Planning for Aggregate

A guide to planning for aggregate resources in Oregon

Oregon Department of Land Conservation and Development

Oregon Department of Transportation

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Foreword

The Oregon Department of Land Conservation and Development (DLCD) and the Oregon Department of Transportation (ODOT) are pleased to release ***Planning for Aggregate: A Guide to Planning for Aggregate Resources in Oregon***. The purpose of this guide is to explain how Oregon's laws on land use planning and zoning deal with aggregate resources and aggregate mining.

Our agencies are very pleased to have worked together on the development of this document. DLCD and ODOT understand the important role that aggregate resources play in many aspects of the state's economy. ODOT depends on a reliable supply of aggregate resources for conducting its business of building and maintaining Oregon's highway network. In addition to serving as an important resource in building and maintaining the state's infrastructure, aggregate resources are an essential element in the construction of residential homes, office buildings, industrial plants, and commercial centers.

Since aggregate is so vital to the state, it is important to adequately plan for protection and utilization of this natural resource. ODOT and DLCD partnered in developing this document to help elected officials, local planners, state agency staff, aggregate operators, and the citizens of Oregon understand the process laid out in Statewide Planning Goal 5. Goal 5 and its administrative rules provide direction and guidance to local governments on how to ensure that the protection, excavation, and transportation of significant aggregate resources are accomplished in a manner that is compatible with existing and future land uses.

DLCD and ODOT hope that this guide will explain how land use planning benefits one of Oregon's most valuable resources. If you have questions or comments about the guide, please contact our agencies at the addresses shown in the boxes at left. We appreciate your interest and trust you will find this guide helpful.

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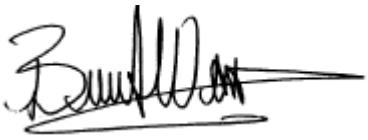

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1. About this guide . . .

The most widely used building material in Oregon isn't timber, steel, plastic or glass. It's *aggregate*, the sand, gravel, and crushed rock used to construct roads, foundations, buildings, and many other structures. Each year, a typical Oregonian uses about 17 tons of aggregate—one dump truck load of rock.

Most of that rock comes from privately owned gravel pits and quarries. But mines owned by the state or by local governments also are vital sources of aggregate (especially for roads). Whether private or public, aggregate mines are an intensive form of land use that often involves large equipment, heavy truck traffic, and major alterations of the landscape. Planning for such a land use is quite a challenge.

Oregon's statewide planning program, however, has many tools to meet that challenge. It uses an array of statutes, goals, and rules specifically for aggregate mining. But those provisions may be difficult to understand or even find. That's the reason for this guide: it brings together and explains the main planning laws that apply to aggregate resources in Oregon. It focuses on Statewide Planning Goal 5 and the "new Goal 5 rule" (OAR 660-023) adopted in 1996.

This guide is about *land use planning* for aggregate resources. It's not about mining operations or laws that deal with technical matters such as reclamation. Like any guide or summary, this one doesn't cover every possible situation or nuance of the law. If you're faced with a question of how Oregon's planning laws apply to a particular site or permit, this guide is a good place to start your research, but be sure to read applicable ordinances and laws, too. They, not this guide, are the final

authority on planning and zoning for aggregate resources.

This guide's intended audience is the many local elected officials, planning commissioners, planners, permit applicants, and citizens who must deal with this difficult land use issue in their communities: Where should aggregate be mined, and what can be done to reduce or eliminate conflicts between aggregate mines and neighboring homes, farms, and other land uses?

2. What is aggregate?

A piece of the rock . .

In the aggregate industry, pieces of rock are classified by their size. The smallest fragments, with no commercial value, are referred to as ***dust***.

Larger fragments at least .002" in diameter but smaller than 3/8 of an inch are ***sand***.

Fragments ranging from 3/8" to 3" in diameter are ***gravel***.

Pieces larger than 3 inches up to 10 inches in diameter are ***cobbles***.

Rocks larger than 10 inches are ***boulders***.

Aggregate is a broad term that encompasses a variety of rock products used in construction of roads and buildings. It generally refers to loose rock in pieces up to 3 inches in diameter and suitable for use as a building material. The main forms of aggregate are sand, gravel, and crushed rock.

For planning purposes, Oregon's administrative rules define *aggregate resources* this way: "naturally occurring concentrations of stone, rock, sand and gravel, decomposed granite, lime, pumice, cinders and other naturally occurring solid materials used in road building." *OAR 660-023-0180(1)(a)*

It's important to note that not all sand and gravel is aggregate. Many deposits of rock are not suitable for construction or road building. The rock may be too soft or have chemical properties that render it unsuitable for commercial use.

