



„New life of post-mining areas” – assessment of the post-mining waste dump „Bogdanka”

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Wrocław, 6th October 2022

Identification And Viability Assessment Of Potential Uses For Spoil Dumps

Database of post-mining waste dumps

Object	Kopalnia	Składowisko	Gmina_Miasto	X_wsp	Y_wsp	Lokalizacja	Kod	Wlasciciel	Powierzchn_h	Obj_odp_m3	Masa_odp_t	Czynne	K_Czynne	Rekult	K
1	Budnyk KWK, Knurów KWK, Bolesław	"Centralne Składowisko Odpadów Górniczych"	Knurów	477002,09	259497,6			Kompania Węglowa S.A., Współinwestor wio	437,3	37000000	2261000	Tak		1 Niezrekultywowana	
2	Andaluzja KWK	"Teren rekultywacji A"	Piekary Śląskie	498590,08	276880,85	Ok. 1 km za zachód od Zakładu Głównego	41-949		10,6	1330000	1970000	Nie		1 Częściowo zrehabilitowana	
3	Anna KWK	"Składowisko przy EC"	Pszów	457133,9	242323,86	Teren KWK Anna			8,2	1157000	208000	Nie		2 Zrekultywowana	
4	Anna KWK	"Teren szybu "Jedłownik"	Wodzisław Śląski	460115,43	238657,44	Teren szybu "Jedłownik"			3,2	122000	8558000	Nie		2 Zrekultywowana	
5	Anna KWK	"Zwałowisko Buków"	Lubomia	449543,04	236611,47	Buków, w dolinie rzeki Odry ok. 170 m c			44	5034000		Nie		2 Częściowo zrehabilitowana	
6	Barbara Chorzów KWK	"Zwałowisko Mariańska II"	Chorzów	495369,07	271665,47	Chorzów, ul. Mariańska			2,8			Nie		2 Zrekultywowana	
7	Barbara Chorzów KWK	"Zwałowisko przy ul. Wiejskiej"	Chorzów	497196,07	272490,63	Chorzów, ul. Wiejska			9,6			Nie		2	
8	Bielszowice KWK	"Zwałowisko Borowa II"	Ruda Śląska	487905,46	264101,35	Ruda Śląska - Halemba, w rejonie ul. Mł		Użytkowanie wyczyste kopalnia	25,5			Nie		2 Zrekultywowana	
9	Bobrek KWK	"Stożki - teren przy szybie Antoni"	Bytom	491013,61	274324,39	W rejonie szybów perłowych "Zbign	41-905		4,4	412000	700000	Nie		2	
10	Bobrek KWK Ruch I	"Zwałowisko nr 1"	Bytom	491823,38	275689,63	Bytom, ul. Wroclawska	41-905		13		1300000	Nie		2 Częściowo zrehabilitowana	
11	Bobrek KWK Ruch I	"Zwałowisko nr 2"	Bytom	490044,47	275647,44	Na zachód od kopalni, ul. Św. Elżbiety			16		2890000	Nie		2 Częściowo zrehabilitowana	
12	Bobrek-Centrum KWK	"B1-A"	Bytom	491645,64	276385,72	Pn-zach. część m. Bytom, przy bocznicy	41-905		2,36	477200	811200	Tak		1 Zrekultywowana	
13	Bobrek-Centrum KWK Ruch Bobrek	"Zdegradowane tereny leśne - pole F-1"	Bytom	487433,92	276236,5	Tereny leśne na zachód od szybów głów		Kompania Węglowa S.A. KWK Bobrek-Centru	32			Tak		1 Częściowo zrehabilitowana	
14	Bobrek-Centrum KWK Ruch Centrum	"Niecka poeksploatacyjna nr 3a"	Bytom	492337,05	277439,63			KWK Bobrek Centrum Ruch Centrum	14,6			Tak		1 Niezrekultywowana	
15	Bobrek-Centrum KWK	"Zwałowisko odpadów powęglowych (staw nr	Bytom	496245,64	274326,35	Przy szybie "Barbara", od pn. linia PKP Z		Skarb Państwa w zarządaniu Bytomskiej Spół	8			Nie		2 Częściowo zrehabilitowana	
16	Bolesław Śmiały KWK	"Składowisko "Skalny"	Łaziska Górne	489695,05	252661,17	Łaziska Górne, ul. Zwałowa		Skarb Państwa, KWK Bolesław Śmiały	30		15500000	Nie		2 Częściowo zrehabilitowana	
17	Bolesław Śmiały KWK	"Składowisko "Waleśka"	Łaziska Górne	491408,33	252746,33	Łaziska Górne, ul. Wyrśka, Marty, Wales		Skarb Państwa KWK, Bolesław Śmiały	18,3			Tak		1 Częściowo zrehabilitowana	
18	Brzeszcze KWK	"Zwałowisko przy potoku Różany - obiekt nr 10"	Brzeszcze	513142,63	235244,6	Przecieszyn, na pn. od ul. Wyzwolenia, l			13,2	970000	1650000	Nie		2 Częściowo zrehabilitowana	
19	Brzeszcze KWK	"Zwałowisko Buczaki - obiekt nr 5"	Brzeszcze	512775,05	236815,3	Brzeszcze-Budy, ul. Ofiar Oświęcimia, p			34,2	1000000	1700000	Nie		2 Częściowo zrehabilitowana	
20	Brzeszcze KWK	"Zwałowisko podziomowe B"	Brzeszcze	511702,4	234025,46	Przecieszyn, ul. Graniczna			30	3500000	5950000	Nie		2 Zrekultywowana	
21	Brzeszcze KWK	"Zwałowisko "F" Łęcznik"	Brzeszcze	508793,8	234966,86	Brzeszcze-Łęcznik, prawy brzeg rz. Wisły		KWK Brzeszcze, wł. prywatna	30,25			Tak		1 Częściowo zrehabilitowana	
22	Brzeszcze KWK	"Zwałowisko i zwałowisko "G" i łącznik pola "E"	Brzeszcze	513597,17	234137,96	Przecieszyn-Skidziwn, na pd od ul. Wzrw		KWK Brzeszcze, wł. prywatna	43,7			Tak		1 Częściowo zrehabilitowana	
23	Brzeszcze KWK	"Zasypanie starego koryta rzeki Białej"	Bestwina	502123,46	226239,38	Gmina Bestwina i gmina Czechowice-D		KWK S.A. - ZZM w Bieruniu, Skarb Państwa, g	14,1			Nie		2 Zrekultywowana	
24	Brzeszcze KWK	"Zwałowisko Kaniów"	Bestwina	502789,09	230555	Kaniów		Skarb Państwa	14,6	3473000	5900000	Nie		2 Zrekultywowana	
25	Brzeszcze KWK	"Zwałowisko skały płonnej Rudoftowice"	Pszczyna	500744,5	231070,36	Rudoftowice		Skarb Państwa, wieczyste użytkowanie KW S	4,76			Nie		2	
26	Brzeszcze KWK	"Zwałowisko Stożek"	Bestwina	501447,68	230672,97	Kaniów		KW S.A., Skarb Państwa	3,83			Nie		2	
27	Centrum-Szombierki KWK Ruch II	"Zwałowisko nr 2"	Bytom	493142,91	273845,1	Zachodnia część obszaru górniczego był	41-902		3			Nie		2 Zrekultywowana	
28	Centrum-Szombierki KWK Ruch II	"Zwałowisko nr 3"	Ruda Śląska	491681,58	273190,02	Teren po byłej kopalni "Karol" Ruda Ślą			3,2			Nie		2 Zrekultywowana	
29	Centrum-Szombierki KWK Ruch II	"Zwałowisko nr 4"	Ruda Śląska	491922,2	273131,42	Teren po byłej kopalni "Karol" Ruda Ślą			2,4			Nie		2 Zrekultywowana	
30	Centrum-Szombierki KWK	"Zwałowisko nr 4"	Bytom	492083,92	276246,27	Obok zwałowiska nr 3 Ruch Centrum	41-902		10			Nie		2 Niezrekultywowana	
31	Chwałowice KWK	"Rejon szybu IV (Kielowiec)"	Rybnik	467539,65	243652,34	Rybnik - Chwałowice, w widłach ul. Szul		Skarb Państwa, Kopalnia wyczyste użytkowa	14,1			Nie		2 Częściowo zrehabilitowana	
32	Chwałowice KWK	"Osadnik mułowy Starzykowice"	Rybnik	468318,95	244926,17	Teren Zakładu Głównego KWK Chwałow		Skarb Państwa w użytkowaniu wieczystym K	6,88			Tak		1 Częściowo zrehabilitowana	
33	Chwałowice KWK	"Osadniki mułowe - Holonowce"	Rybnik	468445,12	243699,99	Rybnik, w pobliżu ul. Koźdoniów			35,3			Tak		1 Częściowo zrehabilitowana	
34	Chwałowice KWK	"Rejon placu drewna i skarp w "Starej Haldy"	Rybnik	468471,29	244855,46	Rybnik-Chwałowice, ul. Zwycięstwa, Tk		Własność prywatna, Skarb Państwa w wieczy	5,64	480000		Nie		2 Zrekultywowana	
35	Chwałowice KWK	"Teren w rejonie Mośnika - Kielowca"	Rybnik	467580,67	243564,84	Rybnik, w pobliżu ul. Radziejskiej		Skarb Państwa, kopalnia wyczyste użytkowa	71,32			Nie		2	
36	Chwałowice KWK	"Zwałowisko rejon D"	Rybnik	468036,92	243402,34	Rybnik - Chwałowice, ul.1-go Maja, Radz		5,36 ha S.P., 1,08 ha wł. prywatna, 18,06 ha S	24,5		27000000	Nie		2 Zrekultywowana	
37	Chwałowice KWK	"Rejon osadników mułowych Rybnik"	Rybnik	468718,17	243614,84	Rybnik, pomiędzy ul. 1-go Maja, potok C			37	3415000	5805000	Nie		2 Częściowo zrehabilitowana	
38	Chwałowice KWK	"Obiekt rekultywacyjny Jar-Wodzisław"	Rybnik	464423,24	243095,7	Rybnik-Popielów, ul. Wodzisławska, Pu			3	120000	204000	Nie		2 Zrekultywowana	
39	Chwałowice KWK	"Obiekt rekultywacyjny Zabik II"	Rybnik	464841,6	244027,34	Rybnik-Popielów, ul. Śląska			8,4	800000	1360000	Tak		1 Zrekultywowana	
40	Chwałowice KWK	"Rów Chwałowicki"	Rybnik	466114,26	244264,06	Rybnik-Radziejów, ul. Okulickiego, Das			3,8	60000	102000	Nie		2 Zrekultywowana	
41	Czecott KWK	"Zwałowisko Pszczynka"	Tychy	509578,77	241042,98	Tychy-Miedzyrzecze, po prawej stronie			12,3	500000	850000	Nie		2 Zrekultywowana	
42	Czecott KWK	"Zwałowisko Wisła"	Miedźna	509546,74	240921,89	Wola, w widłach rzeki Wisły i Pszczynki			9	188000	320000	Nie		2 Zrekultywowana	
43	Debieńsko KWK	"Składowisko kopalniane"	Czerwonka-Leszc	478013	255087,06	Na pn-wsch. od terenu głównego zakłac			97	22000000	35900000	Tak		1 Częściowo zrehabilitowana	
44	Gliwice KWK	"Składowisko przy szybie Ostropa"	Gliwice	469707,82	269379,61	Gliwice-Ostropa			10,34	2594000	5450000	Nie		2 Częściowo zrehabilitowana	
45	Grodziec KWK	"Zwałowisko Gródków"	Psary	507206,68	277886,51	Psary, ul. Zwycięstwa i ul. Pokoju; na zach			8,3	953000	1620000	Nie		2 Częściowo zrehabilitowana	
46	Grodziec KWK	"Zwałowisko przy ul. Sobieskiego"	Wojkowice	504548,64	276831,19	Na granicy gminy Wojkowice i miasta Be			20,8	2700000	4590000	Nie		2 Zrekultywowana	
47	Grodziec KWK	"Zwałowisko przy ul. Sobieskiego"	Wojkowice	502505,63	277814,79	gmina Wojkowice, w widłach ul. Sobies			6,32	203000	345000	Nie		2	
48	Halemba KWK	"Wzrostek ceglany Bielszowice"	Ruda Śląska	489425,67	268183,67	Ruda Śląska, ul. Cynkowa			9,5	360000	612000	Nie		2 Częściowo zrehabilitowana	
49	Halemba KWK	"Zwałowisko Panewniki"	Mikołów	492472,59	261011,64	Mikołów, Katowice, Ruda Śląska		Użytkowanie wyczyste Kopalnia	118,4		31700000	Tak		1 Częściowo zrehabilitowana	
50	Halemba KWK	"Zwałowisko przy Szlach Grunwald"	Ruda Śląska	490339,62	264211,64	Ruda Śląska ul. Zanolckiej		KW S.A.	7,1	300000		Nie		2 Niezrekultywowana	

