INTEGRATED IMPLEMENTATION OF THE ENVIRONMENTAL DATABASE PLATFORM EQUIS AND THE GEOSTATISTICAL SOFTWARE KARTOTRAK TO PERFORM POLLUTION CHARACTERIZATION AND TO DESIGN THE REMEDIATION OF INDUSTRIAL SITES

RAMBOLL DATA MANAGEMENT METHODOLOGY FOR SUCCESSFUL GEOSTATISTICAL ANALYSIS

INTERSOL - PARIS – 27TH MARCH 2018
SESSION B: GIS AND GEOSTATISTICAL TOOLS

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Geovariances

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Geovariances
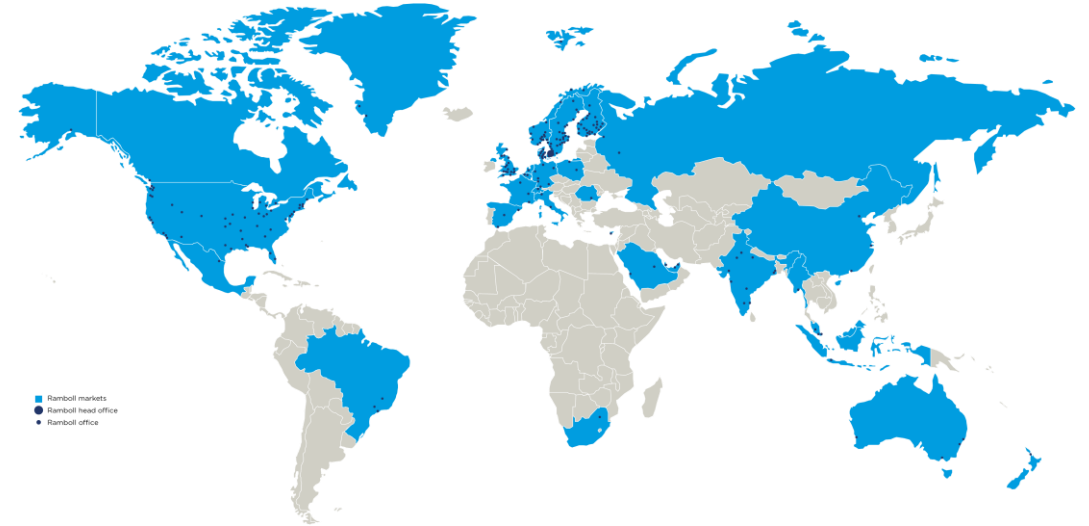
ABOUT RAMBOLL

- Independent consultancy and engineering firm, created in 1945 in Denmark (headquarters)

- Merger with Environ in January 2015

- 13,000 experts, 300 offices, 35 countries

RAMBOLL FRANCE

- Part of Environment & Health division

- Presence in France since 2002

- 90 engineers & experts, 4 agencies

https://www.lne.fr

- **Site Solutions and Remediation**

- **Industrial Risks Control and Prevention**

- **Air Quality Management**

- **Due Diligence Audits**

- **EHS Assistance**

- **ESIA and International Finance**

- **Biodiversity**

- **Water Resource Management**

CONTEXT – PROJECT AND CLIENT NEEDS

- Large amounts of various types of data

  - field data

  - geospatial data

  - chemistry data

  - historical or third party data

- Assurance of data quality over the long term

  - data source traceability

  - data reliability

- Information sharing among multiple stakeholders
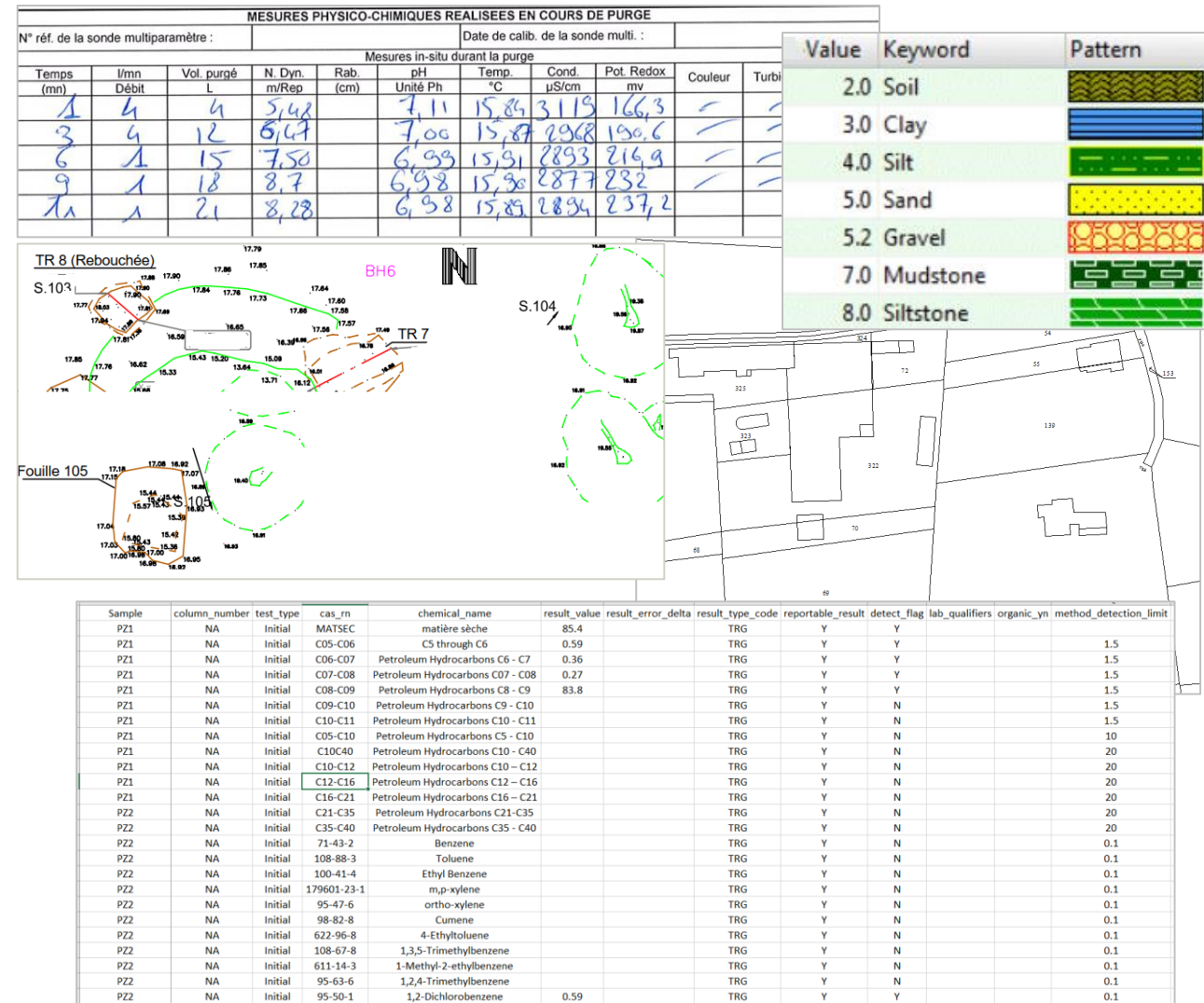
CONTEXT – PROJECT AND CLIENT NEEDS, CONTINUED

- Standardization of deliverables to achieve:

  - accuracy

  - efficiency

  - reproducibility

  - comparability

- Compatibility of data model with numerous modeling, mapping, and calculation software (i.e., GIS, Logs, 2D/3D visualization, etc.)

