

GEOTECHNICAL REPORT

Piezometers on the joint Croatian-Serbian sector of the Danube River



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Piezometers on the joint Croatian-Serbian sector of the Danube River

CLIENT: Ministry of the Sea, Transport and Infrastructure

LOCATION: Cadastral parcel no. 1479/3 cadastral municipality Ilok,
cadastral parcel no. 1924 cadastral municipality Aljmaš,
cadastral parcel no. 441/5 cadastral municipality Batina

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TECHNICAL PART
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1.1. INTRODUCTION

At the request of the Client, in May 2023, piezometers with a depth of $d = 15,0$ m were installed in the settlements of Ilok, Aljmaš and Batina, right next to the Danube River. According to the project assignment, piezometer boreholes will be located within a radius of up to 100 m from the right bank of the Danube. Piezometers were built on the following cadastral parcels:

- Piezometer P-IL at cadastral parcel no. 1479/3 cadastral municipality Ilok
- Piezometer P-ALJ at cadastral parcel no. 1924 cadastral municipality Aljmaš
- Piezometer P-BAT at cadastral parcel no. 441/5 cadastral municipality Batina

The Client of the works is The Ministry of Maritime Affairs, Transport and Infrastructure, and the contractor of drilling and installation of piezometers is Geoservis AS d.o.o. whose authorization is attached to this report.

The purpose of the works is the construction of piezometer wells with boreholes up to 15,0 m deep for the purpose of continuous measurement of oscillations of underground water levels and water temperature. The position of piezometers in the field is given in the situation of piezometers (appendix 1.1).

The works were carried out according to the project assignment submitted by the Client and according to the water regulations issued by Hrvatske vode, VGO for the Danube and Lower Drava Osijek from May 2, 2023. (Water legal conditions attached to this report).

1.2. PERFORMED WORKS

According to the performed work program and water law conditions (Hrvatske vode, VGO Osijek), the drilling of the piezometer P-IL, the installation of the piezometer structure, backfill and buffer, and the conquest (cleaning) of the piezometers were carried out. Field works were carried out in the period from May 2 to 4, 2023.

Borehole mark	Date of drilling	The depth of the borehole [m]	The height of the borehole mouth m n.m.	Coordinates of borehole mouths		Groundwater Appearance (GA) Level (GAL)	
				X	Y	GA [m]	GAL [m]
P-IL	2-4.5.2023.	15,0	-	726094	5014065	3,82	3,82
P-ALJ	9.5.2023.	15,0	-	691538	5046401	3,19	3,19

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P-BAT	10- 11.5.2023.	15,0	-	682728	5081928	4,41	4,41
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Table 1 - Overview of coordinates, depth of research boreholes and the occurrence and level of underground water.

1.3. PIEZOMETER P-IL

1.3.1. Performance of piezometer P-IL

Work was carried out on drilling the piezometer borehole, sealing it with a PVC construction made of solid pipes and sieves with a diameter of $\phi 125$ mm, installing gravel backfill and a clay-bentonite buffer, cleaning and filling, and securing the piezometer. The location of the piezometer P-IL is at the northern corner of cadastral parcel no. 1479/3 cadastral municipality Ilok, at a distance of approx. 15,0 m from the riverbed of the Danube, and the final appearance of the piezometer is shown in the photographs in attachment no. 3.

1.3.2. Drilling and installation of piezometer P-IL

The terrain was probed with a machine drill rig with continuous core extraction, a core tube with a diameter of 168 mm and 146 mm, and field AC-classification and identification of the drilled soil core was performed parallel to the drilling. The occurrence of underground water was registered at a depth of 3,82 m. The exact oscillations of the underground water level will be determined by measuring over a longer period of time. The final drilling depth was 15,0 m.

For the installation of the piezometer structure, high-pressure solid (blind) PVC pipes for boreholes and 1 mm perforation sieves with additionally wound dense PVC mesh ("filter plastic") were prepared. The diameter of the pipe construction is $\phi 125/113$ mm. The piezometer installation schedule is given in the following table:

Overview of piezometer construction P-IL:

Pipe name	Diameter (mm)	Installation interval (m)	Amount (m)	
			Pipes	Sieves
Blind (solid) PVC	125/113	+0,30 – 5,40	5,70	
Sieve, PVC with mesh	125/113	5,40 – 11,40		6,00
Precipitator PVC	125/113	11,40 – 15,00	3,60	
Total:			9,30	6,00

At the bottom of the structure is placed a conical PVC cap wound on the opening, i.e. a solid PVC pipe that forms the precipitator.

In the free annular space around the borehole structure, a granulated backfill of double-washed quartz gravel with grain size $\phi 2-4$ mm, of the Tuzla-quartz type, was installed at an interval of 1,0-15,0 m. After backfilling and conquering the piezometer, the remaining free annular space of 1,00 m to the ground surface is filled with clayey material with the addition of bentonite (clay buffer), in order to protect the entry of surface water into the piezometer borehole and underground water.

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For additional protection, a concrete slab measuring 0,50 × 0,50 × 0,30 m was constructed in the plane of the existing terrain around the piezometer, in order to additionally protect the piezometer from precipitation water entering the piezometer structure itself. A schematic representation of the inflated lithology and the technical construction of the piezometer is given in attachment no. 2.1.

1.3.3. Results of investigative works

1.3.3.1. Lithological composition at the piezometer location P-IL:

On the basis of the geological determination of samples of drilled material taken from the drilling fluid and the monitoring of drilling progress, the interpretation of the lithological profile of drilled deposits at the location of piezometer was performed:

Depth (m)	Material description
0,0 – 0,70	EMBANKMENT, dusty clay with building material
0,70– 1,90	POWDER with interlayers of sand, medium plasticity, firm consistency, brown color
1,90 – 3,30	POWDER clayed with interlayers of sand, medium plasticity, semi-solid consistency, gray color
3,30– 5,40	SAND with excessive powder, poorly compacted, poorly graded, gray color
5,40– 215,00	SAND, well graded, small to large grain fraction, gray color

1.3.3.2. Aquifers in the area of the piezometer P-IL

On the basis of the geological determination of samples of drilled material and the hydrogeological interpretation of the layers, the main aquifer (packages of sand layers) were determined for the P-IL piezometer:

Interval (m)	Thickness (m)	Lithological composition of layers	Horizon number
3,30– 15,0	11,70	SAND, well graded, small to large grain fraction, gray color	I. layer, tapped

Tapped layers are built from fine to coarse grain fraction sand.

The total thickness of tapped aquifers is 11,70 m. Total length of the sieves is 6,00 m, and they are installed in one piece in such a way as to capture the lower part of the aquifer.

1.3.4. Conclusion

For the purpose of determining the lithological composition and hydrogeological features of the subsoil at the location of the piezometer at cadastral parcel no. 1479/3 cadastral municipality Ilok, and for future regular groundwater sampling in order to monitor the groundwater level and temperature, one piezometer borehole, P-IL with a depth of d = 15,0 m, was constructed.

Piezometers were made with a machine drill rig with continuous core extraction, a core tube with a diameter of 146 mm with the installation of protective columns during drilling, and field AC-classification and identification of the drilled soil core was performed parallel to the drilling.

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The piezometer has a construction made of high-pressure solid PVC threaded pipes (type "Plafondplast" - Italy), diameter (125/113 mm), and a PVC sieve with an opening of 1 mm, wrapped with a dense plastic mesh (filter plastica). The total length of the construction is 15,0 m (9,30 m solid pipe and 6,0 m sieves). Aquifers made of sand, mostly fine to coarse grained, were tapped with sieves.

The annular spaces between the built-in structures and the walls of the boreholes are filled with quartz gravel with a granulation of ϕ 1 – 3 mm in the area of the sieve zones, and in the surface interval they are sealed with local clay material with the addition of bentonite (clay buffer).