Identification And Viability Assessment Of Potential Uses For Spoil Dumps

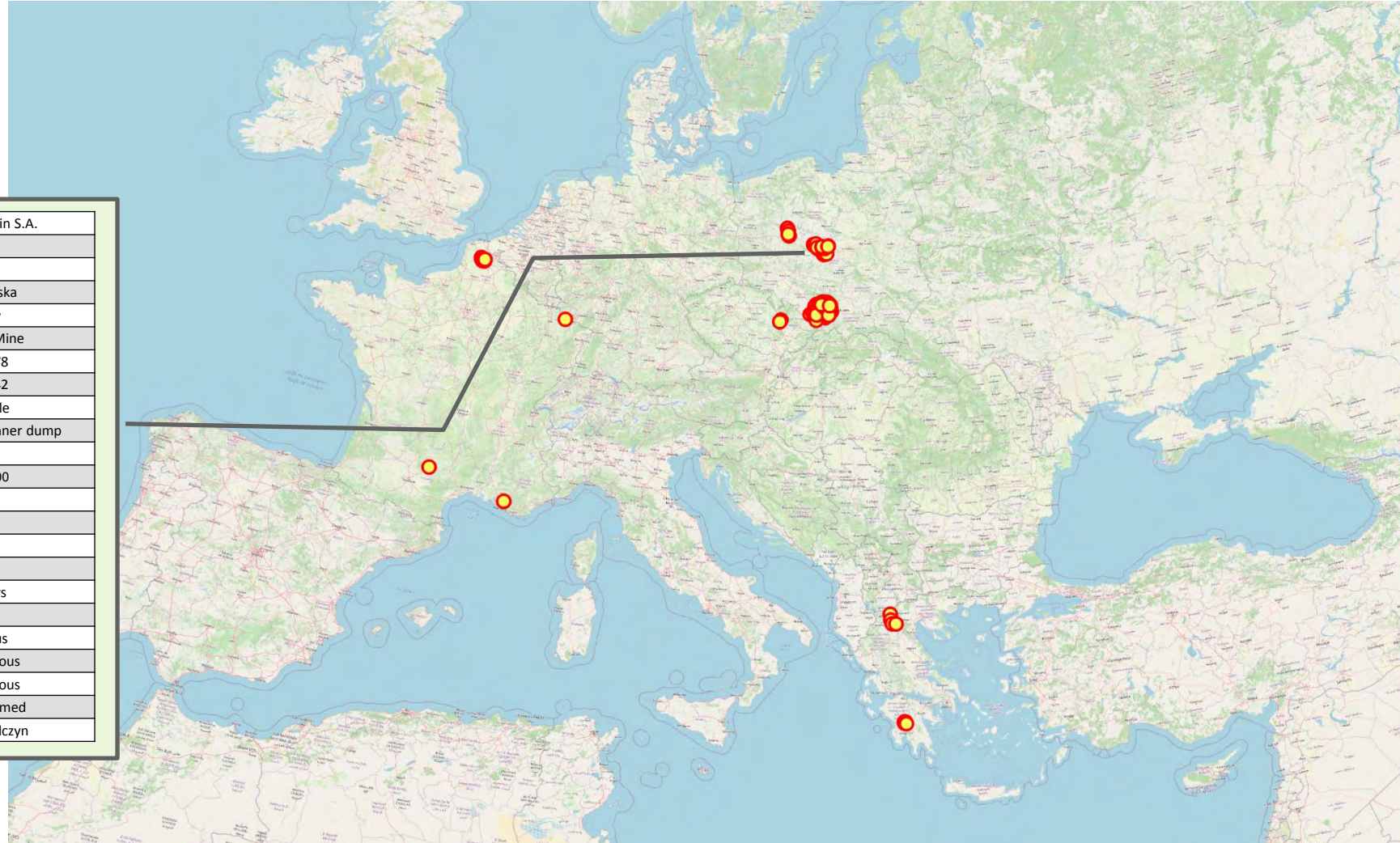
- age of dumps,
- average angle of slopes ($27 \div 33^\circ$),
- volume,
- dumps morphology,
- method of building the heap,
- material type,
- local community,
- hazards (landslides, fire, acid soil).

The screenshot displays a data entry application with a spreadsheet in the background and three overlapping 'New Record' dialog boxes. The spreadsheet has columns for 'No.', 'Owner', 'Age', 'Mass, mg', 'Height of the dump, m', 'Geometry', 'Average angle of slopes', and 'Method of building'. The dialog boxes contain the following fields:

- Basic information:** Owner (SRx), Age (15), Country (Poland), Voivodeship (Silesia region), City (Zabrze), Colliery (Silesia), X coordinate, Y coordinate, Accessibility of the dump (acceptable), Description (test).
- Morphology:** Area (450 ha), Volume (8500 m³), Mass (7900 mg), Height (150 m).
- Geometry:** Four diagrams (a, b, c, d) representing different dump shapes. Option 'c' is selected.
- Average angle of slopes:** 15 degrees.
- Method of building:** (empty field).
- Material type:** Four images representing different material categories (cat. 1, cat. 2, cat. 3, cat. 4). Option 'cat. 2' is selected.
- Hazards:** Landslides (not hazardous), Fire (not hazardous), Acid Soil (not hazardous).
- Reclamation:** Status (partly reclaimed), Local community (empty field).

Identification And Viability Assessment Of Potential Uses For Spoil Dumps

Basic information	Owner	PAK KWB Konin S.A.
	Age	active
Location	Country	Poland
	Voivodeship	Wielkopolska
	City	Złotków
	Colliery	Józwin IIB Mine
	X coordinate	505505.78
	Y coordinate	442817.42
	Accessibility of the dump	acceptable
	Description	Józwin IIB Mine inner dump
Morphology	Area, ha	973
	Volume, m ³	668000000
	Mass, mg	-
	Heigh of the dump, m	78
	Geometry	in pit
	Average angle of slopes	-
	Method of building	spreaders
Hazards	Material type	-
	Landslides	hazardous
	Fire	not hazardous
	Acid soil	not hazardous
Reclamation	Status	partly reclaimed
	Local community	Kleczew, Wilczyn



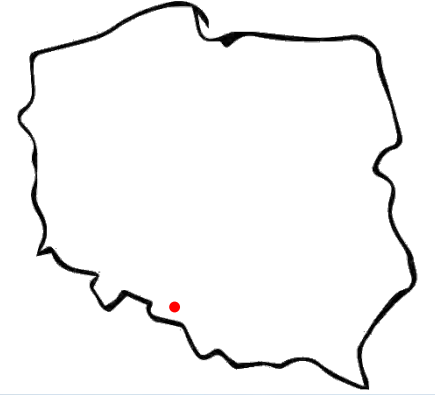
Identification And Viability Assessment Of Potential Uses For Spoil Dumps

Mine-waste dump „Szarlota” in Rydułtowy

It is the tallest facility of this type in Europe.

Height from the base is approx. 134m, and its peak is at an altitude of approx. 406m above sea level.

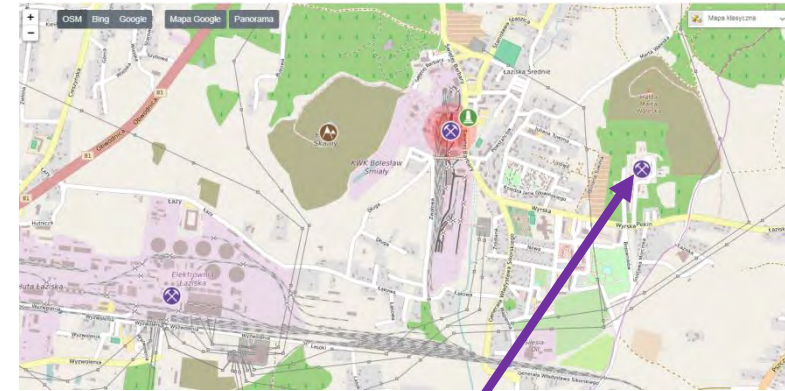
It covers an area of 37ha and has a volume of 13.3 million m³.



Identification And Viability Assessment Of Potential Uses For Spoil Dumps

Mine-waste dump „Marta Waleska”

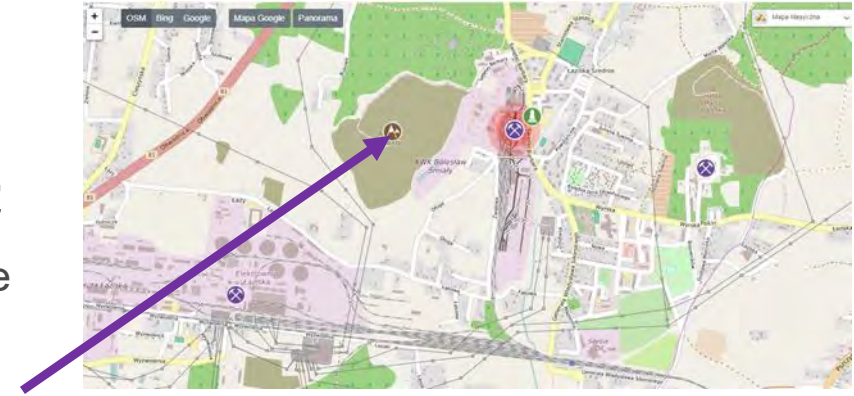
Dump owes its name to a coal mine that once existed in this place. It has been built only since 1994, and already reaches a height of approx. **320 m** above sea level. Area **18.3 ha**. Risk of fires. Place of recreation: tourism, photography, bikers.



Identification And Viability Assessment Of Potential Uses For Spoil Dumps

Mine-waste dump „Skalny”

It is located in Łaziska Górne at KWK Bolesław Śmiały. Its relative height is 92 m, while its absolute height is 389 m above sea level. It also covers an area of 30 ha, which makes it one of the largest in Europe. Its beginnings date back to the turn of the 19th and 20th centuries. For decades, it was a nuisance for the inhabitants due to the release of poisonous gases, and it was extinguished only in 2004. What distinguishes it from others is a lake at the very top.

