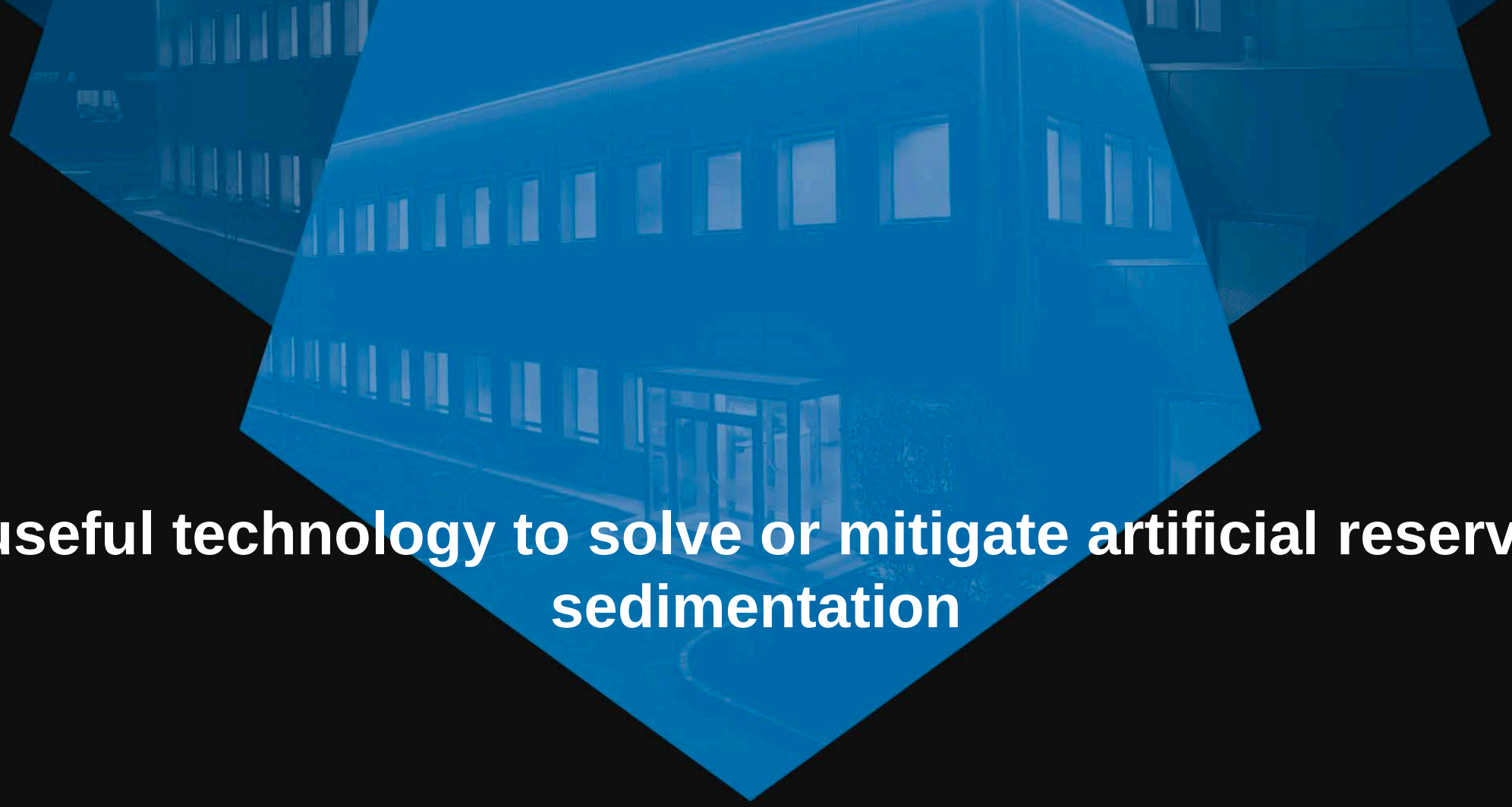

A useful technology to solve or mitigate artificial reservoir sedimentation

Alfredo Ranaldi

DRAGFLOW

ULTIMATE EFFICIENCY

WHY MUST RESERVOIRS BE DREDGED?

- **Restriction of sediment flow** = erosion downstream Water lacking sediments is much more aggressive. A phenomenon called **Hungry Water**
- The **lack of coarse sediment** (sand, gravel) has resulted in channel incision and consequent **effects on bridges and other infrastructure**
- The **lack of fine sediment** (silt, clay, nutrients) can have **serious effects on balance of downstream ecosystems**,
- **Abrasion of hydromechanical parts** leads to a shorter dam life time.

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WHY MUST RESERVOIRS BE DREDGED?

RESERVOIR CAPACITY:
6,000X 10^9 M^3
(WORLDWIDE)

