Research Technical Completion Report
A-084-IDA

IMPACTS OF INDIVIDUAL ON-SITE SEWAGE DISPOSAL FACILITIES ON MOUNTAIN VALLEYS — PHASE I

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Idaho Water and Energy Resources Research Institute
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ABSTRACT

The upper and middle Big Wood River Valley has experienced large population growth associated with recreational development. Much of this growth has been and will continue to be in rural areas, making private and small community water systems and individual on-site sewage disposal facilities necessary.

There are currently about 85 approved subdivisions in the study area, with a projected build-out of 2,151 units, 713 of which are currently built. The currently subdivided buildable area is approximately 5,860 acres of a total buildable area of approximately 21,270 acres. The current building density of non-sewered areas is approximately 6.64 acres per unit for the study area and approximately 1.60 acres per unit for the city of Bellevue. The projected building density of non-sewered areas is approximately 2.21 acres per unit for the study area and approximately 0.75 acres per unit for the city of Bellevue.

It is assumed that individual and group on-site sewage disposal facilities currently contribute about 24,900 pounds per year of nitrate (NO_3-N) and about 4,500 pounds per year of soluble phosphate (P) into the ground water. The Hailey Woodside treatment-disposal facility currently contributes about 4,100 pounds per year of NO_3-N and about 740 pounds per year of P to the ground water. Nutrient loads under maximum projected development are expected to be about 95,000 pounds per year of NO_3-N and about 17,000 pounds per year of P.

INTRODUCTION

The upper and middle Big Wood River Valley has, since the mid-1960's, experienced large population growth associated with recreational development. Much of this growth has been in rural, subdivided areas which are not served by community water or sewer systems. Private wells and small community water systems serve for water supplies, and on-site systems are used for sewage disposal. The possible impact from these on-site sewage disposal systems upon the water quality in the Big Wood River Valley is not yet known.

Purpose and Objectives

This study is the first of several projected phases of study which will evaluate the hydrologic characteristics of the Big Wood River-aquifer system, both qualitatively and quantitatively. The purpose of this phase is to evaluate some possible effects of present and future development in the upper and middle Big Wood River Valley, Idaho to aid in future planning decisions.

The major objectives of this study are:

1. Determine current subdivision build-out and density.
2. Determine intermediate-date and maximum populations in the study area.
3. Determine maximum build-out and density in all current subdivisions and all non-platted areas.
4. Quantify the current on-site sewage disposal systems by type and location.
5. Determine nutrient loadings on the Big Wood River aquifer under current, intermediate, and maximum build-out for the study area.

Location and Extent of Study Area

The study area is located entirely within northern Blaine County, and consists primarily of the valley areas of the Big Wood River and its tributaries between approximately North Fork Big Wood River and 3 miles south of Bellevue (fig. 1). The study area includes all or part of Townships 1 through 5 North, Ranges 17,18, and 19 East. The cities of Ketchum, Sun Valley, Hailey, and Bellevue are situated within the study area. The area was divided into 4 regions for data presentation.

Previous Investigations

The water resources of the Big Wood River area were briefly discussed as a section of U. S. Geological Survey Water-Supply Paper 774 (Stearns et al., 1938). The United States Bureau of Reclamation (1956) investigated the use of ground water for late-season supplemental irrigation water on upper Big Wood River project lands. Smith (1959) and Castelin and Chapman (1972) described the water resources of the middle Big Wood River-Silver Creek area (north to include Township 2 North). Mundorff et al. (1964) discussed water resources of the Big Wood River area in a section of Water Supply Paper 1654. Castelin and Winner (1975) studied the effects of urbanization on the water resources of the study area.

A number of studies relating to land, water, and sewage disposal in the study area have been made by consulting firms. Brown and Caldwell consulting engineers (1976) evaluated existing and alternative wastewater treatment facilities for Blaine County in light of environmental, design, and cost factors, and presented the best

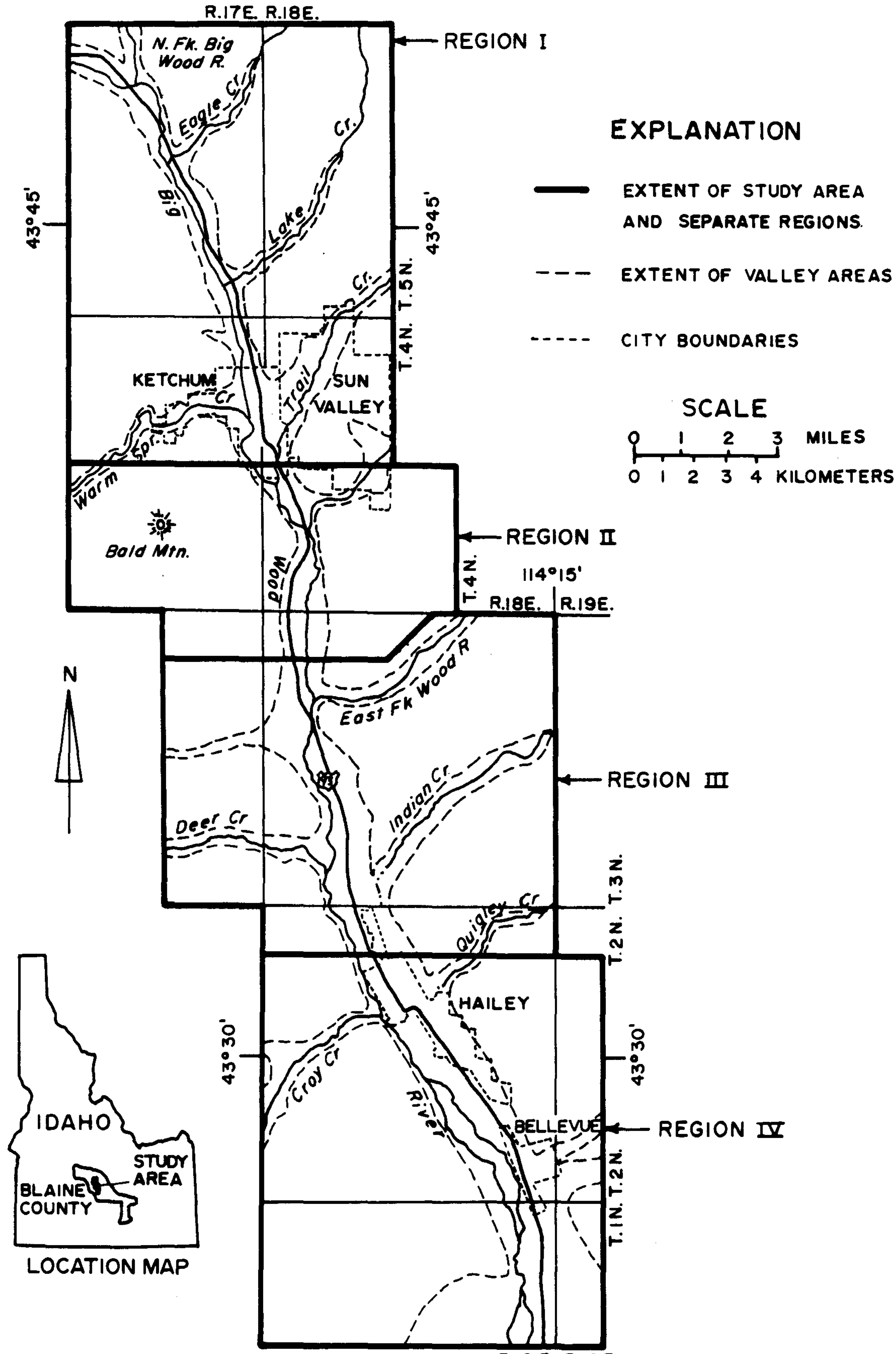

Figure 1.--Location and extent of study area and Region subareas.

alternatives for treating and disposing of wastewater in the study area.

Numerous reports have been written regarding sewage treatment and disposal methods in general, including on-site sewage disposal systems. Several of the reports concerning on-site disposl systems are cited in this paper.

Acknowledgements

The authors would like to acknowledge the following agencies and groups for their support, assistance, and access to records: the Blaine County Planning and Zoning Office; the South Central District Health Department; the Blaine County Assessor's Office; the Bellevue, Hailey, and Ketchum city water and sewer departments; and various other individuals and groups who provided valuable information and assistance.

PHYSICAL SETTING

Geographic Setting

Topography

Steep, rugged mountains, some with peaks exceeding 10,000 feet in altitude, rise sharply from the Big Wood River Valley, which is relatively narrow and flat. The valley floor ranges in width from approximately one-quarter to one and one-half miles until it widens considerably south of Bellevue. Tributary valley floors range in width from approximately one-eighth to one-half mile. The altitude of the valley floor is approximately 5,040 feet at the southern study boundary and approximately 6,240 feet at the mouth of North Fork Big Wood River, about 29 miles upvalley.

Climate

The climate of the area is characterized by moderately cold winters and short, warm and dry summers. The average frost-free period is 95 days. Precipitation averages 17.3 inches annually at Sun Valley and slightly more than 15 inches annually at Hailey. The mountains receive considerably more precipitation, possibly more than 40 inches per year (Pacific Northwest River Basins Commission, 1969).

Economy

Prior to the mid-1960's the economy of the study area depended primarily on agriculture and ranching. The economy is currently dependent on tourism and recreation, resulting in a large transient population. The resident population is employed largely in serviceoriented occupations such as merchandising, construction, and agriculture. The total assessed valuation in Blaine county has increased from approximately $7,440,000 in 1960 to approximately $758,180,000 in 1982.

Geologic Setting

Two general catagories of rocks are found within the study area: 1) consolidated sedimentary and igneous rocks; and 2) unconsolidated fluvioglacial and alluvial deposits. The consolidated rocks generally compose the mountains which surround the valley floors. the unconsolidated deposits make up the valley fill. These deposits include primarily coarse sand and gravel interfingered with clay and silt. The depth of valley fill varies considerably in different locations, ranging from less than 40 feet below land surface to more than 500 feet below land surface as indicated in logged wells. Most wells do not extend to bedrock.

Hydrologic Setting

Surface Water

The Big Wood River and its tributaries drain the study area. Major tributaries include the East and North Forks, Trail Creek, Warm Springs Creek, and Deer Creek. Several smaller tributaries also help to drain the area, including Lake Creek, Quigley Creek, and Croy Creek.

The 67-year average annual discharge at the U.S. Geological Survey gaging station at Hailey is 275,200 acre-feet. Smith (1959, p. 18) indicated the average yearly discharge for a 15-year base period at the same station was 340,000 acre-feet.

Ground Water

The valley fill material composes the major aquifer in the study area. Ground water is for the most part unconfined, and specific capacities range from 6 to 50 gpm/ft in coarse alluvial fill (Castelin and Winner, 1975, p. 27). The depth to ground water ranges from as little as 2 feet on the flood plains to 110 feet on the river terraces or alluvial fans (Castelin and Winner, 1975, p. 25,27).

The ground water and surface water systems above Hailey are closely interrelated. In some reaches the river gains water from the ground-water system and in some reaches the river loses water to the ground-water system. The specific gaining and losing reaches of the river have not been determined. Because of the close relationship of the ground water-surface water system an adverse impact on one may have some adverse impact on the other.

Although no potentiometric surface map has been constructed in the valley, it is assumed that the water table generally corresponds to land surface. Thus ground water moves generally down the valley. Smith (1959, p. 21) estimated the underflow past Hailey to be about 34,000 acre-feet per year, based on the hydraulic gradient and estimated transmissivity.

LAND USE AND POPULATION

Past Land Use, Development, and Population

Prior to the mid-1960's much of the valley-floor land in the study area was agriculturally used. According to U.S. Geological Survey Surface Water Supply records (U.S. Geological Survey) water was diverted to irrigate about 10,300 acres of land above Hailey (1950 determination). The 1966 determination indicates about 8,800 acres of irrigated land above Hailey. The total area of valley floor outside of city boundaries has been determined to be about 12,500 acres above Hailey. By these estimates, irrigated agricultural land composed about 80% of valley land in 1950 and about 70% of valley land in 1966.

