State of Israel

The Ministry of Environmental Protection

Division of Industrial Wastewater & Contaminated Soils and fuels

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Professional Guidelines for Performing a Soil Survey

Comment:
The Hebrew text of the Professional Guidelines shall be authoritative. No guarantee can be given with respect to the validity of the current English translation.

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1. Overview

Soil suspected of contamination is a soil which is, or has been in the past, the site, or near the site, of activity involving polluting substances such as hazardous materials, brines, sewage, explosives and oils. Soil contamination may occur as a result of leaks or spillage of volatile and semi-volatile pollutants onto the soil, which may be harmful to public health through various avenues of exposure, such as: inhalation of carcinogenic or toxic organic substances when soil gases penetrate into structures; children ingesting contaminated soil; dermal contact with contaminated soil; contamination of sources of drinking water; and damage in ecosystems.

In Israel there are many sites suspected of soil contamination, including over one thousand gas refueling stations serving the public or intra-organizational, industrial sites, army bases, security factories, landfills, etc. In order to determine whether the soil in these suspected sites are indeed contaminated and in need of remediation, the soil has to be characterized, the contamination and the exposure of the environment and the public (receptors) to those pollutants based on their quantity and type as well as being based on the existence of transport routes for those receptors.

Soil characterization and the need to treat it are determined in the context of a survey process consisting of several stages - an historical survey, soil investigation (soil gas survey; soil survey; groundwater survey) and evaluation of the general or specific remediation goals for the site (risk-based). However, in some of the sites it may be sufficient to make do with only part of the stages if the risk to public health and the environment can be totally discounted.

The survey process begins with a requirement to perform an historical survey - either as part of the framework terms set in business permits and licenses, or in a requirement based on a specific suspicion of soil contamination. The Ministry of Environmental Protection has published a document of the Ministry's policy principles on preventing soil contamination (hereinafter: "the policy document") specifying the various types of businesses for which requirements will be issued to initiate a soil survey process, at different stages of the business's work, while focusing on businesses with a high pollution potential dealing in potentially polluting activity or in polluting activity. The policy document also sets forth rules for initiating a survey process for all those who deal with polluting substances where there is a suspicion of contamination.

It must be pointed out in this context that the requirement to perform a survey process shall be determined as a part of the enforcement of the Ministry's legal authority, including the Hazardous Substances Law, 1993, the Licensing of

Businesses Law, 1968, the Water Law, 1959, and the Planning and Building Law, 1965. The professional guidelines which will be provided in this document form a professional aid. It contains details of the professional methodology for implementing the requirements regarding performance of a soil survey.
It must also be noted that this professional guidelines document forms a part of a set of professional guidelines which get updated from time to time and published on the Ministry's website (for details of all the guidelines, see the document entitled: List of Professional guidelines of the contaminated soils division).

2. Objectives of the soil investigation

The soil investigation is a physical examination of the soil, based on prior information which has been collected in the first stages of the soil survey and investigation process. The soil survey is intended to fully characterize the soil and the hazard posed by the contaminants within it to the environment and to public health as detailed below:

- Determining the existence of soil contamination at the site - evaluating the existence of the contaminants in the soil, in the soil gas and in the groundwater and their concentrations relative to the limit values, and also to examine the extent to which the contaminants have spread both vertically and horizontally.
- Update the Site Conceptual Model, which began to take shape with the historical survey stage - definition of the transport courses of the contaminants and the receptors within the site and outside it.
- In the appropriate cases - carrying out a risk assessment according to the regulatory prioritization model for remediation of contaminated soil or setting of risk-based values for corrective action according to the IRBCA.
- Planning the remediation of the contaminated soil at the site according to the total information collected within the survey and investigation process and the remediation goals (the limit values or specific goals according to a risk assessment). The plan will include the suggested remediation methods and their method of implementation including a pilot plan.

3. Stages of the investigation process

3.1. Preparations for the investigation process

3.1.1. Information collection - collection of the data accumulated about the site, the historical survey report, additional information collected since the historical survey such as additional analyses carried out and past spills.

3.1.2. Information verification - after collecting the information, its agreement with the current state at the site must be verified in documents and in a tour of the premises - up-to-datedness of the maps and aerial photographs; other visual information that can be collected within the tour; new receptors or transport courses which have added on since completing the historical survey; examination of changes which have been made in the site or its surroundings including as part of planning and construction work, rehabilitation of groundwater by the state authorities and so forth.

