Area Characterization

Figures

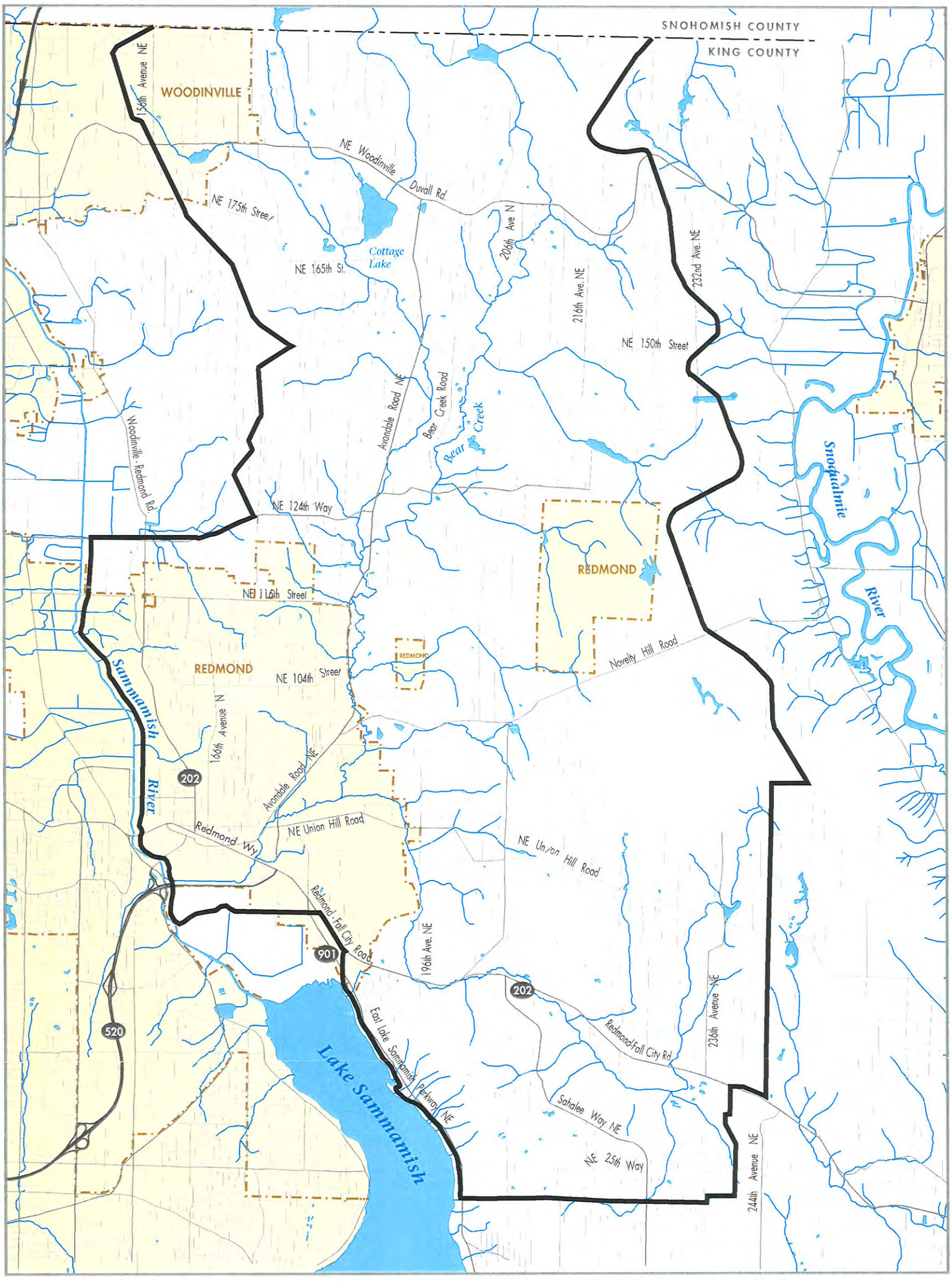
Redmond-Bear Creek Valley
Ground Water Management Plan

February 1999

Figure 2.1

Redmond-Bear Creek Ground Water Management Area Boundary

Redmond-Bear Creek Valley Ground Water Management Area



File name: 2-1_9902RedBearGWMA. ai

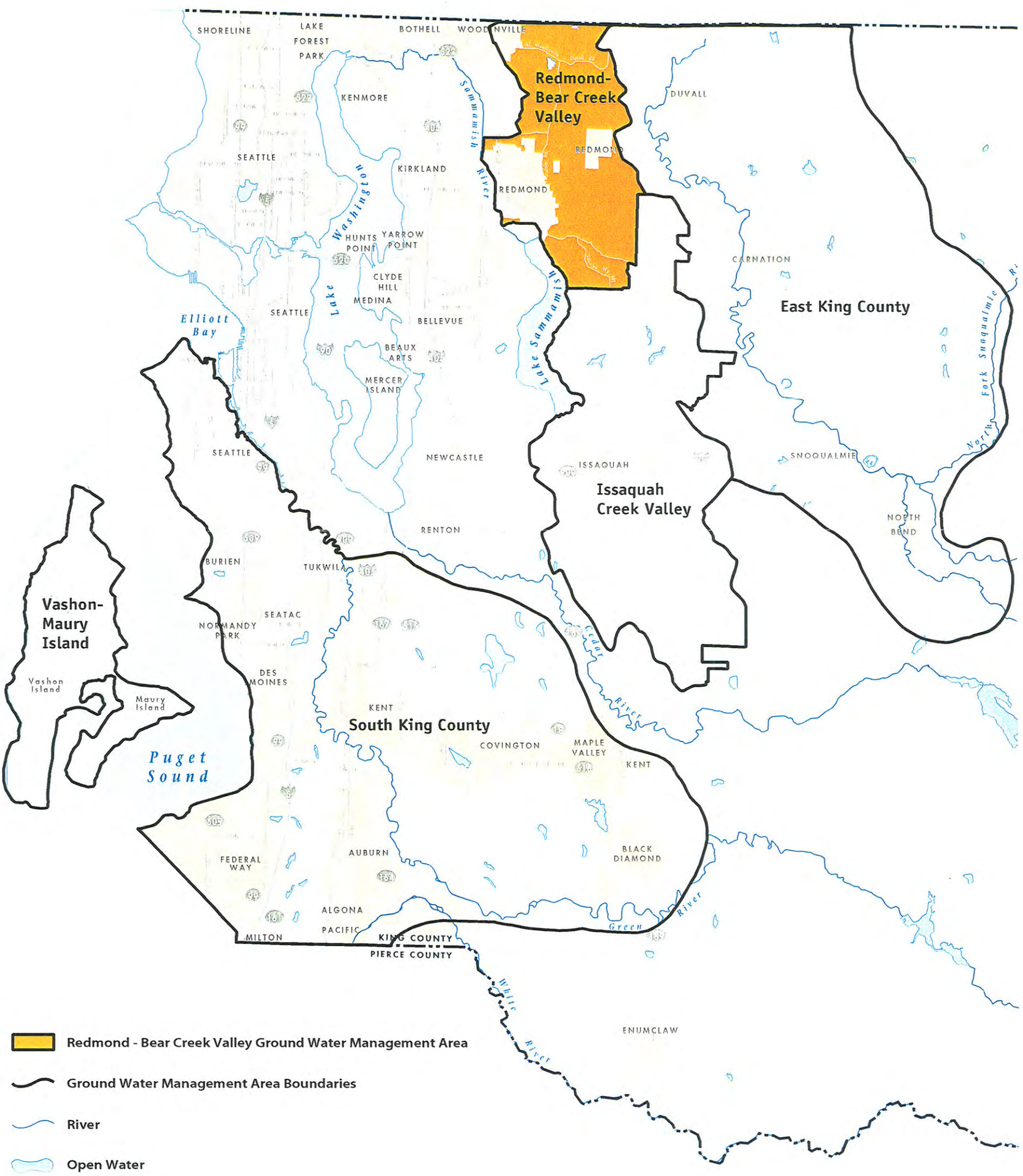
Produced by: Visual Communication & GIS Unit
King County Department of Natural Resources

KING COUNTY
Department of Natural Resources

Figure 2.2

Vicinity Map

Redmond-Bear Creek Valley Ground Water Management Area



Map produced by: Visual Communication & GIS Unit, King County Department of Natural Resources
File name: 9901 RedBearVicinity.ai FB

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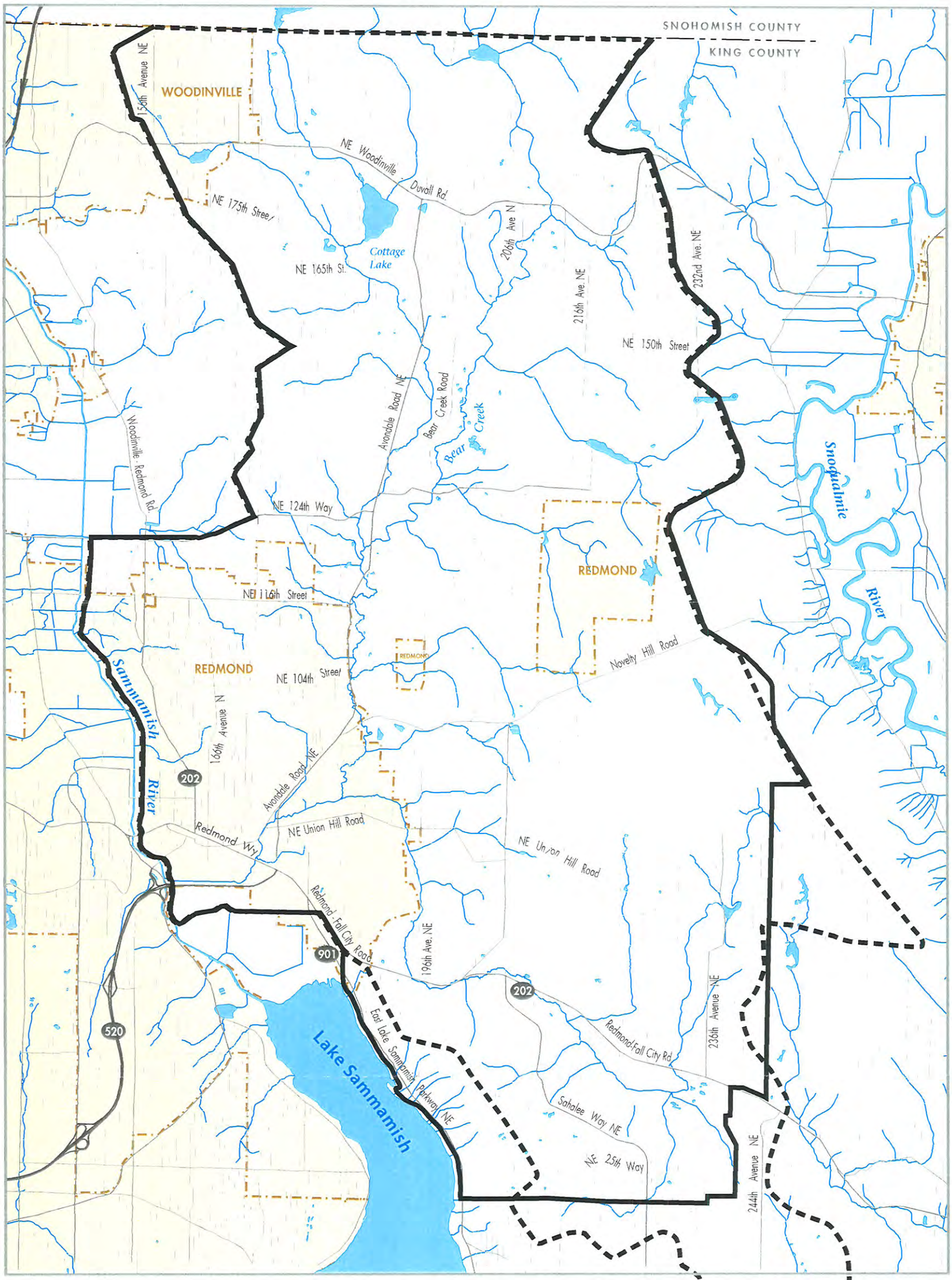
Department of Natural Resources

January, 1999

Figure 2.3

Ground Water Management Area Boundary Change

Redmond-Bear Creek Valley Ground Water Management Area



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Department of Natural Resources

Map produced by: Visual Communication & GIS Unit, King County Department of Natural Resources
File name: 9901RedBearBdyChange. ai FB

January, 1999

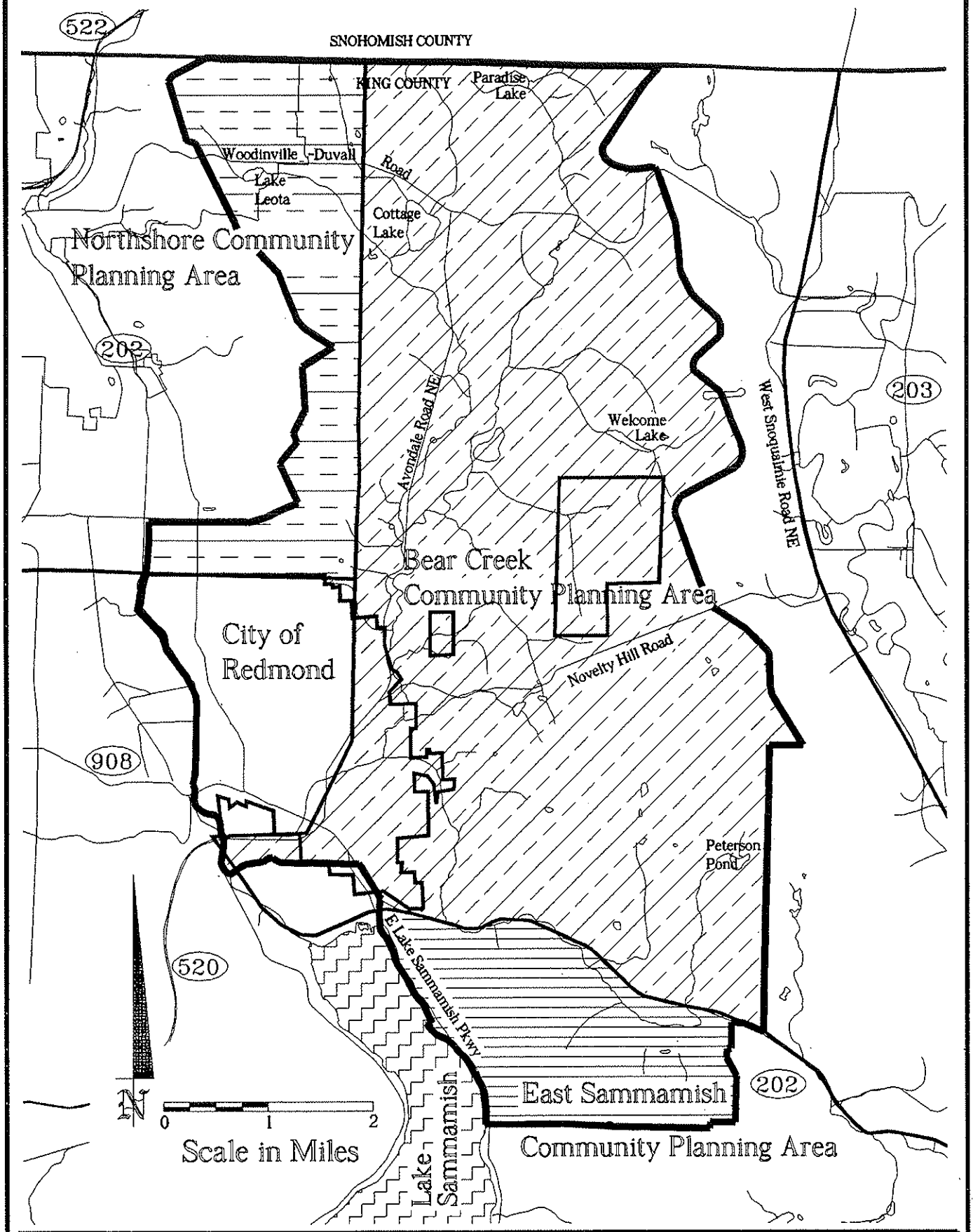


FIGURE 5.1 Local Community Planning Areas

Ground Water Management Area (GWMA) Boundary

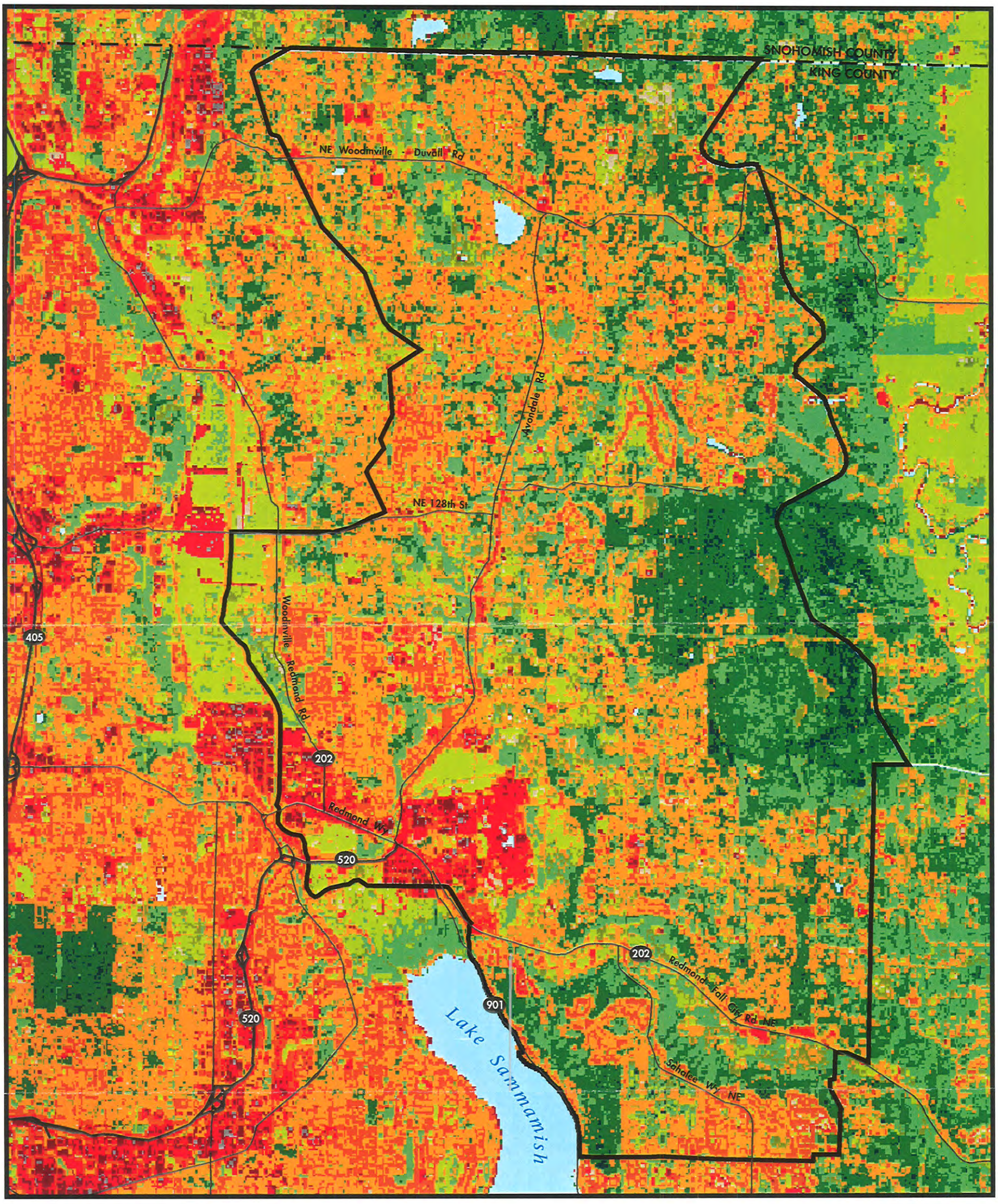
Community Planning Areas within the GWMA Boundary

\GWMAMAPS\RED\RED_COMM.DWG SWG/4-05-96

Figure 5.2

Existing Land Use

Redmond-Bear Creek Valley Ground Water Management Area



Developed Areas

- City Center & Industrial
- Industrial & Commercial
- High Density Urban
- Medium Density Urban & Suburban
- Recent Clearcut

Vegetation

- Grass
- Scrub & Shrub
- Deciduous Forest
- Mixed Forest
- Conifer Forest

Other

- Open Water
- Bare Rock
- Shadow
- Redmond-Bear Creek Management Area Boundary
- Major Road

File Name: 9902 RedBearELU.ai
Produced by: Visual Communications and GIS Unit
Sources: King County Classified Landsat -1995; King County Groundwater Mgt Areas GIS Coverage

N

0 1 2 Miles

August, 1998

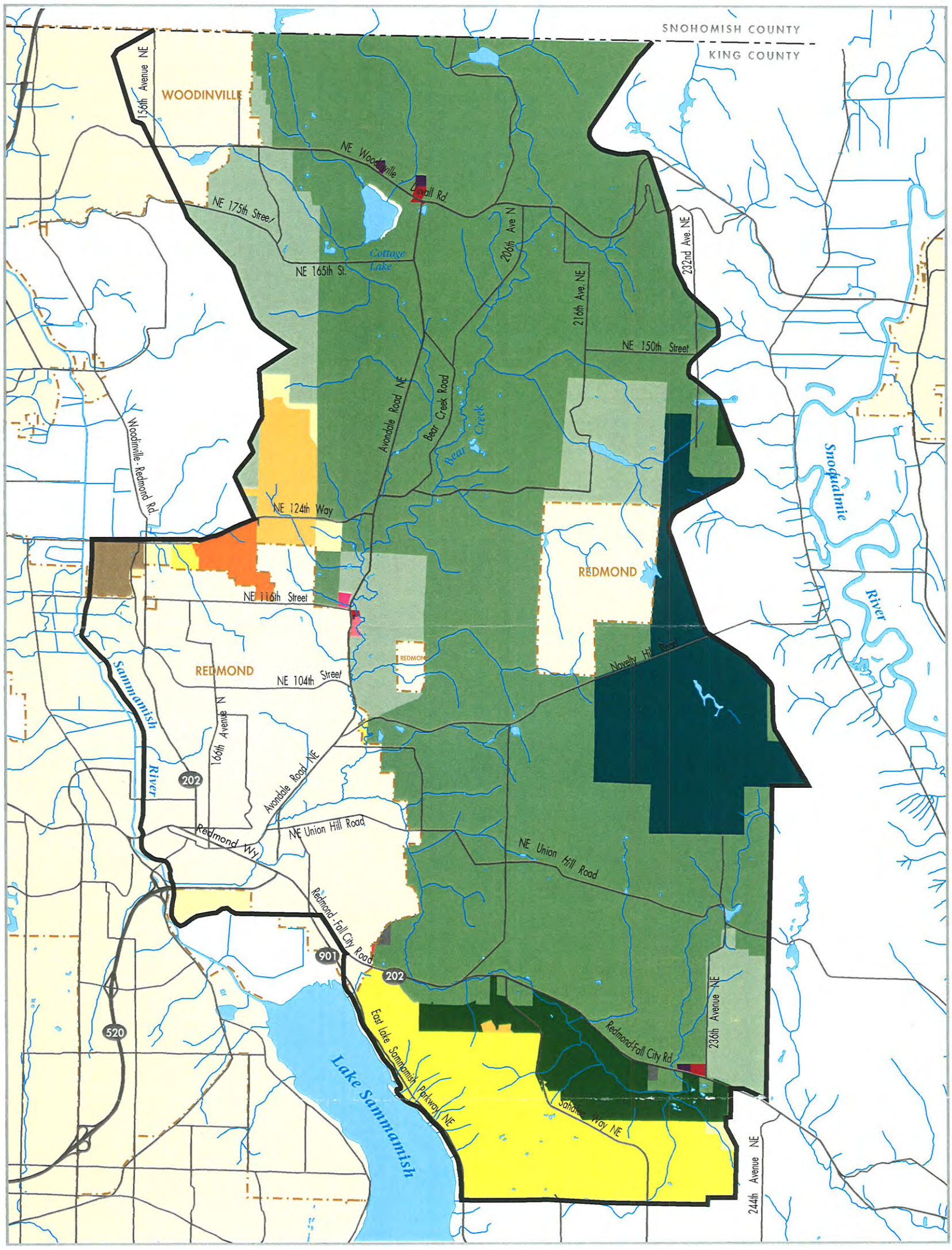
KING COUNTY
Department of Natural Resources

Figure 5.3A

King County Proposed Future Land Use

Redmond-Bear Creek Valley Ground Water Management Area

King County
Department of Natural Resources



- Industrial
- Office
- Community Business
- Neighborhood Business
- Agriculture-10 acres
- Agriculture-35 acres
- Redmond-Bear Creek Ground Water Management Area Boundary
- Residential-24 DU/acre
- Residential-18 DU/acre
- Residential-12 DU/acre
- Residential-8 DU/acre
- Residential-6 DU/acre
- Residential-4 DU/acre
- Residential-1 DU/acre
- Rural-1 DU/2.5 acres
- Rural-1 DU/5 acres
- Rural-1 DU/10 acres
- Urban Reserve
- Forest

N

0 1/2 1 Mile

January 1999

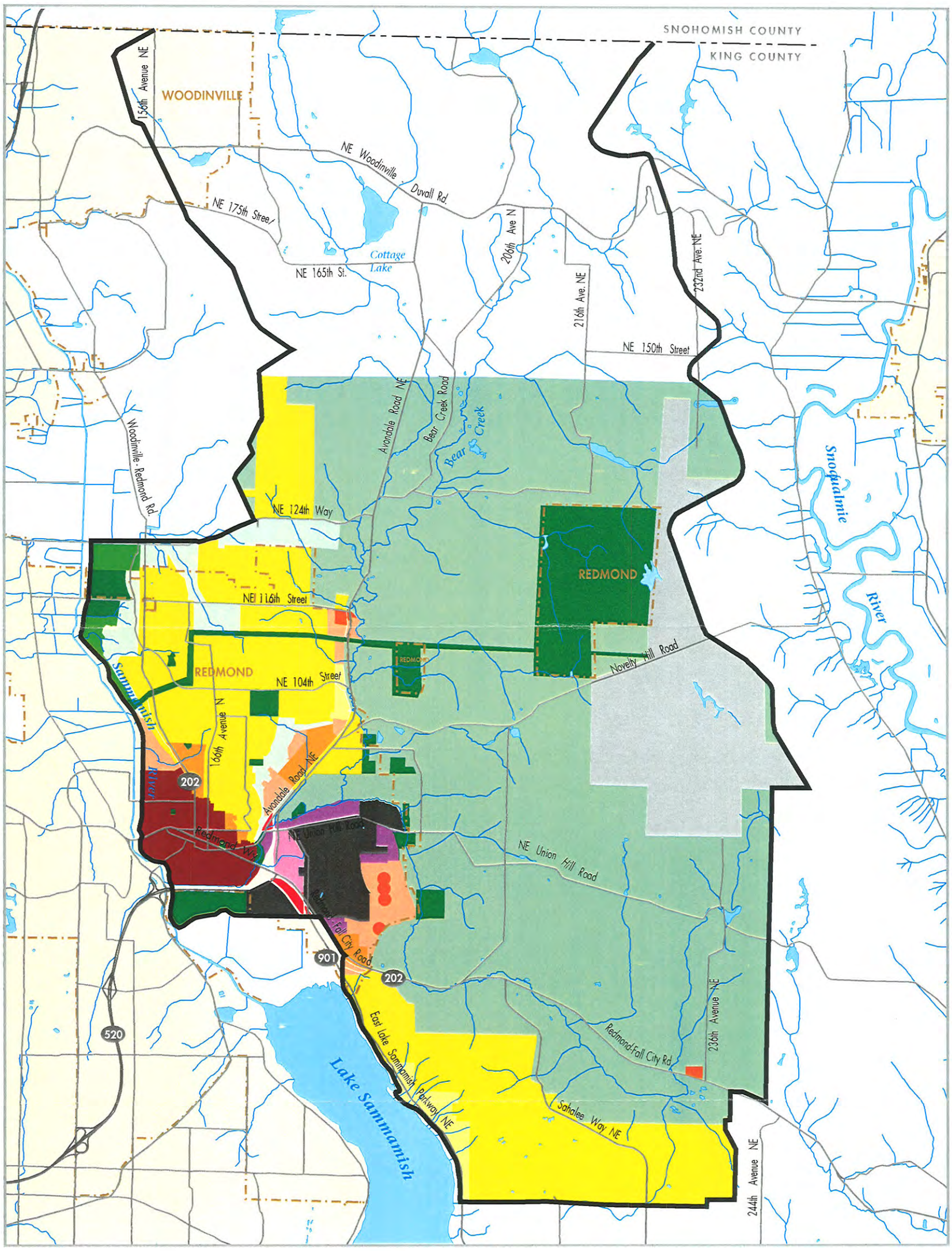
File name: 5-3A_9902RedBearKCFLU. ai
Produced by: Visual Communication & GIS Unit, King County Dept. of Natural Resources
Map Data Source: Planning Department, City of Redmond, 7/3/97

Figure 5.3B

Proposed Future Land Use for the City of Redmond

Redmond-Bear Creek Valley Ground Water Management Area

King County
Department of Natural Resources



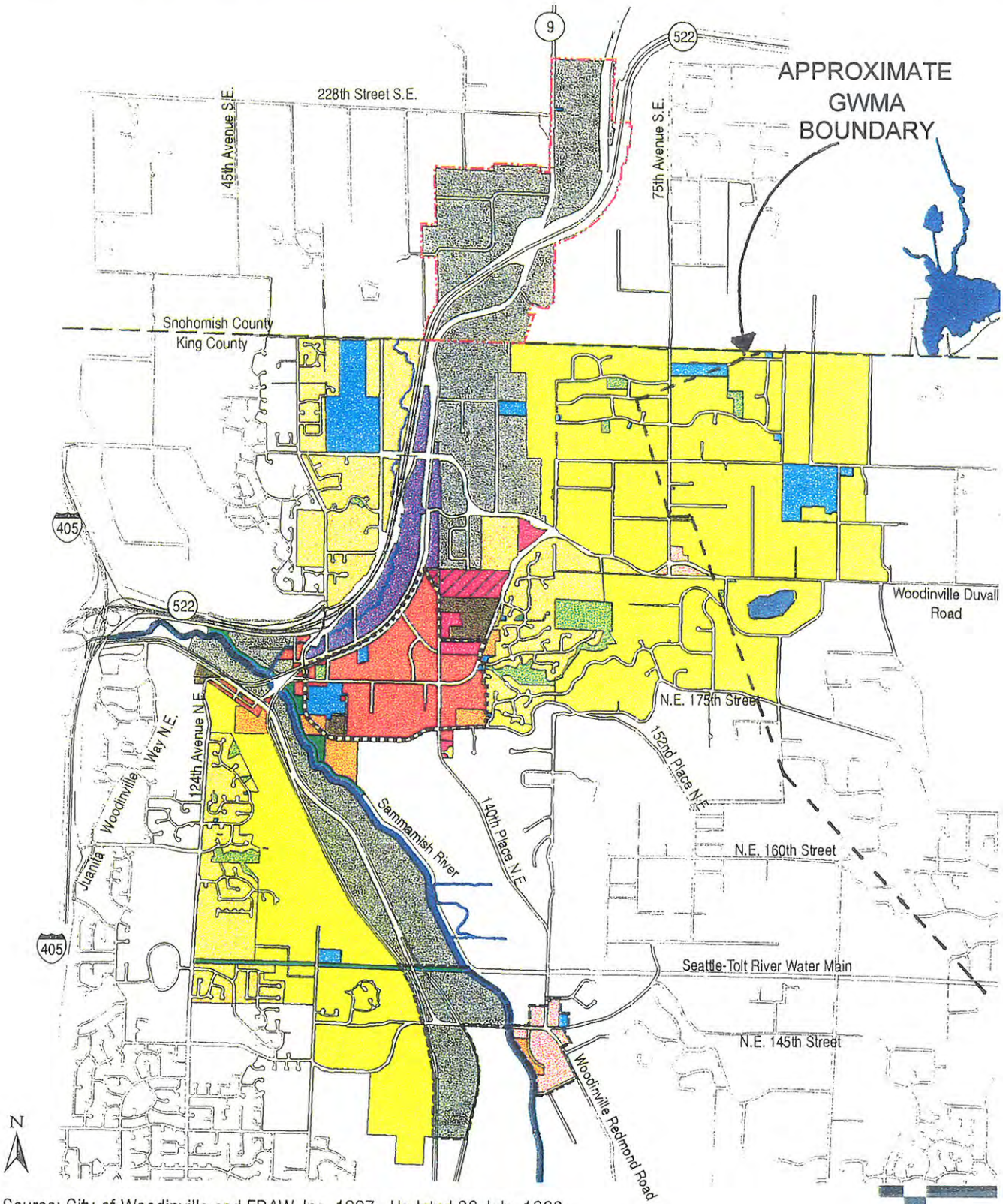
- Redmond-Bear Creek Ground Water Management Area Boundary
- Manufacturing Park
- Business Park
- Design District
- City Center
- Commercial
- Neighborhood Commercial
- Study Area
- High Density Residential
- Moderate Density Residential
- Low-Moderate Density Residential
- Low Density Residential
- Large Lot Residential
- Rural
- Urban Recreation
- Park and Open Space

N

0 1/2 1 Mile

January 1999

File name: 5-3B_9902RedBearREDLU. ai
Produced by: Visual Communication & GIS Unit, King County Dept. of Natural Resources
Map Data Source: Planning Department, City of Redmond, 7/3/97



Source: City of Woodinville and EDAW, Inc. 1997. Updated 26 July, 1998.