- Development of conceptual site models incorporating all relevant data
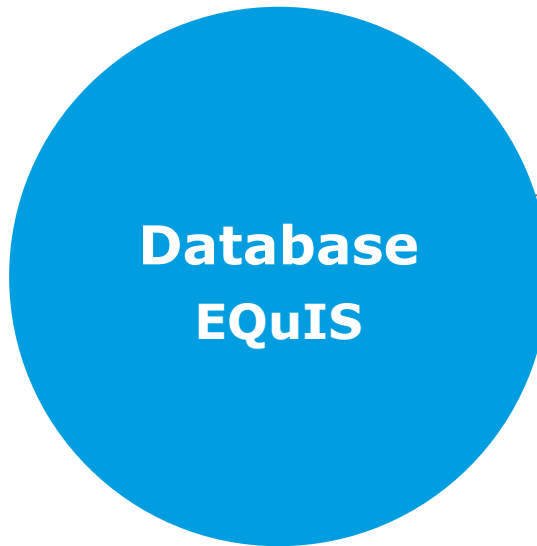
DATA MANAGEMENT

DATA MANAGEMENT MODEL
WHY EQUIS?

EQuIS (Environmental Quality Information System) is EarthSoft's software package, widely used in the US for environmental data storage and analysis.

Inputs

Outputs

FIELD DATA

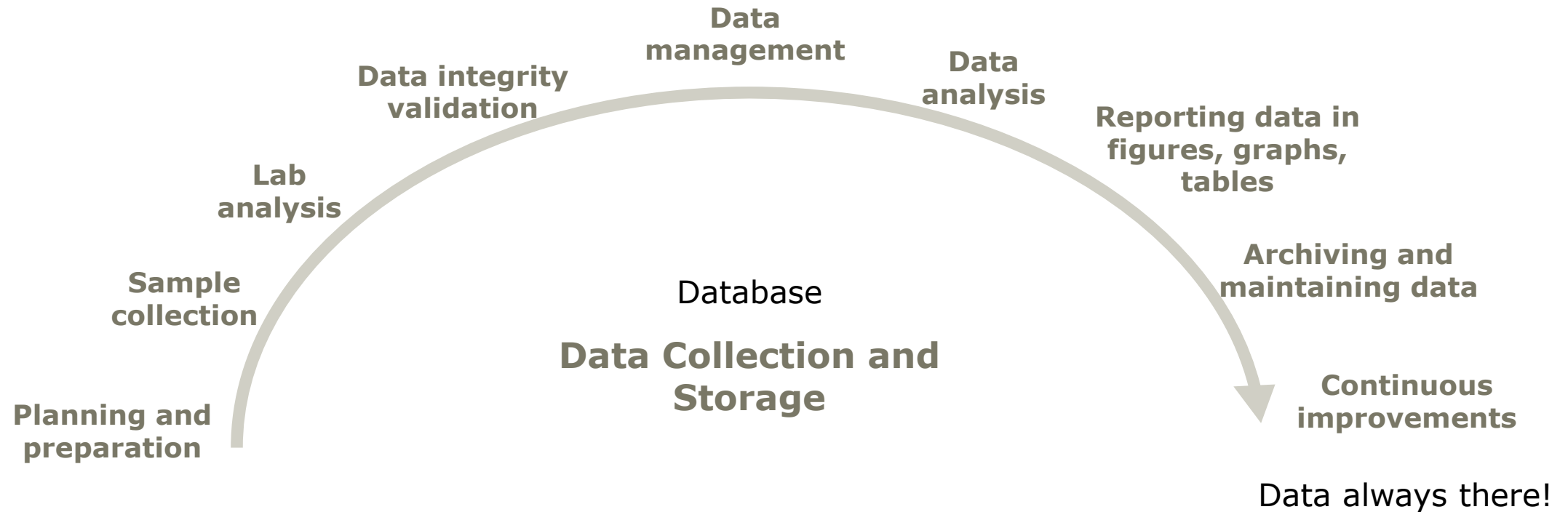CHEMISTRY DATA

3RD PARTY DATA

Database
EQuIS

GRAPHS, CHARTS, TABLES, REPORTS

FIGURES, BORING LOGS

MODELING, CALCULATIONS, ANALYSES

Secured server
Data check
Data storage and queries
Control of field documentation

# DATA MANAGEMENT WORKFLOW IMPLEMENTATION

Data
management

Data integrity
validation

Data
analysis

Reporting data in
figures, graphs,
tables

Lab
analysis

Archiving and
maintaining data

Sample
collection

Database

**Data Collection and
Storage**

Planning and
preparation

Continuous
improvements

Data always there!

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A dedicated Data Management team to support projects