4. Soil survey plan

The plan will be based on the totality of the information collected and the analysis which was carried out during the historical survey stage, such that it will include all of the samplings necessary to check suspicions which may have arisen in the historical survey stage and in the early investigation stages. For example soil gas surveys, if conducted. In addition, more samplings will be planned for areas where no activity has taken place according to the historical survey, in order to confirm the claim that they indeed are not contaminated. The plan will include the chapters as detailed below. Later on in the document, the details and information that must be included in each chapter will be detailed:

- General information chapter
- Chapter: Planning of the deployment of the sampling at the site
- Boring method chapter
- Sampling and analysis chapter
- Chapter on selecting samples for analysis in the laboratory
- Quality control chapter
- Timetable for executing the plan chapter

4.1. General information chapter

This chapter will include data and information based on which the sampling plan was built:

4.1.1. General details: site name, address, coordinates, site owners, land holder, size of the area to be investigated, the professional entity submitting the plan, the supervisor for its execution in the field and who is submitting the findings report, the drilling company and the boring method, the accredited soil sampler, the laboratory to which the samples will be sent.

4.1.2. Description of the information collected in the preparatory stage of the investigation process as per section 4.

4.1.3. A summary of the data on which the preparation of the sampling plan has been based, these data will be taken from the historical survey and when a soil gas survey was performed, data collected also during the survey, which will include - a description of the site and its characteristics including hydrological and geological data, contaminating activity types, receptors at the site and around it, exposure courses, potential areas for contamination or areas already contaminated, visual findings, existing documentation on spills which occurred onto

the soil, information on soil investigations which were carried out at the site in the past. In addition, any other data relevant to the formation of the sampling plan must be mentioned.

4.1.4. Safety, technical and environmental constraints at the site which may affect the way the samples are taken or necessitate precautions of any kind. Details must be provided on the constraints and precautions that will be taken by the entity planning to execute the plan in order to avoid these risks.

4.1.5. Up-to-date map of the site - a digital survey map of the site and its surroundings. The map must be GIS or DWG. It must be executed by a qualified surveyor. Each map must include a scale and indication of the north. The sampling map must include a distance scale, coordinates (based on the new coordinate grid) and the accuracy level of the coordinate which was determined by the qualified surveyor. The map must include the following: all of the layers submitted in the historical survey report; a layer which includes all of the gas sampling points and the findings on the concentrations sampled, insofar as a soil gas survey was conducted; a layer containing all of the proposed sampling points according to the sampling plan (a distinction must be made in the marking between sampling points, gas, soil, water, etc.). In addition, an aerial photograph of the appropriate resolution may be used according to the professional guidelines for executing the historical survey, to anchor it, and on it to mark the sampling points via a GPS at an accuracy level of up to 0.5 meters using a tape measure or point marking by a qualified surveyor.

4.2. Chapter on planning spread of the bores at the site ("sampling plan")

4.2.1. The sampling plan must be submitted by the soil consultant (submitter of the plan) and insofar as this is a soil consultant who is not accredited for sampling by the Laboratory Accreditation Authority, then the plan must state the accredited company which will perform the actual sampling in the field. It is made clear that in any case the submitter of the plan must be present at all times in the field while the sampling is taking place and he must ensure that the work is being performed according to the Ministry's guidelines. The analysis of the field

findings and the laboratory will be done by the soil consultant submitting the plan, who was present in the field throughout the survey. It is made clear that if the soil consultant is a company, rather than a private person, then a representative of the company must be present in the field during the sampling as detailed above.

4.2.2. The sampling in the soil will be planned so as to enable vertical and horizontal delimitation of the contamination hot spots in the areas suspected of contamination. The sampling must be planned according to the instructions below. It is possible to propose in the plan, while providing reasoned arguments, a different quantity and method of sampling. This must be reasoned in order to receive approval from the entity in charge in the Ministry. Furthermore, the entity in charge in the Ministry will be able, in the appropriate cases, to require additional bores besides those detailed below. He may also approve extension of the time for completing the sampling in such cases.

4.2.3. Sampling sequence: in a site where information is available on the estimated relative contamination levels at the various hot spots, the sampling must begin at the less-contaminated area and from there proceed toward the more heavily contaminated areas in order to prevent cross-contamination as a result of using the same boring tools.

4.2.4. For each hot spot suspected of being contaminated, the first sampling points must be positioned at the center of the suspected hot spot and at its periphery. In addition, depending on the findings in the field, sampling must proceed along points progressively increasing in distance from the focus until the point where no suspicion will be found of contamination in the soil samples. In other words, it is possible that additional samples will be taken besides those prescribed in advance in the plan. This will be according to the findings of the sampling in the field. Additional points as mentioned above do not require submission of another plan. They only have to be mentioned in the final report. The delimitation process will be completed no later than half a year after approval of the sampling plan at sites with up to 30 bores and no more than a

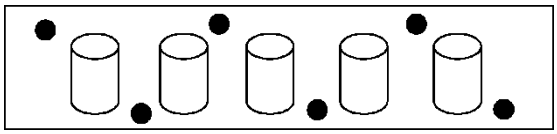
year for the other sites. If, in the course of the sampling, it suspicion arises of groundwater contamination (contaminated soil less than 6 meters away from the groundwater), then the person in charge and the Water Authority must be notified immediately in order to receive further instructions.

