Land Cover 21

Land cover and vegetation can be mapped in numerous ways. The appropriate system for classifying vegetation types depends on the needs of potential users and resources available. Although the U.S. Forest Service and Bureau of Land Management have detailed vegetation cover information for their lands, gathered through field surveys, this information is not available for the entire watershed. The only land cover information readily available for the entire watershed was the USGS Willamette Basin Land Cover, developed from satellite imagery and useful for general purposes.

The USGS Willamette Basin Land Cover map was derived from Landsat Thematic Mapper (satellite) data collected in June and August 1992 and 1993. Satellite imagery is a broad spectrum of light divided into bands, each of which reflects different characteristics of the land cover. The satellite image was then refined using three data layers: elevation, slope, and soils. These layers were used to resolve discrepancies. For example, an area coded as both forest and irrigated crop would be designated forest if it was high elevation and irrigated crop if it was low elevation.

The nine land cover categories are defined as follows:

Urban: areas of urban development with a population density of 1,000 or more persons per square mile, as defined by the USGS and based on 1990 census data.

Mature forest: forested areas that reflected the least amount of light and correspond to older forest stands.

Regrowth forest: forest stands that reflected more light than the mature forest and correspond with younger forest stands.

Early forest and non-forested upland: higher elevation areas without green vegetation and distinct similar areas on the valley floor. This category includes recently harvested areas, open grassland, non-forested alpine areas and barren areas.

Native vegetation, valley floor: vegetated areas of the valley floor that did not appear to be associated with agricultural activities. This category would include wetlands and riparian vegetation associated with streams.

Irrigated crops: areas that formed distinct fields and areas that were non-vegetated in June, but were vegetated in August (the vegetative patterns between the June and August images were compared).

Grass fields, small grains: the grass-seed producing fields of the valley floor, as well as hay fields, pastures and fields of small grains.

Perennial snow: the snowpack on Cascade Range peaks in August.

Water: Open water, including some intermittent open water.

As indicated in Table 6 and Figure 5, the vast majority of the Clackamas watershed is forested, with similar amounts of agriculture and urban land making up the remainder.

Note: *Urban areas were not classified from satellite data. Instead, an urban layer provided by the USGS's Water Resources Division was superimposed over the satellite data. "Urban" is defined here as areas that have a population of more than 1,000 persons per square mile. These areas consist of many land uses, including residential, agricultural, commercial and industrial (refer to the Existing Land Use map for more detailed information in these areas).*

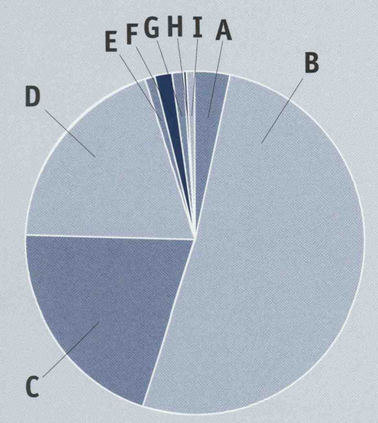
Table 6

Acres by land cover type

Type	Acres	Percent
A. Urban (see definition in note)	18,777	3.13
B. Mature forest	306,662	51.08
C. Regrowth forest	129,443	21.56
D. Early forest and non-forested upland	114,825	19.12
E. Native vegetation, valley floor	8,0623	1.34
F. Irrigated crops	12,023	2.00
G. Grass fields, small grains	7,820	1.30
H. Perennial snow	49	0.01
I. Water	2,733	0.46

Figure 5

Acres by land cover type



Relative Surface Erosion Potential 22

This map shows the potential of undisturbed surface soil to erode, based on slope and soil type. Existing and future land uses were not considered when evaluating whether soil was likely to erode.

This map was derived using two soils data bases because no single detailed soil inventory exists for the entire watershed. Two sources, the U.S. Forest Service (USFS) and the federal Natural Resources Conservation Service (NRCS), cover different portions of the watershed and have different information in their data bases. The Mt. Hood National Forest Soil Resource Inventory (SRI) covers USFS land. Soils in the remaining area were mapped by NRCS as part of the Clackamas County Soil Survey. A few areas had no data available because they are outside agency survey boundaries.

Because there are two different soils data bases, two methods were used to represent erosion potential:

Method 1. Forest Service Data

The USFS information contained pre-calculated information on erosion potential. The interpretation is based on expected losses of surface soil when all vegetative cover, including forest litter, is removed. The interpretation also considered climate, slope, soil characteristics, and hydrologic characteristics of the soil and bedrock materials.

