

DIN ISO 18400-104:2020-11 (E)

Soil quality - Sampling - Part 104: Strategies (ISO 18400-104:2018)

| Contents | | Page |
|---|--|-------------|
| National foreword | | 5 |
| National Annex NA (informative) Bibliography | | 7 |
| Foreword | | 8 |
| Introduction | | 9 |
| 1 | Scope | 12 |
| 2 | Normative references | 12 |
| 3 | Terms and definitions | 12 |
| 4 | Overall investigation strategy | 16 |
| 4.1 | General..... | 16 |
| 4.2 | Zoning..... | 18 |
| 4.3 | Types of investigation..... | 18 |
| 4.3.1 | General..... | 18 |
| 4.3.2 | Preliminary investigation..... | 21 |
| 4.3.3 | Exploratory investigation..... | 22 |
| 4.3.4 | Detailed investigation..... | 22 |
| 4.3.5 | Supplementary investigations..... | 22 |
| 4.4 | Conceptual site model..... | 23 |
| 4.5 | Preliminary risk assessment..... | 23 |
| 5 | Sampling strategies — General aspects | 24 |
| 5.1 | Sampling objectives..... | 24 |
| 5.2 | Scope of the sampling strategy..... | 24 |
| 5.3 | Designing the sampling strategy..... | 25 |
| 5.4 | Principal sampling situations..... | 26 |
| 5.5 | Representative and sufficiently representative samples..... | 27 |
| 5.6 | Characteristics of the spatial distribution..... | 28 |
| 5.7 | Statistical aspects..... | 29 |
| 5.8 | Uncertainty of measurements caused by sampling and analysis..... | 29 |
| 5.9 | Safety and environmental protection..... | 30 |
| 5.10 | Barriers to sampling..... | 30 |
| 5.11 | Timing of investigations..... | 30 |
| 6 | Sampling strategies — Key aspects and concepts | 31 |
| 6.1 | Statistics and geostatistics..... | 31 |
| 6.1.1 | General..... | 31 |
| 6.1.2 | Statistics..... | 31 |
| 6.1.3 | Geostatistics..... | 31 |
| 6.2 | Approaches to sampling..... | 32 |
| 6.2.1 | General..... | 32 |
| 6.2.2 | Judgemental sampling..... | 33 |
| 6.2.3 | Systematic sampling..... | 33 |
| 6.2.4 | Convenience sampling..... | 34 |
| 6.3 | Average properties..... | 35 |

| | | |
|----------|--|-----------|
| 6.4 | Types of samples..... | 35 |
| 6.4.1 | General..... | 35 |
| 6.4.2 | Disturbed and undisturbed samples..... | 35 |
| 6.4.3 | Spot (single) samples..... | 36 |
| 6.4.4 | Cluster samples..... | 36 |
| 6.4.5 | Spatial (composite) samples..... | 36 |
| 6.4.6 | Selective samples..... | 38 |
| 6.5 | Number of samples..... | 38 |
| 6.5.1 | General..... | 38 |
| 6.5.2 | Number of samples at discrete sampling points..... | 39 |
| 6.5.3 | Number of cluster samples..... | 39 |
| 6.5.4 | Number of composite samples..... | 39 |
| 6.6 | Sample sizes..... | 40 |
| 6.6.1 | General..... | 40 |
| 6.6.2 | Practical considerations..... | 41 |
| 7 | Deciding how many samples to take..... | 43 |
| 7.1 | General..... | 43 |
| 7.2 | Basic situations..... | 44 |
| 7.3 | Determining average concentrations..... | 44 |
| 7.3.1 | General..... | 44 |
| 7.3.2 | Using spatial composite samples..... | 45 |
| 7.3.3 | Using spot samples..... | 46 |
| 7.3.4 | Determining relation to threshold limit..... | 46 |
| 7.4 | Finding (hot spots and) areas of interest of a specified minimum size..... | 46 |
| 7.5 | Sampling for particular purposes..... | 47 |
| 7.5.1 | Determination of background values..... | 47 |
| 7.5.2 | Waste classification..... | 47 |
| 7.5.3 | Supplementary investigations for remediation..... | 47 |
| 7.5.4 | Validation of remediation and other works..... | 48 |
| 8 | Sampling strategies for in-ground sampling..... | 49 |
| 8.1 | Approach to sampling..... | 49 |
| 8.2 | Sampling patterns..... | 49 |
| 8.2.1 | General..... | 49 |
| 8.2.2 | Potentially contaminated sites..... | 50 |
| 8.2.3 | Hot spot detection, site investigation design and sampling..... | 51 |
| 8.3 | Types of samples..... | 52 |
| 8.4 | Sampling depths..... | 53 |
| 8.4.1 | General..... | 53 |
| 8.4.2 | Potentially contaminated sites..... | 53 |
| 8.4.3 | Sampling in relation to the groundwater profile and aquifer..... | 54 |
| 8.5 | Size of samples..... | 55 |
| 8.6 | Number of samples..... | 56 |
| 8.6.1 | General..... | 56 |
| 8.6.2 | Number of samples at individual sampling points..... | 56 |
| 8.6.3 | Number of composite samples..... | 56 |
| 9 | Sampling of above-ground deposits..... | 57 |
| 9.1 | General..... | 57 |
| 9.2 | Sampling patterns..... | 57 |
| 9.3 | Types of sample..... | 57 |
| 9.3.1 | General..... | 57 |
| 9.3.2 | Convenience sampling..... | 58 |
| 9.4 | Sampling depths..... | 58 |
| 9.5 | Size of samples..... | 58 |
| 9.6 | Number of samples..... | 58 |

| | |
|--|------------|
| Annex A (informative) Basic statistical concepts | 59 |
| Annex B (informative) Sampling patterns | 65 |
| Annex C (informative) Assessment and modification of sampling uncertainty | 79 |
| Annex D (informative) Examples of sampling for particular purposes | 83 |
| Annex E (informative) Scale of sampling | 88 |
| Annex F (informative) Determination of size and number of samples and increments | 93 |
| Annex G (informative) Statistical methods for estimating soil parameters | 101 |
| Annex H (informative) Geostatistical methods for sampling design and evaluation of soil quality | 114 |
| Annex I (informative) Sampling strategies for risk assessment | 130 |
| Bibliography | 140 |