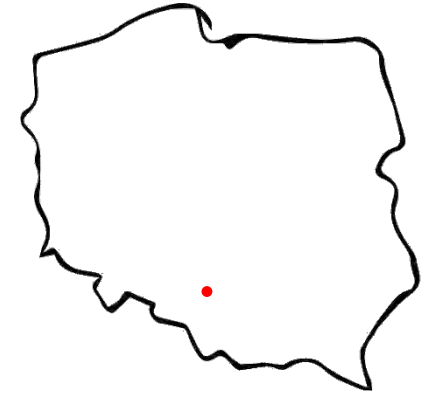


Identification And Viability Assessment Of Potential Uses For Spoil Dumps

Mine-waste dump „Panewniki”

It is one of the largest post-mining waste landfills in Upper Silesia, at its highest point it has a relative height of **12 m**, an area of approx. **100 ha**. The waste stored at Dump Panewnicka comes from the Halemba Coal Mine opened in 1957. It was stored from the 1960s to 2000, about **20 million tons** of waste was collected on the heap.

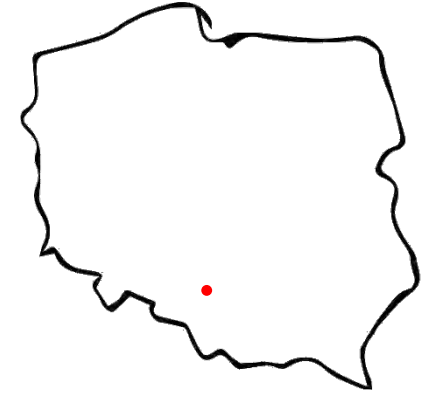
As part of the project implemented by the Haldex company from Katowice, it will be possible to recover approx. 2 million tons of coal, 1 million tons of coal sludge and 16 million tons of stone. reclamation works will last until 2026. A green area is to be arranged on the site. Harmful sulphates and chlorides are released into the groundwater from the heap. Its existence negatively affects the concentration of harmful substances in the air. The heap was used by fans of quads and motorcycles.



Identification And Viability Assessment Of Potential Uses For Spoil Dumps

Mine-waste dump „Wymysłów”

The "**Wymysłów**" dump is located next to the Makoszowy hard coal mine. The mine was located in Zabrze. The dump covers an area of 27.5 ha. It is a closed and partially reclaimed dump. The "Wymysłów" dump is mining waste from the processing plant. It is a wooded dump.



Identification And Viability Assessment Of Potential Uses For Spoil Dumps

Mine-waste dump „Sośnica”

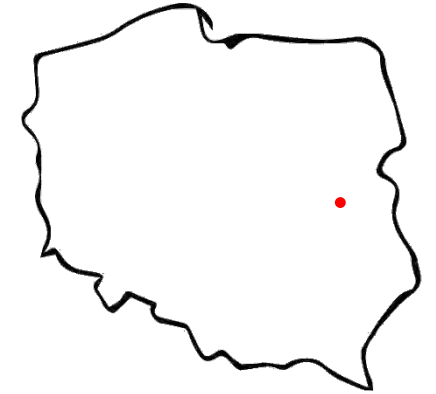
In the vicinity of the Sośnica-Makoszowy hard coal mine and the Sośnica motorway junction in Gliwice, there is a huge "**Sośnica**" dump. It covers an area of 160.9 ha and has a weight waste of 972 million Mg. The dump was built in the place of former fields and meadows, through which the road connecting the Makoszowy settlement with Sośnica passed in the 19th century. The dump is the habitat of many species of wild animals. Roe deer, wild boars and hares live less than a kilometer away. It is also a place that promotes recreation. This place is also chosen by many cyclists.



Identification And Viability Assessment Of Potential Uses For Spoil Dumps

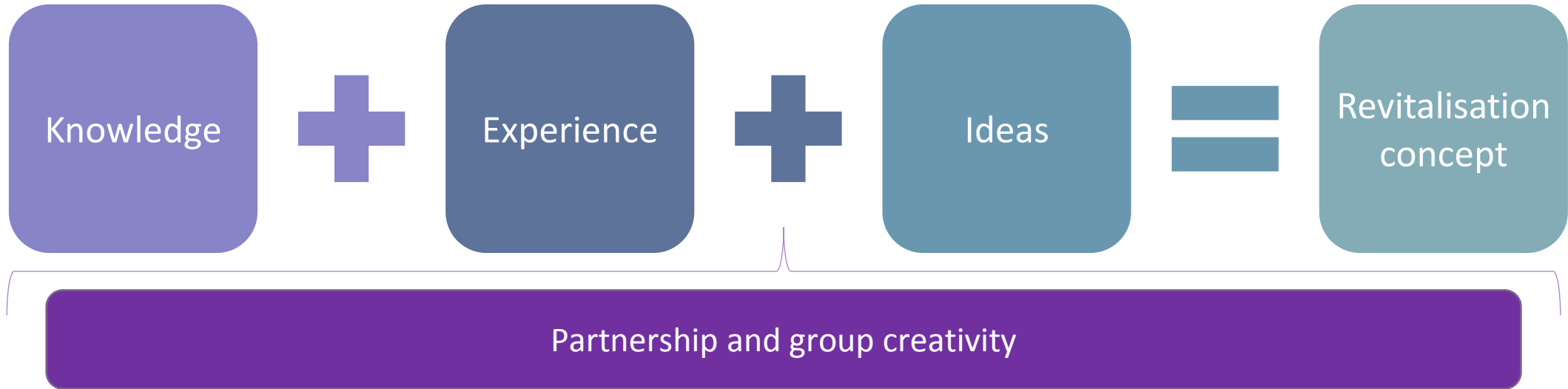
Mine-waste dump area of the mine LW Bogdanka

- the dump does not have a substrate waterproofing,
- landfill foundation ordinate is 170m above sea level,
- the height of the landfill ranges between 16-30m,
- right under the landfill there are plastic sandy and dusty loams and their thickness is varied and ranges from 1.5 to 4.5 m,
- the slopes of the northern and western slopes are 15-25°, while the eastern and southern slopes are from 20-45°.



Identification And Viability Assessment Of Potential Uses For Spoil Dumps

Workshop for local stakeholders



Increase of knowledge on revitalisation

- Philosophy,
- Process,
- Tools,

Identification of different points of view

- Creation of common knowledge,
- Diagnose verification,

Initiating of group creativity

- New ideas,
- Breaking the stereotypes

Ideas integration

- Arrangement of opinions, development directions,
- Coherent concept of revitalisation,

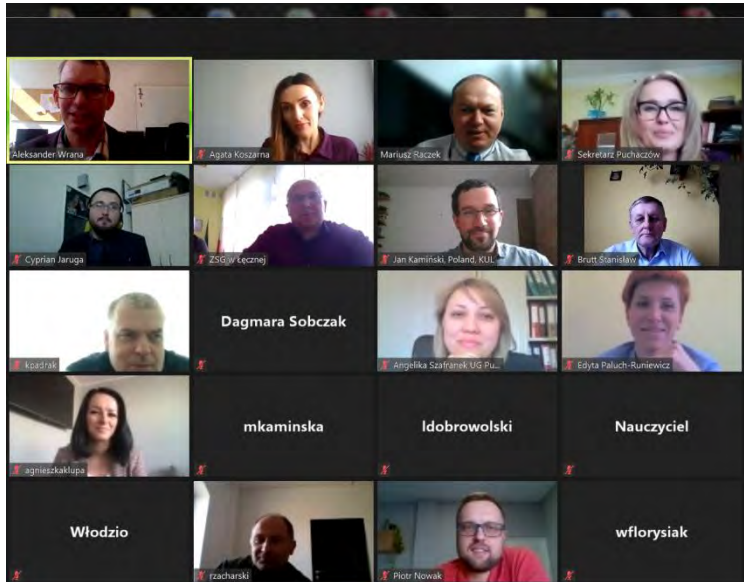
Participation in real processes

- Partnership in concept formulation → partnership in concept implementation

Identification And Viability Assessment Of Potential Uses For Spoil Dumps

Identification of scale of potential sites, assessment of local limitations and effectiveness of existing revitalization activities

Social engagement



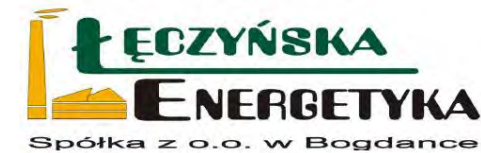
Poleski
Park Narodowy



LUBELSKI WĘGIEL
„BOGDANKA”
SPÓŁKA AKCYJNA



POWIAT
ŁĘCZYŃSKI
magia miejsc



UMCS
MARIA CURIE-SKŁODOWSKA UNIVERSITY



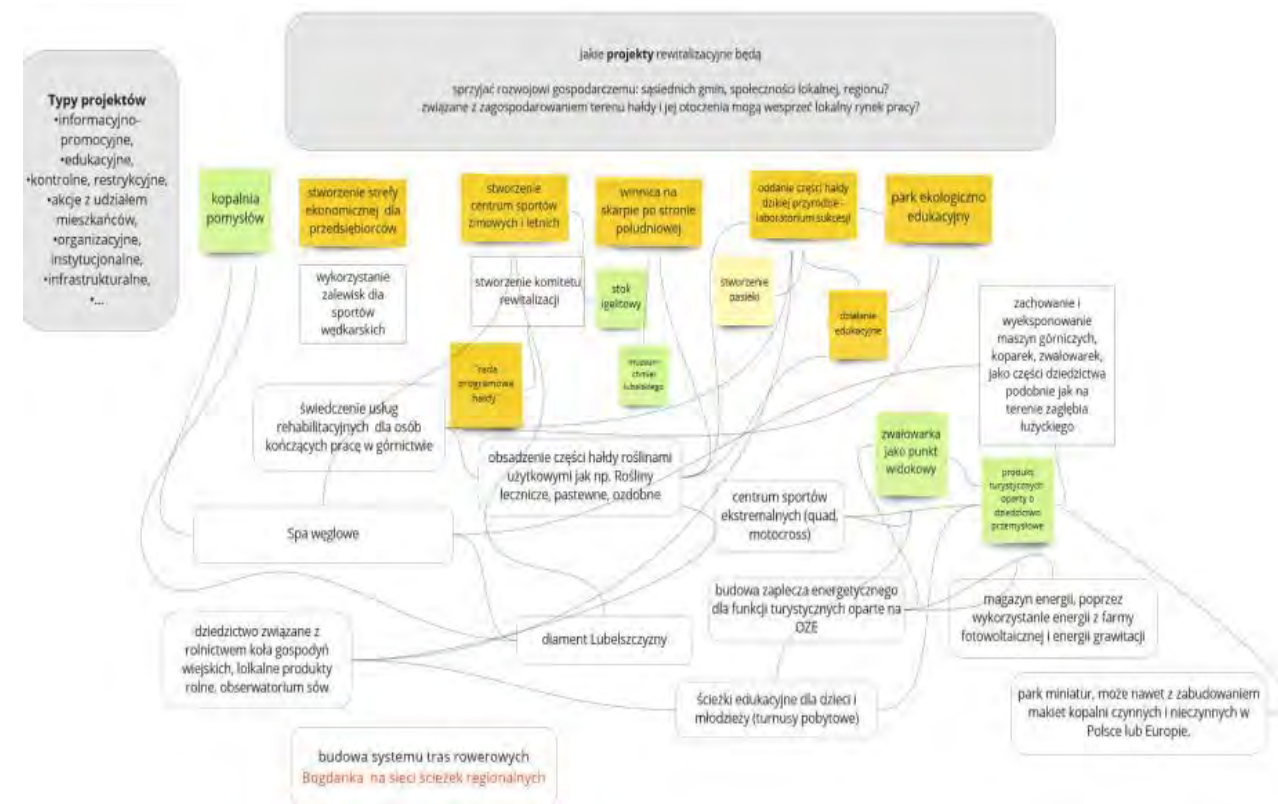
33 participants as representatives of local and regional stakeholders