Soil types were grouped into three general categories, based on their erosion potential:

Slight: Little or practically no loss of surface soil materials is expected. Some minor sheet and rill erosion may occur.

Moderate: Some loss of surface soil materials can be expected. Rill erosion and some small gullies or sheet erosion may occur.

High: Considerable or large loss of surface soil materials can be expected. Rill erosion, numerous gullies, or considerable loss from sheet erosion may occur.

For more information about these erosion potential categories, see the Mt. Hood National Forest Soil Resource Inventory

Method 2. NRCS Data

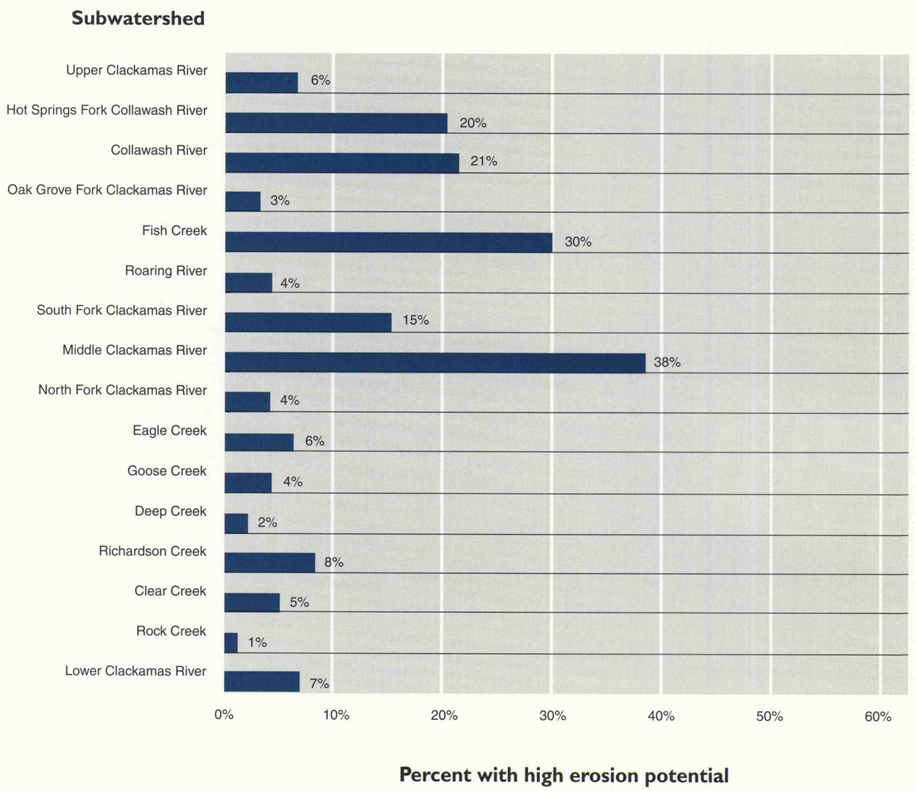
In the absence of a pre-calculated factor for erosion potential, soil scientists from the NRCS and the U.S. Forest Service were consulted for the best method of determining erodibility. Two pieces of information, "K-factor" and "average slope," are available for each mapped soils unit and were recommended for use in calculating erodibility.

K-factor is an erodibility factor that is adjusted for the effect of rock fragments.

Average slope is the average of high and low slope values within a soil mapping unit.

Figure 6

High potential for surface erosion



The formula, used by NRCS in the universal soil loss equation to evaluate prime farmland (K-factor x average slope), produced point values ranging from 1 to 50. These values were classified into three categories:

Slight (less than 2)
Moderate (2-8)
High (8-50)

Resource managers can use the Relative Surface Erosion Potential map to determine general areas within the watershed that are less likely to erode. Although the soil erosion information is not site-specific, it can help guide decisions about where to build new roads, where to concentrate development, or where to harvest timber.

Figure 6 shows the percentage of land area within each subwatershed that has a high potential for surface erosion. For example, in the Middle Clackamas River subwatershed, 38 percent of the land area has a high potential for erosion. In the Rock Creek subwatershed, only 1 percent of the land has a high potential for surface erosion. Like the Relative Surface Erosion Potential map, a high ranking for erosion potential is based on several factors, including soil type and slope.

Relative Infiltration Rate 23

This map shows soil infiltration rates based on soil type. Soil infiltration refers to the ability of water to penetrate the ground surface and pass through the soil below. For example, sandy soils have rapid infiltration rates, meaning that when it rains, the water will soak rapidly into the ground. Dense clay soils, on the other hand, have slow infiltration rates. On these soils, any rain that falls may run off to other areas or remain as puddles on the ground.

