Former Wurtsmith AFB BCT Remedial Investigation
Baseline Risk Assessment
Scoping Meeting Summary

Date of Call: 11/04/2020
Time of Call: 1400 EST
Meeting Leader: Paula Bond, Aerostar SES LLC (ASL)
Attendees:

Name	Organization
Dave Gibson	Air Force Civil Engineer Center (AFCEC) BEC
Dr. Catharine Varley	AFCEC – Risk Assessor
Paula Bond	ASL Project Manager
Dr. Janet Anderson	GSI Environmental Inc. Toxicologist
Dr. Philip Goodrum	GSI Environmental Inc. Toxicologist
Lee Major	CN-AFCEC Support Contractor
Mark Weegar	CN-AFCEC Support Contractor
Dave Kline	EGLE RRD Section Manager
John Bradley	EGLE RRD Supervisor
Brad Ermisch	EGLE Compliance and Enforcement
Dr. Eric Wildfang	EGLE Toxicologist Supervisor
Beth Place	EGLE RRD Project Manager
Matt Baltusis	EGLE Geologist
Dr. Doran Bogdan	AECOM - EGLE Contractor
Dr. Divinia Ries	EGLE Toxicologist
Jeremiah Morse	AECOM - EGLE Contractor
Ken Pinella	AECOM - EGLE Contractor
Andrea Keatley	MDHHS ASTDR Unit Manager
Mounica Nandula	MDHHS Project Coordinator
Dr. Puneet Vij	MDHHS Toxicologist

INTRODUCTION

The remedial investigation (RI) risk assessment (RA) scoping meeting was held between the AFCEC and the Michigan Department of Energy, Great Lakes, and Environment (EGLE) to discuss the methodology to be used during the baseline human health and ecological risk assessments (HHRA and BERA) for the former Wurtsmith Air Force Base (WAFB). These minutes summarize the Air Force Team's proposed approach, including schedule and deliverables, conceptual site models, risk assessment process, exposure and toxicity assessments, risk characterization, and uncertainty analysis. Questions were held until the end of the presentation. Some topics will require further discussion. EGLE and MDHHS will review and comment on the Draft Risk Assessment Work Plan.

The discussion was led by Dr. Janet Anderson of GSI Environmental Inc. (GSI). The first topic discussed was the schedule and deliverables for the project. A stand-alone RA work plan will be developed that discusses the RI data quality objectives (DQOs) for biota sample collection and the methodology for conducting the HHRA and ERA. The Uniform Federal Policy - Quality Assurance Project Plan (UFP-QAPP) currently being

prepared will include a summary of the key objectives of the RAs and will refer to the RA work plan for details.

The RA work plan will be provided for EGLE review in quarter 1 of 2021. RI field samples will be collected in the summer of 2021. Validated data will be included in the RAs, and methods and findings will be included in the RI Report.

The project area for the RAs will be determined once the RI fieldwork is complete and we have a more comprehensive picture of the extent of impacted areas and media. Generally, the project area will be based on the widest of the boundaries that delineate the extent of potential plumes of target analytes migrating off the installation. The entire project area will be divided into different sets of exposure units, each representing an area within which a potential current or future receptor population may be exposed, and following standard U.S. Environmental Protection Agency (USEPA) and Michigan guidance. There will be exposure units for both human health and ecological receptors. Exposure units for the ERA will be based on published information on home ranges and foraging areas. Refinements to the ERA will include reductions in area use factors for receptors with relatively large home ranges, seasonal use factors for migratory species, and habitat preferences throughout the project area.

The conceptual site exposure models were presented, and the changes made since the last scoping call were discussed. The changes to the human health exposure models included:

- The storm drain and the sanitary sewer line were added to the contaminant release mechanisms. This does not change the specific routes or pathways but was added for additional detail.
- The environmental media was reordered to highlight the potential for transport via a groundwater-to-surface-water interface (GSI).
- The exposure route for fugitive dust exposure for the construction workers was added.

The changes to the ecological exposure models included:

- Storm drain and sanitary sewer were added to contaminant release/transport.
- Groundwater, surface water, and subsurface soil were added as a potential pathway transport to the environmental media.

The baseline risk assessment components, policy, and guidance were discussed and included data collection and evaluation and the exposure and toxicity assessments. Data will be gathered and analyzed, and relevant site data used to identify contaminants of potential concern (COPCs). The exposure assessment will evaluate the contaminant release location and concentrations, identify potentially exposed populations, and identify the potential exposure pathways related to each release. Exposure point concentrations will be calculated from site data and contaminant intakes estimated. Toxicity will be evaluated using qualitative and quantitative toxicity information. Risk characterization will include quantifying cancer risk and non-cancer hazard quotients and include an uncertainty analysis.

Regulatory requirements for conducting the RAs will include:

- National Contingency Plan (NCP) Code of Federal Regulations (CFR) Title 40 Parts 264-266, 280, 300, and 373
- Comprehensive Environmental Response Compensation and Liability Act (CERCLA) Title 42 Sections 9601-9675
- USEPA Risk Assessment Guidance (1989-2019)
- Michigan Natural Resources and Environmental Protection Act (NREPA) Parts 201, 213; Administrative Code Part 299

The HHRA process will consist of a tiered approach using the probabilistic risk assessment (PRA) process. Assessments that are high in complexity and regulatory significance can benefit from the application of probabilistic techniques. The assessment will begin with point estimates of exposure using site-specific data and standard exposure factors, consistent with regulatory guidance. Then, as necessary to help with decision-making, a Tier 3 probabilistic approach will be conducted. The goal is with each level of increasing complexity to guide the decision-making using the available data and science. Michigan NREPA, Part 201, §324.20120a (14) does allow for the use of probabilistic approach "if the methods are determined by the Department to be reliable, scientifically valid, and best represent actual site conditions and exposure potential." The USEPA has multiple guidance documents available on PRA and include:

- 2001 – RAGS 3A, Process for Conduction PRA
- 2014 – White Paper: Methods and Case Studies
- 2014 – PRA to Inform Decision Making: FAQs
- 2019 – Guidelines for Human Exposure Assessment.

Exposure point concentrations will be based on the one-sided 95% upper confidence limit (UCL) for the arithmetic mean (95UCL). The 95UCL will be calculated using USEPA tools and methods. For surface soil, 95UCLs will be calculated for each exposure unit using data generated with incremental sampling methods (ISM). Point estimates for exposure factors will be defined from site-specific data, if available. Alternatively, point estimates will be selected from standard default factors recommended by the Michigan Department of Environmental Quality (MDEQ) 2016 Remediation and Redevelopment Division (RRD) Technical Support Document (TSD) Tables and USEPA Risk Assessment Guidance for Superfund (RAGS). Inputs will be further refined by generating probability distributions, as needed, with input from EGLE.

The ecological exposure assessment process will be similar to human health, beginning with point estimates supported by site-specific data and risk assessment guidance. If an ecological PRA is conducted, probability distributions may be developed for exposure factors and toxicity (dose-response), consistent with USEPA guidance on PRA.

There are some PFAS screening levels for the ERA. Screening levels protective of upper trophic level receptors will be used in the initial screening-level risk. Subsequent refinements may include considering a broader range of effect levels that represent taxonomic groups of receptor species. A combination of site-specific biota data and reference values will be used to determine uptake factors (bioconcentration factors and bioaccumulation factors).

The human health toxicity assessment will begin with a screening-level risk assessment following USEPA (2019) and DoD (2019) policies for perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOS), perfluorobutane sulfonic acid (PFBS). The baseline risk calculations will be conducted using Department of Defense (DoD)–approved toxicity values for PFOA, PFOS, and PFBS. Alternative risk calculations using toxicity values for other per- and polyfluoroalkyl substances (PFAS), including toxicity values used by EGLE to support their current maximum contaminant levels (MCLs), will be included in the Uncertainty Analysis for presenting potential risk ranges.

A discussion of the HHRA screening levels began with the policy and guidance documents from the USEPA and DoD on how to conduct the initial risk screening.

- USEPA Office of Solid Waste and Emergency Response (OSWER) Policies
- Defense Environmental Restoration Program (DERP) – DoD Manual 4714.20
- DoD Instruction 4715.18
- USEPA Risk Assessment Guidance 1989–2019

- MI Part 201 and Admin. Code 299, and MDEQ 2016 TSD

The screening values will rely upon USEPA toxicity values and the standard default exposure calculations to translate toxicity values into groundwater, surface water, residential tap water, and residential soil screening values. As the RI progresses, it is acknowledged that more toxicity information may become available on other perfluorinated compounds; the HHRA will use the current and best available information. The toxicity data currently available to be used includes:

- Tier 2 – USEPA Peer-Reviewed Provisional Toxicity Values for PFBS; and
- Tier 3 – USEPA Office of Water 2016 toxicity values for PFOA and PFOS, other state values (pending that they underwent expert peer review and have been finalized).

Human health toxicity values will be selected for risk characterization using these approved tiered sources. The Air Force is proposing to use the DoD-approved and USEPA policy toxicity values (i.e., the USEPA references dose for PFBS, PFOA, and PFOS, and the USEPA cancer slope factor for PFOA) when calculating the primary risk but then carrying forward additional calculations of the range of potential risks, as well as potential cumulative risk calculations, using other Tier 3 toxicity values for these and other PFAS in the uncertainty analysis. The documentation and justification of the level of peer review conducted on Tier 3 values development will be presented in the RA work plan. Because DoD/Office of the Secretary of Defense (OSD) has not issued a final determination on whether these toxicity values apply under the USEPA policy or DoD policy, they will be discussed in the uncertainty analysis.

Human health risk will be compared to a target hazard quotient (THQ) 1.0 and each cancer risk level (10^{-4}, 10^{-5}, 10^{-6}). The risks will be presented per exposure pathway and receptor for reasonable maximum exposure to identify risk drivers. Mixtures will be addressed following USEPA RAGS, MI 2017 TSD, and Goodrum et al. 2020 and will be presented using different grouping strategies. The aggregate and cumulative risk will also be calculated. Probabilistic methods may be employed to ensure accurate, predictive characterization. The risk from non-site related sources ("background") will be presented, consistent with USEPA RAGS, MI Part 201/Code 299, MDEQ 2016 RRD TSD Tables.

The USEPA has not established ecological risk screening levels for PFAS; therefore, the ecological toxicity assessment will use Michigan screening levels for surface water, state ecological benchmarks, and literature that include:

- MDEQ Rule 57 (literature as of 2010);
- Strategic Environmental Research and Development Program (SERDP) (2020; adopted by California); and
- Florida (2019).

Toxicity values will include freshwater acute and chronic values with refinements based on the range of effect levels, specific to the taxonomic group, and exposure-response/probabilistic methods. The range of toxicity values will be discussed in the uncertainty analysis.

