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Summary of the Seattle Urban Area Consequence Management Guidance for a Wide-Area Biological Attack

A Technical Supplement to the *Puget Sound Regional Biological Attack Recovery Plan Annex*

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Summary

A terrorist attack involving a release of biological warfare agent in the Seattle urban area would require decision-makers to make a host of important, and sometimes untested, choices concerning how best to respond and recover. This technical supplement supports the *Puget Sound Regional Biological Attack Recovery Plan Annex to the Regional Catastrophic Plan*, which structures the region's response and recovery approach, by providing technical details on how to conduct a biological remediation. More specifically, the technical supplement identifies the principal issues that must be addressed following a wide-area release of aerosolized *Bacillus anthracis* (*B. anthracis*) spores; explains the resources that are available to address the release; sets forth strategies to reduce the time required for consequence management; and focuses on remediation options, procedures, and tools that can be implemented today should such an incident occur. The content is intended to be used with the *Interim Consequence Management Guidance for a Wide-Area Biological Attack* (LLNL 2009). A second and related purpose of this technical supplement is to serve as a detailed guide for other geographical regions interested in formulating their own consequence management plans. This technical supplement is funded by, and was developed as part of, the Interagency Biological Restoration Demonstration (IBRD) program—a collaborative effort among Department of Homeland Security, Department of Defense, and numerous other Federal, state, and local agencies—to improve the nation's ability to respond to and recover from a wide-area biological incident.

Content of the technical supplement follows the six-phase diagram for responding to and recovering from a biological contamination incident (see Figure 1 on the next page), which represents a consensus scheme developed after multi-agency review and approval. Whereas the focus of the document is on remediation/cleanup activities, the topics of response and recovery structure (Section 2), notification (Section 3), and initial response (also known as first response, Section 4) are discussed relatively briefly because some early decisions related to those three topics can affect subsequent decisions pertaining to remediation and potentially affect timelines and overall effectiveness.

Section 1. Introduction

Section 1 provides background information and an example biological release scenario for the Seattle urban area. Consequence management following the wide-area release of a biological warfare agent (BWA) poses extremely difficult and challenging problems, especially for a persistent agent, such as *B. anthracis*. Emergency response will follow well-established principles; however, the biological response and recovery problem requires an additional level of technical understanding. Public safety is paramount, and economic factors will mandate a quick recovery. Key considerations include determining what must be cleaned up, ascertaining the order (i.e., priority) of cleanup, and selecting appropriate and effective decontamination processes and techniques to meet specified, health-based clearance goals.

The target audience for this technical supplement is members of the technical community who would be involved in biological response and remediation activities, including local, regional, state, and Federal players. It serves as a source document for such individuals and is intended to synchronize and coordinate planning among the various emergency operation centers and

planning cells. The technical supplement will also be of value to emergency managers and decision-makers—both civilian and military—by providing background information and rationale for a variety of necessary decisions.

Response and Recovery*					
		Remediation/Cleanup			
Notification	**First Response**	**Characterization**	**Decontamination**	**Clearance**	**Restoration/ Reoccupancy**
Receive information on biological incident Identification of suspect release sites Notification of appropriate agencies	Initial threat assessment HazMat and emergency actions Forensic investigation Public health actions Screening sampling Determination of agent type, concentration, and viability Risk communication	Characterization of biological agent Characterization of affected site(s) Site containment Continue risk communication Characterization environmental sampling and analysis Initial risk assessment Clearance goals	Decontamination strategy Remediation Action Plan Worker health and safety Site preparation Source reduction Waste disposal Decontamination of sites or items Decontamination verification	Clearance environmental sampling and analysis Clearance decision	Renovation Reoccupation decision Long-term environmental and public health monitoring
*The optimization decision process is applicable to any phase					

Figure 1. Response and recovery phases to a wide-area biological contamination incident.

This technical supplement does not describe in detail public health responses (i.e., specific medical treatments) likely to be necessary following the release of a BWA. References for that topic can be found in the *Interim Guidance* document. Furthermore, our understanding of some technical details important in recovering from a wide-area biological agent attack is currently limited. The *Interim Guidance* document describes such gaps in knowledge, capabilities, and resources, and some of those gaps are identified in this technical supplement in the context of specific activities.

Several characteristics unique to the Seattle urban area differentiate it from other urban environments. Some of the unique environmental, economic, and cultural considerations that

must be considered during any site- and incident-specific BWA remediation effort are briefly discussed in Section 1. Despite regional differences, however, the guidance is applicable to:

- Enclosed facilities, such as commercial, residential, and continental U.S. (CONUS) military facilities.
- Semi-enclosed facilities, such as subways and public transit facilities.
- Outdoor areas (both localized and wide-area), such as building exteriors, streets, parks, and other open spaces.
- Drinking water facilities and water resources.

Section 1 concludes with a discussion of an example release scenario, which was developed by tailoring National Planning Scenario #2, a wide-area outdoor release of *B. anthracis*, to the Seattle urban area. Visual aids characterizing the example release scenario are included.

Section 2. Response and Recovery Structure

This section describes the roles, responsibilities, and relationships of organizations involved in responding to a wide-area biological attack in the Seattle urban area. The content addresses Federal, state, and local agencies, as well as military and tribal agencies, if any are involved, and how they should interact when responding to a terrorist threat or incident. It is expected that following a wide-area release of BWA, the governor would quickly request Federal assistance under the Stafford Act, with FEMA responsible for coordinating support from all Federal agencies and nongovernmental organizations, such as the American Red Cross. Emergency Support Functions (ESFs) provide the structure for coordinating Federal interagency support for a Federal response to an incident. In the context of a wide-area biological attack, ESFs group the functions most frequently used to provide Federal support to states under either declared disasters or for nonStafford Act incidents.

The Incident Command Structure (ICS) in each command center, according to the National Incident Management System (NIMS 2008), will be used to coordinate field operations. Under NIMS, the following command centers might be established:

- Multiple Incident Command Posts (ICPs).
- One or more Area Commands (ACs).
- Several Emergency Operations Centers (EOCs).
- Joint Field Office (JFO).

The Unified Command (UC) structure following a biological release will conform with the content of the NRF (DHS 2008) and implementation of NIMS (2008) guidance, as shown in Figure 2-1 of the *Interim Guidance* document. Four principal sections of the UC structure are the Operations, Planning, Logistics, and Finance/Administration Sections. In addition, it is recommended that an Environmental Clearance Committee (ECC) be convened, as was the case during the 2001 anthrax attacks. An ECC reviews relevant information on decontamination and all environmental sampling of sites and areas, including clearance environmental sampling data, and makes recommendations to the UC in the form of an independent review. A Scientific Support Coordinator (SSC) can be identified by the Incident Command or UC, and this individual can convene Technical Working Groups (TWGs) to evaluate data and make recommendations on technical aspects of the response. Suggested compositions (members) of the

TWG and ECC are distinct for responding to a biological incident, and possible participants along with their roles and responsibilities are discussed.

For a wide-area BWA attack, or the warning of such an attack, the military is prepared to respond with graduated, reinforcing response packages drawn from both the National Guard and active-duty forces under the umbrella of defense support of civil authorities (DSCA). Military support will coordinate operations with the local EOC and the local UC, and will be included in local Incident Action Plans. Both National Guard assets and active-duty forces resources are discussed along with FEMA's pre-scripted mission assignments for DOD entities under the relevant Emergency Support Functions.

Section 2 concludes with a discussion of the Emergency Management Assistance Compact (EMAC). In brief, when disasters exceed capacities of state and local resources, an EMAC can be invoked, which is a congressionally sanctioned mutual aid compact between states. This mechanism provides another means for states to receive interstate aid during a disaster.

Table 1. Recommendations for planning actions to be taken before a biological attack.

