

# EXPOSURE BARRIERS FOR THE DIRECT CONTACT PATHWAY

## Design, Documentation, and Management Guidance Under Part 201

This document was developed by the Michigan Department of Environment, Great Lakes, and Energy (EGLE) Remediation and Redevelopment Division (RRD) to promote a consistent and informed approach for the use of direct contact exposure barriers, also commonly referred to as “capping.”

This document provides information and guidance to EGLE staff, contractors, and other parties making risk management

decisions for the direct contact exposure pathway through the use of barriers. It is explanatory and does not contain any regulatory requirements. It does not establish or affect legal rights or obligations. It does not have the force or effect of law and is not legally binding on the public or the regulated community. Any regulatory decisions made by EGLE regarding the direct contact exposure pathway will be made by applying the governing statutes and relevant Administrative Rules.



Approved: 

Mike Neller, Director

Remediation and Redevelopment Division

March 20, 2024

## TABLE OF CONTENTS

|   |           |
|---|-----------|
| <b>Purpose</b> .....  | <b>3</b>  |
| <b>1.0 Introduction</b> .....   | <b>3</b>  |
| <b>2.0 Exposure Barrier Selection And Considerations</b> .....                                  | <b>4</b>  |
| 2.1 Performance Standard .....  | 4         |
| 2.2 General Design Considerations .....   | 4         |
| 2.3 Land Use and Activities at the Property .....   | 5         |
| 2.4 Area of Exposure Barrier and Presumptive Remedies.....                                      | 5         |
| 2.5 Permitting and Other Requirements.....  | 6         |
| 2.6 Design Life .....   | 6         |
| 2.7 Institutional Controls and Assurances.....  | 6         |
| <b>3.0 Exposure Barrier Types</b> .....   | <b>6</b>  |
| 3.1 Non-Structural Exposure Barriers .....  | 7         |
| 3.1.1 Deviations from Minimum Barrier Thickness .....   | 7         |
| 3.1.2 Borrow Source and Clean Backfill Testing .....  | 8         |
| 3.1.3 Demarcation Layer .....   | 8         |
| 3.2 Structural Exposure Barriers .....  | 9         |
| 3.3 Utilization of Existing Soil as an Exposure Barrier .....                                   | 10        |
| 3.4 Relocating Contaminated Soils and Exposure Barriers Over Stockpiles .....                   | 10        |
| <b>4.0 Documentation</b> .....  | <b>11</b> |
| <b>5.0 Inspection, Maintenance, And Monitoring</b> .....  | <b>12</b> |
| 5.1 Inspections.....  | 12        |
| 5.2 Preventative Maintenance.....   | 13        |
| 5.3 Inspection, Maintenance, and Monitoring Plan .....  | 13        |
| 5.4 Inspection and Monitoring Requirements for Contamination at Depths Greater Than 4 Feet..... | 14        |
| <b>Appendix A - Minimum Non-Structural Exposure Barrier Thickness Based on Land Use</b>         | <b>15</b> |

This publication is intended for guidance only and may be impacted by changes in legislation, rules, policies, and procedures adopted after the date of publication. Although this publication makes every effort to explain to users how to meet applicable compliance obligations, use of this publication does not constitute the rendering of legal advice.

EGLE does not discriminate on the basis of race, sex, religion, age, national origin, color, marital status, disability, political beliefs, height, weight, genetic information, or sexual orientation in the administration of any of its programs or activities, and prohibits intimidation and retaliation, as required by applicable laws and regulations.

To request this material in an alternate format, contact [EGLE-Accessibility@Michigan.gov](mailto:EGLE-Accessibility@Michigan.gov) or 800-662-9278.

## Purpose

This guidance describes the minimum requirements of a direct contact exposure barrier after the determination is made that an exposure barrier is necessary to mitigate or prevent exposure through the soil direct contact pathway. It only addresses exposure barriers implemented to address soil concentrations exceeding the Direct Contact Cleanup Criteria under Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (direct contact criteria). This guidance is not intended to comply with other local, state, or federal laws and regulations or requirements from specific funding sources such as the US Housing and Urban Development or Small Business Administration. Exposure barriers or engineering controls necessary to mitigate other pathways and considerations (infiltration barriers, landfill caps, vapor mitigation, etc.) are not covered by this guidance. Fences, barrier walls, or other access controls are also not covered by this guidance.