There are currently no USEPA ecological benchmarks for PFAS. Surface water toxicity values will be derived from the most current available data from states like California (Tier 1), Michigan, Florida, and Texas (Tier II) and the DoD program SERDP (Tier I and Tier II) (2020). Soil and sediment toxicity data will come from SERDP (2020). Specific proposed values for surface water and soil are shown on slide 17 (see attached slides).

The SERDP approach takes candidate representative receptors and back calculates to obtain a screening level that is the lowest of the candidate values. There are no approaches to estimate sediment screening levels from

surface water screening levels for PFAS; however, SERDP did calculate food intake from candidate species that would directly contact sediment or indirectly contact sediment via biota uptake. Proposed ecological screening values for sediment are presented on slide 18 (see attached slides).

Toxicity reference values (TRV) for calculating doses from birds to mammals have been developed. These are numbers proposed for the risk assessment to provide an adequate level of characterization. A discussion of the strengths and limitations of the database from which toxicity values were generated will also be provided in the RA work plan. Proposed toxicity reference values are shown on slide 19 (see attached slides).
The ecological risk will be summarized in tables and maps illustrating hazard quotients by receptor and exposure unit. The risk ranges will reflect low- and high-end toxicity reference values. Probabilistic methods may be employed to quantify the likelihood and magnitude of effects on growth, reproduction, and/or survival. Risks by exposure pathway will be quantified for upper trophic level wildlife (birds and mammals). The risk from non-site-related sources ("background") will also be included.

Background concentrations of PFAS in soil and biota will be used to establish former WAFB-specific releases and inform risk management decisions regarding the contribution of non-site-specific risks to risk calculations. Background values will not be used for developing cleanup levels.

QUESTIONS AND DISCUSSION

Slide 4 – (Mr. Pinella, AECOM) How will exposure units be defined, and how will receptor information be used to define the EUs?
(Mr. Goodrum, GSI) – The HHRA will focus on various exposure scenarios where we would expect people to be. On the ecological side, exposure scenarios are guided by standard assumptions about home ranges and foraging areas.
(Dr. Ries, EGLE) – Receptors are identified by defining the exposure units first based on exposure scenarios. From there, exposure units are evaluated concerning land uses such as residential, commercial workers, or recreational, and then the receptors are identified.
(Dr. Anderson, GSI) – For human health, a standard 1/4 acre (grid) is used for a hypothetical resident. A standard 2 acres (grid) is used for occupational construction. For a future hypothetical resident, the exposure unit's assumption could be anywhere, but we will also evaluate a realistic scenario based on current residential neighborhoods. The ecological starting point uses basic assumptions about what an exposure unit size is and then looking to see when you overlay that grid what is the habitat underneath. For example, a grid with a 1-acre exposure unit for a terrestrial receptor would not be ideal in the middle of Clark's Marsh.
(Dr. Ries, EGLE) – Shouldn't the source characteristics, the type of contaminants of particular areas, be considered when defining the exposure units—also, the different contaminants and different types of the PFAS and the concentrations in a specific area?
(Dr. Anderson, GSI) – The exposure unit is a grid that overlays the entire project area, and for each exposure unit, the exposure concentration is calculated. USEPA ProUCL will be used to calculate the 95UCL for each perfluorinated compound across the entire project area within each exposure unit. Those will have multiple different grids for different receptors in different sizes. A whole host of exposure point concentrations will be calculated for each exposure unit and receptor pair.
(Dr. Ries, EGLE) –The 95UCL applies to an exposure point concentration for soil, but under Part 201, EGLE does not use a 95UCL for groundwater. I can send you the regulatory language on that.

Slide 5 –
(Ms. Ries, EGLE) –There is an added connection between the surface soil and the groundwater for the groundwater-surface water interface (GSI). Should a separate conceptual site model (CSM) for GSI and GSI protection pathways be developed?
(Dr. Anderson, GSI) – The risk assessment is concerned with the receptor exposure to surface water or groundwater. The exposure point and route would be either direct ingestion of groundwater or direct ingestion,

incidental ingestion, and contact with the surface water. There wouldn't be an exposure to GSI. Understanding GSI is important for the overall conceptual site model for fate and transport, but a risk calculation on GSI wouldn't be practical.
(Dr. Ries, EGLE) – The GSI does not address the risk to receptors. It is related to surface water use, whether it's drinking water or nondrinking water, and the GSI protection pathway relates to groundwater use. It is complicated; I would recommend separating out a CSM to GSI to identify the compliance points. For example, if the discharge of groundwater is a sewer versus directly to surface water.
(Dr. Goodrum) – Do you have an example that you could send us to better understand what a separate GSI pathway would look like?
(Dr. Ries, EGLE) – We can provide an example. It is also recommended that a separate CSM be developed for groundwater in private wells. Consider non-potable water use as a collective exposure, where private well water is being used for irrigation or swimming. If these exposures are not relevant to the area, we can just note that justification for not including them.
(Dr. Anderson, GSI) – Are you asking for an addition or change to the non-potable water? The CSM does have non-potable water being used for irrigation.
(Dr. Ries, EGLE) – The pathway circles that are not shaded are considered incomplete or insignificant. EGLE would like to justify why those pathways are considered not significant to be documented in the baseline RA work plan. Also, surface and subsurface soil should consider inhalation because under Part 201, risks are evaluated from soils from all depths, whether surficial or subsurface. At any point in time, subsurface soil can become surficial soil if it is moved around, and the inhalation component is only for the surficial soil. Include the definition of surface and subsurface soil in the RA work plan.
(Dr. Anderson, GSI) – Those details are included in the RA work plan, and we will follow the USEPA guidance.
(Dr. Wildfang, EGLE) – What is the basis for differentiating between the high contribution pathways and the low contribution pathways?
(Dr. Anderson, GSI) – A low contribution pathway is expected to represent 10% or less of the total exposure from all pathways. Details on how the % contribution will be inferred will be provided in the RA work plan.

Slide 6 – (Mr. Pinella, AECOM) – Regarding mammals, the American Mink is listed. What is the rationale for not including the omnivorous aquatic muskrat, especially given the typically high uptake in plant tissue?
(Dr. Goodrum, GSI) – The American Mink has a mixed diet, including plants and fish. The muskrat will be added.
(Mr. Pinella, AECOM) – It is indicated here a quantitative evaluation of invertebrates will be conducted. For sediment invertebrates that don't have reliable benchmark values, will the benthic invertebrate evaluation be more qualitative? The RA work plan should include the rationale for receptors and pathways.
(Dr. Goodrum, GSI) – There are no sediment screening values, nor do we have any site-specific sediment toxicity data. While we would like to evaluate quantitatively, there are no screening values. After quantifying a particular exposure pathway, it could change and be so minor that the path could be shown as an open circle; it would still be quantified to support that it would be more representative of a minor pathway.

Slide 7 – The Air Force proposed that incomplete or insignificant pathways will be qualitatively addressed.
(Mr. Pinella, AECOM) – How will the surface and subsurface intervals be defined?
(Dr. Goodrum) – We will provide the rationale for “default” depth intervals for some of the burrowing receptors. If there is evidence from the field walks of deeper burrows, we can adjust.
(Mr. Pinella, AECOM) – What is the plan for accounting for herbivorous receptors, for example, a deer or a raccoon?
(Dr. Goodrum, GSI) – The CSM currently does not include an herbivore that is higher up on the food chain or with higher consumption rates. A deer is an unusual receptor from an ecological risk perspective. They can have large home ranges and may not be viewed as the more sensitive of receptors. By using the meadow vole, for example, for a representative mammal, we could extrapolate. The raccoon is proposed to represent

receptors that are omnivores. Additional thought will be given to identifying another mammal that would be a dominant herbivore.
(Mr. Pinella, AECOM) – Provide a discussion or a plan to evaluate a semi-quantitative or qualitative basis as part of uncertainty discussions.
(Dr. Ries, EGLE) – The basis for selecting the receptors is the availability of screening-level information for individual animals. Are specific animal receptors or aquatic receptors included that are predominately at risk in that particular area? Even though you cannot do a quantitative risk assessment, could you identify the receptors and conduct a qualitative assessment?
(Dr. Goodrum, GSI) – The fundamental purpose of using representative receptors is to make connections between standard receptors that have been used in multiple baseline risk assessments and what the actual populations are at a specific site. There's been extensive fieldwork done in this area, plus additional fieldwork with the Aerostar team to establish the more common species and any threatened or endangered species. Threatened and endangered species will receive special attention in the ERA and some discussion in the risk characterization on how to re-evaluate the distribution of risks to account for endangered species. The information would be separately summarized because of habitat and documented observations within the county. Both county information and field observations would be included in discussing overall habitat suitability given receptor life history. The uncertainty analysis would address the extent to which these risk estimates represent the different plants and animals that are threatened and endangered.
(Ms. Place, EGLE) – We were wondering how you would potentially use information like the deer data from MDHHS.
(Dr. Goodrum, GSI) – The deer data provides a line of evidence, helping us understand what PFAS levels are in a mammal that occupies that part of the food web. The challenge with deer collected in this area is limited information on the full extent of the ranges and then trying to associate those tissue levels with any exposure point concentrations that we would estimate from the site. It is helpful, it is a line of evidence, but other types of species would provide a more direct line of evidence. For example, small mammals trapped on-site can more directly relate to the exposure conditions by a more reliable relationship between the soil and plant levels than what is detected in deer tissue.