LEGEND

- Low Density Res.
- Mod. Density Res.
- Med. Density Res.
- High Density Res.
- Central Business
- Neighborhood Bus.
- Auto/General Commercial
- Openspace
- Public/Institutional
- Public Parks
- Office
- High-Density Res./Office
- Industrial
- Tourist District
- Mixed-Use Area
- Joint Planning Area

Fig. 5.3C Proposed Land Use for the City of Woodinville

Figure 5.4

Sewer Service Area Boundary

Redmond-Bear Creek Valley Ground Water Management Area

River

Stream/Lake

Section Line

Ground Water Management Area Boundary

Incorporated Area

Sewer Service Area

N

0 1 2 Miles

February 1999

Produced by: Visual Communications & GIS Unit, King County Department of Natural Resources

File Name: 9901 RedBear GW Mgmt Plan/RedBear SEWERarea.ai

Data Sources: Sewer District Boundaries-King County "SWRDST" coverage. Lake Washington School District boundary derived from KC "ugline98" coverage.

King County
Department of Natural Resources

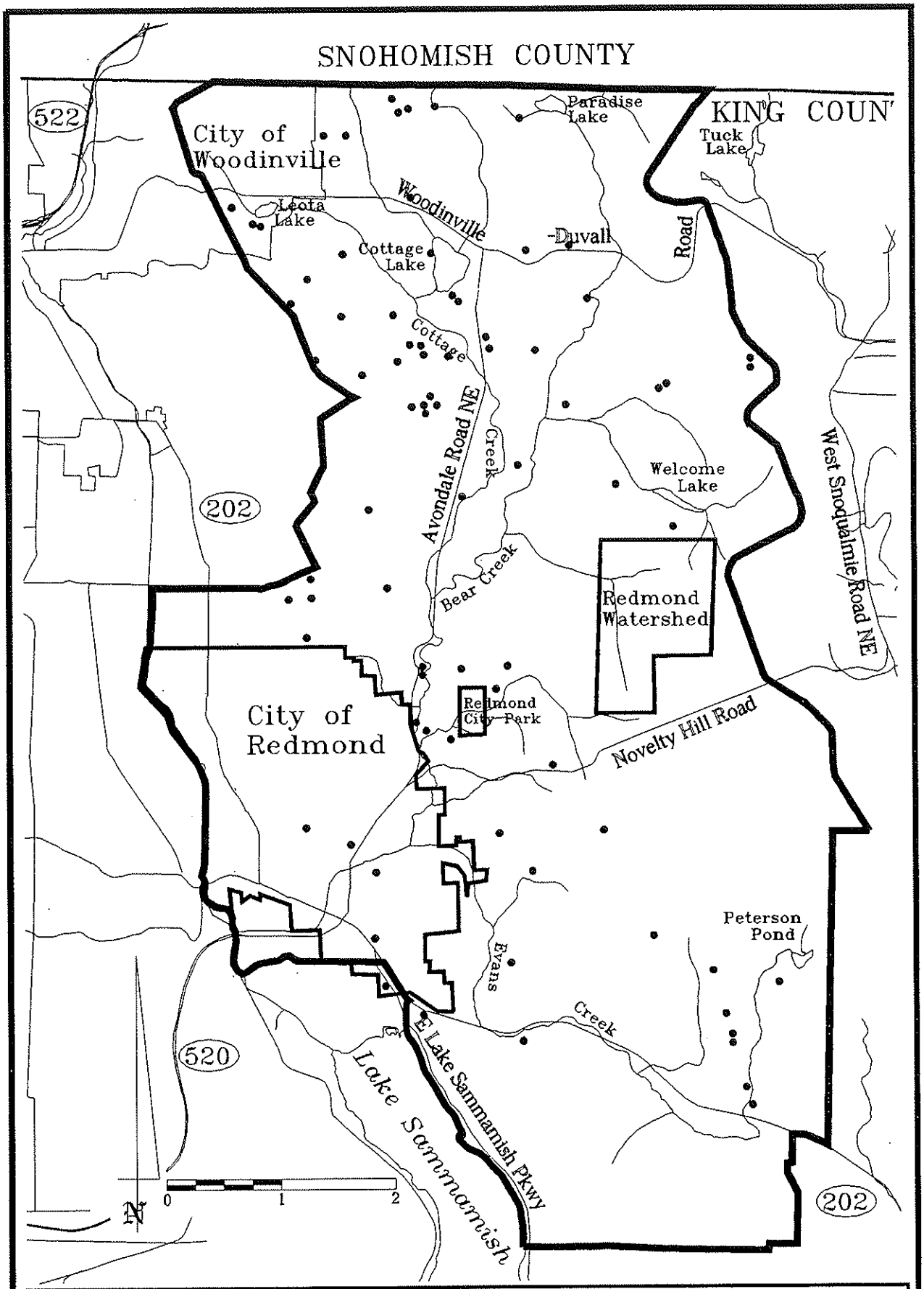


Figure 5.5

Distribution of Septic System Repair Permits (1987)

• – Septic System Location

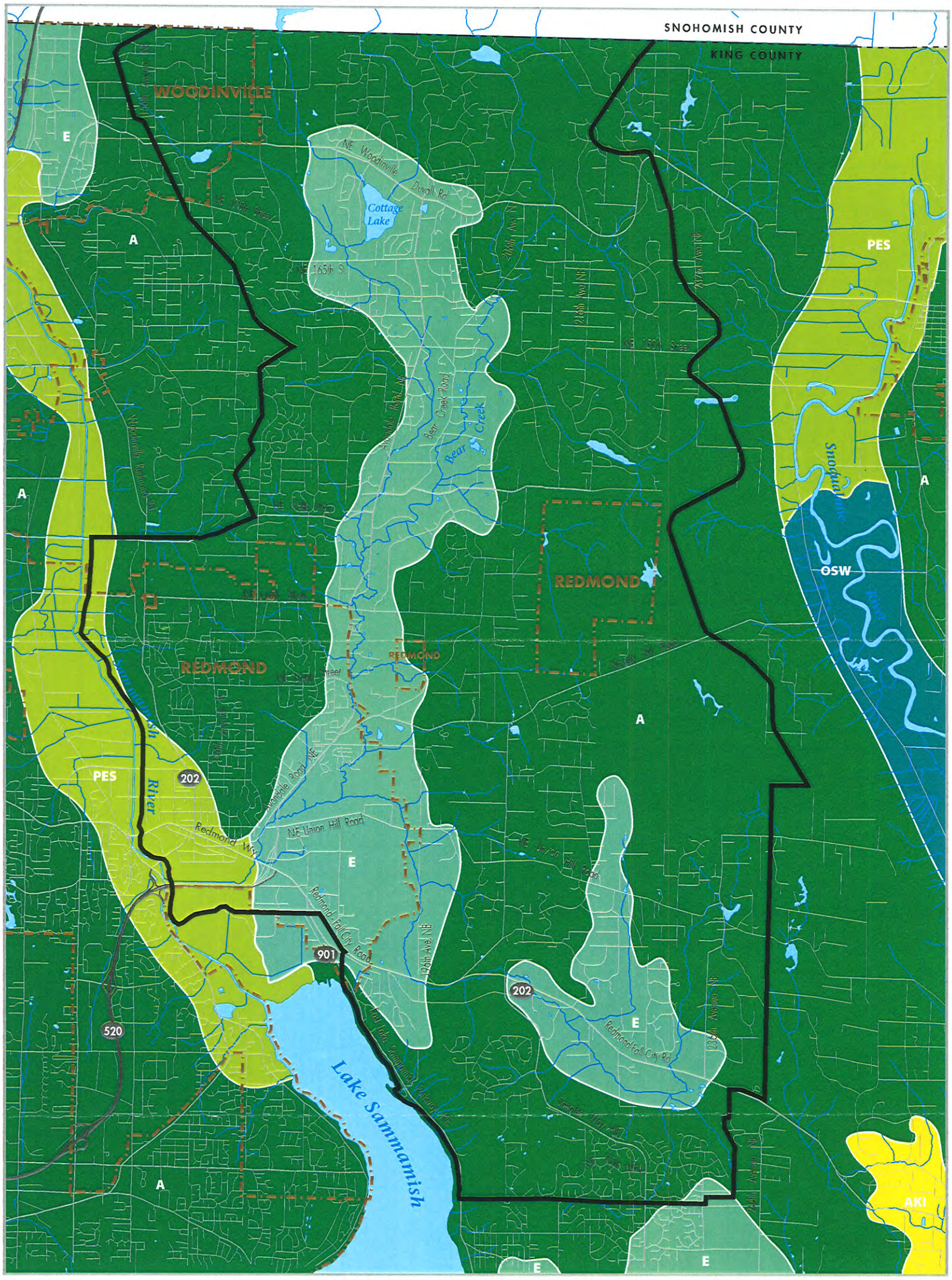
fig_5_5\swg\062896

Figure 5.6

Soils Map

Redmond-Bear Creek Valley Ground Water Management Area

King County
Department of Natural Resources



A **Alderwood association** - Moderately well drained, undulating to hilly soils that have dense, very slowly permeable glacial till at a depth of 20-40"; on uplands and terraces.

OSW **Oridia-Seattle-Woodinville association** - Somewhat poorly drained and very poorly drained, nearly level soils; in major stream valleys.

E **Everett association** - Poorly drained and moderately well drained, nearly level to rolling soils that have dense, slowly permeable and very slowly permeable glacial till at a depth of 20-40"; on uplands.

AKI **Alderwood-Kitsap-Indianola association** - Moderately well drained, nearly level to steep soils that have very slowly permeable glacial till or glacial lake deposits at a depth of 16-40", and somewhat excessively drained, rolling, deep sandy soils; on uplands and terraces.

PES **Puget-Earlmont-Snohomish association** - Poorly drained and somewhat poorly drained, nearly level soils that have layers of peat within a few feet of the surface; in major stream valleys.

N

0 1/2 1 Mile

January 1999

File name: 5-6_9902RedBearSOILSmap. ai

Produced by: Visual Communication & GIS Unit
King County Department of Natural Resources

Soils Source: Soil Survey of King County Area, Washington (Snyder et al, 1973)

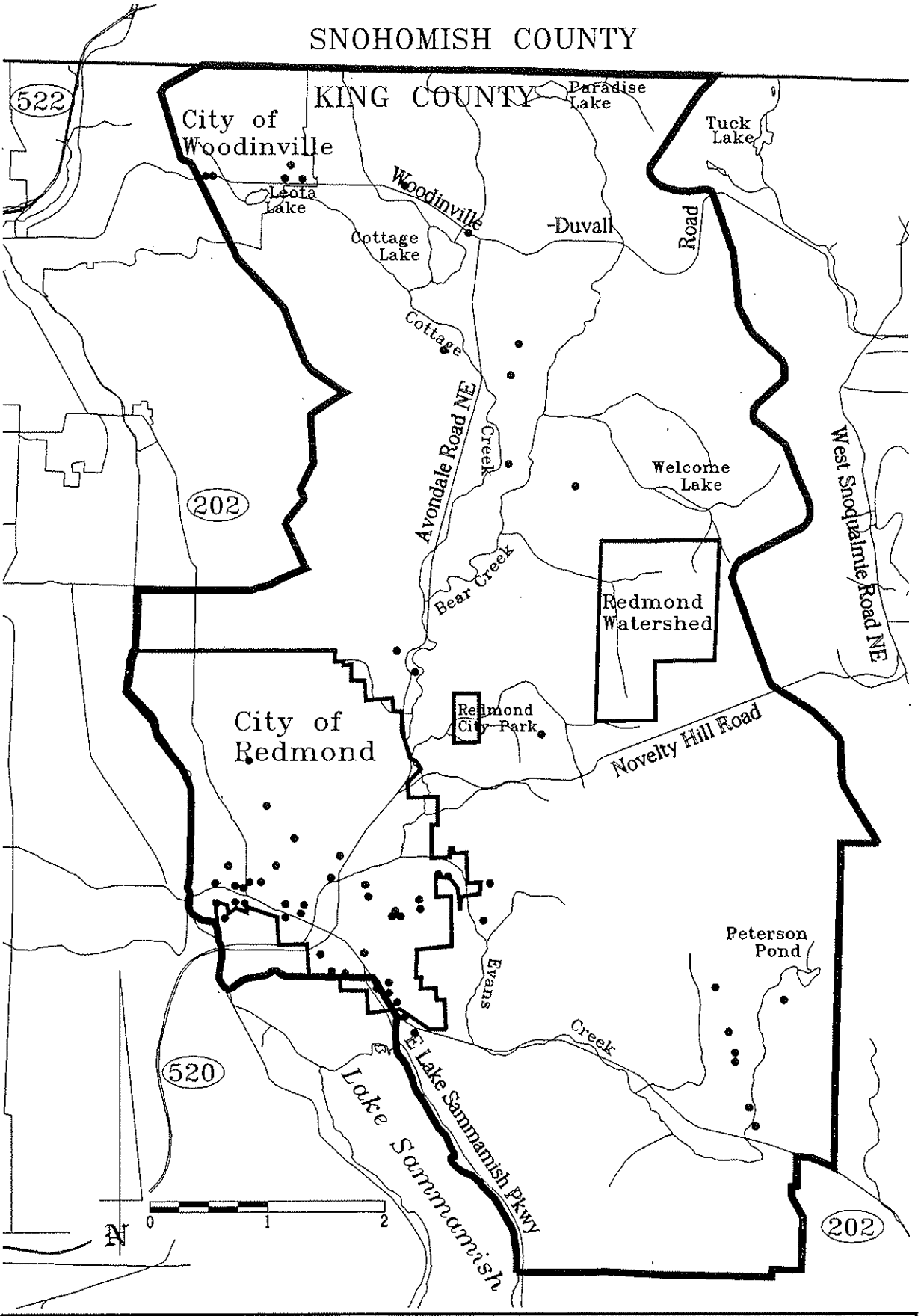


Figure 5.7
Location of Underground Storage Tanks

• – Underground Storage Tank Location

fig_5_7\swg\070196

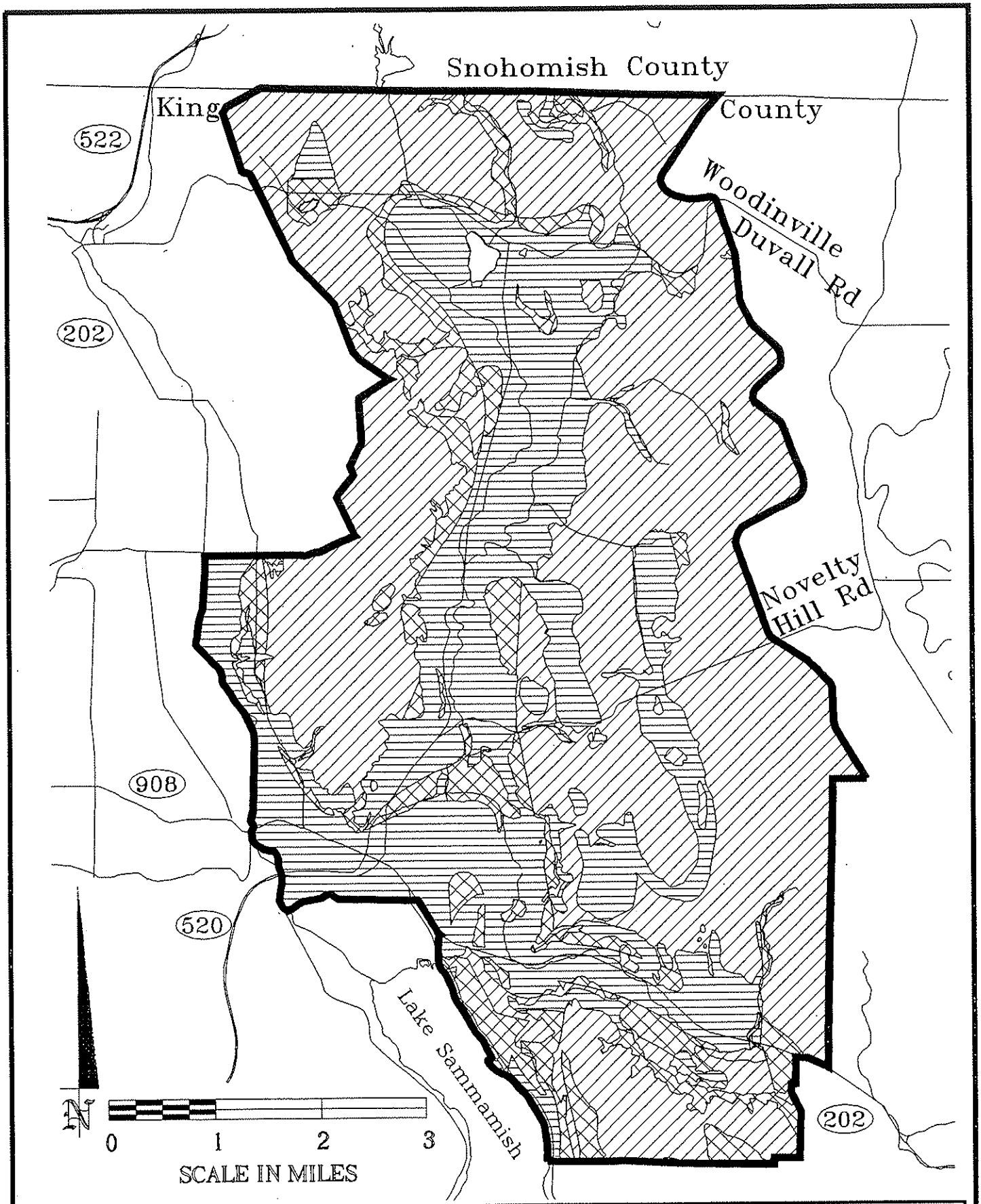


Figure 5.8
Aquifer Susceptibility
to Contamination

\fig_5_8.dwg\swg\62696

Legend

- High Susceptibility
- Medium Susceptibility
- Low Susceptibility

SNOHOMISH COUNTY

KING COUNTY

Paradise Lake

Woodinville - Duvall Road

Leota Lake

Cottage Lake

WOODINVILLE WATER DISTRICT

West Snoqualmie Road NE

Avondale Road NE

Welcome Lake

522

202

CITY OF REDMOND

Novelty Hill Road

908

UNION HILL WATER DISTRICT

Peterson Pond

520

Lake Sammamish Pkwy

NE SAMMAMISH SEWER & WATER DISTRICT

202

LAKE SAMMAMISH

N

0 1 2

MILE

FIGURE 6.1 Group A Purveyor Service Area Boundaries

SWG/4-05-96
\GWMAMAPS\RED\FIG6GRPA.DWG

LEGEND

- Ground Water Management Area (GWMA) Boundary
- Group A Boundary (within the GWMA)

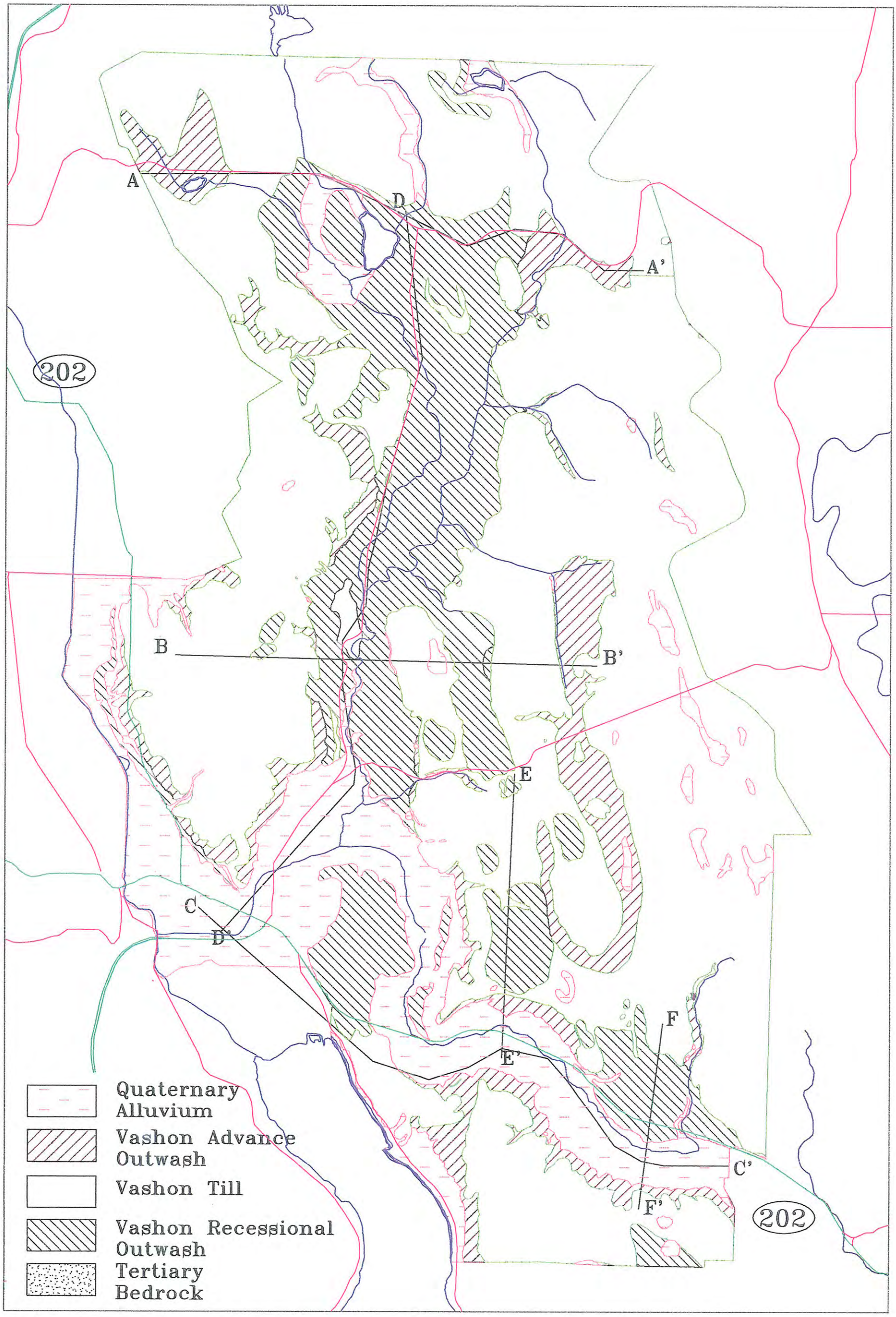
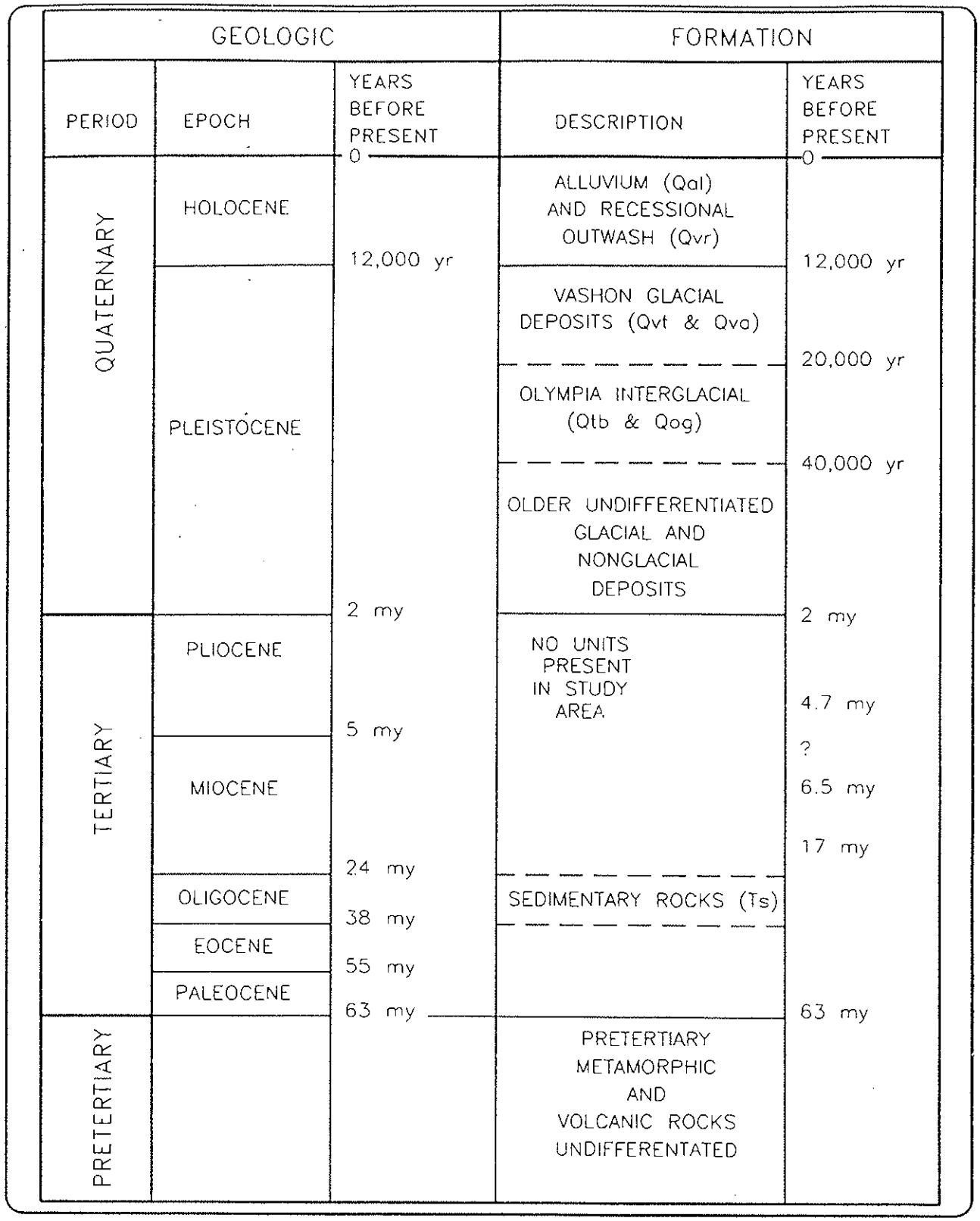


Figure 7.1
Generalized Geologic Map
(shows cross-section locations)



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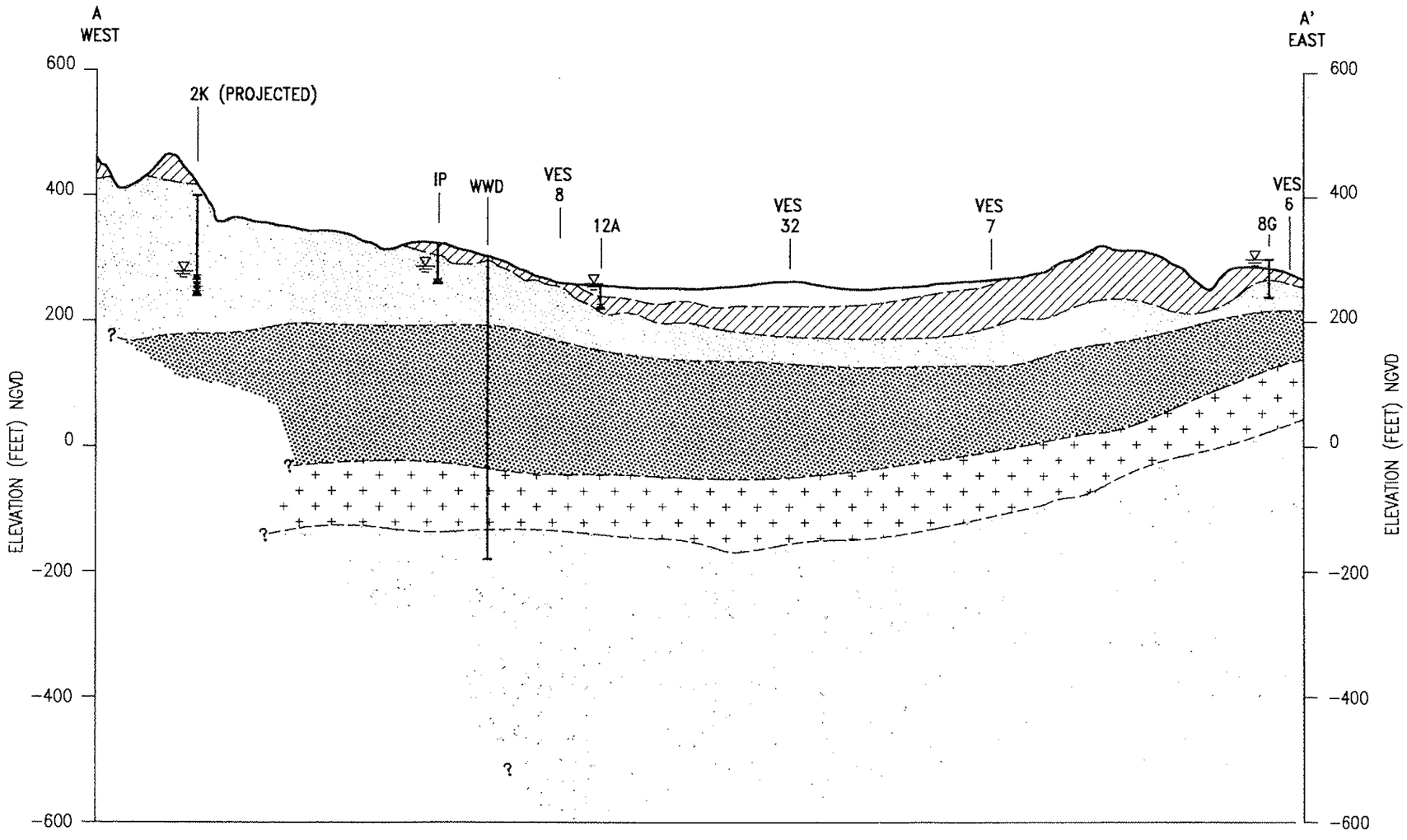
REV
APPR
PROJECT NO 0121-003.07

Fig. 7.2 Generalized Stratigraphic Column

1= 1 11-16-92 0121\003\07C01



LEGEND

- Glacial–Fluvial Recessional Outwash
- Glacial Till
- Glacial Advance Outwash
- Transitional Beds
- Olympia Gravel
- Older Undifferentiated Deposits

Ves–29 Location of Resistivity Sounding

WWD Well Number

—?— — Inferred Geologic Contact

Scale:
Horizontal 1"=2,000'
Vertical 1"=200'

