Testimony to the Oregon House Agriculture and Natural *Resources* committee

# **Gravel mining on Willamette Valley prime farmland**

19 February 2008

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## **Summary**

Hundreds of acres per *year of the* Willamette Valley's best farm soils are being permanently lost *to* gravel mining. Such destruction of farm production capacity is absolutely unnecessary because alternative aggregate supply from basalt quarries abounds and is already in production.

The best farm soils are Class 1, Class 2, Prime and Unique-soils that mantle Valley bottomlands and typically produce crops of high value such as vegetables, berries, filberts, nursery stock, and orchard fruits such *as peaches,* pears, apples, cherries and prunes. Given the ongoing dramatic rise in transportation costs as fuel prices rise, it has become obvious that Oregon needs to protect what's left of its best farm soils. Local fanning minimizes energy demand for food production, and is a fundamental part of a sound economic system to support the current and future citizens of Oregon, both for food and for the economic value of farm production.

Rock aggregate is essential for construction of highways, buildings, bridges and railroads. Nearly half of Willamette Valley aggregate comes from sand and gravel pits on floodplain of the Willamette River and its tributaries. A substantial majority of the pits cut into Class 1 and 2 soils that were productive farmland before being mined for gravel, Of all places on the planet, the Willamette Valley is certainly one of best for supplying aggregate by quarrying basalt from the **hills while preserving** the best **soils** for agricultural **production. Valley quarry basalt production** currently meets more than half of the demand for aggregate at fully competitive costs, and can readily supply much more. Just as other regions of the country have done, it is time for Oregon to step into the 21" century by shifting aggregate production from sand and gravel to quarried basalt and thereby meet its obligation to current and future generations by preserving our *very* best farm soils for farm production while we still have them to preserve. We either save the soils now or lose them forever.

## **Overview of Oregon aggregate sources and production: Round rock and crushed basalt**

Oregon is endowed with modest aggregate resources in the form of sand and gravel, "round rock" (Figure 1), but very large resources of basalt , *which is* crushed *for use as aggregate* (Figure 2). In the Willamette Valley alone, as for the state as a whole, somewhat more than half of the aggregate production is crushed basalt and the rest is sand and gravel, as shown

**Figure** 1. Alluvial aggregate ("round rock").

Figure 2. Crushed basalt ("quarry rock")_

by DOGAMI data in Table 1. In the Willamette valley, most sand and gravel is mined from pits in the active floodplain of the Willamette River. Crushed basalt is mined from basalt rock layers deposited by ancient volcanic activity. Such basalts underlie the Salem Hills and hills of Portland, as well as many other hills within the Willamette Valley and along its edges, providing a ready source of hard rock for quarrying (e.g. Figure 3).

**Willamette Valley Aggregate production (tons)**

**(Data fromOOGAM1, Dec 2006 andDugdale. 2007)**

| Year | 1996-97 | 1997-98 | 1998-99 | 1999-00 | 2000-01 |
|---|---|---|---|---|---|
| Basalt | **19,315,389** | 8,91 1,847 | 14,873.522 | 14,845,659 | 14,342,209 |
| Sand and Gravel | 11.706.351 | 13.831.462 | 11.655.086 | 12,282.310 | **10** |
| Total | 31.021,740 | 29.743,309 | 26,528,608 | 27,127,969 | 25,112,970 |

| Year | 2001-02 | 2002- | 2003-04 | 2004·08 |
|---|---|---|---|---|
| Basalt | 11,987,258 | 11,800,446 | 12,508,306 | 14,348,255 |
| Sand and Gravel | 10,279.621 | 9.750.750 | 11.620.461 | 12.906.523 |
| Total | **22,266,879** | 21,551,196 | 24,128.767 | 27,254,779 |

**Table 1.** Aggregate production in Willamette Valley Counties (Benton, Clackamas, Columbia, Lane, Linn, Marion, Multnoma, Polk, Washington, Yamhill; Lane county production includes small production from the coast). Year column headings indicate year within which the 12month reporting period ended, the month of which differs from one producer to another.

## Oregon production by region

DOGAMI data for aggregate production statewide in 2004-2005 is broken down by region in Table 2, showing that production from the Willamette Valley region **is,** by far, the largest in the state at 66% of the state total. The concentration of production in the Willamette Valley reflects the concentration of population and urban areas in the Willamette Valley, where agricultural production from Class 1 and 2 soils is also concentrated. Modest production comes from other regions of the state shown in Table 2. The DOGAMI data also show that, statewide,

***Figure** 3. Basalt quarry in the southern Willamette* Valley. *The* hill *is* underlain by basalt that is mined and *crushed on site.* Soils *overlying such* uplands *within* and along the Willamette Valley *are Largely poor for farming, Class 5 and* higher, *with some areas of Classes 3 and 4.* Basalt *deposits such as the* one pictured here *are* typically *much more* than 100 ft thick, providing *a* large *amount of rock from a* small area of disturbed land.

