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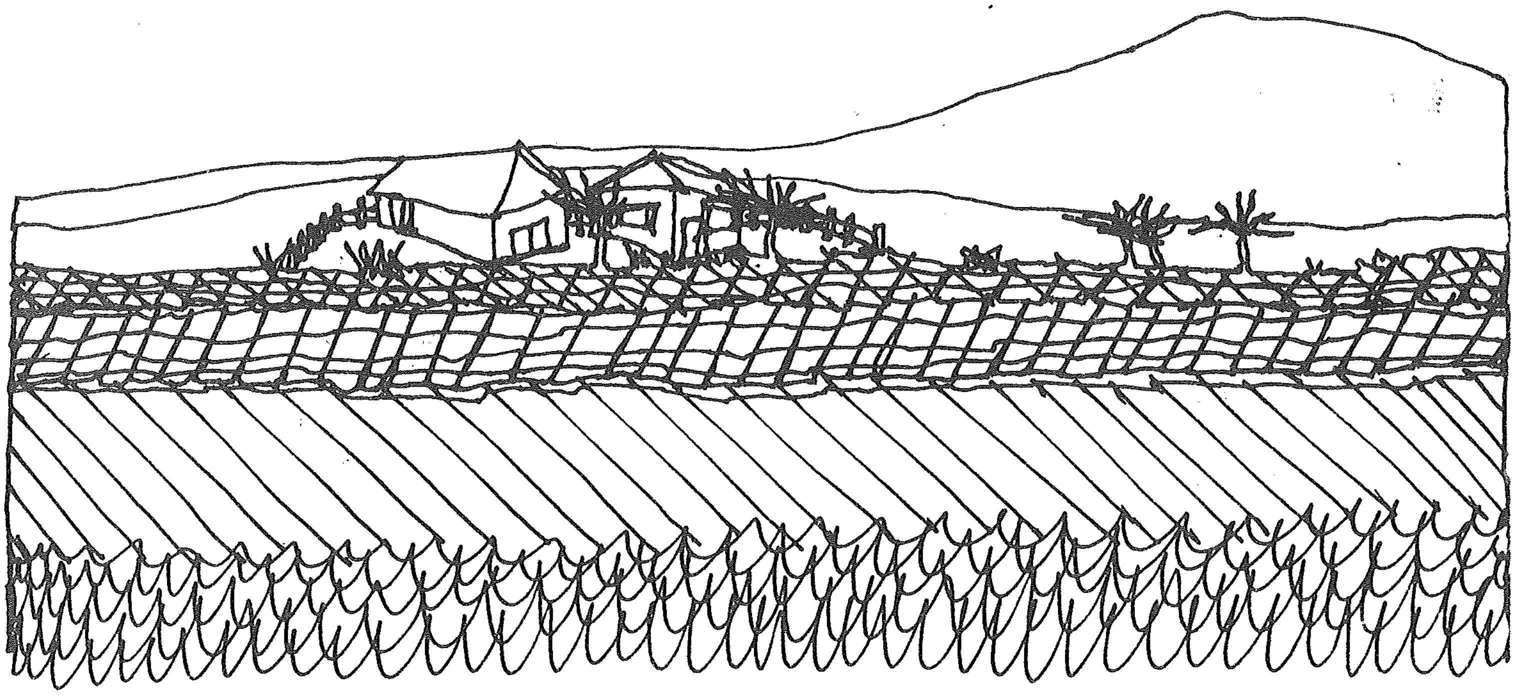
GROUNDWATER QUALITY IN GRAND MOUND



THE GROUNDWATER STUDY GROUP * T.E.S.C. * SPRING, 1978

GROUNDWATER QUALITY

in

GRAND MOUND

A Study of Residential Land Use and Groundwater Quality in Grand Mound, Washington, 1978

ACKNOWLEDGMENTS

The students of the Groundwater Study Group would like to thank the citizens of Grand Mound for the cheerful donation of their time and water.

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The Groundwater Study Group
June 6, 1978

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I. PREFACE

Groundwater quality is dependent, among other things, on the characteristics of the soil, the condition of the aquifer, and the amount of contaminants introduced into the soil and water. The soil has an inherent ability to chemically and biologically reduce levels of contaminants reaching water supplies. The aquifer varies in depth and flow rate. These variables can influence the impact of contaminants on groundwater quality.

This report examines the geologic and hydrologic characteristics of Grand Mound with respect to the relationship between local groundwater quality and housing densities. These studies reveal a high water table and a high degree of permeability in the soil, which with increased effluent load, can allow significant amounts of contaminants to enter the aquifer. There has been a substantial increase in residential development in Grand Mound in the past ten years. Septic tanks are used for sewage disposal in most of these new homes. Effluent from septic drainfields may increase the contaminant load in the water supply if these effluents have overloaded the soil's ability to remove contaminants from them.

This study focuses on both the natural and social factors influencing groundwater quality. Our first step was to research the geologic and hydrologic characteristics of Grand Mound Prairie. Next, we analyzed water samples from selected wells in the Grand Mound area for nitrogen species and coliform bacteria, two common groundwater contaminants. The social facets of our analysis involved an investigation of housing density levels and both current and projected land-use patterns in the community.

From these results, we have related contamination and density levels.

In our final step, we have formulated policy recommendations which are based not only on physical data, but also on existing legal policies and community values, as demonstrated in a land-use policy flow chart and a community opinion survey. These recommendations are designed to maintain a clean residential water supply in Grand Mound.

PHYSIOGRAPHY
and
GEOLOGY

II. Physiography and Geology

Grand Mound Prairie is a flat, well-drained area formed by glacial outwash gravels. Meltwater streams from continental glaciers deposited sand and gravels in the area, and these outwash deposits formed a flat plain. All the physical characteristics of Grand Mound Prairie are determined by the properties of these deposits. The deposits which form the prairie are highly porous and allow water to percolate downward rapidly. Consequently, the surface is well drained and the underlying gravels contain large amounts of groundwater.

Surface runoff drains into Scatter Creek, Prairie Creek, and the Chehalis River. To the east, the prairie is bounded by hills formed from sedimentary rock. Runoff from these hills drains into Scatter Creek and the gravel aquifer (water-bearing material) underlying the prairie. On the prairie, there is a slight drainage gradient to the west.

There were two glacial episodes during which material was deposited in the area. During the Salmon Springs glacial period, ending 35,000 years ago, a lobe of the continental glacier advanced across the area that is now Grand Mound Prairie. Meltwater streams deposited glacial sand and gravel, forming a glacial outwash plain. When the glacier retreated about 35,000 years ago, these deposits were weathered and eroded. The deposits which weathered into clays became compressible.

During the Vashon glacial period, ending 12,000 years ago, a glacial lobe extended as far as the Maytown Uplands, north of Grand Mound Prairie. New outwash was deposited by meltwater streams, and the weathered Salmon Springs sand and gravel was compressed into a hardpan layer in many places by the weight of the younger outwash.[1] Well logs for the Grand Mound area frequently indicate the presence of a layer of cemented sand and gravel within 40 feet of the surface. Above and below this layer are sand and gravel.[2] (Fig. 1)

Soil on Grand Mound Prairie reflects the drainage characteristics of its parent material (outwash gravel). Like the glacial outwash, soils on the prairie are porous and drain rapidly. Since water drains rapidly away from the survace, prairie vegetation, adapted to dry conditions, has predominated.

The prairie soils are classified as Spanaway gravelly sandy loam.[3] The A horizon (top layer) is black and rich in organic matter. It is moderately to stongly acidic, and small pebbles make up about half its volume. This layer is generally 16 to 20 inches deep (two feet deep at maximum. The subsurface layer is composed of sand, gravel, and stones.[4] The water table is shallow, within 30 feet of the surface in most places. Most of the groundwater is contained in the Salmon Springs gravel. This aquifer is penetrated by virtually all the wells in the Grand Mound area, and it has an average yield in excess of 500 gallons per minute.[5] It is recharged through its area by precipitation, and around its perimeter by upland runoff.

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[1] Geology and Groundwater Resources of Thurston County, Washington, Volume 2, p. 68.

[2] Ibid.

[3] Soil Survey, Thurston County, Washington p. 54.

[4] Ibid.

[5] Geology and Groundwater Resources, p. 96.

The shallow, quick-draining soils and the shallow water table may present limitations on the use of septic tanks in the area. Since septic tank effluents will drain quickly through the soils, they may drain deeply into the ground and into the aquifer before bacterial action on contaminants has been completed. The hardpan does not offer much protection from such contamination because it is below the water table and probably intermittent.

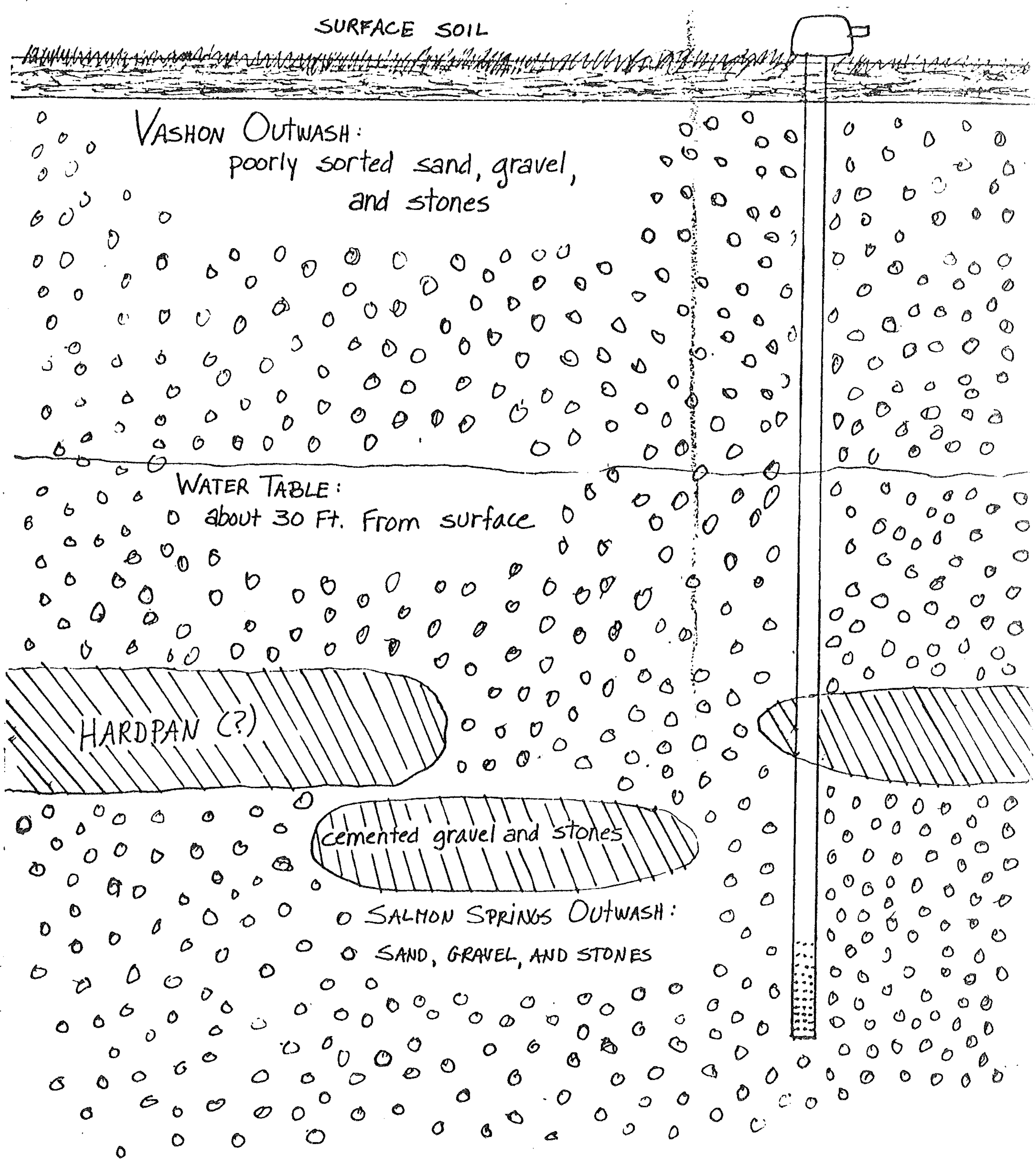

FIGURE 1 : SCHEMATIC CROSS-SECTION OF ALLUVIUM IN THE GRAND MOUND AREA

GROUNDWATER

MOVEMENT

III. GROUNDWATER MOVEMENT

Determination of the rate and direction of groundwater flow beneath Grand Mound allows us to assess the movement and dilution of contaminants. The aquifer in the Grand Mound area is recharged directly by precipitation and runoff from the neighboring hills. Groundwater in the aquifer moves from these areas of recharge to areas of discharge. Critical properties of the aquifer are its ability to transmit water (permeability) and the rate of groundwater flow.

Groundwater flows from one point to another whenever there is a difference in the level of the groundwater table (hydraulic head). The hydraulic gradient is determined by the difference in hydraulic head between two points and the distance between them. The hydraulic gradient in an aquifer and consequently the direction of groundwater movement is always perpendicular to lines of equal hydraulic head.

The aquifer map (Fig. 22) depicts the Grand Mound area with water table contour lines at 10-foot intervals. These are also lines of equal hydraulic head. Where the contour lines are closer together, the level of the water table changes more rapidly from point to point, as does the hydraulic head. Generally, it can be expected that the groundwater discharge is greater where the hydraulic gradient is steeper, unless permeability of the aquifer is significantly less in these areas. Flow direction and discharge of groundwater were roughly calculated for specific sections within the study area.

RESULTS AND DISCUSSION

From an analysis of hydraulic data in well logs (Table 1) and the aquifer map we have approximated the flow velocity and direction of groundwater movement in four regions in the study area. (A detailed methodology appears in Appendix C. The general direction of groundwater flow in the Grand Mound area is towards the southwest. Water from the hills to the east flows southwest under the prairie toward the Chehalis River. The groundwater is recharged locally near the Chehalis River.

Permeability along transect A was averaged from hydraulic test data from six wells in the vicinity of this transect (Fig. 22). This transect is labeled on the aquifer map as A-A. This area had the lowest hydraulic gradient, and the mean probable flow rate was the slowest. A mean probable flow rate was calculated at 1 gal/cu ft/day. Permeability along transect B was averaged from data from three wells near this transect. The mean probable flow rate was calculated at 2.3 gal/cu ft/day. Permeability along transect C was averaged from data from three wells, and the mean probable flow rate was calculated at 3.2 gal/cu ft/day. For transect D, data from two wells was used, and the mean probable flow rate was calculated at 2 gal/cu ft/day.

The calculated flow rates give only approximate values for the groundwater flow rates. However, they are sufficient for qualitatively determining rates of groundwater movement. Considering the large volume of the aquifer, the total underflow is quite large.

Whether contaminants will be effectively diluted by this volume of water is another question, to be dealt with in the synthesis of this report.

(Table 1) Discharges Calculated Along Four Transects

Transect	Permeability gal/cu ft/day	Hydraulic Gradient	Discharge, gal/cu ft/day
A	692	.0015	1
B	192	.012	2.3
C	318	.01	3.2
D	322	.006	2

CURRENT SEPTIC SYSTEMS

IV. CURRENT SEPTIC SYSTEMS IN GRAND MOUND

In Grand Mound, sewage wastes are treated in septic tanks before being discharged into the soil and subsequently, groundwater. This section details the manner in which a typical septic system functions. General standards and capacities of the system are included as well as a description of these systems.

The processes involved with septic disposal systems are related to the soil and groundwater conditions in Grand Mound. By recognizing these conditions as limitations, we can avoid water quality problems that relate to septic disposal.

The individual septic tank with a septic drainfield is the method of sewage disposal most often used by suburban and rural households, where there are no public sewers. Raw sewage from the home enters the septic tank through the hose sewer at a point where it is diverted downward by a sanitary tee. The heavy solids settle to the bottom of the tank where bacterial action digests them to sludge. The lighter solids form a scum layer at the top of the water level. The liquid portion (effluent) flows out of the tank to the drainfield where suspended solids are decomposed and the liquid evaporates or is transpired by vegetation.

Proper absorption of contaminants can take place only in soils with a percolation rate slow enough to allow their assimilation into soils. Location of the septic disposal system also depends on the size and slope of the lot, distance to, and type of surrounding water supply system, distance from bodies of surface water, drainage field area, and roof drainage discharge.

The system should be designed to receive all sewage from the dwelling including laundry waste and basement floor drainage. Footing and roof drainage should not enter the system. Minimum capacities for septic tanks are shown in Table 2.

Table 2 Minimum Capacities for Septic Tanks

No. of Bedrooms	Min. Capacity of Tank in Gallons
1	1,125
2	1,125
3	1,250

For each additional bedroom add 250 gallons. Capacities indicated are sufficient for all domestic sewage wastes.

When septic tanks are constructed, care must be taken to insure that they will be water-tight. The tank should be constructed of material not subject to excessive corrosion or decay. The tank should be structurally sound enough to sustain all dead and live loads, liquids, and earth pressures. The design should provide access for cleaning. Inlet and outlet connections should be submerged or baffled so as to effectively retain scum and sludge. Scum storage volume (space between the liquid surface and the top of the inlet and outlet) should not be less than 14% of the total required capacity. (See Figure 3).

The permeability of the soil and the depth to the groundwater table influence the safety of the septic drainfields. Percolation tests are necessary for determining the soil's permeability. If test holes hold water within four feet of the surface, installation of septic drainfields of any type is not advisable.

The maximum depth of an absorption trench in a drainfield should be three feet. The minimum absorption area (bottom area of trench) recommended is 85 square feet per bedroom. Absorption trenches should not be constructed in filled ground because such soil is too unstable.

The disposal trench system (see Figure 4) is widely used in the Grand Mound area, along with the two-compartment septic tank. Depth of the trenches in the area varies but on the average is a bit more than a foot. This depends on the thickness of the A horizon. The pipe should be placed partially below this layer. If it is placed too far into the loose gravel layer below, percolation will occur too rapidly.

Septic tanks and drainfields work by bacterial decomposition of raw sewage only. No additives or septic tank conditioners need be added. Normal amounts of bleach, soap or detergent will not affect the operation of the tank. The tank needs to be cleaned when the accumulation of scum and sludge exceeds the maximum storage capacity. A check of this accumulation every two years is advisable.

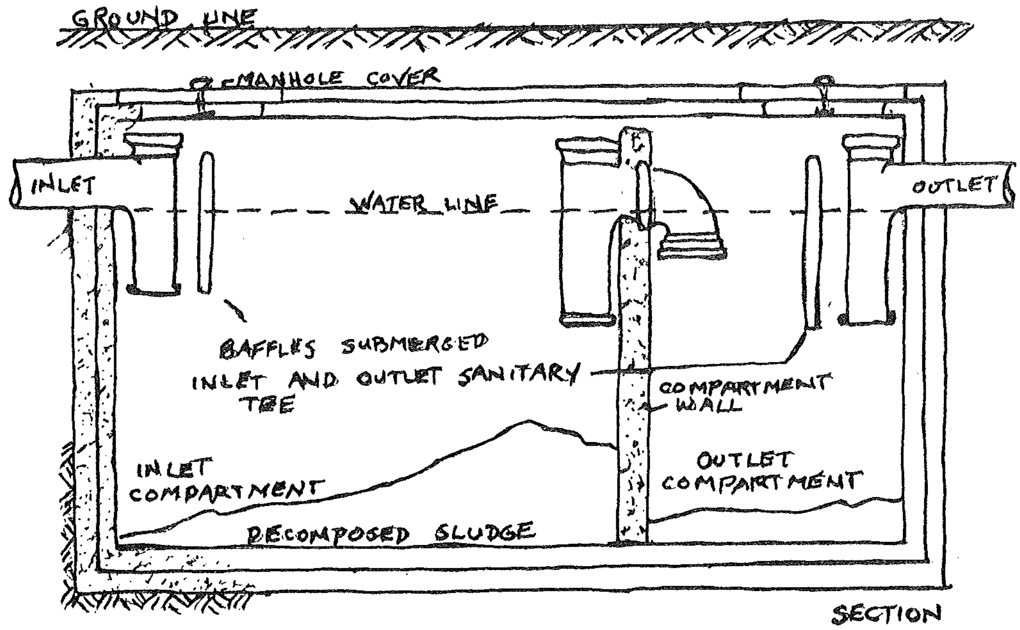

Figure 3: DOUBLE COMPARTMENT SEPTIC TANK

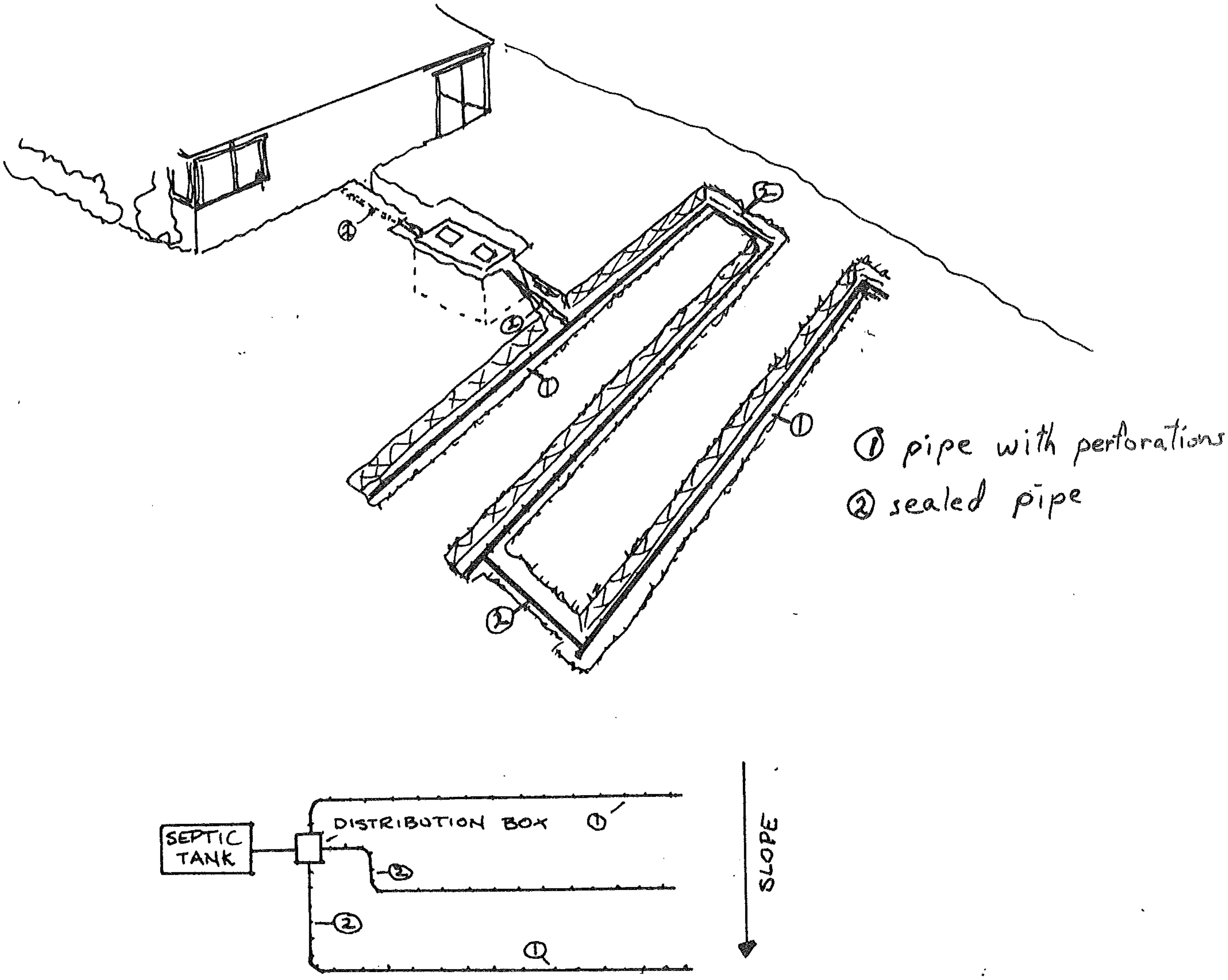

FIGURE 4: DISPOSAL TRENCH SYSTEM

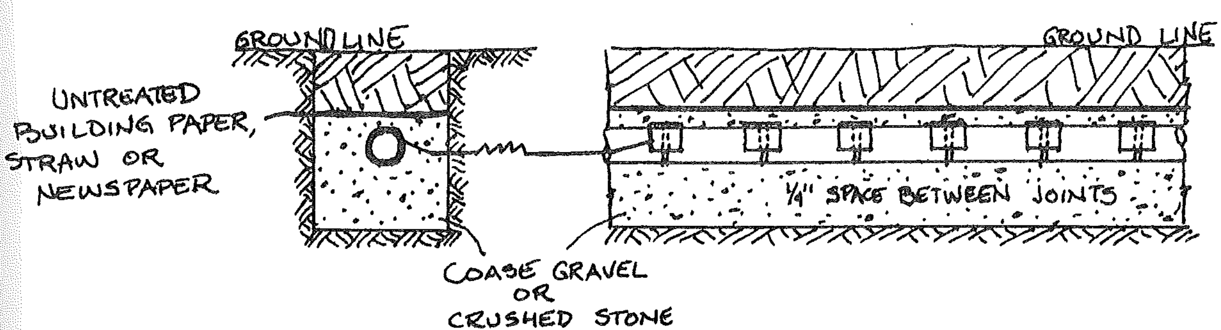

FIGURE 5: DISPOSAL TRENCH CONSTRUCTION

GROUNDWATER QUALITY

V. WATER QUALITY

Well water from Grand Mound was tested for two nitrogen species and coliform bacteria to determine the extent and levels of these contaminants in the groundwater. The following section details our method of site selection, the reasons for the groundwater contaminants analyzed, and the results of the analysis.