DATA MANAGEMENT – ADDED VALUE

Data providers

- Field Teams
- Laboratories
- Topographers
- Project Manager
- Client

QA/QC data analysts

- Data Validators
- Database Administrator

Added value

- Single place for secure storage of all environmental data
- Streamlined internal workflow
- Assurance of data quality
- Homogenization of exports
- Greater sharing of data
- Ease of further data analysis, modeling, and calculations
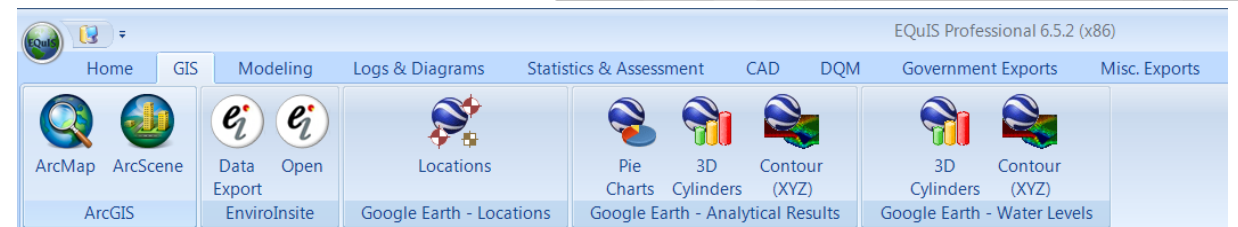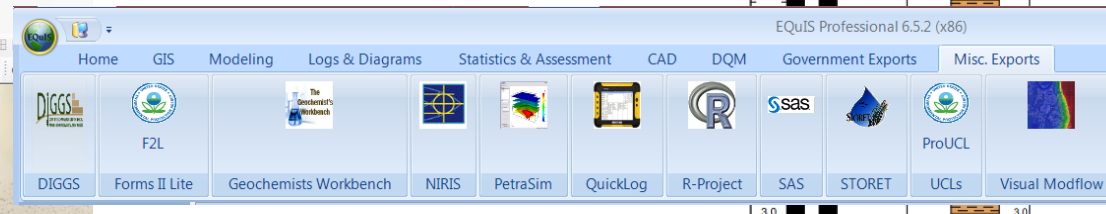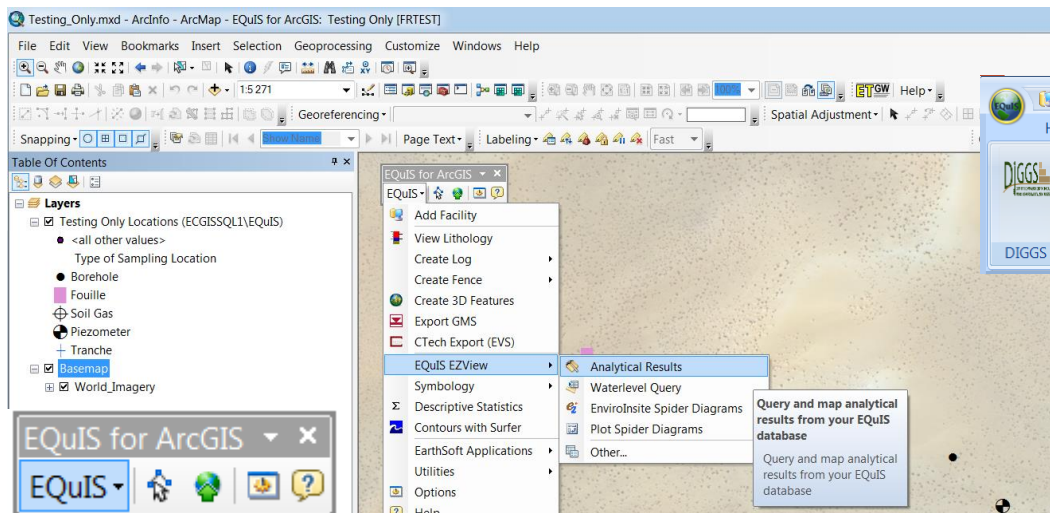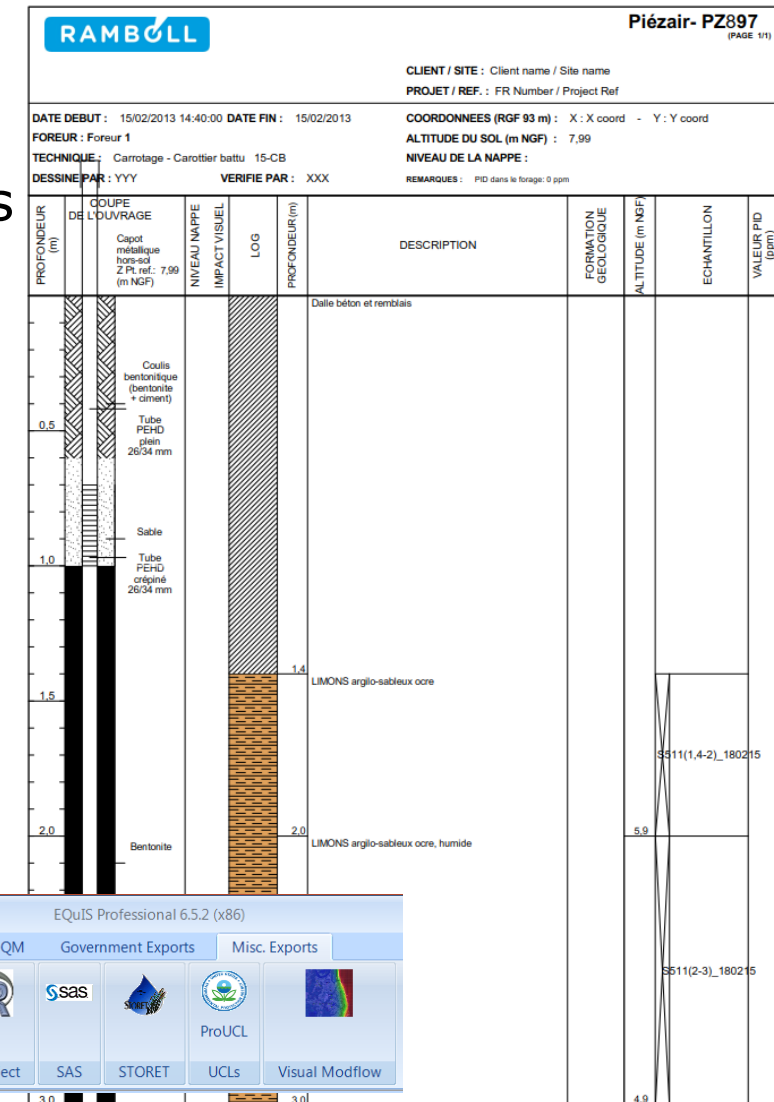- Higher value deliverables to fulfill client objectives
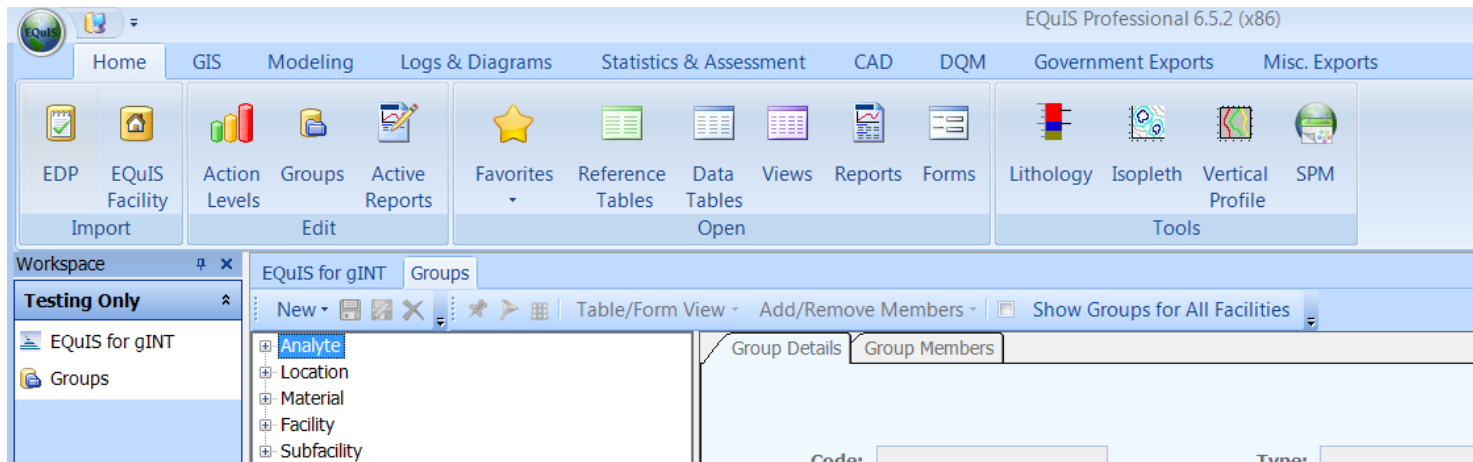
DATA VISUALIZATION AND PROCESSING