*A quarry such as the 139-million-ton Springfield quarry can supply an amount of aggregate equivalent to that mined from* 2000 *acres of prime farrnland.*

56% of production is *basalt* and 44% is sand and gravel. A similar split applies to the Willamette Valley, with 53% basalt and 47% sand and gravel.

### *Comparison to other states*

Oregon can readily meet the aggregate demand from crushed basalt quarry rock and existing gravel sites. Other states have already made the shift so as to preserve their river bottom lands. For example, North Carolina gets 85% *of its aggregate from* crushed quarry *stone* and *14% from* sand and gravel'. Similarly, in the mid-Atlantic region 83% of aggregate came from quarry rock in 1995, up from 68% in 1975[2].

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[1] **North Carolina Geologic Survey (littp;llwww.geology.cnr.statc.nc.uslDcfault_ht(n): "Crushed stone makes** up 85 percent of (NZ.] aggregate production; constnietinn sand and gravel, about 15 percent. North Carolina is the eighth largest crashed stone producing state in the U.S. Aggregate is **produced** from about 135 crushed stone quarries **and about 500 sand and** gravel sites **throughout** the slate."

**2** Gilpin R. **Robinson,** Jr., and William M, Brown, *VS_ Geological Survey Open-File* $_{Repast}$ 02-350. P- 13: "Changes in the aggregate **industry** profile for the **Mid-Atlantic** region **from** 1975 to **1995** illustrate some recent industry trends. In 1975, 116 natural aggregate companies were active in the **Baltimore-Washington** region (Valentin Tcpordci, written **communication,** 1999). These companies produced 36 million metric tons (39.7 million tons) of

**Aggregate Production by Region (year 2004-2405)**

| Region | Production (tons) | % of state | % sand & gravel | °h basalt |
|---|---|---|---|---|
| **Willamette Valley (10 counties)** | **27,254,779** | **66** | **47** | **53** |
| Coast (5 counties) | 2,131,152 | 5 | 26 | 74 |
| Southern Oregon (5 counties) | 4,212,655 | 10 | 48 | 52 |
| Central & Eastern Oregon (18 counties) | 7.295,372 | 19 | 36 | 64 |
| Oregon Total | 41,493,958 | 100 | 44*... | 56 |

Table 2. Summary of total production by region and the percentage of commercial sand gravel mined versus crushed basalt mined for 2004-2005 in Oregon's four regions. Data show that 56% the Oregon's aggregate comes from crushed stone (rock from hard rock quarries) and 44% comes from sand and gravel sites (data from DOGAMI (Marshall), 2006, 2007) and Dugdale, 2007).

Valley Counties: Benton, Clackamas, Columbia, Lane, Linn, Marion, Multnomah, Polk, Yamhiil and Washington. Coast Counties: Clatsnp, Tillamook, Lincoln, Coos and Curry Counties. Southern Counties: Douglas, Josephine and Jackson Counties. Eastern Counties: Hood River. \Vasco, Sherman, Gilliam, Morrow, Umatilla, Wallowa, Union, Baker, Grant, Malheur, Harney, Lake, Klamath. Deschutes, Crook, Wheeler, and Jefferson.

Additional research by the Oregon Farm Bureau *aggregate* workgroup *member* Bill Austin shows that a third of the states that provided aggregate source data' meet more than 70% of their aggregate demand from quarry rock resources (Arkansas, Louisiana, Massachusetts, Oklahoma, Tennessee, Wisconsin). The suggestion from Oregon river gravel producers that crushed quarry rock is not suitable to meet Oregon aggregate demand is highly questionable, especially when we recognize that Oregon's quarry rook, basalt, is one of the best aggregates available. Further, the Portland area has already largely shifted to use of crushed basalt, as pointed out by Jaeger (2006):

.. few alluvial sand and gravel mines still operate in the Portland metro area: the vast majority

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**aggregate from 135 sand and gravel pits** (32 percent **of total aggregate production** for the region) **and** 78 crushed stone quarries **(68 percent** of total aggregate **production** for the region). In 1995, 53 natural aggregate companies **were active in the Baltimore-Washington** region and produced 76 million metric tons **(54** million torts) of aggregate **from** 61 **sand** and gravel pits (17 percent of total aggregate **production** for the **region) and 89** crushed stone quarries **(83 percent** of total aggregate **production** for the region)._ .. These **changes** also **illustrate a regional shift in the source of aggregate from sand and gravel, which Is supplied by many aerially extensive hut low volume operations such as shallow open pits In alluvial deposits, to crushed stone,** which is supplied by quarries that **produce aggregate** in large volume from aerially **more restricted deep quarries or underground mines_ Tepordci (2001, p. I3) notes that since 1974₇ more crushed stone than sand and gravel has been produced in the United States, reflecting a national trend toward greater reliance on rock quarries far aggregate." (Emphasis added).**