A. Site Selection

Based on the population of the Grand Mound area (about 250 households) it was determined that sampling of 75-80 wells in the area would yield statistically significant results. The selection of sites was based on three major criteria:

1. Density classification for the study area
2. The proximity of low and medium density areas to areas of high density
3. The direction of groundwater flow in the area

Density classification was accomplished by using a preliminary density map showing the location of all residences in the Grand Mound area. These residences were plotted by tract and lot location as given in the County Assessor's records. Section lines were also plotted on the map. Next, each of the sections on the map was divided into quarter-quarter sections (40 acres) and the number of dwellings per quarter-quarter section was counted. The quarter-quarter sections containing 18 to 22 dwellings were designated as medium density, and those with 1 to 6 dwellings were designated as low density. These designations are arbitrary and are used only for purpose of comparison among parts of the study area. The proximity of low and medium areas to high density was important to judge the impact of possible pollution from high density areas on contiguous low and medium density areas.

The third factor, the flow direction of the aquifer, was determined by the groundwater contour map in Water Supply Bulletin #10. This criterion was introduced to determine if the spread of contamination is related to groundwater flow direction.

To determine if groundwater contamination is related to population densities, 40 wells were sampled in areas of high density, 25 wells in areas of medium density, and 15 wells in areas of low density. This is not intended to give a representational view of the study area, in which an equal number of samples would be taken in each density classification. We expressly intended to concentrate on areas where we expected highest levels of contamination. The three variables were organized as a matrix (Table 3).

Table 3

High Density	40 samples	
	Up Aquifer from H.D.	Down Aquifer from H.D.
Medium Density		
Contiguous to high density	6 samples	7 samples
Non-contiguous to high density	6 samples	6 samples
Low Density		
Contiguous to high density	3 samples	6 samples
Non-contiguous to high density	2 samples	4 samples

Thus for areas of medium density, contiguous to high density areas, and up aquifer from them, we attempted to get 6 samples. We referred to our preliminary density map and selected the quarter-quarter sections that are medium density and contiguous and up-aquifer from high density areas.

The 6 samples were collected from households within these quarter-quarter sections. We repeated this process until we had plotted the quarter-quarter sections relevant to each matrix classification, and assigned the number of samples to be collected from each quarter-quarter section.

B. Constituents of Sewage Effluent Analyzed

1) Nitrogen species

Nitrogen in the form of ammonia is a common constituent of domestic sewage effluent. As ammonia drains out of the drainfield of a septic system, it reacts with oxygen to form nitrites by a process known as oxidation. If further oxidation occurs, the nitrites will in turn convert into nitrates. These reactions occur readily in aerobic (oxygen-rich) conditions because nitrate is the most stable of nitrogen compounds associated with sewage under aerobic conditions.

Nitrate is easily leached into groundwater systems due to the high solubility of nitrate salts and the failure of colloidal (very small) soil particles to absorb nitrate ions.

Nitrites will be found in groundwater when conditions are not aerobic enough to allow their oxidation to nitrates. For this reason, comparison of nitrite and nitrate levels in groundwater yields insight into subsurface conditions. Under anaerobic conditions, chemical pollutants are neutralized more slowly than under aerobic conditions. Nitrite will not leach into groundwater as readily as nitrate, though, because it binds more readily with fine soil particles.

The presence of nitrite or nitrate in groundwater can lead to a serious health hazard. Nitrite is very toxic to humans since it can replace the oxygen in the hemoglobin, resulting in condition called methmahemoglobinemia.

This conditions reduces the total oxygen in the bloodstream and causes the skin to turn blue. Nitrate, if ingested in drinking water, can be converted to nitrite by bacteria in the intestines of infants and some adults and can also induce methmahemoglobinemia. For this reason, Nitrogen as Nitrate in drinking water should be under 10 parts per million (ppm) as defined by State of Washington drinking water standards.

2) Coliform

Coliform are a type of bacteria commonly found in the intestines of humans and other warm-blooded animals. Hence, as a constituent of human excrement, they are common in domestic sewage effluent. Coliform bacteria themselves pose no threat to health, except in the strain E. Coli which is not found in uncontaminated groundwater. However, the presence of coliform in water has been shown to be an effective indicator of possible contamination by many types of pathogenic (harmful) bacteria and viruses which are transmitted by humans, including those responsible for such diseases as salmonella, shigella, and cholera.

Fecal coliform will die off rapidly in temperatures below 35 degrees. Therefore, the presence of fecal coliforms in groundwater usually indicates rapid percolation of effluents through soils and sub-surface strata. It was therefore desirable to test for fecal coliforms as well.

The fecal coliform test is more specific in temperature requirements than the total coliform test. Fecal coliforms will grow well at 44.5 degrees C, whereas other members of the coliform group do not. To confirm the presence of fecal coliform in groundwater samples, cultures which showed the presence of coliform at the initial incubating temperature of 35 degrees C were transferred to suitable media and incubated at 44.5 degrees C. If growth occurs at the elevated temperature, the sample contains fecal coliforms. If fecal coliforms (those incubated at a higher temperature) are found in drinking water, their presence can indicate that sewage effluent has reached the aquifer.

C. Results of Analysis

Each of the 75 samples collected was analyzed for nitrite, nitrate, and total coliform concentrations. Those samples containing coliforms by the total test were then analyzed by the fecal coliform test. Methodologies of these analyses and tables of all results are located in appendix of this report. The following is a synopsis of the results for each test.

1) Coliform

Total coliform was analyzed by the membrane filter (MF) technique. Of the 75 samples analyzed, 7 were found to contain total coliform at the time of testing. Of these seven samples, 3 contained 1 coliform per 100ml of water, 3 contained 2 coliforms per 100ml of water, and 1 contained 16 coliforms per 100ml of water.

Fecal coliform was analyzed using the most probably number (MPN) technique. Of the seven samples containing total coliform, none contained fecal coliform at the time of analysis.

Given the State drinking water standard for coliform bacterium per 100ml of water, 4 of the 7 samples which contained coliforms represent unsafe conditions for drinking water.

2) Nitrite

Nitrite was analyzed by the method explained in Appendix A. Of the 75 samples analyzed, none contained significant amounts of nitrite.

3) Nitrate

Nitrate was analyzed by the method described in Appendix A. Of the 75 samples analyzed, 1 contained 18ppmN,4 contained between 6 and 10ppmN, 7 contained between 4 and 6 ppm N, 26 contained between 1 and 4 ppm N, and the remaining 37 samples contained less than 1 ppm N.

The State drinking water standard for nitrogen as Nitrate drinking water is 10ppm. The water sample containing 18ppm indicates a very serious health hazard. The water supplies containing between 6 and 10 ppm represent marginal safety conditions and care must be taken to insure that nitrate levels do not exceed safe drinking water standards. The water samples containing less than 6ppm indicate safe drinking water at the present time.

Residents at the homes where dangerous levels of coliform and nitrate were found were informed of the contamination levels in their drinking water. In light of these findings it is evident that well water in the Grand Mound area must be monitored regularly.

Results of the nitrate and coliform analysis were plotted on the water quality map (Fig. 23). These results are discussed and analyzed in terms of physical factors and residential land use in the synthesis of this report.

RESIDENTIAL LAND-USE ANALYSIS

VI. RESIDENTIAL LAND-USE ANALYSIS

A. Introduction

Since this study is primarily concerned with determining what, if any, effect housing density has on the levels of domestic pollutants in the groundwater of Grand Mound, it is important to determine residential land-use practices in the area. Through understanding Grand Mound's growth to date as well as the physical characteristics of the area and community values, citizens and policy-makers will be able to make informed choices about where and to what extent development should occur. Our study has taken place in the Grand Mound area in Township 15N, Range 3W, Sections 1-3, 10-14.

BACKGROUND INFORMATION

In 1869, the first recorded residence in Grand Mound was established.[1] The first tract, Grand Mound, was platted in 1890[2]. Today, all of those original boundaries have been vacated.

There have been periods before 1970 in which development was more active than usual. Among these periods are the early 1920's (1920-1923) when a multiple number of dwellings were erected instead of one or two per year. Another period of increased growth occurred in the mid-1930's (1934-1938). Since that time there have usually been more than two homes built each year. Two individual years of growth since the 1930;s are prominent: 1948 and 1962. Post-war factors might account for the 1948 spurt. Mobile homes were introduced to Grand Mound on a large scale basis in 1962 with the opening of a mobile home park.

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[1] Assessor's Field Books, Thurston County Assessor's Office.

[2] Book of Tract, Thurston Regional Planning Council

Beginning in 1970, Grand Mound's growth rate jumped from an average of 1.66 new living units per year to 28.5 new living units per year. At present, the number of mobile homes is about 40 percent of the total number of residential structures. Single family houses are those residences constructed on-site for which one family occupancy is intended. Mobile homes are single-family residences transported to the home site.

B. Present Situation

At the present time, residential land occupies 1,367 acres in the study area. There are 164 acres being used for agriculture purposes. Commercial endeavors take up another 250 acres of the area. The density map (Fig. 24) illustrates the present residential pattern. The average size of a residential lot in Grand Mound is 3.58 acres. As might be expected, new homes have been located along previously established roads. The most densely settled portion of the study area is the south central sector, while the northeast corner is the second most populated.

Presently, there are about 3,330 acres in the study area that are undeveloped. This figure does not include the acreage in developed areas that can be subdivided. The Rochester Sub-Area Plan provides for three future housing densities: 1 unit, 4 units, and 6 units per acre.[3] Thus, the number of acres open for potential development is greatly increased. At a density of 1 unit/acre, about 4,490 acres are open for development; while at densities of 4 and 6 units/acres, about 4,600 acres are available.

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[3] "Rochester Sub-Area Plan," adopted by Thurston County Board of Commissioners, Feb. 14, 1978, p. 35.

C. Trends

According to existing County ordinances, land in Thurston County can be developed in one of three ways. If an area is divided into parcels, each five acres or larger, no governmental supervision of the subdividing is required. Land divided into five or more parcels, any of which are less than five acres, is a long plot and must be approved by the Planning and County Commissions. Land subdivided into 4 or less parcels, any of which is less than five acres, is a short plat and must be approved by the Planning Department staff. Since records for the first type of land division are not kept, only the trends of the latter two can be compared. Short platting has been the predominant means of dividing land in the study area. Only three long plats have been recorded since 1971, whereas short plats average 6.8/year. The size of an average lot in these short plats is one acre. Each year an average of 36.7 acres are subdivided by this method.

Following this is a table (Table 4) of rates of growth to capacity based on the present growth rates and household size. Capacity is defined as the amount of time it takes to develop an area at a specific density, given a set growth rate and household size. This chart was developed to give citizens and policy-makers a range of rates to capacity at varying densities. This will enable people to compare how fast the area may grow with how much the population will increase. The methodology for the development of this table is included in Appendix D.

Table 4 Rates to Capacity for Grand Mound

Density: units/acre	# acres open to development	# years to capacity	projected population increase
1/3/5	3,896	136	3,406
1/1	4,323	151	13,532
1/2 of study area at 1/1 1/2 at 4/1	4,430	155	34,664
1/3 of study area at 1/1 1/3 at 4/1 1/3 at 6/1	4,471	157	51,315

The first column in the chart indicates the density levels used in the calculations and the second column is the number of acres available for development at that density. So, at 1 unit per 3.58 acres (present density), 3,896 acres can be developed. This will take 136 years to develop fully with a population increase of about 34,400. If half of the area is developed at 1 unit per acre and half at 4 units per acre, the area will be fully developed in 155 years with a population increase of about 34,700. The future land needs of commerce and agriculture were not taken into account when this chart was formulated.

The area in which our study takes place has been designated a growth area by the Sub-Area plan. There are three ways in which residential growth can occur here. If septic tanks are used for sewage disposal, then only 1 unit per acre is allowed. If other means of sewage disposal beyond primary treatment are employed, then a density of up to 4 units per acre is permitted without a site plan review or public hearing (unless otherwise required). Up to

6 units per acre may be allowed with the same stipulations as with 4 units per acre, provided that a site plan review and public hearing take place.

If the present trends in short platting and use of septic tanks continue, the area will probably develop at 1 unit per acre in the near futre. The study area (eight square miles) is large enough, and the population density low enough to make a large scale public sewage system economically unfeasible at the present time.[4] However, if alternatives (group or individual) to septic tank and drainfield disposal which go beyond primary treatment are widely used, then higher densities may occur without endangering groundwater quality. Some of these alternatives are described later in this study.

D. Effects of Satsop Nuclear Reactor on Study Area

Grand Mound is located within twenty miles of the Satsop nuclear power plant, which is presently under construction. The plant is served by State Highway 12, and as a result the area will likely receive a large portion of the population drawn to the area by the plant's construction. The Washington Public Power Supply System, which has compiled reports on the socio-economic impacts of Satsop, asserts that the majority of the labor at the plant will be from a mobile market, i.e., people that will be looking for permanent residences rather than people already established in the Puget Sound area and commuting to the site.[5] Calculations about how many workers will soon settle in the area are being revised as the project is beginning late. (The foundation will be poured in June, 1979.) However, it is "estimated" that nearly 3,000 people will settle in the Rochester sub-area for at least the

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[4] Thurston County: A Comprehensive Water & Sewerage Plan, Cornell, Howland, Hayes & Merryfield, March 1972, pg. 5-1.

[5] Analysis of Socioeconomic Impacts of WNP-3 & WNP-5, Washington Public Power Supply System, Sept. 17, 1975.

duration of the construction.[6] This means that about 958 new dwelling units will have to be established. Thus, at a density of 1 unit per acre, 958.4 acres would be developed for residential use and at 4 units per acre, 239.62 acres would need to be developed for housing. Although these figures represent the entire sub-area, our study area is in the second most dense sector of the sub-area, and has community services attractive to prosoective residents. Whatever growth does occur as a result of Satsop is above and beyond the growth rates expressed earlier in this report.

E. Conclusions

The rates to capacity expressed in this report are conservative estimates. Thurston County is growing rapidly and the study area's location (near Interstate 5--20 miles south of Olympia and 10 miles north of Centralia) is conducive to development.

[6] Thurston County Planning Department Staff Report & Recommendations on The Rochester Sub-Area Plan, Oct. 3, 1977.

SYNTHESIS:
PHYSICAL FACTORS,
LAND-USE,
and GROUNDWATER QUALITY

VII. SYNTHESIS: PHYSICAL FACTORS, LAND-USE AND GROUNDWATER QUALITY

The purpose of this study is to analyze the relationship between residential land-use and groundwater quality in the Grand Mound area. It is also necessary to determine how physical factors influence this relationship. This section shows how the physical factors and residential patterns together are related to groundwater quality. While contamination may also occur from commercial and agricultural wastes, these sources are beyond the scope of this study.

A. Physical Determinants

Generally, the physical characteristics of Grand Mound Prairie indicate hazards to groundwater quality. The shallow, porous surface profile of the soil allows water, including septic tank effluents, to drain rapidly away from the surface. Since the bacterial breakdown of contaminants occurs in the surface layer of the soil, effluents may drain deeply into the ground before the breakdown of contaminants has been completed

Subsurface conditions also indicate the hazards to groundwater quality. The porosity of the subsurface gravels and the height of the water table (usually less than 30 feet from the ground surface) indicate that pollutants may quickly reach the water table.

Beneath the soil surface, aerobic conditions facilitate the breakdown of chemical contaminants. Experimental results show negligible levels of nitrite relative to nitrate in the groundwater. This means that soil conditions are aerobic enough for nitrite to almost completely oxidize to nitrate. Under these conditions, many chemical contaminants are effectively neutralized.

B. Hydrology

From the aquifer map (Fig. 22) and well drawdown data, the direction and rate of groundwater flow can be qualitatively described. The water table contours on the aquifer map indicate that the groundwater flows roughly from northeast to southwest. From groundwater flow rates and water quality data, a model of contaminant movement can be established. This helps to determine the degree of dilution contaminants undergo as they enter the groundwater, and their movement in the aquifer.

A rapid groundwater flow would quickly dilute contaminants as they enter the aquifer. Under these conditions, contaminant levels would be fairly even throughout the aquifer. Slower moving groundwater would not dilute contaminants as rapidly. If contaminants disperse from high initial concentrations in slow-moving groundwater, the high contamination would be more localized and less even than contamination in a fast-moving aquifer.

The discharge figures arrived at do not indicate a high velocity of groundwater movement in the study area. Water quality testing revealed a pattern of localized, high concentrations of pollutants. Together, these factors favor a slow dispersion model of contaminants in the aquifer. From the slow dispersion model, it can be said that contaminants are concentrated near their source, and disperse slowly in the aquifer. The slow dispersion of pollutants indicates a spreading of contaminants in high concentrations. Effluent from many septic tanks in a small area would have a cumulative effect beyond that of individual tanks.

C. Density

The density and water quality maps (Figs. 23 and 24) show a tendency for contamination to occur where housing densities are highest. All but one of the samples containing coliform contamination came from medium to high density areas. The highest nitrate levels occurred in the highest density areas (i.e., in the southern part of Section 11 and the northern portion of Section 14). Water samples from this area frequently contained nitrate levels greater than 6 parts per million. While the gross density in this area is about 1 unit per acre, housing here tends to be clustered. This, in effect, reduces the distances from septic tanks to wells. Also, septic tanks in the contaminated areas are concentrated in a relatively small area, making the effect of their effluents cumulative.

D. Conclusions and Discussion

The following conclusions were arrived at for the reasons discussed this section:

(1) The shallow, porous soils drain rapidly, posing a hazard of untreated effluents reaching the water table.

(2) Soils in Grand Mound are aerobic, facilitating the breakdown of contaminants.

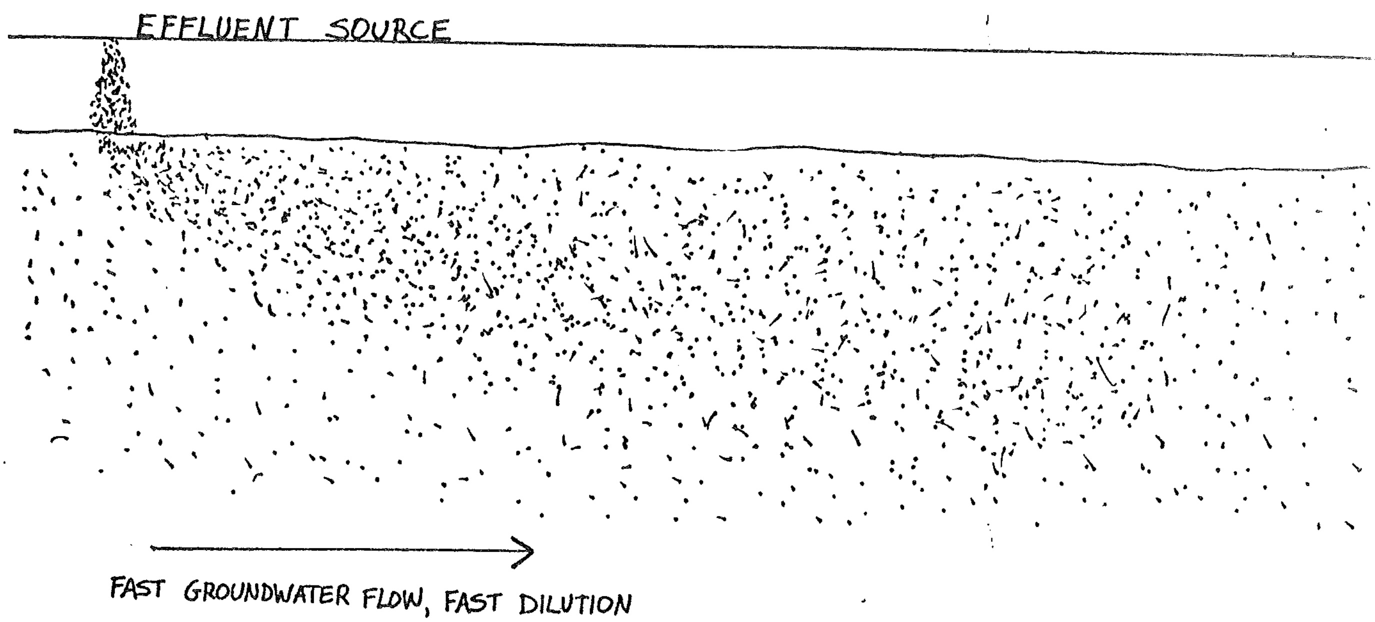
(3) Effluents may reach the aquifer in high concentrations because of rapid perdolation in subsurface gravels and the proximity of the water table to the ground surface.