Direct contact barriers are referenced by various terms such as engineered barriers, engineering controls, caps, or covers; for this guidance, the term *exposure barrier* will be used to include all types of direct contact exposure barriers.

Goals of this guidance:

- Provide consistency and clarity for EGLE-RRD (department) staff, contractors, practitioners, and the regulated community.
- Specify minimum exposure barrier requirements acceptable to the department.
- Assist users with evaluating and selecting exposure barriers that comply with obligations under Part 201.
- Assist users in selecting exposure barriers of appropriate thickness and structural elements that are protective for the use of the property and that avoid excessively burdensome management and maintenance.
- Provide guidance on the documentation, inspection, and maintenance of installed exposure barriers.

## 1.0 Introduction

The Part 201 generic soil direct contact criteria primarily represents soil concentrations that are protective against adverse health effects due to long-term (chronic) ingestion of and dermal contact with contaminated soil. Exposure barriers are one method of mitigating or preventing exposures through the soil direct contact pathway.

An exposure barrier does not destroy or remove contamination; therefore, it must be constructed and maintained in a manner that assures the barrier will mitigate or prevent unacceptable exposure for as long as the contamination remains at the property. To ensure the

long-term effectiveness of an exposure barrier, this guidance provides minimum requirements for the barrier design, maintenance, and documentation.

Persons applying this guidance are expected to have sufficient knowledge and experience in construction measures, engineering practices, and other disciplines applicable to the design, installation, and maintenance of a direct contact exposure barrier. Persons implementing exposure barriers are responsible for ensuring that the design, installation, construction, permitting, monitoring, and maintenance activities are performed and or certified by persons qualified to complete work of this nature.

Each property is a unique situation involving a variety of existing conditions, receptors, land uses, development plans, and operations. It is expected that practitioners and department staff will utilize professional judgement to apply this guidance to the specific conditions at any particular property. Alternative exposure barriers not specifically covered in this guidance may also be acceptable and will need to be evaluated for long-term effectiveness and protection of human health.

## 2.0 Exposure Barrier Selection And Considerations

The following sections provide guidance on the typical design considerations and minimum requirements for exposure barriers.

### 2.1 Performance Standard

For this guidance, the intent or *performance standard* of an exposure barrier is to mitigate or prevent a person's contact with and incidental ingestion of contaminated soils during the normal use of the property. Therefore, exposure barrier selection is based on the site-specific conditions and the current and anticipated future uses of the property. At a minimum, an exposure barrier must remain protective during normal operations and activities at the property.

### 2.2 General Design Considerations

The design of an exposure barrier should consider site-specific conditions, natural forces, and man-made impacts that may affect the construction, integrity, and maintenance of the exposure barrier, including but not limited to:

- Nature and extent of the contamination (Note: Consult with the department for hazardous substances with acute toxicity).
- Current and future land uses, occupancy, and operations.
- Intensive use areas including vehicle and equipment traffic, trails and paths, gardening, pet activities, recreation areas, playgrounds, and sports activities.
- Erosion from precipitation, stormwater runoff, or wind, including steep slopes and places where runoff is channelized.

- Other natural forces including shallow groundwater, surface water, seasonal flooding, freeze and thaw cycles, and frost heave.
- Burrowing animals and wildlife.
- Natural or planted vegetation, including effects caused by roots.
- Utilities.
- Rights of way and easements.
- Pavements, buildings, foundations, and other structural elements.
- Settlement and shifting of installed exposure barrier elements.
- The reasonableness and reliability of institutional controls, land use restrictions, lease agreements, or other assurances that are intended to notify and restrict activities at the property.
- Physical constraints that will affect the constructability and future reliability of the exposure barrier; including but not limited to: topography, uneven terrain, depressions, ravines, low-lying areas, steep slopes, unsuitable soils, wetlands, floodplains, wooded areas, vegetation to remain, structural features, or other features.
- Cost and feasibility of options that are equally protective.
- Gravel, stone, or pavement is the preferred exposure barrier material for pathways and trails.
- Necessary frequency of inspections and ability to implement monitoring and maintenance to meet performance objectives.

### **2.3 Land Use and Activities at the Property**

The primary consideration for exposure barrier selection is the anticipated land use and activities at the property. The anticipated land use and activities should be documented as part of the design process. Future changes to the land use and activities will require reevaluation of the effectiveness of the exposure barrier for new conditions.