Responsible Personnel	Recommended Pre-Incident Actions
City of Seattle City of Tacoma Other local jurisdictions King County Pierce County Area Indian Tribes Washington State JBLM EPA DHHS	• Identify members of the command structure early in the pre-planning process. Determine which agencies contribute tactical or service resources versus those that supply technical assistance or special expertise. Members of the command structure should review this technical supplement and the *Interim Consequence Management Guidance* document (LLNL 2009). • Identify alternative locations for EOCs in the event that one or more EOCs are contaminated with a biological agent. • Identify tools and resources needed to support planning, characterization, decontamination, and clearance efforts, including sample analysis. • Identify candidate sites for marshalling resources, staging waste, and near-site waste-treatment activities, allowing for security, space, and transportation needs. • Identify medical stockpile resources within the Seattle urban area; determine distribution paths and options for treatment. • Identify potential members of a TWG. The TWG should review this technical supplement and the *Interim Guidance* document. • Identify potential technical specialists needed to support the Planning and Operations Sections. • Identify potential members of an ECC. The ECC should review this technical supplement and the *Interim Guidance* document. • Conduct periodic training exercises with likely command personnel, including TWG members, and other responder and agency representatives. Ensure they have appropriate health and safety training. • Organize identified resources and personnel into a database; update periodically because people and resources change over time. • Identify liaison to the JFO. • Establish notification protocols among Seattle-area agencies and area civilian and military organizations. • Prepare decision tree to determine need for expanding a UC into an Area Command. • Establish a process to integrate multi-jurisdictional agencies into a UC.

Section 3. Notification

This section is a brief overview of the notification process that will facilitate a timely and effective transition from response to recovery activities. Initial notification of a potential BWA incident could come from a detection system, such as BioWatch; the discovery of an overt release such as a white powder; or the occurrence of symptoms or disease (syndromic discovery). Depending on the incident, notification could occur one or more days after a release. State and local agencies involved in the receipt and assessment of information include the Washington State Department of Health, county public health departments, local medical facilities, and emergency responders (fire and law enforcement). The notification processes for these and other civilian entities are illustrated in flowchart form.

If a biological incident were to affect military assets in the Seattle urban area, the Washington State Department of Health would notify the Joint Base Lewis–McChord (JBLM) Public Health Emergency Officer. That officer would notify appropriate command personnel and the JBLM Department of Emergency Services, which would activate the JBLM Emergency Operations Center that acts as a central information hub. Notifications, in turn, from the JBLM Installation Dispatch Center are described.

Table 2. Recommendations for notification in approximate order of unfolding events.

Responsible Personnel	Recommended Actions
City of Seattle City of Tacoma Other local jurisdictions King County Pierce County Area Indian Tribes Washington State JBLM EPA FBI and local law enforcement DHHS	Seattle urban area emergency managers, public health officials, FBI, and local law enforcement personnel receive notification that: • A biological incident has been detected, or • A biological incident is suspected, or • Information about a credible threat is received as the result of a detection system, such as BioWatch, medical surveillance, or epidemiologic investigation.
	• Gather information, and continue to assess incident credibility, status, potential effects on the Seattle urban area, and the degree to which a response is needed. • Implement standard EOC communication protocols, including information dissemination via fax, Web-EOC, or other Internet communication tools.
	Seattle urban area emergency managers, public health officials, FBI, and local law enforcement personnel initiate notification by: • Following previously established notification protocols tailored to specific triggers at each stage of the developing incident by alerting responders (Federal, state, and local) or acting on direction from them. • Disseminating information, including preliminary risk communication and public health directives.
	Establish an Incident Command at the scene, and coordinate information at EOCs. Anticipate establishing an ICP for tactical management of a wide-area biological incident by the UC.

Section 4. First Response

First response activities begin with initial protective actions by local police and fire department personnel at or near the scene of a release, if the location is known. Other emergency operations personnel (e.g., emergency managers, HazMat teams, public health officials, the Environmental Protection Agency, and the Federal Bureau of Investigation) would be quickly called in. In addition to initial search and rescue, scene control, and law-enforcement activities, initial responses include containing the area(s) of contamination to the extent possible; protecting the crime scene(s); carrying out public health actions, such as treating potentially exposed persons; decontaminating people; mitigating any conditions that pose an immediate threat to human health; and environmental sampling and analysis. Identification of contaminated areas also commences.

Activation and deployment of local, state, Federal, and military resources are discussed. The numerous types of First-Response Phase response actions and missions are then summarized in a multi-page table. For each of the 20 identified actions or missions, responsible agencies or entities are identified. Topics such as the preliminary determination of zones, forensics investigation and attribution, environmental sampling and analysis, immediate decontamination of individuals and access areas, the dissemination of key information, and worker health and safety are discussed. Section 4 concludes with an account of how various command centers will plan for the transition to remediation and recovery activities. The Washington State EOC will refer to Annexes L and M in the *Washington State Emergency Operation Plan* to facilitate such a transition. During the transition, the composition of the UC within county and city EOCs will change to address new priorities and objectives related to local characterization, decontamination, and clearance. Such activities will use the framework for prioritization, outlined in Section 5, and the risk-based remediation decision methodology, described in Section 6, of this technical supplement.

Table 3. Recommendations for First-Response-Phase protocols.

Recommended action	Comments and approaches
Depending on the method of discovery, first responders, the FBI, the EPA, public health responders, or some combination, will initiate collection and analysis of screening environmental samples as quickly as possible	• Purposes of sampling include determination of the agent's identity, viability, characteristics, and susceptibility to antibiotics; extent; exposure scenarios; public health measures; and subsequent remediation actions. • Initial sampling is done by local response teams. Sample-collection assets vary as a function of local response planning. • Sample analysis is conducted by local LRN capabilities, supplemented by other labs geared to handling LRN surge capacity. • BioWatch mobile BSL-2+ laboratory could be deployed and made operational in 24 hr for sample surge support (100s of samples/day, operated by 2 to 3 people). Throughput varies by sample type.
First responders, state and local EOCs, FBI, EPA, or DHS NOC activates IMAAC and requests assistance in performing plume modeling to estimate the extent of contamination and potential population exposures. Fate and transport modeling is refined as additional data become available.	• Use IMAAC and BioWatch 24/7 capabilities, per the NRF. • Use plume modeling results as input for sampling plans, characterization, and decisions on public and worker protection. • Continue to update results as more sampling data become available. • Initial reachback models may be highly uncertain.
Elected officials, first responders, the FBI, EPA, and public health officials apply initial personnel protection, decontamination, or mitigation methods to avoid the spread of contamination.	• Issue guidance to individuals in the plume to use available masks (i.e., N95 or better). • Instruct individuals to bag clothing and shower. • Reduce immediate potential for re-aerosolization by instructing fire departments to wet down areas, as feasible, after considering impacts. • Direct homeowners to turn on sprinklers and keep grounds moist until further notice. • Provide guidance on decontamination of companion animals.
Elected and public health officials will consider a combination of shelter-in-place and evacuation measures tailored to the specifics of a release and the populations potentially affected. Augment with medical countermeasures for those remaining in place and those who evacuated or left the scene. (Approach assumes medical countermeasures will be effective. If the strain is antibiotic-resistant, an overall evacuation may be needed, and casualties will be greater.)	• Make plans to provision Seattle-area locations used as mass shelters. • Implement a strategy for the orderly evacuation of people at high risk for anthrax, those who may refuse antibiotics, and those determined to leave the city. • Implement a plan for distributing medical countermeasures using postal service options, distribution centers, or both.
Elected officials and public health officials will ensure that information is communicated to stakeholders and the public in an accurate, timely, and consistent fashion.	• Follow the guidance in Table 4-1 in the *Interim Guidance* document. • Deliver consistent messages, coordinated among local government and nongovernment sources along with Federal officials. • Have trusted locals, supported by Federal health authorities, take the lead in delivering health-risk-related and educational messages.

Transition to Remediation

Section 5. Prioritization of Essential Assets and Functions

Numerous buildings could be contaminated after a *B. anthracis* attack in the Seattle urban area, many with great economic or social value. The disruption to daily life could be debilitating to the community. Thus it is vitally important for community leaders to work with stakeholders and expert analysts to chart a strategy aimed at minimizing long-term disruption. Because the specific distribution of contamination over a wide area cannot be known in advance, this section offers a general approach for prioritizing areas and infrastructure to be characterized and remediated, together with examples of assets (e.g., fire stations and hospitals) and functions (e.g., emergency and medical services) in the Seattle area to be prioritized.

The prioritization methodology must address at least four objectives identified in the Homeland Securities Institute (2005) *Wide-Area Biological Restoration Final Report*, namely (1) minimizing adverse health effects, (2) minimizing socio-economic disruption, (3) minimizing costs, and (4) maximizing public satisfaction. The 8-step prioritization strategy that is recommended in Section 5 stresses the essential role of community leaders in working with area stakeholders and expert analysts to chart a strategy aimed at minimizing long-term disruption to the area. The approach, which is summarized in Figure 2, sets priorities according to an evaluation of benefits and costs of available remediation actions. The process described for a wide-area incident expands the underlying principles found in the *Interim Guidance* document. Steps 1 through 7 identify assets and facilities to be remediated and place them in rank order according to the functions they support. Step 8 weighs the rank-ordered list against available resources to produce a strategy for remediation. As remediation progresses, changes can occur in any of the inputs to the prioritization process, causing changes to strategy. Remediation planning is an iterative effort from beginning to end, and it must be adaptable to changing conditions.