Slide 8 – (Dr. Ries, EGLE) – CERCLA exposure concentrations and intakes are estimated. Part 201 uses the maximum concentration and the 95% UCL, but it is compared to a value or criteria, which is a backward risk assessment. Are you considering both a forward and backward risk assessment approach when it comes to the screening of contaminants at the site?
(Dr. Anderson, GSI) – That is shown on slide 9 (see attached slides). In the initial planning and scoping, a simple screening using the maximum concentration and the 95UCL for the exposure units to compare against screening levels. After screening, the RA moves away from using screening levels and uses toxicity values and site-specific information for exposure.
(Dr. Ries, EGLE) – Part 201 criteria are used both for screening and risk characterization. EGLE has general criteria for PFAS, but it would be most advantageous to use site-specific criteria at the screening stage because that would represent the best available information at this time. It would be more justifiable and defensible, knowing that we are using the best information for generating the screening levels.
(Dr. Anderson, GSI) – Do you disagree with using these RfDs to calculate risk in either the forward or backward risk assessment?
(Dr. Ries, EGLE) – We agree with the toxicity values being used to develop screening levels; however, Part 201 should also be considered when developing screening levels.
(Dr. Anderson, GSI) –The Part 201 criteria are the same as USEPA's default exposure assumptions. The RA would start with the defaults, which are more conservative to ensure nothing is artificially screened out, and then move towards replacing conservative default criteria with site-specific criteria. The Michigan 2016 draft technical support document on the EGLE website was used.
(Dr. Ries, EGLE) – The current EGLE generic criteria defaults are not conservative and not based on the best available information because they are old exposure assumptions. The 2016 draft TSD is the justification

document for the proposed 2017 criteria rules, and those use updated assumptions and exposures. I can send you the latest information and work with you to ensure that you have the latest information and consensus about what would constitute the best available information.
(Dr. Anderson, GSI) – The tables in the work plan will list these parameters and list the sources to be clear, and that is why we propose a separate RA work plan. We will follow CERCLA and USEPA guidance and will need to verify if they differ from Part 201. At this point, I'm not aware of any substantial differences.
(Dr. Goodrum, GSI) –Are there any updates from Michigan on ecological screening levels or benchmarks for surface water or other media?
(Dr. Ries, EGLE) – I will check with the water resources division.
(Ms. Place, EGLE) – During the PFAS summit last week, ecological benchmarks were discussed, but those were non-regulatory values.

Slide 9 – (Dr. Ries, EGLE) – EGLE agrees with conducting a PRA; however, the deterministic risk assessment should be completed first. There may be no need for PRA if the deterministic approach is approved.
(Dr. Anderson, GSI) – Referring to (**Slide 22**) – Preliminary risk calculations will be performed to determine if the PRA would be needed, and if it is, then a supplemental work plan will be prepared to outline how the PRA would be done.
(Dr. Goodrum, GSI) – PRA is useful at sites when the risk estimates are very close to the decision thresholds. If it appears the range of point estimates of risk bracket a target risk level, PRA may be useful. If risks are well below those target risk levels or well above them, the decision is obvious, and PRA doesn't help guide remedial decisions.

Slide 10: No discussion on slide 10.

Slide 11 (Mr.Pinella, AECOM) questioned how the maximum site concentrations would be used to calculate the 95 UCL. Using a typical approach, the MDCs would be used for the initial screening and move through the subsequent steps of the exposure assessment using the 95% UCL. Dr. Goodrum agreed that would be the approach and default assumptions.

Slide 12 – (Ms. Ries, EGLE) – Under Part 201, we use both screening and risk characterization criteria. Under Part 201, we use criteria for individual chemicals and recommend considering that when doing risk characterization. EGLE would work with you to ensure that the RA is also compliant with Part 201 requirements.
(Dr. Anderson, GSI) – We will work together on the RA work plan and get your feedback on how we layout the decision process and steps to ensure that it adequately represents the standard CERCLA process of walking through a baseline RA.

Slide 13 – (Mr. Morse, AECOM) – What do the DoD screening values mean for groundwater, surface water, and residential tap. What if the data are below those screening levels but still above Michigan's MCLs for PFOA and PFOS. Specifically, the eight parts per trillion per PFOA sixteen parts per trillion for PFOS?
(Dr. Anderson, GSI) – During the RI and in the delineation effort, we will accumulate all of the PFAS data. Referring to **Slide 15** – We propose using the RfDs derived and accepted by EGLE for those MCLs as a bounding exercise. We will calculate and describe the total range of potential risk in the uncertainty analysis to ensure that information is not lost. It will be captured within the baseline risk assessment while allowing us to be consistent with USEPA and DoD policies.
(Dr. Ries, EGLE) – Were the residential soil screening levels calculated by you?
(Dr. Anderson, GSI) – Yes, using the DoD policy memo's recommendation to accept those RfDs and plug that into the USEPA RSL calculator, this is the level you get.
(Dr. Ries, EGLE) – Using the same RfD, which is the USEPA 2016 RfD for PFOA and PFOS, EGLE developed direct contact criteria for PFOS and PFOA; it's actually higher than what you have there. It's 2.1

mg/kg; however, the Part 201 direct contact criteria should be included. You can consider it a site-specific direct contact criterion, which is the number in our 2017 proposed criteria rules. The reason is to demonstrate you have considered the Michigan site-specific direct contact criteria and that your number will be more protective. A site-specific number has more defensibility and the ability to justify that it's the best available information at this point, and you're complying with the Part 201 20b requirement for being site-specific.
(Dr. Anderson, GSI) – The residential soil is most protective for non-carcinogens for the child. That is the 130 and the 0.13 values. The EGLE direct contact criteria are higher, likely because they are calculated using a developmental pregnant-woman exposure scenario. We will include a section in the RA work plan on toxicity values and the potential risks and hazards behind how these numbers are derived.

Slide 14 – No discussion on slide 14.

Slide 15 – (Dr. Ries, EGLE) – EGLE's Air Quality Division's inhalation toxicity value is a Tier 3 value to calculate a particle inhalation criterion. It is supported by EGLE, and there is a justification that it is appropriate to extrapolate.
(Dr. Anderson, GSI) – We would need to have documentation on how the numbers were derived and if they were peer-reviewed. A route to route extrapolation of the RfD to an RfC is used, which is not supported by the USEPA. Air sample collection is not planned. The evaluation will only consider dust for ingestion. Please reference and explain the peer review requirement for the acceptability of toxicity reference values.
(Dr. Ries, EGLE) –The media is soil, and the exposure pathway is soil to air inhalation. Dust would pose a risk when it's being emitted from the surficial soil, and that risk is measured in terms of how much a concentration of soil would generate risk through that pathway. We know that PFAS is not volatile, but we know that dust or particulates that contain PFAS could be inhaled, so it's soil-based, not air-based. I can help you with that calculation and equation and send it to you for consideration, including the justification for the PFOA and PFOS inhalation toxicity value generated by the air quality division.

Slide 16 – (Mr. Morse, AECOM) – There is impacted sediment in the marsh area south of the base; how will it be addressed?
(Dr. Goodrum, GSI) – We are explicitly talking about sediment screening levels for invertebrates, and because those don't exist, we use sediment screening levels protective of higher trophic level organisms. The screening level considers both direct exposure to sediment as well as the food web. Sediment will still be evaluated as part of the risk assessment; we just don't have a basis for evaluating invertebrate toxicity.
(Mr. Pinella, AECOM) – The Arcadis SERDP report has a very good discussion about what they found and information that should be considered moving forward.

Slide 20 – (Dr. Ries, EGLE) – The CERLCA risk range is between $10^{-4;}$ and 10^{-6}; however, EGLE Part 201 requires at least the more conservative level of 10^{-5}. Site-specific screening and risk characterization criteria should be used for forward risk assessments for mixtures, aggregate, and cumulative risk; we do not specifically address that in Part 201, but the approach you are using is acceptable to EGLE. You already pointed out that the non-site-related source background information would be used for risk management decisions; we are good with that.
(Dr. Varley, AFCEC) – The Team should ensure the RAs abide by DoD policy. Other guidance can be considered, but they will need to be vetted through the proper channels. Back-up documentation for the EGLE peer review process would be helpful.

ACTION ITEMS

1. (Ms. Place, EGLE) Provide the EGLE and MPART peer-review process.
2. (Ms. Place, EGLE) Follow up with WRD on the availability of logical benchmarks and toxicity values.
3. (Dr. Ries, EGLE) provide an example CSM for GSI.

4. (Dr. Ries, EGLE) provide a chemical update form for PFOA and PFOS and updated back-up information on proposed 2017 values.
5. (Dr. Ries, EGLE) proved regulatory information on the use of Part 201 95% UCL of the mean for groundwater.
6. Send Particulate soil inhalation criteria (PSIC) calculation and the EGLE toxicity inhalation toxicity value for PFOA/PFOS.

Wurtsmith AFB
PFAS Baseline Risk Assessment
EGLE/AFCEC RA Mtg

4 Nov 2020

Janet K. Anderson, PhD, DABT
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GSI Environmental Inc.

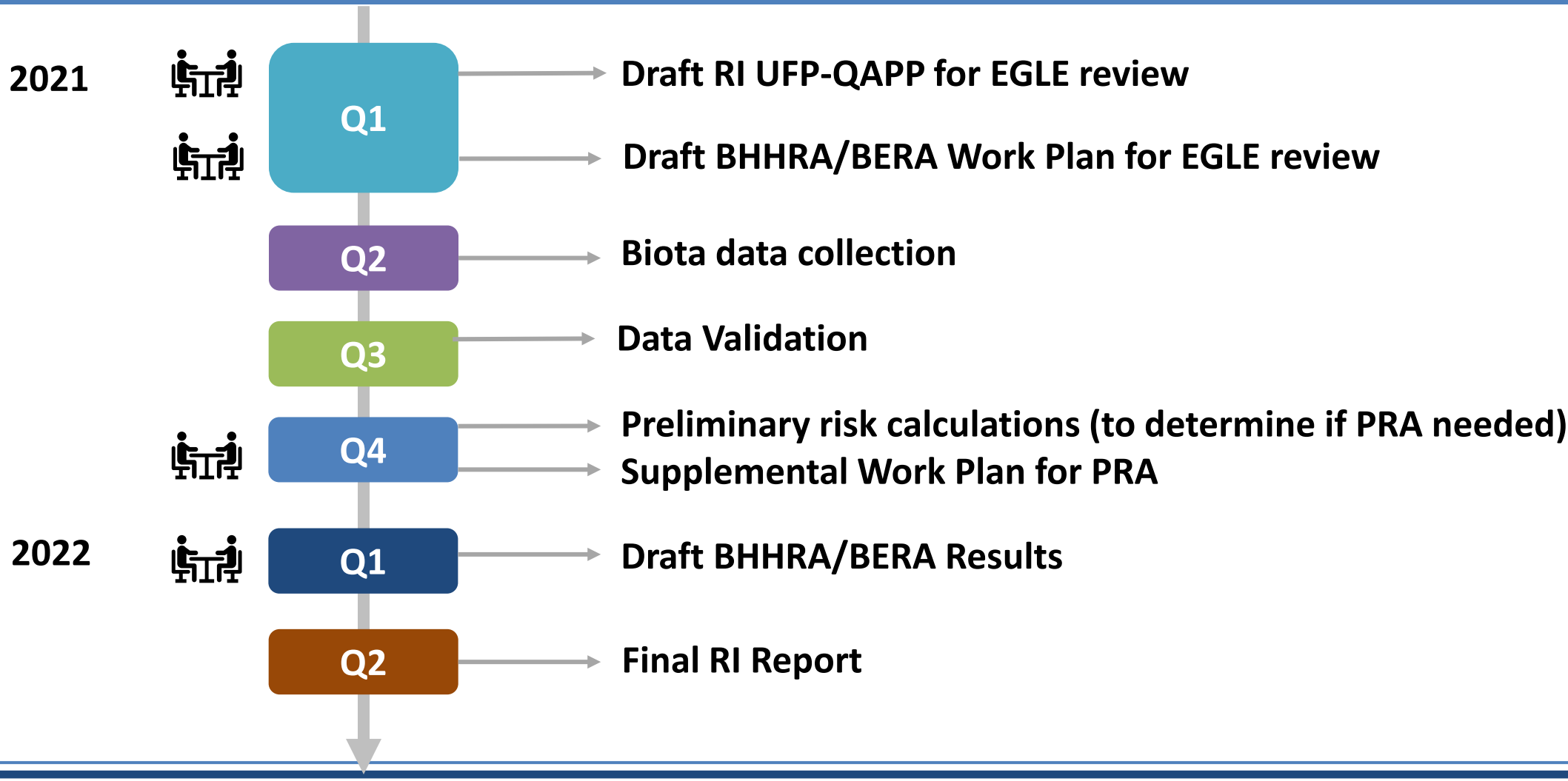
GSI ENVIRONMENTAL

OUTLINE

- Schedule and Deliverables
- Project Area for the Baseline Risk Assessments
- Conceptual Site Models
- Baseline Risk Assessment Components and Process
- Exposure Assessment
- Toxicity Assessment
- Risk Characterization and Uncertainty Analysis