Identification And Viability Assessment Of Potential Uses For Spoil Dumps

Identification of scale of potential sites, assessment of local limitations and effectiveness of existing revitalization activities

Social engagement – key revitalisation initiatives (1/2)

- creating an economic / investment zone for entrepreneurs,
- diamond of the Lublin region - creating a winter and summer sports center,
- establishment of a "heap program council" - as a forum for discussion and creating new projects,
- creating a coal "Spa,,,
- establishing a rehabilitation service center for people leaving the mining industry,
- building a system of bicycle routes - Bogdanka in the network of regional paths,
- use of lagoons for fishing sports,
- creating a winter and summer sports center,

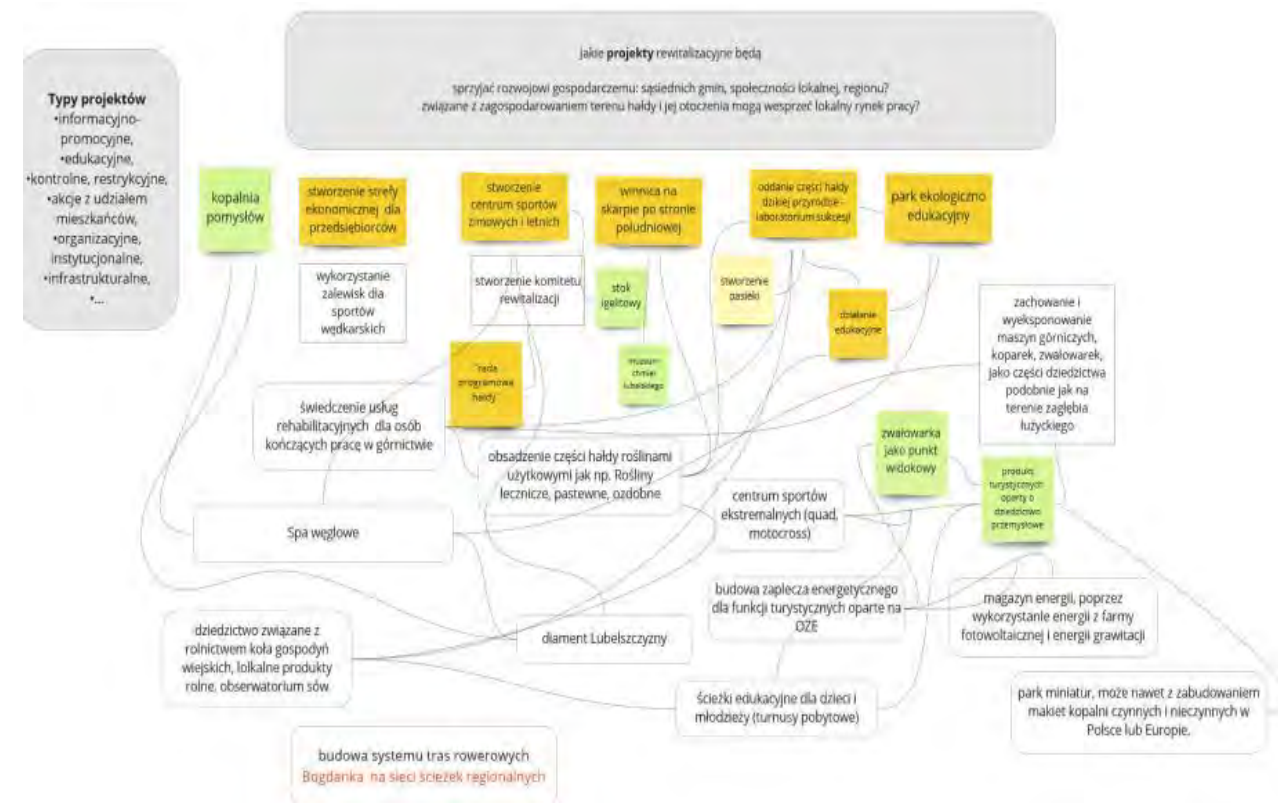


Identification And Viability Assessment Of Potential Uses For Spoil Dumps

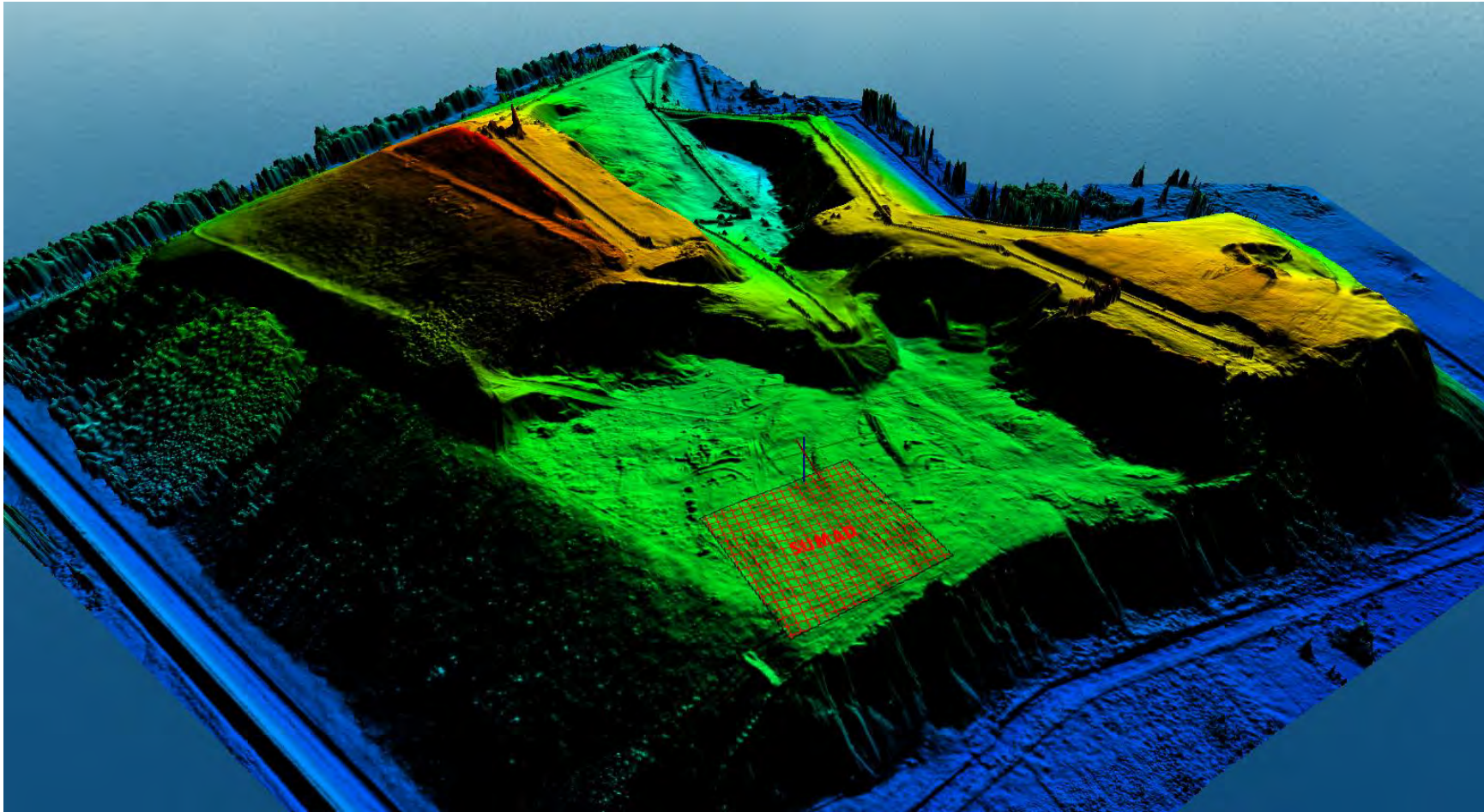
Identification of scale of potential sites, assessment of local limitations and effectiveness of existing revitalization activities

Social engagement – key revitalisation initiatives (2/2)

- creating a vineyard on the southern slope,
- planting a part of the heap with utility plants, such as medicinal,
- donating part of the heap to wild nature - creating a succession laboratory,
- creating a museum of hops from Lublin,
- creation of an ecological and educational park - implementation of educational activities, educational paths for children and youth
- creating a tourist product based on industrial heritage –
- creating an energy storage by using energy from a photovoltaic farm and the energy of gravity,
- construction of energy base for tourist functions based on renewable energy
- creation of a heritage product related to agriculture, rural housewives' circles, local agricultural products.



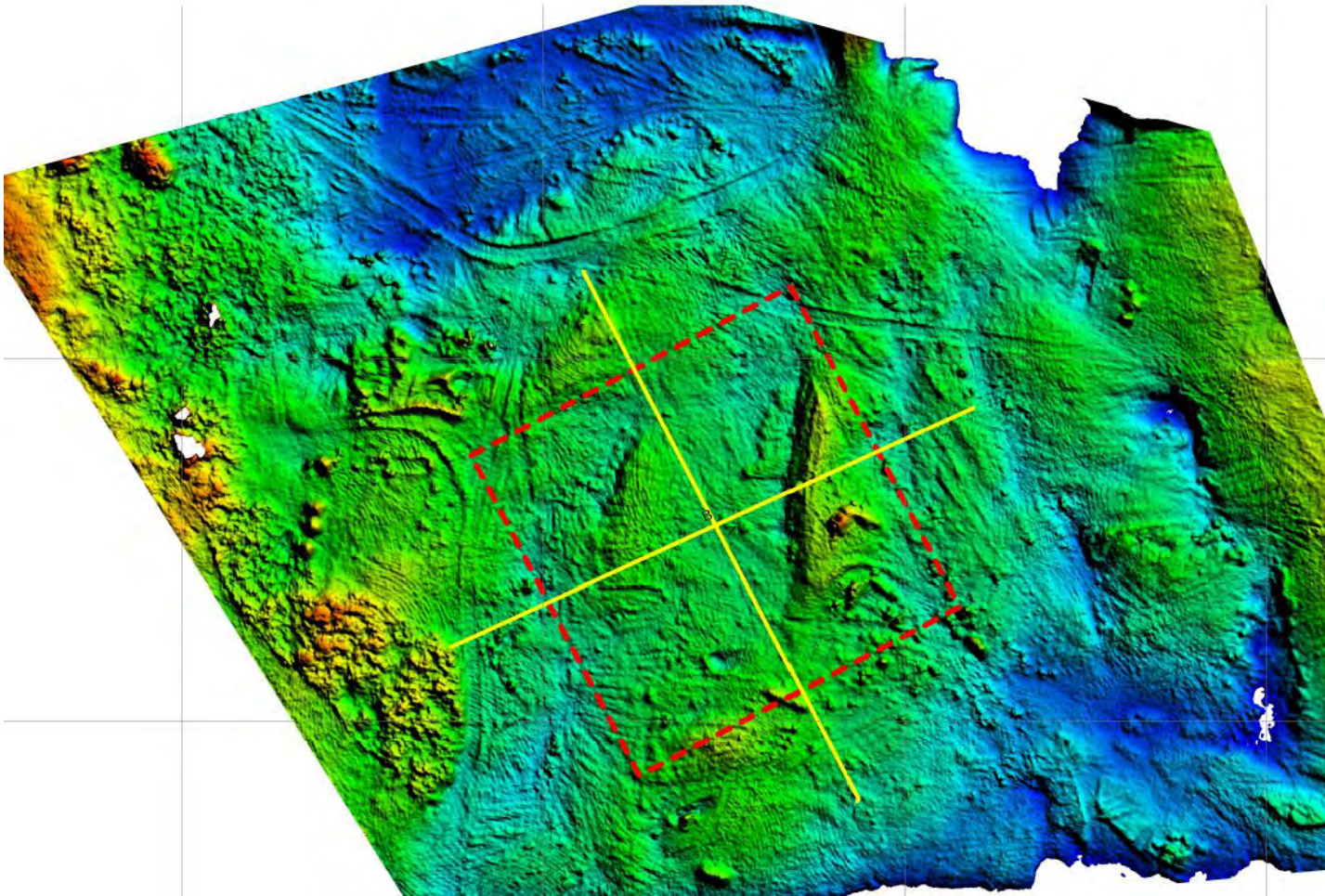
Monitoring of composition and parameters of wastes deposited at LW Bogdanka heap