General recommendations related to prioritization include cleaning outdoor areas before indoor facilities, in particular, those areas surrounding priority assets slated for decontamination. Optimization tools to assist with prioritization, resource planning, and resource allocation include the Prioritization Analysis Tool for All-Hazards (PATH) and Analyzer for Wide-Area Restoration Effectiveness (AWARE). PATH is an analysis and decision-support tool for decision-makers to prioritize critical infrastructure for remediation in preparation for, or during, wide-area recovery. PATH works in tandem with the analysis tool AWARE to provide recovery timelines, enabling critical-path analysis and the optimization of resource allocation and management according to restoration priorities.

DOD instructions are to give remediation priority to Mission Essential Functions and supporting critical mission facilities, the latter of which are identified. Section 5 concludes with a discussion of the roles of a regional task force and local political leaders as they relate to prioritization. In general, such individuals will work with interagency representatives at Federal, state, and local levels to decide how best to use available remediation assets. Once prioritization decisions are made, it is the responsibility of the UC to update stakeholders periodically about review and revision of remediation plans.

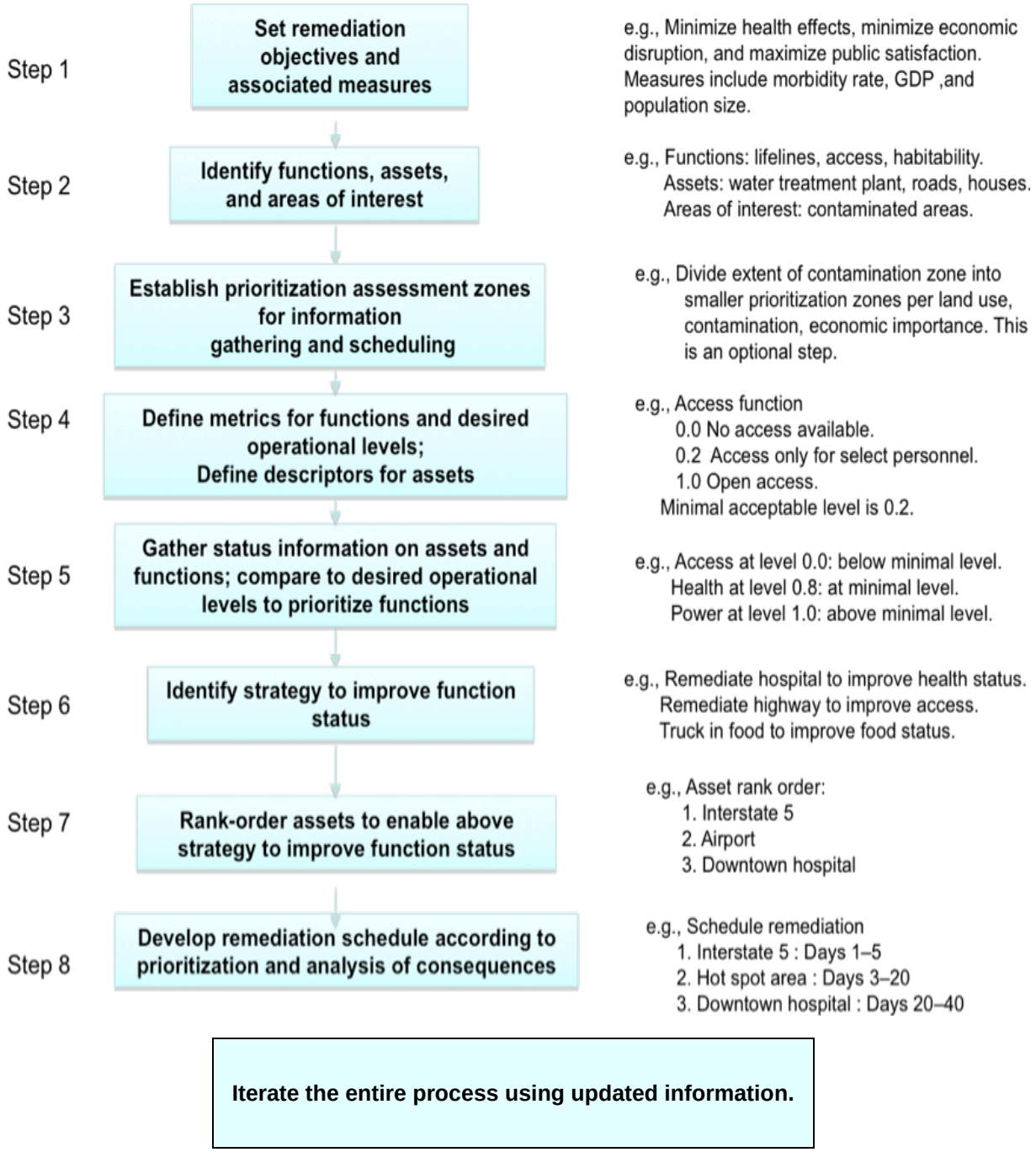

Figure 2. Recommended 8-step prioritization methodology with examples for each step.

Table 4. Summary of recommendations for prioritization.

Recommended item, action, or process	Comments, qualifications, responsible entity or specific approaches and tools
Identify outdoor areas with potential for continued exposure to the public by particle re-suspension or other means.	Use available characterization tools. See Section 7.
Collect information about affected critical infrastructure, and determine the sub-set of critical infrastructure referred to as minimum essential infrastructure (MEI).	Use the *DHS National Asset Database*, NISAC, and other sources to identify critical infrastructure.
Form a prioritization working group of government, business, military, health officials, and stakeholders.	Assign metrics and value to affected assets considering remediation objectives. Provide continued input to the UC throughout remediation.
Set remediation objectives based on public health issues, economic considerations, and national security implications.	See Section 6.
Prioritize areas and infrastructure to be remediated in terms of asset value, availability of work-arounds, critical timelines, dependencies, and political considerations.	Use available tools such as PATH or multi-attribute utility theory (MAUT). However, recognize that the tools have not been used for a wide-area catastrophic incident and, depending on the scale of an attack, may have limitations.
Use an optimization-planning tool to develop the remediation strategy, considering available resources, costs, and asset values.	Consult experts. Consider using planning tools such as AWARE, CPLEX (commercially available), or COIN-OR (commercially available). However, recognize that the tools have not been used for a wide-area catastrophic incident and, depending on the scale of an attack, may have limitations.
First, commence remediation of outdoor areas that remain hazardous to health. Proceed in order of prioritized assets. Proceed to indoor and water-source remediation, as necessary.	See Section 8.

Section 6. Human Health Risk and Clearance Goals

This section addresses the important topics of human health risk and clearance goals that are central to almost all remediation choices. The purpose of risk assessment is to characterize potential adverse health effects arising from varying levels of exposure to *B. anthracis* spores. The four steps in a risk assessment, namely hazard identification, dose–response assessment, exposure assessment, and risk characterization, are described. In brief, hazard identification in the context of a wide-area biological attack is the process of determining whether exposure to *B. anthracis* spores can cause an increase in the occurrence of anthrax disease. A dose–response assessment determines the likelihood that a person will become ill or die after having been exposed to a given dose of *B. anthracis* spores. The historical mortality rate for inhalational anthrax in humans has been estimated to be as high as 90%, but data on doses of *B. anthracis* spores to the victims are extremely limited. People with pre-existing medical conditions or with immuno-compromised systems are likely to be at higher risk than others. The number and extent of uncertainties associated with data relevant to dose–response relationships, particularly in humans, make it problematic to perform a quantitative dose–response assessment at this time. For the purposes of this technical supplement, exposure assessment is defined as the process of estimating the intensity, frequency, and duration of human exposures to *B. anthracis* spores in

the environment following a wide-area, airborne release in the Seattle urban area. Persons could be exposed by inhalation of airborne spores, through dermal contact, and possibly after ingestion of spores. A summary table shows the notional likelihood of adults and children being exposed to *B. anthracis* spores by the principal exposure routes. Although *quantitative* exposure assessments for *B. anthracis* spores are problematic, *qualitative* exposure assessments can be performed from the results of all relevant environmental sampling activities. Risk characterization in the present context translates the contamination level and dose–response relationship into an expected number of illnesses, mortalities, or both. Qualitative risk assessments will be performed multiple times during the response to and recovery from a wide-area *B. anthracis* attack in the Seattle urban area to support different activities, namely, to demarcate contamination boundaries, to help the UC determine what sites should be remediated, to establish clearance goals for specific sites, and to estimate residual risks from remediated sites and ascertain whether clearance goals are met.