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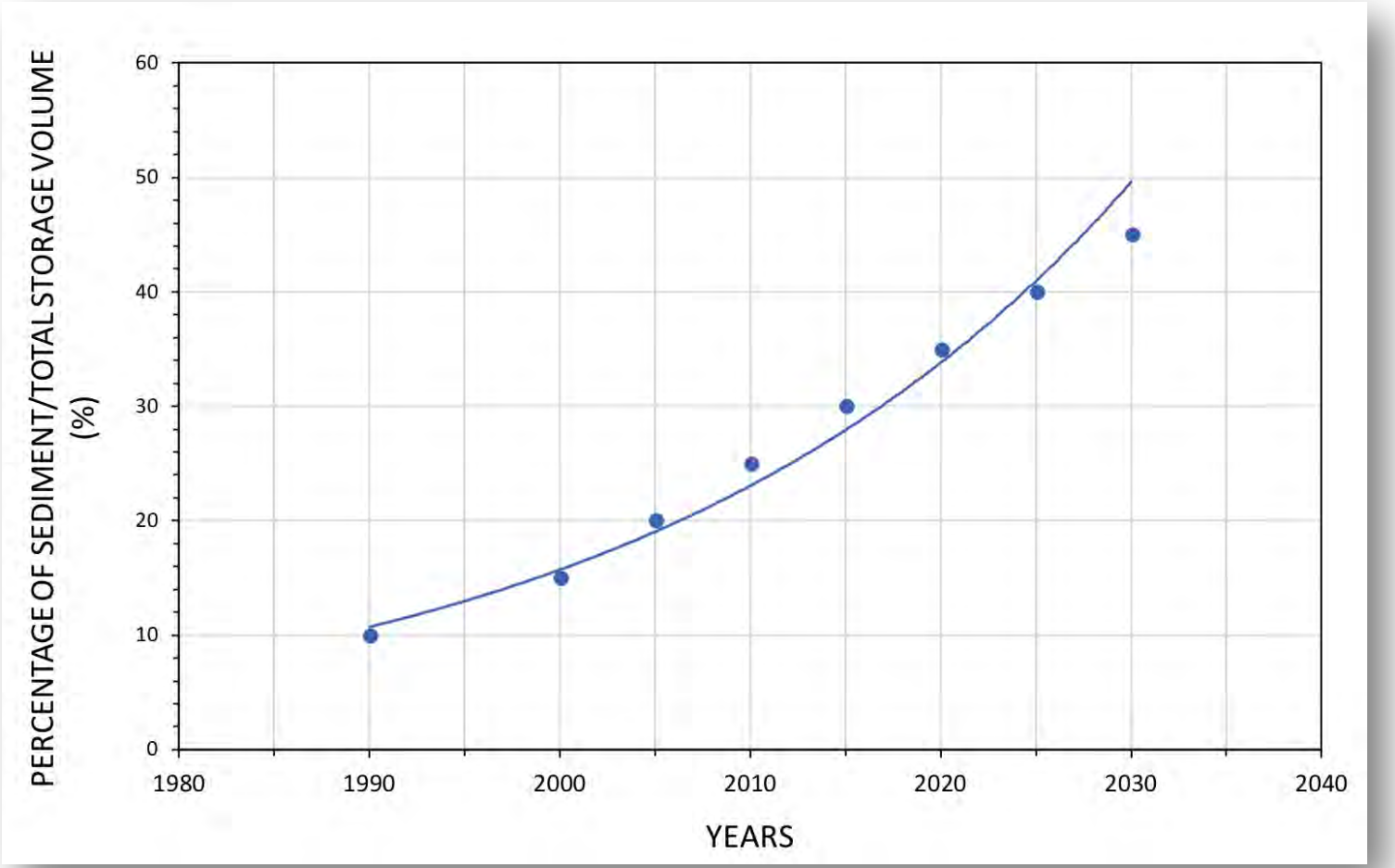
WHY MUST RESERVOIRS BE DREDGED?

In few years the percentage of sediments in the reservoirs will reach 50% of the total storage volume



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MAIN CAUSES

1. *Climate change*
2. *Flash floods*
3. *Soil erosion*
4. *Vegetation degradation*
5. *Agricultural development*
6. *Wood coverage reduction*

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COUNTERMEASURES

Ambiesta Dam, Italy – Subject of current case history

- *CATCHMENT BASIN INTERVENTIONS (SURFACE PROTECTION, WEIRS ALONG TRIBUTARIES, VEGETATION IMPROVEMENT, REFORESTATION, ETC.)*
- *RESERVOIR DESILTING (DESILTING CHANNELS, **DREDGING IN SELECTED AREAS**, ETC.)*

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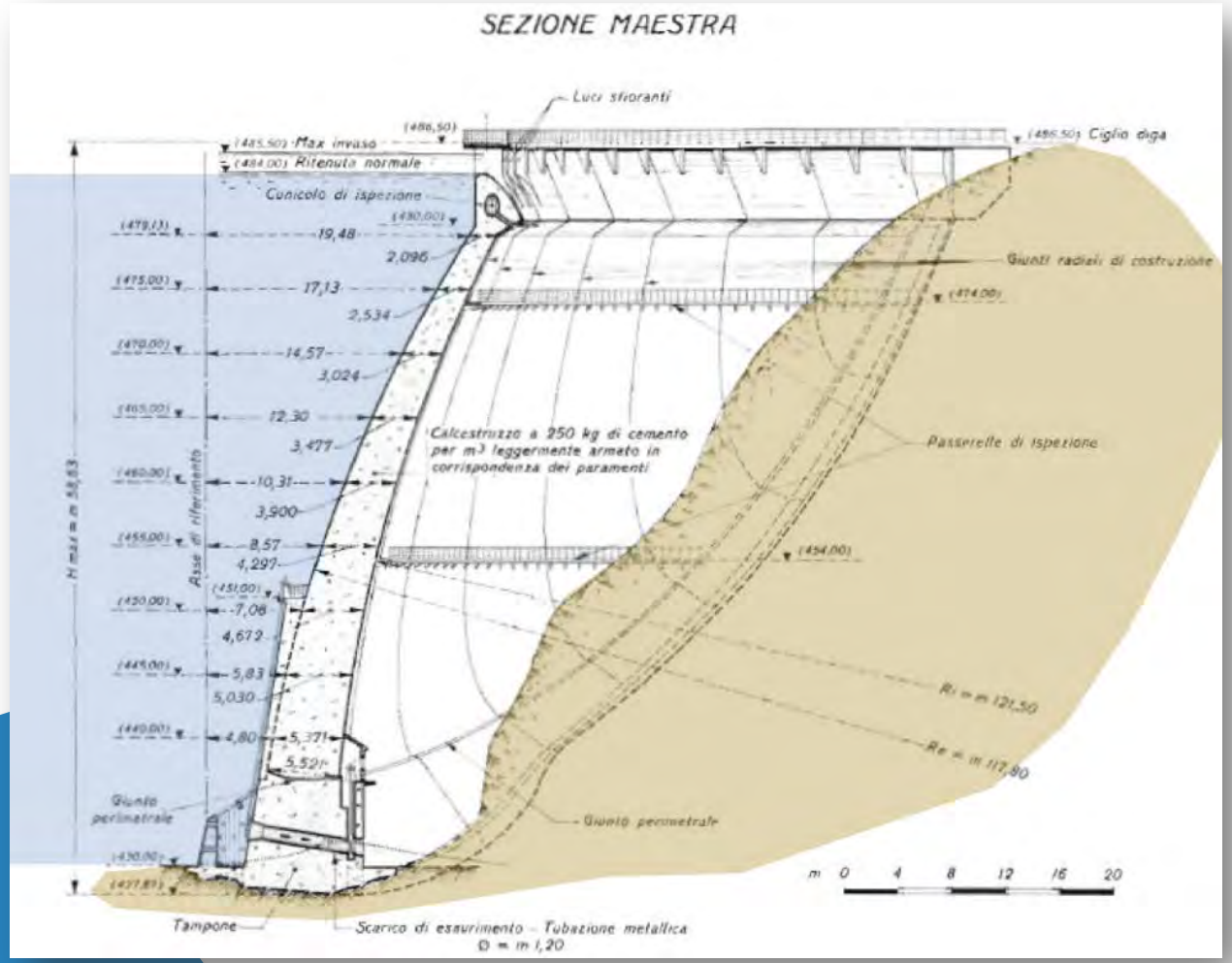
AMBIESTA DAM CASE HISTORY



MAIN CHARACTERISTICS:

