EXHIBIT 39

Jennifer Orozco

From: CarterFamily <carterzbr@gmail.com>
Sent: Wednesday, August 7, 2024 10:58 AM
To: Plan
Subject: Greenbar application

Follow Up Flag: Follow up
Flag Status: Flagged

Hello,

According to an ODOT study for aggregate needs:
https://www.oregon.gov/ODOT/Programs/ResearchDocuments/Aggregate_Needs_Report.pdf
Site 07-031-4, shown in Figure 7.19, is located approximately 6 miles southeast of Prineville in
Crook County on Highway 380. The 23-acre site is comprised of 750,000 yd3 (1,721,250 T) of
very good quality, fine grain, highly fractured basalt. There is good screening from the highway
and plenty of room to work.

Rob Carter
6404 SE Riverdance rd
Prineville OR 97754

AGGREGATE RESOURCE INVENTORY AND NEEDS FORECAST STUDY

Final Report

SPR 314

by

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16. Abstract

This study identified and inventoried ODOT-owned and leased aggregate sites throughout the state, assessing the quality and estimated quantity of material. In addition, an aggregate needs forecast was prepared, projecting that 60,801,320 Mg of aggregate will be required for paving projects, bridge rehabilitation and reconstruction, OTIA modernization projects, and maintenance needs over the next 15 years.

A comparison was made between the 15-year forecast and the estimated reserve from potentially significant and/or key sites for each District. In seven of the Districts, the estimated reserve exceeds the forecast need. However, in the other eight districts the need exceeds the reserve. In Districts 2B, 3, 5, 11 and 13 the estimated reserve is significantly less than the forecast demand.

Estimated reserves were based on field calculations. This study considered only sources of high quality rock suitable as base rock, paving and reinforced concrete structures, and did not address ODOT needs for sand and lower quality fill materials. In addition, the study did not determine whether or not a site is actually usable. A closer look at the distribution of sites and reserves in the study shows that some areas of the state are resource poor, and locations of large reserves do not necessarily match with the areas of highest projected need.

For state owned or leased aggregate sites considered potentially significant or otherwise strategically important, ODOT should develop a program to protect those sites from future incompatible adjacent land uses. This would include submitting a Post-Acknowledgment Plan Amendment (PAPA) application to the local governments having jurisdiction over the sites.

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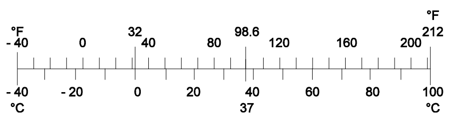
SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	Inches	25.4	Millimeters	mm
ft	Feet	0.305	Meters	m
yd	Yards	0.914	Meters	m
mi	Miles	1.61	Kilometers	km
		AREA		
in^2	Square inches	645.2	millimeters	mm^2
ft^2	Square feet	0.093	meters squared	m^2
yd^2	Square yards	0.836	meters squared	m^2
Ac	Acres	0.405	Hectares	ha
mi^2	Square miles	2.59	kilometers squared	km^2
		VOLUME		
fl oz	Fluid ounces	29.57	Milliliters	mL
gal	Gallons	3.785	Liters	L
ft^3	Cubic feet	0.028	meters cubed	m^3
yd^3	Cubic yards	0.765	meters cubed	m^3
NOTE: Volumes greater than 1000 L shall be shown in m^3.				
		MASS		
oz	Ounces	28.35	Grams	g
lb	Pounds	0.454	Kilograms	kg
T	Short T (2000 lb)	0.907	Mega-grams	Mg
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5(F-32)/9	Celsius temperature	°C

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	Millimeters	0.039	inches	in
m	Meters	3.28	feet	ft
m	Meters	1.09	yards	yd
km	Kilometers	0.621	miles	mi
		AREA		
mm^2	millimeters squared	0.0016	square inches	in^2
m^2	meters squared	10.764	square feet	ft^2
ha	Hectares	2.47	acres	ac
km^2	kilometers squared	0.386	square miles	mi^2
		VOLUME		
mL	Milliliters	0.034	fluid ounces	fl oz
L	Liters	0.264	gallons	gal
m^3	meters cubed	35.315	cubic feet	ft^3
m^3	meters cubed	1.308	cubic yards	yd^3
		MASS		
g	Grams	0.035	ounces	oz
kg	Kilograms	2.205	pounds	lb
Mg	Mega-grams	1.102	short T (2000 lb)	T
		TEMPERATURE (exact)		
°C	Celsius temperature	1.8C + 32	Fahrenheit	°F



***** SI is the symbol for the International System of Measurement

(4-7-94 jbp)

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DISCLAIMER

AGGREGATE RESOURCE INVENTORY AND NEEDS FORECAST STUDY

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1.0 INTRODUCTION

1.1 PROBLEM STATEMENT

Aggregates are needed to build and maintain the transportation system infrastructure. As the demand on the infrastructure increases, so will demand for good quality aggregates, a finite resource already limited in some areas. Future Oregon Department of Transportation (ODOT) requirements and the availability of aggregate sources have not been determined. The establishment of a new aggregate supply source requires advance planning and a lengthy permitting process with the Oregon Department of Geology and Mineral Industries (DOGAMI). Further, existing aggregate sources near developing areas are subject to encroachment and other land use conflicts. Land use protections need to be established early to protect aggregate resources from future land use conflicts.

The demand for good quality aggregate will increase with the growth in Oregon's population. Existing aggregate sources provide a finite supply. Road uses demand a significant amount; according to the U. S. Geological Survey, highway construction accounts for over 30% of the aggregate used in the United States. Land use constraints on mining operations at current sites and on new site development further exacerbate the supply problem.

Oregon's Statewide Planning Goal 5 protects natural resources and conserves scenic and historic areas and open spaces. It pertains to twelve types of natural resources, including mineral resources such as aggregate. Oregon Administrative Rule (OAR) 660-023, which implements Goal 5, explains how ODOT can evaluate its aggregate producing sites and initiate protective land use actions to conserve and protect "significant" sites. Sites are considered significant if one of the following criteria is met:

- A representative set of samples of aggregate material in the deposit meets ODOT base rock specifications for air degradation, abrasion, and sodium sulfate soundness, and the estimated amount is more than 2,000,000 T in the Willamette Valley, or 100,000 T outside the Willamette Valley;
- The material meets local government standards establishing a lower threshold for significance than the subsection above; or
- The aggregate site is on an inventory of significant aggregate sites in an acknowledged plan.

If an aggregate site is determined to be significant, ODOT may act to protect the site from future incompatible adjacent land uses by submitting a Post-Acknowledgment Plan Amendment (PAPA) application to the local government having jurisdiction over the site. Before the start of this research project, however, there was uncertainty about which ODOT sites were "significant."

Further, current information on aggregate sources and needs is limited. A 1995 DOGAMI report provided forecasts of aggregate consumption for the state and each county (*Whelan 1995*). The forecast was for a fifty year (2001-2050) planning horizon, and showed how the need for the mining of construction aggregates such as sand, gravel, and crushed rock will increase as Oregon's population continues to grow. The report provided average, annual aggregate consumption rates for each Oregon county including road use. The forecast was made using an economic model applying indicators of population, income, and demographics to predict aggregate consumption rates.

The DOGAMI report, however, did not address specific aggregate sites, land use considerations or development of new sites. Thus in July 1998, a research project was initiated to investigate ODOT-owned or -leased aggregate sites and to assess future aggregate needs.

1.2 OBJECTIVES

The objectives of this study were a) to investigate each ODOT aggregate site, focusing on aggregate quantity and quality, and land use considerations; and b) to forecast future aggregate needs of the Department. The following tasks were undertaken in order to accomplish the research objectives:

1. Determine the quantity and quality of available aggregate on ODOT property by inventorying sites.
2. Determine the amount of material needed to meet future ODOT maintenance and construction needs and identify the projected shortfall, if any, for the next 30 years.
3. Identify ODOT aggregate sources facing likely land use conflicts so that protection efforts may be initiated.
4. Identify alternate materials for use in maintenance and construction operations to help meet any potential shortfall.

As indicated above, a 30-year forecast was called for in the work plan. Because of the uncertainty, however, about pavement preservation, modernization and bridge rehabilitation and construction projects over that long of a cycle, the forecast horizon was later narrowed to 15 years.

During the course of the study, the fourth task was eliminated. There is an abundance of previous research about use of alternative sources of aggregate (crumb rubber, cullet glass, steel slag, etc.) in paving mixes. If the reader is interested in a particular recycled product, ODOT’s Research Group can help answer questions and serve as an information resource. In addition, the Transportation Research Information Service (TRIS) has an online search engine that can be used to explore topics such as recycled aggregates. The internet address for TRIS is: http://ntl.bts.gov/tris

1.3 REPORT FORMAT

This report documents the results of the research efforts undertaken to achieve the objectives noted above. Chapter 2 describes the methodology for the field investigations and data collection procedures. The ODOT aggregate tests that are used to characterize aggregate quality are discussed in Chapter 3. Chapters 4, 5, 6, 7 and 8 summarize the aggregate sites by ODOT District for Regions 1, 2, 3, 4, and 5 respectively. Figure 1.1 shows the ODOT Region and District boundaries.

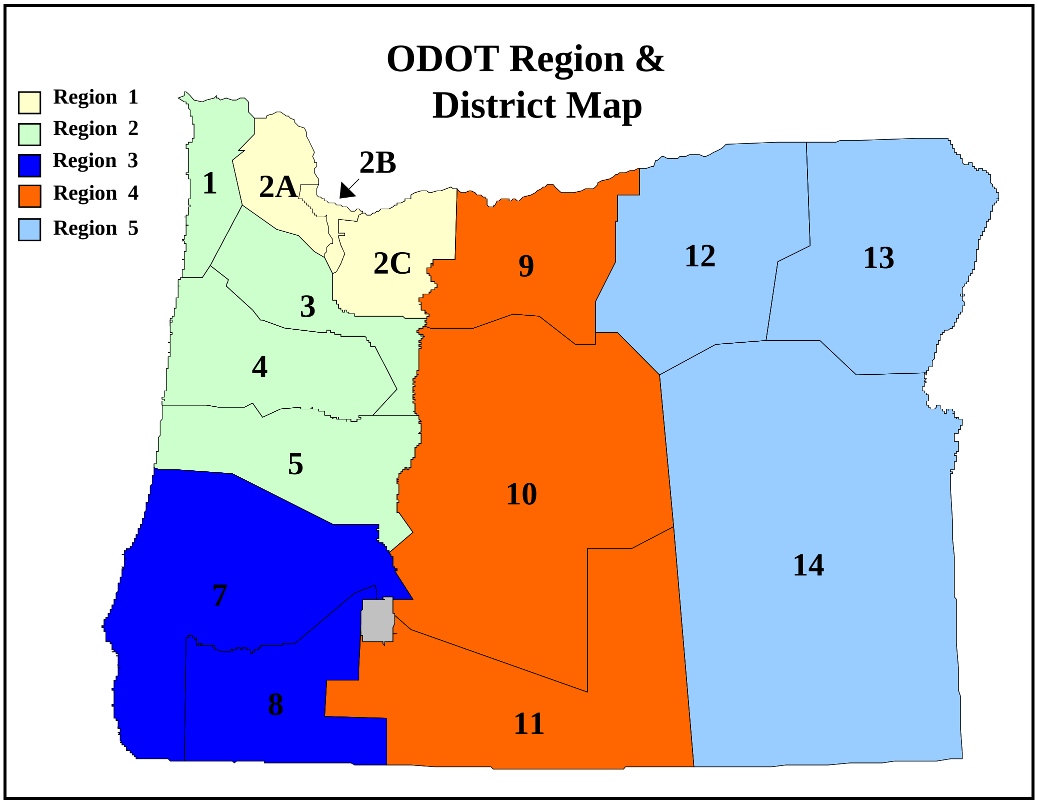

Figure 1.1: ODOT Region and District Map

In Chapters 4-8 many of the values used to characterize the sites are in English units rather than metric units. The units most commonly used are “cubic yards” to describe estimates of reserve, and “acres” when referring to pit size or size of the entire aggregate site. English units are used for consistency with the three databases used extensively in the data collection phase of the research – ODOT’s Aggregate Source Database, ODOT’s Right of Way Database, and DOGAMI’s Database of Permitted Aggregate Sites. These databases characterize the sites using English units. Thus, for simplicity and comparability, many of the volumetric and area descriptions used in this report are in English units.

Chapter 9 provides the aggregate forecast methodology and results, and it presents future aggregate needs for each District. Metric units are used in this chapter. The final chapter is devoted to conclusions and recommendations.

In addition to the information presented in Chapters 1-10, detailed information about each aggregate site is provided in the Appendices. For each site, there are digital images, right of way maps providing boundaries, aerial photos, and data sheets providing qualitative and quantitative information. The Appendices are organized by District. For example, Appendix A contains all of the information about sites in District 1; Appendix B covers District 2A; and so on. The Appendices, similar to Chapters 4-8, use a combination of metric and English units to describe characteristics about each site.

2.0 FIELD DATA COLLECTION PROCEDURES

This chapter describes the preliminary work that took place before starting field investigations and the actual procedures used to assess each site during the field investigations.

2.1 IDENTIFICATION OF AGGREGATE SITES

2.1.1 Project Data Sources

Before any fieldwork, aggregate sites first had to be identified and located to determine how many sites ODOT owned and what information was already available for these sites. It was apparent from the beginning of the project that not all the information about aggregate sites was available through one source. Initially, aggregate related databases were acquired from three different sources:

- The Aggregate Source Database (ASDB) from ODOT's Construction Section;
- The Right of Way (ROW) Database from ODOT's Right of Way Section; and
- The Department of Geology and Mineral Industries (DOGAMI) Database of Permitted Aggregate Sites.

2.1.1.1 Aggregate Source Database

The Aggregate Source Database (ASDB) was a Microsoft Access database compiled from two mainframe databases – "Laboratory Information Management System" (LIMS), and "Quarry." The ASDB contained information about aggregate sites including the location, type of aggregate, an estimate of remaining reserves and all of the laboratory test data recorded for that site.

2.1.1.2 Right of Way Database

The ROW Database contained over 13,000 records with information about every parcel of land owned or leased by ODOT. The database was initially trimmed by the principal investigator to about 1,500 records to review, and finally to about 900 records which contained information about possible aggregate sites (quarries, gravel sites, etc.) around the state that required further investigation. The ROW Database contained ROW map numbers for every site, which helped in locating the exact boundaries of the sites. The maps were used to determine the remaining reserve of aggregate at a site. The ROW Database also was invaluable because it provided the highway number, mile point, township, range, and section numbers, and property notes about each site.

2.1.1.3 Department of Geology and Mineral Industries Database

The DOGAMI Database of Permitted Aggregate Sites helped to verify some of the ROW information and provided sources of new information about ODOT aggregate sites.

2.1.2 Research Project Database

Information from the three databases was merged into one for this study. The merged database provided the basis for site identification. It was agreed early in the research project to limit the field investigations to ODOT-owned or -leased sites. Although commercial aggregate sources supply the majority of aggregate to meet the Department's needs, they were not included because the sites are privately owned, and information such as size and remaining reserves is proprietary. Although the field investigations were limited to ODOT-owned or -leased sites, identifying them still posed a formidable challenge.

One of the difficulties was integrating the three databases. Because the ASDB contained records for all sources – private, and ODOT-owned and -leased – it was used to structure the data. Aggregate sources in the ASDB are assigned a "*Source Number*" – a six digit identifying number (*XX-XXX-X*) – by the ODOT Materials Laboratory. This unique number system was developed for identifying only those aggregate source sites that have had materials submitted for testing. As an example, an aggregate sample from Clatsop County could be assigned a number such as 04-013-2. The first two characters, "04" represent the county number. County numbers are assigned in alphabetical order: Baker – 1, Benton – 2, etc. The middle digits, "013" are assigned to that source, in sequential order for each county, as samples are submitted. The last character in the source number, "2" represents the ODOT Region where the source is located.

When merging the databases, the sites that were ODOT-owned or -leased were first extracted from the ASDB. Unfortunately, the information was not always current, and there was no way to tell if the sites were still owned by ODOT or if the leases were still in effect. Because a number of potential sites had not had material submitted to the Materials Laboratory for testing, it quickly became apparent that there were ODOT aggregate sites not listed in the ASDB.

Since the ROW Database contained detailed property records on all ODOT parcels, it was used to help resolve ownership issues and identify sites that did not have source numbers. Quarry or gravel sites shown in the ROW Database but not in the ASDB were assigned a "900" series source number by the principal investigator. For example, a site located in Clatsop County that was not listed in the ASDB, but shown as a gravel site in the ROW Database, would be assigned a source number such as 04-901-02.

The database from DOGAMI was used to determine which sites had been permitted by DOGAMI, the type of permit, and those sites that were still active. The DOGAMI Database was also used to identify any other sites that were not in the ASDB, but were owned or leased by ODOT.

Another source of information about the sites was the ODOT Region Geologists. Each Region office was contacted about the study. The principal investigator met with the geologists early in the project and reviewed their files for pertinent information that could be used to better identify and classify the aggregate sites. Any relevant information was photocopied and used to help construct a more complete project database.

Additionally, during the course of the study, if there were questions regarding the ownership of a particular site, the principal investigator researched property records at the appropriate county courthouse.

2.1.3 ODOT's Future Aggregate Database

Although not part of this research project's scope, there is a new aggregate database being developed by ODOT's Geographic Information Systems Unit and Geo/Hydro Section. This database will have a compilation of most of the information in the databases listed above plus any new and updated information. It will be available on ODOT's Intranet Web site.

2.1.4 Identification of Sites

Based on the review of the existing databases, 750 aggregate sites were identified and subsequently evaluated as part of this study. The sites were located throughout the state, with most of them east of the Cascade Mountains. Table 2.1 provides a breakdown of their locations by ODOT Region and District. These sites are further described in the Appendices to this report.

Table 2.1: Distribution of aggregate sites by Region and District

Region 1		Region 2		Region 3		Region 4		Region 5	
District	**# of Sites**	**District**	**# of Sites**	**District**	**# of Sites**	**District**	**# of Sites**	**District**	**# of Sites**
02A	11	01	12	07	42	09	70	12	85
02B	1	03	12	08	41	10	133	13	67
02C	13	04	26			11	63	14	145
		05	29						
Total	**25**		**79**		**83**		**266**		**297**

Nearly 76% (569 of 750) of the aggregate sites are located in Regions 4 and 5. District 14 has more sites (145) than any other district; followed by district 10 with 133 sites.

Based on the field investigations, the principal investigator classified the aggregate sites by types. The categories used included:

Quarry – An open excavation from the earth's surface, usually for the extraction of hard rock aggregates.

Gravel – An unconsolidated, natural accumulation of rounded rock fragments resulting from erosion, consisting predominantly of particles larger than sand (diameter greater than 2 mm), such as boulders, cobbles, pebbles, granules, or any combinations of these fragments. Gravel sites are usually found in or along the edge of a stream or river or in land where a river once flowed.

Cinder Pit – A quarry that mines volcanic ejecta from a cinder cone (small volcano). The material is used for sanding highways during the winter months. The material is light in weight, and usually red or black in color.

Borrow – A site consisting of earth materials (soils, gravel, etc.) that have been extracted for fill or road construction at another location. Often the borrow material has suitable or desirable physical properties.

Raw Land – A site where there is no prior disturbance.

Road Cut – Road cuts consist of steep slopes parallel to, and above the highway, produced by the road grade difference with the surrounding terrain. Some of these sites have been given a source number because of the potential use of the material in future road widening projects, and some are listed as quarries in the Right of Way Database.

Stockpile Site – A site now used as a place to store aggregate or maintenance supplies. These sites usually are flat, have small acreage, and are located adjacent to a highway.

Maintenance Yard – A site that has been converted to an ODOT Maintenance Yard will have offices, shops, or other improvements necessary for equipment storage and repair and serves as a staging area for maintenance activities.

Table 2.2 shows the distribution of sites for each District by type. Of these, 37% (276 of 750) are classified as quarries, with almost 80% located in Regions 4 and 5. There are 129 gravel sites, with nearly 40% located in Region 3. Region 4 has 20 of the 30 sites classified as cinder pits, with 8 others being located in District 14. Over 20% of the sites (153 of 750) are classified as "Raw Land" because at these locations there is no evidence of prior excavation or mining.

Table 2.2: Classification of aggregate sites by District

Region	District	Quarry	Gravel	Cinder Pit	Borrow	Raw Land	Road Cut	Stockpile Site	Maint. Yard	Grand Total
1	**02A**	7				1	3			11
	02B		1							1
	02C	6	1			3		3		13
2	**01**	7				3	2			12
	03	6	3	1		1	1			12
	04	11	11			2		2		26
	05	1	17		6	4		1		29
3	**07**	10	26	1	1	1	1	2		42
	08	7	25			8		1		41
4	**09**	43	1		5	15	2	2	2	70
	10	39	2	15	47	25	3	1	1	133
	11	23	3	5	11	17	3	1		63
5	**12**	44	9		1	24	1	3	3	85
	13	29	11		6	15	1	5		67
	14	43	19	8	32	34	2	6	1	145
Total		**276**	**129**	**30**	**109**	**153**	**19**	**27**	**7**	**750**

In Chapters 4-8, the sites will be discussed in detail.

2.2 LOCATING THE SITES

A paramount concern was to determine the specific location of a site before visiting it. It was also useful to gather as much information as possible about the site, particularly the area topography and any unique features. Thus, maps became a critical resource for accurate information about each site.

A right of way map had been produced for each site at the time the property was originally surveyed and acquired. Most of them had a legal description printed on them, or the description could be acquired from the ROW Database. The descriptions allowed the site to be located on a United States Geological Survey (USGS) quadrangle map, whose contours helped to provide a visual three-dimensional representation of the site.

In addition to being found on the small-scale (1 to 24,000) USGS maps, the sites were also located on large-scale (1 to 100,000) maps acquired from the U.S. Forest Service (USFS) and the U.S. Bureau of Land Management (BLM). If the site could not be located on one of these maps, detailed county maps provided by ODOT's Geographic Information Systems Unit were used to locate a site and its proximity to an ODOT highway. The USFS, BLM and ODOT maps were invaluable for site location relative to the highway and local landmarks.

2.3 FIELD DATA COLLECTED

The goal for the field investigations at each site was to acquire relevant information useful to a wide audience, yet specific enough for a singular purpose. While this project was designed to answer very specific questions, it was felt that a study of this magnitude should concurrently capture as much relevant data as possible for an aggregate site. Based on an informal survey of Region Geologists and the project's Technical Advisory Committee members, a field form (shown in Figure 2.1) was designed to be filled out by the principal investigator when visiting each site.

The field form helped to standardize the field procedures and ensure collection of consistent data. The first two lines of the form were for right of way information. Next, two lines noted the Global Positioning System (GPS) data collected at the site. Two lines pertained to reserves and rock qualifiers. Below that, eleven lines were for rock and site specific information. The last four lines addressed National Pollution Discharge Elimination System (NPDES) issues, and any Oregon Statewide Planning Goal 5 questions (protective land use to conserve and protect significant natural resource sites).

The terms used in the field form are described in Table 2.3.

FIELD FORM FOR AGGREGATE STUDY

Date: ________ Name:___________ Source #: _____________ County: ________________

Type of Site: ____________ Map #:_________ R/W file #:__________ Acreage:___________

Latitude: ____________________ Longitude: ____________________ Elev.: ______________

Accuracy of GPS:______________ Location: ____

Length: __________ Width: __________ Depth: __________ Quantity:__________________

Quality: ____

Rx Types: _______________________ Unit:_________________ Color: _________________

Weathering: ________________________________Structure: ____________________________

Jointing: _______________ Hardness: ______________ Field Unit Weight: ______________

Remarks: ____

____

____

____

Status of Site: __________________________ Pit Size: _____________________________

Site Open or Closed: ______________ Direction: _____________________________________

Adjacent Land Use:____

Is this a Significant Site: _____________ Why: ______________________________________

Figure 2.1: Field form used for site investigations by the principal investigator

Table 2.3: Description of aggregate study field form data fields

Data Field	Description
Date	The date when the site was visited.
Name	The name of the principal investigator who visited the site and filled out the form.
Source #	The unique lab number assigned to that site.
County	County where the site is located.
Type of Site	The general purpose of that site (described in Section 2.3.2). The examples are; Quarry, Gravel, Raw Land, Road Cut, Stockpile Site (SSP), Maintenance, Borrow, and Cinder Pit.
Map #	The right of way map that was made for the site and is listed in the Right of Way Database.
R/W file #	The unique 5-digit number assigned to that particular parcel in the Right of Way Database.
Acreage	The amount of ground from the right of way map, Right of Way Database, County Records, or the Region Geology Office.
Latitude:	Acquired with the GPS receiver.
Longitude:	Acquired with the GPS receiver.

Table 2.3 (continued): Description of aggregate study field form data fields

Data Field	Description
Elevation:	Acquired with the GPS receiver.
Accuracy of GPS	Statistical value obtained from the software for a 95% confidence interval.
Location:	Where the GPS receiver was set up to collect the data.
Length:	The length of the existing or future pit; used to calculate a quantity for remaining reserve.
Width	The width of the existing or future pit; used to calculate a quantity for remaining reserve.
Depth	The depth of the existing or future pit; used to calculate a quantity for remaining reserve.
Quantity	The estimated remaining reserve in yd^3.
Quality	A subjective classification given to the site based on the principal investigator's observations of the aggregate. Definitions are in the Appendix.
Rx (rock) Types	The lithologies found at the site.
Unit	The geological map unit from the USGS 1:500,000 State of Oregon Geology map.
Color	This is derived from the rock color chart distributed by The Geological Society of America.
Weathering	The classification derived from the Soil and Rock Classification Manual, Oregon Department of Transportation.
Hardness	The classification derived from the Soil and Rock Classification Manual, Oregon Department of Transportation.
Structure	Large-scale geological features at the site that could affect work.
Field Unit Weight	Field Unit Weight = [B/(B-C)]*62.4 B = Weight of sample in air C = Weight of sample in water 62.4 = Unit weight of water in lbs/ft^3
Remarks	A brief critique of the site plus anything anomalous that would not fit in the field form.
Status of Site	The site was classified as either "active" or "inactive." If there was work in progress the day it was evaluated, the site was active. If there was no work taking place, then it was inactive.
Pit Size	The amount of past disturbance given in acres.
Site Open or Closed	A notation of whether there was any water runoff from the site.
Direction	The direction of the closest body of water.
Adjacent Land Use	The function of the land surrounding the aggregate site.
Significant Site?	A notation of whether the site has the potential for Goal 5 protection.
Why?	Reasons to pursue Goal 5 classification.

2.4 ON-SITE PROCEDURE FOR EVALUATING EACH SITE

2.4.1 Global Positioning System Data

The first action taken at each site was to set up the Global Positioning System (GPS) receiver to collect coordinate data. The GPS unit used was a GeoExplorer® II receiver made by Trimble™. The receiver was placed on a mounting tripod in the quarry pit, or along the highway if the site had no discernable pit. If the quarry was located quite a distance from the highway, a second GPS point was acquired for locating the access road off the highway, and this information was included in the Remarks section of the field form. The data collected in the field was downloaded and post-processed at the ODOT Research Group office. All of the GPS coordinates were then recorded on the field forms.

Since GPS technology is based upon a system of projection (WGS 84) that differs from map projections, the latitude and longitude readings acquired using GPS should not be used to accurately locate a site on a map, unless they are first converted to the particular projection used in the map. The GPS readings can be used to provide accurate locational information in the field, using a comparable GPS instrument.

