NJDEP Technical Guidance - Response to Comments

DOCUMENT: Monitored Natural Attenuation Technical Guidance

START of Comment Period: **Wednesday, May 25, 2011**
END of Comment Period: **Wednesday, July 6, 2011**

#	Page	Section of Draft Document	Section of Final Documen	Comments	Response
1	1	1	1	Regarding the statement in the second paragraph: "Variances from a technical requirement or departure from guidance must be documented and adequately supported with data or other information." We acknowledge the need to document variances from regulation, however, precisely because this is a guidance document, it should not be a requirement that the LSRP document all departures. LSRPs are professional experts by definition on the regulations and guidance documents. There should not be a requirement to provide technical rationale justifying departures from the guidance document. Moreover, the expectation that justification be prepared for these departures, including those that may result from using or implementing updated data, techniques and technologies, will materially increase site remediation costs with no appreciable environmental or health benefit.	Refer to ARRCS 7:26C-6.2(c)4.
2	1	1	1	I recognize that we provided the language for this section to your Committee as "Boiler Plate" language, but please delete the words "Variances from a technical requirement or" from the second sentence of the second paragraph so that it reads "Departure from guidance must be documented and adequately supported with data or other information." Comments received from previously issued documents suggested that it was redundant since the first sentence of the same paragraph describes procedures to obtain a "variance".	This paragraph is standard in all Department guidance documents.
3	1	2	2	The guidance emphasizes that "When relying on natural attenuation processes for organics, NJDEP prefers those processes that degrade or destroy contaminants". A statement must be added that other mechanisms are acceptable, as long the outcome is protective of human health and the environment	Text revised to read: At sites with organic compound contamination, MNA is most effective where the natural processes permanently degrade or destroy contaminants. For inorganics, MNA is most effective where immobilization or radioactive decay is demonstrated to be occurring.
4	1	2	2	MNA is typically used following active remedial actions such as source removal/control or pump and treat systems. Add "However, MNA can also be used as a stand-alone remedial action."	Text revised to read: MNA is typically used following active remedial actions such as source removal/control or pump and treat systems. Refer also to Section 5.1 and response to comment 32.

5	1	2	2	In sentence 2 of paragraph 2, the guidance defines MNA as ". . . the reliance on natural attenuation processes (within the context of a carefully controlled and monitored clean-up approach) to achieve site specific remediation objectives within a reasonable timeframe compared to other methods". We recommend deleting the phrase "within a reasonable timeframe compared to other methods" because 1) it places disproportionate emphasis on timeframe as one of many factors that should be considered in the remedy selection process, 2) there are many other metrics that should factor equally (or more prominently) including effectiveness in protecting public health, safety and the environment, 3) the term "reasonable" is subject to a wide range of interpretations, 4) in many cases, "reasonableness" will likely be judged based factors - such as economics - that are outside the scope and intent of this guidance, and 5) the duration of a remedy does not inherently effect its protectiveness (provided that adequate monitoring, controls and finances are in place).	This section (former Section 5.1.3) has been removed from the document.
6	1	2	2	The statement "When relying on natural attenuation processes for organics, NJDEP prefers those processes that degrade or destroy contaminants" is not necessary. The NJDEP may "prefer" degradation and destruction, however if a MNA process can be demonstrated to mitigate risks to human health and the environment, an LSRP should be allowed to use it whether it destroys the contaminant or not. The next sentence states: "Stabilization, immobilization and radioactive decay are preferred for inorganic contaminants." There are also many semi-volatile organic compounds that are naturally immobilized and not necessarily destroyed.	The guidance primarily addresses volatile organic and inorganic constituents that are mobile in ground water.
7	1	2	2	The statement that for organics the NJDEP "prefers processes that degrade or destroy contaminants" should be removed as dispersion and dilution are physical processes that reduce mass and are equally effective as those that "degrade and destroy".	Refer to response to comment 3.
8	2	2	2	The guidance states that "MNA is typically used following active remedial actions". A statement should be added that MNA can be an appropriate stand-alone remedy under the right conditions.	Refer to response to comment 32.
9	2	2	2	First sentence: "MNA is typically used following active remedial actions such as source removal/control or pump and treat systems". This sentence implies that all sites require active remediation, and the document is not recommended to be that limiting in scope. A detailed section indicating situations where MNA is, and is not, an appropriate approach would be helpful upfront. Suggest including cases (actual) and/or hypothetical where MNA is and is not applicable. Criteria to make this assessment listed within existing NJ regulations and a summary of the rationale should be described with an indication of where the information resides within NJ regulations.	See response to comment 32, and refer to Section 4.2. The provided references include sufficient examples of applying MNA.
10	2	2	2	Second paragraph page 2. "does not address natural attenuation in soil." Please revise this statement to make it clear that it is addressing soil in the vadose zone.	This document provides guidance on natural attenuation of contaminants in groundwater, not soil.
11	2	2	2	In the first paragraph on page 2, the document states: "The goal is to demonstrate that MNA will result in a reduction in ground water contaminants until they meet the Ground Water Quality Standards at N.J.A.C. 7:9C." We recommend that the word "goal" be changed to "objective". The goal is "protection of Human Health and Environment" (first line of section). The objective is to "demonstrate that MNA will result…..: One way to illustrate what is meant by site-specific objectives in the context of MNA, is to illustrate with a simple site example. Site-specific objectives must all be specific, measurable, attainable, realistic and time bound (SMART). This needs to be clearly stated, to avoid the complications of the past (i.e., unrealistic MNA predictions, cleaning to MCLs, etc.)	The document has been revised as suggested.

12	2	2	2	In the 3rd paragraph of Section 2, the second sentence states "Approaches to evaluate MNA as a remedial strategy for ground water are outlined in the document.". To make it more clear what is being referred to, it is suggested that this sentence be modified to read "Approaches to evaluate MNA as a remedial strategy for ground water are outlined in this technical guidance document."	The document has been revised as suggested.
13	2	2	2	The fourth paragraph (first sentence) states "The document does not address enhanced MNA.". This comment relates to point made above... To reduce the potential for misinterpretation, it is recommended you refer to the MNA document as "this technical guidance document" or even "this document" rather than "the document"	The document has been revised as suggested.
14	2	3	3	In general, the draft MNA guidance is useful and its general framework mirrors other known and established MNA guidance documents (e.g. USEPA). However, the Draft MNA guidance document is rigorous with respect to the procedures and the lines of evidence discussed in the general comments which will require a reasonable effort to establish, especially if the third line of evidence (microbial evaluation) is necessary.	The level of work needed to demonstrate that natural attenuation is an appropriate remedy will vary by site. The investigator will determine whether use of the third line of evidence is necessary or appropriate.
15	2	3	3	The guidance states that "MNA should not be considered a default or presumptive remedy at a contaminated site.". This statement is restrictive and counterintuitive. MNA is an appropriate remedy under the right conditions.	See response to comment 32.
16	2	3	3	Fifth sentence of chapter. Change "concentration trends" to "decreasing concentration trends over time" or something to this effect to make it clear that temporal changes are being discussed here.	The document has been revised as suggested.
17	2	3	3	Last sentence of second paragraph. Traditionally the third line of evidence for MNA evaluation referred to laboratory microcosms (USEPA, 1998). This document modifies (appropriately) the third line of evidence to the use of molecular biological tools and stable isotope analysis. Given the relatively low cost (<$500 per sample) of these methods and the more direct evidence they provide relative to general geochemical conditions, I would remove the last sentence stating they are only conducted where the first two lines of evidence are inadequate or inconclusive. Rather, it would be beneficial to acknowledge these are powerful tools and to encourage their use when appropriate.	The document has been revised as suggested. Please also note that Section 6.3 outlines the benefits of the Tertiary line of evidence.
18	2	3	3	Second paragraph. Comments for "A third line of evidence evaluates site specific microbial populations which are direct indicators of natural attenuation": Microbial populations, including those known to be capable of degrading contaminant(s) of concern, may not be actively degrading contaminants. Their presence indicates the potential for contaminant biodegradation but not proof that contaminants are biodegrading. This highlights the importance of isotopic analyses and/or laboratory microcosm studies as 3rd lines of evidence. This sentence should include 3rd lines of evidence for abiotic NA processes including the abiotic destruction of chlorinated solvents and the immobilization of inorganics. Suggest the following to replace this sentence: "Third lines of evidence evaluate the occurrence of site-specific biodegradation and abiotic degradation and immobilization processes. Indicators may include specific microbial populations, stable isotope analysis, and laboratory microcosm measurements of contaminant biodegradation, abiotic degradation, and/or immobilization."	Section 6.3 provides details on using the Tertiary line of evidence. This section has been revised to be consistent with language used in Section 6.3.
19	2	3	3	The document states in the second paragraph of this section that "The guidance outlines a line of evidence approach used to evaluate whether MNA is an acceptable remedial approach." We recommend changing "whether" to "whether or not".	The suggested change does not appear to be warranted.

20	2	3	3	The document states "A third line of evidence evaluates site specific microbial populations which are direct indicators of natural attenuation. The third line of evidence is usually only conducted where the data from the first and second lines of evidence are inadequate or inconclusive." We recommend that the document clarify that the third line of evidence, site-specific microbial data, is not applicable to all MNA processes.	Refer to response to comments 17 and 18.
21	2	4	App F	Use of the term "daughter" product. This term is traditionally used by nuclear physicists for radioactive decay. It would seem more straight forward and less confusing to simply call them "degradation" products.	This section has been moved to Appendix G and the suggested revision has been incorporated.
22	2	4	App F	We disagree with the definition of daughter product: "Daughter Product means a compound that results directly from the biodegradation of another. For example cis-1,2-dichloroethene (cis-1,2-DCE) is commonly a daughter product of trichloroethene (TCE)." We recommend replacing "biodegradation" with "degradation" because some daughters form by abiotic processes. For example, 1,1,1-trichloroethane has two daughter products; one by biodegradation (1,1-DCA) and one by hydrolysis (1,1-DCE). The degradation of 1,1,1-TCA to 1,1-DCE is an abiotic process.	The document has been revised as suggested.
23	3	4	App F	Last paragraph and sentence of Section 4. The term "manganic" is traditionally used to describe compounds containing manganese in the 3+ or 6+ oxidation state, compounds which are strong oxidizers. In natural aquifers, manganese in an oxidized form will usually be in a 4+ oxidation state (see earlier definition of electron acceptor); for example manganese oxide (MnO_2). Suggest replacing "manganic manganese" with "manganese (IV)" or "manganese oxides."	This section has been moved to Appendix G and the suggested revision has been incorporated.
24	3	4	App F	For clarity we recommend that definitions for the following terms be added to Section 4: plume, source or source zone, and natural attenuation capacity.	With the exception of attenuation capacity, the guidance document team decided that most of these terms are too broadly used by the Department to define in this document.
25	3	4	App F	Regarding the definition of LTM - we recommend adding "whether or not" to definition.	The suggested change does not appear to be warranted.
26	3	4	App F	Regarding the definition of MNA: "Monitored Natural Attenuation (MNA) means the reliance on natural attenuation processes (within the context of a carefully controlled and monitored clean-up approach) to achieve site-specific remedial objectives within a time frame that is reasonable compared to other methods.", we recommend replacing "means" with "refers to" and replacing "methods" with "active remedial methods."	This definition has been substantially revised, and incorporates portions of this suggestion.
27	3	4	App F	(3rd paragraph) It is stated "The MNA remedy will require the issuance of a Department Remedial Action Permit for Ground Water." Since a requirement is identified, the regulatory citation needs to be provided.	The document has been revised to state that MNA needs to be implemented within the context of a Remedial Action Permit for Ground Water (RAP-GW). The regulatory citation for RAP-GW is provided previously in the document (N.J.A.C. 7:26C-7) .
28	3-Feb	4	App F	Add definitions for "source"; "free product"; and "residual product"	See response to comment 24. Also please refer to the Light Non-aqueous Phase Liquid (LNAPL) Initial Recovery and Interim Remedial Measures Technical Guidance.

