DEQ	**Remediation and Redevelopment Division POLICY AND PROCEDURE**		DEPARTMENT OF ENVIRONMENTAL QUALITY
Original Effective Date: September 30, 2004 Revised Date: May 25, 2018 Reformatted Date: May 25, 2018	Subject: Request for Calculation of Mixing Zone-Based Groundwater-Surface Water Interface Criteria		Category: ☐ Internal/Administrative ☐ External/Non-Interpretive ☒ External/Interpretive
	Program Name: Part 201 and Part 213		Type: ☐ Policy ☒ Procedure ☐ Policy and Procedure
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A Michigan Department of Environmental Quality (MDEQ) Policy and Procedure cannot establish regulatory requirements for parties outside of the MDEQ. This document provides direction to MDEQ staff regarding the implementation of rules and laws administered by the MDEQ. It is merely explanatory, does not affect the rights of or procedures and practices available to the public, and does not have the force and effect of law. MDEQ staff shall follow the directions contained in this document.

PURPOSE:

This procedure provides information on how to request the calculation of mixing zone-based criteria for the groundwater-surface water interface (GSI) pathway pursuant to Part 201, Environmental Remediation, and Part 213, Leaking Underground Storage Tanks, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA).

Several MDEQ divisions implement response activity and corrective action relying upon the cleanup criteria and process of Part 201. If there are questions of the documents' applicability to facilities subject to other environmental statutes, a person should consult with the appropriate MDEQ division staff.

Information regarding the application of Michigan surface water quality standards and options for compliance with the GSI pathway is available in MDEQ Groundwater-Surface Water Interface Pathway Compliance Options Reference Materials.

DEFINITIONS:

GSI:	Groundwater-Surface Water Interface that is the location at which groundwater enters a surface water body.
GSI criteria:	The water quality standards for surface waters developed by the MDEQ pursuant to Part 31.
Mixing zone:	A mixing zone is the portion of a surface water body in which venting groundwater is mixed with the receiving water.
Part 31	Part 31, Water Resources Protection, of the NREPA

INTRODUCTION:

Compliance with the GSI pathway can be determined using mixing zone-based GSI criteria[1]. If generic GSI criteria are exceeded or reasonably expected to be exceeded at GSI monitoring

[1] A person may demonstrate compliance for a response activity or corrective action providing for venting groundwater by meeting mixing zone-based GSI criteria developed consistent with provisions of Part 31 [MCL 324.20120e(1)(c); MCL 324.21304a(5)(b)]. Part 31 allows for mixing zones for discharges of venting groundwater in the same manner as for point source discharges [MCL 324.3109a]. The Part 4 Water Quality Standards rules (Part 4 rules) in conjunction with the Part 8 Water Quality-Based Effluent Limit Development for Toxic Substances rules (Part 8 rules) establish the requirements and process for the development of mixing zone-based criteria to be used as cleanup criteria [R 323.1082, R 323.1201 to R 323.1221].

points, a person may request the MDEQ to authorize a response activity or corrective action that relies on mixing zone-based criteria. A mixing zone is an allocated portion of the receiving surface water body where venting groundwater discharge is mixed with surface waters. The mixing zone is used to develop mixing zone-based GSI criteria.

For Part 213 corrective action, a request for calculation of mixing zone-based GSI criteria should be submitted to the MDEQ independent of and prior to the submittal of a Final Assessment Report (FAR) or Closure Report to allow the resulting criteria to be factored into the corrective action necessary to address the pathway. The request should be submitted with a Leaking Underground Storage Tank Supplemental Information Cover Sheet (Form EQP 4001). The request needs to contain or reference relevant portions of the initial assessment report that provide site information and site characterization results (including a conceptual site model) with sufficient detail to allow reasonable estimates of the discharge flow rate, appropriate contaminants of concern, and maximum concentrations of contaminants at the GSI to process a request for mixing zone-based GSI criteria. After the MDEQ transmits the calculated mixing zone-based GSI criteria, the criteria should be incorporated as part of the description of corrective action to be implemented in the Corrective Action Plan of a FAR, with a request for the MDEQ to authorize the discharge above generic GSI criteria. The FAR will need to provide sufficient information for the MDEQ to determine the adequacy of compliance monitoring plans when ongoing monitoring is necessary. There may be situations when no further monitoring of mixing zone-based GSI criteria is needed and submittal of a FAR is not necessary. In those circumstances, a Closure Report can demonstrate compliance with the mixing zone-based GSI criteria and request for the MDEQ to authorize the discharge of venting discharge above generic GSI criteria.