Note: Vertical Exaggeration 10X

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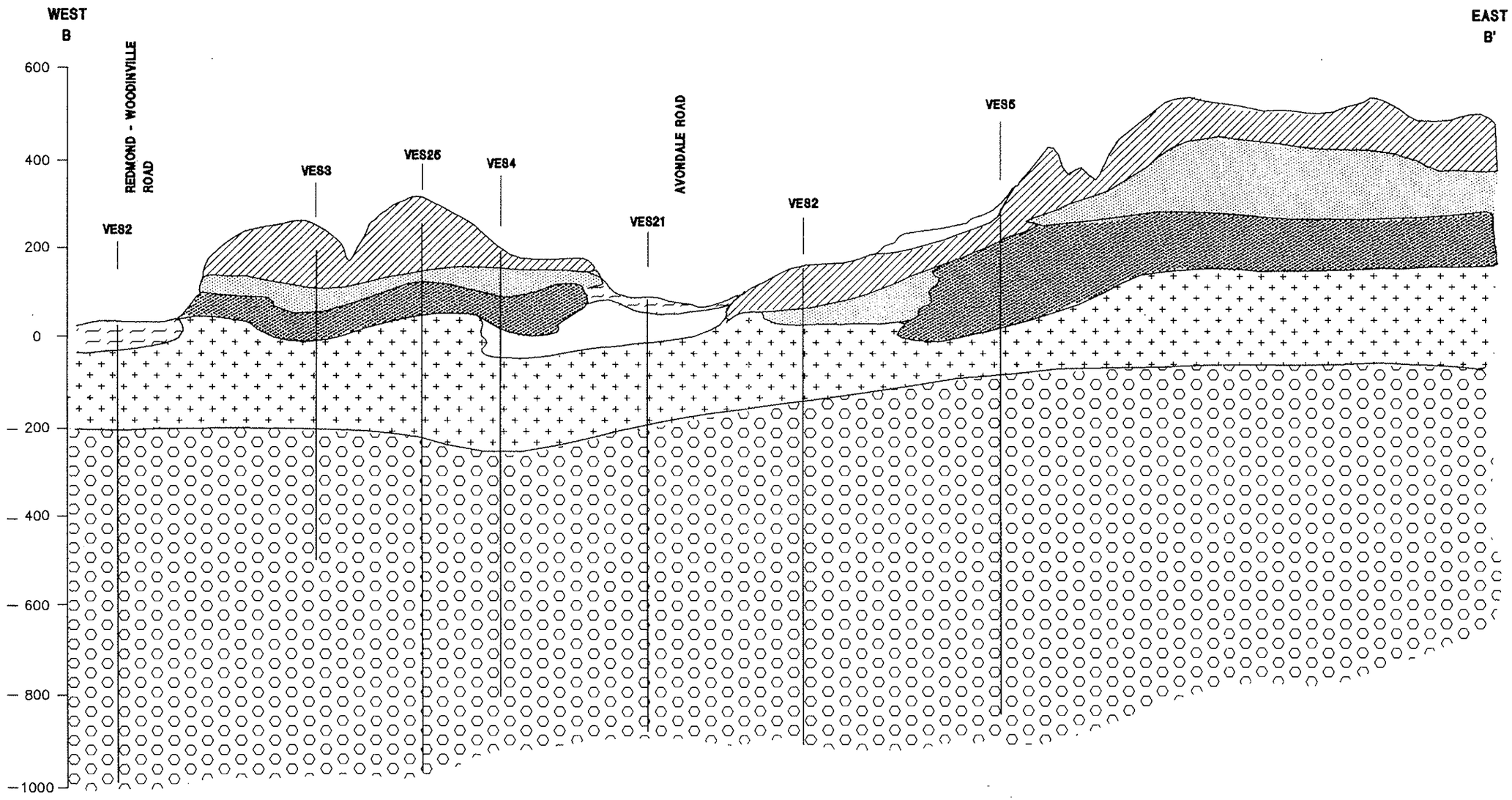
0121003.03

Fig. 7.3 Geologic Cross-Section A-A'

1= 1 3–08–93 D:\0121\003\03C12



LEGEND

- Alluvium
- Glacial–Fluvial Recessional Outwash
- Glacial Till
- Glacial Advance Outwash
- Transitional Beds
- Olympia Gravel
- Older Undifferentiated Deposits

Ves–29 Location of Resistivity Sounding

WWD Well Number

—?— — Inferred Geologic Contact

Scale:
Horizontal 1"=160'
Vertical 1"=16'

Note: Vertical Exaggeration 10X

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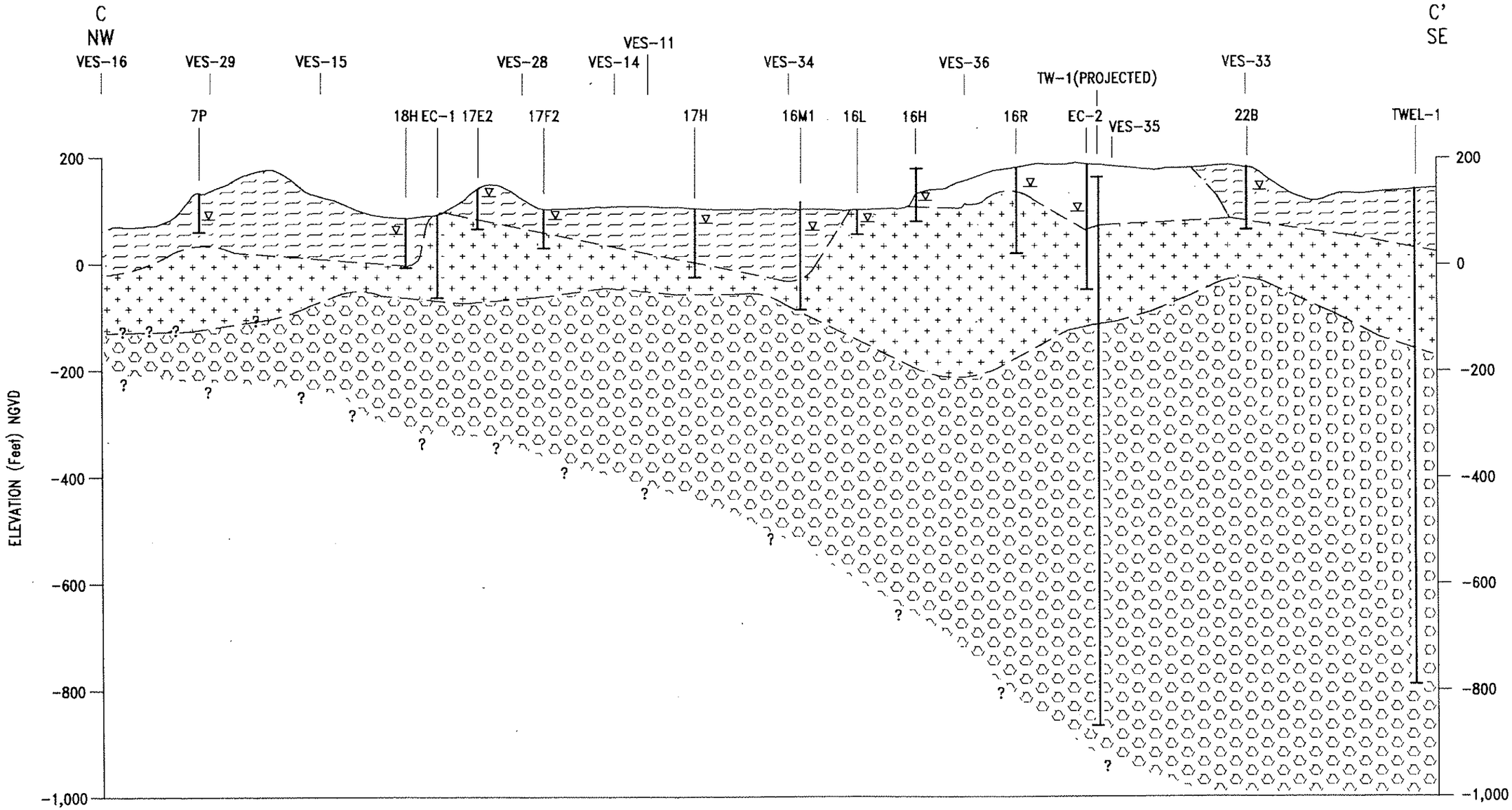
0121–003.07

Fig. 7.4 Geologic Cross-Section B-B'

1= 1 10/20/94 J:\DATA\DWG\0121\003\07C20



LEGEND

- Alluvium
- Glacial–Fluvial Recessional Outwash
- Glacial Till
- Glacial Advance Outwash
- Transitional Beds
- Olympia Gravel
- Older Undifferentiated Deposits

Ves–29 Location of Resistivity Sounding

WWD Well Number

—?— — Inferred Geologic Contact

Scale:
Horizontal 1"=2,000'
Vertical 1"=200'

Note: Vertical Exaggeration 10X

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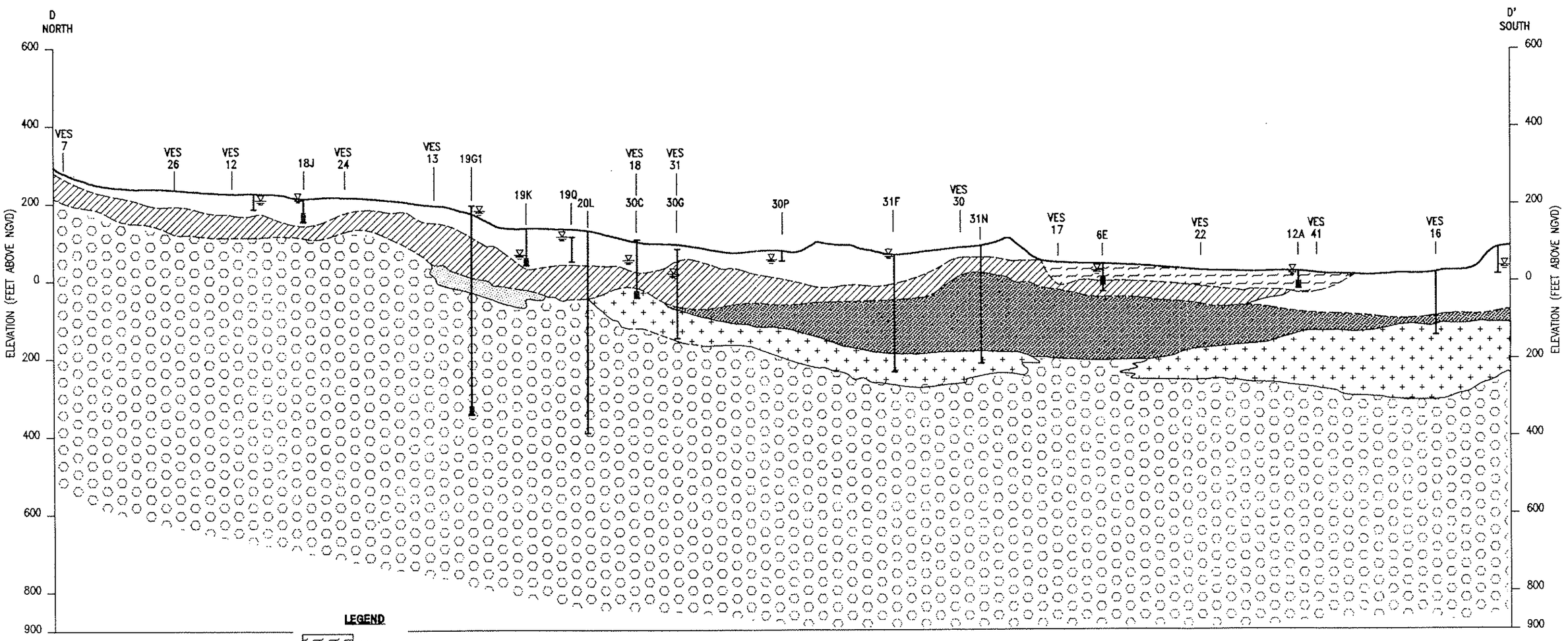
0121–003.07

Fig. 7.5 Geologic Cross-Section C-C'

1= 1 3–08–93 J:..\0121\003\07C03



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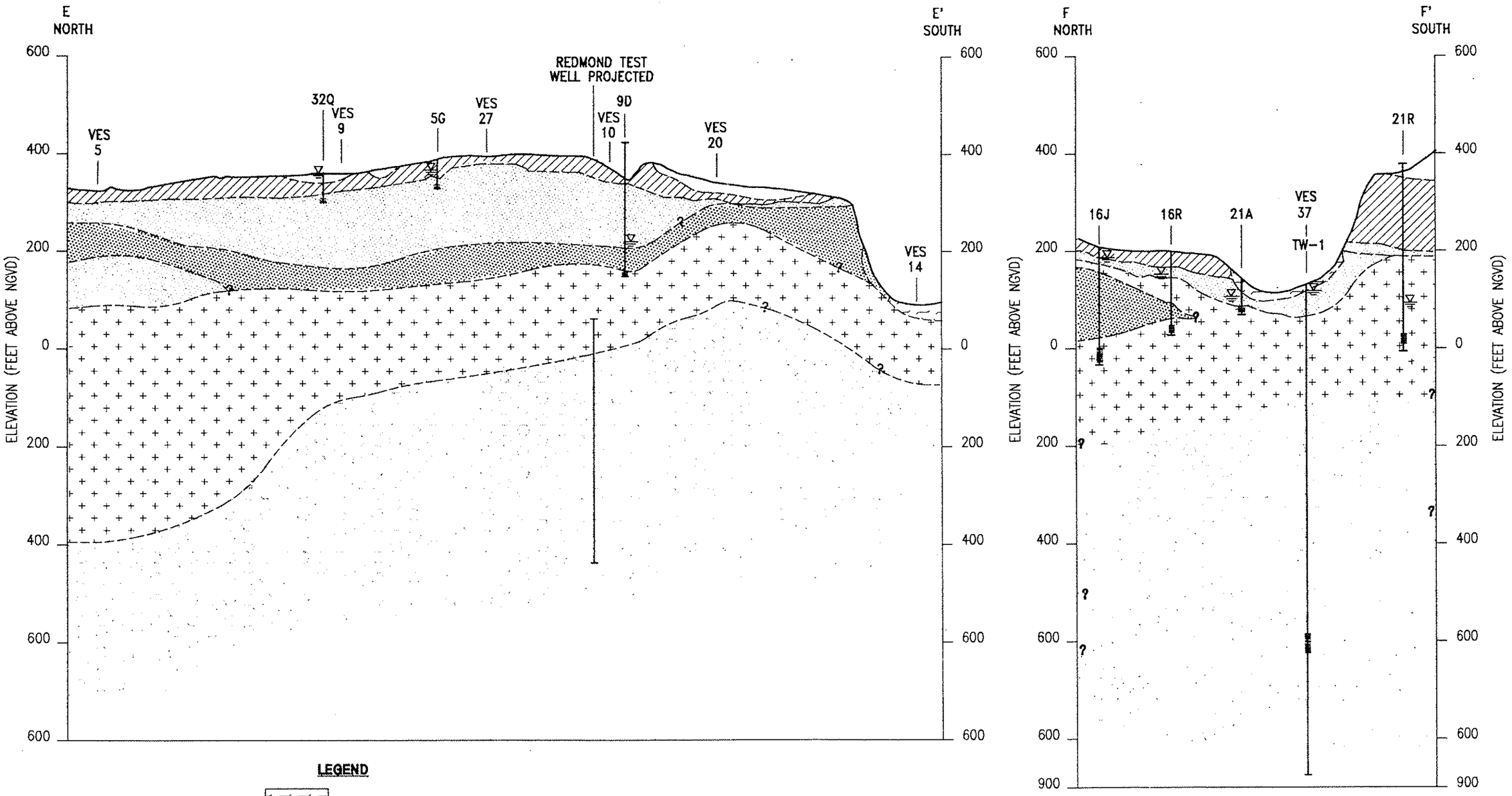
PROJECT NO. 0121003.03

Fig. 7.6 Geologic Cross-Section D-D'

1= 1 11-16-92 0:\0121\003\03C13



LEGEND

- Alluvium
- Glacial–Fluvial Recessional Outwash
- Glacial Till
- Glacial Advance Outwash
- Transitional Beds
- Olympia Gravel
- Older Undifferentiated Deposits

Ves–29 Location of Resistivity Sounding

WWD Well Number

—?— — Inferred Geologic Contact

Scale:

Horizontal 1"=2,000'

Vertical 1"=200'

Note: Vertical Exaggeration 10X

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0121003.03

Fig. 7.7 Geologic Cross-Section E-E' and F-F'

1= 1 11–15–92 D:\0121\003\03C14

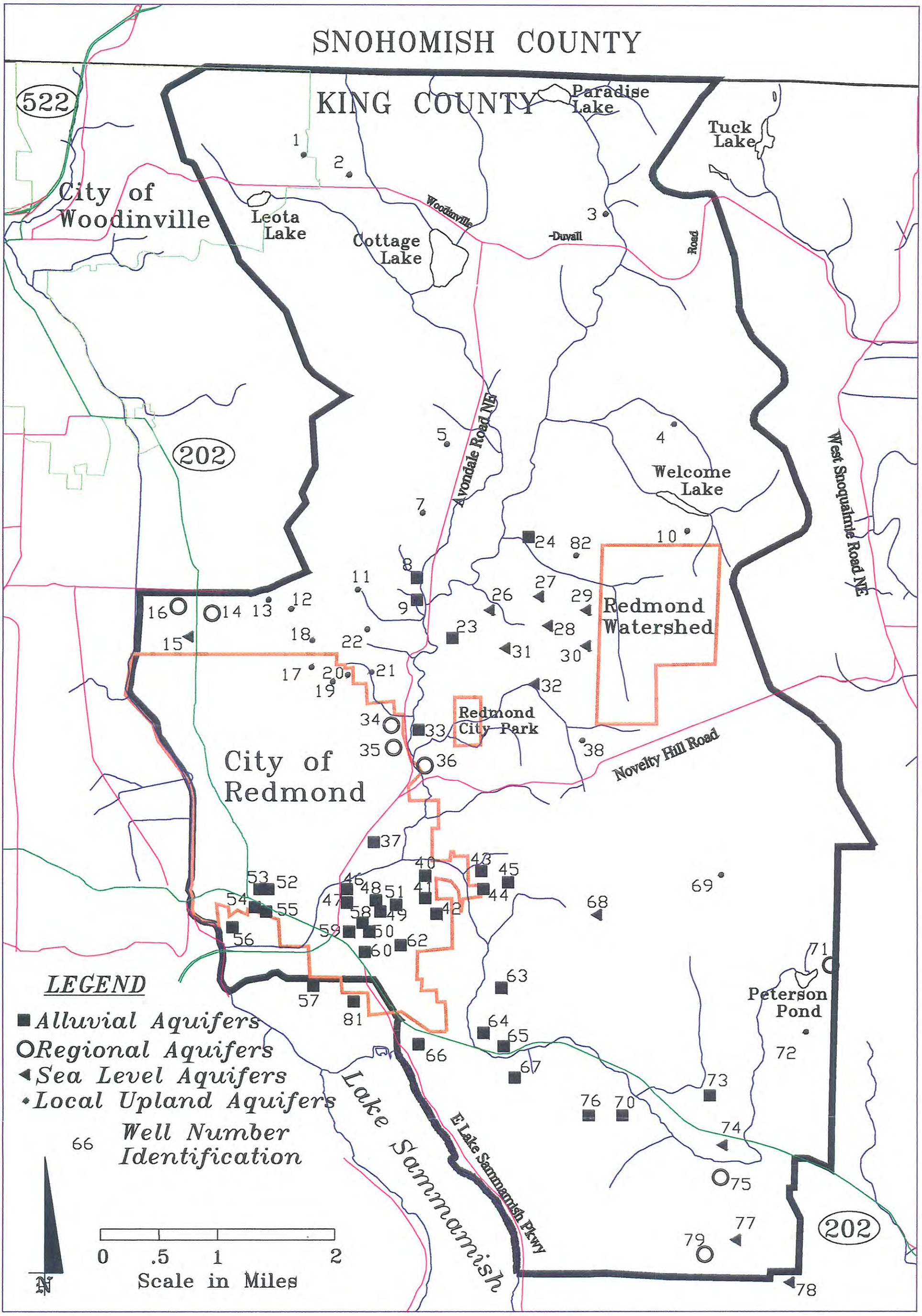

Figure 7.8 Distribution of Monitoring Wells in Area Aquifers

150969

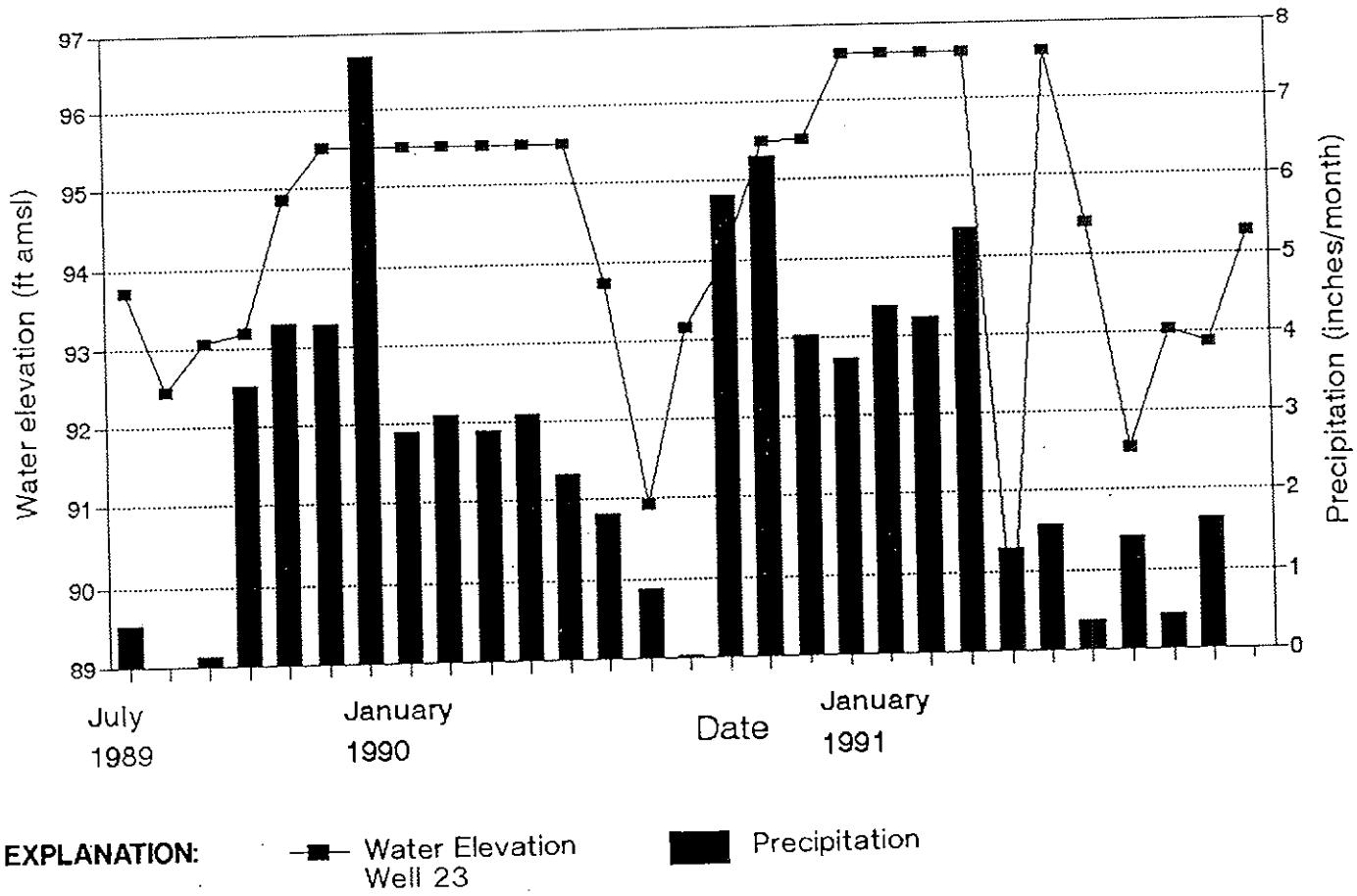

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Fig. 7.9 Water Level versus Precipitation Hydrograph - Alluvial Aquifer

150969

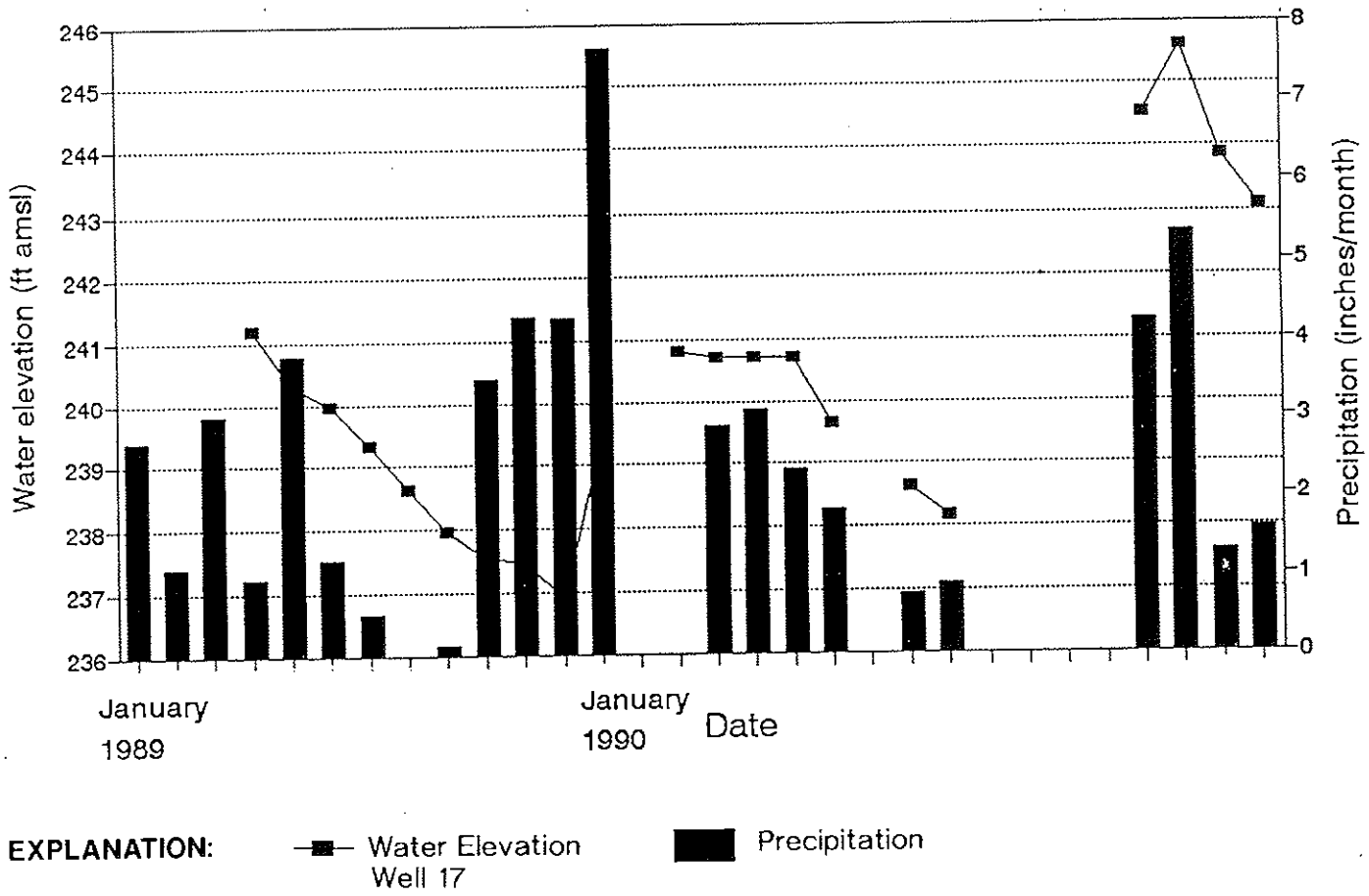

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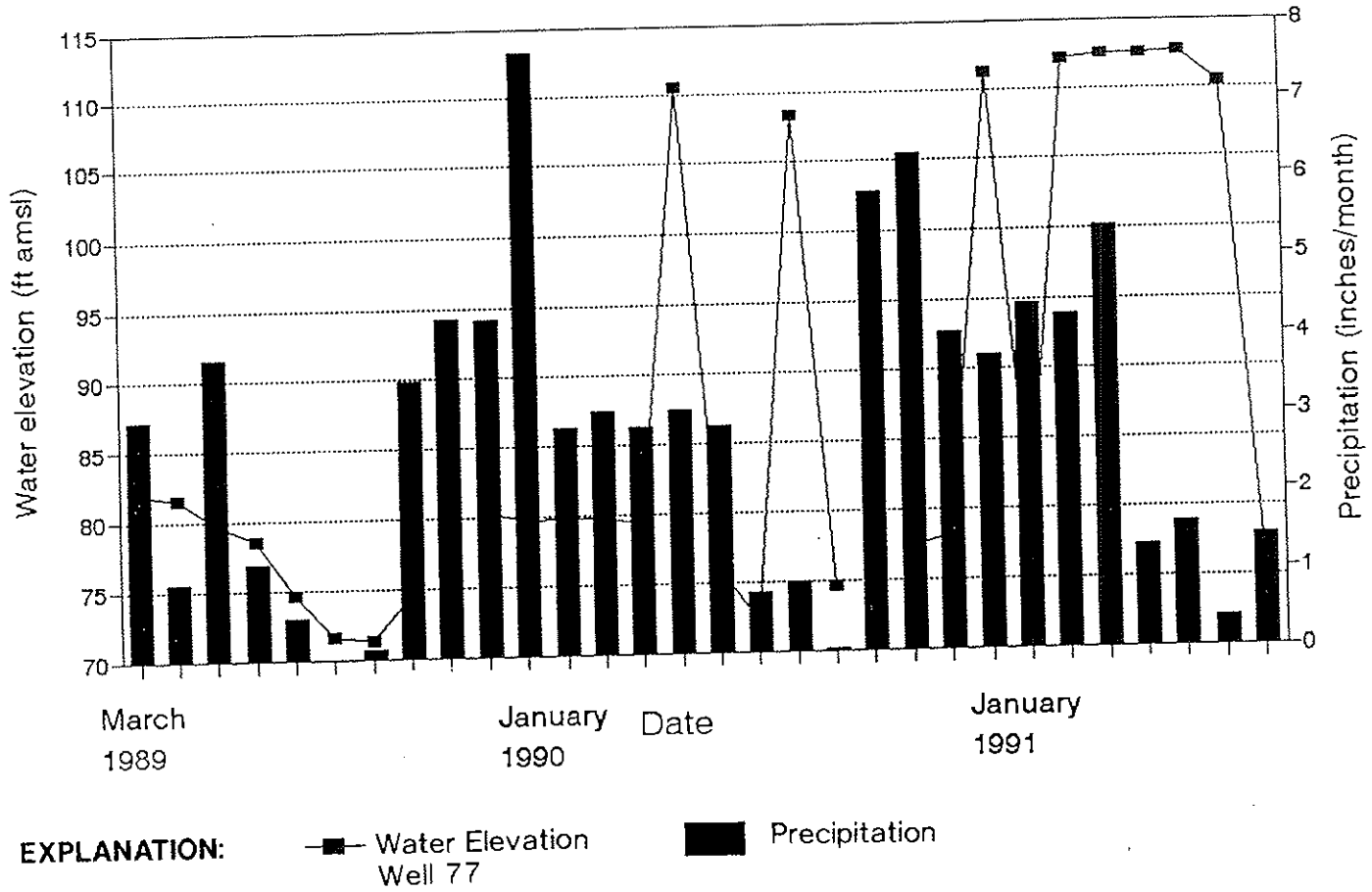
Fig. 7.10 Water Level versus Precipitation Hydrograph - Local Upland Aquifers