4.2.5. Method of planning the distribution of the bore and sampling points:

- General: The investigation plan will include bore points and sampling points within the boreholes. The plan will include the depth of the proposed sampling. As a rule, bores sunk for soil sampling must be at a depth of at least 2 meters below ground level, unless stated otherwise in the instructions detailed below or if there are physical obstructions in the field, such as a layer of rock, groundwater, etc., which form a technical obstacle to deepening the bore. In addition, and insofar as contamination is found at the bottom of the bore, it must be deepened further until soil is found which is not suspected of being contaminated (through physical indications - odor, moisture, field measurement with a PID etc.).
- **Piping sampling (including filling or dispensing piping) or tanks:**
  - Piping: A piping line, for the purpose of this section - is a single or multiple lines, separated by no more than one meter one from the other.
  - One soil bore is required for every 5 meters of piping. The bore will be close to the piping at a distance of no more than 70 cm from them and at a depth of at least 2 meters below the depth of the pipes.
  - In addition, for piping of a total length greater than 15 meters, a bore is required near each connection, connector, dispensing point, and any other potential leakage point.
  - In cases where there is a single piping line longer than 50 meters, the spaces between the bores can be increased along the piping in accordance with the plan which has been approved by the entity in charge in the Ministry.
- Insofar as a soil gas survey has been carried out, or if an impermeability test has been performed, and which confirmed that there had been no leak in the past or present, it is

permissible to submit a scaled-down sampling plan to the Ministry for approval.

- Tanks:
  - Aboveground tanks - at least one bore as close as possible to the tank and an additional bore in the filling and emptying area of the tank (if there is a tank filling area, then a bore must be sunk adjoining this area).
  - Underground tanks - at least two bores, one on each side of the tank as close as possible to the same tank and another bore in the tank's filling and dispensing area. If there are several underground tanks located close to one another, then the bores can be executed so that there will be one bore for each tank on both sides of the tank area intermittently, equidistant for each tank:



מכל תת קרקעי	Underground tank
נקודת קידוח	Bore location

- **Sewage sump sampling:** For the purpose of this section, a sewage sump is a soak pit or drainage pit, whether active or inactive. A bore is required to a depth of 5 meters below ground level or 2 meters below the bottom of the pit, the deeper of the two.
- **Sampling manufacturing sites:** the bores will be as close as possible to the manufacturing facilities and the industrial wastewater disposal installations, including drainage ditches and wastewater treatment facilities.
- **Sampling storage sites:** the bore point will be set at the spot most likely to experience soil contamination, according to the nature of the materials stored there, past and present, the vessels in which they were stored, the land cover and gradients in the area and the existing and past infrastructures, which were intended for draining leachates.
- **Sampling open spaces:** In sites suspected of contamination which include open spaces where there was apparently no contaminating activity, these areas must also be bored and sampled to verify the conception that they indeed were not used for contaminating activity and that soil contamination has not been transported into them from areas where such activity did take place. The bores will be made first in areas which are suspected as having had contamination transported into them, such as river beds or other low-lying areas. In addition, regarding the rest of the area (for which there is no indication of contamination potential), the area must be divided into a grid of sections where each section will be 1000 sq.m. (one Dunam) in size and the bores must be planned as follows:
  - Up to 10 Dunams: at least one bore per Dunam.
  - Between 10-100 Dunams: at least one bore every two Dunams.
  - Between 100-500 Dunams: at least one bore every five Dunams.
  - More than 500 Dunams: the submitter of the plan will include a reasoned proposal for executing the bores.

Bore type (active gas, passive gas, or soil analysis) must be specified in the plan. If in the past a soil gas survey or other survey has already been conducted in the open spaces, then it is possible to suggest in the plan, giving the rationale for it, a lower number of bores than those specified above.

4.3. Bore method chapter

The bore methods must be adapted to the contaminant types and the site characteristics. The bore methods must also enable sampling if undisturbed soils and they must prevent cross contamination to prevent the vertical movement of contaminants from contaminated top layers to non-contaminated deeper layers. The planned boring methods must be specified in the soil survey execution plan. These must be based on the criteria and assumptions detailed below:

4.3.1. Characteristics of the approved boring methods:

- They do not introduce water, drilling fluids, lubricants, drilling mud, or air into the borehole.
- Prevent clay or silt from being spread along the borehole.
- Enable collecting a representative sample of the rock, sediment and soil, while preserving the integrity of the sample and preventing sampling of disturbed soil.
- Suitable for the types of soil and rock at the site.
- Do not cause the borehole walls to cave in.
- Enable precise sampling from the required depth (without mixing soil from different depths).
- Enable sampling of a sequence of samples from the same borehole.
- Generate as small a quantity of waste as possible (minimum soil shavings as a result of the drilling).
- Enable extraction of a “soil log” (“drilling log”).