29	3	5	4	Regarding the statement; "This guidance document assumes that the site evaluating MNA has complied with all pertinent regulatory requirements and technical guidance including but not limited to PA/SI/RI requirements and the evaluation of receptors." Because guidance documents are not regulation, they should not be "complied with", we recommend rewording the sentence to read: "This guidance document assumes that the site evaluating MNA has followed applicable guidance documents and complied with all pertinent regulatory requirements including, but not limited to, PA/SI/RI requirements and the evaluation of receptors."	The guidance document has been revised in response to this suggestion.
30	3	5	4	We recommend deleting the statement "At sites with organics contamination, MNA is most applicable where the natural processes permanently degrade or destroy contaminants." If a MNA process can be demonstrated to mitigate risks to human health and the environment, an LSRP should be allowed to use it whether it destroys the contaminant or not. There are also many semi-volatile organic compounds that are naturally immobilized and not necessarily destroyed, which is preferred by the NJDEP for inorganic contaminants.	The document has been revised to address this issue. Also refer to the response to comment 6 and 32.
31	3	5	4	The statement that "MNA is most applicable where natural processes permanently degrade or destroy contaminants" does not reflect that dispersion and dilution are equally effective natural attenuation processes	See response to comments 30 and 32.
32	3	5.1	4.1	MNA is most appropriate when used in conjunction with other remedial measures or as a follow up to active remediation. Add "<u>However, MNA can also be used as a stand-alone remedial action.</u>"	The document has been revised (Section 4.1) to indicate that MNA may be appropriate as a sole groundwater remedy if no source is present and site conditions reflect that natural attenuation alone would meet the remediation objectives.
33	3	5.1	4.1	incorrect reference to 5.2.3, should be 5.1.3	The referenced section has been removed from the document, so this reference is no longer contained in the text.
34	3	5.1	4.1	We recommend modifying paragraph 1, sentence 4 "MNA can be evaluated along with other remedial approaches and technologies to assess if it is an appropriate component of a site's remediation process" to read "MNA can be evaluated along with other remedial approaches and technologies to assess whether it may be a cost-effective component of the remedy for a site".	Cost-effectiveness is not the driver for determining the appropriate remedial alternative per N.J.A.C. 7:26E
35	3	5.1	4.1	Second paragraph, last sentence reads "The concept of reasonable timeframe is discussed in Section 5.2.3. There is no 5.2.3 in this document; change to Section 5.1.3.	Refer to response to comment 33.
36	4	5.1	4.1	In the second paragraph the following statement is made: "Critical factors when considering MNA include whether the contaminants are likely to be effectively addressed by natural attenuation processes (e.g., degraded if organic contaminants, immobilized if inorganic contaminants),". We recommend changing "immobilized if inorganic contaminants" to "immobilized or decayed if inorganic contaminants" to include radionuclides.	The document has been revised (Section 4.1) to include the suggested change.

37	4	5.1	4.1	In the second paragraph the following statement is made: "Since some natural attenuation processes may create daughter products that are more mobile and/or more toxic than the parent contaminant, this too must be assessed." Because this is a guidance document we ask that the word "must" be changed to "should".	The assessment of degradation products is necessary and warranted in order to fully assess whether implementation of a MNA remedy will be protective in the long-term. The GWQS (N.J.A.C. 7:9C) and Technical Requirements for Site Remediation (N.J.A.C. 7:26E) require the remediation of all contaminants, which would be inclusive of degradation products, that exceed the GWQS. The regulatory citations have been added to the text.
38	4	5.1	4.1	We recommend modifying paragraph 6, sentence 2 "For example, potential advantages include that MNA reduces waste generation, provides sustainable benefits consistent with EPA's Green Remediation Policy, and, in many cases, reduces overall cost" to read "For example, potential advantages include that MNA could reduce waste generation, provide sustainable benefits consistent with EPA's Green Remediation Policy, and, in some cases, could reduce lifecycle cost."	This section of the document has been revised.
39	4	5.1	4.1	In the statement "Contaminants in soil and ground water that are not adequately addressed by source controls jeopardize a successful MNA long-term cleanup strategy.", we recommend replacing the word "jeopardize" with "may reduce the effectiveness of."	The document has been revised to be consistent with EPA's OSWER Directive, which uses the term "complicate".
40	4	5.1	4.1	Regarding "Compliance with the Soil Remediation Standards Impact to Ground Water Pathway should be demonstrated prior to implementation of a MNA remedy." We disagree with this statement for several reasons. The guidance should not tie MNA to compliance with these standards until updates are made to the Department's policy and guidance regarding the determination of site-specific impact to groundwater Soil Remediation Standards. Updates are needed to allow longer timeframes for achievement of the Groundwater Remediation Standards within the source zone (currently set at a maximum of 5 years under the SESOIL and AT123D option). The arbitrary 5-year timeframe specified under the current SESOIL and AT123D guidance has the potential to eliminate MNA as an option for many sites for which it would otherwise be appropriate and cost effective. There are also exceptions to complying with the SRSIGW pathway. For example, parameters with GWQS but no Soil Remediation Standards, such as a site with an ammonia groundwater plume. An MNA remedy may be appropriate to achieve GWQS, however NJDEP has no soil remediation standards for ammonia. We recommend that this sentence be deleted.	The Guidance Document has been developed to work with existing regulation and guidance, and revising the document to incorporate proposed or pending regulation or guidance changes is not appropriate. Remediation of soil to the Soil Remediation Standards in conjunction with the MNA remedy is required by N.J.A.C. 7:26E-6.3(d)3. Complying with the Impact to Groundwater Soil Remediation Standards is part of source control.
41	4	5.1.1	4.1.1	Compliance with the Soil Remediation Standards Impact to Ground Water Pathway should be demonstrated prior to implementation of a MNA remediation. Add "Compliance <u>to the extent practicable</u> with the ..." Source control does not necessarily mean strict compliance with the SRS. MNA should be able to be implemented along with containment, which is recognized in the guidance document but not implicit in the above statement. Additionally, the Department's guidance for IGWSRS are based on the Class IIA ground water.	See response to comment 40.

42	4	5.1.1	4.1.1	If an on-going leak from a pipe is the definition of "source," the paragraph above is true. If it is "stained" or "residual" soils, it is false or at least ambiguous. There needs to be acknowledgement that mechanisms for naturally-occurring attenuation of mass in residual soils exist, and if the consultant can demonstrate that these mechanisms will indefinitely control the rate of contaminant mass from soil to groundwater, then natural attenuation of historic "source" areas, without precedent active remediation, is appropriate.	The Department recognizes that NA processes occur in soil, but the focus of this technical guidance document is groundwater and attenuation in the saturated zone. Addressing soil contamination, LNAPL, or other residual soil sources is beyond the scope of this guidance document.
43	"	"	"	Lacking a definition of "source," statements such as: "Once the source of ground water contamination has been addressed and it has been demonstrated that MNA is an appropriate remedial alternative, the investigator shall establish..." (Section 8, Remedial Action (RA) Permit for Ground Water with long-term Monitoring), will become very problematic with the regulated community left unable to implement MNA due to misunderstandings about the rate of contaminant mass transfer into the groundwater system in comparison to the rate of contaminant mass losses due to degradation and attenuation in the aquifer.	See response to comment 42.
44	4	5.1.1	4.1.1	MNA strategies can also take into consideration Natural Source Zone Depletion (NSZD) in the proper context of the risk associated with the LNAPL source that may be present at the site. If there is sufficient spatial area to address the mass flux from the source prior to reaching any potential receptor, the source may become depleted within a designated reasonable timeframe. These concepts are covered in the ITRC document LNAPL-1.	The Department has determined that the reference to NSZD will be removed. NSZD was addressed in the Response to Comments Light Nonaqueous Phase Liquid (LNAPL) Initial Recovery and Interim Remedial Measures Guidance (June 2011). Similar to the response provided in the LNAPL Response to Comments guidance, the MNA guidance document needs to be consistent with the Technical Requirements for Site Remediation and provide direction consistent with legislative or Department policy. The Water Pollution Control Act, N.J.S.A. 58:10A-2 states that “it is the policy of the State to restore, enhance, and maintain the chemical, physical and biological integrity of its waters….” . Leaving LNAPL to naturally attenuate, when there are other means of recovering or remediating LNAPL (whether free or residual), does not meet the intent of this policy.
45	4	5.1.2	4.1.2	Last sentence referring to "additional information on technical impracticability will be forthcoming" should be deleted or changed to state that available guidance will be used.	This sentence has been revised.
46	4	5.1.2	4.1.2	The guidance states that "Compliance with the Soil Remediation Standards Impact to Ground Water Pathway should be demonstrated prior to implementation of a MNA remedy." This statement is misleading as, oftentimes, while site data prove that there is no impact to groundwater, the numerical standards may suggest otherwise, due to the assumptions and limitations imposed by the underlying calculations. This statement must be caveated accordingly.	See response to comment 40.
47	4	5.1.2	4.1.2	You should add the term "technical Impractibility" to your list of definitions.	Please refer to the Department's forthcoming Technical Impracticability Guidance Document.
48	4	5.1.3	Deleted	The entire section 5.1.3 Reasonable Time Frame for Remediation must be deleted. As the discussion in the section illustrates, the duration of MNA is highly variable. It is well known that conventional remedies (such as pump-and-treat) can operate for decades without achieving the remedial objectives. Therefore, the concept of "reasonable timeframe" is inappropriate.	This section has been removed from the document.

49	4	5.1.3	Deleted	Current practice in site remediation has demonstrated that rapid achievement of the very low remediation standards for groundwater is not practical - particularly in tight formations and bedrock aquifers. Accordingly, some form of MNA is an expected component of nearly every groundwater remedy. The MNA guidance should more clearly articulate that the MNA component of an overall groundwater remedy may require decades to complete, and that the time to complete the MNA portion of the overall remediation is should not be considered excessive or unreasonable when compared to the time to conduct the active portion of the remedy.	See response to comment 48.
50	5	5.1.3	Deleted	The MNA guidance cites conditions that preclude MNA as a sole groundwater remedy. Leaving aside the point that MNA is rarely a stand-alone remedy in any setting, we argue that it can be effective in both porous and fractured media. Bedrock aquifers should not be precluded, a priori, from incorporating MNA remedies; to do so is to dismiss from consideration a potentially valuable tool in the control and restoration of groundwater quality. Two reasons are cited in the draft guidance for precluding MNA in fractured bedrock. The first reason given is that bedrock presents too complicated a setting to monitor contaminant transport and attenuation processes. This is simply illogical and indefensible. Does the guidance, for example, purport that other remedies should be precluded for the stated reason? The guidance seems to suggest that fractured bedrock aquifers cannot be adequately monitored, but this is not a reason to eliminate one remedy over another, rather it may be a reason to improved monitoring techniques in general for fractured bedrock settings. Elimination should be based upon the same reasons that are used to eliminate MNA (or other alternative remedies) in any settling, those being criteria such as: lack of source control, excessively large restoration timeframes relative to other alternatives, expanding plume geometry and concentration trends, a lack of lines of evidence, etc. The guidance document cites all of these factors in other sections. The second reason cited is: "As noted by the Wisconsin Department of Natural Resources guidance on natural attenuation (Wisconsin 2003), attenuation processes such as sorption, cation exchange, biodegradation and hydrolysis are not as effective in fractured bedrock environments." We find it surprising that with all of the knowledge gained about MNA in the past decade, that a guidance document would cite to one vague quote from a single source as the basis to dismiss application of MNA in fractured bedrock aquifers. The Wisconsin statement is far from an accepted principle. Moreover, even if there were a general consensus that the Wisconsin quotation is valid, the quote does not say that MNA in such settings is ineffective; rather that is may not be as effective as in some other settings. Finally the quote itself is troubling because it does not indicate what fractured bedrock environments are being compared to. Reading the quote with in context preserves the broad conclusion that MNA can be effective in bedrock settings, just not as effective as it might be in some other settings. This is true of any possible remedial action; they all have attributes that make them better for some applications than in others, but they are not dismissed until all of the site-specific conditions (physical, chemical, and administrative) have been accounted for in relation to other available options.	Document has been revised to provide clarification.
51	5	5.1.3	Deleted	Establishing a reasonable timeframe for the MNA remedy should primarily be based on demonstrating that MNA is occurring and that it is protective. Noting what the various states consider to be reasonable is not relevant and given the disparity between them (range is from 5 to 30 years), may be confusing.	See response to comment 48.