Some sites could not be positioned with latitude and longitude data collected with the GPS receiver, because the surrounding terrain and forest canopy made it difficult to acquire a satellite link. In those cases the coordinates were obtained using the Maptech® Terrain Navigator® software package. This program provided the latitude and longitude when the site's location was identified on USGS topographic maps (1:24,000 scale). When the location coordinates were obtained in this way, this fact was recorded in a "comments" section of the database.

The township, range and section numbers were also recorded in the database for each site. This information may be used when locating a site on a quad sheet. These figures are based on the Professional Land Survey (PLS) system for Oregon. While some sites may also be identified using the Donation Land Claim (DLC) system, this information was not recorded in this study.

2.4.2 Digital Imagery

In addition to acquiring GPS data, digital images were obtained at each site. Some of the images shown in the Appendices are "stitched together" to produce a panoramic mosaic of a site. For example, a panoramic image could be comprised of the three separate shots shown in Figure 2.2 that cover an area of about 300 degrees. When stitched together as one image, it provides the panoramic view of the site as shown in Figure 2.3.

Figure 2.2: Unstitched images of an aggregate site in Clackamas County

Figure 2.3: Stitched image of an aggregate site in Clackamas County

Many of the images also show either a vehicle or the GPS receiver tripod for scale. In close up shots, a four-pound hammer (approximately 1.3 ft in length) is used for scale. The close-up images also help to highlight any features not reported on the site data sheet.

2.4.3 Collection of Aggregate Samples

At each quarry site, approximately 14 kg of rock samples were collected. The samples were bagged and stored for future testing if needed. If the aggregate site was classified as a gravel, borrow, stockpile, raw land, or maintenance site, samples were not obtained. Samples were not taken at gravel sites because of the lack of homogeneity of the rock; gravel sites, by nature, are the products of the erosion of bedrock and surficial materials and the subsequent transport, abrasion, and deposition of the rock particles (*Langer 1993*). In Oregon most gravel sites are along rivers or streams. Since gravel sites are comprised of material transported by water from more than one source, obtaining a truly representative 14-kg sample was problematic.

2.4.4 Estimating Remaining Reserves

An estimate of the existing pit size (in acres) was made at each quarry site. Not all of the sites had prior disturbance, and pit size was reported only where there was evidence of previous extraction. The remaining reserve was also estimated for all sites (listed as "Quantity" on the data sheet in the Appendices). The quantity of reserves was calculated by determining the size of the site in acres, multiplying the acreage by the theoretical depth of the pit, and converting the volume to cubic yards. This formula was used for sites with relatively flat topography; but on sites where the terrain was 10° and steeper, the calculated volume was halved to take into consideration the bench cuts needed for extracting aggregate. In some instances, the sites were located at the top of a butte or on a hilltop. There, a conical volumetric formula was used to calculate remaining reserves.

The remaining reserve estimate was converted to megagrams by multiplying the quantity in cubic yards by the field unit weight.

The reader is advised to treat the estimates of remaining reserves as a “ballpark” estimate made in the field. Further, the estimate does not take into account any layers of poor quality aggregate or organics that would reduce the soundness and durability of the rock. The estimate also does not consider any loss of material during processing.

2.4.5 Assessing Quality of Aggregate

The aggregate at each quarry site was evaluated for engineering purposes in accordance with ODOT’s Soil and Rock Classification Manual (*ODOT 1987*). Aggregate was classified by:

- Color;
- Structure:
- Relative hardness (Table 2.4); and
- Weathering (Table 2.5).

Table 2.4: ODOT Soil and Rock Classification Manual – Hardness Chart

Term	Hardness Designation	Field Identification	Approximate Unconfined Compressive Strength
Extremely Soft	RO	Can be indented with difficulty or friable with finger pressure.	< 100 psi
Very Soft	R1	Crumbles under firm blows with point of geology pick. Can be peeled by a pocketknife. Scratched with finger nail	100-1,000 psi
Soft	R2	Can be peeled by a pocketknife with difficulty. Cannot be scratched with fingernail. Shallow indentation made by firm blow of geology pick.	1,000-4,000 psi
Medium Hard	R3	Can be scratched by knife or pick. Specimen can be fractured with a single firm blow of hammer/geology pick.	4,000-8,000 psi
Hard	R4	Can be scratched with knife or pick only with difficulty. Several hard hammer blows required to fracture specimen.	8,000-16,000 psi
Very Hard	R5	Cannot be scratched by knife or sharp pick. Specimen requires many blows of hammer to fracture or chip. Hammer rebounds after impact.	> 16,000 psi

Table 2.5: ODOT Soil and Rock Classification Manual - Scale of Relative Rock Weathering

Designation	Field Identification
Fresh	Crystals are bright. Discontinuities may show some minor surface staining. No discoloration in rock fabric.
Slightly Weathered	Rock mass is generally fresh. Discontinuities are stained and may contain clay. Some discoloration in rock fabric. Decomposition extends up to 1 inch into rock.
Moderately Weathered	Rock mass is decomposed 50% or less. Significant portions of rock show discoloration and weathering effects. Crystals are dull and show visible chemical alteration. Discontinuities are stained and may contain secondary mineral deposits.
Predominantly Decomposed	Rock mass is more that 50% decomposed. Rock can be excavated with geologist's pick. All discontinuities exhibit secondary mineralization. Complete discoloration of rock fabric. Surface of core is friable and usually pitted due to washing out of highly altered minerals by drilling water.
Decomposed	Rock mass is completely decomposed. Original rock "fabric" may be evident. May be reduced to soil with hand pressure.

2.4.6 Other Characteristics of the Sites

Status of the Site – A site was listed as “active” if there was mining or aggregate processing currently taking place at the site. If there was no activity, the site was classified as “inactive.” The majority of the 750 sites (98%) were inactive.

Adjacent Land Use – The adjacent land use was described in the field information. For the majority of sites, the adjacent land was open space, e.g., forest or ranch lands. If there were homes nearby, this was also noted.

Site Open or Closed – A site was classified as “closed” if the runoff water from the quarry pit was contained on site. If the runoff water was not contained on-site, the site was classified as “open.”

Direction – The approximate location of the closest creek, stream, river, or other body of water.

Significant Site – The principal investigator’s assessment about whether the site met Oregon’s Statewide Planning Goal 5 criteria for significant sites, as well as the reasoning for regarding the site as significant.

3.0 AGGREGATE TESTING

In the Appendices of this report information on aggregate testing is presented on the data sheet for each site. The tests include the following:

- 202 – Specific Gravity and Absorption of Fine Aggregate
- 203 – Specific Gravity and Absorption of Coarse Aggregate
- 211 – Resistance to Abrasion of Small Size Coarse Aggregate (Los Angeles Machine)
- 206 – Soundness of Aggregate (Sodium Sulfate)
- 208 – Oregon Air Aggregate Degradation

Most of this information was obtained from existing test records maintained by the ODOT Materials Laboratory. The most recent test results were typically used. The principal investigator also conducted tests for a small number of sites for which no test data existed. These were conducted on the rock samples collected during the field investigations (see Section 2.4.3).

The lab test results in this report were based on one series of testing, and they are presented to provide only a general indication of the quality of aggregate at a site. To determine its suitability for construction purposes, further testing would be required. All tests were run in accordance with ODOT Testing Methods, as follows:

ODOT TM 202/AASHTO T-84 – ***Specific Gravity and Absorption of Fine Aggregate***

This method covers the determination of bulk and specific gravity, and absorption of fine aggregate. After 15 hours in water, this method determines the bulk specific gravity and apparent specific gravity based on the mass of the saturated surface-dry aggregate and the absorption. Absorption values are used to calculate the change in mass of an aggregate, due to water absorbed in the pore spaces within the constituent particles, with respect to the dry condition. This is done when it is deemed that the aggregate has been in contact with the water long enough to satisfy most of the absorption potential.

ODOT TM 203/AASHTO T-85 – ***Specific Gravity and Absorption of Coarse Aggregate***

This method covers the determination of specific gravity and absorption of coarse aggregates. The specific gravity may be expressed as bulk specific gravity, bulk-specific gravity (saturated surface dry, SSD), or apparent specific gravity. The bulk specific gravity (SSD) and absorption are based on aggregate after 15 hours soaking in water. The method is not intended to be used with lightweight aggregates. A sample of aggregate is immersed in water for approximately 15 hours to essentially fill the pores. It is then removed from the water, surface dried, and weighed. Subsequently the sample is weighed while submerged in water. Finally the sample is oven-dried and weighed a third time. Using the mass and weight measurements obtained, and formulas in the method, the three types of specific gravity and absorption can be calculated.

ODOT TM 211/AASHTO T-96 - *Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine*

This test is a measure of degradation of mineral aggregates of standard gradings resulting from a combination of actions including abrasion or attrition, impact, and grinding in a rotating steel drum containing a specified number of steel spheres. As the drum rotates, a shelf plate picks up the aggregate sample and the steel spheres, carrying them until they are dropped to the opposite side of the drum, creating an impact/crushing effect. The contents then roll within the drum with an abrading and grinding action, until the shelf again picks up the sample and the steel spheres and the cycle is repeated. After a prescribed number of revolutions, the contents are removed from the drum and the aggregate is sieved to measure the amount of material retained on a 1.7-mm sieve. The calculated loss is determined by the difference of the original weight and the final weight and recorded as a percent loss (*AASHTO 2000*). ODOT Supplemental Standard Specifications for Highway Construction require that aggregate shall not exceed a value of 30% loss (original weight to final) for this test (*ODOT 1998b*).

ODOT TM 206/ AASHTO T-104 – *Soundness of Aggregate by Use of Sodium Sulfate*

The sodium sulfate soundness test is run for both coarse (> 4.75 mm) and fine (< 4.75 mm) aggregate samples. The test determines the resistance of aggregate to disintegration by saturated solutions of sodium or magnesium sulfate. This is accomplished by repeated immersions followed by oven drying to partially or completely dehydrate the salt precipitated in the permeable pore spaces of the aggregate. The sodium sulfate soundness test assesses the aggregate's resistance to breakdown or disintegration. Immersing and drying the sample causes internal expansive forces from the re-hydration of the salt upon re-immersion. This simulates the expansion of water during freeze/thaw cycles, and furnishes information helpful in judging the soundness of aggregates subject to weathering action (*ODOT 1998a*). ODOT Supplemental Standard Specifications for Highway Construction requires that the average percentage of loss shall not exceed 12% by mass for asphalt concrete (*ODOT 1998b*).

ODOT TM 208 – *Oregon Air Aggregate Degradation*

The degradation test is designed to measure the quantity and quality of the material produced by attrition similar to that produced in the roadway under repeated traffic loading and unloading. The degradation test is run for both a coarse and a fine sample.

<u>Coarse Sample</u>: The coarse test consists of 5,000 g of material that passes through a 25 mm sieve but is retained on the 6.3 mm sieve. The material is then run through a small jaw crusher. The crushed sample is screened in a sieve shaker for 10 minutes, and the material passing the 2.00-mm sieve and retained on the 0.850-mm sieve is used. A 130-g portion of material from the 0.850-mm sieve is washed and oven-dried until constant mass has been obtained. The material is then split again to acquire a final 100-g sample.

<u>Fine Sample</u>: The fine aggregate sample is prepared by weighing out 750 g of material that passes a 6.3-mm sieve. The sample is shaken and the material that passes a 2.00-mm sieve but is retained on the 0.850-mm sieve is measured to acquire a 130-g sample. This sample is washed

and oven-dried until a constant mass has been obtained. The material is then split again to acquire a final 100-g sample.

The two 100-g samples (course and fine) are each placed in a hydrometer, and 100 mL of distilled water are added to each. An air dispersal unit inserted inside the hydrometers provides a constant air flow. The air jets create fine material through the rubbing action of one particle against another in the presence of water. After agitating for 20 minutes, the mixture from each hydrometer is poured through a 0.106-mm sieve into a separate sand-equivalent tube. The material that is held on the 0.106-mm sieve is washed using about 15 mL of water in each washing until the sand-equivalent tube is filled with water, and suspended sediment is at a height of 381 mm. The two tubes are covered with a rubber stopper, inverted 25 times, and after settling for 20 minutes, the sediment height in each tube is recorded to the nearest 2.5 mm. The material from the previous step is washed and oven-dried until it reaches constant mass. The two samples (coarse and fine) are screened in a sieve shaker and the material retained on the 0.850-mm sieve is weighed. The difference between the retained amount on the 0.106 sieve and the 0.850 sieve is calculated and recorded as a percentage passing the 0.850 sieve.

Table 3.1 provides a summary of three of the tests and their required specifications.

Table 3.1: Aggregate testing requirements

Material Use	Test	Parameter Measured in Test	Test Method	Specification Requirement	
				Course Aggregate	Fine Aggregate
AC	L. A. Abrasion	Percent Loss	AASHTO T-96	30%	N. A.
	Degradation	Passing 0.850 mm Sieve	ODOT TM 208	30%	30%
		Sediment Height	ODOT TM 208	75 mm	100 mm
	Soundness	Percent Loss	AASHTO T-104	12%	12%
PCC	L. A. Abrasion	Percent Loss	AASHTO T-96	30%	N. A.
	Degradation	Passing 0.850 mm Sieve	ODOT TM 208	30%	N. A.
		Sediment Height	ODOT TM 208	75 mm	N. A.
	Soundness	Percent Loss	AASHTO T-104	12%	10%
BASE	L. A. Abrasion	Percent Loss	AASHTO T-96	35%	N. A.
	Degradation	Passing 0.850 mm Sieve	ODOT TM 208	30%	N. A.
		Sediment Height	ODOT TM 208	75 mm	N. A.
SHOULDER	L. A. Abrasion	Percent Loss	AASHTO T-96	35%	N. A.
	Degradation	Passing 0.850 mm Sieve	ODOT TM 208	30%	N. A.
		Sediment Height	ODOT TM 208	75 mm	N. A.

4.0 REGION 1 SITES

Region 1 encompasses Districts 2A, 2B, and 2C and includes all or parts of Columbia, Clatsop, Tillamook, Washington, Clackamas, Multnomah, and Hood River Counties. There are 25 ODOT-owned or -leased aggregate sites in the Region, which are classified in Table 4.1 by the type of site.

Table 4.1: Region 1 classification of aggregate sites

Reg.	District	Quarry	Gravel	Cinder Pit	Borrow	Raw Land	Road Cut	Stockpile Site	Maint. Yard	Grand Total
1	**02A**	7				1	3			11
	02B		1							1
	02C	6	1			3		3		13
	Total	**13**	**2**	**0**	**0**	**4**	**3**	**3**	**0**	**25**

4.1 DISTRICT 2A

District 2A is located in the northwest part of the Region. The District boundaries fall within the northern Coast Range and the valleys of the Tualatin, Yamhill and Willamette Rivers. Parts of Clatsop, Tillamook, Multnomah, Clackamas, and Washington Counties, as well as all of Columbia County are located within District 2A. The 11 sites are classified as quarries (7), road cuts (7) and one raw land site that has had no prior disturbance. Figure 4.1 shows, by source number, the location of the aggregate sites that were evaluated in this District.

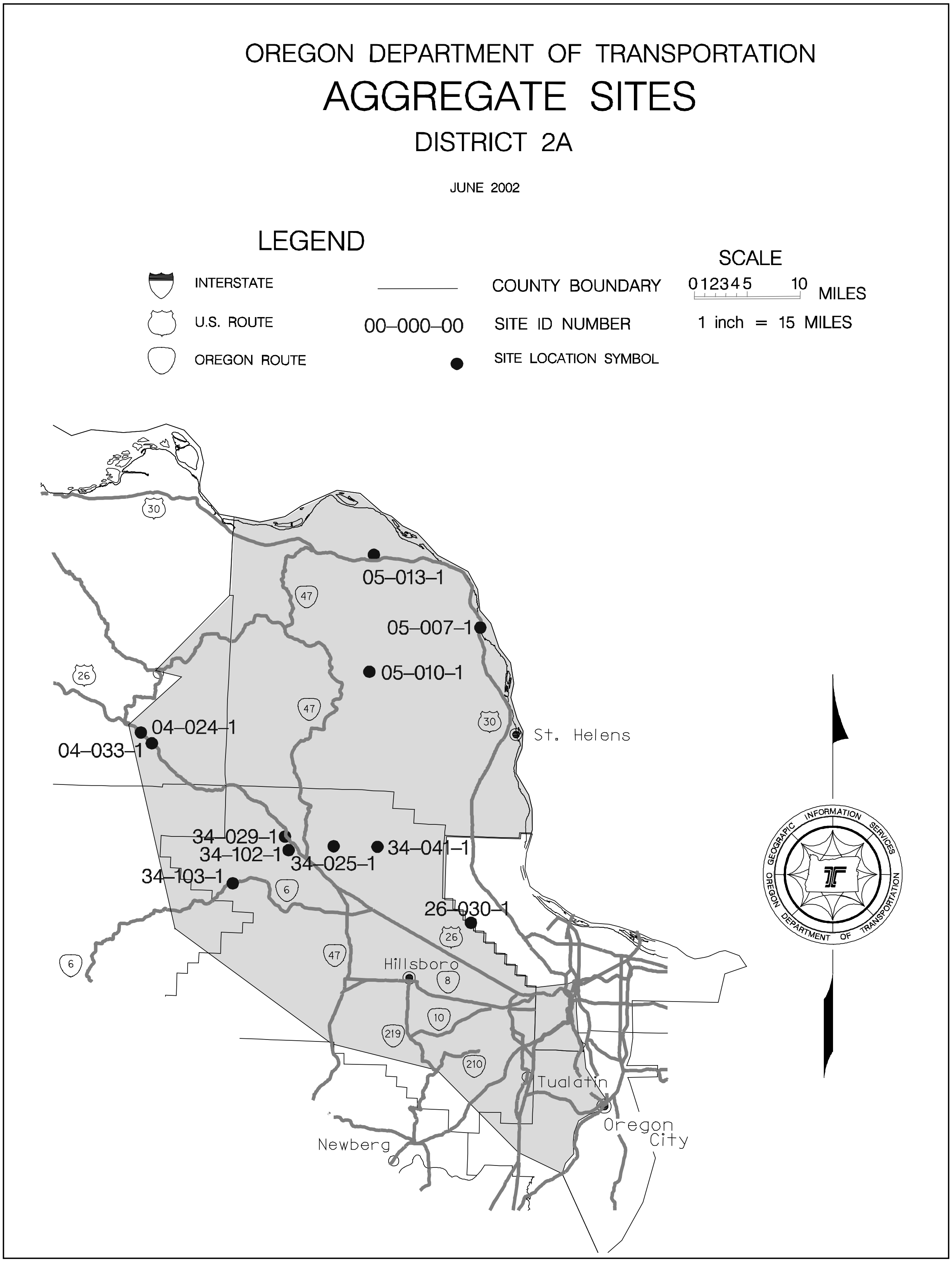

Figure 4.1: District 2A sites

Of the 11 sites, none is considered potentially significant for protection under the provisions of Statewide Planning Goal 5. However, several key sites contain sizeable aggregate reserves.

Luck Quarry (34-041-1), shown in Figure 4.2, is located north of the Sunset Highway on Dairy Creek Road in Washington County. This 21-acre site contains 360,000 yd^3 (972,000 T) of good quality, fine-grain basalt. There is plenty of room to work at the site with some screening from the county road. The terrain is steep and caution should be taken with future development of the site. It should be noted that the quantity of aggregate reserves is below the threshold set for the classification of Goal 5 significant aggregate sites in the Willamette Valley.

Figure 4.2: Luck Quarry

Oak Ranch Creek Quarry (05-010-1), shown in Figure 4.3, is a 20-acre quarry site adjacent to Apiary County Road in Columbia County. This quarry site contains 360,000 yd^3 (753,000 T) of good quality, fine-grain basalt that weathers out perfect dice rock. There is some screening from the road and moderate room to work. There is a private quarry adjacent to the ODOT-owned property. Columbia County administers its own mining permits; (this is the only county in Oregon to do so). This quarry is under permit number 05-0051. The quantity of aggregate reserves is below the threshold set for the classification of Goal 5 significant aggregate sites in the Willamette Valley.

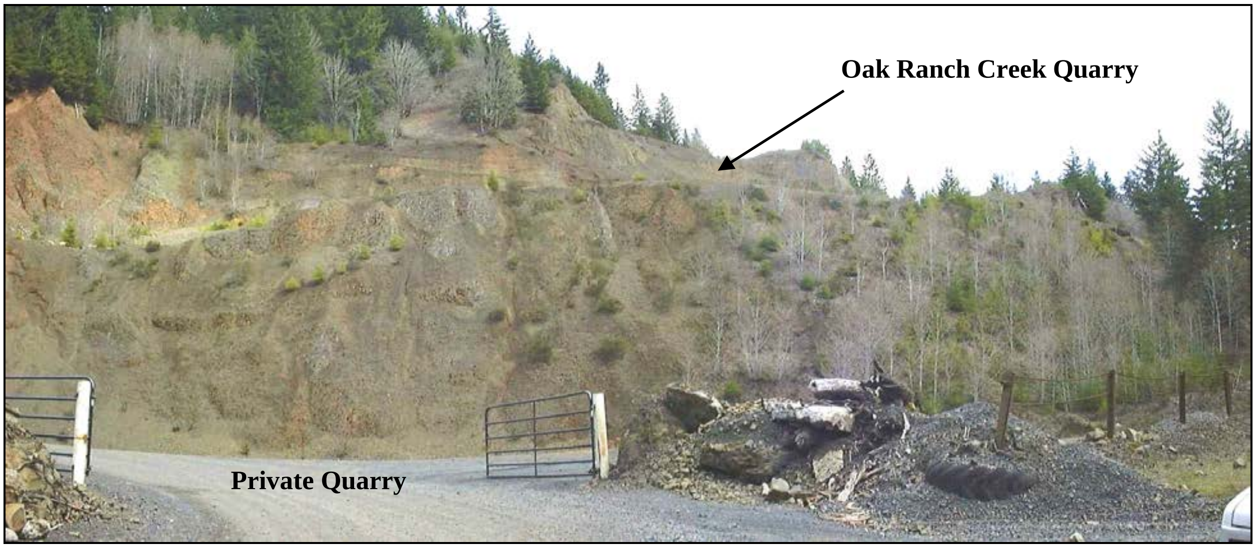

Figure 4.3: Oak Ranch Creek Quarry

Strassel Quarry (34-102-1), shown in Figure 4.4, is located on August Lane just east of the Sunset Highway Tunnel in Washington County. This quarry site covers 88.1 acres and contains 350,000 yd^3 (661,500 T) of fair quality, fine-grain basalt. The terrain is flat when first entering the site but is steep towards the western side. There is a large collection of timber on the site, which could be comparable in value to the aggregate. Again, the quantity of aggregate reserves is below the threshold set for the classification of Goal 5 significant aggregate sites in the Willamette Valley.

Figure 4.4: Strassel Quarry

Table 4.2 summarizes the site locations by highway name and number, and provides estimates of the quantity of aggregate for each highway within District 2A.

Table 4.2: Aggregate site listing by highway for District 2A*

Highway Number	Highway Name	Centerline Mileage	Lane Mileage	Number of Sites	Total Estimated Reserve		
					Yd³	T	Mg
001	Pacific	17.61	55.07				
003	Oswego	11.60	33.73				
029	Tualatin Valley	26.36	83.73				
037	Wilson River	23.82	51.03	1	0	0	0
040	Beaverton-Hillsdale	2.44	9.46				
047	Sunset	52.75	123.76	7	710,000	1,633,500	1,481,585
061	Stadium Freeway	2.24	6.11				
064	East Portland Freeway	8.82	17.31				
091	Pacific Highway West	15.81	47.51				
092	Lower Columbia River	50.38	127.55	2	230,000	519,885	471,536
102	Nehalem	58.41	116.69	1	360,000	753,300	683,243
110	Mist-Clatskanie	11.89	23.78				
140	Hillsboro-Silverton	10.05	20.43				
141	Beaverton-Tualatin	9.91	21.71				
142	Farmington	8.80	20.02				
143	Scholls	6.00	13.14				
144	Beaverton-Tigard	7.44	17.83				
	Total	**324.33**	**788.86**	**11**	**1,300,000**	**2,906,685**	**2,636,364**

* The highway numbers, centerline, and lane mileage were obtained from ODOT's 2000 State Mileage Report.

4.2 DISTRICT 2B

District 2B is located in the Portland Metropolitan area and includes parts of Multnomah, Clackamas, and Washington counties, as well as all of Columbia County. There is only one ODOT-owned or -leased aggregate site in District 2B – Knight Bridge Pit (03-028-1). Figure 4.5 shows the source number and location of the site in District 2B.

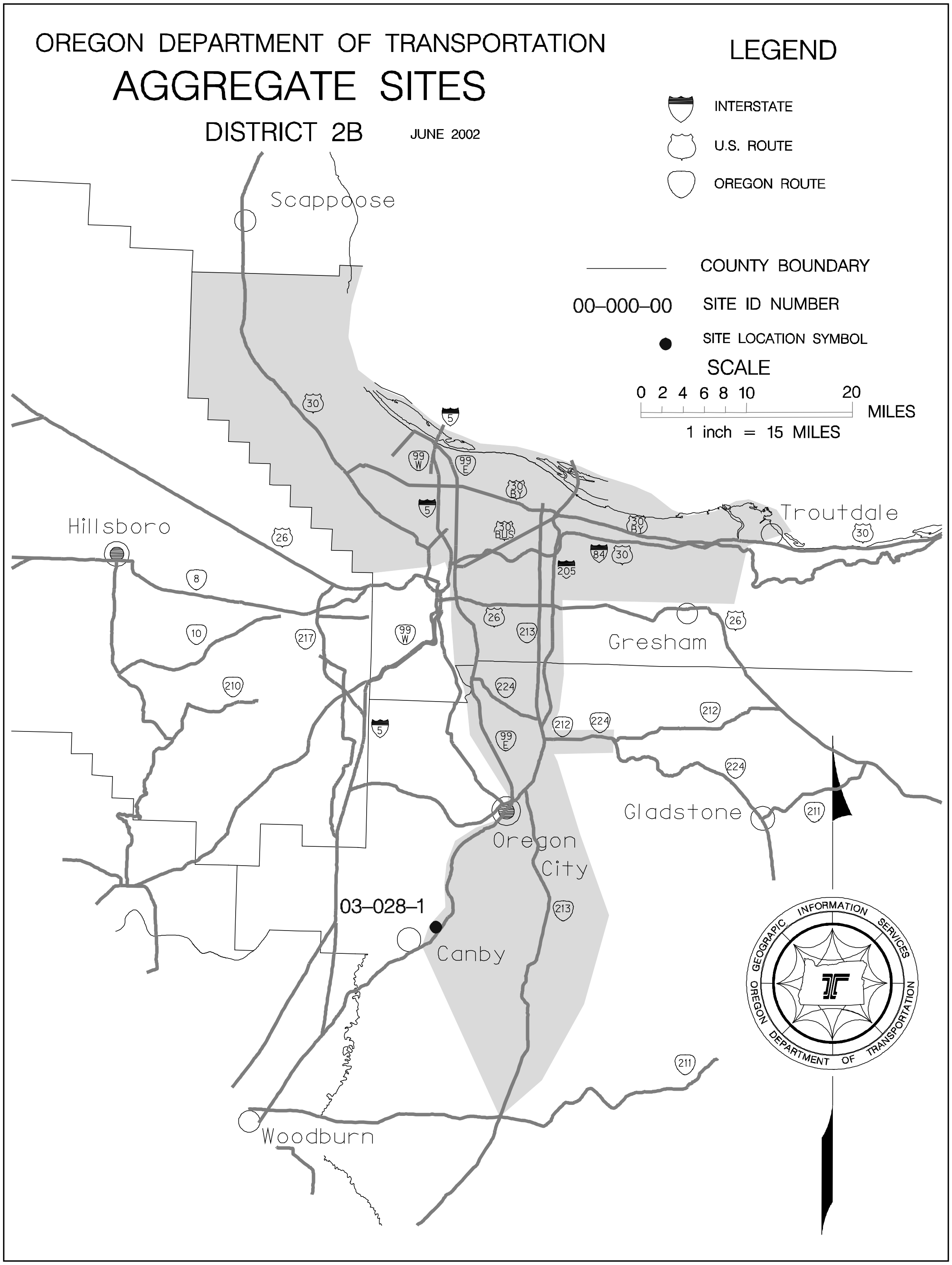

Figure 4.5: District 2B sites

The Knight Bridge Pit (03-028-1), shown in Figure 4.6, is located southwest of Knight Bridge Road and adjacent to the Canby city limits. The 18-acre site is comprised of 120,000 yd^3 (194,400 T) of good quality, volcanic gravel. The site is flat with no past disturbance; however, it is overgrown with brush and trees. The quantity of aggregate reserves is below the threshold set for the classification of Goal 5 significant aggregate sites in the Willamette Valley.