The constructions of both piezometers are secured by a metal protective tube ϕ 128 mm, length approx. 0,50 m, height above ground +0,60 m with cover and padlock. The protective pipes are secured to the ground with a massive concrete block (approx. 0,5 x 0,5 x 0,2 m).

1.4. PIEZOMETER P-ALJ

1.4.1. Performance of piezometer P-ALJ

Work was carried out on drilling the piezometer borehole, sealing it with a PVC construction made of solid pipes and sieves with a diameter of ϕ 125 mm, installing gravel backfill and a clay-bentonite buffer, cleaning and filling, and securing the piezometer. The location of the piezometer P-ALJ is at the northern corner of cadastral parcel no. 1924 cadastral municipality Aljmaš, at a distance of approx. 15,0 m from the riverbed of the Danube, and the final appearance of the piezometer is shown in the photographs in attachment no. 3.

1.4.2. Drilling and installation of piezometer P-ALJ

The terrain was probed with a machine drill rig with continuous core extraction, a 146 mm diameter core tube with the installation of protective columns, and field AC-classification and identification of the drilled soil core was performed parallel to the drilling. The occurrence of underground water was registered at a depth of 3,19 m. The exact oscillations of the underground water level will be determined by measuring over a longer period of time. The final drilling depth was 15,0 m.

For the installation of the piezometer structure, high-pressure solid (blind) PVC pipes for boreholes and 1 mm perforation sieves with additionally wound dense PVC mesh ("filter plastic") were prepared. The diameter of the pipe construction is ϕ 125/113 mm. The piezometer installation schedule is given in the following table:

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Overview of piezometer construction P-ALJ:

Pipe name	Diameter (mm)	Installation interval (m)	Amount (m)	
			Pipes	Sieves
Blind (solid) PVC	125/113	+0,30 – 5,40	5,70	
Sieve, PVC with mesh	125/113	5,40 – 11,40		6,00
Precipitator PVC	125/113	11,40 – 15,00	3,60	
Total:			9,30	6,00

At the bottom of the structure is placed a conical PVC cap wound on the opening, i.e. a solid PVC pipe that forms the precipitator.

In the free annular space around the borehole structure, a granulated backfill of double-washed quartz gravel with grain size ϕ 2-4 mm, of the Tuzla-quartz type, was installed at an interval of 1,0-15,0 m. After backfilling and conquering the piezometer, the remaining free annular space of 1,00 m to the ground surface is filled with clayey material with the addition of bentonite (clay buffer), in order to protect the entry of surface water into the piezometer borehole and underground water. For additional protection, a concrete slab measuring 0,50 × 0,50 × 0,30 m was constructed in the plane of the existing terrain around the piezometer, in order to additionally protect the piezometer from precipitation water entering the piezometer structure itself. A schematic representation of the inflated lithology and the technical construction of the piezometer is given in attachment no. 2.1.

1.4.3. Results of investigative works

1.4.3.1. Lithological composition at the piezometer location P-ALJ:

On the basis of the geological determination of samples of drilled material taken from the drilling fluid and the monitoring of drilling progress, the interpretation of the lithological profile of drilled deposits at the location of piezometer was performed:

Depth (m)	Material description
0,0 – 1,50	POWDER with interlayers of sand, low plasticity, firm consistency, brown color
1,50-3,30	POWDER clayed with admixtures of sand, medium plasticity, firm consistency, gray color
3,30-5,40	SAND with excessive powder, poorly graded, gray-brown color, traces of FeO
5,40-11,0	SAND, well graded, small to large grain fraction, gray brown color
11,00-15,00	CLAY, high plasticity, compressible, easily gooey consistency, gray color

1.4.3.2. Aquifers in the area of the piezometer P-ALJ

On the basis of the geological determination of samples of drilled material and the hydrogeological interpretation of the layers, the main aquifer (packages of sand layers) were determined for the P-ALJ piezometer:

Interval (m)	Thickness (m)	Lithological composition of layers	Horizon number
3,30– 11,0	7,70	SAND, well graded, small to large grain fraction, gray color	I. layer, tapped

Tapped layers are built from fine to coarse grain fraction sand.

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The total thickness of tapped aquifers is 7,70 m. Total length of the sieves is 6,00 m, and they are installed in one piece in such a way as to capture the lower part of the aquifer.

1.4.3. Conclusion

For the purpose of determining the lithological composition and hydrogeological features of the subsoil at the location of the piezometer at cadastral parcel no. 1924 cadastral municipality Aljmaš, and for future regular groundwater sampling in order to monitor the groundwater level and temperature, one piezometer borehole, P-ALJ with a depth of $d = 15,0$ m, was constructed.

The piezometers were made with a machine drill rig with continuous core extraction, a core tube with a diameter of 146 mm, the construction of protective columns, and field AC-classification and identification of the drilled soil core was performed parallel to the drilling.

The piezometer has a construction made of high-pressure solid PVC threaded pipes (type "Plafondplast" - Italy), diameter (125/113 mm), and a PVC sieve with an opening of 1 mm, wrapped with a dense plastic mesh (filter plastica). The total length of the construction is 15,0 m (9,30 m solid pipe and 6,0 m sieves). Aquifers made of sand, mostly fine to coarse grained, were tapped with sieves. According to the drilled lithology at the location of the works in question, one aquifer was determined up to a depth of 11,0 m.

The annular spaces between the built-in structures and the walls of the boreholes are filled with quartz gravel with a granulation of $\phi 1 - 3$ mm in the area of the sieve zones, and in the surface interval they are sealed with local clay material with the addition of bentonite (clay buffer).

The constructions of both piezometers are secured by a metal protective tube $\phi 128$ mm, length approx. 0,50 m, height above ground +0,60 m with cover and padlock. The protective pipes are secured to the ground with a massive concrete block (approx. 0,5 x 0,5 x 0,2 m).

1.5. PIEZOMETER P-BAT

1.5.1. Performance of piezometer P-BAT

Work was carried out on drilling the piezometer borehole, sealing it with a PVC construction made of solid pipes and sieves with a diameter of $\phi 125$ mm, installing gravel backfill and a clay-bentonite buffer, cleaning and filling, and securing the piezometer. The location of the piezometer P-ALJ is at the northern corner of cadastral parcel no. 441/5 cadastral municipality Batina, at a distance of approx. 190,0 m from the riverbed of the Danube, and the final appearance of the piezometer is shown in the photographs in attachment no. 3.

1.5.2. Drilling and installation of piezometer P-1

The terrain was probed with a machine drill rig with continuous core extraction, a core tube with a diameter of 146 mm, and field AC-classification and identification of the drilled soil core was performed parallel to the drilling. The occurrence of underground water was registered at a depth of 4,41 m. The exact oscillations of the underground water level will be determined by measuring over a longer period of time. The final drilling depth was 15,0 m.

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For the installation of the piezometer structure, high-pressure solid (blind) PVC pipes for boreholes and 1 mm perforation sieves with additionally wound dense PVC mesh ("filter plastic") were prepared. The diameter of the pipe construction is ϕ 125/113 mm. The piezometer installation schedule is given in the following table:

Overview of piezometer construction P-BAT:

Pipe name	Diameter (mm)	Installation interval (m)	Amount (m)	
			Pipes	Sieves
Blind (solid) PVC	125/113	+0,30 – 2,80	3,10	
Sieve, PVC with mesh	125/113	2,80 – 8,80		6,00
Precipitator PVC	125/113	8,80– 15,00	6,20	
Total:			9,30	6,00

At the bottom of the structure is placed a conical PVC cap wound on the opening, i.e. a solid PVC pipe that forms the precipitator.

