydraulically.

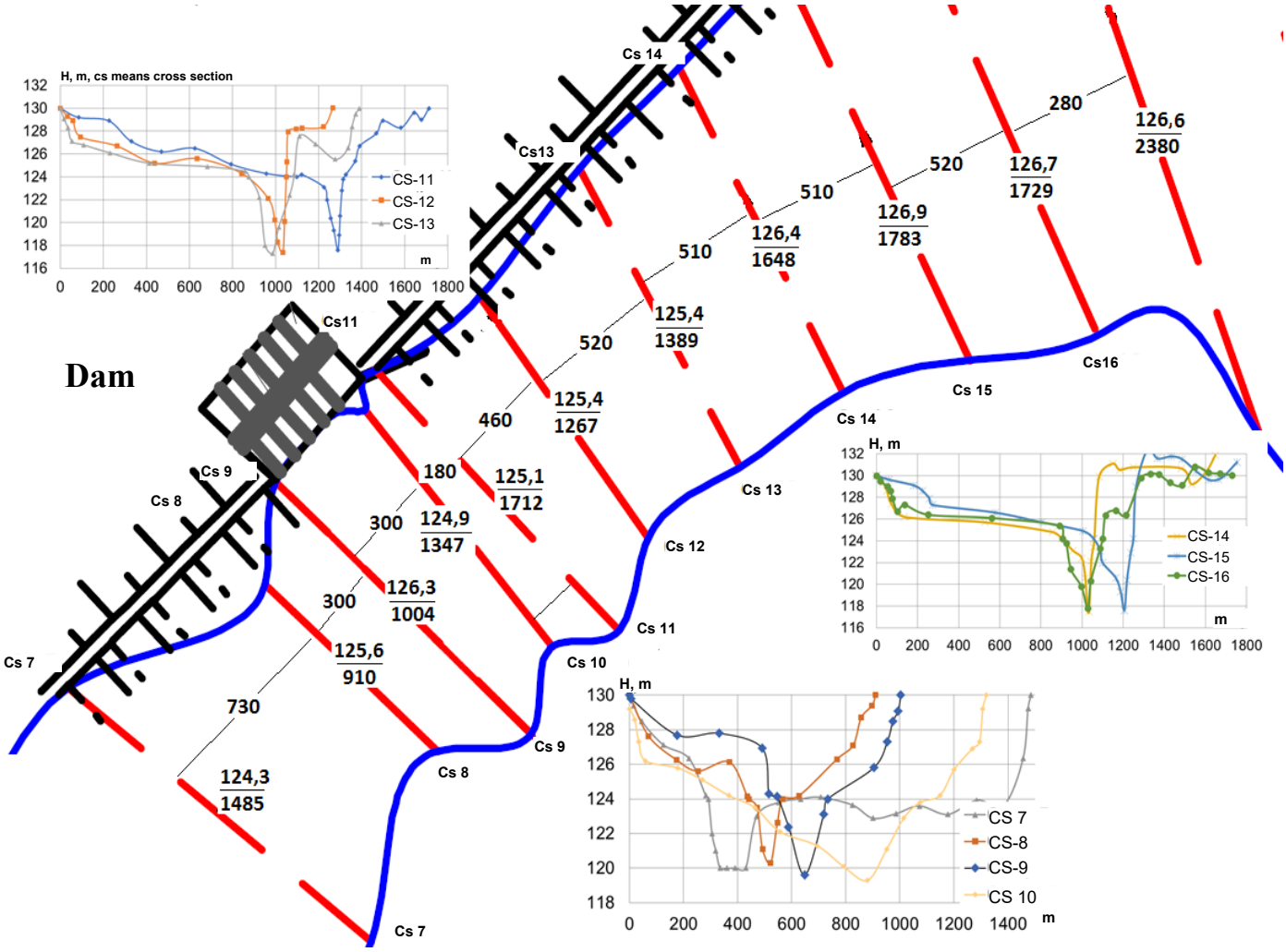


Figure. 12 Schematic plan and cross sections at the section near the Channel reservoir dam

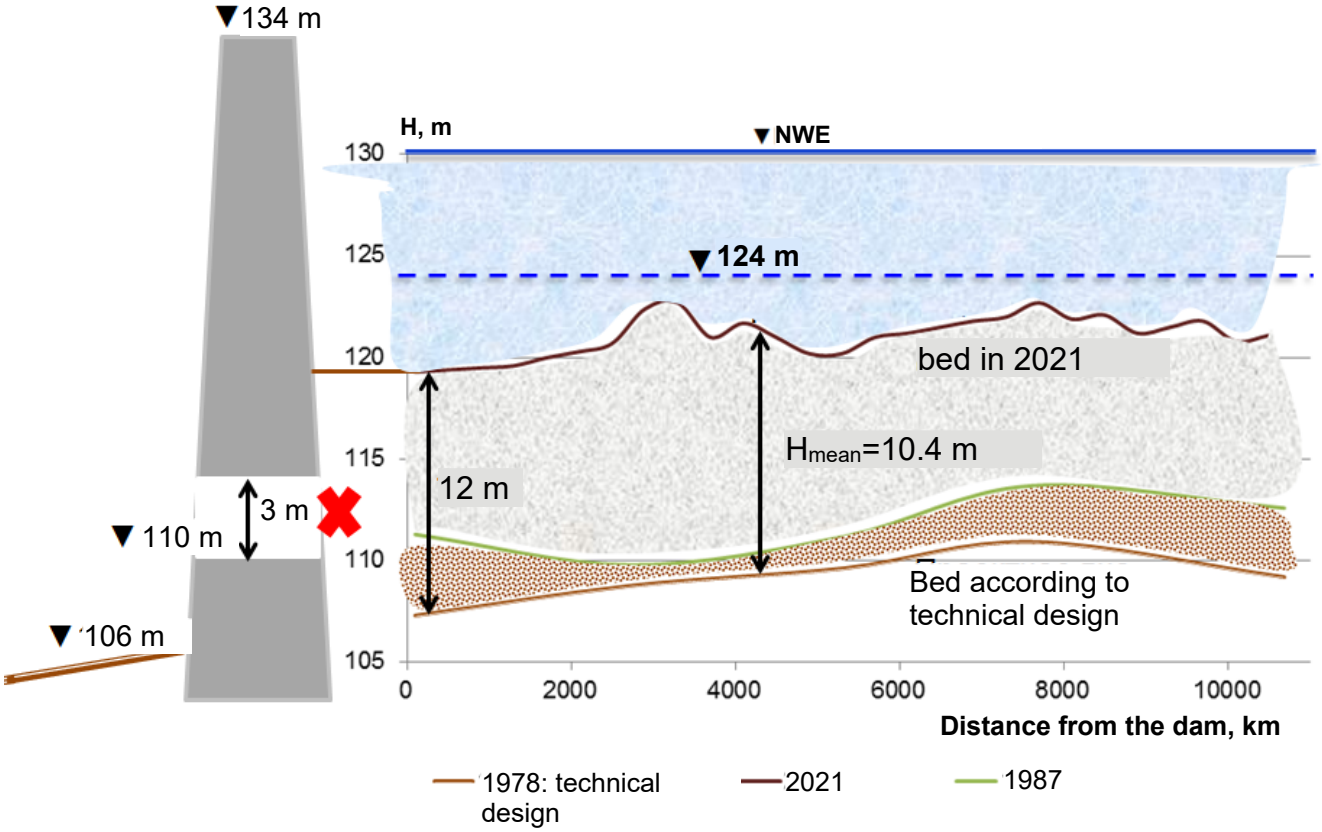


Figure 13. Silting conditions in the reservoir section near the dam

CONCLUSIONS

The following conclusions were made based on the surveys conducted to estimate storage capacity of the Channel reservoir and quantify its sediment volume.

Total capacity of the Channel reservoir at the water height near the dam H=130m was estimated to be equal to **863 mln m^3.** The amount of water at the same height according to the technical design and past surveys is as follows:

Design capacity of the reservoir (1978/1981): 2,340 mln m^3;
Storage capacity of the reservoir in 2008 (BC): 1,287 mln m^3;
Sediment volume accumulated over the entire operation period by 2021:
2,340 – 863 = **1,477 mln m^3**.

The water surface area at a height of 130 m was **248 km^2** against the design area of 300 km^2.

According to the field measurements, the mean slope of the Channel reservoir basin bed is ***i=0,00004*** against the design slope of *i=0,0002.*

The elevation-capacity and the area-elevation tables are provided below.

The elevation-capacity data on the Channel reservoir data for 2021, mln m^3

H m	**Design**	**Measurements**									
		C E N T I M E T E R									
		0	10	20	30	40	50	60	70	80	90
130	**2340**	**862,70**									
129	1950	**539,19**	571,54	603,89	636,24	668,59	700,94	733,29	765,64	797,99	830,35
128	1640	**301,58**	325,34	349,10	372,86	396,63	420,39	444,15	467,91	491,67	515,43
127	1380	**132,86**	149,73	166,61	183,48	200,35	217,22	234,09	250,97	267,84	284,71
126	1130	**64,00**	70,89	77,77	84,66	91,54	98,43	105,32	112,20	119,09	125,98
125	930	**25,00**	28,90	32,80	36,70	40,60	44,50	48,40	52,30	56,20	60,10
124	740	**0,40**	6,10	8,20	10,30	12,40	14,50	16,60	18,70	20,80	22,90
123	570	**0,00**	0,04	0,80	1,20	1,60	2,00	2,80	2,80	3,20	3,60

The area-elevation data on the Channel reservoir for 2021, km^2

H, m	Design	Measurements									
		C E N T I M E T E R									
		0	10	20	30	40	50	60	70	80	90
130	**300,35**	**247,80**									
129	277,27	**211,00**	214,68	218,36	222,04	225,72	229,40	233,08	236,76	240,44	244,12
128	221,93	**175,16**	178,74	182,33	185,91	189,50	193,08	196,66	200,25	203,83	207,42
127	199,96	**134,95**	138,97	142,99	147,01	151,03	155,06	159,08	163,10	167,12	171,14
126	135,75	**69,72**	76,24	82,77	89,29	95,81	102,34	108,86	115,38	121,90	128,43
125	89,92	**8,20**	14,35	20,50	26,66	32,81	38,96	45,11	51,26	57,42	63,57
124	66,42	**1,70**	2,35	3,00	3,65	4,30	4,95	5,60	6,25	6,90	7,55
123	48,81	**0,00**	0,017	0,34	0,51	0,68	0,85	1,19	1,19	1,36	1,53

ANNEXES

Annex 1. Measurement data on the Channel reservoir basin

- By an acoustic doppler-profile recorder or an echo sounder
- Measurements of the dry bed by a geodetic level

Cross-section-1 (9)

Measurement method	Height (H) m	Length (L) m
	130,0	0
	129,1	38,14
	128,3	78,44
	126,8	201,44
	125,1	277,84
	124,2	359,14
	123,8	425,34
	123,2	470,44
	123,3	535,04
	122	593,64
	121,2	659,84
	122,6	714,54
	123,5	782,74
	124,7	835,34
	125,9	886,44
	126,8	945,24
	127,5	1002,44
	128,6	1034,64
	129,6	1060,24
	130	**1072,44**
	125,6	

Cross-section-2 (8)

Measurement method	Height (H) m	Length (L) m
	130,0	0
	129,3	36,91
	128,6	84,41
	127,9	126,11
	126,1	158,96
	125,2	227,66
	124,3	305,06
	123,1	373,16
	122,4	461,36
	121	553,96
	120,3	631,86
	120,1	670,16
	121,6	715,06
	122,9	783,96
	123,6	839,26
	124	896,4
	125,3	968,5
	126,6	1031,8
	127,9	1085,3
	128,6	1109,7
	129,3	1128,5
	129,6	1135,8
	130	**1142**
	125,4	

Cross-section-3 (7)

Measurement method	Height m	Length (L) m
	130,0	0
	129,3	19,1
	128,2	59,3
	127,4	72,8
	126,3	115,4

Cross-section -4 (6)

Measurement method	Height m	Length (L) m
	130,0	0
	129,2	7,6
	128,6	19,7
	127,3	31,6
	127,0	50,8

	125,3	141,7
	124,3	160,8
	124,1	191,4
	123,2	215,8
	122,0	295,6
	121,1	392,2
	120,8	493,2
	119,8	586,4
	120,5	667,6
	121,0	741,2
	122,6	804,6
	123,1	869,3
	124,1	922,6
	125,6	991,2
	126,9	1066,7
	128,2	1118,6
	129,2	1149,8
	129,5	1168,4
	130,0	**1187,0**
	125,1	

	126,3	89,6
	125,4	153,7
	125,0	197,3
	124,6	236,5
	124,0	253,7
	123,1	283,4
	122,6	327,7
	122,2	402,0
	121,5	501,1
	120,4	618,4
	120,1	719,6
	119,8	811,8
	122,7	859,8
	121,2	924,4
	120,3	969,7
	122,6	1054,4
	123,1	1156,6
	123,8	1233,9
	124,1	1316,1
	125,0	1335,8
	125,9	1424,8
	126,7	1536,4
	127,9	1609,6
	128,9	1634,2
	129,3	1645,5
	130,0	**1654,7**
	124,8	

Cross-section 5 (5)

Measurement method	Height m	Length (L) m
	130,0	0
	129,2	38,2
	128,6	49,9
	127,3	52,1
	127,0	69,4
	126,3	94,2
	125,4	183,8
	125,0	291,1
	124,6	389,1
	124,0	485,2
	123,1	584,4
	122,6	692,1
	122,2	803,2
	121,5	896,5
	120,4	995,2
	120,1	1048,3

Cross-section -6 (4)

Measurement method	Height m	Length (L) m
	130,0	0
	129,4	28,9
	128,3	86,0
	126,0	147,2
	123,2	208,8
	122,3	287,9
	118,3	364,8
	120,2	438,0
	121,7	507,3
	120,9	582,6
	119,6	637,9
	121,1	698,2
	123,0	763,5
	123,5	839,8
	124,0	899,1
	124,1	953,3

	119,8	1129,9
	122,7	1199,7
	121,2	1253,1
	120,3	1303,2
	122,6	1375,9
	123,1	1434,6
	123,8	1501,1
	124,1	1558,6
	125,0	1621,9
	125,9	1688,6
	126,7	1738,9
	127,9	1800,0
	128,9	1857,3
	129,3	1893,0
	130,0	**1911,3**
	124,8	

	124,7	1013,5
	126,3	1079,4
	126,5	1130,6
	126,2	1185,4
	125,9	1250,9
	125,8	1316,6
	128,0	1378,1
	129,5	1403,5
	130,0	**1412,5**
	124,7	

Cross-section-7 (3)

Measurement method	Height m	Length (L) m
	130,0	0
	129,4	15,2
	128,5	44,8
	127,1	125,0
	126,4	219,4
	124,2	282,0
	124,0	292,1
	122,0	305,1
	121,0	319,5
	120,0	335,1
	120,0	361,2
	120,0	391,3
	120,0	429,9
	123,0	470,1
	123,8	551,0
	124,0	633,0
	124,1	706,8
	123,6	825,1
	122,9	900,5
	123,2	986,4
	123,6	1072,2
	123,1	1176,9
	123,9	1283,4
	123,7	1386,0
	126,3	1455,8
	129,3	1474,1
	130,0	**1485,3**

Cross-section-8 (2)

Measurement method	Height m	Length (L) m
	130,0	0,0
	127,6	71,2
	126,3	175,3
	125,6	253,6
	126,1	370,2
	124,1	436,1
	124,0	442,1
	123,5	472,1
	121,1	492,1
	120,3	522,1
	122,6	547,1
	124,0	567,1
	124,2	627,1
	126,3	767,1
	127,1	827,1
	128,7	857,1
	129,4	897,1
	130,0	**910,1**
	125,6	