### **2.4 Area of Exposure Barrier and Presumptive Remedies**

The exposure barrier must cover all areas where representative sampling has demonstrated concentrations above applicable criteria. Exposure barriers may be implemented at properties of known contamination or as a presumptive remedy. Presumptive remedies are typically implemented based on historical property use, the unknown nature and extent of contamination, and/or as a conservative measure based on the future use of the property (residences, schools, playgrounds, etc.). Parties should consider the long-term operation and maintenance costs and obligations when considering a presumptive remedy. Installation of a presumptive exposure barrier without sufficient documentation or characterization of contamination on the property may not be acceptable for projects utilizing state or other public funding.

## 2.5 Permitting and Other Requirements

It is the responsibility of the property owner and party implementing the exposure barrier to follow proper engineering practices and comply with all local, state, and federal laws and permitting requirements.

## 2.6 Design Life

The design life and on-going inspection and maintenance of the exposure barrier must be for as long as the contaminated material remains in place.

## 2.7 Institutional Controls and Assurances

Institutional controls are instruments such as deed restrictions, easements, notices, private contracts, and rental or lease agreements that can be used to establish the requirements for the long-term effectiveness and integrity of an exposure barrier. These instruments can be used to inform future property owners and tenants that contamination is present on the property, restrict activities that may damage the exposure barrier, or even set inspection schedules and maintenance instructions.

Depending on the type and purpose, the institutional control may include:

- Specific details about the remaining contamination, including data, maps, and surveys.
- Specific details about the exposure barrier including location, maps, surveys, thickness, and construction materials used.
- Inspection schedule and maintenance requirements.
- Specific activity and use limitations.
- Description of how future lessees, users, and property owners will be notified.

Consult with an environmental professional or the department for model documents and example language, or development and review and of site-specific language for institutional controls.

## 3.0 Exposure Barrier Types

An exposure barrier works by providing physical isolation between the receptor and the contaminated media. Exposure barriers rely on structural or thickness elements or both to provide a physical barrier that is protective and durable. Exposure barriers consisting of structural elements (structural exposure barriers) rely on the inherent nature and/or physical strength of the material to mitigate or prevent contact. Structural exposure barriers include but are not limited to, asphalt, concrete, membrane liners, and building slabs and foundations. Exposure barriers relying on the thickness and depth of a cover material to mitigate or prevent contact (non-structural exposure barriers) include but are not limited to, clean soil, compacted clay, gravel, rock, and other loose aggregate material. The exposure barrier type and thickness can only be selected after clearly understanding the site-specific conditions, the extent of contamination, and the current and future uses of the property.



## 3.1 Non-Structural Exposure Barriers

For this guidance non-structural exposure barriers are defined as soil, gravel, rock, or other loose non-organic material installed to a minimum thickness. Exposure barriers constructed of gravel, rock, and other aggregate materials are categorized the same as other non-structural exposure barriers except for the establishment of a surface vegetative layer. Non-structural exposure barriers should be installed over a demarcation layer, described below. A summary table of minimum non-structural exposure barrier thickness based on land uses is provided in **Appendix A**.

Non-structural exposure barriers must be stabilized to prevent erosion. Soil exposure barriers must be stabilized and maintained with a healthy dense vegetative cover or landscaping material. Clean physically screened organic topsoil that will promote vegetative growth can be included in the measured thickness of the barrier. The vegetive layer, biodegradable landscaping materials (wood chips, mulch, compost, etc.), and shredded rubber mulch are not included in the measured barrier thickness.

### 3.1.1 Deviations from Minimum Barrier Thickness

Deviations from the minimum barrier thickness described in **Appendix A** due to technical infeasibility, existing conditions, cost, or other factors can be proposed but must still effectively mitigate unacceptable exposures. Alternative exposure barrier designs that meet the performance standard to mitigate or prevent a person's contact and incidental ingestion of contaminated soils will be considered by the department.

For instance, it may be impractical or cost prohibitive for the construction of a non-structural exposure barrier with the minimum thickness described in **Appendix A** when site-specific conditions (e.g., existing shrubs or trees, utilities, or structural exposure barriers such as buildings or sidewalks described in Section 3.2) prevent removal of contaminated soil or do not allow for consistent barrier thickness at the interface of those features. For example, the thickness of soil barriers and landscaping materials will likely need to taper to existing trees or shrubs so not to damage roots or bury the trunk.