Geotechnical research site

- 100m x 100m
- on the southwestern part of the dump
- about 196m above sea level

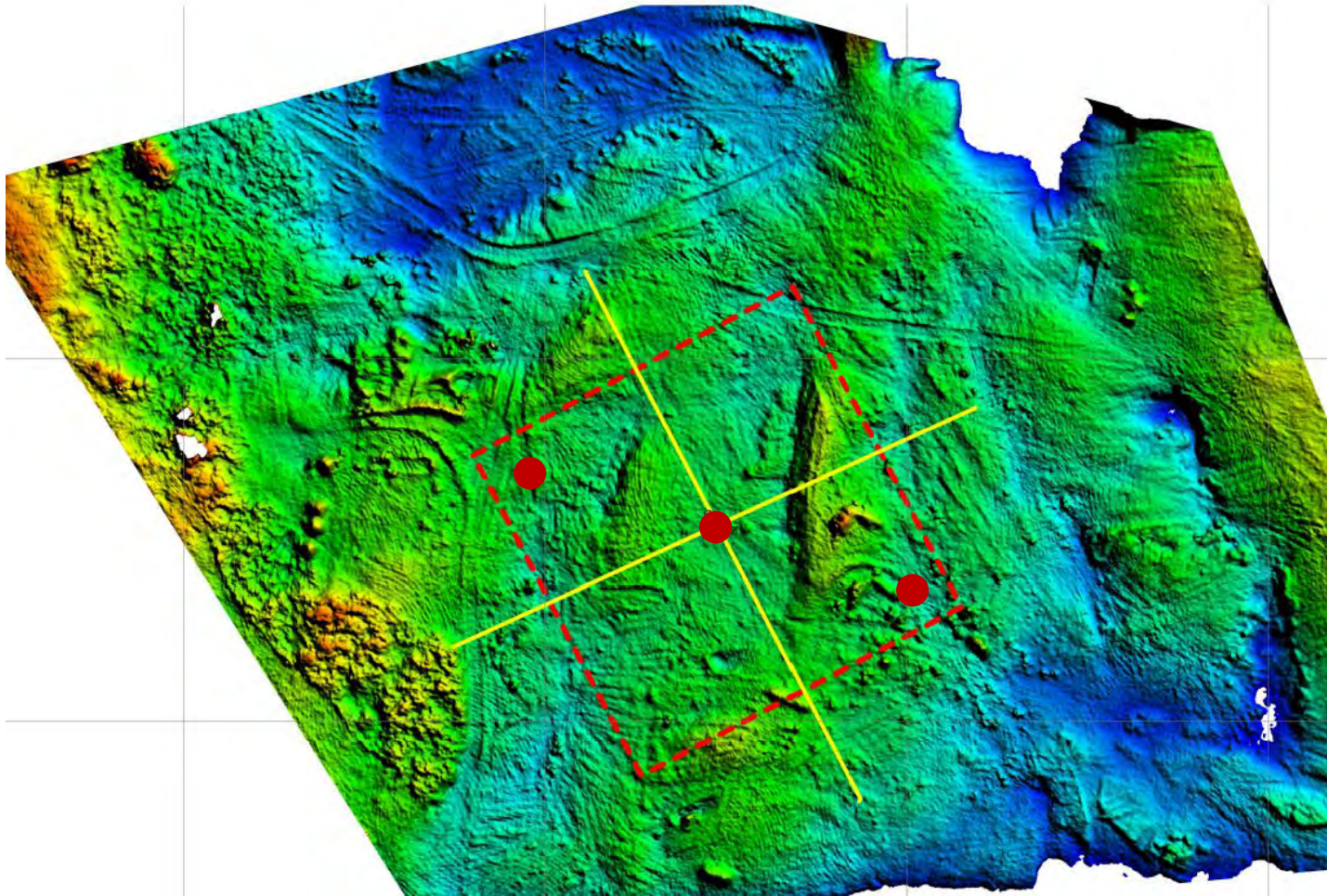
Monitoring of site behaviour



Standard borehole sampling

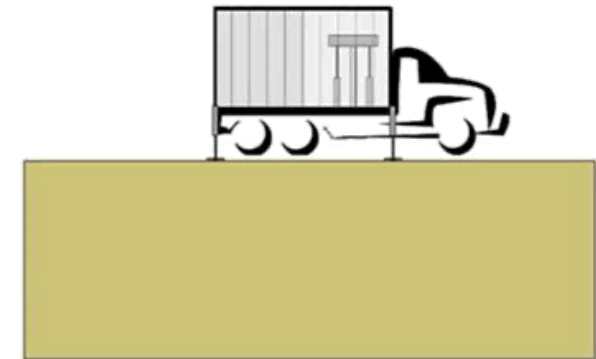
Item	Description
Drilling method	Rotary core drilling
Equipment	Triple tube core-barrel
Number of boreholes	min. 2
Borehole depth	preferably 30 meters

Monitoring of site behaviour



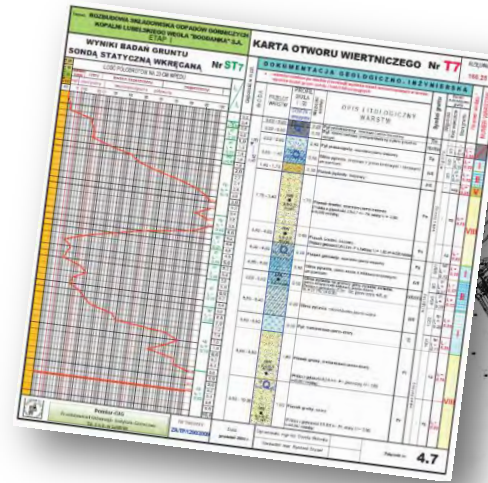
DPSH Dynamic probing

- relatable to geotechnical parameters
- can be used to validate numerical models directly



Monitoring of composition and parameters of wastes deposited at LW Bogdanka heap

- observation piezometers of the water surface and underground monitoring network
- geological and engineering holes made for the expansion of the dump

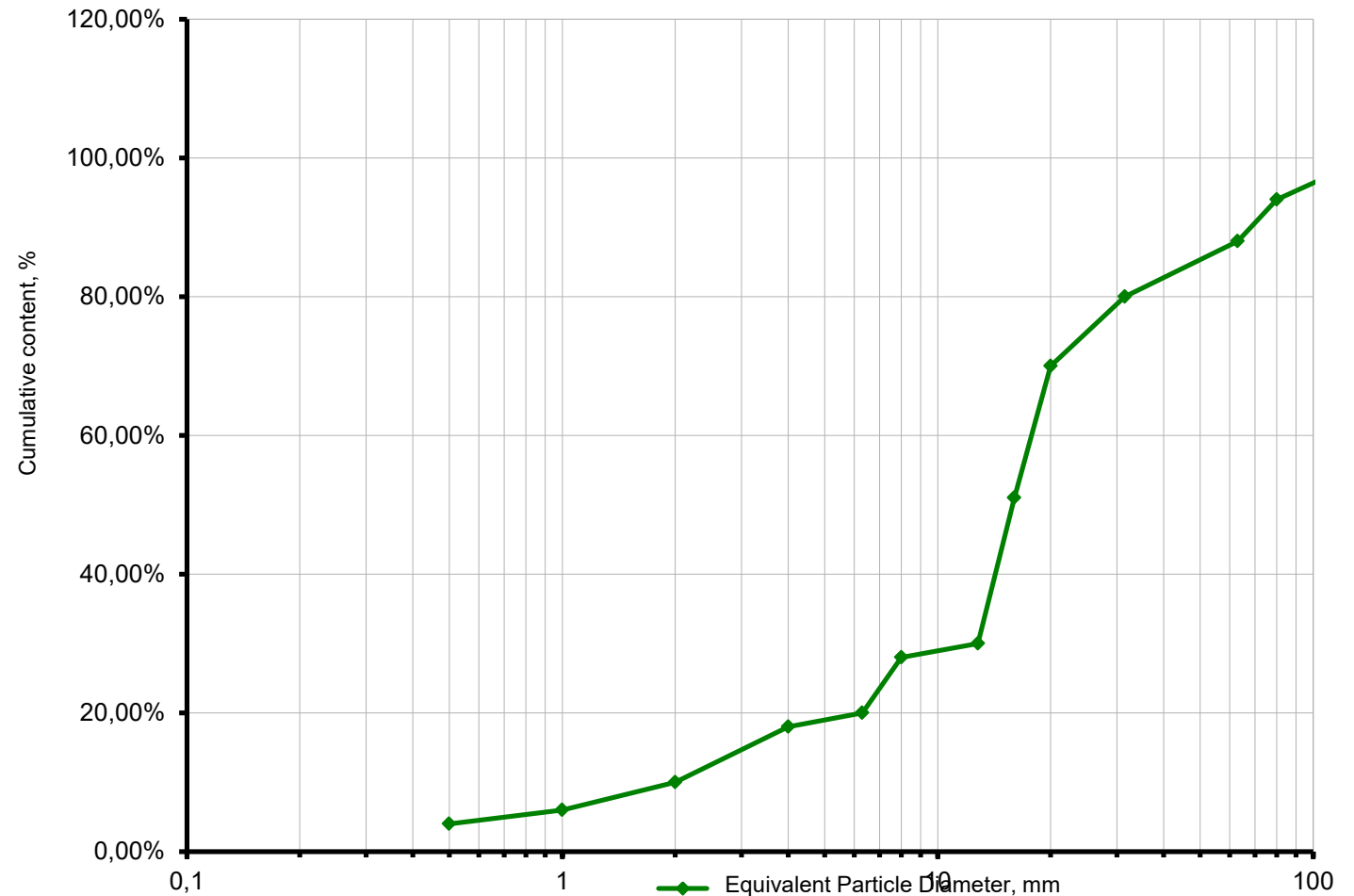


Monitoring of composition and parameters of wastes deposited at LW Bogdanka heap

Samples of post-mining waste from LW Bogdanka were tested at GIG.