150969



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PROJECT NO. 0121-003.07

Fig. 7.11 Water Level versus Precipitation Hydrograph - Sea Level Aquifers

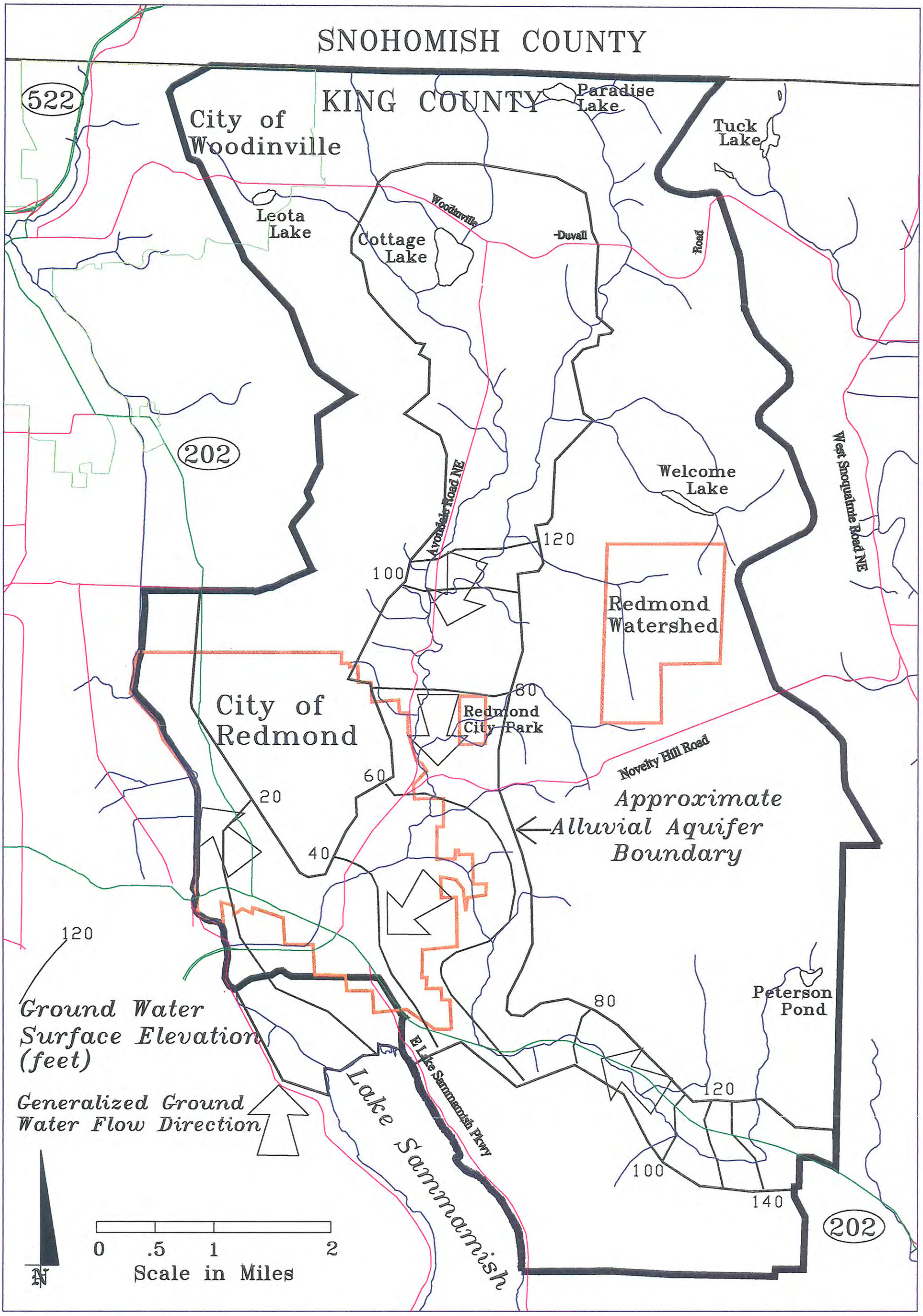


Figure 7.13 Ground Water Elevations Contours, Alluvial Aquifer (Oct. '89)

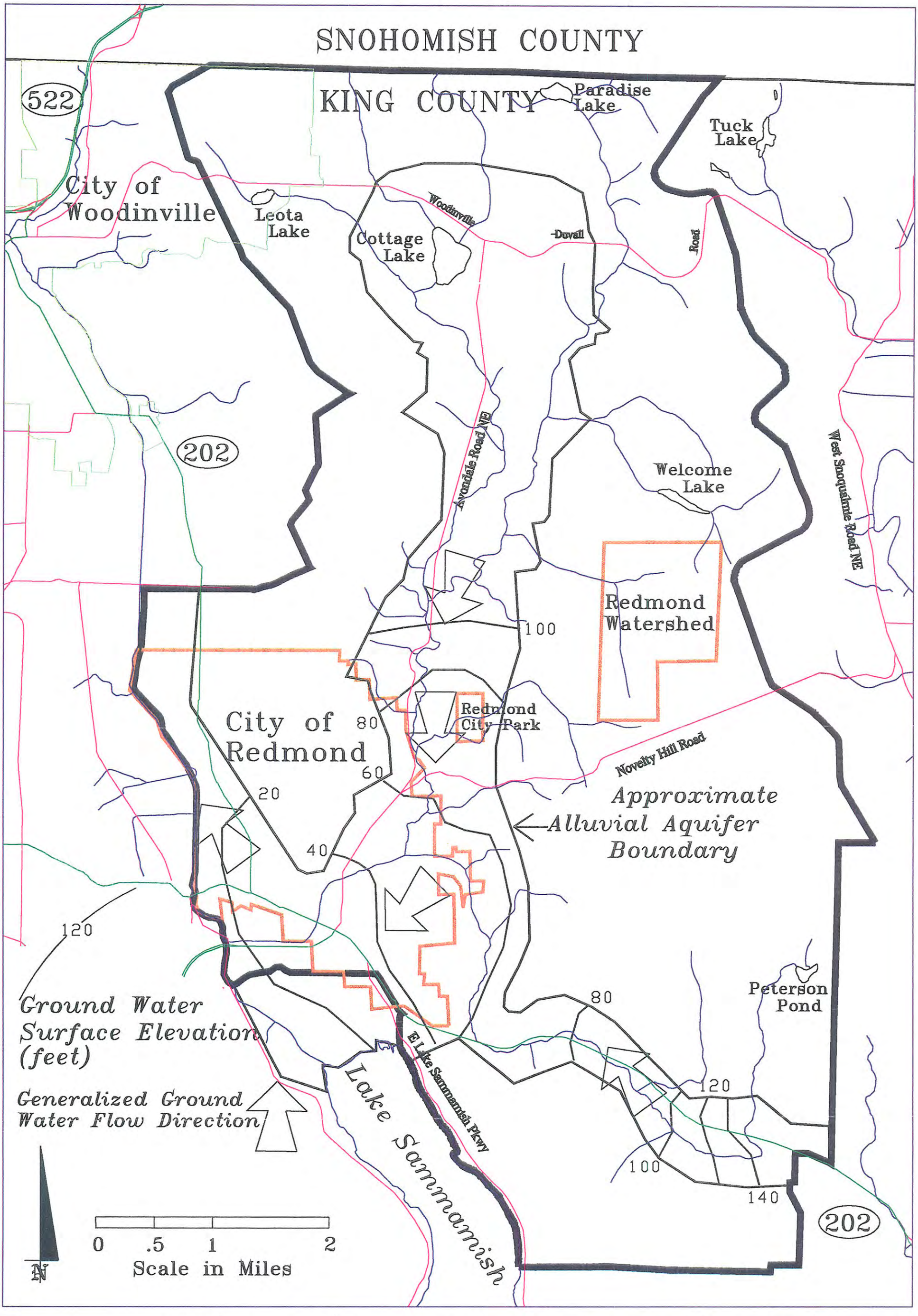


Figure 7.14 Ground Water Elevations Contours, Alluvial Aquifer (Apr. '90)

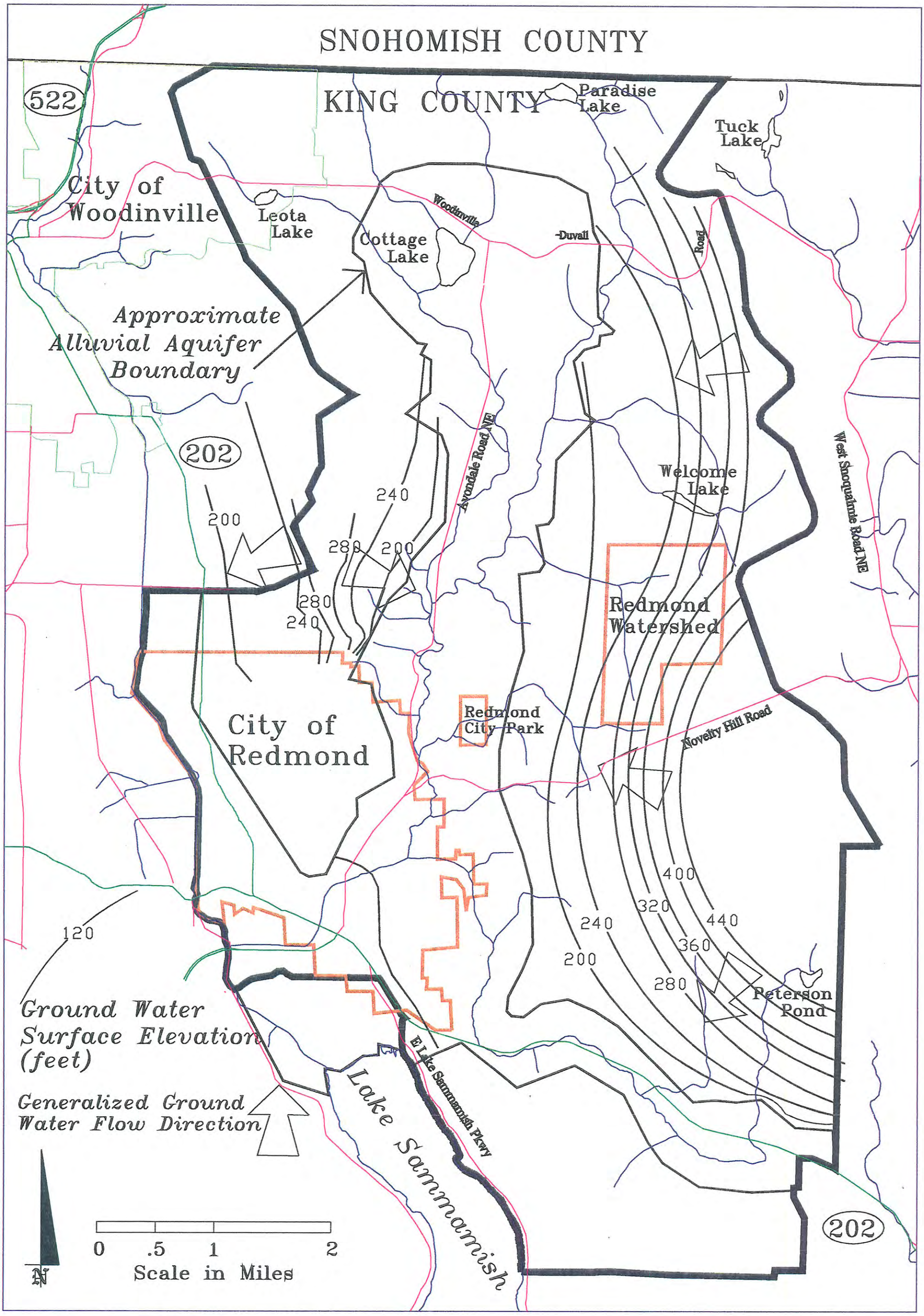


Figure 7.15 Ground Water Elevations Contours, Local Upland Aquifers (Oct. '89)

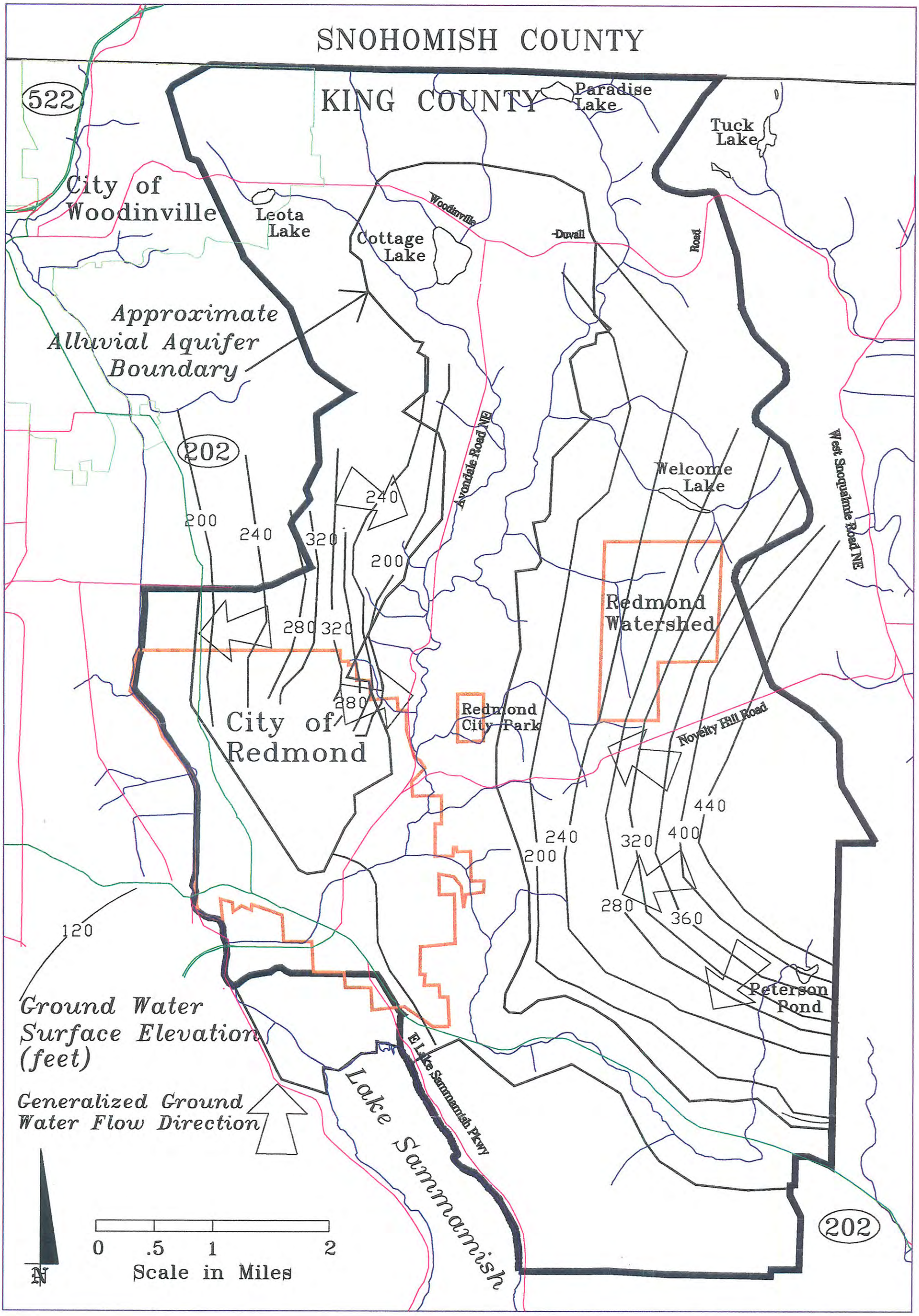


Figure 7.16 Ground Water Elevations Contours, Local Upland Aquifers (Apr. '90)

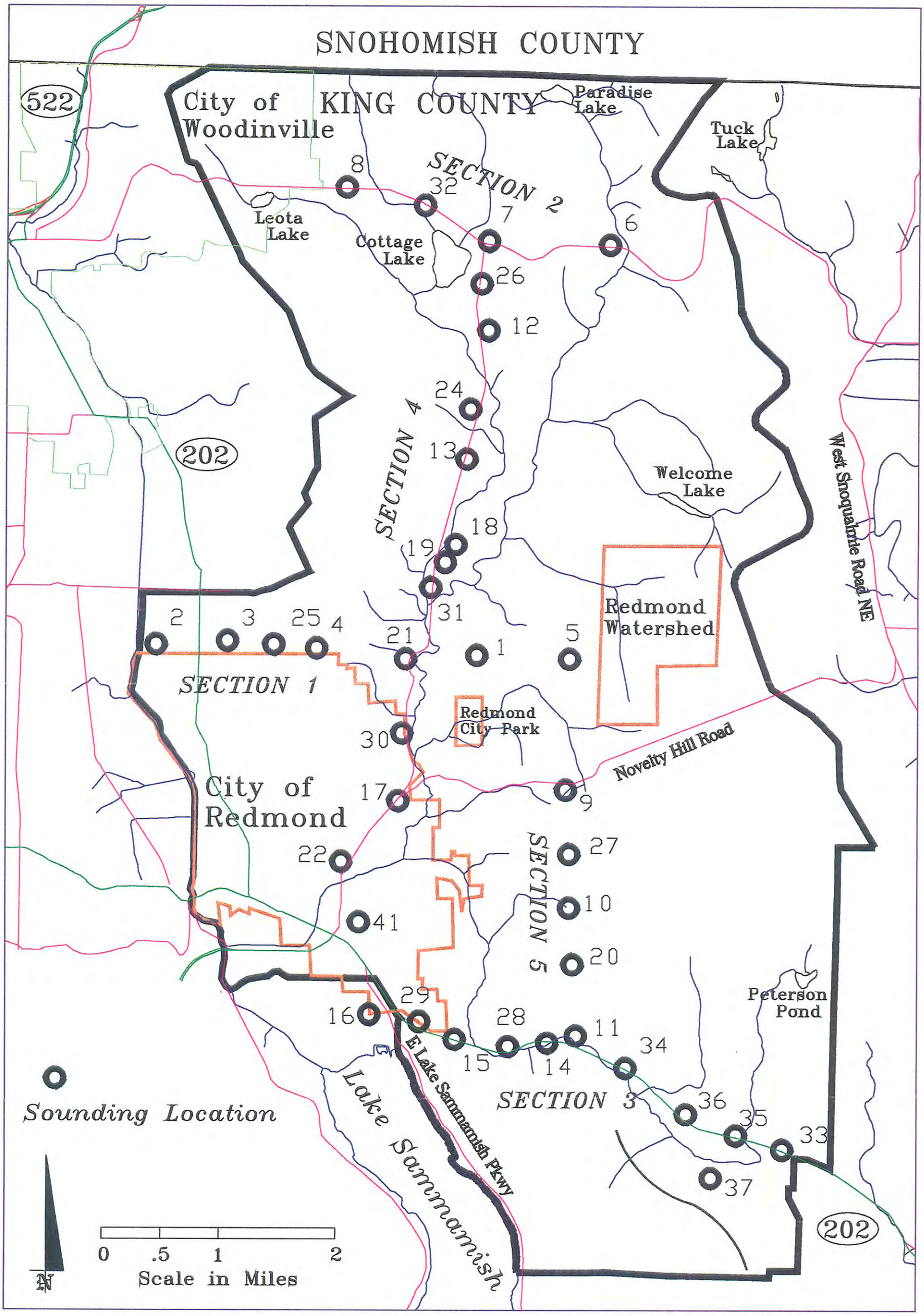
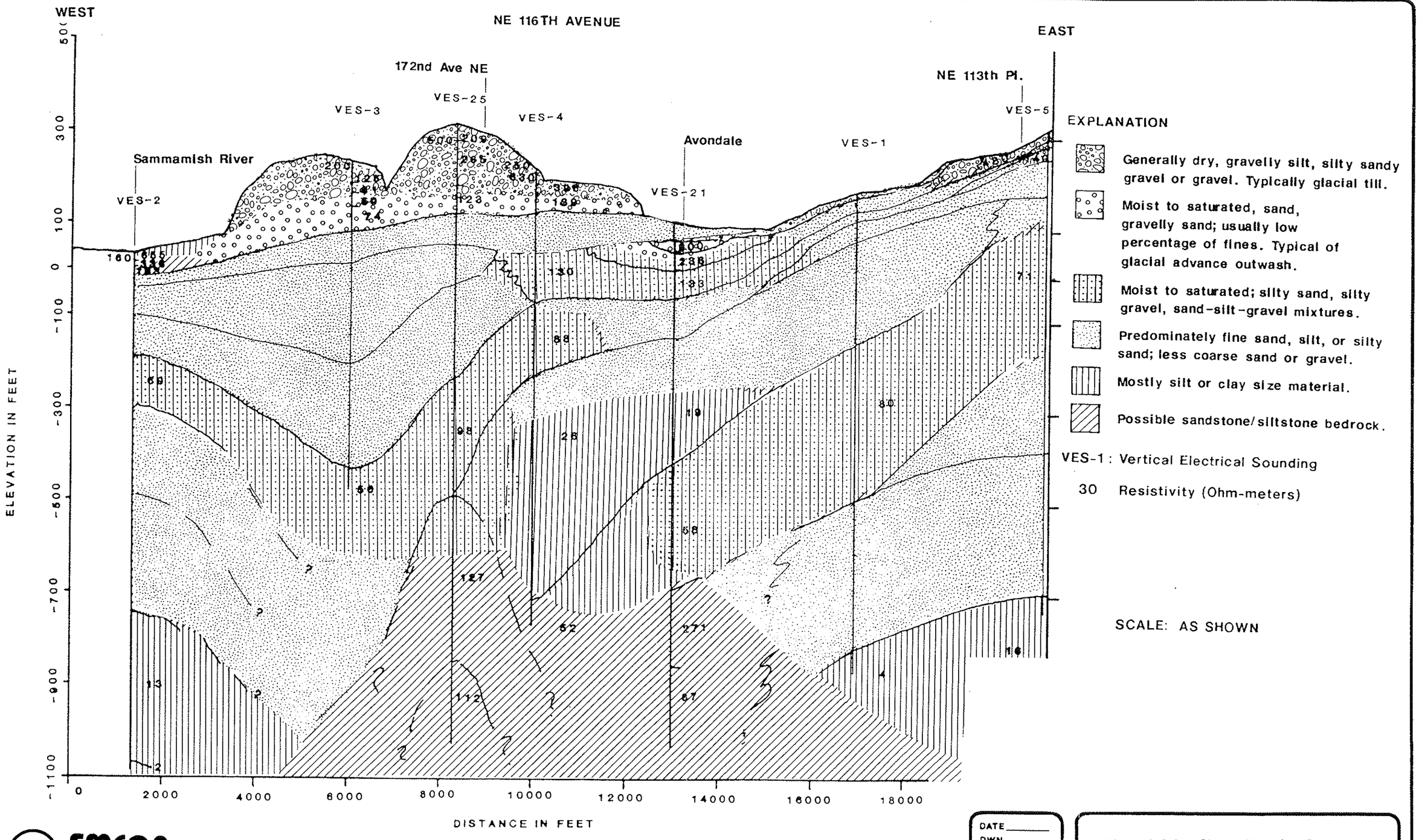


Figure 7.19 Location of Electrical Resistivity Soundings

150969



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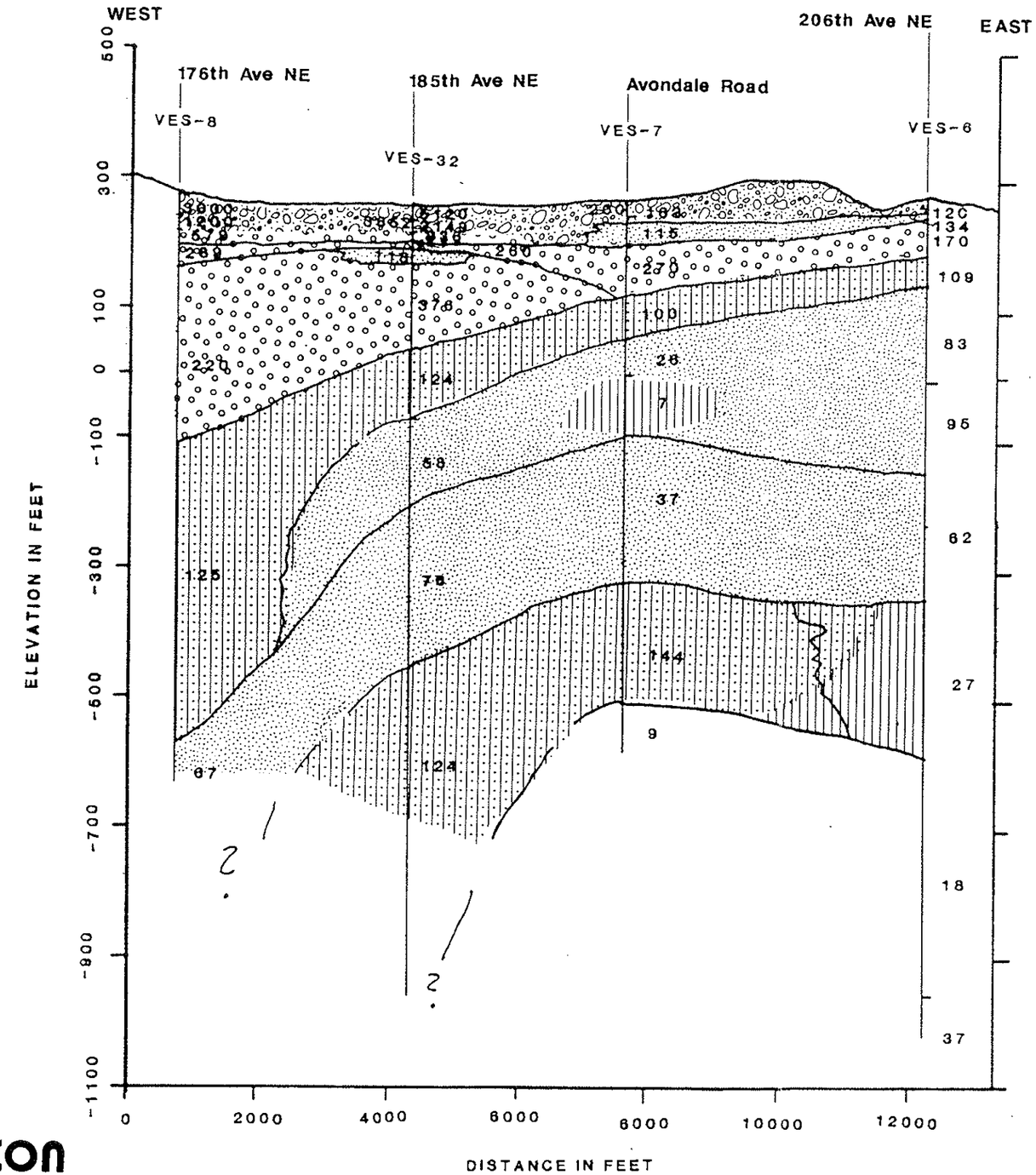
DATE
DWN.
APPR.
REVIS.
PROJECT NO. 0121-003.07

Fig. 7.20 Geophysical Section 1 - NE 116th Avenue

150969

WOODINVILLE - DUVALL ROAD



EXPLANATION

- Generally dry, gravelly silt, silty sandy gravel or gravel. Typically glacial till.
- Moist to saturated, sand, gravelly sand; usually low percentage of fines. Typical of glacial advance outwash.
- Moist to saturated; silty sand, silty gravel, sand-silt-gravel mixtures.
- Predominately fine sand, silt, or silty sand; less coarse sand or gravel.
- Mostly silt or clay size material.
- Possible sandstone/siltstone bedrock.

VES-1 : Vertical Electrical Sounding

30 Resistivity (Ohm-meters)

SCALE: AS SHOWN

EMCON Northwest, Inc.

DATE
DWN.
APPR.
REVIS.
PROJECT NO. 0121-003.07

Fig. 7.21 Geophysical Section 2 - Woodinville-Duvall Rd.

150969

REDMOND-FALL CITY ROAD

WEST

EAST

180th Ave NE

196th Ave NE

Sahalee Way

236th Ave NE

VES-16 VES-29 VES-15 VES-28 VES-14 VES-34 VES-36 VES-35 VES-33

ELEVATION IN FEET

300 100 -100 -300 -500 -700 -900 -1100 -1300

0 2000 4000 6000 8000 10000 12000 14000 16000 18000

DISTANCE IN FEET

EXPLANATION

- Generally dry, gravelly silt, silty sandy gravel or gravel. Typically glacial till.
- Moist to saturated, sand, gravelly sand; usually low percentage of fines. Typical of glacial advance outwash.
- Moist to saturated; silty sand, silty gravel, sand-silt-gravel mixtures.
- Predominately fine sand, silt, or silty sand; less coarse sand or gravel.
- Mostly silt or clay size material.
- Possible sandstone/siltstone bedrock.

VES-15 : Vertical Electrical Sounding

32 Resistivity (Ohm-meters)

SCALE: AS SHOWN

EMCON Northwest, Inc.

DATE
DWN.
APPR.
REVIS.
PROJECT NO. 0121-003.07

Fig. 7.22 Geophysical Section 3 - Redmond-Fall City Rd.

150969

AVONDALE ROAD

NORTH

SOUTH

Woodinville - Duvall Road

VES-7 VES-26 VES-12 VES-24 VES-13 NE 132nd St. VES-31 NE 116th St. VES-21 VES-30 Novelty Hill Road VES-17 VES-22 Union Hill Road VES-41 VES-16

ELEVATION IN FEET

500 300 100 -100 -300 -500 -700 -900 -1100

0 2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 22000 24000 26000 28000 30000 32000 34000 36000

DISTANCE IN FEET

EXPLANATION

- Generally dry, gravelly silt, silty sandy gravel or gravel. Typically glacial till.
- Moist to saturated, sand, gravelly sand; usually low percentage of fines. Typical of glacial advance outwash.
- Moist to saturated; silty sand, silty gravel, sand-silt-gravel mixtures.
- Predominately fine sand, silt, or silty sand; less coarse sand or gravel.
- Mostly silt or clay size material.
- Possible sandstone/siltstone bedrock.

VES-7 : Vertical Electrical Sounding

64 Resistivity (Ohm-meters)

SCALE: AS SHOWN

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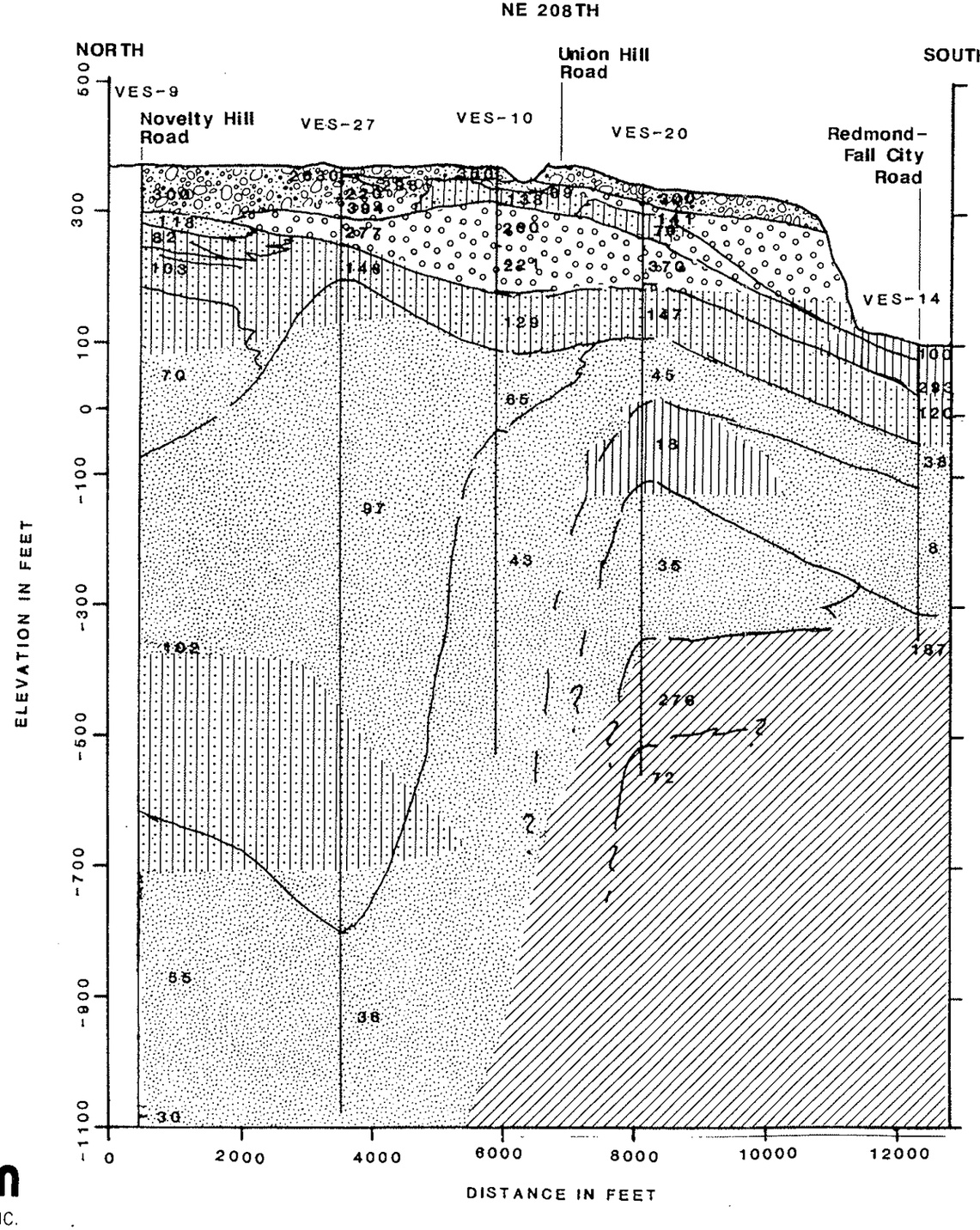
Fig. 7.23 Geophysical Section 4- Avondale Road

150969



EXPLANATION

- Generally dry, gravelly silt, silty sandy gravel or gravel. Typically glacial till.
- Moist to saturated, sand, gravelly sand; usually low percentage of fines. Typical of glacial advance outwash.
- Moist to saturated; silty sand, silty gravel, sand-silt-gravel mixtures.
- Predominately fine sand, silt, or silty sand; less coarse sand or gravel.
- Mostly silt or clay size material.
- Possible sandstone/siltstone bedrock.