An alternative exposure barrier design may propose to incorporate land use and traffic patterns. The total thickness of the exposure barriers might be able to be reduced yet still maintain long-term durability in areas of minimal land use or traffic patterns. Landscape berms, hedges, fencing, sidewalks and bike paths may direct use patterns in open common areas and support the ability to reduce the total thickness in those locations. However, open areas immediately adjacent to a structure and accessible from individual units (e.g., first floor patios) should be considered high use traffic areas affecting the long-term durability of the exposure barrier and therefore reducing the thickness of the barrier in these areas would not be appropriate.

In other scenarios an increased (more frequent) monitoring program may be appropriate to offset a decreased barrier thickness because the increased inspection frequency should more quickly identify the need for maintenance or response activity.

It is also important to note that most professional contracts, engineering plans, and specifications have provisions for allowable tolerances and deviations. For example, a specification may allow for the final installed elevation to be plus or minus 0.1 foot (1.2 inches) or more from design grade. Such minor deviations from the design thickness should not be wholly unexpected and would not indicate the barrier is not protective or installed incorrectly.

### **3.1.2 Borrow Source and Clean Backfill Testing**

The soil layer of the exposure barrier may consist of on or off-site borrow material that meets cleanup criteria applicable to the property. Borrow sources should be identified and tested well in advance of construction to ensure they meet the project specifications and do not contain hazardous substances above applicable criteria. Consult with an environmental professional or the department on appropriate environmental characterization of borrow materials.

### **3.1.3 Demarcation Layer**

The demarcation layer is a durable non-biodegradable material installed as a marker to indicate that soil beneath it is contaminated and that maintenance and/or repairs to the exposure barrier is necessary when it becomes exposed. In addition to serving as an indicator, the demarcation layer also reduces the chance of contaminated soils being brought to the surface by shallow landscaping activities or burrowing animals.

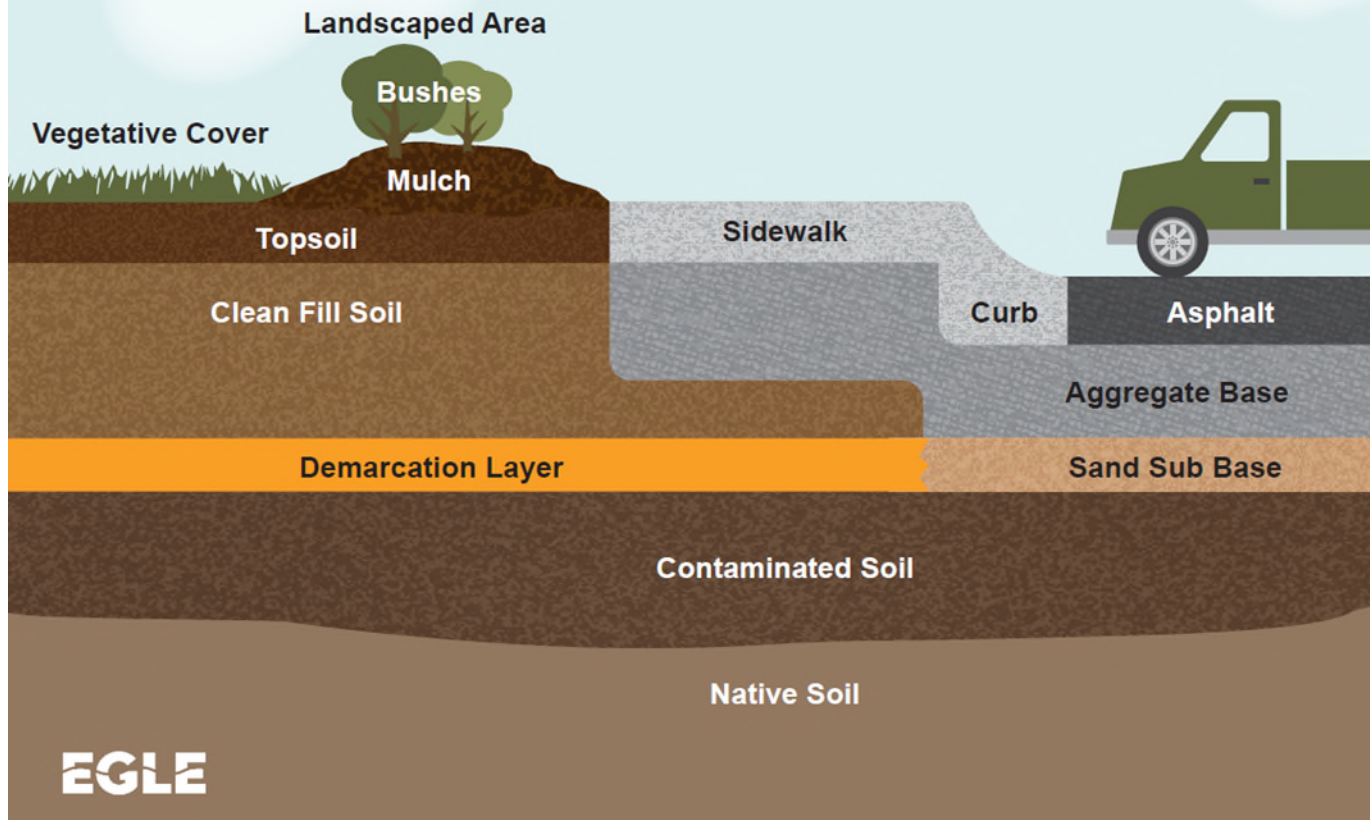
The demarcation layer should be bright, easily distinguishable, durable, suitably permeable for drainage, and designed to be used in subsurface applications. A brightly colored geotextile is common. Geotextiles should be installed so the material is overlapping a minimum of 6-inches without gaps to maintain a uniform layer over the contaminated material. Consult with the project engineer and/or product manufacturer for additional installation guidance.