Some aggregate is obtained by recycling building materials, but most (about 96 percent) is produced by *mining*—extracting it from naturally occurring deposits of rock.

Where does the aggregate come from?

A 1995 report by the Oregon Department of Geology and Mineral Industries (DOGAMI) shows that Oregonians used 53.7 million tons of aggregate in 1993 (*An Economic Analysis of Construction Aggregate Markets and the Results of a Long-Term Forecasting Model for Oregon*, by Robert M. Whelan, Mineral Economist). Most of the rock—48.7 million tons—came from mines in Oregon. The rest came from recycling of building materials or was imported.

State agencies and local governments own many aggregate sites throughout Oregon, but such "government mines" produce less than ten percent of the aggregate used in the state. In 1993, for example, mines owned by ODOT produced about two million tons of aggregate. A similar amount came from quarries and gravel pits owned by city or county governments.

Of the aggregate produced in Oregon, about 85 percent came from privately owned mines. Some 400 of them operated with permits from DOGAMI. These commercial permit-holding operations are Oregon's main producers of aggregate: they produced 40.7 million tons in 1993. Another 800,000 tons of rock was taken from small private quarries and gravel pits exempt from DOGAMI permit requirements.

Government agencies own numerous aggregate mines throughout Oregon. Almost all the aggregate from them is used to build or maintain roads. Most of them may lie dormant for years at a time, to be activated only when a road building or maintenance project in the area sparks a need for rock.

Where and how is the aggregate used?

Most Oregonians use aggregate every day. It's in the roads we drive on, houses where we live, and buildings where we work. In spite of that, precise statewide statistics on current aggregate use in Oregon are not readily available. DOGAMI, however, has prepared some forecasts of aggregate consumption from 2001 to 2050 that reveal the main patterns of consumption.

The forecasts suggest that aggregate use is split fairly evenly between construction of *buildings* and *infrastructure* (roads, sewers, railroads, etc.): buildings consume about 45 percent of the rock; infrastructure uses about 55 percent.

The DOGAMI forecasts for the five major classes of aggregate use are shown here:

TYPE OF USE	PERCENT OF ALL AGGREGATE USED
Residential construction	**16.2 %**
Nonresidential construction	**29.0 %**
Roads	**29.4 %**
Other infrastructure	**19.1 %**
Railroads and non-construction uses	**6.3 %**
TOTAL	**100.0 %**

Why does Oregon's Department of Transportation take an interest in aggregate mining? The answer is simple: ODOT maintains about 7,500 miles of roads and highways across the state. It owns and maintains 2,700 bridges. And it oversees 2,600 miles of passenger and freight rail lines. Maintaining that extensive transportation system takes a lot of rock!

Not too surprisingly, the largest single category of aggregate use is building and maintaining roads. It is surprising, however, that per capita consumption of aggregate tends to be much higher in *rural* counties. For example, rural Baker County, with a population of 16,700 people and an area of 3,089 square miles, used 140,000 tons of aggregate in 1993. Lane County, with more land area and almost twenty times as much population as Baker County, used only 110,000 tons.

Several factors explain the higher per capita aggregate use in rural counties. First, rural counties have more miles of road per person. Second, rural roads often take more maintenance (and hence more aggregate) than urban roads and streets. The final reason rural counties have higher rates of aggregate consumption has to do with the density of development: less densely populated areas use more

rock per household. When houses and other buildings are spread over a wider area, it takes more infrastructure (roads, sewers, etc.) to serve them—and that takes more rock. Also, single-family homes use more aggregate per household than do multi-family units.

How is aggregate mined?

Most aggregate mining involves two main activities: "extraction" (removing rock from the site where it occurs) and "processing" (preparation of the rock for its intended use). *Mining* is used throughout this guide in its broader sense, to include both extraction and any processing that occurs at the extraction site. Such usage is consistent with most of Oregon's laws and court rulings on aggregate resources.

The two main forms of aggregate mines are the ***gravel pit*** and the ***quarry***. Generally, gravel pits produce sand and gravel; quarries produce crushed rock.

Aggregate mining is a form of "surface mining." Such mining is largely a matter of moving aside any soil or other *overburden* that covers the aggregate, extracting the valuable rock, and then replacing the overburden. Tunnels and mine shafts deep within the earth aren't needed.