For Part 201 response activities, a request for calculation of mixing zone-based GSI criteria should be submitted to the MDEQ independent of and prior to a No Further Action Report. It may be advantageous to request calculation of mixing zone-based GSI criteria early in the remedy evaluation to allow the resulting criteria to be used as part of the compliance assessment of the pathway. The request for development of mixing zone-based criteria should be submitted as or included within a Response Activity Plan, using the Request for DEQ Review of Response Activity Plan (Form EQP 4028) unless otherwise required by an administrative order, order of agreement, or judicial decree[2]. The submittal must contain sufficient information from site investigation to allow reasonable estimates of the discharge flow rate, appropriate contaminants of concern and maximum concentrations of contaminants will need to be provided to process a request for mixing zone-based criteria. MDEQ authorization of the venting groundwater above generic GSI criteria will need sufficient information to determine the adequacy of compliance monitoring plans when ongoing monitoring is necessary in a Response Activity Plan or NFA Report.

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[2] A person shall proceed under Section 20114b of Part 201 to undertake response activities that use mixing zone-based GSI criteria. [MCL 324.20120e(7), MCL 324.20114b].

REQUEST FOR CALCULATION OF MIXING ZONE-BASED GSI CRITERIA

The Request for Mixing Zone-Based GSI Criteria (form EQP4483)[3] is provided to assist in submittal of sufficient information for the MDEQ to develop mixing zone-based GSI criteria; the information maybe provided in another format so long as information that addresses all of the following is submitted:

1. The name of the receiving surface water and the location where groundwater is venting.
   a. A map or maps that illustrates the location of the facility, the location of the contaminant plume, and the receiving surface waters.
   b. The GSI pathway exposure assumptions include unrestricted residential and recreational use of the receiving surface water consistent with Part 31 designated uses for surface water bodies. Any physical site conditions that would make these assumptions not applicable to site conditions should be provided.

2. The location, nature, and chemical characteristics of past and current sources of groundwater contamination[4].
   a. The basis for concluding that any hazardous substance released will not exceed generic GSI criteria at the GSI monitoring points.
   b. Identification of hazardous substances that will or are likely to exceed generic GSI criteria at the GSI monitoring points, including the physical extent and range of concentrations.
   c. Any location of mobile, migrating, or residual dense or light non-aqueous phase liquids in relation to GSI monitoring points.

3. The name, chemical abstract service (CAS) number, and concentration of the hazardous substances in the groundwater at the GSI monitoring points and upgradient of the interface that have a potential in the future to reach the GSI monitoring points above generic GSI criteria, and water quality characteristics.
   a. To assure that mixing zone-based criteria are developed for all contaminants likely to exceed generic GSI criteria, maximum concentrations upgradient of the GSI monitoring points should be provided.
   b. Any hazardous substance without established generic GSI criteria should be included.
   c. Any existing water quality characteristic, such as pH, nutrients, dissolved oxygen, or physical characteristic should be included.
   d. CAS numbers can be obtained from chemical dictionaries and the *National Institute of Occupational Safety and Health Pocket Guide to Chemical Hazards*.
   e. Information from the site conceptual site model, including cross-sectional mapping of the contaminant plume, the location of monitoring wells and borings, elevation of each groundwater sampling location, contours for individual or groups of contaminants, and other relevant information should be included to assist in demonstrating the worst case maximum concentrations predicted to reach the GSI monitoring wells.