52	5	5.1.3	Deleted	In the first paragraph after the bullets, it is stated: "In order to compare projected remedial timeframes, an estimate of remediation timeframes for feasible alternatives will need to be determined." We suggest changing "will need to" to "should".	See response to comment 48.
53	5	5.1.3	Deleted	"reasonable timeframe" is extremely subjective - document cites timeframes for states with vastly different hydrogeologic conditions (i.e., Florida)	See response to comment 48.
54	5	5.1.3	Deleted	Third bullet item states that the MNA remedy will "Not be excessive when compared to active remedial alternatives timeframes." Was the intent to leave the word "excessive" undefined or does it literally mean not exceeding the timeframe of other remedial alternatives? If the latter was meant, this should be stated for clarity.	See response to comment 48.
55	5	5.1.3	Deleted	It is stated that each remedy alternative is evaluated per NJAC 7:26E-5.1 in which timeframe is one component of the remedy comparisons. Note that NJAC 7:26E-5.1 does not mention timeframes.	See response to comment 48.
56	5	5.1.3	Deleted	How is the decision of "excessive when compared to active remedial alternatives timeframes" determined? While a reasonable timeframe is site-specific (as stated) and should include protectiveness throughout the duration and able to meet objectives as threshold criteria (1st 2 bullets), the "excessive" component (3rd bullet) is really applicable to any of the alternatives to be compared and is therefore a balancing criteria. If NJAC 7:26E-5.1 covers timeframe in the comparison of alternatives, and defines "excessive", then reference that guidance for this balancing criteria.	See response to comment 48.
57	5	5.2	4.2	To preclude the use of MNA based solely on the perception of a complex geologic system is unreasonable. In addition, the wording “complex systems such as but not limited to fractured bedrock or karst formations…” requires further clarification. Just because a site may have a complex geologic system should not preclude MNA from being evaluated as a valid remedial measure if it can be demonstrated as such. Rather, it would be more appropriate for the LSRP of record to be allowed to evaluate the geologic/hydrogeologic system and determine if the system precludes the use of MNA. This discussion most be re-cast to provide guidance on developing appropriate sampling plans and monitoring schemes, instead of discouraging the application.	See response to Comment 50
58	5	5.2	4.2	In the paragraph on Effective Monitoring Precluded, the wording does not seem to allow for cases where MNA is appropriate in fractured bedrock and karst formations. There have been cases where bioremediation of fractured bedrock has been successful and where MNA is appropriate. We suggest rewording "fractured bedrock or karst formations present a complicated setting" to "fractured bedrock or karst formations can present a complicated setting", and "This complicates adequate monitoring of a natural attenuation remedy" to "In some cases, this complicates adequate monitoring of a natural attenuation remedy".	See response to Comment 50
59	5	5.2	4.2	An introductory statement should be added saying that these are not absolute prohibitions, but rather cautionary statements, and that MNA may be an appropriate component of the overall site remedial action. For example, fractured bedrock should not be definitively precluded from MNA	See response to Comment 50

60	6	5.2	4.2	This subsection discusses conditions that preclude the application of MNA as a sole remedy for groundwater contamination. Under the "Presence of Free and/or Residual Product:" category, the conditions should account for situations where the RP has met the conditions of NJAC 7:26E-6.1(d), "Free and/or residual product...shall be treated or removed when practicable, or contained when treatment of removal are not practicable." Recommend the second to last sentence in this paragraph be modified to read as follows: "However, MNA may be considered as a potential remedy where it can be demonstrated that residual, immobile LNAPL is not a source of increasing dissolved contamination or where the LNAPL has been treated or removed when practicable, or contained when treatment or removal are not practicable." It seems that if the RP has met the condition of NJAC 7:26E-6.1(d), which could include containment, then they should at least be able to consider the use of MNA in the context of all of the other requirements of the MNA guidance. This is consistent with the existing language in the Tech Rules (7:26E-6.3(d)2. (Rule expiration date May 7, 2012).	See response to Comment 44 and LNAPL Guidance document
61	6	5.2	4.2	The rationale behind the NJ guideline that requires LNAPL and residual hydrocarbon be removed at ALL sites prior to implementing NA is not clear. While there are cases where LNAPL sources should be addressed, a strong case can be made to leave source zone hydrocarbons including LNAPL in place under many circumstances based on the following: 1) Natural attenuation driven primarily by biodegradation results in hydrocarbon plume stability over short paths relative to more recalcitrant contaminants such as some chlorinated solvents, MTBE, and non biodegradable inorganics. BTEX plumes including at sites where source zone hydrocarbons are left in place, rarely reach lengths common to chlorinated solvent plumes. The vast majority of BTEX plumes originating from fuel spills are less than 250 feet long and stable (Parsons, 1999; reference below). 2) Recent information from the Bemide, MN USGS long-term research site clearly indicates significant biodegradation of residual hydrocarbons within the source zone over the 25 year period that the oil was spilled (Essaid, 2009; Complete reference listed in Comment 34). This attests to the potential of biodegradation in source zones over relatively short periods of time. Biodegradation and dissolution resulted in the preferential loss of smaller more water soluble hydrocarbons and n-alkanes in the source zone. Remaining source zone hydrocarbon will thus become enriched with less water soluble and less mobile hydrocarbons. An example of this process includes the formation of heavily biodegraded, highly viscous, and nearly immobile crude oils within oil reservoirs. 3) Hydrocarbon vapors are typically biodegraded in the vadose zone over short distances thus minimizing vapor phase health risks (see 2009 ITRC LNAPL document cited in guidance document). Parsons. 1999. Natural attenuation of fuel hydrocarbons. Performance and cost results form multiple Air Force demonstration sites. AFCEE.	See response to Comment 44 and LNAPL Guidance document. Please also be advised that the requirement is a regulation from the Technical Requirements and not a guideline. For clarity, the specific reference has been added to the document per response to Comment 68.
62	6	5.2	4.2	incorrect reference to 5.2.2, should be 5.1.2; unclear what reference to 7.4 is	Reference has been corrected.
63	6	5.2	4.2	Under "Effective Monitoring Precluded", the reader is directed to "See Section 5.2.2 and 7.4 for more information", presumably on natural attenuation in fractured bedrock. There is no Section 5.2.2 and Section 7.4 consists of three sentences on obtaining a variance for sites with historic discharges where ground water concentrations have reached asymptotic levels. Please provide the appropriate references.	References have been removed.

64	6	5.2	4.2	Regarding conditions that preclude the application of MNA as a sole remedy for ground water contamination: "Receptors Impacted: Contamination has impacted human and/or ecological receptors (e.g., potable wells, wellhead protection areas, surface water, vapor intrusion to indoor air, utilities). We disagree with the inclusion of "wellhead protection areas" and ask that this be deleted. The location of a plume within a mapped well head protection area (WHPA) does not mean that a receptor is impacted. There are many examples of CEAs established within a mapped WHPA in New Jersey. Many PCWS are no longer pumping or are abandoned and sealed, but are still mapped on the Department's website as WHPAs. WHPAs in New Jersey are mapped areas calculated around a Public Community Water Supply (PCWS) well that delineate the horizontal extent of ground water captured by a well pumping at a specific rate over a two-, five-, and twelve-year period of time for confined wells. The two-, five-, and twelve-year tiers have different bases. The outermost 12-year travel time boundary is based on a 1991 preliminary study in seven counties that found travel times between 10 and 15 years encompassed the full length of most plumes. The five year boundary is in part based on NJDEP reaction time to a discharge and the two year is based on the transport of bacteria in aquifers. Therefore just because contamination is identified within one of these mapped boundaries doesn't mean a receptor is impacted or in imminent danger of being impacted. In many cases, the PCWS wells draw from deep confined aquifers and are not at risk from some water table plumes. Including the entire WHPA, i.e. out to the 12-year boundary, is also inconsistent with receptor evaluation regulations, which state that one only has to determine if the ground water contamination is located within a Tier 1 or a Tier 2 area, not the outermost Tier 3.	The document has been revised to clarify this issue.
65	6	5.2	4.2	Regarding "Imminent Threat to Receptors"; If there is a imminent treat, how does calibrating a model meet one of site-specific objectives or remedial goal. It is not clear what portion of Section 8 discusses in further detail the travel time to receptors.	Document has been revised to clarify this issue.
66	6	5.2	4.2	Under the heading "Presence of Free and/or Residual Product" the term "immobile LNAPL" is used. This term means different things to different people. To reduce the potential for misinterpretation, this term should be defined in this section and also added to the list of definitions.	Please refer to N.J.A.C. 7:26E and LNAPL Technical Guidance Document.

67	6	5.2	4.2	This is referenced in 5.2 "Conditions that Preclude MNA as a Sole Ground Water Remedy" and this section refers to "residual, immobile LNAPL" The NJDEP LNAPL Guidance does define "residual phase product" which is consistent with 7:26E-1.8 and I recommend that this is the term that should be used in the MNA document. I also noticed that for an IRM, the LNAPL Guidance only allows an IRM for "monitoring only" when there is high viscosity LNAPL, poor LNAPL mass recovery and low levels of dissolved phase contamination. Since natural attenuation of free and residual product is not allowed, the LNAPL Guidance does not reference the ITRC "Natural Source Zone Depletion of LNAPL" Guidance document nor does it accept NSZD as an acceptable remedy from the list of LNAPL remedial technologies in the ITRC document "Evaluating LNAPL Remedial Technologies for Achieving Project Goals". The way the MNA document reads, it allows NSZD when residual LNAPL is not a source of "increasing dissolved contamination" (and at what levels???). The way this is written, a site could have blown out levels of VOAs, but as long as the levels are not increasing , it is okay to use natural source zone depletion. This is inconsistent with 7:26E-6.1(d) and should be revised. MNA for LNAPL should only be allowed when a technical determination has been made that it is impracticable to remediate the LNAPL using hydraulic (pumping) or phase change technologies (or excavation too).	See response to Comment 44
68	6	5.2	4.2	Two comments. The first one is easy. Can we use the specific reference, N.J.A.C. 7:26E-6.1(d), for the Tech Rules? The specific citation is: N.J.A.C. 7:26E-6.1(d) "…Natural remediation of free and/or residual product will not be allowed". The second highlighted section is my bigger concern. "However, MNA may be considered as a potential remedy where it can be demonstrated that residual, immobile LNAPL is not a source of increasing dissolved contamination in ground water." This sentence reads more like policy than guidance. It also doesn't jibe with the intent of the tech rules in 7:26E-6.1(d), 7:26E-6.3(d)1 and 7:26E-6.3(d)2. N.J.A.C. 7:26E-6.3(d) 1. "Ground water contaminant concentrations will decrease to applicable remediation standards…" N.J.A.C. 7:26E-6.3(d)2. Free and/or residual product in the unsaturated and saturated zones, as determined pursuant to N.J.A.C. 7:26E-2.1(a)14, is treated or removed, if practicable, or contained if treatment or removal are not practicable. The big concern is that areas of free and residual product are often static plumes where concentrations are neither decreasing nor increasing. The only plumes that are likely to show increasing trends are fresh spills that have not achieved equilibrium. So while a static plume can show that natural attenuation is occurring it also shows that source material is present. Source material must be remediated and MNA is specifically prohibited. The intent is to have improving ground water quality. That is the "restore and enhance" component of the clean water act. My recommendation is to end this section after the first sentence.	The document will be revised to include the reference, NJAC 7:26E-6.1(d). See also response to Comment 44

69	6	5.2	4.2	As presented, this statement will also lead to confusion and misunderstanding between NJDEP and the regulated community. The terms "free" and "residual" require definition. "Free" product is not necessarily "mobile" product, even at apparent thicknesses of several inches measured in monitoring wells. Recognized methods exist for establishing LNAPL mobility which should be brought into the context of the above paragraph. "Free" product that is not "mobile," and in this context "residual" product will contribute contaminant mass to groundwater at a rate that is quantifiable, and a regulatory mechanism should be explicitly made available to allow the demonstration that even with the presence of "residual" product, groundwater plumes can remain stable, and MNA under such conditions once demonstrated may be appropriate and is permissible. In other words, a plume, with "residual" mass in vadose soils above it, can still naturally attenuate within a "reasonable" timeframe (e.g., 10 to 30 years), and the regulated community should not be precluded from selecting MNA just because there is "residual" or "source" mass in vadose soils. The Guidance needs to be more explicit and less rigid. As currently written, the text forces the remediator (LSRP) to conclude that even if a miniscule amount of TCE or similar residual product in soils that could act as a source, therefore that miniscule amount must be remediated before one can propose MNA for groundwater." Soil and groundwater are one system that can naturally attenuate together; they should not be forced to be dealt with separately in this circumstance.	See response to comments 10 and 44, and the Department's Soil Remediation Standards and associated guidance.
70	6	5.2	4.2	The first paragraph on this page references Sections 5.2.2 & 7.4. Note that there is no Section 5.2.2 in this document.	See response to Comment 63.
71	6	5.2	4.2	The statement regarding NZSD appears here. Perhaps the last two sentences here need to be also included in Section 5.1.1 (comment #16) to make the two sections of the document consistent and reaffirming.	See response to Comment 44
72	6	6	5	This preamble to site characterization is focused primarily on how the long-term monitoring program will be established. Suggest it also discuss that site characterization needs to be done properly for determining the applicability of MNA to the site in the first place.	The preamble has been revised to include a reference to the Department's SI/RI/RA Ground Water Technical Guidance Document.
73	6	6	5	Regarding the statement: "Basic aquifer matrix and hydraulic characteristics must be measured or estimated in order to evaluate contaminant transport over time," because this is a guidance document we ask that the word "must" be changed to "should".	Document has been revised.
74	6	6	5	Add to definition that, a CSM should be used to identify the source(s) of contamination, risk to receptors and the migration pathways associated with the media (e.g., soil, groundwater, vapor). Consider adding to this section, "a CSM should be developed at the beginning of a remedial action, and should be revisited frequently when evaluating the effectiveness of an MNA approach". A simple figure illustrating the elements of a CSM should be included in this section. It will clear up the thoughts proposed in this section.	Please refer to the Department's CSM Technical Guidance Document.
75	6	6.1	5.1	The sentence "CSM for sites where MNA is proposed, data should be acquired to characterize site conditions and natural processes that would influence contaminant fate and transport." seems awkward. Consider modifying to "When developing a CSM at sites where MNA is proposed, data should be acquired to characterize site conditions and natural processes that would influence contaminant fate and transport."	Document has been revised to clarify.