Examples of bore methods which comply with the characteristics listed above:

- Direct push methods, consisting of two possible methods:
  - Two Tube (cased, dual tube) method - a drilling method consisting of two tubes: an outer casing tube, which prevents the borehole from caving in, and which forms a part of the drill bit, and a narrower inner tube.

- Single Tube (single rod) method - a drilling method which makes use of a single tube.

The two-tube method is preferable since it enables undisturbed sampling, as well as drilling in the presence of a non-aqueous phase liquid (NAPL) or a aqueous contaminated layer. Accordingly, the entity in charge in the Ministry will be able to require the use of this method instead of the single tube in the appropriate cases.

- Hollow stem auger (HSA) method - this method consists of an outer protective tube such that in contrast with a conventional solid stem auger, there is no need to extract it from the borehole, and the sampled soil does not get disturbed, enabling insertion of a small-diameter sampler via the protective tube for collecting the soil sample.

4.3.2. **Exception:**

in special cases, and for reasons which will be recorded, the entity in charge in the Ministry will be permitted to approve a drilling method which does not include all of the features detailed above. Following are examples of such cases which as a rule disturb the soil and cause the loss of volatile organic substances. They therefore do not comply with the characteristics, however they will be approved in exceptional cases subject to circumstances and depending on the site for which the plan is being submitted:

- Manual bore methods:
  - A stainless steel (scoop or trowel) - use will be conditional upon it being applied down to a depth of 20 cm after the vegetation and the roots have been removed from the surface.
  - Hand auger - use will be conditional upon the auger being frequently removed outside the bore and removal of the soil to enable deepening the bore.
- Mechanized boring and digging methods:
  - Bucket auger
  - Power auger
  - Backhoe loader
  - Hydraulic excavator
  - Backhoe

- Solid Stem Auger - use will be approved for preliminary drilling prior to the drilling which will be carried out for the sampling. This will be done when there is a need for very deep sampling where accessibility is technically difficult using the approved drilling methods.

4.3.3. **Means of collecting soil samples from the bore:** in order to collect an undisturbed soil sample from the borehole (hereinafter: "core"[1]) from which the sample will be taken for laboratory testing (hereinafter: "the sample"), a **means of collection must be used which will prevent disturbing the soil and cross contamination** must be used. For each drilling method there are suitable means of sampling for the core as will be detailed below. For each means of collection, a disposable liner must be used, made of the right material and resistant to the contaminants and concentrations expected in the soil - PVC, Teflon, or a [2]CAB liner (hereinafter - "liner"). In exceptional and special cases, permission may be requested from the entity in charge in the Ministry to collect the sample without a liner, if this seems possible to the person carrying out the survey according to the planned analyses. In any case, such permission will be on condition that a sampling means made of stainless steel be used, and that it be cleaned between one sampling and another. As a rule, in boring methods involving two tubes, it is also possible to use open sampling means, but where a single tube is used, closed sampling means must be used.

4.3.4. Following are examples of soil core sampling methods approved for use according to the criterion set (prevention of disturbing the soil and cross contamination) and the coring methods which may be suitable for them:

- Piston sampler-type closed barrel sampler - a closed means, wide diameter, which includes a liner and piston, which remains shut at its end until it reaches the required depth, when the

[1] Core when the bore is done using power or manual means, the soil to be collected for sampling will also be referred to as a core.
[2] CAB - cellulose acetate butyrate

piston opens for the sampling. Can be used together with direct push methods.

- Open barrel sampler [3]- a wide-diameter method, which remains open at the inserted end down to the required depth and enables the soil to enter the means of sampling. Can be used together with coring methods such as: dual-tube direct push and HSA. In addition, in exceptional cases, where the use of a Solid Stem Auger will be approved, it will be possible to use means of this kind for sampling purposes. For example:
  - Split-spoon sampler - an open means, wide diameter, which splits in two lengthwise.
  - **S**tandard **P**enetration **S**ampler - Split barrel sampler - an open, narrow diameter means.
  - Open solid barrel - an open means, wide diameter, made of steel or stainless steel, 30-150 cm in length.
  - Soil coring Device - an open means, wide diameter, made of stainless steel, suitable for shallow boring (down to 60 cm depths).

4.4. Matching the boring and sampling methods to the analysis types:

the boring method and the method of sampling must be adapted to the type of analyses which must be performed on the soil sample according to the sampling plan, and the list of sampling and analysis methods attached to these guidelines as **appendix A**. This will be done based on an analysis of the materials and their level of volatility, according to the contaminant groups needing to be tested in the laboratory. These groups include:

- Volatile organic compounds (VOC) - for example, gasoline.
- Semi-volatile organic compounds (SVOC). This list includes fuel components (TPH-DRO) and light components of PAHs (for example, Naphthalene).
- Non-volatile substances such as TPH (for components heavier than Diesel fuel), metals, PAHs, etc.

