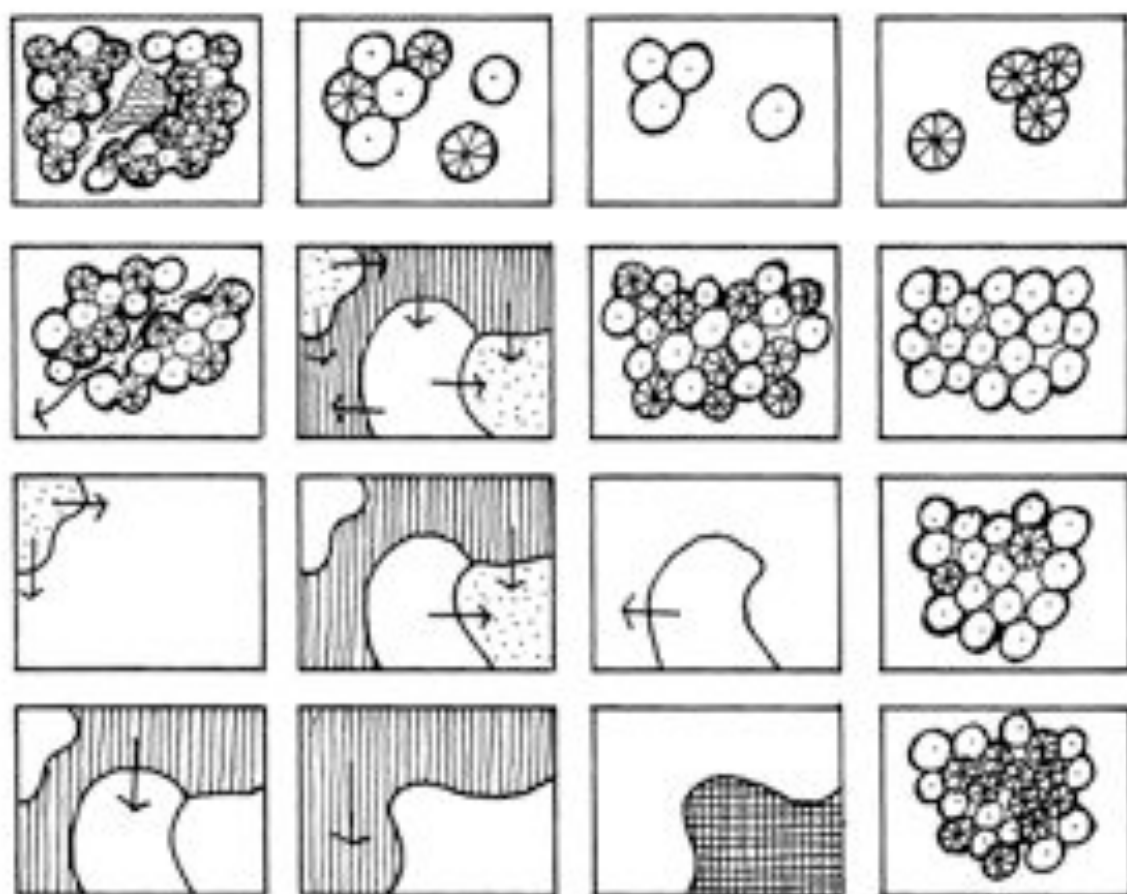


# WOODLANDS NEW COMMUNITY

## GUIDELINES FOR SITE PLANNING



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This report was prepared for:

**The Woodlands Development Corporation**  
One Shell Plaza  
Houston, Texas

This report was prepared by:

**Wallace, McHarg, Roberts and Todd**  
1737 Chestnut Street  
Philadelphia, Pennsylvania 19103

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December, 1973

**Wallace McHarg Roberts and Todd**  
1737 Chestnut Street  
Philadelphia, Pennsylvania 19103

Partner-in-Charge: Ian L. McHarg  
Associate Partner-in-Charge: Jonathan Sutton  
Project Director: Anne Whiston Spirn

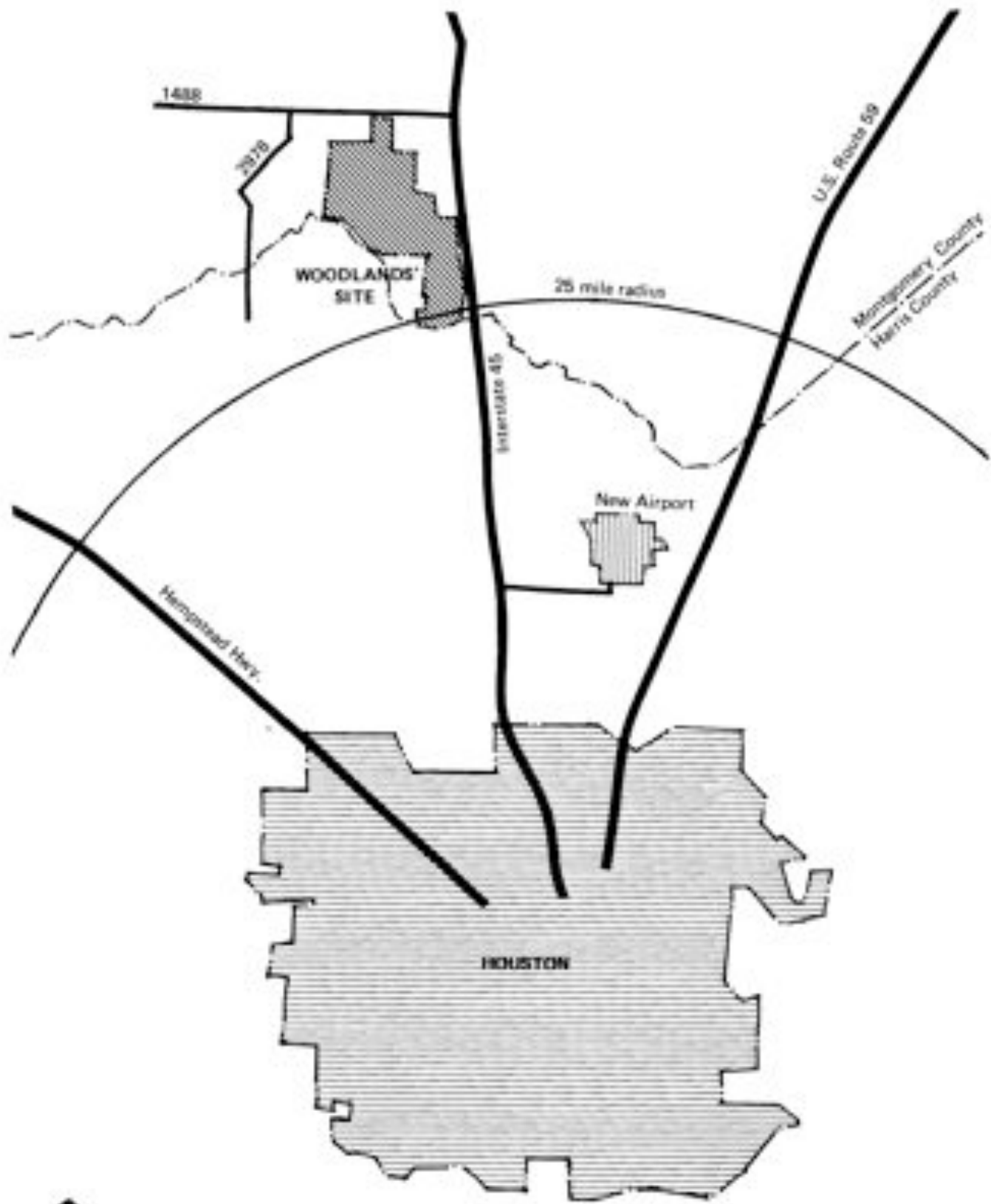
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Final report layout: Jane Laughlin

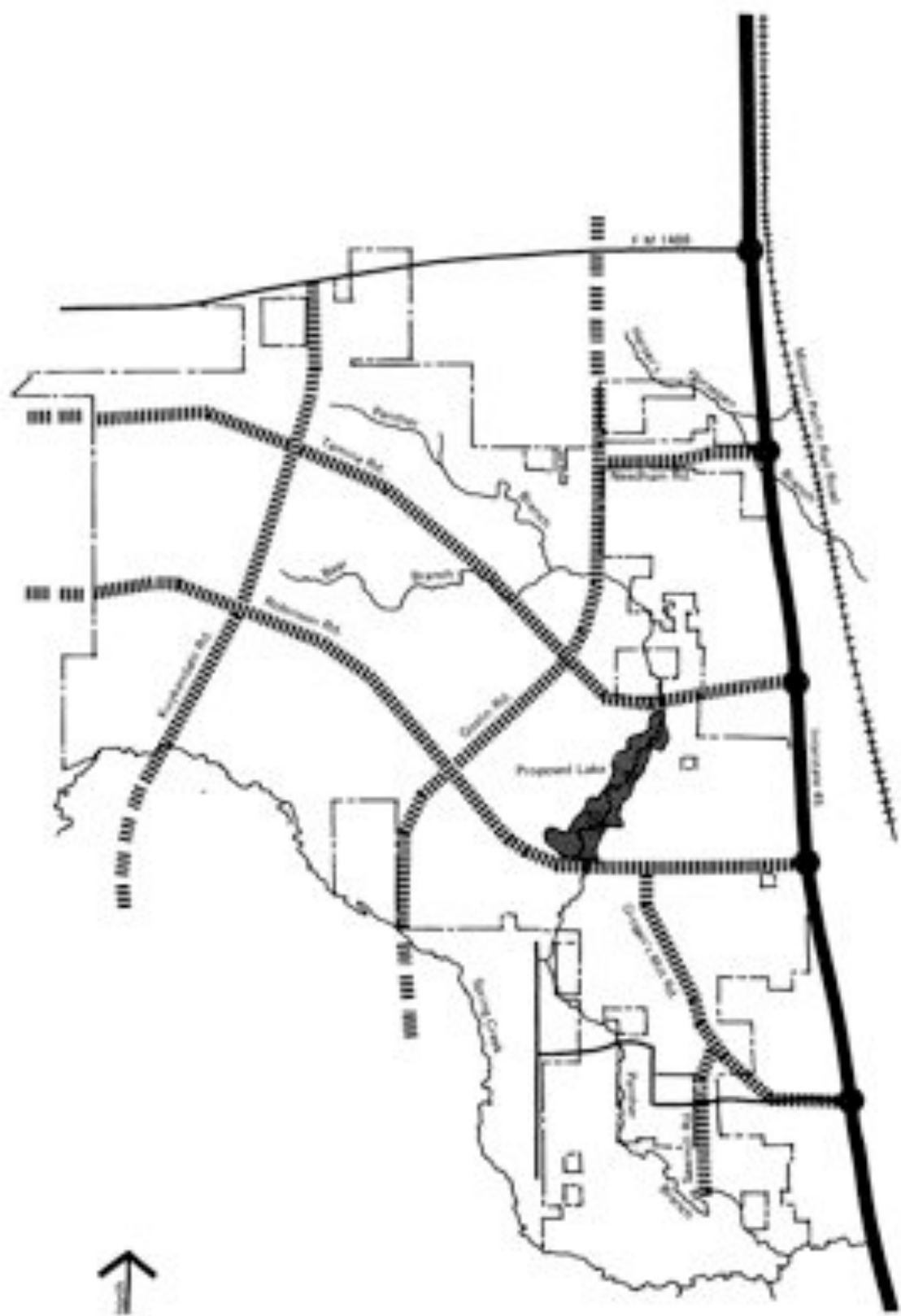
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Regional Context



Woodlands New Community  
General Plan

# PLANNING METHOD

## Introduction

The site of the future Woodlands New Community is 25 miles north of Houston in Montgomery County, Texas, just west of I-45, the major highway between Houston and Conroe. The 18,000 acres of gently sloping to flat terrain are presently covered by a pine-oak woodland. Spring Creek, the largest of several streams which flow through the site, forms the southern boundary of both the Woodlands property and the County.

This manual is one of a series of working documents produced by Wallace, McIlarg, Roberts and Todd. It updates the findings of previous reports in response to the ongoing study of environmental conditions of the Woodlands and the challenges of detailed site planning. As the planning, design, and development of Woodlands New Community proceeds, this report will be revised and refined, based upon new data or demonstrated performance.

## General Plan

In 1971 an ecological planning study (Ecological Planning Study for the New Community, Houston, Texas, WMRT, July 1971) was undertaken by WMRT as part of a team of consultants planning a new town for The George Mitchell Development Corporation. This master planning project formed the basis of the first Woodlands General Plan. Data concerning climate, geology, subsurface and surface hydrology, limnology, soils, vegetation, and wildlife were collected and interpreted in light of implications for development. The synthesis revealed the intrinsic suitability of specific areas for specific uses and identified opportunities and constraints for active and passive recreation and low to high intensity development. A General Plan was prepared from the results of this investigation.

This plan and later revisions responded to several objectives:

- Preservation of a woodland environment;
- A natural drainage system which would utilize existing floodplains, drainage channels, ponds, and recharge soils;
- Preservation of certain areas of vegetation noted for species diversity, high quality, stability, and uniqueness;
- Provision for wildlife habitats and movement, so that wildlife now living on the site may remain.

Subsequent revisions to the first general plan have been made as more detailed environmental, marketing, transportation and design studies have been completed and the first phase of development has begun.

#### **Phase I**

The site for Phase I of the Woodlands New Town is in the southeastern corner of the property. It was selected primarily for its proximity to I-45. The planning for the first village of Grogans Mill (some 1700 acres) permitted greater refinement in the information utilized in the design process than was possible in the preparation of the General Plan. (Woodlands New Community Phase I: Progress Report on Land Planning and Design Principles, WMRT, April 1973.) Detailed field data relating to hydrology, limnology, soils, vegetation, wildlife, and climate were collected, mapped, and interpreted in terms of opportunities and constraints for residential development. Several general principles and specific objectives were derived from this investigation and used to formulate design guidelines for a master plan. The mapped data, interpretation of suitabilities, principles, and objectives were combined to produce a Design Synthesis Map.

The Woodlands Site poses serious problems to a developer wise enough to exploit the opportunities and to respect the constraints of the natural environment. The Site includes the floodplains of two major creeks and is covered by a pine-oak forest of varying composition. Extensive flat terrain and an abundance of impermeable soils render the Site difficult to drain without clear-cutting the woods and installing concrete drainage ditches. This solution is expensive and destructive, and was therefore rejected outright for economic and environmental reasons. Therefore a strategy for minimizing the cost of a drainage system and maintaining areas of existing woods on both the town-wide and residential scales was developed.

Operating under the belief that one should let nature do the maximum work for man at the least cost, the strategy of a natural drainage system was formulated and developed in detail in planning for Phase I. The properties of existing soils, vegetation, and the hydrologic system will be used to drain the Site and store runoff during storms: existing swales, the excess storage capacity of well-drained soils, and the water retention capacity of existing ponds and im-

permeable soils will be exploited. Runoff from the high frequency storm of 1 inch in 6 hours will be recharged on suitable soils in the individual development parcels or temporarily impounded in storm-water retention areas. Since this natural drainage system does not necessitate ditching if the floodplain of the 25 year storm is respected, it permits the maintenance of all existing vegetation in drainage easements along swales and creeks and within development parcels on recharge soils and impounded areas. This will preserve a network of woods from town-wide scale down to scale of the residential setting. Significantly it will provide double savings, avoiding both the expense of an artificial drainage system and the expense of planting replacement trees. Besides these savings additional benefits will accrue since the erosion, siltation, increased runoff and flooding hazards which occur with conventional methods of draining new development will be minimized.

The drainage system easements and areas of mature high quality vegetation provide a network of wooded primary and secondary open space and provide natural boundaries for the development parcels.

#### **Guidelines for Site Planning**

This site planning manual is concerned primarily with the achievement of the natural drainage system and the preservation of woodland in the planning and design of the development parcel. It both complements and supersedes portions of the Phase I Progress Report.

The key method employed in the manual was developed to identify the areas that are intrinsically suited to specific land uses. The method organizes ecological data in a form which can be readily applied by planners and designers, and outlines the step-by-step process of applying selected criteria to a specific site. The data, objectives, and criteria are explicit; the process is a replicable one. Given the criteria and the procedure, all consultants who employ the method can produce a variety of designs all of which satisfy the stated environmental objectives. The method will not dictate a specific plan or design. The outcome of the process provides the framework within which the plan or design will evolve, directed by the guidelines. The quality of the final product still depends on the ingenuity of the individual site planner.



The method ensures only that the plan will be responsive to selected site conditions, thereby meeting certain environmental standards.

This site planning manual applies the key method to the Woodlands New Town in order to determine suitability for residential land uses — housing, circulation, and open space — in the context of a natural drainage system and the maintenance of a woodland environment.

The manual has four sections. The first three outline a process and guidelines for planning and the fourth applies the above method to a specific site. The first section summarizes principles, objectives, and strategies related to each topic in the ecological inventory — geology, hydrology, limnology, soils, vegetation, wildlife, and climate. These are general and were intended to be applied anywhere on the Site.

The second and third sections focus on aspects of the environment particularly relevant to the planning and design of residential development at the Woodlands. These factors, related to soils, drainage, and vegetation cannot be covered adequately by general principles since significant conditions vary even within small development parcels.

The soil and drainage key (the second section), by combining factors of soil types, slopes, and physiographic relationships, enables the planner to identify site conditions and to match these conditions with specific guidelines for site planning. The requirements for draining and recharging runoff are outlined for each condition.