Blaine County had no zoning ordinance until 1971, so land development prior to that time was subject to the Idaho Code. One subdivision, Barlow (planned for a total of 21 units), was approved in the 1950's, and 9 more subdivisions planned for a total of 459 units were approved in the 1960's. Fifty subdivisions with a planned build-out of 1,336 units were approved in the 1970's, and 25 subdivisions planned for 335 units have been approved since 1980. These statistics indicate the tremendous growth that has occurred in the study area, especially during the 1970's. This growth, which has occurred in both permanent and seasonal populations, has accompanied the development of the area as a well-known winter and summer resort area.

The population of Blaine County was 5,384 in 1950, 4,598 in 1960, 5,749 in 1970, and 9,841 in 1980. The study area has contained an increasingly large percent of Blaine County population. It is estimated that in 1980 about 90% of the permanent population resided in the study area.

Current Land Use, Development, and Population

Agricultural land in much of the study area has given way to residential development. The current area of irrigated agricultural land has not been determined, however the total area of valley floor above Hailey outside of platted subdivisions and city boundaries is about 7,500 acres. The area of irrigated agricultural land is probably substantially less than 7,500 acres (60% of valley floor).

The current Blaine County zoning ordinance was enacted in 1977. The ordinance accomplishes objectives of the Blaine County Comprehensive Plan (Blaine County Planning and Zoning Commission, 1975, p. 48) by containing current and future development within the middle and upper Big Wood River Valley, and by reducing the past residential zoning densities. The zoning districts, the area of land within each district, the percent of total buildable land in each district, and the area of land in acres which has been subdivided within each district are given in table 1. The calculated density given in the table refers to the building densities calculated for the districts based on projected densities of subdivisions located within the districts. These figures are used for population projections. The current zoning districts are shown on figures 2 through 5.

There are currently about 85 approved subdivisions in the study area, with a planned build-out of 2,151 units. The current build-out is 713 units, or 33 percent of those planned. Tables 2 through 5 present

Table 1.--Area and percent of total buildable area of each zoning district, area of subdivided land within each zoning district, remaining buildable land in each zoning district, and calculated density of each zoning district in the study area.

Zoning District		Area (Acres)	% of Total Area	Subdivided Area(Acres)[1]	Remaining Area(Acres)	Calculated Density(Ac/Unit)
R-0.4	(Mid-density residential)	870	4.1	200	670	0.61
R-1.0	(Low-density residential)	2280	10.7	920	1360	1.15
R-2.0	(Planned residential development)	2440	11.5	790	1650	2.04
R-2.5	(Rural residential)	720	3.4	330	390	3.43
R-5.0	(Residential/agricultural)	7950	37.4	2000	5950	6.50
FP	(Flood-plain management)	4100	19.3	1260	2840	5.0[2]
A-10	(Unproductive agriculture)	1390	6.5	0	1390	10.0[3]
A-20	(Productive agriculture)	1520	7.1	360	1160	20.0[3]
	Total:	21270		5860	15410	

1 The category of ´subdivided area´ includes tax lots and trailer courts. The zoned density is applied to each tax lot dwelling to determine the tax lot area.

2 The density was not calculated for floodplain management districts. A density of 5.0 acres/unit is assumed, based on communication with Blaine County Planning and Zoning officials.

3 The densities used for A-10 and A-20 are those determined by the Blaine County Planning and Zoning office.

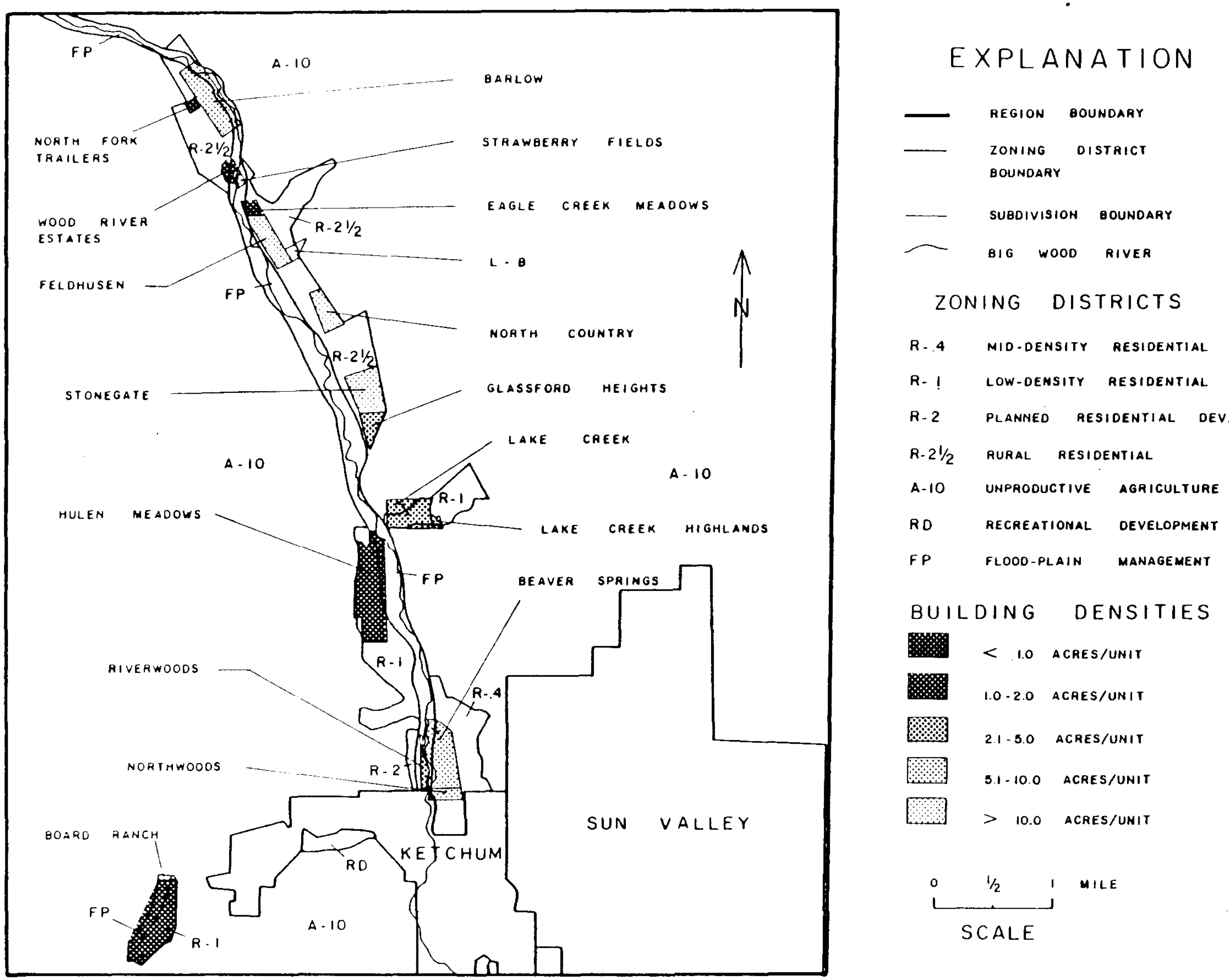

Figure 2.--Locations of current subdivisions and zoning districts, and current building densities of non-sewered areas within Region I.

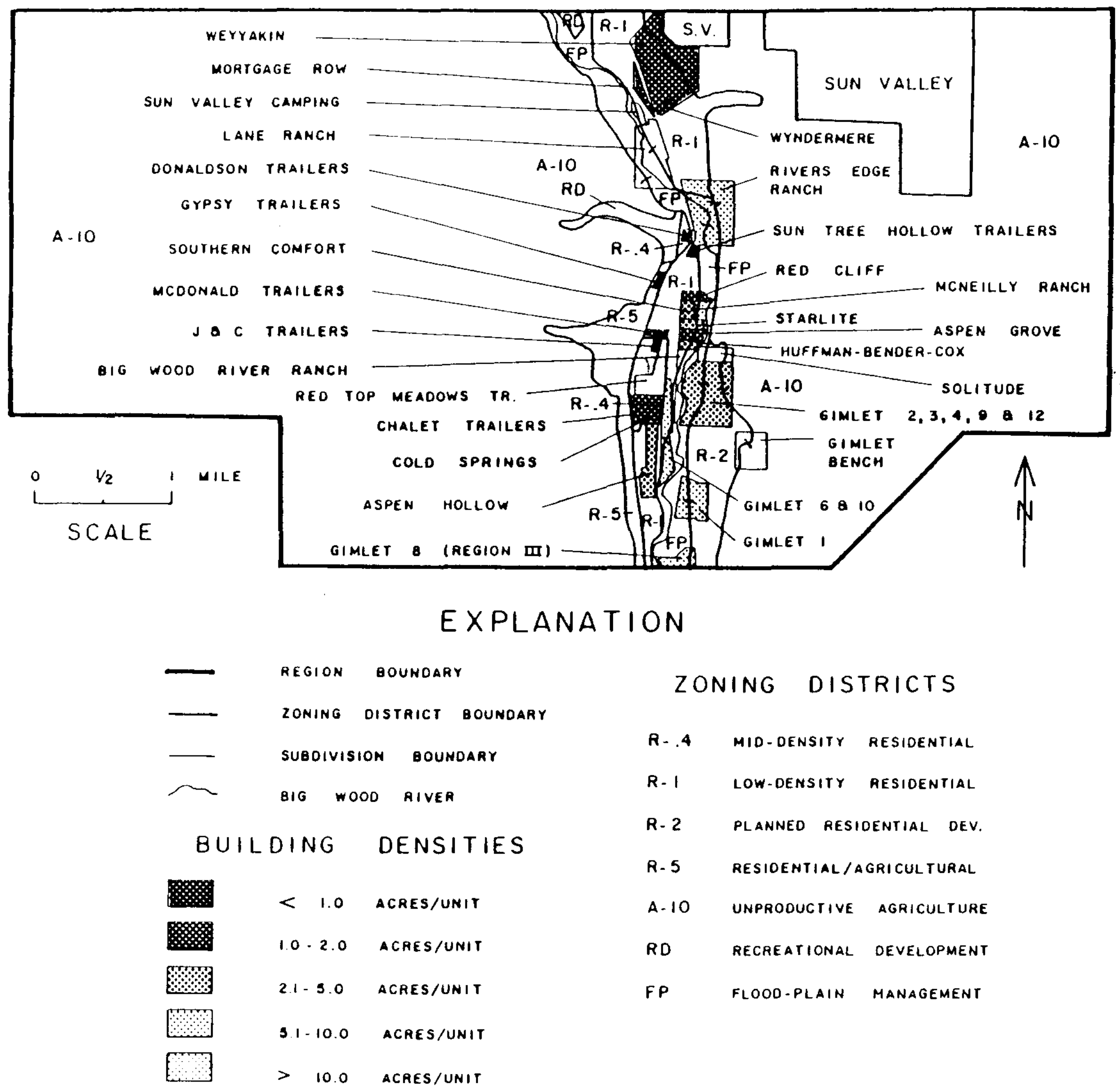

Figure 3.--Locations of current subdivisions and zoning districts, and current building densities of non-sewered areas within Region II.