When selecting the boring method and the means of collection, as well as while performing the boring and collection, all of the necessary measures must be taken to minimize the loss of volatile organic substances. To determine the volatility level of fuel components

[3]Open barrel sampler - the soil sampler remains open at its end where it is pushed down to the required depth and enables the material to enter at all times and depths. It is therefore regarded an open, unprotected sampler.

(gasoline, jet fuel, Diesel fuel, kerosene etc.), the types of materials comprising the compound must be evaluated. For this one can rely on table 6-1 in the IRBCA document which presents the list of materials in each one of the compounds.

It must be noted, that the entity in charge in the Ministry will be able to approve any other method or means of collection which meets those criteria.

4.5. Sampling and analysis chapter

Sample taking from within the soil core collected from the borehole must be done according to the guidelines detailed below by a **certified sampler**, qualified for soil sampling[4]:

4.5.1. Direct sampling versus homogeneous sampling

- Direct sampling - sampling directly from a single core using suitable sampling vessels as will be detailed later on. This sampling is required for volatile contaminants and semi-volatile contaminants including: VOC, TPH, TPH-GRO, TPH-DRO, BTEX, S-VOC, MTBE, chlorinated hydrocarbons PAHs
- Homogeneous sampling - direct sampling from a single core or from several cores which the sampler mixes the soil in a special vessel to obtain a homogeneous sample, prior to taking the sample. As a rule, homogeneous sampling must not be done at the site itself, with the exception of sampling metals or other non-volatile compounds, for which advance approval has been given by the entity in charge in the Ministry.

4.5.2. Sampling and analysis tools

The sampling tools include clean means for collecting the sample from within the core and storage vessels for transferring the sample to the laboratory, which must be transferred to the laboratory under conditions that preventing cross contamination or evaporation. After the sample arrives at the laboratory, the analysis must be performed according to a list of sampling and analysis methods attached to these guidelines (**appendix A).** The list refers to the analysis method, to whether it is permitted to homogenize it, the means for collecting the sample, the storage vessels, the conditions under

[4] A sampler certified by the Laboratory Accreditation Authority in accordance with ISO 17025

which the vessels must be transferred to the laboratory, the maximum storage time until performing the analysis, and the maximum delay time between collecting the sample from the collecting tool until inserting it into the sampling vessel, which will be transferred to the laboratory for the analysis.

4.6. Guidelines on the method of taking the sample -

- The certified sampler must arrive at the site with the approved sampling plan and work according to it and according to the guidelines of this document.
- Sampling must not be done under extreme weather conditions such as continuous rain, dust storm, strong winds or any weather which may affect the sampling results.
- All of the sampling points must be marked in the field according to the approved plan.
- Upon arrival at the site, the sampler must spread a clean work surface on which the soil samples will be taken from their collection tools (mostly the sleeve) into the sampling vessel.
- Sampling near contamination sources from which volatile substances are emitted - must be avoided. Examples of volatile substances are: oils, motors, vehicle exhaust pipes from the sampling areas on site and so forth.
- The insertion of the samples into the sampling vessels as defined in appendix A must be done while using special gloves, powder-free and disposable. Gloves must be replaced between one bore and another, and also in any case where there is a concern that the glove has become contaminated from a contaminated sample to a less-contaminated sample.
- The samples will be stored in refrigeration in a picnic cooler with at least 20% ice inside a frozen ice pack. The volume of the cooler bag must be known and written on it.
- Execution of the collection and sampling in the field -

4.7. Sleeve:

- Immediately after extracting the sleeve from the bore hole, it must be plugged from both sides with special plugs. After that, the sleeve must be cut in such a way that there will be no additional layer of air left in addition to the layer of soil. The sleeve must be plugged again, an arrow must be drawn on the sleeve with a permanent marker. The

arrow head must point downwards (toward the bottom of the bore). In addition, the hour at which the sleeve was extracted from the bore must be written on the sleeve with a permanent marker.

- While a single bore is in progress, it is forbidden to store more than five sleeves simultaneously prior to their transfer to a sampling vessel. It is also forbidden to store sleeves in the field for more than **one hour**.
- The sample that will be sent to the laboratory must include a layer of soil, the quantity of which will be at least sufficient for the required analyses for that soil.
- VOC sampling will take place up to 2 minutes after opening the sleeve and no more than one hour from the moment the sleeve was extracted from the soil.
- Sampling of SVOC or other non-volatile substances must be done up to 5 minutes after opening the sleeve and no more than one hour from the moment the sleeve was extracted from the soil.

4.8. Jar or vial:

- On the jar or vial destined for the laboratory, the date, bore number, sample number and name of the certified sampler must be written.
- If it is not possible to fill in all the details on the vial, then the following must be written: site, date and number of sample and company ID.
- All of the boring and sampling actions must be documented in the bore log (COC - example in **Appendix B**) and in the logbook for records of the field findings as detailed below:
  - Date and time
  - Site name
  - Name of certified sampler
  - Boring devices
  - Sampling instruments[5] and references (for example - PID - instrument number; calibration expiry date)
  - Meteorological conditions - rainy day, cloudy, summery, temperature.
- Background conditions at the site - PID reading in the area's open air.
- Field findings will be written in the table and will include
  - Bore number (consecutive K numbers - K1, K2 and so forth).