DATA VISUALIZATION

- Visualization of the data is facilitated by ready-made links to third party software, such as
  - GIS, CAD, Google Earth,
  - Logs & Diagrams software
  - Modeling…
- Customized exports can be created for other third party software such as
  - Kartotrak

DATA VISUALIZATION & PROCESSING:

Case study

- Former industrial site of 1.3 Ha

- Demolition materials left in place as backfill

- Used as a waste disposal

- Environmental issues

  - Soils impacted with metals and organic molecules

  - Demolition waste

  - Domestic & industrial waste

  - Asbestos

- Unclear delineation of backfill, waste, alluvial materials and substratum
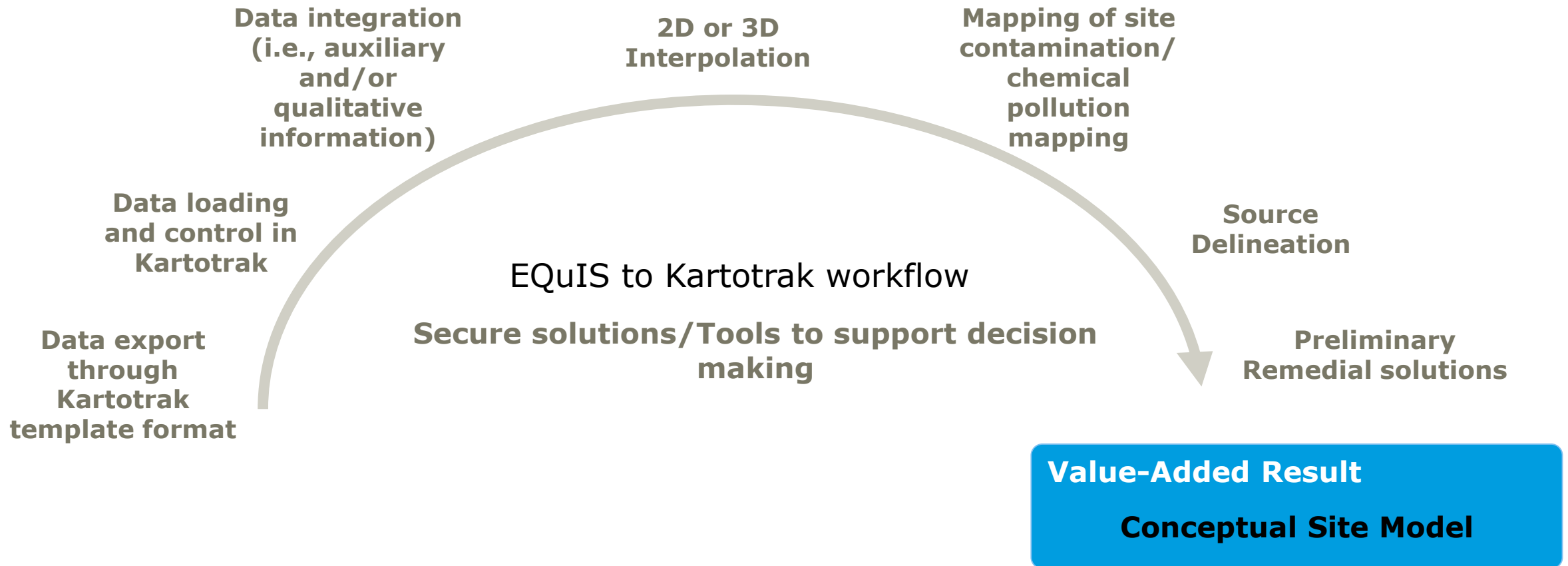

Geostatistics – what for?

- To Provide a good estimation of impacted volumes

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Geovariances

DATA VISUALIZATION & PROCESSING: KARTOTRAK

Data integration (i.e., auxiliary and/or qualitative information)

2D or 3D Interpolation

Mapping of site contamination/ chemical pollution mapping

Data loading and control in Kartotrak

Source Delineation

EQuIS to Kartotrak workflow

Secure solutions/Tools to support decision making

Data export through Kartotrak template format

Preliminary Remedial solutions

Value-Added Result

Conceptual Site Model

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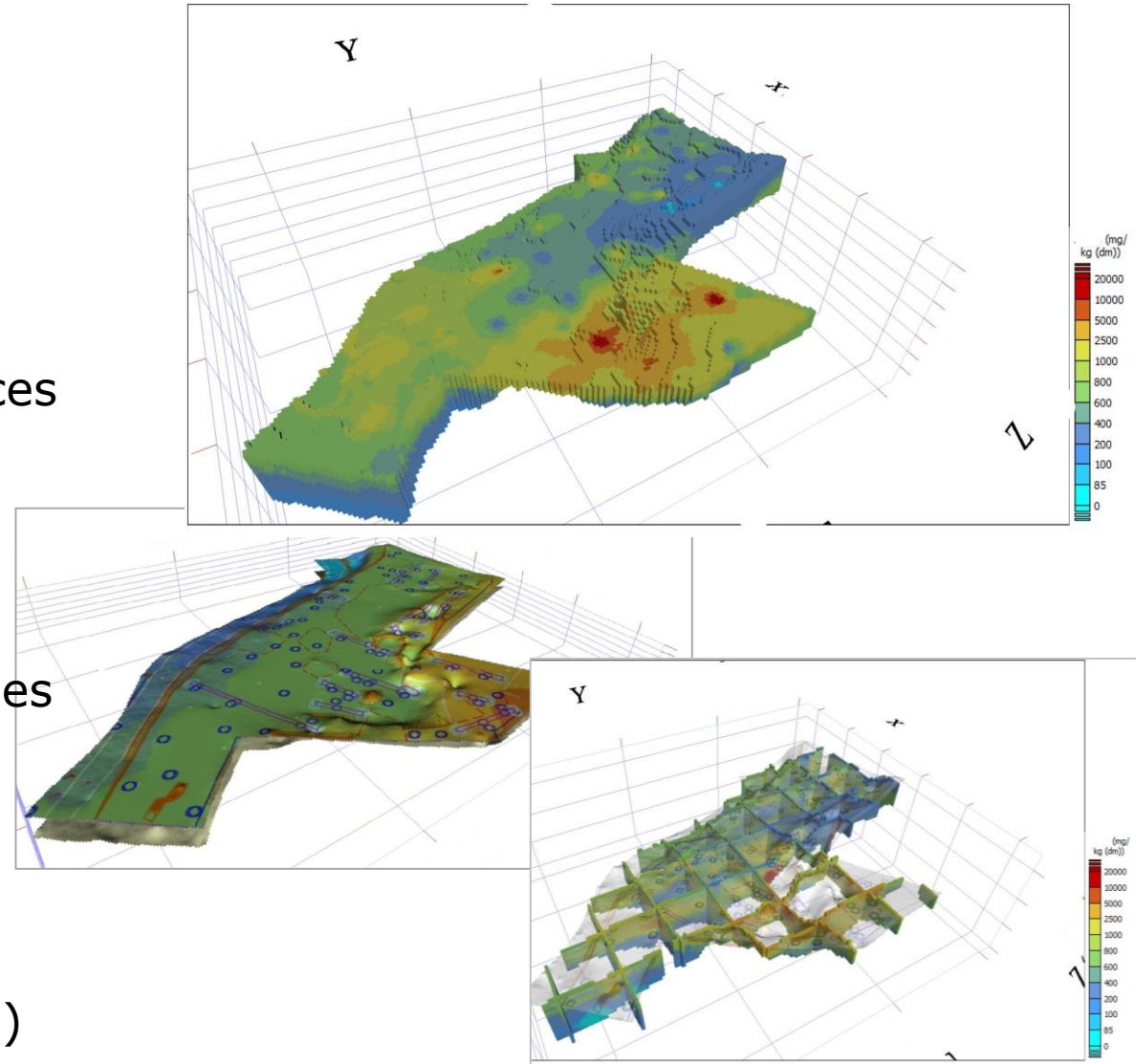# DATA VISUALIZATION & PROCESSING:

