

Protocol 2: Site-Specific Numerical Soil Standards

May 2018

Stakeholder Comments / Recommendations	Ministry Response(s)
Considering very thin aquifers may not produce a sustainable yield, should there be a minimum thickness of the aquifer for which this applies?	The GPM is formulated on a conceptual site model of a contaminated site, which calculates the concentration in the shallowest unconfined aquifer based on a source in the unsaturated zone. This CSM does not necessarily fit all sites and modifications are required. Alternatively, if the CSM does not match a site, it's recommended in TG24 to use the default parameters. Please note that P21 provides exclusions for certain shallow aquifers and P2 is only applicable where DW applies.
Why can we not use site specific values for infiltration?	The document has been modified to clarify that a site-specific infiltration can be used in the model under a director's decision. Given that a site-specific annual infiltration rate is often difficult to determine for a site, for variables such as run-off and evapotranspiration, the look-up tables are considered a preferred method for AP's to use.
Cannot use site specific values for water filled porosity - clarification required on porosity and bulk density	Site-specific values are possible for water filled porosity.
If we have site specific porosity values outside of this range (0.2 – 0.4) and are more conservative than the range allowable, can we not use this approach, or should we still be using less conservative values (.e.g input water table of 1m if it is 0.5 m deep)?	The parameter ranges are set based on what is considered acceptable for use within the GPM. If site-specific investigations show parameters values outside these ranges, the QP can apply for a director's decision. Please note that it makes no difference for the model output to use a depth to water table of 0.5 m instead of 1 m, since a dilution factor of 1 is applied when the source extends into the water table.
Page 6 bullet 4 states groundwater should be sampled in the imminent vicinity of the 'source'. If the intent is to demonstrate there is no source, then bullet 4 should be modified to "potential/previous source".	"Potential" source has been added to both the first and fourth bullet.
Why can source dimensions not be modified if GW impacts are present, as long as GW is delineated and is demonstrated to be stable/decreasing?	Source dimensions can be modified even if GW impacts are present, as specified in the petroleum hydrocarbon sources section - paragraph 1. The specific requirement only refers to the situation when there is no NAPL, nor VHs and EPHs concentrations that exceed 100 µg/g or 1000 µg/g respectively by which to define the source. In this situation, site-specific dimensions cannot be tangibly determined and instead default source dimensions are utilized, however "depth to water table" can be modified. Please note, source dimension parameter values are not very sensitive in the GPM, however "depth to water table" is a sensitive parameter.

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Also source dimensions should consider background concentrations, i.e. may have source that is huge if background?	A bullet including local/regional background has been added.
Any modification to number of days frozen, must be based on site-specific conditions . Why is it not checked off accordingly in Table 1, page 5, where there is a blank under the site-specific cell for this parameter?	The table has been updated for any parameter that can be site-specific, but requires a director's decision, such as days frozen.
This link still refers to the old GPM XL file and is not compatible with Excel versions newer than 2003. Attempting to open the posted file causes Excel 2010 to lock up when the macros are allowed to run.	The new updated model and link is available in TG13 on the ministry's website.
P28 not available for review or reference.	Protocol 28 was not finalized in time for the comment period. Protocol 28 is posted on the ministry's website.
What site-specific values are to be used for the values in Table 1 if there is a range? Median? 95th percentile?	Section 3.2 of TG24 provides further guidance on the selection of site-specific values. The ministry relies on professional judgement when evaluating the most representative site-specific value. TG24 also specifies that where the values cannot be reliably determined, the default model parameters values should be used.
Data should be sorted alphabetically by Station Name	Table 1 has been updated.
Reviewers have questioned whether these should be LEPHs and HEPHs as recognized in the new standards. In Proc 8 there is no definition for EPHs 19-32 or for VHs for soil.	Procedure 8 was updated and now includes the definitions of VPHs and EPHs for soil.
Currently, anthracene, B(a)p, DDT, fluoranthene, PCBs and PCDDs/DFs (and Hg) are in Sched 3.1 part 1 but the soil to water pathway standards have not been calculated for these matrix substances – as such, no Site Specific Soil Standards(SSS) can be derived for them. Is there a plan to calculate these standards?	No, there is no plan to calculate these standards since the soil to groundwater pathway is not considered to be critical for these substances.
Please note that Pb, Co, Mn, naphthalene and Th have more stringent mandatory standards than the groundwater use standards. Does this mean that no SSSs could be derived for these parameters unless for risk assessment purposes?	Yes, for substances where the mandatory standards are more stringent there is no need to derive SSSs for the soil to groundwater pathway. Please note, that for lead, cobalt and thallium, SSSs could be derived when mandatory CL or IL land use standards apply.