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[3] This form contains no substantive changes since it original use in 1996.
[4] For this purpose, “sources of groundwater contamination” include environmental contamination.

4. An estimate of the discharge rate[5], in cubic feet per second, of that portion of the venting groundwater plume that exceeds, or is likely in the future to exceed, a generic GSI criterion.
   a. The plume discharge rate is estimated using Darcy's Law ($Q_P = k \cdot i \cdot A$) where:
      Q_P = Discharge rate, in cubic feet per second, of groundwater plume for the area contaminated above generic GSI criteria.
      k = A representative hydraulic conductivity within the area of plume discharge.
      i = A representative hydraulic gradient within the area of plume discharge.
      A = The cross-sectional area of the plume perpendicular to groundwater flow that encompasses the entire plume that exceeds the generic GSI.
   b. The hydraulic conductivity value (k) should be obtained from properly designed and representative aquifer pumping tests (pumping tests). If rising and falling head tests (i.e., slug tests) are proposed in lieu of pumping tests as the means of determining hydraulic conductivity at a facility, documentation to demonstrate the results are representative for site conditions should be provided. Documentation should include an analyses of the test results that includes, as a minimum, information that addresses the following:
      - Details of the procedures followed in the design, performance, and analysis phases of the test program and details of the design, construction, and development of the monitoring wells tested as well placement and effective well development are very important elements of a slug test program.
      - An evaluation to determine if the test results are reliable and within a range of values that are appropriate for the aquifer material types known to exist at the site.
      - How the number of tests and test locations are appropriate for effectively characterizing the site based upon the site conditions and size. The most conductive formation material should be included in the slug test program. Three or more rising and falling head tests of varying displacement values should be performed at each well location included in the slug testing program.
      - If the hydraulic conductivity values obtained from a slug testing program are not consistent with the values associated with the aquifer materials known to exist at the site, or if there is uncertainty regarding the quality of the slug test program, then an appropriately conservative multiplier (e.g., three to ten times) should be used to obtain a representative value. Documentation and justification to support the multiplier should be included.
   c. The hydraulic gradient (i) used should not underestimate the gradient. The maximum hydraulic gradient observed at a site from several representative hydraulic gradient determinations should be used to calculate the discharge rate. In the event that seasonal variations occur, the highest hydraulic gradient should be used.
   d. The limits of the cross-sectional area (A) extend to the nearest adjacent wells along the GSI in which groundwater concentrations are consistently below generic GSI

[5] The mixing zone-based criteria are calculated based upon the maximum discharge rate of venting groundwater [R 323.1209, Development of wasteload allocations for toxic substances, of the Part 8 rules].

criteria. The vertical extent must also be based upon wells with consistent concentrations below generic GSI criteria or on demonstrated geological constraints such as the top of the water table to a basal or confining clay layer. The assumption is that groundwater concentrations exceed generic GSI criteria within the defined areas.

5. If available, the location of other venting groundwater plumes in the vicinity of the facility in question, together with information about the names and concentrations of hazardous substances in those plumes.
   a. Available information from the MDEQ Web site (see references for further information), or general knowledge should be used to identify locations of contaminated sites and possible locations of venting groundwater or point source discharges that may affect the mixing zone allocation. For a lake discharge, information regarding other discharges in the watershed vicinity should be included. For a stream discharge, information regarding other discharges in the vicinity of the receiving stream segment should be included.