- Normal operating water level: 484 m.a.s.l. (1574ft)
- Maximum water level: 485.50 m.a.s.l. (1592ft)
- Dam volume: 28,734 m^3 of concrete
- Crest length: 144.64 m (472ft)
- Dam thickness (at the top): 1.80 m (59ft)
- Dam thickness (at the toe): 5.52 m (18.11ft)

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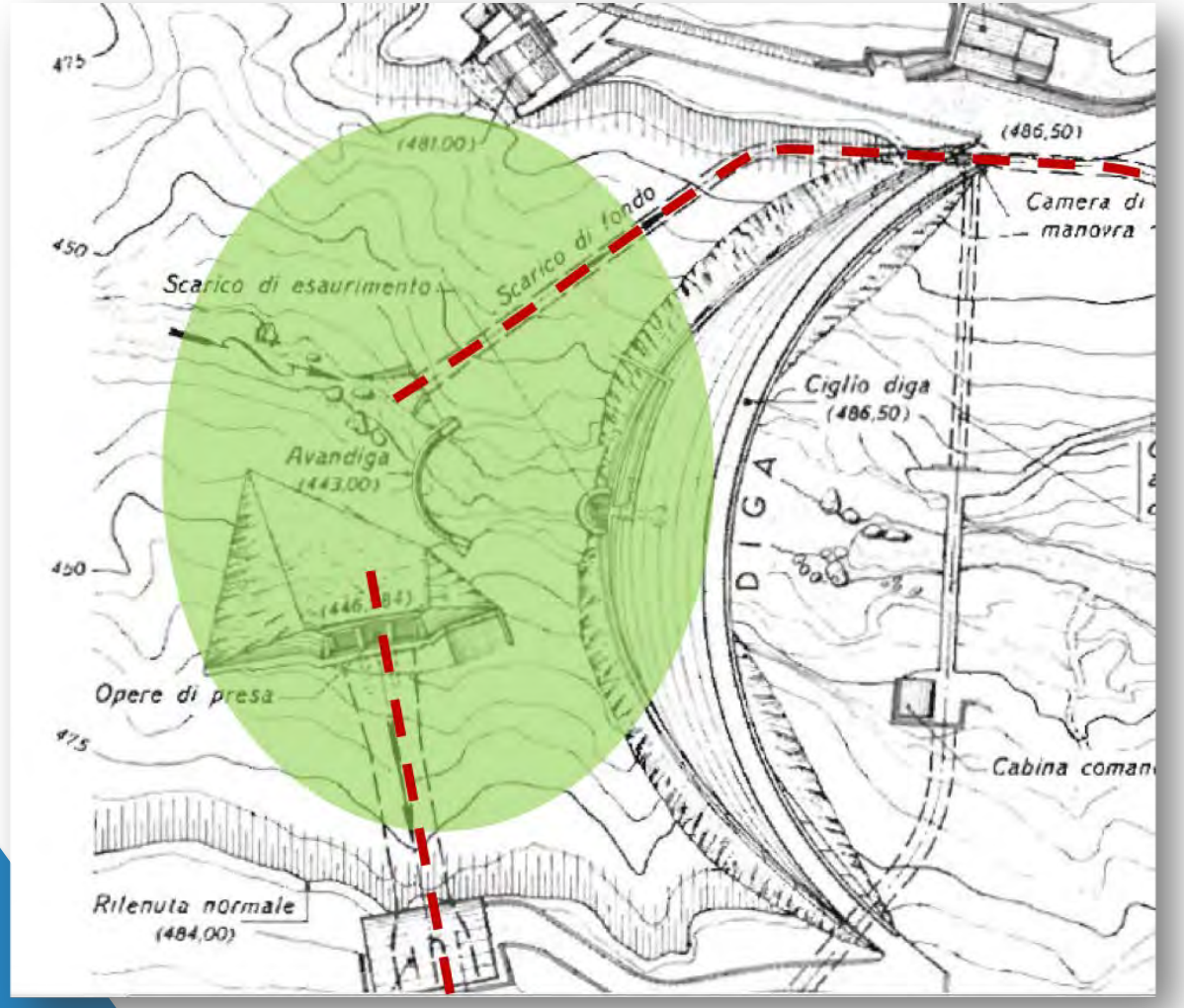
AREA TO BE DREDGED



- Total surface: 4,500 m^2
- Water depth: 20 – 36 m (65 – 118ft)
- Volume to be dredged: 28,000 m^3
- Sediment thickness: 6 – 10 m (19 – 33ft)

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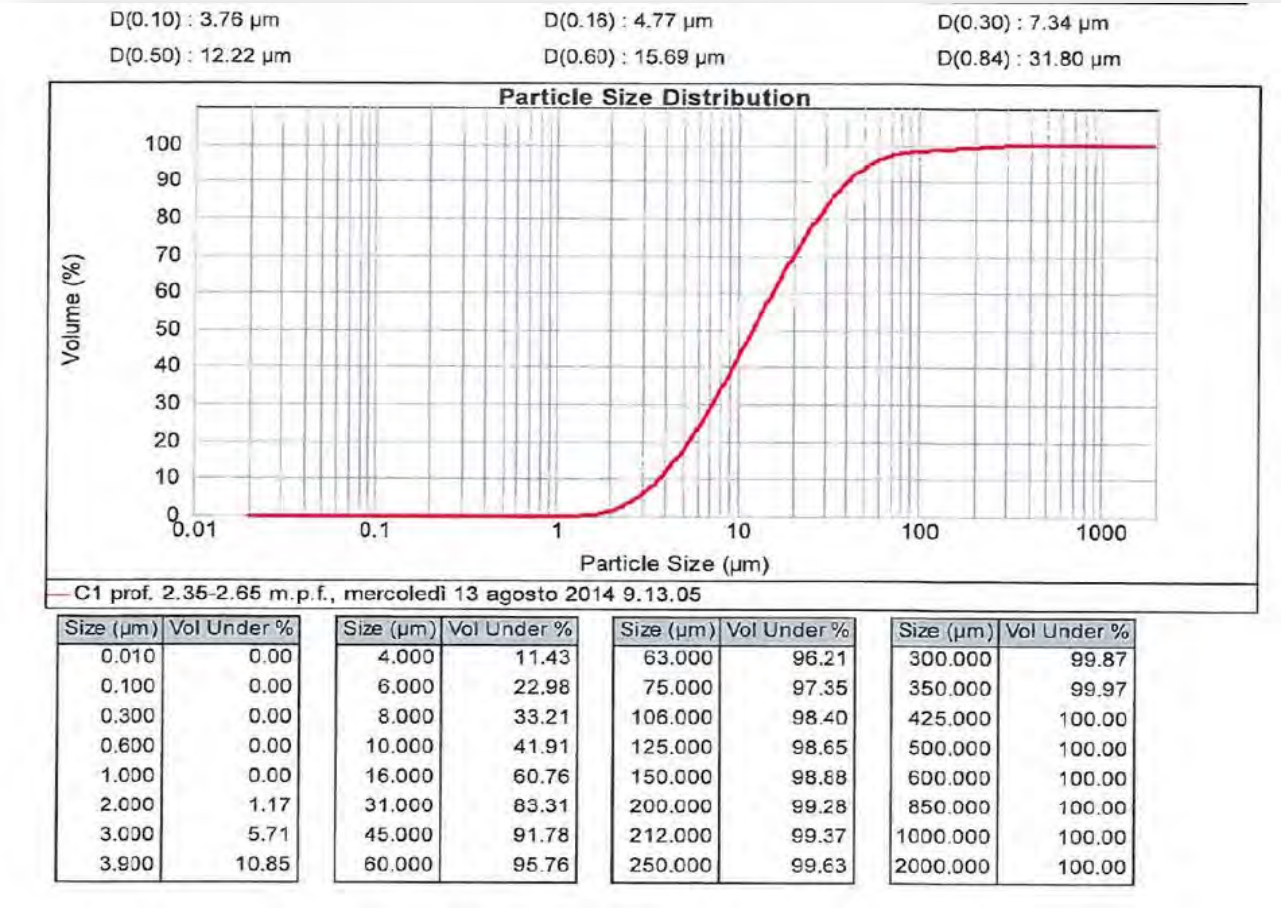
DESIGN CRITERIA & ENVIRONMENTAL CONSTRAINTS



Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.010	0.00	4.000	11.43	63.000	96.21	300.000	99.87
0.100	0.00	6.000	22.98	75.000	97.35	350.000	99.97
0.300	0.00	8.000	33.21	106.000	98.40	425.000	100.00
0.600	0.00	10.000	41.91	125.000	98.65	500.000	100.00
1.000	0.00	16.000	60.76	150.000	98.88	600.000	100.00
2.000	1.17	31.000	83.31	200.000	99.28	850.000	100.00
3.000	5.71	45.000	91.78	212.000	99.37	1000.000	100.00
3.900	10.85	60.000	95.76	250.000	99.63	2000.000	100.00

- SEDIMENT QUANTITY
- TOTAL SURFACE TO BE DREDGED
- WATER DEPTH
- DREDGING TIME (100 DAYS)
- DISPOSAL AREA
- SEDIMENT CONCENTRATION (9G/L)
- TURBIDITY LIMITATIONS

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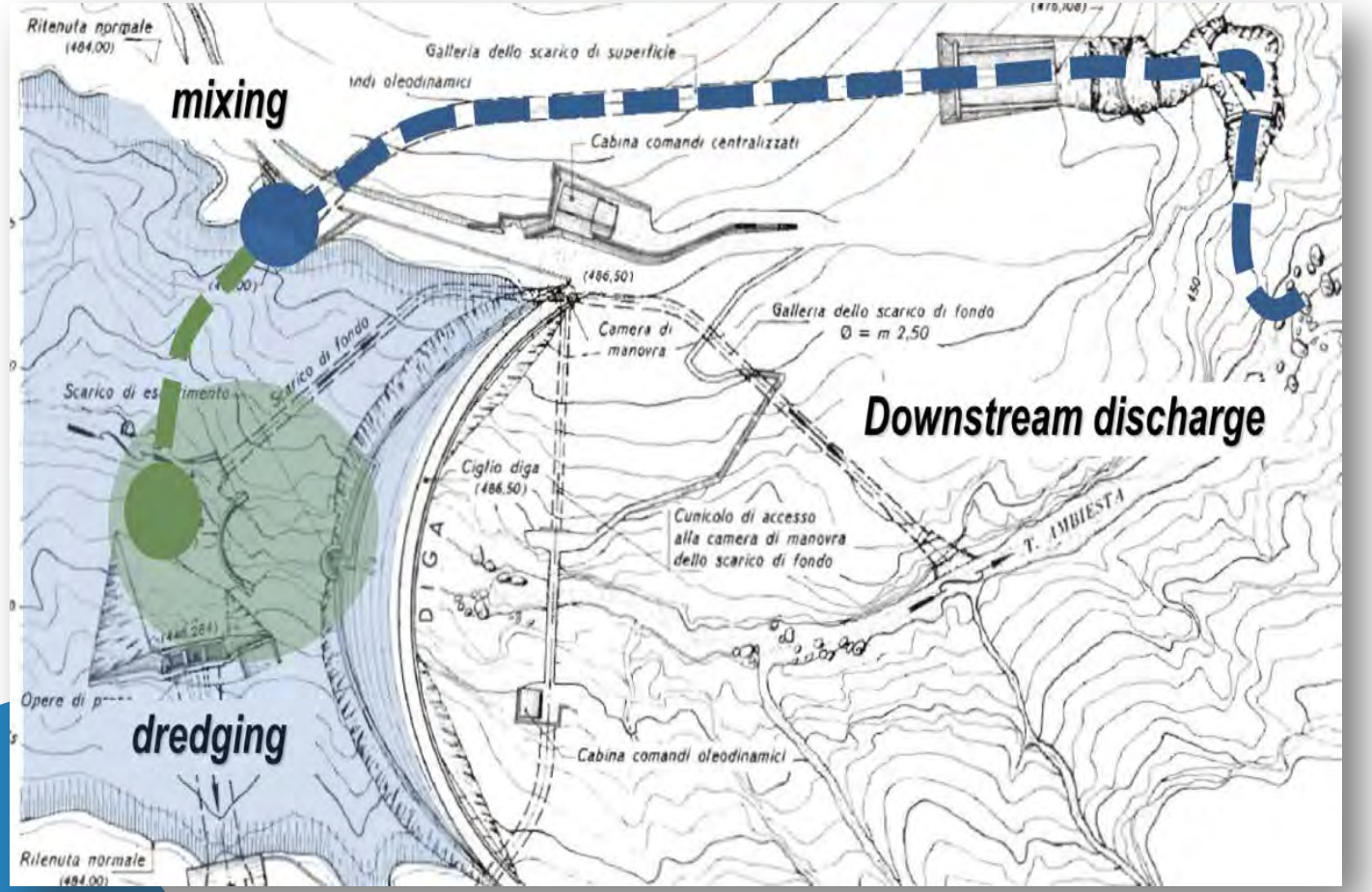
DESIGN OF COST EFFECTIVE SOLUTION



1. Pump selection
2. Accessories (side cutters, noise reduction tool)
3. Discharge pipe (booster station)
4. Dredger (power pack)
5. Service boat