In the free annular space around the borehole structure, a granulated backfill of double-washed quartz gravel with grain size ϕ 2-4 mm, of the Tuzla-quartz type, was installed at an interval of 1,0-15,0 m. After backfilling and conquering the piezometer, the remaining free annular space of 1,00 m to the ground surface is filled with clayey material with the addition of bentonite (clay buffer), in order to protect the entry of surface water into the piezometer borehole and underground water. For additional protection, a concrete slab measuring 0,50 × 0,50 × 0,30 m was constructed in the plane of the existing terrain around the piezometer, in order to additionally protect the piezometer from precipitation water entering the piezometer structure itself. A schematic representation of the inflated lithology and the technical construction of the piezometer is given in attachment no. 2.1.

1.5.3. Results of investigative works
1.5.3.1. Lithological composition at the piezometer location P-BAT:

On the basis of the geological determination of samples of drilled material taken from the drilling fluid and the monitoring of drilling progress, the interpretation of the lithological profile of drilled deposits at the location of piezometer was performed:

Depth (m)	Material description
0,0 – 2,00	EMBANKMENT, dusty clay with building material
2,00-7,20	SAND with layers of clay up to 30 cm long, poorly graded, poorly compacted, gray color
7,20-8,70	SAND with excessive dust and clay, poorly graded, gray color
8,70-15,00	BRECCIA, loosely bound gravel and sand in a powdery texture, very compacted, light brown to olive color

1.5.3.2. Aquifers in the area of the piezometer P-BAT

On the basis of the geological determination of samples of drilled material and the hydrogeological interpretation of the layers, the main aquifer (packages of sand layers) were determined for the P-BAT piezometer:

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Interval (m)	Thickness (m)	Lithological composition of layers	Horizon number
2,00– 8,70	6,70	SAND with excessive dust and clay, poorly graded, gray color	I. layer, tapped

Tapped layers are built from fine to coarse grain fraction sand.

The total thickness of tapped aquifers is 6,70 m. Total length of the sieves is 6,00 m, and they are installed in one piece in such a way as to capture the lower part of the aquifer.

1.5.3. Conclusion

For the purpose of determining the lithological composition and hydrogeological features of the subsoil at the location of the piezometer at cadastral parcel no. 441/5 cadastral municipality Batina, and for future regular groundwater sampling in order to monitor the groundwater level and temperature, one piezometer borehole, P-BAT with a depth of $d = 15,0$ m, was constructed.

The piezometers were made with a mechanical drilling rig with continuous core extraction, a core tube with a diameter of 146 mm and the installation of protective columns during drilling, and in parallel with the drilling, field AC-classification and identification of the drilled soil core was performed..

The piezometer has a construction made of high-pressure solid PVC threaded pipes (type "Plafondplast" - Italy), diameter (125/113 mm), and a PVC sieve with an opening of 1 mm, wrapped with a dense plastic mesh (filter plastica). The total length of the construction is 15,0 m (9,30 m solid pipe and 6,0 m sieves). Aquifers made of sand, mostly fine to coarse grained, were tapped with sieves. According to the drilled lithology at the location of the works in question, one aquifer was determined up to a depth of 8,70 m.

The annular spaces between the built-in structures and the walls of the boreholes are filled with quartz gravel with a granulation of $\phi 1 - 3$ mm in the area of the sieve zones, and in the surface interval they are sealed with local clay material with the addition of bentonite (clay buffer).

The constructions of both piezometers are secured by a metal protective tube $\phi 128$ mm, length approx. 0,50 m, height above ground +0,60 m with cover and padlock. The protective pipes are secured to the ground with a massive concrete block (approx. 0,5 x 0,5 x 0,2 m).

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1.6. MEASUREMENT DATA

PIEZOMETER BOREHOLES

In the area of the Danube River, in Croatia, three piezometer boreholes were drilled to monitor the level of groundwater, and data analysis helps us understand the impact of groundwater on the Danube River and the waterway. The locations of the boreholes are in Batina (P1), Aljmaš (P2) and Ilok (P3).

Piezometers are made by inserting a DN125 mm PVC pipe into a 15 m deep borehole. The borehole itself is protected by a concrete foundation into which a steel pipe with a cover is installed. The cover is secured with a padlock to prevent unauthorized access to the installed probe.

A piezometer probe is installed inside the borehole. A probe is a device for measuring and recording the level and temperature of underground water. The device is programmed to record data twice a day, at midnight and noon. The dimensions of the probe are:

- Length - 110 mm
- Diameter - 22 mm
- Weight - 104 g

The measuring device is attached to the PVC cap with a system of carabiners, fuses and a steel reinforced plastic cable.



Probe TD-Diver DI810

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1.6.1. Piezometer P-IL

Data on the measurement, placement and calibration of the probe, at the location P3 Ilok, are given in the table.

Piezometer	Ilok
Probe serial number	EY327
Probe model	TD Diver DI810

	Start of measurement	End of measurement
Date	29.03.2024.	29.04.2024.
Time	0:00	0:00

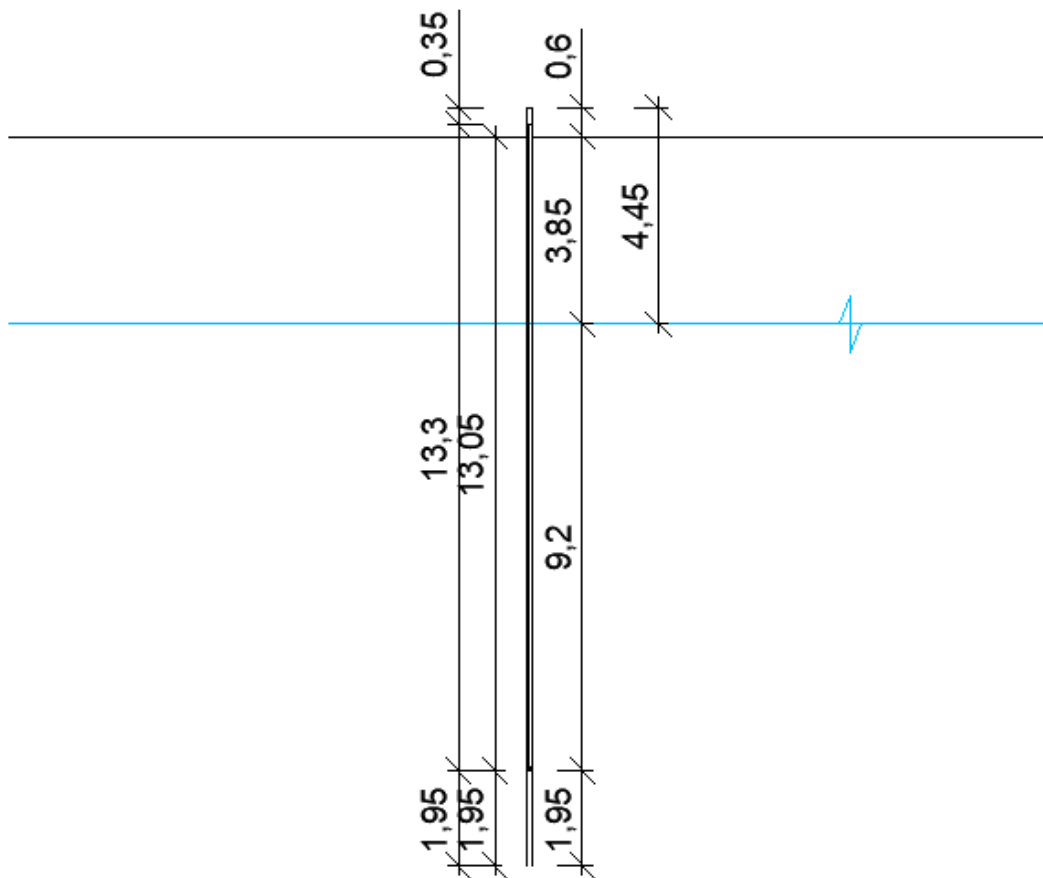
Measurement interval	12 h	12:00 / 00:00
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Elevation of the terrain [m.a.s.l.]:	79,00 m.n.m.
Probe immersion height [m.a.s.l.]:	65,95 m.n.m.