76	7	6.1 Organics and Inorganics List	5.1 Organics and Inorganics List	References summarizing the application of these parameters and/or specific cases in which the parameters were used to support MNA should be provided.	The relevance of these parameters to MNA is described in several of the references identified in the guidance document.
77	7	6.1 Organics List	5.1 Organics List	Suggest adding bullets for molecular biological tools and evaluating reactive minerals in aquifer sediments.	Document has been revised to clarify.
78	7	6.1 Inorganics List	5.1 Inorganics List	This bullet list seems to focus solely on sorption or cation exchange for heavy metals or radionuclides. Suggest adding bullets regarding the biodegradation of perchlorate, and the microbial reduction of Cr(VI) and nitrate.	These specific chemical/biological reactions are covered in the list of pertinent data; for example, chemical speciation.
79	7	6.1	5.1	Perhaps covered in the NJDEP CSM Guidance, but there is no mention of understanding background conditions, particularly geochemical parameters in developing a CSM to support MNA	The document has been revised to reference the need to characterize background conditions in the CSM.
80	7	6.1	5.1	In order to include radionuclides, we suggest adding the following bullet to "Inorganics"; ◦ Radioactive decay calculations	Document revised as suggested.
81	7	6.1	5.1	Under the heading of "Organics", the first bullet states "Parameters necessary to document natural attenuation including the effects of sorption, volatilization and biodegradation (e.g. VOCs, Total organic matter)". This bullet seems redundant considering the remaining bullets seem to cover most of the items identified (e.g., COC distribution to evaluate volatilization potential, sorption and biodegradation).	Document has been revised as suggested.
82	7	6.2	5.2	Section "6.2 Hydrogeologic Data Requirements" discusses general hydrogeologic data analysis procedures and should be deleted as these are general practice issues and not specific to MNA.	This section provides more information than available in the Department's SI/RI/RA GW Technical Guidance document. The MNA document development team believes that this information is useful in supporting the suggested technical methods outlined in the document (e.g., analytical and numerical modeling). In recognition that the level of detail provided in this section may be excessive for the document text, it has been moved into an appendix in the final document (Appendix D).
83	7	6.2.1	App D	While the need to provide complete guidance on characterization is helpful, calculating the site hydraulic gradient is not specific to MNA. If this is covered in NJDEP CSM Guidance (as referenced in Section 6.1), does this need to be also written here? Has this text been reconciled with that guidance? Which supersedes if there are differences?	See response to comment 82.
84	7	6.2.1	App D	reference to "same caveats as described earlier":; however, there were no caveats described earlier	The caveats are included in Section 6.1.2.1 (Spatial Analysis). The document has been revised to include the correct reference.
85	7	6.2	5.2	As this is a guidance document, we recommend removing the word “Requirements” from the title of this section – i.e. “6.2 Hydrogeologic Data Requirements"	Document has been revised.
86	7	6.2.1	App D	The statement "The calculation of site specific hydraulic gradient (change in hydraulic head elevation with change in distance) is fundamental to understanding the orientation and velocity of ground water flow." may be overstating the importance of horizontal gradient. We recommend that the guidance qualify this by also stating that "In the case of aquitards, vertical flow often dominates and therefore vertical gradients and head distribution is most important to understand."	Document has been revised.

87	7	6.2.1	App D	Regarding the statement: "The horizontal head distribution must be mapped separately within discrete monitoring zones (e.g., overburden and bedrock, confined and unconfined aquifers)." Because this is a guidance document we ask that the word "must" be changed to "should", as it is used in the sentence that follows: "Vertical gradients should be determined where monitoring clusters have been installed;".	Document has been revised.
88	7	6.2.1	App D	See http://www.epa.gov/athens/learn2model/part-two/onsite/vgradient02.html for the EPA vertical gradient calculator.	Reference and concept has been added.
89	7	6.2.2	App D	same as comment #21 but for hydraulic conductivity; not specific to MNA	See response to comment 82.
90	8	6.2.2	App D	We recommend removing the parenthetical statement “(for example, using both slug insertion and slug extraction methods)”. Time vs. drawdown data obtained during slug insertion are not appropriate for use in estimating hydraulic conductivity in wells that are screened across the water table.	Document has been revised.
91	8	6.2.2	App D	Regarding "Midwest Geosciences Group (www.midwestgeo.com) provides educational materials to improve the performance of slug testing and the accuracy of the derived data.", we suggest modifying the language to "free educational materials" to avoid endorsing a private for profit company.	A statement regarding references to specific products or providers has been added to the guidance document.
92	8	6.2.2	App D	First line - It is stated "...slug test data is…" Since "data" is plural, this should be "...slug test data are..."	Document has been revised as suggested.
93	8	6.2.2	App D	With regard to ensuring that slug testing is comprehensive (first paragraph), such testing should be conducted in multiple wells.	Document has been revised as suggested.
94	8	6.2.3	App D	same as comment #21 but for porosity; not specific to MNA	See response to comment 82.
95	8	6.2.4	App D	The last paragraph begins "Extensive data is…" Since "data" is plural, this should be "Extensive data are…"	Document has been revised as suggested.
96	8	6.2.4	App D	While soil organic content in itself is not necessarily specific to MNA, the information in this section does include guidance regarding default values, values specific to soils of the State, and relevant references to find values. This is in contrast to the other subsections of 6.2 that are much more general.	In this case, the guidance document team identified New Jersey specific data; it was included to allow for easy reference.
97	9	6.2.4	App D	We find the following statement on organic carbon very misleading: "These data generally support a decrease in foc with depth." This may be true for the referenced shallow soil study but does not hold true for deeper, and more relevant, aquifer materials in New Jersey. For example, if one vertically profiled foc in Woodbury NJ you would find strongly increasing foc with depth as you sampled deeper into the Woodbury formation. The presentation of foc findings in surface soils does not seem to be relevant to fate and transport in aquifer materials.	The document has been revised.
98	9	6.3	5.3	Section "6.3 Contaminant Spatial and Temporal Distribution" is better suited for an appendix as it is a highly technical discussion of methods and procedures. While it is valuable information and considerable effort was expended compiling this information, none the less, it is more appropriate for a technical manual rather than a guidance document. The guidance should be revised to identify the kinds of issues and variables that the investigator should consider in evaluating the application of MNA.	This is a technical guidance document, and the guidance document team determined that incorporation of these methods and procedures in the document text was directly relevant and important for the appropriate evaluation of MNA.

99	9	6.3	5.3	The guidance conveys an expectation for detailed analysis of spatial and temporal groundwater variability that is excessive for some sites and may not be required to demonstrate MNA in accordance with Section 7 of the guidance. While the issues conveyed should appropriately be considered, the guidance provides the strong impression that eight quarters of monitoring and 4 successive quarters are minimum expectations to utilize MNA as a component of a remedy. For many VOCs that have been demonstrated to readily degrade, this type of analysis may not be necessary - particularly with the LTM provisions outlined later in the guidance. The guidance should be revised to allow for greater use of professional judgment in the application of MNA and in the LTM sampling frequency with the understanding that any remedy must still be protective. The requirements as written will increase the cost of remediation and may delay implementation of some remedies pending completion of the MNA assessment.	The only portion of this guidance document that is prescriptive is the need for 8 rounds of groundwater sampling to evaluate the applicability of MNA as a remedy (N.J.A.C. 7:26E-6.3(e)1i currently requires 8 consecutive quarters). The collection of a minimum of eight rounds of sampling data (with four being consecutive quarters) is recommended to provide data necessary for not only characterizing plume stability and distribution, but also to support statistical/graphical methods for demonstrating decreasing trends. Beyond that, as noted in several places within the document, the investigator may deviate from the recommendations of the guidance document with proper rationale. As noted, the investigator can utilize historic data (which may not necessarily reflect "quarterly" rounds), as appropriate, as part of the recommended eight "rounds" of sampling.
100	9	6.3	5.3	Because this is guidance, we suggest the following rewording in the second paragraph of this subsection: change "monitoring of these parameters will be necessary to determine the short-term variation" to "monitoring of these parameters should be performed to determine the short-term variation."	Document has been revised as suggested.
101	9 to 12	6.3	5.3	Each of the subsections in 6.3 are not necessarily specific to MNA; is this covered in other guidance already issued by the State? Reconciled; supersedence?	Section 6.3 describes the significance of understanding contaminant spatial and temporal distribution with respect to developing and implementing a MNA remedy.
102	9	6.3.1	5.3.1	Last paragraph - "…the scenarios described above generally do not apply to downgradient monitoring wells." This statement requires clarification. This can be interpreted to mean that changes in water table elevations will not impact downgradient monitoring wells because there is typically no source material in the vadose zone. However, fluctuations in concentrations in the source area will migrate downgradient. It should be pointed out that the travel time between the source and downgradient monitoring wells must be accounted for when interpreting seasonal variations.	As noted in the heading of the table, the evaluation of seasonal conditions should be performed using source zone wells. The subject sentence was intended to highlight the fact that variations in downgradient monitoring wells may not be readily evident, and that it is more efficient to evaluate seasonal fluctuations in source zone wells. The document has been revised to clarify this point.
103	9	6.3.1	5.3.1	Complete the reference "Additional information concerning timing of quarterly sampling may be found in…..Ref Wiedemeier, Haas, Barden, Dickson)."	The reference has been corrected.
104	9	6.3.1	5.3.1	Wiedemeier et al reference needs citation year (2005).	The reference has been corrected.
105	10	6.3.1	5.3.1	In the table, suggest changing "Release of entrained LNAPL (with observed sheen or floating product" to "Wetting of unsaturated matrix with residual source" to apply to more source types.	The document has been revised to incorporate this suggestion.
106	10	6.3.1	5.3.1	First paragraph - It is stated that seasonal concentration variation in downgradient wells may be the result of shifts in orientation of ground water flow due to seasonal variations in recharge, coupled with aquifer heterogeneity & anisotropy. Note that such shifts in ground water flow direction may also be the result of seasonal aquifer pumping (e.g., irrigation, additional supply, etc.).	Document has been revised to provide clarification.