VES-9 : Vertical Electrical Sounding

36 Resistivity (Ohm-meters)

SCALE: AS SHOWN

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Fig. 7.24 Geophysical Section 5 - NE 208th Avenue

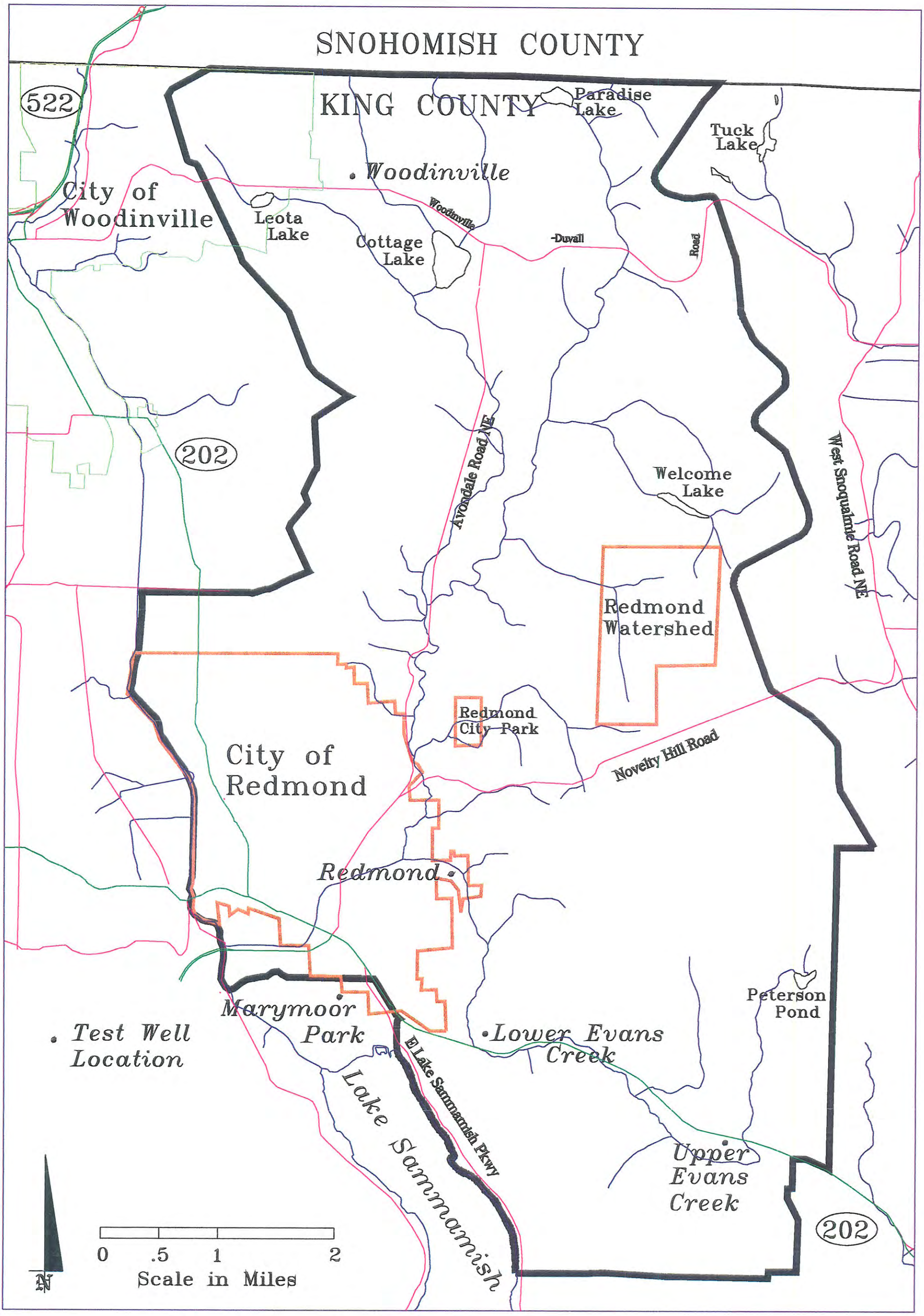

Figure 7.25 Location Of New Test Wells

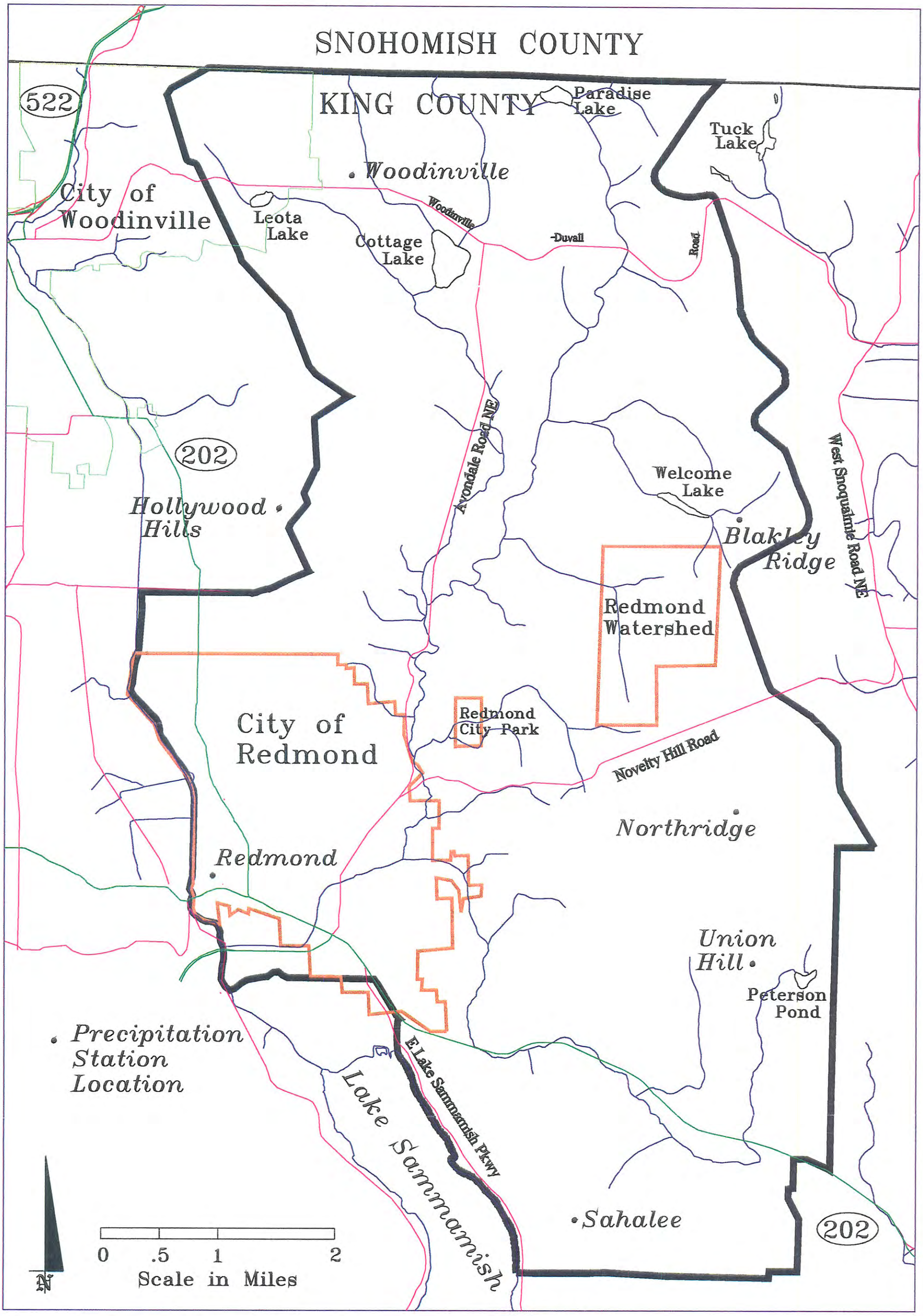

Figure 7.26 Precipitation Station Locations

150969

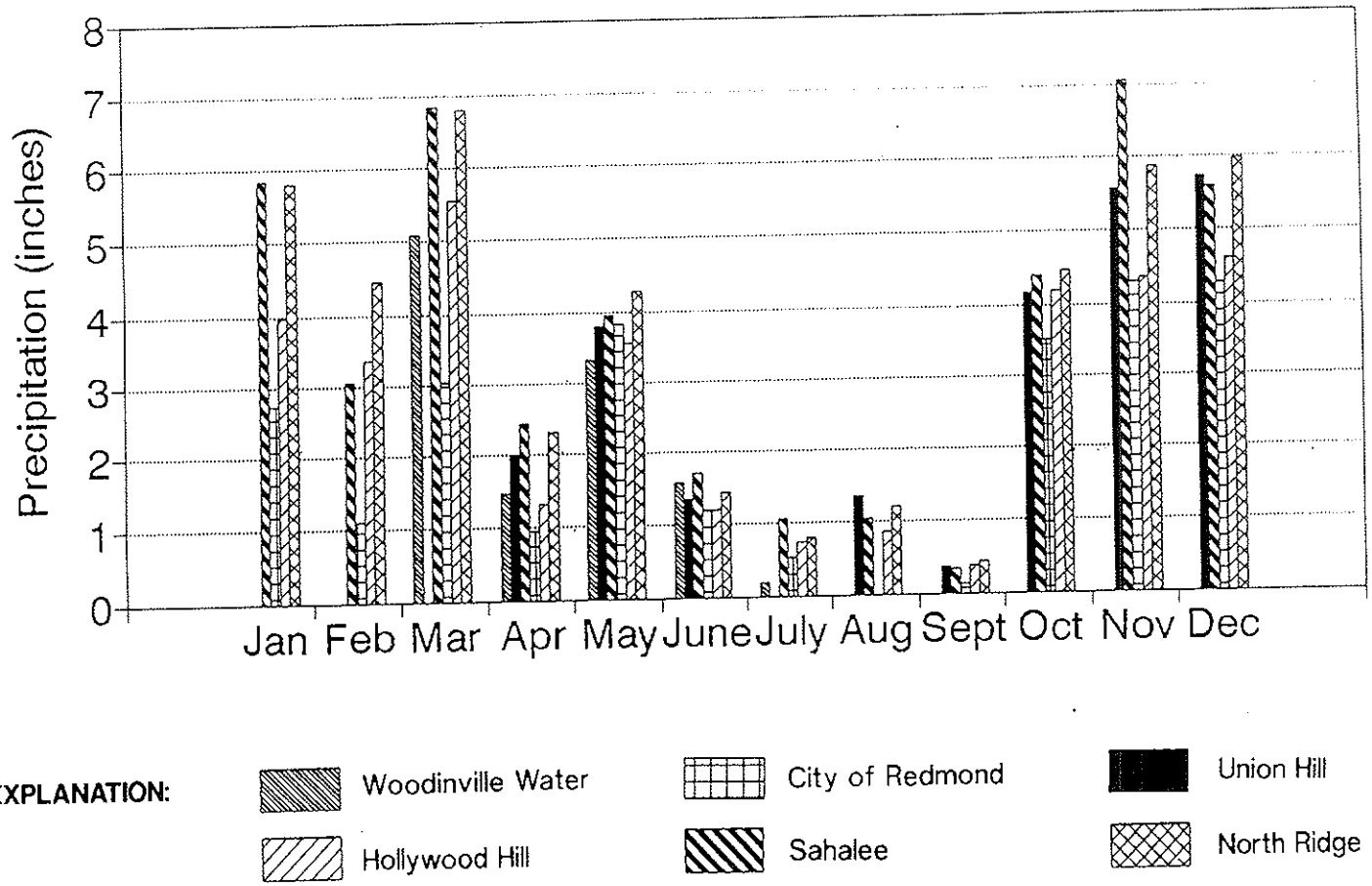

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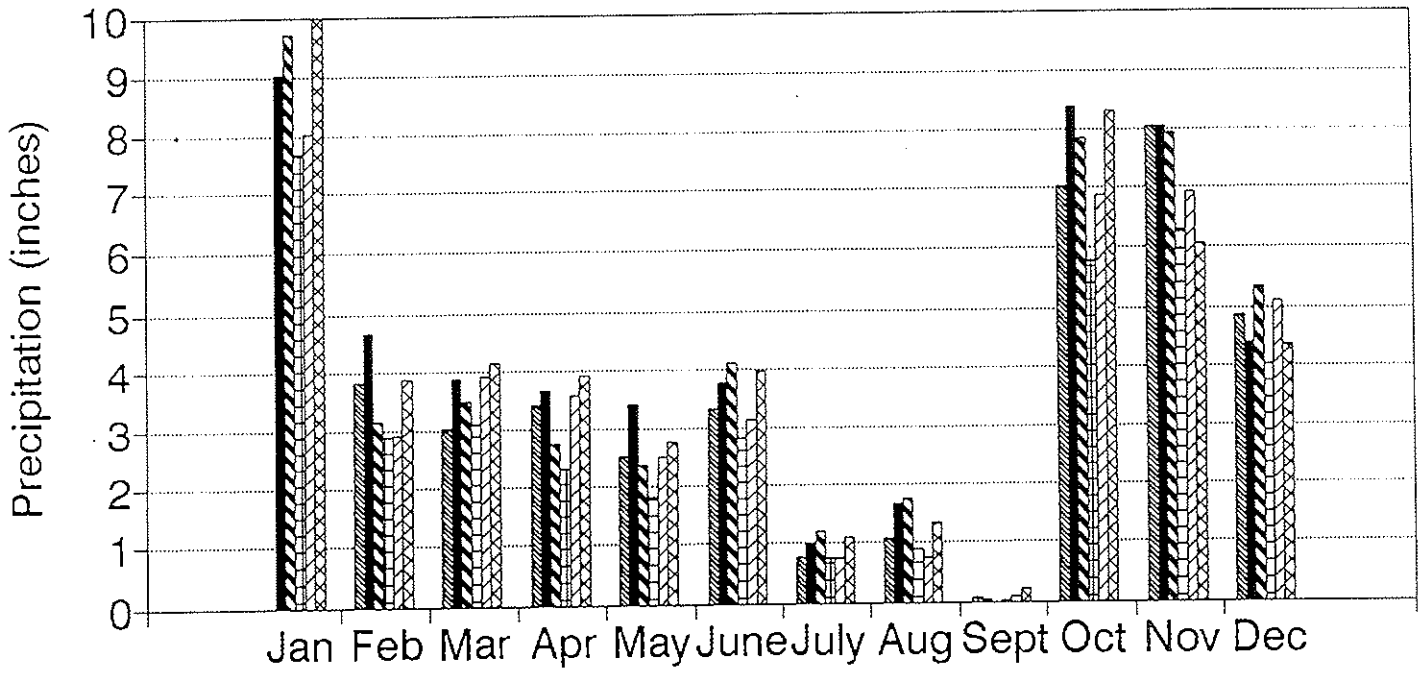
Fig. 7.27 Monthly Precipitation 1989

150969



EXPLANATION:

- Woodinville Water
- City of Redmond
- Union Hill
- Hollywood Hill
- Sahalee
- North Ridge MPD

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Fig. 7.28 Monthly Precipitation 1990

150969

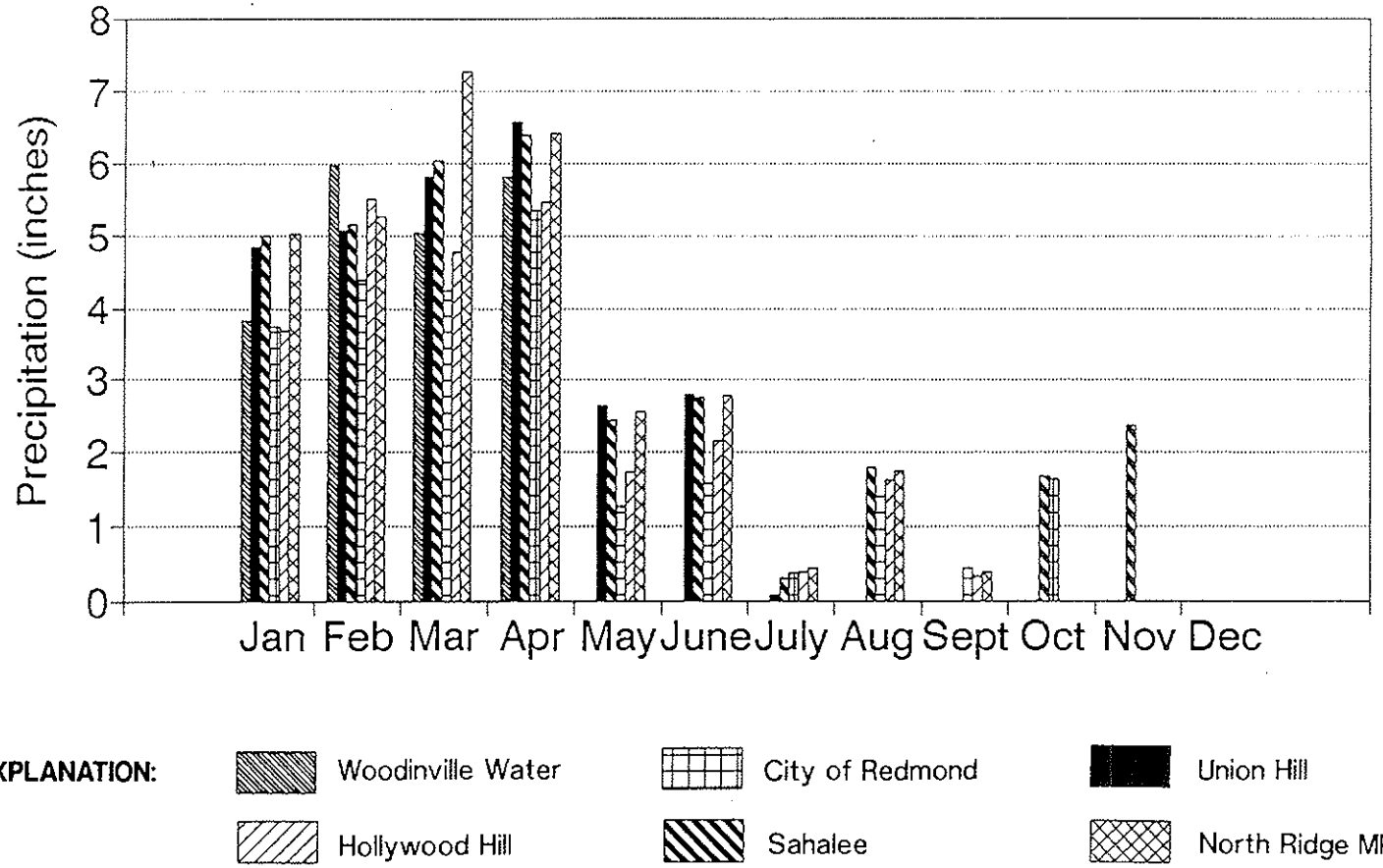

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Fig. 7.29 Monthly Precipitation 1991

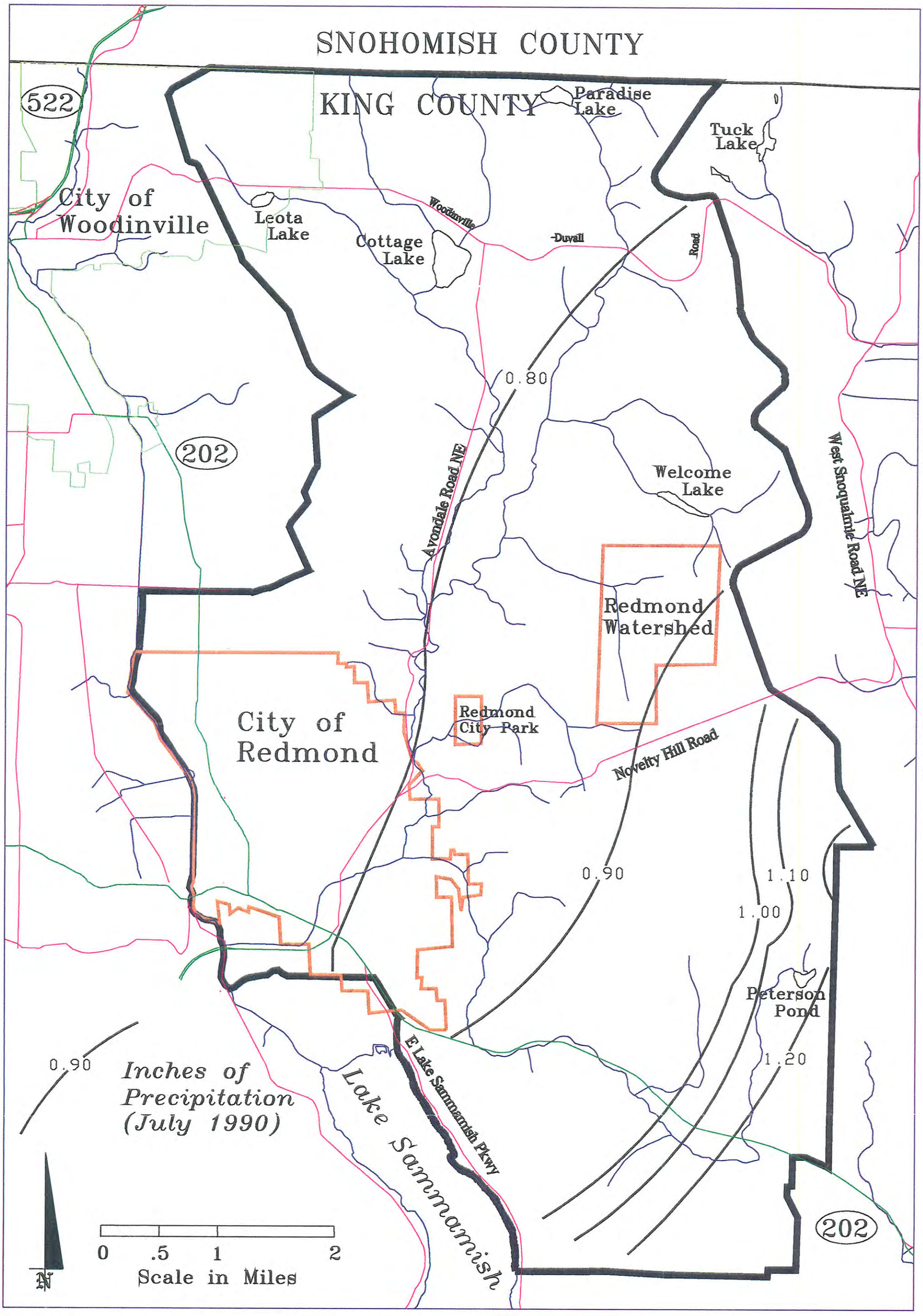

Figure 7.30 Isohyetal Map (July 1990)

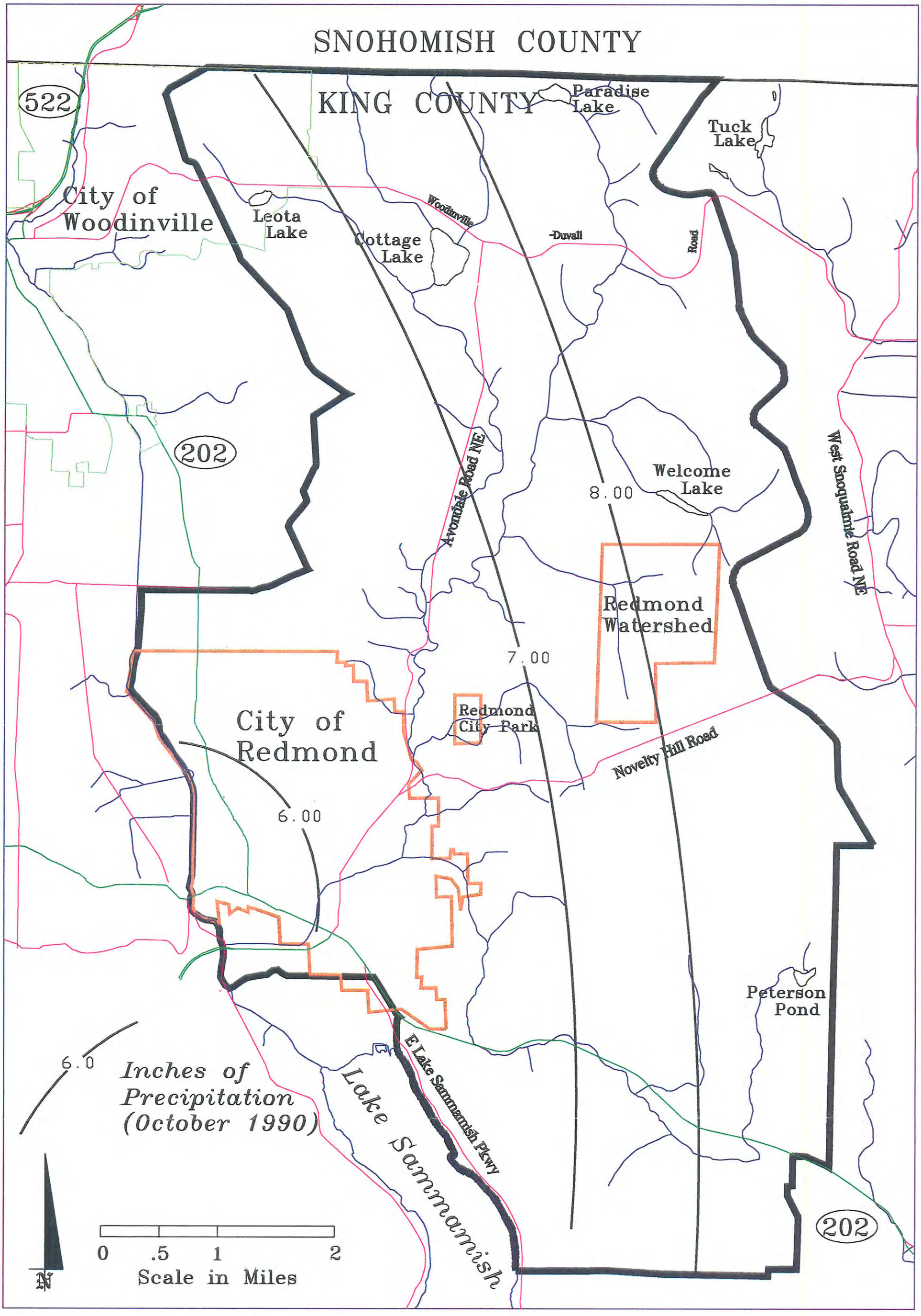

Figure 7.31 Isohyetal Map (October 1990)

150969

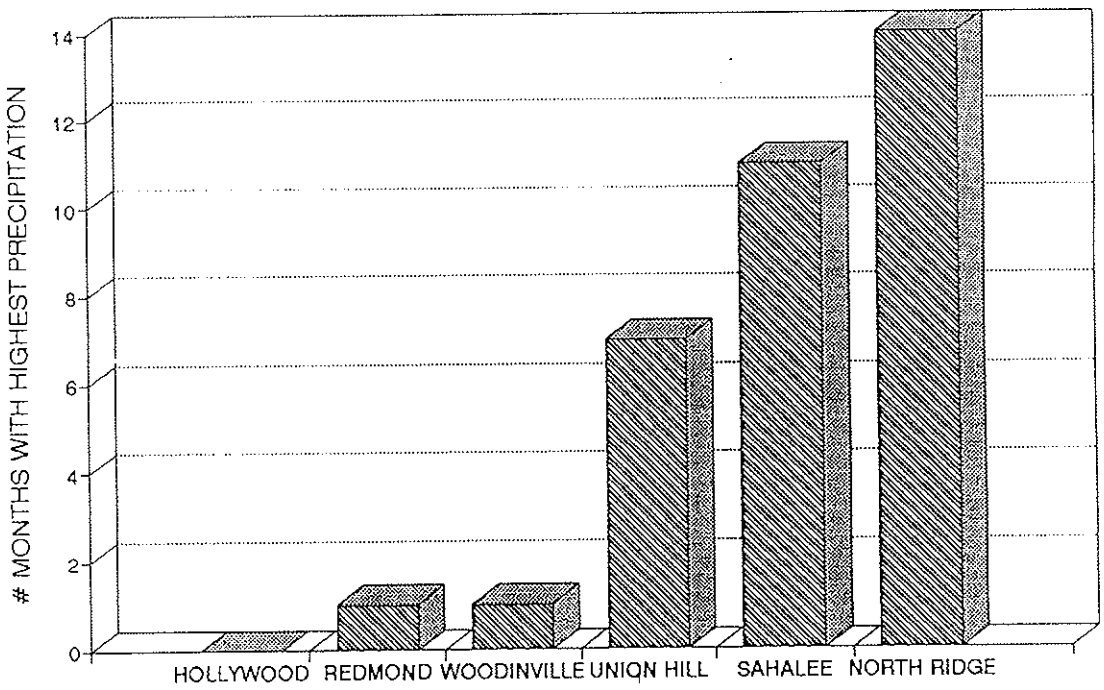

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Fig. 7.32 Frequency of Highest Recorded Precipitation