Like the Relative Surface Erosion Potential map, this map was derived using two soils databases because no single detailed soil inventory exists for the entire watershed.

Both the Mt. Hood National Forest Soil Resource Inventory (SRI) and the NRCS Clackamas County Soil Survey contain the property "hydrologic soil group," defined by the U.S. Forest Service as:

"Used in watershed management planning to estimate runoff from rainfall. Soil properties that influence the minimum rate of infiltration obtained for a bare soil after prolonged wetting are considered. These properties include: depth of seasonally high water table, infiltration rate and permeability after prolonged wetting, and depth to very slowly permeable layers. The influence of ground cover is treated independently."

The hydrologic soil groups, as defined by the Forest Service, are:

A. Soils having rapid infiltration rates even when thoroughly wetted and consisting primarily of deep, well to excessively well drained sands and gravels. These soils have a high rate of water transmission.

B. Soils having moderate infiltration rates when thoroughly wetted and consisting primarily of moderately deep to deep, moderately well to well drained soils, soils with moderately fine to moderately coarse textures and moderately slow to moderately rapid permeability. These soils have a moderate rate of water transmission.

C. Soils having slow infiltration rates when thoroughly wetted and consisting chiefly of soils with a layer that impedes downward movement of water, soils with moderately fine to fine texture, soils with slow infiltration due to salts or alkali, or soils with moderate water tables. These soils may be somewhat poorly drained.

D. Soils having very slow infiltration rates when thoroughly wetted and consisting primarily of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer near the surface, soils with very slow infiltration rates due to salts or alkali, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission.

For this map, current land use was not factored into infiltration rates, except in highly developed urban areas. Because of their high imperviousness (inability to be penetrated by water), developed commercial and industrial lands were assigned to the category of lowest infiltration, regardless of what kind of soil was under the buildings and parking lots.

Slope 24

Slope, or the change in elevation over distance, is shown on this map. Note that the lower portion of the watershed, west of Estacada, is relatively flat. More rugged terrain occurs in the middle watershed near the Cascade mountains. The eastern portion of the watershed is high plateau, especially around Timothy Lake. By comparing the slope, elevation and ecoregion maps, it is possible to see basin-wide patterns.

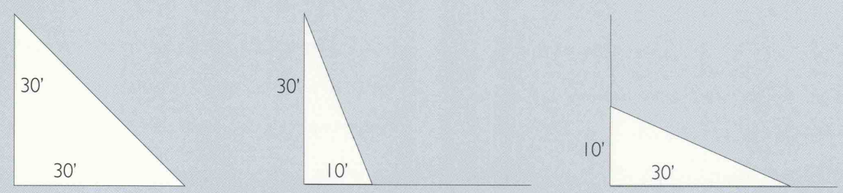
As shown in Figure 7, slope measurements can be expressed in percent. Percent slope is calculated as the vertical elevation (rise) divided by the horizontal distance (run), then multiplied by 100.

Data for this map came from a USGS Digital Elevation Model (see Page 6 for more information).