6. If the venting groundwater is a new or increased discharge to the surface waters of the state, then information to support an antidegradation demonstration or exemption, if one is required or allowed[6].
   a. Waters of the state that are currently better water quality than the water quality standards are not allowed to be degraded by a "new or increased loading" unless there is an "antidegradation demonstration." The effective date of this provision is July 1997. The antidegradation demonstration applies to venting groundwater as a "new" loading. If the contaminant plume vented to surface waters prior to July 1997 and continues to vent it is considered an existing loading. A contaminant plume that began to vent after July 1997 is considered a new loading. If a contaminant plume has been intercepted through response activity and it is proposed to stop the response activity and allow the plume to vent, the discharge is considered a new loading. An increased loading is a contaminant plume in which the groundwater contaminant concentrations have or will substantially increase due to the migration of source area contamination, leaching of soil contaminants, or further migration of contaminated groundwater.
   b. The venting groundwater may qualify for an exemption under the antidegration provisons[7]. An explanation of why the exemption applies should be provided.
   c. If an exemption does not apply, the demonstration must show the discharge is in the public interest based upon identified social or economic benefits to the area in which the new or increased loading will occur. Venting groundwater contamination frequently from Part 201 facilities or Part 213 sites is from historical practices; and there is no current operating presence to balance employment, production, or efficiencies with quantifiable additional costs of remediation. The demonstrations for these facilities has balanced the additional remediation costs to an increased use of the facility (e.g., redevelopment or other industrial, commercial, or residential growth) and other economic or social benefits to the community. Simply removing any perceived social stigma associated with the contaminated site to allow

[6] R 323.1098, Antidegradation, of the Part 4 rules.
[7] R 323.1098(8)(c)

redevelopment has not been considered a social or economic benefit to justify allowing the increased loading.

The request for mixing zone-based GSI criteria (Form EQP4483) includes a certification statement that will need to be signed by an appropriate authorized party for Part 213 and Part 201 submittals. The authorized party for this request may be different than the person signing the Response Activity Plan or Supplemental Information Report.[8]

CALCULATION OF MIXING ZONE-BASED CRITERIA

Upon receipt of sufficient information, the MDEQ will calculate mixing zone-based GSI criteria consistent with Section 3109a of Part 31 and the related rules promulgated under Part 31 and will provide the mixing zone-based GSI criteria to the requester.

Chronic mixing zone-based criteria are calculated based on dilution of the maximum discharge flow of venting groundwater and the allocated low flow value of the receiving surface waters. Low flow values for surface waters may be available from the MDEQ Web site (see references for further information).

Acute mixing zone-based criteria are calculated as maximum concentrations not to be exceeded at the GSI monitoring points in order to prevent harm to aquatic life. Dilution is not a factor in the calculation of acute criteria.

For certain chemicals and for stream segments with waste load allocations, the dilution afforded by the surface water body may be the limiting factor in determining mixing zone-based GSI criteria because the assimilative capacity of the stream segment has been reached for specific contaminants. A list of stream segments with waste load allocations and the specific contaminants affected is available from the MDEQ district offices.

Ambient concentrations in most Michigan surface waters exceed the applicable water quality standards for polychlorinated biphenyls (PCBs) and mercury, and mixing zone-based calculations for these bioaccumulative chemicals of concern (BCCs)[9] have not historically included dilution. Existing discharges of BCCs are no longer allowed mixing zones unless specific provisions[10] can be demonstrated. No mixing zone is available for new discharges of BCCs.

In some circumstances, chemical-specific criteria may not be protective of aquatic life due to the number or nature of toxic substances and/or unidentified substances found in the venting contaminant plume. Whole Effluent Toxicity testing of the groundwater contaminant plume at the GSI may be necessary to assess the toxicity of the groundwater. The MDEQ may specify requirements, including test methods, for such testing with the development of mixing zone-based criteria.

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[8] The request serves in lieu of a permit application [MCL 324.3109a] A permit application must be completed in accordance and subject to guidelines in 40 CFR §122.21 [R 323.2108(1)]; 40 CFR 122.22 designates authorized signatures.

[9] Table 5 of R 323.1057(8), Toxic substances, of the Part 4 rules

[10] R 323.1082(6)(c) or (d), Mixing zones of the Part 4 rules

The calculation of mixing zone-based GSI criteria alone does not constitute MDEQ authorization for the discharge of venting groundwater.