3 Bill Austin surveyed State DOT's in fifty states and received responacs from sixteen on the question of *how* much of their aggregate comes *from* quarry rock, river rock and recycled rock sources. One more state, Iowa, gets more than 50% of its aggregate from quarry sources-

4 Numerous studies of aggregate qualities have **found** that basalt (or "trap rock", as it is commonly called in the East) is makes especially good aggregate because it is dense, non-porous, tightly crystalline (making it tough), **hard, and** it **bonds** well **to** cement.

of aggregate consumers in the Portland metro area already rely on crushed rock from quarries that do not generally conflict with high-value farmland,"

### Distribution of <u>alluvial</u> aggregate resources in the Willamette Valley

Essentially all Willamette Valley production of sand and gravel (Tables 1, 2) comes from the very young alluvial deposits in the 100-year floodplains of the Willamette River and its tributaries, as shown on the map in Figure 4_ The green color (or darker gray along rivers) on the map shows the areal extent of the post Pleistocene alluvium deposited as the rivers meandered across their floodplains during the past 10,000yr (geology of gravel deposits is largely from the USGS geologists O'Connor, et al., 2001)_ This young gravel is fresh, little weathered, and of good quality for making concrete. Beneath this young alluvium and laterally adjacent to it in beige color (light gray) on the map, lies older alluvium that filled the Valley during the Pleistocene and earlier times. Much of this older rock is poor quality for concrete, but some of it is suitable for base aggregate.

The red (dark gray) dots on the map (Figure 4) show the locations of **all** currently and formerly permitted alluvial gravel pits in the Valley as tabulated by DOGAM]. (2005, 2006). It is quite evident that the gravel pits closely track the distribution of the young alluvium (green or dark gray on map), reflecting the interest in mining the relatively thin layer (20 to 40 ft thick) of concrete-grade gravel along the rivers, The near absence of mining in *the* older alluvium (beige or light gray) reflects the lack of interest in mining the poor quality deeper rock.

One general point to recognize is that some round rock makes good aggregate and some is poor. Most of the Valley alluvial deposits arc poor quality, but the rock along the river floodplains (where the soils are best) is good quality, thus the gravel miners seek it.

### Distribution of <u>basalt</u> aggregate resources in the *Willamette* Valley

In contrast to sand and gravel, the supply of basaltic rock in the Valley is enormous, as shown by the tan color (medium gray) on map Figure 5_ The basalts shown on the map include a variety of types, including the widespread and famous Columbia River basalts that underlie the Salem Hills, Portland Hills, and some of the hills along the Columbia River north of Portland, as well as *huge areas of* Central and Eastern Oregon and Washington_ Other basalts and related rocks (diabase, gabbro) underlie most of the hills and knobs of the Valley floor, parts of the Cascade foothills, parts of the Coast Range, and additional hills in the Portland area (Boring lavas of SE Portland).

The black squares on the map (Figure 5) show the locations of all currently and formerly permitted basalt quarries in the Valley as tabulated by DOGAMI (2005, 2006; Columbia County quarries *are* located by DOGAMI but permitting is separate). The rock units shown in tan (gray) *are* shown only if they contain rock quarries, i.e. if a particular formation is not mined for basalt aggregate, that unit is not shown on the map_ It is apparent from the map that one reason more than half of Valley aggregate production is basalt is that basalt is plentiful in the Valley.

As for round rock, some basalts make good aggregate and others do not. Just like *the* basaltic aggregate produced elsewhere in the country (e.g. the "trap rocks" of New England), much of the Oregon basalt make excellent aggregate, which accounts for its large production in the Valley and in the state as a whole.

Round rock producers argue that round rock makes better concrete because it can be more

## Willamette Valley Alluvial Gravel Pits

Recent alluvial gravel area Old (poor quality) alluvium

ElUrban **areas** Active gravel pits*

*Smaller symbols indicate inactive mines

Geologic map showing young river alluvium (green) where nearly all gravel is mined (red circles) and showing older river alluvium (beige) that is generally poor in quality for aggregate.

The *best* farming soils, used to grow fruits and vegetables, overlie the young 411wium (green). Generally lower quality farming soils, used for rye grass and wheat, overlie the older alluvium. (Mine data from DOGAMI (Marshall), 2006, 2007; Dugdale, 2007)

**Figure 6**

# Willamette Valley Basalt Formations and Quarries

**Areas containing quarry rock**

'2 **Urban areas**

**II Active basalt quarries*** *Smaller symbols indicate inactive mines

Geologic map showing solid rock areas (tan) from which basalt is mined in numerous quarries (black squares).