Risk management is the process of evaluating alternative activities to address a specified risk, and then selecting actions from among them. The decision-making process entails consideration of political, social, economic, and technical information in conjunction with risk-based information to develop, analyze, and compare options for action and then to select the appropriate option. In the case of a wide-area release of *B. anthracis* spores, the options to be evaluated involve the need for and extent of remediation of contaminated sites and priorities for the order of remediation of those sites. Risk management decisions for the Seattle urban area will be made by the UC in consultation with key local, state and Federal officials.

After outlining the steps of risk management, the numerous challenges associated with setting "acceptable cleanup levels" (i.e., clearance goals) are explained. A clearance goal in the context of this technical supplement is defined as an amount of residual *B. anthracis* spores in an area (e.g., in the air, on surfaces, in soil, or in water), which, once achieved following the conclusion of all decontamination activities, provides acceptable protection to human health and the environment. Clearance goals after a wide-area attack would be needed for indoor, outdoor, and water sources. Following a wide-area attack, a policy of "no growth of *B. anthracis* spores on all clearance environmental samples" might not be feasible for all contaminated indoor or outdoor areas; however, no current evidence supports a less-stringent alternative to this option. A possible outdoor clearance goal is "no viable anthrax spores detected above background levels from any high-volume (and possibly aggressive) air sampling." In the absence of consensus water guidelines, starting points for water clearance goals are suggested. The proposed clearance goals are summarized in Table 5.

The remainder of Section 6 provides example risk assessments for the Seattle urban area following a biological attack. An example of a conservative dose–response relation for inhalation anthrax is given. Following discussion of a conceptual risk model, two hypothetical cases of risk assessment and management options for Seattle-area facilities are presented: one for a large distribution center (such as that for Costco or Target) and another for selected container terminals and intermodal railroad areas located at the Port of Seattle.

Table 5. Recommendations related to risk management and clearance goals.

Recommended action	Comments
Perform Risk Assessments: • Perform a qualitative microbial risk assessment using all applicable resources, including environmental sampling data, data from number and distribution of anthrax cases, and relevant epidemiological data. Provide the assessment to the UC to be used along with other risk management considerations to establish and approve clearance goals. • Consider population distribution and land use in determining risk assessment assumptions for specific sites and areas. It is expected that 4 types of risk assessment will need to be done (some multiple times) over the course of remediation.	• Assign contaminated areas and sites to high, medium, low, or negligible risk categories for use in risk management. • Risk estimates are site-specific for inhalation, cutaneous, and ingestion pathways. • All assumptions need to be clearly identified. • The UC, all relevant public health officials, and other key stakeholders must agree on priorities determined by risk assessment. • Initial qualitative risk estimates will be conservative, but may be relaxed with time.
Consider Options: Establish whether conventional remediation is necessary by understanding the risks (see above) and associated costs, or consider other management options, or incorporate a combination of both. Options include: • Medical intervention and health monitoring only until long-term risks can be better quantified. • Cleanup to level such that all clearance environmental samples demonstrate no growth of *B. anthracis* spores • Apply temporary low-level cleanup to reduce risks, and apply full cleanup later. • Remove facilities and soil from area using appropriate procedures to prevent spread of contamination during removal and transport to disposal site. Rebuild • Maintain a long-term abandonment with appropriate security and monitoring controls.	• Risk management options represent tradeoffs between reduced risk and costs. • Reduced risk based on medical prophylaxis is not a long-term solution. • Risk assessments may change later in the process, if better exposure-related data become available.
Continue Air Sampling: Continue air sampling of areas post-remediation, including monitoring of areas not decontaminated.	• Contamination levels can change with time. • Some areas may be missed.
Maintain Medical Monitoring and Countermeasures: Maintain medical monitoring of all sites. Maintain medical countermeasures (prophylaxis and vaccination) for all remediation workers until the remediation is complete. Consider medical countermeasures for those persons, other than remediation workers, who may enter sites at which partial cleanups have been conducted.	• Contamination levels can change with time. • Risk assessment has large uncertainties.
Maintain Documentation: Document risk assessment and management process, including how information was gathered, assumptions, and uncertainties	• Provide information to the UC as well as the public.

Table 5. Recommendations, continued.

Recommended action	Comments
Set indoor clearance goal: Use the current clearance goal for building interiors, namely, "no spore growth on all post-remediation environmental samples" unless other data become available showing that a less conservative approach can be taken, or if the risk assessment for a site- and situation-specific incident justifies a less conservative value. See Section 7 for a discussion of clearance criteria (number of samples needed and confidence in the sampling results.)	• Same as the EPA cleanup clearance goal used for the interiors of anthrax-contaminated buildings following the 2001 attack (GAO 2003). • 2003 NAS committee found no scientific basis for establishing a level of residual *B. anthracis* contamination that could be safely left behind for indoor facilities. • Consider alternatives, such as assessing the incidence of disease as a criterion or using the best engineering practices and operational controls.
Set outdoor clearance goal(s): • As yet there are no defined clearance goals for outdoor remediation. Goals will be site- and incident-specific. • A recommended clearance goal for outdoor contamination is "no viable *B. anthracis* spores above background levels detected from any high-volume (and possibly aggressive) air samples." • It may be necessary to set an additional surface clearance goal for gastrointestinal and cutaneous anthrax, although there are currently are no infectious dose numbers.	• The primary goal is based on understanding and eliminating inhalation risk only, thereby requiring high-volume aggressive air sampling for verification (see Section 9). • The primary recommended outdoor clearance goal assumes some surface samples can be positive. • Consider alternatives, such as assessing the incidence of disease as a criterion or using the best engineering practices and operational controls.
Set water resources clearance goal: • Risk trade-offs must be considered as part of the decision-making process for monitored natural attenuation versus other treatment methods. Monitored natural attenuation is an option for consideration. • Approaches to strictly limit or prevent secondary contamination of water systems should be incorporated into remediation planning.	• Drinking water is already treated with disinfection products, which may help reduce spore concentration. • Other approaches may be impractical or may cause undue harm to the environment.
Set drinking-water distribution-system goal: • As a starting point, refer to USACHPPM (2008) *Technical Guide 188* for levels of *B. anthracis* spores in drinking water that cause illness (57 spores/L for drinking 15 L/day; 171 spores/L for drinking 5 L/day for 7 days). • Point-of-use water treatment options (see Section 8) may need to be considered for implementation.	• Individual states have drinking water regulations based on stakeholders' requirements, and this fact must be taken into account when determining water guidelines related to an anthrax attack in the Seattle area. • Reuse of a previously contaminated drinking water distribution system must be approved by appropriate agencies in the State of Washington.

Section 7. Characterization

Characterization provides remediation planners with estimates of how widespread the contamination is by assessing outdoor surface contamination, outdoor air contamination from re-suspension of spores, and indoor contamination of facilities. With the important proviso that environmental characterization approaches would be adapted to the specifics of an actual incident, Section 7 addresses three cases in which little or no information (e.g., syndromic discovery), some information (e.g., BioWatch detection), or good information (e.g., a witnessed, overt release) is available to planners about the contamination from *B. anthracis* spores following a wide-area attack. The discussion in general follows the step-by-step decision flowchart that was developed for the *Interim Guidance* document. Early on, little will be known about the relative degree of contamination of different sites or areas, the overall extent of contamination, and the associated health risks, and estimates can have large uncertainties, but the process of characterization continues until risk management, prioritization, and decontamination decisions can be made with confidence.

Information from first responders, including any sampling and early containment measures taken, together with meteorological assessment and site-specific characteristics (such as Seattle-area population density), as well as data on case distribution, are used to help develop initial fate and transport models. As much information as possible about agent properties—such as positive confirmation of the type of biological agent involved, agent characteristics (e.g., particle size, propensity to resuspend, and hydrophobicity), bacterial strain, viability, and susceptibility to antibiotics—is obtained. Site-specific characteristics needed for environmental characterization include regional meteorology, geographical and land cover classifications (e.g., developed versus forest), building density and types, principal pathways for fomite transport (e.g., roads), and drinking water resources, among others, and each is discussed in turn.