	124,3

Cross-section-9 (1)

Measurement method	Height m	Length (L) m
	130,0	0,0
	129,79	6,5
	127,69	176,7
	127,80	331,7
	126,94	490,8
	124,30	515,7
	124,15	545,66
	122,39	588,66
	119,60	648,66
	123,11	718,66
	124,00	733,66
	125,81	903,66
	127,31	953,66
	128,48	973,66
	129,07	993,66
	130,00	**1003,66**
	126,3	

Cross-section-10

Measurement method	Height m	Length (L) m
	130,0	0
	129,2	19,3
	128,6	34,5
	127,3	59,4
	126,2	177,5
	125,8	269,7
	125,1	367,3
	124,2	463,6
	123,5	557
	122,1	693,9
	121,3	791,6
	120,1	880,4
	119,3	951,6
	121,1	1014,8
	122,9	1074,4
	123,8	1148,3
	124,2	1200,8
	125,7	1267,6
	126,9	1294,7
	127,3	1306,74
	129,2	1319,39
	130,0	**1346,84**
	124,9	

Cross-section-11

Measurement method	Height m	Length (L) m
	130,0	0
	129,2	84,3
	128,9	225,6
	127,1	329,9
	126,2	469,0
	126,5	624,7
	125,1	793,0
	124,3	956,7
	124,0	1099,0
	124,2	1122,0
	123,1	1225,3
	122,0	1239,6
	120,4	1257,1
	119,3	1271,5
	117,6	1288,9

Cross-section-12

Measurement method	Height m	Length (L) m
	130,0	0
	129,3	32,8
	128,9	58,0
	127,5	94,1
	126,7	263,0
	125,2	439,1
	125,6	635,1
	124,3	843,4
	122,1	966,4
	120,2	996,3
	118,3	1010,2
	117,4	1033,7
	120,1	1042,0
	124,0	1050,1
	125,3	1053,2

	118,9	1296,4
	120,6	1300,4
	122,8	1308,4
	123,8	1315
	124,2	1327,2
	125,4	1369,9
	126,7	1391,8
	127,8	1468,8
	128,9	1499,7
	128,3	1582,2
	129,6	1644,4
	129,0	1678,1
	130,0	**1712,3**
	125,1	

	127,9	1058,4
	128,2	1096,0
	128,2	1123,3
	128,4	1223,1
	130,0	1266,7
	125,4	

Cross-section-13

Measurement method	Height m	Length (L) m
	130,0	0,0
	129,1	15,9
	128,3	34,7
	127,1	53,6
	126,8	107,1
	126,1	230,7
	125,2	412,9
	124,9	683,4
	124,5	858,5
	124,0	876,0
	122,2	925,0
	118,0	952,0
	117,3	987,0
	119,6	1015,0
	122,4	1066,0
	124,2	1087,0
	127,6	1110,6
	126,9	1186,3
	125,5	1277,3
	126,6	1337,8
	128,4	1355,4
	129,5	1372,6
	130,0	**1389,9**
	125,4	

Cross-section-14

Measurement method	Height m	Length (L) m
	130,0	0
	129,3	32,1
	128,6	50,5
	127,4	72,2
	126,2	135,9
	125,7	528,2
	124,8	857,1
	124,2	901,0
	123,1	956,0
	122,4	999
	120,6	1016
	118,7	1023
	117,5	1034
	122,1	1045
	123,4	1055
	124,2	1060
	129,90	1082,9
	131,10	1150,0
	130,53	1183,3
	130,76	1249,7
	130,66	1483,6
	129,20	1534,0
	130,43	1606,2
	131,86	**1648,0**
	126,4	

Cross-section-15

Measurement method	Height m	Length (L) m
	130,0	0,0

Cross-section-16

Measurement method	Height m	Length (L) m
	130,0	0,0

	129,6	60,9
	129,1	181,8
	128,6	224,0
	127,9	257,1
	127,3	273,3
	126,6	577,0
	125,7	805,1
	124,9	1005,1
	124,2	1056,0
	123,1	1089,0
	122,0	1100,0
	120,6	1164,0
	119,3	1188,0
	117,6	1206,0
	120,4	1219,0
	122,9	1237,0
	124,2	1250,0
	129,0	1263,2
	132,4	1319,1
	131,6	1367,2
	131,8	1434,9
	131,5	1487,8
	130,4	1554,6
	129,6	1616,2
	129,6	1663,1
	130,0	1695,0
	131,2	1754,0
	130,1	**1783,0**
	126,9	

	129,5	18,4
	129,0	53,4
	128,6	67,7
	127,9	77,9
	126,7	102,5
	127,3	136,4
	126,4	251,1
	126,1	559,7
	125,4	891,0
	124,2	906,0
	123,8	923,4
	121,4	945,8
	119,8	996,7
	117,8	1028,3
	120,3	1043,4
	123,3	1088,6
	124,2	1101,0
	126,4	1115,0
	126,8	1164,7
	126,4	1214,4
	129,8	1287,6
	130,2	1333,4
	130,1	1374,3
	129,4	1427,8
	129,1	1486,3
	130,8	1549,7
	130,3	1614,9
	130,2	1671,8
	130,0	**1728,8**
	126,7	

Cross-section-17

Measurement method	Height m	Length (L) m
	130,0	0
	129,3	24,5
	128,7	56,1
	128,9	78,8
	128,1	158,9
	127,6	174,5
	126,8	196,2
	126,3	204,5
	127,0	233,7
	126,8	257,0
	126,1	438,4
	125,6	514,7
	125,1	586,1

Cross-section-18

Measurement method	Height m	Length (L) m
	130,0	0
	129,6	10,2
	129,1	20,5
	128,4	38,1
	127,1	68,8
	126,3	169,9
	125,9	356,4
	125,1	546,5
	124,9	608,6
	124,6	781,9
	123,3	889,6
	122,7	952,3
	123,8	1081,9

	124,8	696,0
	124,0	774,2
	123,6	838,9
	122,4	887,5
	123,6	921,2
	124,6	963,8
	125,3	1082,5
	125,2	1188,7
	124,9	1211,9
	124,4	1240,7
	123,8	1257,8
	122,6	1263,1
	121,5	1280,9
	120,6	1302,4
	120,6	1327,9
	123,5	1350,6
	123,8	1497
	126,6	1536,6
	125,8	1627,63
	125,1	1736,65
	128,8	1777,48
	133,3	1804,49
	133,8	1869,62
	133,6	1946,02
	132,5	2048,49
	132,2	2132,46
	131,1	2242,53
	128,9	2343,44
	130,0	**2379,67**
	126,6	

	124,7	1200,7
	125,4	1336,8
	126,0	1456,7
	125,4	1535,1
	124,7	1604,2
	124,3	1666,1
	123,8	1756,8
	122,6	1776,5
	121,5	1793,4
	121,7	1842,4
	122,7	1863,6
	123,0	1886,3
	123,8	1919,6
	128,1	1963,28
	128,3	2066,96
	128,1	2170,52
	126,8	2276,94
	125,6	2385,75
	124,4	2534,74
	123,5	2657,99
	123,7	2783,84
	125,2	2889,3
	127,6	2993,44
	129,5	3068,42
	129,3	3152,73
	130,0	**3195,28**
	125,7	

Cross-section-19

Measurement method	Height m	Length (L) m
	130,0	0
	129,6	25,1
	129,2	45,2
	128,0	85,8
	127,2	160,2
	126,5	266,8
	126,0	338,7
	125,3	534,7
	124,1	610,7
	123,3	780,7
	122,1	967,7
	121,3	1350,4
	121,0	1594,7

Cross-section-20

Measurement method	Height m	Length (L) m
	130,0	0
	129,4	18,1
	129,0	101,6
	128,2	122,8
	127,2	245,8
	126,6	421,0
	126,3	605,7
	125,9	922,0
	124,2	1194,1
	123,5	1393,2
	122,4	1599,8
	121,7	1801,1
	122,5	1981,3

121,6	1794,6
122,2	2082,7
123,7	2289,3
124,0	2466,4
125,1	2617,5
125,9	2720,7
126,1	2865,1
125,2	2966,7
124,1	3066,0
123,0	3173,0
122,1	3266,3
121,1	3334,3
123,0	3382,3
124,1	3444,5
124,3	3516,6
122,8	3580,6
122,1	3640,3
121,5	3690,7
120,6	3721,7
122,8	3762,4
126,5	3794,22
127,0	3871,62
126,8	3974,09
126,5	4072,12
125,9	4156,94
125,4	4239,47
125,2	4328,6
127,8	4374,07
131,1	4400,47
131,4	4478,21
129,3	4552,66
130,0	4627,51
130,2	4721,01
129,0	4801,77
130,0	**4973,35**
125,4	

123,3	2173,3
124,6	2347,7
125,5	2550,3
126,1	2731,5
126,7	2911,6
127,1	3095,8
127,9	3268,0
128,2	3465,8
127,1	3647,7
126,6	3867,9
126,1	4061,6
125,3	4253,7
124,8	4544,8
124,6	4722,1
124,0	4950,3
123,2	5150,0
122,4	5361,2
121,1	5568,9
122,2	5746,2
123,0	5958,8
124,1	6138,7
125,4	6346,5
126,1	6616,6
126,3	6823,2
125,9	7142,5
125,8	7441,7
125,1	7674,9
124,8	7852,1
124,2	8050,9
122,8	8086,6
121,6	8107,8
120,2	8134,2
117,9	8163,9
118,7	8196,7
120,4	8230,6
121,3	8268,4
122,8	8300,6
124,3	8550,6
130,3	8552,1
132,0	8649,61
131,1	8729,48
131,5	8831,05
129,8	8926,94
127,9	9004,75
128,0	9135,74
128,8	9268,72
129,5	9358,64

	128,8	9457,49
	128,7	9533,27
	128,7	9625,24
	126,1	9695,49
	125,3	9775,616
	126,8	9828,742
	130,0	**9851,742**
	125,6	

Cross-section-21

Measurement method	Height m	Length (L) m
	130,0	0
	129,6	31,3
	129,0	83,9
	129,1	199,9
	128,4	323,1
	127,9	442,4
	127,6	663,5
	127,0	945,8
	126,9	1322,7
	126,3	1705,7
	125,8	2083,4
	125,1	2410,5
	124,9	2755,1
	124,6	3154,8
	122,8	3173,4
	121,3	3192,6
	119,4	3210,6
	118,2	3256,4
	120,8	3302,6
	121,5	3341,7
	122,8	3374,8
	124,1	3574,8
	129,6	3576,8
	131,0	3674,3
	130,3	3754,2
	130,8	3855,8
	129,1	3951,6
	127,1	4029,5
	127,2	4160,4
	128,1	4293,4
	128,7	4383,3
	128,1	4482,2
	128,1	4558,0
	128,0	4649,9

Cross-section-22

Measurement method	Height m	Length (L) m
	130,0	0
	129,3	31,3
	128,7	72,0
	128,3	154,7
	127,9	266,4
	127,5	659,1
	127,2	1043,3
	126,7	1467,6
	126,3	1687,2
	125,9	2010,9
	125,6	2292,9
	125,4	2509,4
	124,9	2691,8
	124,7	2701,3
	122,8	2728,3
	120,1	2820,6
	119,2	2847,4
	117,5	2863,4
	118,6	2982,3
	121,4	3050,2
	122,8	3014,7
	125,3	3042,6
	126,2	3061,7
	127,5	3108,1
	127,4	3186,6
	126,9	3223,8
	126,7	3266,7
	126,5	3327,2
	126,4	3383,8
	126,3	3443,0
	127,3	3492,1
	131,0	3642,1
	127,0	3665,4
	125,4	3735,6

	125,4	4720,2
	124,7	4800,3
	126,3	4853,4
	130,0	**4876,4**
	126,5	

	126,1	3809,4
	128,4	3844,2
	130,0	**3879,0**
	125,8	

Cross-section-23

Measurement method	Height m	Length (L) m
	130,0	0
	129,4	31,3
	128,9	53,5
	128,3	72,8
	127,4	95,2
	126,0	294,0
	127,4	341,9
	128,2	365,9
	129,0	407,0
	129,8	462,7
	130,0	500,1
	129,1	577,1
	130,2	617,2
	131,1	690,1
	132,2	719,6
	133,0	744,5
	134,2	756,1
	134,0	785,4
	133,3	861,9
	132,4	949,5
	131,2	971,8
	129,7	1004,0
	128,5	1031,9
	127,4	1078,4
	126,9	1165,7
	126,2	1255,3
	125,4	1355,2
	124,6	1462,8
	124,2	1549,0
	123,3	1642,3
	122,1	1731,0
	121,0	1805,6
	120,2	1899,7

Distance 1300

Cross-section-24

Measurement method	Height m	Length (L) m
	130,0	0
	129,6	31,3
	129,1	58,4
	128,0	90,7
	127,1	129,6
	126,6	319,9
	126,2	578,2
	125,3	766,4
	124,8	1019,1
	124,4	1128,4
	122,2	1177,3
	121,3	1201,2
	120,6	1223,1
	119,8	1263,8
	117,4	1300,8
	117,6	1350,7
	118,2	1373,0
	119,6	1411,8
	121,2	1452,6
	121,8	1520,3
	122,2	1584,6
	123,0	2074,6
	122,8	2174,5
	122,6	2280,0
	125,3	2392,4
	126,1	2505,9
	126,1	2628,2
	126,8	2671,7
	126,3	2695,0
	127,6	2765,2
	129,6	2839,0
	130,0	**2873,8**
	124,3	

	120,6	1973,3
	121,7	2067,7
	122,6	2170,0
	123,8	2289,6
	124,0	2413,3
	124,8	2515,3
	125,5	2608,6
	126,2	2663,2
	122,8	2712,4
	121,6	2763,6
	119,4	3006,7
	118,5	3053,1
	117,5	3115,7
	118,6	3148,7
	121,4	3176,3
	122,8	3212,4
	127,1	3244,46
	127,8	3279,13
	127,4	3479,13
	128,9	3662,13
	129,9	3854,13
	130,2	4060,13
	130,8	4261,13
	130,9	4441,13
	131,1	4591,13
	130,7	4761,13
	130,6	**4881,13**
	126,9	

Cross-section 25

Measurement method	Height m	Length (L) m
	130,0	0
	129,2	31,3
	128,1	71,0
	127,7	103,2
	127,1	195,8
	126,9	318,5
	126,1	467,8
	125,8	664,6
	125,2	853,1
	124,2	909,6
	122,2	924,7
	120,4	946,8
	119,5	978,1

Cross-section 26

Measurement method	Height m	Length (L) m
	130,0	0
	129,4	31,3
	128,3	56,4
	127,1	146,4
	126,7	319,7
	126,2	479,3
	126,0	672,0
	125,7	786,4
	124,2	801,6
	122,4	845,2
	119,6	873,2
	117,4	899,9
	118,2	919,4

	117,6	999,8
	119,8	1015,3
	121,0	1045,3
	121,8	1101,0
	122,2	1153,0
	124,2	1219,6
	125,7	1301,4
	128,3	1388,8
	127,4	1457,7
	125,9	1598,8
	127,9	1678,2
	124,6	1779,4
	126,8	1985,7
	127,0	2098,8
	127,5	2188,3
	128,4	2319,9
	128,9	2488,1
	129,8	2588,7
	130,0	**2641,9**
	125,5	