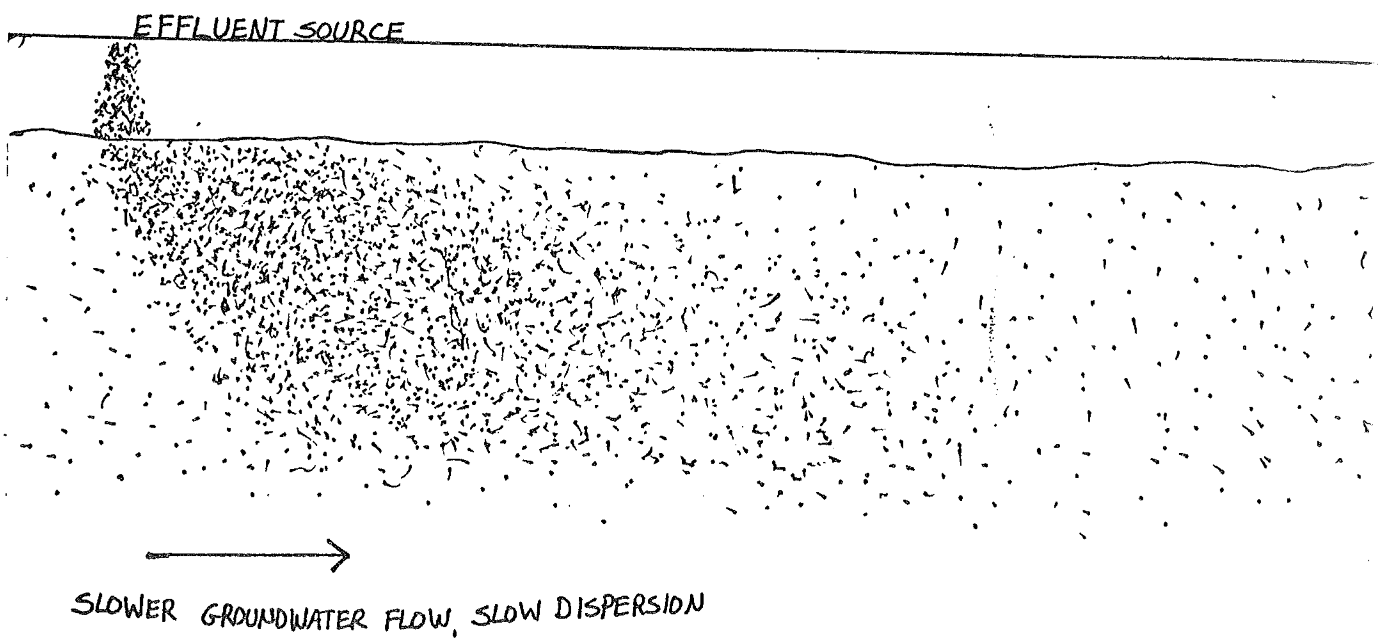
(4) Pollutant levels tend to be localized because of the slow velocity of the Grand Mound's aquifer.

(5) Generally, bacterial and chemical contamination levels tend to correlate with housing densities.

It has been demonstrated that the aquifer is vulnerable to contamination from sources including septic tanks. The cumulative effect of septic tank effluents is demonstrated by the occurrence of well water contamination in cluster developed areas. This places a limit on the volume of septic tank pollution that can be safely absorbed in a given area.

FIGURE 6 : CONCEPTUAL MODELS OF EFFLUENT DISPERSION IN GROUNDWATER





SOCIAL DETERMINANTS

VIII. SOCIAL DETERMINANTS

In order to develop policy recommendations which assure a safe water supply, the social elements which determine the scope of such policies were analyzed. Guidelines which are sensitive to the desires and needs of the community can ease administrative efforts of the designated agencies and promote acceptance among residents. It is the goal of our recommendations to represent a balance between the requirements of maintaining groundwater quality and the community values relating to groundwater quality and community development.

The next two sections detail these values in two ways. The first section is a land-use policy flow chart. We will outline existing recommendations by the Rochester Area Citizens' Planning Council, the implementation of development policies, and the list of agencies designated in the decision-making process. The second section will present the results of an opinion survey conducted in Grand Mound on the issues of groundwater quality and community development. Conclusions and recommendations based on these results will be presented.

A. Land-Use Policy & Related Flow Charts

The purpose of this section is to present the administrative procedures followed for land-use development and for the formulation of land-use policies. This section should be useful for anyone with a desire to develop land in Thurston County. This data can also help develop an understanding of how, and where, proposed land-use recommendations may be implemented into the policy-making process.

The information covered in this section is specifically directed at land-use development and policies in the Grand Mound area. However, much of the material covered can be applied to other areas in Washington State (especially Thurston County).

For convenience, this section has been divided into three parts: (1) land-use recommendations proposed in the Rochester Sub-Area Plan; (2) land-use development implementation; and (3) breakdowns of important land-use regulating agencies. The first part deals with the Rochester Sub-Area Plan. It provides a brief introduction to the Plan, a summary of the Plan's goals and objectives for land-use in Grand Mound, and a statement on the community involvement process. The second part deals with the implementation of land-use development and includes flow charts that explain the administrative procedures one must undertake in order to develop land. This section looks at the procedures followed, and the permits required, for obtaining legal permission to develop land in Thurston County. Also, this portion details a breakdown of the agencies involved in the land-use development process (i.e., the Thurston Regional Planning Council, the Thurston-Mason Health District, the Thurston County Building Department, the Department of Ecology, and the Department of Social and Health Services).

1. The Rochester Sub-Area Plan

Grand Mound is included in the recently-completed Rochester Sub-Area Plan, adopted by the Thurston County Board of Commissioners. The Sub-Area Plan developed out of the Rochester Community Report which was formulated in 1973 and 1974. The Plan is based on general guidelines originating from the Thurston County Comprehensive Plan. It is the product of work contributed by local citizens' groups, County government agencies, and elected officials.

The policies presented in the Sub-Area Plan, including those for residential, commercial, and industrial land-use, have been carefully evaluated on many levels. Apparently, these policies reflect the opinions of residential, commercial, and industrial land-use, have been carefully evaluated on many levels. Apparently, these policies reflect the opinions of the majority of local residents. The recommendations in the Plan have been adopted by resolution, as opposed to having been adopted as an ordinance. However, the Sub-Area Plan must be used as a guideline until a zoning ordinance that conforms to the Plan is adopted for the area. Because of the limited scope of this report, only those Sub-Area Plan policies dealing with residential land-use will be reviewed.

Grand Mound has been classified as a growth area. According to the Rochester Sub-Area Plan, growth areas are:

> "areas where relatively high intensity, mixed-use development can take place with minimal negative impact on the environment, natural resources, and character of the area. They are areas where public services can be provided most economically and where higher intensity uses are already in existence."

This means that growth areas, including Grand Mound, are considered to be open to high degrees of development that conform with the following policies set down in the sections of the Sub-Area Plan that deal with residential, commercial, and industrial land-uses.

> "Uses encouraged in the growth areas should be those which will enhance the tax base and employment opportunities of the area and will provide a range of housing types for area residents. Therefore, the growth areas should permit a mix of residential, commercial, and industrial uses subject to conformance with specified standards to insure compatibility of these areas."

<u>Policy for Residential Uses</u>

The goals established for residential land-uses by the Sub-Area Plan are to provide all socio-economic groups with appropriate housing and to assure a satisfactory housing environment. These are to be achieved by four residential land-use objectives.

The first objective is to vary types of housing and to mix income levels in residential neighborhoods.

The second objective seeks to keep the water supply free from sewage pollutants. This is to be achieved by limiting residential growth in the growth area to 1 unit per acre when individual or group septic tanks are installed, to 4 units per acre without the need for a site plan review or public hearing when sewage treatment methods other than septic tanks are used, and to 6 units per acre with a site plan review and a public hearing when more effective sewage treatment methods are used.

Objective three is designed to encourage housing of good quality construction and "efficient design of neighborhoods". It is stressed that dwelling units should be clustered and that large amounts of contiguous open space be available for aesthetic and recreational purposes. Furthermore, when secondary treatment methods are installed and more than 20% of the land is left to open space, the maximum allowable density should be 6 units per gross site acre. If secondary treatment systems are utilized and more than 15% of all the property is open space, a maximum density of 4 units per gross site acre is permitted. Development of densities in excess of 4 units per gross acre requires a public hearing and approval of a site plan review before authorization is granted. Criteria for the site plan review should include, but not be limited to, sound-proofing, sufficient parking space, visual privacy, buffers, accessibility, and landscaping. Other suggestions for development include height and size limitations on buildings, assurance of residential areas indirect to principle arterials and main collectors, conformance of undersized lots to applicable zoning ordinances, combination of lots (if possible), minimum impervious cover, storm runoff control in residential lots and housing developments, and avoiding interference with adjacent land drainage due to landfill.

The fourth major objective of the Sub-Area Plan is to insure that areas outside fire districts be held to a maximum density of 1 unit for every 5 acres.

Community Input Process

Presently, much of the citizen involvement in land-use planning is channeled through the five-member Rochester Community Planning Council. Members of this council are elected annually. On February 25, 1975, the council formulated the following Statement of Purpose with the hope that local citizens would participate in land-use policy-making decisions:

(1) To represent the desires of the people in planning for the Rochester area. This includes taking both majority and minority views into account.

(2) To protect and preserve the area's resources.

(3) To consider the capabilities and limitations of the land.

(4) To consider the economic impact of planning in the area.

(5) To encourage participation from the community in planning the development.

(6) To foster communication between the community and this council.

(7) To act as a liaison between the citizens of Rochester and the Thurston Regional Planning Council and the Thurston County Commissioners. This includes informing the citizens of the development of the Comprehensive Plan and the effects of this plan.

(8) To enclurage better services to the Rochester area such as health, safety, and recreational facilities.

(9) To encourage orderly implementation of the plan this council adopts with the Thurston County Planning Commission and the Thurston County Commissioners.

Furthermore, the Council has made three recommendations which may stimulate citizen participation in land-use decisions. These recommendations are as follows:

(1) Notices of proposed developments should be sent to the Rochester Community Planning Council by the Thurston County Regional Planning Staff.

(2) The Rochester Community Planning Council proposes to meet between Thurston County Planning Commission hearings, and the Planning Commission's Land-Use Committee meetings, on issues relating to major commercial, industrial, and residential developments that will be of densities greater than 4 units per acre.

Land-Use Development Flow Charts

The Land-Use Development Flow Chart section is designed to clear away some of the confusion that may confront persons who wish to develop their land. The flow charts depict the steps one must go through in order to receive permits to build a home or place a trailer on a new lot.

Anyone who wishes to construct or alter any building, including mobile homes not situated in a trailer court, must obtain a permit from the Thurston County Building Department. Before filing a permit application, the applicant must first obtain the Assessor's parcel number and a legal description of the property.

Persons building minor structors or single-family homes must submit two copies of the plan for the project. For commercial buildings and housing developments, the contractor or owner of the proposed project must turn in three copies of the blueprints to the Building Department. If a commercial building exceeds 2,000 square feet in size, the plan must bear the seal of a professional architect or engineer.

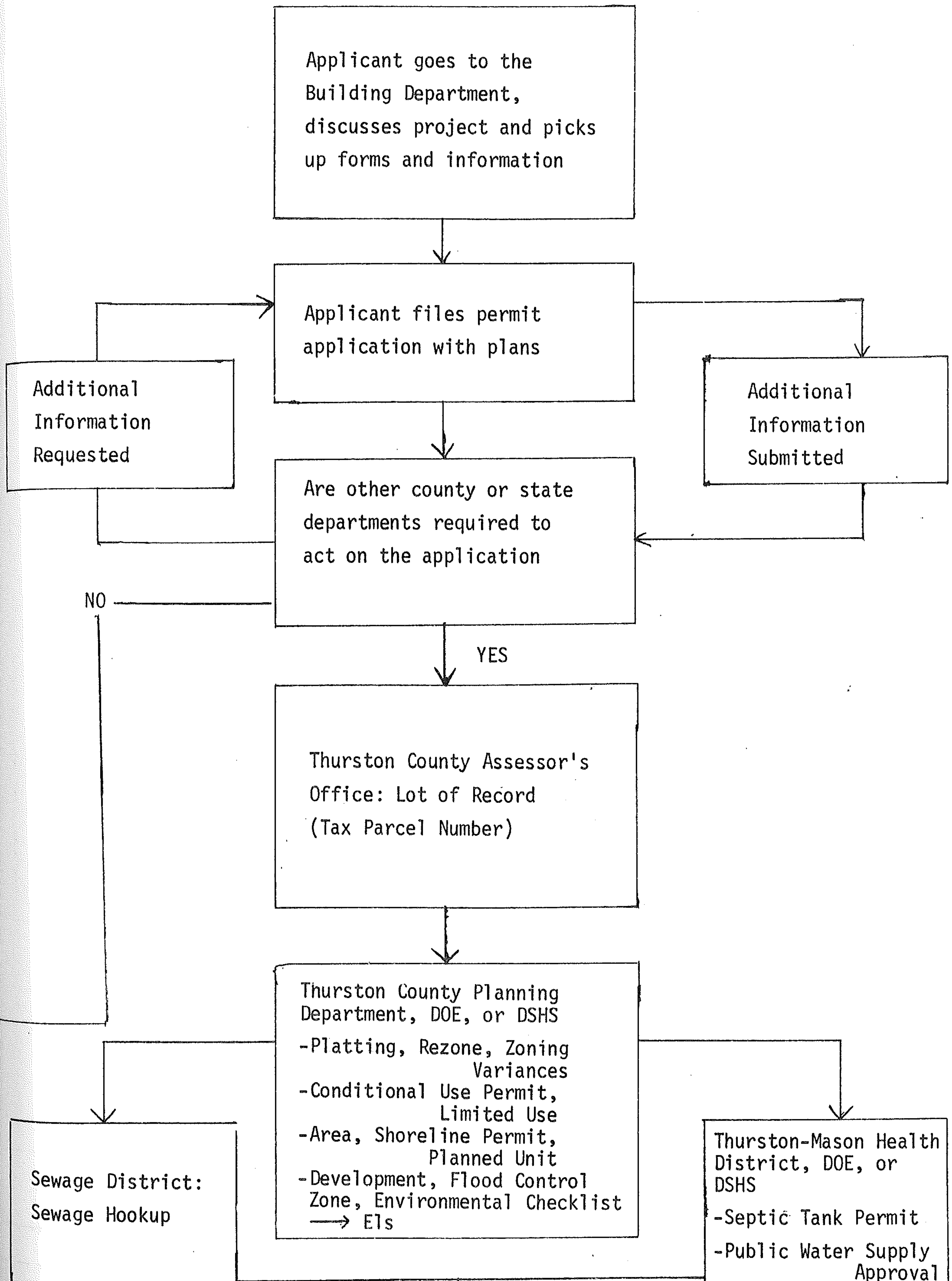
The fees for building permits are based on the value of the proposed building or development. The minimum fee is five dollars but the cost of the average single-family home permit is one hundred and seventy-five dollars. Plumbing and mechanical permits are required for all new homes and their cost is twenty-five dollars.

Building permits for minor structures may be issued at the time of application. If extensive plan checks or other approval procedures are required, no permits will be issued until all approvals have been granted and other applications processed.

Any new plumbing or mechanical installations in Thurston County require permits. Plumbing permits can only be obtained by the homeowner or a registered contractor. This also applies to mechanical permits. The fee for plumbing permits is based on the number of plumbing fixtures being installed. For a single-family dwelling, the average cost of a plumbing permit is seventeen dollars. Mechanical permit fees are based on the capacity of the equipment being installed and they cost approximately eight dollars for most single-family homes. Both plumbing and mechanical permits are usually issued at the time of application. Electrical permits are issued by the State Department of Labor and Industries.

A building permit flow chart on the following page depicts the various steps involved in obtaining permits from the appropriate agencies. Many of the steps outlined in the flow chart do not necessarily follow a single direction. Many permits, inspections, and reviews are carried out simultaneously so the whole process can proceed more rapidly than the flow chart suggests.

BUILDING PERMITS



Thurston County Public Works Dept.:
Encroachment Permit

Thurston County Building Dept.
- Plan Check
- Mechanical Permit
- Plumbing Permit
- Mobile Home Permit
- Building Code Variance
* Electrical Permit

With all necessary approvals completed a building permit can be issued.

*Electrical Permits are granted by the State Department of Labor and Industries.

Much of the process outlined here need not flow in a single direction. Many permits, inspections and reviews may go on simultaneously so that the process can usually proceed faster.

Septic Tank Permits

A septic tank must be installed at any new building from which sewage is generated. Buildings serviced with sewers are exempt from this requirement. A septic tank permit is required before a building permit will be granted. Septic tank permit applications are available at the Environmental Health Division of the Thurston-Mason Health District. The completed application and a copy of the septic system plans must be submitted to the Health District for approval. If adequate information about the applicant's property is not on record, a site inspection is carried out.

A septic tank permit can be purchased once the system design is approved. If the specific installation detailed in the permit is not completed within one year, the permit expires and the applicant must re-apply for another permit.

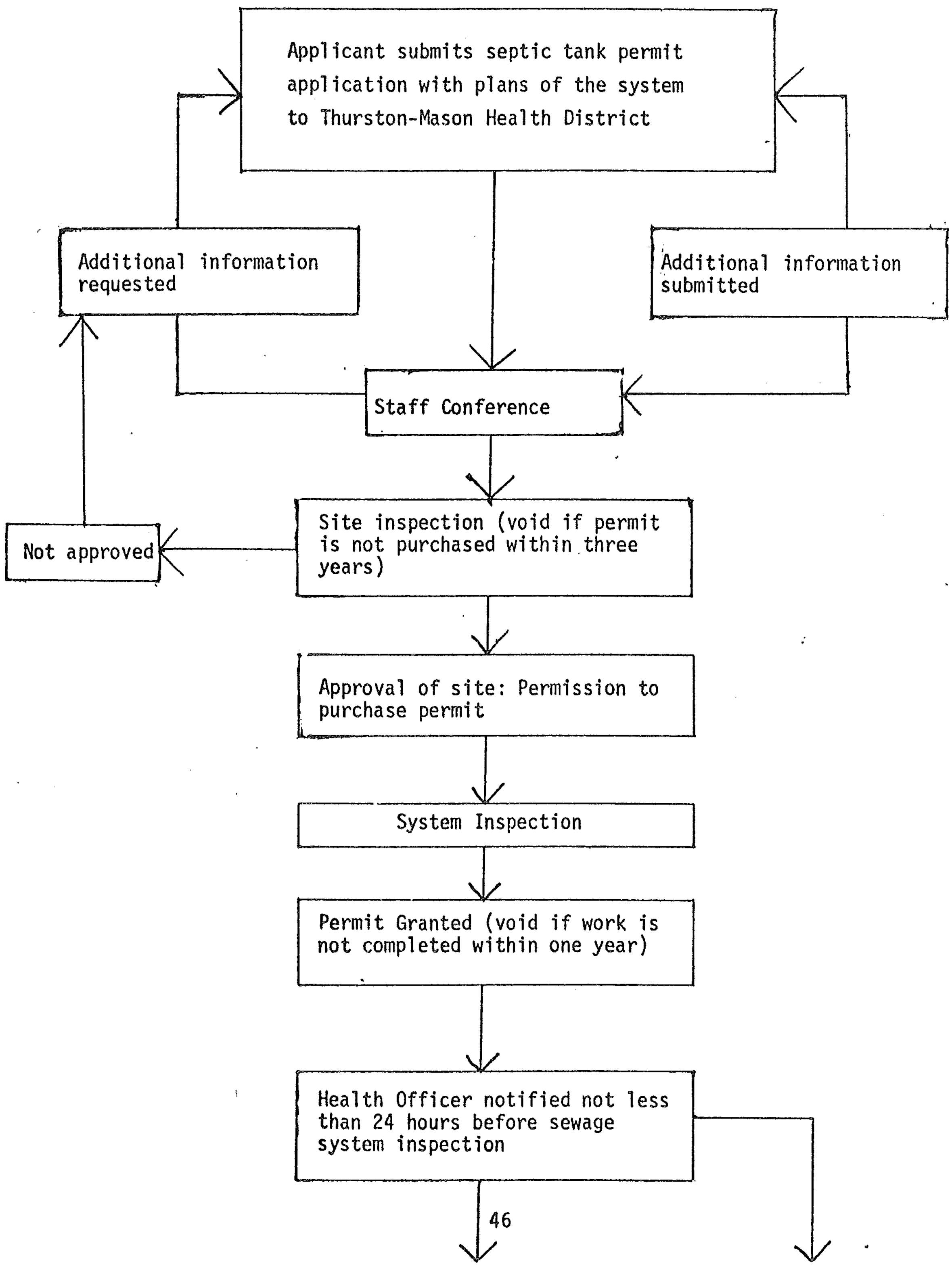
Another inspection is required after the installation of the system, but before the trenches are back-filled. If the system is not approved at this time, a written notice will be left by the inspector. Any appeals or variance requests must be addressed to the Health District.

An encroachment permit is an agreement between the applicant and the Public Works Department. It details where and how a driveway or private right of way should meet a public right of way. The applicant requests an encroachment permit from the County Public Works Department or the County Road District Supervisor. If a person seeks an encroachment permit from the Public Works Department, an appointment for a site inspection will be made and the applicant must bring the permit form to the site. If the appointment is made with the County Road District Supervisor, he will bring the permit form to the site:

> "When making the site inspection, the Supervisor will specify the location of the encroachment and the amount of culvert required. Encroachments are only allowed every 500 feet on a major arterial."

When the inspection is completed, the incomplete form is returned to the Public Works Department for final authorization.