The research included:

- the grain analysis of the post-mining waste sample,
- the SEM EDS microscopic analysis - mineralogical and chemical composition.



Monitoring of composition and parameters of wastes deposited at LW Bogdanka heap

The mineralogical and chemical composition was tested with the SEM EDS scanning microscope.

Table 1. Mineral composition of post-mining waste from LW Bogdanka

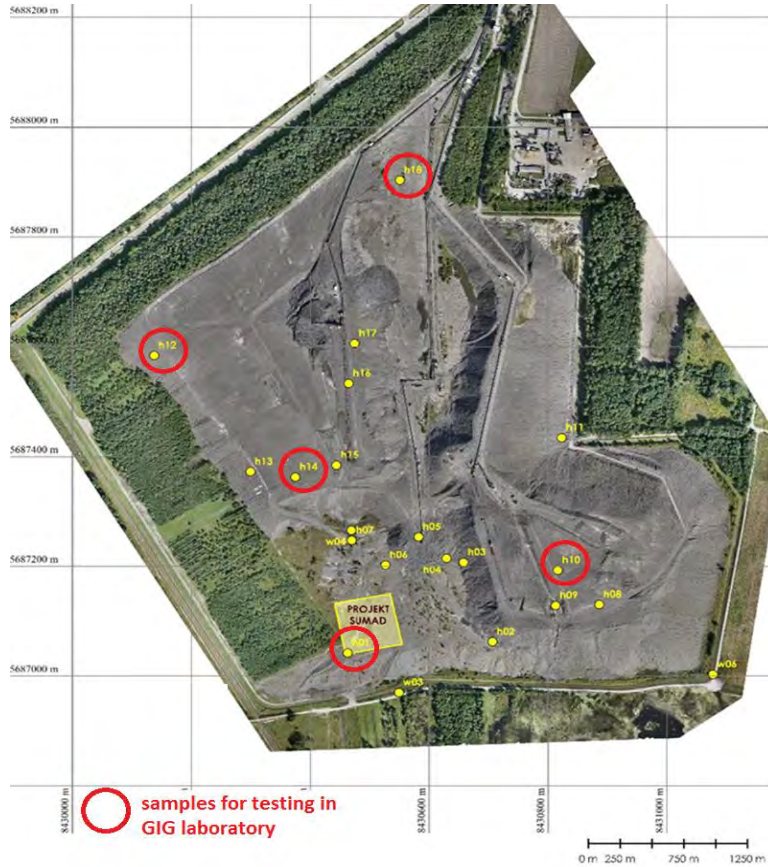
	Content [%]
Clay minerals	57
Quartz	19
Scaling	2
Siderite	5
Pyrite	1
Organic substance	8
Other	8

Table 2. Chemical composition of post-mining waste from LW Bogdanka

	Content [%]
SiO ₂	52,3
TiO ₂	0,8
Al ₂ O ₃	24,2
Fe ₂ O ₃	4,04
CaO	1,23
MgO	1,05
Na ₂ O	0,20
K ₂ O	2,42
P ₂ O ₅	0,21
SO ₃	0,35
LOI	13,2

Monitoring of composition and parameters of wastes deposited at LW Bogdanka heap

Monitoring of site behaviour



Location of sampling sites at the Bogdanka post-mining waste landfill



The location of the sampling sites on the Bogdanka mining waste dump

Samples of mining waste dump from LW Bogdanka

Monitoring of composition and parameters of wastes deposited at LW Bogdanka heap

By locating individual boreholes, an attempt was made to capture the greatest variability of waste, which could result from the manner in which it was deposited in the landfill.

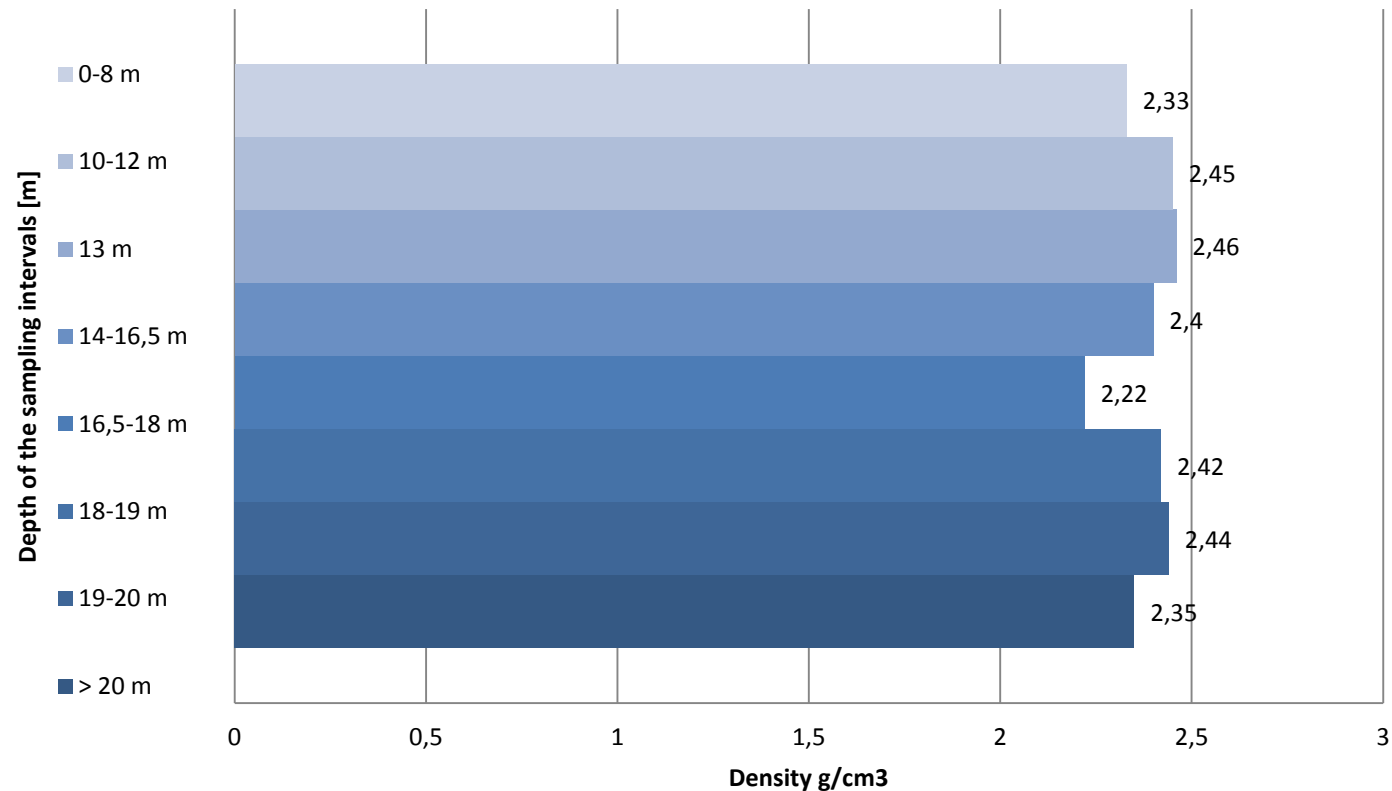
Table 1. Physico-chemical tests for the collected samples from the borehole

Determination	707.1-21 0-8m			707.2-21 10-12m			707.3-21 13m			707.4-21 14-16,5m			707.5-21 16,5-18m			707.6-21 18-19m			707.7-21 19-20m			707.8-21 +20		
	as received	analytical	dry mass	as received	analytical	dry mass	as received	analytical	dry mass	as received	analytical	dry mass	as received	analytical	dry mass	as received	analytical	dry mass	as received	analytical	dry mass	as received	analytical	dry mass
	base	base	base	base	base	base	base	base	base	base	base	base	base	base	base	base	base	base	base	base	base	base	base	base
	%																							
analytical moisture		1,33			1,2			1,2			1,18			1,18			1,21			1,16			1,29	
total moisture	7,45			7,03			7,55			7,05			11,22			8,6			8,39			4,71		
ash content	74,07	78,97	80,03	78,59	83,52	84,53	77,99	83,34	84,36	75,77	80,56	81,52	67,69	75,34	76,24	77,48	83,74	84,77	77,49	83,61	84,59	76,54	79,29	80,33
total carbon	9,94	10,6	10,74	6,53	6,94	7,02	6,59	7,04	7,13	8,72	9,27	9,38	13,28	14,78	14,96	6,44	6,96	7,05	6,47	6,98	7,06	9,74	10,09	10,22
total inorganic carbon TIC	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03	<0,03
total organic carbon TOC	9,94	10,6	10,74	6,53	6,94	7,02	6,59	7,04	7,13	8,72	9,27	9,38	13,28	14,78	14,96	6,44	6,96	7,05	6,47	6,98	7,06	9,74	10,09	10,22
total hydrogen	0,83	0,88	0,89	0,61	0,65	0,65	0,58	0,62	0,63	0,78	0,83	0,84	0,93	1,04	1,05	0,59	0,63	0,64	0,61	0,66	0,67	0,83	0,86	0,87
total sulphur	0,39	0,42	0,43	0,25	0,27	0,27	0,23	0,25	0,25	0,25	0,27	0,27	0,35	0,39	0,39	0,77	0,83	0,84	0,53	0,57	0,58	0,92	0,95	0,96
	[J/g (kJ/kg)]																							
gross calorific value		3980	4030		2360	2390		2370	2400		3280	3320		5720	5790		2280	2310		2470	2500		3740	3790
net calorific value	3360	3750	3830	1920	2190	2250	1900	2200	2260	2750	3070	3140	4660	5470	5560	1770	2110	2170	1950	2290	2350	3320	3520	3600
density	2,33 g/cm3			2,45 g/cm3			2,46 g/cm3			2,40 g/cm3			2,22 g/cm3			2,42 g/cm3			2,44 g/cm3			2,35 g/cm3		