Figure 4.6: Knight Bridge gravel bar

4.3 DISTRICT 2C

District 2C is located east of District 2B. The District's boundaries extend from the Columbia River on the north to Clackamas County's southern boundary on the south, and from Oregon City and Molalla on the west to the eastern borders of Hood River and Clackamas Counties on the east. There are 13 sites in District 2C, which are classified as quarries (6), gravel site (1), raw land (3), and stockpile sites (3). Figure 4.7 shows the source number and location of each of the 13 sites located within the District.

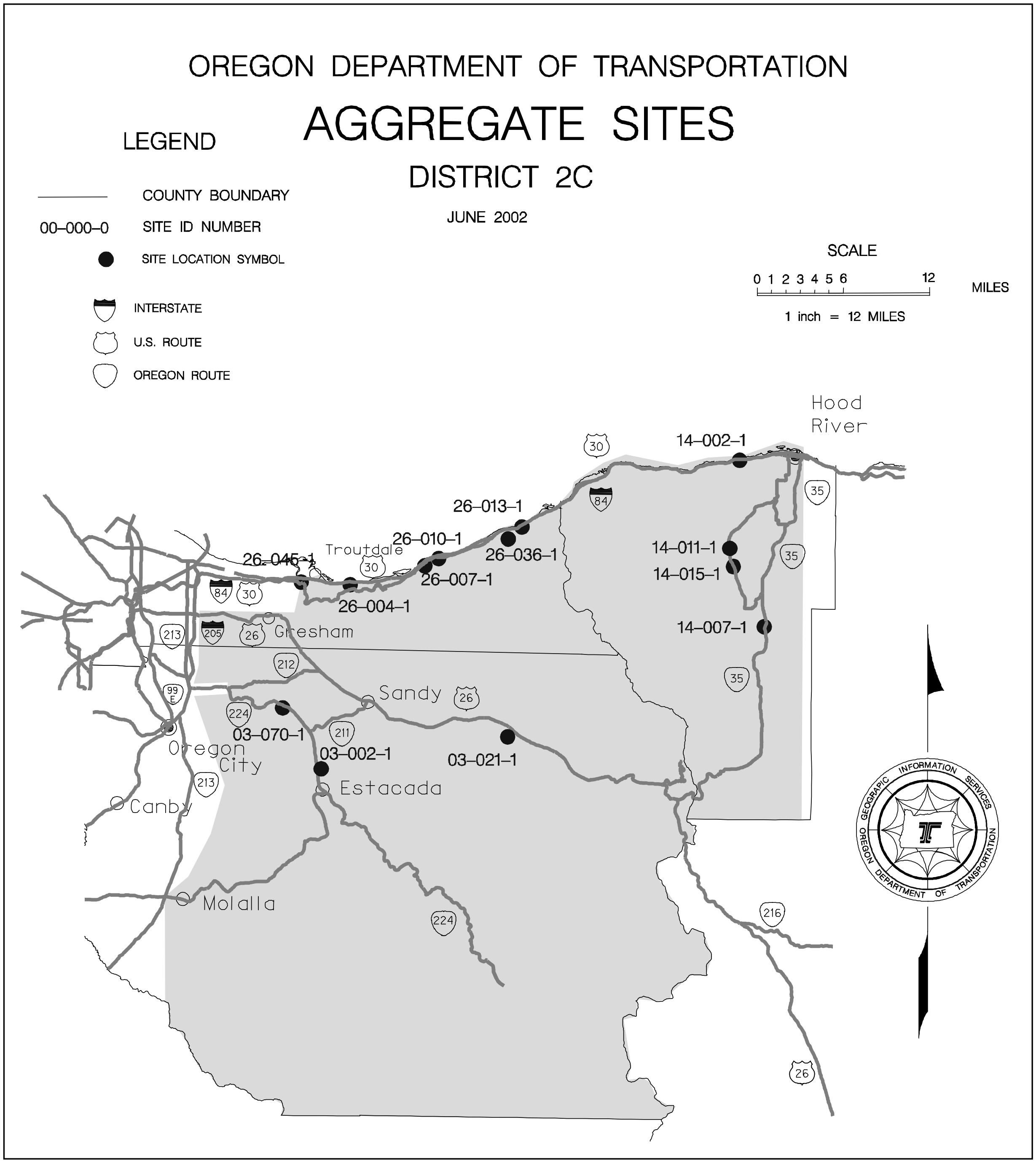

Figure 4.7: District 2C sites

Of the 13 sites within District 2C, Dee Quarry (14-015-1) is the only potentially significant site. In addition, Brightwood Quarry may be considered a key site due to its rock quality, size and location.

Dee Quarry (14-015-1), shown in Figure 4.8, is located east of the Hood River Highway at mile point 12.8. This 46.7-acre site contains 1,090,000 yd^3 (2,560,410 T) of good quality, fine-grain, moderately vesicular basalt. The quarry is in an area of very steep terrain and care should be used when developing this site to work from the top down. There is plenty of room to work at the site, but there is limited to no screening from the highway. The Forest Service and Hood River County also use the site.

Figure 4.8: Dee Quarry

Brightwood Quarry (03-021-1), shown in Figure 4.9, is located 200 meters west of Highway 26 at mile point 38.06 in Clackamas County. This 62.1-acre site contains 726,000 yd^3 (1,666,170 T) of good quality, fine-grain, vesicular basalt. The reserve quantity may be larger depending on the exact property boundaries. There is very good screening from the highway and plenty of room to work. The Bureau of Land Management owns this site.

Figure 4.9: Brightwood Quarry

Table 4.3 summarizes the locations of the material sites by highway name and number, and provides estimates of the quantity of aggregate for each highway within District 2C.

Table 4.3: Aggregate site listing by highway for District 2C*

Highway Number	Highway Name	Centerline Mileage	Lane Mileage	Number of Sites	Total Estimated Reserve		
					Yd^3	T	Mg
002	Columbia River	46.62	93.24	7	0	0	0
026	Mt. Hood	87.93	251.65	2	736,000	563,040	1,525,909
053	Warm Springs	4.61	11.07				
100	Historic Columbia River	27.60	54.27				
161	Woodburn-Estacada	22.17	44.30				
171	Clackamas	44.71	104.96	2	0	0	0
172	Eagle Creek-Sandy	6.17	12.34				
173	Timberline	5.37	10.32				
174	Clackamas-Boring	8.84	18.66				
281	Hood River	19.01	38.85	2	1,150,000	879,750	2,410,452
282	Odell	3.45	6.84				
	Total	**276.48**	**646.50**	**13**	**1,886,000**	**1,442,790**	**3,936,361**

* The highway numbers, centerline, and lane mileage were obtained from ODOT's 2000 State Mileage Report.

5.0 REGION 2 SITES

Region 2 encompasses Districts 1, 3, 4, and 5 and all or parts of Clatsop, Tillamook, Washington, Clackamas, Marion, Polk, Yamhill, Lincoln, Benton, Linn, and Lane Counties. There are 80 aggregate sites within Region 2. Table 5.1 classifies them by the type of site.

Table 5.1: Region 2 classification of aggregate sites

Reg.	District	Quarry	Gravel	Cinder Pit	Borrow	Raw Land	Road Cut	Stockpile Site	Maint. Yard	Grand Total
1	**01**	7				3	2			12
	03	6	3	1		1	1			12
	04	11	11			2		2		26
	05	1	17		6	4		1		29
	Total	**25**	**31**	**1**	**6**	**10**	**3**	**3**	**0**	**79**

5.1 DISTRICT 1

District 1 is located in the upper northwest portion of the state and extends from the Columbia River on the north to Lincoln City on the south, and from the Pacific Ocean on the west to near the divide of the Coast Range on the east. It encompasses parts of Clatsop, Tillamook and Yamhill Counties. District 1 contains 12 sites, of which seven are quarries, three are classified as raw land and two are road cuts. Figure 5.1 shows the source number and location of each of the 12 sites in District 1.

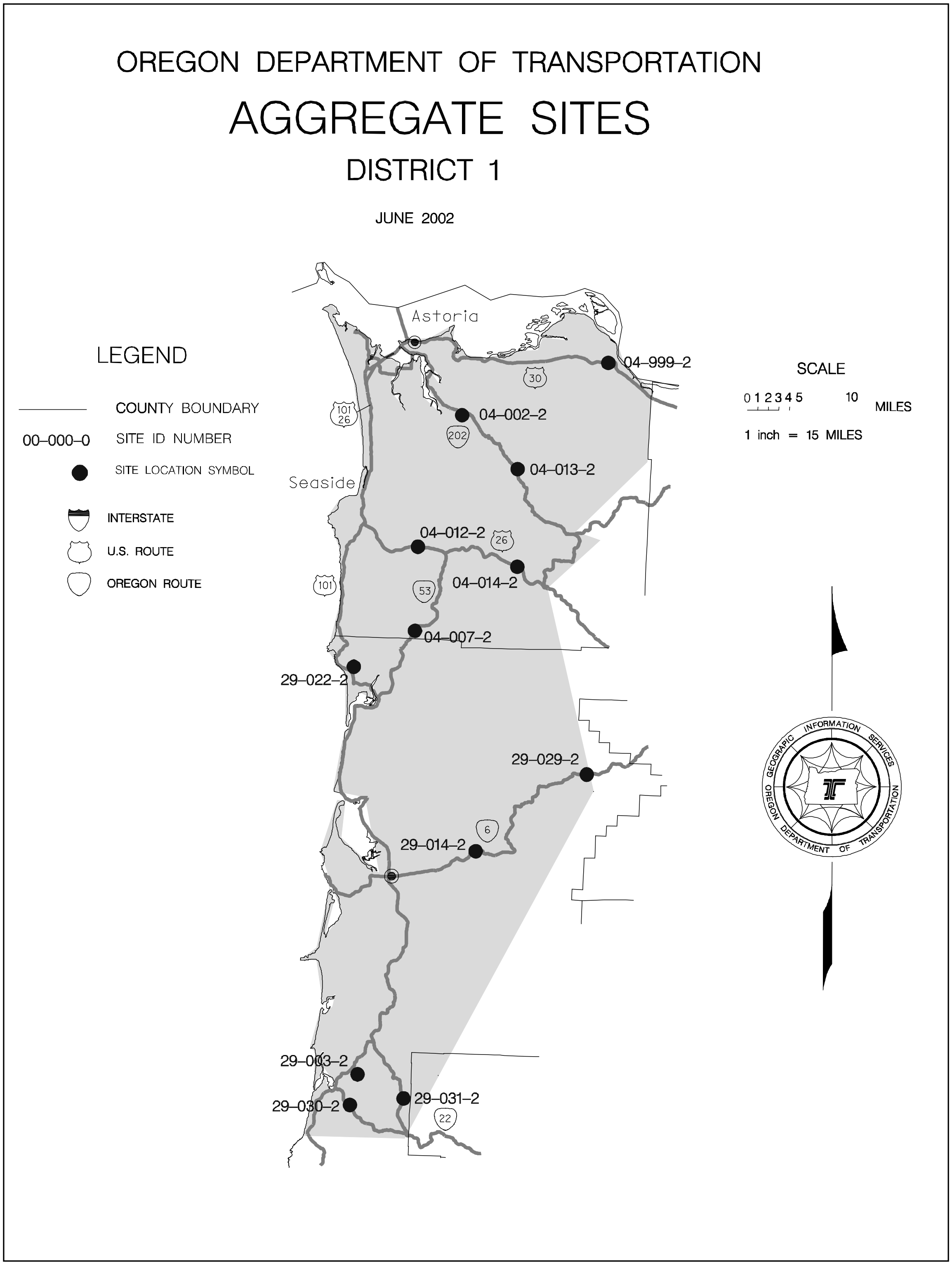

Figure 5.1: District 1 sites

There are four potentially significant sites within District 1: Olney, Cooperage, Alder Creek, and Hjortland Quarries.

Olney Quarry (04-002-2), shown in Figure 5.2, is bisected by Oregon Route 202 and the Klaskanine River in Clatsop County. The 24.4-acre site is comprised of 300,000 yd^3 (684,450 T) of good to very good quality material. This site has had limited work in the past and would need to be developed to make room for further production.

Figure 5.2: Olney Quarry

Cooperage Quarry (04-013-2), shown in Figure 5.3, is located east of Oregon Route 202 in Clatsop County. The 5.9-acre site is comprised of 120,000 yd^3 (286,740 T) of good quality, fine grain basalt. The South Fork of the Klaskanine River runs adjacent to the site where there is little room to work, but there is excellent screening from the highway. The access road would provide ample room for a future stockpile site.

Figure 5.3: Cooperage Quarry

Alder Creek Quarry (29-031-2), shown in Figure 5.4, is located approximately 8 miles south of Hebo on Oregon Route 22. The 7.37-acre site is comprised of 120,000 yd^3 (267,300 T) of good quality basalt. The terrain is very steep, providing limited room to work and no screening from the highway. There is timber value associated with the site.

Figure 5.4: Alder Creek Quarry

Hjortland Quarry (04-012-2), shown in Figure 5.5, is located near the intersection of Highway 26 West and Highway 53 in Clatsop County. The 15.2-acre site is comprised of 150,000 yd^3 (376,650 T) of good quality, fine-grain basalt. The terrain is steep and has no screening from the highway, but there is adequate room for working at the site.

Figure 5.5: Hjortland Quarry

Table 5.2 summarizes the site locations by highway name and number, and provides estimates of the quantity of aggregate for each highway within District 1.

Table 5.2: Aggregate site listing by highway for District 1*

Highway Number	Highway Name	Centerline Miles	Lane Miles	Number of Sites	Total Estimated Reserve		
					Yd^3	T	Mg
009	Oregon Coast	93.13	199.32	2	250,000	523,125	474,474
031	Albany-Corvallis	9.08	21.26				
032	Three Rivers	10.63	57.62	1	120,000	267,300	242,441
037	Wilson River	27.43	37.82	2	120,000	243,000	220,401
046	Necanicum	18.91	52.95	1	200,000	491,400	445,700
047	Sunset	21.96	64.54	2	150,000	376,650	341,622
092	Lower Columbia River	27.48	57.84	1	0	0	0
102	Nehalem	29.09	18.04	2	420,000	971,190	880,869
103	Fishhawk Falls	9.02	13.96				
104	Fort Stevens	6.98	14.86				
105	Warrenton-Astoria	7.24	18.80				
130	Little Nestucca	9.4	18.37	1	0	0	0
	Total	**270.35**	**575.38**	**12**	**1,260,000**	**2,872,665**	**2,605,507**

* The highway numbers, centerline, and lane mileage were obtained from ODOT's 2000 State Mileage Report.

5.2 DISTRICT 3

District 3 is located in the mid-Willamette Valley. It extends from the summit of the Cascade Mountains on the east to the Coast Range on the west, and covers the Interstate 5 corridor from Wilsonville to just south of Salem. District 3 includes all of Marion County; most of Yamhill County; parts of Clackamas, Linn, Polk, Tillamook, and Washington Counties; and small portions of Deschutes and Jefferson Counties.

There are 12 sites located within District 3: quarries (6), gravel sites (3), cinder pit (1), raw land (1) and a road cut (1). Figure 5.6 shows the source number and location of each of the 12 sites located within the District.

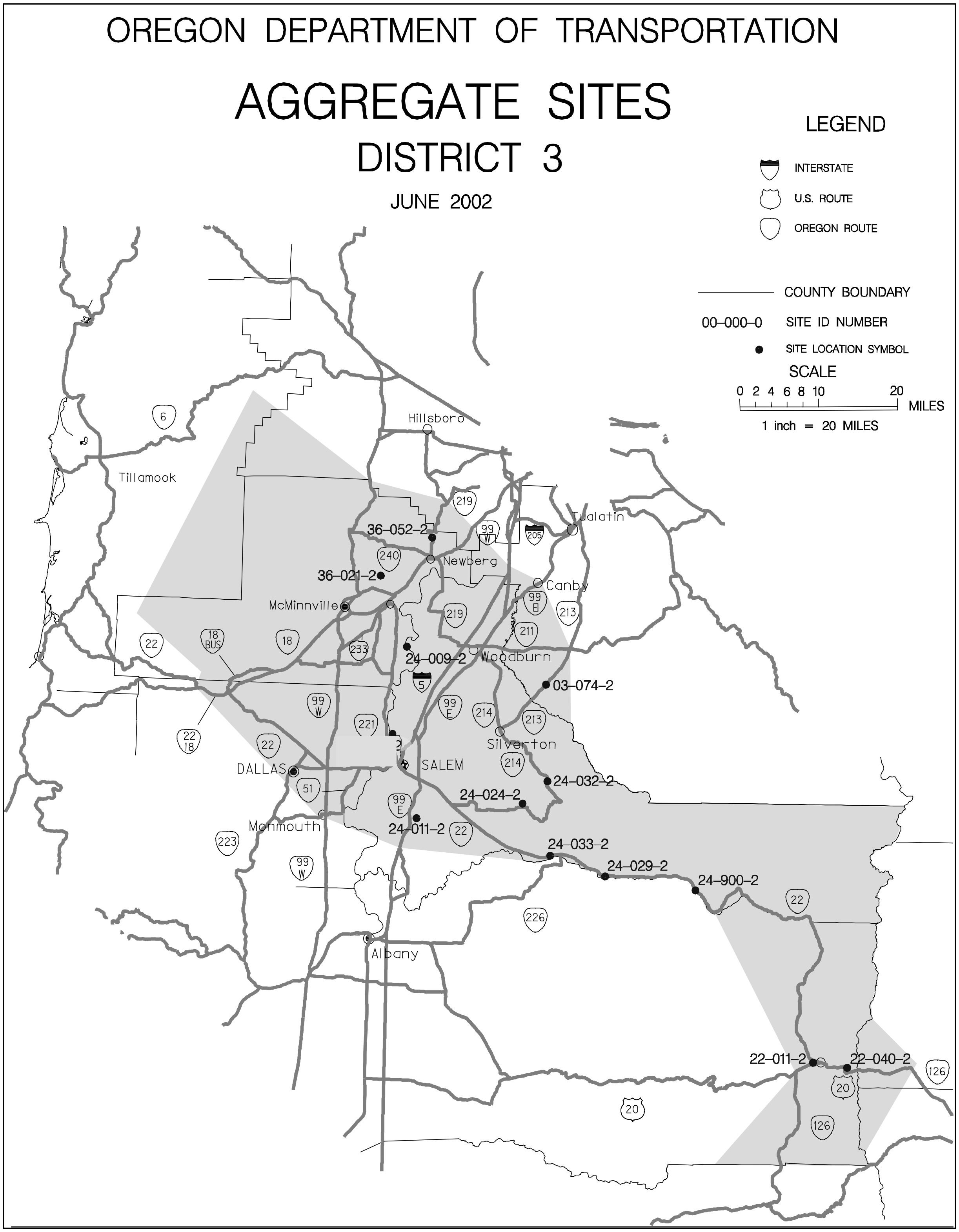

Figure 5.6: District 3 sites

Out of the 12 sites within the District, none of them was considered to be potentially significant under Statewide Land Use Planning Goal 5. However, the Baker Creek Quarry should be noted as a key site due to its size and quantity of material.

Baker Creek Quarry (24-011-2), shown in Figure 5.7, is located two miles south of Salem on Battle Creek Road. The 29.7-acre site is comprised of 720,000 yd^3 (1,632,960 T) of good quality, fine-grain basalt. The area is currently being used as a waste site. There is very little overburden, but many trees. The terrain is moderately steep and provides good screening from the road and ample room for working. This site does not meet the requirements to be considered a significant site under Goal 5.

Figure 5.7: Baker Creek Quarry

Table 5.3 summarizes the locations of the material sites by highway name and number, and provides estimates of the quantity of aggregate for each highway within District 3.

Table 5.3: Aggregate site listing by highway for District 3*

Highway Number	Highway Name	Centerline Miles	Lane Miles	Number of Sites	Total Estimated Reserve		
					Yd³	T	Mg
001	Pacific	37.96	102.73	1	720,000	1,632,960	1,481,095
016	Santiam	17.66	45.38	3	1,890,000	3,178,980	2,883,335
029	Tualatin Valley	15.95	31.90				
030	Willamina-Salem	26.31	66.75				
039	Salmon River	30.54	68.62				
043	Monmouth-Independence	2.35	4.70				
051	Wilsonville-Hubbard	5.94	11.38				
072	Salem	8.48	27.32				
081	Pacific Highway East	26.03	67.76				
091	Pacific Highway West	47.13	109.55	1	350,000	798,525	724,262
140	Hillsboro-Silverton	40.10	82.10	2	318,000	523,665	474,964
150	Salem-Dayton	20.74	42.55				
151	Yamhill-Newberg	11.50	23.00				
153	Bellevue-Hopewell	14.27	28.50				
154	Lafayette	6.26	12.52				
155	Amity-Dayton	9.19	18.30				
157	Willamina-Sheridan	8.56	16.53				
160	Cascade Highway South	13.61	27.22	1	80,000	173,880	157,709
161	Woodburn-Estacada	11.21	22.42				
162	North Santiam	80.64	186.73	2	440,000	712,800	646,509
163	Silver Creek Falls	32.06	63.96	2	140,000	344,250	312,235
189	Dallas-Rickreall	4.01	7.93				
191	Kings Valley	4.73	9.51				
193	Independence	6.34	12.68				
215	Clear Lake-Belknap Springs	13.02	27.76				
	Total	**494.59**	**1,117.80**	**12**	**3,398,000**	**7,365,060**	**6,680,109**

* The highway numbers, centerline, and lane mileage were obtained from ODOT's 2000 State Mileage Report.

5.3 DISTRICT 4

District 4 is located south of District 3. The District's boundaries extend from the Pacific Ocean on the west to the Cascades Mountains on the east, and from Turner on the north to Harrisburg on the south. District 4 includes parts or all of Benton, Lincoln, Linn, Polk, Tillamook and Yamhill Counties. There are 26 sites in District 4: quarries (11), gravel sites (11), raw land (2) and stockpile sites (2). The map in Figure 5.8 shows the source number and location for each of the sites within the District.

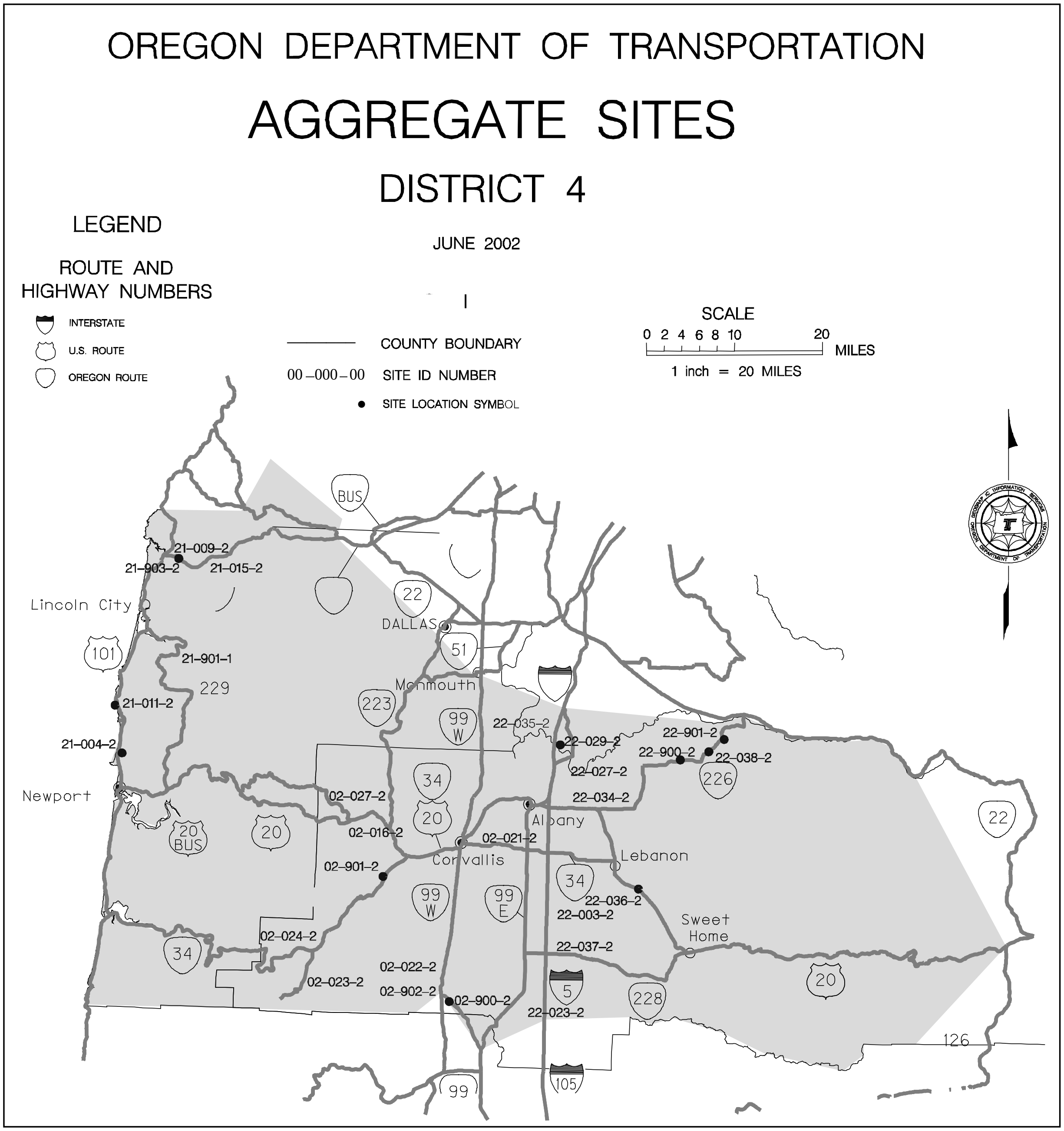

Figure 5.8: District 4 sites

Three of the 26 sites in District 4 are potentially significant: Iron Mountain, Saddle Butte, and Dobson Quarries.

Iron Mountain Quarry (21-004-2), shown in Figure 5.9, is north of Newport, about ¼ mi east from U.S. Route 101. The 49.34-acre site is comprised of 5,000,000 yd^3 (11,947,500 T) of very good quality, fine grain basalt. Access to the site is through a residential and industrial area. The site has been used for storage of waste rock. There is also timber on the property that could be of some value.