BASELINE RISK ASSESSMENT

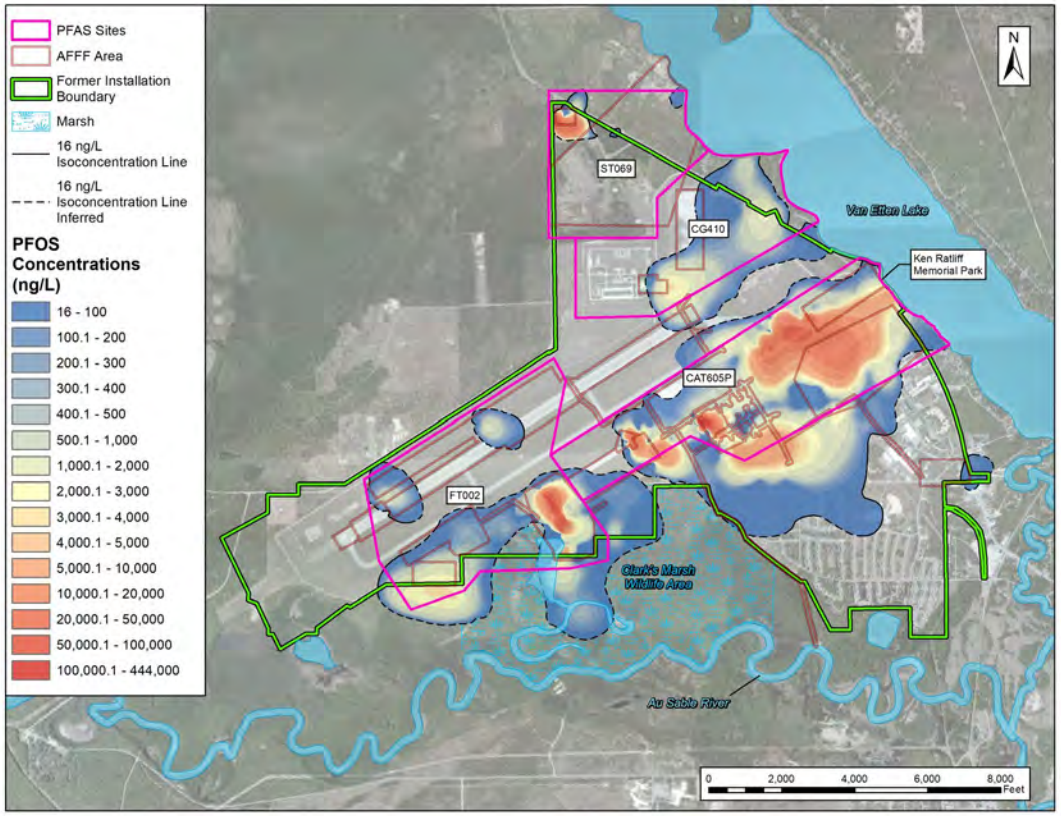
Schedule and Deliverables for EGLE



GSI ENVIRONMENTAL

PROJECT AREA AND EXPOSURE UNITS

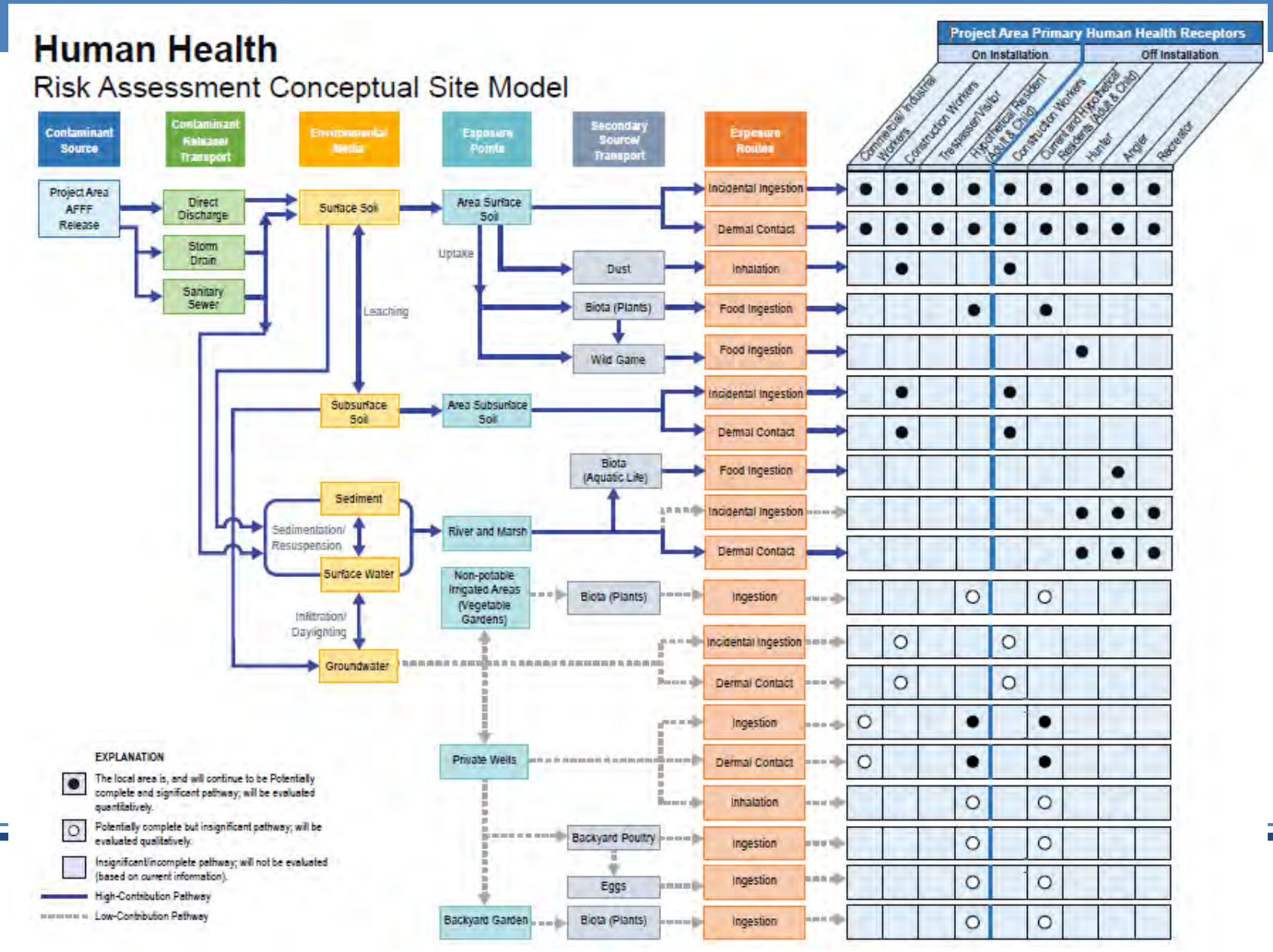
Updated following RI Delineation



- Project Area is based on widest delineated boundary
- Exposure Units are receptor specific, within the Project Area