Use of Kartotrak for:

- Data handling and global visualization:

    - Analytical and spatial statistics

    - 2D/3D interpolation by kriging using correlations with lithology, other substances

- Geostatistical simulations to provide volumes estimation

    - Spatial structure & distribution of concentrations and associated uncertainties

3D site geometry & geology building

- Topography (DEM, site layout, satellite/drone imagery)

- Lithologic layers/boundaries (e.g. substratum)

- Water levels

➔ **According to our site knowledges, we fully use and affine these analyzes to define excavation plans!**
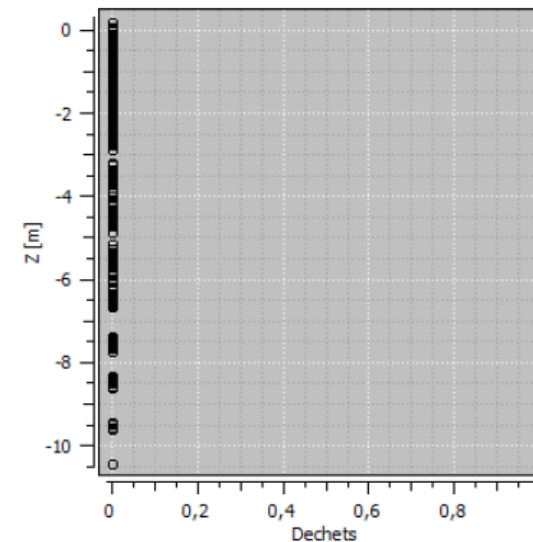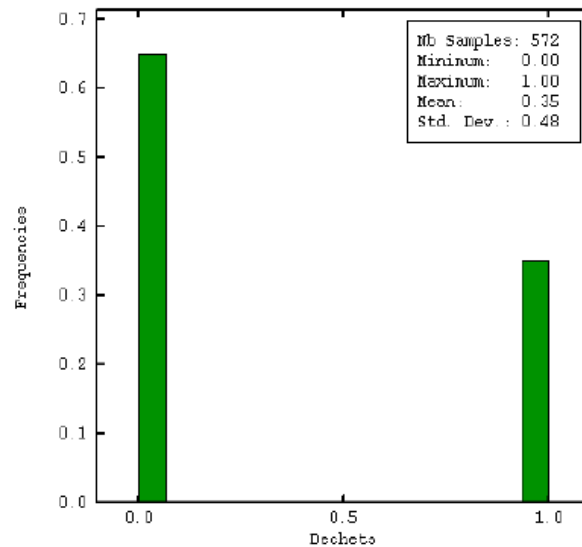
DATA VISUALIZATION & PROCESSING:

Integration and analysis of auxiliary or qualitative data

- Semi-quantitative field data: PID, XRF, etc.

- Qualitative ("presence/absence") data: odor, color, waste, asbestos, etc.

3D view of the probability of the presence of waste
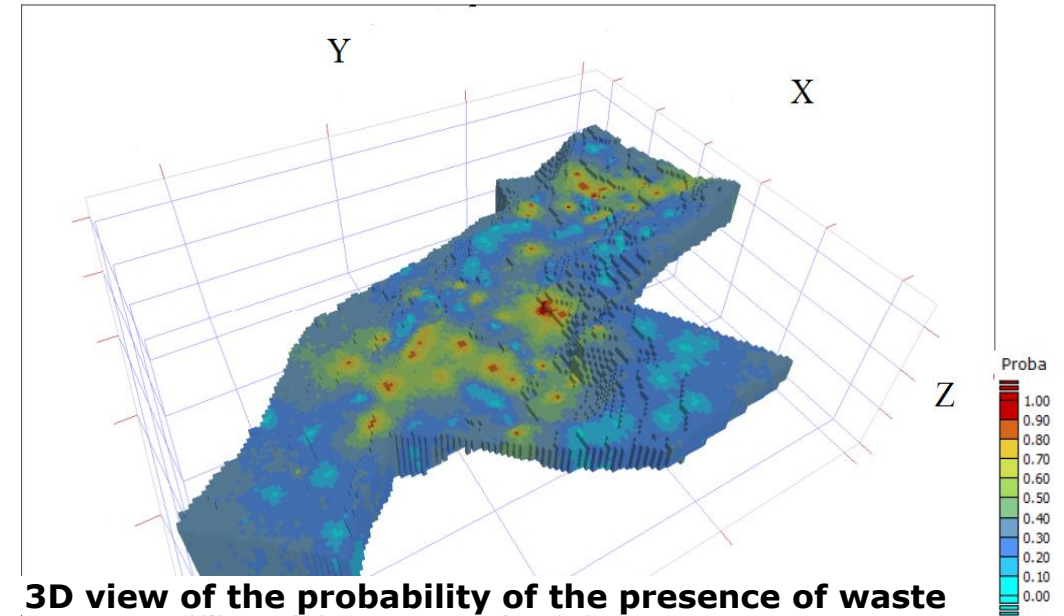
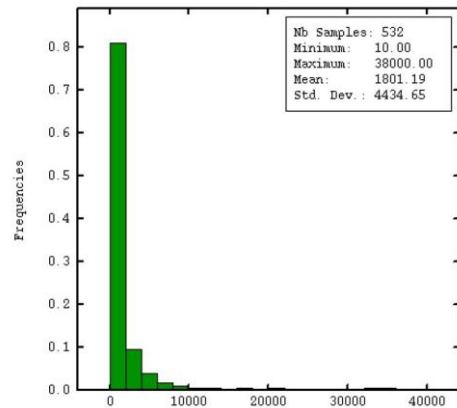**Histogram of frequencies of presence/absence of waste**