Figure 5.9: Iron Mountain Quarry

Saddle Butte Quarry (22-003-2), shown in Figure 5.10, is located south of Albany and is approximately 300 yd east of Interstate 5. The 132-acre site is comprised of 3,500,000 yd^3 (8,032,500 T) of a heterogeneous mix of igneous flows that produces some soft rock. The lithology is variable depending on which flow is analyzed. The terrain is moderately steep, and work done to the south-facing bench of the pit has made it even steeper. Out of the 132-acres, 26 are leased to the Albany Gun Club, and 40 are in a wetland that could be used for mitigation. The large size and quantity of igneous rock, combined with the proximity to Interstate 5, make this a potentially significant site in District 4.

Figure 5.10: Saddle Butte Quarry

Dobson Quarry (21-009-2), shown in figure 5.11, is located adjacent to and south of Highway 18 in Lincoln County. The 5-acre site is comprised of 120,000 yd^3 (194,400 T) of good quality, fine-grain, vesicular basalt with less than 10% zeolites. The terrain is gradually steep and overgrown with vegetation with no screening from the highway and little room to work. However, if the east side of the site were opened for access, more room would be available.

Figure 5.11: Dobson Quarry

Table 5.4 summarizes the locations of the material sites by highway name and number, and provides estimates of the quantity of aggregate for each highway within District 4.

Table 5.4: Aggregate site listing by highway for District 4*

Highway Number	Highway Name	Centerline Miles	Lane Miles	Number of Sites	Total Estimated Reserve		
					Yd^3	T	Mg
001	Pacific	35.62	71.24	5	4,340,000	9,584,460	8,693,106
009	Oregon Coast	70.17	168.36	2	5,025,000	11,999,813	10,883,830
016	Santiam	71.54	179.20	1	0		0
027	Alsea	56.61	113.28	2	135,000	277,223	251,441
031	Albany-Corvallis	11.17	22.96	1	75,000	121,500	110,201
032	Three Rivers	14.34	28.68				
033	Corvallis-Newport	52.72	119.70	1	0		0
039	Salmon River	23.11	51.17	3	120,000	243,000	220,401
058	Albany-Junction City	32.34	79.11				
091	Pacific Highway West	45.08	96.21	2	80,000	129,600	117,547
164	Jefferson	8.39	16.32				
180	Eddyville-Blodgett	19.23	38.46				
181	Siletz	31.45	63.53	1	20,000	41,850	37,958
182	Otter Rock	0.75	1.50				
191	Kings Valley	26.67	53.34	1	25,000	58,725	53,264
194	Monmouth	7.56	15.12				
201	Alsea-Deadwood	9.49	18.98	1	400,000	896,400	813,035
210	Corvallis-Lebanon	18.12	68.53				
211	Albany-Lyons	25.32	50.70	5	184,000	368,415	334,153
212	Halsey-Sweet Home	21.4	42.80	1	65,000	105,300	95,507
	Total	**581.08**	**1,299.19**	**26**	**10,469,000**	**23,826,286**	**21,610,443**

* The highway numbers, centerline, and lane mileage were obtained from ODOT's 2000 State Mileage Report.

5.4 DISTRICT 5

District 5 is located in the southern portion of the Willamette Valley. The boundaries of District 5 extend from the Pacific Ocean on the west to the Cascade Mountains on the east, and along the Interstate 5 corridor from Harrisburg in the north to Cottage Grove in the south. District 5 includes all, or parts of Douglas, Klamath, and Lane Counties.

There are 29 sites in District 5: quarry (1), gravel site (17), borrow (6), raw land (4), and stockpile site (1). The map in Figure 5.12 shows the source number and location of each of the sites within the District.

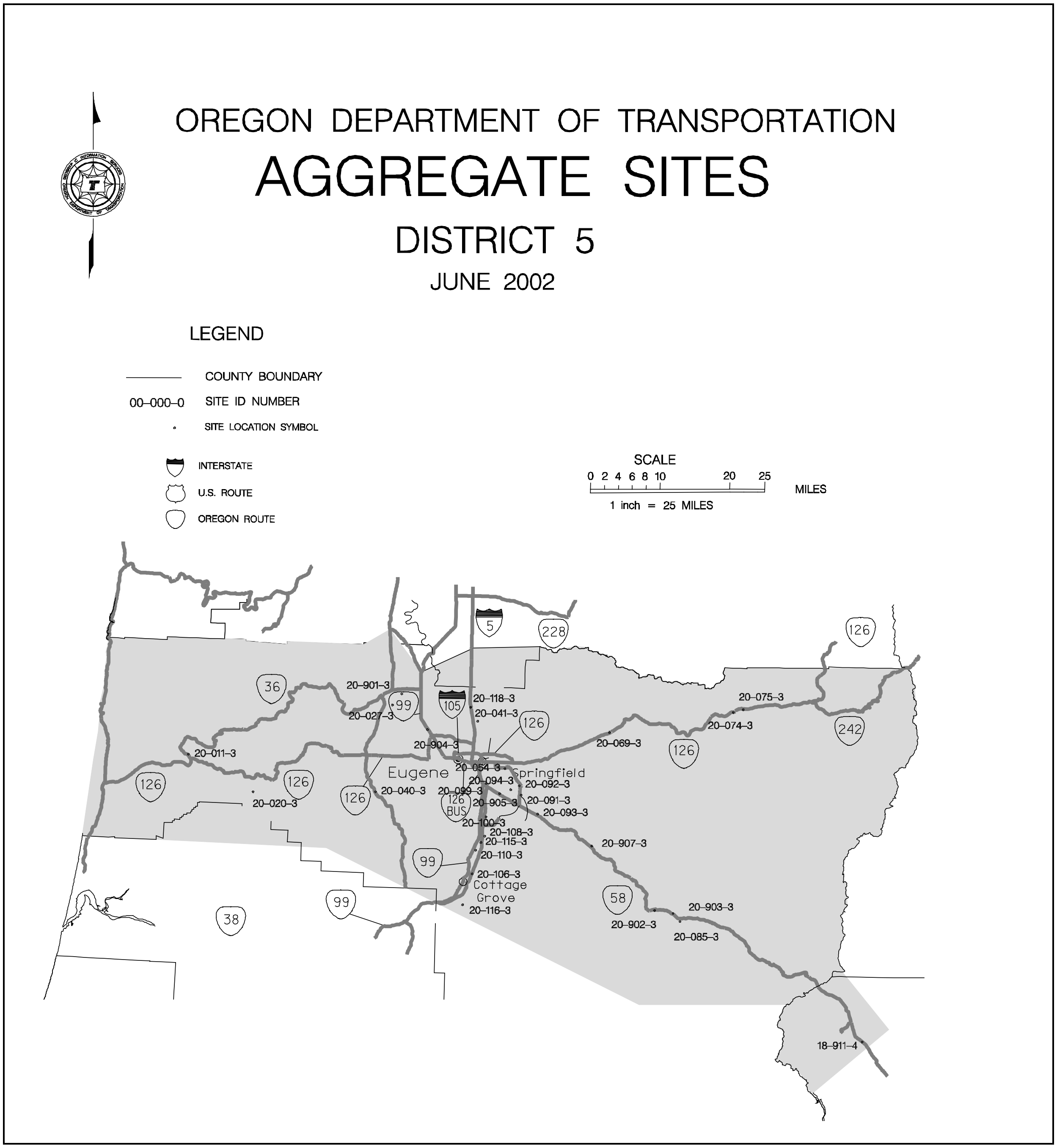

Figure 5.12: District 5 sites

Of the 29 sites that were evaluated, none of them was noted as being potentially significant. However, two of the gravel sites within the District should be noted as key sites due to their size and quantity.

The Tennis Gravel Bar (20-091-3), shown in Figure 5.13, is located southeast of Springfield adjacent to the Middle Fork of the Willamette River. This site is within the floodplain of the river. The easement for the property is through a bordering privately owned farm. The 23.5-acre site is comprised of 160,000 yd^3 (259,200 T) of gravel that could be removed without endangering the river.

Figure 5.13: Tennis Gravel Bar

Site 20-901-3, shown in Figure 5.14, is located south of Junction City and west of Oregon Route 99W. There is little to no screening at this site, but there is ample room to work. The 40-acre site has approximately 450,000 yd^3 (729,000 T) of volcanic gravel available for removal. This is one of the few sites in the area that has room to work, good quality gravel, and is relatively close to a highway.

Figure 5.14: Site 20-901-3

Table 5.5 summarizes the locations of the material sites by highway name and number, and provides estimates of the quantity of aggregate for each highway within District 5.

Table 5.5: Aggregate site listing by highway for District 5*

Highway Number	Highway Name	Centerline Miles	Lane Miles	Number of Sites	Total Estimated Reserve		
					Yd^3	T	Mg
001	Pacific	41.05	84.34	10	613,000	996,300	903,644
009	Oregon Coast	30.92	68.74				
015	McKenzie	76.05	166.53	3	103,000	166,860	151,342
018	Willamette	70.3	156.14	8	435,000	704,700	639,163
062	Florence-Eugene	52.65	111.52	1	120,000	243,000	220,401
069	Belt Line	13	26.32				
091	Pacific Highway West	17.6	66.41	1	450,000	729,000	661,203
200	Territorial	42.12	84.21	2	340,000	699,570	634,510
215	Clear Lake-Belknap Springs	6.79	13.70				
222	Springfield-Creswell	11.16	22.32	3	350,000	567,000	514,268
225	McVay	2.52	4.74				
226	Goshen-Divide	19.87	39.94				
227	Eugene-Springfield	9.97	20.34				
228	Springfield	1.4	2.44				
229	Mapleton-Junction City	50.05	103.28	1	0	0	0
429	Crescent Lake	2.39	4.78				
	Total	**447.84**	**975.75**	**29**	**2,411,000**	**4,106,430**	**3,724,531**

* The highway numbers, centerline, and lane mileage were obtained from ODOT's 2000 State Mileage Report.

6.0 REGION 3 SITES

Region 3 is located in southwest Oregon. It encompasses Districts 7 and 8 and includes all or parts of Coos, Curry, Douglas, Jackson, Josephine, Klamath and Lane Counties. Table 6.1 classifies the 83 aggregate sites within Region 3 by type of site.

Table 6.1: Region 3 classification of aggregate sites

Reg.	District	Quarry	Gravel	Cinder Pit	Borrow	Raw Land	Road Cut	Stockpile Site	Maint. Yard	Grand Total
3	**07**	10	26	1	1	1	1	2		42
	08	7	25			8		1		41
	Total	**17**	**51**	**1**	**1**	**9**	**1**	**3**	**0**	**83**

6.1 DISTRICT 7

District 7 covers the northern and western areas of Region 3 and includes parts or all of Coos, Curry, Douglas, Josephine, Klamath, and Lane Counties. The 42 aggregate sites are classified as quarries (10), gravel sites (26), cinder pit (1), borrow site (1), raw land site (1), road cut (1), and stockpile sites (2). Figure 6.1 shows, by source number, the location of all of the aggregate sites that were evaluated in the District.

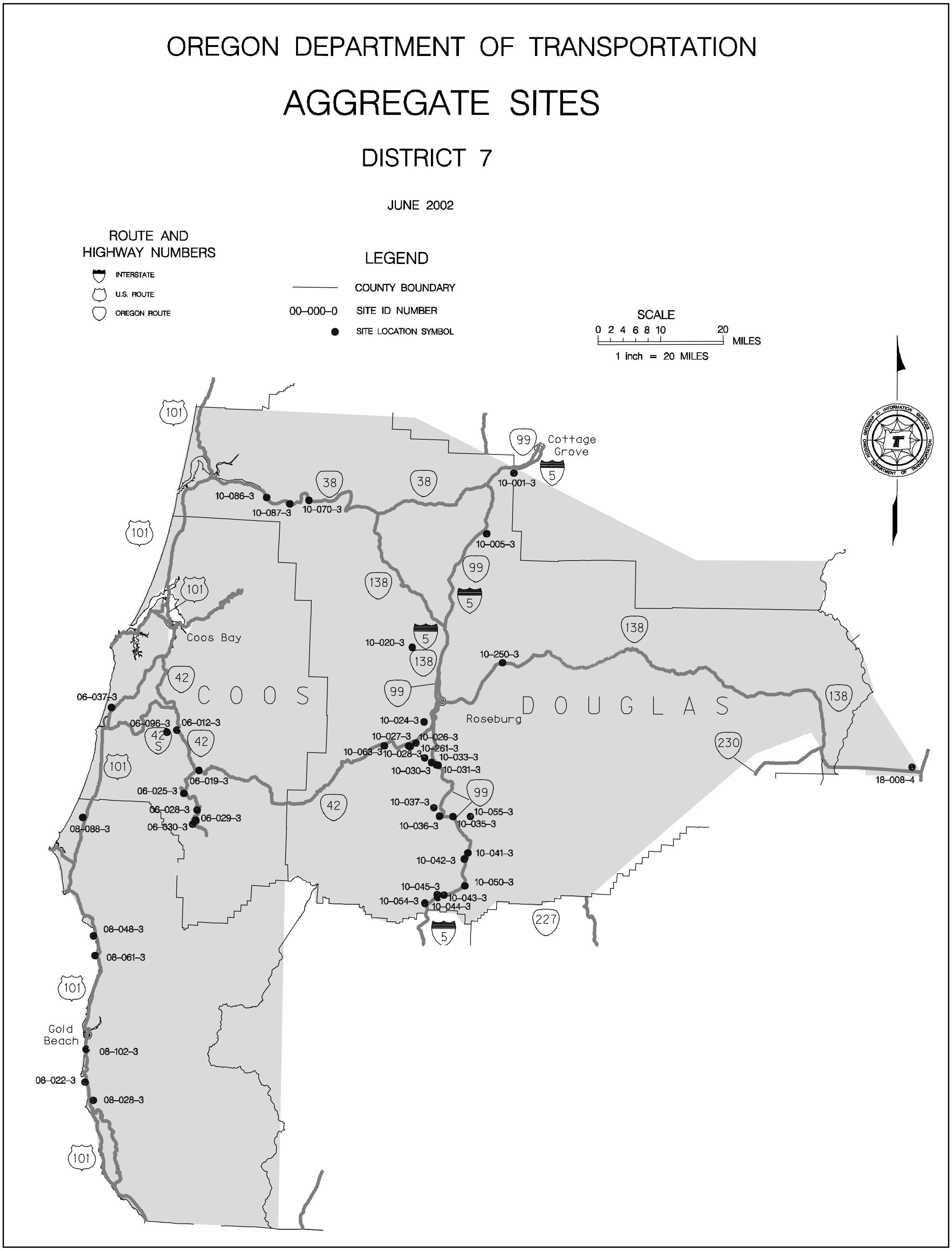

Figure 6.1: District 7 sites

Out of the 42 sites within District 7, six are potentially significant: McLeod Quarry, Rattlesnake Butte Quarry, Boucock Quarry, Site 10-042-3, Cranfill Gravel Bar, and Lawson Bar.

McLeod Quarry (06-012-3), shown in Figure 6.2, is adjacent to and east of Highway 42 in Coos County. The 29.5-acre site is comprised of 500,000 yd^3 (1,073,250 T) of medium-grain submarine basalt. There is some mineral alteration that would degrade the rock specifications. The terrain is gradually sloping, with up to five feet of overburden, and there is no screening from highway. The easternmost pit wall is approximately 600 feet from the highway, and the property line is another 1,300 feet beyond that. There is no screening from the highway, but there is ample room to work at the site.

Figure 6.2: McLeod Quarry

The Rattlesnake Butte Quarry (10-001-3), shown in Figure 6.3, borders the Douglas/Lane County line. Access to the quarry is from Interstate 5 in Douglas County, but the quarry is in Lane County. The 80-acre site is comprised of 600,000 yd^3 (1,328,400 T) of qood quality, fine-grain basalt with little weathering. There is very good screening and plenty of room to work here. The terrain is moderately steep and is overgrown with common coast range vegetation. A steep, paved, locked and gated road provides access to the site.

Figure 6.3: Rattlesnake Butte Quarry

The Boucock Quarry (10-005-3) shown in Figure 6.4, is located ½ mile south of Elkhead County Road in Douglas County. The 31.1-acre site is comprised of 600,000 yd^3 (1,328,400 T) of good quality, medium- to fine-grain amygdaloidal basalt. This site may have some significance for future aggregate production in the area. There is plenty of room to work with complete screening from all roads. The easement is over some open range land, and the access point has a locked chain acrossed it. This site is currently used to store waste rock.

Figure 6.4: Boucock Quarry

Site 10-042-3, shown in Figure 6.5, is located approximately five miles south of Canyonville, on both sides of the Interstate 5 in Douglas County. This site may be a significant source of aggregate for the area. This large 118-acre is comprised of 1,900,000 yd^3 (4,257,900 T) of soft, foliated and nonfoliated Greenstone. The terrain is very steep at this site and the overburden could be up to 10 feet deep. The terrain is steep and provides limited screening and marginal room to work.

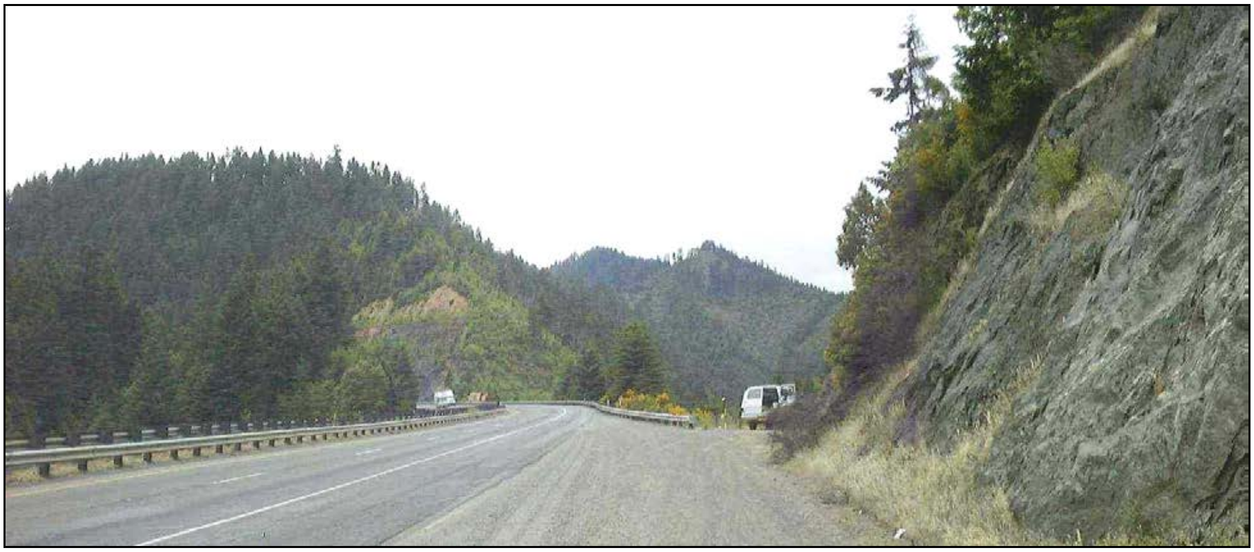

Figure 6.5: Site 10-042-3

Cranfill Gravel Bar (10-020), shown in Figure 6.6, is located on the inside radius of the Umpqua River, off of Garden Valley Road in Douglas County. The 36.4-acre site has approximately 160,000 yd^3 (259,200 T) of river gravel. It appears there is a high percentage of sand mixed with the gravel. There is no screening from the road, but there is adequate room to work at the site. A new easement would need to be developed on the east side of the river for access.

Figure 6.6: Cranfill Gravel Bar

Lawson Bar (10-036-3), shown in Figure 6.7, is at the end of Lawson Bar Road along the South Umpqua River in Douglas County. The 25.4-acre site has approximately 100,000 yd^3 (162,000 T) of a heterogeneous mix of lithologies that range from volcanic and plutonic to metamorphic. The good quality gravel ranges in size from boulder to sand. The Oregon Department of Fish and Wildlife has an agreement for public access to the river through this site.

Figure 6.7: Lawson Bar

Table 6.2 summarizes the site locations by highway name and number, and provides estimates of the quantity of aggregate for each highway within District 7.

Table 6.2: Aggregate site listing by highway for District 7*

Highway Number	Highway Name	Centerline Miles	Lane Miles	Number of Sites	Total Estimated Reserve		
					Yd^3	T	Mg
001	Pacific	87.21	174.42	18	5,722,000	12,290,508	11,147,489
009	Oregon Coast	152.51	377.41	7	274,000	558,428	506,493
035	Coos Bay-Roseburg	73.31	196.30	8	700,000	1,456,650	1,321,182
045	Umpqua	56.89	125.99	3	100,000	210,600	191,014
073	North Umpqua	86.01	206.41	1	20,000	32,400	29,387
231	Elkton-Sutherlin	25.39	52.12				
234	Oakland-Shady	10.43	26.84				
240	Cape Argro	11.95	27.84				
241	Coos River	17.47	34.70				
242	Powers	18.78	37.48	4	6,000	9,720	8,816
244	Coquille-Bandon	16.94	33.88				
250	Cape Blanco	5.41	10.42				
251	Port Orford	0.76	1.52				
255	Carpenterville	25.86	51.72				
425	East Diamond Lake	14.82	29.64	1	90,000	145,800	132,241
	Total	**603.74**	**1,386.69**	**42**	**6,912,000**	**14,704,106**	**13,336,622**

* The highway numbers, centerline, and lane mileage were obtained from ODOT's 2000 State Mileage Report.

6.2 DISTRICT 8

District 8 is located in the southeastern portion of Region 3 and includes Cave Junction, Grants Pass, Ashland and Medford. Parts or all of Jackson, Josephine, and Klamath Counties are located within District 8. The 41 aggregate sites within District 8 are classified as quarries (7), gravel sites (25), raw land sites (8), and stockpile site (1). The map in Figure 6.8 shows, by source number, the location of all of the aggregate sites that were evaluated in the District.

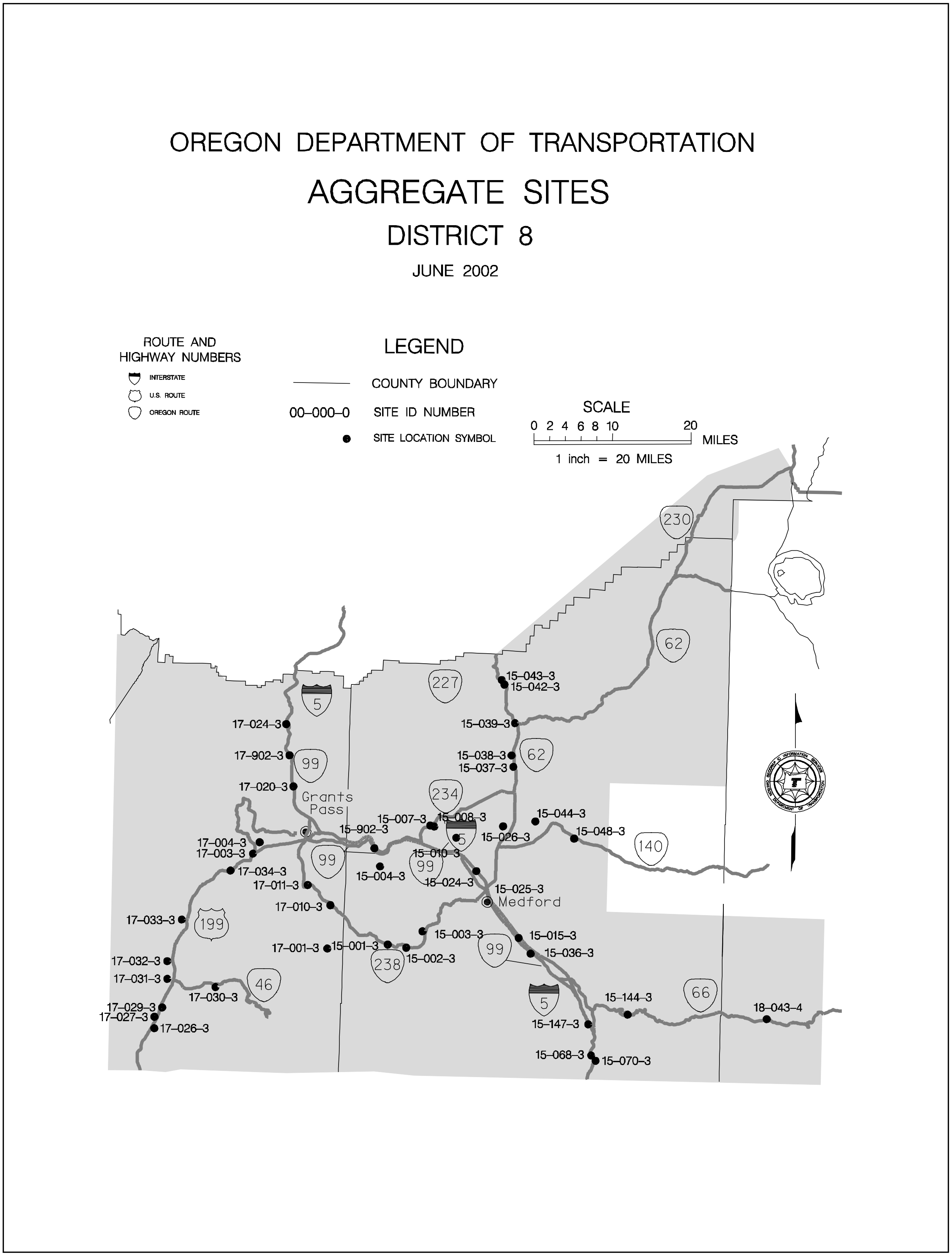

Figure 6.8: District 8 sites

Out of the 41 sites in District 8, six are potentially significant: Hicks Quarry, Hofman Bar, Chancellor Quarry, Rough and Ready Creek Bar, Ousterhout Bar, and Cushman Ranch.

Hicks Quarry (15-144-3), shown in Figure 6.9, is located adjacent to and north of Highway 66 in Jackson County. The 20-acre site is comprised of 190,000 yd^3 (497,610 T) of good quality, fine-grain basalt with minor vesicular lenses dispersed throughout. There is no room to work in the steep terrain and no screening from the highway.

Figure 6.9: Hicks Quarry

Hofman Bar (17-004-3), shown in Figure 6.10, is located west of and adjacent to the Applegate River in Josephine County. The 41.2-acre site is comprised of 100,000 yd^3 (162,000 T) of good quality, cobble size and less, gravel. The access road is from the east side and through the river to the site. (There is no access from the west side of the river to the property.) The gravel bar is situated on the inside of the river radius. A new access road from the west would need to be acquired for the property to be utilized in the future.

Figure 6.10: Site 17-004-3

Chancellor Quarry (17-020-3), shown in Figure 6.11, is located east of the I-5 rest area in Merlin. The large 243.4-acre site is comprised of 3,870,000 yd^3 (8,359,200 T) of good quality, serpentinite (hydrated peridotite.) The rock can be very blocky with fracturing to produce a lot of fines. The oxidized zone is up to 15 feet thick. This zone is of marginal quality and would be best used for fill or shoulder rock. There is some screening with plenty of room to work. The terrain is moderately steep, around 15 to 20 degrees.

Figure 6.11: Chancellor Quarry

Rough and Ready Creek Quarry (17-027-3), shown in Figure 6.12, is adjacent to Highway 199 at Rough and Ready Creek in Josephine County. The 20-acre sight is comprised of 160,000 yd^3 (259,200 T) of small to medium size boulders (10 to 25 inches), with little to no sand. There is plenty of room to work but no screening from the highway, with the creek bisecting the property.