GSI ENVIRONMENTAL

CONCEPTUAL SITE MODELS - HUMAN



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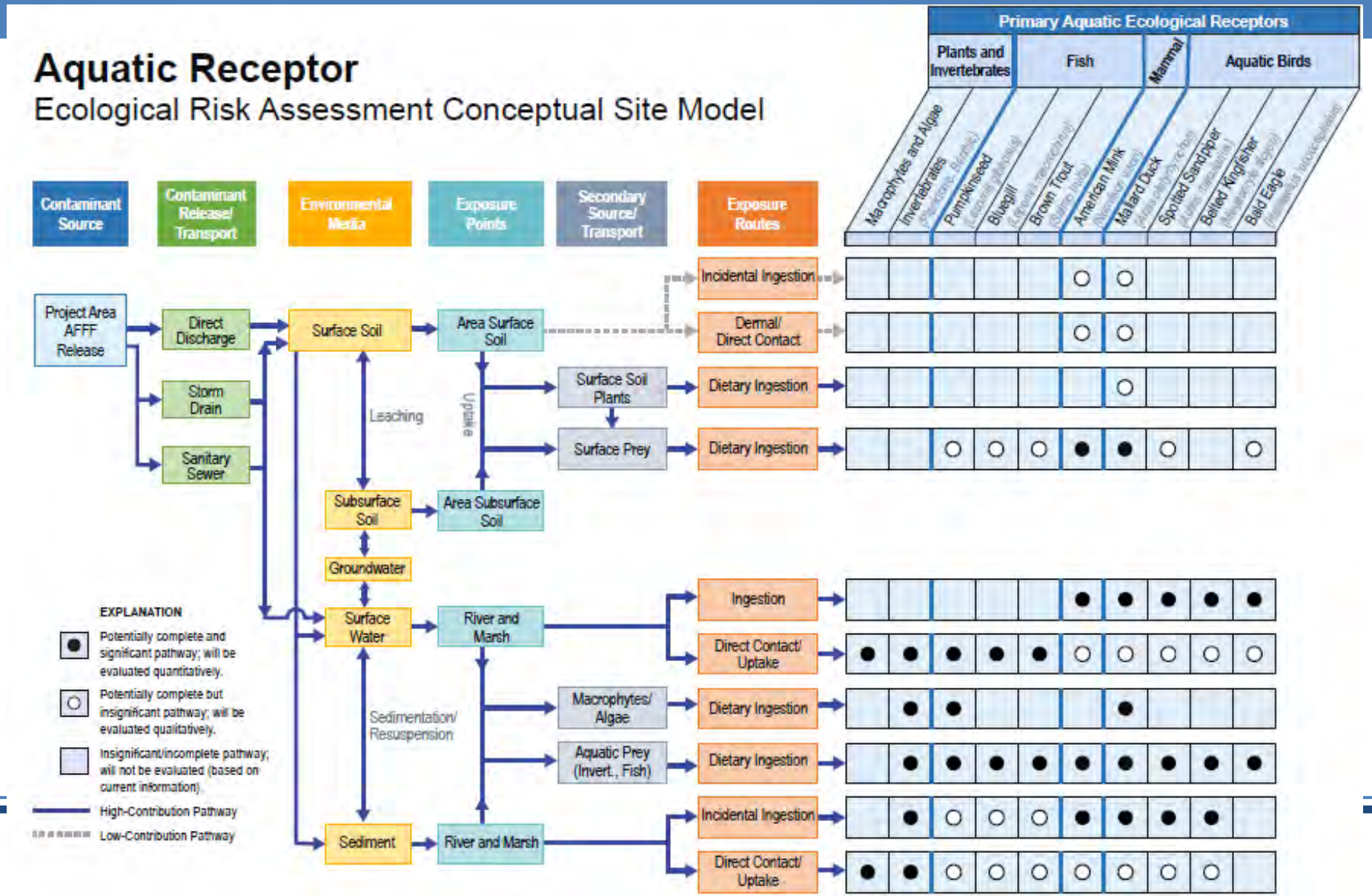
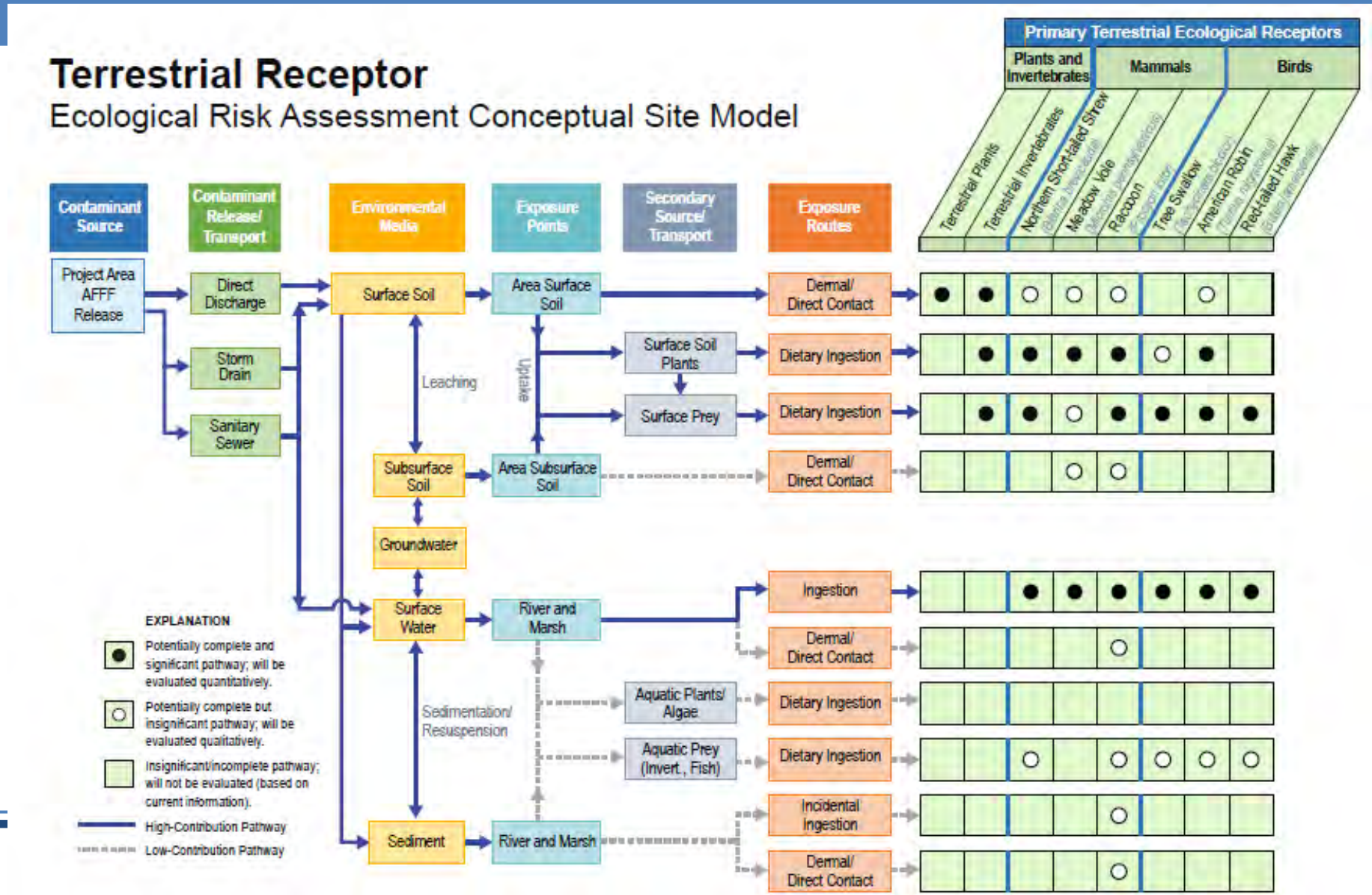
CONCEPTUAL SITE MODELS – ECO AQUATIC



CONCEPTUAL SITE MODELS – ECO TERRESTRIAL



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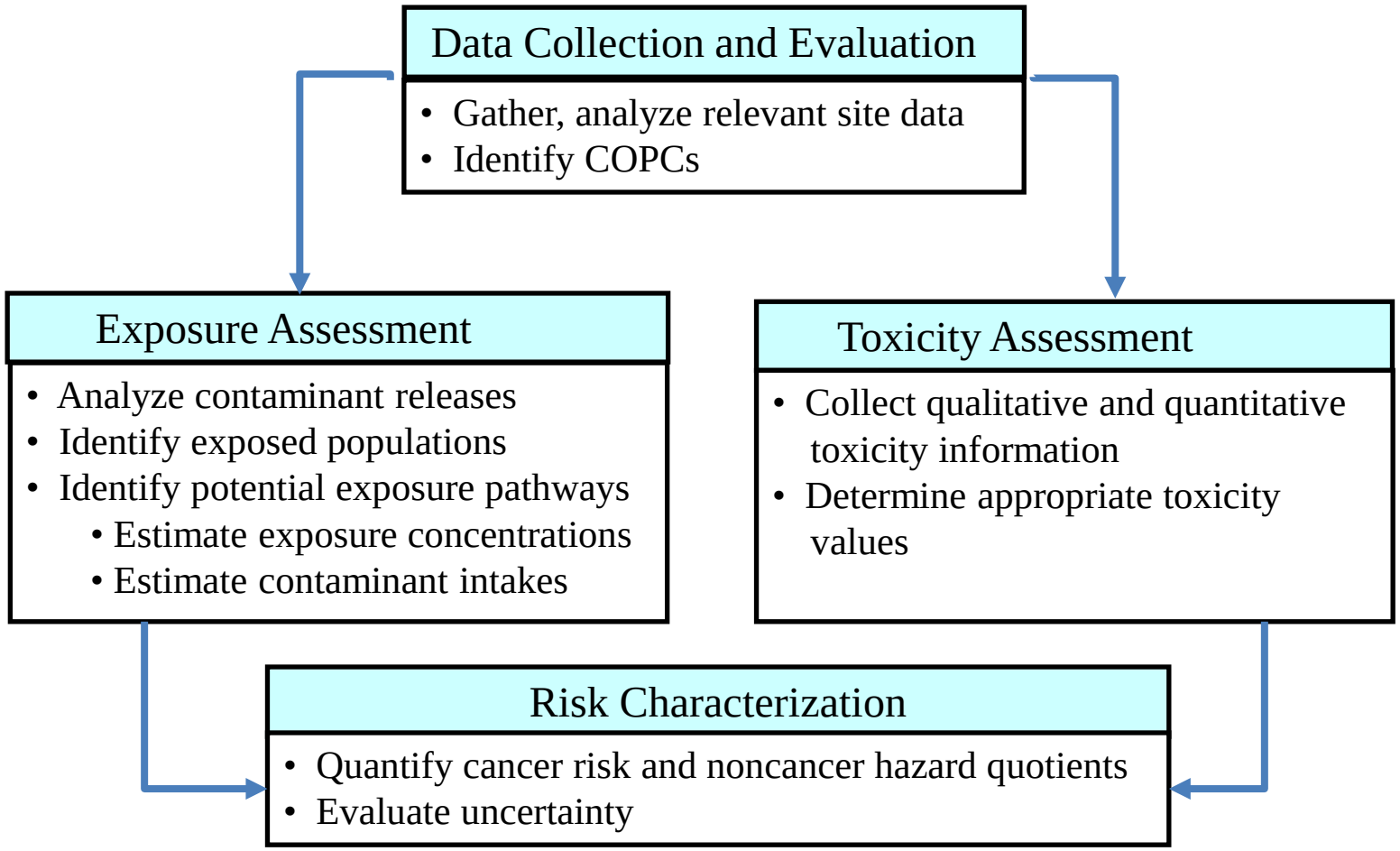
BASELINE RISK ASSESSMENT COMPONENTS and POLICY/GUIDANCE



- **NCP CFR Title 40 Parts 264-266, 280, 300, and 373**
- **CERCLA Title 42 Sections 9601-9675**
- **USEPA Risk Assessment Guidance (1989 – 2019)**
- **Michigan NREPA Parts 201, 213; Administrative Code Part 299**