Abundant basalt is readily available within the Valley, providing an inexpensive source of aggregate to meet demand without destroying the limited area of prime farmland along the rivers. (Mine data from DOGAMI (Marshall), 2006, 2007; Dugdale, 2007)

**Figure 7**

easily smoothed, However, smoothing of crushed rock concrete is an art that finishers have mastered just about everywhere but Oregon, apparently, for example in building the tarmacs of Dulles Airport, O'Hare Airport, Indianapolis Airport, to name three where crushed rock aggregate is used, plus curbs, sidewalks and streets all over the eastern US, and elsewhere.

**Estimates of farmland destroyed**

W. Jaeger (2006) has estimated the demand for aggregate in Oregon based on various economic trends. Using his estimate for demand, the area of land destroyed by mining can be estimated, as shown in Figure 6. The estimate takes into account the Chapin Factor, 62%, an estimate by Bruce Chapin of the typical area actually mined relative to the minimum area necessary to yield a given volume of rock assuming vertical mining to total depth; i_e_ the factor accounts for sloped mine walls, setbacks, islands, processing areas, roadways, and the like.

**Cumulative land area destroyed by gravel mining**

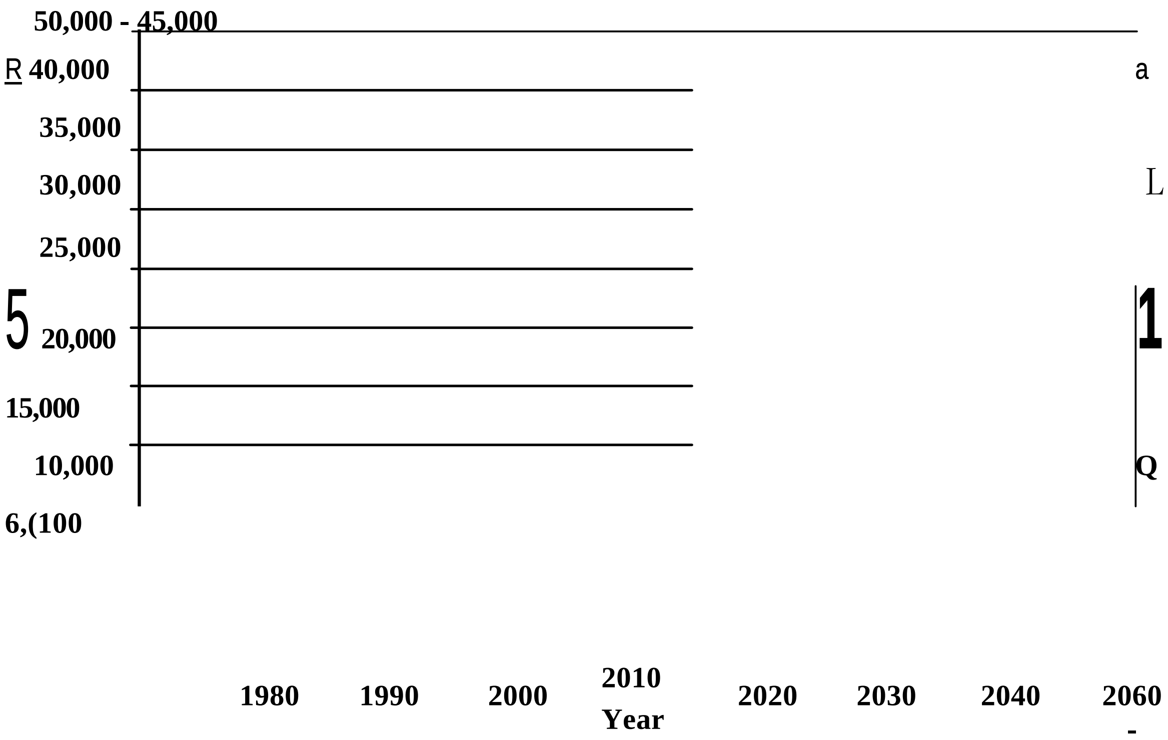


**Figure 6** Cumulative land area of Willamette Valley land destroyed since 1970 by gravel mining projected to the year 2050. The graph assumes: a) continued production of 46% of Willamette Valley aggregate from sand and gravel sources, b) an average mined thickness of 20 ft, c) an areal mining efficiency of 62% (Chapin Factor, sec text), and d) a mining rate intermediate between the

extremes estimated by W. Jaeger (2006). Historic production is smoothed.

## Conclusion

Willamette Valley aggregate can be fully supplied by production from basalt quarried in the Valley and along the Columbia River, as is already the case in Portland and much of the rest of the country. Oregon's best farmland, which lies in the floodplains along the rivers of the Willamette basin, is irreplaceable and essential to production of food-all the more so as transportation energy costs continue to rise into the future. Protection of the remaining farmland for current and future agricultural production would be most prudent.

## References


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