Figure 6.12: Rough and Ready Creek Quarry

Ousterhout Bar (15-026-3), shown in Figure 6.13, is located south of Nick Young Road in Jackson County. The south side of the 26.1-acres is adjacent to Little Butte Creek. There is approximately 60% silt and organics mixed with 190,000 yd^3 (307,800 T) of volcanic gravel. The area provides adequate room for working, but there is little screening from the road. A new access would need to be developed for future use.

Figure 6.13: Ousterhout Bar

Cushman Ranch (15-039-3), shown in Figure 6.14, is located along the Tiller Trail Highway, northwest of Highway 62 in Jackson County. The 7.6-acre site is comprised of 120,000 yd^3 (275,400 T) of very good quality, highly fractured, fine-grain basalt. The material could be ripped or drilled and blasted for removal. There is room to work at the site but with little screening from the highway.

Figure 6.14: Cushman Ranch

Table 4.2 summarizes the site locations by highway name and number, and provides estimates of the quantity of aggregate for each highway within District 8.

Table 6.3: Aggregate site listing by highway for District 8*

Highway Number	Highway Name	Centerline Miles	Lane Miles	Number of Sites	Total Estimated Reserve		
					Yd^3	T	Mg
001	Pacific	80.80	161.60	12	4,974,000	10,147,680	9,203,946
021	Green Springs	44.49	91.55	2	250,000	623,160	565,206
022	Crater Lake	63.24	152.86	4	440,000	822,150	745,690
025	Redwood	46.56	120.17	8	660,000	1,267,380	1,149,515
038	Oregon Caves	19.33	38.66	1	13,000	21,060	19,101
060	Rogue River	14.95	29.54	1	160,000	259,200	235,094
063	Rogue Valley	24.12	83.76				
230	Tiller-Trail	11.26	22.52	2	30,000	66,825	60,610
233	West Diamond Lake	23.80	47.86				
260	Rogue River Loop	20.84	41.68	1	100,000	162,000	146,934
270	Lake of the Woods	16.04	34.67	2	97,000	157,140	142,526
271	Sams Valley	18.74	37.29	2	0	0	0
272	Jacksonville	38.93	83.19	6	291,000	465,394	433,604
273	Siskiyou	12.42	24.99				
	Total	**435.52**	**970.34**	**41**	**7,015,000**	**13,991,989**	**12,702,226**

* The highway numbers, centerline, and lane mileage were obtained from ODOT's 2000 State Mileage Report.

7.0 REGION 4 SITES

Region 4 encompasses Districts 9, 10, and 11 and extends from the Columbia River on the north, to the Oregon/California border on the south, and Hood River and Klamath Falls on the west to Boardman and Riley on the east. It includes all or parts of Crook, Deschutes, Gilliam, Harney, Jefferson, Lake, Klamath, Morrow, Sherman, Wasco and Wheeler Counties. Table 7.1 classifies the 266 aggregate sites within Region 4 by type of site.

Table 7.1: Region 4 classification of aggregate sites

Reg.	District	Quarry	Gravel	Cinder Pit	Borrow	Raw Land	Road Cut	Stock Pile Site	Maint. Yard	Grand Total
4	09	43	1		5	15	2	2	2	70
	10	39	2	15	47	25	3	1	1	133
	11	23	3	5	11	17	3	1		63
	Total	**105**	**6**	**20**	**63**	**57**	**8**	**4**	**3**	**266**

7.1 DISTRICT 9

District 9 is located in north-central Oregon. The District extends from the Columbia River on the north to Antelope and the Jefferson County line on the south, and from the summit of the Cascade Mountains on the west to Boardman and Fossil on the east. It encompasses a majority of Gilliam, Sherman, and Wasco Counties as well as a small portion of Hood River, Morrow, Jefferson and Wheeler Counties. District 9 contains 70 aggregate sites. Those 70 sites include quarries (43), gravel (1), borrow (5), raw land (15), road cuts (2), stockpile sites (2) and maintenance yards (2). Figure 7.1 is a map showing the source number and location of each of the 70 sites within District 9.

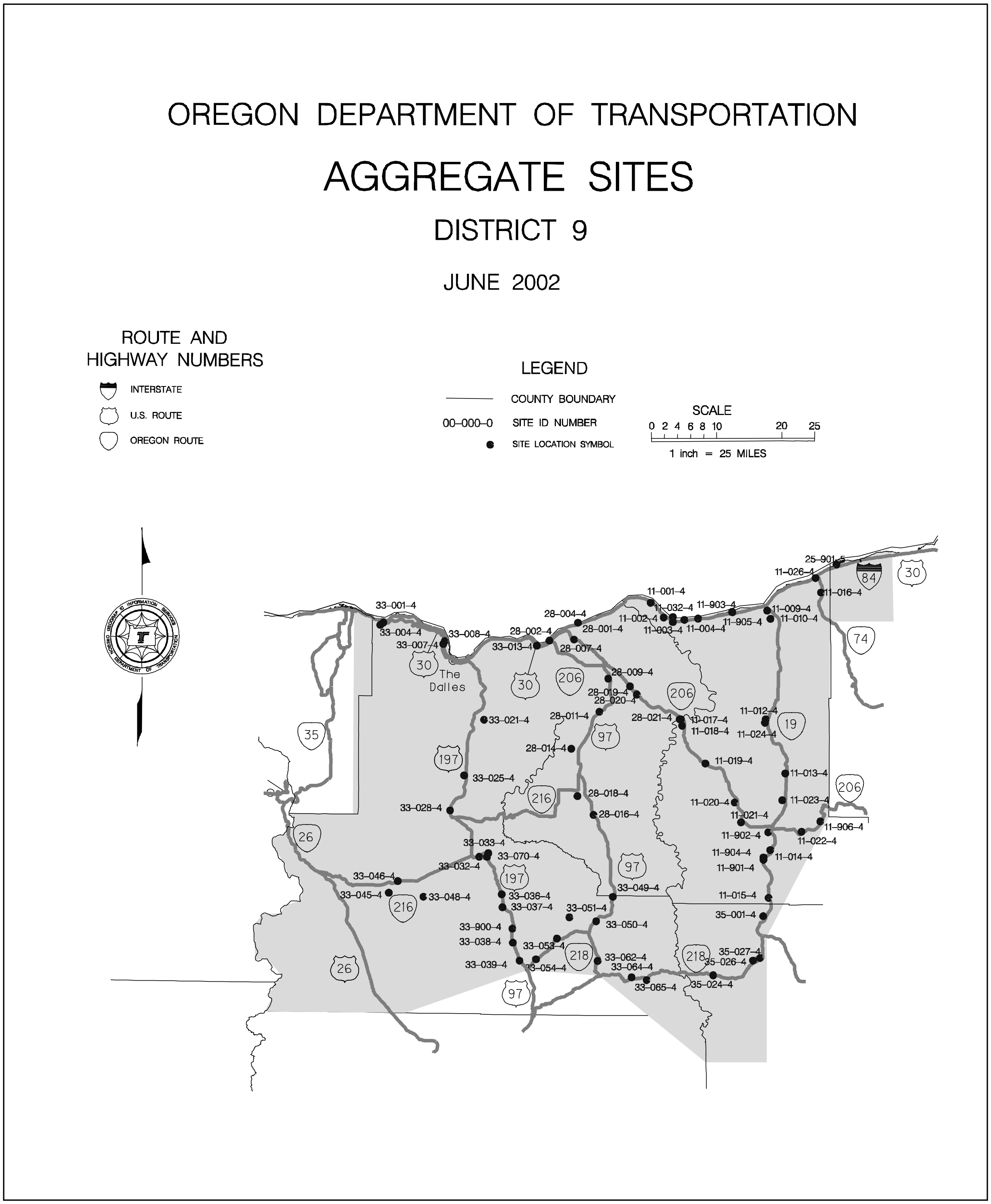

Figure 7.1: District 9 sites

Of the 70 sites within District 9, 15 are potentially significant: Mosier Quarry, Balsinger Quarry, Site 33-025-4, Hinson/Schmidt Quarry, Adams Quarry, Fulton Canyon Quarry, Site 11-010-4, Site 11-020-4, Abbott Quarry, Taylor Quarry, Hinton Quarry, East Ore Land Company, Site 28-020-4, 30 Mile Creek, and Mayville Quarry.

Mosier Quarry (33-001-4), shown in Figure 7.2, is located adjacent to the City of Mosier in Wasco County and is within the Columbia Gorge National Scenic Area. This quarry site has had its difficulties with land use issues in the past. The site is rather large at 74.35-acres and contains approximately 3,000,000 yd^3 (6,601,500 T) of good quality basalt that breaks into very angular pieces ranging in size from cobble to boulder. This site does have good quality rock and is in a very desirable location, along I-84.

Figure 7.2: Mosier Quarry

Balsinger Quarry (28-014-4), shown in Figure 7.3, is located west of Highway 97 off of Sayrs County Road in Sherman County. It contains approximately 415,000 yd^3 (986,040 T) of good quality basalt that would need to be drilled and blasted. The 22.96-acre site has plenty of room to work and is close to Highway 97.

Figure 7.3: Balsinger Quarry

Site 33-025-4, shown in Figure 7.4, is located 160 yd west of Highway 197 in Wasco County. The 19.12-acre site has approximately 400,000 yd^3 (918,000 T) of material available. The rock is a good to fair quality basalt that contains a large percentage of biotite that promotes the platy fracture pattern. The site is located at the top of Tygh Ridge and has little overburden, some screening from the highway and plenty of room to work.

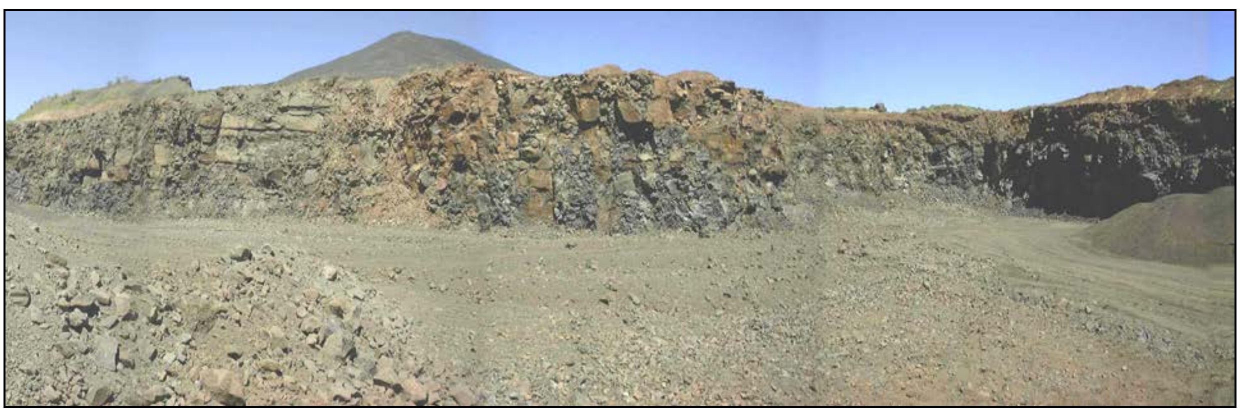

Figure 7.4: Site 33-025-4

The Hinson/Schmidt Quarry (33-053-4), shown in Figure 7.5, is located adjacent to and south of Highway 97 in Wasco County. The 46.49-acre site lost a small portion of land to the realignment of the highway, but still has plenty of room to work. The rock is a fine-grain, good quality basalt with approximately 200,000 yd^3 (450,900 T) available for removal.

Figure 7.5: Hinson/Schmidt Quarry

The Adams Quarry (28-016-4), shown in Figure 7.6, is located adjacent to and east of Highway 97 in Sherman County. There are approximately 100,000 yd^3 (240,300 T) of reserve available for removal. The rock is a fine to medium grain basalt, which is very blocky and can produce a moderate amount of riprap. The 19.3-acre site has no screening from the highway, but has plenty of room to work.

Figure 7.6: Adams Quarry

Fulton Canyon Quarry (28-002-4), shown in Figure 7.7, is about ¼ mi south of the Columbia River along I-84 in Sherman County. The site contains approximately 110,000 yd^3 (288,090 T) of fine-grain, vesicular basalt with a modest supply of riprap. There is no screening from the interstate, but there is plenty of room to work at the site.

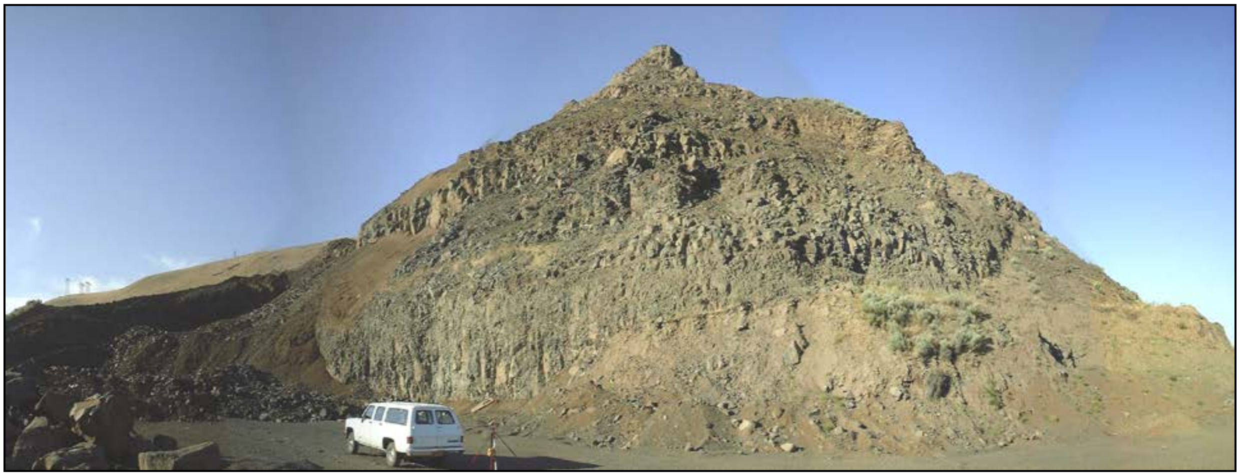

Figure 7.7: Fulton Canyon Quarry

Site 11-010-4, shown in Figure 7.8, is adjacent to Rattlesnake County Road just outside of Arlington in Gilliam County. The site contains approximately 200,000 yd^3 (494,100 T) of good quality, fine-grain basalt. A small percentage of riprap can be extracted from the site. There is no screening from the county road and limited room to work at the site.

Figure 7.8: Site 11-010-4

Site 11-020-4, shown in Figure 7.9, is adjacent to and southwest of Highway 206 in Gilliam County. The 21.6-acre site consists of approximately 200,000 yd^3 (464,400 T) of fine grain basalt, with up to five feet of overburden. There is no screening from the highway, but there is room to work at the site. Drilling and blasting would be required for aggregate extraction.

Figure 7.9: Site 11-020-4

Abbott Quarry (33-048-4), shown in Figure 7.10, is located ¼ mi east of Wapinita Road and about 3.5 miles south of Highway 216 in Wasco County. The 5-acre site is comprised of 100,000 yd^3 (233,500 T) of fine-grain, highly fractured basalt. The terrain is flat with plenty of room to work, but has little screening from the road. The pit floor could be lowered to gain access to more aggregate.

Figure 7.10: Abbott Quarry

Taylor Quarry (33-064-4), shown in Figure 7.11, is located 160 yd north of Highway 218 in Wasco County. The 9.1-acre site is comprised of 150,000 yd^3 (354,375 T) of good quality, fine-grain basalt that can be ripped. There are talus slopes at higher elevations that can produce good sized crushing rock. There is limited room to work in this steep terrain and no screening from the highway. The easement road may need work to decrease the angle of entry onto the highway.

Figure 7.11: Taylor Quarry

Hinton Quarry (33-151-4), shown in Figure 7.12, is located adjacent to and west of Bakeoven County Road near the intersection of Highway 97 in Wasco County. The 9.2-acre site is comprised of 80,000 yd^3 (207,360 T) of fine-grain basalt that has a pronounced spheroidal weathering pattern. The top 10 to 15 feet are more weathered and would produce more fines. There is good screening at the site with adequate room to work. The basalt could be ripped, but it may have to be drilled and blasted. The terrain is flat with power lines traversing the site.

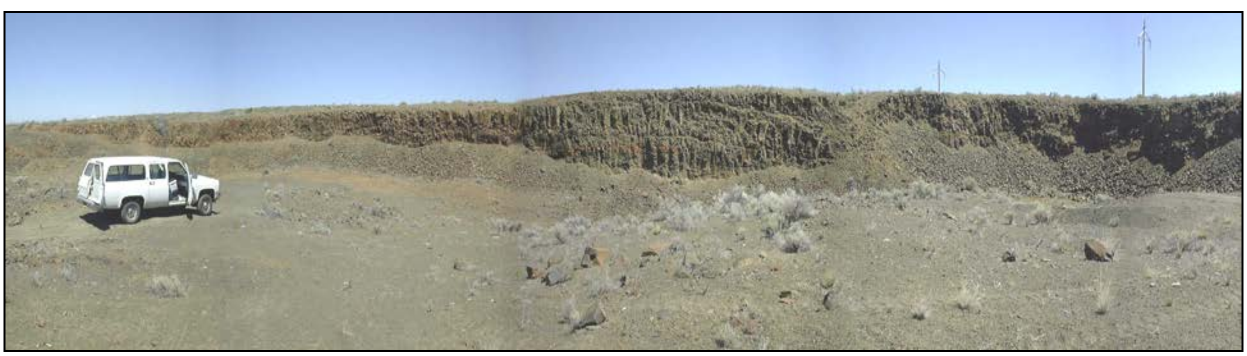

Figure 7.12: Hinton Quarry

East Ore Land Company (33-049-4), shown in Figure 7.13, is adjacent to and west of Highway 97 in Wasco County. The 11.6-acre site contains 320,000 yd^3 (730,080 T) of fair quality, vesicular basalt. Most of the rock would need to be drilled and blasted, while some may be ripped. The terrain is flat, providing adequate room for working and fair screening from the highway.

Figure 7.13: East Ore Land Company

Site 28-020-4, shown in Figure 7.14, is located adjacent to and northeast of Highway 206 in Sherman County. The 9.3-acre site is comprised of 120,000 yd^3 (395,280 T) of good quality, fine-grain basalt with a sharp fracture pattern. The rock would need to be drilled and blasted for removal, and it would also need to be crushed to prevent producing elongated pieces. The terrain is steep, provides no screening and there is currently no room to work. Realigning the highway would alleviate this problem.

Figure 7.14: Site 28-020-4

The 30 Mile Creek site (11-014-4), shown in Figure 7.15, is located adjacent to and east of Highway 19 in Gilliam County. The 8.1-acre site contains 96,000 yd^3 (224,208 T) of good quality, fine-grain vesicular basalt. The rock would need to be drilled and blasted for removal. The terrain is steep, providing some screening from the highway and room to work. A cliff with large cracks exists on the north side of the site; this formation presents a danger that should be addressed to alleviate any future risks to workers.

Figure 7.15: 30 Mile Creek

Mayville Quarry (11-015-4), shown if Figure 7.16, is located east of Mayville in Gilliam County. The 6.3-acre site is comprised of 50,000 yd^3 (113,400 T) of good quality, fine-grain basalt. The rock would need to be drilled and blasted for removal. The site is currently used for stockpiling. There is fair screening from the highway and plenty of room to work.

Figure 7.16: Mayville Quarry

Table 7.2 summarizes the site locations by highway name and number, and provides estimates for the quantity of aggregate for each highway within District 9.

Table 7.2: Aggregate site listing by highway for District 9*

Highway Number	Highway Name	Centerline Miles	Lane Miles	Number of Sites	Total Estimated Reserve		
					Yd^3	T	Mg
002	Columbia River	94.85	189.70	15	3,220,000	7,101,810	6,441,343
004	The Dalles-California	93.68	214.72	11	660,000	1,487,835	1,349,466
005	John Day	58.19	116.07	12	1,527,000	3,482,177	3,158,336
018	Willamette	16.45	34.06				
042	Sherman	68.37	143.74	10	1,485,000	3,411,855	3,094,553
044	Wapinitia	25.85	52.01	3	175,000	412,763	374,376
052	Heppner	8.44	16.65	2	200,000	356,400	323,255
053	Warm Springs	34.27	71.23				
100	Historic Columbia River	15.46	30.92				
290	Shears Bridge	28.47	56.94	1	80,000	192,240	174,362
291	Shaniko-Fossil	42.25	84.50	6	855,000	2,009,138	1,822,288
292	Mosier-The Dalles	1.63	3.08				
300	Wasco-Heppner	56.56	113.12	10	2,375,000	5,318,798	4,824,150
301	Celilo-Wasco	18.39	36.59				
	Total	**562.86**	**1,163.33**	**70**	**10,577,000**	**23,773,016**	**21,562,129**

* The highway numbers, centerline, and lane mileage were obtained from ODOT's 2000 State Mileage Report.

7.2 DISTRICT 10

District 10 is located in central Oregon and extends from Antelope on the north to Valley Falls on the south, and from the summit of the Cascade Mountains on the west to Dayville and Riley on the east. The District includes parts or all of Crook, Deschutes, Jefferson, Klamath, Lake and Wheeler Counties as well as a very small part of Grant and Harney Counties.

District 10 contains 133 aggregate sites. Those 133 sites include quarries (39), gravel sites (2), cinder pits (15), borrow sites (47), raw land (25), road cuts (3), stockpile sites (3) and maintenance yard (1). Figure 7.17 is a map showing the source number and location of each of the 133 sites located within the District.

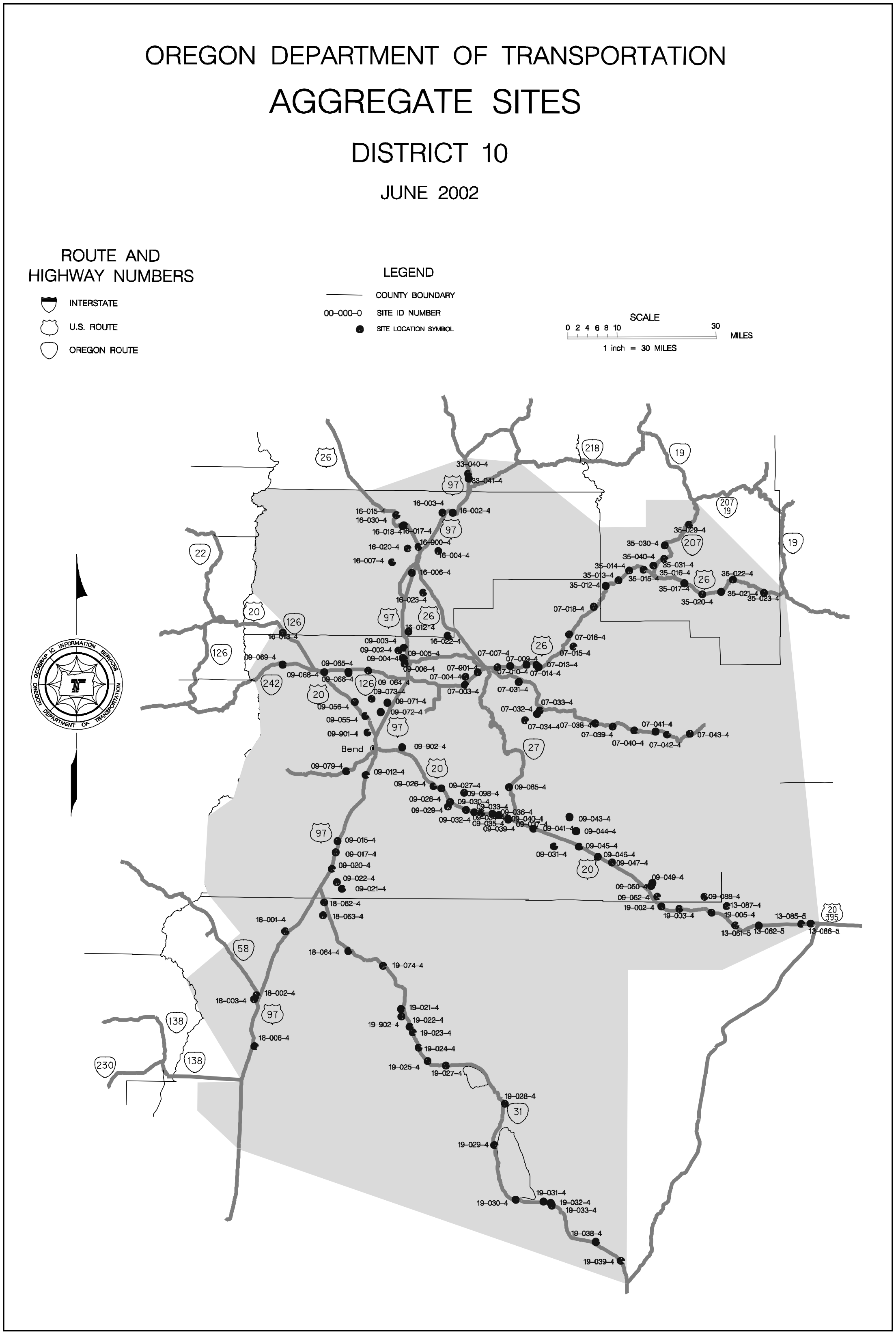

Figure 7.17: District 10 sites

Of the 133 sites, 8 are potentially significant: Grassy Butte, Site 07-031-4, Site 6-015-4, Bolter Quarry, Site 07-003-4, Site 07-033-4, Lyle Gap Quarry, and Site 07-014-4.

Grassy Butte (09-044-4), shown in Figure 7.18, is located 2.5 miles north of Highway 20 in Deschutes County. This 85-acre site contains 1,250,000 yd^3 (2,025,000 T) of cinder available for sanding purposes. The site has ample room to work and process the cinder, with good screening from the highway. At the base of the cinder cone is a 20-foot thick, very tabular, lava flow that could be used to extract basalt aggregate in the future.

Figure 7.18: Grassy Butte Cinder Pit

Site 07-031-4, shown in Figure 7.19, is located approximately 6 miles southeast of Prineville in Crook County on Highway 380. The 23-acre site is comprised of 750,000 yd^3 (1,721,250 T) of very good quality, fine grain, highly fractured basalt. There is good screening from the highway and plenty of room to work.

Figure 7.19: Site 07-031-4

Site 16-015-4, shown in Figure 7.20, is a 40-acre quarry site located adjacent to and east of Highway 26 in Jefferson County. The quarry is comprised of 400,000 yd^3 (928,800 T) of fine-grain basalt, with some vesicular flows intermixed. Adjacent to the ODOT-owned site is a 40-

acre site owned by the U.S. Government. This site is in a good location along Highway 26 and should produce a large quantity of good quality aggregate.

Figure 7.20: Site 16-015-4

Bolter Quarry (33-041-4), shown in Figure 7.21, is a 16.5-acre site located adjacent to and east of Highway 97 in Wasco County. The quarry contains 300,000 yd^3 (737,100 T) of fine grain, highly fractured basalt. There is limited screening from the highway and there is some room to work within the quarry. The site has a locked gate and is mostly enclosed by fencing.

Figure 7.21: Bolter Quarry

Site 07-003-4, shown in Figure 7.22, is located on Highway 126 between Redmond and Prineville in Crook County. The 52.8-acre site is comprised of 250,000 yd^3 (567,000 T) of good quality, fine-grain, highly fractured basalt. There is good screening for the southern pit and fair screening for the northern pit, with plenty of room to work at the site.