BASELINE RISK ASSESSMENT PROCESS

Tiered Approach

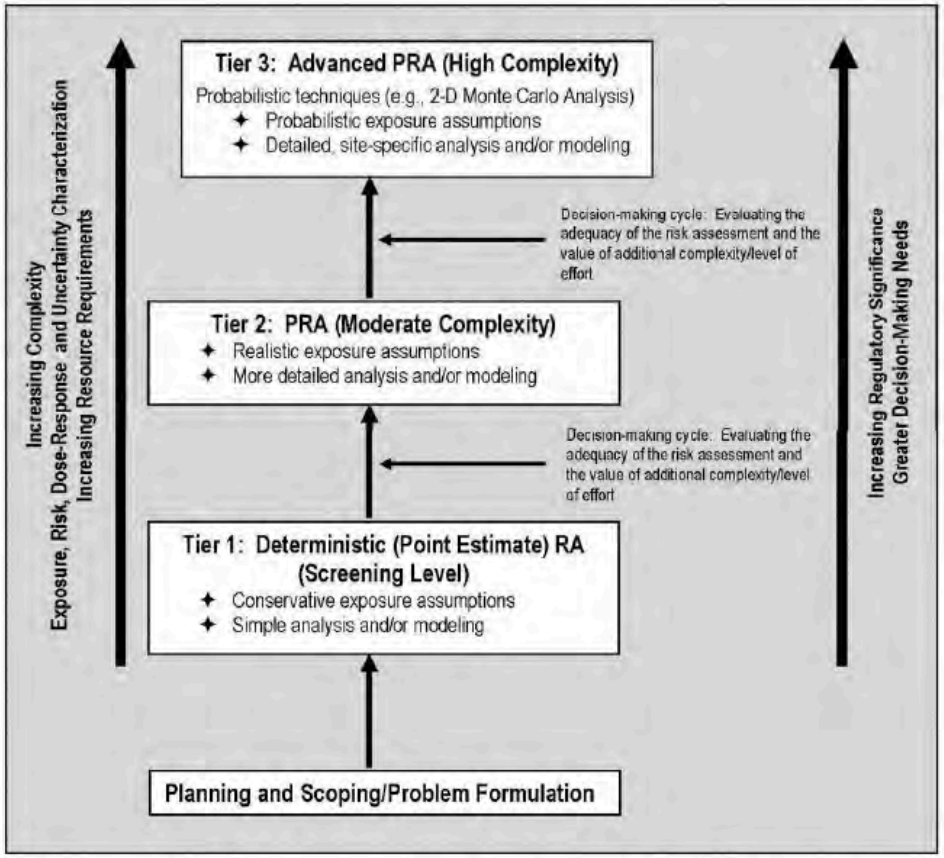


Figure 2. Tiered Approach for Risk Assessment. The applicability of a probabilistic approach depends on the needs of decision makers and stakeholders. Assessments that are high in complexity and regulatory significance benefit from the application of probabilistic techniques.
Source: Adapted from USEPA 2004a and WHO 2008.

- USEPA. 2014. Risk Assessment Forum White Paper: Probabilistic Risk Assessment Methods and Case Studies.

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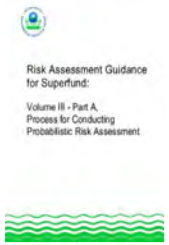
BASELINE RISK ASSESSMENT PROCESS

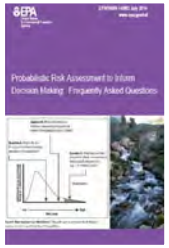
Probabilistic Risk Assessment (PRA)

Michigan NREPA, Part 201, §324.20120a (14):
"The Department shall approve the use of probabilistic or statistical methods or other scientific methods… if the methods are determined by the Department to be reliable, scientifically valid, and best represent actual site conditions and exposure potential."

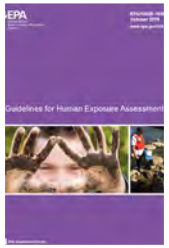


2001 – RAGS 3A, Process for Conducting PRA

2014 – White Paper: Methods and Case Studies



2014 – PRA to Inform Decision Making: FAQs



2019 – Guidelines for Human Exposure Assessment

- Advantages and disadvantages of PRA
- Tiered approach, beginning with deterministic (point estimate)
- Selecting distributions for exposure and dose-response
- Sensitivity analysis

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BASELINE RISK ASSESSMENT

Exposure Assessment

Human Health

1. Calculate Exposure Point Concentrations
   - 95 UCLs (use ISM data for surface soil)
2. Use default exposure factor assumptions (MDEQ 2016 RRD TSD Tables and EPA RAGS)
   - Use for "backwards" risk assessment (screening)
3. Refine to use site-specific point estimates (e.g. frequency, duration, BAFs)
   - Use for calculating risk in "forward" calculations
4. Refine to use probability distributions, if needed

Ecological

1. Calculate Exposure Point Concentrations
   - 95 UCLs (use ISM data for surface soil)
2. Compare to ecological screening levels protective of upper trophic level receptors
3. Refine to calculate dose and compare with toxicity reference values (mg/kg-day)
   - Estimate biota concentrations with BCFs/BAFs
4. Refine to use site-specific point estimates (e.g., biota data, area-use factor, seasonal-use factor)
5. Refine to use probability distributions, if needed

BASELINE RISK ASSESSMENT

Toxicity Assessment - Overview

Human Health

- Screening level risk assessment will follow USEPA (2019) and DoD (2019) policies for PFOA, PFOS, PFBS
- Baseline risk calculations will be conducted using DoD approved toxicity values for PFOA, PFOS, PFBS
- Alternative risk calculations using toxicity values for other PFAS (see following slides) will be included in the Uncertainty Analysis for presenting ranges of potential risk

Ecological

No USEPA ecological screening levels for PFAS (for any medium). Use Michigan screening levels for surface water, state ecological benchmarks, and literature:

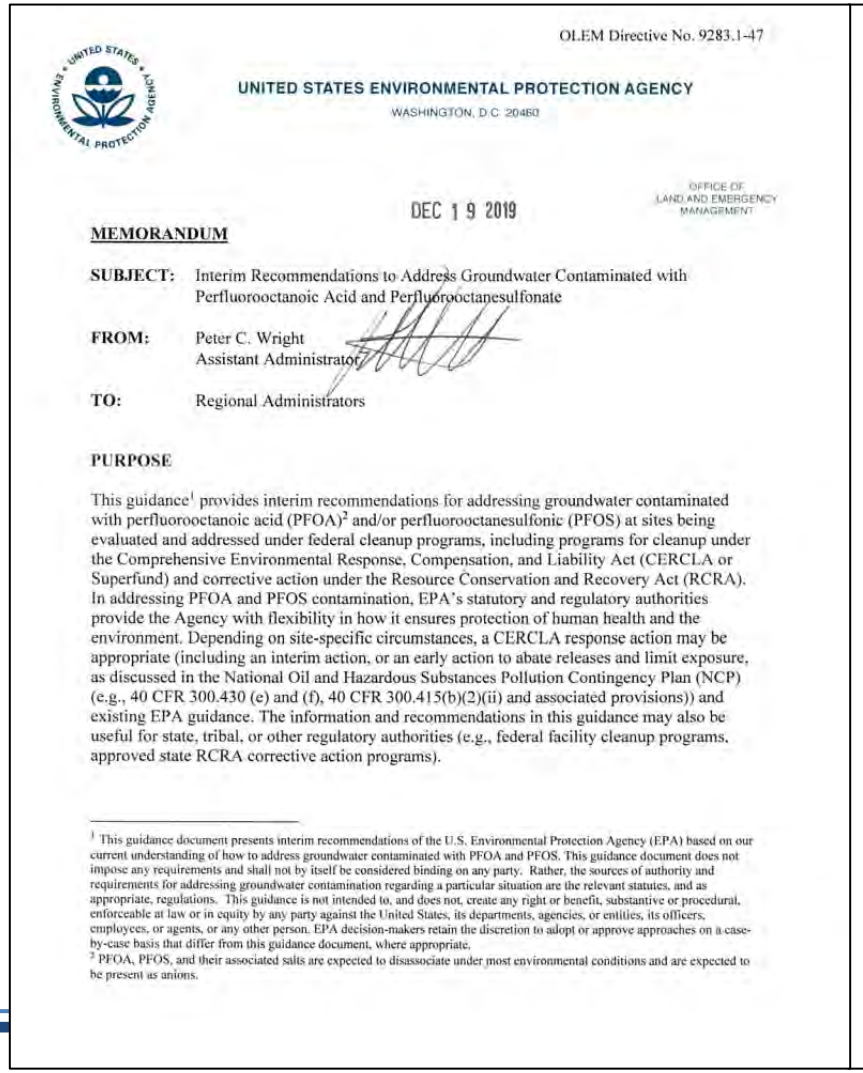
- Michigan DEQ Rule 57 (literature as of 2010)
- SERDP (2020; adopted by California)
- Florida (2019)

1. Freshwater acute and chronic values
2. Refinements:
   - Range of effect levels
   - Specific to taxonomic group
   - Exposure-response /probabilistic
3. Discuss range of toxicity values in the Uncertainty Analysis

HUMAN HEALTH RISK ASSESSMENT

Screening

Chemical	Toxicity Value Source	Screening Level	
		Groundwater Surface Water (Residential Tap) (ng/L; ppt)	Residential Soil (mg/kg)
PFBS	USEPA PPRTV	40,000	130
PFOA	USEPA 2016	40	0.13
PFOS	USEPA 2016	40	0.13



OLEM Directive No. 9283.1-47

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF LAND AND EMERGENCY MANAGEMENT

DEC 19 2019

MEMORANDUM

SUBJECT: Interim Recommendations to Address Groundwater Contaminated with Perfluorooctanoic Acid and Perfluorooctanesulfonate