SEPTIC TANK PERMIT



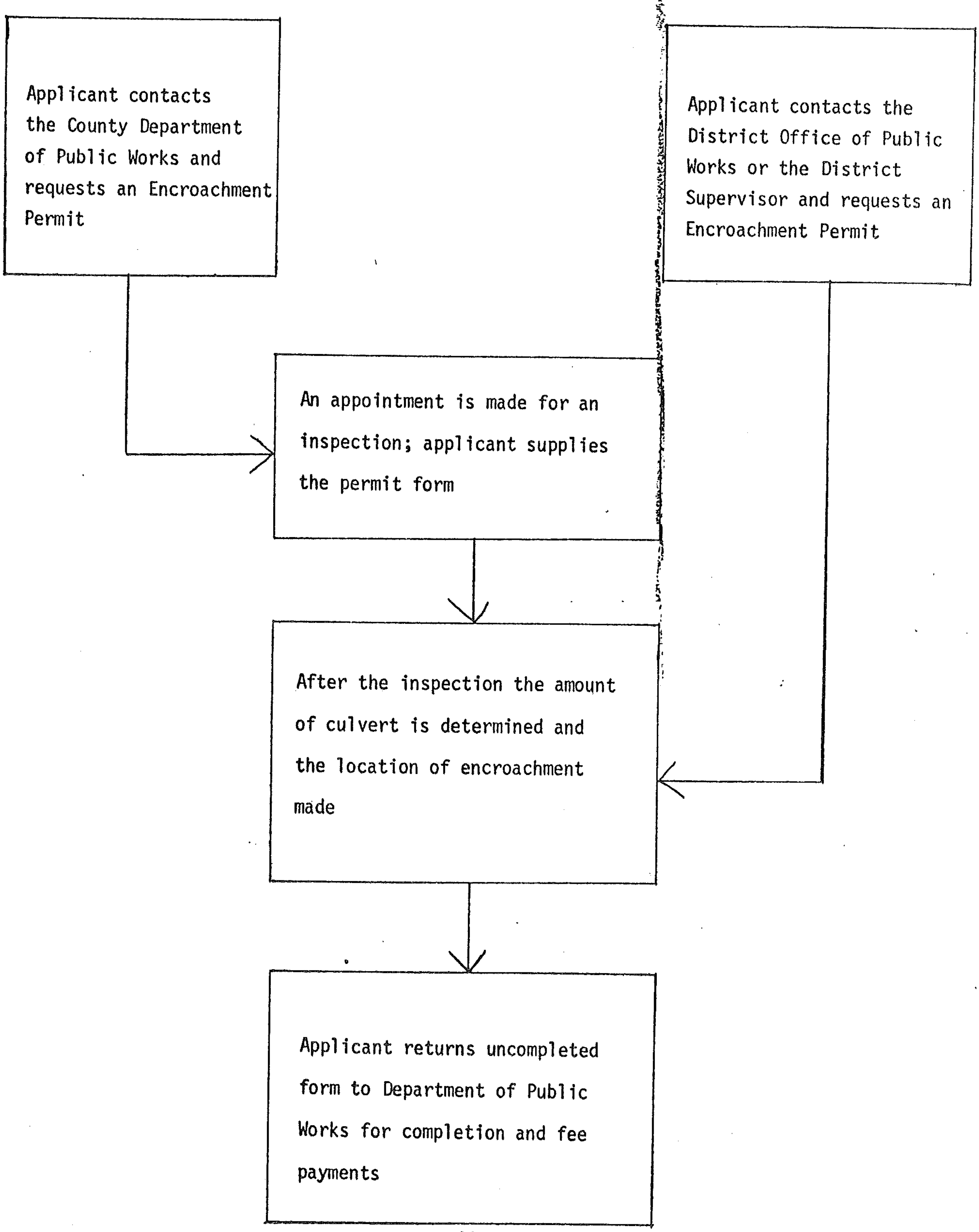
Encroachment Permit

An Encroachment Permit provides for where and how your driveway or private road will join the public right of way. It also covers how drainage will be handled. The permit is an agreement between the applicant and the Public Works Department; the request for an Encroachment Permit must be made at the County Public Works Department or to the County Road District Supervisor. If the Public Works Department is contacted, an appointment for a site inspection will be made and the applicant must bring the permit form to the site. If the appointment is made with the District Supervisor he will bring a permit form with him.

> "When making the site inspection, the Supervisor will specify the location of the encroachment and the amount of culvert required. Encroachments are only allowed every 500 feet on a major arterial." (p.7)

When the inspection is over return the incomplete form to the Public Works Department for completion, pay the required fee ($10 if no culvert is necessary; $12/ft. for installation of a culvert that must be provided by the applicant, if one is necessary). If the encroachment is in a sub-division with rolled-edged streets, the site inspection is not required but the forms must be filled out at the County Public Works Department.

ENCROACHMENT PERMIT



The cost of an encroachment permit is ten dollars if no culvert needs to be installed. If a culvert needs to be installed, the permit costs twelve dollars for every foot of culvert.

Subdivisions with "rolled-edge" permits do not require a site inspection in order to receive an encroachment permit.

The permit must be filled out at the County Public Works Department. However, fees for encroachment permits are collected by the Engineering Department for Thurston County.

Subdividing of Land

I. Short Plats

Short Plats are simplified procedures for subdividing property and may be used to create up to four lots when at least one of these lots is smaller than five acres. Supplements to short plats may be made to adjust boundary lines, and this can be done by contacting the Regional Planning Office at the time of application. Although the legal description of the lots must be certified by a title company or surveyor, most of the platting application can be prepared by the applicant. Complete applications must be returned to the Thurston Regional Planning Council office.

Processing fees for short plats are twenty-five dollars for two lots, fifty dollars for three lots, and seventy-five dollars for four lots. Lots may be sold until the short plat has been approved and filed with the Office of the County Auditor. The processing time will take at least thirty days.

II. Platting

Platting is the formal procedure which must be followed to subdivide property into more than four parcels, if any of the parcels are smaller than five acres. There are various steps which must be followed in the platting process. The first step is the pre-submission conference between the developer and the Thurston Regional Planning Council. At the time of application, a sketch of the proposed subdividion must be made available. The conference is a meeting between the applicant and the agencies having an interest in the proposed project. Discussion covers the compliance of the proposal to local subdivision regulations and, if necessary, modifications will be suggested.

The second step in the platting process is according to the standards of the County Subdivision Ordinance. Seventeen copies of the plat, an environmental checklist, and soil percolation data must be submitted to the Thurston Regional Planning Council approximately one month prior to the consideration of the plat at a Planning Commission meeting. Fees during the preliminary plat process are one hundred dollars, one dollar per lot for the plat submission, and twenty dollars for an environmental checklist.

Upon completion of the preliminary plat, the third step starts with a review of the proposal at a public Planning Commission hearing. The Land-Use Committee of the Planning Commission makes recommendations based on the results of this hearing and submits them to the Planning Commission. The Commission, in turn, submits its recommendations to the Board of County Commissioners who approve, or reject, the plat. This whole process takes about three months. All preliminary plats must be reviewed for potential environmental impacts. If such impacts will be significant, an environmental impact statement must be drawn up by the developer. This last process usually adds about another two months to the process of approval for preliminary plats.

The final plat must be sumitted no later than three years after the approval of the preliminary plat. However, roads, utilities, and other services must be completed before the final plat is submitted. Applications for final plats are made at the Thurston Regional Planning Department. No lots may be sold until final approval has been granted by the Board of

County Commissioners and lot records have been compiled by the County Auditor's Office. Final plat fees are fifty dollars plus one dollar per lot.

Planned Unit Developments

Planned Unit Developments are a type of subdivision that make it possible for the developer to overcome some County planning ordinances. Planning regulations are relaxed by authorities because planned unit developments are considered to involve better subdivision design. However, the special features of this type of subdivision must overcome any problems created by the relaxation of standards. Mobile home parks in unzoned areas of the County, such as Grand Mound, are established according to the standards and procedures of Planned Unit Developments (PUD's). In order to receive official approval for a PUD, the developer must undergo the same procedures as those followed to obtain permission for standard plats. However, developers of PUD's must provide planning agencies with more detailed information about their proposal. Preliminary application fees for PUD's are one hundred and fifty dollars and five dollars per acre and final fees are one hundred dollars plus one dollar per acre.

Non-platted Streets

If any proposed subdivision involves the building of a private road serving more than four parcels, the road must gain approval of the County Board of Commissioners and it must adhere to County road building standards. If the long platting process is used, or if the smallest parcel served by the road is larger than forty acres, the above approval procedures need not be observed.

The steps involved in winning approval of non-platted streets are very similar to those followed for preliminary plats. Applications are filed at the Thurston Regional Planning Office. The Planning Commission reviews the proposal and presents its recommendations on the matter to the Board of County Commissioners. It is up to the Board to approve or reject the proposal. The proposed division of property may not be carried out until approval for the construction of the road has been granted and the road completed. Construction of such roads is done under the supervision of the County Public Works Department. Approval of non-platted roads is sometimes not given until the developer submits an environmental impact statement. Even if an environmental impact statement is not required, approval for the construction of non-platted roads will usually take three months.

Zoning Ordinance Procedures

Because Grand Mound is not presently covered by zoning ordinances, zoning policies for Thurston County are not applicable to that area. Thus, variances, conditional use permits, zoning district amendments (rezones), and limited use areas are not applicable to Grand Mound at this time. A zoning ordinance that will put the Rochester Sub-Area Plan into effect is presently being prepared. Once the ordinance is drawn up, it must undergo the same formal adoption measure with the Planning Commission and County Commissioners as the original Sub-Area Plan.

Environmental Review

In order to safeguard against detrimental environmental impacts, an environmental review process is enacted. This is not a permit process but a procedure carried out to insure that all potential environmental impacts have been assessed. It is required by State law and by County ordinance that most new building and development proposals submit to an environmental review. Such reviews are intended to determine the effects that the proposal will have on the environment and to suggest ways in which any detrimental impacts can be avoided. The first step in this process is a review of the environmental checklist by the County Environmental Review Officer. If no adverse environmental effects are identified, the permit process continues uninterrupted. If potential ecological destruction is noted, the following steps are followed:

(1) The project sponsor prepares a draft environmental statement and submits it to the Environmental Review Officer.

(2) The Environmental Review Officer prepares the draft environmental impact statement and circulates it.

(3) A public hearing is held, if required.

(4) After circulation of the environmental impact statement and once the public hearing has been held, if required the Environmental Review Officer prepares the final environmental impact statement.

Any permit for a proposed development project may be made conditional or denied outright if the proposal will lead to significant degradation of the natural environment.

Fees for the environmental review process are as follows: twenty dollars for an environmental checklist, one hundred dollars for an environmental impact statement if the project costs up to one hundred thousand dollars, and ten dollars for each additional ten thousand dollars of the project's cost.

Permit Coordination Policy For Projects Requiring Multiple Permits

(1) "Project sponsors desiring permits or approvals from any County agency for projects which will require a County building permit will apply for the building permit at the Building Department."

(2) "After the acceptance of the building permit application and plot plan, the Building Department will review the project to determine its relationship to other County Departments and the regulations they administer. If the project requires no approvals or actions other than a building permit, the Building Department will act on the building permit application."

(3) "If approvals or actions are required of other County agencies, the applicant will be so advised. The Building Department will supply the applicant with a copy of the building permit application and a County permit checklist with all the necessary County permits and approvals. The applicant will be advised that to shorten waiting time he should apply for permits concurrently. A copy of the checklist will be kept by the Building Department."

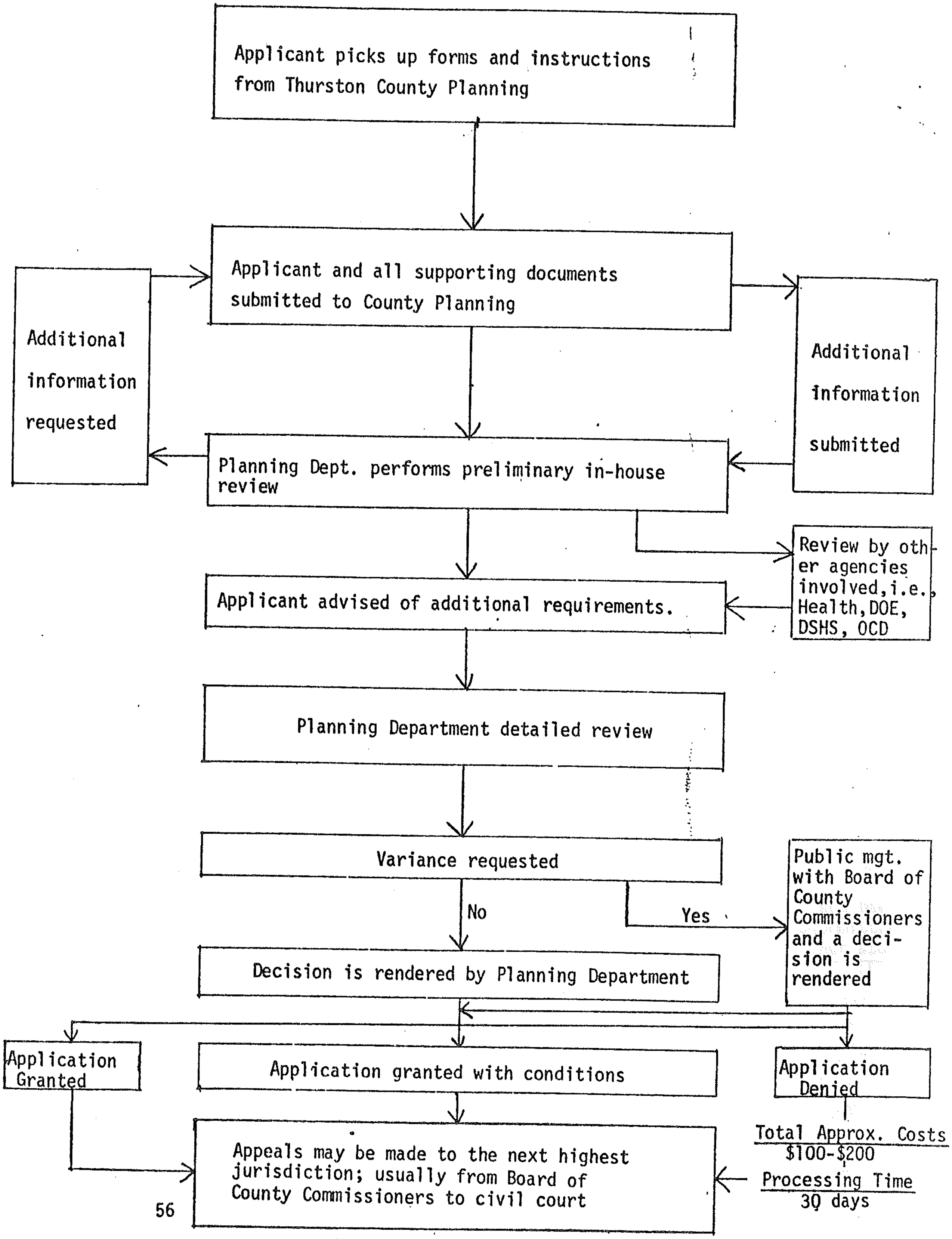
(4) "The applicant will apply for the necessary permits and approvals indicated on the County permit checklist."

(5) "When a County agency takes action on a permit or approval for a project requiring a building permit, that agency will contact the Building Department where the actions of all affected agencies will be recorded on the County permit checklist copy retained by the Building Department."

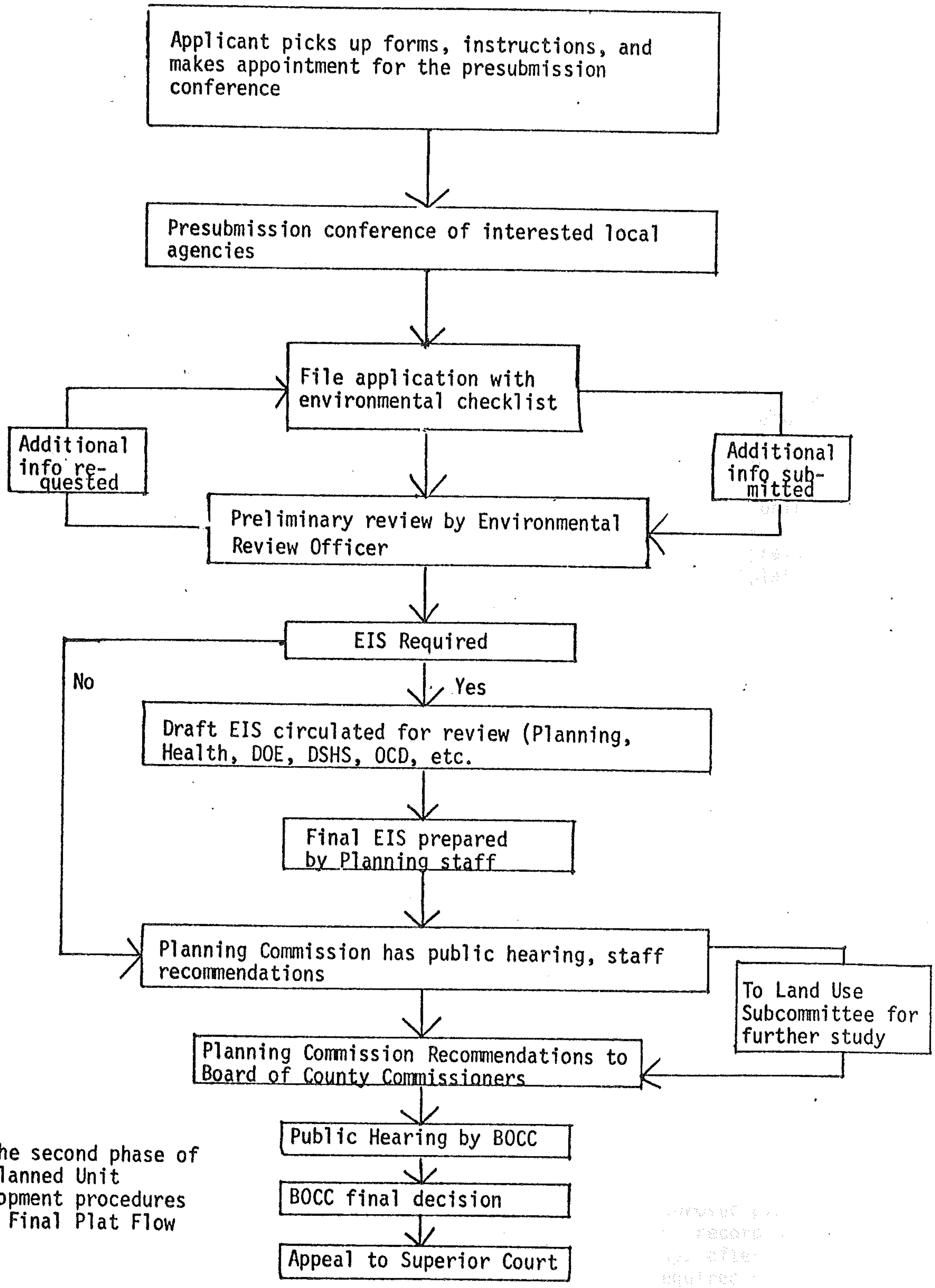
(6) "When all necessary approval actions have been taken, the project sponsor will be so advised by the Building Department and a building permit may be issued. If negative action is taken on any County actions or buildings for a project and the Building Department is notified, the County building permit will be withheld until such permits are issued. However, it is not the County's responsibility to determine if permits of other jurisdictions are necessary or if they have been issued."

(7) "When no building permit is required but other construction permits, such as plumbing or mechanical, are required in addition to other County approval actions, no construction permits will be issued until all other approvals have been obtained. The procedure outlined above for issuance of building permits will be followed."

SHORT PLATS


Applicant picks up forms and instructions from Thurston County Planning
Applicant and all supporting documents submitted to County Planning
Additional information requested
Additional information submitted
Planning Dept. performs preliminary in-house review
Review by other agencies involved, i.e., Health, DOE, DSHS, OCD
Applicant advised of additional requirements.
Planning Department detailed review
Variance requested
No
Yes
Public mgt. with Board of County Commissioners and a decision is rendered
Decision is rendered by Planning Department
Application Granted
Application granted with conditions
Application Denied
Appeals may be made to the next highest jurisdiction; usually from Board of County Commissioners to civil court
Total Approx. Costs
$100-$200
Processing Time
30 days

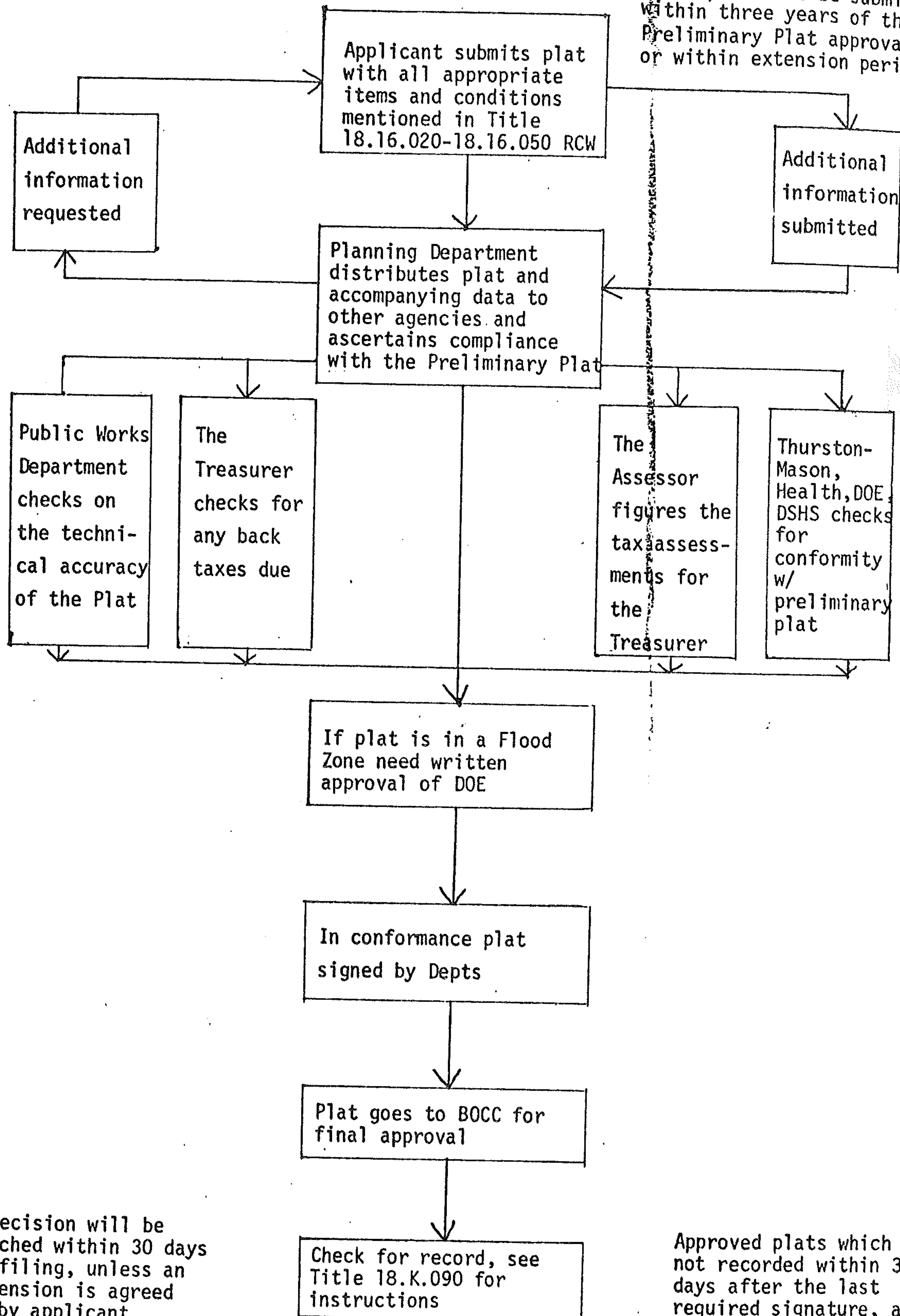
PRELIMINARY PLATS AND PLANNED UNIT DEVELOPMENTS



For the second phase of the Planned Unit Development procedures go to Final Plat Flow Chart

FINAL PLAT

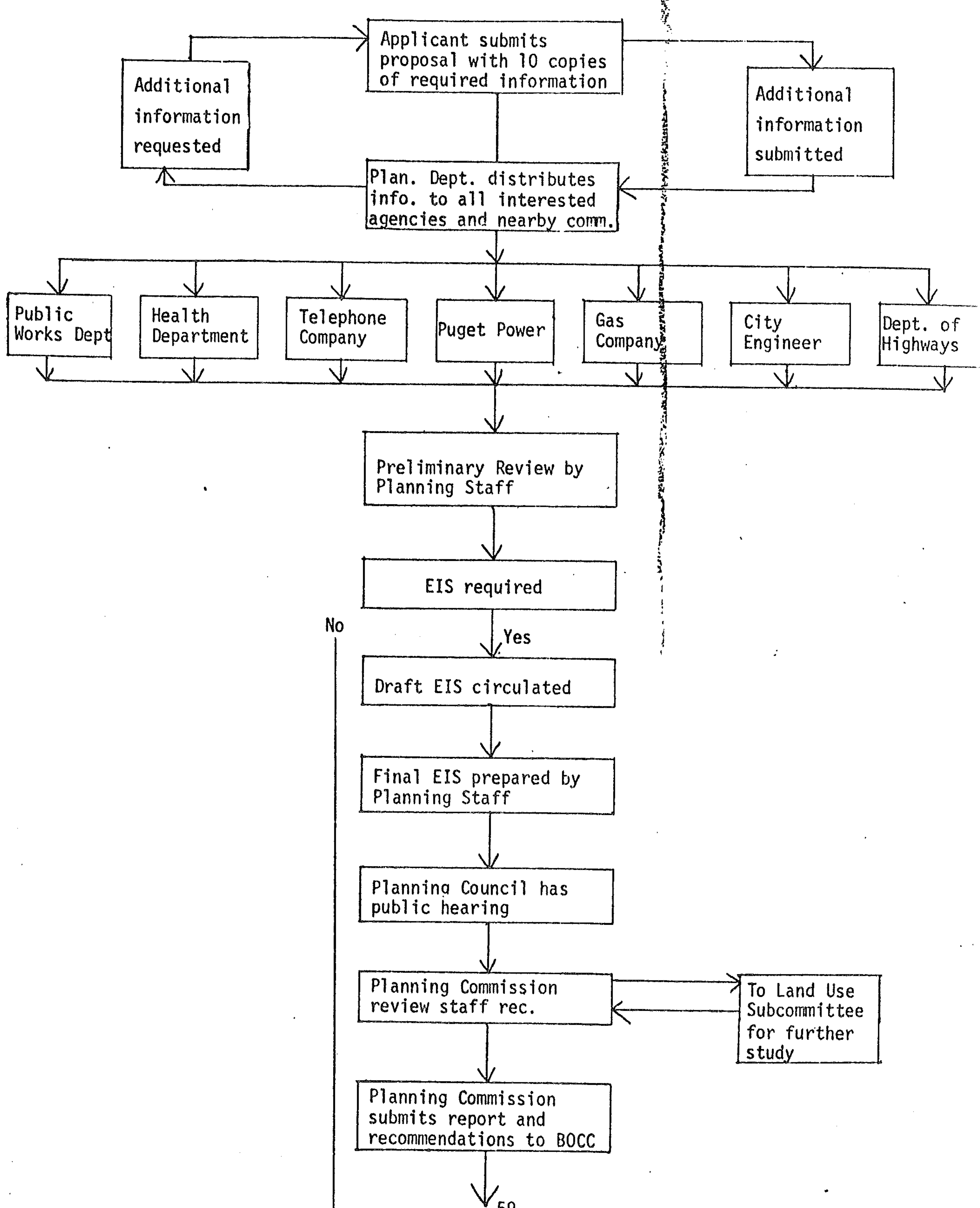
Final plat must be submitted within three years of the Preliminary Plat approval, or within extension period.