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SOLUTION SELECTED FOR AMBIESTA RESERVOIR

- DREDGER EQUIPPED WITH WINCHES
- HYDRAULIC POWER PACK
- GPS SYSTEM FOR CORRECT POSITIONING
- N. 1 HYDRAULIC PUMP HY85/160B
- N. 2 SIDE CUTTERHEADS
- SERVICE BOAT
- DISCHARGING PIPELINE WITH FLOATERS

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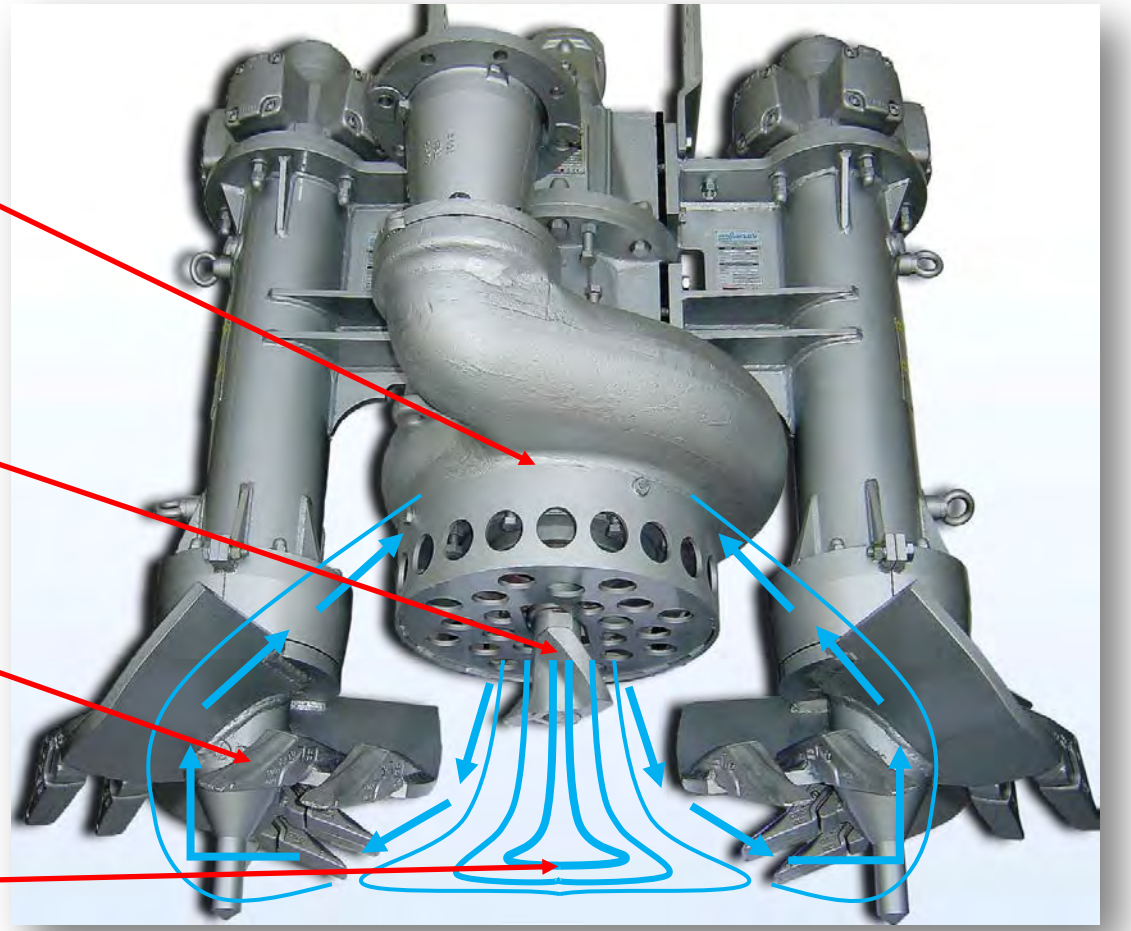
SOLUTION SELECTED FOR AMBIESTA RESERVOIR



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SOLUTION SELECTED FOR AMBIESTA RESERVOIR

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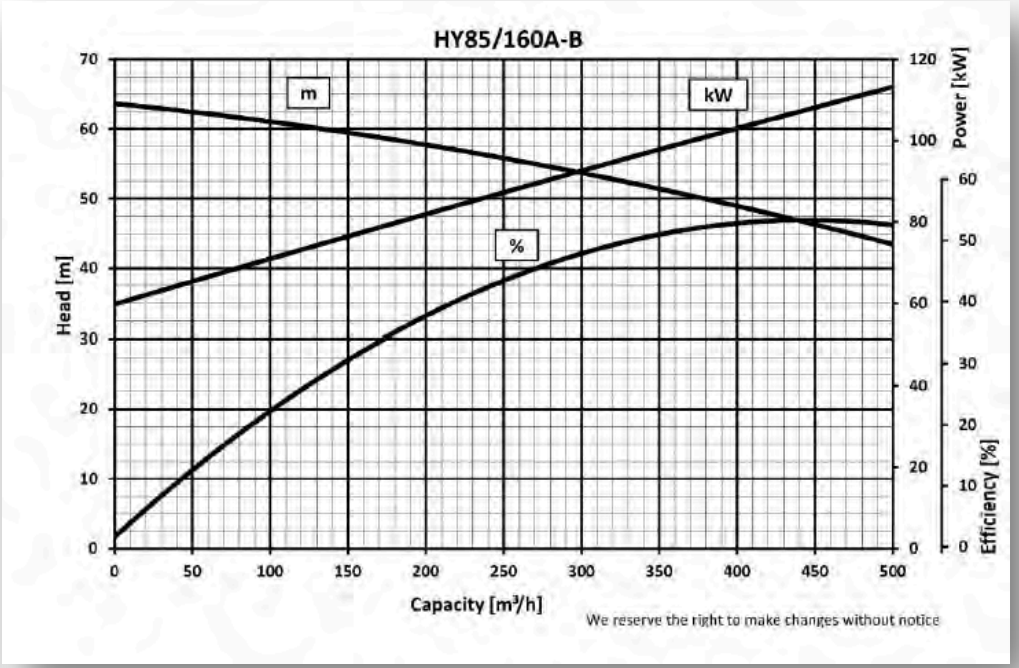
DREDGING PUMP: HY85/160B



OUTPUT = 500m3/h (2200GPM)

PUMP SPECIFICATIONS	Mod. A	Mod. B
Capacity [m³/h]	250	460
Head [m]	56	48
Impeller diameter [mm]/type	440/3blades closed	
Flanged bore size [DN…/PN…]	DN200/PN10	DN250/PN10
Cross section diameter [mm]	60	
Weight [kg]	820	840