Orange geotextiles that may be considered for demarcation layers are readily available from suppliers for environmental construction and barrier applications. Examples of acceptable geotextile fabrics include: MIRAFLI 140NLO and TerraTex® SD Orange.

Demarcation layers are not applicable when relying on an existing (in situ) layer of soil as an exposure barrier. A demarcation layer is optional for soil exposure barriers that are comprised of minimum of 4 feet or greater in thickness or for structural exposures barriers as described in the following section.



## Example of Engineered Exposure Barrier with Variety of Surface Covers



### 3.2 Structural Exposure Barriers

Structural exposure barriers include building floors, foundations, asphalt, and concrete pavement including streets, sidewalks, parking lots, and other permanent structural components. A structural exposure barrier may also consist of a geomembrane typically installed within a stormwater pond or as part of a layered engineered system designed to protect the membrane from damage. Depending on the design and construction materials used, some athletic fields utilizing synthetic turf or engineered playground surfacing may be considered structural exposure barriers as determined by the department on a site-specific basis.

Structural components are often part of the development plan and can be a cost-effective exposure barrier for properties undergoing redevelopment. Structural exposure barriers are highly effective at mitigating or preventing exposures, are durable, and are typically readily observable for damage and deterioration. Note that the mere presence of cracks or deterioration does not mean a structural barrier is no longer protective; however, it may indicate the need for repair and maintenance to ensure the longevity of the barrier.

Structural exposure barriers may be used in conjunction with a demarcation material; however, it is not required as the structural component can serve as the indicator layer over the contaminated material.

Thickness of structural exposure barriers and subgrade components are not specified in this guidance assuming they are designed in accordance with general engineering practices appropriate for their intended use and in accordance with applicable permitting and building codes. Existing pavements and buildings may be designated as exposure barriers, even if the design details are unknown. Buildings with dirt floors or open crawl spaces with direct contact criteria exceedances should be treated like any other portion of the property with bare soils that require an exposure barrier.

### **3.3 Utilization of Existing Soil as an Exposure Barrier**

An existing (in situ) layer of soils may serve as an exposure barrier if it meets direct contact criteria and comprises the minimum thickness shown in **Appendix A**. To demonstrate existing soils are acceptable, environmental samples must be collected representative of the minimum soil thickness across the entire area of the exposure barrier. The samples should be analyzed for contaminants of concern and results shall not exceed applicable criteria. Consult with an experienced environmental professional or the department to determine a representative sampling strategy applicable to the property.

When existing soil is used to mitigate or prevent direct contact with contamination within 4 feet of the ground surface, inspection, maintenance, and monitoring of the exposure barrier are required elements and must take into consideration the absence of the demarcation layer as an indicator of required repair. Refer to Section 5.4 for inspection and monitoring requirements for contamination greater than 4 feet below grade.