	119,8	955,5
	121,1	986,4
	121,9	1001,3
	122,4	1036,6
	124,6	1116,4
	125,5	1201,2
	125,9	1306,8
	126,7	1390,8
	127,2	1476,5
	128,9	1564,8
	127,6	1688,3
	125,8	1791,4
	128,7	1874,8
	129,4	1946,2
	129,7	2079,5
	130,0	**2188,3**
	125,4	

Cross-section 27

Measurement method	Height m	Length (L) m
	130,0	0
	129,1	31,3
	128,0	104,4
	127,1	154,2
	126,2	256,4
	125,3	391,0
	124,9	515,3
	124,1	575,2
	123,3	654,8
	122,7	774,1
	121,6	875,3
	119,3	912,2
	117,6	976,4
	119,8	993,8
	121,9	1045,2
	122,4	1088,8
	124,6	1191,2
	125,7	1287,2
	127,3	1401,6
	126,7	1487,7
	127,6	1576,3
	126,2	1690,0

Cross-section 28

Measurement method	Height m	Length (L) m
	130,0	0
	129,1	50,3
	128,7	79,6
	128,1	118,0
	127,5	137,2
	127,0	161,6
	126,4	259,9
	125,6	379,5
	125,2	483,4
	124,9	556,6
	124,4	685,8
	124,2	754,1
	122,2	799,4
	120,6	856,1
	118,3	903,3
	117,4	951,3
	119,6	988,4
	120,8	994,9
	122,4	1008,6
	124,8	1136,5
	125,6	1248,9
	126,4	1379,2

	126,8	1808,9
	125,9	1968,8
	127,6	2123,3
	129,4	2346,1
	128,7	2397,1
	130,0	**2478,4**
	125,4	

	127,8	1506,9
	126,9	1648,3
	127,3	1767,9
	126,6	1879,4
	125,8	1945,3
	126,6	2088,8
	129,1	2164,7
	130,0	**2270,3**
	125,3	

Cross-section 29

Measurement method	Height m	Length (L) m
	130,0	0
	129,6	42,6
	129,1	105,9
	128,6	143,1
	127,4	218,9
	126,9	287,2
	126,2	383,6
	125,5	477,0
	124,0	563,7
	123,1	647,0
	122,2	739,9
	123,6	824,6
	124,8	889,7
	125,7	967,8
	126,2	1037,4
	124,2	1097,4
	122,2	1124,6
	119,8	1156,4
	117,7	1196,1
	119,6	1219,2
	121,3	1248,5
	122,4	1289,7
	124,6	1354,1
	125,3	1488,6
	125,6	1564,3
	124,3	1705,5
	125,6	1850,4
	127,8	1962,3
	126,1	2087,6
	126,2	2204,3
	125,9	2327,9
	128,1	2451,0

Cross-section 30

Measurement method	Height m	Length (L) m
	130,0	0
	129,7	16,3
	129,1	32,0
	128,5	74,1
	127,2	163,9
	126,8	252,5
	126,3	325,8
	125,1	414,1
	124,2	465,2
	123,3	514,8
	122,4	578,6
	121,9	677,3
	122,8	718,6
	123,9	766,2
	124,2	802,5
	125,8	882,3
	126,4	1001,9
	127,2	1125,2
	126,4	1155,6
	124,6	1189,1
	122,2	1212,4
	120,6	1271,6
	118,3	1303,8
	117,7	1329,2
	120,1	1358,7
	121,6	1381,5
	124,6	1401,3
	125,4	1541,2
	126,3	1687,0
	125,3	1766,1
	124,2	1845,2
	124,0	1964,6

	130,0	**2517,4**
	125,1	

	126,6	2077,3
	127,2	2216,3
	125,7	2405,5
	126,1	2545,9
	127,2	2677,4
	130,0	**2870,0**
	125,0	

Cross-section 31

Measurement method	Height m	Length (L) m
	130,0	0
	129,4	31,3
	128,3	83,2
	127,4	116,3
	126,1	189,6
	125,2	276,3
	124,6	337,4
	124,2	390,8
	123,1	484,1
	122,4	556,5
	122,1	608,1
	123,7	656,7
	124,1	700,2
	124,3	756,9
	125,4	880,6
	126,2	1074,0
	126,4	1198,7
	126,6	1310,2
	124,3	1376,4
	122,2	1389,3
	120,6	1412,5
	118,3	1450,0
	117,5	1488,2
	119,5	1499,0
	120,8	1508,2
	121,4	1529,1
	123,9	1551,3
	124,2	1556,3
	125,2	1665,8
	125,8	1790,4
	125,0	1828,2
	126,2	1966,7
	125,1	2123,3
	124,3	2271,6
	123,6	2380,4
	125,8	2506,2

Cross-section 32

Measurement method	Height m	Length (L) m
	130,0	0
	129,2	33,4
	128,5	78,0
	128,0	105,0
	127,1	148,7
	125,4	211,9
	124,2	289,5
	123,7	386,1
	122,1	467,8
	121,2	545,5
	122,7	622,9
	123,8	709,6
	124,2	800,9
	125,6	974,2
	126,2	1088,9
	126,4	1212,9
	126,6	1401,1
	126,1	1620,3
	125,3	1814,0
	124,2	1867,7
	122,4	1901,1
	120,3	1925,5
	118,6	1948,6
	117,4	1984,6
	119,6	2016,6
	120,8	2058,1
	122,4	2089,4
	124,6	2101,3
	125,1	2215,0
	125,0	2340,7
	126,2	2469,8
	125,8	2531,2
	127,3	2675,3
	126,1	2727,1
	126,4	2855,8
	130,0	**2994,0**

	130,0	**2608,2**
	124,4	

124,7

Cross-section 33

Measurement method	Height m	Length (L) m
	130,0	0
	129,1	40,1
	128,0	79,2
	127,2	117,9
	126,0	260,1
	125,1	317,4
	124,2	365,7
	123,0	458,3
	122,2	542,0
	121,5	591,7
	123,4	660,4
	124,7	741,8
	125,2	948,9
	125,6	1142,3
	126,1	1309,9
	125,8	1507,2
	125,4	1696,0
	126,0	1807,7
	125,8	2001,8
	126,4	2199,1
	124,2	2256,6
	122,3	2267,3
	120,6	2290,1
	118,7	2326,7
	117,6	2388,1
	119,2	2406,0
	120,8	2456,2
	122,3	2480,7
	124,1	2499,6
	125,0	2500,6
	125,3	2616,3
	126,2	2689,9
	126,9	2816,7
	125,1	2878,8
	124,3	2908,2
	126,8	2967,7
	129,3	2991,1
	128,1	3080,4
	126,4	3167,6
	130,0	**3293,1**

Cross-section 34

Measurement method	Height m	Length (L) m
	130	0
	129,2	93,1
	128,2	140,0
	127,1	162,9
	126,1	233,2
	126,6	321,6
	126,2	415,3
	126	463,8
	125,3	512,0
	124,2	568,4
	123,4	640,5
	122,1	703,9
	121,8	757,4
	122,6	822,1
	123,5	909,7
	124	921,3
	124,3	998,8
	124,9	1062,7
	125,7	1200,0
	126,2	1383,0
	125,8	1582,6
	126,4	1778,7
	126,1	1955,8
	126,2	2051,8
	126,4	2237,9
	126	2435,2
	124,2	2461,3
	122,6	2489,1
	120,2	2515,9
	118,6	2558,3
	117,5	2588,9
	119,8	2606,1
	120,3	2641,8
	122,4	2685,7
	123,8	2701,6
	126,8	2884,3
	126,4	3060,8
	127,3	3216,2
	125,5	3377,4
	126,4	3499,7

	124,8

	127,6	3540,1
	130,0	**3635,2**
	124,85	

Cross-section 35

Measurement method	Height m	Length (L) m
	130	0
	129,2	30,4
	128,1	63,5
	127,2	99,8
	126,5	196,0
	126,1	284,3
	126,4	403,5
	126,4	536,9
	126,2	637,3
	126	734,6
	126,2	818,0
	125,2	909,6
	124,2	998,0
	123,4	1119,6
	122,1	1211,0
	121	1267,7
	120,8	1356,2
	122,3	1430,8
	123,7	1474,9
	124,8	1568,0
	125,2	1651,1
	125	1762,7
	125,4	1890,0
	126	2032,2
	126,4	2195,5
	125,9	2355,1
	126,1	2496,2
	126	2673,5
	124,2	2698,1
	122,3	2745,3
	120,1	2790,0
	119,6	2837,7
	118,5	2890,1
	117,6	2909,9
	119,7	2924,0
	121,1	2959,9
	122,9	2988,5
	124,2	3012,0
	125,4	3216,0

Cross-section 36

Measurement method	Height m	Length (L) m
	130	0
	129,6	25,3
	129,1	51,0
	128	88,8
	127,1	124,0
	126,5	197,2
	126	245,4
	125,3	326,7
	124,9	404,4
	125,3	469,0
	126,2	545,6
	126,4	657,7
	126	768,0
	125,9	900,9
	126,1	1049,2
	126	1183,1
	125,4	1285,3
	124,6	1402,0
	124,1	1503,8
	123,3	1631,2
	122,4	1753,1
	121,1	1864,4
	122,6	1961,8
	123,9	2050,4
	124,2	2146,5
	124,9	2255,3
	125,2	2362,3
	125,9	2471,6
	126,2	2575,0
	126,1	2675,3
	124,2	2717,7
	122,4	2751,3
	120,3	2789,9
	119,1	2811,3
	118,5	2860,4
	117,4	2883,7
	119,6	2920,1
	121,5	2957,3
	122,4	2985,3

	123,3	3380,0
	129,4	3491,1
	129,2	3567,0
	130	**3686,5**
	124,635	

	124,6	3098,1
	125,2	3216,2
	124,6	3348,9
	123,2	3507,6
	126,9	3597,0
	127,9	3677,3
	130,0	**3795,3**
	124,58	

Cross-section 37

Measurement method	Height m	Length (L) m
	130	0
	129,1	34,9
	128	73,6
	127,2	140,3
	126,3	178,7
	125,4	256,0
	124,65	304,3
	124,3	341,9
	125,3	416,5
	124,9	497,6
	125,3	542,3
	124,4	611,1
	125	688,8
	125,3	783,3
	125,9	866,6
	125,7	965,8
	126,1	1060,5
	126	1141,7
	125,7	1243,9
	126,2	1350,3
	125,6	1429,4
	125,1	1528,1
	124,9	1604,8
	124,2	1704,1
	124	1802,4
	123,7	1891,1
	122,6	1964,5
	121,9	2055,9
	120,6	2117,6
	121,5	2173,0
	122,6	2236,4
	123,8	2284,8
	124,6	2358,9

Cross-section 38

Measurement method	Height m	Length (L) m
	130	0
	125,2	30,0
	123,2	75,0
	120,5	145,0
	118,4	175,0
	120,6	215,0
	121,7	295,0
	125,3	391,6
	126,3	515,0
	124,6	613,3
	121,3	687,6
	120,5	752,7
	120,6	879,1
	121,3	1168,7
	126,9	1537,0
	126,7	1949,2
	126,9	2278,1
	125,8	2555,7
	128,6	2951,9
	127,2	3190,9
	128,6	3314,2
	130	**3440,9**
	124,3	

	125,3	2439,2
	126,1	2526,8
	125,9	2620,9
	126,0	2660,8
	124,6	2706,3
	122,1	2761,4
	120,6	2790,9
	119,3	2845,3
	116,5	2899,9
	118,6	2916,6
	120,4	2961,4
	122,4	2984,5
	124,6	3104
	125,0	3256,2
	126,8	3450,1
	128,9	3516,4
	127,6	3780,6
	124,6	3945,8
	125,6	4111,2
	128,7	4288,7
	124,3	4456,6
	126,5	4670,5
	130,0	**4793,8**
	124,7	

Cross-section 39

Measurement method	Height m	Length (L) m
	130	0
	126,1	30,1
	124,3	75,6
	122,5	138,8
	120,2	212,9
	122,6	282,2
	126,6	381,8
	127,7	466,5
	125,2	585,8
	122,3	693,5
	119,3	841,9
	121,6	967,2
	122,9	1112,9
	123,1	1249,6
	121,3	1410,7
	126,7	1605,3
	125,9	1800,8
	127,8	1927,6

Cross-section 40

Measurement method	Height m	Length (L) m
	130	0
	129,6	78,7
	129,1	173,0
	129	206,7
	129,2	250,1
	128,2	342,0
	127,4	470,3
	127	943,5
	126,9	1332,2
	127,2	1734,8
	126,5	2072,9
	127,4	2360,9
	125,3	2560,5
	123,2	2628,8
	121,5	2819,5
	120,6	2937,6
	120	3109,1
	123,3	3241,3

	126,1	2177,2
	127,6	2492,7
	126,7	2921,0
	129,9	3232,7
	130	**3532,4**
	124,8	

	126,1	3325,4
	127	3372,6
	127,8	3421,8
	128,1	3483,4
	129,9	3533,8
	126,7	3591,9
	127,4	3640,6
	126,6	3762,2
	126,2	3844,1
	127,9	3898,3
	128,8	3945,9
	130	**4103,2**
	126,7	

Cross-section 41

Measurement method	Height m	Length (L) m
	130	0
	129,6	30,0
	130,6	87,1
	131	151,1
	130,3	254,7
	131,2	390,8
	130,9	458,1
	130,1	555,1
	131,2	602,9
	130,9	656,3
	129,6	716,0
	128,7	815,6
	127,2	905,8
	125,3	989,5
	121,1	1078,1
	118,1	1153,3
	120,6	1241,6
	123,2	1308,4
	125,3	1376,9
	123,4	1560,0
	121,7	1737,3
	121,1	1849,3
	122,1	1995,9
	126,6	2173,1
	128,7	2312,3
	130,6	2435,5
	131,7	2547,1
	128,1	2695,3
	127,6	2818,7

Cross-section 42

Measurement method	Height m	Length (L) m
	130	0
	129,2	14,1
	130,2	38,3
	129	87,6
	129,1	143,9
	130	161,9
	131	184,2
	130,4	376,7
	131,2	560,2
	130,2	626,5
	131,1	717,6
	130,2	895,7
	129,4	943,1
	128,2	969,3
	127,4	1065,5
	124,2	1138,5
	119,4	1200,7
	121,5	1238,7
	123	1284,2
	126,3	1375,8
	128,2	1464,0
	128,4	1573,3
	127,8	1838,1
	128,6	2142,4
	128,32	2378,8
	128	2556,5
	128,8	2775,6
	127,9	2963,8
	128,3	3199,5

	126,3	3014,9
	123,2	3159,1
	125,6	3281,6
	126,8	3473,0
	127,7	3679,3
	127,6	3927,3
	128,1	4141,7
	127	4362,4
	126,3	4543,5
	129,4	4662,6
	130	**4851,6**
	127,0	

	128,6	3681,5
	128,1	3950,6
	128,7	4099,4
	128	4305,1
	128,7	4423,9
	129,4	4461,3
	129,2	4494,9
	130	**4504,9**
	128,2	

Cross-section 43

Measurement method	Height m	Length (L) m
	130	0
	130,7	17,2
	130,1	37,9
	129,3	68,7
	128,2	91,6
	127,1	134,8
	126,3	166,4
	125,2	189,9
	121,6	209,7
	120,3	233,0
	121,6	251,7
	120,3	297,0
	121,3	359,3
	125,6	476,6
	125,7	640,4
	126,7	888,1
	126,3	1199,2
	127,9	1686,2
	127,1	2230,4
	126,3	2713,4
	127,6	3039,5
	128,6	3129,2
	127,1	3245,7
	127,9	3333,3
	128	3555,7
	126,5	3775,6
	126,9	3975,3
	127,4	4158,2
	127,1	4223,6
	126,2	4423,3