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<p>We understand that pathway exclusion (for example, the presence of pavement cover) is a risk assessment step, and that numerical standards (whether matrix or SSS) are used to determine if a site is contaminated. Correct?</p>	<p>Correct.</p>
<p>Note that not all members of the P2 review team at CSAP had access to draft TG24 and its supporting documents.</p>	<p>TG24 was made available to the public at the same time as P2. The supporting documents within TG24 were not finalized at that time and were not part of the consultation.</p>
<p>The reviewers commented that whether or not this protocol is used will depend on whether it provides relief in a useful range of cases. To that end, it would be useful to conduct a sensitivity analysis for both the GPM and Leachate Test method using realistic site data and/or samples.</p>	<p>The results of a sensitivity analysis on the GPM are listed on the website under Discussion Papers and Reports.. The ministry is currently reviewing examples that contain real site data and could use the Modified GPM method.</p>
<p>Please clarify if presence of mobile NAPL would negate the use of SSS for all parameters or only those related to the NAPL – e.g., can we derive SSS for arsenic in the presence of diesel NAPL? What about other metals? In either case, the rationale for this exclusion should be stated here for transparency.</p> <p>We suggest also stating that if NAPL is present but determined to be immobile then SSSs can be derived for relevant organic or inorganic substances.</p>	<p>When mobile NAPL is present, the site is considered high risk. Those high risk conditions will need to be addressed. Co-contaminants such as manganese could be present as a result of hydrocarbon contamination.</p> <p>The text has been updated to indicate SSS can be derived for contaminants that are not related to the NAPL.</p>
<p>One of the reviewers notes that the GPM version included with the link would not run in 64 bit mode. It was created in a 32 bit 1997/2003 excel version. The GPM model should be updated to current software standards.</p>	<p>The new updated model and link is available in TG13 on the ministry's website.</p>
<p>Please confirm that the model only applies to protection of an unconfined aquifer. If so, perhaps this should be included as a precluding condition.</p>	<p>An unconfined aquifer is not a precluding condition. The GPM is formulated on a conceptual site model of a contaminated site which consists of a source in the unsaturated zone and it calculates concentrations in the shallowest unconfined aquifer. The standards calculated from the GPM apply to all soils onsite, regardless of whether an unconfined aquifer is present. This CSM does not necessarily fit all sites and TG24 suggests that in this case, default parameters are used.</p>

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Can MOE confirm that the physical/chemical properties are the most up to date/best literature values available? Also, we suggest that there should be a reality check before they are formalized if it is found that they have been set using very limited data sets.	The physical/chemical properties of the model were reviewed, consulted on, and updated as part of the Stage 10 CSR "Proposed amendments to Schedule 5 soil to groundwater pathway standards". Site-specific values for physical/chemical parameters can be applied under a director's decision.
Site-specific infiltration rates should not be excluded. Also, rates calculated for nearby sites may also be applicable.	The document has been modified to indicate a site-specific infiltration may be used and submitted for a director's decision. Given that a site-specific annual infiltration rate is often difficult to determine for variables such as run-off and evapotranspiration, the look-up tables are an easier method.
The hydraulic gradient and depth to water vary temporally. Does TG24 provide clear guidance regarding acceptable approaches to estimate these?	Please refer to TG24 and TG8. Section 3.2 of TG24 provides further guidance on the selection of site-specific values. The ministry relies on professional judgement when evaluating the most representative site-specific value. TG24 also specifies that where the values cannot be reliably determined, the default model parameters values should be used.
Does the foc apply to both unsaturated and saturated soils? How are peat soils handled?	The fraction of organic carbon (foc) should be measured in the unconfined flow system and be represented as such in the model. For peat soils where the foc is higher than 5%, a director's decision may be sought. Please note, foc only impacts derivation of SSS for organic substances.
Table 1 – half-lives -We note that there are relatively few organic parameters listed in Schedule 3.1 part 1, limiting the utility of the protocol.	The organic soil to groundwater soil standards are derived when there is a soil to groundwater pathway. The other mandatory site specific factors are toxicity based.
Further, the half-lives generated by Axiom in the SLRA tables appear overly conservative for the hydrocarbon parameters. One of the reviewers modeled a site using the new LEPH half-life starting with 5000 ug/l. The plume flow length exceeded 500 m before concentrations dropped below standards. Hydrocarbon plumes (excluding exotic conditions) will normally not extend beyond 200 m.	The physical/chemical properties of the model were reviewed and updated as part of the Stage 10 CSR "Proposed amendments to Schedule 5 soil to groundwater pathway standards". Site-specific values for substance half-life can be applied under a director's decision.
Should the Physical/chemicals properties be added below in Table 2 with reference to a table and to TG24, and the default value for days frozen, Dfr = 0 days?	The physical/chemical properties are all particular to a specific substance. In order to keep the document readable and succinct, the values are available in Protocol 28 and the GPM Model.
Table 1, solubility - Please clarify whether this refers to effective solubility or absolute solubility	The limit value used is 50% of the theoretical solubility of the substance. This is to minimize the potential for calculation of standards at