### **3.4 Relocating Contaminated Soils and Exposure Barriers Over Stockpiles**

Relocating and consolidating contaminated material and covering with an exposure barrier reduces the footprint of contamination on the property and may be easier to manage over time. Development plans may call for material to be consolidated into greenspace berms or beneath structural features at the property. Representative sampling is necessary to confirm contamination above direct contact criteria does not remain on other portions of the property.

It is critically important that any relocation of contaminated soil is done in accordance with Part 201 Section 20120c. This statute details the provisions under which contaminated soils may be relocated. For example, material should not be relocated to a location that is not a facility. Relocation to uncontaminated areas may create a new facility for which the property owner and contractors can be held responsible. Some situations may require prior notification to the department before contaminated materials can be relocated.

## 4.0 Documentation

The performance and effectiveness of a well-designed exposure barrier relies on proper installation. Maintaining documentation of the construction and installation of an exposure barrier is required when performed as a Part 201 response activity, or to comply with due care. Documentation must be provided to the department upon request, and it is highly recommended that the documentation be provided to current and future owners and operators of the property to meet disclosure requirements for contaminated properties. The documentation must demonstrate that the exposure barrier is effective to mitigate exposures. The documentation will need to demonstrate proper construction, thickness of the exposure barrier, and materials used. Documentation should also include the plan for inspecting and monitoring the exposure barrier.

As applicable, documentation for an installed exposure barrier should include, but not be limited to:

- Basis for the design including known current and future land uses.
- The exposure barrier design including specifications and product specification sheets.
- Representative evidence the exposure barrier was installed to the specifications, which may include:
  - Photographic documentation of specific exposure barrier components that are representative of the entire construction. This includes but is not limited to structural components, the installed demarcation layer with overlapping seams, and representative photographs showing the measurements from the depth of the demarcation layer to the top of the non-structural exposure barrier.
  - Surveys if relied on for demonstration of exposure barrier location, elevations, and thickness. For example, a licensed professional surveyor or engineer can conduct a grade survey before and after installation of the exposure barrier as a form of documentation. This baseline survey can assist with future monitoring of the barrier thickness.
  - Surveyed control points, settling plates, pins, or rods if relied on to measure wear and degradation of the exposure barrier.
  - Field measurements.
  - Field logs documenting the exposure barrier construction.
  - As built plans documenting the exposure barrier as installed, including deviations from the design plans.
  - Representative verification cores or excavations if relied upon to demonstrate the barrier location and thickness.

- Documentation that all borrow source materials meet criteria applicable to the property.
- Detailed scaled and/or surveyed property maps depicting the following, as appropriate:
  - Site features including structures, paved surfaces, utilities, greenspaces, and operations.
  - Contaminant concentration maps, including sample locations used to determine the extent of the area to be mitigated.
  - The known or presumed area to be mitigated.
  - The location, types, dimensions, and description of exposure barriers. Include overlay of site features and analytical testing results, if available.
  - Restrictive covenant and easement areas.
- Copies of institutional controls (restrictive covenants, notifications, lease and rental agreements, easements, etc.).
- Documentation of all damage and breaches over the life of the exposure barrier and the associated restoration.
- The plan for inspection, maintenance, and monitoring of the exposure barrier.

## 5.0 Inspection, Maintenance, And Monitoring

As long as contamination remains in place beneath an exposure barrier, inspection, maintenance, and monitoring is required under Part 201 to ensure the continued effectiveness of the remedy. A written inspection, maintenance, and monitoring plan is recommended for all exposure barriers and is required when seeking department approval. Records of installation and repairs over the life of the exposure barrier will also be necessary for submittals to the department for approval and must be made available if requested by the department.

### 5.1 Inspections

Regular maintenance, inspection or monitoring is performed to ensure that the exposure barrier remains intact, and to evaluate damage due to settling, exposure to the weather, wear from traffic, increasing age, and other actions (digging, vehicle ruts, etc.) that may result in deterioration of the exposure barrier.

Non-structural exposure barriers will require more frequent inspections (monthly to quarterly) during the first couple of years to ensure the surface cover remains in sound condition without signs of erosion. Once a good seasonal track record is established, the inspection frequency can be reduced. Vegetated soil exposure barriers may require daily to weekly inspections immediately following construction until the vegetative cover is established. Industry standards typically call for at least 90 percent healthy turf growth across seeded areas before inspection frequencies are reduced.