Cross-section 44

Measurement method	Height m	Length (L) m
	130	0
	129,6	13,2
	129,1	43,3
	129,2	79,1
	122,1	90,4
	125,2	114,0
	122,6	133,7
	121,1	145,4
	124,5	171,8
	125,3	191,5
	125,3	211,8
	125,2	605,8
	125,6	905,0
	126,3	1216,1
	126,5	1520,0
	127,77	1854,2
	127	2145,3
	126,3	2394,1
	125,8	2709,6
	126,5	2927,3
	127,7	3176,5
	128,5	3238,6
	129,6	3287,5
	128,1	3316,8
	129,6	3348,2
	130,4	3361,4
	129	3409,0
	128,1	3421,7
	127,3	3479,0
	126,2	3539,3

	125,5	4532,4
	124,2	4612,8
	127,8	4680,2
	128,7	4762,4
	130	**4899,1**
	126,4	

	125,1	3551,6
	122,3	3603,2
	121,7	3621,0
	123,5	3666,3
	125,8	3709,6
	126,5	3729,2
	127,4	3779,3
	127	3802,9
	127,3	3830,5
	126,1	3872,7
	123,6	3902,9
	121,2	3935,1
	120,1	3953,6
	121,4	3990,9
	123,5	4032,6
	125,3	4171,0
	126,9	4299,7
	127,4	4369,0
	129,3	4414,1
	129,8	4529,3
	130	**4739,7**
	126,1	

Cross-section 45

Measurement method	Height m	Length (L) m
	130	0
	129	15,9
	129,1	45,3
	128,2	115,8
	127,8	159,7
	127	282,5
	126,3	365,2
	124,1	413,4
	121,6	454,7
	120,2	507,9
	121,6	546,2
	124,3	614,4
	126,6	665,7
	126	701,9
	124	719,1
	121,6	738,7
	118	760,3
	120,6	772,0
	123,2	795,5
	124,5	815,2

Cross-section 46

Measurement method	Height m	Length (L) m
	130	0
	129,1	534,0
	128,2	578,6
	127,3	744,3
	126,1	837,7
	127	918,3
	126,4	1298,5
	126,1	1761,3
	126,3	2309,5
	125,2	2541,6
	124,1	2604,3
	120,3	2707,6
	122,2	2749,7
	125,2	2780,0
	126,6	2801,7
	127,3	2947,7
	128,1	3005,8
	129,3	3178,8
	129	3205,0
	129,6	3300,2

125,6	835,5
126,1	874,1
127	963,8
127,7	1082,9
127,2	1266,6
126,1	1357,9
125,2	1414,5
123,7	1453,2
122,2	1493,2
124,7	1544,3
125,9	1593,8
126,3	1653,7
127	1759,9
127,2	1837,3
126,3	1925,9
125,5	2017,0
125	2080,7
123,2	2118,4
121	2160,0
120	2198,7
121,6	2219,0
123,7	2242,6
125,6	2274,2
127,1	2324,8
128,3	2431,0
128	2571,6
127,2	2951,6
127,5	3011,6
127	3351,6
127,3	3894,8
127,1	4082,8
128	4252,8
129,1	4335,5
127,4	4528,7
127,1	4717,3
128,3	4809,6
130,1	4880,2
131	5106,7
130,4	5240,7
130,2	5441,3
128,6	5525,5
127,4	5621,8
126,1	5733,1
124,3	5868,3
123,1	5960,8
121,4	6043,4
119,1	6130,3

130	3409,3
128	3571,3
126,8	3655,3
126,1	3799,7
126,2	3816,3
127,4	3912,5
128,5	4006,5
129,3	4195,3
129	4241,0
130	4395,8
129,4	4455,8
129,1	4502,6
129,5	4663,3
128,1	4710,7
128,7	4860,0
129,3	4976,3
130,1	5050,7
129,3	5117,9
124,2	5284,2
121,3	5377,4
120,5	5448,2
122,6	5597,5
123,5	5686,4
124,6	5718,6
126,1	5829,3
127	5984,6
128,4	6030,3
129,1	6108,6
130	6220,9
129,2	6344,4
127,3	6443,2
126,1	6560,2
127	6693,5
128,2	6752,4
130	6858,4
129,3	6954,4
128,6	7254,7
130	7324,7
129	7459,7
128,2	7584,7
127,5	7635,6
126	7756,2
125,31	7875,5
122,6	7999,2
124,6	8030,8
125,3	8166,0
126	8213,9

	120,3	6189,0
	122,6	6288,6
	124,5	6361,8
	126,6	6444,2
	127,1	6589,2
	127,3	6849,2
	127	7049,5
	128,2	7090,7
	129,6	7114,4
	130	**7131,0**
	125,7	

	127,9	8336,9
	128,74	8455,9
	124,3	8474,9
	120,3	8500,2
	123,5	8623,3
	126,2	8734,5
	129,1	8780,5
	130	8865,5
	129	8890,5
	128,2	8919,2
	126,3	9126,2
	126	9103,2
	126,1	9253,1
	127,6	9316,9
	128,9	9436,2
	130	**9481,5**
	127,0	

Cross-section 47

Measurement method	Height m	Length (L) m
	130	0
	129,6	14,0
	129	30,3
	125,2	43,6
	122,6	54,0
	124,3	72,2
	125,6	82,8
	126,7	96,2
	127	121,3
	128,1	153,8
	129,2	236,5
	128,2	307,7
	127	338,3
	126,3	356,0
	126	552,6
	126,5	672,5
	126,1	960,7
	126,3	1138,0
	127,5	1163,7
	128,2	1223,8
	129	1830,8
	127	1846,1
	126,4	1924,0
	126	2114,3
	125,5	2195,9

Cross-section 48

Measurement method	Height m	Length (L) m
	130	0
	129,2	11,1
	124,2	27,1
	121,6	65,3
	123,1	84,8
	126,2	96,1
	129,6	119,8
	130	146,5
	125	158,8
	120	165,2
	122,2	171,0
	124,6	177,4
	128,3	185,1
	128,7	415,1
	129,4	665,7
	129,1	845,7
	130	922,4
	128	1072,3
	127,2	1510,3
	126	2302,4
	124,3	2337,4
	122,6	2355,7
	121,6	2371,9
	122,3	2400,5
	123,7	2448,9

	124,2	2296,9
	122,6	2408,5
	120,1	2501,2
	121,36	2618,1
	124,6	2715,3
	126	2822,5
	127,1	2900,9
	128,4	2947,2
	129,2	3026,6
	129,6	3137,0
	127,1	3238,8
	126,2	3391,2
	128	3436,5
	129	3451,9
	130	**3459,7**
	126,6	

	125,8	2507,6
	126,4	2582,6
	128,2	2602,2
	130	**2652,5**
	126,0	

Cross-section 49

Measurement method	Height m	Length (L) m
	130	0
	129,5	14,8
	126,1	34,5
	124,2	44,8
	121,3	54,6
	123,5	66,2
	125,7	82,5
	126,9	160,7
	127,8	279,0
	127,6	422,3
	127	522,9
	128,1	599,7
	129,3	657,5
	130	837,3
	129,2	877,5
	128,1	938,2
	126,3	989,0
	123,2	1079,8
	122,7	1160,4
	121	1262,0
	122,2	1360,6
	123,1	1451,5
	124,1	1561,2
	125,2	1654,5
	126,6	1765,7
	127,1	1829,5
	128,2	1870,0

Cross-section 50

Measurement method	Height m	Length (L) m
	130	0
	129	20,0
	128,2	31,3
	127	215,9
	128	255,9
	129,1	292,0
	130	332,0
	129,2	395,1
	128,3	428,5
	126,2	492,5
	124,2	514,5
	122,1	533,5
	123,2	639,5
	122,4	757,7
	123,6	864,7
	125	975,8
	126	1092,1
	127,5	1265,9
	128,4	1385,1
	129,7	1412,3
	130	1547,0
	129,3	1611,2
	127,1	1724,2
	125	1750,4
	123,1	1812,4
	124,6	1921,2
	126,7	1961,5

	130	2011,9
	129,1	2041,2
	130	2181,4
	129,2	2233,7
	128	2375,1
	126	2422,5
	127,1	2586,4
	128,2	2626,7
	129,1	2789,3
	130	2826,2
	129	2955,7
	128	3018,7
	129,2	3082,9
	130	**3124,1**
	126,9	

	128,8	1982,7
	130	2023,1
	129	2151,8
	128,1	2200,3
	127,2	2245,0
	126,1	2321,6
	127	2448,7
	126	2504,0
	127	2554,0
	128	2586,2
	129,2	2629,6
	130	2679,3
	129,2	3014,1
	128,3	3077,1
	128	3149,1
	127,1	3182,5
	123,1	3204,6
	122,9	3258,2
	125,2	3276,4
	126,7	3296,3
	127,6	3348,0
	128,1	3428,5
	129	3563,3
	130	3612,2
	129,2	3651,4
	123,4	3697,0
	124,6	4037,3
	127,2	4064,1
	129	4084,2
	128,1	4108,8
	129	4234,6
	130	**4285,8**
	127,2	

Cross-section 51

Measurement method	Height m	Length (L) m
	130	0
	129	10,3
	125,4	136,3
	123,3	450,3
	123,5	698,3
	124,6	775,3
	126,3	862,9
	124,4	946,9
	125,1	1036,8

Cross-section 52

Measurement method	Height m	Length (L) m
	130	0
	129	120,5
	128	180,9
	129	351,0
	130	1283,8
	129	1608,8
	128	1711,1
	123	1793,5
	124,1	1889,8

	123,1	1252,8
	126,8	1327,5
	129,3	1359,6
	130	2480,6
	127	2573,8
	123,6	2635,9
	124,4	2690,6
	123,1	2954,6
	124	3236,6
	127,2	3268,8
	129,1	3332,2
	130	**3349,8**
	126,0	

	123,2	1964,2
	124,6	2076,1
	123,2	2122,4
	125,7	2160,4
	128,6	2223,7
	129,1	2282,8
	130	2457,0
	128	2553,2
	129,1	2691,8
	129,5	2910,8
	130	**2957,1**
	127,4	

Cross-section 53

Measurement method	Height m	Length (L) m
	130	0
	129	95,9
	128	183,7
	124,3	229,7
	126,6	303,7
	127,6	362,7
	126,4	410,4
	125,6	499,1
	126,1	588,6
	128,9	777,3
	129,4	883,8
	128,8	1071,4
	129	1161,1
	129,5	1257,1
	130	**1238,4**
	127,8	

Cross-section 54

Measurement method	Height m	Length (L) m
	130	0
	129	36,0
	127	715,6
	128	735,9
	129	806,0
	130	1165,8
	129,2	1196,1
	128,4	1261,3
	127,2	1357,6
	128,1	1445,9
	127,2	1542,2
	126,8	1661,0
	124,9	1734,2
	123,1	1804,0
	127,6	1885,1
	129,1	1941,4
	130	**1912,5**
	127,8	

Cross-section 55

Measurement method	Height m	Length (L) м
	130	0
	129	36,0
	127	62,2
	125,2	115,5
	123,9	193,1
	126,5	242,2
	128,6	389,9
	129,3	586,1

Cross-section 56

Measurement method	Height m	Length (L) m
	130	0
	129,3	6,0
	128,4	17,0
	127,2	160,0
	128,4	540,0
	129,2	831,1
	128	1073,1
	126,2	1162,5

	130	**618,2**
	127,6	

	123,9	1255,7
	125,3	1301,9
	126	1323,2
	128	1396,5
	129,4	1405,3
	130	1440,3
	129	1490,3
	130	**1550,3**
	128,0	

Cross-section 57

Measurement method	Height m	Length (L) m
	130	0
	129	140,8
	130	423,8
	129,4	673,9
	128,6	887,9
	127,3	1106,1
	128,9	1242,1
	129,5	1464,2
	129,8	1516,3
	130	1546,5
	127,3	1584,2
	123,4	1626,3
	125,8	1677,6
	126	1710,2
	128,1	1752,1
	129,2	1808,4
	128,5	1897,4
	130	**1912,6**
	128,4	

Cross-section 58

Measurement method	Height m	Length (L) m
	130	0
	129,3	46,0
	129,1	128,3
	129	181,4
	128,6	502,4
	128,4	644,4
	129,1	926,4
	129	952,4
	128,8	985,7
	130	1002,5
	129	1233,5
	127,2	1696,5
	126,1	1792,9
	123,1	1886,2
	125,9	1989,8
	128,8	2045,9
	129,1	2078,9
	130	**2103,9**
	128,4	

Cross-section 59

Measurement method	Height m	Length (L) m
	130	0
	130	13,2
	128	27,7
	127	125,4
	126	202,0
	124	275,5
	126	349,8
	128	393,3
	129	500,2
	130	782,2
	129	984,2

Cross-section 60

Measurement method	Height m	Length (L) m
	130	0
	129	52,3
	128	64,7
	127,8	212,3
	129,3	596,3
	128,6	840,8
	128,8	1012,7
	130	1034,7
	129,6	1057,9
	130	1194,5
	127,5	1295,6

	129	1081,3
	130	1214,4
	130	1377,4
	128	1447,8
	130	**1469,9**
	128,4	

	123,8	1392,7
	128,2	1488,2
	129,3	1544,4
	130	**1598,0**
	128,8	

Cross-section 61

Measurement method	Height m	Length (L) m
	130	0
	129,3	21,0
	127,3	119,2
	127,9	225,5
	128,9	306,7
	129	353,0
	130	492,5
	128	568,7
	127	602,1
	123,5	653,6
	129	709,9
	130	739,9
	127,3	858,2
	126,2	901,9
	128,1	982,2
	129,3	1068,6
	129	1125,9
	129,5	1172,4
	130	**1217,1**
	128,5	

Cross-section 62

Measurement method	Height m	Length (L) m
	130	0
	129,3	11,6
	128,2	53,2
	127,2	89,9
	126,8	120,4
	123,6	154,1
	127,8	182,7
	129,1	202,3
	130	518,5
	127,6	618,1
	127,2	701,4
	126,8	778,1
	127,9	869,3
	128,8	932,8
	129,1	974,9
	130	**985,6**
	128,16	

Annex 2. Elevation-capacity calculations

Cross sections	Distance between cross sections m	Mean height at cross section m	Width of cross section m	Area of cross section m^2	Mean area m^2	Water volume mln m^3	130 m height			
							Mean width m	Area m^2	Mean height m	Volume mln m^3
1		125,6	1072	4730						
	570				5020	2,86	1107	631115	125,5	2,859
2		125,4	1142	5310						
	660				5561	3,67	1165	768580	125,2	3,668
3		125,1	1187	5812						
	730				7212	5,26	1421	1037242	124,9	5,239
4		124,8	1655	8613						
	670				9281	6,22	1783	1194603	124,8	6,218
5		124,8	1911	9948						
	620				8691	5,39	1662	1030361	124,8	5,393
6		124,7	1412	7434						
	750				7923	5,94	1449	1086659	124,5	5,937
7		124,3	1485	8411						
	730				6203	4,53	1198	874310	125,0	4,395
8		125,6	910	3995						
	300				3866	1,16	957	287065	125,9	1,164
9		126,3	1004	3736						
	300				5274	1,58	1175	352575	125,6	1,548
10		124,9	1347	6811						
	180				7568	1,36	1530	275323	125,0	1,365
11		125,1	1712	8324						