107	10	6.3.2	5.3.2	First paragraph. Anisotropy is a fixed aquifer characteristic. While anisotropy may cause a plume to change flow direction, it should not cause the direction of flow to change "over time." Suggest segregating the discussion to clarify that anisotropy may cause a plume to migrate in a direction that varies from that inferred by the hydraulic gradient, and then describe how seasonal variations or other hydraulic perturbations (e.g., periods of drought or man-made changes) can cause the direction of ground water flow to vary "over time."	This sentence has been revised.
108	10	6.3.2	5.3.2	End of first paragraph. "Pumping tests or other hydrologic testing methods may be used to evaluate anisotropy." This statement requires clarification, suggest adding some references regarding these methods.	A reference to an ASTM method for evaluating anisotropy has been added.
109	10	6.3.2	5.3.2	At the end of the second paragraph of this section, suggest adding a statement that a simpler well network may be all that is required at some sites, as stated later at the end of the first paragraph of section 7.1.	This sentence has been revised.
110	10	6.3.2	5.3.2	Regarding the statement in the last paragraph: "This requires an understanding of the three-dimensional relationship between contaminants and stratigraphy to ensure that monitoring wells are screened in the appropriate hydrogeologic unit, and that they are in the path of contaminated ground water flow." Because one needs wells that are not "in the path of contaminated ground water flow" to define a plume, we suggest clarifying "and that they" with "and that plume performance wells."	This sentence has been revised.
111	10	6.3.2	5.3.2	Last paragraph - It is stated "In many cases, field screening tools (e.g., membrane interface probe) or vertical profiling with a hydropunch (e.g., Waterloo sampler)…" Note that Hydropunch is a brand name. Use of a generic term like "direct-push sampling" is recommended.	This sentence has been revised; also, see response to Comment 91.
112	11	6.3.2	5.3.2	Second to last paragraph of Section 6.3.2. This would be a good location to reference USEPA TRIAD approach guidance documents on rapid and flexible site investigations using dynamic work plans.	The document has been revised as suggested.
113	11	6.3.2	5.3.2	"vertical intervals as small as one foot" is overly conservative	It is not uncommon for discrete lenses to retain and/or convey significant contamination within a larger water-bearing unit, and this phenomenon should be considered as part of the CSM and MNA remedial design. The discussion of this concept has been revised.
114	11	6.3.3	5.3.3	Last paragraph - See NJAC 7:26E-3.7(e)3iii regarding the requirements for determining tidal influences.	The reference has been added.
115	12	6.3.3	5.3.3	A portion of the last sentence of the second paragraph that reads, "Additionally, the effects of perturbations were generally more appropriately characterized when the spatial location of monitoring points was increased rather than the frequency of monitoring increased" is confusing. What is mean by "...spatial location of the monitoring points was increased..."? Does this mean more wells or fewer wells? If the spatial location is increased I take this to mean more distance between them, but is this really what was meant? Clarify for the reader.	The document has been revised to clarify this issue.
116	12	6.3.3	5.3.3	The last paragraph of this section mentions the term "signal variability". That is not a commonly used term and probably should be better defined to reduced confusion.	It is agreed that this term may be confusing and it has been removed.

117	8, 10 & 11	6.2.3 & 6.3.2	5.2.3 & 5.3.2	More emphasis, in either or both of these subsections, on the importance of high porosity but low hydraulic conductivity layers or lenses within the plume (that become contaminated by diffusion as a plume migrates through higher permeability zones that they are in contact with), might enhance the document. As discussed in a presentation by Tom Sale (attached to email used to send these comments) low permeability layers or lenses may hold a significant mass of contaminants even though they don't horizontally transmit a significant amount of flow. After concentrations decrease in higher permeability zones, the low flow zones can act as a secondary source area and potentially prolong the timeframe for natural attenuation, especially if degradation processes are more effective in the zones with higher flow rates. Although the T. Sale presentation is more relevant to active remediation technologies, many of the slides, especially 15, 32-35 & 37, seem to have important implications for site characterization, natural remediation timeframes, effective monitoring design and possibly the accuracy of mass flux/discharge estimates.	A discussion of this process has been added to the document. See also the Department's SI/RI/RA Ground Water Guidance Document.
118	12	7	6	Section "7 LINES OF EVIDENCE" is a detailed technical discussion of methods and procedures that is best suited for a technical appendix or a standalone technical manual, but not for a guidance document. The guidance should identify the types of information that is needed and the decisions that the investigator must make.	This is a technical guidance document, and the document development team determined that incorporation of these methods and procedures in the document text was directly relevant and important for the appropriate evaluation of MNA.
119	12	7	6	On the last sentence, we suggest adding "where appropriate" to the end since microbiological and isotopic studies are not applicable to all MNA processes.	This edit is not necessary, since the referenced sentence begins with the phrase "In some cases...".
120	12	7.1	6.1	Indicate the rationale behind upgradient monitoring wells including establishing the geochemical conditions including the electron-acceptor status of non-impacted water.	Data from upgradient or non-impacted wells provides the baseline conditions existing within the aquifer under natural (non-impacted conditions). This information would be necessary where an investigator is determining whether naturally occurring aquifer conditions can support MNA of the compounds being investigated at their existing concentration levels. Geochemical data from both within and outside the contaminant plume are typically required to allow for an assessment of the limits of the various degradation processes, and allow for predictive modeling where appropriate given site conditions/complexity.
121	13	7.1	6.1	Last paragraph Section 7.1. "A minimum of eight rounds will typically be needed.." Suggest adding that eight rounds of data are typically required to apply the statistical tools described in Section 7.1.2.	The document has been revised as suggested.
122	13	7.1	6.1	incorrect reference to 6.2, should be 6.3	Document has been corrected (Section 5.3).

123	13	7.1.1	6.1.1	The discussion on plume behavior verges on being over simplified. Suggest adding a discussion on variations to the plume behavior scenarios to include evaluations of changes in the centroid of mass of a plume (for example using the MAROS tool) and taking into account source reduction measures.	The level of detail and provision of examples was considered during the preparation of the draft document. Since there are numerous permutations and scenarios available, it would not be possible to include all of them. Rather it was determined that an appropriate strategy would be to provide a framework for the complex subject of plume behavior along with some simple examples. The investigator should proceed with their own in-depth review and research commensurate with their site-specific conditions. The MAROS tool is specifically referenced within the document (6.1.3); additional information and a link to the MAROS software is provided in Appendix E.
124	13	7.1.1	6.1.1	Regarding the use of sentinel wells, the guidance should include language to take into consideration highly industrialized areas where you might not have a sentinel well with a concentration below the ground water quality standard - for example due to multiple commingled on and off-site plumes or other site/regional conditions. At a minimum the guidance should acknowledge that this might be a potential scenario but should not preclude the consideration of MNA at the site.	This condition is noted in Section 6.1. Note that details regarding sentinel well placement and associated modifications/detailed scenarios are a component of the Department's SI/RI/RA Groundwater Technical Guidance Document.
125	14	7.1.1	6.1.1	First bullet paragraph - Reference is made to the "aerial extent of the plume". Note that this should be "areal", not "aerial".	Document has been corrected.
126	14	7.1.2.1	6.1.2.1	Regarding the statement: "When such software is used, it is important to recognize that site hydrology and hydrogeology must be accommodated", because this is a guidance document we ask that the word "must" be changed to "should".	The document has been revised as suggested.
127	14	7.1.2.1	6.1.2.1	Regarding the statement: "When such software is used, it is important to recognize that site hydrology and hydrogeology must be accommodated; for example contouring cannot occur across surface water features, and discrete vertical monitoring zones must be mapped separately." Contouring can be valid across surface water features for confined aquifers, therefore we suggest that this sentence be clarified by changing "contouring cannot occur" to "contouring of water table conditions cannot occur."	The document has been revised as suggested.
128	15/16	7.1.2.2	6.1.2.2	See http://www.epa.gov/nrmrl/pubs/540s02500/540S02500.pdf for EPA document on calculation of first-order rate constants.	The reference has been added.
129	17	7.1.3	6.1.3	Under "Regression analysis:..." It is unclear why there is a discussion of linear regression when it is discounted as a method as it can not "account for contaminant decay processes..." half way through the paragraph. The paragraph should be re-written to focus the discussion on exponential regression if that is truly the method that the guidance would like to put forward as a viable option.	Linear regression is appropriate for the evaluation of degradation processes that do not exhibit first order (exponential) decay; for example advection, dispersion, precipitation, sorption, etc.
130	17	7.1.3	6.1.3	Under "Regression analysis:...", 2nd paragraph, in the last sentence that begins "The EPA 2009 guidance document…" change " a minimum of 8 to 10 measurements is" to "a minimum of 8 to 10 measurements are…"	The document has been revised as suggested.
131	17	7.1.3	6.1.3	Under "Regression analysis:...", 3rd paragraph, second to last sentence that begins "Qualifications for exponential regression…" change the word "must" to "should"	The document has been revised.
132	17	7.1.3	6.1.3	See http://www.epa.gov/nrmrl/pubs/540s02500/540S02500.pdf for EPA document on calculation of first-order rate constants.	See response to comment 128

133	18	7.1.3	6.1.3	Under "Mann-Whitney U:", 1st sentence, toward end of sentence "...approximately 0.5, them it is likely..." should be "...approximately 0.5, then it is likely..."	The document has been revised.
134	18	7.1.3 Regressio n Analysis	6.1.3 Regressio n Analysis	Partial paragraph starting at sentence beginning with "R^2 ranges from -1 to +1." et seq. The paragraph is inadvertently referencing the correlation coefficient, R, not the square of the correlation coefficient, R^2.	The document has been revised.
135	18	7.1.3 Mann-Kendall	6.1.3 Mann-Kendall	It should be made clear that using M-K alone and finding "no-trend" is not the same as saying the plume is stable. The null hypothesis of M-K is that the data do not exhibit a trend. It is only when the absolute value of the calculated S statistic is greater than the critical comparator, Smax, that the null hypothesis is rejected. Otherwise the null hypothesis is retained. Therefore "no-trend" simply means it is not statistically possible to show that the data have a significant up or down trend. As stated in Wisconsin DNR guidance: "A 'no trend' result does not equate to a stable plume. The 'no-trend' result simply means that the M-K test could not discern either an up or a down trend for the given set of data, and in fact a 'decreasing' or 'increasing' result from the M-K test is a more robust conclusion than the 'no trend' result." DNR goes on to say, however, that a calculation of coefficient of variation can be used to assess scatter in the data, such that if the calculated CV is equal to or less than unity the M-K "no–trend" result can be used to support a stable plume hypothesis.	Document has been revised.
136	18	7.1.3	6.1.3	Top of the page: r vs. R for the correlation coefficient.	Document has been revised.
137	19	7.1.3	6.1.3	Under "Non-Detect (ND) Results:", 2nd sentence, change "…the investigator must identify…" to "the investigator should identify…"	Document has been revised as suggested.
138	19	7.1.3	6.1.3	Regarding the statement: "Prior to initiating any trend test on data, the investigator must identify how ND values are to be processed,", because this is a guidance document we ask that the word "must" be changed to "should".	Document has been revised as suggested.
139	19	7.1.3	6.1.3	Mann-Whitney U test (top of the page): "This test was previously required within New Jersey technical regulations…" As the sentence reads, one cannot determine if this is still required (and this guidance is restating that requirement) or has been changed (to allow use of the modified Mann-Whitney test)?	Document has been revised to clarify this issue.
140	19	7.1.3	6.1.3	Non-Detect (ND) Results. This discussion should probably come ahead of the various statistical methods for which these ND values are handled differently.	The guidance document team felt that this discussion was secondary to the primary discussion of statistical methods, so did not alter the text.
141	19	7.1.4	6.1.4	The discussion of mass flux and mass discharge is less about the line of evidence of MNA and more about the characterization of the site. It even states that the primary "benefit is prioritizing treatment zones or remedial action across many sites." MNA is just an option of the prioritization at this stage. Suggest moving this section into Section 6	The Department recognizes that mass flux and mass discharge can be used for both characterization and demonstrating the applicability of MNA.
142	20	7.1.5	6.1.5	Add a section that speaks to reduction in Plume Toxicity (Toxicity Equivalent) as a line of evidence. Toxicity equivalent is a useful metric to assess whether or not remedial objectives are being met and the change in risk to receptors. Understanding this metric allows the reduction in the overall toxicity of the site to be quantified over time as the mix in VOCs change.	Ultimately, GWQS must be achieved, and it is unclear whether this approach would meet that objective. Plume analyses that involve evaluation of changes in contaminant mass, mass discharge/mass flux, and documentation of degradation indicator parameters represent the primary means of describing natural attenuation processes.