[5] The sampling must be done using measuring instruments according to the guidelines of the Ministry on this matter, including - professional guidelines for field use of PID-type or FID-type measuring instruments as a part of a soil investigation; professional guidelines on using an MIP instrument.

- Boring start time.
- Sample numbers, which will be divided by days in the field. The first day will be marked as A, the second day B and so forth. For each day, consecutive sample numbers will be assigned (A1, A2; B1 B2).
- Samples which will be sent for repeat analysis at the same laboratory (Field Duplicates) will be marked as D (source sample A1, the split sample will be marked as A1D).
- • Samples which will be sent for splitting in different laboratories (Split Samples) will be marked with an S (source sample A1, the split sample will be marked as A1S).
- Description of the sample - soil type by grain size according to visual impression6; color; odor; moisture; PID value, remarks.

[6] Later on, and according to the laboratory tests, data enhancement will be done for the soil type according to grain size.

Example of a field findings table in the records for two days of field work:

Date	Bore No.	Start time	Sample No.	Depth (meters)	Soil type	Color	Odor	Moisture	PID value	Remarks
1.1.16	K1	8:00	A1	0.5	Coarse sand	Gray	Gasoline	None	84	
			A2	1.0	Fine sand					
			A3	2.0	Clay silt					
	K2	8:40	A4							
	K3	8:50	A5							
2.1.16	K4	8:00	B1							
	K5	8:40	B2							
	K6	8:50	B3							

5. Chapter on selecting samples for analysis in the laboratory

The more samples sent to the laboratory for testing, the higher the level of certainty as to the delimitation of the contamination, enabling arrival at an intelligent decision as to the need for treatment. It must be made clear that when a contamination is found in the soil, and if it has not been delimited through further samples, the entire soil cross-section will be regarded to be contaminated or as far as a clean sample. Delimitation of the contamination at a high level of certainty will reduce the need for filling in gaps in the knowledge prior to carrying out a risk assessment according to the IRBCA methodology. Sample selection will be done as follows:

5.1. As a rule, analyses must be performed for all the contaminants which may be present in the soil according to the existing information about the site, according to the historical survey or through any other means.

5.2. For each bore, samples must be taken **to characterize the field findings**, a sample at half a meter, meter and every meter down to a depth of five

meters and beginning at five meters downward - at a depth of every two meters. In deeper bores, it is sufficient to make do with less samples, subject to a sampling plan which will be approved by the person in charge.

5.3. In cases where probing is necessary to find underground piping, the plan must include a proposal for use of manual boring devices (such as a spiral auger). Should there be field findings indicating contamination of soil by volatile substances (PID reading greater than 20 PPM), and if no additional contaminations have been found in the field findings, then the probing sample must be sent for VOC analysis. This is an exception to the principle that soil sampling must not be done in disturbed sampling.

6. **Transferring samples for analysis - samples must be sent for analysis according as per the following:**

6.1. If a contaminated sample was found in the field samples, sampling must be done one meter above and below it until the contamination can be delimited. If a sequence of contaminated samples is found in the bore, then the sample suspected of being the most severely contaminated must be sent for analysis at the laboratory, as well as the top and bottom sample in this sequence, in order to delimit the contamination.

6.2. For the primary contaminant - in each bore **down to a depth of 5 meters**, **at least 2 different samples** of the primary contaminant must be sent for laboratory analysis. The samples will be selected from different representative depths and must as a minimum include the bottom of he sampling pit and the most severely contaminated sample. Two samples must be sent for analysis even if no signs indicating contamination have been found. In each bore **deeper than five meters**, 2 samples must be sent from the first five meters and in addition, **as least one more sample for every two meters and at least one of them must be from the bottom of the bore pit** (for example - in a 10-meter-deep bore, five samples will be taken, one of them being from the bottom of the bore). If there is an impervious rock layer - a sample will be taken from directly above that impervious layer.

- When the source of the primary contaminant is a fuel raffinate (such as gasoline, kerosene or Diesel fuel) - in each bore, **one sample** must be sent for VOC analysis. If a **sequence** of contaminated samples is found in the bore, then the sample

suspected of being the most severely contaminated must be sent for analysis at the laboratory, as well as the top and bottom sample in this sequence, in order to delimit the contamination.

6.3. For the secondary contaminants - with every bore, 20% of the samples sent to the laboratory must be sent for secondary contaminants analysis (for analysis for the primary contaminant as detailed above). For this, the samples suspected as being the most severely contaminated according to the field findings will be selected. Additionally, if metals, volatile or semi-volatile substances were not the primary or secondary contaminant, then an analysis must be done to screen for metals through acid leaching, screening for volatile substances (VOC) and screening for semi-volatile substances (SVOC) at least in 10% of the samples that were transferred to the laboratory and which are suspected as the most severely contaminated according to the field findings.