Manual measurement	
a) Date and time of measurement	09:25 / 28.03.2024.
b) Probe immersion depth [m]	13,1
c) Measured water level in the borehole [m]	3,9
d) Height of the water column above the probe (b-c) [m]	9,2
e) Air pressure [hPa]:	1.005

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Sketch of the piezometer borehole P-IL- the day the probe was installed

At the location of the piezometer borehole P-IL in the period from 29.03. until 29.04., the measuring probe recorded 63 measurements. The data are given in the table.

Ordinal number of measurements	Date / Time	Absolute height of water in the borehole [m.a.s.l.]	Water level above the probe [m]	Depth of water in the borehole [cm]
1	29.3.2024 0:00	75,15	9,20	445,00
2	29.3.2024 12:00	75,18	9,23	442,13
3	30.3.2024 0:00	75,15	9,20	444,64
4	30.3.2024 12:00	75,13	9,18	446,79
5	31.3.2024 0:00	75,12	9,17	447,87
6	31.3.2024 12:00	75,10	9,15	449,66
7	1.4.2024 0:00	75,11	9,16	449,30
8	1.4.2024 12:00	75,08	9,13	452,17
9	2.4.2024 0:00	75,02	9,07	457,54
10	2.4.2024 12:00	75,11	9,16	448,94
11	3.4.2024 0:00	75,14	9,19	446,43

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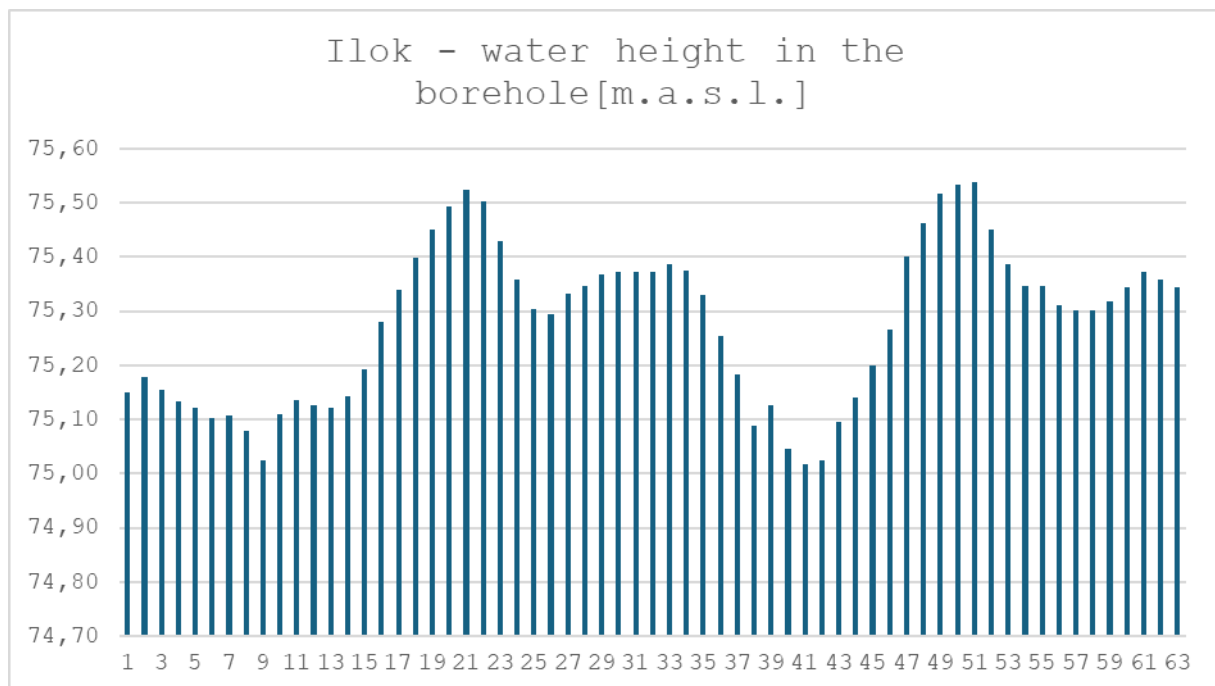
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Ordinal number of measurements	Date / Time	Absolute height of water in the borehole [m.a.s.l.]	Water level above the probe [m]	Depth of water in the borehole [cm]
12	3.4.2024 12:00	75,12	9,17	447,51
13	4.4.2024 0:00	75,12	9,17	447,87
14	4.4.2024 12:00	75,14	9,19	445,72
15	5.4.2024 0:00	75,19	9,24	440,70
16	5.4.2024 12:00	75,28	9,33	432,10
17	6.4.2024 0:00	75,34	9,39	426,01
18	6.4.2024 12:00	75,40	9,45	420,28
19	7.4.2024 0:00	75,45	9,50	414,90
20	7.4.2024 12:00	75,49	9,54	410,60
21	8.4.2024 0:00	75,52	9,57	407,74
22	8.4.2024 12:00	75,50	9,55	409,88
23	9.4.2024 0:00	75,43	9,48	417,05
24	9.4.2024 12:00	75,36	9,41	424,22
25	10.4.2024 0:00	75,30	9,35	429,59
26	10.4.2024 12:00	75,29	9,34	430,67
27	11.4.2024 0:00	75,33	9,38	426,73
28	11.4.2024 12:00	75,35	9,40	425,29
29	12.4.2024 0:00	75,37	9,42	423,14
30	12.4.2024 12:00	75,37	9,42	422,78
31	13.4.2024 0:00	75,37	9,42	422,78
32	13.4.2024 12:00	75,37	9,42	422,78
33	14.4.2024 0:00	75,39	9,44	421,35
34	14.4.2024 12:00	75,38	9,43	422,43
35	15.4.2024 0:00	75,33	9,38	427,09
36	15.4.2024 12:00	75,25	9,30	434,61
37	16.4.2024 0:00	75,18	9,23	441,78
38	16.4.2024 12:00	75,09	9,14	451,09
39	17.4.2024 0:00	75,12	9,17	447,51
40	17.4.2024 12:00	75,05	9,10	455,39
41	18.4.2024 0:00	75,02	9,07	458,26
42	18.4.2024 12:00	75,02	9,07	457,54
43	19.4.2024 0:00	75,10	9,15	450,38
44	19.4.2024 12:00	75,14	9,19	446,08
45	20.4.2024 0:00	75,20	9,25	439,99
46	20.4.2024 12:00	75,26	9,31	433,53
47	21.4.2024 0:00	75,40	9,45	419,92
48	21.4.2024 12:00	75,46	9,51	413,83
49	22.4.2024 0:00	75,52	9,57	408,45
50	22.4.2024 12:00	75,53	9,58	406,66