Figure 7

Slope equation and examples

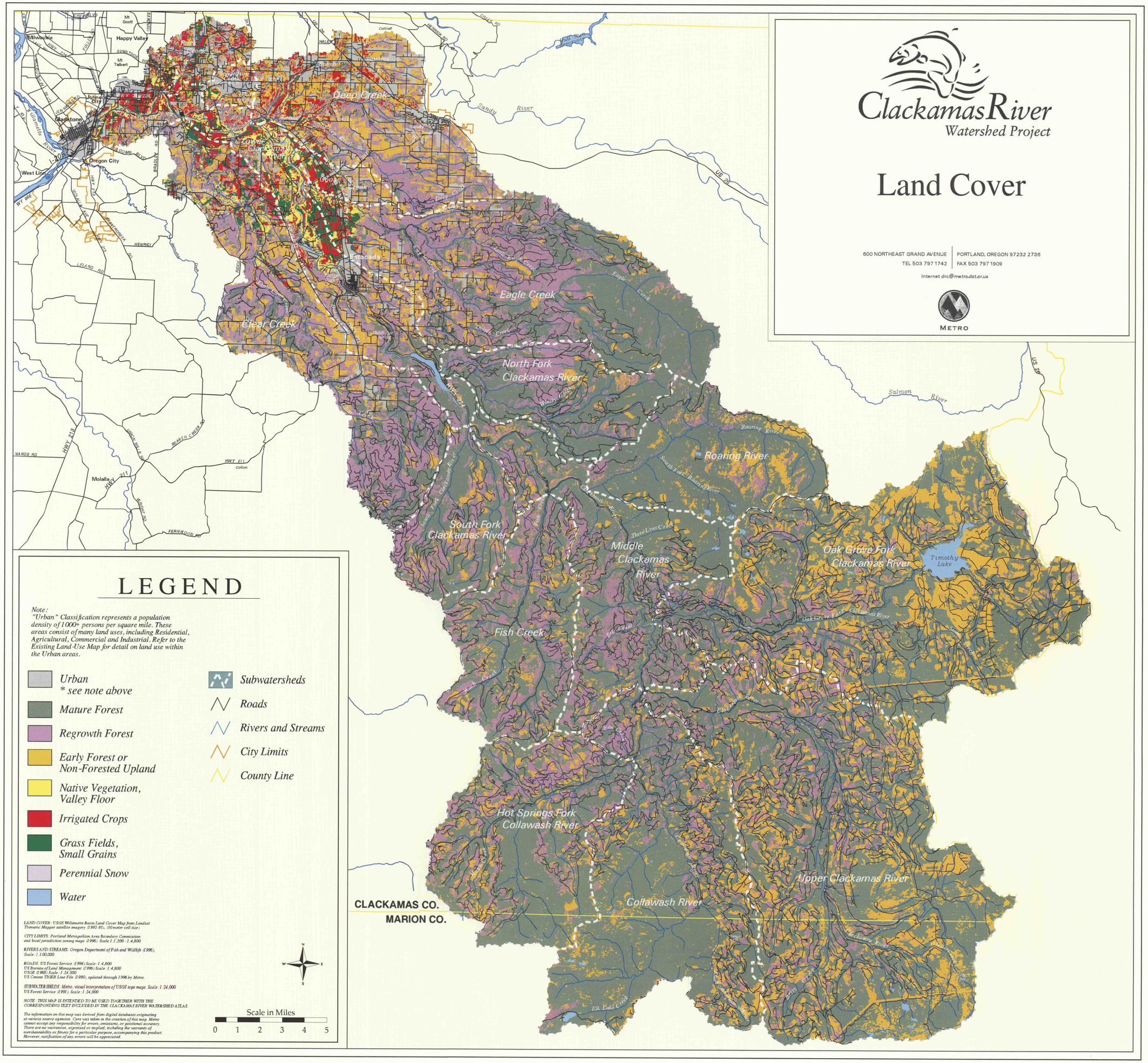
$$\text{Percent of slope} = \frac{\text{rise}}{\text{run}} \times 100$$