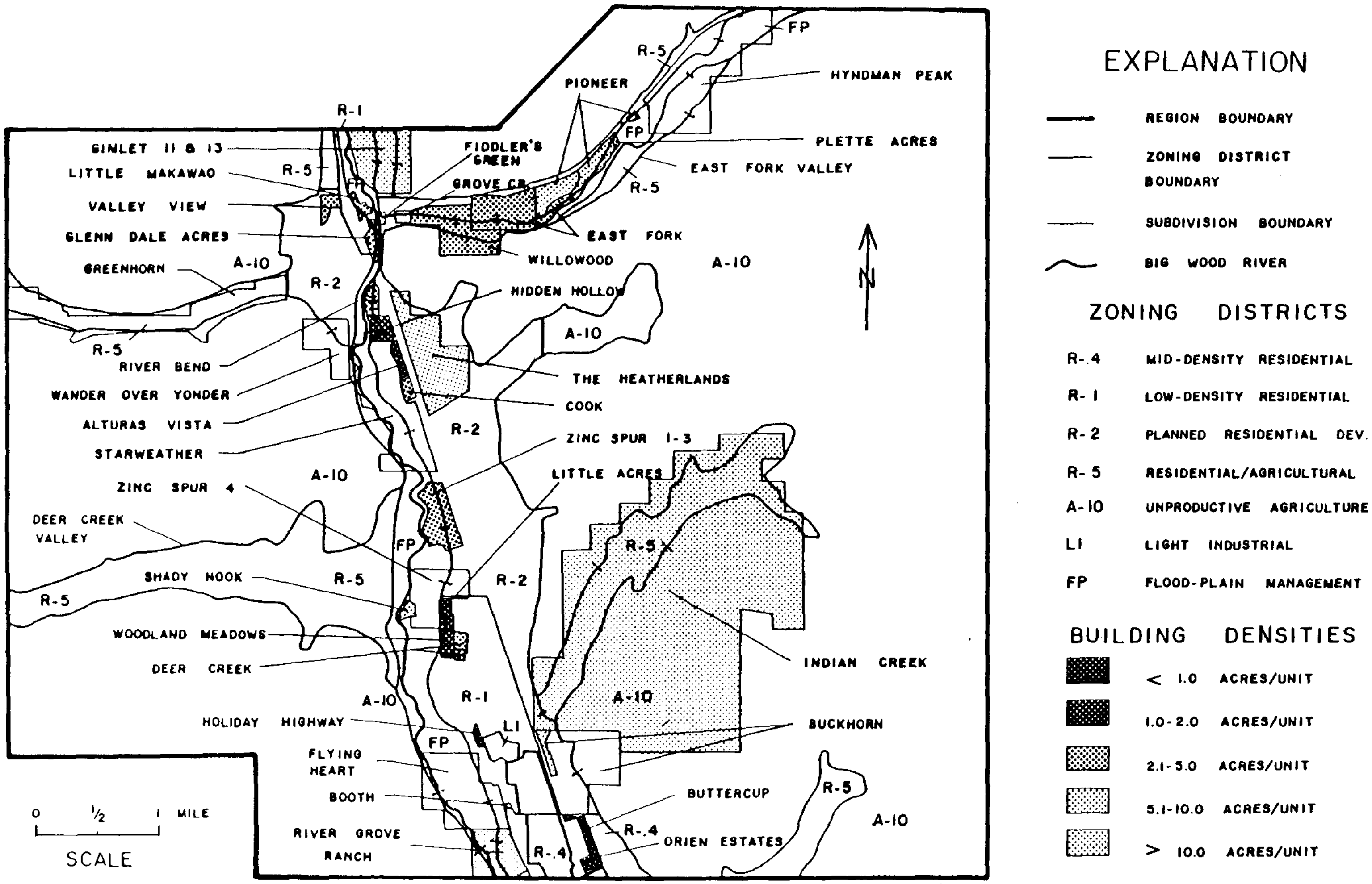

Figure 4.--Locations of current subdivisions and zoning districts, and current building densities on non-sewered areas within Region III.

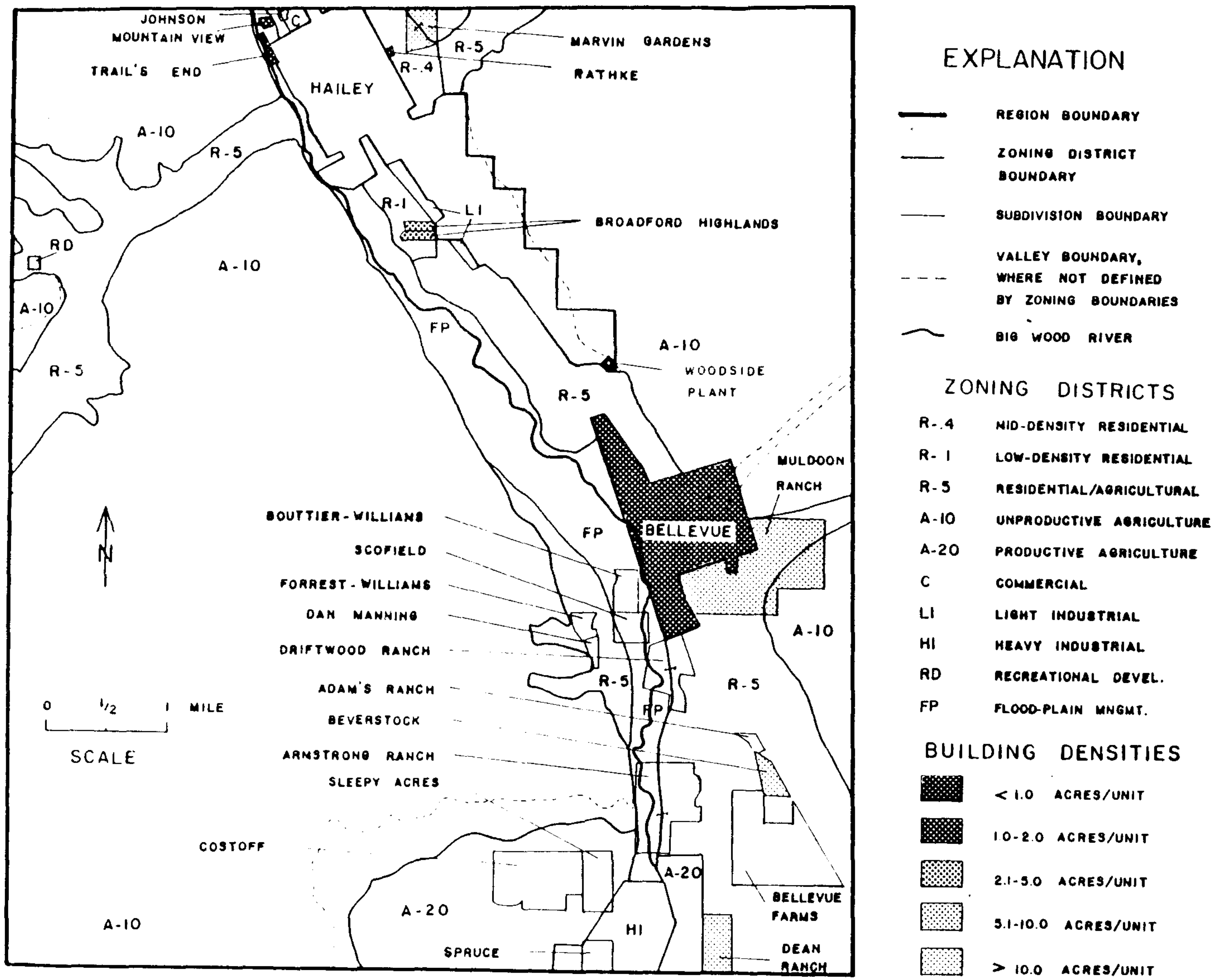

Figure 5.--Locations of current subdivisions and zoning districts, and current building densities of non-sewered areas within Region IV.

data on the build-out, occupancy, sewage disposal systems, densities, and nutrient loads of subdivisions and other areas in the study area. Summary data for non-sewered areas for all 4 regions are given in table 6. The locations of the subdivisions and the current building densities of the subdivisions are shown on figures 2 through 5.

The 8 trailer parks in the study area contain 270 units and are 100 percent built-out. The units designated by legal description (4N17E--) refer to tax lots (those dwellings built outside of subdivisions, cities, or trailer parks). Hailey and Ketchum-Sun Valley are included in the tables in order to document sewage disposal permits which have been received.

Further explanation of tables 2 through 5 should be given:

1. Number of Units refers to the number of dwelling units (a duplex is considered 2 units). Curr. refers to the number of units currently built. Proj. refers to the number of units projected or planned.

2. Build Out by % refers to the number of units currently built over the number of units projected.

3. Comm. Water indicates whether the subdivision has (Y) or does not have (N) a community water system.

4. Time Occ. by % refers to the overall time of occupancy in the subdivision as a whole, as a percent. It is assumed a permanent resident lives in the subdivision 100 percent of the time and a seasonal resident (whose permanent address is outside the study area) lives in the subdivision 50 percent of the time.

5. Planned Disposal refers to the types of on-site sewage disposal systems required within the subdivision. The figure under Std. indicates the number of standard disposal systems planned, and the figure under Mod. indicates the number of modified disposal systems planned. Further discussion is included in the `Sewage Treatment and Disposal´ section of this report.

6. Permits Received indicates the number of permits for each type of disposal system received by the South Central District Health Department.

7. Buildable Area indicates the number of acres in each subdivision which are considered `buildable,´ i.e., land within the valleys which has about 25 percent slope or less.

8. Densities refers to the number of acres per dwelling unit under current conditions, under projected conditions, and of the zoning district the greatest area of the subdivision lies in.

9. Nutrient Load refers to the total calculated weight (in pounds per year) of nitrate (NO_3-N) and phosphate (P) expected from each group of units under current build-out. This is discussed in detail in `Impacts of On-Site Sewage Disposal Systems´ later in this report.

Table 6 summarizes much of the above information for each region and also for Bellevue. The heading Comm.Water-Proj.Units indicates the number of units (#) planned to be on a community water system, and this figure as a percent (%) of the total number of units planned in the region. The heading % Perms. Recvd. indicates the total number of sewage disposal permits received as a percent of the current number of units built in the region.

The regional totals in table 6 show that the time of occupancy for subdivisions is 88 percent. The time of occupancy for subdivisions, tax lots, and trailers (excepting Red Top Meadows) is 83 percent. The lowest occupancy percent indicated in this table occurs in the tax lots, where many houses are owned by seasonal residents. Most of the seasonal population in the study area as a whole occurs within the cities of Ketchum and Sun Valley. The current population of Blaine County is estimated to be about 10,500 based on the number of building permits which have been issued since the 1980 census. The current population of

Table 2.--Summary of build-out, water supply, percent occupation, sewage disposal systems, sewage permits, building areas and densities, and assumed nutrient loads for Region I.

Subdivision Name (or Location)	Number of Units: Curr.	Proj.	Build Out by %	Comm. Water (Y,N)	Time Occ. by %	Planned Disposal Std.	Mod.	Permits Received Std.	Mod.	Buildable Area (Acres)	Densities (Ac/Unit) Curr.	Proj.	Zoned[1]	Curr. Nutrient Load (Lbs/Yr) NO_3-N	P
Barlow	15	21	71	N	87	?	?	3	0	90	6.0	4.3	N/A[2]	230	42
Beaver Springs	10	21	48	N	90	?	?	7	5	70	7.0	3.3	0.4	160	29
Eagle Creek Meadows	21	32	66	N	69	?	?	2	2	14	0.7	0.4	N/A	260	47
Feldhusen	1	8	13	N	100	8	0	1	0	49	49.0	6.1	2.5	18	3
Glassford Heights	10	22	45	N	85	?	?	2	0	27	2.7	1.2	N/A	150	28
Hulen Meadows	98	168	58	Y	90	168	0	59	2	130	1.3	0.8	N/A	1600	290
L-B Sub	0	2	0	N	-	?	?	0	0	6	-	3.0	2.5	0	0
Lake Creek	19	62	31	N	92	42	20?	12	3	40	2.1	0.6	N/A	310	57
Lake Creek Highland	1	4	25	N	100	?	?	0	0	4	4.0	1.0	1.0	18	3
North Country	3	12	25	N	50	12	0	2	0	35	11.7	2.9	2.5	27	5
North Fork Trailers	18	18	100	N	100	?	?	3	0	5	0.3	0.3	N/A	320	58
Northwoods	2	14	14	Y	100	?	?	3	0	14	7.0	1.0	0.4	36	6
Riverwoods	5	11	45	Y	70	5	6	1	3	13	2.6	1.2	1.0	63	11
Stonegate	2	20	10	Y	75	20	0	1	0	54	27.0	2.7	2.5	27	5
Strawberry Fields	1	2	50	N	50	?	?	0	1	8	8.0	4.0	FP[3]	9	2
Wood River Estates	9	19	47	N	83	?	?	8	1	11	1.2	0.6	N/A	130	24
Ketchum-Sun Valley	?	?	?	Y[4]	-	XX	XX[4]	6	0	-	-	-	-	360	65
4N17E--Board Ranch	62	?	-	N	60	?	?	25	3	95	1.5	?	-	670	120
4N17E-1--15	6	?	-	N	83	?	?	0	2	-	-	-	-	90	16
5N17E-	50	?	-	N	77	?	?	24	4	-	-	-	-	690	120

1 Density of zoning district in which the greatest area of buildable land lies.
2 N/A--Subdivision was platted prior to zoning ordinance.
3 Flood-plain management district, assumed density of 5.0 acres/unit.
4 More than 400 units in Ketchum are served by private wells. Ketchum is served by a community sewer system, however 28 on-site systems are in use in Ketchum.