6.4. Also, if **volatile** substances were used in the area being investigated, including chlorinated gases such as PCE, TCE and their derivatives, and if there is a concern that gases will penetrate adjoining or future buildings, then an active gas test will be required in addition to the tests done on the soil to evaluate the need to protect the buildings.

6.5. If deviations will be found from the limit values in the site soil, then tests must be performed to determine grain size for every soil type within the vertical soil cross-section as will be described below. The soil type must be determined through 3 representative soil samples for each soil type identified at the site based on the field findings. The samples must be collected, for each soil type, from three different bores at the site, spread throughout the space. These tests will form part of the analysis report of the investigation findings. It is very important that the definition of the soil type be homogeneous across all of the certified samplers, since the different grain sizes in the soil cross-section affect the transporting abilities of the contaminant as well as influencing the preferred remediation technology.

In cases where the contamination is of limited proportions and there is no need to do a risk assessment, or when employing the regulatory prioritization mechanism, or when remedying soil not through landfill, the person in charge in the Ministry is permitted to waive grain size tests.

Routine determination of the soil type will be done according to procedure ASTM 2487-06D to determine the grain size as per the table below:

Soil type (mechanical composition)	Particle size (diameter in mm)	Sieve No.
Gravel particles (G) (G- gravel)	Larger than 4.75	>10
Sand, coarse (Sc) (Sc- Sand Coarse)	2.0 to 4.75	10
Sand, medium (Sm) (Sm- Sand Medium)	0.425 to 2.0	40
Sand, fine (Sf) (Sf- Sand Fine)	0.075 to 0.425	200
Silt (M) + clay (C) (M -medium) (C- Clay)	Smaller than 0.075 M- Plasticity index smaller than 4 (*) C- Plasticity index larger than 4 (*)	<200

(*) Plasticity index for grain size smaller than 0.075 mm is not required in a routine test.

Note: There is no requirement that the test be carried out by an accredited laboratory, however there is a requirement to work with sieves and with calibrated instruments including analytic scales, a heater, etc.

The particle distribution in the soil type must be noted, as detailed below:

Component	% of component total
Primary	Higher than 50
Partial	30<49
Low	10<29
Residual	Lower than 10

In the report, in the chapter dedicated to the soil types at the site, the distribution of the component particles must be noted precisely for each soil section, in percentages based on the 3 representative tests. In addition, in the field findings

table in the report, the soil type must be described only for the two main components. For example, if the soil section is 40% coarse sand, 30% medium sand, 20% fine sand and the rest is silt/clay, then the soil type will be described only based on the two primary components - in this case “Coarse-Fine sand”, such that the primary component is named first, followed by the lower percentage.

7. Quality control chapter

All of the stages of the execution of the soil sampling, beginning with the boring stage through to the laboratory analysis, require compliance with stringent quality control rules as detailed below:

7.1. General:

control of the nature and quality throughout all the sampling stages will be according to the EPA documents detailed below, using their most up-to-date versions as posted on the EPA website:

- Soil Sampling: Operation procedure, region 4.
- Standard SW-846: Test methods for evaluating solid waste, Physical/chemical methods.
- US-EPA- Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), EPA

7.2. Equipment cleanliness:

- All of the tools and equipment must be thoroughly cleaned before departure for the site.
- Disposable collection and sampling equipment must be used, or clean specialized equipment, which has been cleaned between uses using a procedure approved in advance by the Laboratory Accreditation Authority as detailed in appendix A and as per the EPA reference document:

  SESD Operating Procedure for Field Equipment Cleaning and Decontamination for collection of samples for trace metals or organic compound analyses (SESDPROC-205).
  - All of the reusable equipment that has been cleaned must be kept clean.
  - Sampling sleeves must be stored in a clean, airtight environment prior to use.
  - The work surfaces must be cleaned thoroughly between samples.
  - The equipment and the work surfaces must be cleaned at a
  - ocation remote from the sampling point, to prevent cross contamination.
  - Regarding the mechanical drilling equipment, if lubricants are used to lubricate the sampling equipment, then inert materials must be used, which to not contain hydrocarbons.
  - Waste from the equipment cleaning must be collected and disposed of legally.

7.3. Quality controls:

- Quality control must be performed according to table 2 - Field sampling quality control, appendix A.
- For a representative 10% of the samples (the most severely contaminated and the least contaminated) - the sum of the values obtained must be summed for each standard substances list of all the VOCs or SVOCs (the standard list appears in appendix A) and they must be compared with the overall total measured with the sampling instrument. If there are differences greater than a single order of magnitude, then the source of the discrepancy must be found, meaning the additional substance which caused the exception must be identified.