	460				7085	3,26	1490	685177	125,3	3,247
12		125,4	1267	5847						
	520				6123	3,18	1328	690724	125,4	3,184
13		125,4	1390	6400						
	510				5381	2,74	1294	659905	125,9	2,721
14		126,4	1198	4361						
	510				4448	2,27	1340	683635	126,7	2,290
15		126,9	1483	4535						
	520				5120	2,66	1606	835047	126,8	2,655
16		126,7	1729	5705						
	280				6049	1,69	1804	505180	126,6	1,693
17		126,6	1880	6393						
	260				10137	2,64	2537	659744	126,1	2,555
18		125,7	3195	13881						
	630				18068	11,38	4034	2541618	125,5	11,324
19		125,4	4873	22255						
	580				31757	18,42	7163	4154277	125,5	18,553
20		125,6	9452	41260						
	600				28554	17,13	6964	4178455	126,0	16,517
21		126,5	4476	15849						
	590				15933	9,40	4153	2450114	126,1	9,462
22		125,8	3829	16017						
	1200				13624	16,35	3705	4446096	126,3	16,270
23		126,9	3581	11230						
	1300				13736	17,86	3227	4195705	125,6	18,436
24		124,3	2874	16243						
	1200				14016	16,82	2758	3309420	124,9	16,736
25		125,5	2642	11789						
	760				10935	8,31	2415	1835476	125,5	8,323

26		125,4	2188	10081						
	750				10803	8,10	2333	1750013	125,4	8,100
27		125,4	2478	11525						
	840				11086	9,31	2374	1994454	125,3	9,314
28		125,3	2270	10648						
	520				11442	5,95	2394	1244802	125,2	5,944
29		125,1	2517	12236						
	470				13335	6,27	2694	1266039	125,1	6,260
30		125,0	2870	14433						
	420				14505	6,09	2739	1150422	124,7	6,108
31		124,4	2608	14578						
	530				15252	8,08	2801	1484583	124,5	8,097
32		124,7	2994	15926						
	520				16447	8,55	3144	1634646	124,8	8,559
33		124,8	3293	16968						
	480				17844	8,57	3464	1662792	124,8	8,565
34		124,9	3635	18721						
	570				19207	10,95	3661	2086685	124,8	10,947
35		124,7	3687	19693						
	590				20132	11,88	3741	2207131	124,6	11,876
36		124,58	3795	20571						
	600				23087	13,85	4295	2576730	124,6	13,864
37		124,7	4794	25603						
	580				22616	13,12	4117	2388075	124,5	13,189
38		124,3	3441	19630						
	1306				18935	24,73	3487	4553591	124,6	24,745
39		124,8	3532	18240						
	1480				15919	23,56	3818	5650344	125,8	23,950
40		126,7	4103	13597						

	1553				12576	19,53	4002	6215727	126,9	19,503
41		127,0	3902	11555						
	1915				8981	17,20	3753	7187493	127,6	17,030
42		128,2	3605	6407						
	2145				12058	25,86	4252	9120561	127,3	24,589
43		126,4	4899	17709						
	2076				18018	37,40	4819	10005074	126,3	37,426
44		126,1	4740	18327						
	2625				24561	64,47	5935	15580294	125,9	63,763
45		125,7	7131	30795						
	3000				29397	88,19	8306	24918750	126,4	90,598
46		127,0	9482	27999						
	2620				19910	52,16	6471	16952972	126,8	53,991
47		126,6	3460	11820						
	2200				11248	24,75	3056	6723420	126,3	25,016
48		126,0	2653	10676						
	2710				10145	27,49	2888	7827347	126,4	27,797
49		126,9	3124	9615						
	2400				10903	26,17	3705	8891928	127,0	26,330
50		127,2	4286	12192						
	2300				12863	29,58	3818	8780940	126,6	30,228
51		126,0	3350	13533						
	2850				10572	30,13	3153	8987361	126,7	29,720
52		127,4	2957	7611						
	3000				5168	15,50	2098	6293280	127,6	15,021
53		127,8	1238	2724						
	3000				3478	10,43	1575	4726350	127,8	10,428
54		127,8	1913	4231						
	2610				2869	7,49	1265	3302564	127,7	7,678

55			127,6	618	1507						
	3010					2340	7,04	1084	3263593	127,8	7,317
56			128,0	1550	3173						
	3130					3117	9,75	1731	5419439	128,2	9,881
57			128,4	1913	3060						
	3320					3232	10,73	2008	6667390	128,4	10,727
58			128,4	2104	3403						
	2710					2912	7,89	1787	4842499	128,4	7,904
59			128,4	1470	2420						
	2810					2186	6,14	1534	4310400	128,6	6,181
60			128,8	1598	1952						
	2610					1912	4,99	1408	3673706	128,6	5,070
61			128,5	1217	1873						
	2810					1843	5,18	1101	3094794	128,3	5,228
62			128,2	986	1814						
											130
	Distance					**Volume, mln m^3**		**247804592**	**m^2**	**862,696**	**mln m^3**
TOTAL	**82490**					**859,21**		**247,8**	**km^2**	0,7%	
								Area		**Reservoir storage capacity**	

Cross section	Width of cross section	129 m height		
1	1007			
		1046	596220	2,105
2	1085			
		1103	727650	2,745
3	1120			
		1376	1004480	4,069
4	1632			
		1741	1166470	4,905
5	1850			
		1610	998200	4,227
6	1370			
		1412	1059000	4,726
7	1454			
		1151	839865	3,382
8	847			
		920	276000	0,843
9	993			
		1147	343950	1,166
10	1300			
		1447	260460	1,031
11	1594			
		1403	645380	2,413
12	1212			
		1278	664560	2,399
13	1344			
		1423	725730	2,266

Cross section	Width of cross section	128 m height		
		Mean width	Area	Volume
1	1040			
		999	569145	1,440
2	957			
		1004	662310	1,837
3	1050			
		1323	965425	2,945
4	1595			
		1683	1127275	3,613
5	1770			
		1535	951700	3,078
6	1300			
		1369	1026750	3,556
7	1438			
		1105	806650	2,441
8	772			
		686	205800	0,423
9	600			
		942	282450	0,675
10	1283			
		1243	223740	0,662
11	1203			
		1128	518880	1,421
12	1053			
		1187	617240	1,611
13	1321			
		1166	594405	1,262

14	1502			
		1292	658665	1,547
15	1081			
		1158	601900	1,312
16	1234			
		1494	418180	0,983
17	1753			
		2367	615290	1,768
18	2980			
		3662	2307060	7,972
19	4344			
		6633	3846850	13,333
20	8921			
		6849	4109100	12,134
21	4776			
		4300	2537000	7,260
22	3824			
		3489	4186800	11,135
23	3154			
		2948	3832400	13,007
24	2742			
		2600	3119400	12,656
25	2457			
		2186	1661360	5,872
26	1915			
		2115	1586250	5,756
27	2315			
		2215	1860180	6,827
28	2114			

14	1010			
		1004	512040	0,691
15	998			
		1090	566800	0,668
16	1182			
		1387	388220	0,524
17	1591			
		2273	590980	1,107
18	2955			
		3622	2281545	5,602
19	4288			
		6518	3780440	9,323
20	8748			
		6580	3948000	7,710
21	4412			
		4051	2389795	4,449
22	3689			
		3215	3857400	6,401
23	2740			
		2708	3519750	8,426
24	2675			
		2462	2954400	9,032
25	2249			
		1997	1517340	3,846
26	1744			
		1882	1411125	3,709
27	2019			
		2001	1680420	4,487
28	1982			

		2244	1166880	4,405			2145	1115400	3,096
29	2374				29	2308			
		2621	1231870	4,859			2482	1166540	3,435
30	2868				30	2656			
		2709	1137570	4,902			2557	1073730	3,553
31	2549				31	2457			
		2735	1449550	6,457			2633	1395490	4,820
32	2921				32	2809			
		3076	1599260	6,774			2990	1554800	5,031
33	3230				33	3171			
		3359	1612080	6,692			3266	1567440	4,939
34	3487				34	3360			
		3512	2001840	8,500			3384	1928595	6,260
35	3537				35	3407			
		3633	2143470	9,390			3498	2063820	6,978
36	3729				36	3589			
		3992	2394900	10,491			3648	2188800	7,399
37	4254				37	3707			
		3779	2191820	9,913			3449	2000130	7,046
38	3304				**38**	3190			
		3197	4175282	18,514			3100	4048600	13,904
39	3090				39	3010			
		3432	5078620	16,448			3283	4858840	10,878
40	3773				40	3556			
		3810	5916930	12,648			3399	5278647	6,005
41	3847				41	3242			
		3728	7138162,5	9,775			3102	5940330	2,194
42	3608				42	2962			
		4151	8903895	15,101			3776	8098447,5	5,636

43	4694	4502	9346152	25,615	43	4589	4367	9064854	15,779
44	4310	5355	14055562,5	43,467	44	4144	4872	12789000	26,761
45	6399	6898	20692500	54,540	45	5600	5900	17700000	28,953
46	7396	5259	13778580	30,102	46	6200	4206	11019720	13,055
47	3122	2843	6254600	17,017	47	2212	1992	4382400	7,541
48	2564	2316	6276360	16,013	48	1772	1786	4838705	7,506
49	2068	2591	6218400	12,195	49	1799	2042	4899600	4,709
50	**3114**	2868	6596400	16,111	50	2284	2277	5237100	7,554
51	2622	1814	5168475	11,923	51	2270	1361	3877425	5,067
52	1005	1035	3105000	4,306	52	451	523	1567500	0,606
53	1065	1290	3870000	4,668	53	594	964	2892000	0,596
54	1515	1033	2694825	3,571	54	1334	840	2191095	0,712
55	550	1017	3061170	3,802	55	345	862	2594620	0,628
56	1484	1576	4932880	4,061	56	1379	781	2442965	0,000
57	1668				57	182			

		1642	5451440	3,319
58	1616			
		1051	2846855	1,800
59	485			
		810	2276100	0,988
60	1135			
		1075	2805750	1,067
61	1015			
		989	2779090	1,916
62	963			
				129
		m^2	**211000669**	**539,190** **mln m^3**
		km^2	**211,0**	63 %

		400	1328000	0,000
58	618			
		492	1333320	0,000
59	366			
		401	1126810	0,000
60	436			
		541	1410705	0,000
61	645			
		795	2232545	0,000
62	944			
				128
		m^2	**175157998,5**	**301,583** **mln m^3**
		km^2	**175,2**	35 %

Cross section	Width of cross section	127 m height		
		Mean width	Area	Volume
1	1018			
		1029	586530	0,898
2	1040			
		1053	694650	1,232
3	1065			

Cross section	Width of cross section	126 m height		
		Mean width	Area	Volume
1	885			
		936	533520	0,283
2	987			
		1002	660990	1,172
3	1016			

		1304	951555	1,951
4	1542			
		1641	1099470	2,425
5	1740			
		1543	956350	2,137
6	1345			
		1403	1052250	2,592
7	1461			
		1144	834755	1,691
8	826			
		895	268500	0,284
9	964			
		1100	329850	0,458
10	1235			
		1149	206730	0,405
11	1062			
		936	430560	0,749
12	810			
		1048	544960	0,877
13	1286			
		1129	575790	0,646
14	972			
		978	498525	0,174
15	983			
		1034	537680	0,096
16	1085			
		1325	370860	0,130
17	1564			
		2245	583570	0,509

		1220	890235	1,825
4	1423			
		1554	1041180	2,296
5	1685			
		1378	854360	1,909
6	1071			
		1261	945375	2,329
7	1450			
		1105	806650	1,635
8	760			
		830	249000	0,263
9	900			
		995	298500	0,415
10	1090			
		1001	180090	0,353
11	911			
		931	428030	0,744
12	950			
		988	513760	0,827
13	1026			
		973	495975	0,557
14	919			
		748	381480	0,133
15	577			
		566	294320	0,053
16	555			
		941	263480	0,092
17	1327			
		1430	371800	0,325

18	2925				18	1533			
		3569	2248470	3,273			1762	1109745	1,615
19	4213				19	1990			
		6260	3630510	5,322			2810	1629510	2,389
20	8306				20	3629			
		6113	3667500	3,495			2706	1623600	1,547
21	3919				21	1783			
		3348	1975025	1,702			1953	1151975	0,993
22	2776				22	2122			
		2634	3160200	2,084			2040	2447400	1,614
23	2491				23	1957			
		2536	3296150	4,595			2004	2604550	3,631
24	2580				24	2050			
		2242	2689800	5,534			1591	1908600	3,926
25	1903				25	1131			
		1617	1228540	1,885			979	744040	1,142
26	1330				26	827			
		1613	1209750	1,970			1131	847875	1,381
27	1896				27	1434			
		1937	1627080	2,717			1277	1072260	1,791
28	1978				28	1119			
		2095	1089400	1,934			1132	588380	1,045
29	2212				29	1144			
		2363	1110610	2,160			1138	534860	1,040
30	2514				30	1132			
		2449	1028580	2,375			1225	514290	1,188
31	2384				31	1317			
		2553	1352825	3,320			1437	761610	1,869
32	2721				32	1557			

		2907	1511380	3,379		1633	848900	1,898
33	3092				33	1708		
		3180	1526160	3,283		1738	834000	1,794
34	3267				34	1767		
		3309	1885845	4,235		1452	827355	1,858
35	3350				35	1136		
		3412	2012785	4,792		1483	874970	2,083
36	3473				36	1830		
		3372	2023200	4,816		1726	1035300	2,464
37	3271				37	1621		
		3229	1872530	4,724		1584	918430	2,317
38	3186				**38**	1546		
		3049	3981341	9,691		1647	2150329	5,234
39	2911				39	1747		
		2906	4300880	5,328		1444	2136380	2,646
40	2901				40	1140		
		2084	3236452	0,446		1231	1910966,5	0,263
41	1267				41	1321		
		789	1509977,5	0,000		799	1529127,5	0,000
42	310				42	276		
		2200	4717927,5	0,000		912	1955167,5	0,000
43	4089				43	1547		
		3947	8192934	6,068		1494	3101544	2,297
44	3804				44	1441		
		3402	8930250	9,756		1121	2941312,5	3,213
45	3000				45	800		
		4009	12025500	7,645		1150	3450000	2,193
46	5017				46	1500		
		3368	8824160	1,630		1436	3761010	0,695

47	1719	1605	3529900	2,544	47	1371	1097	2413400	1,739
48	1490	1278	3463380	1,909	48	823	812	2199165	1,212
49	1066	1452	3483600	0,000	49	800	750	1800000	0,000
50	1837	1903	4376900	1,936	50	700	990	2277000	1,007
51	1969	1209	3445650	1,057	51	1280	846	2409675	0,739
52	449	444	1330500	0,000	52	411	331	991500	0,000
53	438	373	1119000	0,000	53	250	250	750000	0,000
54	308	244	636840	0,000	54	250	189	493290	0,000
55	180	685	2061850	0,000	55	128	145	434945	0,000
56	1190	663	2075190	0,000	56	161	123	383425	0,000
57	136	320	1060740	0,000	57	84	42	139440	0,000
58	503	374	1012185	0,000	58	0	74	200540	0,000
59	244	171	479105	0,000	59	148	74	207940	0,000
60	97	98	254475	0,000	60	0	0	0	0,000
61	98				61	0			

			81	227610	0,000				0	0	0,000
62		64					62		0		
					127						126
		m^2		**134945272**	**132,861**	**mln m^3**			**m2**	**69722552**	**74,036**	**mln m^3**
		km^2		**134,9**	15	%			**km^2**	**69,7**	9	%