Table 3.--Summary of build-out, water supply, percent occupation, sewage disposal systems, sewage permits, building areas and densities, and assumed nutrient loads for Region II (page 1 of 2).

Subdivision Name (or Location)	Number of Units: Curr.	Proj.	Build Out by %	Comm. Water (Y,N)	Time Occ. by %	Planned Disposal Std.	Mod.	Permits Received Std.	Mod.	Buildable Area (Acres)	Densities (Ac/Unit) Curr.	Proj.	Zoned[1]	Curr. Nutrient Load (Lbs/Yr) NO_3-N	P
Aspen Grove	9	12	75	Y	83	?	?	5	0	10	1.1	0.8	1.0	130	24
Aspen Hollow	15	36	42	Y	87	0	34?	1	12	39	2.6	1.1	1.0	230	42
Big Wood River Rnch	0	1	0	N	-	?	?	1	0	13	-	13.0[2]	N/A[3]	0	0
Chalet Trailers	19	19	100	Y	100	?	?	1	0	?	?	?	N/A	340	62
Cold Springs	54	74	73	Y	94	?	?	49	1	33	0.6	0.4	0.4	910	160
Donaldson Trailers	13	13	100	Y	100	?	?	0	0	?	?	?	N/A	230	42
Gimlet 1	5	12	42	N	80	?	?	3	2	36	7.2	3.0	N/A	72	13
Gimlet 6 & 10	5	11	45	N	100	6	5	3	2	37	7.4	3.4	2.0	90	16
Gimlet 2,3,4,9 & 12	20	38	53	N	88	?	?	16	0	95	4.8	2.5	N/A	320	57
Gimlet Bench	0	15	0	N	-	?	?	0	0	26	-	1.7	?	0	0
Gypsy Trailers	10	10	100	Y	95	?	?	1	0	2	0.2	0.2	N/A	170	31
Huffman-Bender-Cox	2	6	33	N	100	?	?	2	0	9	4.5	1.5	1.0	36	6
J & C Trailers	33	33	100	Y	100	?	?	0	1	?	?	?	N/A	590	110
Lane Ranch	0	14	0	Y	-	14	0	0	0	54	-	3.9	FP[4]	0	0
McDonald Trailers	6	6	100	Y	100	?	?	0	0	?	?	?	N/A	110	19

1 Density of zoning district in which the greatest area of buildable land lies.
2 Big Wood River Ranch is resubdividable, so it is not used in the Region II density calculations.
3 N/A--Subdivision was platted prior to zoning ordinance.
4 Flood-plain managementg district, assumed density of 5.0 acres/unit.

Table 3.--Summary of build-out, water supply, percent occupation, sewage disposal systems, sewage permits, building areas and densities, and assumed nutrient loads for Region II (page 2 of 2).

Subdivision Name (or Location)	Number of Units: Curr.	Proj.	Build Out by %	Comm. Water (Y,N)	Time Occ. by %	Planned Disposal Std.	Mod.	Permits Received Std.	Mod.	Buildable Area (Acres)	Densities (Ac/Unit) Curr.	Proj.	Zoned[1]	Curr. Nutrient Load (Lbs/Yr) NO_3-N	P
McNeilly Ranch	1	4	25	N	50	?	?	1	0	9	9.0	2.3	FP[2]	9	2
Mortgage Row	21	21	100	N	83	?	?	2	0	11	0.5	0.5	0.4	310	56
Red Cliff	6	6	100	Y	100	?	?	5	1	10	1.7	1.7	1.0	110	19
Red Top Meadows Tr	146	146	100	Y	100	XX	XX[3]	0		?	?	?	N/A[4]	-	-
Rivers Edge Ranch	1	6	17	N	100	6	0	0	0	66	66.0	11.0	FP	18	3
Southern Comfort	2	12	17	Y	100	12	0	2	0	10	5.0	0.8	1.0	36	6
Solitude	0	5	0	N	-	?	?	0	0	14	-	2.8	2.0	0	0
Starlite	2	8	25	Y	75	8	0	2	0	8	4.0	1.0	1.0	27	5
Sun Tree Hollow Tr	25	25	100	Y	100	?	?	0	1	?	?	?	N/A	450	81
Sun Valley Camping	32	32	-	Y	15	0	4?	0	0	?	?	?	FP	86	16
Weyyakin	59	98	60	Y	51	0	3	0	0	83	1.4	0.8	1.0	540	97
Wyndermere	4	7	57	Y	100	7	0	3	1	8	2.0	1.1	1.0	72	13
3N18E-1--6	10	?	?	N	90	?	?	4	0	-	-	-	-	160	29
4N17E-23--36	1	?	?	N	50	?	?	1	0	-	-	-	-	9	2
4N18E-19--36	35	?	?	N	81	?	?	12	1	-	-	-	-	510	92

1 Density of zoning district in which the greatest area of buildable land lies.
2 Flood-plain management district, assumed density of 5.0 acres/unit.
3 Red Top Meadows Trailers is served by a community sewer system.
4 N/A--Subdivision was platted prior to zoning ordinance.

Table 4.--Summary of build-out, water supply, percent occupation, sewage disposal systems, sewage permits, building areas and densities, and assumed nutrient loads for Region III (page 1 of 2).

Subdivision Name (or Location)	Number of Units: Curr.	Proj.	Build Out by %	Comm. Water (Y,N)	Time Occ. by %	Planned Disposal Std.	Mod.	Permits Received Std.	Mod.	Buildable Area (Acres)	Densities (Ac/Unit) Curr.	Proj.	Zoned[1]	Curr. Nutrient Load (Lbs/Yr) NO_3-N	P
Alturas Vista	11	43	26	N	91	?	?	9	0	16	1.5	0.4	N/A[2]	180	32
Booth	0	2	0	N	-	?	?	0	0	2	-	1.0	0.4	0	0
Buckhorn	1	7	14	Y	100	?	?	0	0	14	14.0	2.0[3]	2.0	18	3
Buttercup	28	28	100	Y	98	28	0	28	0	23	0.8	0.8	0.4	490	89
Cook	5	7	71	N	90	?	?	2	0	12	2.4	1.7	2.0	81	15
Deer Creek	4	20	25	N	100	?	?	4	0	14	3.5	0.7	N/A	72	13
East Fork	29	64	45	N	95	?	?	25	1	106	3.7	1.7	N/A	500	89
Fiddler's Green	0	2	0	N	-	?	?	0	0	2	-	1.0	1.0	0	0
Flying Heart	1	52	2	(16)	100	24	28	2	0	171	-	3.3	FP[4]	18	3
Gimlet 8,11,13	7	53	13	N	79	37	16	3	2	117	16.7	2.2	2.0	100	18
Glenn Dale Acres	6	12	50	N	83	?	?	6	0	14	2.3	1.2	N/A	90	16
Greenhorn Gulch	0	36	0	Y	-	36	0	0	0	186	-	5.2	5.0	0	0
Grove Creek	0	5	0	N	-	5	0	0	0	7	-	1.4	1.0	0	0
Heatherlands	4	116	3	Y	88	116	0	5	0	190	47.5	1.6	2.0	63	11
Hidden Hollow	12	19	63	N	100	?	?	4	0	22	1.8	1.2	2.0	220	39
Holiday Highway	6	20	30	Y	100	20	0	6	0	8	1.3	0.4	N/A	110	19
Hyndman Peak	0	40	0	N	-	33	7?	1	0	220	-	5.5	5.0	0	0

1 Density of zoning district in which the greatest area of buildable land lies.
2 N/A--Subdivision was platted prior to zoning ordinance.
3 Buckhorn density calculation does not include Buckhorn #2, which is resubdividable.
4 Flood-plain management district, assumed density of 5.0 acres/unit.

Table 4.--Summary of build-out, water supply, percent occupation, sewage disposal systems, sewage permits, building areas and densities, and assumed nutrient loads for Region III (page 2 of 2).

Subdivision Name (or Location)	Number of Units: Curr.	Proj.	Build Out by %	Comm. Water (Y,N)	Time Occ. by %	Planned Disposal Std.	Mod.	Permits Received Std.	Mod.	Buildable Area (Acres)	Densities (Ac/Unit) Curr.	Proj.	Zoned[1]	Curr. Nutrient Load (Lbs/Yr) NO_3-N	P
Indian Creek	11	230	5	N	100	?	?	18	5	550	50.0	2.4	5.0	200	36
Little Acres	11	13	85	N	77	?	?	7	0	14	1.3	1.1	1.0	150	27
Little Makawao	3	4	75	N	83	?	?	1	3	8	2.7	2.0	FP[2]	45	8
Orien Estates	3	3	100	N	100	3	0	2	0	3	1.0	1.0	0.4	54	10
Pioneer	9	37	24	N	83	37	0	7	0	68	7.6	1.8	1.0	130	24
Plett Acres	1	2	50	N	50	2	0	1	0	3	3.0	1.5	FP	9	2
River Bend	7	16	44	N	79	?	?	8	0	16	2.3	1.0	2.0	100	18
River Grove Ranch	6	12	50	N	83	11	1	6	0	74	12.3	6.2	2.0	90	16
Shady Nook	2	3	67	N	100	3	0	0	3	11	5.5	3.7	2.0	36	6
Starweather	0	97	0	Y	-	?	?	0	0	195	-	2.0	FP	0	0
Valley View	3	7	43	N	100	?	?	2	0	14	4.7	2.0	2.0	54	10
Wander Over Yonder	0	2	0	N	-	?	?	0	0	20	-	10.0	2.0	0	0
Willowood	37	98	38	N	91	?	?	33	1	80	2.2	0.8	N/A[3]	610	110
Woodland Meadows	10	13	77	Y	90	?	?	10	1	18	1.8	1.4	FP	160	29
Zinc Spur	25	46	54	N	96	?	9?	22	2	65	2.6	1.5[4]	FP	430	78
2N18E-1--5	18	?	?	N	92	?	?	5	0	-	-	-	-	300	54
3N17E-13--36	4	?	?	N	63	?	?	1	0	-	-	-	-	45	8
3N18E-7--36	28	?	?	N	88	?	?	9	1	-	-	-	-	440	80

1 Density of zoning district in which the greatest area of buildable land lies.
2 Flood-plain management district, assumed density of 5.0 acres/unit.
3 N/A--Subdivision was platted prior to zoning ordinance.
4 Zinc Spur density calculation does not include Zinc Spur #4, which is resubdividable.

Table 5.--Summary of build-out, water supply, percent occupation, sewage disposal systems, sewage permits, building areas and densities, and assumed nutrient loads for Region IV outside of Bellevue (page 1 of 2).