Repartition of waste with depth
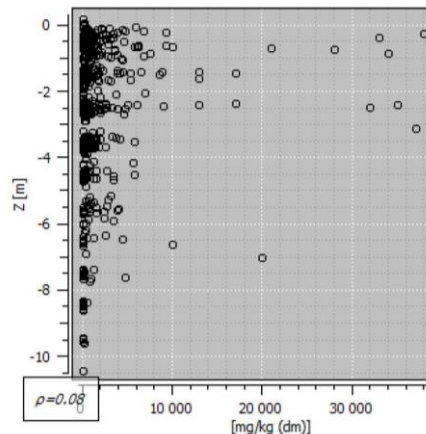
DATA VISUALIZATION & PROCESSING:

Data analysis, quality control and validation

- Use simple univariate and multivariate statistics and exploratory analysis of all available information

- Characterize and model the spatial structure/distribution of the main variables, individually and among each others
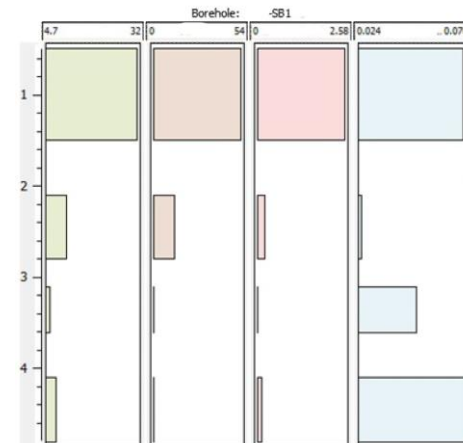
➔ **Better understanding of the site data: Inputs for cost estimations**
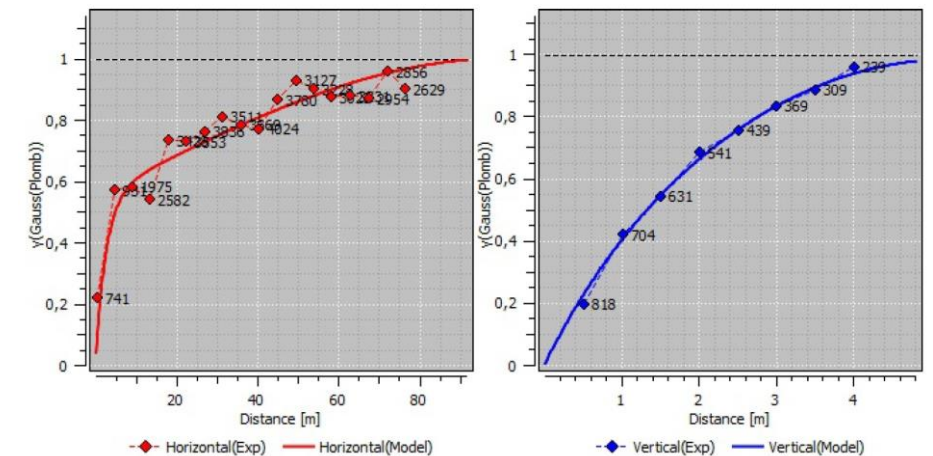
3D scatter plot of concentrations
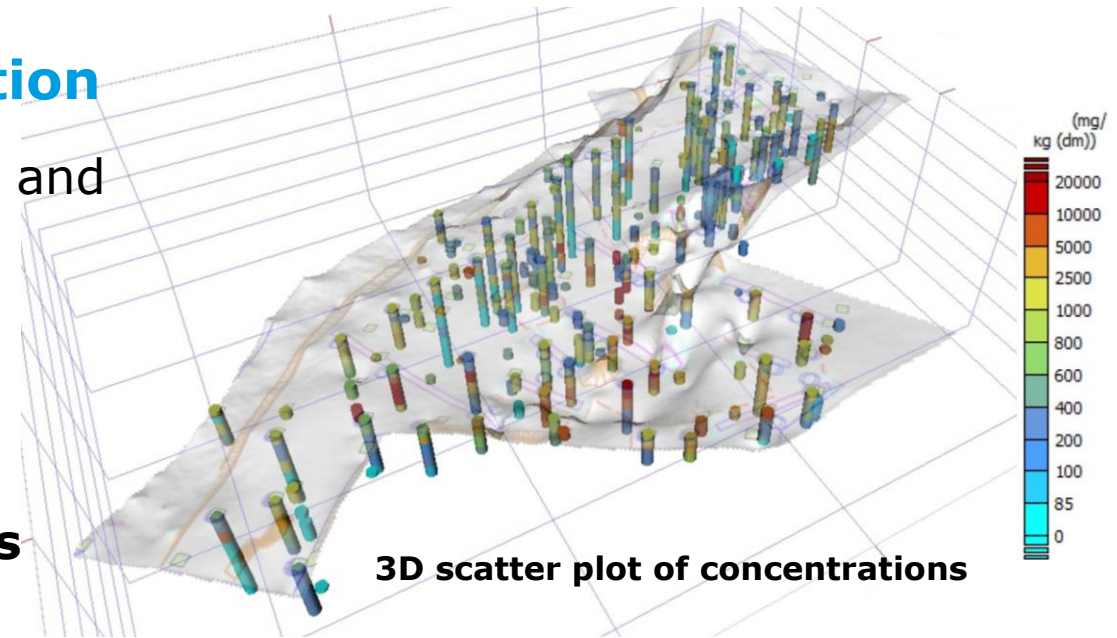
Histogram of concentrations

Repartition of concentrations with depth – all data

**Concentrations with depth 1 boring – 4 substances**

Experimental and fitted variograms

DATA VISUALIZATION & PROCESSING:

Building of Conceptual Site Model

- Site contamination mapping + integration and analysis of all available information: ➔ **Contamination placed into the environmental context which strengthens the overall understanding of the challenges**