Annex 3. Cross section lines of the Channel reservoir

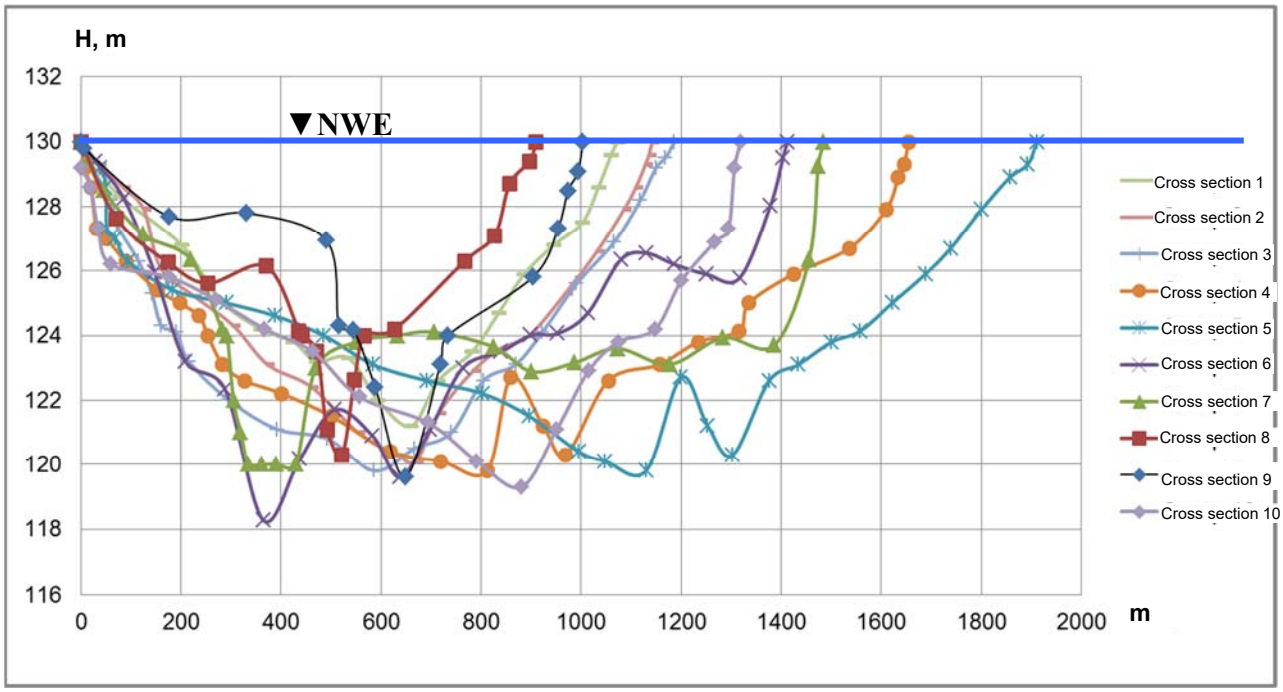


Figure 1. Cross sections 1-10

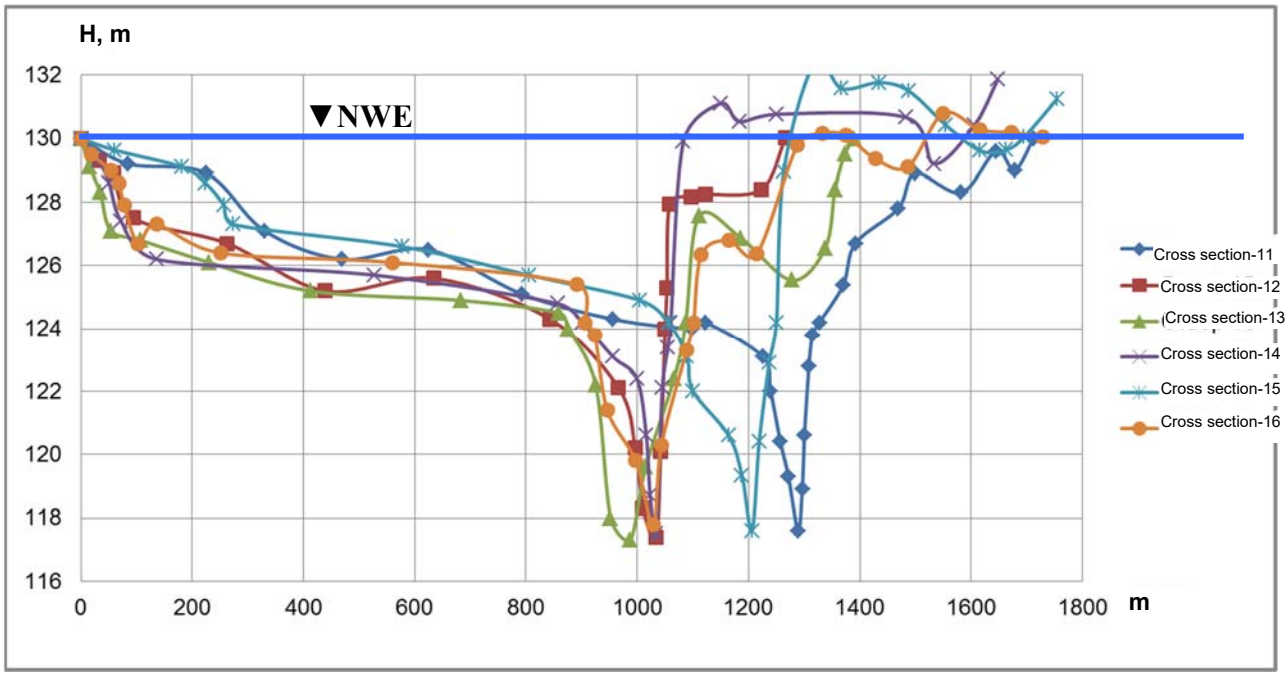


Figure 2. Cross sections 11-16

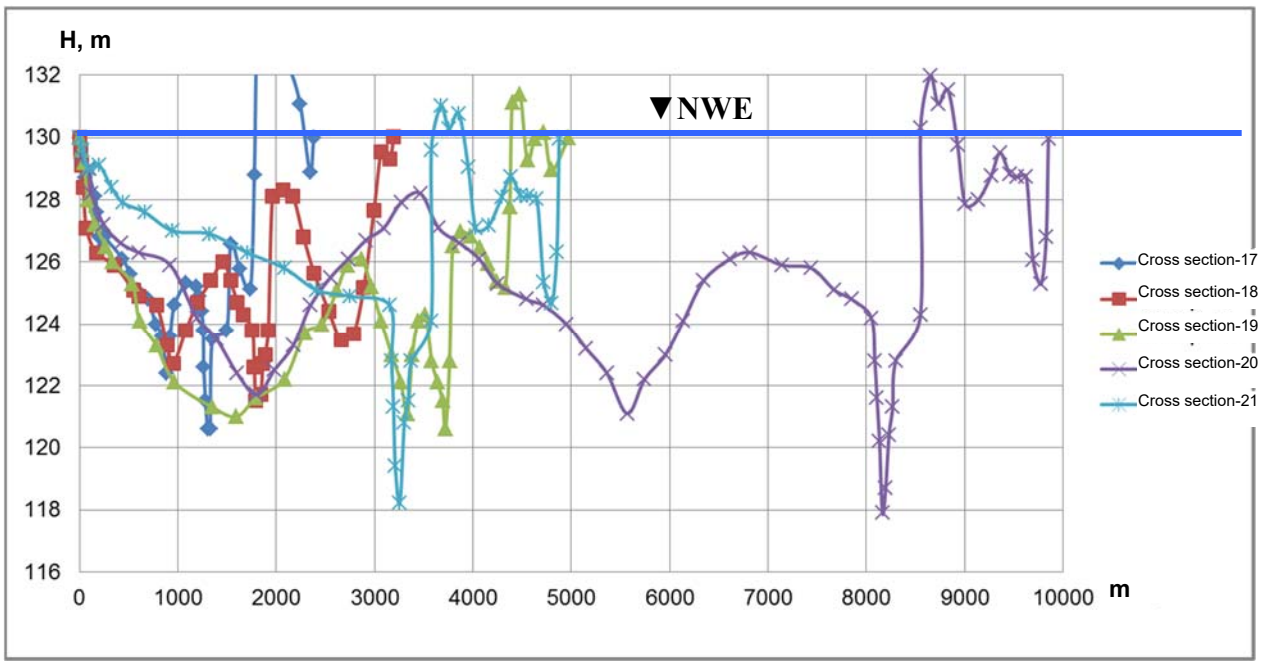


Figure 3. Cross sections 17-21

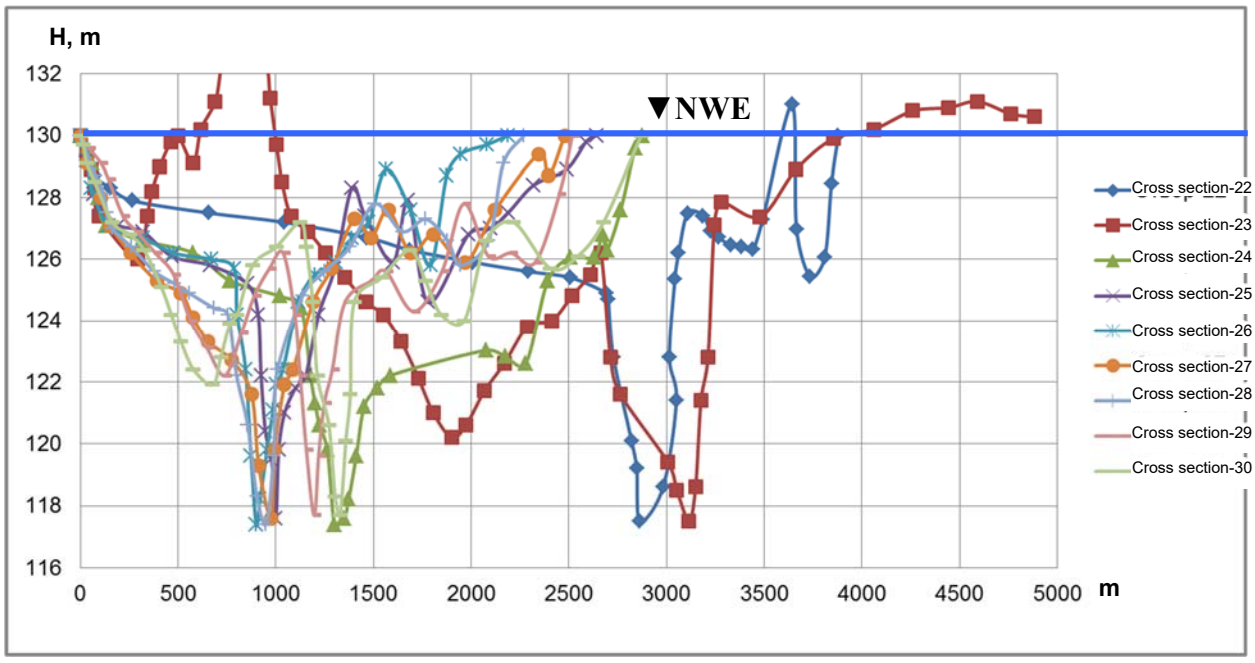


Figure 4. Cross sections 22-30

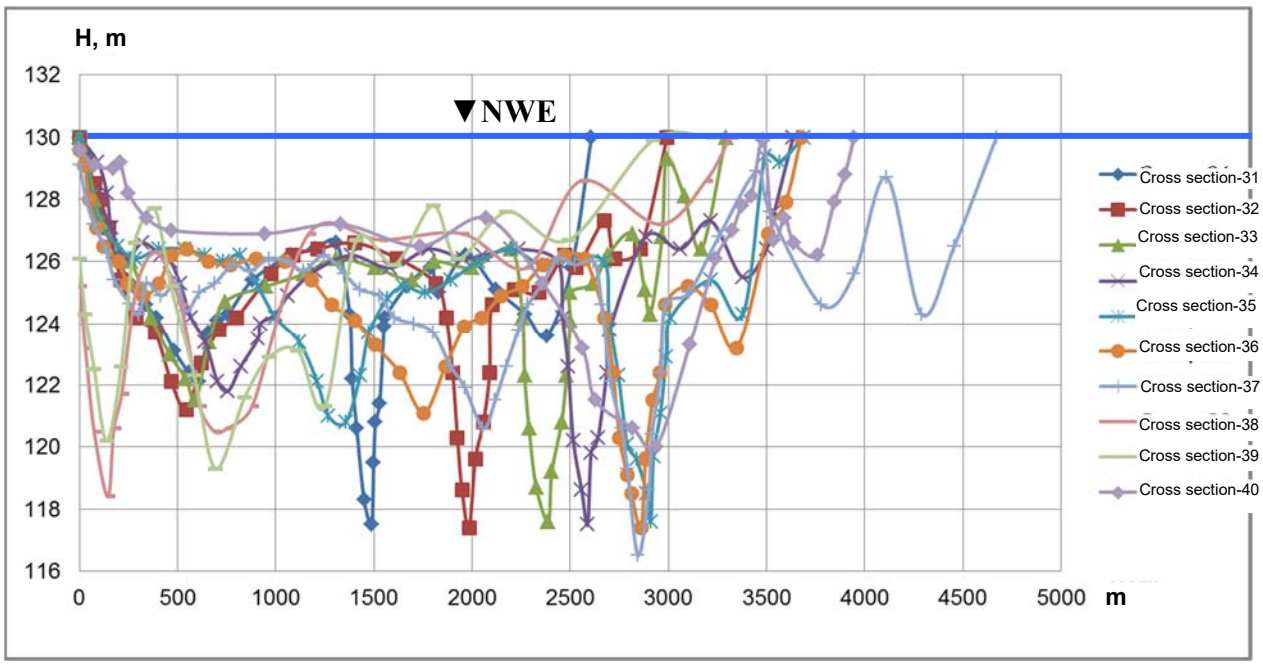


Figure 5. Cross sections 31-40

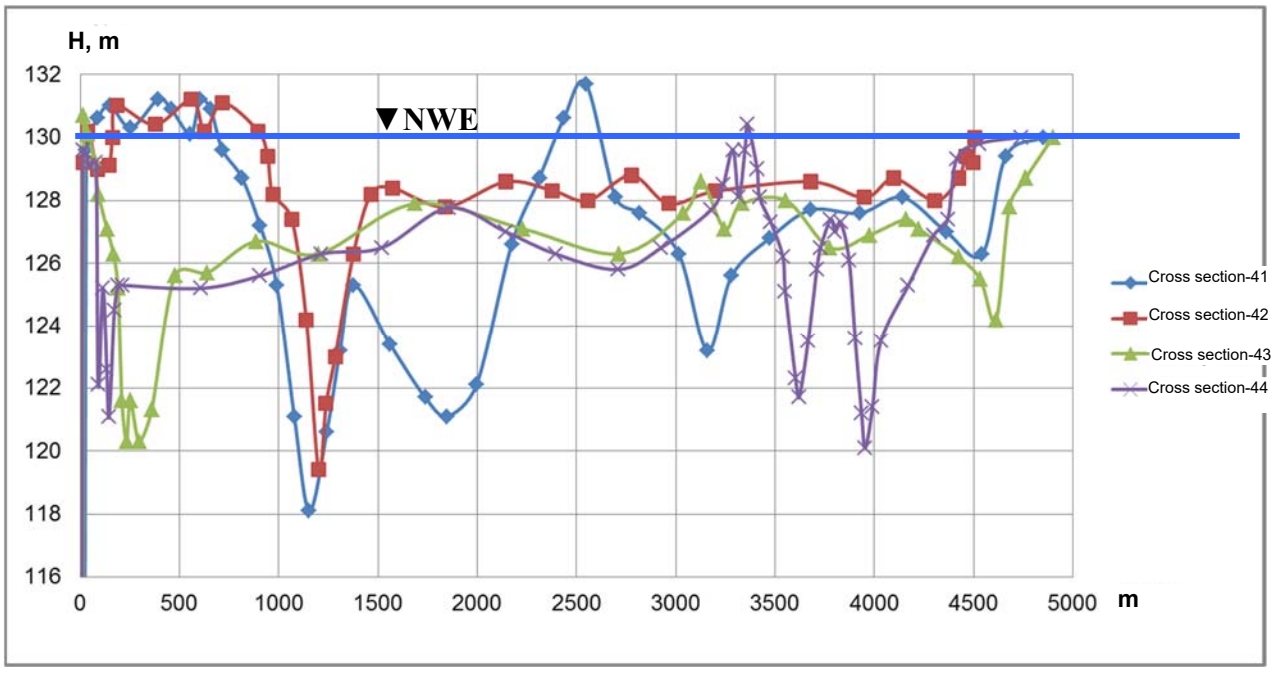


Figure 6. Cross sections 41-44

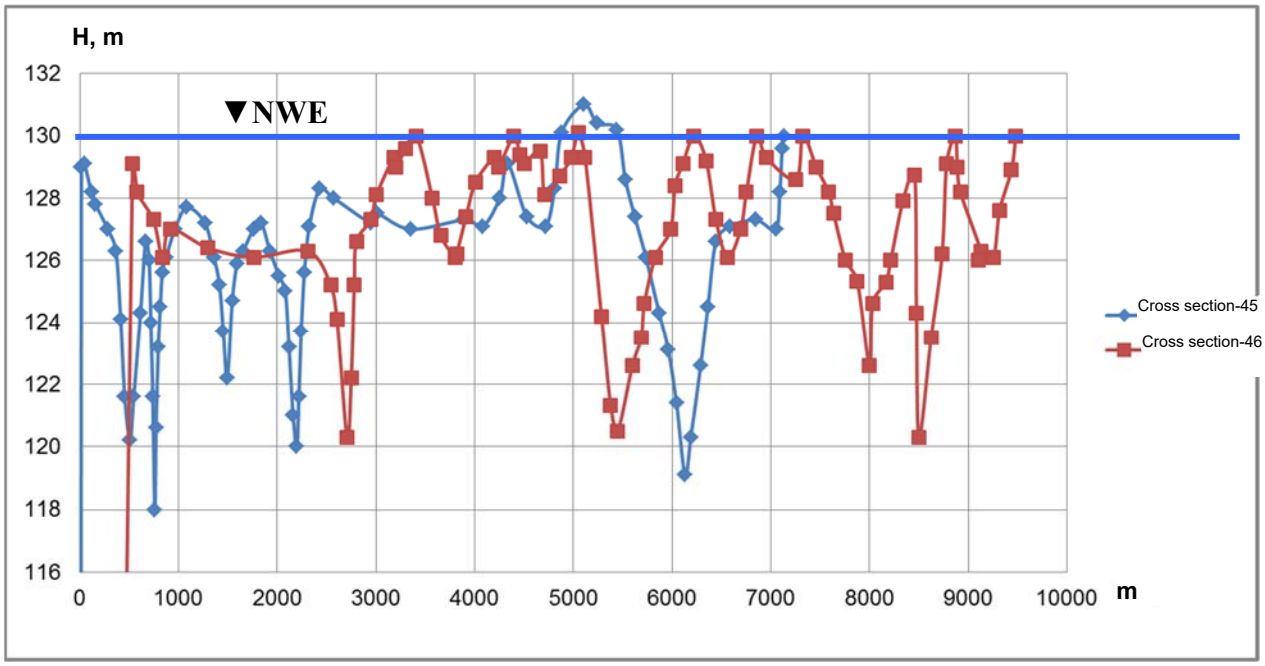


Figure 7. Cross sections 45-46

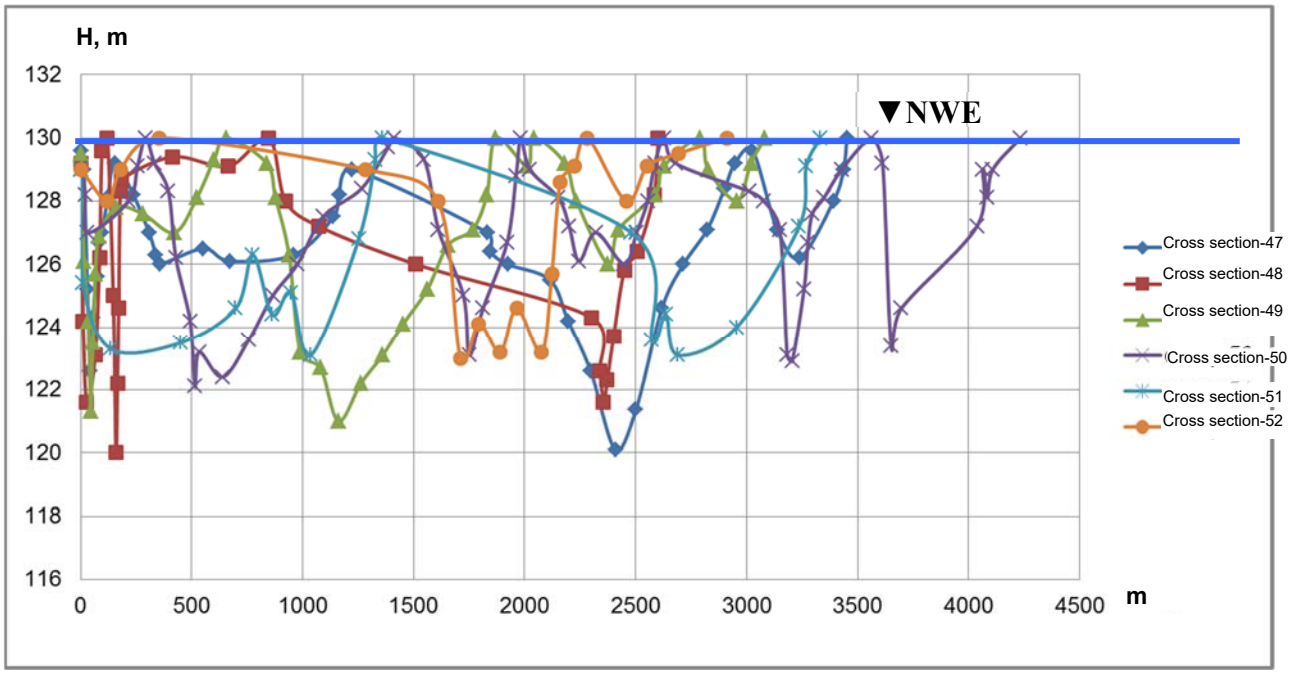


Figure 8. Cross sections 47-52

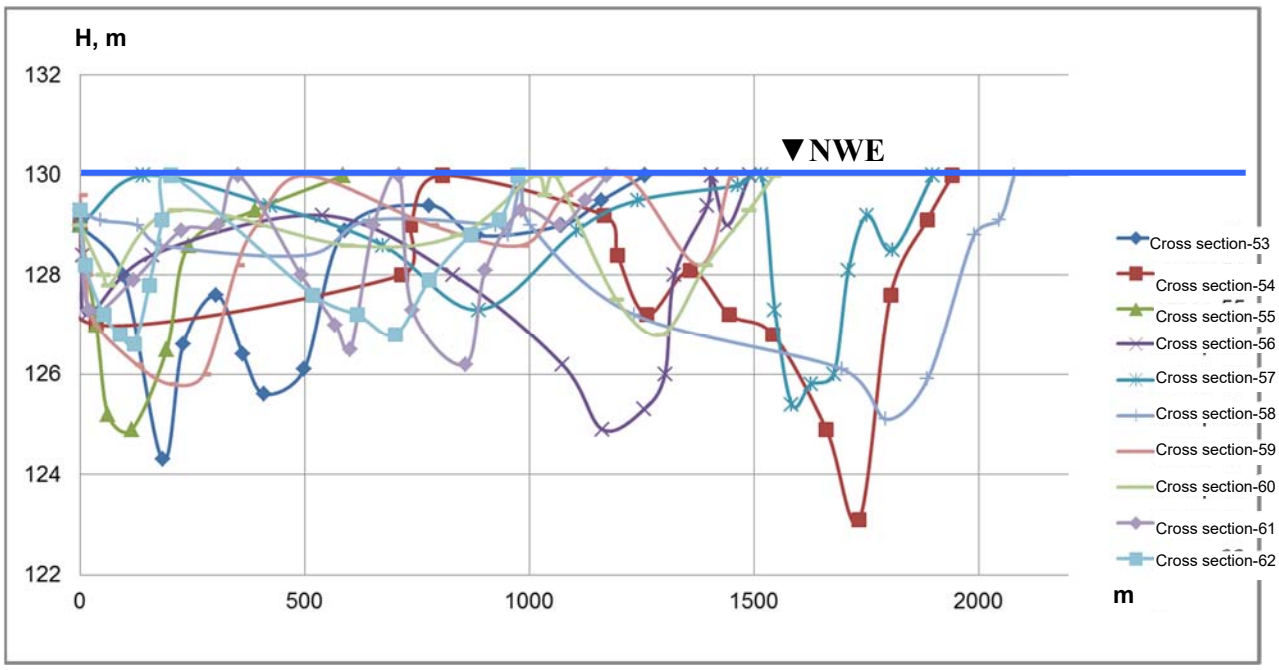


Figure 9. Cross sections 53-62

Annex 3. Changes over time in the reservoir bed elevations in 1981-2021

Cross section	Distance between cross sections m	Distance from the dam m	**1981** (design) bed elevation m	**1987** bed elevation m	**2021**			
					Cross section	Distance between cross sections m	Distance from the dam m	Mean bed elevation m
1	0	0	107,31	111,3	1	0	0	125,6
2	100	100	108,78	109,8	2	570	570	125,4
3	2630	2730	109,64	111,2	3	660	1230	125,1
4	2600	5330	110,93	113,7	4	730	1960	124,8
5	2290	7620	109,2	112,6	5	670	2630	124,8
6	3070	10690	111,85	114,7	6	620	3250	124,7
7	3020	13710	114,34	116,1	7	750	4000	124,3
8	2890	16600	114,39	115,7	8	730	4730	125,6
9	2710	19310	113,9	115,6	9	300	5030	126,3
10	1800	21110	115,44	118,0	10	300	5330	124,9
11	3530	24640	112,24	118,1	11	180	5510	125,1
12	2750	27390	116,57	118,2	12	460	5970	125,4
13	1882	29272	116,83	118,1	13	520	6490	125,4
14	2460	31732	117,28	119,6	14	510	7000	126,4
15	1520	33252	117,22	120,5	15	510	7510	126,9
16	3100	36352	115,16	122,0	16	520	8030	126,7
17	2790	39142	119,32	121,4	17	280	8310	126,6
18	2610	41752	119,11	122,4	18	260	8570	125,7
19	4420	46172	121,32	122,5	19	630	9200	125,4
20	2820	48992	120,93	121,4	20	580	9780	125,6
21	2870	51862	118,09	121,3	21	600	10380	126,5
22	4500	56362	116,4	122,2	22	590	10970	125,8
23	2010	58372	121,54	122,2	23	1200	12170	126,9
24	2150	60522	119,49	123,6	24	1300	13470	124,3
25	3820	64342	122,59	124,7	25	1200	14670	125,5
26	2300	66642	117,17	122,9	26	760	15430	125,4
27	2600	69242	123,52	123,8	27	750	16180	125,4
28	2900	72142	124,45	125,1	28	840	17020	125,3
29	3070	75212	125,07	125,9	29	520	17540	125,1