Subdivision Name (or Location)	Number of Units: Curr.	Proj.	Build Out by %	Comm. Water (Y,N)	Time Occ. by %	Planned Disposal Std.	Mod.	Permits Received Std.	Mod.	Buildable Area (Acres)	Densities (Ac/Unit) Curr.	Proj.	Zoned[1]	Curr. Nutrient Load (Lbs/Yr) NO_3-N	P
Adams Ranch	0	2	0	N	-	?	?	0	0	10	-	5.0	5.0	0	0
Armstrong Ranch	0	3	0	N	-	?	?	0	0	15	-	5.0	5.0	0	0
Beverstock	2	4	50	N	100	4	0	2	0	37	18.5	9.3	5.0	36	6
Bellevue Farms	1	43	2	N	100	43	0	1	0	290	-	6.7	5.0	18	3
Bouttier-Williams	0	2	0	N	-	?	?	0	0	40	-	20.0	FP[2]	0	0
Broadford Highlands	12	21	57	N	92	21	0	11	0	26	2.2	1.2	1.0	200	36
Costoff	0	2	0	N	-	?	?	0	0	205	-	102.5	10.0	0	0
Dan Manning	0	4	0	N	-	4	0	0	0	20	-	5.0	5.0	0	0
Dean Ranch	8	17	47	N	94	?	?	5	0	153	19.1	9.0	5.0	140	24
Driftwood Ranch	0	13	0	N	-	?	?	0	0	100	-	7.7	FP	0	0
Forrest-Williams	0	4	0	N	-	?	?	0	0	23	-	5.7	5.0	0	0
Johnson	0	2	0	N	-	2	0	0	0	3	-	1.5	C[3]	0	0

1 Density of zoning district in which the greatest area of buildable land lies.
2 Flood-plain management district, assumed density of 5.0 acres/unit.
3 Commercial zoned district.

Table 5.--Summary of build-out, water supply, percent occupation, sewage disposal systems, sewage permits, building areas and densities, and assumed nutrient loads for Region IV outside of Bellevue (page 2 of 2).

Subdivision Name (or Location)	Number of Units: Curr.	Proj.	Build Out by %	Comm. Water (Y,N)	Time Occ. by %	Planned Disposal Std.	Mod.	Permits Received Std.	Mod.	Buildable Area (Acres)	Densities (Ac/Unit) Curr.	Proj.	Zoned[1]	Curr. Nutrient Load (Lbs/Yr) NO_3-N	P
Little Indio(Hailey)[2]	17	?	?	N	68	?	?	1	0	?	?	?	-	210	37
Marvin Gardens	2	6	50	N	100	4	0	1	0	27	13.5	4.5	0.4	36	6
Mountain View	4	7	57	Y	88	?	?	3	1	8	2.0	1.1	1.0	63	11
Muldoon Ranch	23	58	40	N	87	58	0	19	0	250	10.9	4.3	N/A[3]	360	65
Rathke	1	2	50	N	100	2	0	0	0	2	2.0	1.0	0.4	18	3
Scofield	0	6	0	N	-	6	0	2	0	43	-	7.2	FP[4]	0	0
Sleepy Acres	0	4	0	N	-	?	?	2	0	70	-	17.5	10.0	0	0
Spruce	0	2	0	N	-	2	0	0	0	38	-	19.0	HI[5]	0	0
Trail´s End[2]	15	36	42	N	87	?	?	9	1	14	0.9	0.4	N/A	230	42
Hailey	?	?	?	Y	-	XX	XX[6]	5	0	-	-	-	-	-	-
1N18E-1--15	29	?	?	N	93	?	?	19	6	-	-	-	-	490	87
1N19E-1--18	8	?	?	N	94	?	?	5	1	-	-	-	-	140	24
2N18E-8--36	68	?	?	N	82	?	?	24	1	-	-	-	-	1000	180
2N19E-	1	?	?	N	100	?	?	0	0	-	-	-	-	18	3

1 Density of zoning district in which the greatest area of buildable land lies.
2 Little Indio (not a legal subdivision) and Trail´s End are not served by Hailey water or sewer.
3 N/A--Subdivision was platted prior to zoning ordinance.
4 Flood-plain management district, assumed density of 5.0 acres/unit.
5 Heavy industrial zoned district.
6 Hailey is served by a community sewer system.

Table 6.--Summary table for non-sewered subdivisions, tax lots, and trailers for all Regions and Bellevue.

Region	Number of Units		Build Out	Comm.Water-Proj.Units		Time Occ.	Permits Received			% Perms.	Bldable. Area	Avg.Density (Ac/Unit)		Curr.Nutrient Load (Lbs/Yr)	
	Curr.	Proj.	by %	#	%	by %	Std.	Mod.	Tot.	Recvd.	(Ac)	Curr.	Proj.	NO_3-N	P
(Subdivisions)															
I	197	418	47	213	51	86	101	17	118	60	565	2.87	1.35	3050	550
II	206	386	53	267	69	83	95	20	115	56	532	2.58	1.38	3080	550
III	242	1109	22	333	30	92	197	16	213	88	2243	9.27	2.03	4010	720
IV	68	238	29	7	3	90	53	3	56	82	1394	20.50	5.77	1100	200
Total(Avg)	713	2151	33	820	38	88	446	56	502	70	4734	6.64	2.21	11240	2020
(Subdivisions, Tax Lots, and Trailers)[1]															
I	333	554[2]	60	213	38	79	150	26	176	53	N/A[3]	N/A	N/A	5100	920
II	390	602[2]	65	405	67	79	120	22	142	36	N/A	N/A	N/A	5550	1000
III	292	1159[2]	25	333	29	91	212	17	229	78	N/A	N/A	N/A	4780	860
IV	191	361[2]	53	7	2	86	108	12	120	63	N/A	N/A	N/A	2960	530
Total(Avg)	1206	2672[2]	45	958	36	83	590	77	667	55	N/A	N/A	N/A	18390	3310
Bellevue	374	800[4]	47	374	100	96	161	22	183	49	600	1.60	0.75	6460	1160

1 Red Top Meadows Trailers is served by a community sewer system, and therefore is not included.
2 These figures include only currently built tax lots, and do not account for future building on such.
3 Buildable areas outside of platted subdivisions are not considered in this table.
4 From Blaine County Comprehensive Plan: Residential Development Status Table, page 68.

the study area is estimated to be about 9,500.

The total buildable area in the currently approved subdivisions is about 4,734 acres. The average building density on buildable lands within the subdivisions is 6.64 acres per unit. Similar data for individual subdivisions are given in tables 2 through 5. The current building density outside of subdivisions, trailer parks, and cities is generally very low.

The city of Bellevue is also included in table 6. Currently there are 374 units in Bellevue (Blaine County Assessor´s Office). The projected number of 800 units is from the Blaine County Comprehensive Plan (Blaine County Planning and Zoning Commission, 1975, p. 68). The total buildable area within the Bellevue city limits was planimetered and determined to be about 600 acres, which results in a current building density of 1.60 acres per unit.

Future Land Use, Development, and Population

As residential development increases on residentially-zoned lands, agricultural land use will necessarily decrease. In 1974, close to 100 percent of the property owners in the study area stated the intent to develop some degree of residential use over the following 20 years (Blaine County Planning and Zoning Commission, 1975, p. 47). Under the current zoning ordinance, 1,520 acres are designated productive agriculture, all of which lie south of Bellevue. Should residential development continue to its maximum under current zoning, it is possible that no land north of Bellevue would be under agricultural production.

The large majority of development and growth in Blaine County will occur in the study area, which is one objective of the 1977 zoning ordinance. Table 1 shows that of a total of 21,270 acres of buildable land in the study area, 15,410 acres (72 percent) have not been subdivided.

Future residential development and population growth will depend largely on the national economy and recreational development and trends. The 25-year growth rate from 1975 to 2000 was expected to be a compound rate of 4 percent per year (Brown and Caldwell, 1976, p. 25). The population has increased since 1974 at a compound rate of about 3 percent per year. Population related to a recreational economy is difficult to predict because it is highly sensitive to several variables. The Blaine County Comprehensive Plan (Blaine County Planning and Zoning Commission, 1975, p. 78) makes the following prediction:

> "On the basis of actual construction trends, school enrollment trends and anticipated recreational development, it is projected that the present permanent population will increase from 8,000 to between 16,000 and 18,000 by the year 1990."

Straight-line projections of population between 1970, 1980, and 1990 indicate a population of about 14,000 in the year 1990. The Comprehensive Plan's lower population estimate of 16,000 is therefore used in this report for the 1990 population projection. The 1990 projection of population for the study area is assumed to be about 15,000. No attempt was made to determine where in the study area the intermediate growth will occur.

A population projection for maximum development and population in the study area was also made. It was assumed that subdivisions will on the average be built out to 90 percent of the projected number of units.

This figure was also applied to potential build-out in zoned areas not yet subdivided. The calculated density values were applied to the remaining area within each zoning district (table 1), then multiplied by 90 percent. The total number of projected units within the non-subdivided areas is about 4,230, compared to the 90 percent build-out within currently approved subdivisions of about 1,930. The current number of tax lot and trailer units, not considered to increase, is 635. Within the city of Bellevue the projected number of units is expected to reach near 100 percent, or about 800. The projected maximum number of units outside of Hailey, Ketchum, and Sun Valley therefore is about 7,595. The projected population for these units is about 22,780, assuming 3 residents per unit. Data indicate that about 66 percent of the home-owners outside of Hailey, Ketchum, and Sun Valley are permanent residents, which results in a projected permanent population of about 15,030 outside of Hailey, Ketchum, and Sun Valley. The maximum population for these three cities was assumed to be equal to the 1990 projected values, which is about 6,650. Maximum projected permanent population in the study area is therefore determined to be about 21,680 based on current land-use considerations.

The projected density of all the currently approved subdivisions at 100 percent build-out is about 2.21 acres of buildable land per unit, or about 2.45 acres per unit at 90 percent build-out. (See table 6). Projected building densities of individual subdivisions at 100 percent build-out are shown on tables 2 through 5. The projected building density within the city of Bellevue is about 0.75 acres of buildable land per unit at 100 percent build-out.

Projected densities for each zoning district are given in table 1, and are shown for currently approved subdivisions and for the zoning districts on figures 6 through 9.