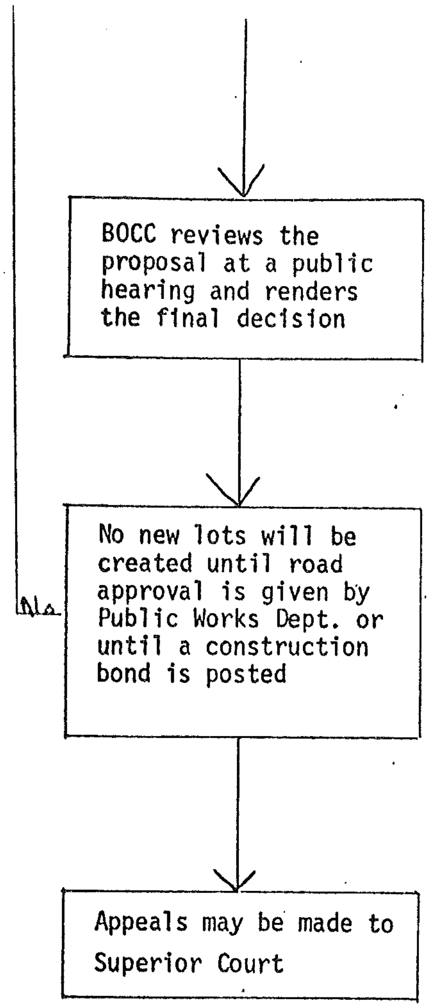


A decision will be reached within 30 days of filing, unless an extension is agreed to by applicant.

Approved plats which are not recorded within 30 days after the last required signature, are null and void.

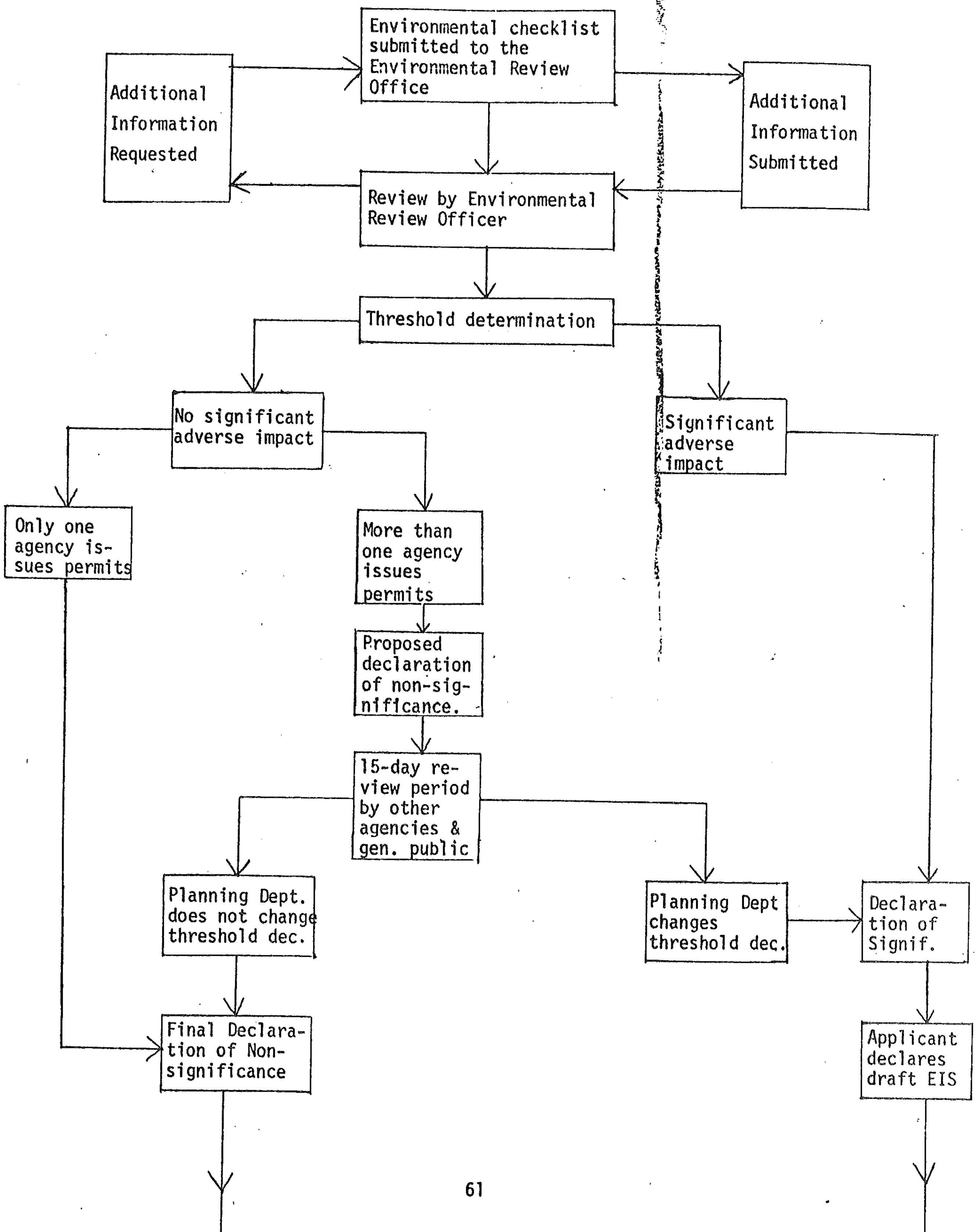
NON-PLATTED STREETS

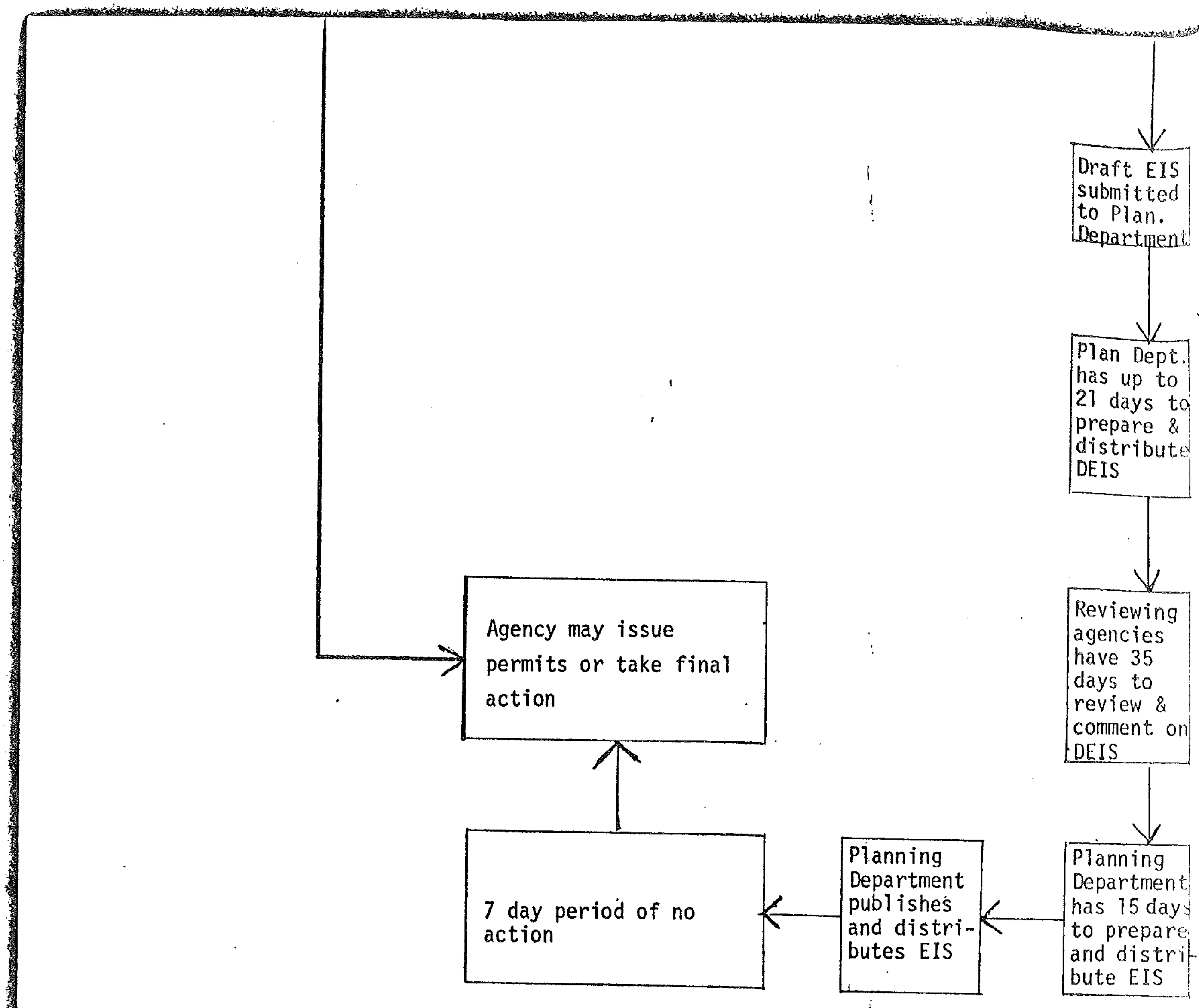




The fee for application is $50.

ENVIRONMENTAL REVIEW PROCESS

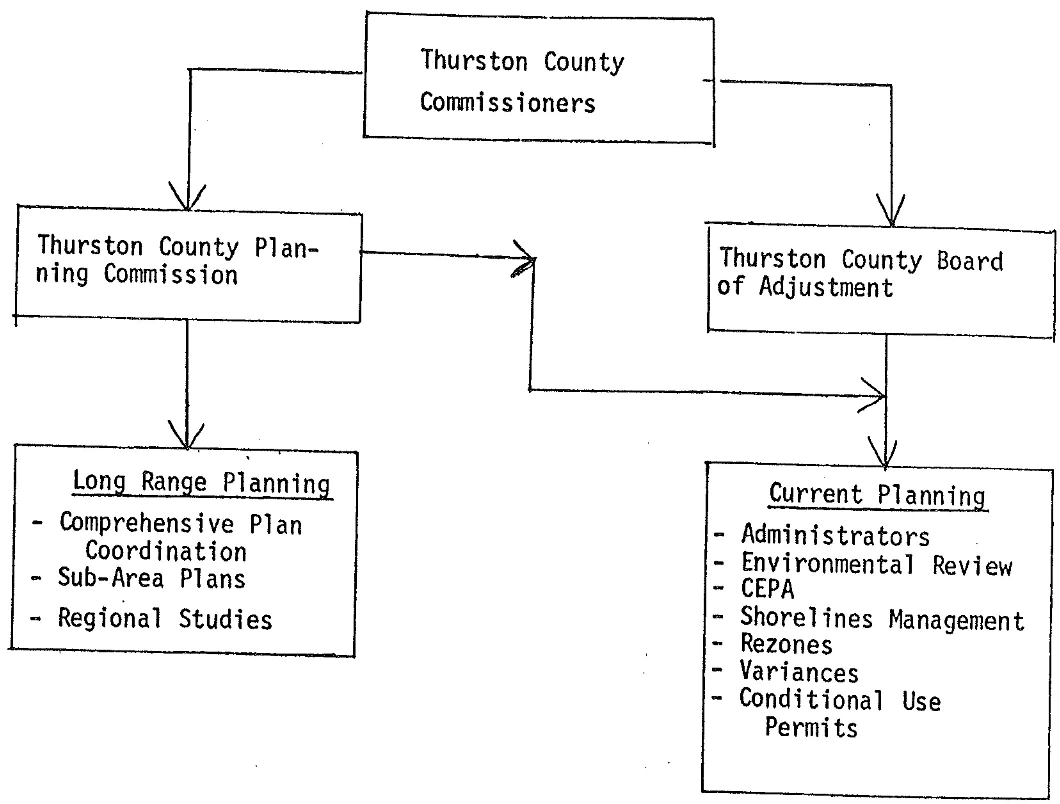



Draft EIS submitted to Plan. Department
Plan Dept. has up to 21 days to prepare & distribute DEIS
Reviewing agencies have 35 days to review & comment on DEIS
Planning Department has 15 days to prepare and distribute EIS
Planning Department publishes and distributes EIS
7 day period of no action
Agency may issue permits or take final action

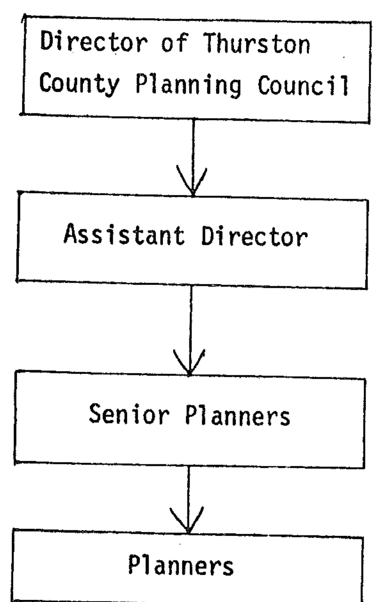
Agency Flow Charts

The agency flow charts provide a breakdown of the main regional and State agencies that are concerned with land-use development and water quality in Thurston County. The charts include a breakdown of each agency as well as some of the programs regulated by the agency.

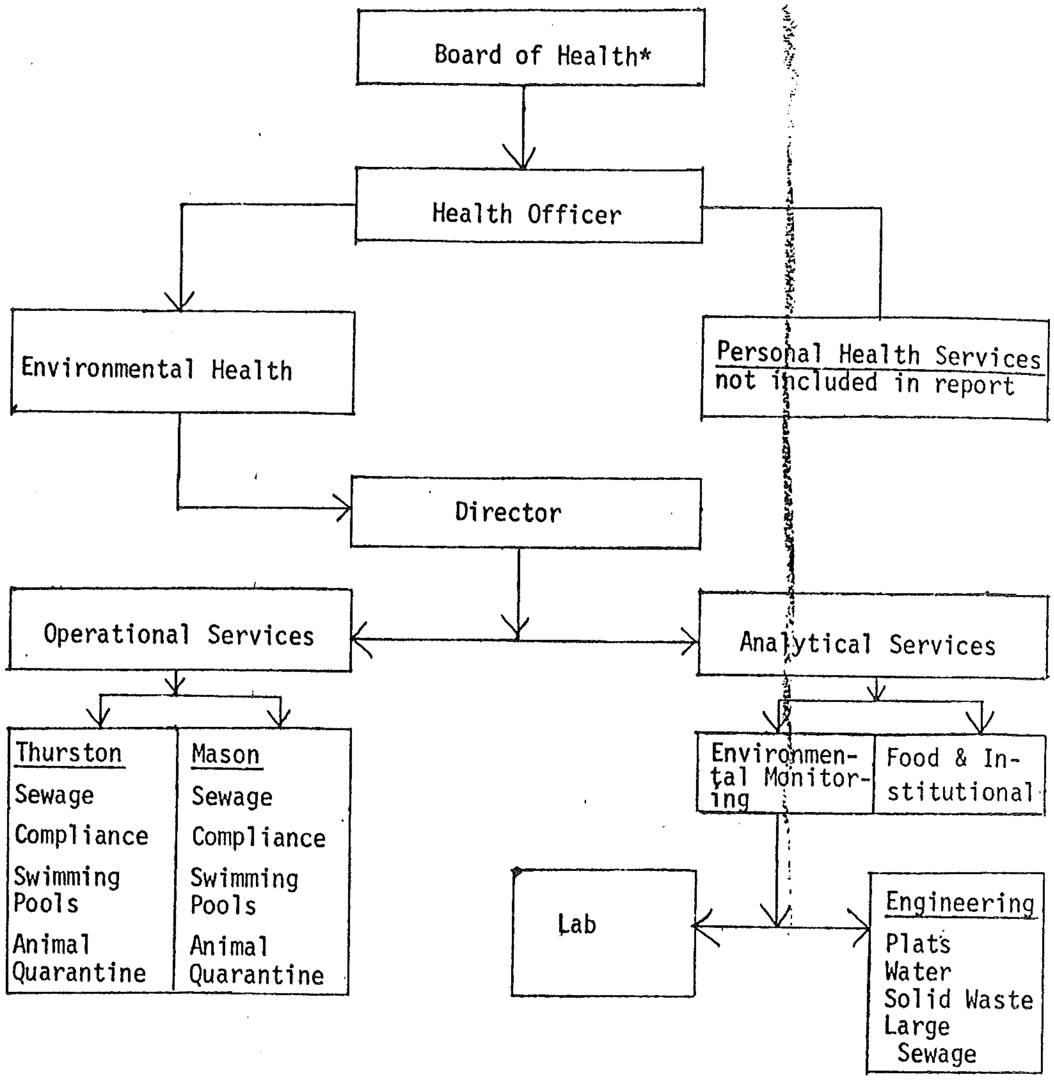
THURSTON COUNTY COMMISSIONERS (elected)



THURSTON COUNTY PLANNING DEPARTMENT

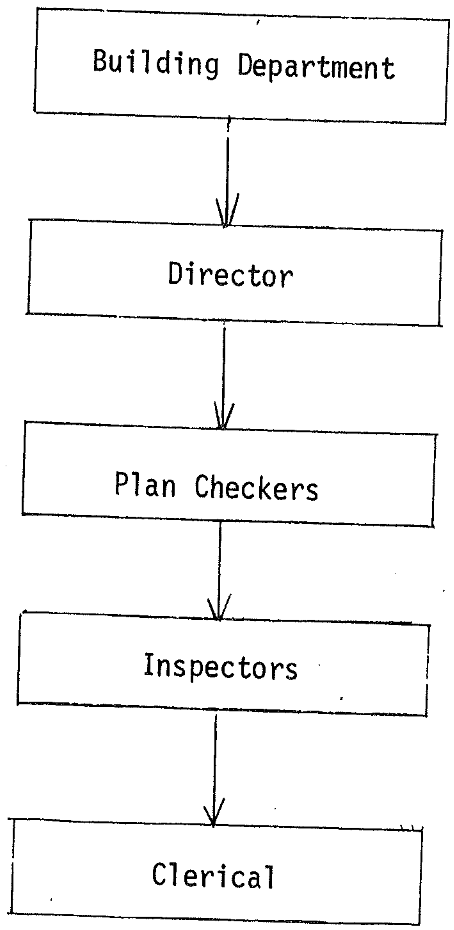


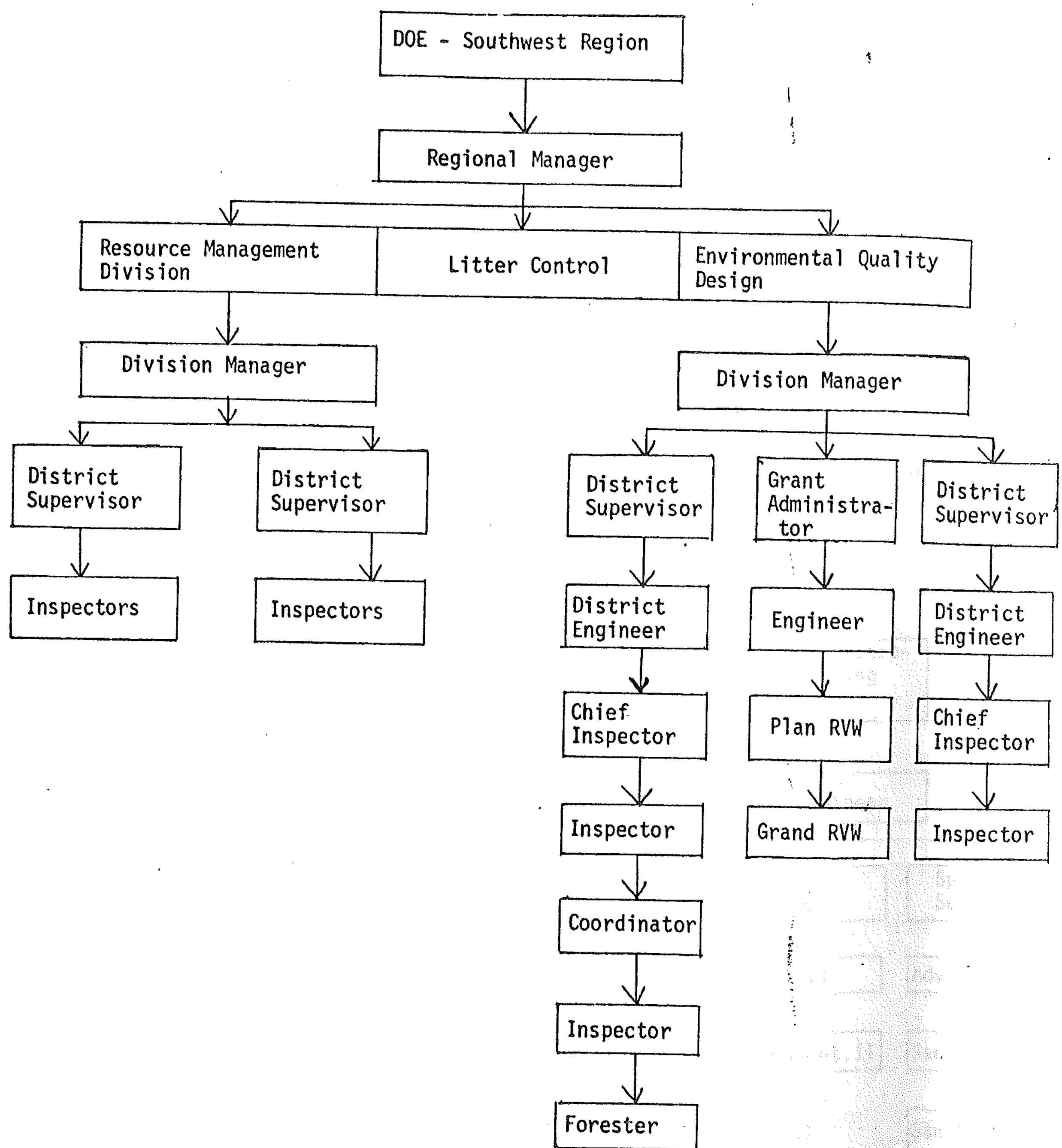
BOARD OF HEALTH



*The Board of Health is composed of two County Commissioners from each county, one elected governmental official, such as the Mayor, from all large cities, i.e., Olympia, Tumwater, Lacey, Shelton, etc., and one elected official from the combined smaller towns.