Each soil and drainage condition has specific limitations on the area which may be cleared and rendered impervious. In the third section these are combined with limitations for clearing based on the value of certain vegetation types. Criteria and priorities are given for determining the type, quality, and distribution of both the vegetation to be preserved and the areas which may be cleared. Guidelines for management and site planning are outlined for specific vegetation types and stand sizes.

After determining which areas should be left in woodland and which might be cleared, a preliminary site plan can be formulated, following the general guidelines for existing conditions. These guidelines should then be referred to once again

and used to evaluate and refine the site plan.

The value of this key method lies in its applicability to all phases of planning and design. During the preliminary stages it facilitates an estimate of the program or "carrying capacity", an indication of suitable housing types and densities, and an identification of problem areas and areas most easily developed. Finally, it guides the site planning process and provides criteria for refining and evaluating all plans and designs.

# ECOLOGICAL INVENTORY WITH SUMMARY SHEETS

## **Introduction**

Data collected and interpreted in the ecological inventory for the General Plan and Phase I are summarized in this chapter. The sheets at the end present objectives for development at Woodlands New Community and adaptive strategies for attaining them.

## **Geology**

The Site is located on the Atlantic Coastal Plain and is underlain by unconsolidated sediments of Tertiary age. All of the formations are constituted of sands, gravels, silts, and clays in varying proportions and provide adequate bearing strength for most urban purposes.

The Site is essentially flat. Slopes of over 5% gradient are encountered in very small areas. These are a result of stream dissection and are mostly along Spring Creek, the lower part of Panther Creek, and in the northwestern part of the Site.

## **Subsurface Hydrology**

It is estimated that Woodlands New Community will need a water supply of 15 million gallons a day (mgd). As there is no available surface water which can provide this amount on a sustained basis, groundwater resources will have to be tapped.

Aquifers underlying the Site are the sands of the Chicot Formation, the Evangeline Formation (known as the "heavily pumped layer" in the Houston District), the Burkeville Aquiclude Formation, the upper and lower part of the Jasper, and the Catahoula Sandstone Formation. The upper aquifers are of limited utility for water supply development on the Site, but are tapped for this purpose in Houston. The lower artesian aquifers at depths of 400-1800 feet are most suited and are expected to yield 20 mgd. These are recharged by precipitation entering outcrop areas northwest and north of the Woodlands Site.

Creation of additional water surface on the Site will make added demands on the groundwater supply. The available flow in streams is not adequate to sustain a lake against losses due to evaporation and minimum outflow necessary to avoid stagnancy. A sample water budget for a lake of 250 surface acres and an

average depth of 5 feet produces a storage capacity of 300 million gallons and requires 4.5 mgd to sustain it. Of this 1.5 mgd are to compensate for evaporative loss and 3 mgd (4 cubic feet per second) as outflow to prevent stagnancy. Three wells, each of 1.5 mgd capacity will be required.

Of the 15 mgd required for the projected development, only 5 mgd need be lost in various consumptive uses. Remaining 10 mgd can be returned to the water regimen in the form of sewage. This is a valuable resource available to replace the withdrawals being made from the subsurface reservoir. The artificial recharge can be accomplished in a variety of ways. The sewage after secondary treatment can be recharged by spray irrigation over areas of high permeability; or after tertiary treatment it can be recharged through dry wells. Tertiary treated effluent can also be utilized to maintain the proposed lake or stabilize flow of streams by direct gradual discharge or through holding ponds.

### Surface Hydrology

The Site lies within Spring Creek watershed, which drains into Lake Houston. Except for the southwestern edge, which drains directly to Spring Creek, the Site lies within the Panther Creek Basin, a tributary of Spring Creek. Only a small part of the Panther Creek Basin lies outside the northwestern limits of the Site.

Spring Creek and the lower part of Panther Creek are the only perennial streams within the Site. Except for Spring Creek and the lower part of Panther Creek, other streams on the Site are intermittent and flow only during storm conditions. A number of low level depressions exist on the Site. Some of these have a small amount of water present perennially, but most of these are filled only during wet weather. The fluctuations in storm flow are extreme. The normal flow in Panther Creek at its confluence with Spring Creek is 33 cubic feet per second (cfs). The estimated flood discharge five miles above the confluence is 5,000 cfs for 5-10 year flood and 10,000 cfs for 100 year flood (Olympic Engineers). These estimated fluctuations on Panther Creek are based on the current fully forested condition.

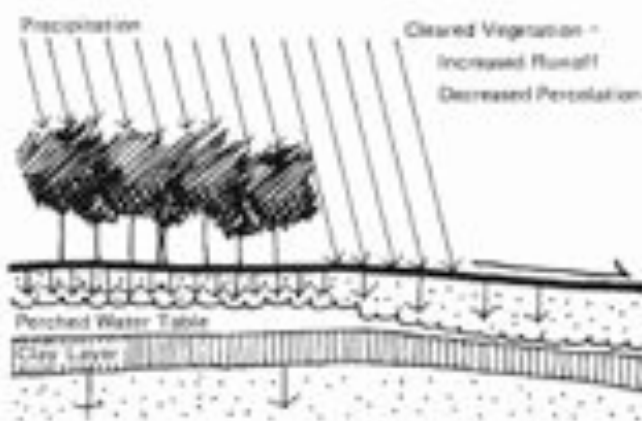
Removal of forest cover and the addition of impervious surface will increase frequency of flooding and change stream characteristics. However, the use



Spring Creek



Swale



Impact of Vegetation Clearance

of a natural drainage system would increase water table recharge and increase lag times for runoff entering the stream. Protection of floodplains and drainage swales is imperative for flood control, for regulating stream flow, and for maintaining water quality.

### Limnology

Since water quality records for Spring and Panther Creeks are incomplete, a program for limnological investigations was outlined by WMRT in the Ecological Planning Study for the New Community, (July 1971). Maintaining base flow in streams, maintaining a vegetated buffer around streams and water bodies to control erosion, and taking measures to avoid eutrophication of the proposed lake are essential to preserve water quality.

### Soils

The soils on the Site are red-yellow podzolic, and are characteristic of soils developed under a mild climate, abundant rainfall, and a mixed conifer deciduous forest cover. They are highly leached, acid, and fine in texture with a zoned clay accumulation.

The podzolization process has led to the formation of soils which have a leached sandy surface layer capable of high rates of infiltration. At varying depths below this leached horizon silicate clay materials have accumulated. This has led to the formation of a less permeable layer which is the result of both the physical aggregation of the finer textured particles and the chemical changes that are induced by various mineral constituents. These layers will vary in thickness and may or may not be continuous, but because of their presence, the permeability of the soil is decreased and the perched water table that results poses a definite constraint to development.

The soils are generally stable, but slightly to moderately erodible, because of the sandy A horizon. Removal of vegetative cover results in rapid erosion producing siltation in streams. Difficulty in maintaining road edges and lawns may be encountered and will be pronounced over even moderately sloping areas.

A detailed soil survey has been completed for the Woodlands New Community by the Soil Conserva-



Standing Water on Impermeable Soil

bion Service, Department of Agriculture. This field survey included soil profiles, descriptions of soil properties, and a map of soil types. In the Phase I study soil types were grouped according to drainage and permeability characteristics, topographic position, and susceptibility to ponding or flooding.

An analysis of soil characteristics led to the calculation of recharge capacity in highly to moderately permeable soils. Soils with excess storage capacity were critical in planning a natural drainage system, where runoff from the high frequency storm (1 inch in 6 hours) will be impounded locally and recharged to the perched water table.

### Vegetation

Most of the Woodlands New Community Site is wooded. It is located within the Pineywoods vegetation zone of the Coastal Plain and the forest is a moist, mixed woodland, dominated by loblolly pine. These pines are associated in mature stands with taller growing species of hardwoods, chiefly oaks, sweetgum, hickories, tupelo gum, occasional elms, magnolia, and sycamore. Shortleaf pine rather than loblolly pine may dominate and name the forest type on the drier, more elevated soils. In such instances, there is a corresponding shift of associated tree species.

Because of the evergreen pines, numerous species of semi-evergreen subordinates (lesser tree understory) and a number of evergreen shrubs and vines, this forest type has long been referred to as the Southeastern Evergreen Forest.

This particular forest area is complex and presents a number of different forest types, some only weakly differentiated from those contiguous. In many areas the original structure has been altered by repeated harvesting of mature pines and hardwoods, development of pipelines, drilling, and storage facilities.

The extensive woodlands make the Site an attractive location for development, but this valuable resource will vanish unless the proposed development is carefully regulated. The forest also moderates the quantity and quality of surface and ground waters, retards erosion, and provides rich habitats for a variety of wildlife.

Areas of vegetation noted for species diversity, high



Waller Pond



Bedias Lake

quality, stability, and uniqueness have been identified for preservation. The most sensitive vegetation types on the Site are floodplain and wet weather pond associations. These are well adapted to local environmental stresses, and provide valuable habitat to wildlife. The cost of replacing these functions would be high.

### **Wildlife**

The Woodlands Site supports a variety of wildlife, including endangered and sensitive species. Provisions should be made for this wildlife to remain on the Site during and after development.

Diversity of habitat is of prime importance to wildlife. Vegetation types which provide this diversity have been identified and should be protected for wildlife use.

The provision of a continuous system for wildlife movement is also essential. Such a system of corridors is best located along streams and should be insulated from adjacent development by an undisturbed buffer. It is especially important that more extensive areas of favorable habitats be protected in addition to the narrow corridors required for movement. There should be a link between major wildlife corridors and Jones State Forest.

### **Climate**

Houston's climate is subtropical with mild winters and warm, humid summers. During the summer average daily maximum temperature is 93.5°F with high probability of over 100°F being recorded during the months of June through August. Concurrently, relative humidity levels range from 75% to 90%. Winters are generally mild with average maximum temperature of 63.2°. Freezing temperatures (32°F or lower) occur on an average of 7 to 15 days every year, but these freezing spells generally last only a few hours.

The Site lies within the humid subtropical belt which extends northward from the Gulf of Mexico. Rainfall is abundant and fairly evenly distributed throughout the year. On an average total monthly rainfall exceeds four inches. Storm intensities of 4.3" rainfall in an hour can be expected to occur. Snowfall is rare and none has been recorded for several winters.

Because of nearness to the Gulf, the prevailing winds are from the southeast and south. In January, frequent passages of high pressure areas bring invasions of polar air. Prevailing winds during this period are from the north. The average wind speed ranges from 8 to 15 mph through the year, with daily fast wind intensities of 30-40 mph. During the fall storm season daily wind intensities of 55 mph are not uncommon.

The region within which the Site is located favors the development of both ground and advective fogs. On an average 16 days of heavy fog and 62 days of light fog can be expected every year. The short spells of freezing temperature occur between December 11th and February 15th, producing an average growing season of 270 days.

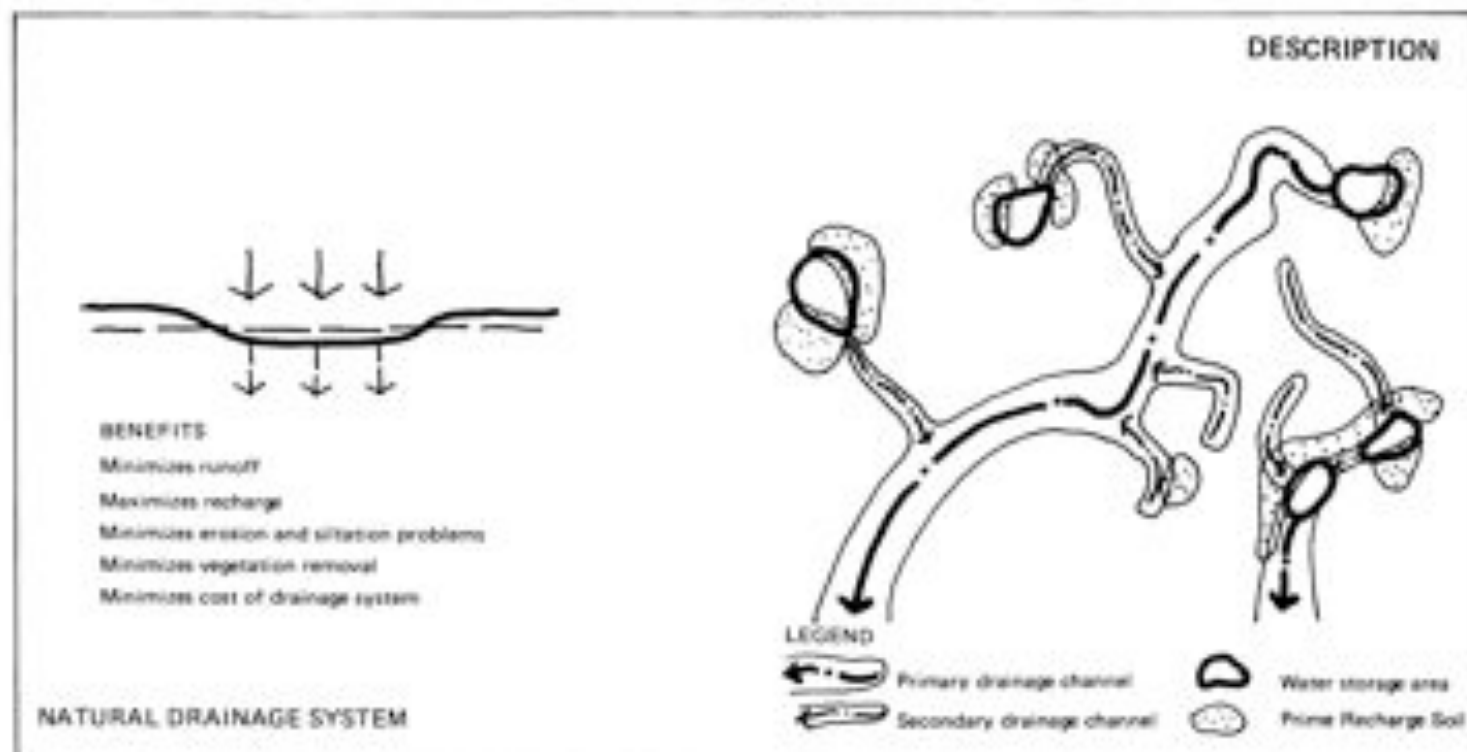
Uniform climatic conditions prevail over the Site. There are no discernible sub-zones which have locational advantages from the point of view of climate. The pervasive factors which have to be taken into account in site development are intense storms and the incidence of hot-humid conditions during the summer.

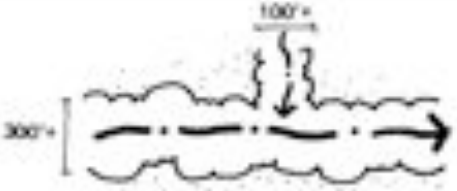




The area is subject to intensive storm activity during the fall season. Extensive flooding results, which is often aggravated by obstruction of natural drainage channels. There is a great disparity between normal runoff and storm flood, and storms are generally accompanied by high winds. Thinning of the forest will increase the wind throw hazard, to which shallow rooted trees are especially vulnerable. Wherever possible forests should be left in solid stands or thinned selectively after detailed examination of the existing trees.

Refrigerated air conditioning is resorted to in order to alleviate the discomfort caused by hot humid summer days. This high cost can be reduced if care is taken in locating development and controlling its form. Clearings in the forest will increase both the wind speed and the incidence of solar radiation. A number of alternative choices for forest clearings of variable shape, size and orientation have been tested. The results show that the expected increase in wind intensity of 20% produced by forest clearings does not significantly increase the probability of comfort for man, because any improvement in wind intensity is negated by higher amounts of solar insolation resulting from removal of forest cover. Selected clearing and retention of some shade is indicated to be most desirable.



# SUMMARY: HYDROLOGY



OBJECTIVES	ADAPTATIONS
Reduce flooding.	<p>Ensure ability of existing primary and secondary drainage channels to handle storm run-off by defining drainage easements.</p> <p>These drainage easements will be determined by the 25 year floodplain, however, a minimum vegetation easement of undisturbed forest and understory must be respected: 300' for primary drainage channels and 100' for secondary drainage channels.</p> 
Minimize erosion and siltation.	<p>Prohibit clearing of ground cover, shrub understory, or trees within drainage easements.</p> <p>Enhance existing channels where necessary with berms and "create" natural swales by introducing layered plantings of native vegetation.</p>  
Contribute no increase in off-site discharge during the Design Storm.	<p>Provide adequate storage of runoff generated by Design Storm in impoundments or temporary water storage ponds.</p> 
Retard runoff and maximize recharge to even base flow of streams.	<p>Use check dams in swales and on lots to slow flow over permeable soils to enhance recharge.</p> <p>Install trickle tubes in impounded areas to permit even flow.</p> 

# SUMMARY: LIMNOLOGY

## OBJECTIVES

Establish permanent water bodies which will be neither eutrophic nor hazardous to health.

Provide a good habitat for fish.

Maintain water quality and dense herbaceous vegetation in Waller Ponds.

Minimize erosion and siltation.

Establish perennial flow in Panther Creek.

## ADAPTATIONS

Keep temperature of water as cool as possible:

- Maximize depth
- Minimize shallow areas
- Shade shallow margins with trees
- Plants such as water lily will moderate water temperature if properly controlled.

Minimize retention time.

Clear leaf litter before the area is flooded.