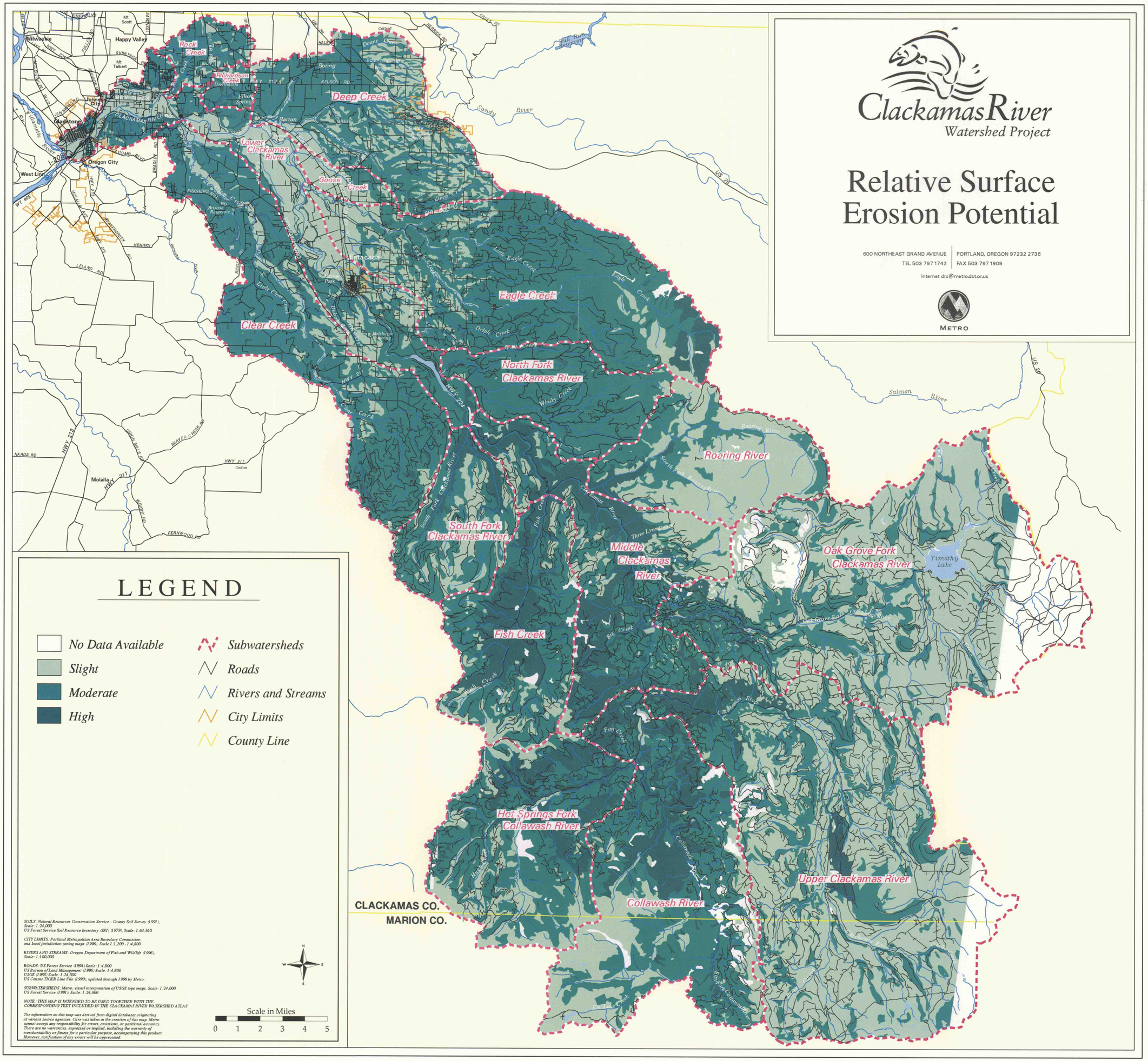


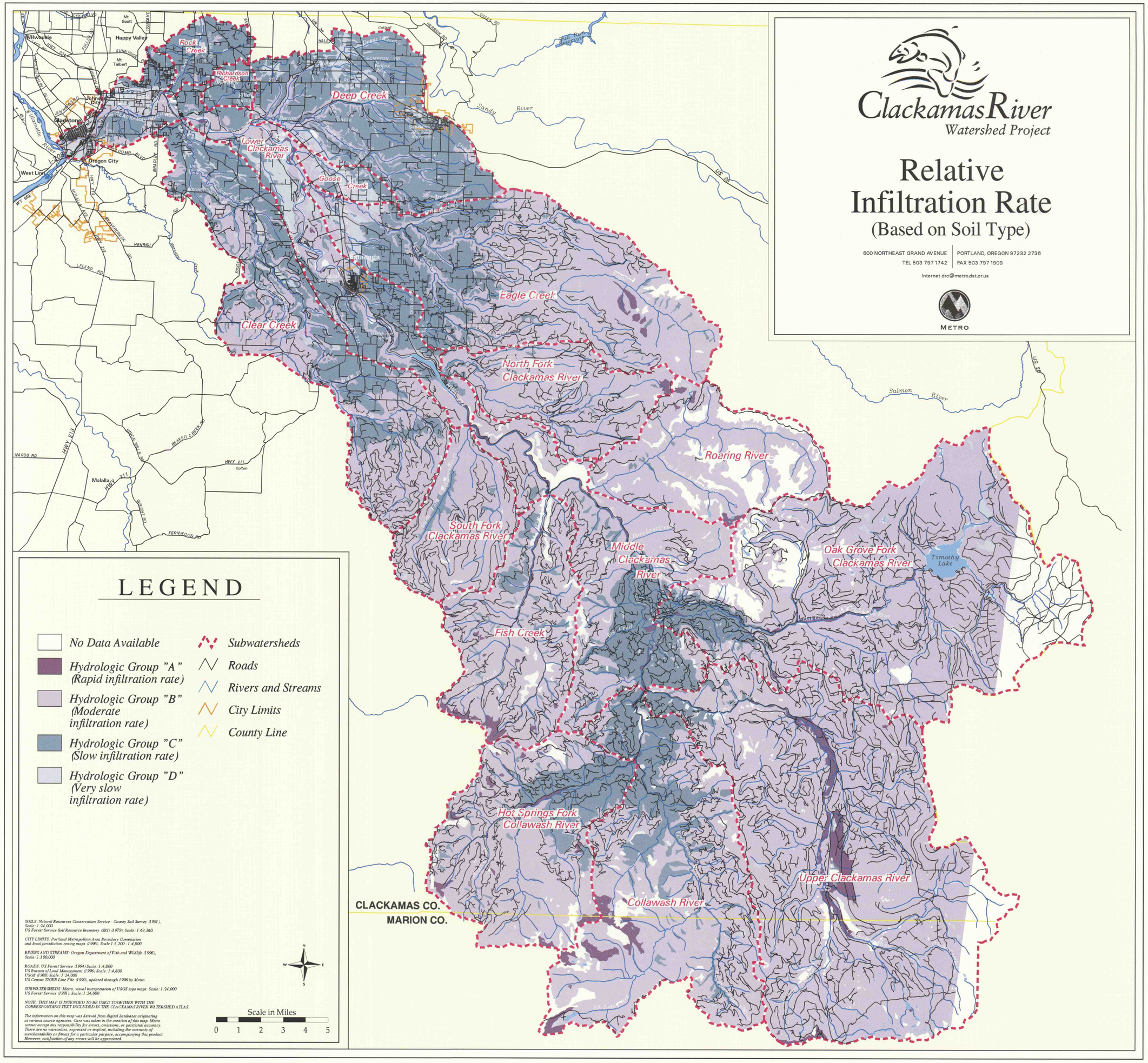
Slope = 100 percent
rise = run

Slope = 300 percent
rise > run

Slope = 33 percent
rise < run


Clackamas River
Watershed Project
Land Cover
600 NORTHEAST GRAND AVENUE
TEL 503 797 1742
PORTLAND, OREGON 97232 2736
FAX 503 797 1909
Internet drc@metro.dst.or.us
METRO
Milwaukie
Happy Valley
Mt Scott
Mt Talbert
Gladstone
Oregon City
West Linn
Molalla
Estacada
Sandy
Deep Creek
Clear Creek
Eagle Creek
North Fork Clackamas River
Roaring River
South Fork Clackamas River
Middle Clackamas River
Oak Grove Fork Clackamas River
Timothy Lake
Fish Creek
Hot Springs Fork Collawash River
Collawash River
Upper Clackamas River
Salmon River
Sandy River
CLACKAMAS CO.
MARION CO.
LEGEND
Note: "Urban" Classification represents a population density of 1000+ persons per square mile. These areas consist of many land uses, including Residential, Agricultural, Commercial and Industrial. Refer to the Existing Land-Use Map for detail on land use within the Urban areas.
Urban
* see note above
Mature Forest
Regrowth Forest
Early Forest or Non-Forested Upland
Native Vegetation, Valley Floor
Irrigated Crops
Grass Fields, Small Grains
Perennial Snow
Water
Subwatersheds
Roads
Rivers and Streams