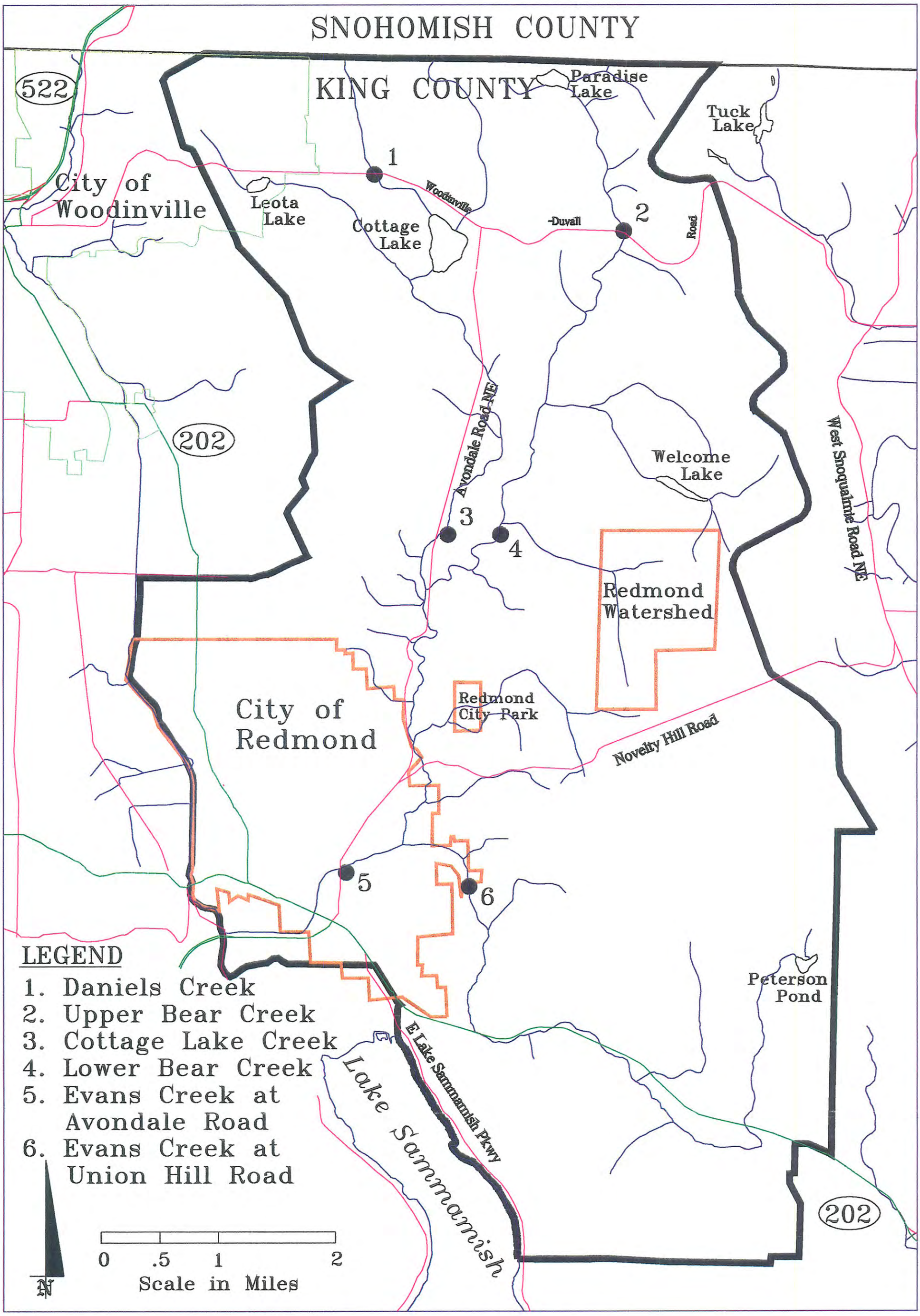

Figure 7.33 Location Of Stream Gauging Stations

150969

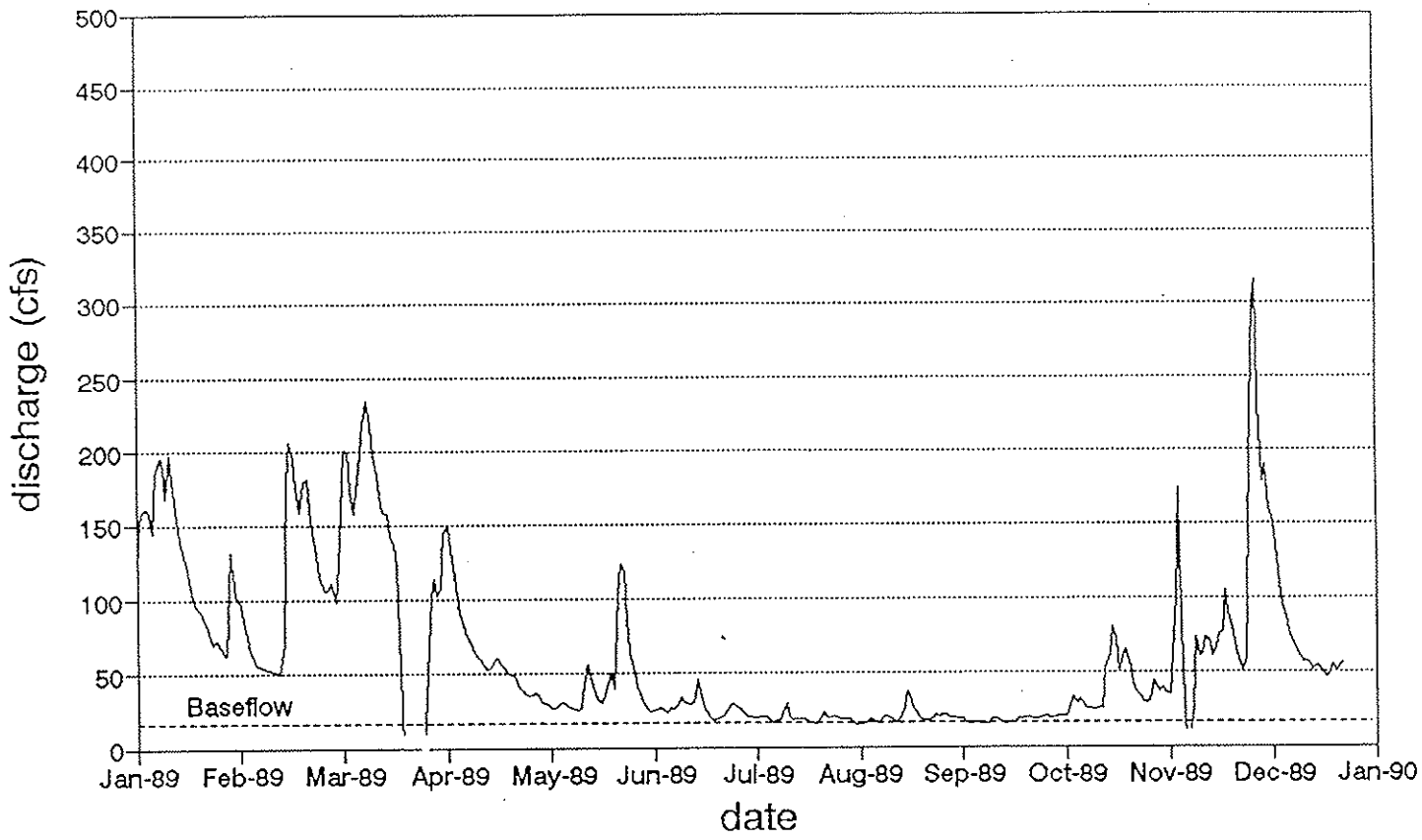

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Fig. 7.34 Stream Flow Hydrograph for Station 5-1989

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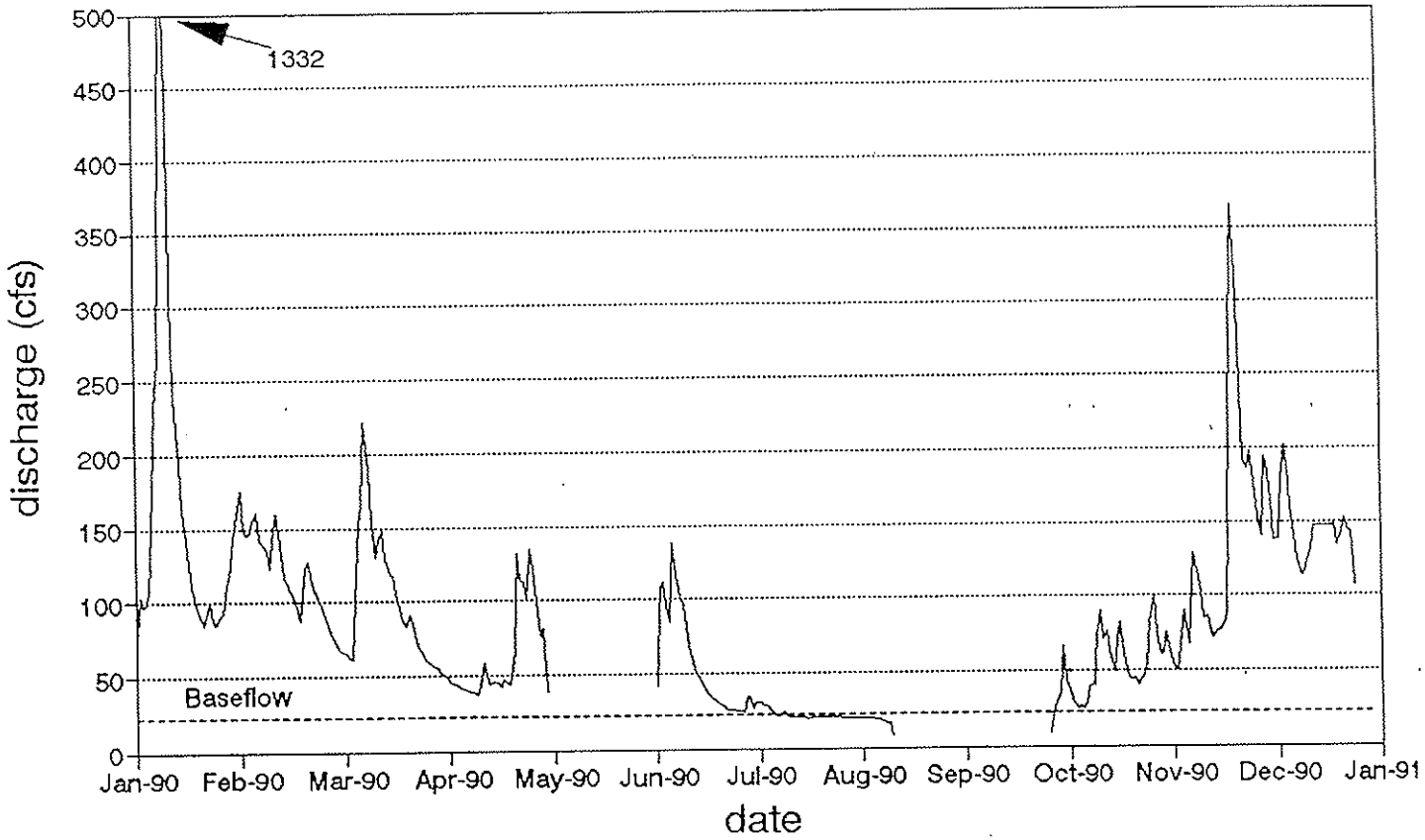

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Fig. 7.35 Stream Flow Hydrograph for Station 5-1990

150969

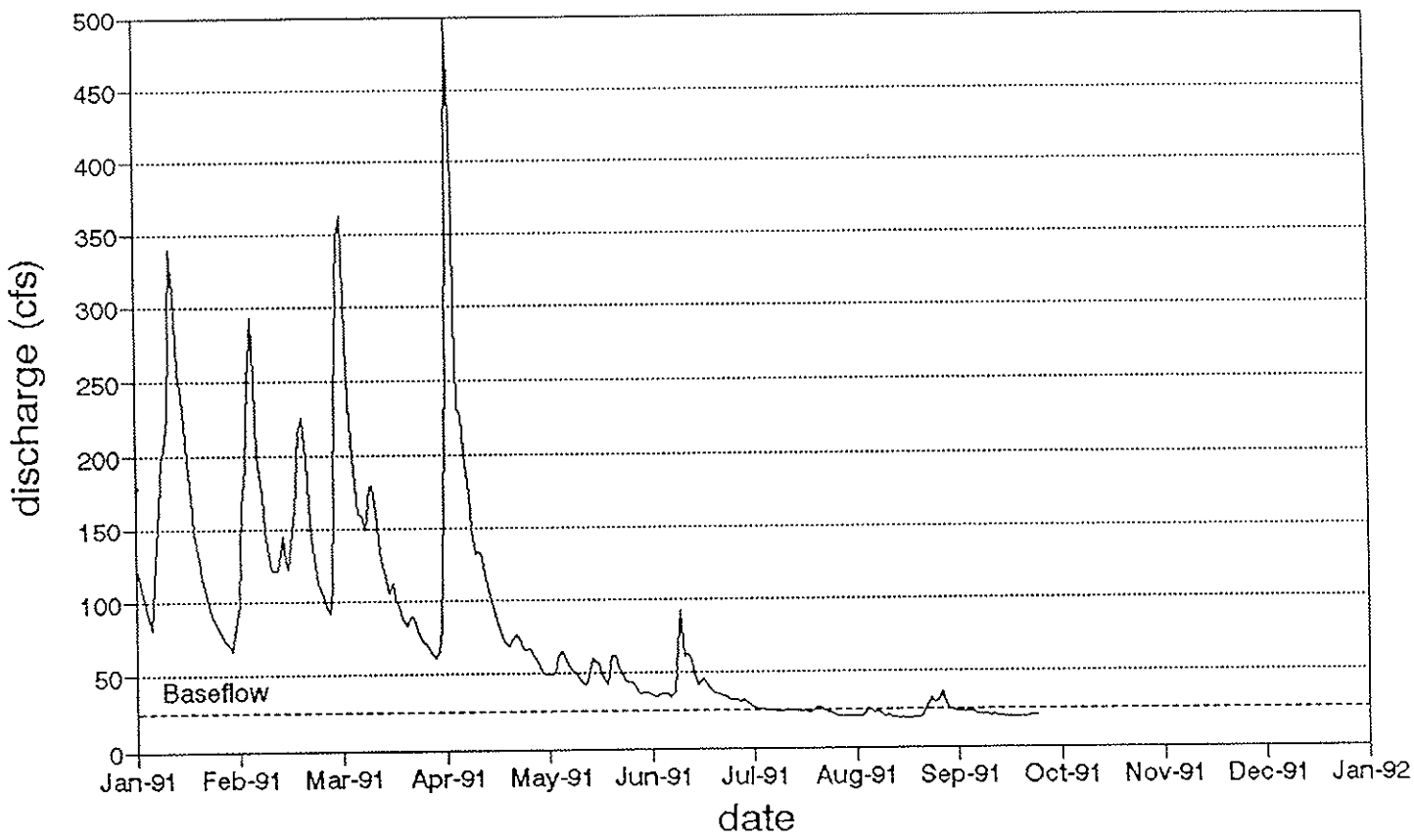

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Fig. 7.36 Stream Flow Hydrograph for Station 5-1991

150989

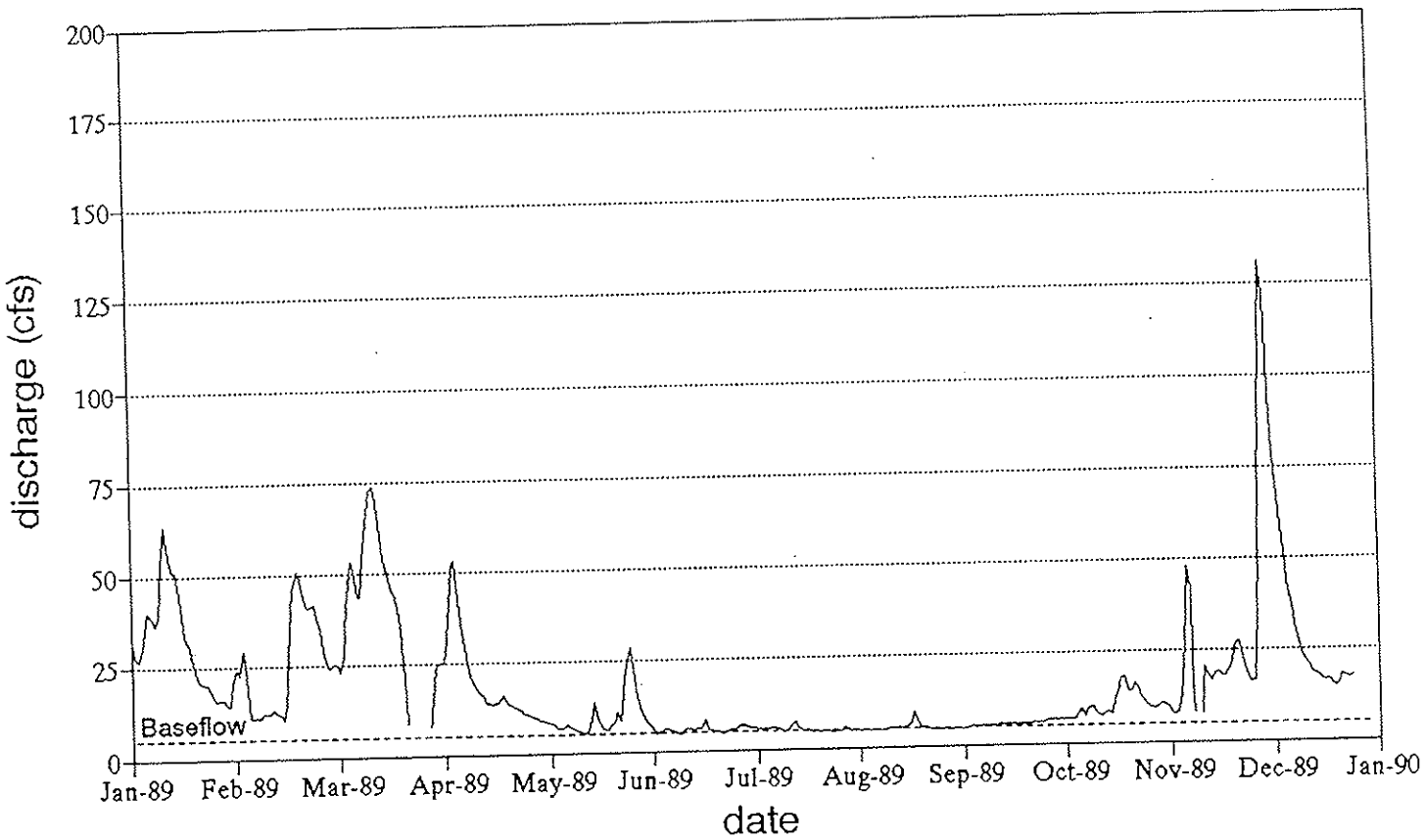

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Fig. 7.37 Stream Flow Hydrograph for Station 6-1989

150969

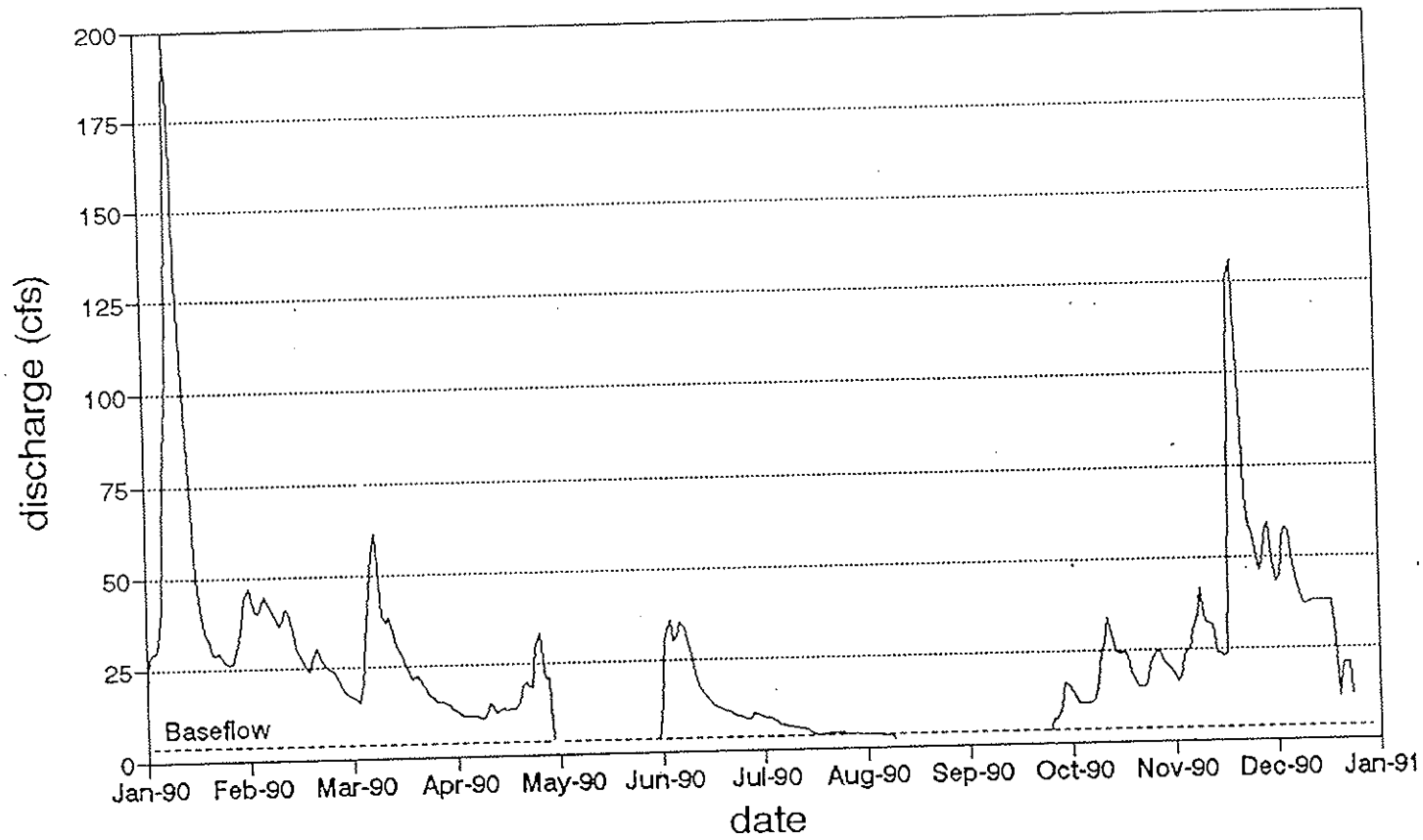

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Fig. 7.38 Stream Flow Hydrograph for Station 6-1990

150969

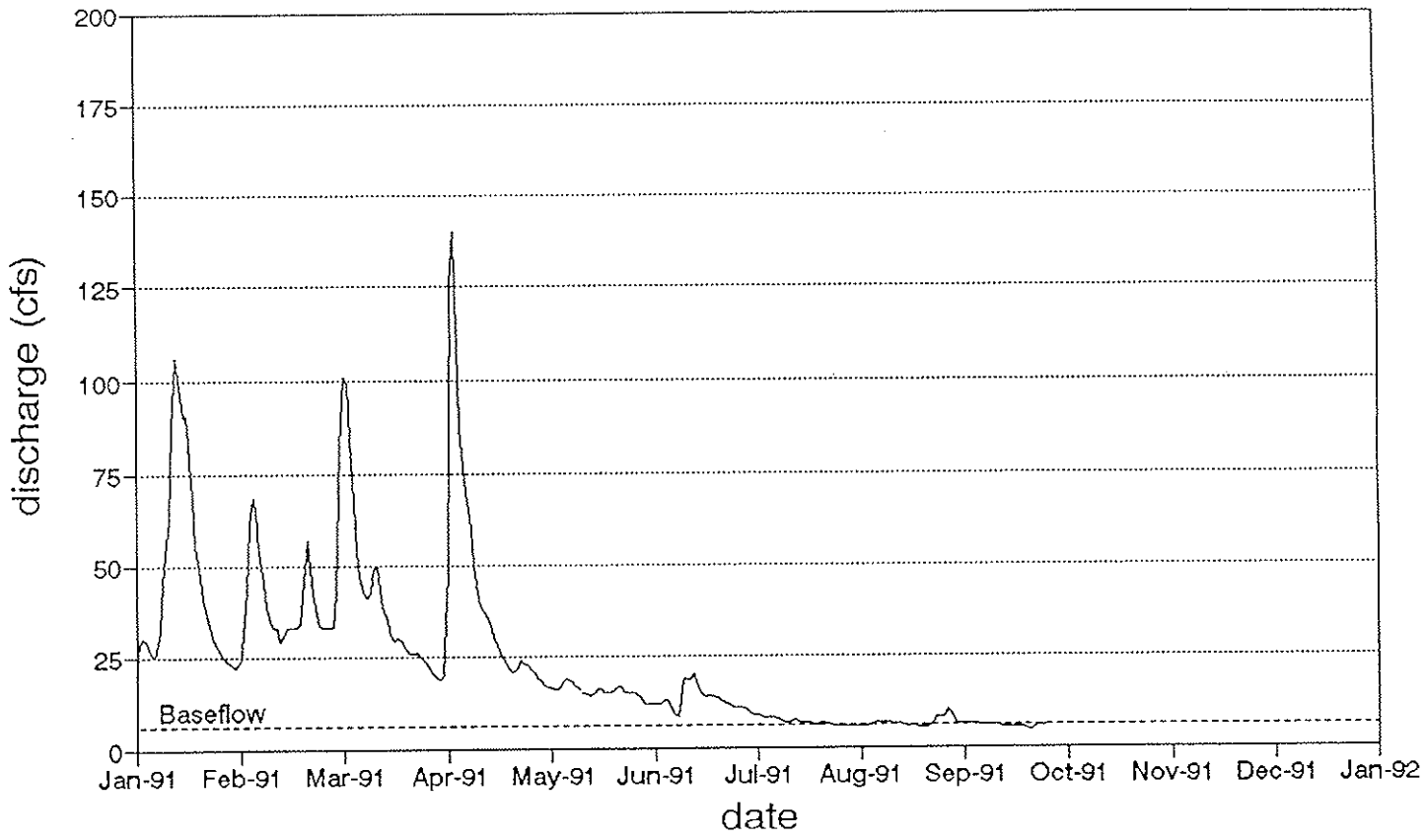

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Fig. 7.39 Stream Flow Hydrograph for Station 6-1991

150969

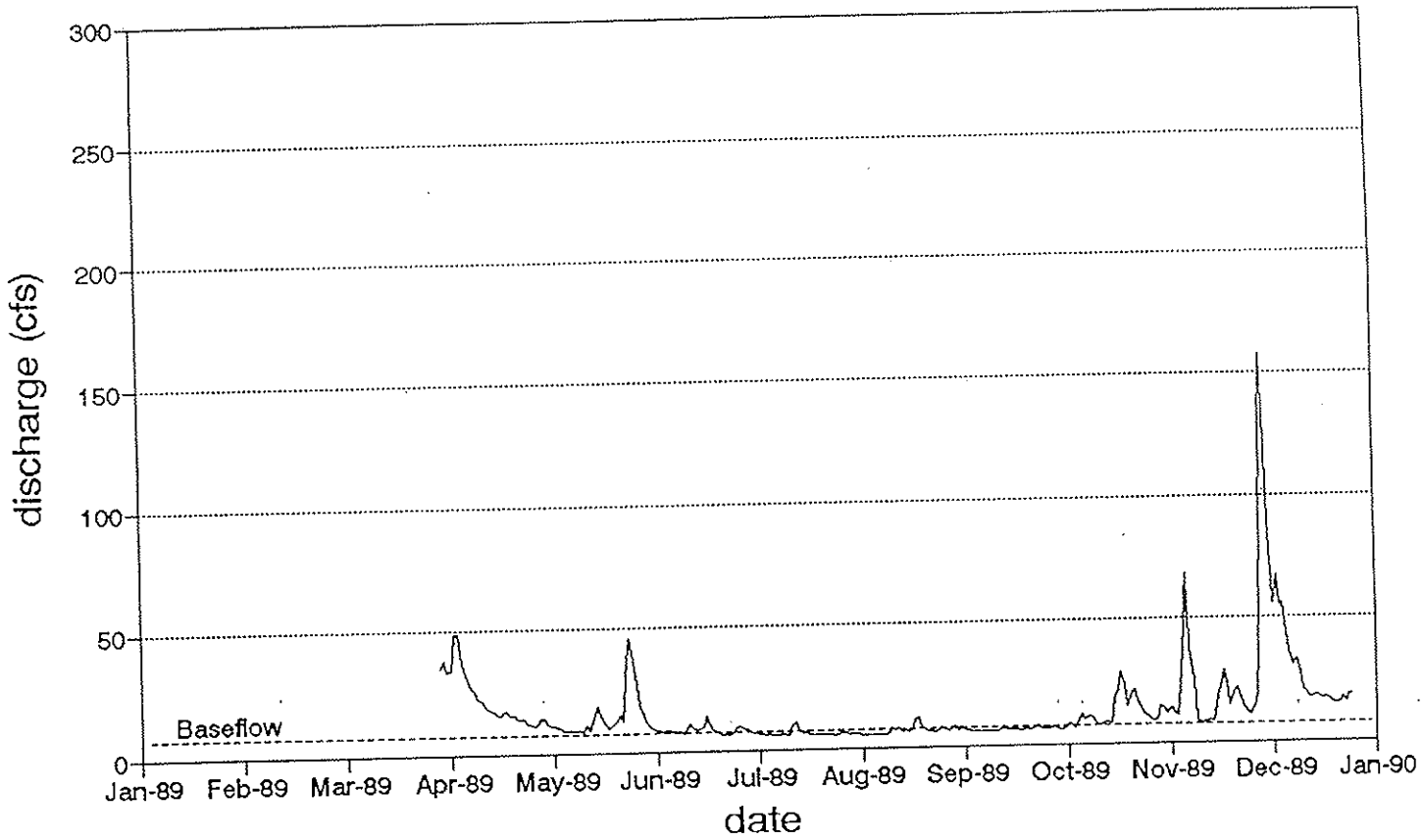

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Fig. 7.40 Stream Flow Hydrograph for Station 4-1989

150969

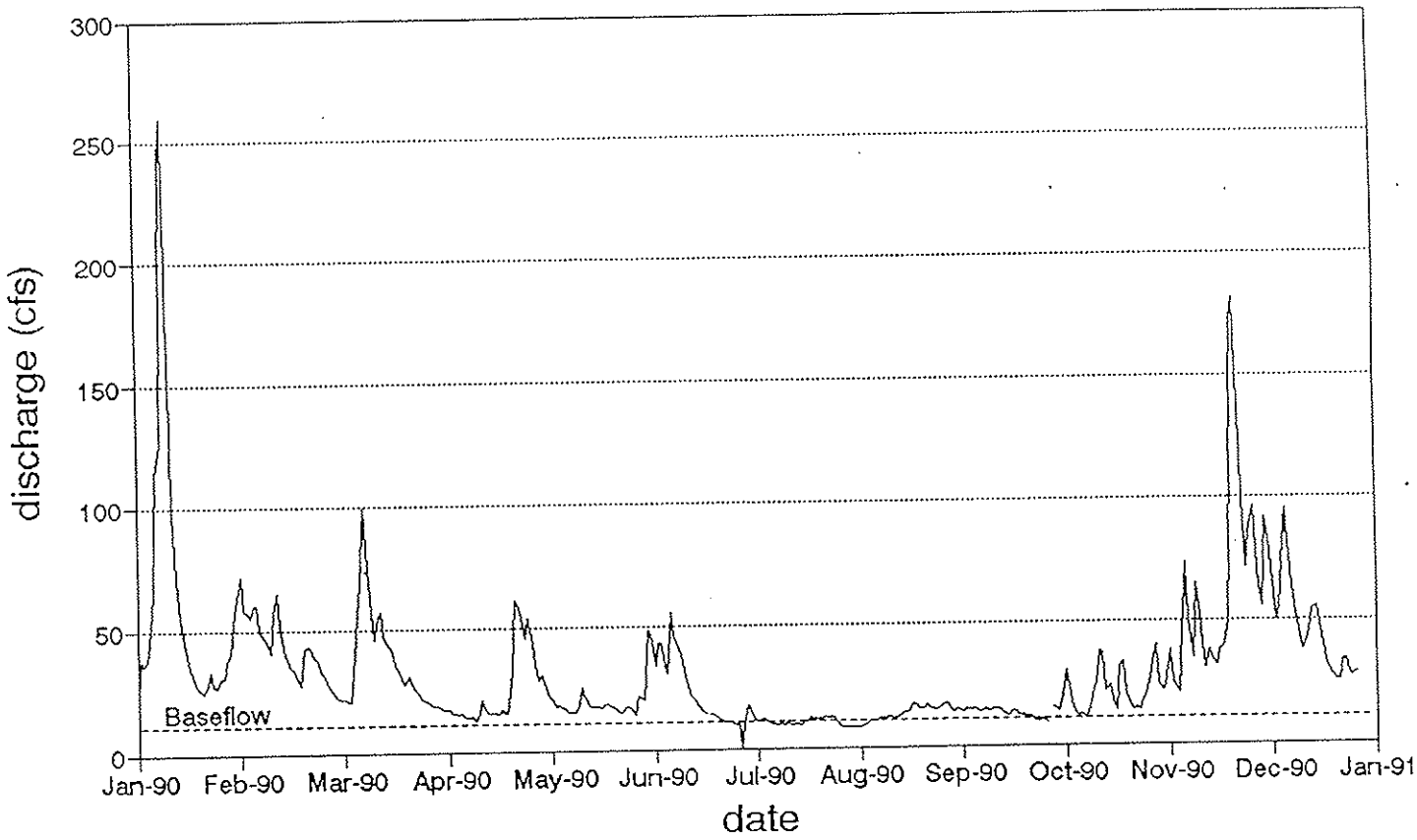

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Fig. 7.41 Stream Flow Hydrograph for Station 4-1990