Comprehensive characterization sampling strategies are then developed to make the best use first of regional—and subsequently of national—resources, including sampling support and analytical laboratories. Regional environmental sampling resources include local EPA contractors and Region X sampling teams, the Washington National Guard 10th Civil Support Team, and the Joint Base Lewis–McChord 110th Chemical Battalion (Technical Escort) sampling capabilities. Local analytical laboratories include the local Laboratory Response Network (LRN) BioWatch laboratory, which has cooperative agreements with several other laboratories in the region, including LRN laboratories in Tacoma, Spokane, Oregon, and British Columbia. Regional infrastructure and facility information as well as GIS support is available through the counties, local agencies, and private parties, examples of which are identified. In the short term, the primary local source for modeling and meteorological information is the Washington State Department of Ecology, which has an extensive air-monitoring system deployed throughout the Seattle area. EPA Region X staff would contact EPA Headquarters with requests to augment Seattle-area resources with outside resources, such as mobile laboratories, technical specialists from throughout EPA, analytical resources from the U.S. Army Medical Research Institute of Infectious Diseases, the BioWatch Emergency Sampling Team, and Federal meteorological support obtained from the National Oceanic and Atmospheric Administration. Federal airborne fate and transport modeling resources would be coordinated by the Interagency Modeling and Atmospheric Assessment Center (IMAAC) upon activation. The importance of data management, visualization, and analysis systems and tools necessary to support characterization

is stressed, and several tools that can be used for those purposes are recommended (e.g., SCRIBE, BROOM, and VSP), with supporting information about them provided in Appendix D.

Initial characterization goals are to (1) begin to estimate the extent of residual surface contamination, and (2) begin to map patterns of residual surface contamination as a means to infer (a) where the release device was located and (b) areas that present a greater health risk. Characterization zones are developed and refined over time to reflect the information that is currently available. A general characterization strategy for the first 1 to 2 weeks following a wide-area release is outlined in some detail for the three defined cases of attack identification (i.e., little, some, or good information is known). Ongoing characterization after the first few weeks, which would largely focus on refining contamination boundaries and identifying remediation zones, will be incident-specific and cannot be planned ahead in detail. However, several techniques are useful in refining characterization results to support risk management, prioritization, and decontamination decisions. Examples include event reconstruction derived from fate and transport modeling, geostatistical methods, and adaptive sampling methods. As characterization proceeds, data are provided to the Situation Unit. Additional characterization activities are planned, as needed, according to input from environmental risk assessors, decontamination planners, public health authorities, and the UC.

Table 6. Summary of recommendations for characterization.

Recommended action or process	Comments and qualifications
Modeling: • Consult with fate and transport modeling experts to obtain initial plume modeling results. • Use plume model results to inform sampling plans, extrapolate the extent of contamination from available sampling data, and interpolate between confirmed contamination measurements. • Update plume models as new sampling data become available as part of an iterative process to characterize extent of contamination.	• Zone boundaries are determined by contaminant levels and health-risk assessments (Section 6). • Per the NRF, contact IMAAC to perform fate and transport modeling and event reconstruction.
Sampling strategies: • Initial priority is to estimate the overall extent of contamination. • High-priority infrastructure or functions may be characterized simultaneously with characterization for overall extent. • Address the issue of whether or not to decontaminate as the sole purpose of sampling. • Determine appropriate characterization environmental sampling strategies. Consider judgmental, systematic, statistical, and geostatistical approaches.	Evaluate sampling strategies appropriate to the spatial scale and specifics of the incident. For example, obtain: • Judgmental samples to target specific locations. • Systematic samples based on grids or transects. • Statistical samples to evaluate random locations. • Geostatistical analyses to optimize sampling design. Plan initial characterization per local LRN throughput described below. Sampling personnel are sufficient for this effort. Pre-incident sampling zones based on regional land cover for a minimum-information scenario have been developed for this technical supplement.
Sampling methods: • Determine appropriate sampling methods for potentially contaminated outdoor, indoor, semi-enclosed, and water system locations. • Aim sampling at determining whether or not a health	Recommended methods are: • Surface sampling to determine contaminated zone(s) and help define extent of contamination. – HEPA vacuuming for porous surfaces, HVAC filters, and all large-area samples, including those for

Recommended action or process	Comments and qualifications
risk exists, with emphasis on inhalation risk for *B. anthracis*. Understanding re-aerosolization and re-suspension is the primary goal.	nonporous surfaces. – Small numbers of wipes and swabs for nonporous surfaces, as needed. • High-volume air sampling to characterize inhalation risk in the contaminated zones. • Bulk samples for water distribution/treatment systems.
Laboratory analysis methods: Use the best available sample analysis capabilities. • Use PCR to test for the presence or absence of biological agents, but not viability. RODAC agar plates are recommended for detection on surfaces of sanitary importance. • Use RV-PCR when possible for rapid-viability analysis. Plate count is the recommended "gold standard" for determining the viability of *B. anthracis* spores.	• Local LRN laboratory can process 50 surface samples/day PCR, with 1 in 10 for viability, by running multiple shifts and can maintain this level for two to three weeks. • Local LRN has cooperative agreements with other laboratories in the region, including Tacoma and Spokane, as well as with laboratories in Idaho and British Columbia. Total combined surge capacity of laboratories is fewer than 100 samples per day. • LLNL mobile HTP lab can process 100s to 1000s of most sample types per day; ~200 soil or vacuum-sock samples/day. • For more analysis support contact other labs, such as – DHS LLNL/NCR BioWatch. – DHS LLNL HTP BioWatch laboratory in Livermore, CA. – CDC in Atlanta, GA. – USAMRIID in Frederick, MD. • At least 1200 samples/day can be processed using all existing assets.
Data Management methods: • Use a rapid data-collection, processing, storage, and reporting system. Recommend using systems with which local responders are most familiar. • Other tools would be used for statistical sampling design, including VSP [offered by Pacific Northwest National Laboratory (PNNL)], BROOM [offered by Sandia National Laboratories (SNL)], and F/S Plus (EPA).	Recommended methods today are: Outdoors: • SCRIBE–offered and used currently by EPA. • Also consider the EPA Region 6 Response Manager web-based system. Indoors: • BROOM–offered by SNL.
Iteration: • Iteratively plan and perform sampling and modeling to refine remediation zone and contamination zone boundaries. • Work to reassign indeterminate areas as either needing or not needing remediation. • Within remediation zones, categorize facilities or functions according to the prioritization framework (Section 5), risk assessment (Section 6), and facility characteristics.	• Characterization sampling and modeling must be iterative processes because of acquisition of new data, natural attenuation, tracking, re-aerosolization, re-suspension, and other fate and transport mechanisms. • The result of characterization is a list of areas and facilities designated as needing remediation and facilities or functions organized by remediation priority.

Section 8. Decontamination

The purpose of decontamination is to clean up areas affected by a wide-area biological release, with the highest priority placed on human health and restoring critical infrastructure first to minimize economic and social impacts to the area. Choices regarding decontamination technologies should focus on identified best practices while taking into account cost–benefit and risk–benefit considerations together with site-specific environmental parameters. This section addresses the prioritization of decontamination activities, required tools and techniques, pet and wildlife issues, indoor versus outdoor decontamination, preparation of one—or likely multiple—Remediation Action Plans, decontamination implementation, verification of decontamination processes, and the important issues of waste management and disposal. Every decision about which decontamination method to apply needs to be site-specific, including the possible use of monitored natural attenuation in areas or facilities that may be deemed less critical than others for remediation. In accordance with the Washington State Comprehensive Emergency Management Plan, agencies that should be part of decontamination decisions are identified.

Because the numbers and types of facilities potentially contaminated in the hypothetical Seattle urban area scenario would exceed previous experience, all feasible decontamination methods should be considered. A multi-page table in Section 8 summarizes the key properties and characteristics of decontamination reagents demonstrated in the scientific literature to be effective for treating *B. anthracis* contamination. Information is organized in terms of efficacy and practicality of a given technology, safety (e.g., materials compatibilities and human health effects), impacts on scheduling, costs, and waste issues. Appendix E describes the decontamination approaches further according to critical factors and performance metrics. Topics addressed in this section include the immediate decontamination of people and clothing per CDC recommendations, source reduction (decreasing the amount of contamination within a facility prior to undertaking the main decontamination activity), monitored natural attenuation for areas deemed less critical than others, citizen-performed decontamination, and decontamination strategies for wildlife, pets, and livestock.