City Limits
County Line
LAND COVER: USGS Willamette Basin Land Cover Map from Landsat Thematic Mapper satellite imagery (1992-93), (30 meter cell size)
CITY LIMITS: Portland Metropolitan Area Boundary Commission and local jurisdiction zoning maps (1996). Scale 1:1,200 - 1:4,800
RIVERS AND STREAMS: Oregon Department of Fish and Wildlife (1996), Scale: 1:100,000
ROADS: US Forest Service (1994) Scale: 1:4,800
US Bureau of Land Management (1996) Scale: 1:4,800
USGS (1988) Scale: 1:24,000
US Census TIGER Line File (1990), updated through 1996 by Metro.
SUBWATERSHEDS: Metro, virtual interpretation of USGS topo maps. Scale: 1:24,000
US Forest Service (1991). Scale: 1:24,000
NOTE: THIS MAP IS INTENDED TO BE USED TOGETHER WITH THE CORRESPONDING TEXT INCLUDED IN THE CLACKAMAS RIVER WATERSHED ATLAS.
The information on this map was derived from digital databases originating at various source agencies. Care was taken in the creation of this map. Metro cannot accept any responsibility for errors, omissions, or positional accuracy. There are no warranties, expressed or implied, including the warranty of merchantability or fitness for a particular purpose, accompanying this product. However, notification of any errors will be appreciated.
Scale in Miles
0 1 2 3 4 5


