Appendix B

Statewide Shoulder Soil Investigations

1 Introduction

Between 2015 and 2018, ODOT conducted a series of statewide investigations of highway shoulder soils. The following summary is intended to document the interagency coordination, sample and analysis plans, shoulder soil sampling efforts, and data evaluation which was used to develop the policies and procedures detailed in this Program Manual.

This work was completed to support the understanding of the nature of highway shoulder soil contaminants across the state, and used to negotiate a Beneficial Use Determination (BUD) with Oregon Department of Environmental Quality (DEQ). The BUD (BUD-20181204) provides a range of allowed reuse options for soil that does not meet DEQ's published Clean Fill Screening Levels (CFSLs). Material reuse is ODOT's preferred method of material management, where the material would otherwise require landfill disposal.

This appendix provides the background for the policies and procedures provided in Section 6.0 of the HazMat Program Manual. The detailed technical information, sample plans, sample data, and data evaluation and interpretation that provides the foundation for Section 6.0 of the HazMat Program Manual is in the reports referenced, and linked, below.

2 Background

Section 00290.20(c)(2) of the *Oregon Standard Specifications for Construction* (2021), specifies the disposition of Clean Fill for construction projects:

> *"Clean fill, as defined by OAR 340-093-0030, becomes property of the contractor at the place of origin."*

As referenced in the Standard Specifications, Oregon Administrative Rules (OAR) 340-093-0030 (18) defines Clean Fill as:

> *"…material consisting of soil, rock, concrete, brick, building block, tile, or asphalt paving which do not contain contaminants which would adversely impact the waters of the State or public health. This term does not include putrescible wastes, construction and demolition wastes and industrial solid wastes."*

Previous to 2014, DEQ did not have or provide screening levels or consistent guidance on what concentrations should be used to determine if a material met the definition of Clean Fill as defined by OAR 340-093-0030 (18). In 2014, DEQ issued an Internal Management Directive (IMD) entitled *Clean Fill Determinations* (July 7, 2014, updated February 2019). This IMD provided guidance to staff in the Solid Waste/Materials Management and Cleanup Sections on evaluating Clean Fill Determinations, but also included Clean Fill Screening Levels (CFSLs). These CFSLs provided a list of contaminant concentrations that allowed comparison to fill (e.g., excess soil generated during a project) sample results in order to make a Clean Fill Determination. The IMD also provided DEQ internal guidance to statistically evaluate data when several samples from a single area were analyzed. This internal guidance, therefore, could be used for generators of fill material to evaluate and screen excess material for potential use as Clean Fill.

During the development of CFSLs, DEQ split the state into ten physiographic provinces (refer to Figure 1 of this Manual). These provinces do not align with ODOT's regions, districts or other divisions. The CFSLs for metals and metalloids vary across the provinces based on naturally occurring background concentrations. CFSLs for other compounds (e.g., organic) are consistent across the state.

Based on DEQ's IMD and establishment of the CFSLs, ODOT needed to prevent fill material being made the property of the contractor at the point of generation without first determining whether the material met the definition of Clean Fill per Standard Specification 00290.20(c)(2), as stated above. This required the development of Technical Bulletin GE 14-01(D) (September 17, 2014, now rescinded), which made the assumption that all shoulder soil may contain contaminants and could not be made property of the contractor without sampling and analysis. This Technical Bulletin impacted projects, requiring sampling of likely excess soils during project planning and increased interaction with DEQ on a broad range of projects. One of the biggest impacts to project costs were increased fees for disposal of lightly contaminated soil. The volumes of excess soil ODOT can generate on any project can be significant. When considered at a statewide scale, the disposal cost and the volume of material sent to landfills is significant, impacting budgets and landfill capacities.

The HazMat Program developed an initiative to conduct a statewide shoulder soil study, focusing on potential traffic related contamination in roadside shoulder soils. The goal of this initiative was to understand what contaminants were present, their concentrations, how contaminant concentrations varied at distance and depth from the edge of pavement, and develop a process to streamline this work for construction projects.