Do not permit drainage from adjacent developed areas to run off into lake.

Where eutrophic conditions develop, nuisance plants should be harvested. Herbicides must not be used.

Waste water treated to an advanced level should be used to provide water for a lake.

Provide shaded shallows with dense grass cover for fish spawning.

Basin habitat is improved by leaving fallen trees and stumps.

The minimum depth for bass is 8-10 feet.

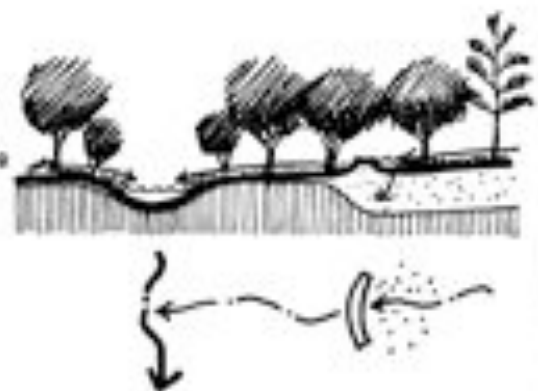
Do not use Waller Ponds as sites for permanent water bodies.

If impounded, install trickle tubes at the normal water level to ensure continuous drainage after storms.

Maintain the integrity of small swales which feed and drain the ponds.

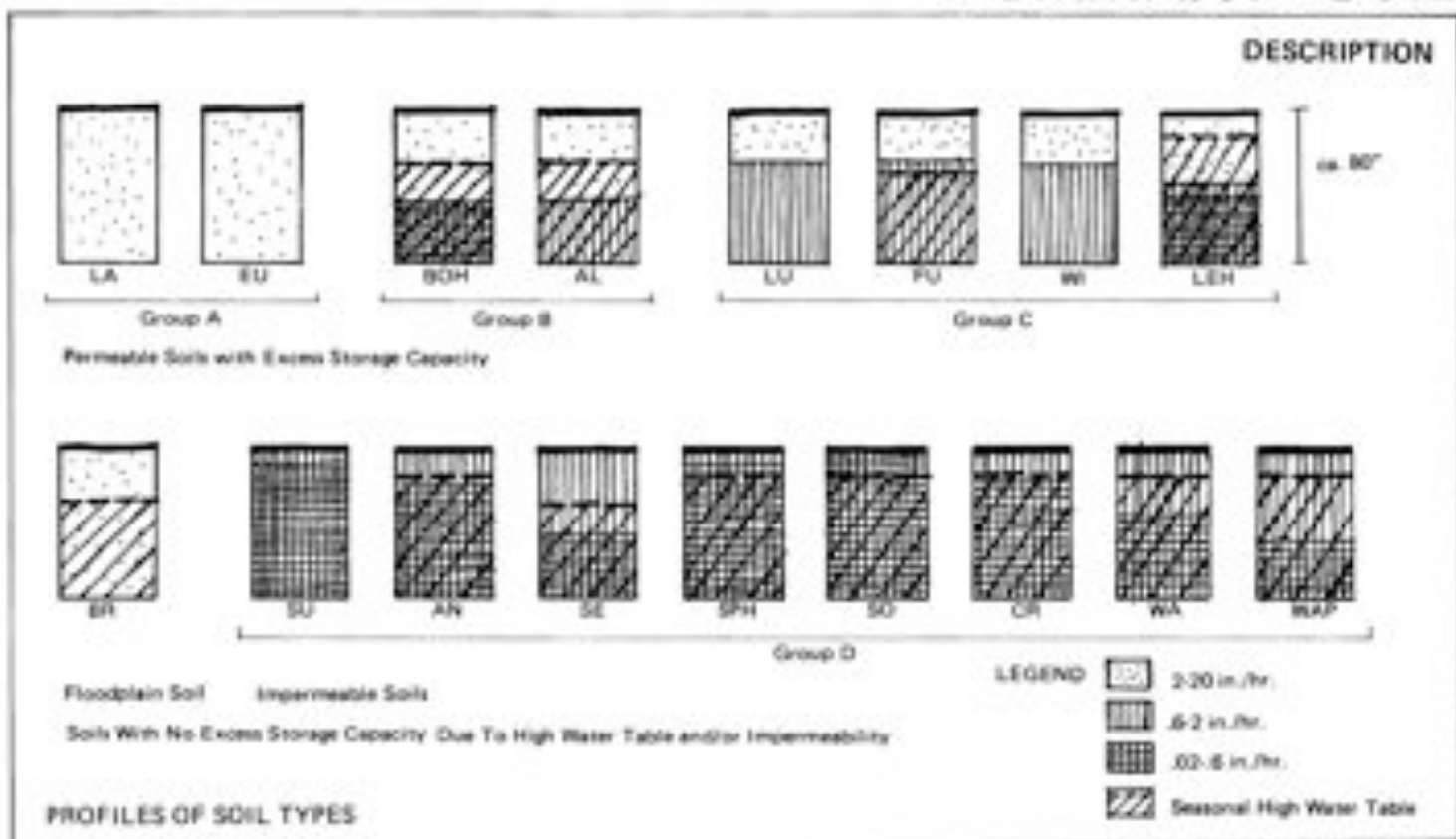
No clearing within the 50 year floodplain of Spring and Panther Creeks and the 25 year floodplain of Bear Creek.

Retard runoff and increase recharge by the use of unclarified natural swales and by directing runoff over permeable soils and into water storage areas to even base flow.





# SUMMARY: SOIL



OBJECTIVES	ADAPTATIONS
Use recharge capacities of suitable soils to enhance a natural drainage system and even out base flow of streams.	Direct runoff over permeable soils with excess storage capacity.
Minimize coverage of permeable soils.	Use roads, berms, and checkdams in swales to impound runoff by blocking flow over permeable soils.
Houses and outdoor activity areas should be located to be as dry as possible.	Locate structures on impermeable soils. Locate backyards and intensively used recreation areas on permeable soils.
	Buildings and patios should be constructed on raised foundations or fill.
	Pedestrian paths should be raised or on fill if located on impermeable soils.

# SUMMARY: VEGETATION

## DESCRIPTION



Pine Predominant



Hardwood Predominant



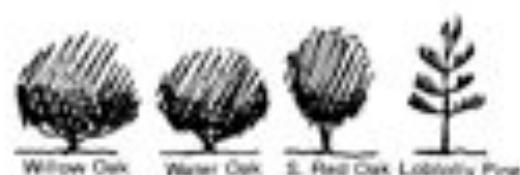
Floodplain



Water Pond



Loblolly Pine S. Red Oak Post Oak



Willow Oak Water Oak S. Red Oak Loblolly Pine



Willow Oak Water Oak S. Red Oak River Birch Loblolly Pine Sweetgum S. Magnolia Red Maple



Herbaceous Species Sweetgum Persimmon

## VEGETATION TYPES

## PREDOMINANT SPECIES

## OBJECTIVES

Retain as much existing vegetation as possible.

## ADAPTATIONS

Minimize clearing and compacted area around buildings.

Minimize front and side yards to increase un-cleared, uncompacted area in lot.

Use multi-story buildings.

Areas of preserved woods should be circular in form rather than linear.

Areas of preserved woods should be as large as possible.

Uneven edges are recommended.



Not This

This


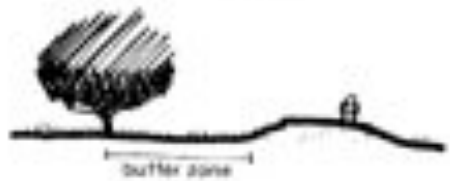







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# SUMMARY: VEGETATION

OBJECTIVES	ADAPTATIONS
<p>Retain as much existing vegetation as possible.</p>	<p>Preserve an edge of smaller trees and shrubs around woods.</p> <p>Maintain layers of vegetation within the woods.</p>  <p>No grade change or impervious paving within a buffer zone one canopy width from the trunks of trees to be saved.</p> 
<p>Maximize the immediate experience of the woodlands through use of vegetation in site planning and design.</p>	<p>Use vegetation to buffer narrow front yards.</p> <p>Limit the artificial environment along roads.</p> <p>Use scalloped or uneven edge in planting on road shoulders.</p> <p>Plant shrubs and trees as close to the road edge as possible while still remaining good visibility.</p>  <p>Break up parking with substantial areas of vegetation.</p> 
<p>Successful replanting after development.</p>	<p>Native vegetation should be used extensively.</p> <p>Transplant specimens from the Woodlands Site. Prune the roots and canopy before transplanting during the dormant period. This method will be most successful with young trees and shrubs.</p>  <p>Bare root stock shrubs like yucca which do not transplant well.</p>  <p>Transplant tiny seedlings.</p> 

# SUMMARY: WILDLIFE

## DESCRIPTION



Upland Woods

Bottomland Woods

Field

Pond

## HABITAT TRANSECT



**Cover:**  
Dense evergreen under-  
story like yucca is  
best for cover.



**Food:**  
Oak species, shrubs, and  
herbaceous species are  
especially valuable for  
wildlife food.



**Water:**  
Streams and Water  
Ponds are sources of  
water for wildlife.

## WILDLIFE NEEDS

## OBJECTIVES

Provide for wildlife needs so that the maximum number of species which are present now can remain after development.

Provide cover, food, and water in areas which are accessible to wildlife.

## ADAPTATIONS

Allow a dense vegetation to grow up along edges of wooded areas by leaving an unmowed strip. This dense edge provides both food and cover for many wildlife species.



lawn unmowed strip woods

Provide a layered effect — large trees, small trees, and shrubs — whenever possible in planting design. This will provide birds and other wildlife with both food and cover.



# SUMMARY: WILDLIFE

## OBJECTIVES

Provide for wildlife movement.

Butler wildlife from disturbance by humans.

## ADAPTATIONS

Form continuous wildlife corridors which include food, cover, and water. Some of these corridors should be located in the floodplain, which not only provides water and cover, but also has the most diverse vegetation with many valuable species for wildlife food.

Major corridors should be 500-600' wide.

Minor corridors should be 100' wide.

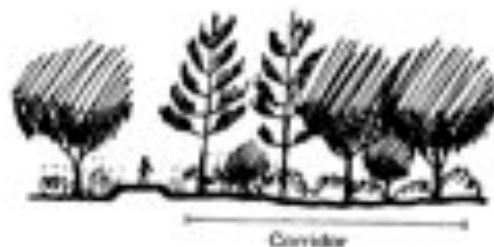
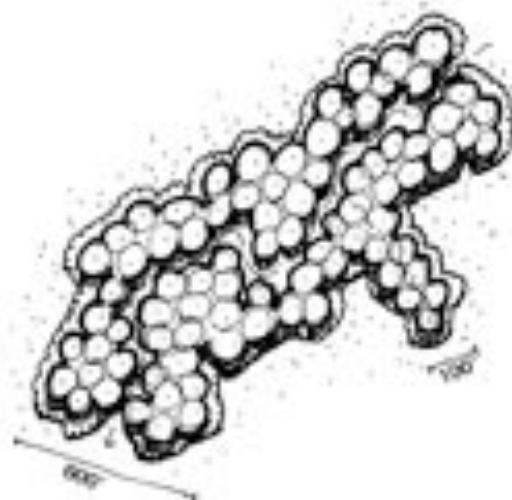
Major wildlife corridors along the floodplain should connect the new town to Jones State Forest.

Provide large areas offering diverse vegetation cover, and water which are suitable as wildlife refuges. Natural areas not suited for active recreation should be selected as refuges.

Major wildlife corridors should connect these natural areas.

Minimize crossings of the wildlife corridors by pedestrian and vehicular movement.

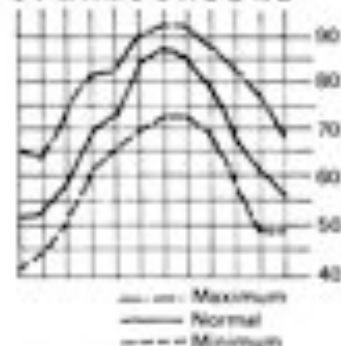
Keep human activity to the periphery of wildlife corridors to minimize disturbance.



# SUMMARY: CLIMATE

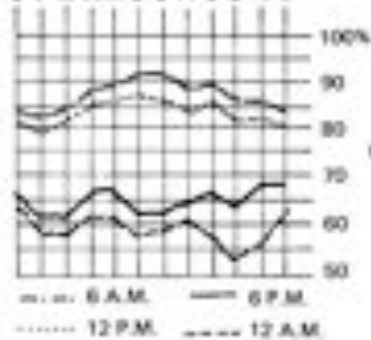
## DESCRIPTION

J F M A M J J A S O N D

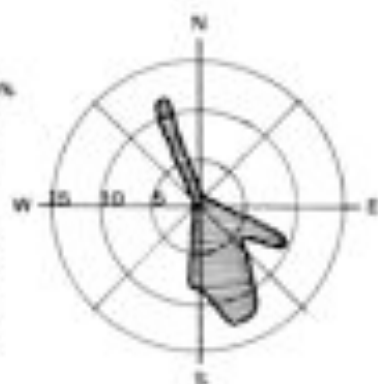


TEMPERATURE

J F M A M J J A S O N D



HUMIDITY



J	12.0 mph
F	12.2 mph
M	12.8 mph
A	13.1 mph
M	11.1 mph
J	10.2 mph
J	8.9 mph
A	8.4 mph
S	9.2 mph
O	9.9 mph
N	11.3 mph
D	11.3 mph

WIND



Summer (June 22) Sunrise  
25° North of East



Winter (December 22) Sunrise  
16° South of East

SOLAR ORIENTATION



Winter (December 22)  
12 Noon Elevation 36°



Summer (June 22)  
12 Noon Elevation 85°

SUN ANGLES

## OBJECTIVES

Reduce heat absorption in summer.

## ADAPTATIONS

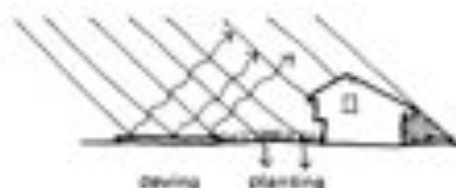
Orientation along east-west axis minimizes overheating.

Hip roof reduces heat load and provides insulating space.

A roof moderately pitched toward the north intercepts less radiation than a flat roof or dome.

A double roof reduces reradiation to the interior.

The ground cover adjacent to the structure should have a low albedo and relatively high conductivity to prevent reradiation and reflective heating.



# SUMMARY: CLIMATE

## OBJECTIVES

Maximize shade in summer.  
Maximize sun in winter.

## ADAPTATIONS

Locate structure in deciduous woods or plant deciduous trees for summer shade and winter sun.



In summer the structure should be shaded in the late morning and afternoon.



Frequently used outdoor spaces should be shaded from late morning and afternoon sun in summer.



Pedestrian circulation routes should be shaded by vegetation, canopies, pergolas, or arcades.  
Deciduous trees should be located on the south side of pedestrian paths to allow winter sun.



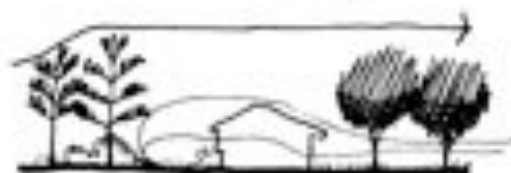
Increase comfort and reduce humidity by maximizing summer ventilation.

Protect from storm winds.

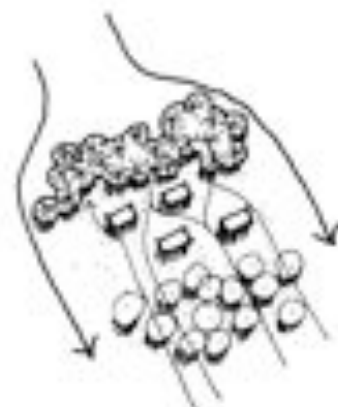
Orient structures and outdoor spaces to capture summer breezes and protect them from storm winds.



Deciduous trees with open understorey permit the passage of cooling breezes.  
Evergreen trees with dense understorey offer protection from storm winds.

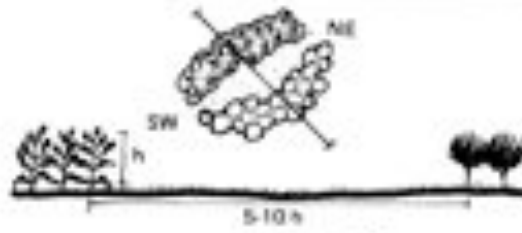





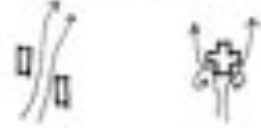



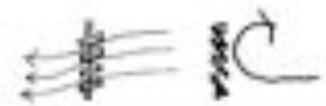


A preferred location for development is N-NW of a predominantly hardwood forest with open understorey and S-SE of a dense predominantly pine forest.