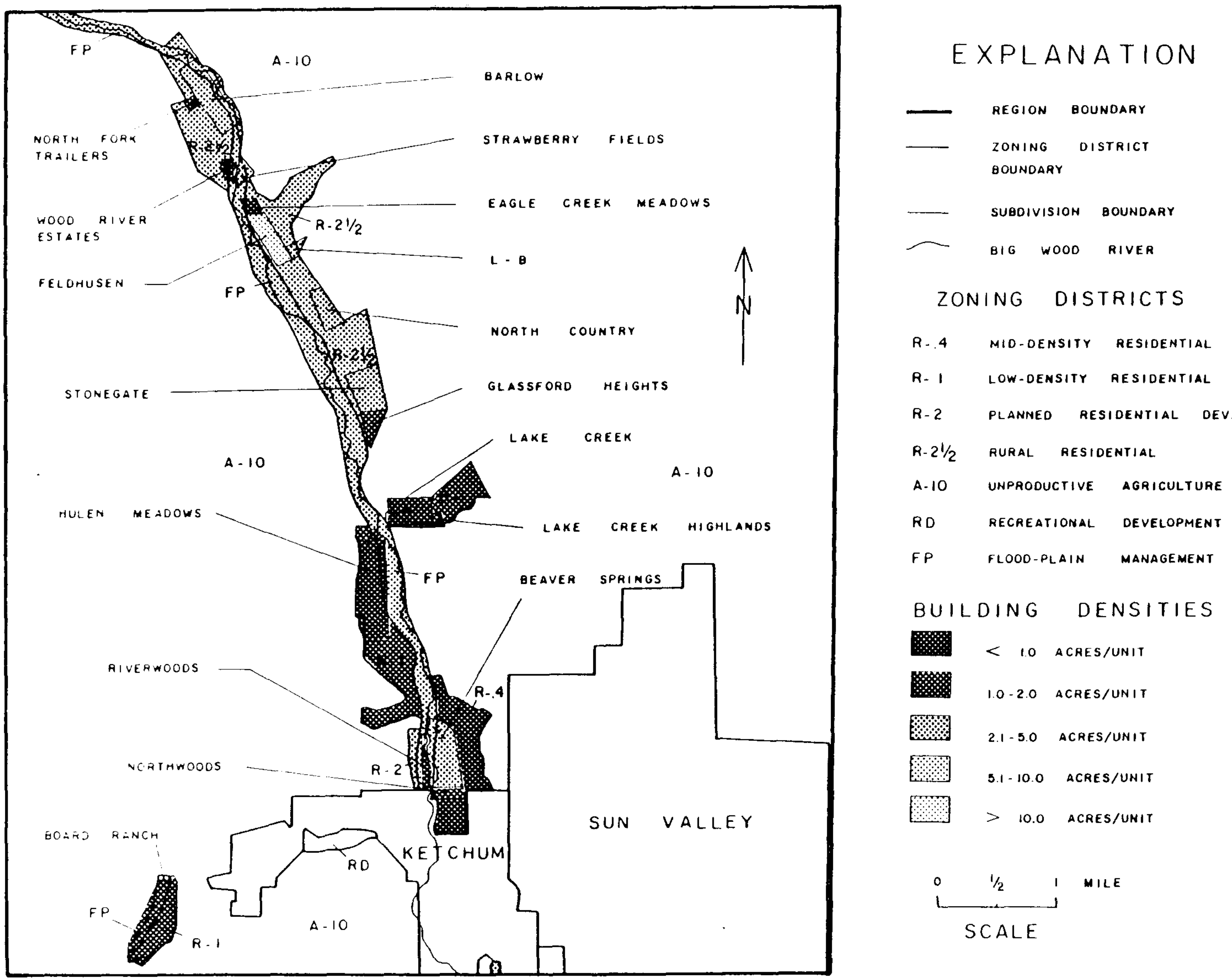

Figure 6.--Building densities of non-sewered subdivisions, cities, and zoning districts at maximum build-out within Region I.

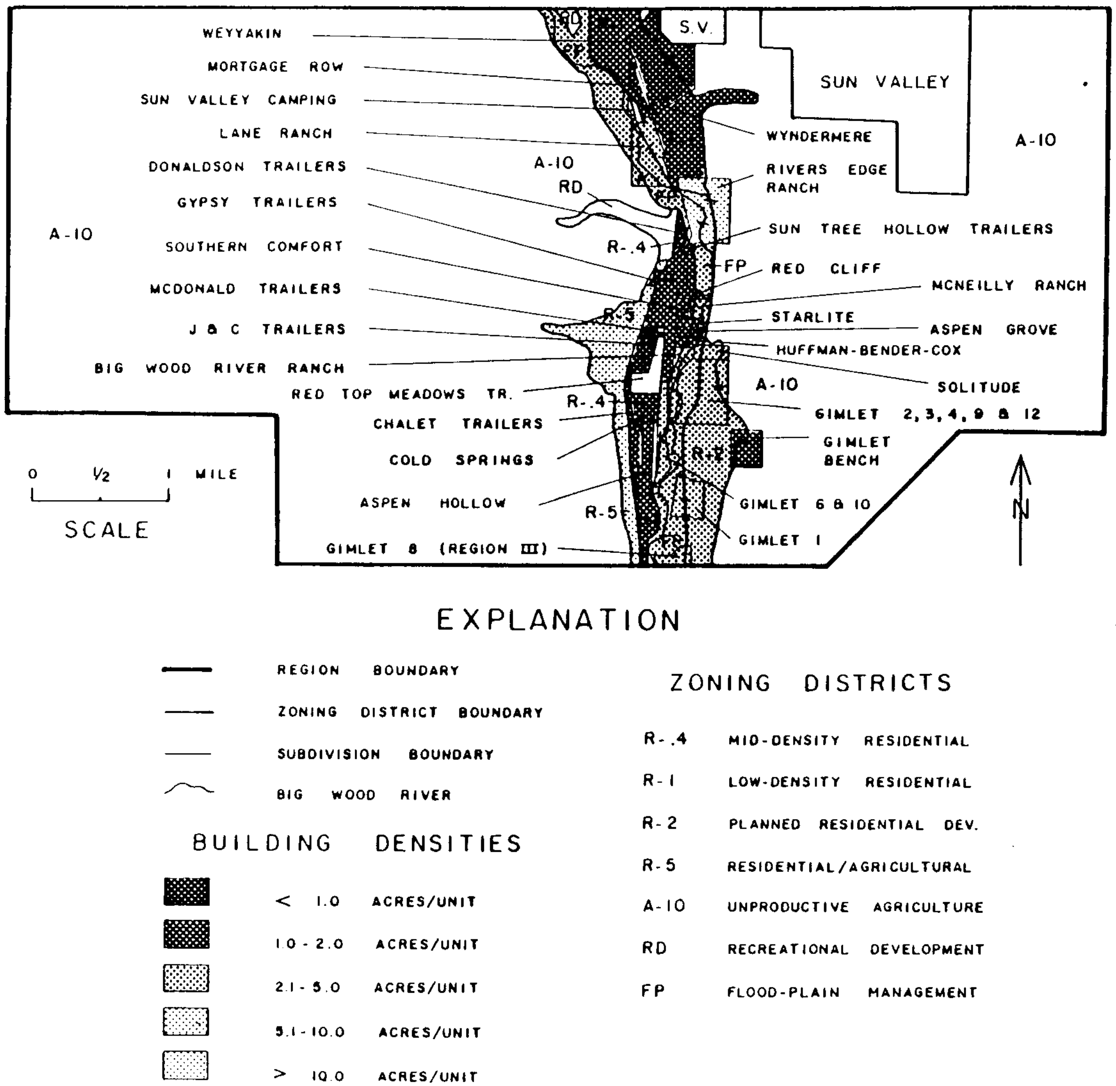

Figure 7.--Building densities of non-sewered subdivisions, cities, and zoning districts at maximum build-out within Region II.

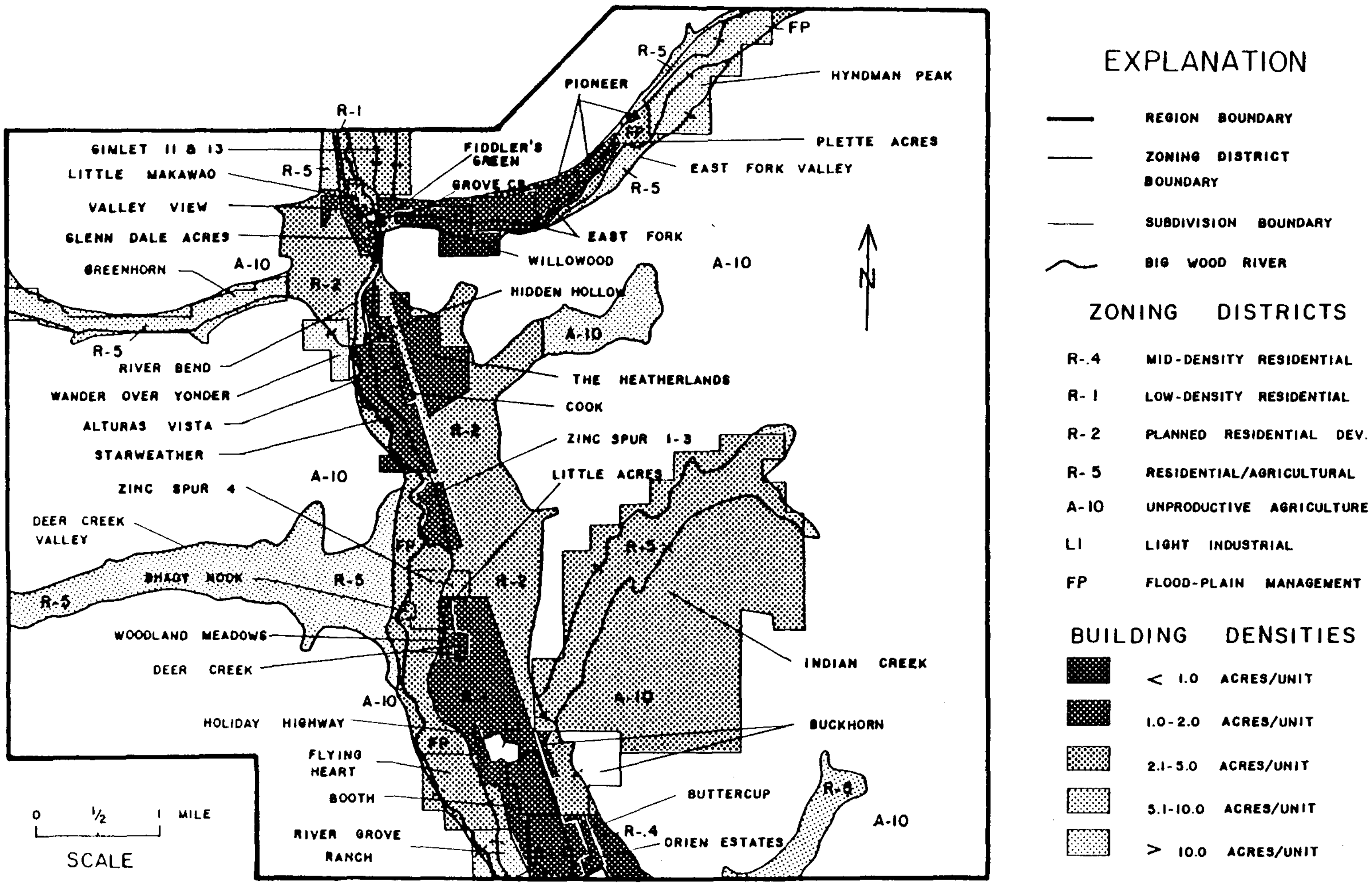

Figure 8.--Building densities of non-sewered subdivisions, cities, and zoning districts at maximum build-out within Region III.

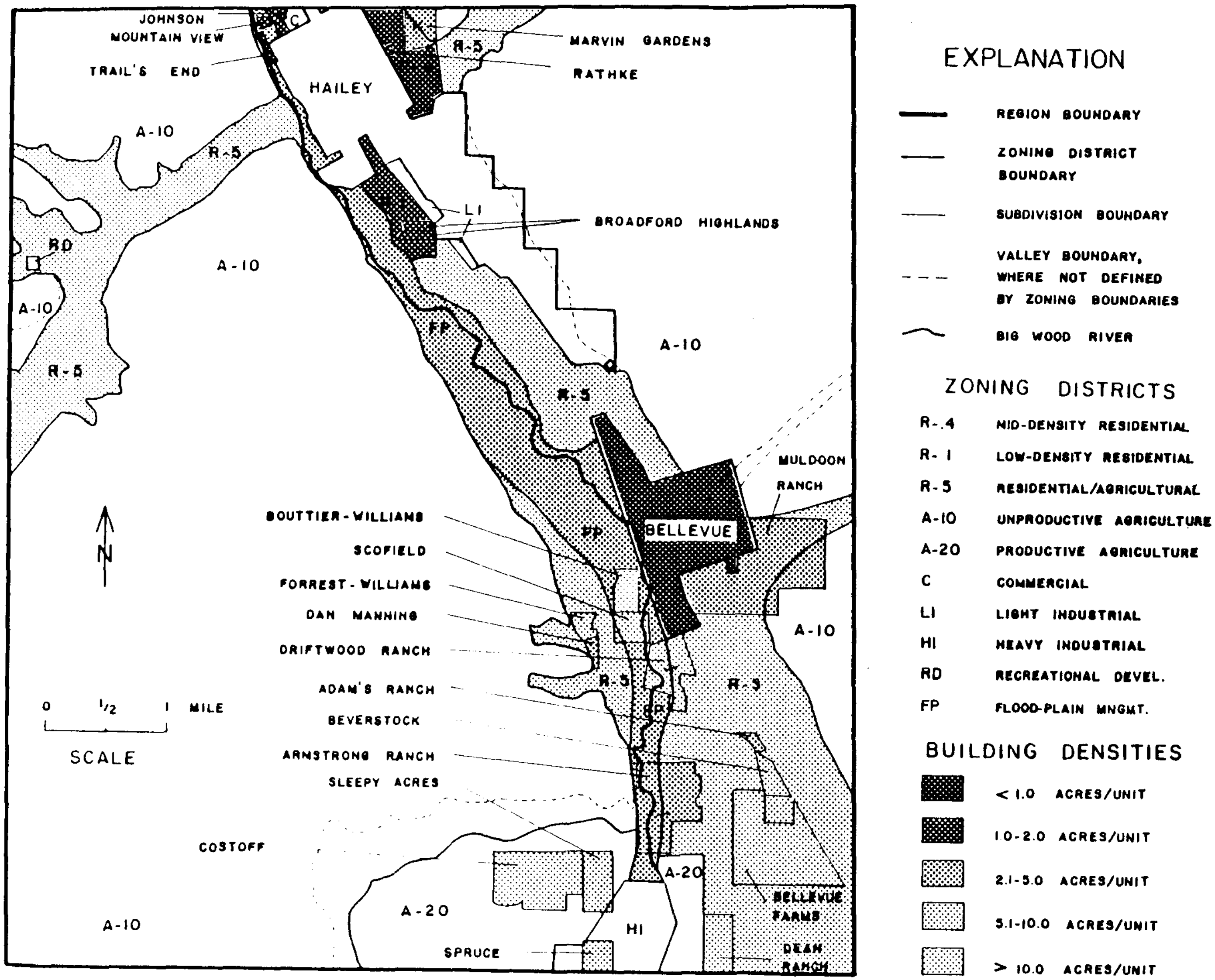

Figure 9.--Building densities of non-sewered subdivisions, cities, and zoning districts at maximum build-out within Region IV.