On the floors of river valleys such as Oregon's Willamette Valley, aggregate mining is largely a matter of scooping out sand and gravel deposited by rivers or glaciers. Over millions of years, moving water or ice has worn down the bedrock to produce sand and the small, rounded particles of rock known as gravel. These waterborne forms of aggregate are especially good for making concrete. The mines where such aggregate is extracted are commonly referred to as *gravel pits*.

Gravel Pits

At most gravel pits, the aggregate deposits lie beneath a layer of o*verburden* (soil or rock not suitable for use as construction material). Extraction of the aggregate thus consists of three main steps: removing the overburden, setting it aside in *spoil banks*, and removing the sand and gravel with equipment such as excavators or augurs.

Until recently, about 85 percent of the sand and gravel produced in Oregon came from such gravel pits. The rest was taken from sand and gravel bars in rivers. But the amount taken from rivers declined sharply in the 1990's with the increase in measures to protect salmon and steelhead habitat. Now, almost all sand and gravel is extracted from gravel pits; little is taken directly from rivers and streams.

The feasibility of extracting sand and gravel from a given pit depends on several factors:

- proximity of the gravel pit to its markets;
- amount of overburden to be removed;
- thickness of the aggregate deposits;
- quality of the rock;
- the presence of other land uses in the area that might conflict with mining.

These feasibility factors apply equally to extracting aggregate from quarries, as discussed in the following section.

Quarries

In higher elevations, such as the foothills of the Coast and Cascade mountain ranges, the more common form of aggregate mine is the *quarry*. Here, a different form of extraction (often referred to as "hardrock mining") is employed. Drilling and blasting may be used to break large outcroppings of bedrock into smaller chunks, which are then ground into finer, more uniform pieces to produce crushed rock. Sometimes, *talus* (fallen rock fragments at the base of a steep slope) is the raw material from which the crushed rock is obtained. Most crushed rock from quarries is used to build asphalt roads and streets.

Aggregate taken from a gravel pit or quarry sometimes is used as it comes from the earth, without any processing. Such rock is called *pit run* or *quarry run*. These types of untreated rock are used mainly as fill at construction sites or to build logging roads. Pit run and quarry run are the least valuable forms of aggregate. This unprocessed rock accounts for only a small part of the aggregate used in Oregon.

Who regulates aggregate removal from in-stream sources?

"DSL" is Oregon's ***Department of State Lands***. It's the state agency that regulates in-stream aggregate removal. DSL's main office is in Salem at:

775 Summer Street
NE Suite 100
Salem, OR 97301
503.378.3805

www.statelands.dsl.state.or.us

Some aggregate material is still mined or dredged from in-stream sources in Oregon. The Oregon Department of State Lands (DSL) regulates aggregate mining or dredging activities within the bed and banks of "waters of the state". Oregon's Fill-Removal Law (ORS 196.800-990) requires individuals who remove or fill 50 cubic yards or more in "waters of the state" to obtain a permit from DSL. "Waters of the state" are defined as "natural waterways including all tidal and non-tidal bays, intermittent streams, constantly flowing streams, lakes, wetlands, and other bodies of water in this state, navigable and non-navigable, including that portion of the Pacific Ocean which is in the boundaries of this state." In State Scenic Waterways or areas designated by DSL as essential indigenous anadromous salmonid habitat, most removal-fill activities require a permit

regardless of the number of cubic yards affected. In addition, the Oregon Department of Environmental Quality (DEQ) is responsible for water quality certification under section 401(a) of the Clean Water Act. This certification is required as part of the DSL permitting process. Division of State Lands fill-removal permits generally undergo a joint review by DSL and the United States Army Corps of Engineers.

How is aggregate processed?

Most aggregate undergoes some type of *processing* after it's taken from the ground. That word covers a variety of activities, including washing, drying, milling, screening, and crushing. The term also includes *batching*, which is the manufacture of asphaltic concrete or Portland cement concrete.

As used in Oregon's planning laws, the term "aggregate resources" includes decomposed granite, lime, pumice, cinders, and other "naturally occurring solid materials used in road building." It also includes sand. The definition is found in the new Goal 5 rule, at OAR 660-023-0180(1)(a).

Asphalt is a paving material made by blending crushed rock with petroleum-based bonding agents. Technically, *asphalt* means the substance manufactured in oil refineries that's used to bind aggregate together to make pavement, but the word is widely used to mean the paving material as well. The most common type of asphalt paving material, *hot-mix*, is about 94 percent crushed rock and 6 percent bonding agent. Most urban streets are made from hot-mix asphalt. Another type of asphalt, *cold-mix,* is used on roads that get only light traffic. It's cheaper but less durable than hot-mix.