150969

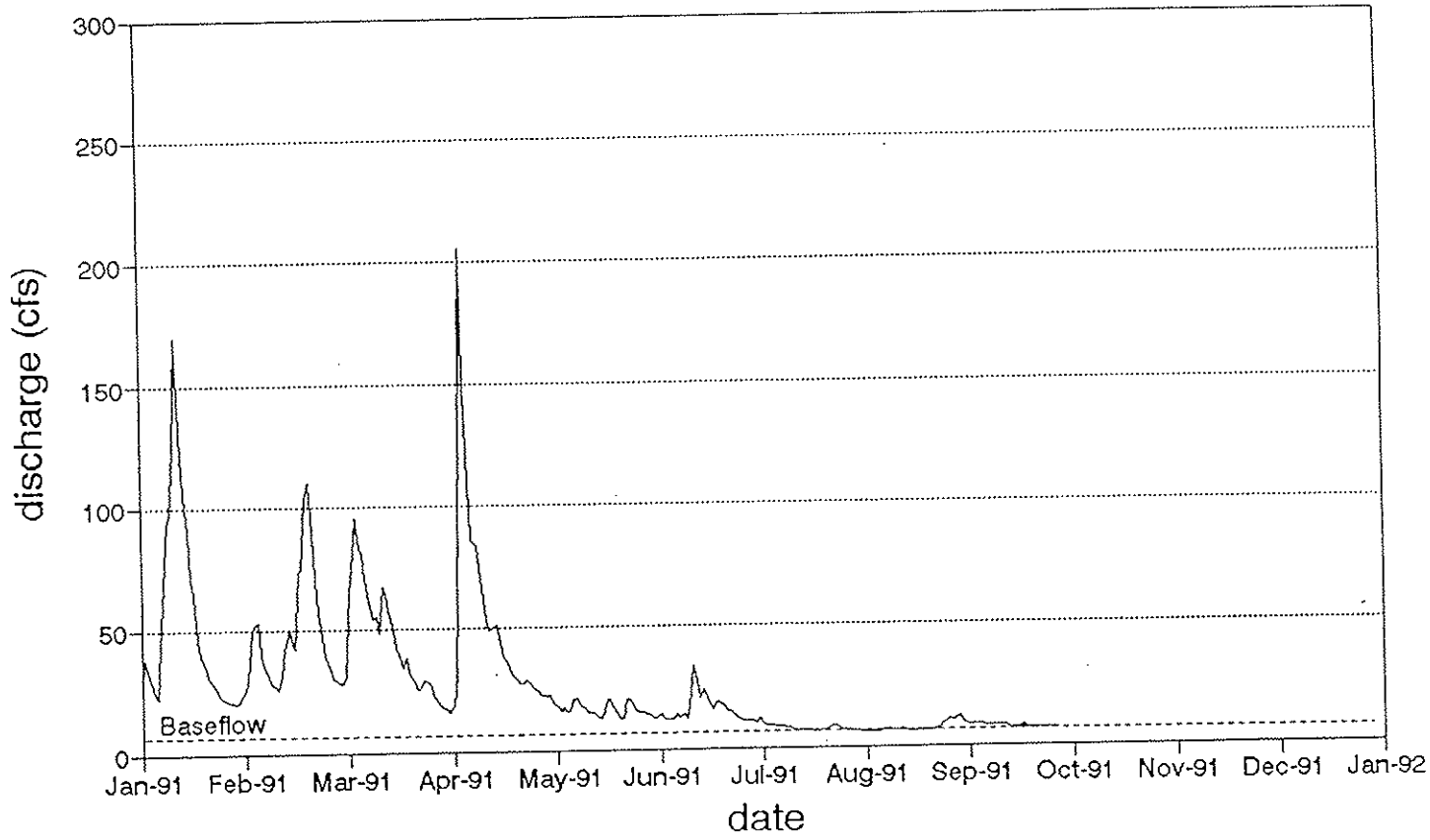

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Fig. 7.42 Stream Flow Hydrograph for Station 4 - 1991

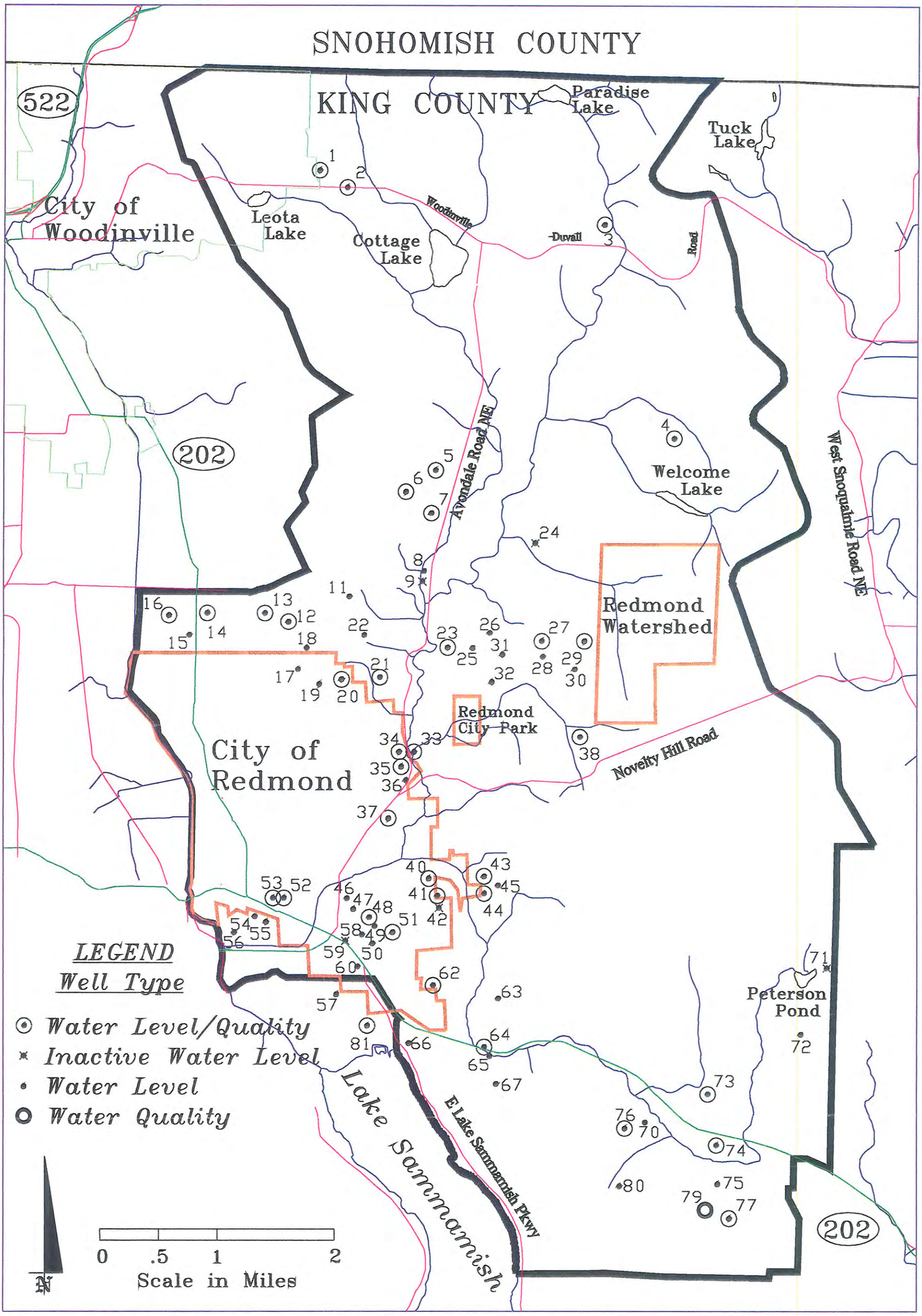

Figure 7.43 Location of Monitoring Wells in Redmond-Bear Creek GWMA

150989

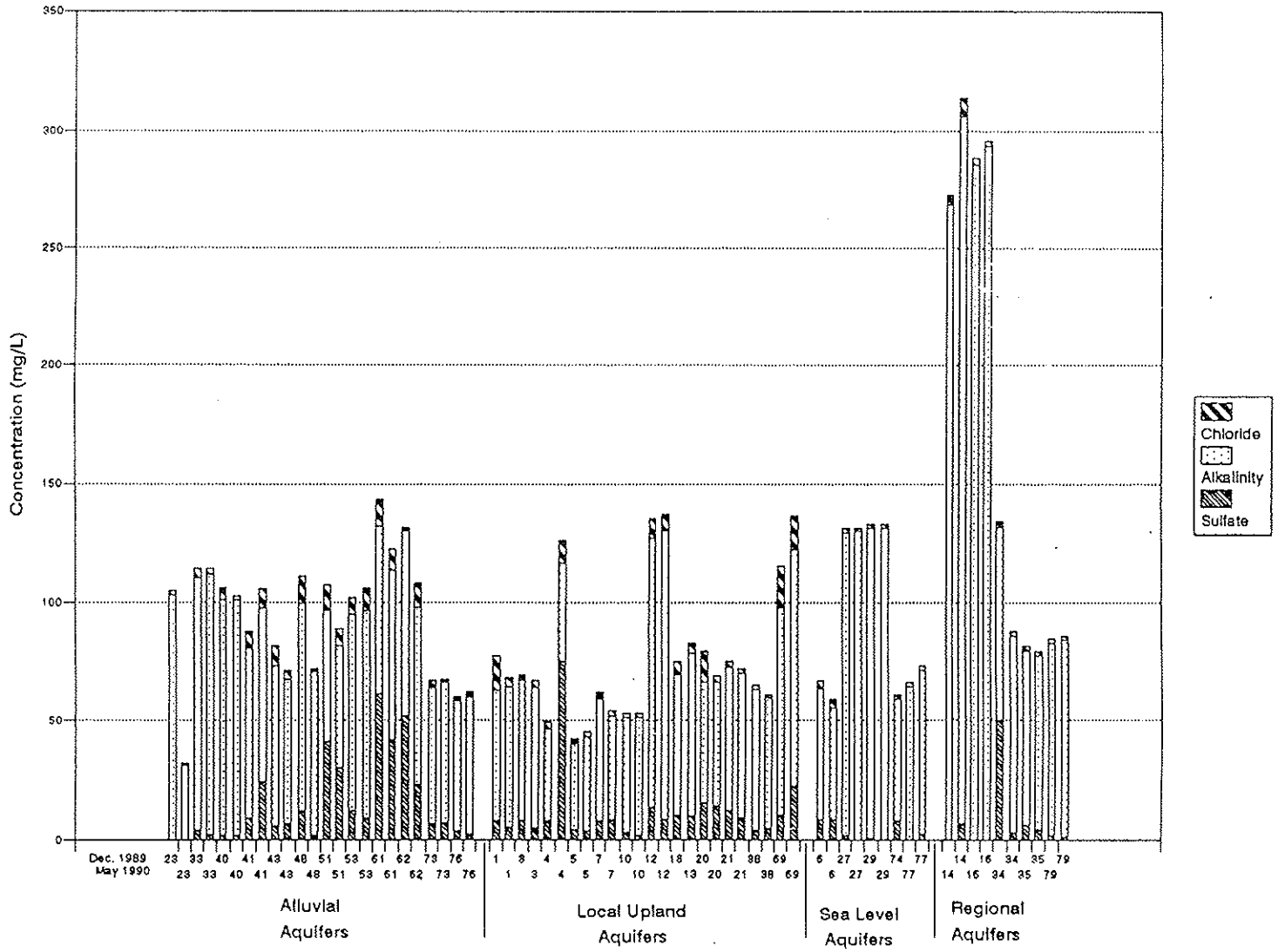

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Fig. 7.44 Distribution of Major Anion Concentrations in Ground Water

150969

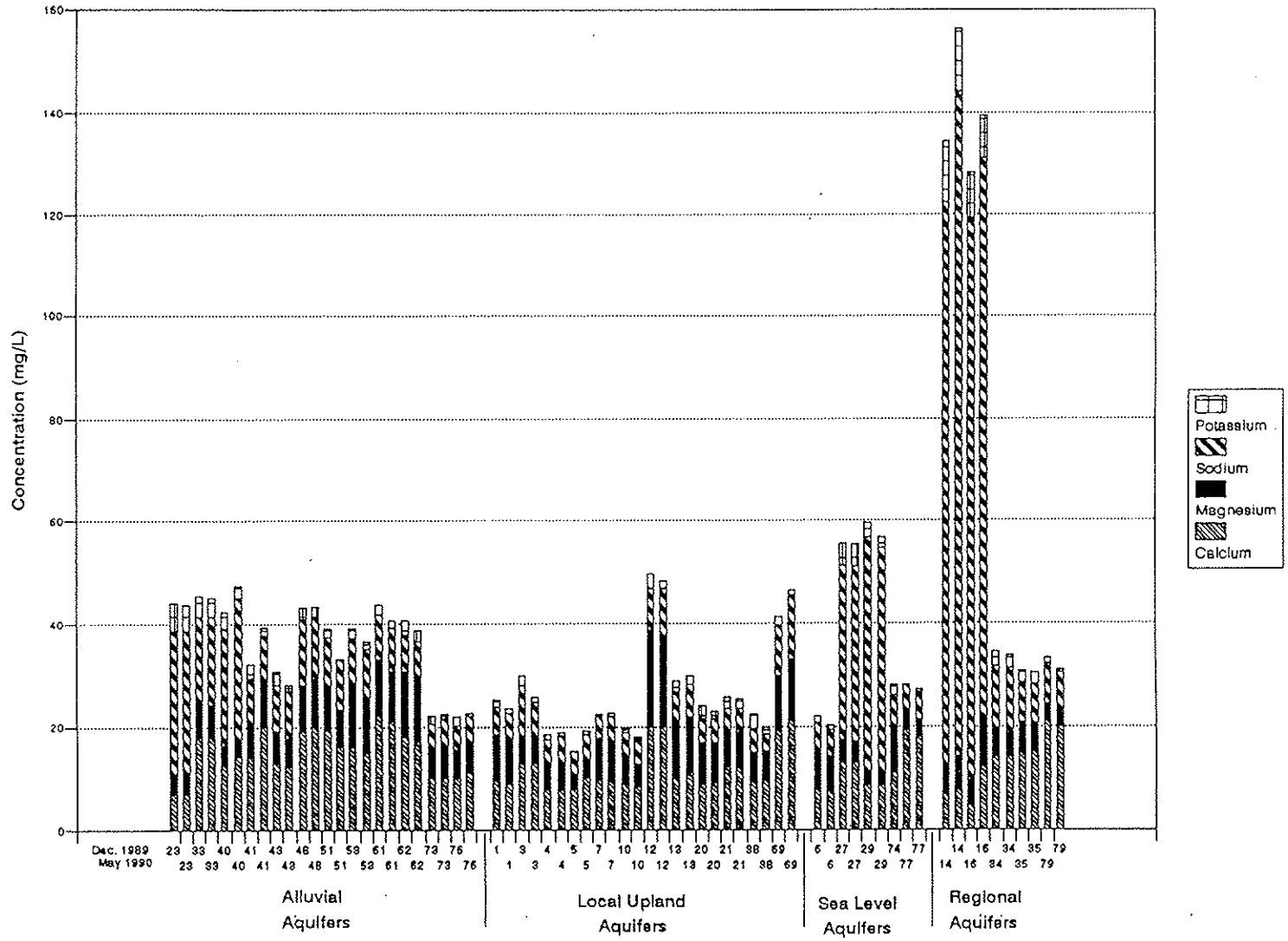

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Fig. 7.45 Distribution of Major Cation Concentrations in Ground Water

150968

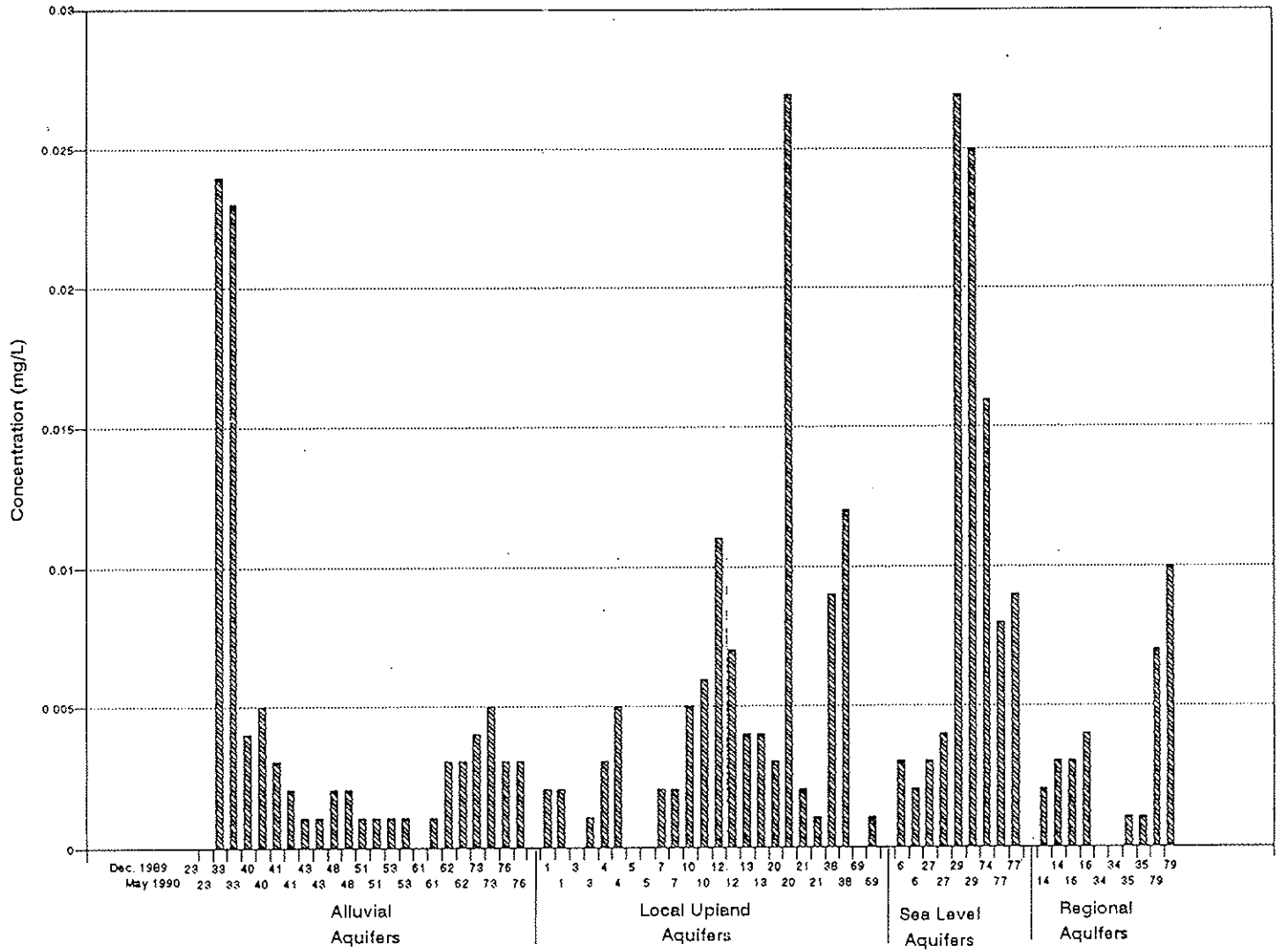

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Fig. 7.46 Distribution of Arsenic Concentrations in Ground Water

150969

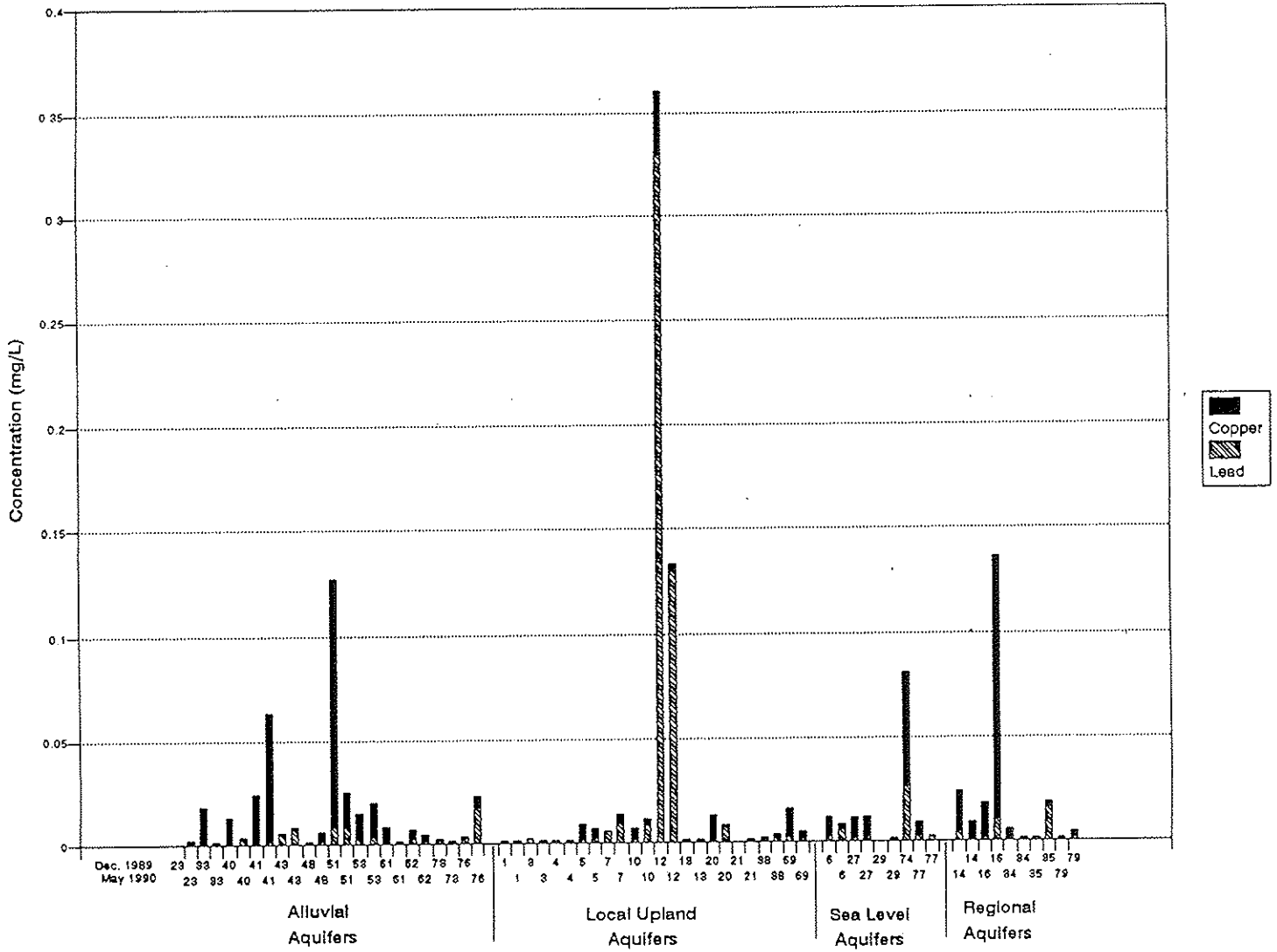

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Fig. 7.47 Distribution of Copper and Lead Concentrations in Ground Water

150959

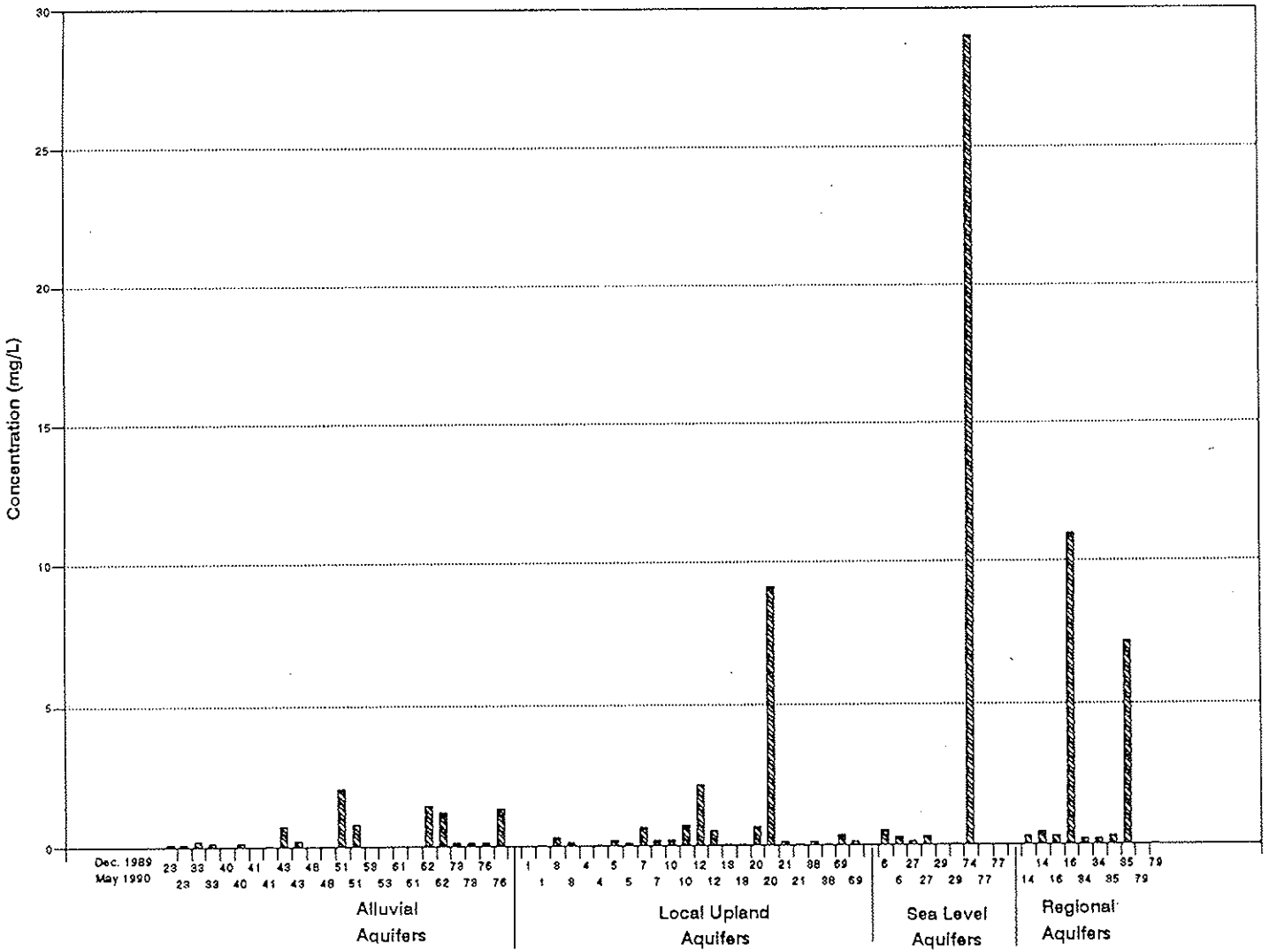

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Fig. 7.48 Distribution of Iron Concentrations in Ground Water

150969

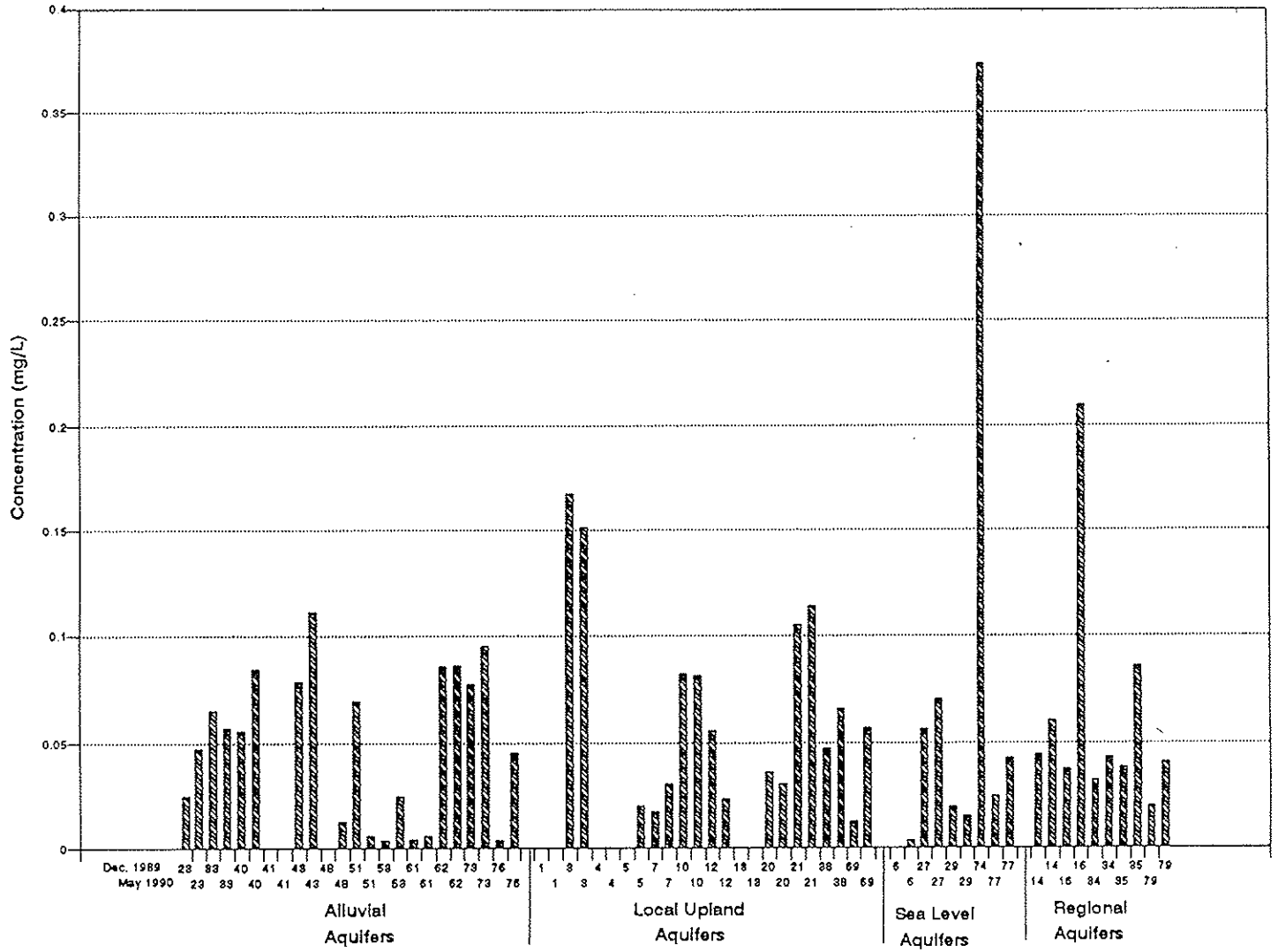

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Fig. 7.49 Distribution of Manganese Concentrations in Ground Water

150968

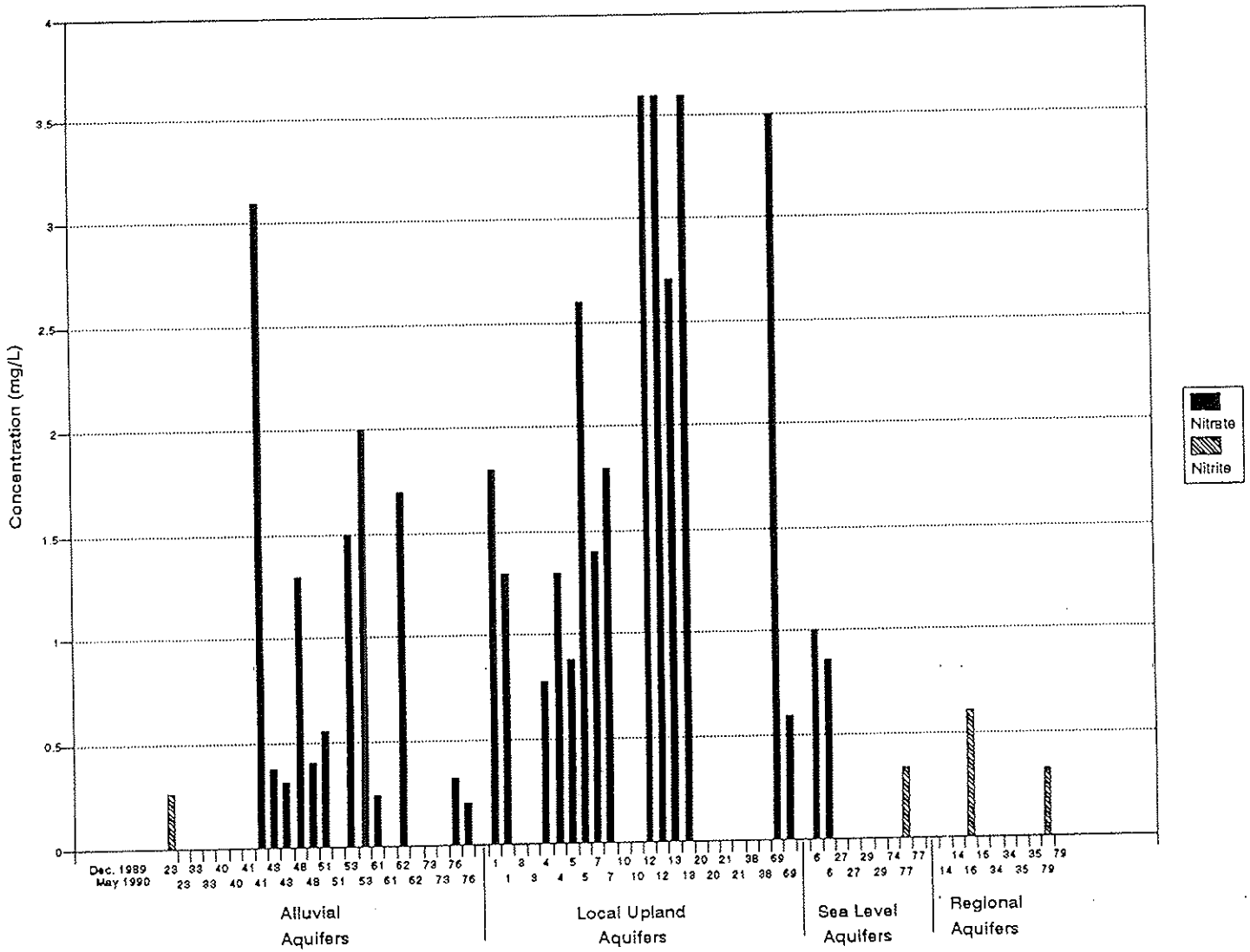

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Fig. 7.50 Distribution of Nitrate and Nitrite Concentrations in Ground Water