GEOTECHNICAL REPORT

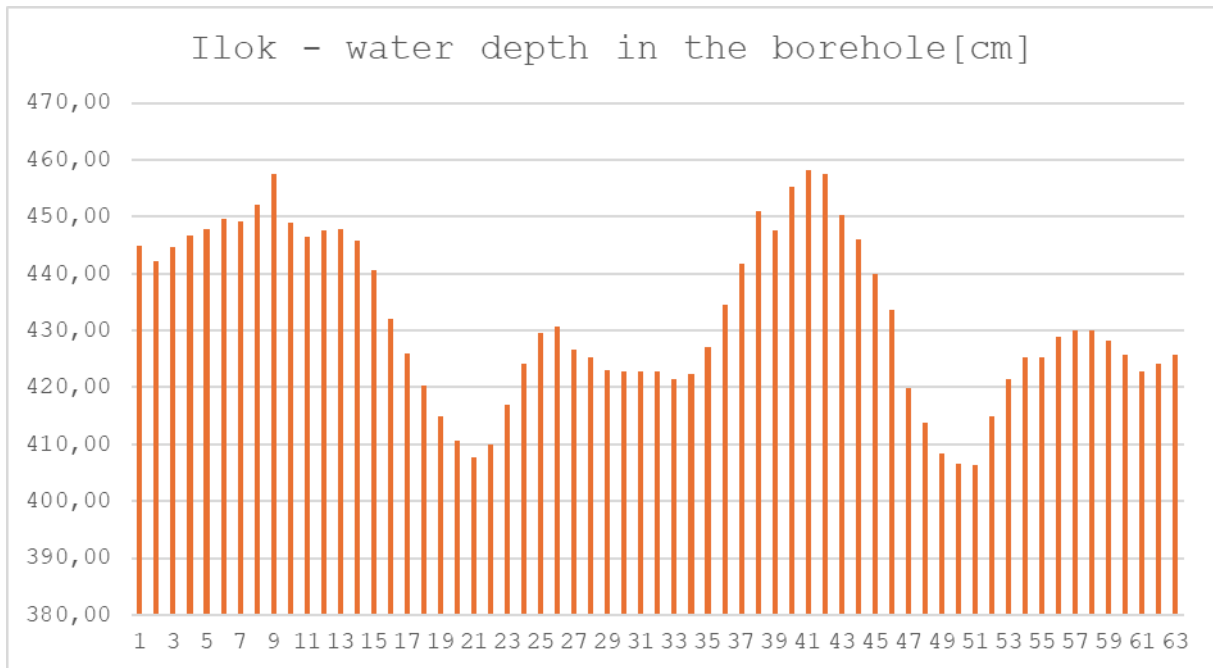
Piezometers on the joint Croatian-Serbian sector of the Danube River

Ordinal number of measurements	Date / Time	Absolute height of water in the borehole [m.a.s.l.]	Water level above the probe [m]	Depth of water in the borehole [cm]
51	23.4.2024 0:00	75,54	9,59	406,30
52	23.4.2024 12:00	75,45	9,50	414,90
53	24.4.2024 0:00	75,39	9,44	421,35
54	24.4.2024 12:00	75,35	9,40	425,29
55	25.4.2024 0:00	75,35	9,40	425,29
56	25.4.2024 12:00	75,31	9,36	428,88
57	26.4.2024 0:00	75,30	9,35	429,95
58	26.4.2024 12:00	75,30	9,35	429,95
59	27.4.2024 0:00	75,32	9,37	428,16
60	27.4.2024 12:00	75,34	9,39	425,65
61	28.4.2024 0:00	75,37	9,42	422,78
62	28.4.2024 12:00	75,36	9,41	424,22
63	29.4.2024 0:00	75,34	9,39	425,65



GEOTECHNICAL REPORT

Piezometers on the joint Croatian-Serbian sector of the Danube River



1.6.2. Piezometer P-ALJ

Data on the measurement, placement and calibration of the probe, at the location P-ALJ, are given in the table.

Piezometer	Aljmaš
Probe serial number	EY324
Probe model	TD Diver DI810

	Start of measurement	End of measurement
Date	29.03.2024.	29.04.2024.
Time	0:00	0:00

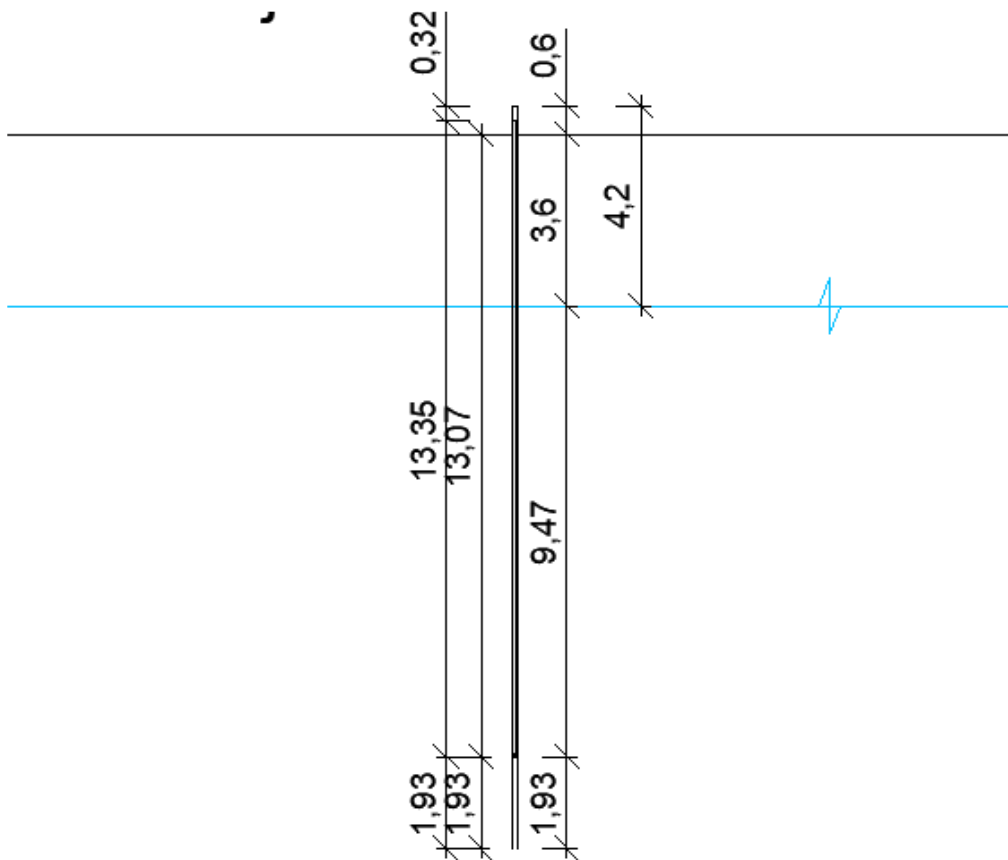
Measurement interval	12 h	12:00 / 00:00
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Elevation of the terrain [m.a.s.l.]:	80,00 m.n.m.
Probe immersion height [m.a.s.l.]:	66,93 m.n.m.

Manual measurement	
a) Date and time of measurement	11:30 / 28.03.2024.
b) Probe immersion depth [m]	13,1
c) Measured water level in the borehole [m]	3,6
d) Height of the water column above the probe (b-c) [m]	9,5
e) Air pressure [hPa]	1.004

GEOTECHNICAL REPORT

Piezometers on the joint Croatian-Serbian sector of the Danube River



Sketch of the piezometer borehole P-ALJ - the day the probe was installed

At the location of the piezometer borehole P-ALJ in the period from 29.03. until 29.04., the measuring probe recorded 63 measurements. The data are given in the table.