Clackamas River
Watershed Project
Relative Surface
Erosion Potential
600 NORTHEAST GRAND AVENUE
PORTLAND, OREGON 97232 2736
TEL 503 797 1742
FAX 503 797 1909
Internet drc@metro.dst.or.us
METRO
Rock Creek
Richardson Creek
Deep Creek
Lower Clackamas River
Goose Creek
Eagle Creek
Clear Creek
North Fork Clackamas River
Roaring River
South Fork Clackamas River
Middle Clackamas River
Oak Grove Fork Clackamas River
Fish Creek
Hot Springs Fork Collawash River
Collawash River
Upper Clackamas River
CLACKAMAS CO.
MARION CO.
LEGEND
No Data Available
Slight
Moderate
High
Subwatersheds
Roads
Rivers and Streams
City Limits
County Line
Scale in Miles
0 1 2 3 4 5


Clackamas River
Watershed Project
Relative
Infiltration Rate
(Based on Soil Type)
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PORTLAND, OREGON 97232 2736
TEL 503 797 1742
FAX 503 797 1909
Internet dro@metro.dst.or.us
METRO
Rock Creek
Richardson Creek
Deep Creek
Lower Clackamas River
Goose Creek
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CLACKAMAS CO.
MARION CO.
Sandy River
Salmon River
Milwaukie
Happy Valley
Mt Scott
Mt Talbert
Johnson City
Gladstone
Oregon City
West Linn
Estacada
Molalla
LEGEND
No Data Available
Hydrologic Group "A" (Rapid infiltration rate)
Hydrologic Group "B" (Moderate infiltration rate)
Hydrologic Group "C" (Slow infiltration rate)
Hydrologic Group "D" (Very slow infiltration rate)
Subwatersheds
Roads
Rivers and Streams
City Limits
County Line
SOILS: National Resources Conservation Service - County Soil Survey (1991), Scale: 1:24,000
US Forest Service Soil Resource Inventory (SRI) (1979), Scale: 1:63,360
CITY LIMITS: Portland Metropolitan Area Boundary Commission and local jurisdiction zoning maps (1996). Scale 1:1,200 - 1:4,800
RIVERS AND STREAMS: Oregon Department of Fish and Wildlife (1996), Scale: 1:100,000
ROADS: US Forest Service (1994) Scale: 1:4,800
US Bureau of Land Management (1996) Scale: 1:4,800
USGS (1988) Scale: 1:24,000
US Census TIGER Line File (1990), updated through 1996 by Metro.
SUBWATERSHEDS: Metro, visual interpretation of USGS topo maps. Scale: 1:24,000
US Forest Service (1991). Scale: 1:24,000
NOTE: THIS MAP IS INTENDED TO BE USED TOGETHER WITH THE CORRESPONDING TEXT INCLUDED IN THE CLACKAMAS RIVER WATERSHED ATLAS.
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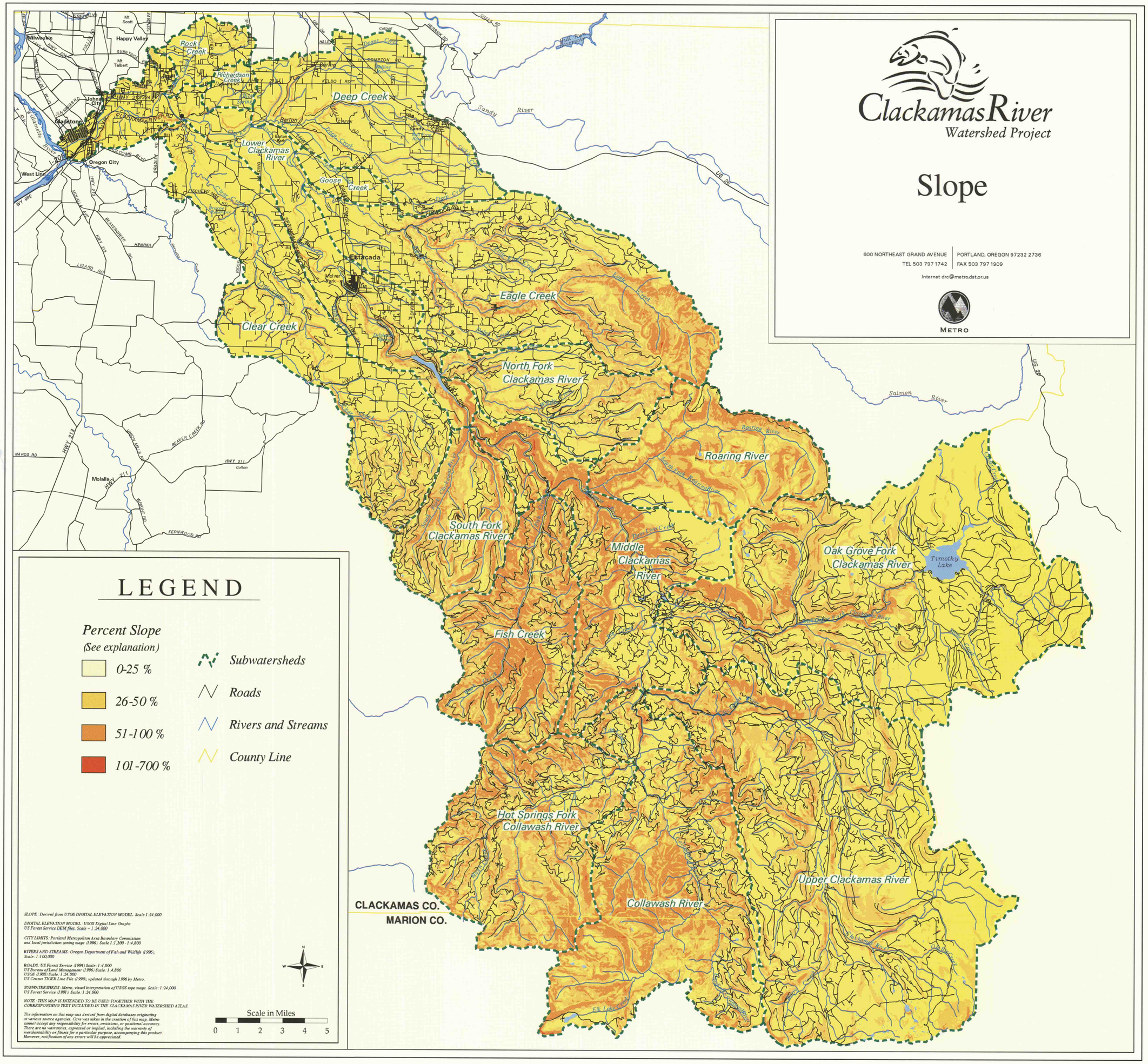
Scale in Miles
0 1 2 3 4 5