Figure 7.22: Site 07-003-4

Site 07-033-4, shown in Figure 7.23, is located at the upper reaches of the Prineville Reservoir at the confluence with the Crooked River in Crook County. The 14.9-acre site contains 100,000 yd^3 (220,00 T) of good quality, fine-grain basalt. The rock would need to be drilled and blasted for removal; there is a possibility of acquiring some riprap. The terrain is steep with no screening but plenty of room to work. The site could be developed from the top down.

Figure 7.23: Site 07-033-4

Lyle Gap Quarry (16-002-4), shown in Figure 7.24, is adjacent to and south of Highway 97 in Jefferson County. The 37-acre site is comprised of 225,000 yd^3 (479,925 T) of good quality, fine-grain basalt that breaks into very sharp conchoidal fracture patterns. The rock would need to be drilled and blasted for removal. The terrain is moderately steep, providing fair screening from the highway and plenty of room to work.

Figure 7.24: Lyle Gap Quarry

Site 07-014-4, shown in Figure 7.25, is located along the inside radius of Highway 26 about 9 miles east of Prineville in Crook County. The 12.9-acre site contains 120,000 yd^3 (260,820 T) of good quality, porphyritic basalt, with a fine-grain ground mass and phenocrysts of plagioclase. The phenocrysts make up less than 5% of the site and are less than 3 mm in size. The rock can be blocky with a possible use as riprap. Drilling and blasting would be required for rock removal. The terrain is steep, and falling rock could pose a danger to workers. Screening is not provided, and there is currently no room to work at this site.

Figure 7.25: Site 07-014-4

Table 7.3 summarizes the site locations by highway name and number, and provides estimates of the quantity of aggregate for each highway within District 10.

Table 7.3: Aggregate site listing by highway for District 10*

Highway Number	Highway Name	Centerline Miles	Lane Miles	Number of Sites	Total Estimated Reserve		
					Yd^3	T	Mg
002	Columbia River	94.85	189.70	15	3,220,000	7,101,810	6,441,343
004	The Dalles-California	93.68	214.72	11	660,000	1,487,835	1,349,466
005	John Day	58.19	116.07	12	1,527,000	3,482,177	3,158,336
018	Willamette	16.45	34.06				
042	Sherman	68.37	143.74	10	1,485,000	3,411,855	3,094,553
044	Wapinita	25.85	52.01	3	175,000	412,763	374,376
052	Heppner	8.44	16.65	2	200,000	356,400	323,255
053	Warm Springs	34.27	71.23				
100	Historic Columbia River	15.46	30.92				
290	Shears Bridge	28.47	56.94	1	80,000	192,240	174,362
291	Shaniko-Fossil	42.25	84.50	6	855,000	2,009,138	1,822,288
292	Mosier-The Dalles	1.63	3.08				
300	Wasco-Heppner	56.56	113.12	10	2,375,000	5,318,798	4,824,150
301	Celilo-Wasco	18.39	36.59				
	Total	**562.86**	**1,163.33**	**70**	**10,577,000**	**23,773,016**	**21,562,129**

* The highway numbers, centerline, and lane mileage were obtained from ODOT's 2000 State Mileage Report.

7.3 DISTRICT 11

District 11 is located in south-central Oregon and extends from Crater Lake, Valley Falls, and Riley on the north to the Oregon/California border on the south, and from the Harney/Lake County line and Riley on the east to Lake of the Woods and Klamath Falls on the west. The District includes parts of Harney, Klamath, and Lake Counties as well as a small portion of Jackson County. District 11 contains 63 sites, which include quarries (23), gravel sites (3), cinder pits (5), borrow sites (11), raw land (17), road cuts (3), and stockpile site (1). Figure 7.26 is a map showing the source number and location of each of the 63 sites in District 11.

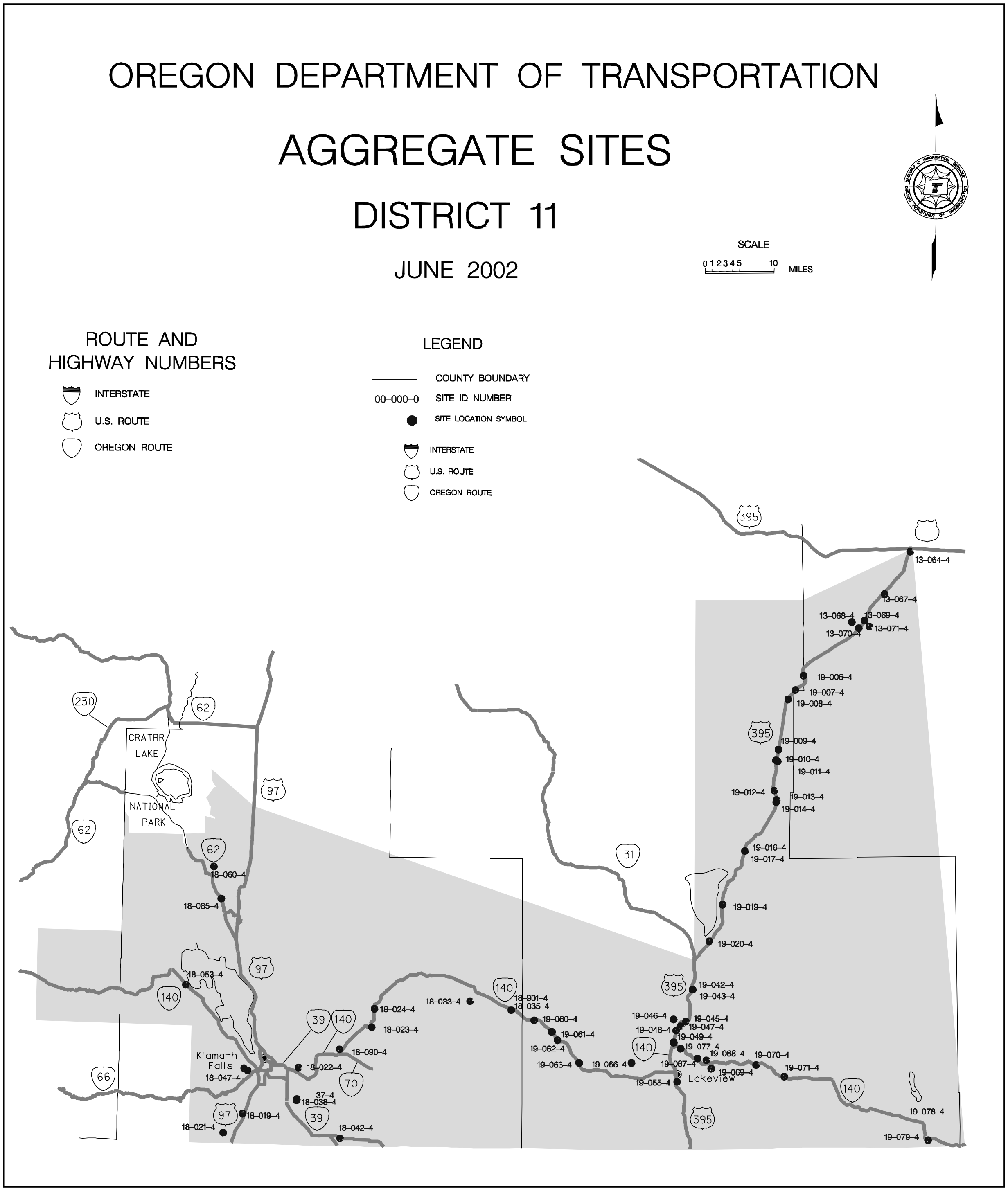

Figure 7.26: District 11 sites

Of the 63 sites within District 11, Odessa Gravel Pit is the only site that is potentially significant. Some sites within the District meet the tonnage requirements, but they are not owned by the state.

Odessa Gravel Pit (18-052-4), shown in figure 7.27, is adjacent to and east of Highway 140 in Klamath County. The 28-acre borrow site is comprised of 320,000 yd^3 (518,400 T) of good quality gravel. The gravel composition is as follows: 15% cobbles, 45% pebbles, and 40% sand/silt. There is room to work but no screening from the highway.

Figure 7.27: Odessa Gravel Pit

Table 7.4 summarizes the site locations by highway name and number, and provides estimates of the quantity of aggregate for each highway within District 11.

Table 7.4: Aggregate site listing by highway for District 11*

Highway Number	Highway Name	Centerline Miles	Lane Miles	Number of Sites	Total Estimated Reserve		
					Yd^3	T	Mg
004	The Dalles-California	63.53	142.79	9	1,430,000	3,185,325	2,889,090
019	Fremont	37.16	74.32	8	780,000	1,413,450	1,281,999
020	Klamath Falls-Lakeview	95.72	204.70	11	1,075,000	2,206,980	2,001,730
021	Green Springs	15.19	31.02	2	1,050,000	2,227,500	2,020,343
022	Crater Lake	20.28	40.33	1	0	0	0
023	Dairy-Bonanza	6.97	13.94				
049	Lakeview-Burns	89.67	179.34	18	7,304,000	12,669,278	11,491,034
050	Klamath Falls-Malin	31.92	70.26	3	600,000	1,255,500	1,138,739
270	Lake of the Woods	52.72	119.03	3	854,000	1,383,480	1,254,817
420	Midland	5.65	13.89				
422	Chiloquin	5.48	10.96				
424	South Klamath Falls	5.91	12.07				
426	Hatfield	2.42	4.84				
431	Warner	65.24	130.48	8	2,460,000	4,729,050	4,289,248
	Total	**497.86**	**1,047.97**	**63**	**15,553,000**	**29,070,563**	**26,367,000**

* The highway numbers, centerline, and lane mileage were obtained from ODOT's 2000 State Mileage Report.

8.0 REGION 5 SITES

Region 5 encompasses Districts 12, 13, and 14, and all or parts of Baker, Gilliam, Grant, Harney, Malheur, Morrow, Umatilla, Union, Wallowa and Wheeler Counties. Table 8.1 classifies the 297 sites within Region 5 by type of site.

Table 8.1: Region 5 classification of aggregate sites

Reg.	District	Quarry	Gravel	Cinder Pit	Borrow	Raw Land	Road Cut	Stockpile Site	Maint. Yard	Grand Total
5	12	44	9		1	24	1	3	3	85
	13	29	11		6	15	1	5		67
	14	43	19	8	32	34	2	6	1	145
	Total	**116**	**39**	**8**	**39**	**73**	**4**	**14**	**4**	**297**

8.1 DISTRICT 12

District 12 is located in the northwest corner of Region 5, and its boundaries extend from the Oregon/Washington border on the north to Dayville and Long Creek on the south, and from the summit of the Blue Mountains on the east to Boardman and Fossil on the west. It encompasses parts of Grant, Morrow, Umatilla and Wheeler Counties. Table 8.1 shows that District 12 contains 85 sites, which include quarries (44), gravel sites (9), borrow site (1), raw land (24), road cut (1), stockpile sites (3), and maintenance yards (3). Figure 8.1 is a map showing the source number and location of each of the 85 sites in District 12.

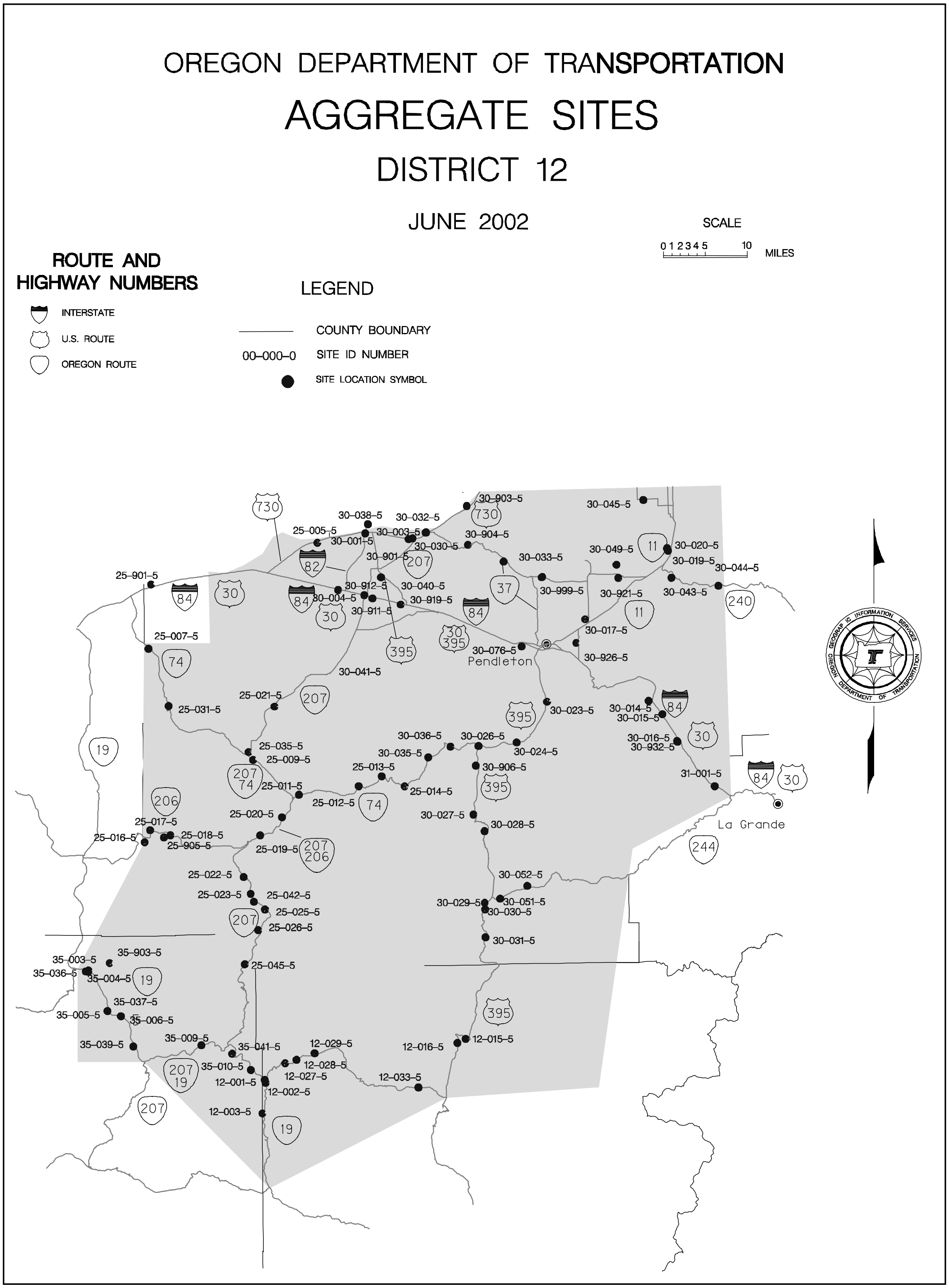

Figure 8.1: District 12 sites

Of the 85 sites, nine are potentially significant: Cason Canyon Quarry, Weston Pit, Site 30-16-5, Nye Junction Quarry, Lexington Quarry, Site 30-032-5, Site 30-027-5, Dry Creek Quarry, and Kennedy Pit.

Cason Canyon Quarry (25-019-5), shown in Figure 8.2, is a 31-acre site located adjacent to and north of Highway 206 in Morrow County. The rock at the quarry is a fine grain, slightly vesicular, highly fractured basalt with an estimated reserve of 1,000,000 yd^3 (1,500,000 T.) There is ample room to work at this site, but it provides no screening from the highway.

Figure 8.2: Cason Canyon Quarry

Weston Pit (30-043-5), shown in Figure 8.3, is located adjacent to and south of Highway 204, 2 miles east of Weston. The rock at this 10.4-acre quarry site is a weathered, highly fractured, fine grain basalt that has minor vesicular structure. There is an estimated reserve of 1,000,000 yd^3 (1,500,000 T) available for removal. The site has ample room to work and provides good screening from the adjacent highway.

Figure 8.3: Weston Pit

Site 30-016-5, shown in Figure 8.4, is located adjacent to and west of Interstate 84 in Umatilla County. The 36.8-acre, raw land site contains 1,000,000 yd^3 (1,500,000 T) of removable fine grain, moderately fractured basalt. The site has no past disturbance and no developed access. Room to work at the site could be provided, and there is limited screening from the adjacent freeway.

Figure 8.4: Site 30-016-5

Nye Junction Quarry (30-026-5), shown in Figure 8.5, is located at the junction of Highway 74 and Highway 395 in Umatilla County. This 26-acre quarry site is comprised of 400,000 yd^3 (934,200 T) of slightly weathered, very vesicular basalt available for removal. There is a sanding shed associated with the site, ample room to work, but no screening from the adjacent highways.

Figure 8.5: Nye Junction Quarry

Lexington Quarry (25-009-5), shown in Figure 8.6, is located just east of Lexington on Highway 74 in Morrow County. The 14.9-acre site contains 300,000 yd^3 (450,000 T) of fine grain, highly fractured basalt. There are multiple flows exposed in the pit, and some of the rock is vesicular. The rolling terrain provides room to work, but there is no screening from the highway.

Figure 8.6: Lexington Quarry

Site 30-032-5, shown in Figure 8.7, is located at the junction of the Cold Springs Highway and Highway 730 in Umatilla County. The 133.3-acre site is comprised of 320,000 yd^3 (669,600 T) of good quality thin, intermittent, fine grain, moderately fractured basalt flow exposed with terrace gravel all around. The gravel is a heterogeneous mix of lithology and size, 50% of which is sand. The terrain is flat with adequate room to work, but the site has no screening from the highway.

Figure 8.7: Site 30-032-5

Site 30-027-5, shown in Figure 8.8, is adjacent to and west of Highway 395 in Umatilla County, covering 11.3 acres. The site is comprised of good quality, fine grain, slightly vesicular, highly fractured basalt, with an estimated reserve of 300,000 yd^3 (708,750 T). The rock can be ripped, but the pit floor would need to be lowered to pull out more material. There is no screening from the highway, but there is adequate room to work.

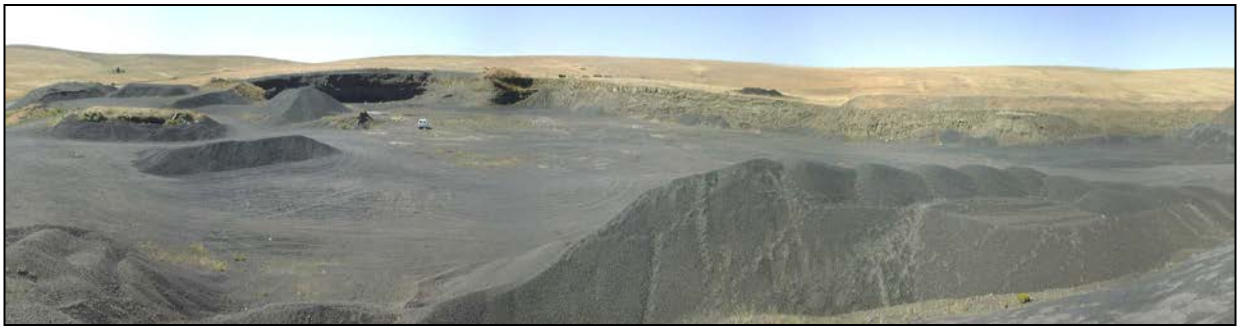

Figure 8.8: Site 30-027-5

Dry Creek Quarry (30-019-5), shown in Figure 8.9, is located adjacent to and east of Highway 11 in Umatilla County. The 28.9-acre site is comprised of 100,000 yd^3 (150,000 T) of good quality, fine grain, highly fractured basalt (classic dice rocks.) The material can be ripped. The flat terrain provides plenty of room to work and some screening from the highway.

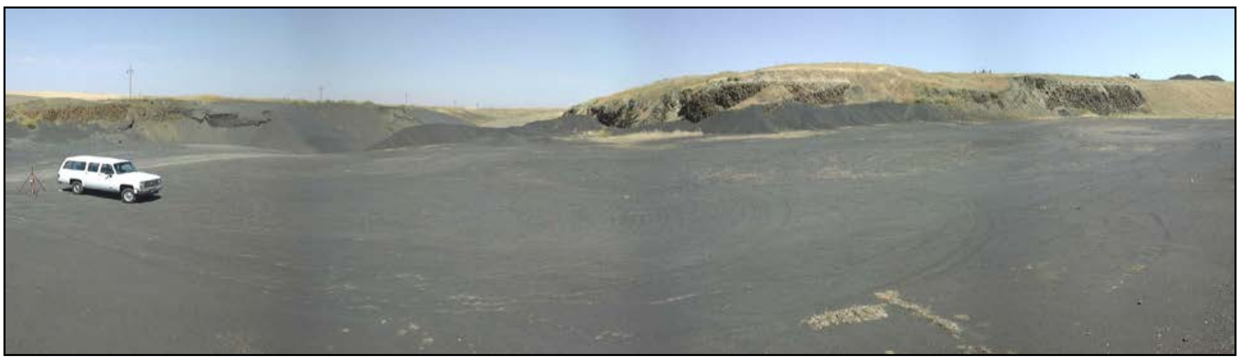

Figure 8.9: Dry Creek Quarry

Kennedy Pit (30-001-5), shown in Figure 8.10, is located south of Highway 730 and east of I-82 in Umatilla County. The 121.8-acre site is comprised of a heterogeneous mix of lithologies and sizes, with an estimated reserve of 360,00 yd^3 (753,300 T). The sizes range from gravel on top to Columbia River Basalts below. There is 40% gravel and 60% sand by volume exposed in the pit. There is good screening from the highway and ample room to work at this site.

Figure 8.10: Kennedy Pit

Table 8.2 summarizes the site locations by highway name and number, and provides estimates of the quantity of aggregate for each highway within District 12.

Table 8.2: Aggregate site listing by highway for District 12*

Highway Number	Highway Name	Centerline Miles	Lane Miles	Number of Sites	Total Estimated Reserve		
					Yd^3	T	Mg
002	Columbia River	43.98	92.06	6	2,200,000	4,973,550	4,558,627
005	John Day	62.58	125.16	14	1,704,000	3,153,903	1,764,614
006	Old Oregon Trail	85.25	177.39	8	4,140,000	6,452,250	7,242,622
008	Oregon-Washington	34.07	88.82	3	160,000	275,550	309,786
028	Pendleton-John Day	90.28	185.08	11	2,155,000	4,052,475	4,431,896
036	Pendleton-Cold Springs	30.41	60.01	3	370,000	774,225	702,222
052	Heppner	74.64	149.28	9	970,000	1,822,275	1,935,609
054	Umatilla-Stanfield	12.86	50.26	2	600,000	1,215,000	1,102,005
067	Pendleton	5.92	11.41				
070	McNary	11.21	22.42				
300	Wasco-Heppner	29.26	58.52	6	2,140,000	3,246,383	4,449,895
320	Lexington-Echo	40.15	80.06	3	262,000	492,090	524,553
321	Heppner-Spray	40.87	81.74	6	300,000	528,150	500,800
330	Weston-Elgin	11.74	28.88	2	1,000,000	1,500,000	2,204,010
331	Umatilla-Mission	4.84	9.48				
332	Sunnyside-Umapine	7.93	15.86	1	0	0	0
333	Hermiston	18.06	36.10	1	0	0	0
334	Athena-Holdman	18.16	36.32	3	150,000	225,000	325,090
335	Havana-Helix	8.66	17.32	1	160,000	367,200	333,050
339	Freewater	5.25	10.81				
341	Ukiah-Hilgard	23.54	47.08	2	200,000	300,000	450,597
402	Kimberly-Long Creek	34.88	69.76	4	96,000	144,000	182,198
	Total	**694.54**	**1,453.82**	**85**	**16,607,000**	**29,522,051**	**31,017,574**

* The highway numbers, centerline, and lane mileage were obtained from ODOT's 2000 State Mileage Report.

8.2 DISTRICT 13

District 13 is located in the upper northeast corner of Oregon. Its boundaries extend from the Oregon/Washington border on the north to Sumpter on the south, and from the Oregon/Idaho border on the east to the summit of the Blue Mountains on the west. It encompasses all of Wallowa County and portions of Baker, Grant, Umatilla, and Union Counties. District 13 contains 67 sites, which include quarries (29), gravel sites (11), borrow sites (6), raw land (15), road cut (1), and stockpile sites (5). Figure 8.11 is a map showing the source number and location of each of the 67 sites in District 13.

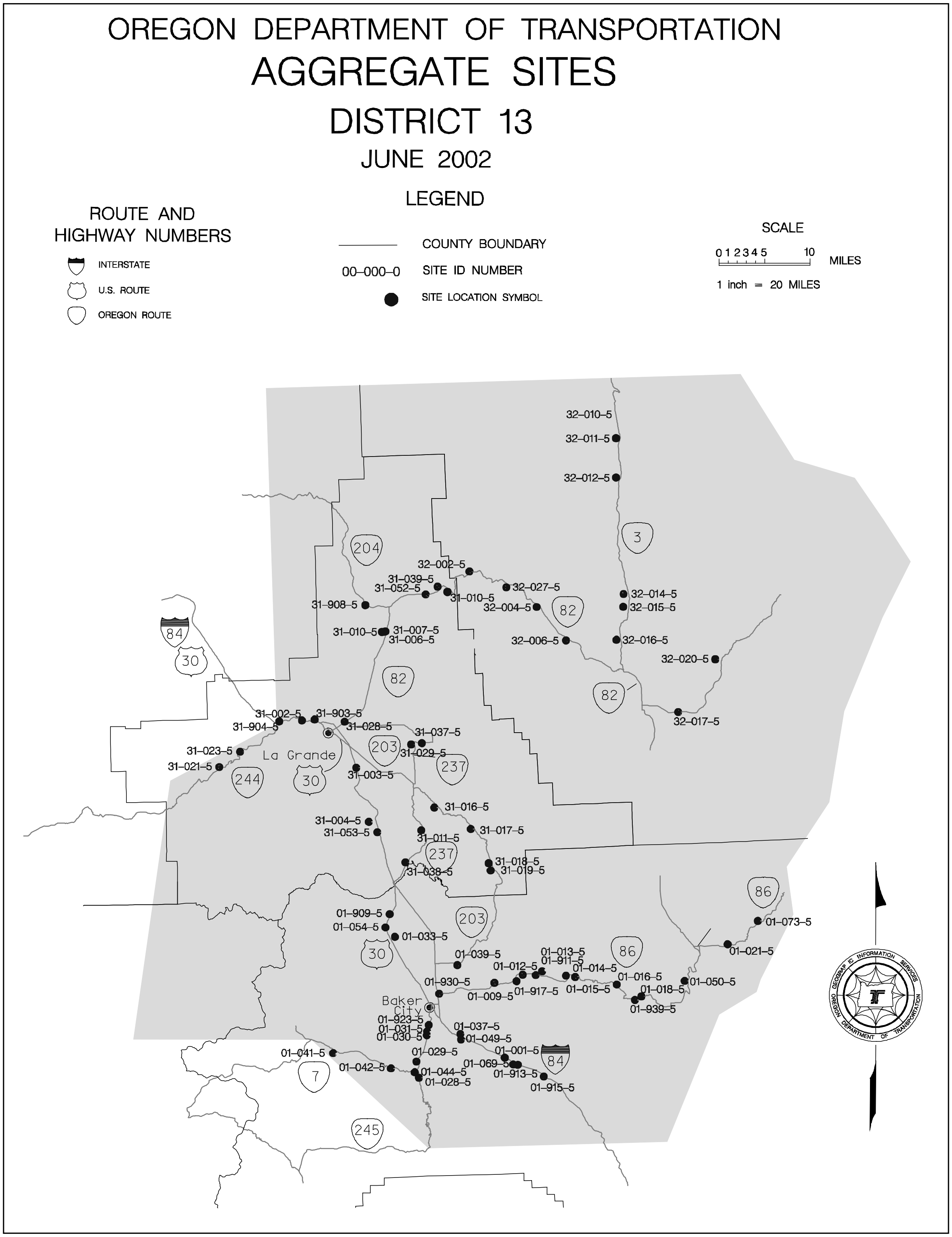

Figure 8.11: District 13 sites

Of the 67 sites, three are potentially significant: Site 32-016-5, Site 01-001-5 and Site 01-033-5.