# SUMMARY: CLIMATE

OBJECTIVES	ADAPTATIONS
<p>Increase comfort and reduce humidity by maximizing summer ventilation.</p> <p>Protect from storm winds.</p>	<p>Cleavings oriented NE to SW should have a cross section 5-10 times the canopy height.</p> 
	<p>Orient cleared or planted corridors of vegetation to increase wind velocity.</p> 
	<p>Roadways can act as wind corridors, and if heavily shaded can be used to cool residential areas.</p> 
	<p>Hedges should be placed at a distance from buildings so as not to block air movement or used as a wind funnel.</p> 
	<p>Capture of breezes over shaded lawns should be maximized.</p> <p>Parking areas should be located downwind from houses or recreation areas.</p> 
	<p>Siting of housing clusters should respond to desired air movement patterns.</p> 
	<p>Rectangular and circular buildings are preferred over irregular forms with greater wind exposure.</p> 
	<p>Slightly elevated structures are preferred to avoid dampness.</p> 
	<p>Internal organization of structure should allow free cross ventilation.</p> 
	<p>Overhangs can be used to channel breezes into structure.</p> 
	<p>Adjustable louvers and screens will block solar radiation and storm winds and allow passage of cooling breezes.</p> 



# SUMMARY: CLIMATE

## OBJECTIVES

Increase comfort and reduce humidity by maximizing summer ventilation.

Protect from storm winds.

The internal organization of uses should respond to the time sequence of activities in relation to solar radiation and to factors of wind direction and humidity.

## ADAPTATIONS

The optimum position for ventilation openings is the lower half of the wall on the windward side. The leeward vent location can be variable.



If recreation areas or paths are located adjacent to trees with an open understory and next to a heat generating land use, air movement will be increased as cool air replaces the rising warm air.



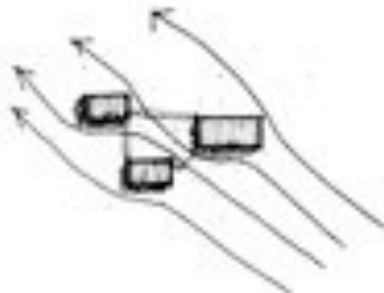
To protect paths from storm winds, they should be located on the leeward side of the forest edge within a quiet zone equal to five times the height of the canopy.



The recreation system should include "breeze towers" that enable the user to appreciate the site while enjoying the more intense air movement at upper elevations.



When larger buildings or groups of buildings are required—as in community facilities and recreation areas—they should be open and loosely connected with free passage for breezes and shaded pedestrian walks.



Non-living areas of the house (garage, storage area, laundry) can be used to buffer living areas from MNW storm winds or undesired solar radiation from E and SW.

Heat and moisture producing areas of the house should be ventilated and separated from the rest of the structure.

	N	SE	W
Living	●	●	●
Dining	●	●	●
Kitchen	●	●	●
Bed	●	●	●
Storage	●	●	●
Laundry	●	●	●
Garage	●	●	●
Outdoor Space	●	●	●

# GUIDELINES FOR SOIL AND DRAINAGE CONDITIONS

## Introduction

A major objective in the development of the Woodlands is to incorporate a natural drainage system that has been designed to minimize some of the usual, adverse environmental impacts of conventional drainage methods. It is anticipated that the natural drainage system if used throughout the Woodlands will:

- provide a system of undisturbed, forested floodplains and swales which can be utilized as the primary and secondary open-space system;
- maintain the integrity of permanent and ephemeral drainage courses by avoiding channelization; and
- maintain or increase natural water table elevations, by preventing the serious loss of forest vegetation that would result from lowered water tables produced by a graded drainage system.

The natural drainage system will accommodate runoff from the 25 year storm in a system of undeveloped natural drainage swales and floodplain areas and in a series of storm-water retention areas — either artificial ponds or temporarily impounded Waller Ponds. Runoff generated by the high frequency storm (1 inch in 6 hours) will be recharged entirely on the individual development parcels.

The soils and drainage key applies these general objectives to the handling of surface runoff in specific site conditions. Surface runoff can be handled in several ways:

- by holding runoff on designated recharge soils;
- by holding runoff in designated storm water retention areas; or
- by directing runoff to primary and secondary swales, where the existing natural vegetation will retard the rate of runoff and allow for recharge over permeable soils.

## Definitions

The structure of the soils and drainage key incorporates eight distinct, idealized conditions, each with characteristics that present opportunities and constraints for development. These conditions are defined by soil types, slopes, and physiographic relationships, as well as special conditions represented by areas adjacent to Waller Ponds and in major floodplains.

These conditions are found in complex combinations on the Site; in fact, a given development parcel may be composed of many conditions. In order to understand and adapt to these complex situations, it is necessary to recognize the basic patterns and the elements which form them. The following definitions are intended to aid this process:

**Primary and Secondary Drainage System:**

Both primary drainage channels and Waller Ponds are mapped as the Primary Drainage System on the Design Synthesis Map.

**Water Storage Areas** are both impounded retention areas which have been designated as suitable for holding runoff during and immediately after storms and those Waller Ponds which will be used as temporary impoundments.

**Primary Drainage Channels** are major existing drainage channels. They should be left in their natural condition with a minimum vegetated easement of 300 feet as a buffer to slow storm flow, to promote recharge of runoff, and to maintain water quality by preventing erosion. The easements must be more than 300 feet if the natural floodplain for the 25 year storm exceeds this dimension.

**Secondary Drainage Channels** are existing swales which drain to water storage areas or primary drainage channels. They should be left in their natural condition with a minimum vegetated easement of 100 feet as a buffer to slow storm flow, to promote recharge of runoff and to maintain water quality by preventing erosion. Easements must be more than 100 feet if the natural floodplain for the 25 year storm exceeds this dimension.

**Soil Groups:**

Soils are grouped according to the amount of additional storage capacity which is available for the recharge of runoff after accommodating the high frequency storm (1 inch of precipitation in 6 hours).

The calculation of this capacity is based on the depth of the upper pervious layer, its percolation rate and the height of the seasonal high water table. The four groups range from A, greatest capacity, to D, least capacity. That area which can be rendered impervious without affecting the ability of the remaining soil to absorb runoff from the high frequency storm was derived from the excess storage capacity for each soil type. This area is expressed



Water Storage Area - Waller Pond



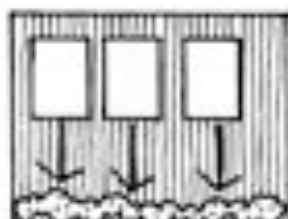
Primary Drainage Channel



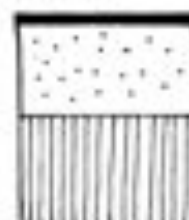
Secondary Drainage Channel



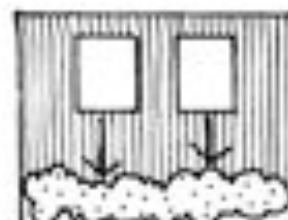
Diagrammatic Profile  
A Soils



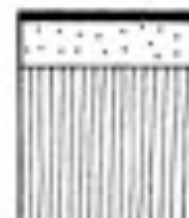
Cleared to 90%



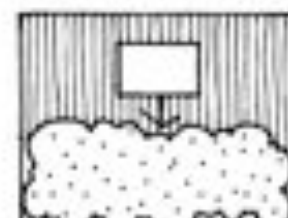
Diagrammatic Profile  
B Soils



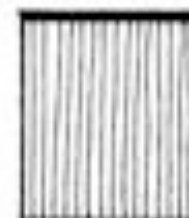
Cleared to 75%



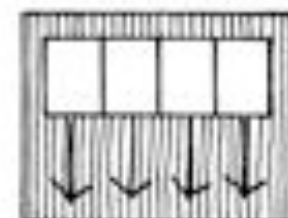
Diagrammatic Profile  
C Soils



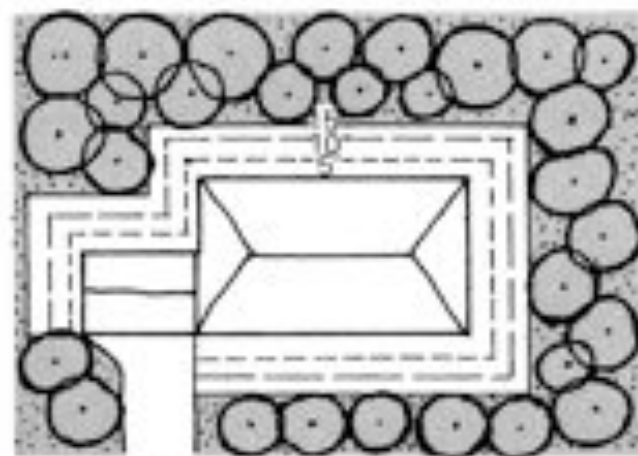
Cleared to 50%



Diagrammatic Profile  
D Soils



Cleared to 100%



Building Zones

as a percentage of a total area which can be cleared and rendered impervious.

**A (LA, EU, BL) and B (BOH, AL, WI) Soils** have the most excess storage capacity and are designated on the Design Synthesis Map as recharge soils. These soil types have deep sand layers and low to moderately low water table conditions and can therefore be used to recharge runoff from impermeable soils and impervious surfaces. Depending on their location and physiographic relationships to other soil types, they may be left uncleared to recharge runoff from surrounding developed areas on other, less permeable soils or cleared up to 75-90%.

**C Soils (Lu, FU, LEH, CO, COG)** comprise an intermediate group of permeable soils with moderate recharge capacity. They have some excess storage capacity, but not as much as A or B soils. A relatively high water table and/or shallow sand layer limits the amount of runoff that can be recharged on these soils. Depending on the physiographic relationship to other soil types, they may be cleared and developed in any density or left uncleared to recharge runoff from impermeable soils or impervious surfaces. More uncleared area of C soil is required to absorb a given amount of runoff than would be required of A or B soils. A or B soils are therefore preferred as recharge soils, but C soils should be used if neither A or B soils are available.

**D Soils (SU, AN, SE, SEG, SPH, SO, SS, TK, BI, TU, CR, WA)** have very little storage capacity. Rain which falls on these soils soaks in at a rate of only .02-2 inches per hour in upper layers of the soil. Furthermore, the perched water table is frequently very high.

Each condition is considered separately in the pages following the soil and drainage key, and specific strategies for adapting to individual conditions are outlined in these pages. The suggestions are not meant to be exhaustive, only illustrative of the range of appropriate solutions. Guidelines for each condition are grouped under three headings:

**Management Guidelines** gives the minimum uncleared area necessary to accomplish recharge of runoff of the design storm from the impervious area. This minimum, expressed as a percentage of an entire area, is based on the assumption that during the construction period cleared land within the building zone will become compacted and the soils rendered

at least partially impermeable. Special development restrictions and guidelines for specific conditions are also considered here.

**Housing Suitability** gives a range of suitable house types and densities. Housing types, densities, lot sizes, floor area, and parking requirements were taken from "Criteria for Residential Dwelling Units, July 21, 1973" in *Residential Development Standards* prepared by Woodlands Development Corporation. Setback of the house and garage from the road was assumed to be 20 feet in all cases except estates (50 feet) and single family detached (30 feet).

The percentage of the lot that would be cleared and covered by impervious surface (buildings, parking, driveways) was calculated for zones of 5 feet, 10 feet, and 15 feet around the buildings. 5 foot building zones are most appropriate if site conditions and vegetation are tolerant of development, and 15 foot building zones where conditions and vegetation are intolerant. The recommended size

of the building zone may be adjusted based on results of completed development. The percentages for clearance and coverage obtained from these calculations are summarized in the following pages. These figures are merely indicators, ideally percentages should be calculated for specific conditions.










The clearance percentages can be reduced by design measures such as clustering or reducing the length of driveways. The prototypes are not necessarily recommended, but were used to give an indication of suitable housing types and densities for a given soil and drainage condition. Other house types and densities than those recommended for a particular condition may be used if clearance requirements outlined in Management Guidelines are met.

**Siting Considerations** covers general guidelines for siting structures, roads, and paths in order to meet the requirements of the natural drainage system related to each condition.

**Table 1:**  
**Required Percentage Clearance of Lot for Various Dwelling Unit Types and Density Standards**

Dwelling Unit Type	Gross Density DU/Acre	Average Floor Area (Sq. Ft.)	Average Lot Area (Sq. Ft.)	Average Lot Dimensions	Parking Spaces/DU	Parking/DU Relationship	No. of Stories	Required % of Clearance				
								5 Ft.	10 Ft.	15 Ft.		
<b>Regular Single Fam. D.</b>												
Estate	1	3,000	43,560	150 x 290'	3	Attached	1	13.8	17.4	21.5		
		3,000						9.6	12.6	16.1		
		3,000						14.7	19.4	25.2		
		3,000						10.7	14.8	19.5		
High	2.5	2,600	10,300	85 x 120'	3	Attached	1	50.0	64.7	81.3		
								Attached	2	35.2	47.5	62.7
								Detached	1	51.1	66.1	81.9
								Detached	2	35.3	53.4	68.6
Medium	3.0	2,000	8,260	75 x 110'	2	Attached	1	32.1	44.8	60.0		
								Attached	2	46.6	61.8	79.8
Low	4.0	1,350	6,500	65 x 100	2	Attached	1	47.4	64.6	89.9		
<b>Part Attached</b>												
Medium	5.5	1,600	5,000	50 x 100'	2	Attached	1	49.0	62.4	76.7		
Low	6.0	1,150	4,050	45 x 90'	2	Attached	1	61.1	76.5	94.4		
<b>Townhouses</b>												
High	6.0	1,900	3,200	32 x 100'	2	Attached	2	69.0	75.0	81.9		
Medium	7.0	1,550	2,800	28 x 100'	2	Attached	2	66.5	75.1	81.5		
								Detached	2	62.1	78.0	83.0
Low	8.0	1,150	2,500	25 x 100'	2	Detached	1	83.0	96.0	97.0		
								Detached	2	60.0	73.0	78.0
<b>Garden Apartments: Attached</b>												
Medium	15.0	1,000	43,560	150 x 290'	1.6	Detached	2	44.7	59.1	75.4		
								Detached	3	35.2	48.2	58.5
Low	18.0	875	43,560	150 x 290'	1.6	Detached	2	47.5	60.5	73.0		
								Detached	3	38.9	48.9	60.2

**Table 2:  
Number of Dwelling Units per Cleared Acre Based on Required Clearance in Square Feet for Various  
Dwelling Unit Types and Density Standards**

Dwelling Unit Type	Unit Area One Cleared Acre	Parking Spaces/DU	Parking/DU Relation- ship	No. of Stories	No. of DUs/Cleared Acre			Required Clearance (Sq. Ft.)		
					5 Ft. Clearing	10 Ft. Clearing	15 Ft. Clearing	5 Ft. Clearing	10 Ft. Clearing	15 Ft. Clearing
<b>Regular Single Family Detached</b>										
Estate		3	Attached	1	7.3	5.7	4.6	6000	7600	9400
			Attached	2	10.4	7.9	6.2	4200	5500	7000
			Detached	1	6.8	5.2	4.0	6400	8450	10900
High		3	Detached	2	9.5	6.9	5.1	4600	6350	8500
			Attached	1	8.5	6.6	5.2	5100	6600	8300
			Attached	2	12.1	9.0	6.9	3600	4850	6300
Medium		2	Detached	1	8.3	6.5	5.2	5220	6740	8360
			Detached	2	11.8	8.0	6.2	3700	5450	7000
			Attached	1	16.4	11.8	8.8	2650	3700	4950
Low		2	Attached	2	11.3	8.5	6.6	3850	5100	6550
			Attached	1	14.1	10.4	7.9	3080	4200	5520
			Attached	1	18.2	14.0	11.4	2400	3120	3826
<b>Partial Attached</b>										
Medium		2	Attached	1	17.6	14.1	11.4	2475	3100	3825
Low			Attached	1	18.2	14.0	11.4	2400	3120	3826
			Attached	1	17.6	14.1	11.4	2475	3100	3825
<b>Townhouses</b>										
High		2	Attached	2	20.9	18.2	16.6	2080	2400	2620
Medium			Attached	2	23.4	20.7	19.1	1864	2104	2284
			Detached	2	25.0	19.9	18.7	1729	2184	2324
Low		2	Detached	1	21.0	18.2	16.0	2075	2400	2425
			Detached	2	20.0	23.9	23.3	1500	1825	1950
<b>Garden Apartments*</b>										
<b>Attached</b>										
Medium		1.6	Detached	2	38.2	28.8	22.6	2783	3020	3850
			Detached	3	48.3	36.9	29.1	2700	3540	4480
Low		1.6	Detached	2	43.6	34.2	26.4	2000	2548	3073
			Detached	3	53.4	42.3	34.5	2454	3090	3802

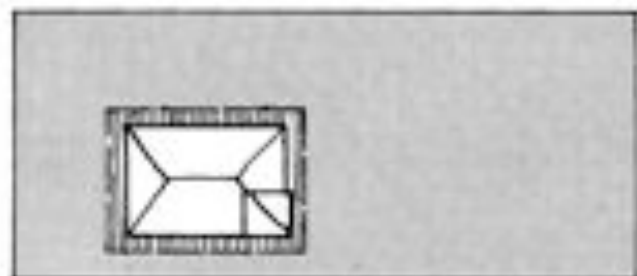
### Program Densities Related to Clearance and Coverage

The percentage of a lot which must be cleared varies with housing type, density, number of stories, and parking situation. Once this percentage is known, the clearance/coverage impact of different housing types for three different building zones can be compared (Table 1).