30	2300	77512	126,2	126,7	30	470	18010	125,0
31	2830	80342	126,5	127,1	31	420	18430	124,4
					32	530	18960	124,7
					33	520	19480	124,8
					34	480	19960	124,9
					35	570	20530	124,7
					36	590	21120	124,6
					37	600	21720	124,7
					38	580	22300	124,3

					39	1306	23606	124,8
					40	1480	25086	126,7
					41	1553	26639	127,0
					42	1915	28554	128,2
					43	2145	30699	126,4
					44	2076	32775	126,1
					45	2625	35400	125,7
					46	3000	38400	127,0
					47	2620	41020	126,6
					48	2200	43220	126,0
					49	2710	45930	126,9
					50	2400	48330	127,2
					51	2300	50630	126,0
					52	2850	53480	127,4
					53	3000	56480	127,8
					54	3000	59480	127,8
					55	2610	62090	127,6
					56	3010	65100	128,0
					57	3130	68230	128,4
					58	3320	71550	128,4
					59	2710	74260	128,4
					60	2810	77070	128,8
					61	2610	79680	128,5
					62	2810	82490	128,2

Annex 4. Calculations of sediment volumes along the length of the Channel reservoir basin

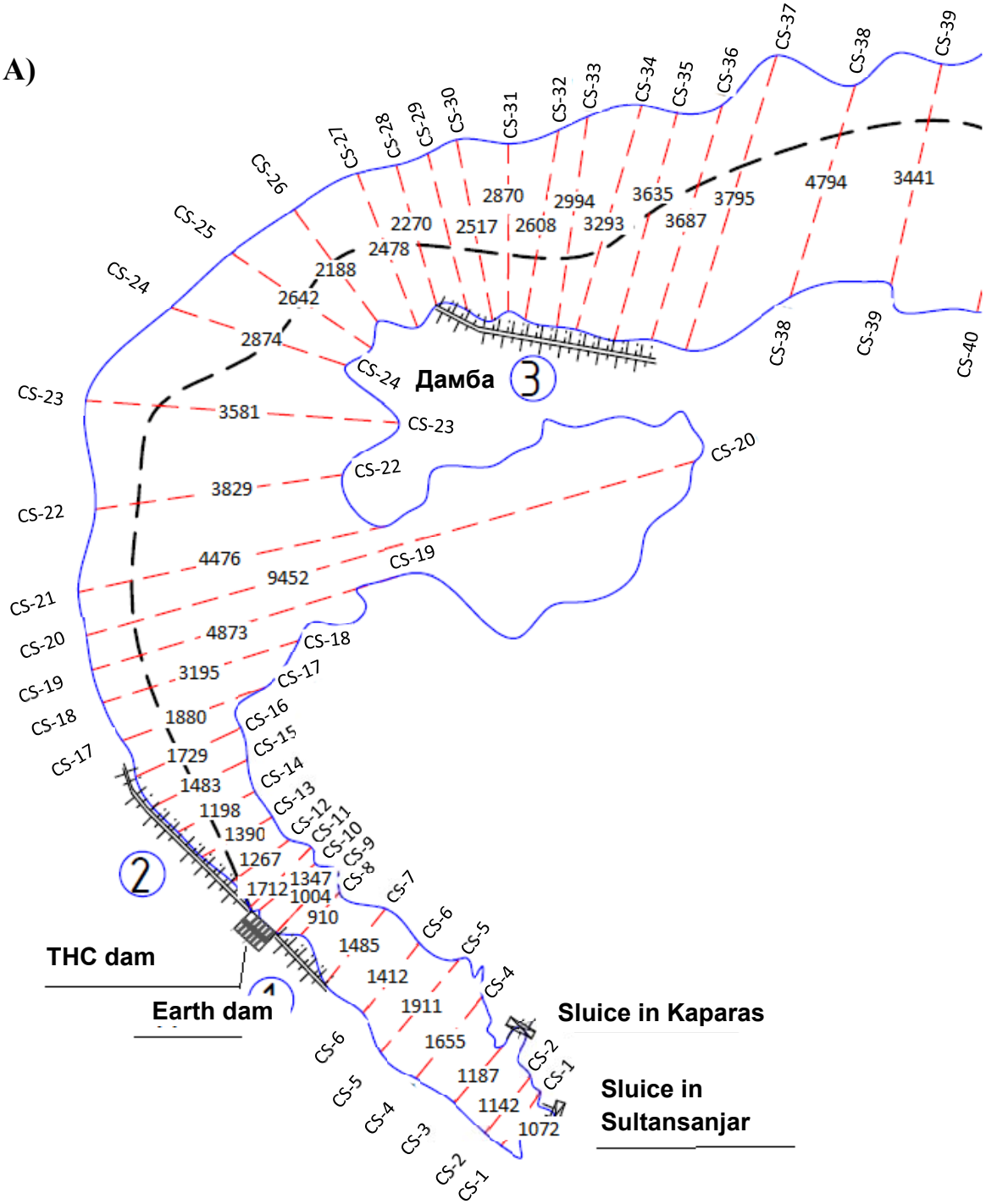
1981 design	1987	Water volume based on 2021 measurements					Sediment volume, 2021						
		Cross section	Distance between cross sections m	Distance from the dam m	Mean bed elevations m	Water volume mln m^3	Section	Section length m	Cross section width m	Mean width of the section m	Mean bed elevation	Mean thickness of sediment layer m	Sediment volume mln m^3
109,3	111,3	1	0	0	125,6	2,861	CS 1-21	10380	1072	2180	125,6	10	226,289
110,8	109,8	2	570	570	125,4	3,670			1142				
112,6	111,2	3	660	1230	125,1	5,265			1187				
113,9	113,7	4	730	1960	124,8	6,218			1655				
114,2	112,6	5	670	2630	124,8	5,389			1911				
116,9	114,7	6	620	3250	124,7	5,942			1412				
117,3	116,1	7	750	4000	124,3	4,528			1485				
117,4	115,7	8	730	4730	125,6	1,160			910				
116,9	115,6	9	300	5030	126,3	1,582			1004				
118,4	118,0	10	300	5330	124,9	1,362			1347				
117,2	118,0	11	180	5510	125,1	3,259			1712				
119,6	118,2	12	460	5970	125,4	3,184			1267				
119,8	118,1	13	520	6490	125,4	2,744			1390				
121,3	119,6	14	510	7000	126,4	2,268			1198				
120,2	120,5	15	510	7510	126,9	2,662			1483				
119,2	122,0	16	520	8030	126,7	1,694			1729				
122,3	121,4	17	280	8310	126,6	2,636			1880				
122,1	122,4	18	260	8570	125,7	11,383			3195				
124,3	122,5	19	630	9200	125,4	18,419			4873				
123,9	121,4	20	580	9780	125,6	17,133			9452				