Site 32-016-5, shown in Figure 8.12, is ¼ mi east of Highway 3 in Wallowa County. The 21.25-acre sight has 300,000 yd^3 (712,800 T) of fine-grain, highly fractured basalt available for removal. The terrain around the site is gradually sloping up, at about 5-8 degrees with little to no overburden. The site has some screening and ample room to work.

Figure 8.12: Site 32-016-5

Site 01-001-5, shown in Figure 8.13, is a large 166.94-acre quarry site located north of and adjacent to Interstate-84 in Baker County. The site has 400,000 yd^3 (600,000 T) of fine to medium grain, highly fractured, and slightly weathered basalt available for removal. The terrain is moderate to gradual with some screening from the Interstate and ample room to work.

Figure 8.13: Site 01-001-5

Site 01-033-5, shown in Figure 8.14, is located one mile east of Haines in Baker County. The 4-acre site is comprised of 90,000 yd^3 (239,355 T) of good quality, fine grain, platy, highly fractured basalt that has little weathering. The rock can be ripped to acquire minor amounts of riprap. The terrain is moderate, provides no screening from the highway, and has minimal room to work.

Figure 8.14: Site 01-033-5

Table 8.3 summarizes the site locations by highway name and number, and provides estimates of the quantity of aggregate for each highway within District 13.

Table 8.3: Aggregate site listing by highway for District 13*

Highway Number	Highway Name	Centerline Miles	Lane Miles	Number of Sites	Total Estimated Reserve		
					Yd^3	T	Mg
006	Old Oregon Trail	82.93	165.86	11	1,120,000	2,152,800	2,342,861
010	Wallowa Lake	70.74	154.85	9	926,000	1,835,490	1,816,348
011	Enterprise-Lewiston	43.17	86.34	6	705,000	1,620,480	1,505,218
012	Baker-Copperfield	70.33	143.16	14	1,555,000	2,738,325	3,146,909
066	La Grande-Baker	54.45	112.03	6	1,176,000	2,525,310	2,290,456
071	Whitney	26.00	52.00	7	282,000	571,455	518,310
330	Weston-Elgin	30.15	60.30	1	0	0	0
340	Medical Springs	38.89	77.50	5	497,000	1,112,333	1,008,885
341	Ukiah-Hilgard	23.68	47.06	2	40,000	81,000	73,467
342	Cove	22.07	44.14	3	150,000	297,675	269,991
350	Little Sheep Creek	29.36	58.72	2	317,000	589,425	605,490
351	Joseph-Wallowa Lake	6.94	13.88				
410	Sumpter	3.71	7.42				
413	Halfway-Cornucopia	11.28	17.10				
414	Pine Creek	0.91	1.82				
415	Dooley Mountain	15.49	30.98	1	115,000	240,638	218,258
	Total	**530.10**	**1,073.16**	**67**	**6,883,000**	**13,764,931**	**13,796,193**

* The highway numbers, centerline, and lane mileage were obtained from ODOT's 2000 State Mileage Report.

8.3 DISTRICT 14

District 14 is the largest in the state and is located in the southeast corner of Oregon. Its boundaries extend from Sumpter and Dayville on the north to the Oregon/Nevada border on the south, and from Riley on the west to the Oregon/Idaho border on the east. It encompasses all of Malheur County and portions of Baker, Grant and Harney Counties. District 14 contains 145 sites, which include quarries (43), gravel sites (19), cinder pits (8), borrow sites (32), raw land (34), road cuts (2), stockpile sites (6) and maintenance yard (1). Figure 8.15 is a map showing the source number and location of each of the 145 sites in District 14.

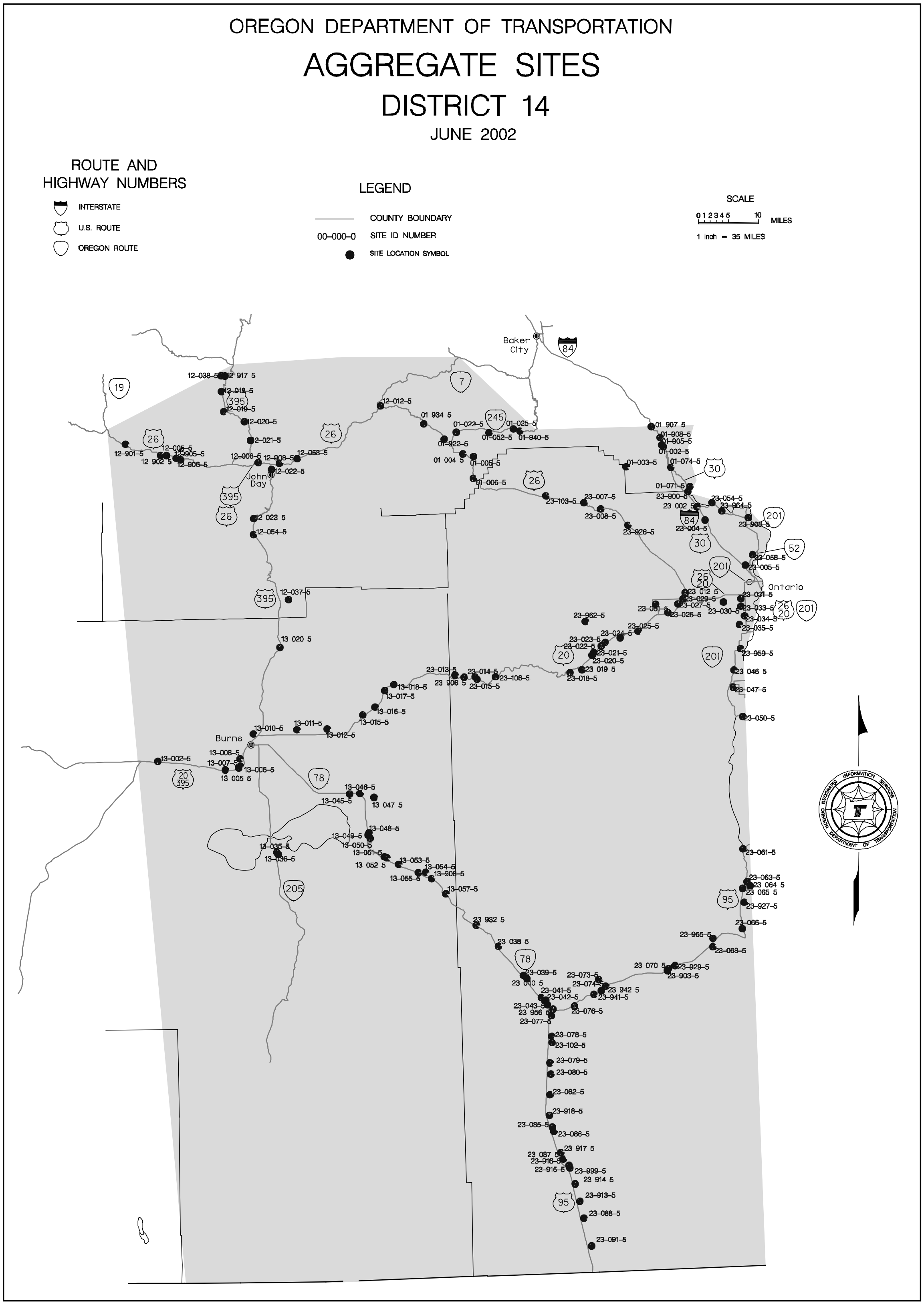

Figure 8.15: District 14 Sites

Of the 145 sites, eight are potentially significant: Site 13-045-5, Crooked Creek Quarry, Site 23-064-5, Silvies Quarry, Brogan Hill Quarry, Buchanan Quarry, Site 13-020-5, and Hope Gravel Pit.

Site 13-045-5, shown in Figure 8.16, is located 300 yd south of Highway 78 in Harney County. The 29.3-acre cinder pit contains 1,400,000 yd^3 (2,268,000 T) of various size cinders.

Figure 8.16: Cinder Pit Site 13-045-5

Crooked Creek Quarry (23-102-5), shown in Figure 8.17, is a 20-acre quarry site located on either side of Highway 95 in Malheur County. The pit is located east of the highway and provides little screening and ample room to work. The quarry contains 600,000 yd^3 (1,231,200 T) of fine grain, very platy basalt.

Figure 8.17: Crooked Creek Quarry

Site 23-064-5, shown in Figure 8.18, is a 96-acre quarry site located approximately one mile east of Highway 95 in Malheur County. The quarry contains 750,000 yd^3 (1,125,000 T) of fine-grain basalt available for removal. There is ample room to work at the site, and there is some screening from the highway. This is a very good site, and development should be protected for future projects.

Figure 8.18: Site 23-064-5

Silvies Quarry (12-037-5), shown in Figure 8.19, is located 1.5 miles east of Highway 395, off of Silvies Hopper Ranch Road in Grant County. The 76.4-acre site is comprised of 300,000 yd^3 (450,000 T) of fine grain, slightly weathered, highly fractured, olive-grey basalt available for removal. The terrain is flat to gradually sloping, and the site has had minor reclamation.

Figure 8.19: Silvies Quarry

Brogan Hill Quarry (23-007-5), shown in Figure 8.20, is adjacent to and south of Highway 26 in Malheur County. The 15.8-acre site contains 100,000 yd^3 (150,000 T) of highly fractured, fine-grain basalt. The material can be ripped and good size pieces acquired to be crushed. The terrain is flat and there is ample room to work with limited screening from the highway.

Figure 8.20: Brogan Hill Quarry

Buchanan Quarry (13-015-5), shown in Figure 8.21, is adjacent to and south of Highway 20 in Harney County. The 21-acre site is comprised of 300,000 yd^3 (450,000 T) of good quality, fine-grain, highly fractured basalt. The material can be ripped. The site is currently used for stockpiling. There is ample room to work with good screening from the highway.

Figure 8.21: Buchanan Quarry

Site 13-020-5, shown in Figure 8.22, is adjacent to and west of Highway 395 in Harney County. The 26.4-acre site is comprised of fair quality, medium-grain porphyritic andesite, with estimated reserves of 95,000 yd^3 (192,375 T). The plagioclase is turning to clay, but the exposed rock is hard. The terrain is moderate and provides ample room to work with some screening from the highway.

Figure 8.22: Site 13-020-5

Hope Gravel Pit (23-051-5), shown in Figure 8.23, is located north of Highway 20, two miles off of Graham Blvd and Whitney Road in Malheur County. The 24.9-acre site contains 100,000 yd^3 (150,000 T) of good quality, volcanic gravel and sand/silt. The gravel is cobble size and comprises 60% of the site. The site is used as a stockpile, waste rock, and grindings site. The terrain is flat with ample room to work and fair screening from the roads.

Figure 8.23: Hope Gravel Pit

Table 8.4 summarizes the site locations by highway name and number, and provides estimates of the quantity of aggregate for each highway within District 14.

`Table 8.4: Aggregate site listing by highway for District 14*

Highway Number	Highway Name	Centerline Miles	Lane Miles	Number of Sites	Total Estimated Reserve		
					Yd^3	T	Mg
005	John Day	152.75	307.92	20	768,000	1,334,783	1,344,382
006	Old Oregon Trail	42.25	84.50	12	2,410,000	4,427,800	4,231,700
007	Central Oregon	160.94	338.26	29	3,697,000	6,714,978	6,919,266
028	Pendleton-John Day	28.20	57.59	6	858,000	1,534,512	1,616,419
048	John Day-Burns	67.52	134.97	4	570,000	896,475	1,143,023
071	Whitney	24.96	49.92				
415	Dooley Mountain	21.13	42.26	4	664,000	1,359,795	1,277,959
440	Frenchglen	73.35	146.70	2	160,000	334,800	303,664
442	Steens	91.55	183.10	19	9,205,000	16,660,995	15,408,112
449	Huntington	11.07	21.63	2	640,000	1,412,700	1,302,814
450	Succor Creek	24.97	49.94	2	0	0	0
451	Vale-West	10.39	20.76	2	100,000	150,000	146,934
453	Adrian-Arena Valley	3.19	6.38				
454	Adrian-Caldwell	5.09	10.18	1	5,000	7,500	7,346
455	Olds Ferry-Ontario	37.10	88.28	5	300,000	450,000	440,802
456	I.O.N.	121.30	242.60	37	13,343,000	21,908,478	20,561,731
	Total	**875.76**	**1,784.99**	**145**	**32,720,000**	**57,192,816**	**54,704,152**

* The highway numbers, centerline, and lane mileage were obtained from ODOT’s 2000 State Mileage Report.

9.0 AGGREGATE FORECAST

Aggregate needs were projected for a 15-year period. The projection was based on:

- Paving needs;
- Bridge rehabilitation and reconstruction needs;
- Oregon Transportation Initiative Act (OTIA) modernization projects; and
- Maintenance needs.

The projection methodologies differed for each of the four categories; each approach was relatively simple, however. The paving, bridge rehabilitation/construction, and maintenance methodologies were based on projected requirements. The modernization needs were based on an extrapolation of historical data. The first section of this chapter focuses on aggregate needs for paving. The next section addresses the bridge aggregate forecast and the methodology used. The third section covers the modernization requirements. The fourth section covers the maintenance requirements. In the last section, the four aggregate forecasts are combined to show the total requirements for each District.

9.1 AGGREGATE NEEDS FOR PAVEMENT PRESERVATION

For the pavement needs forecast, some basic assumptions were made. Based on input from ODOT's Pavement Management Engineer, the following assumptions were used to create the pavement preservation projection model.

1. The pavement preservation forecast was based on the use of asphalt concrete (AC) for overlay/inlays on all highways and the use of chip seals on low volume highways (i.e., < 1,000 Average Daily Traffic (ADT)).
2. Preservation needs were determined using a 15-year cycle.
3. OTIA pavement preservation projects were also included in the preservation needs forecast.
4. Three existing pavement types were considered:
   - Asphalt Concrete (AC);
   - Jointed Concrete Pavement (JCP); and
   - Continuously Reinforced Concrete Pavement (CRCP).
5. Different preservation options were applied depending on the following highway characteristics:
   - Existing pavement type;
   - Traffic volumes (< 1,000 ADT or not); and
   - Urban or rural location.

Using these parameters, Table 9.1 summarizes the preservation options used in the model to estimate aggregate needs.

Table 9.1: Preservation options based on existing pavement type, ADT, and location

Highway Classification	Existing Pavement Type	Preservation Treatment
Interstate, Region, State, District	AC	50 mm inlay of travel lanes and 50 mm overlay full width for AC sections (100 mm total thickness)
	JCP	Rubblize JCP and a 200 mm AC overlay
	CRCP	150 mm AC overlay of CRCP
<1000 ADT	AC	One chip seal and a 50-mm AC overlay or inlay.
	JCP	Rubblize JCP and a 200 mm AC overlay
	CRCP	150 mm AC overlay of CRCP
Urban	AC	Thick AC overlay (150 mm).
	JCP	Rubblize JCP and a 200 mm AC overlay
	CRCP	150 mm AC overlay of CRCP

Using the preservation options shown in Table 9.1, the required paving thickness for each highway type is listed in Table 9.2.

Table 9.2: Pavement preservation thickness

Highway Type	Thickness of New Paving (mm) for Existing Pavement Type		
	AC	CRCP	JCP
Interstate, Region, State, District	100	150	200
<1000 ADT	50	150	200
Urban	150	150	200

The length of each highway segment in the ODOT system, as well as their corresponding paved surface width was provided by Transportation Data Section in a spreadsheet format. The total surface area of each highway segment was determined by multiplying the length of the segment times the corresponding surface width. Thus, by knowing surface area and the thickness of the desired treatment (from Table 9.2), volumetric calculations (*length* x *width* x *thickness*) of required paving were made for each highway segment.

The aggregate requirements for chip seals were determined by multiplying an estimated application rate times the pavement surface area.

In determining the paving and chip seal aggregate requirements, the following assumptions were used:

Unit weight of aggregate -- 2,316 kg/m^3

Asphalt Content -- Assumed 5% by weight

Chip application rate -- 10.8 kg/m^2

The volumetric paving requirements were converted to weight by applying the conversion listed above (2,316 kg/m^3). The paving requirements were combined with any chip seal needs for each highway segment. Chip seal aggregate needs represent only a portion of total highway preservation needs (less than one percent in each District).

Table 9.3 provides a summary of the 15-year asphalt paving and chip seal requirements in Mg, for each District (column 5). The total aggregate requirements also account for the OTIA pavement preservation projects (column 4).

Table 9.3: Aggregate needs for pavement preservation

(1)	(2)	(3)	(4)	(5) = (3) + (4)
District	**Highway Lane Mileage (miles)**	**15- Year Aggregate Needs (Mg)**	**OTIA Preservation Needs (Mg)**	**Total 15-Year Aggregate Needs (Mg)**
1	575.4	1,201,099	81,200	1,282,299
2A	788.9	2,452,064	79,676	2,531,740
2B	499.0	1,969,088	9,579	1,978,667
2C	646.5	1,757,372	66,179	1,823,551
3	1,117.8	3,378,131	92,784	3,470,916
4	1,299.2	2,966,907	29,432	2,996,339
5	975.8	2,374,010	115,892	2,489,901
7	1,386.7	3,812,321	42,241	3,854,562
8	970.3	2,762,236	20,807	2,783,043
9	1,163.3	2,122,955	34,091	2,157,046
10	1,601.9	3,431,033	115,356	3,546,389
11	1,048.0	1,884,877	150,127	2,035,005
12	1,453.8	3,029,287	68,109	3,097,396
13	1,073.2	2,383,558	4,746	2,388,304
14	1,785.0	3,016,402	0	3,016,402
Totals	**16,384.68**	**38,541,340**	**910,219**	**39,451,559**

9.2 AGGREGATE NEEDS FOR BRIDGE REHABILITATION AND REPLACEMENT

ODOT is responsible for 2,633 state-owned bridges. The average age of ODOT's bridges is 39 years; 20% are more than 50 years old (*ODOT 2000*). Unlike pavements, which have a relatively steady 15-year preservation cycle, bridges are unique structures. Preservation cycles vary from bridge to bridge, depending on their expected design life, location, type of bridge, and traffic loading. Projecting aggregate needs for bridges is a challenge because of this variation. Therefore, aggregate projections are based on the currently available information about future bridge rehabilitation and replacement projects. This information is changing rapidly; in 2001, at least 14 reinforced concrete deck girder (RCDG) bridges were weight limited, and 35 had load problems pending. As the need for emergency bridge repairs grows, other planned rehabilitation projects are subject to delay because of limited funding. Thus, the projection of aggregate needs for the next 15 years is made with a degree of uncertainty about the level and scope of bridge rehabilitation and replacement in this period.

The aggregate forecast in this study for bridge needs was based on the *1998 Bridge Needs Study* (BNS) that was conducted for the Oregon Highway Plan (*Sartain and Groff 1999*). The BNS identified needs on 1,240 bridges. Needs were identified in terms of rehabilitation costs for preservation or modernization of the bridge. The needs were quantified based on the deficiency categories contained in Table 9.4.

Table 9.4: Deficiencies identified in the *1998 Bridge Needs Study*

Code	Preservation Needs	Deficiency Description:
SE	Seismic	Susceptibility to collapse in moderate earthquakes
SC	Scour	Susceptibility to undermining of bridge foundations in stream beds
LC	Load Capacity – Deterioration	Deficiency in carrying capacity for legal loads due to deterioration
SB	Substructure	Spalling, cracking, etc. in piers, columns and footings
SP	Superstructure	Spalling, cracking, etc. in girders and truss members
DE	Bridge Deck	Rutting, cracking, delaminating, etc. in bridge decks
RA	Rails	Safety hazards (vehicle snagging) or inadequate crash resistance
UW	Under-Width – Bridge	Insufficient width to handle traffic demand based on the bridge width standards only (bottleneck bridges)
UC	Under-clearance	Inadequate vertical clearance due to obsolete design
MO	Movable Bridges	Obsolete or deteriorated mechanical or electrical systems
CO	Corrosion	Coastal bridges subject to corrosion from salt intrusion
PA	Major Paint	Major steel structures in need of protective coating
Code:	**Modernization Needs**:	**Deficiency Description:**
LM	Load Capacity – Design	Deficiency in carrying capacity for legal loads due to obsolete design
AW	Under-Width – Approaches	Insufficient width to handle traffic demand based on approach roadway traffic demand

The BNS needs were separated into three time bands:

- Band 1: 1998-2001 (old Statewide Transportation Improvement Plan (STIP) period)
- Band 2: 2002-2007 (“Short Term Needs”)
- Band 3: 2008-2017 (“Long Term Needs”)

Over 200 bridges had needs identified in both Bands 2 and 3, indicating that these bridges had both “short term” and “long term” rehabilitation needs. Aggregate requirements to support bridge preservation/modernization and construction needs for a 15-year cycle were determined for the period 2003-2017. (The work identified in Band 1 had already been done and thus was not included in the forecast.) All bridges in Band 2 were considered except those identified in the STIP for repair, rehabilitation or replacement in 2002. Every bridge identified in Band 3 was also included in the aggregate forecast. Based on these selection criteria, 1,166 of the 1,240 bridges listed in the BNS were included in the 15-year aggregate forecast. Each of the preservation and modernization needs identified in Table 9.4 from the BNS was considered except for "Painting." Of the 1,166 bridges, 160 were identified for replacement.

The BNS data was also adjusted to account for the OTIA bridge replacement projects. In the original 1998 BNS, all of the OTIA bridges had been included. Some that were originally earmarked in the BNS for rehabilitation, however, are now to be replaced under OTIA. For those bridges being replaced by OTIA, the BNS (and the aggregate forecast derived from it) was adjusted to reflect the additional replacements.

Based on the "Preservation and Modernization Needs" categories in Table 9.4, the 1,166 bridges identified in the BNS were divided into 3 groups:

1. Bridge deck reconstruction (no other work);
2. Seismic retrofit (no other work); and
3. All other bridgework that encompasses any combination of "Preservation and/or Modernization Needs" listed in Table 9.4 and those 160 bridges that were to be replaced.

The BNS listed 105 bridges for bridge deck replacement. There were 416 individual bridges slated for seismic upgrade. The "all other bridge work" category included 923 bridges. The sum of the bridges in each needs category exceeds 1,166 because, as was noted earlier, over two hundred bridges had needs identified in both time band 2 (short term), and time band 3 (long term).

9.2.1 Bridge Deck Reconstruction

For those bridges identified only for deck reconstruction, estimating aggregate needs was fairly straightforward. The replacement deck thickness was assumed to be 0.203 m for all bridges, and the replacement deck area was provided in the BNS. It was also assumed that the replacement decks would be constructed with portland cement concrete. The volume of concrete required was simply the deck thickness (0.203 m) multiplied by the replacement deck area. After calculating volumes, the 105 bridges identified for deck replacement were sorted by District. The total concrete requirements (in m^3) were totaled for each District, as shown in Table 9.5.

Table 9.5: Bridge deck reconstruction concrete requirements

District	Number of Bridges	Bridge Deck Reconstruction Concrete Requirements (m^3)
1	4	19,067
2A	3	1,364
2B	3	26,747
2C	6	960
3	4	1,173
4	3	839
5	4	990
7	12	2,959
8	17	4,292
9	14	3,678
10	11	1,338
11	6	995
12	6	1,461
13	6	1,631
14	6	949
Total	**105**	**68,443**

9.2.2 Seismic Retrofit (no other work)

There were 416 bridges identified in the BNS for seismic retrofit. Concrete needs for these bridges were estimated using historical data from past seismic retrofit contracts. From this data, an average "volume of concrete" (m^3 per m^2 of deck area) was determined. The calculated index based on previous contracts was 0.24 m^3 per m^2 of deck area. This means that on average, for every square meter of bridge deck area, an estimated 0.24 m^3 of concrete is needed to support the required construction work to seismically retrofit a bridge.

To estimate the volume of concrete required for each of the 416 bridges, the average volume of concrete per m^2 of deck area (0.24 m^3/m^2) was multiplied by the deck area of each bridge. The product of these two numbers yielded an *unadjusted volume of concrete* required for retrofit. Not all the retrofits, however, are of the same scope and magnitude. A retrofit on a larger and more highly traveled bridge such as an interstate highway bridge crossing the Willamette River would be more extensive than a bridge located on a rural secondary highway. To account for the differences in scope of the retrofits, an adjustment factor was determined for each of the 416 bridges. To better illustrate how the "scope adjustment factor" was determined, an example is provided to illustrate the methodology.

1. **Identify the bridge and its corresponding retrofit need and deck area from the BNS.**

   Bridge # 08522, Salmon River, Highway 26
   BNS Seismic Retrofit Need: $501,000.
   Bridge Deck Area: 3,698 m^2

2. **Obtain the average volume of concrete information from contract data.**

   Volume of concrete required per m^2 of deck area: 0.24 m^3/m^2.

3. **Determine the *unadjusted volume of concrete* required.**

   Multiply the volume of concrete required per m^2 of deck area (from Step 2) by the deck area (from Step 1).

   The *unadjusted volume of concrete* required = 3,698 m^2 x 0.24 m^3/m^2 = 888 m^3.

4. **Determine bridge seismic needs ($$) per unit deck area.**

   Divide the seismic needs (from Step 1) by the deck area (from Step 1).

   Seismic Needs/Area: $501,000 ÷ 3,698 m^2 = $135/$m^2$.

   A different needs/area ($/$m^2$) value was determined for each of the 416 bridges.

5. **Determine an average needs/area value for the 416 bridges.**

   The arithmetic average of the "needs/area" values of the 416 bridges is $237/$m^2$.

6. **Determine the "scope adjustment factor."**

   This is calculated by dividing the needs/area ($/$m^2$) for each bridge (from Step 4) by the average value for needs/area ($237/$m^2$).

   The scope adjustment factor for Bridge # 08522 = $135/$m^2$ ÷ $237/$m^2$ = 0.57.

   For the entire data set of 416 bridges, the mean and median values of the scope adjustment factors were 1.0 and 0.69 respectively.

7. **Apply the scope adjustment factor to estimate the volume of concrete required for the retrofit.**

   This is accomplished by multiplying the *scope adjustment factors* (from Step 6) times the *unadjusted volume of concrete* (from Step 3).

   The adjusted volume of concrete required for seismic retrofit for Bridge # 08522 = 888 m^3 x 0.57 = 508 m^3.

The adjusted values for volume of concrete required were then totaled for each District and are summarized in Table 9.6.

Table 9.6: Bridge seismic retrofit concrete requirements

District	Number of Bridges	Concrete Required for Seismic Retrofit (m^3)
1	21	4,813
2A	68	20,851
2B	49	79,343
2C	5	966
3	30	11,486
4	56	24,681
5	25	9,573
7	95	47,083
8	30	10,870
9	5	874
10	2	287
11	9	1,939
12	7	1,629
13	2	328
14	12	802
Total	**416**	**215,525**

9.2.3 All Other Bridge Work

As noted earlier, 923 bridges in the third category, identified for "all other work," included 160 that were identified for replacement. For the "all other work" category, the methodology to estimate the concrete requirements for each bridge involves more steps than in the previous two categories. Since the methodology is somewhat tedious, BNS data for the OR Route 126 Willamette River Bridge (Bridge # 08051) is used to help illustrate the steps used to develop concrete requirements.