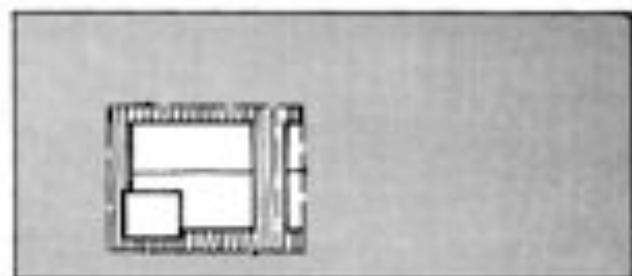
Given one acre of land which may be cleared and rendered impervious, the number of units which

will fit in this area varies with unit type. Table 2 shows the number of units of each housing type and density for 5 feet, 10 feet, and 15 feet building zones, which will fit in one cleared acre. For example, assuming a 10 feet building zone, 5.7 one story single family estates with attached parking can fit in one cleared acre, while 18.2 two story townhouses (High) with attached parking will also fit in that same area without additional impact. Thus Table 2 demonstrates the site planning options for a given area in terms of the residential program.

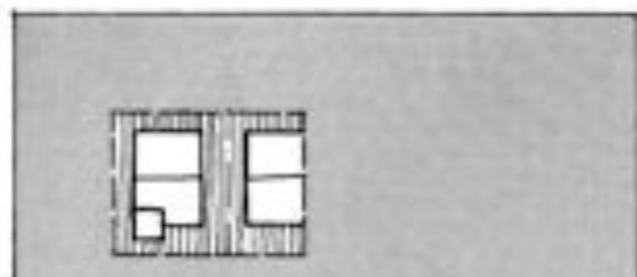




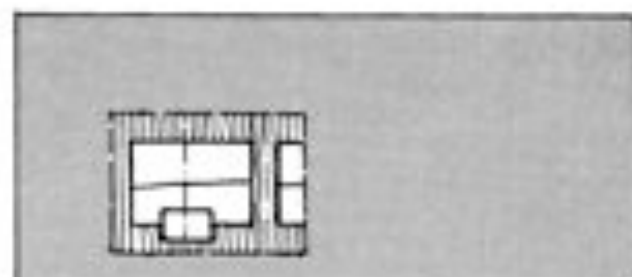
**SFD: Estate 1 DU/Acre**  
 1 story, attached parking (3 cars)  
 Building zone: 10'  
 1 Unit per 7,600 sq.ft. cleared



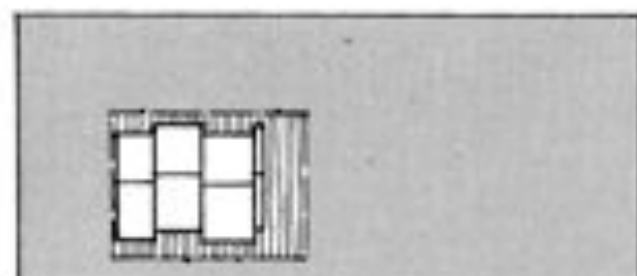
**SFD: High 2.5 DU/Acre**  
 1 story, attached parking (3 cars)  
 Building zone: 10'  
 1.15 Units per 7,600 sq.ft. cleared



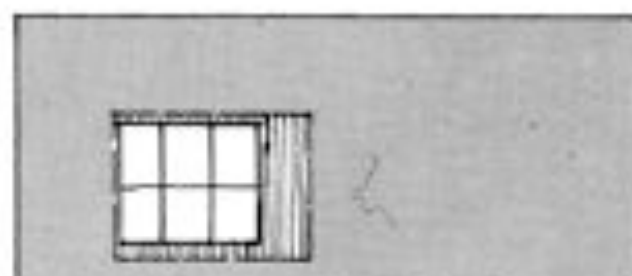
**SFD: Low 4 DU/Acre**  
 1 story, attached parking (2 cars)  
 Building zone: 10'  
 1.8 Units per 7,600 sq.ft. cleared



**Patio: Low 6 DU/Acre**  
 1 story, attached parking (2 cars)  
 Building zone: 10'  
 2.5 Units per 7,600 sq.ft. cleared



**Townhouse: Low 8 DU/Acre**  
 1 story, detached parking (2 cars)  
 Building zone: 10'  
 3.2 Units per 7,600 sq.ft. cleared



**Garden Apartment: Low 18 DU/Acre**  
 2 stories, detached parking (1.6 cars)  
 Building zone: 10'  
 5.8 Units per 7,600 sq.ft. cleared

These figures should be viewed as standards for purposes of comparison. They may vary slightly in a specific site design. Furthermore, the clearance percentages are merely for the lot itself and not for collector or access roads, for which a clearance factor must be added separately based on housing density and distribution.

These diagrams illustrate the applications of figures in Table 2. The clearing required by a one story single family estate with attached parking and 10 feet building zone was used as a unit with which other types could be compared. For this housing type 17.4% of the one acre lot or 7,600 square feet must be cleared. More units of other dwelling types will fit in this same cleared 7,600 square feet. Selected types are compared in the diagrams.

## Key to Guidelines for Soil and Drainage Conditions

This key enables the reader to identify soil and drainage conditions which occur on a given development parcel. Guidelines for each condition are summarized on the pages following the key.

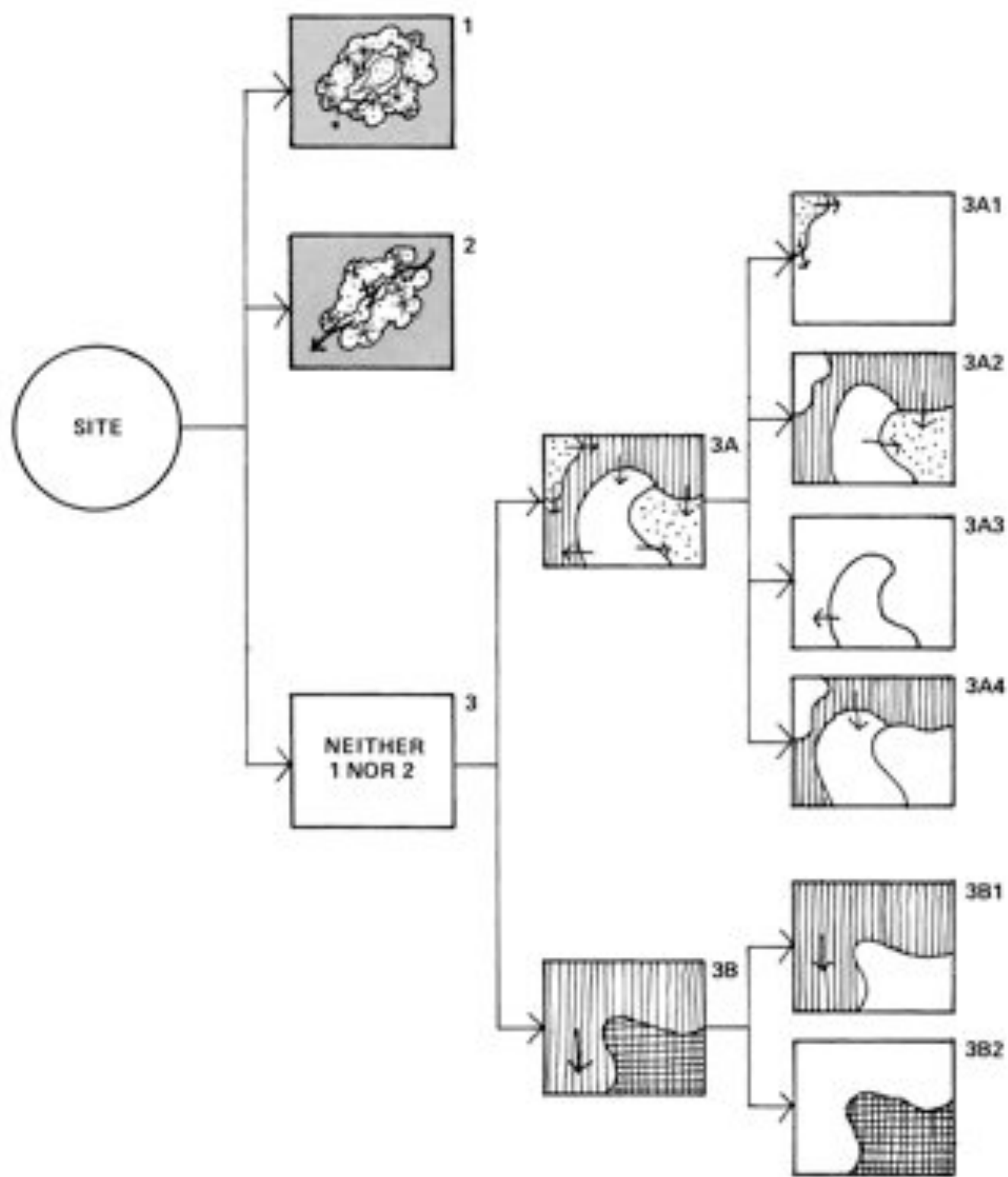
1. Read the Introduction and Definitions at the beginning of this chapter.
2. Locate the development parcel on the Design Synthesis Map.
3. Indicate all soil and drainage elements which occur on the development parcel – watershed boundaries, primary and secondary drainage channels, flow lines, slopes less than 1%, Waller Ponds, 50-100 year floodplain of Panther and Spring Creeks, soil groups.
4. Identify all soil and drainage conditions occurring within the development parcel by working through the key. Work through the key for each condition which occurs.
5. Refer to management guidelines, housing suitability, and siting considerations for each condition in the corresponding pages following the key.
6. Turn to the vegetation section to combine soil coverage limitations with restrictions on the clearing of vegetation.

## Key:

1. Areas adjacent to Waller Ponds
2. 50-100 year floodplain of Panther and Spring Creeks
3. Other than 1 or 2 above
  - 3A. Areas of recharge soils or areas draining to recharge soils
    - 3A1.AB Soils (LA, EU, BL, BOH, AL, WI) which receive no runoff from other soils
    - 3A2.AB Soils (LA, EU, BL, BOH, AL, WI) with C Soils (LU, FU, LEH, CO, COG) and/or D Soils (SU, AN, SE, SEG, SPH, SO, SS, TK, BI, TU, CR, WA) where AB Soils receive runoff from C and/or D Soils
    - 3A3.C Soils (LU, FU, LEH, CO, COG) which receive no runoff from other soils
    - 3A4.C Soils (LU, FU, LEH, CO, COG) with D Soils (SU, AN, SE, SEG, SPH, SO, SS, TK, BI, TU, CR, WA) where C Soils receive runoff from D Soils
  - 3B. Other than 3A above
    - 3B1.D Soils (SU, AN, SE, SEG, SPH, SO, SS, TK, BI, TU, CR, WA) with slope greater than 1% which do not drain to recharge soils
    - 3B2.D Soils (SU, AN, SE, SEG, SPH, SO, SS, TK, BI, TU, CR, WA) with slopes less than 1%



# KEY: SOIL AND DRAINAGE CONDITIONS





## AREAS ADJACENT TO WALLER PONDS

The Waller Ponds, many of which will be impounded for water storage during storms with greater than 1" of precipitation, are crucial to the maintenance of the natural drainage system. The vegetation in and adjacent to these ponds and the minor swales to and from them are critical to their continued functioning. AB and C Soils adjacent to these ponds can accomplish recharge, even if uplope.

### Management Guidelines

Maintain integrity of drainage to and from Waller Ponds.

Maintain sufficient vegetation as a buffer around ponds to maintain good water quality and utility to wildlife. No more than 40% of the pond perimeter may be utilized for development. 50' of forest must be left between any clearing and the pond edge. A minimum of 100-300' must be left undisturbed between clearings. The 60% of the edge left undisturbed must have self-maintaining vegetation or 150' buffer between it and adjacent development. (See Guidelines for Vegetation regarding requirements for self-maintaining stands.)

In this condition, it is recommended that D Soils remain undeveloped.

Before site planning the quality of existing vegetation and the exact location of minor swales should be checked in the field. Development should be excluded from areas important to drainage or of good quality vegetation.

### Housing Suitability

Only very low density is acceptable where runoff drains directly to a Waller Pond. Houses should be constructed on posts to prevent disruption of recharge on AB or C Soils.

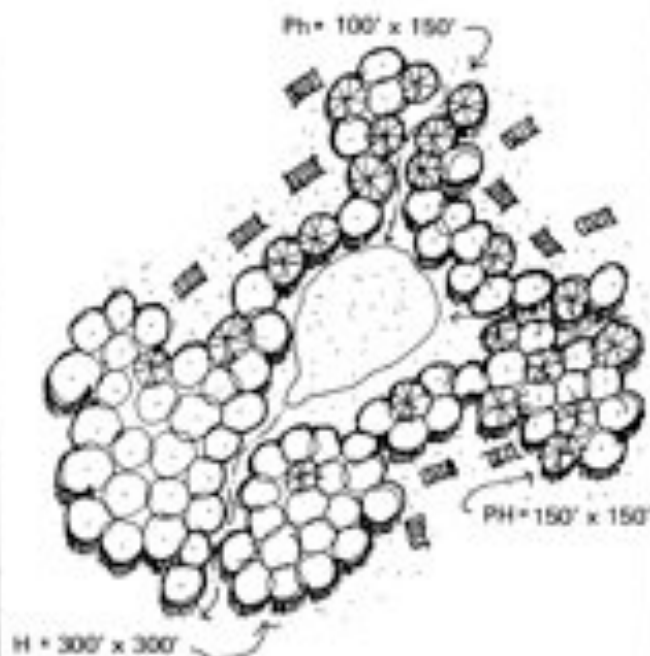
### Siting Considerations

Houses must be set back beyond the 50' vegetation boundary or 30' beyond the inundation level of the pond, whichever is further from the edge of the pond.

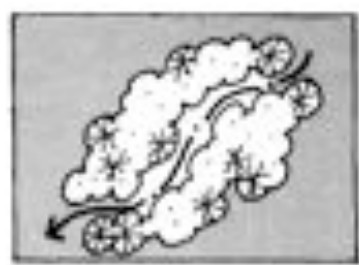
Roads must not interrupt drainage patterns to and from the pond.

Access to houses should be from an outer road to prevent any clearing of the edge.

Foot traffic in the pond should be restricted or controlled. Allow for specifically designed places where people can approach the edge. They can walk out over the pond surface on boardwalks.



### 50-100 YEAR FLOODPLAIN OF PANTHER CREEK AND SPRING CREEK



The floodplain of Panther and Spring Creeks has some of the most diverse and spectacular vegetation in the Woodlands and is essential to flood control. Development on the 50 year floodplain is prohibited. The following guidelines apply only to that part of the 100 year floodplain which is beyond the 50 year floodplain. The way this land is developed could mean the difference between destruction of property or minor inconvenience in case of a major flood.

#### Management Guidelines

Maintenance of trees, understory, and ground cover is essential for flood control. Vegetation should be self-maintaining. (See Vegetation Section for requirements for specific vegetation types.)

Only minimal clearing should be permitted around dwellings. No lawns or yards will be allowed. All existing vegetation adjacent to the house must be preserved to maintain recharge and to minimize erosion and siltation.

#### Housing Suitability

Only very low net density is permitted. Structures must be raised on posts well above the 100-year flood level, so as not to impede floodwaters.

#### Siting Considerations

Development should be in predominantly pine areas, because this vegetation type is more tolerant of disturbance than hardwood.

Locate structures on less permeable soils where possible. Ground coverage should be minimized.

There should be no major modifications for site drainage in the floodplain.

Roads crossing the floodplain should be minimized. Road crossings should be perpendicular to the stream.

Driveways and access roads should approach development from the direction away from the floodplain, entering it only where necessary.





### AB SOILS (LA, EU, BL, BOH, AL, WI) WHICH RECEIVE NO RUNOFF FROM OTHER SOILS

These soils have a high storage capacity for excess runoff, but when located upslope from less permeable soils, they cannot be used to drain them. In this condition, the excess storage capacity should be used to recharge runoff from higher density development on the AB Soils themselves.

A Soils have more excess storage capacity than B Soils. Therefore, less area of A Soils is required to recharge a given amount of runoff.

#### Management Guidelines

A Soils may be cleared up to 90% and still achieve local recharge of the 1" storm.

B Soils may be cleared up to 75% and still achieve local recharge of the 1" storm.

Areas used for recharge should remain wooded.

#### Housing Suitability

On A Soils all types and densities are suitable.

On B soils most types and densities are suitable. Refer to Table 1, page 23 for specific types. Housing types and densities which require more than 75% clearance cannot be accommodated without additional uncleared A or B soils. This would result in decreased gross density.

#### Siting Considerations

Situate buildings and impervious surfaces on higher elevations so that runoff will drain to lower elevations where it can be recharged.

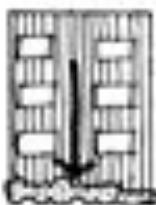
Situate buildings and impervious surfaces so that they drain to the uncleared area.



A Soils  
Up to 90% Cleared  
and Rendered  
Impermeable



B Soils  
Up to 75% Cleared  
and Rendered  
Impermeable



**AB SOILS (LA, EU, BL, BOH, AL, WI) WITH C SOILS (LU, FU, LEH, CO, COG) AND/OR D SOILS (SU, AN, SE, SEG, SPH, SO, SS, TK, BI, TU, CR, WA) WHERE AB SOILS RECEIVE RUNOFF FROM C AND/OR D SOILS**



AB Soils have excess water storage capacity, and can be used to recharge runoff from other less permeable soils.

A Soils have more excess storage capacity than B Soils. Therefore less area of A Soils is required to recharge a given amount of runoff.

#### Management Guidelines

**A Soils:** For every cleared area to be drained, an area equal to 11% of uncleared LA or EU soils must be provided to accomplish recharge of the 1" storm.