Indoor decontamination encompasses both enclosed structures (houses, buildings, infrastructure facilities, businesses, and hospitals) and semi-enclosed buildings (e.g., sports venues such as Qwest Field and Safeco Field, bus terminals, train stations, and platforms such as Seattle Amtrak station). Indoor decontamination techniques can be selected to address surface hotspots (e.g., on flooring, furniture, and in crevices), sensitive and valuable items (e.g., artwork, documents, and electronics), broad surfaces (e.g., floors and walls), and volumetric spaces (e.g., entire rooms and HVAC systems). Most of those categories can be further divided in terms of porous and nonporous surfaces present. Decontamination of hotspots on low-value surfaces can be achieved using many of the decontamination products containing pH-amended bleach, calcium hypochlorite, aqueous ClO_2, hydrogen peroxide/peroxyacetic acid, or hydrogen peroxide. Options for indoor surface decontamination include application of vapor-phase hydrogen peroxide (VPHP), which is more efficient if porous or reactive surfaces are removed. The use of gaseous ClO_2 can cause corrosion in sensitive electronics and bleaching of colors on photos, artwork, and textiles, so removal and offsite decontamination of essential items is recommended before fumigation in enclosed areas. For high-value and sensitive items, offsite decontamination possibilities include techniques such as ethylene oxide, gamma irradiation, and x-ray or electron-beam irradiation. Indoor fumigation will be limited in both schedule and scope by the number of

vendors able to perform onsite decontamination activities. The current capacities of gaseous ClO_2 fumigation and VPHP indoor decontamination are discussed.

Outdoor strategies for wide-area decontamination have not been well tested. Thus, they must be carefully considered and, if possible, field tested before implementation. Various options are discussed, including the use of soil stabilizers (e.g., mulch), building containment (shrink wrapping), and application of fixatives to temporarily bind spores in place and avoid re-aerosolization and re-suspension. For those areas where decontamination is not feasible, such as large areas of soils and vegetation, monitored natural attenuation should be considered. Where outdoor decontamination is necessary, four options are presented. Because none of the approaches have been comprehensively validated, plot-scale testing is strongly recommended. In brief, the alternatives are:

- **Option 1 for Evaluation**. Wash contaminated buildings and surfaces with a liquid decontaminant reagent using fire-fighting equipment and specialized aircraft.
- **Option 2 for Evaluation**. Wash building exteriors and street surfaces with equipment, such as fire trucks, using a mild surfactant in water, then decontaminate the liquid runoff and ground using a decontaminant.
- **Option 3 for Evaluation**. Facilitate spore decontamination by spraying an inexpensive nutrient solution or germinant to initiate desporulation. (This option is still undergoing research and development.)
- **Option 4 for Evaluation.** Treatment of spore-contaminated water with high doses of chlorine has a limited (2-log) ability to kill spores. Flocculation, and sedimentation followed by sterile filtration, give better (>3 log) performance. Point-of-use decontamination techniques, such as membrane filtration or boiling in a covered vessel for at least 10 minutes should be considered.

In terms of outdoor decontamination, for hard, nonporous surfaces, the choice of decontamination reagents include pH-amended bleach, liquid chlorine dioxide, and other products such as hydrogen peroxide. Decontaminating soils has the potential to reduce the capacity for future vegetative growth in those soils. Field testing would be required to define the appropriate initial concentration of a decontamination reagent and impacts to soil productivity. Given the Seattle climate, a reasonable approach may be to wait to decontaminate areas with substantial vegetation or many trees to allow the opportunity for precipitation to wash down spores. Methods for applying decontamination reagents and appropriate volumes and areas scales are summarized in table format.

Section 8 contains a discussion of waste-management and waste-disposal options, which can greatly affect the pace and costs of remediation. Throughout remediation, all Federal, state, and local regulatory requirements concerning the environment, public health, worker safety, and transportation of potentially hazardous materials must be met. Any discharge of treated wastewater, for example, would require waste-discharge permits or waivers from the Washington State Department of Ecology and potentially from King County and the City of Seattle. Topics covered under waste management include waste categorization, waste management storage and accumulation areas, and the EPA's web-based decision-support tool (DST) developed to assist decision-makers in planning the disposal of residual materials from remediation of contaminated buildings and building infrastructure.

Summary

The Remediation Action Plan RAP is the approved work plan implemented by the UC and used to guide operations by describing all actions required to remove, reduce, or eliminate contamination at the site(s) to specified levels. Whether there is a single, master RAP or a series of sequential and case-specific RAPs will be determined by the details of a situation and risk-prioritization considerations factoring in safety, cost, schedule, and feasibility. Topics addressed in the RAP include establishing the necessary infrastructure for remediation, organizing and staging engineered decontamination processes, ensuring safe working conditions, and preventing the spread of contamination. Members of the Technical Working Group of the UC are expected to provide information for several RAP sections, including those addressing the contaminated site(s), project team members, incident details, initial responses, and results to date. Because the RAP specifies how remediation activities will be carried out in detail, the UC, coordinating with appropriate state, local, military, and tribal authorities, must approve the plan before it is implemented and must approve any changes as remediation progresses. Prior to RAP approval, input from, and interactions with, stakeholders must be solicited. Following a discussion of the principal steps for implementing decontamination, Section 8 concludes with an example of decontamination for selected parts of the Port of Seattle and Harbor Island area.

Table 7. Summary of recommendations for decontamination.

Recommended strategy	Comments or qualifications
Decontamination Planning	
Determine if decontamination needs to be done; consider implementing medical countermeasures as the primary protective measure, or proceed with a combination of both. • If no inhalation hazard exists in a specific location, decontamination may not be necessary, but consider gastrointestinal and cutaneous risks. • Surface contamination may represent a potential cutaneous anthrax health hazard, which can be mitigated by medical monitoring and treatment, and targeted surface decontamination.	The UC, TWG, and Planning Section review characterization data and determine incident- and site-specific trade-offs. • Use risk-based approach (Section 6) and cost analysis. • Use medical countermeasures, assuming antibiotics and vaccines are available and effective. • Implement risk communication (Section 4). • Implement targeted surface decontamination (Table 8-1).
Identify areas and infrastructure to be decontaminated versus implementing removal, reuse, or disposal options according to characterization results and agreed-on clearance goals. • See Sections 6 and 7 recommendations for goals. • See "EPA's Suite of Disaster Debris Management and Disposal Decision Support Tools," available at <http://www2.ergweb.com/bdrtool/home.asp> to assist with assessments.	• Minimize waste to focus remediation efforts per characterization results. Only high-value items, perishables, and reagent-consuming items should be removed from contaminated areas to manage costs, reduce time, and address limited space. • Incorporate a cost–benefit analysis in decisions concerning retention versus disposal versus decontamination in situ of all other items.
• Establish decontamination zones, and control access and egress according to characterization results, updated data, modeling results, and decontamination options. • Establish transition areas, with access control, into and out of the decontamination zones • Identify key assets in each zone. • Set decontamination priorities by coupling previous infrastructure prioritization with remediation strategies to optimize schedules and costs.	• UC works with the Planning Section to rank key assets by priority (Section 5). • UC works with the Planning Section to create protocols for entrance to and exit from key assets to mitigate potential for cross-contamination. • UC works with the Planning Section to identify the materials and equipment required, staging and storage, as well as transportation and shipping for those resources.