7.4. **Sample storage vessels:**

Dedicated vessels must be used, which are intended for a single use, provided by a manufacturer who also provides an analysis document testifying to the cleanliness of the vessel or vessels delivered. The document must be from an accredited laboratory which tested (and did a blank) that they are not contaminated. Details on the issue of sampling vessels are included in appendix A.

7.5. **Restoring the state of the site at the end of the soil investigation:**

At the end of the soil investigation, the ground must be restored to its original state, any waste materials from the investigation activity must be cleared from the site, and all boring openings must be sealed with the same material which was excavated during the drilling - earth, concrete or asphalt.

7.6. **Report: findings and analysis:**

At the end of the investigation, and no later than thirty business days from receipt of the laboratory results, unless permitted otherwise in advance by the person in charge in the Ministry, a soil survey findings report must be prepared, which will include all of the following:

- The sampling plan which has been approved as specified in these guidelines, including previous survey findings and additional up-to-date information.
- All of the investigation findings - the various bores, the information collected in the logbook, the analysis and quality control findings.

- Details of any missing information or of work done not according to the plan and an explanation for the shortfall or change.
- Analysis of the investigation findings - the analysis will refer to the field findings, to the correlation between them and the laboratory findings, the contamination levels at the site compared with the limit values permitted at the site, and according to that update of the CSM referring to the contamination levels, the receptors and the transport routes to them.
- If, in the laboratory tests, in the trial run and during the investigation, suspicion has arose that additional substances are present in the soil, which were not required in advance in the investigation, this must be noted explicitly in the report, and a special investigation must be made to identify those substances.
- The findings must be presented verbally, in a table, and on a site map containing numbered sampling points, and deviations found from the limit values for the various substances.
- Regulatory prioritization questionnaire according to the regulatory prioritization model - remediation of contaminated soils.
- Rehabilitation recommendations - according to an analysis of the investigation findings and the regulatory prioritization questionnaire, and in the event that soil in need of remediation according to the Ministry policy has been found, then an alternatives plan must be presented:
- Evaluation of alternatives for remediation at the site - evaluation of alternatives is an evaluation of the various possibilities for remediation of the soil, which include various methods and technologies. For each alternative, a techno-economic analysis is required - in other words, an analysis of the feasibility of the method, its safety and impacts on the environment, taking into consideration the necessary inputs, its effectiveness and the costs.
- Proposal of rea pilot of the preferred alternative: after evaluation of the alternatives, a plan for running a small-scale pilot at the site.

In the appropriate cases, and insofar as the proposed alternative is complicated and consists of several sub-alternatives for its implementation, it will be possible to submit a more detailed report for the preferred alternative, which will include a proposal for a pilot, following approval of the soil survey. For this, the findings report must include a reasoned explanation of the need for such a separate report. The plan

must be prepared according to the document: “Professional guidelines and criteria for remediation of soil for rehabilitation”, which is posted on the Ministry’s website and which is updated from time to time.

7.7. Validity of the investigation findings:

From the publication of these guidelines, an investigation findings report will remain valid for **three years**, unless a leak event occurred or if there is a suspicion that such an event occurred at or near the site. Soil remediation after more than three years following the submission of the report will require an up-to-date soil investigation.

Appendix A

Sampling and analysis methods attached as a separate file.

Appendix B - Sample COC document

Soil/water/gas samples - Custody and test requirements form Page of

Company + logo:	Site data Sampling site ID GIS Site address: Contact person name: Phone: Designation: residential / commercial / industrial / agricultural / other: Estimated groundwater level ▫ Low ▫ Medium ▫ Deep	Laboratory name: The laboratory results will be sent via email or fax to the following company:
Accreditation No.: Address: Postcode Phone Fax: Email:	* Sampling vessel: 1. Glass container 2. Canister 3. Soil sleeve 4 Other ** Exceptions: 1. Stored at the wrong temperature 2 Was not received/handled within the time required in the method. 3 . Received damaged (not airtight, vessel not completely full) 4 . Other:	Payment debit Contac person: Company: Phone: Notes on the required tests: Notes on the sampling site:

	Sample ID	Sampling date	Sampling time	Sampling tool*	PID value PPM	Composite= C/ Grab= G	Required tests + % moisture: TPH	VOC	SVOC	Metals			Urgent Regular	Laboratory use only: Irregularities** - (see details in the notes)	Sample No. in laboratory
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															

Witnesses to the		Name:	Signature:		
Provided by the		Received by	Date:	Received	By:
Name:	Date:	Signature:	Time:	Name:	Date:
Signatur	Time:	To be filled if the sample was		Signature:	Time:

Storage - in case the sample is stored prior to being delivered to the laboratory, the following details must be filled in:

Storage provider:	Storage location:		Person in charge of the storage	
Storage start - Date:	Time:	Storage end - Date:	Time:	Storage conditions (refrigerated, airtight, or other):