**B Soils:** For every cleared area to be drained, an area equal to 33% of uncleared BOH or AL soils must be provided to accomplish recharge of the 1" storm.

After sufficient A or B Soils have been allotted to accomplish recharge of runoff from C or D Soils, the remaining A or B Soils may be developed according to guidelines and suitability outlined in 3A1.

If there are insufficient A or B Soils to recharge runoff from the entire amount of C or D Soils, then D Soils are preferred for development and clearance. If both C and D Soils remain, develop according to guidelines outlined in 3A4. If only C Soils remain, see 3A3. If only D Soils remain, see 3B1.

#### Housing Suitability

AB Soils used for recharge of runoff from C or D Soils must not be developed or cleared. However, lot lines may extend into these wooded areas.

C and D Soils for which sufficient A or B Soils have been provided to accomplish recharge have no development restrictions except those dictated by vegetation. All housing types and densities are suitable.

#### Siting Considerations

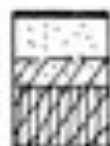
Situate buildings and impervious surfaces so that they drain to uncleared AB Soils. No man-made alterations are required where slopes are sufficient.

Fill may be used on C or D Soils to enhance drainage where necessary.

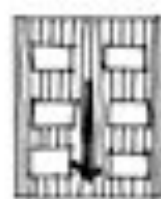


A Soils

Excess  
Storage  
Capacity

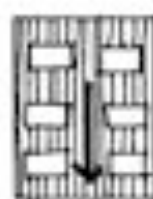


B Soils



11% Acre A Soils

1 Acre  
C/D Soils



33% Acre B Soils



3A3

3A4

3B1



3A1



**C SOILS (LU, FU, LEH, CO, COG) WHICH RECEIVE NO RUNOFF FROM OTHER SOILS**



C Soils have less excess water storage capacity than A or B Soils. However, in conditions where there are no AB Soils to accomplish recharge, C Soils should be used.

**Management Guidelines**

C Soils may be cleared up to 50% and still achieve local recharge of the 1" storm.

Areas used for recharge should remain wooded.

**Housing Suitability**

Only single family estates (1 du/acre) allow sufficient uncleared land for local recharge of the 1" storm with all building zones. Single family 2.5-4 du/acre and garden apartments 15-18 du/acre allow sufficient uncleared land only if the 5' building zone is employed. Other housing types and densities cannot be accommodated without additional uncleared C soils to equal the area cleared and rendered impervious. This would result in a decreased gross density.

**Siting Considerations**

Situate buildings and impervious surfaces on higher elevations so that runoff will drain to lower elevations where it can be recharged.

Situate buildings and impervious surfaces so that they drain to the uncleared area.



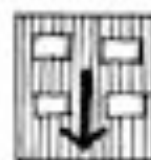
Excess Storage Capacity



50% Cleared and Rendered Impervious

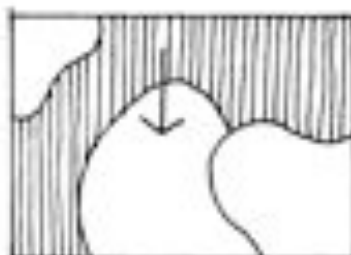


50% Uncleared





C SOILS (LU, FU, LEH, CO, COG) WITH D SOILS (SE, SEG, AN, SU, SPH, SO, SS, TK, BI, TU, CR, WA) WHERE C SOILS RECEIVE RUNOFF FROM D SOILS



C Soils have less water storage capacity than A or B Soils. However, in conditions where there are either insufficient or no AB Soils to accomplish recharge, C Soils should be used.

#### Management Guidelines

For every area of D Soils to be drained an equal area of uncleared C Soils is required to accomplish recharge of the 1" storm.

After sufficient C Soils have been allotted to accomplish recharge of runoff from D Soils, the remaining C Soils may be developed according to guidelines and suitabilities outlined in 3A3.

If there are insufficient C Soils to accomplish recharge of runoff from the entire area of D Soils, the remaining D Soil should be developed according to guidelines and suitabilities outlined in 3B1.

#### Housing Suitability

C Soils used for recharge of runoff from D Soils must not be developed or cleared. However, lot lines may extend into these wooded areas.

D Soils for which sufficient C Soils have been provided to accomplish recharge have no development restrictions except those dictated by vegetation. All housing types and densities are suitable.

#### Siting Considerations

Site buildings and impervious surfaces so that they drain to uncleared C Soils. No man-made alterations are required where slopes are sufficient.

Fill may be used on D Soils to enhance drainage where necessary.

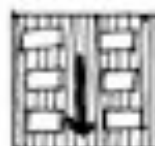


Excess Storage Capacity

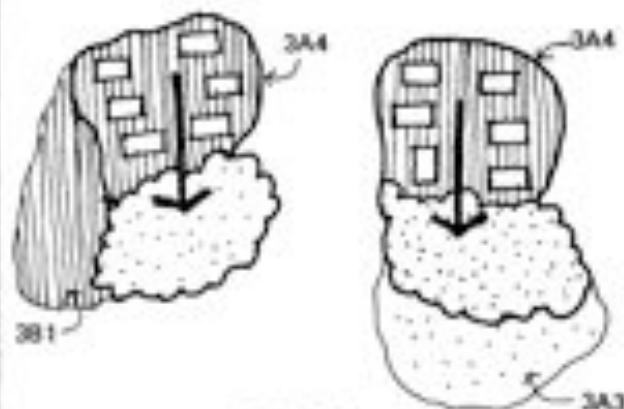


C Soils

1 Acre D Soils



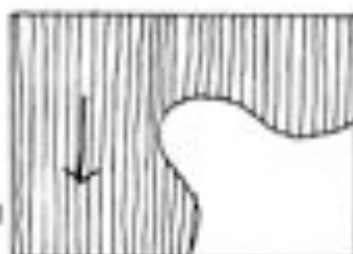
1 Acre C Soils



3B1



**D SOILS (SU, AN, SE, SEG, SPH, SO, SS, TK, BI, TU, CR, WA)  
WITH SLOPE GREATER THAN 1% AND WHICH DO NOT DRAIN  
TO A, B, OR C SOILS**



D Soils with slope greater than 1% are impermeable and therefore have minimal recharge capacity. When runoff from these soils cannot be recharged on A, B, or C Soils, it should be directed to a swale, water storage area, or area of uncleared D Soil with slope less than 1% which can be temporarily flooded.

**Management Guidelines**

The extent of clearing and the amount of impervious surface are not restricted except for limitations established by existing vegetation. (See vegetation guidelines.)

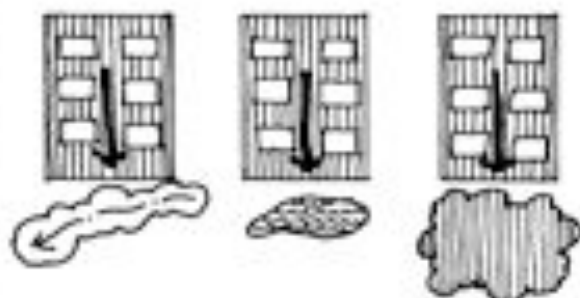
**Housing Suitability**

Since D Soils are already impervious they are especially suited to high density development.

**Siting Considerations**

Situate and design buildings, roads, and paths so as not to impound runoff.

Major pedestrian traffic should be on fill parallel to the line of slope, or raised on posts if traffic is perpendicular to the line of slope.





# GUIDELINES FOR VEGETATION AND PERMITTED CLEARANCE

## Introduction

This section complements the preceding chapter by combining the requirements of specific soil and drainage conditions with criteria for selecting the vegetation to be preserved, and with guidelines for maintaining this vegetation.

The quality, quantity, and distribution of preserved vegetation are crucial to two major objectives of the Woodlands Development Corporation. The maintenance of existing vegetation is essential to the success of a natural drainage system and to keeping a woodland environment with a sense of the "forest," composed of a diverse array of trees, shrubs, vines, wildflowers, and grasses. These objectives will be accomplished in several ways:

- Major areas of ecological importance to drainage, vegetation, and wildlife will be preserved in the Primary Open Space System. This includes major floodplain areas and vegetation of exceptional quality and diversity.
- Existing vegetation will be preserved in the natural drainage system thereby providing the framework for the multi-use non-vehicular circulation system.
- Within the development parcel, all prime vegetation must be preserved as a valuable resource and amenity.

## Definitions

The following definitions are intended to facilitate the use of the next chapter:

**Vegetation Types** range from pure stands of hardwood to pure stands of pine. Intermediate types are varying mixtures of hardwood and pine. In Phase I each type was also classified by density and size: open, medium spaced, densely spaced, and very large trees. Vegetation types were evaluated for tolerance of compaction and development activities, landscape value, and value as wildlife food. Since hardwoods are less tolerant of compaction and development activities than pines, have a high value as landscape trees, and are generally more valuable as wildlife food than pines, permitted clearing is less for hardwood stands than for pine stands.

**Prime Vegetation** is composed of pure hardwood stands of medium spaced and very large trees.



Hardwood

**Secondary Vegetation** is composed of predominantly hardwood stands of medium spaced and very large trees and very large trees of all other types.

**A Self-Maintaining Stand** is of sufficient size to meet the cultural requirements for the major plant species within that stand if understory and ground cover are uncleared and hydrologic conditions are not greatly modified. As older trees die, they are replaced naturally without any major change in the species composition of the stand. Replanting at man's expense is not required. By providing a sufficient number of self-maintaining stands, the developer can help assure the future residents of the Woodlands that they will always live in a "woodland environment". Self-maintaining stands of diverse vegetation types have different requirements in order to be self-maintaining.

**A Small Stand** is a group of trees which is too small to be self-maintaining. If understory and ground cover is uncleared, naturally occurring regrowth will often be of undesirable species. If the ground cover is mowed no regeneration will take place. Though short run restrictions are fewer for maintaining this type of stand, in the long run, greater expenditures of time, energy, and money are required.

Saving **Individual Trees** places the fewest short run restrictions on the developer. In the long run, however, he risks losing these trees to age, pests, and disease. Individual trees are therefore more suitably left in areas which normally receive high maintenance — in a private yard as opposed to a public park.

**Hardwood** species are both lowland (Water oak, Willow oak, etc.) and upland (Southern Red Oak, Post Oak, etc.) They are generally less tolerant of development than pine species. Younger trees are more tolerant than older trees, and upland species are more tolerant than lowland species.

**Pine** trees in Phase I are mostly Loblolly Pine. They are assumed to be more tolerant to compaction and development than hardwood species. Shortleaf Pine is a predominant pine species west of Phase I.

Guidelines for self maintaining stands, and small stands and individual trees have been applied to each vegetation type and are presented on sheets following the key to vegetation guidelines.

**Management Guidelines** outline the size of stand or



Self-Maintaining Stand



Small Stand



Individual Trees



Pine



**D SOILS (SU, AN, SE, SEG, SPH, SO, SS, TK, BI, TU, CR, WA)  
WITH SLOPES LESS THAN 1%**

These are impermeable soils with no positive drainage. Rainfall remains in puddles on the site. This condition if developed requires a maximum of human intervention (clearing, compaction, cutting, filling).

Since neither recharge nor drainage can be achieved by the natural drainage system, the cost of draining and developing this condition may be considerable.

**Management Guidelines**

Developed areas of this soil may be cleared up to 100% with the exception of restrictions imposed by existing vegetation. (See vegetation guidelines.)

**Housing Suitability**

All types and densities are suitable. However, economics may dictate high density development that can return the expense of more costly foundations and site drainage.

**Siting Considerations**

Since the natural topography cannot be used to direct runoff siting considerations based on drainage characteristics are not conclusive. Large mature hardwoods occur frequently on this soil condition, so high quality vegetation will be a major siting factor.

Areas immediately adjacent to recharge soils or to primary or secondary drainage channels will require less effort to drain.

Drainage of the cleared areas can be accomplished by using sufficient fill to achieve positive flow. Do not fill in the wooded areas or around individual trees.

Cutting to achieve drainage is only acceptable when it does not necessitate cutting below grade at recharge soils or existing drainage channels. Do not cut in wooded areas or around individual trees.

Runoff may also be directed to an uncleared portion of the parcel where temporary ponding conditions will be acceptable.

Buildings may be sited at the road to minimize fill.

Another alternative is to build houses off the ground on posts. In this case, water would be permitted to remain on the ground after rain.



buffer zone required to retain the specific vegetation and stand type. The stand sizes are estimates based on the best available data and practical experience. Other considerations relate to clearing and filling.

**Siting Considerations** cover the relationship of structures and the configuration and alignment of roads, driveways and paths with respect to specific vegetation types and stand size.

### Determination of Permitted Clearance

This section presents criteria and priorities for determining the types, quantity, and distribution of vegetation to be preserved, and areas which may be cleared. It is organized as a series of steps:

1. Follow all steps in the Soil and Drainage Key.
2. Read the **Introduction and Definitions** at the beginning of this chapter.
3. Identify all vegetation types found within the development parcel by referring to the vegetation map. Once soil and drainage conditions and vegetation types have been identified, the permitted clearance for specific areas can be established.
4. Certain soil and drainage conditions and vegetation types require that vegetation be maintained in stands of minimum size in accordance with specific guidelines:

Preserve stands of vegetation in the following areas as self-maintaining stands. (See vegetation guidelines.)

- Areas of prime vegetation: Hm&b, Hm&tb, Hum&b
- 50-100 year floodplain of Panther and Spring Creeks
- The undeveloped edge of Waller Ponds
- Primary drainage channels

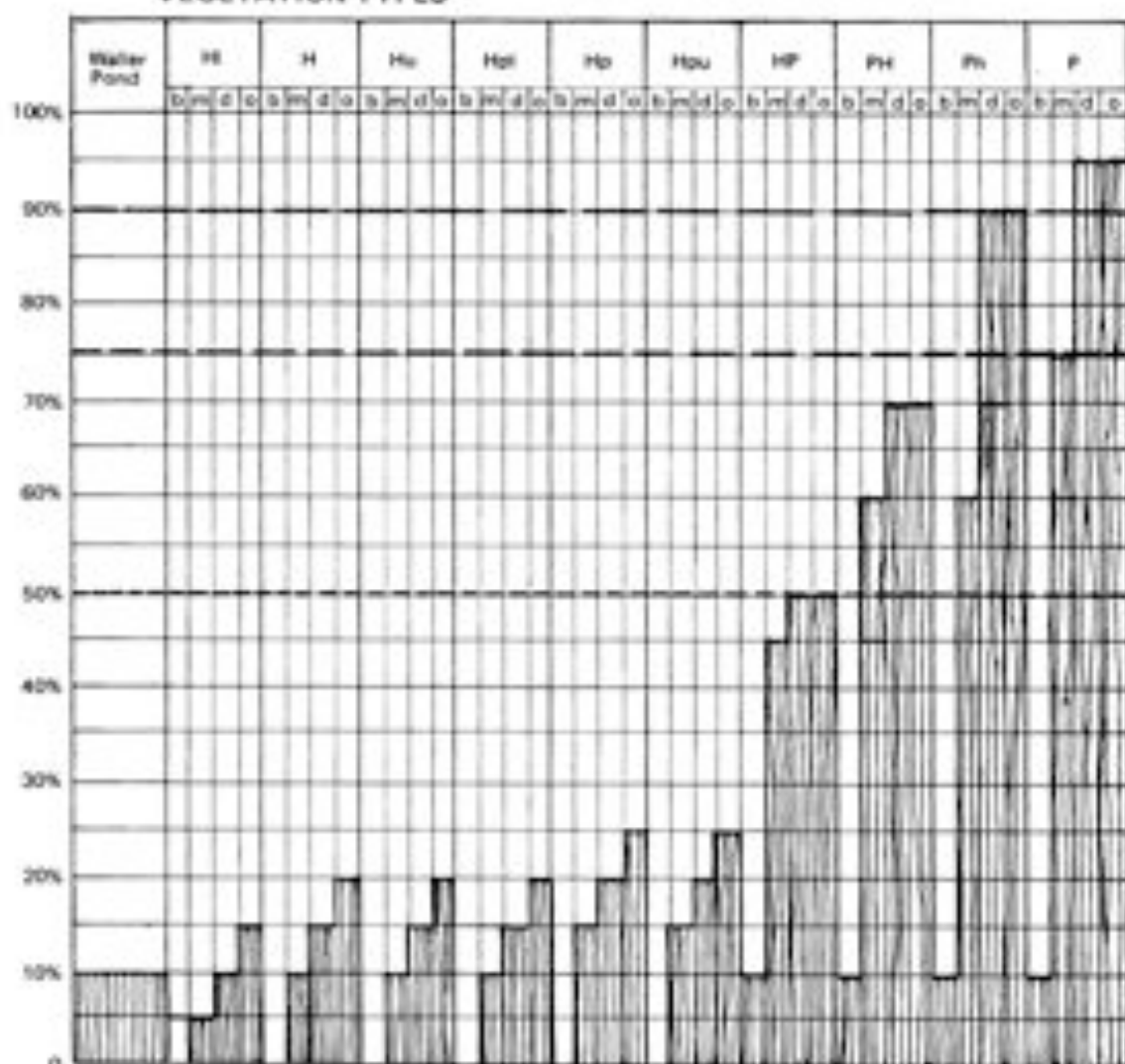
Stands of vegetation in the following areas should be self-maintaining though this is not absolutely essential so long as criteria outlined in the soil and drainage guidelines are met, and so long as clearance does not exceed the permitted percentage:

- Areas of secondary vegetation: Hpim-b, Hpm-b, Hpam-b, HPb, PHb, Pb
  - Secondary drainage channels
- Whenever possible, leave a sufficient area of

adjacent vegetation types uncleared to make the stand self-maintaining.