150969

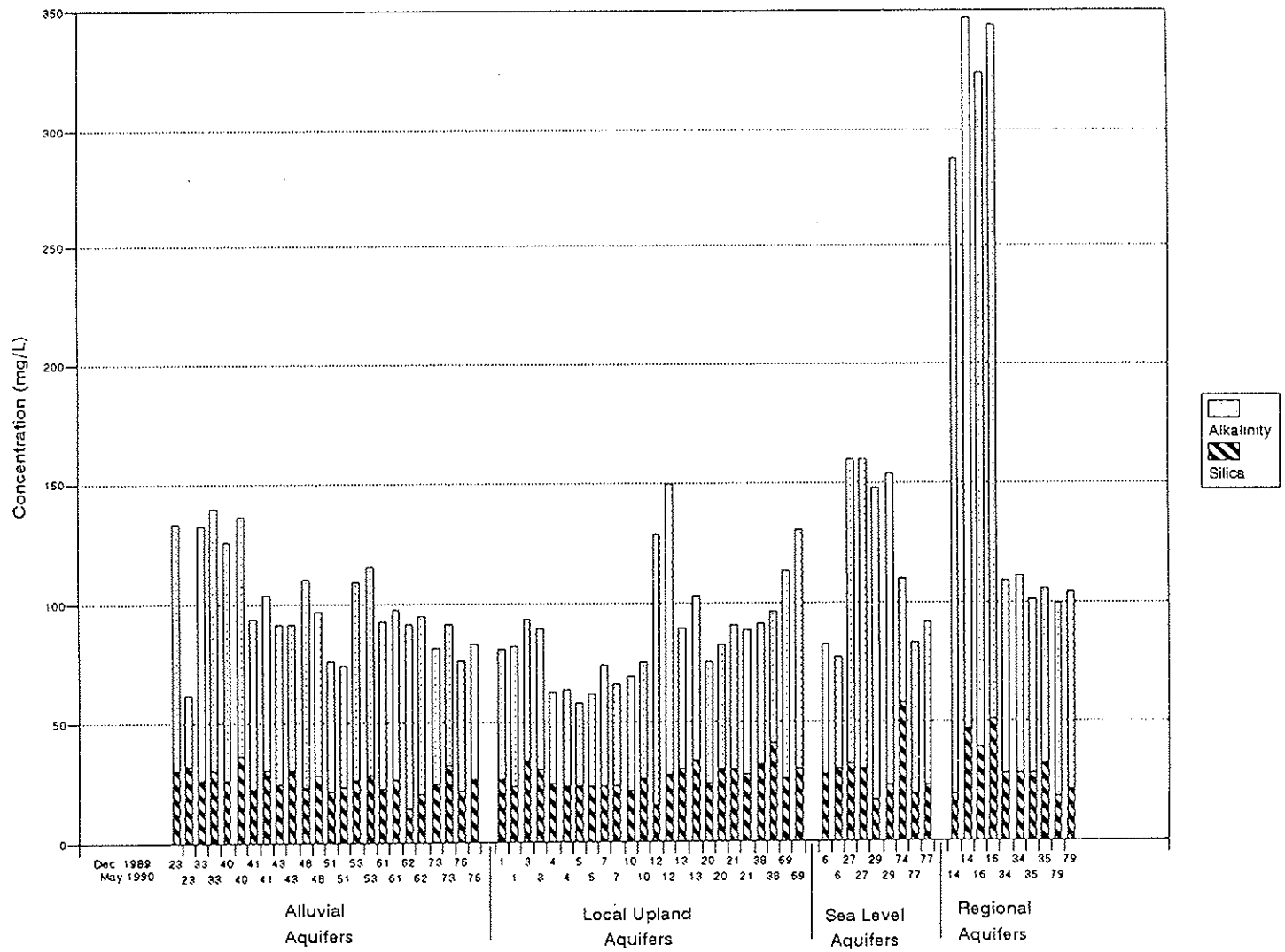

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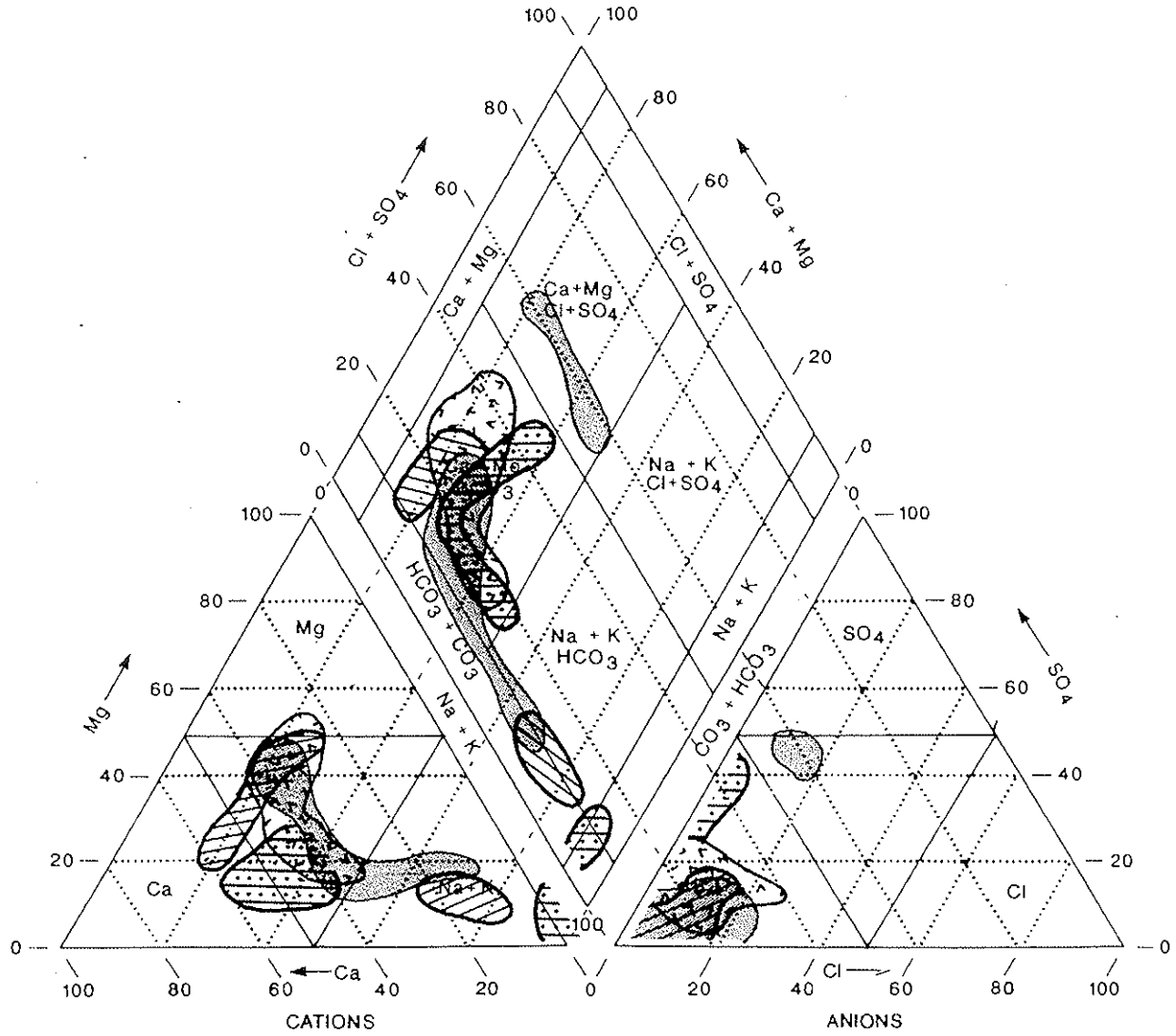
Fig. 7.51 Distribution of Silica and Alkalinity Concentrations in Ground Water

142322



LEGEND:

- Alluvial
- Local Upland
- Sea Level
- Regional

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Fig. 7.52 Trilinear Plot of Major Ion Concentrations for all Aquifer Zones

142322

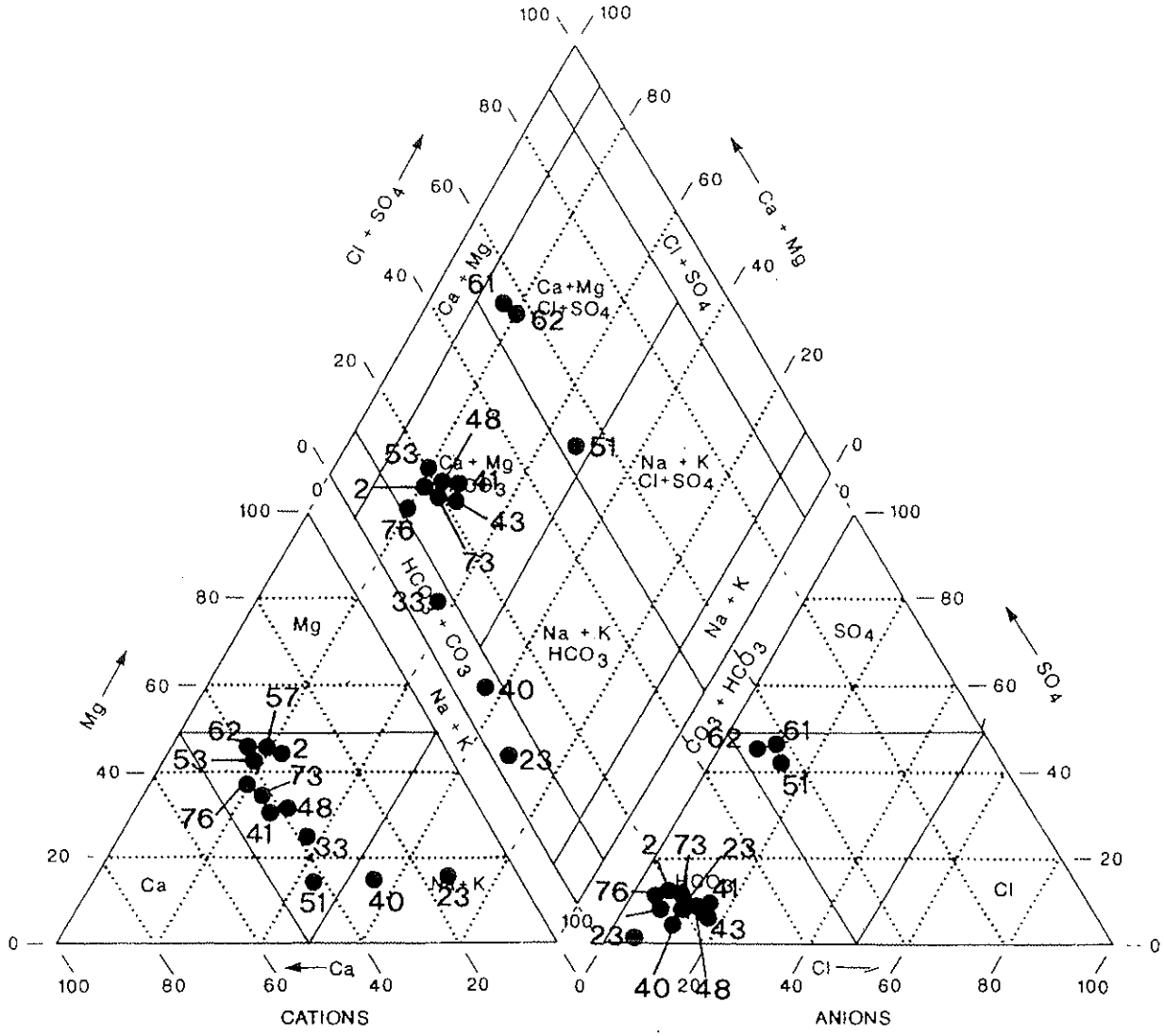

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Fig. 7.53 Trilinear Plot of Major Ion Concentrations for Alluvial Aquifer

142322

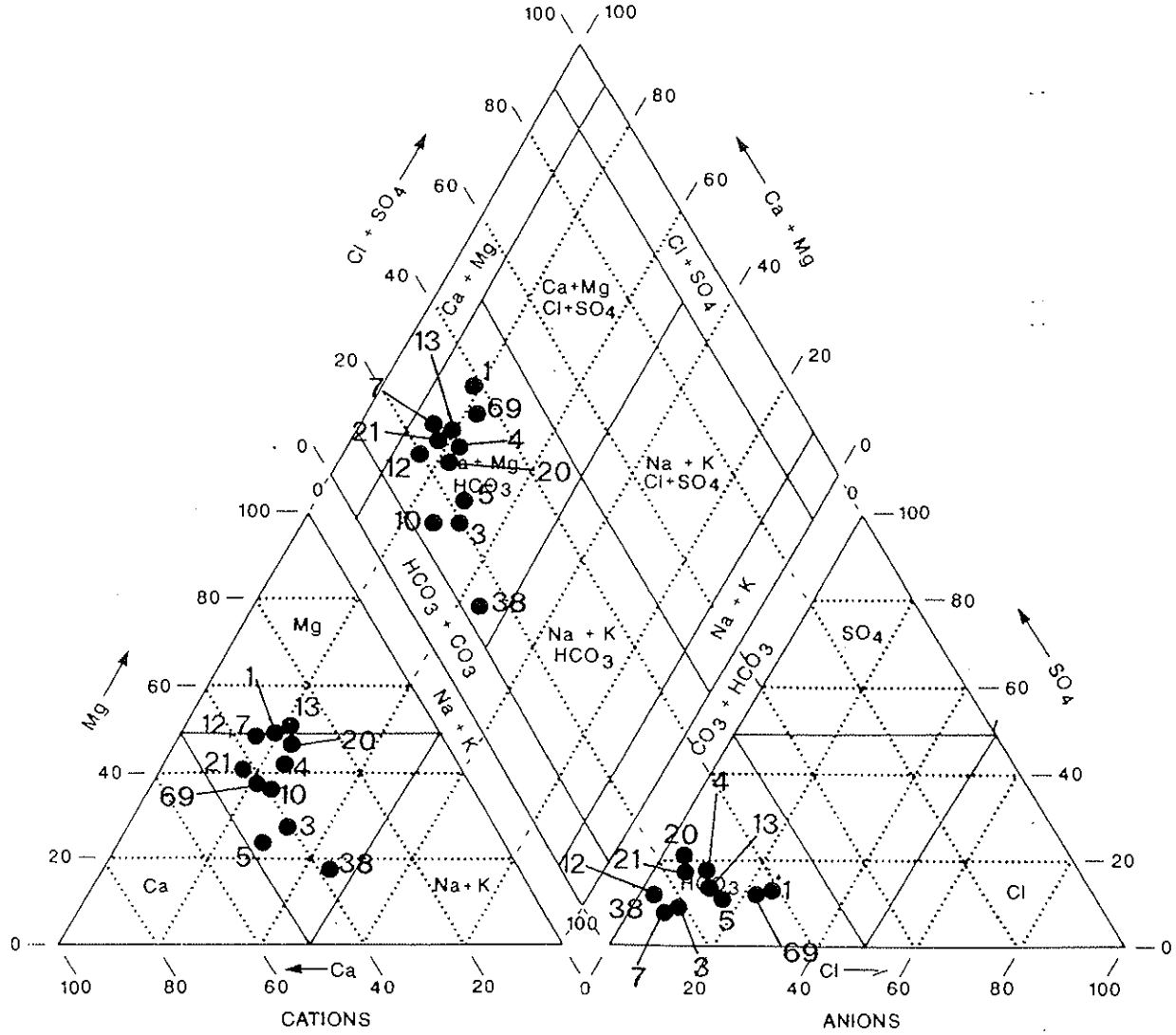

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Fig. 7.54 Trilinear Plot of Major Ion Concentrations for Local Upland Aquifer

142322

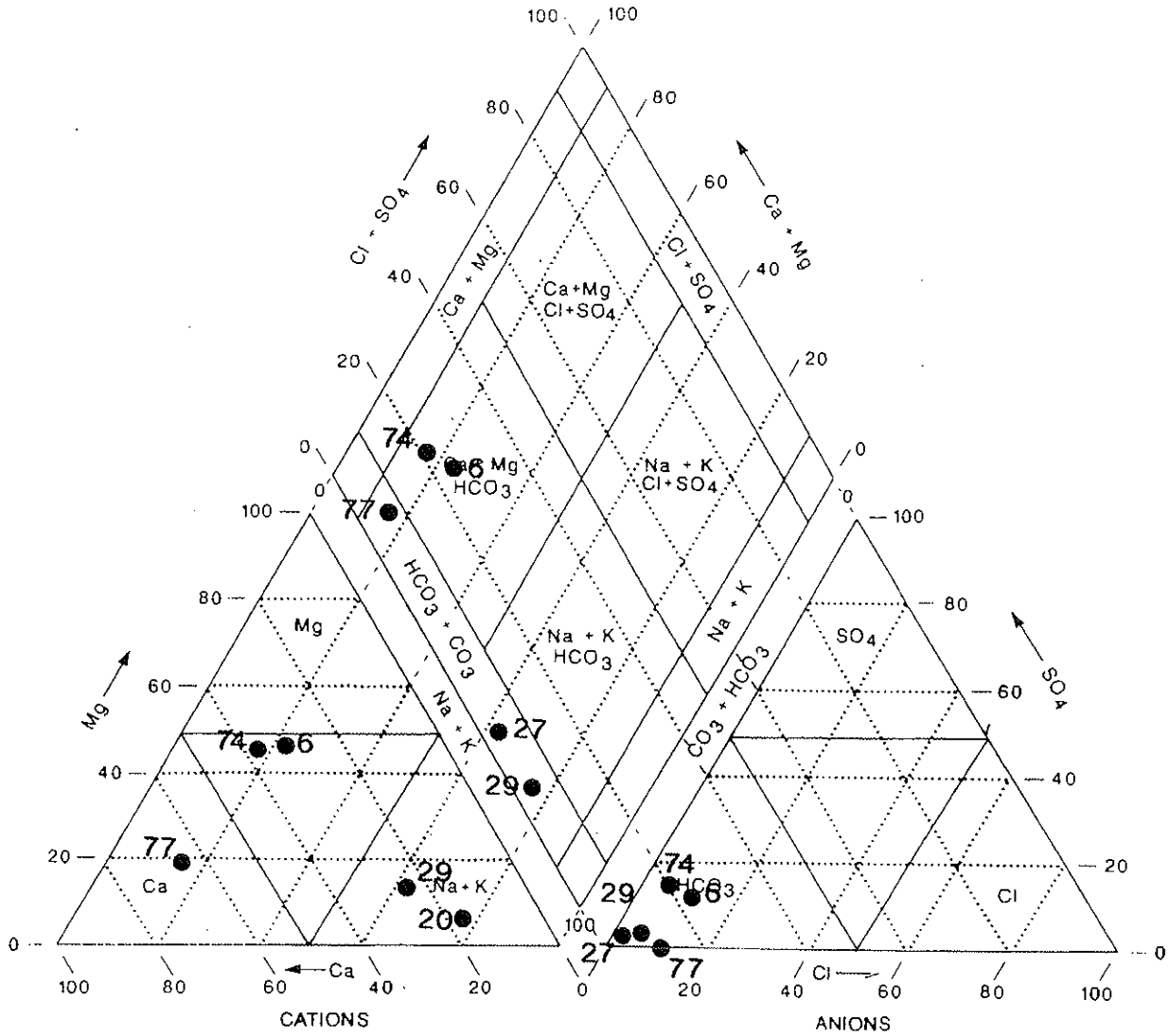

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Fig. 7.55 Trilinear Plot of Major Ion Concentrations for Sea Level Aquifer

142322

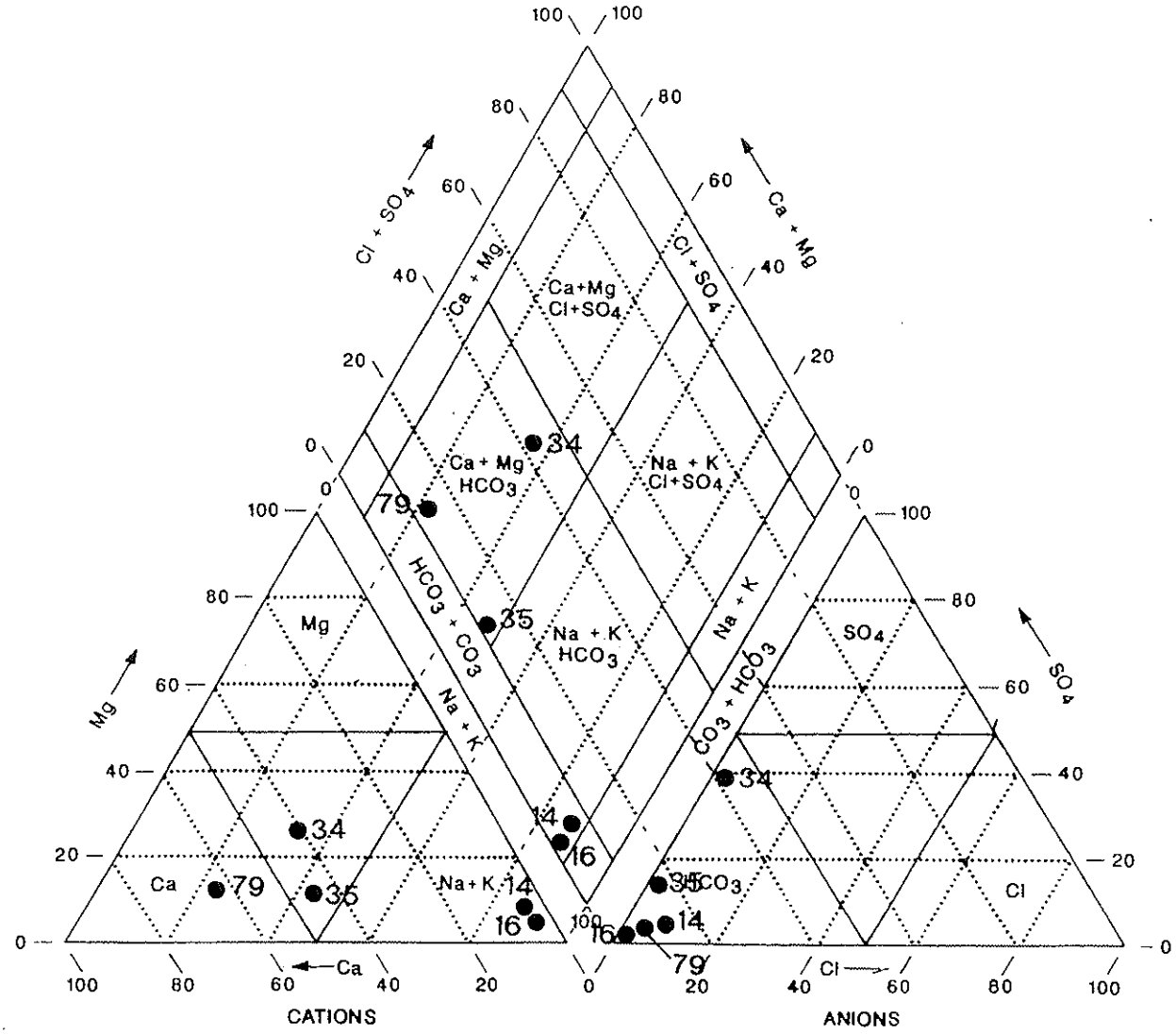

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Fig. 7.56 Trilinear Plot of Major Ion Concentrations for Regional Aquifer

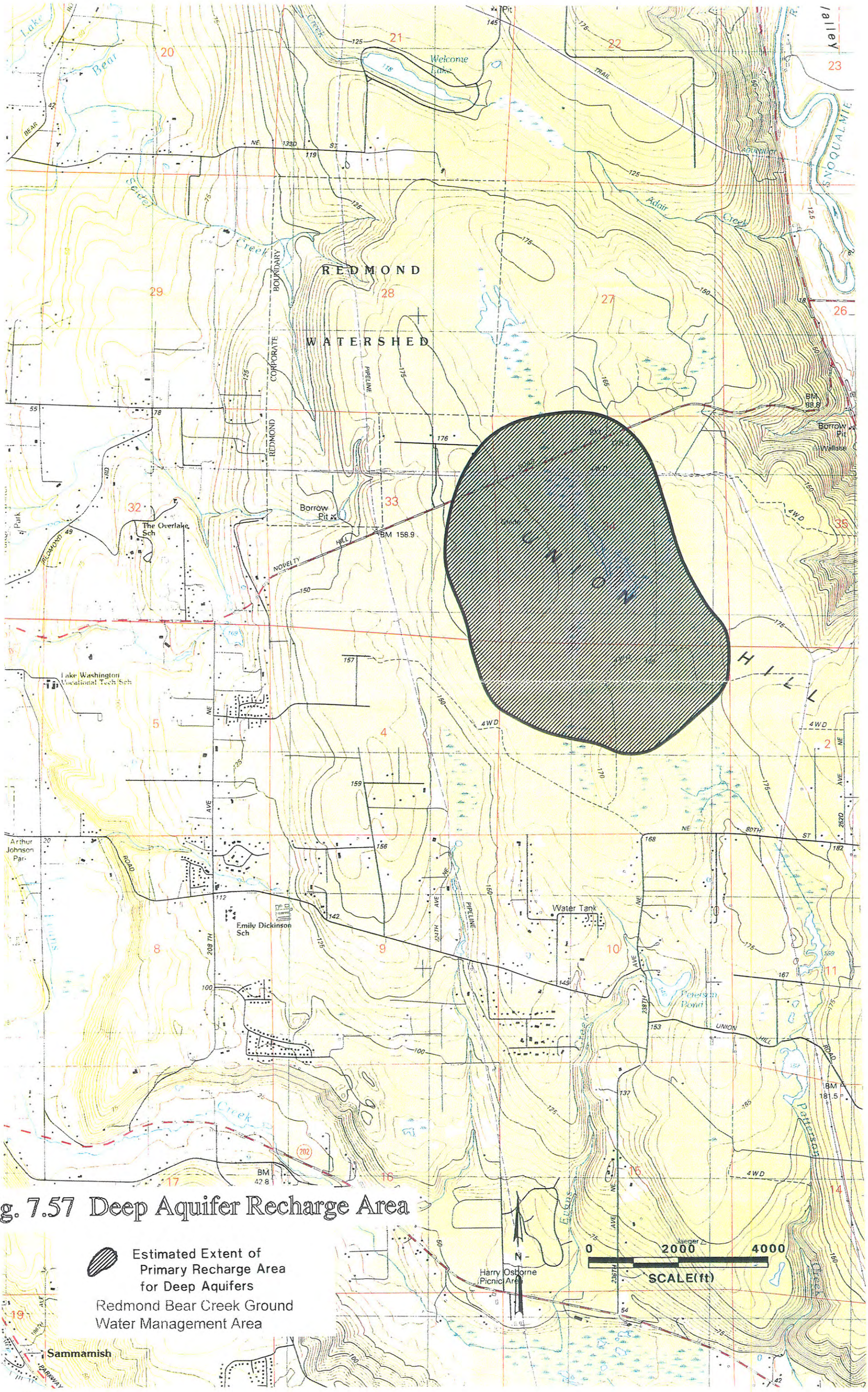

Fig. 7.57 Deep Aquifer Recharge Area

Estimated Extent of Primary Recharge Area for Deep Aquifers

Redmond Bear Creek Ground Water Management Area

December 1995

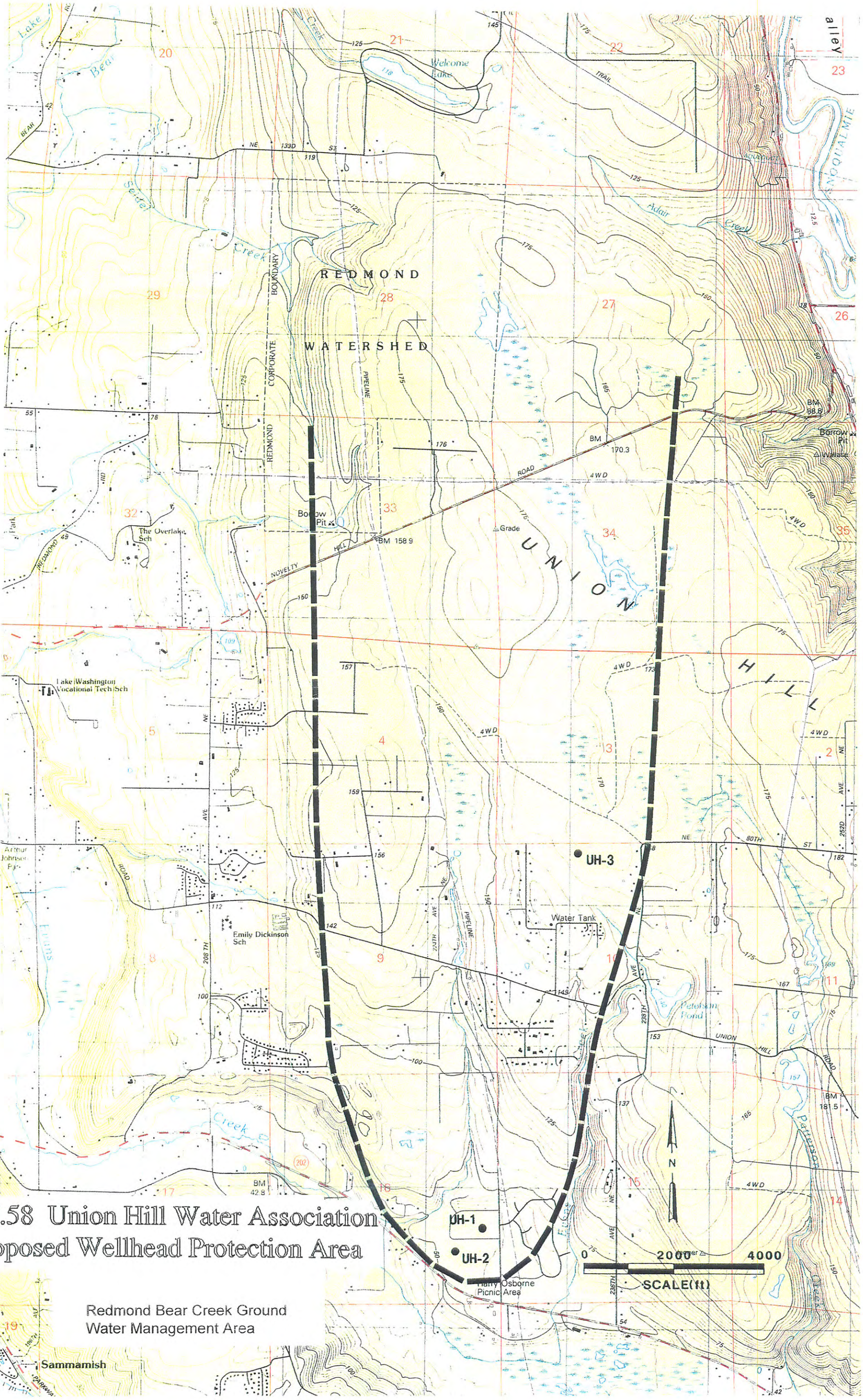

Fig. 7.58 Union Hill Water Association Proposed Wellhead Protection Area

December 1995