143	20	7.2	6.2	Suggest splitting this table into 3 sections (organics, chlorinated solvents, and inorganics) or creating 3 tables. Splitting the text into these sections should also be considered. This would allow for the inclusion of additional specific information on how different geochemical conditions influence the NA of different contaminants. Additional information should include: 1) indicate how reducing conditions generally result in decreased mobility of many inorganics, 2) pH has a strong influence on the mobility and solubility of many inorganics, 3) reducing conditions favor the biodegradation of VOC's with an increased degree of halogenation but can decrease the biodegradability of lesser halogenated compounds and some daughter products (VC for example). There is no discussion in the document on how the spatial distribution of redox conditions, TEAP's, and presence of organics (hydrocarbons) influences chlorinated solvent natural biodegradation. This is critical for interpreting the NA of chlorinated solvents and warrants a stand-alone section somewhere in the report (possibly here).	This table has been moved to Section 6.2.1 Organics in the final document. The suggested additions are detailed in the documentation provided in Appendix A. TEAs are discussed in Section 6.2.1.1 in the final document.
144	20	7.2	6.2	Replace the term "substrate" with electron acceptor for sulfate and nitrate within the "data use" column. The term substrate is often used to indicate a source of electron donor.	Document has been revised as suggested.
145	20	7.2	6.2	Perhaps recommended sampling/analytical methods can be provided in the table to measure the various geochemical parameters	Please refer to other Department rules and guidance for analytical test methods. For those methods not specified by existing Department rules or guidance, please refer to USEPA 1998.
146	20	7.2	6.2	In the table located under 7.2 Secondary Line of Evidence - Geochemical Conditions; Nitrate and Sulfate are referred to as "substrates", which they are not. Nitrate and Sulfate are electron acceptors.	See response to comment 144
147	20	7.2	6.2	In the table located under 7.2 Secondary Line of Evidence - Geochemical Conditions; we recommend adding that Conductivity is a surrogate parameter for ionic strength and salt content, important considerations in MNA.	In the final document, conductivity is discussed in Section 6.2.1.2 Degradation By-products and other Indicators.

148	20	7.2.1.1	6.2.1.1	After the table suggest adding text detailing additional information on interpreting TEAP processes and important "lessons learned" on TEAP controls on hydrocarbon biodegradation in contaminated aquifers. Here are examples. TEAP processes are not exclusive due to aquifer heterogeneity. Groundwater samples will often show indications of multiple TEAP processes, and in some cases may be conflicting (e.g., elevated methane with ORP in the iron reducing range). This is usually due to collecting groundwater samples that may represent a number of "micro" climates within the aquifer matrix or due to groundwater mixing. Suggest re-enforcing the concepts of multiple lines of evidence and the potential for a number of processes to be apparent at any given location within an aquifer. For example, methane generated within a source area may migrate for tens to hundreds feet with groundwater flow from the location where it is produced. Other geochemical indicators (ORP, dissolved hydrogen) may be necessary to delineate where methanogenesis is occurring. Another example is that the redox state under which Fe (III) will be utilized varies based on its mineralogy. Some forms of ferric iron will be reduced after sulfate reduction becomes energetically favorable. Third, significant temporal variability in TEAP's attributed to rainfall and increased recharge may result in increased flux of soluble electron acceptors (mainly dissolved sulfate and dissolved oxygen; Van Stempvoort refs below). Recommend indicating that electron acceptor availability is the primary factor governing hydrocarbon biodegradation rates within impacted aquifers and that sulfate availability can play a key roll as indicated by the Van Stempvoort reference (below) and others (http://ipec.utulsa.edu/14.d/14_FinalRev.pdf for example). Another good reference detailing spatial and temporal variability of TEAP's in hydrocarbon contaminated aquifers, and other conditions that influence hydrocarbon NA rates, is provided in the review paper below (Essaid). This reference provides a strong case example illustrating the applications of a variety of data sets and approaches to characterize the NA of hydrocarbon impacted aquifers. Dale R. Van Stempvoort, James Armstrong, Bernhard Mayer. Seasonal Recharge and Replenishment of Sulfate Associated with Biodegradation of a Hydrocarbon Plume. Hedeff I. Essaid, Barbara A. Bekins, William N. Herkelrath, and Geoffrey N. Delin. 2009. Crude Oil at the Bemidji Site: 25 Years of Monitoring, Modeling, and Understanding. Groundwater.	The Department believes the document incorporates many of the concepts articulated in this comment. The cited references are valuable and may be consulted when interpreting the geochemical data.
149	21	7.2.1	6.2.1	Summarize target values in a summary table. More useful than in narrative form, as currently presented.	Values have been added to the table.
150	21	7.2.1.1	6.2.1.1	Recommend a brief section detailing how ethanol effects the fate and transport of hydrocarbons (http://www.epa.gov/oust/altfuels/ethfate.htm).	The Department appreciates this information; however, this scenario does not justify expansion of the guidance document at this time.
151	21	7.2.1.1	6.2.1.1	3 dissolved oxygen readings are collected during sampling events: pre-purge, post-purge and post-sample. The Guidance document should make a statement on the relevance of each reading.	The dissolved oxygen levels used during the evaluation of natural attenuation should be those that are representative of the formation water. Please refer to the Field Sampling Procedures Manual for additional information.
152	21 to 22	7.2.1.1	6.2.1.1	For consistency, if including a discussion specific to BTEX under each of the TEAs, suggest also doing the same for chlorinated compounds which is only discussed in some. If the TEA has no relevance to degrading the COC, then state that. State them as examples. Using TEAs as a secondary line of evidence should also include a statement of comparison to background conditions.	The document has been revised.

153	21	7.2.1.1	6.2.1.1	Table in Section 7.2 lists Mn, but it is not mentioned in the text of TEAs	For consistency, Mn has been removed from the table.
154	21	7.2.1.1	6.2.1.1	Perhaps more of a comment about writing style but, under the Dissolved Oxygen section, needs revision to focus on aerobic conditions (title of the section). Example: instead of stating that reductive dechlorination can occur when DO isn't there (< 0.5 mg/L), state that reductive dechlorination cannot occur in aerobic conditions (DO >0.5 mg/L).	The document has been revised.
155	22	7.2.1.2	6.2.1.2	Second paragraph on ORP. Please clarify that the redox range cited (and usually used in the literature) applies to ORP relative to a standard hydrogen electrode (Eh), while field measurements are usually measured against a silver/silver chloride electrode. Therefore, field measurements must be corrected (often a 200 mV difference) before comparing field measurements against literature values relative to Eh.	The comment is appreciated, but is beyond the scope of the guidance document.
156	22	7.2.1.2	6.2.1.2	Last paragraph on Chloride. The suggestion that chloride concentrations can be used to infer that dechlorination is occurring should be qualified. Natural concentrations of chloride are usually in the milligrams per liter range while chlorinated compounds are often in the micrograms per liter range. Only when concentrations of chlorinated solvents start to approach that of natural chloride could you expect to observe a measurable difference between the plume and background conditions.	As noted elsewhere in the document, the investigator must consider background conditions during development of their conceptual site model, including the presence of elevated background levels of chloride. The document has been revised to note that chloride is of potential value in this regard only when source concentrations of constituents are in the ppm range.
157	22	7.2.1.2	6.2.1.2	The metabolic activity of microorganisms can result in a measurable increase is temperature that can be used to demonstrate biodegradation and in some cases may be used to estimate rates,	References for the accurate measurement of temperature changes due to metabolic activity would be needed in order to include helpful guidance in the document.
158	22	7.2.1.2	6.2.1.2	Is there a reference to support the statement of the use of chloride to estimate biodegradation rates?	EPA (1998); see also response to comment 156.
159	22	7.2.1.3	6.2.1.3	We note that the entire Section 7.2 Organics is about biodegradation of organics. Some organics can naturally degrade to daughters without biodegradation. For example, 1,1,1-TCA degrades abiotically by hydrolysis as soon as it enters water to 1,1-DCE, its primary daughter product. The rate of this degradation is not dependent on microbial activity. This parent/daughter pair is common in groundwater remediations. We recommend that a paragraph on abiotic degradation be added to subsection 7.2.1.3 Daughter Products.	The document has been revised as suggested.
160	22	7.2.1.3	6.2.1.3	Suggest removing the "sequential reductive dechlorination (...)" statement in the first sentence; other reactions beside reductive dechlorination can result in measurable daughter products. Perhaps use reductive dechlorination as an example in this section.	The document has been revised as suggested.
161	22	7.2.2	6.2.2	Suggest removing the phrase "like organic compounds" from the sentence "Metals and radionuclides are not destroyed like organic compounds during attenuation." Some MNA processes do not destroy organic contaminants.	The document has been revised as suggested.

162	22-24	7.2.2	6.2.2	Table(s) are suggested to help link information to specific inorganic contaminants. The table would include: 1) listing of inorganic contaminants, 2) the primary biogeochemical natural attenuation mechanisms for each (such as direct microbial reduction including for perchlorate, precipitation of many metals with hydrogen sulfide forming nearly insoluble metal sulfides, precipitation upon chemical or microbial reduction for chromium VI, uranium, and technetium etc.) with key associated references, 3) key NA measurements/data, and 4) case study references. In regard to 1 and 2, the below Hulebech reference for example provides a review of information on various specific biogeochemical conditions that influence the solubility and transport of several common inorganic contaminants. Eric D. van Hullebusch, Piet N.L. Lens, and Henry H. Tabak. 2005. Developments in bioremediation of soils and sediments polluted with metals and radionuclides. 3. Influence of chemical speciation and bioavailability on contaminants immobilization/mobilization bio-processes. Reviews in Environmental Science & Bio/Technology (2005) 4:185–212.	A table similar to that which was requested is included in the 2010 ITRC document referenced in this section of the guidance document.
163	23	7.2.2	6.2.2	USEPA references 2007b and 2010 are not listed in the reference list at the end of the document.	The references have been corrected.
164	23	7.2.2	6.2.2	The last paragraph references 3 documents (USEPA 2007a, 2007b & 2010). Only USEPA 2007a is included in Section 10 - References.	The references have been corrected.
165	23	7.3.1	6.3.1	Stroo and Ward reference. This is a general reference to the entire monograph, suggest the more concise reference of: Wilson, J.T. 2010. Monitored Natural Attenuation of Chlorinated Solvent Plumes. In H.F. Stroo and C.H. Ward (eds.), In Situ Remediation of Chlorinated Solvent Plumes, SERDP and ESTCP Remediation Technology Monograph Series. Springer Science+Business Media, LLC, New York, NY. This chapter also includes a summary of the Twin Cities Army Ammunition Plant where degradation of DCE has been attributed to abiotic dechlorination by magnetite.	The entire monograph is actually the “SERDP/ESTCP Remediation Technology Monograph Series” edited by Herb Ward, of which this particular volume (referenced as Stroo and Ward) pertains to “In Situ Remediation of Chlorinated Solvent Plumes”. There is much useful information in the reference relevant to MNA beyond the single chapter identified in the comment (J. T. Wilson); consequently, the entire volume is referenced. The technical guidance document has been expanded to discuss abiotic degradation processes.
166	24	7.3	6.3	Last paragraph lists providers of certain services. This paragraph should be deleted as it is not appropriate and may become dated.	Please refer to the disclaimer provided at the beginning of the guidance document.
167	24	7.3	6.3	Microbial and Isotopic Studies are promoted as a tertiary line of evidence. Consideration should be given to promoting this understanding, to some degree, as part of the evaluation of MNA. Because MNA is a longer time remedial action, determining whether or not the MNA has a biological component and the viability of the microbial ecology, will help in the setting of SMART objectives. Deferring this understanding to when the system is not performing, is reactive and much time is lost in the remedial program.	The guidance document team does not disagree with this statement. All lines of evidence could be used based on professional judgment and site specific conditions.
168	24	7.3	6.3	1st sentence, suggest changing "reductive dechlorination" to "degradation"; has been used for more than just reductive dechlorination	The document has been revised as suggested.
169	24	7.3.1	6.3.1	Bullet list is focused on chlorinated compounds. MBTs are also useful to understand the breakdown and sources of certain petroleum compounds such as MTBE and TBA	The document has been revised as suggested.
170	25	7.3.2	6.3.2	Second paragraph. Change "during chemical reactions, molecules with" to "during chemical and biological reactions, molecules with"	Document has been revised as suggested.
171	25	7.3.2	6.3.2	Consider including hydrogen and its heavier isotope in the list.	Document has been revised as suggested.