Concrete is made from a mixture of aggregate, Portland cement, and water. Portland cement is a combination of clay, limestone, and sand that has been heated to high temperatures and then ground into a fine powder. By volume, concrete typically contains about 25 percent sand and 41 percent gravel or crushed rock.

Gravel is the aggregate of choice for concrete. Its natural roundness makes it easier to mix. In the aggregate industry, the word *gravel* is defined quite precisely. It refers to naturally occurring pebbles and stones with rounded surfaces worn by the movement of water or air, and ranging in size from three-eighths of an inch to three inches in diameter.

Crushed rock is preferred for asphalt pavement, because its multi-faceted surfaces stick together and wear better under traffic. The term *crushed rock* includes both *crushed gravel* and *crushed stone*. Crushed gravel is aggregate taken from a gravel pit and ground or hammered to make the pieces smaller and more uniform in size. Crushed stone is bedrock or talus that has been taken from a quarry and ground or hammered into small fragments.

Concrete and asphalt are made in *batch plants*, which blend, mix, and in some cases heat the ingredients. The word "plant" sometimes is misleading, in that it conjures up images of a large factory. Some batch plants are indeed large, fixed facilities that resemble factories. Typically, they are located at the extraction site, and the "ready mix" concrete or hot-mix asphalt they produce is trucked to construction sites. But some batch plants are smaller pieces of equipment that can be moved readily from one site to another. With this portable equipment, the batching usually occurs at the construction site, not at the mine.

The extent of processing done at the site greatly influences a mine's effects on nearby land uses. With a simple gravel pit, where no processing is done, the main off-site impact is likely to be truck traffic. The extraction itself may be fairly unobtrusive. A more complex operation with onsite crushing and batching may have large pieces of equipment many stories high and conveyor belts that reach many hundreds of feet. Such machinery generates more noise, odor, and dust than simple extraction of rock. A mine with on-site processing is likely to operate for longer periods because a greater investment in equipment has been made. It's also likely to generate more truck traffic, as "ready mix" concrete or asphalt is hauled from the mine to various construction sites.

How does aggregate get to market?

The short answer to this question is "by truck": more than 90 percent of the aggregate in Oregon gets from mine to market via truck. The remainder travels by barge or rail.

Rock is heavy, and therefore costly to transport. Transportation thus is a crucial factor in determining both the price of aggregate and the location of mines.

The state's Department of Geology and Mineral Industries (DOGAMI) estimates that in the mid 1990's, the average price for a ton of aggregate at its source was $4.39. The cost of trucking that amount of rock averaged 16.2 cents a mile. At such prices, aggregate would cost $6.01 a ton if trucked to a site ten miles from the mine. The same aggregate would cost $7.63 at a site twenty miles from the mine and $9.25 at a site thirty miles away - half again as much as a site ten miles away.

Trucking costs are heavily dependent on fuel prices, which have been increasing. The DOGAMI estimate of 16.2 cents per "ton-mile" (hauling a ton of material one mile) therefore, is probably outdated.

"DOGAMI" is Oregon's ***Department of Geology and Mineral Industries***. It's the state agency that regulates most mining operations. Its main office is in Portland at:

800 NE Oregon Street, Suite 965
Portland OR 97232
503.731.4100
www.dogami.state.or.us

DOGAMI's ***Mined Land Reclamation*** (MLR) program is based in Albany at:

229 Broadalbin St. SW
Albany OR 97321-2246
541.967.2039

At the time of this writing (2001), ODOT's highway planners are using 25 cents per ton-mile as a rule of thumb, which would increase the cost figures given above. But as with all rules of thumb, it's approximate: the actual cost of getting aggregate from mine to market varies widely from one area to another.

Because trucking is the predominant mode for transporting aggregate, *trip generation* is an integral part of most decisions about aggregate mining.

Most quarries and gravel pits produce aggregate that will be used at a construction site within twenty miles of the mine. Usually, the aggregate is taken from the mine to the construction site by a truck. Since the trucks are making short trips, each vehicle is likely to leave the mine and return to it several times each day. A typical mine therefore produces large volumes of truck traffic.

Planners refer to that as *trip generation*. They count a "trip" as the one-way movement of a vehicle from an origin to a destination: a truck hauling a load of gravel from a mine to a construction site and then returning to the mine makes *two* trips, not one.