HYDRAULIC MOTOR	
Motor displacement [cc]	160
Max. oil flow rate[l/min]	240
Max. pressure [bar]	300
Power [kW-HP]	120-165
Speed [RPM]	1450

MATERIALS	
Casing	Spheroidal cast iron EN-GJS-800-2 (EN 1563)
Motor housing	Cast iron EN-GJL-250 (EN 1561)
Wear parts	High chrome EN-GJN-HV600 (XCr18) (EN 12513)
Main shaft	High tensile steel 39NiCrMo3 (AISI 9840)

SEALS / LUBRICANT	
Motor side seals	2 lip seals (2 BUNA)
Impeller side seals	5 lip seals (3 BUNA + 2 PTFE) + 1 V-RING (TPU)
Oil type	ISO 320

DIMENSIONS [mm]

H	W	D	F	H1	A	B	C
1390	933	747	548	290	362	428	197

PERFORMANCE CURVES

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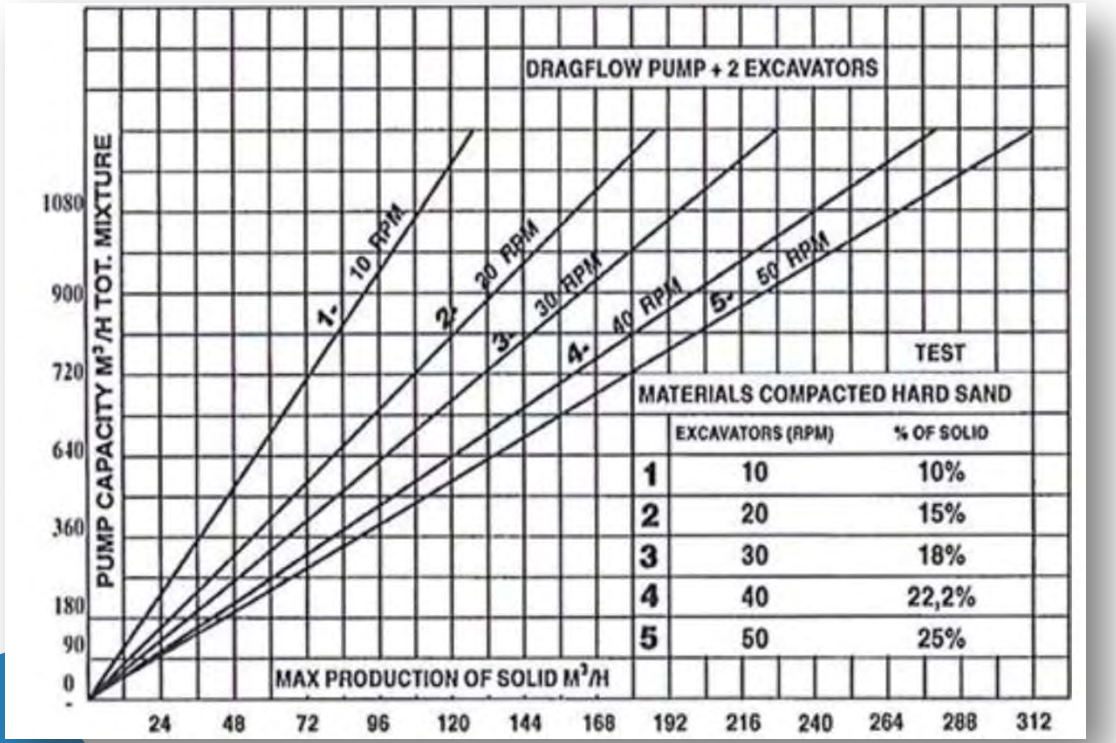
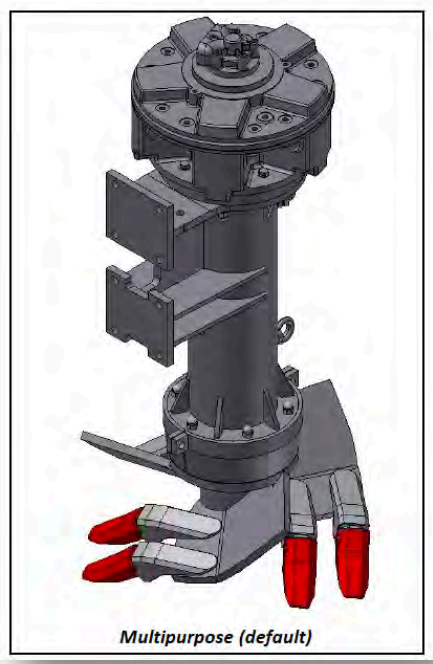
SIDE CUTTER HEADS EXHY20





Multipurpose (default)

EXCAVATOR SPECIFICATIONS	
Torque (kNm)	2.8
Blades n°	3
Teeth n° (each blade/total)	2/6
Weight [kg]	500

HYDRAULIC MOTOR	
Motor displacement [cc]	700
Max. oil flow rate [l/min]	35
Max. pressure [bar]	250
Power [kW-HP]	14.5-19.8
Speed [RPM]	50