FROM: Peter C. Wright
Assistant Administrator

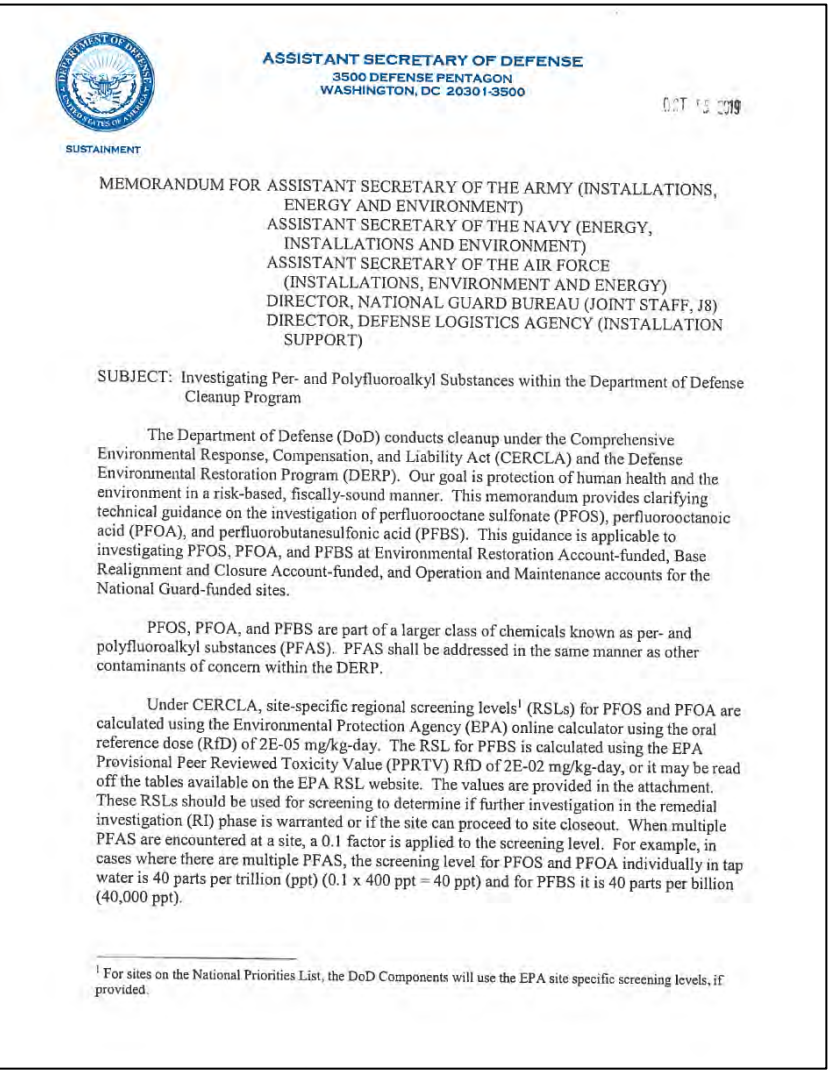
TO: Regional Administrators

PURPOSE

This guidance[1] provides interim recommendations for addressing groundwater contaminated with perfluorooctanoic acid (PFOA)[2] and/or perfluorooctanesulfonic (PFOS) at sites being evaluated and addressed under federal cleanup programs, including programs for cleanup under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) and corrective action under the Resource Conservation and Recovery Act (RCRA). In addressing PFOA and PFOS contamination, EPA's statutory and regulatory authorities provide the Agency with flexibility in how it ensures protection of human health and the environment. Depending on site-specific circumstances, a CERCLA response action may be appropriate (including an interim action, or an early action to abate releases and limit exposure, as discussed in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (e.g., 40 CFR 300.430 (e) and (f), 40 CFR 300.415(b)(2)(ii) and associated provisions)) and existing EPA guidance. The information and recommendations in this guidance may also be useful for state, tribal, or other regulatory authorities (e.g., federal facility cleanup programs, approved state RCRA corrective action programs).

[1] This guidance document presents interim recommendations of the U.S. Environmental Protection Agency (EPA) based on our current understanding of how to address groundwater contaminated with PFOA and PFOS. This guidance document does not impose any requirements and shall not by itself be considered binding on any party. Rather, the sources of authority and requirements for addressing groundwater contamination regarding a particular situation are the relevant statutes, and as appropriate, regulations. This guidance is not intended to, and does not, create any right or benefit, substantive or procedural, enforceable at law or in equity by any party against the United States, its departments, agencies, or entities, its officers, employees, or agents, or any other person. EPA decision-makers retain the discretion to adopt or approve approaches on a case-by-case basis that differ from this guidance document, where appropriate.

[2] PFOA, PFOS, and their associated salts are expected to disassociate under most environmental conditions and are expected to be present as anions.



ASSISTANT SECRETARY OF DEFENSE
3500 DEFENSE PENTAGON
WASHINGTON, DC 20301-3500

SUSTAINMENT

OCT 15 2019

MEMORANDUM FOR ASSISTANT SECRETARY OF THE ARMY (INSTALLATIONS, ENERGY AND ENVIRONMENT)
ASSISTANT SECRETARY OF THE NAVY (ENERGY, INSTALLATIONS AND ENVIRONMENT)
ASSISTANT SECRETARY OF THE AIR FORCE (INSTALLATIONS, ENVIRONMENT AND ENERGY)
DIRECTOR, NATIONAL GUARD BUREAU (JOINT STAFF, J8)
DIRECTOR, DEFENSE LOGISTICS AGENCY (INSTALLATION SUPPORT)

SUBJECT: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program

The Department of Defense (DoD) conducts cleanup under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Defense Environmental Restoration Program (DERP). Our goal is protection of human health and the environment in a risk-based, fiscally-sound manner. This memorandum provides clarifying technical guidance on the investigation of perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanesulfonic acid (PFBS). This guidance is applicable to investigating PFOS, PFOA, and PFBS at Environmental Restoration Account-funded, Base Realignment and Closure Account-funded, and Operation and Maintenance accounts for the National Guard-funded sites.

PFOS, PFOA, and PFBS are part of a larger class of chemicals known as per- and polyfluoroalkyl substances (PFAS). PFAS shall be addressed in the same manner as other contaminants of concern within the DERP.

Under CERCLA, site-specific regional screening levels[1] (RSLs) for PFOS and PFOA are calculated using the Environmental Protection Agency (EPA) online calculator using the oral reference dose (RfD) of 2E-05 mg/kg-day. The RSL for PFBS is calculated using the EPA Provisional Peer Reviewed Toxicity Value (PPRTV) RfD of 2E-02 mg/kg-day, or it may be read off the tables available on the EPA RSL website. The values are provided in the attachment. These RSLs should be used for screening to determine if further investigation in the remedial investigation (RI) phase is warranted or if the site can proceed to site closeout. When multiple PFAS are encountered at a site, a 0.1 factor is applied to the screening level. For example, in cases where there are multiple PFAS, the screening level for PFOS and PFOA individually in tap water is 40 parts per trillion (ppt) (0.1 x 400 ppt = 40 ppt) and for PFBS it is 40 parts per billion (40,000 ppt).

[1] For sites on the National Priorities List, the DoD Components will use the EPA site specific screening levels, if provided.

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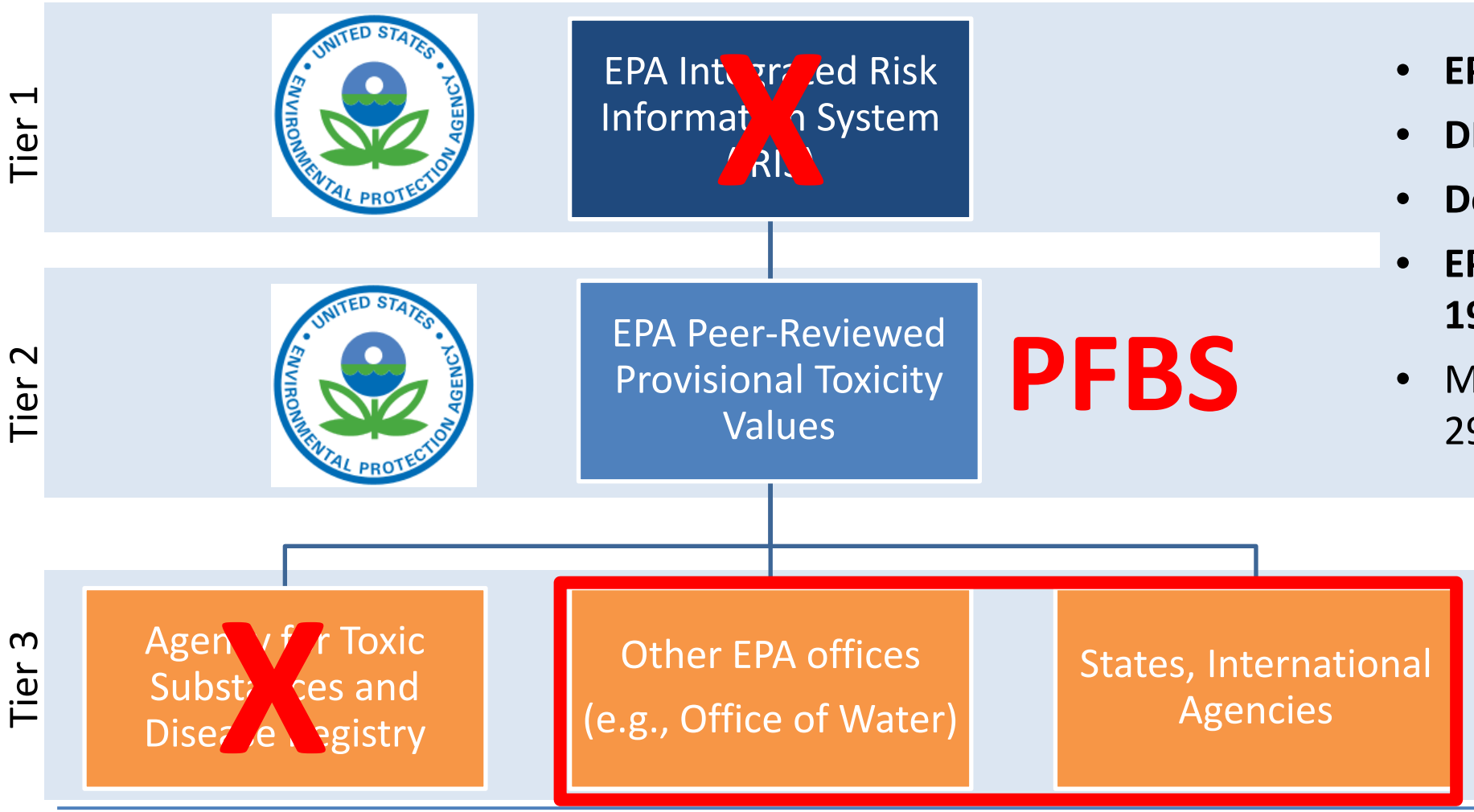
HUMAN HEALTH RISK ASSESSMENT

Sources of Toxicity Value Information for PFAS Risk Calculation



- **EPA OSWER Policies**
- **DERP - DoDM 4714.20**
- **DoDI 4715.18**
- **EPA Risk Assessment Guidance 1989 – 2019.**
- MI Part 201 and Admin. Code 299, and MDEQ 2016 RRD TSD

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BASELINE RISK ASSESSMENT

Human Toxicity Value Selection – For Risk Calculation

For Primary Risk Calculation and Risk Characterization

Chemical	Toxicity Value Source	RfD (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	Selection Rationale
PFBS	**USEPA PPRTV**	2.00E-02	NA	DoD Policy (2019)
PFOA	**USEPA 2016**	2.00E-05	7.00E-02	DoD Policy (2019)
PFOS	**USEPA 2016**	2.00E-05	NA	DoD Policy (2019)

For Uncertainty Analysis and Understanding the Range of Potential Risks and Cumulative Risks

Chemical	Potential Tier 3 Toxicity Value Source	RfD (mg/kg-day)	Year	Peer Review Conducted (Y/N)	Rationale
PFBS	**Michigan EGLE**	3.00E-04	2019	Y?	The MPART Science Advisory Workgroup provided recommendations to MI. Dept. of Health and Human Services, however, it is unclear if that meets the requirements for independent peer-review. **Neither EPA nor DoD/OSD have issued a final determination on the applicability of these toxicity values under CERCLA.** *Value derived in the peer-reviewed literature (Luz et al 2019); however, an additional 3-fold uncertainty factor was applied by the MPART Science Advisory Workgroup
PFOA	**Michigan EGLE**	3.90E-06	2019	Y?	
PFOS	**Michigan EGLE**	2.89E-06	2019	Y?	
PFHxA	**Michigan EGLE**	8.30E-02	2019	Y*	
PFHxS	**Michigan EGLE**	9.70E-06	2019	Y?	
PFNA	**Michigan EGLE**	2.20E-06	2019	Y?	