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	concentrations approaching the presence of nonaqueous phase liquids. Please refer to Section 5.2 of Protocol 28..
It is not clear why the upper foc is limited to 5%	The previous version of P2 listed the upper limit of the fraction of organic carbon to 2%. The ministry anticipates that 5% foc would capture most sites across the province. If site-specific data are found above the range, then a director's decision may be sought.
The only hydrocarbon parameters this would pertain to for developing SSSs are BETX. PAHs (e.g., BaP, fluoranthene, naphthalene) either don't have soil to groundwater pathways, or the mandatory factors are more stringent.	Correct.
VH limits -Should this be 200 ug/g? Or perhaps 150, or between 150 and 100 ug/g? The lowest standard for VHs is 150 for wild lands, so this would need to be at least slightly less than 150. 100 ug/g is too extreme as is approaching lab method limits.	VHs and EPHs are used as surrogates for NAPL contamination in P2. Sites that have VHs concentrations of 200 µg/g can leach and cause groundwater contamination. Lab method detection limits for VHs are between 20-50 µg/g.
VH limits -Essentially, one needs samples that are less than the applicable standard that are outside of your source zone so you can define the source boundary. Given the different standards for different land uses, then as a reasonable alternative, for LEPH and HEPH why not specify the standard less 10%.	Sites that have VHs concentrations of 200 µg/g can leach and cause groundwater contamination. The source definition needs to capture BTEX and PAHs as well as LEPH and HEPH.
VH limits -Again, should this be 200 ug/g?	Sites that have VHs concentrations of 200 µg/g can leach and cause groundwater contamination.
EPH and VH selection -These should be LEPH and HEPH	No, the source needs to capture BTEX and PAHs as well as LEPH and HEPH.
Meeting four requirements - It will be up to APs to determine if the four criteria described above have been met. We see ample opportunity for professional judgement and disagreement – e.g., were the two annual GW sampling events conducted at times that were reasonable worst case (e.g. when water table is in contact with the source soils)? Greater clarity provided here would reduce this concern.	The ministry relies on professional judgement when evaluating groundwater. Solid arguments supported by site data must be presented. Guidance on the assessment of groundwater can be found in Technical Guidance 8 and the background document "Groundwater Investigation in Site Assessment".
Inorganic sources and organic (non-petroleum hydrocarbon) sources - Insert "For the purposes of P2". Otherwise, exceedances of Sched 3.1 Part 2 and Part 3 standards does	Correction done.

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not indicate a source is present.	
Consider adding “or greater than the substance regional/ local background soil concentrations as defined in Protocol 4 “Determining Background Soil Quality” .” We note that the table lookup in the current draft Protocol 4 is of limited value.	The corrections have been made.
Inorganic source size - How would this apply to a set of sites that are impacted by the same COC. – e.g., metals contaminated fill. Is it possible that for a small site, SSS could be derived that are greater than matrix standards, while an adjacent large site with the same COCs would not be able to do so by virtue only of its larger size? Or must each site assume the full size of the source area even if it extends beyond an individual site’s boundaries? I think the latter is correct, and if so this should be clarified somewhere in this section.	Source size is not defined by a property boundary, but defined by substances greater than the standard.
Parameters with higher sensitivity -Should aquifer thickness be included here?	Aquifer thickness has been added to the lower sensitivity section (the parameter is not considered sensitive).
Distance to receptor - Please clarify that SSS can be developed when there are no groundwater exceedances, and that the 10 m default applies when there are exceedances.	SSS can be derived regardless of a groundwater exceedance. The “distance to receptor” parameter cannot be modified when there are exceedances.
Distance to receptor for AW - Why must standards be met at the property boundary? Given that the AW receptor location doesn’t change, why not assess the distance to receptor from the leading edge of plume? This would require demonstration that the plume is stable, and that concentrations decrease from source to downgradient in accordance with model predictions.	Given that P2 provides a new numerical site-specific soil standard for that particular source site, the protocol does not provide the ability to contaminate a neighbouring affected parcel that is subject to a numerical standard. Those arguments are acceptable for risk assessment, but not for setting a new numerical standard.
Wording for If a qualified professional prefers to use site-specific values, a director’s approval of SSS must be obtained as described in Section 7.0 -Please note that this isn’t the same wording as in TG24:	Both the protocol and tech guidance have been modified to provide further clarity.