3 Statewide Shoulder Soil Studies

ODOT contracted with two environmental consultants in 2015 and 2016 to conduct statewide shoulder soil evaluations that had four goals: 1) to identify baseline traffic related contaminants present in shoulder soil; 2) to understand the magnitude and extent of these contaminants; 3) identify any areas in the state that naturally met DEQ's CFSLs; and, 4) provide a basis to develop a streamlined path to minimize project costs, delays, and identify beneficial uses for the excess fill in accordance with the Solid Waste General Provisions (OAR 340-093-0005 through 340-093-0290). These evaluations are summarized below.

2015 Study

In early 2015, ODOT contracted with Apex to perform an evaluation of state highway shoulder soils across the state and conduct a literature review on traffic related roadside contaminants and contaminant migration. This evaluation was submitted to ODOT in a report titled

Department of Transportation State-Wide Highway Shoulder Soil Data Analysis (Apex, September 1, 2015). As an initial phase in that evaluation, ODOT provided soil sample data from 64 projects across the state to provide information of contaminants identified on projects, the migration pathways of those contaminants, and factors like the annual average daily traffic (AADT) loads of state highways. The primary migration pathways evaluated included runoff, aerial deposition, and infiltration of runoff through sampling at different distances from the edge of pavement and depths from the ground surface.

This initial study focused on metals (antimony, chromium, copper, lead, mercury, selenium, and zinc), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and volatile aromatic hydrocarbons (VOCs). These common constituents were selected as known or suspected traffic related contaminants, or related to older coatings on highways (e.g., striping paint) and bridges. In addition to the initial 64 ODOT projects with soil data, Apex sampled 74 locations across the state. Each of those locations included nine soil samples at three distance ranges from the edge of pavement (0-15 feet, 15-30 feet, and greater than 30 feet), and at three depths below ground surface at each distance interval (0-0.5 feet, 0.5-1.0 feet, and 1.0-1.5 feet).

While this first sampling effort improved ODOT's understanding of the nature and extent of average shoulder soil conditions across the state, it was difficult to draw conclusions broadly. When controlling for variables of distance, depth, AADT, and physiographic province, it became clear that there were data gaps that prevented statistical evaluation of the data. The report was able to show that there were only two of the constituents analyzed in this study that were traffic related and regularly identified at concentrations greater than the CFSLs: lead and benzo(a)pyrene (BaP) (one of the PAHs). The main recommendation was that additional sampling for lead and BaP be conducted in strategic locations across the state to build regional databases that allowed for statistical evaluation. This would allow ODOT to make conclusions on whether certain areas met the CFSLs or not, and if not, provide a starting point to evaluate beneficial use options for shoulder material at the regional level.

2016 Study

Based on the conclusions of the 2015 study, ODOT contracted with Cascadia Associates to evaluate the data gaps in the dataset, work with ODOT to develop a Sampling and Analysis Plan (SAP), implement the SAP to address the data gaps in the 2015 study, and develop regional beneficial uses for material that did not meet the CFSLs. This work was performed in 2016 through 2017, and is summarized in the following reports: *Sampling and Analysis Plan – Statewide Highway Shoulder Soil* (Cascadia, October 6, 2016), and *2016 Statewide Highway Shoulder Soil Evaluation Results Report* (Cascadia, June 30, 2017). The 2017 report included all of the data from the 2015 study as part of the data evaluation.

2016 Sampling and Analysis Plan – Statewide Highway Shoulder Soil

In 2016, ODOT, DEQ, and Cascadia met to present and discuss the findings of the 2015 study, and lay out a framework to develop a SAP that would produce results that DEQ would accept in the development of a statewide Beneficial Use Determination. It was important for the agencies to agree, so that DEQ would be familiar with ODOT's goals and have an interagency understanding on the process leading to the future data evaluation report.

Interagency coordination in the SAP development focused on four main points:

1. Shoulder soil should be characterized using a classification tree random forest model (the statistical evaluation of the data) that uses multiple variables (e.g., depth, distance from edge of pavement, and physiographic province within the state).