Recommended strategy	Comments or qualifications
• Identify staging areas for contaminated waste and equipment, decontaminated waste and equipment, and clean areas to store material and equipment (possibly Boeing Field). • Consider building isolation and maintenance of key access routes, like entrance and exit corridors (see Sections 8.5.1 to 8.5.2).	
• Prepare a strategy for handling pets, wildlife, and livestock, including vector control. • Identify and procure goods and services required for decontamination.	• UC works with WSFWS to establish procedures for decontamination, evacuation, and carcass disposal for pets and wildlife. Vector control may be necessary for rodents, feral pets, and other vermin. • UC works with the Planning Section to establish contracts and procure subcontractor services for a qualified workforce and other resources.
Evaluate monitored natural attenuation versus engineered in situ decontamination options. Use high-volume air sampling in key areas to determine if inhalation threat exists (should have been done during characterization and before any decisions regarding decontamination).	• Monitored natural attenuation (simply waiting with periodic sampling and analysis) should be considered as a decontamination option within a risk-based framework. • Use caution because *B. anthracis* spores can remain viable for long periods in the environment.
Plan for decontamination activities, and plan to prepare RAP(s). Choose the specific decontamination approach for each environment. • No single technology is effective in every situation. • Tailor decontamination approach to available resources. Understanding available resources as early as possible in the planning process helps narrow the choices. • Choose decontaminant appropriate for surface material (Table 8-1). • Inventory surface areas and estimate the volumes of decontaminant required for surface areas to be decontaminated (see Sections 8.5.3 and 8.5.6). • Choose reagent dispersal technique appropriate for spaces and areal scales (Table 8-2).	Emergency exemptions for reagents may be required. Those decontaminants given prior EPA approval under crisis exemptions are: • Vaporous hydrogen peroxide • Liquid and gaseous chlorine dioxide • Liquid sodium hypochlorite (diluted 1:9) • Solid paraformaldehyde heated to gas • Gaseous methyl bromide • Liquid peroxyacetic acid with hydrogen peroxide • Liquid hydrogen peroxide • Gaseous ethylene oxide (EtO).
Decontamination Operations	
Initiate source control and agent stabilization methods, as needed. **For highly contaminated outdoor areas**, perform hotspot decontamination, stabilization, or source removal early to prevent the further spread of contamination. **For high-source-term indoor areas**, tailor treatment to porous versus nonporous surface types.	In high-source-term areas outdoors: • Consider fixative strategies used for alpha radioactive contamination (e.g., spraying oil or paint suspensions to bind material to fixed surfaces) or soil stabilization methods. • Apply adjusted sodium hypochlorite solution or strong oxidants (documented sporicides per Table 8-1), or implement removal and disposal options. For high-source-term areas indoors: • Use HEPA vacuuming first on porous surfaces • Then use surface treatment (e.g., adjusted sodium hypochlorite solution or other strong oxidants documented as sporicidal chemicals).

Summary

Recommended strategy	Comments or qualifications
Conduct necessary outdoor decontamination first, before decontaminating facilities within the contaminated footprint.	Ensure that facilities remain free of contamination from a continued source of spores or vegetative cells.
For outdoor, wide-area, surface decontamination, select from three approaches (see Section 8.5.4): Option 1: Wash down buildings, streets, and surfaces with liquid decontamination reagent. (e.g., bleach solution, peroxygen solutions) and evaluate alternatives in Table 8-1. Option 2: Wash down buildings and streets with water–surfactant solution to mobilize spores, followed by liquid reagent to treat runoff, as described above in Option 1. Option 3: Spray a germinant solution to initiate spore growth, making spores more vulnerable to natural and engineered decontamination approaches. Once in vegetative form, use a lower-concentration decontaminant from Table 8-1, or use chemicals that can cause cell rupture via osmosis. Note: Collecting runoff from Options 1 and 2 should be evaluated and implemented, as appropriate, or permissions obtained to allow discharges to combined sewer system in the Seattle area .	• Minimal knowledge and experience about applying wide-area decontamination technologies mandates caution. Any strategy must be tested on a smaller scale and evaluated for effectiveness before large-scale application. Options 2 and 3 require testing and evaluation before being used on a large scale. • Lack of enough equipment for dissemination (e.g., large-scale spraying) is an operational gap. Options include aerial systems, as with forest firefighting aircraft, crop dusters, and helicopters; and ground-based systems, such as fire trucks and large military equipment. Spraying from fire trucks or similar truck-mounted, water-spraying systems is an efficient way to dispense liquids. Spraying could also entail street-cleaning equipment augmented by facility sprinklers or hose distribution systems.
For indoor facilities, first conduct HEPA vacuuming for physical removal before decontamination, then use liquid surface biocides or volumetric fumigant decontamination.	• Fumigants: chlorine dioxide and VPHP. • Liquid decontaminants: adjusted sodium hypochlorite solution or other strong oxidants documented as sporicidal chemicals (Table 8-1).
For highly sensitive and valuable equipment (electronics, artwork, medical), use less corrosive and nonliquid options to avoid damage. **For less sensitive items**, such as emergency vehicles, use hotspot decontamination methods.	• EtO or VPHP in an offsite chamber (for valuables). • X-ray or gamma ray irradiation (for documents).
For water resources and drinking water systems: • Treatment of spore-contaminated water with high doses of chlorine has a limited (2-log) ability to kill spores. Evaluate chlorination at 10× the standard treatment level. • Flocculation and sedimentation followed by sterile filtration may yield better (>3-log) performance. • Consider membrane filtration sized appropriately for spore size or boiling water in a covered vessel for at least 10 min. • Monitored natural attenuation to attain an acceptable usage condition, rather than treatment, is currently recommended for outdoor water resources such as streams, lakes, and rivers. Intent is to avoid longer-term ecological damage.	• Drinking water options include (a) continued treatment of water by conventional disinfection, (b) increasing disinfection levels for all or part of the system, (c) end-of-pipe treatment devices. • Pipes in water-treatment facility systems impact the availability of free chlorine. • *B. anthracis* spores are known to be trapped by biofilms, which make system-wide treatment less effective.
Work with officials at the West Point Treatment Facility for wastewater discharges and City of Seattle and King County regarding the Combined Sewer Overflow (CSO) system. Waste and wastewater decontamination and disposal methods and management tools are available, but they are capacity-limited and expensive. In general, use: • Sodium hypochlorite or aqueous chlorine dioxide. • Other promising methods identified in Table 8-2.	• Consider repurposing small CSO treatment facilities near downtown Seattle for wastewater treatment with sodium hypochlorite. • Minimize waste and wastewater to reduce costs and address resource and capacity issues. • Adhere to existing solid waste and wastewater regulations and requirements, or obtain exemptions when necessary.

Recommended strategy	Comments or qualifications
Initiate the process to establish a dedicated monofill for disposal of solid BWA-contaminated waste at Roosevelt Regional Landfill.	• A dedicated monofill will require an expedited agency-approval process as well as standard contractual documents that could include an indemnification clause.
Consider unconventional decontamination paradigms and approaches for all settings.	• Consider applying tested and approved decontamination product(s), but perform no environmental sampling afterward. • Consider exploiting seasonal advantages.
Verification Operations	
Implement decontamination verification strategies	• Use biological indicators (BIs), process-control sensors, or both for fumigations. • Use treatment-specific chemical (GC–MS) and biological monitoring for liquid treatments. • Include syndromic surveillance as a key component of a long-term monitoring program.

Section 9. Clearance

Clearance is the process of determining that a specified clearance goal—developed from the risk assessment and management processes described in Section 6—has been met for a contaminant in or on a specific area, site, or item. This technical supplement recommends that an ECC be created early during remediation and briefed on proposed clearance sampling so that its members are familiar with the processes generating the data they will later review. The UC and a broad stakeholder group participate in developing the strategy for clearance.

When a given site or area is decontaminated, clearance of that location will necessarily follow decontamination. Wide-area clearance is likely to be done in phases, with some parts of the Seattle urban area undergoing clearance before others according to the prioritization scheme explained in Section 5. Thus, at times there may be decontaminated sites and areas ready for clearance, with certain surrounding locations still untreated. For example, opening roads and operating utility systems would be required to allow access to facilities and residences for characterization and decontamination.

Key elements of the clearance process include:

- Reviewing and incorporating relevant information from the entire response phase and previous steps of the remediation phases.
- Developing a clearance sampling strategy, and preparing a Clearance Environmental Sampling and Analysis Plan documenting the strategy.
- Conducting clearance environmental sampling, including aggressive air sampling where possible.
- Performing laboratory culture analyses of clearance environmental samples for the presence of viable spores.

- Evaluating results of all three sampling events (initial, characterization, and clearance) and the decontamination process in relation to clearance goals, and determining whether or not to release a specified area or facility for restoration/reoccupancy (Section 10).

It is possible that with so many individual sites and areas needing remediation, resources will not support an extensive, formal clearance plan and clearance sampling for all of them. In that event, lessons learned from clearing the most critical infrastructure early during recovery might be used to design and implement less in-depth clearance processes for other, similar sites decontaminated later during recovery. Given the limited number of experts available to clear numerous sites and the need for as rapid return to functionality as possible, such an approach could be a mechanism to shorten the overall recovery.