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RfD = reference dose CSF = cancer slope factor NA = not available

BASELINE RISK ASSESSMENT

Ecological Toxicity Benchmarks

Surface Water Criteria - Tier I
- 8 recommended families of aquatic organisms

- ☐ USEPA
- ☑ States: CA (adopted SERDP, 2020)
- ☑ SERDP (2020): PFOS, PFOA

Surface Water Criteria - Tier II
- Great Lakes Initiative (USEPA 1995)
- Apply uncertainty factors to address data gaps

- ☐ USEPA
- ☑ States: MI, FL, TX
- ☑ SERDP (2020)

There are currently no USEPA ecological benchmarks for any PFAS

Sediment Screening Level for Invertebrates
- Sediment toxicity studies
- Model estimates using surface water value and partition coefficients (K_{ow}, K_{oc})

X

- ☐ USEPA
- ☐ States
- ☐ SERDP (2020)

Soil Screening Level
- Soil toxicity studies, USEPA (2005) EcoSSL methodology

- ☐ USEPA
- ☐ States
- ☑ SERDP (2020)

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BASELINE RISK ASSESSMENT

Ecological Screening Level

- Surface water (µg/L)

Chemical	Benchmark Type	Value	Source
PFBS	FCV Tier 2	3,400	SERDP (2020)
PFBA	FCV Tier 2	470	SERDP (2020)
PFHxA	FCV Tier 2	2,300	SERDP (2020)
PFOA	FCV Tier 2 SL Tier 2 FCV Tier 1	880 1,300 3,900	MDEQ Rule 57 Florida (2019) SERDP (2020)
PFOS	FCV Tier 2 SL Tier 2 FCV Tier 1	140 37 51	MDEQ Rule 57 Florida (2019) SERDP (2020)
PFNA	FCV Tier 2	120	SERDP (2020)

FCV = final chronic value SL = screening value

- Soil (mg/kg) from SERDP (2020)

Chemical	Benchmark Type	Value (mg/kg)	Receptor with Lowest Value
PFBS	NOAEL RBSL	9.1	Little brown bat
PFBA	NOAEL RBSL	29	Meadow vole
PFHxA	NOAEL RBSL	1,200	Meadow vole
PFOA	NOAEL RBSL	0.057	Long-tailed weasel
PFOS	NOAEL RBSL	0.013	House wren
PFNA	NOAEL RBSL	1.0	Little brown bat

NOAEL = no observed adverse effect level

RBSL = risk based screening level for *terrestrial* wildlife

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BASELINE RISK ASSESSMENT

Ecological Screening Levels

- Sediment (mg/kg) from SERDP (2020)

Chemical	Benchmark Type	Value (mg/kg)	Receptor with Lowest Value
PFBS	NOAEL RBSL	0.73	Tree swallow
PFBA	NOAEL RBSL	1.6	Little brown bat
PFHxA	NOAEL RBSL	1.8	Little brown bat
PFOA	NOAEL RBSL	0.006	Little brown bat
PFOS	NOAEL RBSL	0.0014	Tree swallow
PFNA	NOAEL RBSL	0.01	Little brown bat

NOAEL = no observed adverse effect level

RBSL = risk based screening level for *aquatic* wildlife

BASELINE RISK ASSESSMENT

Ecological Toxicity Reference Values (mg/kg-day)

- Birds (mg/kg-day) from SERDP (2020)

Chemical	NOAEL	LOAEL	Receptor
PFBS	92	153	Northern Bobwhite quail
PFOS	0.079	0.79	Northern Bobwhite quail

- Mammals (mg/kg-day) from SERDP (2020)

Chemical	NOAEL	LOAEL	Receptor(s)
PFBS	50	200	mouse
PFBA	73	175	mouse
PFHxA	84	175	rat, mouse
PFOA	0.3	0.6	mouse
PFOS	0.1	0.166	rat, rabbit, mouse
PFNA	0.83	1.1	mouse

BASELINE RISK ASSESSMENT

Risk Characterization and Uncertainty Analysis

Human Health

- Risks will be compared to **THQ 1.0** and for each Cancer Risk level (10^{-4}, 10^{-5}, 10^{-6})
- Risks will be presented per exposure pathway and receptor for **reasonable maximum exposure** to identify risk drivers
- **Mixtures** will be addressed following EPA RAGS, MI 2016 TSD, and Goodrum et al. 2020, and will be presented using different grouping strategies
- **Aggregate and Cumulative** risk will also be calculated
- Probabilistic methods may be employed, to ensure accurate, predictive, characterization
- Risk from **non-site related sources** ("background") will be presented, consistent with EPA RAGS, MI Part 201/Code 299, MDEQ 2016 RRD TSD Tables (see next slide)

Ecological

- Risk will be summarized in Tables and maps illustrating hazard quotients by receptor and exposure unit
- Risk ranges will reflect **low and high-end toxicity reference values**
- Probabilistic methods may be employed to quantify the likelihood and magnitude of effects on growth, reproduction, and/or survival
- Risks by exposure pathway will be quantified for **upper trophic level wildlife** (birds and mammals)
- Risk from non-site related sources ("background") will be presented

BASELINE RISK ASSESSMENT

Risk Characterization – Use of Background

Background concentrations of PFAS in soil and biota will be used to:

1. **Establish WAFB-specific releases**
2. **Inform risk management decisions regarding the contribution of non-site-specific risks to risk calculations**

NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION ACT (EXCERPT)
Act 451 of 1994

PART 201
ENVIRONMENTAL REMEDIATION

324.20101 Definitions.
Sec. 20101. (1) As used in this part:

(e) "Background concentration" means the concentration or level of a hazardous substance that exists in the environment at or regionally proximate to a facility that is not attributable to any release at or regionally proximate to the facility. A person may demonstrate that a hazardous substance is not present at a level that exceeds background concentration by any of the following methods:

survey.
(*iv*) A site-specific demonstration.

Will NOT be used for determining cleanup criterion

Will be calculated using statistical analysis (two-sample hypothesis testing), following EPA RAGS and flexibility within MI Part 201

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BASELINE RISK ASSESSMENT

Schedule and Deliverables for EGLE

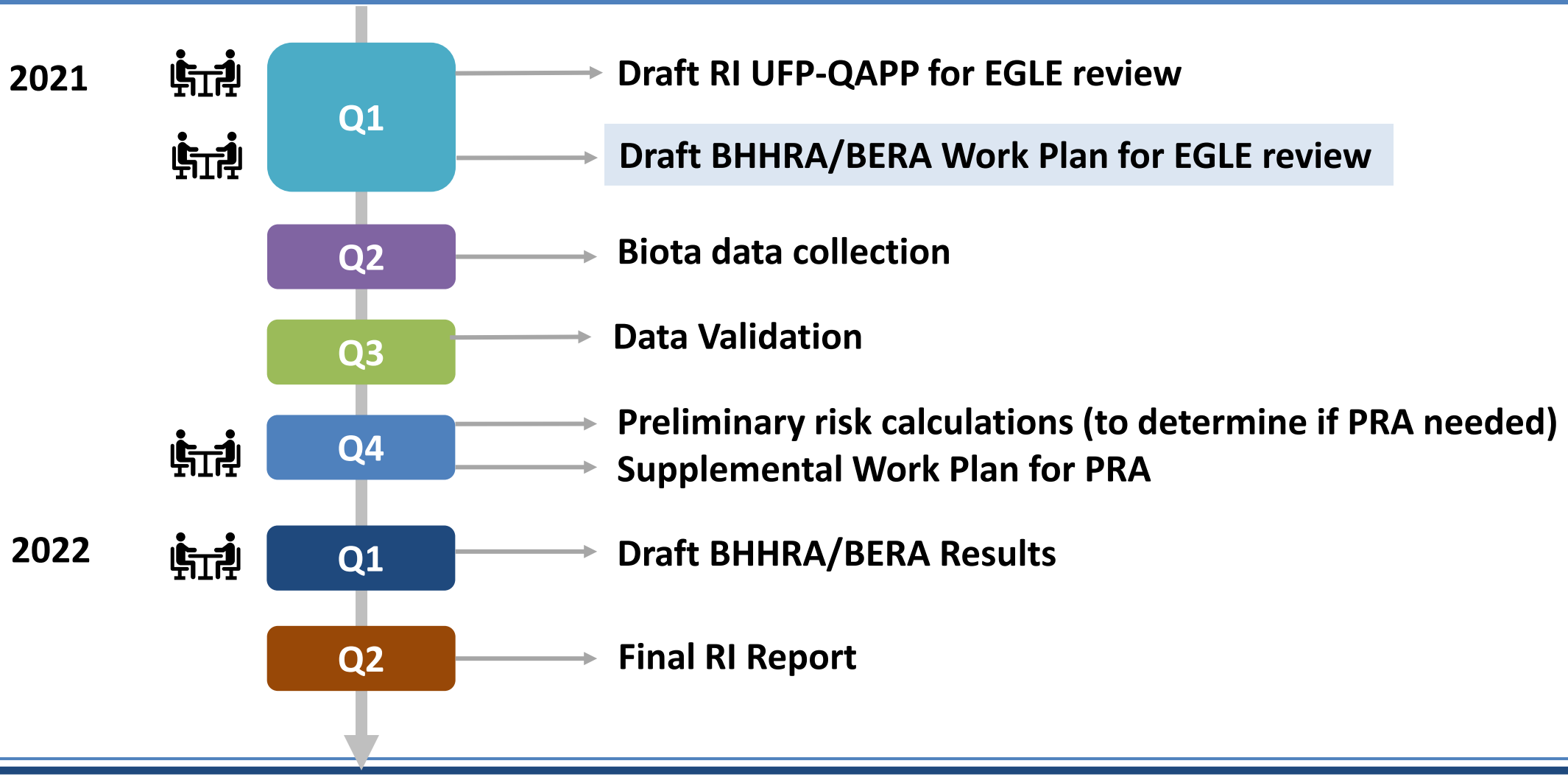

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Image: Mobile plasma reactor that destroys PFAS

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