172	25-29	8	7	See http://www.epa.gov/nrmrl/pubs/600R04027/600R04027.pdf for Performance Monitoring of MNA Remedies for VOCs in Ground Water.	The guidance document team used this reference to develop the framework for evaluating the results of long-term monitoring results.
173	25	8	7	Regarding "Once the source of ground water contamination has been addressed and it has been demonstrated that MNA is an appropriate remedial alternative, the investigator shall establish a CEA (if not already established) and apply for a Ground Water Remedial Action Permit for MNA.", because this is a guidance document we ask that the word "shall" be changed to "may".	A reference to the regulations requiring a CEA have been added.
174	26	8.1	7.1	Table "Monitoring Well Sampling Frequency" is prescriptive and arbitrary. There is no explanation of how the listed sampling frequencies were arrived at. Generally, the sampling frequencies are too aggressive, given that by the time the remedial permit is issued, there will be a good data set available to predict plume behavior. The table should be modified to state that the investigator should propose a sampling frequency, based on the existing data.	The technical basis for the recommendations contained in this table regarding monitoring concepts (travel time) and frequency (annual minimum) are not arbitrary; they were derived from NJDEP (2003), Wisconsin DNR (2003), and McHugh et al. (2011).
175	26	8.1	7.1	The proposed long-term monitoring frequency makes no provision to abandon wells and eliminate sampling until the termination date of a CEA/groundwater permit under a Limited Restricted Use RAO. If degradation trends are established through the procedures outlined in N.J.A.C 7:26E 6.3 (eight quarters of sampling completed, statistical analysis indicated decreasing trends, modeling establishes timelines and sentinel wells historically below GWQS), the requirement to maintain and sample wells during the permit duration at the frequency recommended in the guidance is unnecessary and burdensome to RPs.	This guidance has been developed to address the majority of the cases, in which long-term monitoring is justified to evaluate potential changes in subsurface conditions, and/or obtain data to calibrate models used in the prediction of contaminant fate and transport. Professional judgment may be used to determine if this approach is appropriate for a given site condition. For example, in the case of low concentrations of BTEX constituents, a short duration CEA, and no potential threat to receptors, closure monitoring only at the end of the predicted CEA duration may be acceptable given appropriate justification.
176	26	8.1	7.1	Given that many sites with CEA/GW permits are divested, and that no threat to receptors is demonstrated, the long-term requirement for implementation of a sampling program for the duration of the permit is overly burdensome. This includes costs for maintaining the wells, ensuring access agreements and sampling analytical requirements. When degradation trends and no threat to receptors have been demonstrated, the requirement for sampling is overly conservative. The risks of cross-contamination from additional third party releases, surface influx when wells are damaged (i.e. plowing, vandalism) far outweigh the benefit of sampling at the proposed MNA frequency in the guidance when the degradation trends have already been demonstrated. With the demonstration of the degradation trends indicating receptors are protected and a CEA/Groundwater permit is established, a provision to abandon wells and sample at the termination to demonstrate compliance must be considered under the long-term Monitoring Program.	See response to comments 174 and 175.
177	26	8.1	7.1	Reporting Schedule should not be a driver for sampling schedule.	The sampling schedule was not developed based on the CEA biennial certification requirements (see response to comment 174); however, for convenience, a recommended reporting schedule was identified to coincide with the CEA biennial certification to eliminate the need for multiple submittals.

178	26	8.1	7.1	The proposed monitoring well sampling frequencies may be excessive for many sites. These frequencies may be more appropriate when evaluating if MNA is appropriate as a remedy, not for implementation of the long-term monitoring portion of the MNA remedy, and therefore may be more appropriate in Section 6.	See response to comments 174 and 175.
179	26	8.1	7.1	There is no justification for sampling sentinel wells biennially in order to report the results with the CEA biennial certification. It is not required for the recert.	See response to comment 177.
180	26	8.1	7.1	The specific monitoring requirements for a LTM should either be included in the revised Tech Rule, where they are subject to a proper review and comment process associated with rulemaking, or should be more clearly identified as guidance. They should not be established as minimum requirements without formal rulemaking. Given the many differences in site conditions that impact MNA (many of which are discussed throughout the guidance), such minimum requirements are unsupported in the draft document. The LTM requirements should be established by the LSRP based upon site-specific considerations.	The recommended monitoring is provided as guidance. Also see response to comments 174 and 175.
181	26	8.1	7.1	The footnote for the proposed Performance Well Sampling Frequency Table states "If contaminant degradation is not occurring as predicted, the applicability of the MNA remedy must be evaluated in accordance with the MNA guidance." This statement is ambiguous and unclear. We recommend that the document provide additional specific direction, such as revisit CSM, check remedial objectives to meet goal are SMART (e.g., realistic), additional active remediation may be required. Guidance without a few clarifying examples leaves readers guessing and prone to repeating the same pitfalls of the past.	Evaluation of data obtained during long-term monitoring is detailed in Section 7.2 of the guidance document.
182	26	8.1	7.1	Footnote under the Monitoring Well Sampling Frequency Table: is there a range around predicted values that are considered acceptable? It states "with each monitoring event" rather than the overall trend over a given timeframe. Potentially impedes progress for situations where, for example, climatic variations (year over year) need to be incorporated into the prediction.	The guidance document team determined that establishing an acceptable range of fluctuations would be overly prescriptive. Natural variability should not necessarily trigger a contingency remedy; rather, monitoring should continue to verify the long-term trends. See Sections 7.2, 5.3.1, and 5.3.3 of the guidance document.
183	26	8.2	7.2	The long-term monitoring component of the MNA program has been changed to include a very prescriptive monitoring program. For example, the monitoring frequency for the first four years after issuance of the ground water remedial action permit is annually. The sampling frequencies appear to be somewhat arbitrary. While these frequencies might be considered, it should be the responsibility of the investigator to develop an appropriate sampling frequency.	See response to comments 174 and 175.
184	27	8.1	7.1	There are provisions to vary from the prescribed monitoring schedule with proper justification; however, the draft guidance states that “The investigator may, with proper justification, propose (emphasis added) a monitoring frequency that differs from the frequency outlined in the table.” It is not clear if that “proposal” is to the NJDEP and whether or not NJDEP approval is required.	The investigator will propose the sampling schedule in the Remedial Action Permit for Ground Water application. The Department reviews and issues the permit and may require additional information to support the proposed monitoring schedule prior to approval.
185	27	8.1	7.1	"Under Sentinel Well Monitoring Frequency", 3rd paragraph, 2nd sentence. The last part of the sentence should be revised to include the scenario that the sentinel wells could not be installed in a location where the groundwater concentration was below the applicable standard - see Comment from page 13 on Sentinel wells.	The Department recognizes that this situation may occur in some cases and that a variance will be needed from the requirements to fully delineate the contaminant plume and establish a sentinel well (N.J.A.C. 7:26E-6.3(e)1i(4) and 6.3(e)3i(1).

186	27	8.1	7.1	Performance Monitoring Well Frequency - second paragraph: "investigator may, with proper justification, propose a monitoring frequency that differs from the …table" - this option should be included in the table, not as an exception. Investigator should be able to determine what an appropriate frequency is, and not have to justify why it is different than the arbitrary frequencies presented in the table.	See response to comments 174 and 175.
187	27	8.1	7.1	Sentinel Monitoring Well Frequency - third paragraph: "...then sentinel wells must be sampled at the same frequency as the performance monitoring wells." There is no justification for linking the two sampling frequencies together. The investigator should be able to determine what an appropriate frequency is. Use of "must" is unjustified.	The sampling schedule has been established to meet two objectives: (1) protection of human health, and (2) monitoring of aquifer characteristics over time. Sampling of sentinel wells may be important to monitor potential changes in aquifer characteristics and, therefore, should be sampled in conjunction with performance monitoring wells. It is recognized that this is not a regulatory requirement and 'must' has been changed to 'should'.
188	27	8.1	7.1	Regarding the statement: "If ½ the travel time is greater than the performance monitoring frequency then sentinel wells must be sampled at the same frequency as the performance monitoring wells.", because this is a guidance document we ask that the word "must" be changed to "should".	Document has been revised as suggested.
189	27	8.1	7.1	Using travel time that is based solely on seepage velocity and distance to receptors is an assumption that there are no natural attenuation processes occurring. However, in order to get to the point where an LTM plan is implemented according to the schedule in this guidance, natural attenuation has to have been demonstrated to get permitted. This overly conservative approach is then doubled with another overly conservative sentinel well monitoring frequency that is as frequent as the performance monitoring well frequency from which the natural attenuation was demonstrated in the first place.	The guidance allows for the development of a site-specific sentinel monitoring well frequency based on fate and transport modeling calibrated using site-specific field monitoring data, or the availability of sufficient historical ground water monitoring data that demonstrates plume stability with a high degree of confidence. Also, please see response to comment 187
190	27,28	8.1	7.1	This section imposes reporting requirements that are not based on regulation or technical considerations. For example, use of 1/2 of time of travel may be a good rule of thumb for risk management, it has no basis in regulation and it has no technical derivation. Similarly, the requirement for analyzing and reporting each round of data when received is not based on regulation. The remediation permit will specify the reporting requirements. And while it is a good practice to evaluate data when it is received, it cannot be a guidance document requirement.	The guidance document does not require reporting of the sampling data following each round. See response to comment 177.
191	28	8.1	7.1	"Under Sentinel Well Monitoring Frequency", 6th paragraph, last sentence. The sentence should be rewritten to include the scenario where the sentinel wells could not be installed in a location where the groundwater concentration was below the applicable standard - see Comment from page 13 on Sentinel wells.	See response to comment 185.
192	28	8.1	7.1	Sentinel Monitoring Well Frequency - first paragraph: "the investigator may propose a sentinel well monitoring frequency that differs from the method outlined above." The investigator should be able to determine what an appropriate frequency is and what the basis is, without having to address it as if it were an exception.	See response to comment 189.

193	28	8.1.1	7.1.1	Comment on sentence "Geochemical parameters may be necessary to evaluate whether aquifer conditions continue to be conducive to natural attenuation (e.g., do aerobic conditions remain or have conditions changed to anaerobic?)." This implies that biodegradation ceases under anoxic conditions. Anaerobic biodegradation is the primary hydrocarbon biodegradation mechanism in most aquifers. Recommend changing the text in parentheses to "e.g., have electron acceptors been depleted".	Document has been revised as suggested.
194	28	8.1.1	7.1.1	Regarding the statement: "The suite of parameters may be modified relative to those used during the initial evaluation of the appropriateness of MNA but must include CEA parameters and degradation byproducts.", because this is a guidance document we ask that the word "must" be changed to "should".	Document has been revised as suggested.
195	28	8.1.2	7.1.2	They does not seem to be any guidance on how wells are designated as performance monitoring wells. Do the wells designated as performance monitoring wells remain throughout the duration or can they be "delisted" and wells closer to the original source become new performance wells as the plume contracts? Wells located at the plume "fringe" are much more relevant for the primary line of evidence of a stable or shrinking plume on a spatial analysis. Similarly on a temporal analysis, wells in the plume fringes generally show greater reduction in time than wells closer to the original source since the TEAs present in the fringes are more energetically favorable for degradation (i.e. more likely towards the aerobic end of the TEA spectrum on the fringe vs. highly reduced towards the source).	Please refer to Section 5.3.2 of the guidance document for the discussion of performance monitoring well placement. Professional judgment should be used to determine what portion of the Remedial Investigation monitoring well network should be used for long-term monitoring.
196	29	8.2	7.2	Under "Implement a Contingency Remedy", 2nd paragraph, 3rd bullet. The sentence should be rewritten to include the scenario where the sentinel wells could not be installed in a location where the groundwater concentration was below the applicable standard - see Comment from page 13 on Sentinel wells.	See response comment 185.
197	29	8.2	7.2	Under "Implement a Contingency Remedy", 2nd paragraph, 4th bullet. The sentence states that "Contaminant concentrations are not decreasing at predicted rates", however, this statement should be rewritten to reflect the fact that the predicted rates were estimates. A more reasonably criteria would be to say that "…concentrations are not decreasing consistent with predicted rates." The recommended language is more broad and leaves room for the scenario where the actual degradation rates in the subsurface do not exactly reflect the predicted rates but may still be protective, which will likely be the case in most instances.	Document has been revised as suggested.
198	29	8.2	7.2	Under "Verify the goals of the MNA remedy have been met and terminate the LTM program", 1st paragraph, last sentence. The sentence states "…should be timed to account for seasonally elevated periods as identified from historic sampling data." It is a little unclear what "seasonally elevated periods" means. Does this refer to concentrations? If so, recommend the sentence be re-written as follows, "should be timed to include the two quarterly events (or seasons) that typically contained the highest concentrations as identified from historic sampling data"	The text has been revised to clarify this issue. Current regulations require sampling during the period of seasonally high water table. Using the sampling as stated in the MNA guidance would be a variance, and the investigator would reference this guidance as justification for this variance.
199	29	8.2	7.2	See Section 6.9.2.5.1.1 of the FSPM regarding site closure when using PDB sampling methods. Specifically, "When data are needed to document site closure, it is necessary to document that the PDBS interval used during the sampling program is still appropriate, and that data being submitted to close the site represents a worst case scenario. This shall be accomplished by re-profiling the well using PDBS." The same would apply to low-flow sampling since it targets a discrete interval	The investigator should follow the procedures outlined in the FSPM where applicable.