5. For all remaining areas use the percentage of permitted clearance based on soil and vegetation types (Chart 1). Once the percentage of permitted clearance is established for a given area, select the portion which may be cleared. The following guidelines should be considered:
  - Match areas of permitted clearance with conditions most easily developed for a given program. For instance, a combination of high permitted clearance (75-100%) and impermeable soils (D) less than 1% slope would be most suitable for a high density program requiring extensive clearing and coverage.
  - Match uncleared areas with soils used for recharge.
  - Match uncleared areas with those conditions most difficult to develop.
  - Preserve vegetation in stands as large as possible, preferably self-maintaining.
  - Preserve areas of diverse vegetation (species, density, age).
6. Refer to the Key to Vegetation Guidelines and the pages following to obtain guidelines for self-maintaining stands and small stands or individual trees.
7. Refer to General Guidelines for Site Planning on page 46.

CHART 2: PERCENTAGE OF PERMITTED CLEARANCE FOR PHASE I  
VEGETATION TYPES



- MAXIMUM CLEARING
- MAXIMUM PERMITTED CLEARANCE FOR A SOILS\*
- MAXIMUM PERMITTED CLEARANCE FOR B SOILS\*
- MAXIMUM PERMITTED CLEARANCE FOR C SOILS\*

- Hb LOWLAND HARDWOOD
- H HARDWOOD
- Hu UPLAND HARDWOOD
- Hbl LOWLAND HARDWOOD WITH OCCASIONAL PINE
- Hb HARDWOOD WITH OCCASIONAL PINE
- Hbu UPLAND HARDWOOD WITH OCCASIONAL PINE
- HP HARDWOOD-FINE
- PH PINE-HARDWOOD
- Ph PINE WITH OCCASIONAL HARDWOOD
- P PINE

- b VERY LARGE TREES
- m MEDIUM SIZE TREES
- e OPEN, WITH FEW TREES
- d DENSELY SPACED TREES

\*If recharge of runoff is to be achieved

# KEY: VEGETATION GUIDELINES

## A. Self-maintaining stands

A1. Self-maintaining stands of prime vegetation (HI, H, Hu)

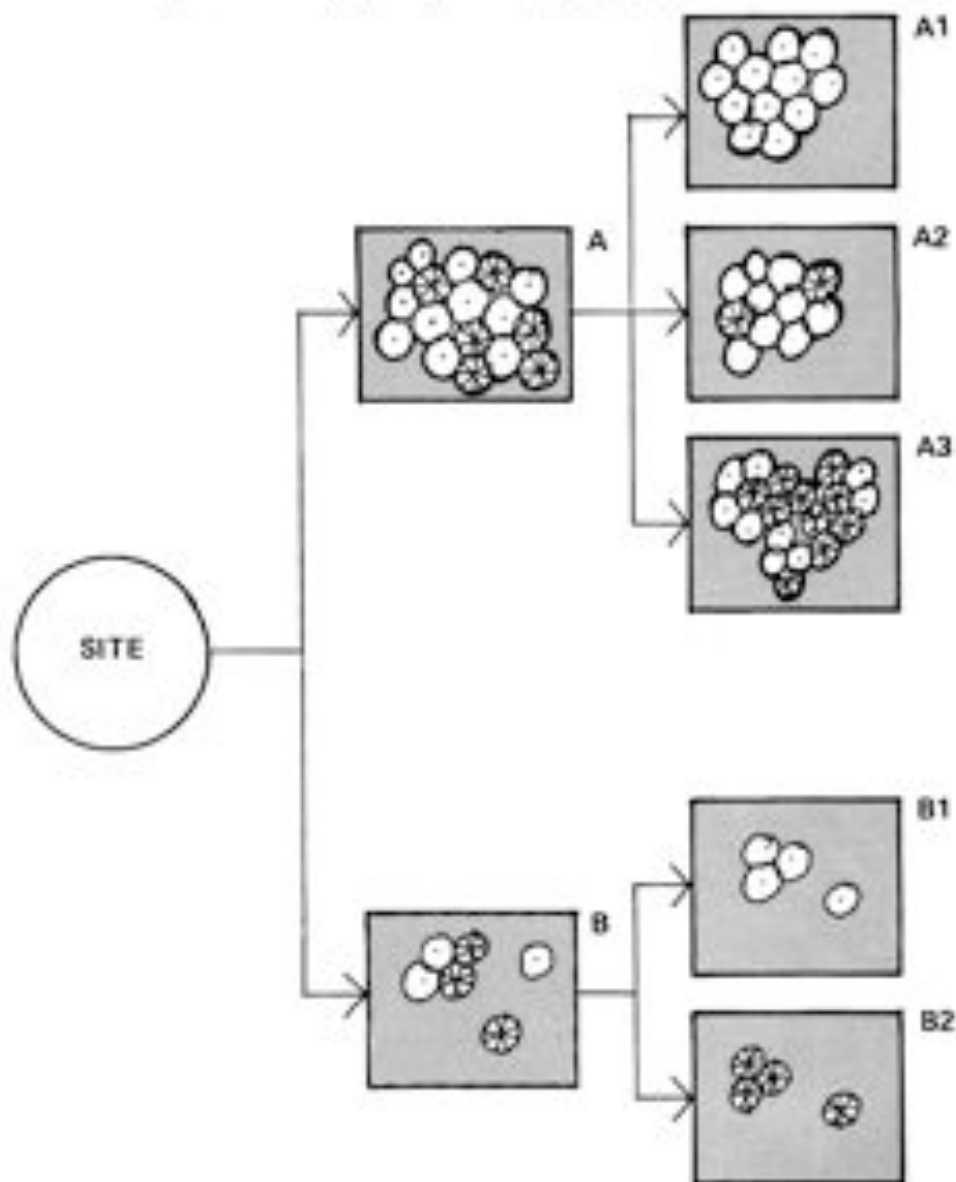
A2. Self-maintaining stands of Hpl, Hp, Hpu

A3. Self-maintaining stands of HP, PH, Ph, P

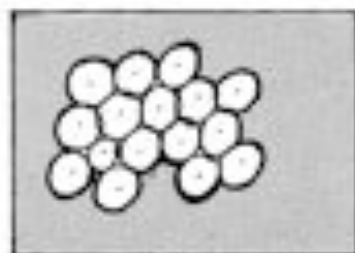
## B. Individual trees and small stands

B1. Individual hardwood trees and small stands of predominantly hardwood species (HI, H, Hu, Hpl, Hp, Hpu, HP)

B2. Individual pine trees and small stands of predominantly pine species (PH, Ph, P)







## SELF-MAINTAINING STANDS OF PRIME VEGETATION (H1, H, Hu)

Since development will primarily favor pine, those few stands of pure hardwood which do exist now should be retained.

If the existing stand is over 300' x 300' it must be retained as a self-maintaining stand.

### Management Guidelines

Minimum boundaries of 300' x 300' must be observed.

Understory and ground cover within the stands must not be cleared.

Do not change existing grade within the stand.

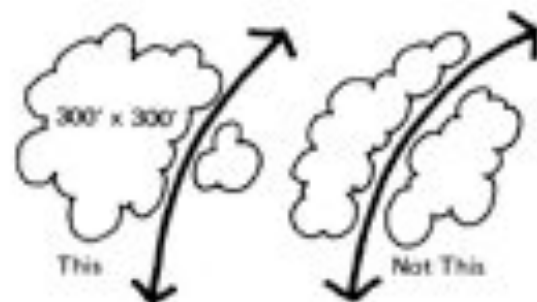
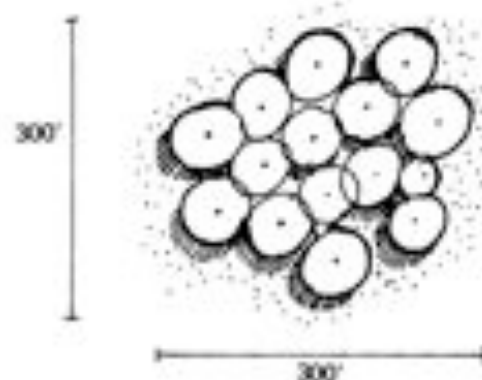
### Siting Considerations

Roads and their R.O.W. should not be located within the stand.

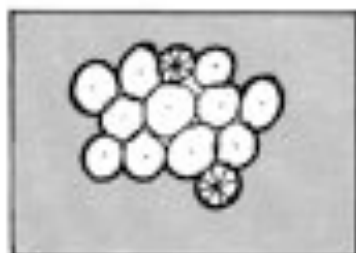
However, if this is absolutely necessary, a section at least 300' x 300' must be left outside the road R.O.W.

Heavy pedestrian traffic should not be directly through stands of predominantly lowland species (H1).

If paths are necessary, design them to minimize damage to roots from compaction. Major trails should be located under young trees or raised on a boardwalk.







### SELF-MAINTAINING STANDS OF Hpl, Hp, Hpu

This vegetation type is slightly more tolerant of development than pure hardwood vegetation types, but management guidelines and siting considerations are similar (see A1) with the exception of the dimensions required for a self-maintaining stand.

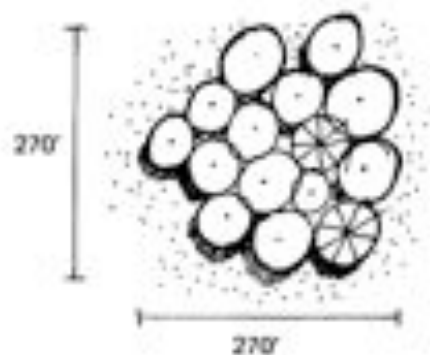
#### Management Guidelines

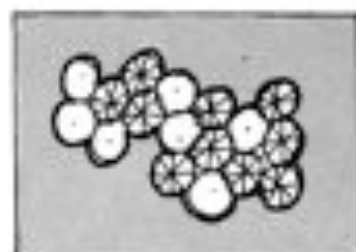
Minimum boundaries of 270' x 270' must be observed.

Refer to guidelines in A1.

#### Siting Considerations

Refer to A1.





### SELF-MAINTAINING STANDS OF HP, PH, Ph, P

These vegetation types are mostly pine predominant, and are therefore more tolerant of development than other types of vegetation.

#### Management Guidelines

The minimum-area requirements for self-maintaining stands differ according to the relative predominance of hardwood or pine.

less tolerant more limitations	HP	200' x 200'
	PH	175' x 175'
	Ph	150' x 150'
most tolerant fewest limitations	P	100' x 100'

These minimum dimensions must be observed.

Do not clear understory or ground cover in the stand.

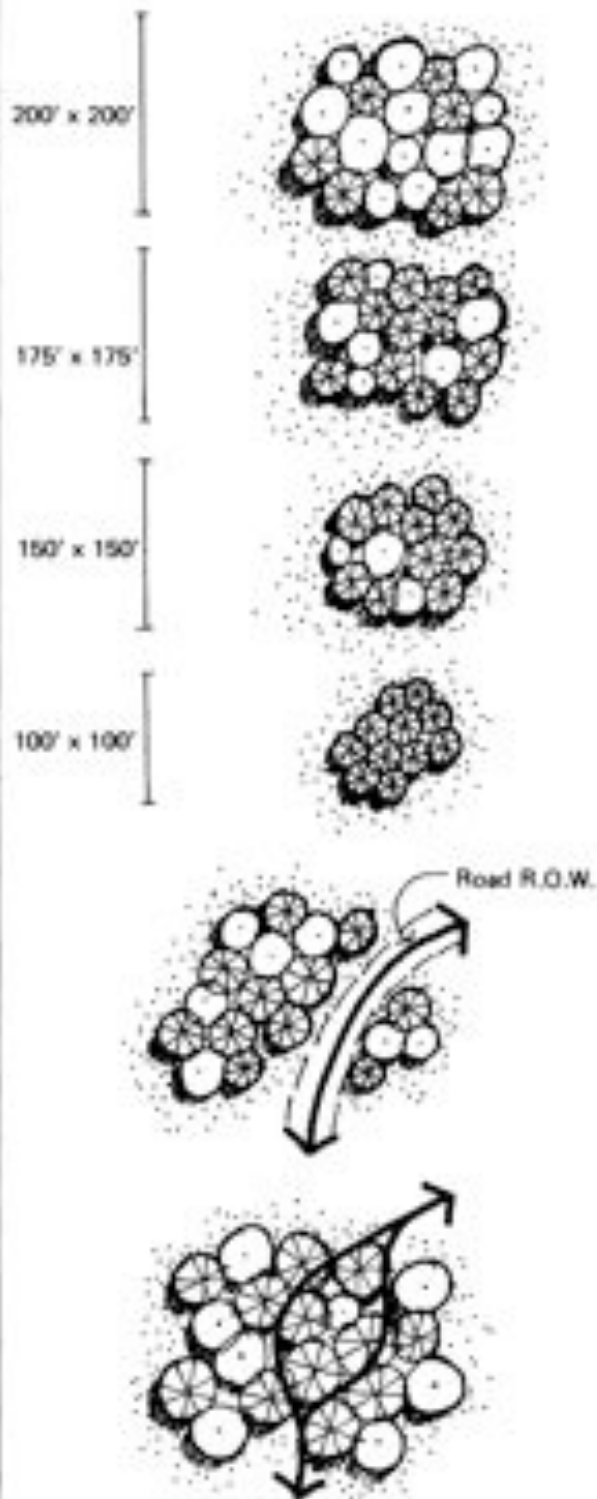
Do not fill within the stand.

#### Siting Considerations

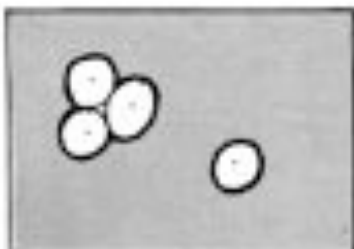
Roads and their R.O.W. should not be located within the stand.

If a road does cut through the stand, an area of at least the minimum required to retain the stand as self maintaining must be left outside the R.O.W.

Pine predominant vegetation types can better sustain heavy traffic or use. Major pedestrian, bicycle, and horse paths should therefore be located in pine predominant stands and should keep beneath pines, skirting the hardwoods.



**INDIVIDUAL TREES AND SMALL STANDS OF  
PREDOMINANTLY HARDWOOD SPECIES (HI, H,  
Hu, Hpl, Hpu, HP)**



Upland hardwoods (southern red oak, post oak) are more tolerant than lowland hardwoods (willow oak, water oak) of compaction, variation in drainage, or other environmental changes. Younger trees of any type are also most likely to adapt successfully to changes in conditions.

**Management Guidelines**

Maintain a buffer zone around each individual tree or stand. This buffer zone should extend one canopy diameter from the trunk of the tree.

Do not change existing grade within the buffer zone.

**Siting Considerations**

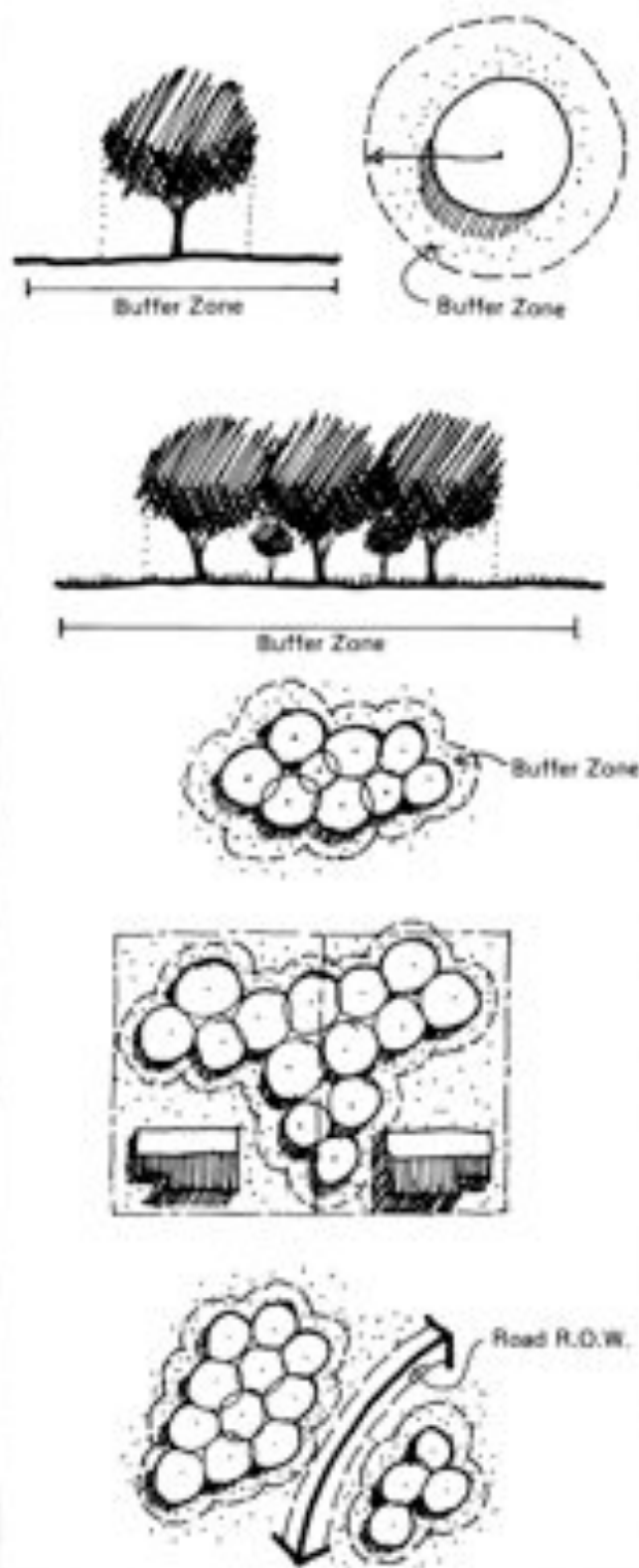
Site buildings and impervious surfaces outside the buffer zone.