LUBRICANT	
Oil type	ISO 320

CUTTER POWER 20HP EACH

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DREDGING UNIT

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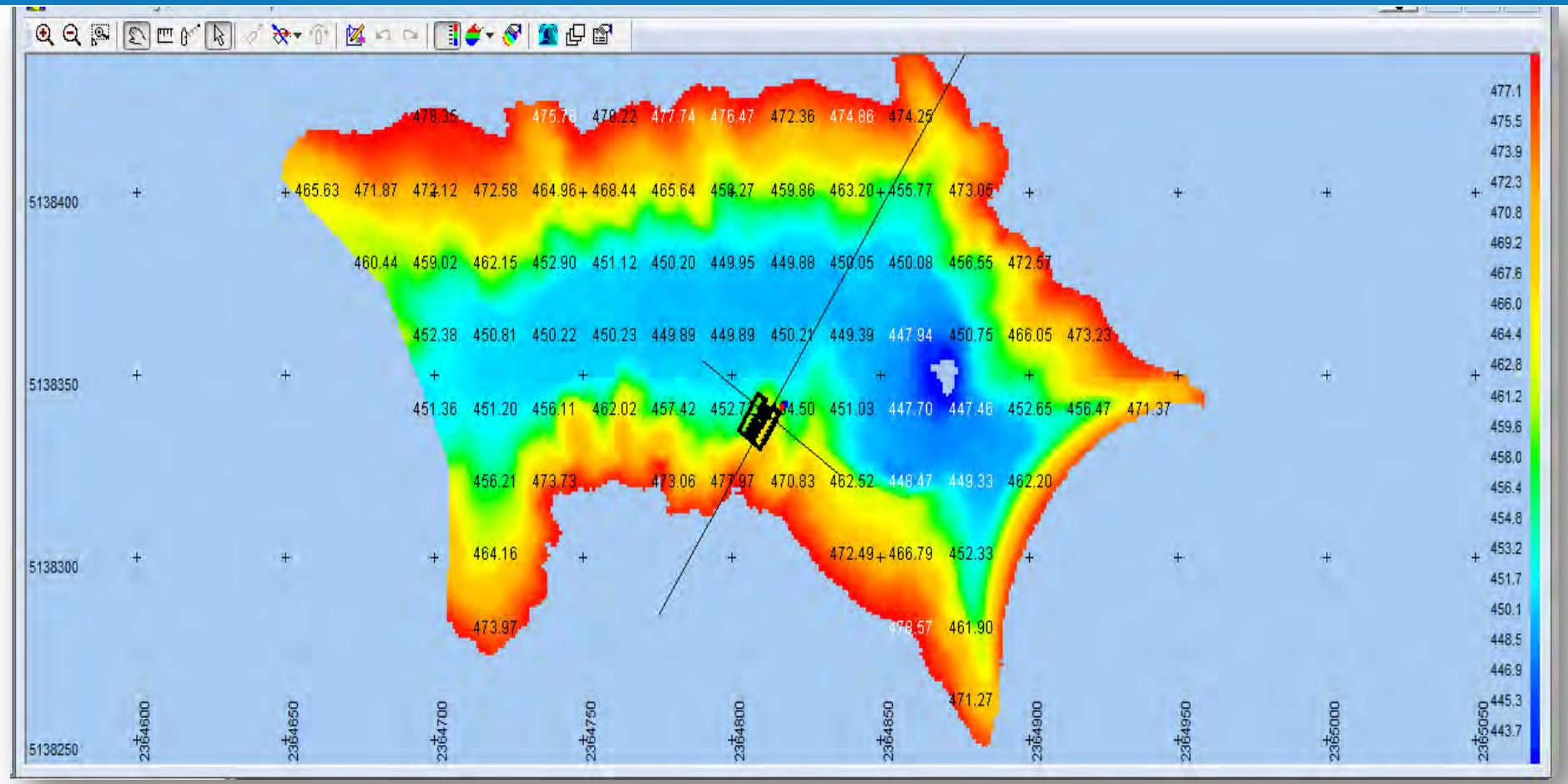
DREDGING EXECUTION



GPS SYSTEM TO DETERMINE PUMP POSITION

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PARAMETERS MONITORED DURING THE PROJECT

1. GPS for real time position of the pump (x,y,z coordinates);

2. Sediment concentration device installed on three positions: at the dredge, at the mixing point and at the river junction.
   Maximum concentration at river junction: 9g/l

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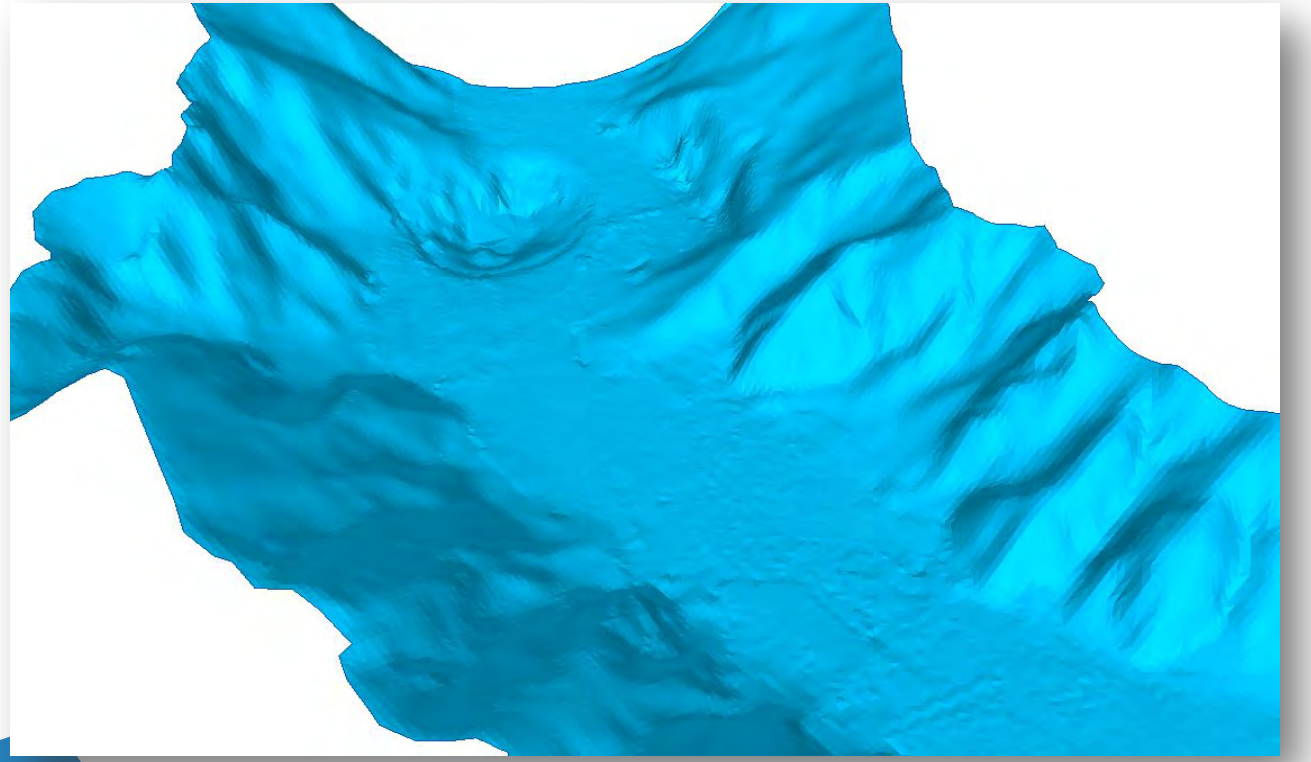
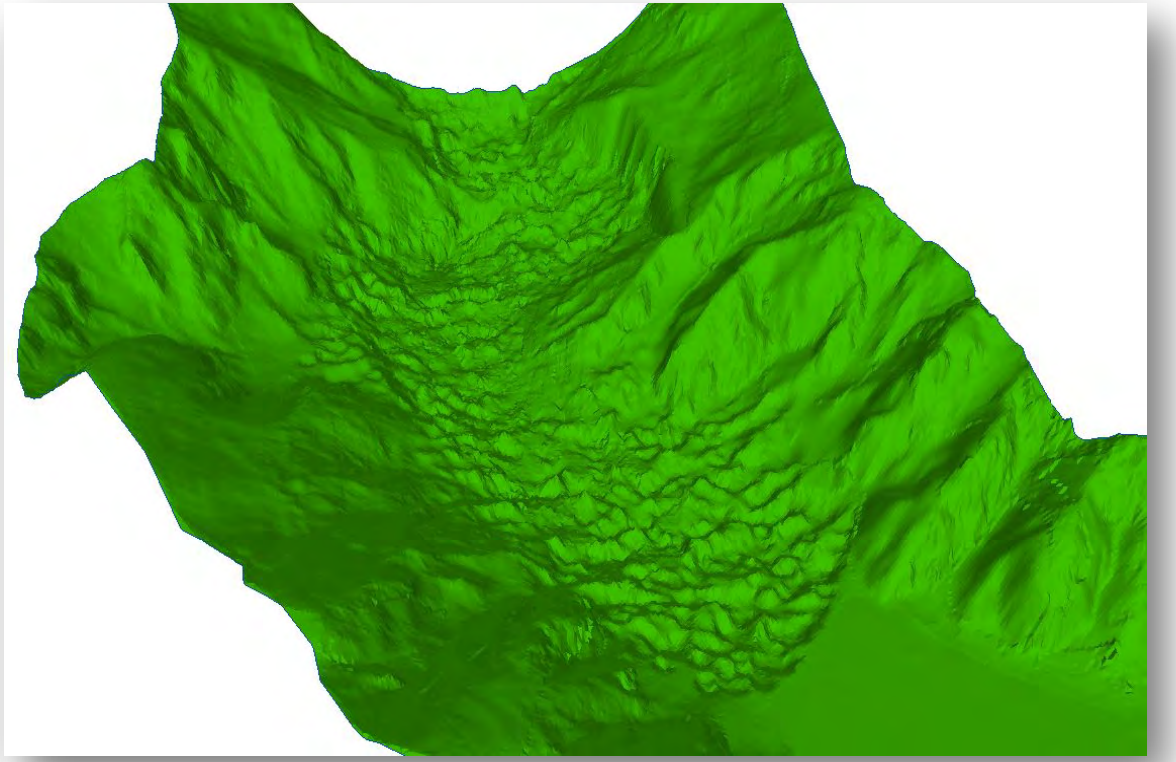
PRE AND POST DREDGING SURVEY