2. Pesticides, VOCs, and PCBs were not important traffic related contaminants in shoulder soil (outside urban areas). Polycyclic aromatic hydrocarbons (PAHs), particularly BaP, was a commonly identified shoulder soil contaminant, and DEQ requested that the primary pollutant list of selected PAHs be analyzed. Lead was the most common and likely contaminant to be identified in shoulder soil, but DEQ requested that the full EPA target analyte list (TAL) of metals be carried into the SAP. That list includes the following metals: aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc. While other metals are not constituents of concern, DEQ thought the TAL list valuable to assist in the statistical modelling.

3. Sample collection and analysis should use some incremental sampling methods (ISM) sample preparation (e.g., lab blending and grinding) which are considered to provide representative concentrations, while reducing data variability and non-detect analytical results. ISM sampling and analytical methods (compositing, decision suits, etc.) would not be used because ODOT's samples at the initial 64 projects were all grab samples.

4. It may be possible to develop a predictive model which ODOT could use to manage shoulder soil, classified in two or more categories (clean fill, solid waste, etc.). DEQ proposed the use of a decision tree model, and made recommendations on statistical packages that would be appropriate for use.

In its SAP review comments, DEQ recommended calculating mean concentrations instead of using the 90% Upper Confidence Limit (UCL). DEQ commented that the 90% UCL is set as a risk exposure estimator for risk assessments. Because these studies were to be used in material management decisions, the risk assessment standards set forth in Oregon Administrative Rules were not required to be met.

Once finalized with DEQ review and approval, the SAP was used to continue statewide sampling efforts discussed below.

3.1 2016 Statewide Highway Shoulder Soil Evaluation Results Report

Based on previous data and evaluation of data gaps in the 2015 study, sampling was focused on the Basin and Range, Blue Mountains, and Deschutes-Columbia physiographic provinces (see Figure 1 of this Manual). These provinces correspond with parts of ODOT Districts 9, 10, 11, 12, 13, and 14. Sample locations were selected based on data gaps, lack of evidence of contamination (i.e., staining or odor), and away from urban areas and potential point sources of contamination (commercial facilities). In total, an additional 462 samples were collected from 150 borings at 71 sampling locations. As with the 2015 study, soil samples were collected at three prescribed distances from edge of pavement (0′-15′, 15′-30′, >30′) and at three discrete depth intervals (0-0.5′, 0.5′-1.0′, 1.0′-1.5′).

The report makes four main conclusions:

1. Shoulder soil in the Basin and Range and Blue Mountains physiographic provinces typically contain lead and BaP in concentrations below the CFSLs.

2. Shoulder soil in the Deschutes-Columbia physiographic province typically contains lead and BaP in concentrations above the CFSLs within 0-15 feet from the edge of pavement to a depth 1.5 feet and to a depth of approximately 0.5 feet to a distance of 15-30 feet from edge of pavement.

3. Datasets were limited in the Portland Basin and South Willamette Valley physiographic provinces, but detected concentrations of lead and BaP were generally greater than CFSLs, but less than DEQ's Construction Worker Risk Based Concentrations (RBCs).

4. Soil sample datasets for the Cascade Range, Coast Range, High Lava Plains, Klamath Mountains, and Owyhee Upland physiographic provinces were limited and insufficient for a full statistical evaluation of lead and BaP concentrations. Based on available data, some trends were apparent:

    a. The High Lava Plains province mean concentrations of lead and BaP are generally less than CFSLs;

    b. The Coast Range province mean and 90% UCL concentrations are above CFSLs, but below DEQ's Residential RBCs; and,

    c. Little to no data are available in the Cascade Range, Klamath Mountains, and Owyhee Uplands provinces.

These conclusions were used to create a list of several recommendations. Many of these focused on physiographic province specific management options for shoulder soil that does not meet CFSLs.

4 Conclusion

The recommendations in the 2016 Study can be reviewed in detail in Section 6.0 of the Cascadia Report . These recommendations provided the basis for the statewide BUD, discussed in Section 6.2 of the HazMat Program Manual. Cascadia also made recommendations for ODOT to conduct shoulder soil sampling for making Clean Fill Determinations on future projects.

There were also recommendations made in the 2016 Cascadia Report for shoulder soil sampling in physiographic provinces where there was insufficient data to draw conclusions on the nature of shoulder soil contaminants. These recommendations are reflected in the first bullet, subsection "Shoulder Soil Sampling" of Section 6.1 of the HazMat Program Manual.