Ordinal number of measurements	Date / Time	Absolute height of water in the borehole [m.a.s.l.]	Water level above the probe [m]	Depth of water in the borehole [cm]
1	29.3.2024 0:00	76,40	9,47	420,00
2	29.3.2024 12:00	76,45	9,52	414,98
3	30.3.2024 0:00	76,45	9,52	415,34
4	30.3.2024 12:00	76,42	9,49	417,85
5	31.3.2024 0:00	76,41	9,48	418,57
6	31.3.2024 12:00	76,38	9,45	421,79
7	1.4.2024 0:00	76,37	9,44	422,51
8	1.4.2024 12:00	76,35	9,42	425,38
9	2.4.2024 0:00	76,32	9,39	427,53
10	2.4.2024 12:00	76,40	9,47	420,00
11	3.4.2024 0:00	76,44	9,51	416,42
12	3.4.2024 12:00	76,39	9,46	421,08
13	4.4.2024 0:00	76,43	9,50	417,13

GEOTECHNICAL REPORT

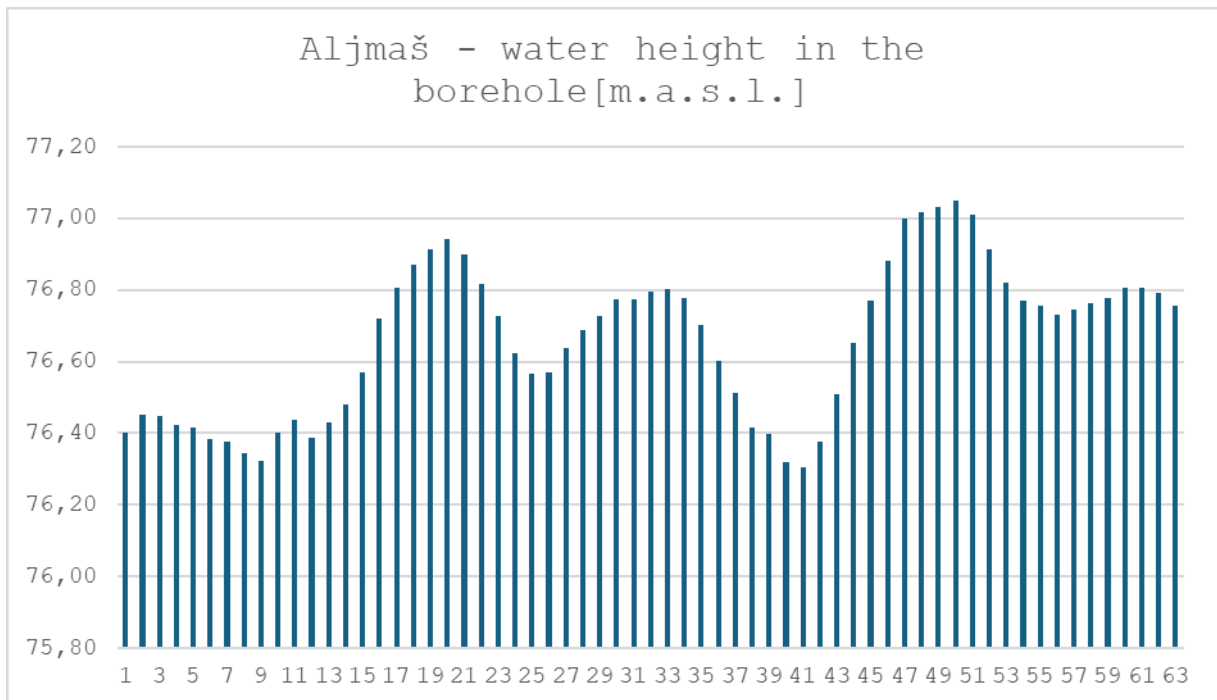
Piezometers on the joint Croatian-Serbian sector of the Danube River

14	4.4.2024 12:00	76,48	9,55	412,12
15	5.4.2024 0:00	76,57	9,64	403,16
16	5.4.2024 12:00	76,72	9,79	388,11
17	6.4.2024 0:00	76,80	9,87	379,51
18	6.4.2024 12:00	76,87	9,94	373,06
19	7.4.2024 0:00	76,91	9,98	368,76
20	7.4.2024 12:00	76,94	10,01	365,89
21	8.4.2024 0:00	76,90	9,97	370,19
22	8.4.2024 12:00	76,82	9,89	378,44
23	9.4.2024 0:00	76,73	9,80	387,39
24	9.4.2024 12:00	76,62	9,69	397,79
25	10.4.2024 0:00	76,56	9,63	403,52
26	10.4.2024 12:00	76,57	9,64	403,16
27	11.4.2024 0:00	76,64	9,71	396,35
28	11.4.2024 12:00	76,69	9,76	391,33
29	12.4.2024 0:00	76,73	9,80	387,39
30	12.4.2024 12:00	76,77	9,84	382,73
31	13.4.2024 0:00	76,77	9,84	382,73
32	13.4.2024 12:00	76,79	9,86	380,58
33	14.4.2024 0:00	76,80	9,87	379,87
34	14.4.2024 12:00	76,78	9,85	382,38
35	15.4.2024 0:00	76,70	9,77	389,90
36	15.4.2024 12:00	76,60	9,67	399,94
37	16.4.2024 0:00	76,51	9,58	408,89
38	16.4.2024 12:00	76,41	9,48	418,57
39	17.4.2024 0:00	76,40	9,47	420,36
40	17.4.2024 12:00	76,32	9,39	427,88
41	18.4.2024 0:00	76,31	9,38	429,32
42	18.4.2024 12:00	76,37	9,44	422,51
43	19.4.2024 0:00	76,51	9,58	409,25
44	19.4.2024 12:00	76,65	9,72	394,92
45	20.4.2024 0:00	76,77	9,84	383,09
46	20.4.2024 12:00	76,88	9,95	371,98
47	21.4.2024 0:00	77,00	10,07	360,16
48	21.4.2024 12:00	77,02	10,09	358,37
49	22.4.2024 0:00	77,03	10,10	356,94
50	22.4.2024 12:00	77,05	10,12	355,14
51	23.4.2024 0:00	77,01	10,08	359,08
52	23.4.2024 12:00	76,91	9,98	368,76
53	24.4.2024 0:00	76,82	9,89	378,08
54	24.4.2024 12:00	76,77	9,84	383,09
55	25.4.2024 0:00	76,75	9,82	384,53

GEOTECHNICAL REPORT

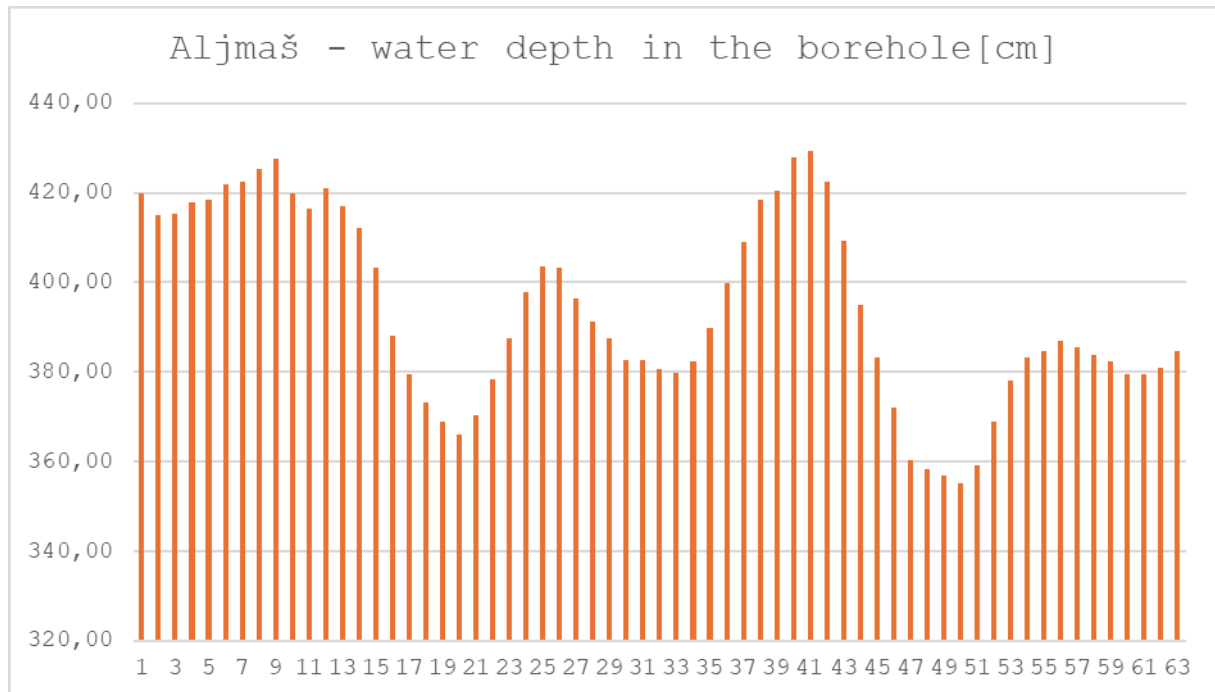
Piezometers on the joint Croatian-Serbian sector of the Danube River

56	25.4.2024 12:00	76,73	9,80	387,04
57	26.4.2024 0:00	76,74	9,81	385,60
58	26.4.2024 12:00	76,76	9,83	383,81
59	27.4.2024 0:00	76,78	9,85	382,38
60	27.4.2024 12:00	76,80	9,87	379,51
61	28.4.2024 0:00	76,80	9,87	379,51
62	28.4.2024 12:00	76,79	9,86	380,94
63	29.4.2024 0:00	76,75	9,82	384,53



GEOTECHNICAL REPORT

Piezometers on the joint Croatian-Serbian sector of the Danube River



1.6.3. Piezometer P-BAT

Data on the measurement, placement and calibration of the probe, at the P-BAT location, are given in the table.