SEWAGE TREATMENT AND DISPOSAL

Sewered Areas

The cities of Hailey, Ketchum, and Sun Valley and the Red Top Meadows mobile home park are served by sewage collection and treatment facilities. Hailey uses two treatment and disposal sites: one site discharges treated effluent into the Big Wood River, and the other site, Woodside, discharges treated effluent into the ground at a site located at the extreme south end of Hailey (fig. 5). The latter site is considered in the 'Environmental Aspects...' section of this report. Ketchum and Sun Valley share a facility which discharges treated effluent into the Big Wood River. Red Top Meadows mobile home park also discharges its treated effluent into the Big Wood River. These wastewater treatment and disposal systems are regulated under the authority of the Idaho Department of Health and Welfare, Division of Environment, and the U.S. Environmental Protection Agency.

On-Site Sewage Disposal

An on-site sewage disposal system refers to a cesspool or a system composed of a septic tank and some type of liquid effluent disposal area. The case of several dwelling units using a common septic tank and/or disposal area is included as an on-site system.

Characteristics of On-Site Sewage Disposal Systems

The cesspool is the most primitive type of sewage disposal system used in the study area. It is typically a 5- to 6-foot diameter pit, into which the raw sewage is dumped. Solids settle to the bottom while the liquid seeps out through openings in the pit (Miller, 1980, p. 187,189). Many cesspools are still in use in Bellevue, however even a close estimate of this number is not available.

The septic tank-subsurface disposal system is the most widely used and accepted on-site system in the study area. This system is made up of the septic tank, which collects and traps the floating scum and settleable solids contained in the raw sewage, and the subsurface liquid disposal field, which receives the liquid effluent from the septic tank (Miller, 1980, p. 187). The septic tank may range in capacity from several hundred to several thousand gallons, the most common size being about 1,000 gallons. It contains baffles which help separate the solids from the liquid effluent, which is discharged by gravity or by pumping.

Three major types of subsurface effluent or wastewater disposal systems are used in the study area. They vary in efficiency depending on the type of system and construction practices. The types of subsurface systems primarily used are absorption trenches, seepage beds, and seepage pits. A soil absorption trench typically consists of 4-inch agricultural drain tile, vitrified clay sewer pipe, or perforated nonmetallic pipe. The tile or pipe is laid in level trenches which contain coarse material under- and overlying the tile or pipe. Backfill material covers the coarse material. The trenches must be at least 2 feet deep, and the spacing between trenches must be at least 6 feet. An absorption system having trenches wider than 3 feet is referred to as a seepage bed. More than one tile or pipe may be placed in the bed. A seepage pit is a large cylinder-shaped pit which is lined with unmortared brick or block. The bottom of the pit is usually backfilled with 1 foot of clean gravel, and it is recommended that the entire pit be filled with gravel to prevent cave-in.

The absorption-area requirement of these systems is determined by a percolation test and the number of bedrooms to be served by the system. The systems described above are referred to as `standard´ systems in this report. The maximum ground-water level must be at least 4 feet below the bottom of the trench, bed, or pit (Idaho Department of Health, 1971).

The Wisconsin mound is the most widely used effluent disposal system in locations where the maximum ground-water level or impervious rock lies less than about 6 feet below land surface. The Wisconsin mound is an above-ground system composed of a fill of specific size sand. The effluent from the septic tank is pumped to the mound, which provides for a more controlled and uniform distribution of the effluent. The system must be designed by a licensed professional engineer (Dingman, 1982). The Wisconsin mound system is referred to as a `modified´ system in this report.

Other modifications of the `standard´ types of systems include community drainfields and systems in which the liquid effluent is pumped to the disposal area for some reason. These modifications of `standard´ systems are also considered to be `modified´ systems. `Modified´ systems are usually more efficient and reliable because of the control and uniformity of effluent distribution afforded by pumping.

Rules and regulations for locating and constructing the septic tank-disposal system have been established and are enforced by the Idaho

State Board of Health (Idaho Department of Health, 1971). Minimum distances are required between the septic tank-disposal area and dwellings, property lines, wells, and surface-water bodies. A minimum project density of 1 acre per unit has been set for dwellings using on-site systems. Installers are required to be bonded, and the system is to be inspected prior to use. Time constraints and lack of personnel make inspection of each site very difficult, if not impossible.

Characteristics and Fate of the Liquid Effluent

The first treatment of wastewater occurs within the septic tank. In the tank bacteria function without free oxygen (anaerobically), primarily in the hydrolysis of complex compounds. Organic forms of nitrogen (N) and phosphorous (P) are greatly reduced, and the suspended solids are reduced to about 20 percent of the concentration in the raw wastewater. The biological oxygen demand (BOD_5) is reduced to about 50 percent of the concentration in raw wastewater (Ziebell et al., 1975).

The liquid effluent from the septic tank varies greatly in its characteristics, depending largely on domestic practices. Concentrations of different forms of N and P are given in table 7. Average determinations of total suspended solids range from about 44 mg/liter to about 69 mg/liter. Average BOD_5 determinations range from about 122 mg/liter to about 176 mg/liter. Average counts of fecal coliforms range from about 290,000 per 100 ml to about 1,100,000 per 100 ml. (See Karikari et al., 1975; Otis et al., 1975; Sauer, 1977; Ziebell et al., 1975). The volume of wastewater produced has been determined to be about 45 gallons per day per person (Bennet et al., 1975; Jones, 1975; Witt et al., 1975). This figure is rounded to about 50 gallons

Table 7.--Nitrogen and phosphorus concentrations of septic tank and drainfield effluents (page 1 of 2).

Chemical constituent	Concentration of septic tank effluent Mg/liter	(reference)	Concentration of drainfield effluent Mg/liter	(reference)
NH_4-N	34	(Magdoff and others, 1974)	<1	(Magdoff and others, 1974)[1]
	23-52	(Otis and others, 1975)	0.8-1.1	(Sauer, 1977)[2]
	19.2	(Sauer, 1977)		
	62	(Walker and others, 1973)		
	38.7	(Ziebell and others, 1975)		
Average NH_4-N	38		1	
NO_3-N	0.3	(Sauer, 1977)	19.6-20.4	(Sauer, 1977)[2]
	0.6	(Ziebell and others, 1975)	76	(Walker and others, 1973)
Average NO_3-N	0.45		48	
(NO_2 & NO_3)-N	1	(Magdoff and others, 1974)	31	(Magdoff and others, 1974)[1]
	0.2-2.4	(Otis and others, 1975)		
Average (NO_2 & NO_3)-N	1		31	

1 These determinations were from uncrusted experimental columns.

2 These effluents are from a sand filter disposal system. The concentrations of NO_3-N are much lower than those determined in other studies.

Table 7.--Nitrogen and phosphorus concentrations of septic tank and drainfield effluents (page 2 of 2).

Chemical constituent	Concentration of septic tank effluent Mg/liter	(reference)	Concentration of drainfield effluent Mg/liter	(reference)
Total N	73	(Karikari and others, 1975)	<33	(Magdoff and others, 1974)[1]
	45	(Magdoff and others, 1974)		
	33-71	(Otis and others, 1974)		
	75	(Walker and others, 1973)		
	55.3	(Ziebell and others, 1975)		
Average Total N	60		<33	
Orthophosphate	8.7	(Sauer, 1977)	6.7-7.1	(Sauer, 1977)[2]
Total P	23.9	(Magdoff and others, 1974)	11.8	(Magdoff and others, 1974)[1]
	9-17	(Otis and others, 1975)	1.6	(Magdoff and others, 1974)[3]
	14.6	(Ziebell and others, 1975)		
Average Total P	16.9		6.7	

1 These determinations were from uncrusted experimental columns.
2 These effluents are from a sand filter disposal system. The concentrations of NO_3-N are much lower than those determined in other studies.
3 These determinations were from crusted experimental columns.

per day per person for this study.

The treatment is completed with a more advanced and complete biodegredation in the disposal field. The primary bacteriological action occurs with adequate oxygen (aerobic) and is concentrated primarily at the trench fill-soil interface. BOD_5 is reduced to low levels, ammonia (NH_4-N) is oxidized to nitrate (NO_3-N), and other important oxidation reactions occur. The material in the disposal field provides mechanisms for filtering and adsorbing suspended and dissolved solids. Pathogenic bacteria are effectively removed from the effluent in an efficient system, as is shown by indicator bacteria counts.

Concentrations of N and P compounds in the drainfield effluent are given in table 7. The NH_4-N is almost completely nitrified to NO_3-N. An average effluent NO_3-N concentration of 40 mg/liter is assumed in this report. This is based on the greater amount of information available for NH_4-N concentrations in the septic tank effluent, and assuming the NH_4-N is almost completely nitrified. Most P entering the drainfield (about 85 percent) is in the soluble orthophosphate form (Magdoff et al., 1974; Otis et al., 1975). The study by Magdoff et al. (1974) showed that total phosphorous concentrations in the drainfield effluent varied with the amount of crusting present in the experimental columns. Phosphate concentration reductions are primarily the result of adsorption and precipitation. An average effluent soluble P concentration of about 7 mg/liter is assumed for this report.

Total suspended solids can be significantly reduced in the drainfield (Sauer, 1977; Viraraghavan and Warnock, 1976). BOD_5 concentrations are also found to be greatly reduced (Sauer, 1977;

Viraraghavan and Warnock, 1976). Average fecal coliform counts of drainfield effluents ranged from about 5 to about 800 per 100 ml (Magdoff et al., 1974; Sauer, 1977; Ziebell et al., 1975). These counts vary considerably with the point of sample collection and the drainfield soil material. A very coarse gravel may not have the capability to filter all pathogenic organisms until they have in some cases traveled relatively large distances (Hagedorn et al., 1981).

The effectiveness of the disposal area is affected by several conditions including the soil properties and the hydraulic loading rate of the effluent. The soil in the disposal field must have enough fine material to filter out pathogenic organisms and suspended solids, and to allow time for nitrification of NH_4-N before the effluent reaches the ground water. However, the soil must not be so fine that movement of the effluent is severely restricted. The hydraulic loading rate is the rate of effluent disposal to the field in units of volume per time per area, i.e. gallons per day per sq. ft. The loading rate can be controlled by the size of the disposal field. Control of the frequency and uniformity of effluent dispersion may also help to increase the efficiency of the disposal field. This is best accomplished by pumping the effluent to the disposal field.