THURSTON COUNTY BUILDING DEPARTMENT



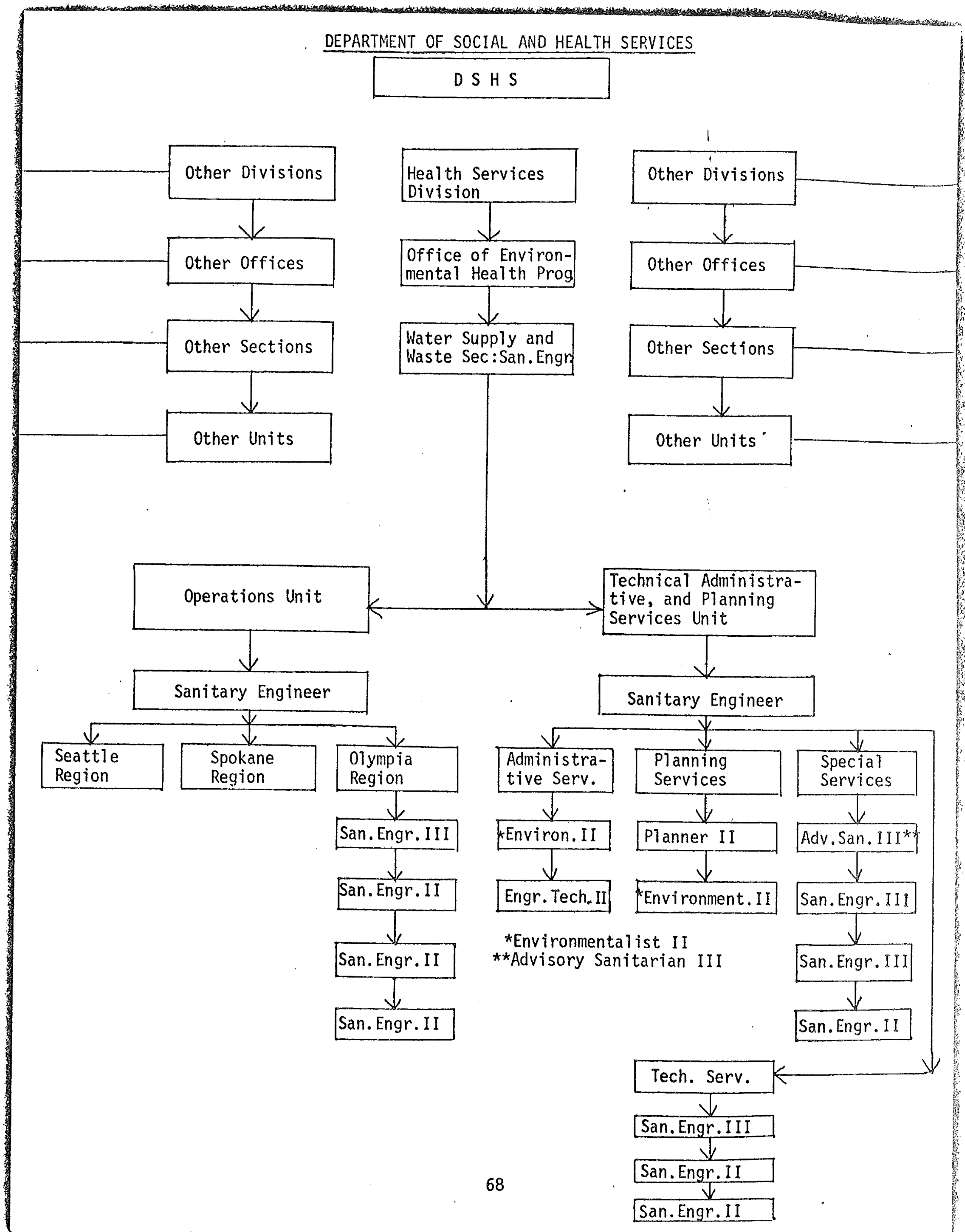


Programs

Water Rights
Shorelines
Flood Control
ECPA
Reservoir Permits
Well Drillers

Programs

Waste Discharge Permits
Construction Grants
Oil Spills and Complaints
Water Quality Certification
Solid & Hazardous Wastes
Wastewater Quality Certification



DEPARTMENT OF SOCIAL AND HEALTH SERVICES
D S H S
Other Divisions
Health Services Division
Other Divisions
Other Offices
Office of Environmental Health Prog
Other Offices
Other Sections
Water Supply and Waste Sec:San.Engr
Other Sections
Other Units
Other Units
Operations Unit
Technical Administrative, and Planning Services Unit
Sanitary Engineer
Sanitary Engineer
Seattle Region
Spokane Region
Olympia Region
Administrative Serv.
Planning Services
Special Services
San.Engr.III
*Environ.II
Planner II
Adv.San.III**
San.Engr.II
Engr.Tech.II
*Environment.II
San.Engr.III
San.Engr.II
San.Engr.III
San.Engr.II
San.Engr.II
*Environmentalist II
**Advisory Sanitarian III
Tech. Serv.
San.Engr.III
San.Engr.II
San.Engr.II

I. The Thurston Regional Planning Council

Much of the planning authority granted within the State of Washington comes from the State Planning Enabling Act. This Act specifically grants planning authority to local or regional jurisdictions which may or may not have contracted services done by a regional planning council. Thurston County does have a planning council. Although the Thurston Regional Planning Council does have some direct authority, most of their work is done under contract to more localized jurisdictions. The Regional Planning Council also functions as an advisory staff for the Thurston County Board of Commissioners which has planning authority over all unincorporated areas of the County (including Grand Mound).

II. Thurston-Mason Health District

The Thurston-Mason Health District functions much like the Thurston Regional Planning Council. The Health District is subordinate to similar agencies at the State level, but it still has control over some health regulations that are in compliance with State and Federal codes. The Health District works within bounds established by the Department of Ecology and the Department of Social and Health Services.

III. Thurston County Building Departments

The Thurston County Building Department is in charge of building, plumbing, and mechanical permits within Thurston County. This agency acts as the initial contact agency for most construction permits and it functions in close connection with the County Planning Council and the Health District. Besides issuing permits, the Building Department is also responsible for on-site investigations involving building standards.

Department of Ecology

The Department of Ecology (DOE) is a State agency responsible for overseeing regulations concerned with environmental quality. Its interactive role with local health and planning agencies is in an advisory and review capacity. The DOE regulations must be upheld by local agencies. There are many branches of the DOE extending into many fields. However, for this study only those branches dealing directly with water quality will be examined.

IV. The Department of Social and Health Services

The Department of Social and Health Services (DSHS) is the official health agency of Washington State. Among other duties, it provides technical assistance to local health agencies, such as the Thurston-Mason Health District. The regulations and minimum standards set by the DSHS, like those set by the DOE, must be obeyed by the local agencies. The DSHS also reviews water and waste systems that serve 10 to 50 dwellings. The County Health District reviews only water and sewage systems serving up to 10 dwellings and the DOE reviews these systems if they are serving more than 50 homes.

C. SURVEY RESULTS

Of 240 questionnaires mailed, 23 were returned (9 by return mail and 14 by pickup). The low response resulted from a problem in locating residents during the study. A site investigation showed that a substantial number of occupied homes were not listed on the Assessor's records due to construction after the time of the most recent assessment. Many residents stated that they had not received a copy of the survey. Surveys were returned by the post office with incorrect addresses and, though surveys went to residences in the area, some of the homeowners lived outside Grand Mound. The low return of surveys (10%) did not justify the use of a computer to tabulate the results. The results cannot be construed as a detailed representation of community opinion, but they do point out issues and areas of concern which can be the focus of refined survey methods.

Groundwater Quality

None of the respondents knew of any contamination in Grand Mound and all but 8% reported no problem with their own water supply. A majority (72%) have done nothing to improve their water quality. Over a third responded that they had improved their sewage system by cleaning either their septic tank or drainfield within the last five years.

A third of the respondents stated that no improvements are needed to water quality in Grand Mound. However, 50% of those questioned made specific suggestions for improvements: private sewage treatment (11.5%), public treatment (15.4%), or density limitations as a response to growth (23.1%). There was a close division between those who would support such improvements (39%) and those who would not (34%).

Community Development

Most respondents (60%) feel that future development in their neighborhood represented a threat to their water supply. It is possible to correlate this response with the fact that more than 70% stated that there was no likelihood that they would build on or develop their property within the next five years, with the exception that 36% indicated that they would probably erect outbuildings (barn, garage, etc.).

Policy Decisions and Information

Most respondents (58%) chose the Health District as the most likely agency they would contact about problems concerning water quality. The

Department of Ecology and the Department of Social and Health Services were the next two most popular choices.

Newspapers were selected by 51% as the source of information on development they most relied on. Other sources mentioned were contacts with friends (9%) and public officials (13%). Other respondents chose more formal means of information: County Commission meetings (3%), Planning Commission meetings (10%), and community organizations (6%).

Among open-end comments, people mentioned the need "...to be prepared for the future..." and that there is "...not enough futuristic planning... to figure out what the area will be like ten to twenty years from now..." References were made to previous studies with the comment that "there is no danger of groundwater pollution from development in the Grand Mound-Rochester area," and that industries were discouraged from locating in Thurston County due to "rigid and unneeded delays by county planners." Others felt the survey was misleading to the degree it implies there must be some type of pollution" and local residents should have been consulted before it was undertaken.

Most respondents saw no problems with community or individual water supplies nor did they suggest any means to improve water quality for the present. A significant portion of those answering the survey showed an active interest and made suggestions to insure a continued safe water supply. There are suggestions that, as development continues in Grand Mound, sewage treatment and density regulations would be advisable to protect groundwater quality. Many respondents rely on local agencies for information on water quality, but for community development, they use the newspapers as their chief source. In view of comments concerning lack of consultation on the survey and on delays for site location by industry, we feel that a public relations program sponsored by County agencies and the community could provide accurate and up-to-date information on development activities and policies for the sake of concerned Grand Mound residents.

RECOMMENDATIONS

IX. RECOMMENDATIONS

The following recommendations arise from the results of this study's research into the physiography, water quality, community values, land-use policies, and development patters of Grand Mound. The recommendations fall into four basic categories:

1) Area development
2) Sewage treatment alternatives
3) Public information
4) Further research

Area Developments

As stated in the synthesis section of this report, the presence of nitrates and coliform in groundwater in the study area tends to correlate with density levels. It was discovered that cluster zoned developments, in which homes are serviced by septic tanks, tend to increase nitrate and coliform concentrations in groundwater. Groundwater flow and water quality data show that these increased nitrate and coliform concentrations dilute slowly and may adversely affect neighboring well water supplies.

Objective 3(a) of the Sub-Area Plan states that development as 1 unit per gross site acre "...should be encouraged through a variable density mechanism to cluster land uses and to designate large amounts of contiguous open space..."[1] Clustering of residences equipped with septic tanks may lead to levels of nitrate and coliform in the water supply that go beyond acceptable limits.

[1] Rochester Sub-Area Plan, Thurston County Planning Department, 1978.

Sewage Treatment Alternatives

According to the Rochester Sub-Area Plan, sewage treatment facilities installed within densities greater than 1 unit per acre should be of at lease a secondary treatment level. The installation of jet aeration septic systems in Grand Mound may be an effective and appropriate means of achieving with this objective. Ibe advantage of such systems is that they can be installed by private homeowners, development contractos or the municipality.

The intermittent sand filter system is another sewage treatment that should be considered for future use in Grand Mound. This system requires the use of large volumes of sand which are readily available in the area. The development of most other types of secondary sewage treatment facilities would not be feasible, primarily because of their high construction and maintenance costs. It is suggested that further study be carried out to obtain detailed information about the cost-effectiveness of each of the major secondary treatment systems that could be used in the area.

Public Information

It was learned from the opinion survey, as well as from actual conversations, that many residents of Grand Mound wish to see more effective methods of sewage treatment brought into use. Many of these people also expressed a desire for improved communication between the public and agencies concerned with land-use policies. Thus it is advisable that a public information program sponsored by County planning offices and the general public be established.

This program should have three goals: 1) improved communication between the County government and residents of Grand Mound; 2) active involvement of residents in land-use decisions; and 3) use of available local human resources if and when major developments are undertaken.

The Rochester Community Planning Council should, in accord with its statement of purpose, act as administrator of the information program, with resource support and expertise provided by the Thurston Regional Planning Council. Supplies and clerical services for the program could perhaps be provided by the County budget.

A strong effort needs to be made to provide for views representative of all sectors of the community on the council. Information on public hearings, proposed or on-going studies in the area, policy modifications, development activities and possible means for local resident participation should be directed to the Community Planning Council. From here, the information should be channeled to the local news media and to interest groups such as the Chamber of Commerce and the Farm Bureau. Citizens have a right and responsibility to bring issues concerning community development before the local planning council and to the attention of appropriate agencies. In this way, government becomes directly aware of community needs and desires and can act accordingly. The information program may best accomplish this goal.

Further Research

It appears that there are other factors than housing densities that have an influence on groundwater quality and warrant further study. The exact influence that set back distances from septic tanks to wells needs to be further investigated. The static water level (the distance from the soil surface to the water table) and the efficiency of septic systems also affect the purity of groundwater in Grand Mound. These features also call for more in-depth study.

Nitrate levels should be monitored in developing areas to assure that safe levels are not exceeded. This will also help verify the relationship between groundwater quality and housing density. Groundwater movement may be further studied using tracer analysis methods. This would give more precise data on groundwater flow rates and the dilution of contaminants.

We did not address the impact of commercial, industrial or agricultural activity on groundwater in Grand Mound due to time and resource limitations. However, the importance of the impact of these activities on groundwater quality is not to be underestimated. A research method similar to the one used in this study can point out how these types of land uses can affect water supply.

RECOMMENDATION IMPLEMENTATION

RECOMMENDATION IMPLEMENTATION

This section is designed to correlate the report's four basic policy recommendations with the appropriate agency in the land-use policy flow chart. This is to anticipate how the recommendations will be administered.

Area Development

The proper development of Grand Mound will require water quality monitoring and land-use capacity planning. This means that the Thurston-Mason Health District and the Thurston Regional Planning Council must remain actively involved in planning Grand Mound's future growth. Together they should plan to assure good water quality throughout Grand Mound, paying particular attention to high density areas, and cluster developed areas. The Building Department should work in conjunction with the Health and Planning authorities since it is this agency that oversees plumbing and other building permits. Close coöperation among these agencies in planning, along with monitoring of groundwater, should minimize groundwater quality problems caused by development and help to avoid future development problems.

Alternative Sewage Treatment

Sewage treatment comes under the auspices of the Thurston-Mason Health District as well as the Department of Ecology and the Department of Social and Health Services. It is within the authority of these agencies to regulate the types of sewage treatment allowed in Grand Mound. The Health District should further investigate alternative sewage disposal systems and encourage the use of any such systems that are ecologically and economically sound.

Public Information

Getting accurate and up-to-date information to the public shall be the primary responsibility of the Rochester Community Council. It should remain aware of the residents' needs and present those needs to all appropriate agencies and councils. The Council should be aided in this responsibility by the Regional Planning Council and the County Commissioners. If this task is carried out, concerned citizens should be aware of current land-use policies and proposed developments.

Continued Research

The recommendations made under continued research focus on environmental health and planning. Consequently, it is the responsibility of the local health and planning agencies to carry out the research, if feasible. Research data should be properly circulated to all agencies that are involved with Grand Mound's development. The Health District should assume a lead role in the research process.

All of the implementation suggestions are within the legal capabilities of agencies mentioned. Financing for many of these projects could come from County, State or Federal resources.

APPENDICES

APPENDIX A

METHODOLOGY FOR ANALYSIS OF NITRATES AND NITRITES IN DRINKING WATER SAMPLES

Cleaning of Glass and Plastic Ware

All of the glass and plastic ware was washed in warm, soapy water and then rinsed with tap water. Next, each glass and plastic article was rinsed with 3 M HCl and then rinsed with distilled water.

Reagents

(1) Amalgamated Zinc (Jones Reductor): The zinc columns were prepared in the manner detailed in Quantitative Chemical Analysis, J.M. Kilthoff et al., New York: The Macmillan Company, 1973, p. 829. The columns were preconditioned by pumping more than 50 ml of 0.1 M HCl NH_4Cl through them.

(2) Ammonium Chloride: 250 ml of 4 M NH_4Cl and 250 ml of 0.1 M NH_4Cl were prepared, transferred to separate amber-colored glass bottles, and stored in the cold.

(3) Sulphanilamide Solution: 50 ml of concentrated HCl was added to 300 ml of distilled water and mixed. Next, 5 ml of suphanilamide was added to this solution and the entire solution was then diluted to 500 ml with distilled water. The solution was transferred to an amber-colored glass bottle which was stored in the cold.

(4) N(1-Naptyl)-Ethylenediamine Solution: 0.5 g of N(1-Napthyl)-Ethylenediamine dihydrochloride was dissolved in 500 ml of distilled water. The solution was then transferred to an amber-colored glass bottle which was stored in the cold.

(5) Nitrate Standards: 250 ml of 10 M KNO_3 (potassium nitrate) was quantitatively prepared, transferred to an amber-colored bottle and stored in the cold. Dilute standards were prepared from the concentrated stock prior to analysis, as detailed in the following table.

Table 5: Dilute Nitrate Standards for Analysis

Concentration of Nitrates (m mole/l)	Volume of 10^{-2} M KNO_3 Diluted to 1000 ml (ml)
0.00	0.00
2.50	0.250
5.00	0.500
10.00	1.00
20.00	2.00
30.00	3.00
100.00	10.00

(6) Nitrite Standards: A 250 ml solution of $5x10^{-3}$ M $NaNO_2$ (sodium nitrite) was was quantitatively prepared, transferred to an amber-colored glass bottle, and stored in the cold. Dilute standards were prepared from this concentrated stock prior to analysis as depicted in the following table:

Table 6: Dilute Nitrite Standards for Analysis

Concentration of Nitrites (m mole/l)	Volume of $5x10^{-3}$ M $NaNO_2$ Diluted to 1000 ml (ml)
0.00	0.000
1.75	0.250
2.50	0.500
5.00	1.00
7.50	1.50
15.00	3.00

Equipment

All weighings were carried out with the use of Mettler Analytic Balance (model H78AR). Nitrates were reduced to nitrites by pumping the solution through an amalgamated zinc column (Jones Reductor). The nitrite solutions pumped through the column with a Sale Peristaltic Pump (model 375A). All optical measurements were made with the use of a Varian 635 Spectrophotometer and either 1 cm or 10 cm glass cuvettes.

Testing Procedure

Seventy-five samples of water were analyzed for their nitrate and nitrite concentrations. One-hundred ml of each sample was transferred from the plastic sample bottles to dry 125 ml Erlenmeyer flasks.

A/ Nitrate: 100 ml of each sample was measured into a dry calibrated 125 ml Erlenmeyer flask. One ml of 4 M NH_4Cl was added to each solution with a 10 ml Mohr pipet. All of the samples were pumped at 10 ml/minute through the amalgamated zinc column. The first 25 ml of each solution to come through the column was discarded. The next 50 ml of each solution was collected in a 50 ml gradulated cylinder and then transferred to a dry 125 ml Erlenmeyer flask. One ml of sulphanilamide solution was then added to each sample with a 10 ml Mohr pipet and the solutions were mixed. Between 2 and 8 minutes later, a 10 ml Mohr pipet was used to transfer 1 ml of naptylethylenediamine to each solution. All of the solutions were again mixed. At least 10 minutes, but less than 1 hour later, the solutions were alanyzed spectrophotometrically at 540 nm in 1 cm glass cuvettes. The dulute standards were processed in the same manner as above.

B/ Nitrite: Using a 50 ml graduated cylinder, 50 ml of each sample was transferred to a dry 125 ml Erlenmeyer flask. A 10 ml Mohr pipet used to transfer 1 ml of sulphanilamide to each solution and the solutions were then mixed. After a period of between 2 and 8 minutes, 1 ml of napthylethylenediamine was added to each solution with a 10 ml Mohr pipet and the solutions were once again mixed. Between 10 and 60 minutes later, each solution was analyzed spectrophotometrically at 40 nm in 10 cm glass cuvettes. The 5×10^{-3} M $NaNO_2$ solution was used to quantitatively prepare fresh dilute standards for each analysis.

APPENDIX B

METHODOLOGY FOR TOTAL COLIFORM ANALYSIS OF DRINKING WATER SAMPLES

Two-hundred ml of M-Endo broth (4.8 g/100 ml) were prepared in the lab of the Thurston-Mason Health District. The broth was used within two hours of its preparation. The broth was sterilized in a TESC lab by placing the flask in a boiling water bath for 5 minutes. Sterile technique was used throughout this experiment. Two ml of the broth were transferred with a 10 ml Mohr pipet to 47 mm Millipore media pads in each of the 75, 47 mm petri dishes. One hundred ml of each sample was filtered through 47 mm Millipore 0.4 gridded filters (see Fig. 15) and each filter was transferred to the media pads in the petri dishes. The petri dishes were then stored at 37.5 degrees Celsius in an ELCONAP incubator (model AH-2) for a least 24 hours. Coliform counts were determined by the number of green-sheen colonies that appeared in some of the petri dishes.