COMPLIANCE EVALUATION WITH MIXING ZONE-BASED GSI CRITERIA

Compliance with mixing zone-based GSI criteria is demonstrated if there are no mixing zone-based GSI criteria exceedances in the GSI monitoring points, and no other water quality standards concerns, such as pH, nutrients, or dissolved oxygen or physical characteristics such as color, foam, sheen, taste or odor that require response activity.

Compliance with mixing zone-based GSI criteria that are based on chronic toxicity endpoints may be demonstrated by a statistical evaluation of the data of the plume area above generic GSI criteria[11]. The statistical evaluation may be based, if sufficient data are available, on a properly calculated and documented 95 percent upper confidence limit on the mean, or other appropriate statistical technique for data evaluation. Compliance with mixing zone-based GSI criteria that are based on acute toxicity must be demonstrated on a point-by-point basis.

ALTERNATIVE MIXING ZONE REQUESTS

As a minimum restriction, the final acute value for aquatic life must not be exceeded when developing mixing zone-based criteria, unless the MDEQ determines or it is demonstrated to the MDEQ that a level higher is acceptable in accordance with the mixing zone rule provisions[12].
Acute mixing zones are allowed under specific mixing zone rule provisions.
Mixing zone-based criteria calculations can provide no greater than a tenfold dilution factor to groundwater venting to the Great Lakes or inland lakes[13] and cannot allocate more than 25 percent of the receiving surface water low flows in river systems[14] unless it can be demonstrated to the MDEQ that use of a larger volume is acceptable consistent with the mixing zone rule provisions.

To demonstrate to the MDEQ that an alternative mixing zone is acceptable, sufficient information must be submitted that addresses the mixing zone rule provisions. The Request for Mixing Zone-Based GSI Criteria (form EQP4483) information is not sufficient for this demonstration.

AUTHORIZATION OF VENTING GROUNDWATER

The MDEQ may authorize a discharge of venting groundwater that does not meet generic GSI criteria (water quality standards) if a mixing zone has been allocated by the MDEQ[15].
The approval of the submittal requesting calculation of mixing zone-based GSI criteria and transmittal of the calculated criteria does not constitute MDEQ authorization for the discharge of venting groundwater. The MDEQ authorization of venting groundwater above generic GSI criteria is provided with the approval of FAR/CAP, Closure Report, Response Activity Plan, or

[11] Section 20120a(14) of Part 201
[12] R 323.1082(7)
[13] R 323.1082(5), Mixing zones of the Part 4 Rules
[14] R 323.1082(2) and R 323.1090, Applicability of water quality standards of the Part 4 rules
[15] R 323.1090

NFA Report that proposes compliance for the GSI pathway. Public notice is necessary prior to approval of these documents.

The MDEQ authorization of venting groundwater above generic GSI criteria cannot be for a period longer than five years[16]. Whether a reauthorization requires additional information to be submitted to the MDEQ for review will be determined on a case-by-case basis, and the document providing the MDEQ authorization will establish any conditions for reauthorization. In all cases, the MDEQ will review the conditions used to develop the mixing zone-based GSI criteria including site information, the plume contaminants, and receiving waters flow conditions to assure that there have not been significant changes since the original authorization.

REFERENCES:

MDEQ Groundwater-Surface Water Interface Pathway Compliance Options Reference Materials

Part 4. Water Quality Standards Rules

The MDEQ Environmental Mapper has locational information for contaminated sites and is available from the MDEQ Web site:
The current link is: http://web1.mcgi.state.mi.us/environmentalmapper/ or go to www.Michigan.gov/deq | Land | Remediation | Program Information | Sites of Contamination | Environmental Mapper
Please note: do not save this web site as a favorite; frequent updates make reaccessing the web site necessary.

The MDEQ Low Flow Discharge Database is available from the MDEQ Web site:
The current link is: http://www.deq.state.mi.us/flow/lflowqry.asp or go to www.Michigan.gov/deq | Water | Water Management | Hydrologic Data Collection & Analysis | Flood & Low Flow Discharge Reporting System | Low Flow Discharge Database

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[16] R 323.2150, Duration of permits, of the Part 21 Wastewater Discharge Permits rules

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