Clackamas River
Watershed Project
Slope
600 NORTHEAST GRAND AVENUE
TEL 503 797 1742
PORTLAND, OREGON 97232 2736
FAX 503 797 1909
Internet drc@metro.dst.or.us
METRO
LEGEND
Percent Slope
(See explanation)
0-25 %
26-50 %
51-100 %
101-700 %
Subwatersheds
Roads
Rivers and Streams
County Line
SLOPE: Derived from USGS DIGITAL ELEVATION MODEL. Scale 1:24,000
DIGITAL ELEVATION MODEL: USGS Digital Line Graphs
US Forest Service DEM files. Scale ~ 1:24,000
CITY LIMITS: Portland Metropolitan Area Boundary Commission
and local jurisdiction zoning maps (1996). Scale 1:1,200 - 1:4,800
RIVERS AND STREAMS: Oregon Department of Fish and Wildlife (1996).
Scale: 1:100,000
ROADS: US Forest Service (1994) Scale: 1:4,800
US Bureau of Land Management (1996) Scale: 1:4,800
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Scale in Miles
0 1 2 3 4 5
N
W
E
S
Rock Creek
Richardson Creek
Deep Creek
Lower Clackamas River
Goose Creek
Clear Creek
Eagle Creek
North Fork Clackamas River
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Gladstone
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West Linn
Barlow
Barton
Sandy
Estacada
Molalla
Colton
Salmon River
Sandy River
Fall River
US 26
I-205
WY 99E
HWY 213
HWY 211
HWY 224
HWY 26
HWY 23
HWY 46
HWY 422
HWY 212
HWY 224
HWY 211
FERNWOOD RD
NARDS RD
LELAND RD
HENRICI
BEAVER CREEK RD
WARNER RD
FIRWOOD RD
SUNNYSIDE RD
KELSO RD
SOMPTON RD
HALLER RD
HERMAN RD
COLTON RD
FISCHERS MILL RD
BRADLEY RD
WILSONVILLE RD
JENNINGS RD
FINLEY RD
FINCHLEY RD
MOLALLA AVE
BEAVERCREEK RD
UNION MILLS RD
WALKER RD
Mt Scott
Mt Talbert
Molver Park
Three Lynx Creek
Elk Lake Creek
Timothy Lake