METHODOLOGY FOR FECAL COLIFORM ANALYSIS OF DRINKING WATER SAMPLES

The analysis for fecal coliform in water samples found to contain total coliform, was undertaken by the staff of the Thurston-Mason Health District on May 7, 1978. The methodology for this experiment is detailed in Standard Methods for the Examination of Water and Wastewater, 13th Edition, ed. Michael J. Fatas, et al., Washington, D.C.: American Public Health Association, p. 669.

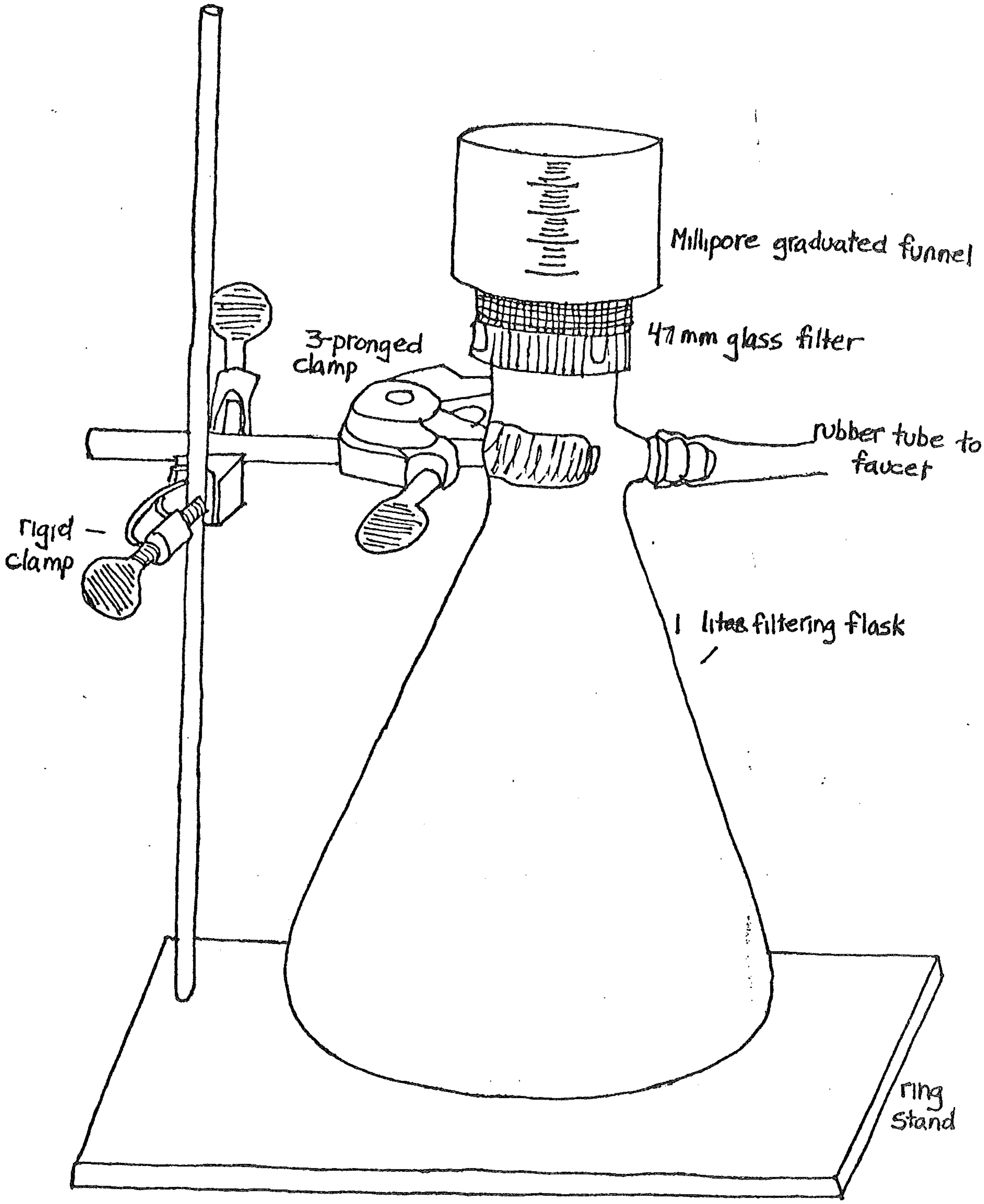


FIGURE 15: FILTERING APPARATUS USED IN THE TOTAL COLIFORM EXPERIMENT

AQUIFER FLOW METHODOLOGY

The rate of groundwater flow can be roughly calculated through mathematical models using well drawdown and groundwater level data. Methods of determining these rates are primarily based on the principles of groundwater flow represented by Darcy's Law (1).

To use Darcy's Law, the coefficient of permeability (3) and hydraulic gradient (2) must be calculated.

DARCY's LAW (1)

$$V = PI$$

where
V = Velocity of flow
P = coefficient having the same units as velocity (permeability)
I = slope of the hydraulic gradient

HYDRAULIC GRADIENT (2)

$$I = \frac{h_1 - h_2}{d}$$

where
I = hydraulic gradient
$h_1 - h_2$ = difference in hydraulic head
d = distance along flow path

COEFFICIENT OF PERMEABILITY (3)

$$P = \frac{1055\ Q\ \log10(r_2/r_1)}{(h_2^2 - h_1^2)}$$ [1]

where
P = coefficient of permeability, in gallons per day per square foot
Q = pumping rate, in gallons per minute
r_1 = distance of the 1st observation well from the pumped well, in feet
r_2 = distance of the 2nd observation well from the pumped well, in feet
h_1 = depth of groundwater at the 1st ovservation well (depth of aquifer minus drawdown) in feet
h_2 = depth of groundwater at the 2nd observation well (depth of aquifer minus drawdown) in feet

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[1] Water Supply and Pollution Control, 3rd Ed. P. 82

Where a relatively high permeability is anticipated, the formula can be adapted to drawdown data from single wells. This is done with the following assumptions:

1) There is an observation well 1 ft. from the pumped well, with a drawdown equal to that of the pumped well.

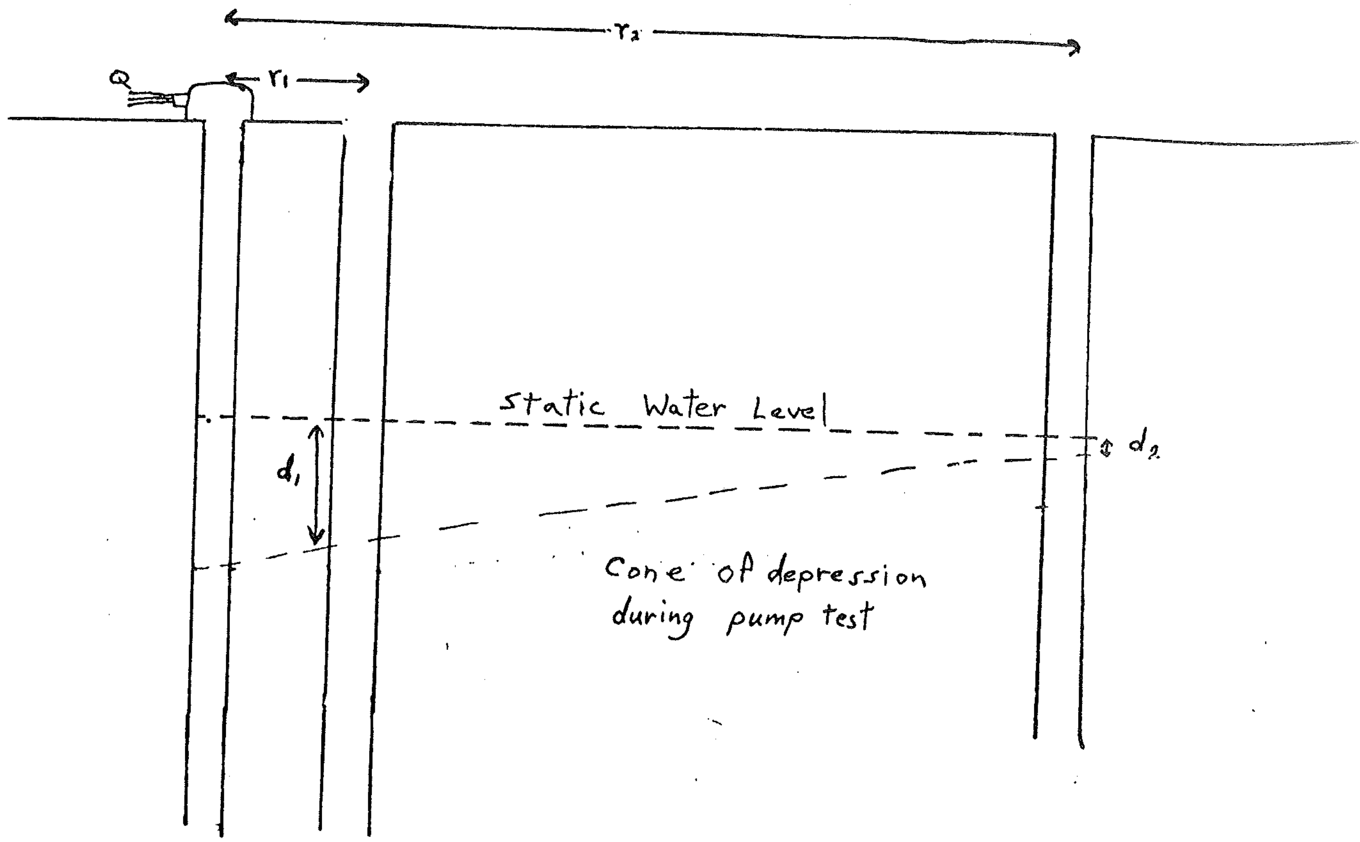
2) There is an observation well 1,000 ft. from the pumped well, with a drawdown of zero.

Permeability is the amount of water that will flow through a square foot cross-section of aquifer material under a hydraulic gradient of 1. When permeability is multiplied by the hydraulic gradient, this gives discharge in gallons per cubic foot per day.

The U.S.G.S. water supply division in Tacoma estimates that the average depth of the alluvium in the Grand Mound area is about 125-130 feet[2]. Subtracting the static water level (25-30 ft.) from this figure, we get the depth of water in the aquifer (about 100 feet). 100 feet is the assumed thickness of the aquifer throughout our calculations.

[2] Personal communication, May, 1978

Fig 16 Definition of terms for calculating permeability.



Where Q = rate of pumping, in gallons per minute

r_1 = distance to the first observation well, in feet

r_2 = distance to the second observation well, in feet

d_1 = drawdown in the first observation well, in feet

d_2 = drawdown in the second observation well, in feet

APPENDIX C

METHODOLOGY FOR LAND-USE ANALYSIS

The data gathered for the land-use analysis was collected from the Thurston County Assessor's Office and the Thurston Regional Planning Council. Unfortunately, some of the Assessor's records are out-of-date and land which is termed undeveloped in this section may now be developed. It is expected that the area will be reassessed in 1979.

Several calculations were made for the land-use analysis and each of these required its own methodology. These calculations dealt with present densities, present growth rates, rates to capacity, projected population increase, and rate of short-platting. Present density was determined by adding all residential lot sizes in each land tract, mete and bound of donation land claim. This figure was divided by the number of residential lots. The growth rate was determined by adding together all new residences from 1970, when the existing growth spurt began, to the present. This figure was then divided by that same number of years.

The total acreage open for development was divided by the present growth rate to calculate the various rates to capacity (shown in Table 4). To determine the number of acres open for development the undeveloped acreage was added to the acreage in residential areas that can be subdivided. The undeveloped acreage was the total study site acreage minus the agricultural, commercial, and residential acreage. The residentially-developed acreage which can be further developed was determined by checking each parcel and noting if it could be divided to the appropriate density. (For example, a residential parcel must be at least two acres to be subdivided to achieve a density of one unit per acre). Next, all of the residential parcels that can be subdivided were totaled and added to the undeveloped acreage to arrive at the total number of acres open for development.

The rate of short-platting was determined by totaling all short plats since 1975--when records were first kept--and dividing by three (1978-1975 - 3 years).

To obtain the projected population increase the number of acres open to development was divided by the appropriate density resulting in the number of households for that density. This number was multiplied by 3.13, the current average household size in Thurston County.

APPENDIX D

METHODOLOGY OF OPINION SURVEY

This survey was designed to determine three characteristics of opinions of Grand Mound residents on groundwater quality and community development. The first characteristic was perception: What is the problem seen by the respondent? The second was impact: How does the problem affect the respondent? The third was expectation: How does the respondent expect the problem to be resolved? The questions which would determine these characteristics were written for each of the following topics.

(1) groundwater quality in Grand Mound and the residents' homes

(2) community development

(3) decision-making and information dissemination

Table 7 illustrates the intent of each question (Q) on the survey to determine an opinion characteristic.

Table 7

Topic	Characteristics Determined in Opinion Survey		
	Perception	Involvement	Expectation
Groundwater quality	Question 2	Q4, Q5, Q6, Q7	Q9, Q10
Community development	Q11	Q12, Q18	
Decision-making & information	Q8, Q19		

The survey was restricted to Sections 1, 2, 3, 10, 11, 12, and 14. Township 15N Range 3W. The specific road boundaries were: north, along Township Rd. (183rd St.); east, along Nutme St., and down Old Highway 99; south, from 210th St., along Old Highway 99 to the intersection of James and Carper Roads; west, along Joselyn Rd. According to the Assessor's records, there are 240 residences in the area and we mailed surveys to all of these homes. Surveys were coded with a density variable so that response patterns of residents could be determined for each area of Grand Mound.

APPENDIX E

ALTERNATIVES TO THE SEPTIC SYSTEM

Nitrate levels in the Grand Mound aquifer indicate that the effective limits of septic tank use are being approached at current densities.

This study's investigation of the area's present trends of development leads to the conclusion that density levels have increased and will continue to increase; therefore, more effective sewage treatment systems are needed. The Rochester Sub-Area plan stipulates that all future sewage treatment systems for the Grand Mound area be of a secondary level. It is for this reason that secondary modes of treatment should be considered as an alternate to the present system (i.e., septic tanks).

The terms "primary" and "secondary" refer to the degree to which sewage is cleansed of contaminants. Primary treatment involves the removal of settleable solids by gravitational settling, or screens. The septic tank is an example of primary treatment.

Secondary treatment is the reduction of the biochemical oxygen demand (BOD) through biological digestion of the sewage to yield a stabilized product. The success of this kind of treatment is dependent upon micro-organism cultures needed to break down the sewage.

Jet Aeration

Jet aeration is a secondary treatment system which is currently undergoing tests in Spokane. Though more study needs to be done on the system, it appears to successfully treat large amounts of septic effluent, as well as smaller amounts from individual septic systems.

The jet aeration system begins with primary treatment in the form of a settling tank which is used to pre-treat the sewage. In a second tank, air is injected with a pump to facilitate the biological process that breaks down the effluent.

This system can be used by an individual home equipped with a 1000 gallon sewage tank. It would also work well for homes in cluster developed areas. Because of this, this process is especially suited for the Grand Mound area. Jet Aeration is also relatively simple, compared to most other modes of secondary treatment. It is also versatile since it can be implemented on either an individual or municipal level.

Intermittent Sand Filters

An intermittent sand grain filter contains a specially prepared bed of sand or other fine-grained material. The effluents from primary treatment, trickling filters, or secondary settling tanks are applied intermittently to the surface of this bed from distribution pipes. The sewage can be applied through an automatic siphon or manually-operated valves.

Once applied, the effluent percolates through the sand bed and is withdrawn from the bottom of the filter through a system of underdrains. No control devices are necessary on this outlet because the rate of filtration is regulated by the initial rate of sewage input.

The final product of the intermittent sand filter process is a relatively clean effluent which surpasses the treatment standards for most areas. This system is economical if sand suitable for filtering is available locally. It is also economical to plant agricultural crops over the sand, turning it into a multi-use area.

A potential problem with the quality of Grand Mound's water supply is contamination from nitrates in the aquifer. The intermittent sand filter method of sewage treatment converts ammonia in the effluent to elemental nitrogen instead of allowing it to reach the aquifer in the form of nitrates.

Intermittent sand filters can be used on either an individual or community basis depending upon the cost effectiveness in the given situation.

Compost Privy

Another alternative to current sewage treatment in Grand Mound may soon be available for use in Washington. This is the compost privy in which waste material is decomposed and, in turn, yields fertilizer suitable for agriculture. In traditional septic systems the process of sewage breakdown is an anaerobic one. Without oxygen there is no heat build-up, and destruction of pathogenic bacteria and other parasites can take up to six months. With an aerobic system the high temperatures from oxidation destroy pathogens in hours.

A built-in garbage chute from the kitchen allows for the collection of kitchen waste in the compost privy system and with air-ducts and vent pipes to promote aeration, the production of nutrient-rich fertilizer is accomplished.

Despite its popularity in Scandinavia, the compost privy has not been permitted for use in most states. The State of Oregon recently legalized its use and although still not legally sanctioned in Washington, it may soon be granted official approval. Its effectiveness has been demonstrated in other countries. In Thurston County, two experimental permits for the compost privy have been granted and data is presently being accumulated on the system by the Thurston-Mason Health District.

The Clivus-Mulltrum unit is a type of compost privy that is a 10-foot long, and 4-foot wide, fiberglass reinforced, plastic container. This particular device can accommodate 2-3 years output of domestic sewage. It consists of a large compost tank having a sloped bottom and it is equipped with incoming toilet and kitchen waste pipes, an outgoing air vent, and an unloading door. The main tank is divided into three interconnecting chambers. The first receives sewage wastes; the second, kitchen wastes; and the third, acts as a storage chamber for combined wastes. When the unit is in operation, the toilet wastes slowly slide downhill into the kitchen wastes. The two types of waste combine and further decompose as they slide into the storage chamber. A family of four would, on the average, use the unit for up to 10 years before the stabilized end product would have to be removed. This waste can be used for garden soil or soil conditioner.

Installation of compost privies are only feasible for single-family dwellings. Another system would have to be employed to deal with multi-family complexes. The Clivus requires only a minimum of maintenance. Its cost-effectiveness must be determined by each individual homeowner.

In determining the cost-effectiveness of alternative systems, one must weigh the financial costs against the consequences of not implementing that alternative. The determining factors are in a constant flux; a fact which inhibits our ability to make any specific statements in this area. Because our study did not research the current costs of these systems, we are unable to weigh the two factors.

The homeowner is responsible for the cost of the individual sewage treatment (on lot-by-lot basis). This includes both primary and secondary methods. In an area of cluster design, 15 to 20 homeowners may utilize a complex sewage system. In cases such as this, it is possible for the Federal or State government to absorb as much as 90% of the cost. Consequently, the system would be operated and maintained by the County or other municipality.

FIGURE 17: SAMPLE SURVEY MAP OF GRAND MOUND

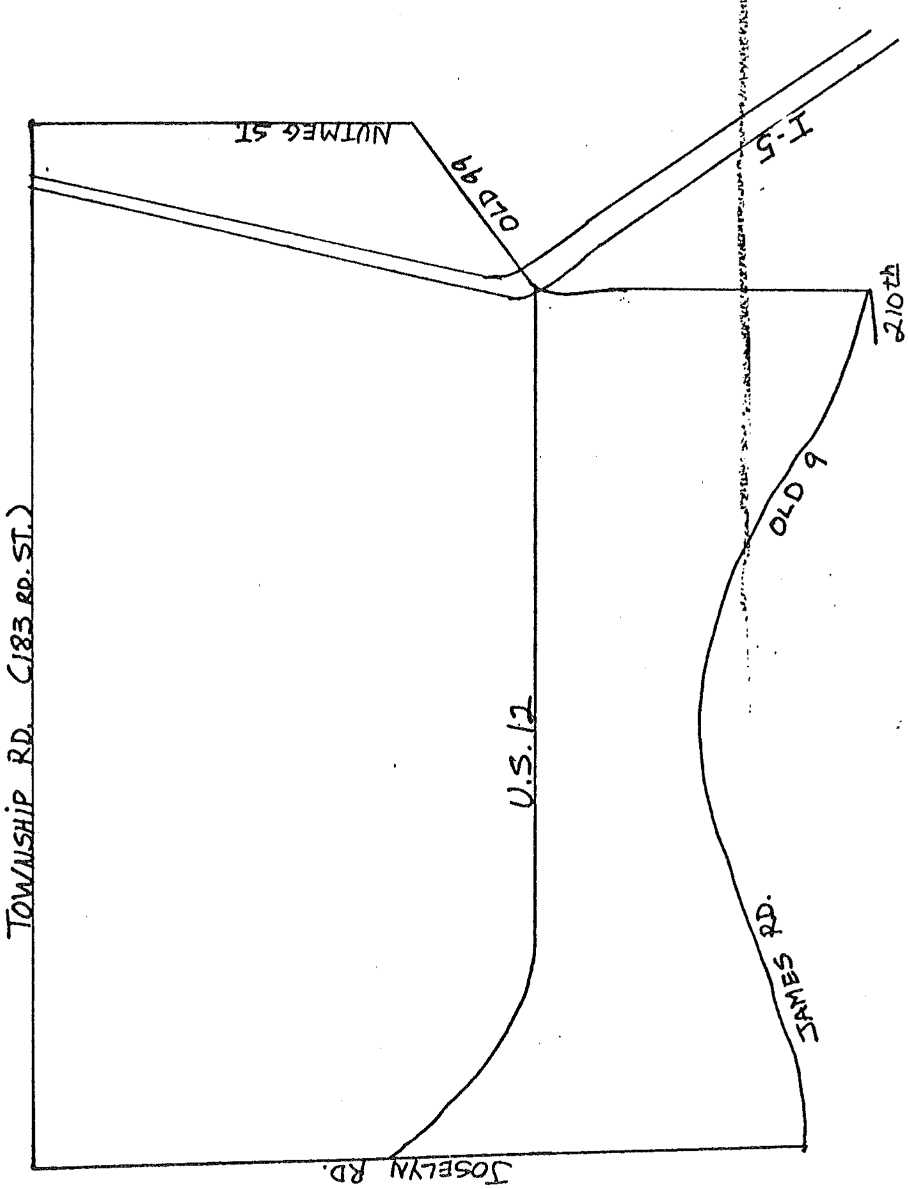


FIGURE 18:

The Evergreen State College

Dear Resident:

This spring, a group of students in the Applied Environmental Studies program at The Evergreen State College, in co-operation with Thurston Regional Planning and the Thurston-Mason Health District, are conducting a study of groundwater quality in Grand Mound. The purpose of the research is to determine the relationship between groundwater quality and housing densities in your community. The results of the study will be used to produce a series of recommendations to resolve problems of well water quality and to determine how much and what type of development corresponds to safe levels of groundwater quality. These recommendations will be based on three sources of information: (1) analysis of water samples taken from selected sites in Grand Mound; (2) analysis of physical and development characteristics of the area; (3) opinions and perceptions of residents on water quality.

The following questionnaire asks your opinions and perceptions on water quality and related issues. There are no "right" and "wrong" answers. We ask that you answer each question by picking the one response that you agree with the most. All answers will be strictly confidential and used only as totals of opinions of Grand Mound residents who responded to the survey.