Monitoring of composition and parameters of wastes deposited at LW Bogdanka heap

Monitoring of site behaviour

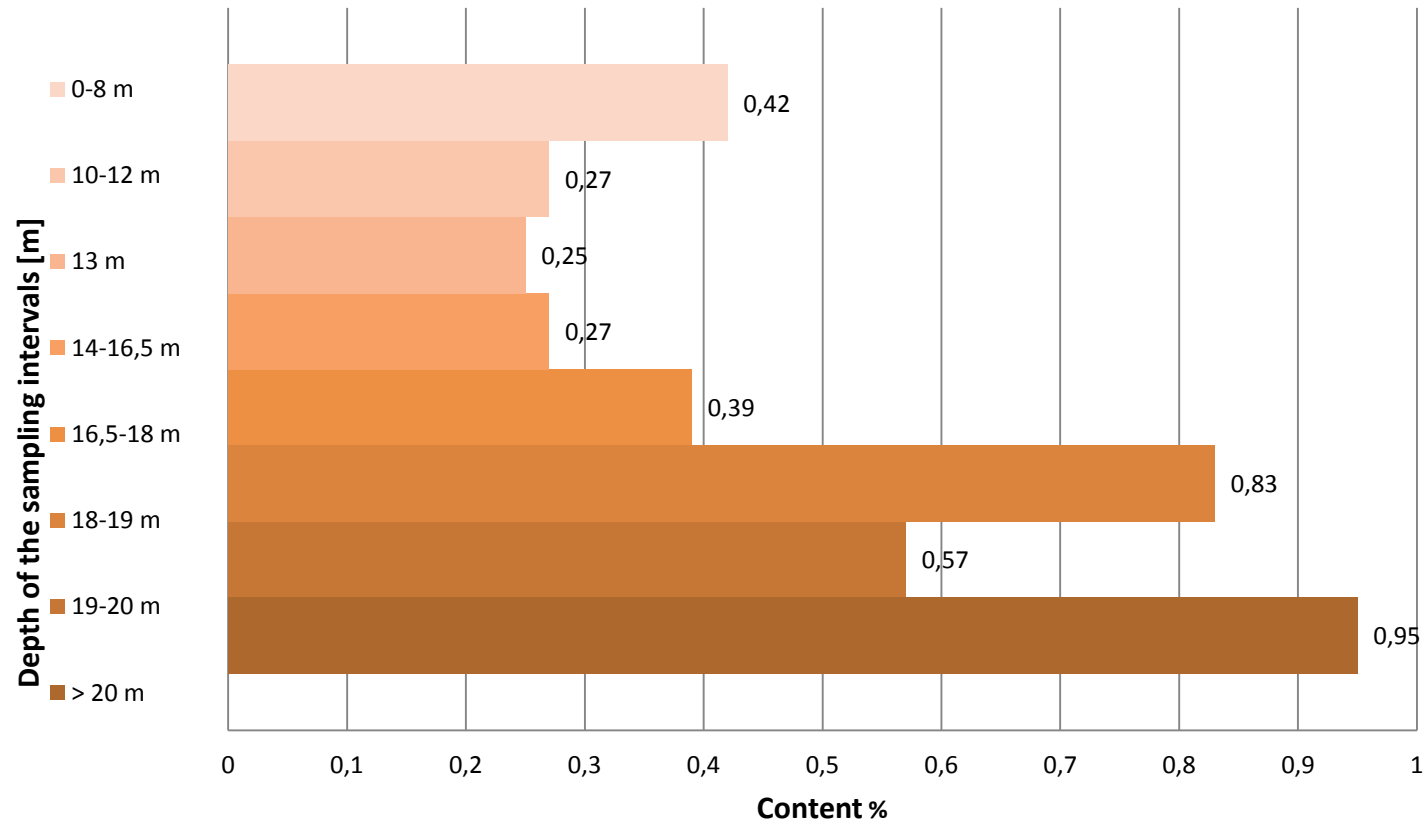
Vertical distribution of waste density content in averaged samples from borehole



Monitoring of composition and parameters of wastes deposited at LW Bogdanka heap

Monitoring of site behaviour

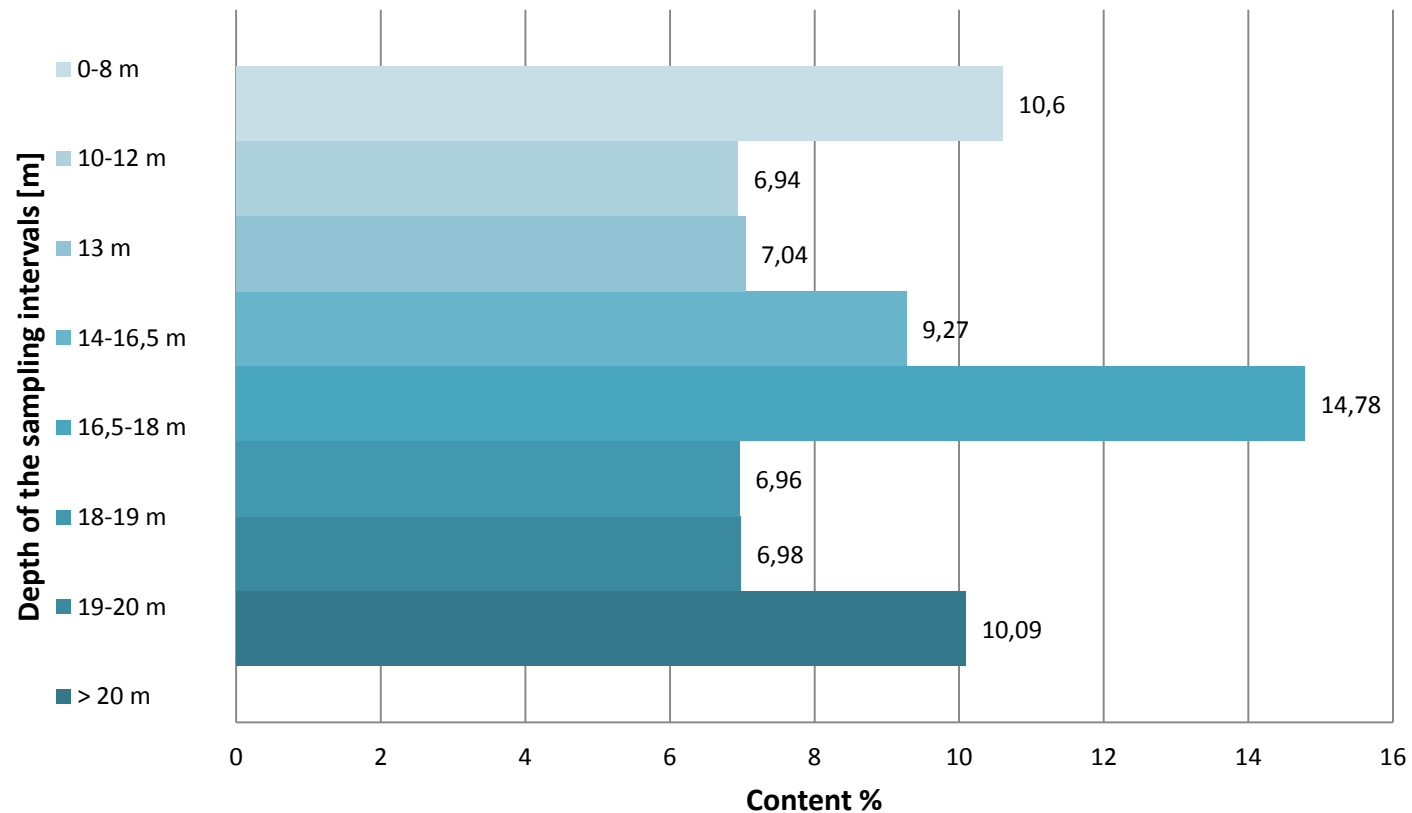
Vertical distribution of total sulfur content in waste in averaged samples from borehole



Monitoring of composition and parameters of wastes deposited at LW Bogdanka heap

Monitoring of site behaviour

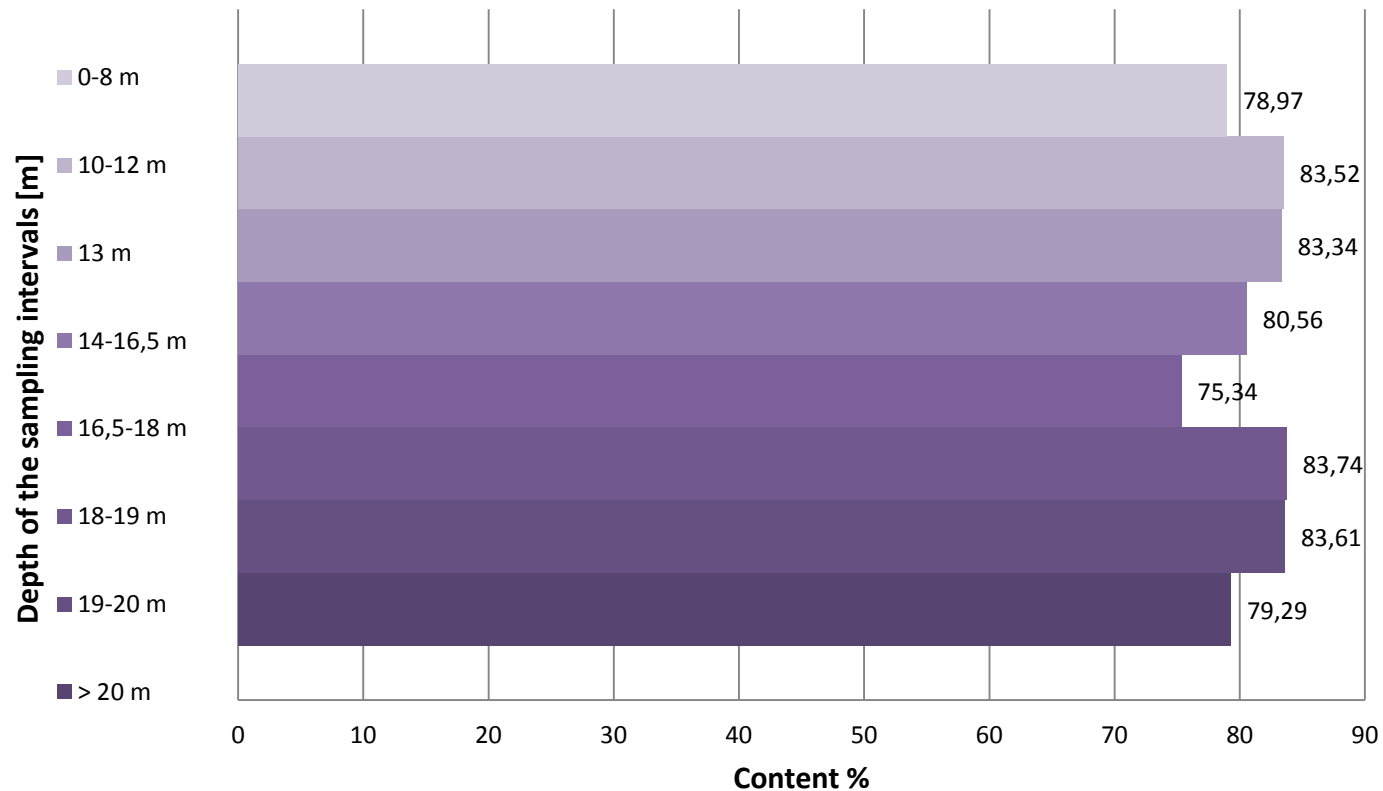
Vertical distribution of total carbon content in waste in averaged samples from borehole