1. **Determine the total rehabilitation and/or modernization needs ($) for each bridge.**

   The BNS estimated each bridge's rehabilitation and/or modernization needs (in $) for the categories shown in Table 9.4. The total bridge rehabilitation and/or modernization costs were determined for each bridge by summing the individual costs in each category.

   The Willamette River Bridge (BR # 08051) has rehabilitation needs as shown in Table 9.7.

   Table 9.7: Bridge # 08051 rehabilitation/modernization needs

Sub- Super-Structure Need	Deck Need	Rail Need	Sum of All Needs
$919,000	$460,000	$230,000	$1,609,000

2. **Determine Unadjusted Volume of Concrete per Unit Bridge Deck Area (m^3 per m^2).**

   To translate bridge needs (in $) into portland cement concrete requirements, some assumptions had to be made. Similar to the seismic retrofit methodology, determining concrete requirements used historical contract data, the bridge deck area, and several adjustment factors. The historical contract data was categorized by type of bridge, providing initial "volume of concrete per unit bridge deck area" (m^3 per m^2) values for specific types of bridges.

From past bridge replacement contracts, an average volume of concrete was determined for specific types of bridges. The types of bridges and the "volume of concrete per unit deck area" (m^3 per m^2) for each bridge type, is shown in Table 9.8.

Table 9.8: Bridge type concrete requirements per unit deck area

Type of Bridge	Volume of Concrete per Unit Deck Area (m^3/m^2)
Pre-cast	0.96
Pre-stressed Slab	1.39
Pre-cast Bulb T	1.02
Post Tensioned	1.26
Concrete Arch	1.29
Reinforced Concrete Deck Girder	1.10
Cast-In-Place Slabs	0.87
Steel	0.75
Culvert	6.38
Timber	0.69

The Willamette River Bridge (Bridge #08051) is a structural steel bridge, so the volume of concrete per unit deck area (from Table 9.8) is 0.75 m^3/m^2.

3. **Estimate the *unadjusted volume of concrete* (m^3) required.**

The *unadjusted volume of concrete* (m^3) required is estimated by multiplying the bridge deck area (m^2) times the volume of concrete required per unit deck area (from Step 2).

The bridge deck area for Bridge #08051 is 2,850 m^2. Multiplying the deck area times the volume of concrete per unit deck area yields: 0.75 m^3/m^2 x 2,850 m^2 = 2,137 m^3.

4. **Determine needs ($) per unit deck area ($m^2$).**

Since the size and scope of the rehabilitation/modernization needs in the BNS vary for each bridge type, a "scope adjustment factor" was needed for each of the 923 bridges. The first step in determining a scope adjustment factor required calculating the "needs ($) per unit deck area ($m^2$)" for each bridge. The needs per unit deck area was determined by dividing the total bridge rehabilitation/modernization needs ($) by the bridge deck area.

For Bridge #08051, the "Sum of All Needs" from Table 9.7 ($1,609,000) was divided by the bridge deck area, 2,850 m^2. The result was: $1,609,000 ÷ 2,850 m^2 = $565/$m^2$.

5. **Calculate the average value of needs ($) per unit deck area ($m^2$) for all bridges.**

An average needs/area value was then determined for all 923 bridges. The average value was $567/m^2.

6. Determine a "scope adjustment factor."

The scope adjustment factor for each bridge was then calculated by dividing the needs/area ($/m^2) for each bridge (Step 4) by the average value for needs/area (Step 5).

For Bridge #08051, the scope adjustment factor was calculated by dividing its needs/area value, $565/m^2 by the average needs/area value for all 923 bridges. The result was: $565/m^2 ÷ $567/m^2 = 0.997 ≈ 1.0.

The scope adjustment factors for the 923 bridges ranged from 0.04 to 19.98 and the mean and median values of the scope adjustment factors were 1.0 and 0.68 respectively.

7. Adjust the volume of concrete (m^3) required for bridges.

For each bridge, the scope adjustment factor calculated in Step 6 was multiplied by the *unadjusted volume of concrete* (m^3) value determined in Step 3. The product yielded an adjusted value for the volume of concrete (m^3) required for the rehabilitation/construction of each bridge.

For Bridge #08051, this adjusted volume of concrete was: 2,137 m^3 x 1.0 = 2,137 m^3.

8. Determine rehabilitation adjustment factor.

One final adjustment was necessary. The "volume of concrete per unit deck area" estimates in the previous step were based on past bridge ***replacement*** projects. Only 160 of the 923 bridges in this section of the BNS were scheduled for replacement between 2003 and 2017. The majority (83%) were to be rehabilitated. An assumption was made that preservation/modernization concrete needs are less than the needs for the construction of a replacement bridge. Thus, an adjustment factor was determined to account for the reduced concrete requirements associated with rehabilitation. The adjustment factor was calculated by dividing the total cost for bridge rehabilitation/modernization work by the estimated bridge replacement costs, provided for each bridge in the BNS.

For Bridge #08051, the total rehabilitation/modernization cost (from Step 1) was $1,609,000. From the BNS, the replacement cost for Bridge # 08051 was $4,596,000. The rehabilitation adjustment factor was calculated as: $1,609,000 ÷ $4,596,000 = 0.35.

Projects scheduled for rehabilitation had adjustment factors less than 1.0, and bridges scheduled for replacement had adjustment factors equal to 1.0. In four cases involving historic bridges, the bridge will not be replaced although the rehabilitation requirements exceeded the replacement cost. For these four bridges, the "rehabilitation adjustment factor" was greater than 1.0.

9. Calculate the *final* adjusted volume of concrete (m^3).

After the rehabilitation adjustment factors were determined, a “final adjusted volume of concrete” was calculated for each of the 923 bridges. The final adjusted volume of concrete (m^3) was calculated by multiplying the adjusted volume of concrete from Step 7 by the rehabilitation adjustment factor determined in Step 8.

The final adjusted volume of concrete required for Bridge #08051 was: 2,137 m^3 x 0.35 = 746 m^3.

10. Estimate concrete requirements for other structures (retaining walls and tunnels).

Six tunnels were included in the BNS. Previous contract data was not available for tunnels, so an estimate of concrete requirements for relining each tunnel was made. The concrete requirements varied with each tunnel, depending on the height, width and length of the tunnel. Volumetric calculations for each of the six were made to determine the concrete requirements.

Retaining wall requirements were based on extrapolation of the five-year contract data (by Region) for a 15-year period.

11. Summarize the bridge data.

The total concrete needs (m^3) were determined for each District by summing the bridge deck needs, seismic retrofit needs, other bridge needs, and other structure needs. The volumes were converted to weight by using a conversion factor of 2.4 Mg/m^3, which is a typical unit weight for concrete.

To calculate the weight of the aggregate constituent, the concrete weights were reduced by 12% to account for the weight of cement. Table 9.9 provides a summary of aggregate requirements by District for pavements from Section 9.1, and for bridges and structures. As shown in Table 9.9, total requirements for ODOT bridge aggregate needs are less than one-tenth the amount of total aggregate needs for pavements.

Table 9.9: Total aggregate needs for pavements, bridges and structures

District	Total Aggregate Needs for Pavements* (Mg)	Total Aggregate Needs for Bridges & Structures* (Mg)
1	1,282,299	134,188
2A	2,531,740	322,497
2B	1,978,667	628,522
2C	1,823,551	99,533
3	3,470,916	247,733
4	2,996,339	443,683
5	2,489,901	348,803
7	3,854,562	791,064
8	2,783,043	181,292
9	2,157,046	81,357
10	3,546,389	36,906
11	2,035,005	21,525
12	3,097,396	56,112
13	2,388,304	85,025
14	3,016,402	49,946
Total	**39,451,559**	**3,528,186**

* Includes OTIA projects

9.3 AGGREGATE NEEDS FOR OTIA MODERNIZATION PROJECTS

The Oregon Transportation Investment Act (OTIA) was passed in May of 2001 to allow the issuance of Highway User Tax Bonds for financing preservation and modernization projects chosen by the Oregon Transportation Commission. The approved modernization projects as of June 2002 were used for this forecast:[1]

The estimates for aggregate needs were based on the bid item totals from recently completed projects. The four types of projects used for extracting the historical contract data included:

- Interchanges;
- Roadway Widening;
- Roadway Reconstruction; and
- Roadway Resurfacing.

The following assumptions were used to extract aggregate weights from the historical data:

- Asphalt concrete is comprised of 95% aggregates by weight.
- Concrete is comprised of 88% aggregates by weight.
- Unit weight of concrete is 2.40 Mg/m^3.
- Pre-stressed, pre-cast concrete bridge sections are approximately \$600/m^3.

In reviewing the historical contract data, some of the aggregate-based bid items such as concrete were listed as “lump sum,” or in units of meters (m), or meters squared (m^2) instead of being

[1] These are listed on the ODOT web site: http://www.odot.state.or.us/otia/pdf/approved/ModernizationProjects.pdf

expressed as a weight or volumetrically. Thus, for this forecast, the dimensions used for these bid items had to be converted to units of weight, using project specific and standard drawings or assistance from outside sources in the construction industry to allow for accurate comparison. For example, structural concrete for pre-stressed, pre-cast concrete bridge sections was listed as a lump sum. To convert the bid item to a volumetric quantity, a factor of $600/m^3 was used. The $600/m^3 conversion factor was obtained from one of ODOT's bridge contractors.

The volumetric bid items were converted to weight for every "aggregate-based bid item" on four previous projects, each project fitting one of the four types of modernization categories noted above (interchanges, roadway widening, etc.).

Next, the project prospectus for each OTIA modernization project was obtained from ODOT's Project Delivery Unit. The aggregate-related item costs were identified in a modernization project's prospectus. These costs were compared with the past projects to obtain the modernization project's estimated aggregate weights.

The following is one example to illustrate the process used. The OTIA project used to illustrate the process is *Pacific Way – Dooley Unit 3* (Hwy 101 multi-lane major reconstruction.) The project used for comparison is *Pacific Hwy – Hwy 217/Kruse Way Unit 1* (I-5 interchange major reconstruction.)

1. **Extract applicable data from modernization project prospectus:**

Table 9.10: Pacific Way – Dooley Bridge Unit 3

Item	Classification	Item Cost
Bridge	Structures	$1,750,000
Sound walls	Structures	$300,000
Paving	Roadway	$2,422,000

2. **Extract applicable historical data from a previous ODOT project:**

Table 9.11: Previous Project: Pacific Hwy – Hwy 217/Kruse Way Unit 1 – Let Year: 1999

Item	Qty	Classification	Item Cost
Sound Walls, Pre-cast	174.4 m^3	Structures	$233,415
Conc. Box Culvert (Bridge), Pre-cast	19.3 m	Culverts-Drainage	$52,191
Bridge Sections	Unknown	Structures	$5,542,700
Plant Mix Aggregate Base	100,000 Mg	Earth-Base-Rock	$1,400,000
Hot Mix Asphalt Concrete	110,500 Mg	AC Pavement	$4,143,900
Hot Mix Asphalt Concrete	377 Mg	Curbs – Incidentals	$12,218

3. **Use the aforementioned assumptions to calculate aggregate needs for *sound walls*:**

Convert to weight:
Weight = (174.4 m^3) x (2.40 Mg/m^3) = 419.2 Mg
Account for aggregate weight only:

Weight = (419.2 Mg) x (.88) = 369 Mg

4. Retrieve information from standard drawings to calculate aggregate needs for a *culvert*:

Conc. Box Culvert, Pre-cast -- Cross-Sectional Area: 2.01 m^2

Calculate culvert volume:
Volume = (19.3 m) x (2.01 m^2) = 39 m^3
Convert to weight:
Weight = (39 m^3) x (2.40 Mg/m^3) = 93.7 Mg
Account for aggregate weight only: Weight = (93.7 Mg) x (.88) = 82 Mg

5. Use the aforementioned assumptions to calculate aggregate needs for *bridge sections*:

Calculate bridge section volume:
Volume = ($5,542,700) / ($600/m^3) = 9,238 m^3
Convert to weight:
Weight = (9,238 m^3) x (2.40 Mg/m^3) = 22,203 Mg
Account for aggregate weight only:
Weight = (22,203 Mg) x (.88) = 19,539 Mg

6. Use the aforementioned assumptions to calculate aggregate needs for *roadway*:

Pavement – Aggregate weight only:
Weight = (110,550 Mg) x (.95) = 104,975 Mg
Curbs-Incidentals – Aggregate weight only:
Weight = (377 Mg) x (.95) = 358 Mg

7. Standardize data from historical project:

Table 9.12: Standardized data: Pacific Hwy – Hwy 217/Kruse Way Unit 1 – Let Year: 1999

Item	Qty	Aggregate Weight (Mg)	Item Cost
Sound Walls, Pre-cast	174 m^3	369	$233,415
SOUND WALLS (Total)		369	$233,415
Conc. Box Culvert, Pre-cast	19.3 m	98	$52,191
Bridge Sections	Unknown	19,539	$5,542,700
BRIDGE (Total)		82 + 19,539 = 19,621	$52,191 + $5,542,700 = $5,594,891
Plant Mix Aggregate Base	100,000 Mg	100,000	$1,400,000
Hot Mix Asphalt Concrete	215,763 Mg	104,975	$4,143,900
Hot Mix Asphalt Concrete	377 Mg	358	$12,218
ROADWAY (Total)		100,000 + 104,975 + 358 = 205,333	$5,556,118

8. **Use standardized data and cost ratios to estimate modernization project's (*Pacific Way – Dooley Bridge Unit 3*) aggregate requirement:**

Calculate required aggregate for sound walls:
Weight = ($300,000) / ($233,415) x (369) = 474 Mg
Calculate required aggregate for bridgework:
Weight = ($1,750,000) / ($5,594,891) x (19,621) = 6137 Mg
Calculate required aggregate for paving:
Weight = ($2,422,000) / ($5,556,118) x (205,333) = 89,508 Mg
Calculate total aggregate required for project:
Total Weight = 474 Mg + 6137 Mg + 89,508 Mg = **96,119 Mg**

The estimating procedure illustrated above was carried out for each OTIA modernization project. Table 9.13 provides a summary of aggregate requirements by District for the approved OTIA modernization projects. Note that districts 2B and 2C have no OTIA modernization projects scheduled.

Table 9.13: Modernization aggregate needs

District	Total Aggregate Needs for Modernization (Mg)
1	155,240
2A	358,222
2B	0
2C	0
3	112,178
4	171,984
5	128,465
7	193,233
8	487,939
9	141,886
10	292,361
11	77,084
12	4,266
13	102,412
14	106,753
Total	**2,332,025**

9.4 AGGREGATE NEEDS FOR MAINTENANCE

Maintenance needs were originally estimated using the historical data on aggregate and asphalt usage from the Maintenance Management System. There were gaps in the data collected between 1996 and 2001, however, that produced questionable estimates.

To overcome this problem, each District was contacted directly for estimated future needs. The estimates were based on previous materials usage for a variety of work activities, including:

- Asphalt concrete repairs (inlay, surface and base);
- Chip sealing;
- Shoulder rebuilding;
- Slide repair; and
- Sanding.

Acquiring this information from the Districts also proved to be challenging. Several Districts could not provide the information. Two other Districts suggested the estimate should be based on actual requirements to maintain a certain level of condition rather than an estimate based on historical usage. They reasoned that the maintenance needs for specific areas were not always met due to funding constraints. For example, to maintain its highways in "fair or better" condition, a District might have had a requirement of 8,000 Mg to make asphalt repairs every year, but because of funding constraints it had actually used only 5,000 Mg annually.

Instead of asking each District again for their aggregate needs based on actual requirements, a third approach was taken. In this approach, only one District was contacted and asked to provide aggregate needs based on requirements to maintain their highways at a certain condition level. District 3 provided the following data, which was used as a baseline for the remaining Districts.

- Asphalt Concrete = 32,652 Mg
- Shoulder Rock = 16,326 Mg
- Base rock = 10,884 Mg
- Sanding rock = 40,560 m^3
- Chip seal rock = 3,820 m^3
- Rip Rap, etc = 3,056 m^3

The volumetric data was converted to Mg by assuming a unit weight of 1.54 Mg/m^3 for the aggregate. The one-year total was multiplied by 15 to arrive at a 15-year estimate of aggregate needs for maintenance. It was assumed that aggregate usage would be stable over time.

The 15-year total requirement for District 3 was estimated to be 1,056,732 Mg. Sanding requirements were not included in this total because of the widely varying requirements for sanding in each District. The total highway lane mileage for each District was obtained from ODOT's 2000 State Mileage Report. For District 3, the total highway lane mileage was 1,117.8 miles. Thus, the aggregate required per mile of highway was calculated by dividing 1,056,732 Mg by 1,117.8 miles to get 945.4 Mg/mile.

To determine the projected needs for the other Districts, an assumption was made that the usage was proportional to the amount of lane miles of highway maintained. Table 9.14 illustrates how the individual District totals of aggregate needs were determined.

Table 9.14: 15-Year aggregate requirements by District for maintenance

District	(1)	(2)	(3)
	Highway Lane Mileage (miles)	**15-year Total Requirements per Highway Mile (Mg/mile)**	**15-year District Aggregate Requirements (Mg)** (3) = (1) * (2)
1	575.4	945.4	543,946
2A	788.9	945.4	745,763
2B	499.0	945.4	471,767
2C	646.5	945.4	611,180
3	1,117.8	945.4	1,056,732
4	1,299.2	945.4	1,228,213
5	975.8	945.4	922,443
7	1,386.7	945.4	1,310,932
8	970.3	945.4	917,328
9	1,163.3	945.4	1,099,775
10	1,601.9	945.4	1,514,357
11	1,048.0	945.4	990,717
12	1,453.8	945.4	1,374,395
13	1,073.2	945.4	1,014,531
14	1785.0	945.4	1,687,472
Total	---	---	**15,489,552**

9.5 TOTAL FUTURE AGGREGATE REQUIREMENTS

Future total aggregate requirements for pavement preservation, bridge, modernization, and maintenance are presented in Table 9.15 and graphically in Figure 9.1. The requirements represent a 15-year estimate.

Table 9.15: 15-Year forecast of aggregate requirements for ODOT (2003 –2017)

District	Pavement Aggregate Needs* (Mg)	Bridge Aggregate Needs* (Mg)	OTIA Modernization Aggregate Needs (Mg)	Maintenance Aggregate Needs (Mg)	Total Aggregate Needs (Mg)
1	1,282,299	134,188	155,240	543,946	2,115,673
2A	2,531,740	322,497	358,222	745,763	3,958,222
2B	1,978,667	628,522	0	471,767	3,078,956
2C	1,823,551	99,533	0	611,180	2,534,264
3	3,470,916	247,733	112,178	1,056,732	4,887,559
4	2,996,339	443,683	171,984	1,228,213	4,840,219
5	2,489,901	348,803	128,465	922,443	3,889,612
7	3,854,562	791,064	193,233	1,310,932	6,149,791
8	2,783,043	181,292	487,939	917,328	4,369,602
9	2,157,046	81,357	141,886	1,099,775	3,480,064
10	3,546,389	36,906	292,361	1,514,357	5,390,013
11	2,035,005	21,525	77,084	990,717	3,124,331
12	3,097,396	56,112	4,266	1,374,395	4,532,169
13	2,388,304	85,025	102,412	1,014,531	3,590,272
14	3,016,402	49,946	106,753	1,687,472	4,860,573
Total	**39,451,559**	**3,528,186**	**2,332,025**	**15,489,552**	**60,801,320**

* Includes OTIA projects

The 15-year total requirement for aggregate is over 60-million Mg. On an annual basis, ODOT total aggregate needs are slightly over 4-million Mg. Pavement needs account for over 65% of the total requirement. Bridge needs represent 5.8% of the total need, and maintenance needs are 25% of the total. District 7, because of its size and number of bridges, has the greatest overall aggregate need; the District's estimated 15-year aggregate need is over 6.1 Mg.

Projecting the demand for aggregate 15 years into the future is inexact at best and laden with a high possibility of error. Further, there are limitations associated with these projections, and the reader should be aware of them if these future estimates are going to be used in decision making about aggregate needs. The limitations include:

- Highway modernization projects are limited to OTIA. What modernization projects will take place after OTIA expires is unknown. Therefore, modernization beyond OTIA has not been considered in this forecast of aggregate needs.
- As noted earlier in Section 9.2, the level of future bridge rehabilitation is very difficult to project because of ongoing problems in reinforced concrete deck girder bridges.
- The preservation forecast model assumes a stable paving cycle in the 15-year period. The forecast for preservation does not consider fluctuations in funding levels from year to year.
- Maintenance needs are based on District 3 requirements and then extended to the other Districts by normalizing the District 3 estimate to highway lane miles elsewhere. Other factors that influence maintenance requirements, such as climate, traffic volume, and roadway type, have not been considered.

Even with these limitations, the projections presented in this chapter represent ODOT's best assessment of future aggregate needs using reasonable assumptions and rational engineering judgment.

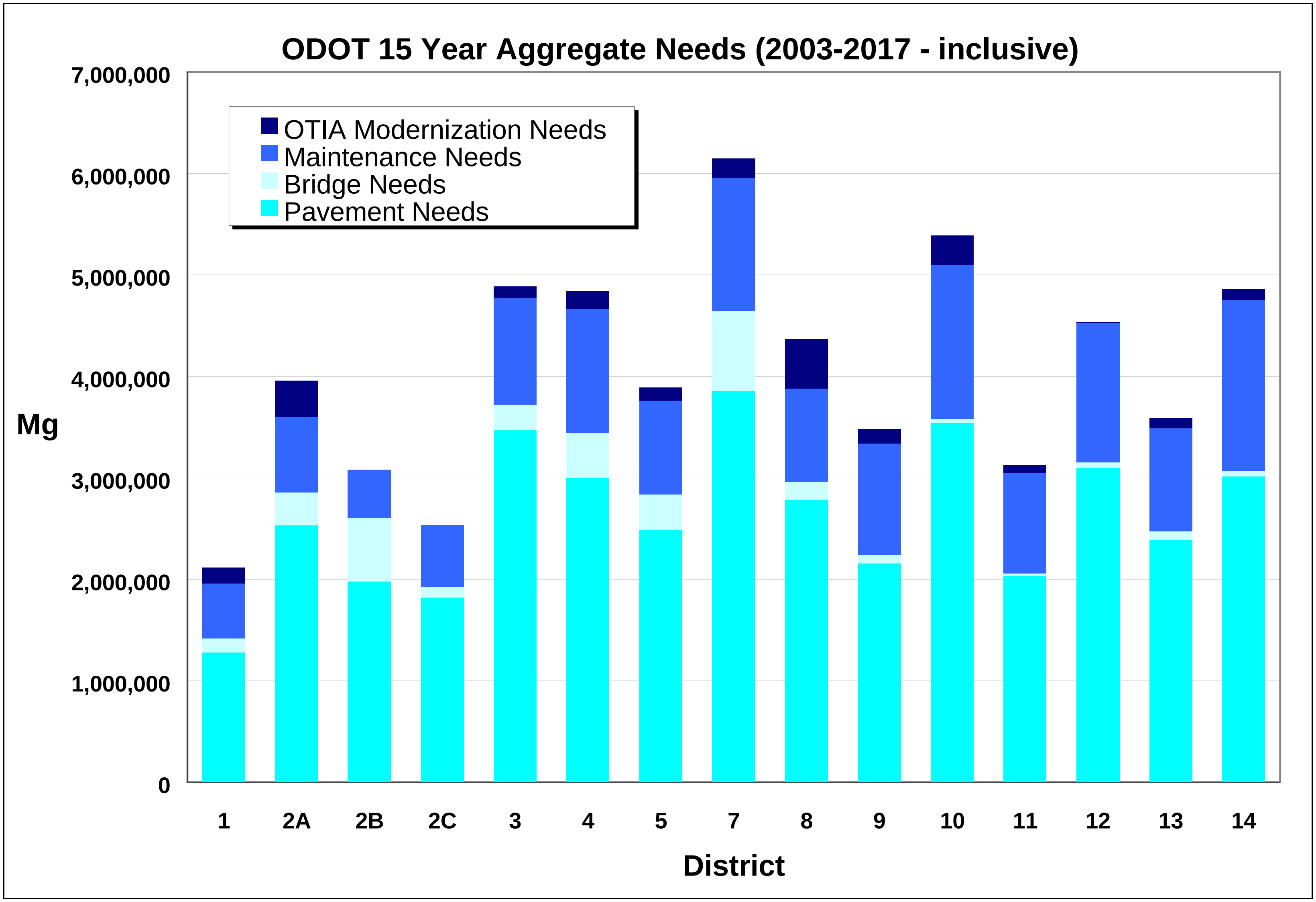

Figure 9.1: 15-Year forecast of aggregate requirements for ODOT (2003 –2017)

10.0 CONCLUSION

This ambitious study identified and inventoried a total of 750 ODOT-owned and -leased aggregate sites throughout the state. Based on Statewide Land Use Planning Goal 5 criteria, 64 of these 750 sites were considered potentially significant for protection of the resource. The estimated reserve from the potentially significant sites totaled 71,228,085 Mg. In addition, eight "key" sites were identified (based on a combination of size, location, and/or rock quality) in Districts not having any sites that met Goal 5 criteria. The estimated reserve from these key sites totaled 6,230,455 Mg.

It was projected that 60,801,320 Mg of aggregate will be required for paving projects, bridge rehabilitation and reconstruction, OTIA modernization projects, and maintenance needs over the next 15 years. Originally, a 30-year forecast was called for in the work plan; however, because of the uncertainty for pavement preservation, bridge rehabilitation and construction, and modernization projects over that long of a cycle, the forecast horizon was narrowed to 15 years.

A comparison between the 15-year forecast and the estimated reserve from potentially significant and/or key sites for each District is shown in Table 10.1. The shaded cells in the table indicate where there are no potentially significant or key sites in that particular District.

Table 10.1: Summary of aggregate requirements vs. aggregate reserve

District	Total Aggregate Needs from 15 Year Forecast (Mg)	Estimated Reserve Aggregate from Potentially Significant Sites (Mg)	Estimated Reserve Aggregate from Key Sites (Mg)
1	2,115,673	1,465,245	
2A	3,958,222		2,165,019
2B	3,078,956		175,996
2C	2,534,264		1,511,540
3	4,887,559		1,481,412
4	4,840,219	18,302,096	
5	3,889,612		896,489
7	6,149,791	7,628,731	
8	4,369,602	8,946,031	
9	3,480,064	11,522,755	
10	5,390,013	6,295,831	
11	3,124,331	470,289	
12	4,532,169	7,408,011	
13	3,590,272	1,408,106	
14	4,860,573	5,458,201	
Total	**60,801,320**	**71,228,085**	**6,230,455**

The table shows that in seven of the Districts, the estimated reserve exceeds the forecast need. Alternatively, in Districts 2B, 3, 5, 11, and 13, the estimated reserve is significantly less than the forecast demand.

The comparison in Table 10.1 assumes that future ODOT projects will use aggregate from ODOT-owned or -leased sites. The aggregate supplied by commercial sources, however, has not been considered. The estimated reserve at commercial sources is proprietary and not available for this study. Thus, the comparison made here is limited to ODOT sources. The reader should understand this limitation when reviewing the aggregate reserve versus the 15-year demand in each District.

This study has brought together a tremendous amount of information to aid ODOT planners and policy makers in managing the state's aggregate resources. For state-owned or -leased aggregate sites considered significant, ODOT should develop a program to protect those sites from future incompatible adjacent land uses. This would include submitting a Post-Acknowledgment Plan Amendment (PAPA) application to the local governments having jurisdiction over the sites. Careful management of this resource will help to assure an adequate supply of quality aggregate in the future.

11.0 REFERENCES

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