Piezometer	Batina
Probe serial number	EY319
Probe model	TD Diver DI810

	Start of measurement	End of measurement
Date	29.03.2024.	29.04.2024.
Time	0:00	0:00

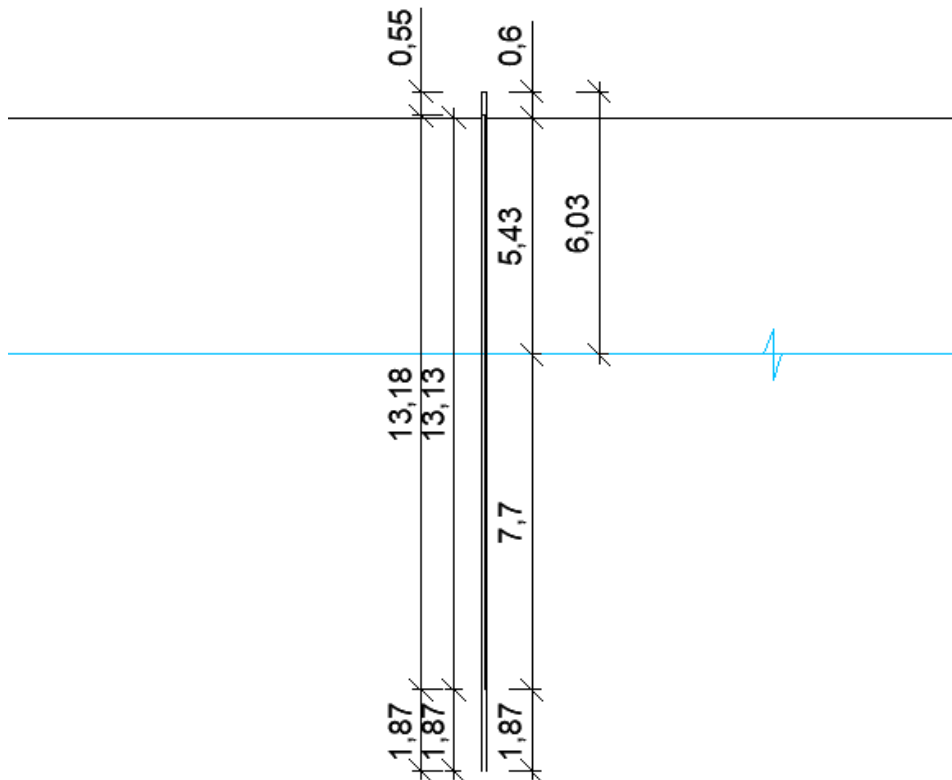
Measurement interval	12 h	12:00 / 00:00
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Elevation of the terrain [m.a.s.l.]:	85,00 m.n.m.
Probe immersion height [m.a.s.l.]:	71,87 m.n.m.

Manual measurement	
a) Date and time of measurement	13:40 / 28.03.2024.
b) Probe immersion depth [m]	13,1
c) Measured water level in the borehole [m]	5,4
d) Height of the water column above the probe (b-c) [m]	7,7
e) Air pressure [hPa]	1.003

GEOTECHNICAL REPORT

Piezometers on the joint Croatian-Serbian sector of the Danube River



Sketch of the piezometer borehole P-BAT - the day the probe was installed

At the location of piezometer borehole P-BAT in the period from 29.03. until 29.04., the measuring probe recorded 63 measurements. The data are given in the table.

Ordinal number of measurements	Date / Time	Absolute height of water in the borehole [m.a.s.l.]	Water level above the probe [m]	Depth of water in the borehole [cm]
1	29.3.2024 0:00	79,57	7,70	603,00
2	29.3.2024 12:00	79,61	7,74	599,06
3	30.3.2024 0:00	79,63	7,76	596,55
4	30.3.2024 12:00	79,62	7,75	597,63
5	31.3.2024 0:00	79,60	7,73	600,49
6	31.3.2024 12:00	79,56	7,69	604,08
7	1.4.2024 0:00	79,54	7,67	605,51
8	1.4.2024 12:00	79,54	7,67	605,51
9	2.4.2024 0:00	79,50	7,63	610,17
10	2.4.2024 12:00	79,52	7,65	608,02
11	3.4.2024 0:00	79,57	7,70	603,36
12	3.4.2024 12:00	79,56	7,69	604,08
13	4.4.2024 0:00	79,56	7,69	604,08
14	4.4.2024 12:00	79,56	7,69	604,08

GEOTECHNICAL REPORT

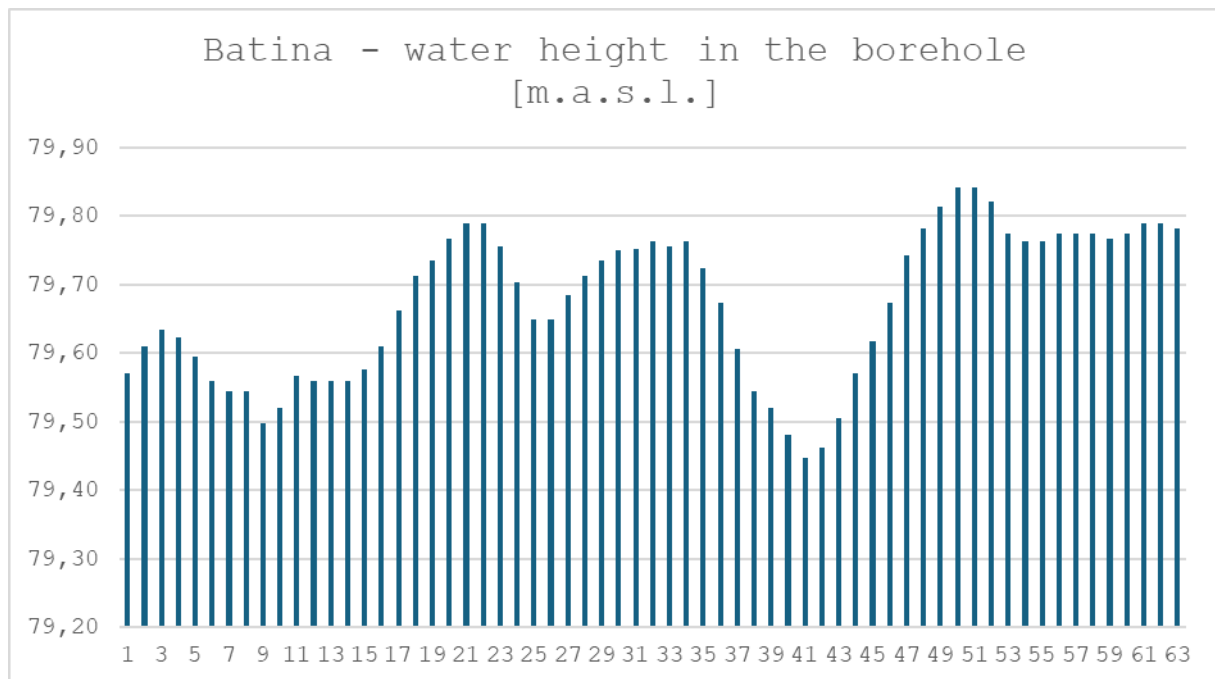
Piezometers on the joint Croatian-Serbian sector of the Danube River