Monitoring of composition and parameters of wastes deposited at LW Bogdanka heap

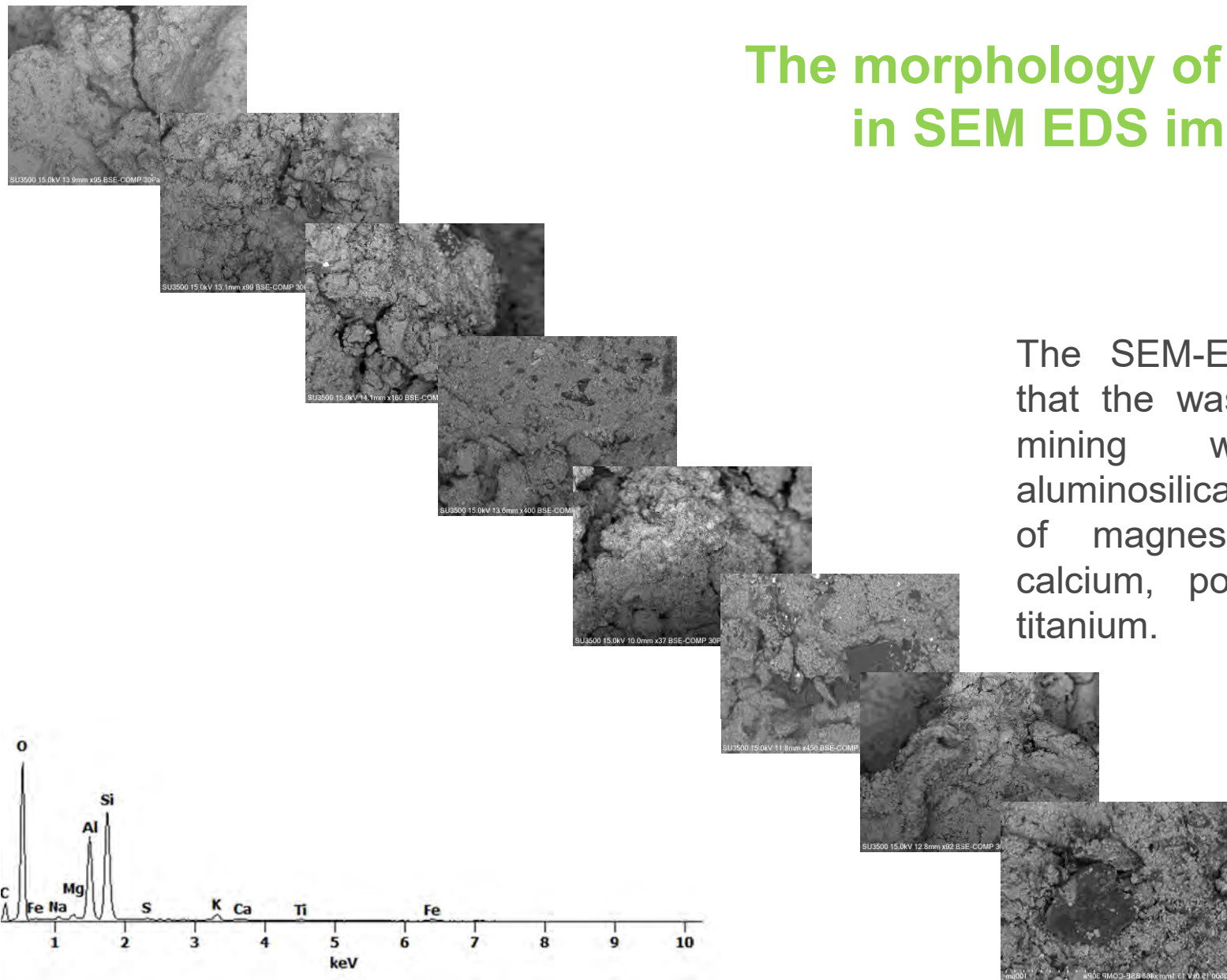
Monitoring of site behaviour

Vertical distribution of ash content in waste in averaged samples from borehole



The morphology of particles in SEM EDS images

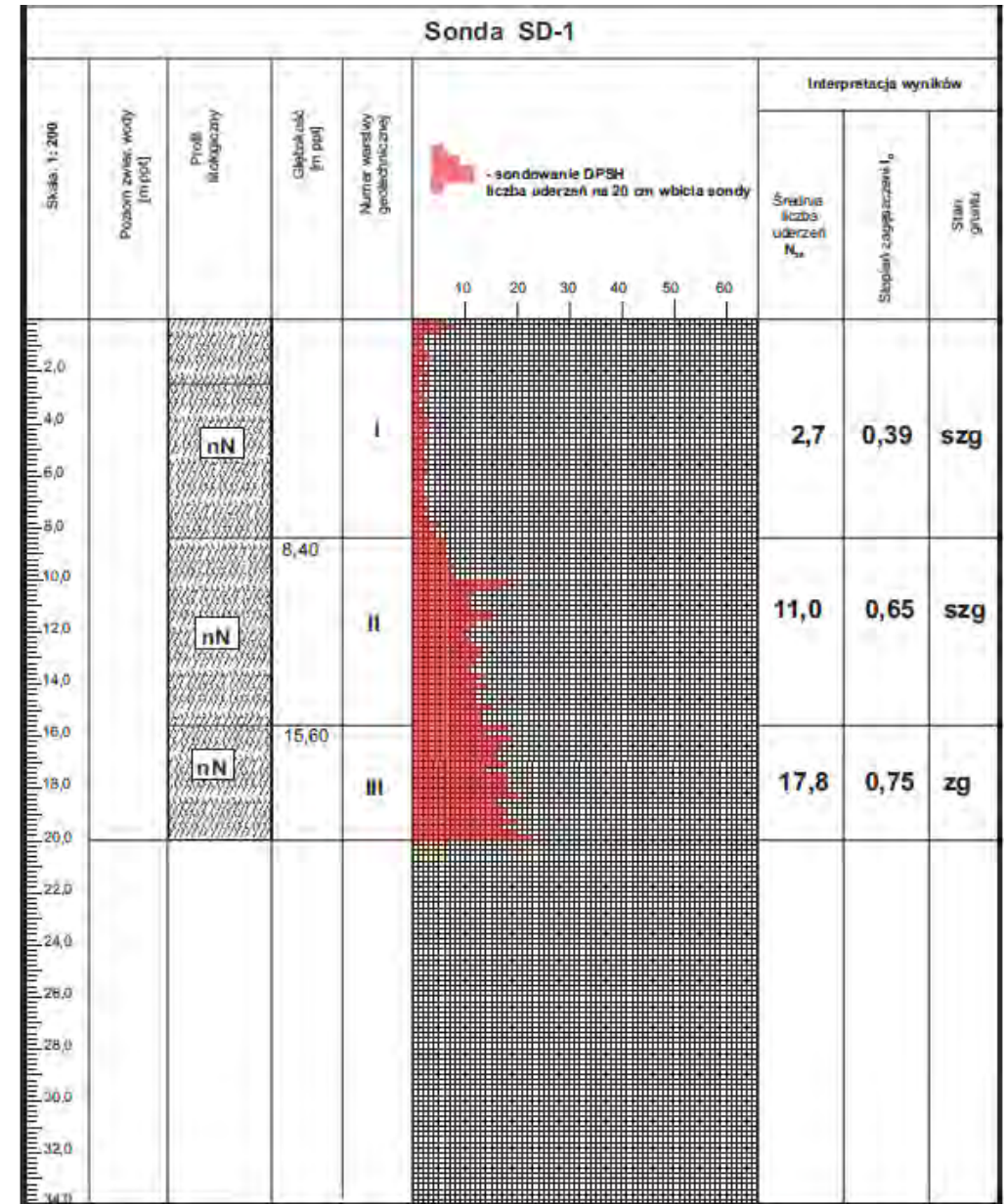
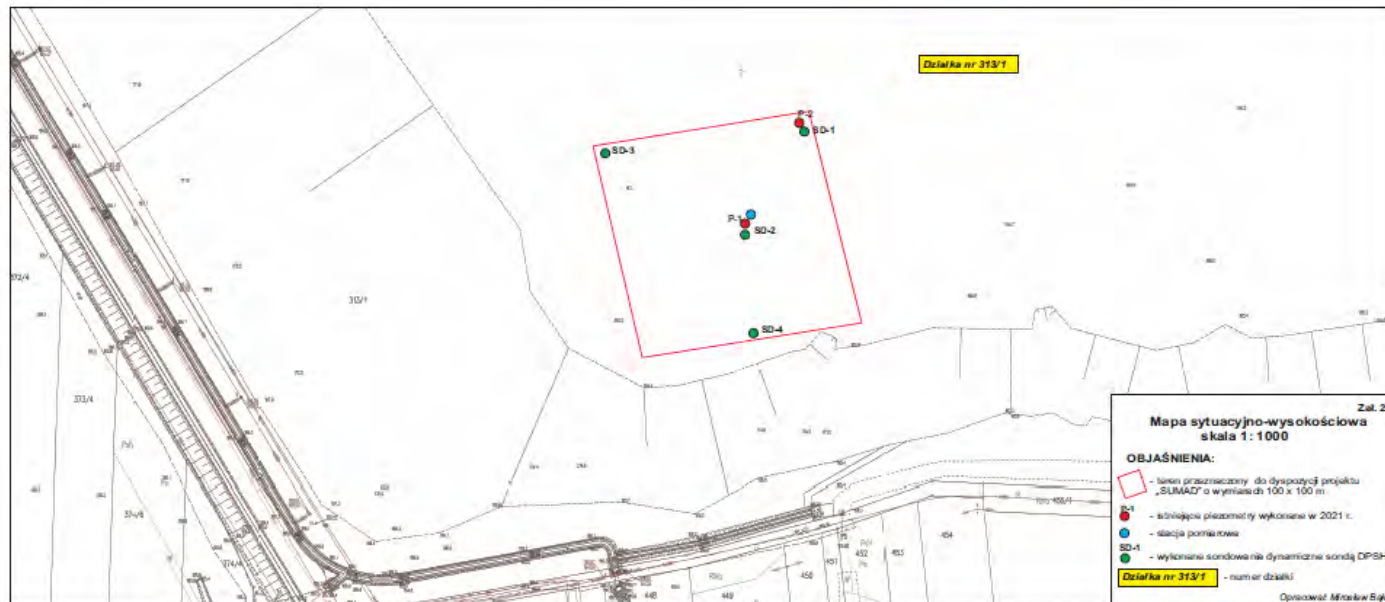
- 0-8 m
- 10-12 m
- 13 m
- 14-16,5 m
- 16,5-18 m
- 18-19 m
- 19-20 m
- > 20 m



The SEM-EDS research shows that the waste in the Bogdanka mining waste dump is aluminosilicates with admixtures of magnesium, sodium, iron, calcium, potassium, sulfur and titanium.

DPSH Dynamic probing

- 4 dynamic probing procedures by means of DPSH were performed as part of the field work, to a depth of 20.0 m, with a total length of 80.0 running metres.
- The soils found in the ground were divided into 3 geotechnical layers based on the DPSH probing results.
- The identified layers I and II are semi-dense soils with density indices $ID = 0.39$ to 0.50 for layer I and $ID = 0.63$ to 0.65 for layer II, whereas the identified layer III constitutes dense soils with a density index $ID = 0.71$ to 0.75 .



Conclusions:

The research physicochemical tests for the collected samples from LW Bogdanka dump shows that:

- The density of waste at particular depths was similar and ranged from 2.22 g/cm³ to 2.46 g/cm³.
- Sulfur content ranged from 0.42% to 0.95% and its content increased with depth.
- Carbon content ranged from about 7% to 15% and was highest at a depth of 16.5 to 18 meters.
- The ash content was in the range of 80-84%.

The SEM-EDS research shows that the waste in the Bogdanka mining waste dump is aluminosilicates with admixtures of magnesium, sodium, iron, calcium, potassium, sulfur and titanium.

Based on dynamic probing research identified layers I and II are semi-dense soils with density indices $ID = 0.39$ to 0.50 for layer I and $ID = 0.63$ to 0.65 for layer II, whereas the identified layer III constitutes dense soils with a density index $ID = 0.71$ to 0.75 .

Based on the laboratory and geotechnical tests carried out, a more informed analysis can be carried out to assess the operation of the heap and to analyze possible design scenarios.

**Thank you for your
attention**