121,1	121,3	21	600	10380	126,5	9,400			4476				
120,4	122,2	22	590	10970	125,8	16,348	CS 22-35	10150	3829	2962	125,2	10	300,638
124,5	122,2	23	1200	12170	126,9	17,857			3581				
123,5	123,6	24	1300	13470	124,3	16,819			2874				
125,6	124,7	25	1200	14670	125,5	8,311			2642				
122,2	122,9	26	760	15430	125,4	8,102			2188				
126,5	123,8	27	750	16180	125,4	9,508			2478				
127,5	125,1	28	840	17020	125,3	5,950			2270				
128,1	125,9	29	520	17540	125,1	6,267			2517				
129,2	126,7	30	470	18010	125,0	6,092			2870				
		31	420	18430	124,4	8,084			2608				
		32	530	18960	124,7	8,552			2994				
		33	520	19480	124,8	8,565			3293				
		34	480	19960	124,9	10,948			3635				
		35	570	20530	124,7	11,878			3687				
		36	590	21120	124,6	13,852	CS 36-43	10169	3795	4009	125,8	7	285,366
		37	600	21720	124,7	13,118			4794				
		38	580	22300	124,3	24,729			3441				
		39	1306	23606	124,8	23,560			3532				
		40	1480	25086	126,7	19,530			4103				
		41	1553	26639	127,0	17,198			3902				
		42	1915	28554	128,2	21,424			3605				
		43	2145	30699	126,4	25,864			4899				
		44	2076	32775	126,1	37,405	CS 44-47	10321	4740	6203	126,4	5,5	352,115
		45	2625	35400	125,7	64,472			7131				
		46	3000	38400	127,0	88,191			9482				
		47	2620	41020	126,6	52,163			3460				
		48	2200	43220	126,0	24,746		9610	2653	3353	126,5	6	193,337

		49	2710	45930	126,9	27,494	CS 48-51		3124				
		50	2400	48330	127,2	26,168			4286				
		51	2300	50630	126,0	29,584			3350				
		52	2850	53480	127,4	30,130	CS 52-55	11460	2957	1682	127,6	4	77,082
		53	3000	56480	127,8	15,503			1238				
		54	3000	59480	127,8	10,434			1913				
		55	2610	62090	127,6	7,488			618				
		56	3010	65100	128,0	7,043	CS 56-58	9460	1550	1856	128,2	2	35,108
		57	3130	68230	128,4	9,755			1913				
		58	3320	71550	128,4	10,729			2104				
		59	2710	74260	128,4	7,891	CS 59-62	10940	1470	1318	128,4	0,5	7,208
		60	2810	77070	128,8	6,143			1598				
		61	2610	79680	128,5	4,991			1217				
		62	2810	82490	128,2	5,180			986				
											Sediment volume		**1477**

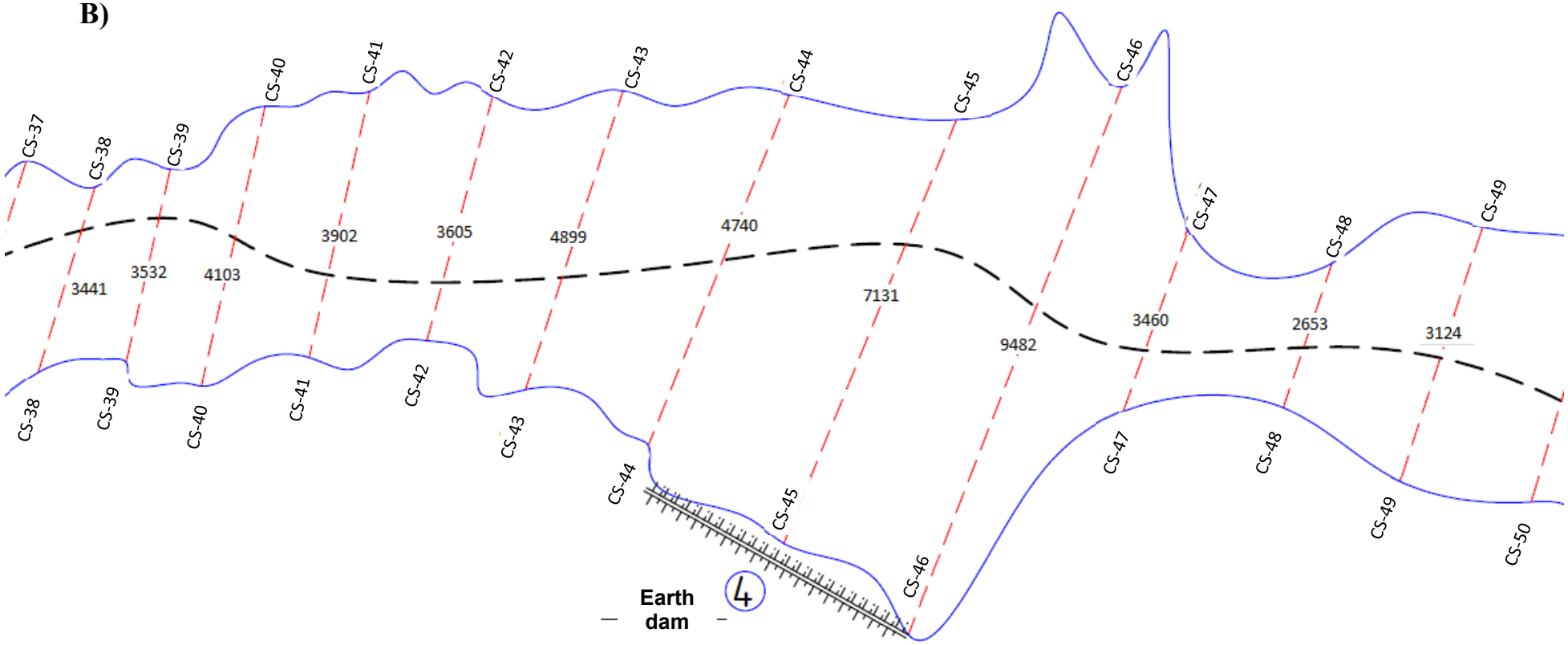
Annex 5. Sections of the reservoir basin with cross sections and their width

A)



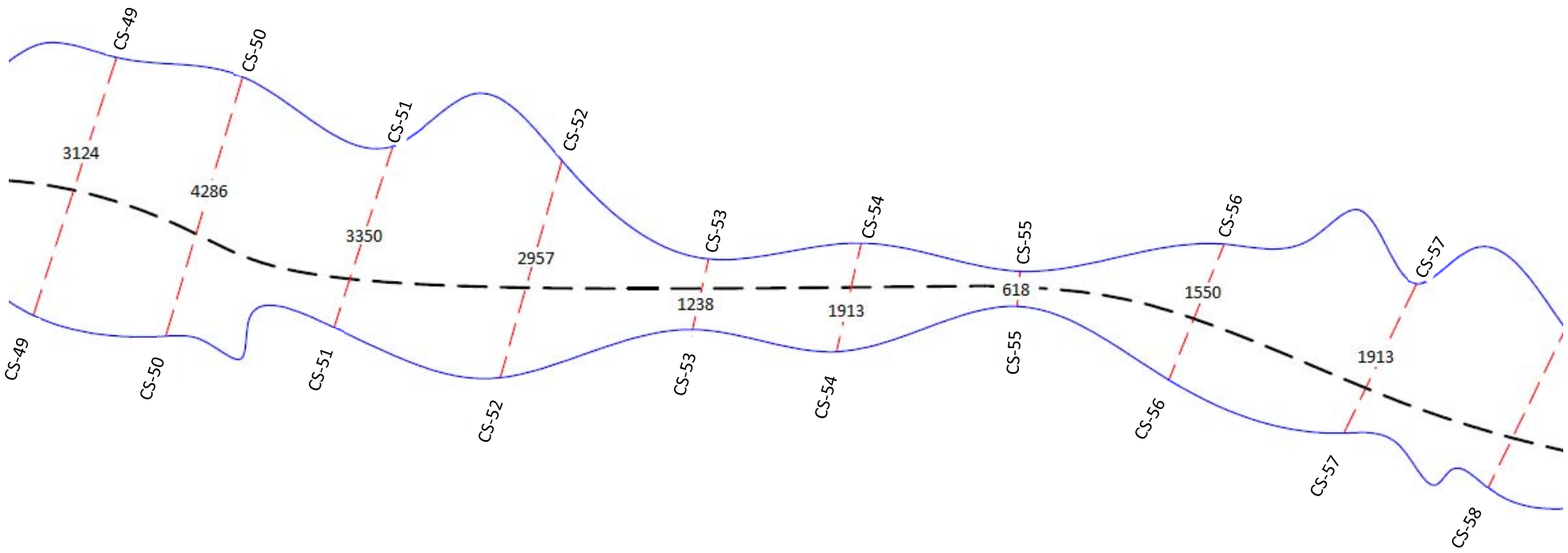
The section between cross sections 1 – 38, its length is 22.3 km.

B)



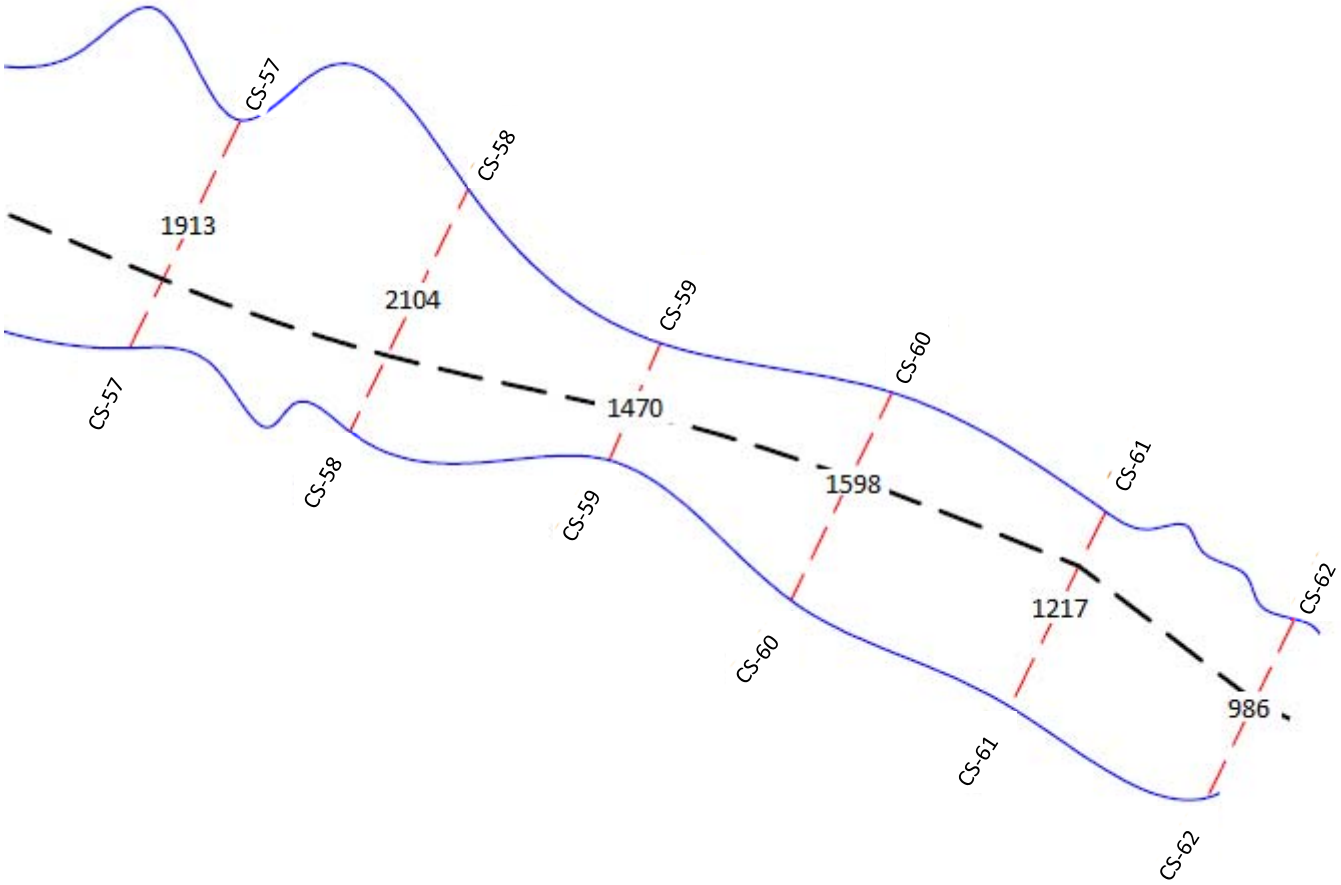
The section between cross sections 38 - 49, its length is 23.6 km.

C)



The section between cross sections 49-57, its length is 25 km.

D)



The section between cross sections 57-62, its length is 17.4 km.

Annex 6. Photographs of field survey measurements of the Channel reservoir

Contacts:

Regional Environmental Centre for Central Asia
40, Orbita-1 microdistrict
050043, Almaty, Kazakhstan
+7 (727) 265 4333
+7 (727) 265 4334
info@carececo.org
https://carececo.org/