Before dredging



After dredging

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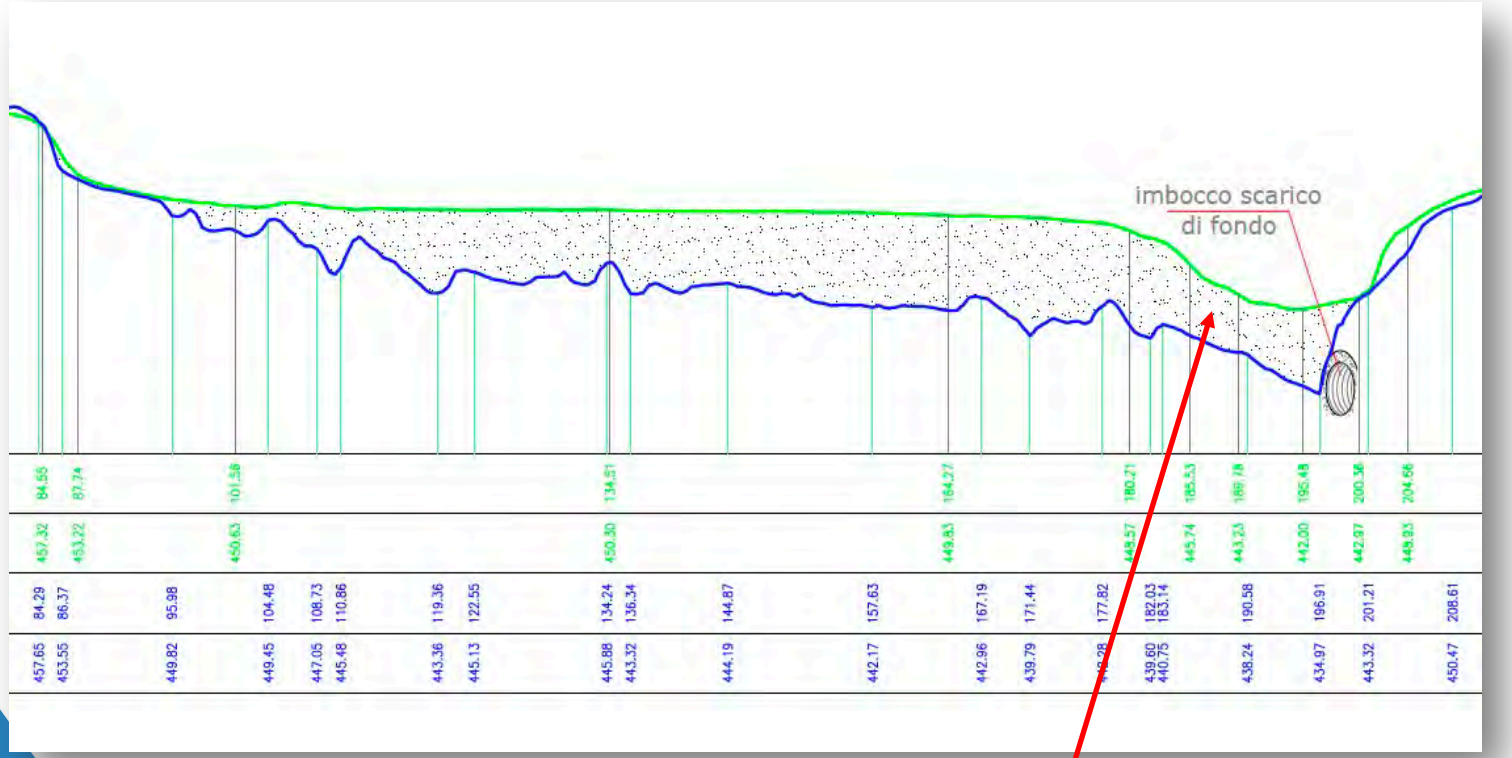
COUNTERMEASURES



Dredged sediment according to Client's requirements

- Dredging solution demonstrated its validity
- Dredging activity has been developed in the requested time
- Productivity 200 – 800 m^3/day
- No stand by time has occurred
- Material has been dredged exactly where was needed
- Environmental constraints have been fully respected

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THANK YOU FOR YOUR ATTENTION

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