Inspection frequencies for established exposure barriers typically range from quarterly to annually. It is recommended that exposure barriers are formally inspected at least once per year. Non-routine inspections should be conducted following certain triggering events such as construction activities, severe storms, and flooding.

## 5.2 Preventative Maintenance

Routine preventative maintenance may be necessary to extend the long-term effectiveness of the exposure barrier. Preventative maintenance of vegetative exposure barriers may include fertilization, irrigation when drought stressed, mowing, and removal of unwanted deep rooting vegetation and burrowing animals. Pavement maintenance may include cleaning, crack filling, application of protective treatments, and sealing.

## 5.3 Inspection, Maintenance, and Monitoring Plan

Inspection, maintenance, and monitoring details will vary, depending on the design of the exposure barrier and anticipated land use. General contents for a written inspection, maintenance, and monitoring plan will include but is not limited to:

- Design and construction documentation for the installed exposure barrier, as described in Section 4 above. If not included in the plan reference where this information may be found.
- Schedule and description of the inspection, monitoring, and preventative maintenance for the exposure barrier.
- Description of exposure barriers that need to be inspected and maintained, including:
  - An inspection checklist.
  - Common signs and evidence of deterioration that may be observed.
  - List of prohibited activities (excavation, residential uses, gardening, etc.).
  - Conditions that require repair or further actions to be taken.
- Scaled or surveyed maps of the property and potentially photographs that clearly identify barriers to be inspected and maintained.
- Actions to be taken when conditions are identified that require repair.
- A provision for maintaining documentation of damage identified and repairs undertaken.
- Identification of parties responsible for inspection, maintenance, and repair.
- Contact information for the property owner, environmental professional, contractors, or suppliers, as appropriate.

## **5.4 Inspection and Monitoring Requirements for Contamination at Depths Greater Than 4 Feet**

When contamination is present at a depth greater than 4 feet or an exposure barrier is installed with a thickness of 4 feet or greater, inspection and monitoring requirements may be reduced or eliminated. Four feet was selected based on a depth not typically excavated during routine residential landscaping and excavation activities such as installation of fence or deck posts, utility work, planting of trees, and other minor construction that would bring contaminated soils to the surface. The property owner will still have obligations including proper notifications, restrictions, soil management, and repair and maintenance of the exposure barrier.



## Appendix A - Minimum Non-Structural Exposure Barrier Thickness Based on Land Use

| Site Controls  | Residential Single-Family, Owner-Occupied, and Rental<br><br>Example:<br>Single-family and individually owned homes on private or shared lots | Managed Residential / Schools<br><br>Example:<br>Rented or leased apartments, schools, day care | Non-Residential Commercial, Office, Retail<br><br>Example:<br>Commercial, office, hotel, and retail structures without a residential component | Industrial<br><br>Example:<br>Warehousing, manufacturing, and distribution centers | Passive Recreational<br><br>Example:<br>Naturalized greenspace, open park, gravel trails | Active Recreational<br><br>Example:<br>Sports fields, campgrounds, picnic areas, non-motorized dirt trails (such as biking or walking) |
|--|---|---|--|--|--|--|
| Site activities are reliably controlled through land use restrictions, lease agreements or other assurances. |   | ✓   | ✓  | ✓  | ✓  | ✓  |
| Monitoring and maintenance of the barrier is regularly conducted.  |   | ✓   | ✓  | ✓  | ✓  | ✓  |
| Notices to tenants, construction, and utility workers of restrictions.                                       |   | ✓   | ✓  | ✓  | ✓  | ✓  |
| Landscaping, yard maintenance, and construction controlled and or contracted.                                |   | ✓   | ✓  | ✓  | ✓  | ✓  |
| Activities primarily limited to paved surfaces.  |   |   | ✓  | ✓  |  |  |
| Minimum Barrier Thickness over Demarcation Material  | 24 inches   | 12 inches   | 6 inches   | 6 inches   | 6 inches   | 12 inches/<br>Designated<br>Playgrounds 18 in  |

- Notes:** 1) Deviations from the minimum barrier thickness due to being technically infeasible, existing conditions, cost, or other factors can be proposed but must still effectively mitigate unacceptable exposures. See section 3.1.1 for additional discussion.  
 2) Consideration should be given that multiple land use scenarios may be present on the same property and the barrier thickness may vary across the site.  
 3) Consult with department on intensive uses (off-road vehicles, etc.).