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<p>“However, should alternative, scientifically defensible values be available for modifying these parameters, an application for a director’s approval including rationale and supporting documentation can be made.”</p>	
<p>Biodegradation rate for days frozen -We assume this is the “half-life” referenced earlier? Does it apply equally to the vadose zone as well as the saturated zone?</p>	<p>Text has been changed to half-life. Model details regarding half-lives are summarized in Protocol 28. The vadose zone half-life is 50% of the saturated zone half-life.</p>
<p>Hint box using 3.3 DF - We suggest that this could be laid out as Option 2 in a figure similar to that shown in Figure 3.</p>	<p>The hint box functions as a shortcut within the GPM. Option 2 includes running the model which is substance dependent and could yield different results.</p>
<p>SSS cannot be derived under Leachate Test method - As commented by reviewers in P27 – this negates the opportunity to develop SSS remediation targets until after completion of remediation (assuming that the source generates leachate and is then removed through remediation) and possibly not until after sufficient time has been allowed for natural attenuation of residual GW contamination related to the now-remediated source area. If this restriction was eliminated, then SSS targets could be pre-established. In cases where the groundwater plume can be risk managed after the source soil is remediated, pre-established SSS remediation targets would allow for greater certainty for proponents. This would also incentivize proponents to conduct source removal sooner rather than later.</p>	<p>This comment pertains to limitations within P27 and is not relevant to the limitation of the P2 Leachate Test method. The limitation within this document pertains to leachate concentrations that are higher than the Groundwater Standards and higher than the modelled leachate concentrations. In this case, the specific leachate concentration is considered to reach the groundwater in a concentration above the numerical standard.</p>
<p>Discussion could be added to include use of other models (e.g., see Method IIC in current P2) and/or alternative, scientifically defensible values for the chemical parameters.</p>	<p>Section 7.0 provided examples and is not limited. To date, the ministry has not received an application using an alternative model. Documentation for defending the use of an alternative model could be extensive.</p>
<p>Section 6.0 states “A SSS cannot be derived under the Leachate Test method, when the measured concentration of a substance in soil leachate is greater than the modelled concentration of that substance...”. In Figure 1, the QP is invited to “select a method”. However it seems that both methods must be applied in order to satisfy the condition as stated above. Are the two methods actually intended to run</p>	<p>A sentence has been added to Section 3.0 Overview to indicate that the QP can freely choose which method to use or even try both methods. The confusion seems to stem from the fact that the GPM is used both under the Modified GPM method and potentially also under the Leachate Test method to calculate the modelled leachate concentration (the leachate test is compared to either the numerical GW standard or a modelled leachate concentration).</p>

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in series – First GPM, then more robust analysis using leaching test method if GPM is deemed too conservative?	
SSS should be derivable for non-NAPL related substances.	<p>Co-contaminants such as manganese could be present as a result of hydrocarbon contamination.</p> <p>The text box has been updated to indicate SSS can be derived for substances that are not related to NAPL.</p>
It would be helpful to the reader to include the TG24 flowchart here in P2 as it explains and supports much of the text in P2.	Protocols contain mandatory requirements. The flowchart in TG24 is a suggestion, not a requirement and for this reason cannot be included in P2.
Regional Infiltration Data -Can a reference be provided upon which the data is sourced?	A reference has been added.
Figure – Infiltration Data -This figure could use a North arrow, legend and reference.	Figure has been corrected.
It still remains unclear how the CSR guidance documents and updates will be harmonized with the Organic Matter Recycling Regulation (OMRR). As of November 1, 2017 the OMRR Schedules 9 and 10 will be repealed and substituted with Schedule 10.1 (Order in Council 747). However, the OMRR does not explicitly indicate which CSR guidance documents may be used to develop site-specific numeric soil standards for land application of organic matter such as biosolids. This lack of specificity has historically led to the inability to apply site-specific guidance documents to biosolids projects. A clarification as to whether biosolids land application is considered a beneficial land use and whether there is an intention to harmonize the CSR Protocols and Technical Guidance documents related to site-specific numerical soil standards with the OMRR for biosolids land application would add value to this Protocol.	We will forward this comment to the ministry program that is responsible for the oversight of OMRR.
This Protocol allows for the development of less restrictive standards based on site-specific conditions. The prescribed methodology has been simplified and we support this change.	The ministry appreciates this feedback.
Confusing whether or not distance to receptor can be modified (due to use of and).	The flowchart text box can only contain a limited amount of characters; the flowchart should always be used in conjunction with the document.

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Does the site have to be within jurisdictional boundaries to use data or can the nearest data be applied to any site?	See TG24 Section 3.1