Most trucks that haul aggregate are heavy-duty vehicles with at least three axles. A common dump truck carries ten to twelve cubic yards of rock weighing 26,000 to 31,200 pounds. The truck itself weighs at least that much. The combination of dump truck plus rock thus is likely to weigh 40,000 to 60,000 pounds.

Larger trucks and truck-trailer combinations can easily haul as much as 20 cubic yards of rock or more. When loaded, one of these large units can easily approach the maximum weight limit permitted on Oregon's highways: 105,500 pounds.

The truck traffic generated by a typical aggregate mining operation is significant to land use planning for several reasons. The trucks may cause noise and vibration that's offensive to people in homes, schools, or businesses near the mine. The trucks also may cause congestion and traffic safety problems on some roads. Finally, heavy vehicles cause heavy wear of streets and roads.

"Cubic Yard" is the standard measure of aggregate volume. A full-size pickup truck holds about two cubic yards. A typical dump truck holds ten to twelve cubic yards.

"Ton" (2,000 pounds) is the standard measure of aggregate weight. A cubic yard of aggregate typically weighs about 2,600 pounds. But that's a rough rule of thumb. The weight of a given volume of rock depends on size of the particles, moisture, type of rock, etc. A yard of wet sand is heavier than a yard of dry quarry run.

What happens to a site after mining?

After the mining is done, the mined land usually must be *reclaimed*. That is, the land must be restored to make it suitable for some "beneficial use."

In reclamation, the overburden set aside during mining may be used to fill holes. Steep slopes are backfilled and graded to make them less steep and

more stable. Trees and shrubs are planted. These and other measures help make the mined land safe and suitable for some long-term end use. Typical end uses or "second uses" for reclaimed mining sites include lakes, wildlife habitat, wetlands, golf courses, farming, parks, and industrial development. With appropriate reclamation, a former aggregate mining site can become a valuable asset to a community.

Mining reclamation in Oregon, except in Columbia County and on tribal lands, is administered by the Mined Land Reclamation Program (MLRP) at the Oregon Department of Geology and Mineral Industries (DOGAMI). Columbia County is the only Oregon county that currently administers its own mining permitting and reclamation program. An overview of the Mined Land Reclamation Program provided by DOGAMI's MLRP staff is included in *Appendix F* of this guide.

A key aspect of the Statewide Planning Goal 5 rule for aggregate (OAR 660-023-0180(4)(f)) directs local governments to determine a post-mining use of the site (where mining is allowed) that is consistent with the pre-mining comprehensive plan designation and zoning of the site. The designated post-mining use of the site must then be provided for in the jurisdiction's comprehensive plan and land use regulations. The same portion of the rule mandates that local jurisdictions must coordinate with DOGAMI about the regulation and reclamation of mining sites, except where sites are exempt under state law. DOGAMI's operating statutes also require that the agency coordinate with local governments during the mining and reclamation approval processes.

Good coordination among local governments, natural resource agencies, and DOGAMI during the land use and reclamation approval processes is critical to the success of each part of the permitting process. Local governments must make an appropriate land use decision regarding the post-mining use of the site, that works with the final approval of a reclamation plan by DOGAMI's MLRP staff, for the reclamation program to be successfully implemented.

An informational pamphlet entitled *Reclamation, Regulation, and You* is available from DOGAMI's Mined Land Reclamation Program office in Albany. This brief pamphlet provides basic information about mining site reclamation and its relationship to land use planning and regulation in Oregon in an easy-to-understand question and answer format.

State law *(ORS 517. 750 to 517.901)* requires that a reclamation plan be put into effect when a mine produces more than 5,000 cubic yards of aggregate or disturbs more than one acre of land in any one year.

Plans and permits for mining reclamation in Oregon are generally administered by DOGAMI's Mined Land Reclamation Program in Albany.

A program overview of the Mined Land Reclamation Program is contained in Appendix F.

For additional details about the technical aspects of mined land reclamation, please see ***Best Management Practices for Reclaiming Surface Mines in Washington and Oregon***, by David K. Norman, Peter J. Wampler, Allen H. Throop, E. Frank Schnitzer and Jaretta M. Roloff, Washington Division of Geology and Earth Resources Open File Report 96-2 and Oregon Department of Geology and Mineral Industries Open File Report O-96-2, Revised Edition, January 1998. This excellent publication about mining site reclamation was the result of a joint effort by Mined Land Reclamation Program staff at DOGAMI and geology division staff at the Washington Department of Natural Resources. The technical mined land reclamation guide is available for purchase from DOGAMI's Internet web site at http://sarvis.dogami.state.or.us/pub&data/pub&data.htm.