Research has been done on improving the efficiency of septic tank-effluent disposal systems. The introduction of the Wisconsin mound system is one result of this research. A nitrogen removal test system was found to be successful in removing 60-100 percent of N from effluent (Sikora et al., 1976). A professor at the University of Minnesota has developed a way to draw NO_3-N pollution out of well water (Anon., 1982).

These and other research endeavors may hold promise for reducing NO_3-N concentrations in drainfield effluents.

<u>Number and Density of On-Site Sewage Disposal Systems</u>

The number and density of on-site sewage disposal systems generally corresponds to the number and density of housing units in non-sewered areas, i.e. excluding Hailey, Ketchum, Sun Valley, and Red Top Meadows mobile home park. The exceptions are those areas where a single system serves several units, such as in Weyyakin subdivision. Several on-site systems are still used within Ketchum and Hailey.

The summary table for non-sewered areas (table 6) shows the greatest current building density occurs in Region II (fig. 3). Much of this region is zoned low- or mid-density residential. The majority of current and projected housing units lie within a section of the valley extending about 2 miles south from the new highway bridge south of Ketchum. It is noted that Cold Springs is the largest subdivision with a current building density of less than 1 acre per unit. This subdivision and several others were approved prior to the 1 acre minimum lot size established by the Idaho State Board of Health for units served by on-site sewage disposal systems.

Other subdivisions with current building densities of less than 1 acre per unit include Eagle Creek Meadows, Mortgage Row, Buttercup, and Trail's End. All the non-sewered trailer parks have building densities of less than 1 acre per unit. The current densities for all subdivisions are shown on figures 2 through 5.

The greatest projected building density in all zoned lands also occurs in Region II (fig. 7). Fifteen subdivisions in the study area were determined to have projected building densities of less than 1 acre per unit. The projected densities for all subdivisions and residentially zoned lands in the study area are shown on figures 6 through 9. The areas of greatest housing densities will also be the areas of greatest densities of on-site sewage disposal systems unless alternative methods of sewage treatment and disposal are used.

ENVIRONMENTAL ASPECTS OF ON-SITE SEWAGE DISPOSAL SYSTEMS

General Environmental Aspects

Nationwide, septic tanks and cesspools rank highest in total volume of wastewater discharged directly into ground water (Allen and Geldreich, 1975; Miller, 1980). They have been rated as the key potential source of ground-water contamination (Miller and Scalf, 1974). Bacteria and viruses can, under favorable conditions, reach the ground water, however the major concern is the possibility of ground-water contamination by high concentrations of NO_3. Regional ground-water quality problems have occurred in a few densely-populated areas, however most problems are related to individual homesites or subdivisions where private wells have been affected (Miller, 1980). Constituents from septic tank systems which present the greatest threat to ground-water quality and some of the problems which arise are:

1. High concentrations of NO_3-N produce a bitter taste and may cause physiological disorders, such as methemoglobinemia (blue baby) in infants. High NO_3-N concentrations can also be a factor in eutrophication of surface-water bodies.

2. Discharge of ground water with high phosphate concentrations to surface-water bodies can cause eutrophication.

3. Excessive BOD in septic effluent discharged to surface water from clogged drain fields can deplete oxygen supplies.

4. Pathogenic organisms discharged rapidly to nearby wells through very coarse materials or discharged to surface water from clogged drain fields may cause disease.

Environmental Aspects Within the Study Area

Miller (1980) states that "... a septic tank density of greater than 40 per sq. mile designates a region of potential contamination problems." The study area currently has a non-sewered housing unit density (and assumed septic tank density) of about 38 per sq. mile within the valley area.

Septic Tank-Disposal System Failures

The most obvious impact of on-site sewage disposal systems occurs when a system malfunctions or fails. The failure can occur from clogging, excessive hydraulic loading, or at the other extreme from too coarse materials in the disposal area. The underlying cause for system failures may be faulty siting, design, or construction, or inadequate maintenance. A system failure often results in wastewater backing into the home or the effluent rising to the surface above the disposal field. System failures have been reported in recent years in the study area.

Nutrient Loading and Potential Impacts

The less obvious, but probably more serious, impacts of on-site sewage disposal systems are, as have been mentioned, the introduction of high concentrations of NO_3-N and P into the ground water. The load upon the aquifer of these nutrients was calculated for all non-sewered areas under current conditions (tables 2 through 6). The nutrient loads, in pounds per year, were calculated using the average assumed concentrations of 40 mg/liter and 7 mg/liter for NO_3-N and P, respectively, and an effluent volume of 50 gallons per day per person, or 150 gallons per day per housing unit. These values were then adjusted for occupancy percent. The total current load from on-site sewage disposal systems is about 24,900 pounds per year (1.3×10^{10} mg/year) of NO_3-N, and about 4,500 pounds per year (2.3×10^9 mg/year) of P. The nutrient load from the Woodside treatment plant-disposal system, not included in the above values, is estimated to be about 4,100 pounds per year of NO_3-N and about 740 pounds per year of P. The most concentrated source of nutrient loading is the city of Bellevue combined with the Woodside plant. These contribute a combined load of about 10,600 pounds per year of NO_3-N and about 1,900 pounds per year of P, which is about 36 percent of the total. Region II, which has the smallest land area, contributes more to the total nutrient load than any other single region, excluding Woodside and Bellevue from Region IV.

The nutrient loads for the projected 1990 and maximum populations residing in non-sewered areas were calculated. The loads calculated for 1990 are about 54,000 pounds per year of NO_3-N and about 10,000 pounds per year of P. The calculated nutrient loads under the maximum projected population are about 95,000 pounds per year of NO_3-N and about 17,000 pounds per year of P.

The capability of the aquifer to adequately disperse or dilute the calculated nutrient loads was estimated. The ground-water underflow at Hailey averages about 34,000 acre-feet per year (Smith, 1959, p. 21). Assuming 100 percent mixing or dispersion of the effluents and uniform seasonal input to the ground water, the nutrient concentration increases were estimated to be about 0.3 mg/liter NO_3-N and about 0.06 mg/liter P. These concentrations are not significant in relation to ground-water quality. However, the assumption of 100 percent mixing or dispersion is not valid because the effluent is not uniformly applied over the study area; and the nutrients will tend to remain near the top of the aquifer before dispersing vertically into the aquifer.

Water-quality problems associated with on-site sewage disposal systems are usually individual or local in extent (Miller, 1980). Individual wells constructed near on-site systems generally have more potential to draw contaminated ground water than do community wells. The reasons may include: 1) a greater incentive to protect several families by locating the well a safer distance from any on-site systems; 2) the capability to afford a well-constructed, deeper well; and 3) more stringent design considerations required for community-type water systems. Wells serving community water systems within a subdivision may also have a potential for nutrient contamination, especially in relatively high-density subdivisions. Tables 2 through 6 indicate the number of housing units served by community water systems.

Available data do not show any indication of water-quality problems which may be related to on-site sewage disposal systems, nor do they show trends which may indicate future water-quality problems. However, there is very little ground-water quality information available for the study area, especially in specific areas which may have a potential for ground-water contamination from on-site systems. Some subdivisions or areas of concern regarding possible ground-water contamination are: Eagle Creek Meadows; Mortgage Row; Alturas Vista; Little Acres; Trail's End; and most of the non-sewered trailer parks. These subdivisions and trailer parks have building densities of 1.5 acres per unit or less, have at least 10 units currently built, and are served by individual wells. Several other subdivisions will meet these criteria in the future if they are built out as planned. Other current areas of concern include the area of intense development about 3 miles south of Ketchum (including Cold Springs), the area near the confluence of Big Wood River and East Fork, and the Bellevue area.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

1. There are currently about 85 approved subdivisions in the study area, with a current build-out of approximately 713 units. This is about 33 percent of the projected build-out of 2,151 units. The current building density within subdivisions on buildable lands is about 6.64 acres per unit, and is highest in Region II and in Bellevue. The current building density in Bellevue is about 1.60 acres per unit. The projected building density within subdivisions is about 2.21 acres per unit, and within Bellevue is about 0.75 acres per unit.

2. The total buildable land in the study area outside of city boundaries has been determined to be approximately 21,270 acres. Subdivisions account for about 5,860 acres, leaving about 15,410 acres available for development. Under current calculated zoning district densities, the non-platted zoned lands could accomodate approximately 4,230 units at 90 percent build-out.

3. The current population in the study area is estimated to be about 9,500. The 1990 projected population in the study area is estimated to be about 15,000, and the maximum projected population is estimated to reach about 21,700.

4. The cities of Ketchum, Sun Valley, and Hailey, and Red Top Meadows mobile home park are served by sewage collection and

treatment facilities. All other areas are considered to use on-site sewage disposal facilities. There are currently about 1,610 units in the study area which use some type of on-site sewage disposal system. About 713 of these are in subdivisions, and about 374 are in the city of Bellevue. Permits for about 54 percent of these are on file with the South Central District Health Department. The density of on-site sewage disposal facilities corresponds to the density of dwelling units.

5. The total current nutrient load from on-site sewage disposal systems is about 24,900 pounds per year of nitrate (NO_3-N) and about 4,500 pounds per year of phosphate (P). The current nutrient load from the Hailey Woodside subsurface disposal system is about 4,100 pounds per year of NO_3-N and about 740 pounds per year of P. Region II contributes more to the nutrient load than any other single region, however the Woodside plant and Bellevue combined contribute approximately 36 percent of the total load. The nutrient loads projected for 1990 are about 54,000 pounds per year of NO_3-N and about 10,000 pounds per year of P. The loads calculated for the maximum population projection are about 95,000 pounds per year of NO_3-N and about 17,000 pounds per year of P.

6. Some areas of concern which may have a potential for nutrient contamination of ground water include: Eagle Creek Meadows; Mortgage Row; Alturas Vista; Little Acres; Trail's End; and most non-sewered trailer parks. The major concern in these

areas is individual well contamination. Other areas of concern include the area of intense development about 3 miles south of Ketchum, the area near and south of the confluence of the Big Wood River and East Fork, and the Bellevue area.

Recommendations

1. A ground-water monitoring network of wells should be established to: a) detect any current individual or local ground-water quality problems; b) establish a ground-water quality base from which predictions can be made or from which trends can be detected; and c) provide data for ground-water flow system analyses.

2. Procedures should be established and funds provided to an agency for continued collection of ground-water quality data, and for periodic publication of the data.

3. The ground-water flow system in the study area should be analyzed and better defined. This should include: a) analysis of the geologic framework; b) construction of potentiometric surface maps; c) re-evaluation of the water budget; and d) determination of the river-aquifer relationships.

4. Results of this and any future studies should be used for planning purposes, and also to determine other future study needs.

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16. Abstract

The upper and middle Big Wood River Valley has experienced large population growth associated with recreational development. Much of this growth has been and will continue to be in rural areas, making private and small community water systems and individual on-site sewage disposal facilities necessary.

There are currently about 85 approved subdivisions in the study area, with a projected build-out of 2,151 units, 713 of which are currently built. The currently subdivided buildable area is approximately 5,860 acres of a total buildable area of approximately 21,270 acres. The current building density of non-sewered areas is approximately 6.64 acres per unit for the study area and approximately 1.60 acres per unit for the city of Bellevue. The projected building density of non-sewered areas is approximately 2.21 acres per unit for the study area and approximately 0.75 acres per unit for the city of Bellevue.

It is assumed that individual and group on-site sewage disposal facilities currently contribute about 24,900 pounds per year of nitrate (NO_3-N) and about 4,500 pounds per year of soluble phosphate (P) into the ground water. The Hailey Woodside treatment-disposal facility currently contributes about 4,100 pounds per year of NO_3-N and about 740 pounds per year of P to the ground water. Nutrient loads under maximum projected development are expected to be around 95,000 pounds per year of NO_3-N and about 17,000 pounds per year of P.

17a. Descriptors

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