200	29	8.2	7.2	This states that GWQS must not be exceeded during 2 consecutive quarterly monitoring events (NJAC 7:26E-6.3(e)3i). Note that only 6.3(e)3i(3) references 2 consecutive quarterly events (for plume fringe wells). NJAC 7:26E-6.3(e)3i(2) requires contaminant levels in source area wells to meet GWQS for 2 consecutive seasonal high water table events. Likewise, NJAC 7:26E-8.6(b)7i requires 2 events such that the timing between events accounts for seasonal fluctuations in the water table.	See response to comment 198.
201	29	8.2	7.2	The paragraph: "Changes in the LTM program such as changes in the monitoring well network, sampling frequency, or analytical parameters will require modification of the ground water RA permit. However, these changes may be incorporated into the original LTM program proposed in the RA permit based on reaching certain site-specific performance goals. If these changes are incorporated into the original permit, then modification of the RA permit would not be needed. Short term changes in monitoring frequency to verify changing conditions will generally not require modification of the permit." could be the most important for a successful MNA remedy. Additional guidance on interim performance goals (milestones), timeframes to reach milestones, and acceptable changes to the LTM program based on those milestones would be helpful. As long as protectiveness and site objectives are met, what flexibility can be written into the RA permit? That is where guidance is needed. Section 8.1 and subsections therein describe the basics, but do not provide that guidance.	As supported by Table 4, the following example provides establishment of a milestone and performance objective: Non-BTEX constituent is initially > 10 X GWQS, but is predicted to decrease < 10 X GWQS by Year 8. If prediction is verified by LTM, monitoring frequency could transition to 8 year frequency instead of 4 year frequency after Year 8 without need for formal permit modification. Establishment of alternative milestones is sensitive to site-specific conditions, and elaboration is beyond the scope of this document.
202	28/29	8.2	7.2	Understood that Chapter 8 (and Section 8.2) do not address sampling methods. However, see Section 6.9.2.5.1.10 of the FSPM regarding the use of PDBs in sentinel wells. Specifically, "...sentinel wells with saturated screens/open boreholes in excess of five feet must be vertically profiled every sampling round." The same would apply to low-flow sampling since it targets a discrete interval.	See response to comment 199.
203	30	9	8	This section is entitled Reporting Requirements. Guidance cannot impose requirements. The bulleted items can only be suggested contents or sections of the respective reports. The section must be retitled and a statement that these are only suggestions, not requirements, must be added.	"Requirements" has been removed from the title
204	30	9	8	Permit Monitoring (Biennial Certification), 3rd bullet. If originally written into the RA permit, shouldn't changes to the monitoring frequency, monitoring well network and analytical parameters all be included in the proposed changes? Are these proposed changes that can be done during the biennial cert or in the original RA permit, or both?	Changes can be written into original permit based on predictions, or proposed during biennial certification based on actual conditions observed during monitoring.
205	30	9	8	under RAW, the 4th bullet incorrectly references 5.3, it should be 52.	The discrepancy has been corrected (Section 4.2 in final document).
206	30	9	8	under RAR, the 3rd bullet incorrectly references 5.3, it should be 52.	The discrepancy has been corrected (Section 4.2 in final document).
207		APP 1	APP A	Regarding the graphic on KEY DECHLORINATION REACTIONS; in the boxes on the left the document indicates that 1,2-DCE is "Easier for Biological Degradation" and that PCE and TCE are "More Difficult for Biological Degradation". This seems to say that PCE and TCE are more difficult to degrade than 1,2-DCE, which is not a true statement.	This is Appendix A in the final document. The referenced graphic (Scenario 3-3) pertains to aerobic conditions (see heading at top of page) where 1,2-DCE is more easily degraded than PCE or TCE. Refer also to Scenario 1-3 (anaerobic conditions).
208		Appendix 4	Appendix E	Section F "Upper Confidence Limits" - there is nothing there	Reference to the Upper Confidence Limits has been removed.

209	--	Appendices	Appendices	The inclusion of reference material as appendices is unusual. The material provided often is not a complete discourse on the subject matter, but leads one to believe that this is the primary key information that should be used in the NA assessments. See additional comments for recommendations - additional recommendations are below. If any of the appendix material is to remain, a better correlation between the text and appendices is required. For example, when referencing the appendix in the text clearly state the relevance of the material and how it may be used for applying an MNA remedy. Providing an example illustrating the relevance of the material would also be useful. (e.g., the method was used to demonstrate MNA of radionuclides at site X).	This is a technical guidance document and the guidance document team determined that incorporation of selected materials from pertinent reference documents would be helpful to investigators in the evaluation of MNA. The guidance document has been updated to provide a more comprehensive correlation between topics identified in the text and relevant appendix materials.
210	--	Appendices	Appendices	The summary of the MTBE appendix indicates that MTBE is dependent on anaerobic conditions. This is not true as documented within the referenced document. This sentence should be removed.	The document has been revised as suggested.
211	General			The document references sections in the TRSR; however, the TRSR is being revised. Will the references still be valid?	The guidance document will be updated to incorporate necessary revisions following promulgation of the final regulations.
212	Throughout document			Document contains many grammatical/typographical errors (e.g.. Section 6.1, paragraph 2, 4th Line - "CSM for sites where…"; also Section 6.3.1, paragraph 1, last sentence "may be found in….")	Extensive review and editing of the draft document has been performed to support final document preparation; these and other grammatical and typographical errors have been corrected.
213	Throughout document			There are several instances where qualitative words are used to describe a quantitative measure (e.g. widely varying, significant, excessive, reasonable, etc.) Without further quantification, these words tend to lead to ambiguity as to the recommended guidance or step to be taken.	See response to comment 212.
214		6 and 7	5 and 6	Both sections are very prescriptive and do not take into account, nor do they provide for, the professional judgment and perspective of site scale. These sections provide valuable technical "how-to" that is best suited for a technical manual, not for guidance document. The discussion here must be focused on the types of procedures and evaluations that should be made.	See comment responses for Section 6 and 7 (Sections 5 and 6 in final document).
215		General	General	In numerous places within this document (refer to sections 3 and 8) it states that a Conceptual Site Model (CSM) must be prepared. A CSM is not a required document for submittal to the NJDEP, therefore, this guidance document should not require its preparation or use.	Document text has been revised in Section 3.

216		General	General	The document would provide additional guidance and be more complete by frequently referencing scientific literature and NA protocols within many sections of the document where references are not provided. Tables that link relevant references with the primary biogeochemistry and the natural attenuation (NA) mechanisms, key tools and measurements, NA case examples or case summaries, and all relevant existing NA protocols for different contaminants are suggested. Separate tables, or divisions within tables could be used to segregate this information by contaminant class including hydrocarbons, chlorinated VOC's, and inorganics. While the information provided in the appendix is useful, it is not complete and leads one to believe that this is the primary key information that should be used in the NA assessments. It is recommended that the above-referenced tables (with the list of references and addition relevant information) replace the existing appendix materials. Or, if it is the intent of the MNA committee to include technical information in the appendix, then the appendix could contain one good general MNA document for petroleum and one good general MNA document for chlorinated organics and then supplement these documents with the comprehensive table(s) of references and "links" or "keys" to the text material in the main part of the guidance. If the appendix remains, it should be more explicitly stated what the intent of the appendix is (examples, partial key background information etc.) perhaps at the front of the appendix. Further, the sections of the appendix do not appear to be linked to the guidance document in a way that allows one to identify what section of the appendix to refer to. Labeling each appendix section (such as A-1, A-2 etc.) and referencing these section within the document would help address this.	The document has been edited to improve referencing of source materials and the Appendices.
217		General	General	This document and the EPA inorganic MNA guidance references provide good framework for evaluating the applicability and documentation of MNA for many inorganic contaminants with sufficient science on the core NA processes but do not provide case examples. The addition of case studies that illustrate how one practically (step by step example) goes about documenting MNA for inorganics is needed. A recent perchlorate natural attenuation protocol (Lieberman and Borden; reference below) provides a concise approach for documenting the NA of perchlorate with case examples. A good source of scientific references and case studies on multiple aspects of the NA of inorganics (especially radionuclides) is provided by the U.S DOE's Office of Science, Subsurface Biogeochemistry Research Program (http://esd.lbl.gov/research/projects/ersp). Case studies include the Hanford, Riffle, and Oak Ridge sites. M.T. Lieberman and R.C. Borden. 2008. Natural attenuation of perchlorate in groundwater: processes, tools, and monitoring techniques. ESTCP project ER-0428.	The "References" section of the document has been expanded to incorporate a section specific to case studies.

218				One area of research that could be critical to evaluations of MNA of chlorinated organic compounds is abiotic reactions with minerals present in common aquifer sediments; for example, abiotic dechlorination of DCE with magnetite or reduction of PCE and TCE with reduced iron sulfides. The following references should be added and discussed in the document, and the case study paper may be appropriate as an appendix. United States Environmental Protection Agency (USEPA). 2009. Identification and Characterization Methods for Reactive Minerals Responsible for Natural Attenuation of Chlorinated Organic Compounds in Ground Water. Office of Research and Development, National Risk Management Research Laboratory, Ada, Oklahoma. EPA 600/R-09/115. Ferrey, M.L., R.T. Wilken, R.G. Ford, and J.T. Wilson. (2004a). Nonbiological Removal of cis-Dichloroethylene and 1,1-Dichloroethylene in Aquifer Sediment Containing Magnetite. Environmental Science & Technology, Vol.38(60:1746-1752.	The document has been expanded to discuss abiotic degradation processes.
219		General	General	Another degradation process for TCE that warrants discussion is aerobic cometabolism in the presence of low concentrations of methane. A brief discussion is warranted, and the following references would be useful. Wymore, R.A., M.H. Lee, W.K. Keener, F.S. Colwell, A.R. Miller, M.E. Watwood, and K.S. Sorenson, Jr. (2007). Intrinsic Aerobic TCE Cometabolism by Methanotrophs Expressing sMMO. Bioremediation Journal, Vol: 11:125-139. Lee, M.H., S.C. Clingenpeel, O.P. Leiser, R.A. Wymore, K.S. Sorenson, Jr., and M.E. Watwood, 2008. Activity-Dependent Labeling of Oxygenase Enzymes in a Trichloroethene-Contaminated Groundwater Site. Environmental Pollution, Vol. 153:238-246. The degradation processes in this and the preceding comment are relevant to guidance on MNA because they may provide an attenuation mechanism for large, dilute solvent plumes that are difficult to remediate with engineered remedies (simply due to the volume of aquifer to be treated).	The guidance development team appreciates this information; however, this scenario does not appear to be common at most sites in New Jersey, or justify expansion of the guidance document.
220		General	General	A discussion detailing typical MNA field sampling procedures is recommended with key references.	Please refer to the Department Field Sampling Procedures Manual.
221		General	General	Overall: This is a very well written document packed with great technical information. However, in its present form, it is very prescriptive and "one-size-fits-all" and leaves little room for professional judgment and site-specific customization. In its present form, this document will be forcing the investigator to invoke deviations when there the investigator is not "deviating" in the true sense of the word, but simply using professional judgment to develop an approach that is commensurate with the project needs.	See Section 1 of the document and see responses to comments 14, 98, 99, and 175.
222	All of them	All of them	All of them	You guys did an excellent job! This is a first rate guidance document so I wanted to make that my first comment.	The guidance development team is appreciative of this comment.