- Source zone delineation

- Remedial objectives thresholds definition

- Contaminated surfaces/volumes/masses computation and categorization

- Residual concentrations/mass estimation

- Remedial strategy and engineering solutions design

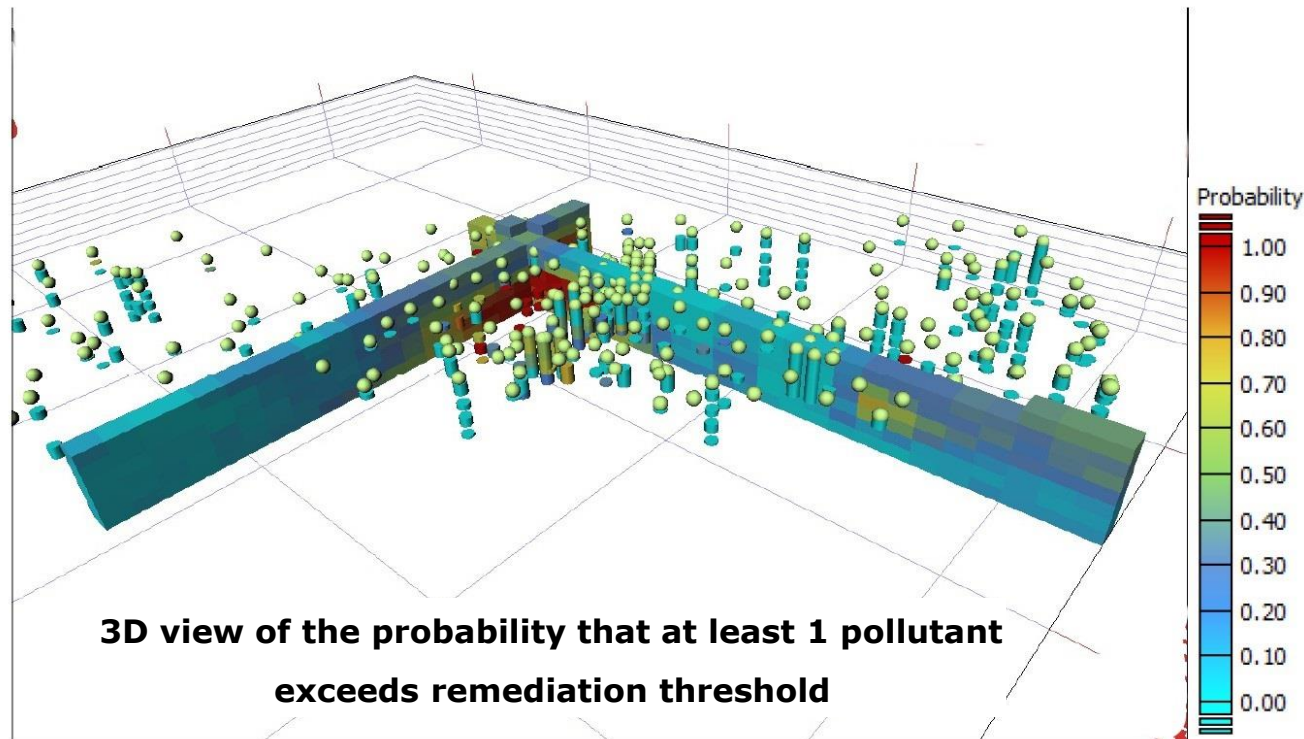- Remedial works preparation with anticipation of operational constraints
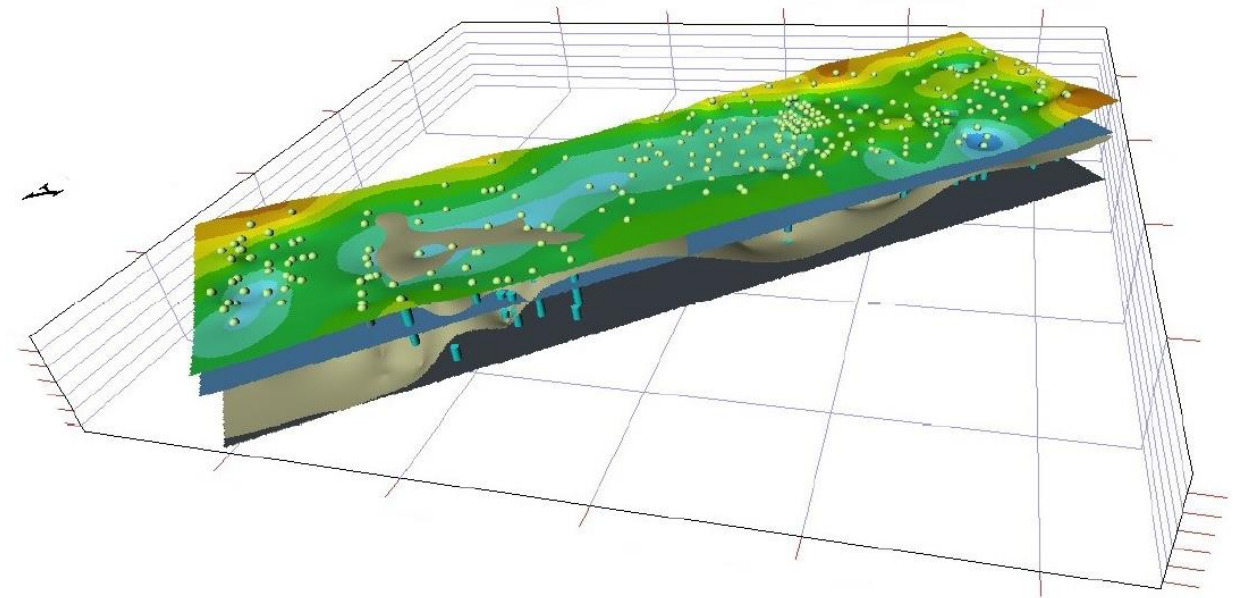
➔ **Overall optimization of characterization and remediation costs**

Geovariances

DATA VISUALIZATION & PROCESSING:
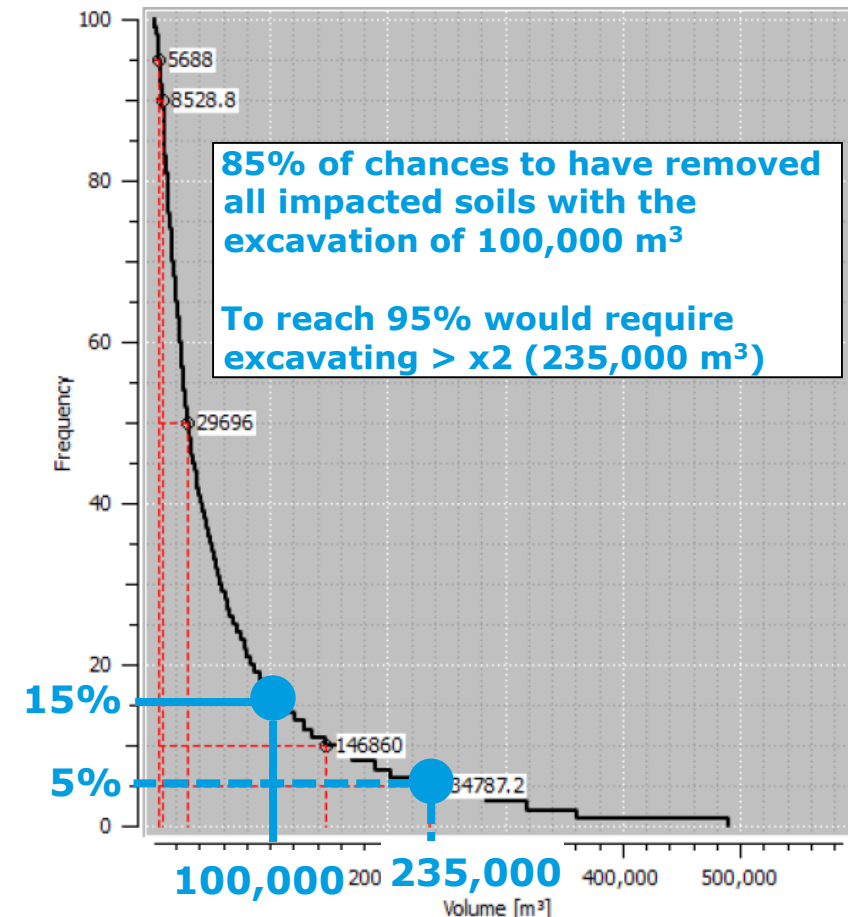
Geostatistical simulations