Since this survey is important to our study, we ask that you complete it as soon as possible. We will stop by your house to pick up the survey on May 12th. If you have any questions, you can write to us at the following address:

Groundwater Study
c/o Dr. Kaye V. Ladd
Lab II
The Evergreen State College
Olympia, Wa. 98505

You can also contact us by calling 1-866-6337 on Tuesdays and Thursdays between 9 and 11 AM and between 2 and 5 PM.

We sincerely appreciate your participation in this study and hope it will be of some benefit to you and your family.

Yours truly,

Nick D'Alonzo, Survey Representative, Groundwater Study

Olympia, Washington 98505

FIGURE 19 :

PLEASE PICK THE ONE ANSWER THAT YOU AGREE WITH THE MOST

1. ____

GROUND WATER QUALITY

2. Do you know of any well water contamination in Grand Mound ?

(1)___yes (2)___no

3. What do you think is the most important cause of ground water contamination ? PICK ONE

(1)___there is no contamination
(2)___inadequate swptic tank
(3)___wastes from drain field seeping into ground water
(4)___poor soil conditions
(5)___agricultural fertilizer
(6)___industrial waste
(7)___other:specify________________
(8)___I don't know the cause of water contamination

4. What is the most severe problem you have had with your own water supply ? PICK ONE

(1)___bad taste
(2)___discoloration of appliances
(3)___cause of illness
(4)___other:specify
(5)___I have no problem with my water

5. What have you done to improve your own water quality ? PICK ONE

(1)___boiled my water
(2)___installed filter system
(3)___moved septic tank
(4)___dug deeper well
(5)___chlorinated my well
(6)___other:specify________________
(7)___I have done nothing to improve my water quality

6. Have you cleaned your septic tank within the past five years ?

(1)___yes (2)___no

7. Have you cleaned your drain field within the past five years ?

(1)___yes (2)___no

8. What person or agency would you most likely go to if you had a question or problem about water quality ? PICK ONE

(1)___Planning Department
(2)___Health District
(3)___Assessor
(4)___Department of Ecology
(5)___Department of Social and Health Services
(6)___County Commissioners
(7)___other:specify________________
(8)___I wouldn't know who to go to

9. What is the most important thing that can be done to improve water quality in Grand Mound ? · PICK ONE

(1)___private sewage treatment system (such as Rochester Water Association)
(2)___public treatment system
(3)___chlorination of water
(4)___other:specify______________________________
(5)___nothing needs to be done
(6)___I don't know what can be done

10. Would you be willing to support such an improvement ?

(1)___yes (2)___no (3)___I don't know

COMMUNITY DEVELOPMENT

11. Do you feel that future development in your neighborhood will be a threat to groundwater quality?

(1)___yes (2)___no (3)___I don't know

12. through 18

What is the likelihood of your building or developing on your property in the next five years? - FOR EACH QUESTION, CHOOSE ONE RESPONE - (1) (2) (3) (4)

	(1)DEFINITE LIKELIHOOD	(2)PROBABLE LIKELIHOOD	(3)NO LIKELIHOOD	(4)DON'T KNOW
12. residence				
13. mobile home				
14. addition to present structure				
15. residential subdivision				
16. outbuildings (barn, garage, etc.)				
17. commercial developement				
18. agricultural uses				

L(. Whick do you rely on the most for information of development in Grand Mound? PICK ONE
(1)____Newspapers
(2)____Conversation w/ frineds
(3)____Direct contact w/ public officials
(4)____Through county commission mtgs.
(5)____Through planning commssion. mtgs.
(6)____Through community organizations (PTA, grange, church, fraternal group, etc.)
(7)____Other: specify______________________________
(8)___I have no source of information

20. Do you have any comments on the survey or on the issues mentionned?

THANK YOU FOR YOUR PARTICIPATION

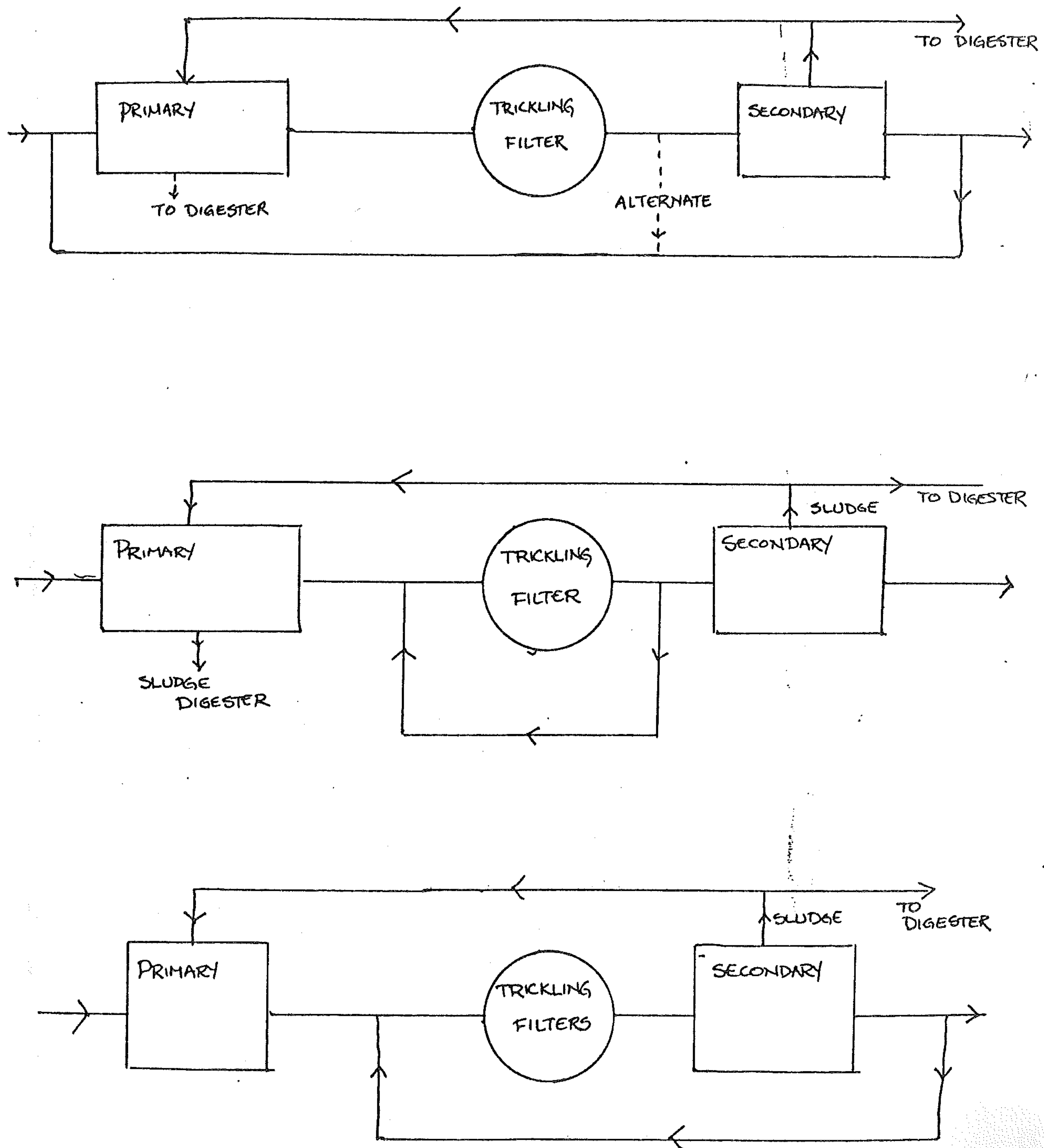


FIGURE 20: SECONDARY TREATMENT TRICKLING FILTERS

GRAND MOUND STUDY AREA

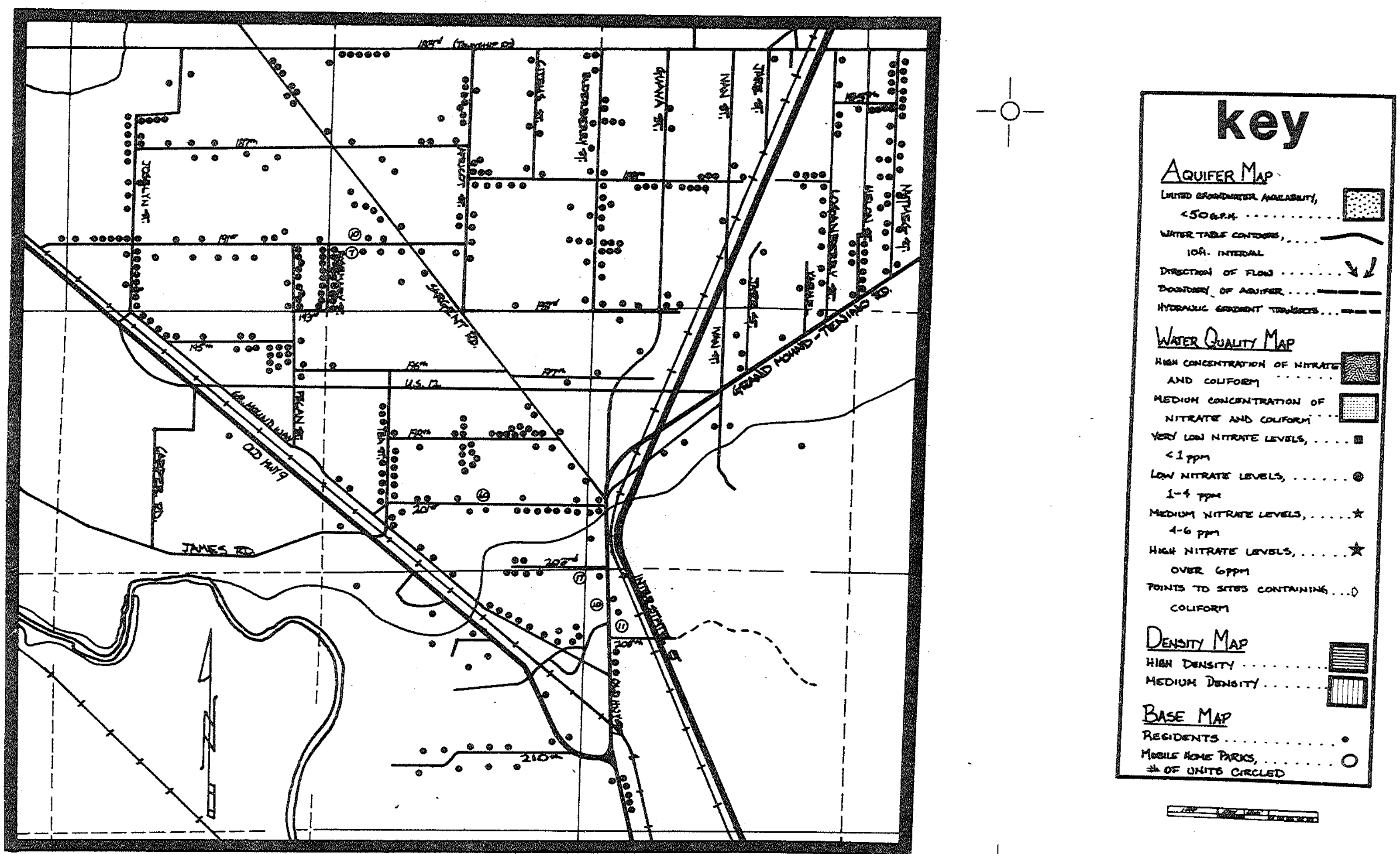
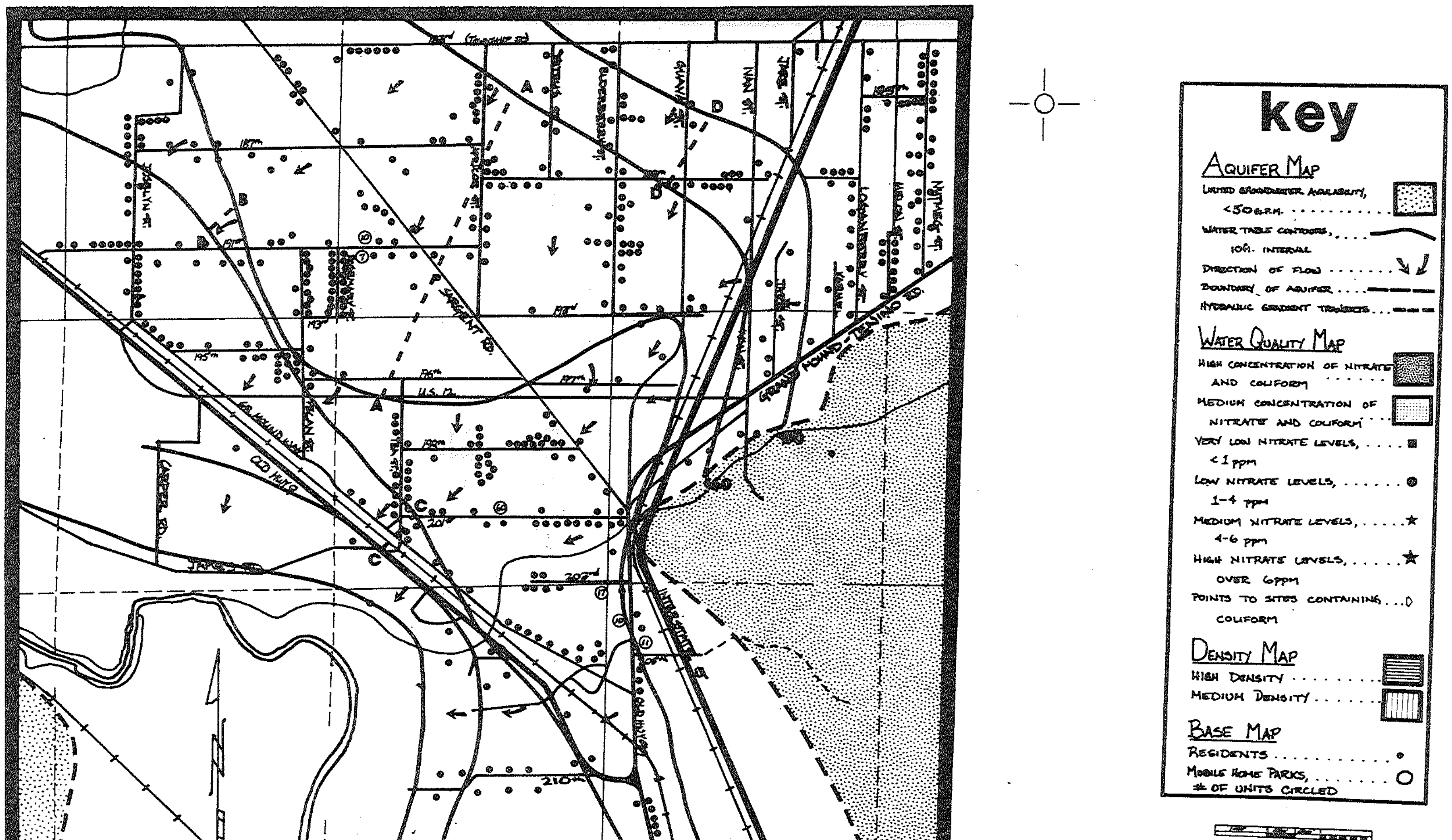


FIGURE 21

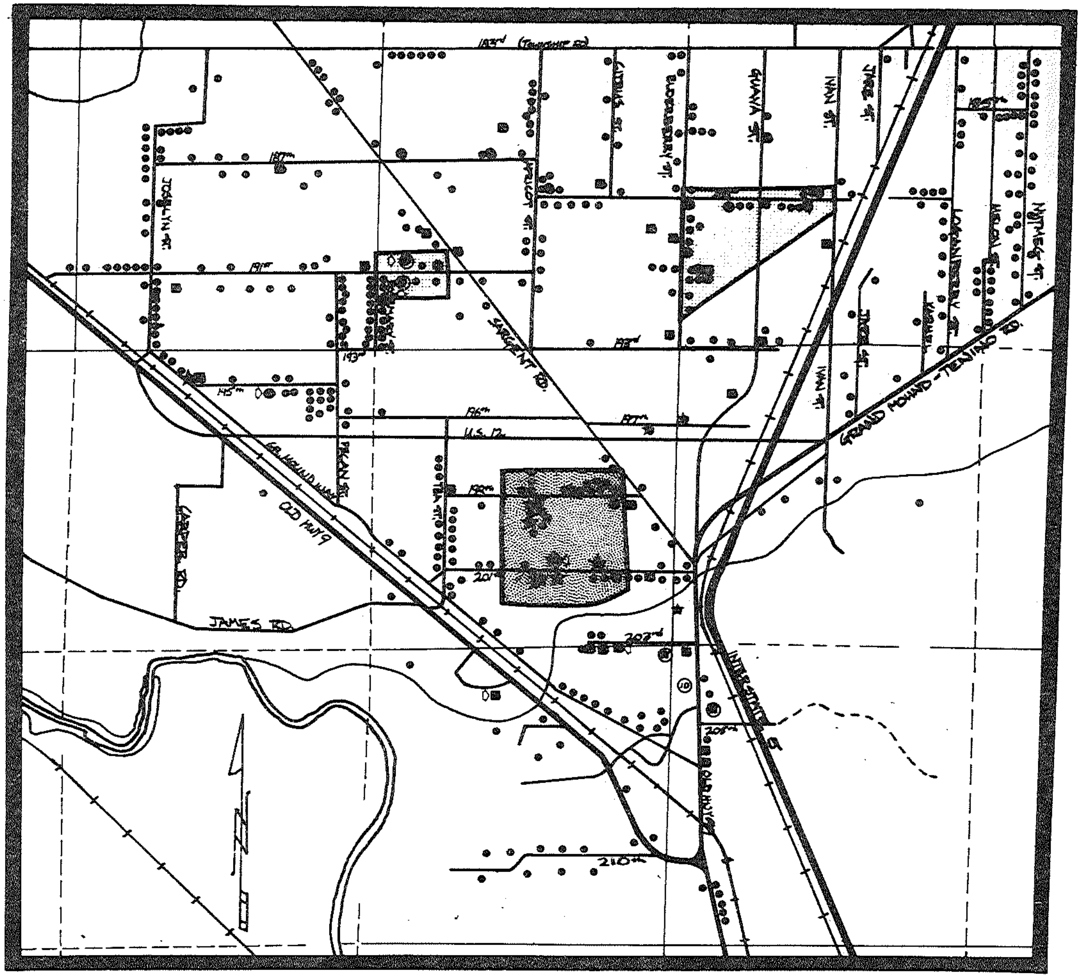
GRAND MOUND STUDY AREA

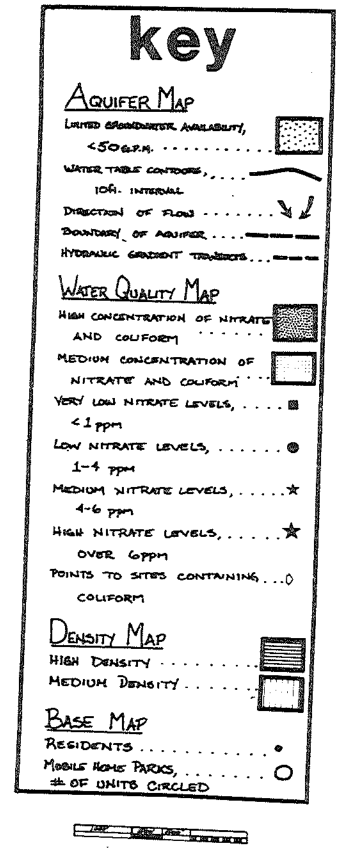


aquifer

FIGURE 22

GRAND MOUND STUDY AREA

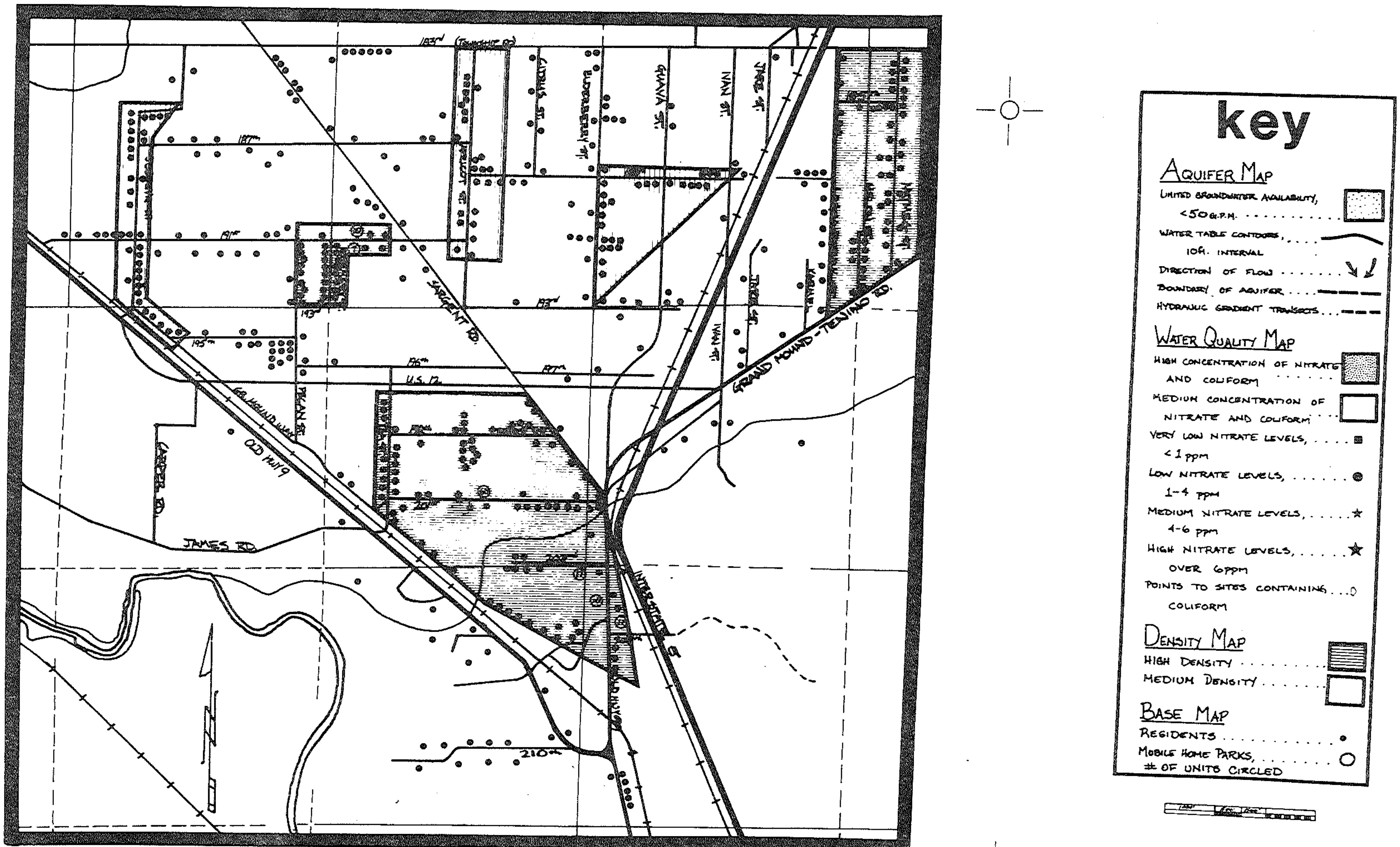




★ **water quality**

FIGURE 23

GRAND MOUND STUDY AREA



★ **density**

FIGURE 24

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