Ordinal number of measurements	Date / Time	Absolute height of water in the borehole [m.a.s.l.]	Water level above the probe [m]	Depth of water in the borehole [cm]
15	5.4.2024 0:00	79,58	7,71	602,29
16	5.4.2024 12:00	79,61	7,74	599,06
17	6.4.2024 0:00	79,66	7,79	593,69
18	6.4.2024 12:00	79,71	7,84	588,67
19	7.4.2024 0:00	79,73	7,86	586,52
20	7.4.2024 12:00	79,77	7,90	583,29
21	8.4.2024 0:00	79,79	7,92	581,14
22	8.4.2024 12:00	79,79	7,92	581,14
23	9.4.2024 0:00	79,76	7,89	584,37
24	9.4.2024 12:00	79,70	7,83	589,74
25	10.4.2024 0:00	79,65	7,78	595,12
26	10.4.2024 12:00	79,65	7,78	595,12
27	11.4.2024 0:00	79,68	7,81	591,54
28	11.4.2024 12:00	79,71	7,84	588,67
29	12.4.2024 0:00	79,73	7,86	586,52
30	12.4.2024 12:00	79,75	7,88	585,09
31	13.4.2024 0:00	79,75	7,88	584,73
32	13.4.2024 12:00	79,76	7,89	583,65
33	14.4.2024 0:00	79,76	7,89	584,37
34	14.4.2024 12:00	79,76	7,89	583,65
35	15.4.2024 0:00	79,72	7,85	587,60
36	15.4.2024 12:00	79,67	7,80	592,61
37	16.4.2024 0:00	79,61	7,74	599,42
38	16.4.2024 12:00	79,54	7,67	605,51
39	17.4.2024 0:00	79,52	7,65	608,02
40	17.4.2024 12:00	79,48	7,61	611,96
41	18.4.2024 0:00	79,45	7,58	615,19
42	18.4.2024 12:00	79,46	7,59	613,75
43	19.4.2024 0:00	79,51	7,64	609,45
44	19.4.2024 12:00	79,57	7,70	603,00
45	20.4.2024 0:00	79,62	7,75	598,35
46	20.4.2024 12:00	79,67	7,80	592,61
47	21.4.2024 0:00	79,74	7,87	585,80
48	21.4.2024 12:00	79,78	7,91	581,86
49	22.4.2024 0:00	79,81	7,94	578,64
50	22.4.2024 12:00	79,84	7,97	575,77
51	23.4.2024 0:00	79,84	7,97	575,77
52	23.4.2024 12:00	79,82	7,95	577,92
53	24.4.2024 0:00	79,77	7,90	582,58

GEOTECHNICAL REPORT

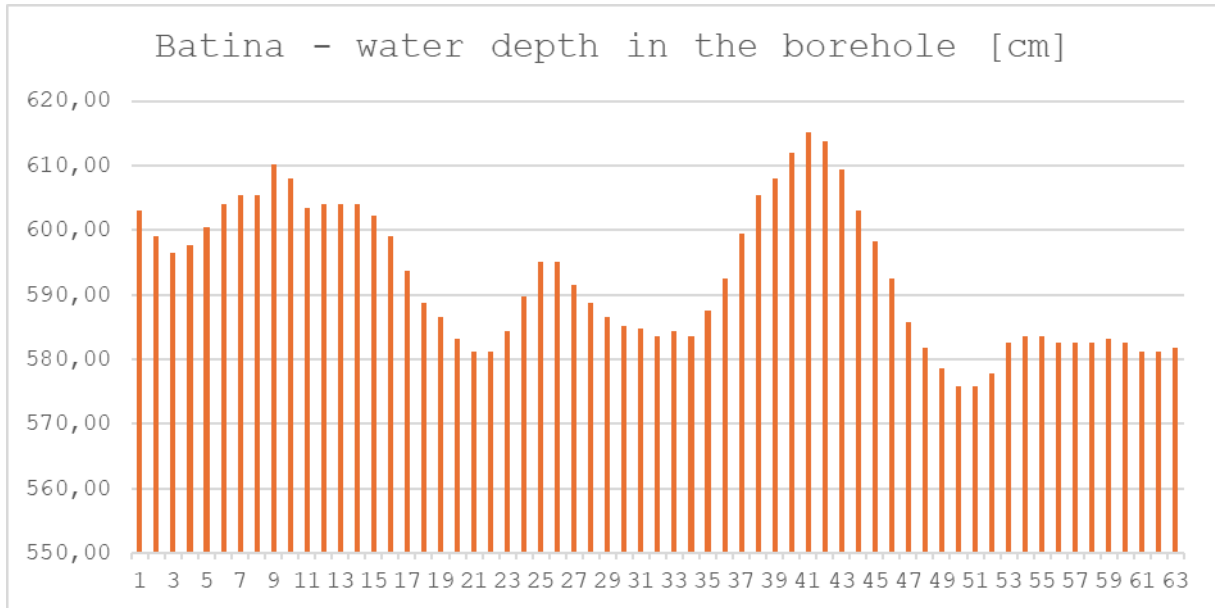
Piezometers on the joint Croatian-Serbian sector of the Danube River

Ordinal number of measurements	Date / Time	Absolute height of water in the borehole [m.a.s.l.]	Water level above the probe [m]	Depth of water in the borehole [cm]
54	24.4.2024 12:00	79,76	7,89	583,65
55	25.4.2024 0:00	79,76	7,89	583,65
56	25.4.2024 12:00	79,77	7,90	582,58
57	26.4.2024 0:00	79,77	7,90	582,58
58	26.4.2024 12:00	79,77	7,90	582,58
59	27.4.2024 0:00	79,77	7,90	583,29
60	27.4.2024 12:00	79,77	7,90	582,58
61	28.4.2024 0:00	79,79	7,92	581,14
62	28.4.2024 12:00	79,79	7,92	581,14
63	29.4.2024 0:00	79,78	7,91	581,86



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Piezometers on the joint Croatian-Serbian sector of the Danube River



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Piezometers on the joint Croatian-Serbian sector of the Danube River

ATTACHMENTS

1. SITUATION OF INVESTIGATIVE WORKS

- 1.1. Microlocation of piezometer installation P-IL**
- 1.2. Microlocation of piezometer installation P-ALJ**
- 1.3. Microlocation of piezometer installation P-BAT**

2. LITHOLOGICAL SECTION OF THE BOREHOLE SHOWING THE INSTALLATION OF THE PIEZOMETER

- 2.1. Piezometer P-IL (0-10 m)**
- 2.2. Piezometer P-IL (10-15 m)**
- 2.3. Piezometer P-ALJ (0-10 m)**
- 2.4. Piezometer P-ALJ (10-15 m)**
- 2.5. Piezometer P-BAT (0-10 m)**
- 2.6. Piezometer P-BAT (10-15 m)**

3. PHOTO DOCUMENTATION

- 3.1. Photo documentation P-IL**
- 3.2. Photo documentation P-ALJ**
- 3.3. Photo documentation P-BAT**

4. OTHER ATTACHMENTS

- 4.1. Water management conditions - piezometer P-IL**
- 4.2. Water management conditions - piezometer P-ALJ**
- 4.3. Water management conditions - piezometer P-BAT**
- 4.4. Authorization of the contractor**