- Uncertainty assessment of the contamination knowledge = reliable estimation of the contamination risk

➔ **Support, improve and secure technical & financial decision-making process for remediation**

3D view of the probability that at least 1 pollutant exceeds remediation threshold

Probability
- 1.00
- 0.90
- 0.80
- 0.70
- 0.60
- 0.50
- 0.40
- 0.30
- 0.20
- 0.10
- 0.00

Bringing cost reductions opportunities!

Risk (probability) to leave in place potentially impacted soils vs. soil volumes to excavate

85% of chances to have removed all impacted soils with the excavation of 100,000 m³

To reach 95% would require excavating > x2 (235,000 m³)

5688
8528.8
29696
146860
34787.2

15%
5%
100,000
235,000
400,000
500,000
200
Volume [m³]
Frequency

DATA VISUALIZATION & PROCESSING:

Outcomes for the case study

- Confirmation of the volumes of backfill materials

- **Delineation** and estimation of soil volumes impacted **with the different types of pollution**

- **Estimation of the impacted volume** as a function of the selected **remediation thresholds**, incl. uncertainties

- **Estimation** of the impacted volumes for each type of offsite waste disposal facilities: **pollution cocktail vs facility acceptance thresholds**

- **Reduction by 25%** of the uncertainties on financial provisions **(several M€)**
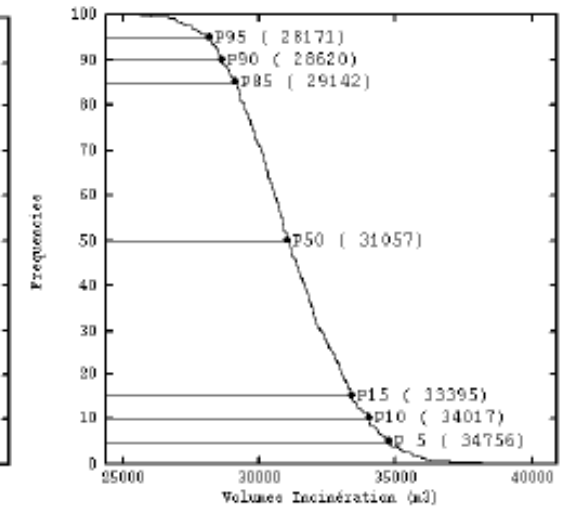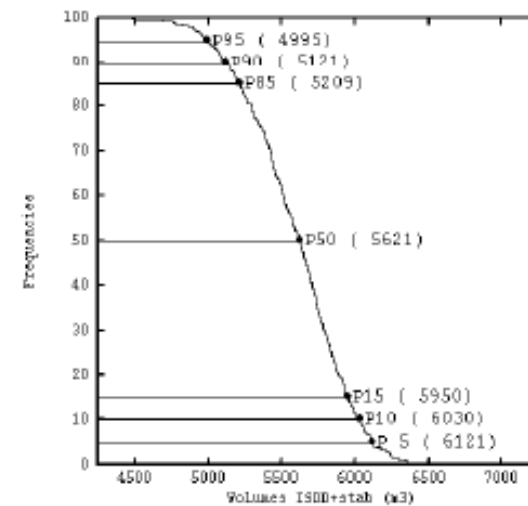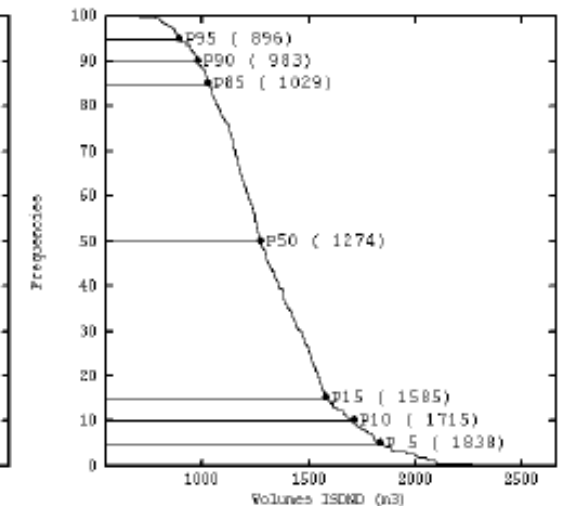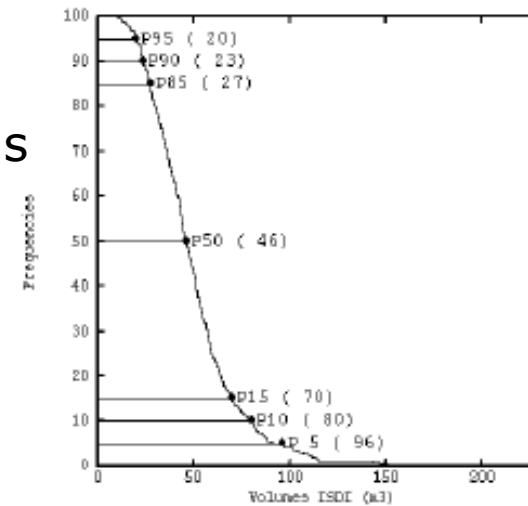
CONCLUSIONS

CONCLUSIONS

Ramboll's Data Management Workflow results in high confidence in the data:

- Powerful tools used by Ramboll: successfully manage very large and complex sites

- Data quality: validation is assured at every step

Ramboll's Client Focus Methodology develops the best solutions:

- High quality data management provides the basis for a robust analysis, management plan, and remediation implementation

- Efficient communication through clear 2D/3D visualization components

Ramboll and Geovariances' partnership improved the decision-making process

- Site contamination mapping + integration and analysis of all types of available information

- Geostatistical simulations improved technical and financial decision making

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THANKS