Risk-based clearance goals specific to the incident should be developed as early as possible because they will be used to help determine what areas or facilities need decontamination. It is also possible that information developed during characterization or decontamination could suggest that goals might have been set too high or too low. Such a finding would lead to a review of clearance goals. The UC would make such a decision after reviewing recommendations from public health officials; the TWG; and relevant local, state, and Federal stakeholders.

Section 9 illustrates two example clearance sampling zones associated with the Port of Seattle together with the selection of outdoor sampling locations and associated strategies that can be applied for clearance purposes. After clearance environmental sampling has been conducted (including aggressive air sampling in outdoor areas), the Environmental Unit (EU) evaluates all relevant data, with input from the TWG. After evaluation by the EU and a determination that the remediation has been successful, data are provided to the ECC for independent review. If the ECC also concludes that the remediation is effective and recommends clearing a given site or area for re-use, the EU forwards the recommendation to the UC for review and action. In general, the UC submits ECC recommendations for clearing sites to the local public health official for final decisions.

Table 8. Summary of recommendations for clearance.

Recommended item, action, or process	Comments or qualifications
Order the clearance activities as a function of prioritization.	Priorities should be established before decontamination takes place. See Sections 5 and 9.1.
Establish clearance sampling plans, decision criteria, and risk-assessment parameters early (before decontamination).	See Section 9.2. See Section 6 for risk-assessment details, background information, and references.
Consider current clearance goal for building interiors: no growth of spores from all clearance samples taken.	Based on EPA cleanup clearance values used for anthrax-contaminated buildings; see Section 6.
Consider recommended clearance goal for outdoor contamination: "No viable *B. anthracis* spores detected above background levels from any high-volume air samples."	• Goal based primarily on eliminating inhalation risk. Assumes some surface samples can be positive, monitoring for cutaneous anthrax will be done, and additional actions are taken as appropriate. See Section 6 for options set according to risk. • Value may change given indigenous anthrax.
Use clearance sampling and analytical methods that can identify the presence of any viable spores.	• Nonviable spores are not a concern. • Rapid viability-detection methods need to be used for efficiency, and augmented with current "gold standard," CDC bacterial culturing protocols. • Sampling methods must be evaluated to ensure viability is not affected during sample collection.
Apply sampling strategies, including any or all of focused, biased, and random. Statistical analysis should be used for quantitative confidence in having met clearance goals.	See Section 9.3.2.
Apply aggressive air sampling supplemented by a set of surface samples for indoor clearance. Specify in the clearance sampling plan.	See Section 9.3.3.
Use high-volume "aggressive" air sampling, which is recommended as the primary assessment tool for outdoor clearance because it targets inhalation exposure potential.	• Include indoor and outdoor locations with high re-suspension potential, and areas with high population density (including "fixed" and transient populations). See Section 9.3.4. • Depending on site-specific use, limited surface sampling indoors and outdoors may be needed in previously high-contamination areas to meet stakeholder needs.
Plan water-distribution system clearance sampling according to system hydrology and locations currently used for water-quality assessments.	See Section 9.3.5.
Organize clearance activities using the same zones for areas and facilities used for characterization and decontamination.	See Section 9.1.
Obtain ECC input for clearance decisions. If clearance goals are not met, consider additional decontamination (first), or modifying clearance goals (second).	Evaluate whether clearance decision criteria have been met, or consider an additional risk assessment to modify clearance goals, if appropriate. Modifying clearance goals implies changes to risk-management decisions. See Section 9 introduction and Sections 9.2, 9.3, and 9.5.

Section 10. Restoration/Reoccupancy

Reoccupancy and a return to normal functioning of the Seattle urban area is the ultimate goal of remediation. Although it is the final step of recovery from a biological incident, planning for restoration/reoccupancy begins during prioritization and continues while all other work activities associated with remediation are in progress. The Joint Federal Office (JFO), which is the primary Federal incident-management field structure, is the central coordination point for all entities that provide restoration and reoccupancy assistance.

Section 10 presents a framework for planning for reoccupancy, including a review of general reoccupancy considerations, discussion of long-term medical monitoring, the use of post-clearance environmental monitoring, public assurances and incentives to reoccupy buildings and areas, and a short discussion of stakeholder issues. Facility renovation and reoccupancy are also covered in the *Puget Sound Regional Biological Attack Recovery Plan Annex to the Regional Catastrophic Plan*, except for considerations related to long-term monitoring.

In general, a broad stakeholder group representing civic, community, and business interests will likely be selected to participate, along with scientific and technical personnel from state and Federal agencies, in developing the strategy for reoccupancy. The recommended methodology for determining the readiness to repopulate an area or sub-area follows the same steps, with slight modification, as those applied for prioritization (see Figure 2, above).

Ongoing medical surveillance and treatment protocols will be developed by the State of Washington and local public health agencies, with Federal (e.g., CDC) input and coordination support. Planners will likely have the benefit of the best available information about release location(s), fate and transport modeling, characterization data, and morbidity and mortality cases, which can be used to identify target populations and geographic areas of concern. Planners should prepare information about early-warning signs and symptoms, and access to medical care, and they should develop dissemination and public-awareness campaigns to ensure that all types of populations are reached. During the recovery phase of an anthrax incident, air monitoring for *B. anthracis* spores can be used to assess the presence of spores in the breathing zone in areas accessible to the public. The absence of viable spores would provide a measure of assurance to the public, even though it is only one measure of potential risk. Environmental monitoring plans will need to be coordinated to ensure consistency. Because inhalation and ingestion routes of exposure pose greater health risks than those arising from skin contact, planners should emphasize air and domestic water sampling, along with viability analysis, as opposed to surface and soil sampling. The question of the extent and duration of long-term environmental monitoring will depend on the specifics of the scenario. A large attack over a wide area may dictate a long-term monitoring program because of the substantial degree of uncertainty involved. An aggressive campaign of public reassurance using accurate information is essential for successful reoccupancy. Risk communicators should ensure that messages delivered to the public are free of jargon and technical language, and that content provides clear instructions. An important consideration for effectively resolving ongoing concerns is to ensure that stakeholders continue to be engaged in all aspects of the post-reoccupancy process.

Table 9. Summary of recommendations for Restoration/Reoccupancy.

Recommended action or process	Comments or responsible entity
Ensure that reoccupancy and reuse criteria are met before releasing areas or facilities for reoccupancy or reuse.	Reoccupancy plans and criteria for indoor and outdoor locations should be developed and implemented (see Section 10.1). Verify remediation and readiness.
Provide government incentives to businesses and individuals willing to reoccupy areas or facilities.	• Free long-term medical monitoring and care should be a high priority. • Consider tax advantages and incentives for both individuals and businesses.
Implement long-term medical monitoring plans.	Local public health agencies should implement the plans with Federal oversight if medication or other treatment is deemed appropriate (Section 10.2).
Plan and initiate post-clearance environmental monitoring plans. Include: • Ambient-air-monitoring programs to ensure no inhalation risk. • Targeted surface or bulk sampling if air monitoring results in detection. • Monitoring at borders between cleared and yet-to-be-decontaminated areas. • Monitoring of susceptible domestic and wild animal populations for symptoms of infection.	Focus should be on sampling and analytical methods to detect viable spores (Section 10.3). Determine whether existing programs (such as BioWatch) are adequate or require augmentation. Review existing ambient, particulate air-monitoring programs for incorporation, or implement new programs to address stakeholder needs. Coordinate inter-agency data reporting protocols.
Implement long-term public information and communication programs to address remaining stakeholder concerns. Develop strategies for regional, national, and international target audiences	Ongoing stakeholder involvement and public information programs are a continuation of processes developed early during the incident.

Additional Information

Appendixes to the technical supplement provide more detailed information on eight topics:

- Prioritization tools (Appendix A).
- Seattle area climate and soil conditions (Appendix B).
- A sampling template that can be adapted by remediation planners for characterization and clearance environmental sampling (Appendix C).
- Characterization strategies and sampling locations in the Seattle urban area (Appendix D).
- Features of specific decontamination reagents (Appendix E) that might be applied.
- A Remediation Action Plan template (Appendix F).
- An example Health and Safety Plan template (Appendix G).
- Acronyms and glossary of terms (Appendix H).

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