Individual trees can be retained in side lots if sufficient buffer is left.

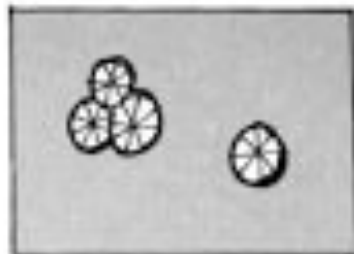
Site roads and their R.O.W. outside the buffer zone.

Heavy pedestrian traffic should not be directed through stands of predominantly lowland species (HI, Hpl).

If such paths are necessary, design them to minimize damage to roots from compaction. Major trails should be located under young trees, pines, or raised on a boardwalk.



## INDIVIDUAL TREES AND SMALL STANDS OF PREDOMINANTLY PINE SPECIES (PH, Ph, P)



Pines are more tolerant of development than hardwoods. In intensively developed areas where sufficient buffer zone is not available, pine trees are more likely to survive.

### Management Guidelines

Maintain a buffer zone around each individual tree or stand. This buffer zone should extend one canopy radius and a half from the trunk of the tree.

Do not change existing grade within the buffer zone.

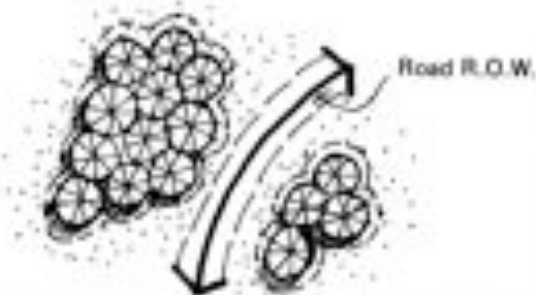
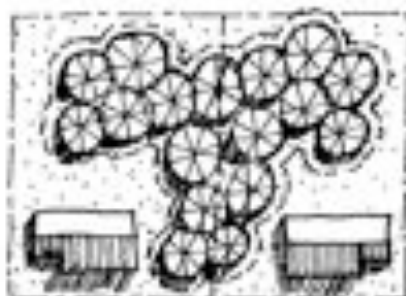
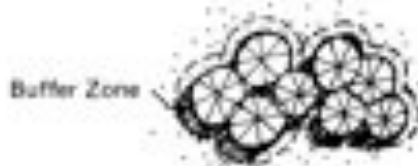
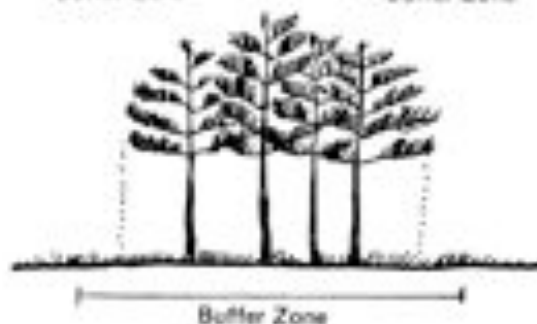
### Siting Considerations

Site buildings and impervious surfaces outside the buffer zone.

Individual trees can be retained in side lots if sufficient buffer is left.

Site roads and their R.O.W. outside the buffer zone.

Major pedestrian, bicycle, and horse paths are most suitably located in pine predominant stands, and should keep beneath pines, skirting the hardwoods.



## GENERAL GUIDELINES FOR SITE PLANNING

Uncleared woods need not be exempted from salable real estate. Buildings may be located on the periphery of these stands and lot lines may be extended into them.



Cutting to achieve drainage is only acceptable when it does not necessitate cutting below grade at existing drainage channels or recharge soils.



Fill cleared areas to achieve drainage and direct runoff to recharge soils. Trees cannot be retained if existing grade is changed.



Roads may be used to direct or impound runoff.

Swales may be sited along roads to minimize disturbance.



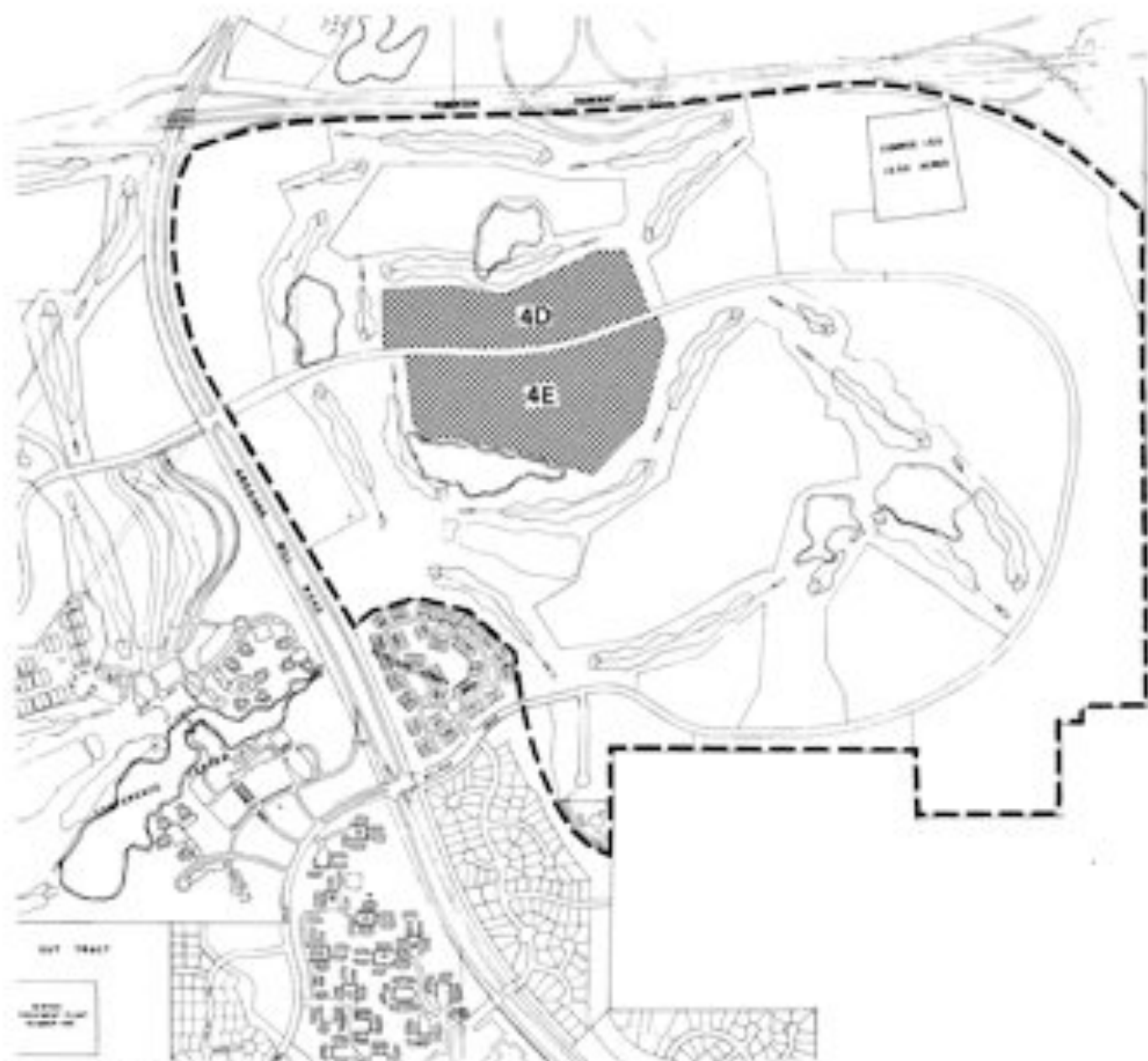
## Introduction

This section employs the method and guidelines described in the preceding sections to site planning of two development parcels in Grogan's Mill Village of the Woodlands New Community. The parcels (4D and 4E) contain a total of 53 acres, 24 acres in 4D and 29 acres in 4E. They are separated by a major road and are bounded by golf course and a primary drainage easement. Though not all the soil and drainage conditions and vegetation types described previously appear in these parcels, nevertheless a sufficient range of site conditions exists to demonstrate the use of the key method, and the application of site planning guidelines. A preliminary site plan has been prepared for these parcels and is included at the end of this section.

## SAMPLE PARCEL



Grogan's Mill Village - Phase I Woodlands New Community



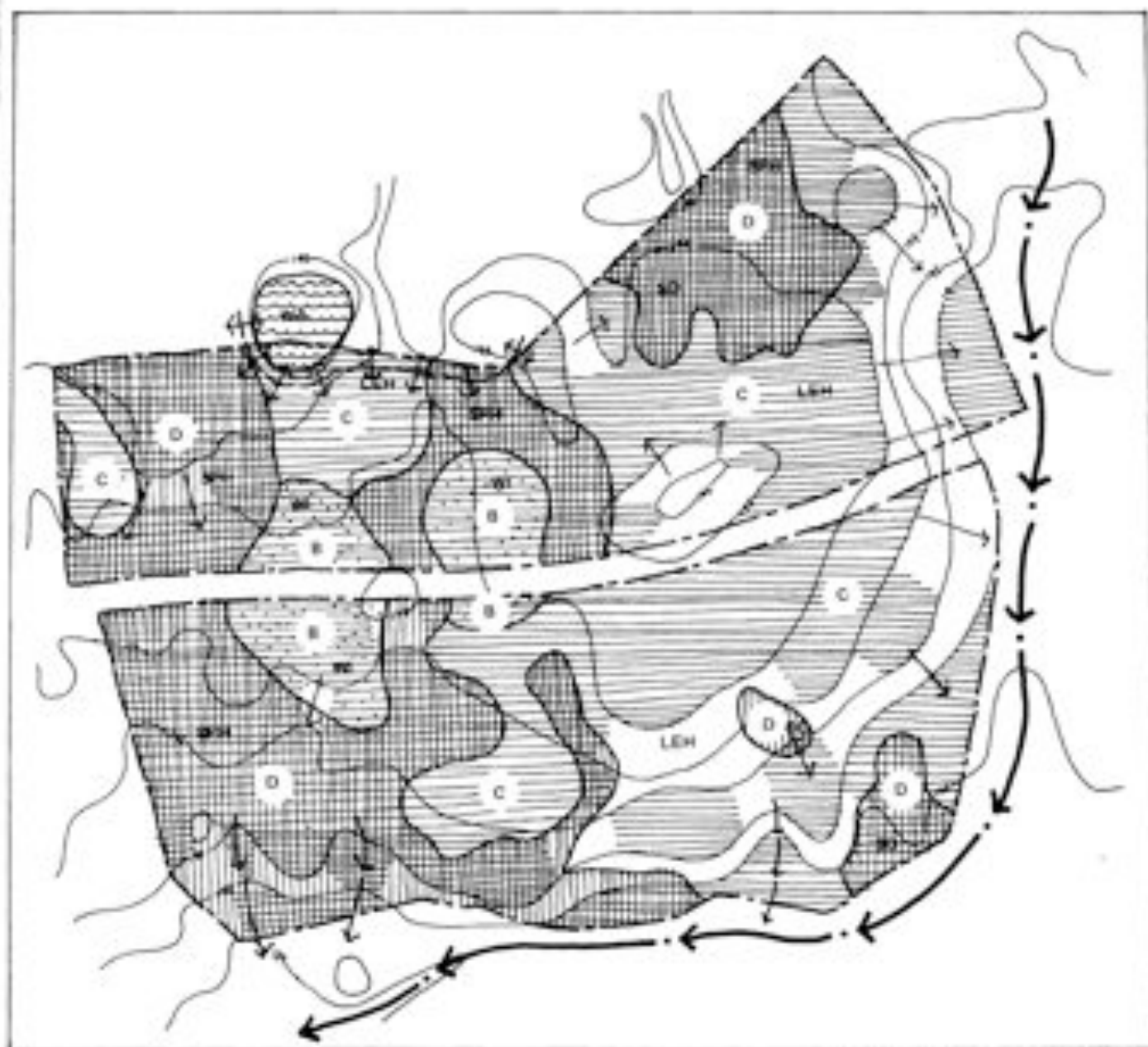
#### Grogan's Mill Village - Zone 4

##### Program

"Parcels 4D and 4E, taken together, will form a sub-community of distinctive high and medium priced detached homes." Of the total 53 acres, all except the 60' vegetation easements along Millrun Drive (which will be assigned to the Community Association) and internal streets should be converted to deeded home sites. "The site plan should provide sites for a total of 143 units consisting of 40 single family detached high (SFD-H) and 103 single family

detached-medium high (SFD-MH). Up to 20% of this total can be planned as clustered patio type units. If patio units are planned, they should be located both on and off the golf course in both parcels." (Woodlands Development Corporation, July 1973)


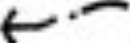













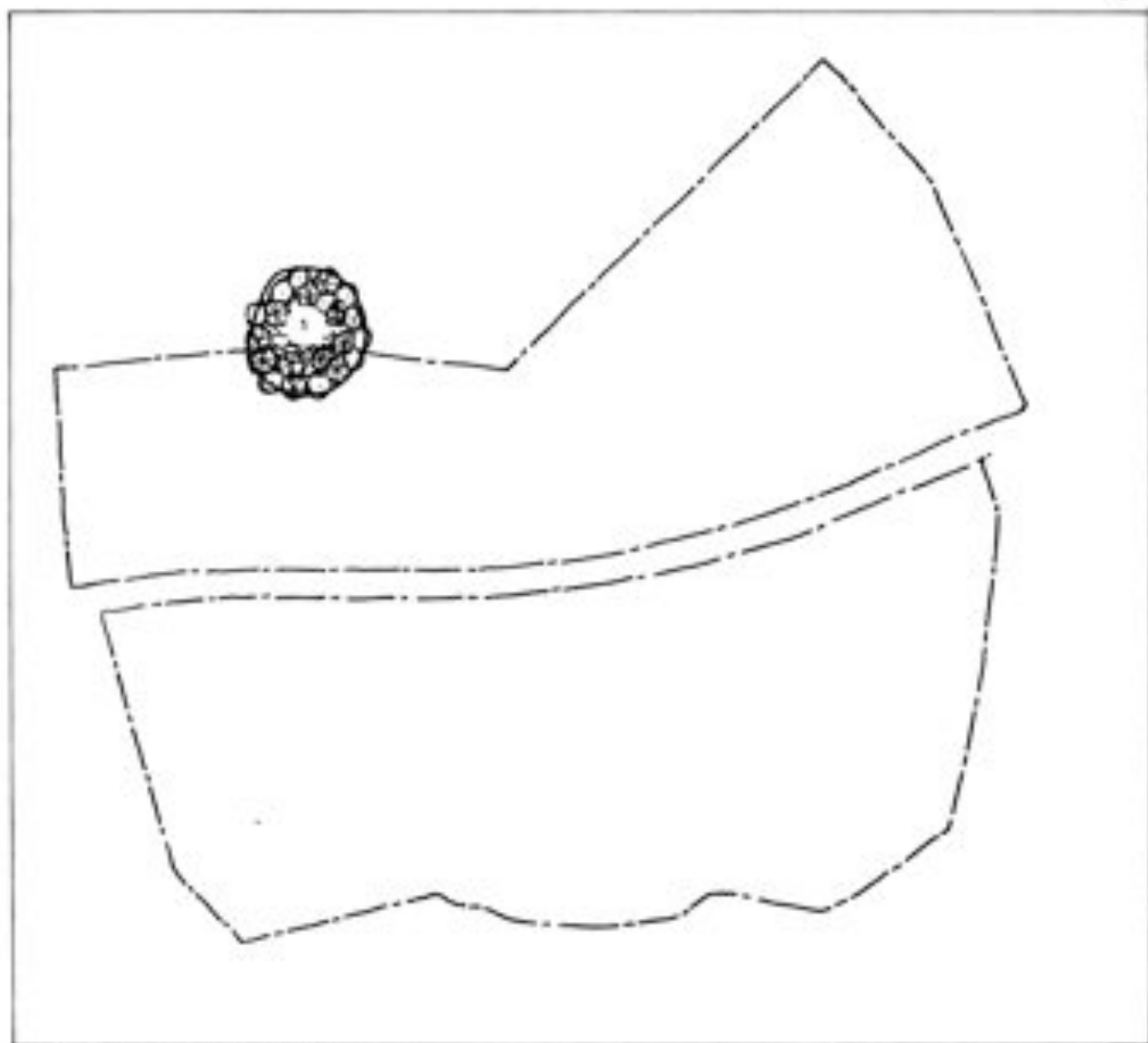
Identification of Site Elements

### Soil and Drainage Key

Indicate all soil and drainage elements which occur on the development parcel:

-  Watershed boundaries
-  Primary drainage channels
-  Secondary drainage channels
-  Swale lines
-  Slopes less than 1%

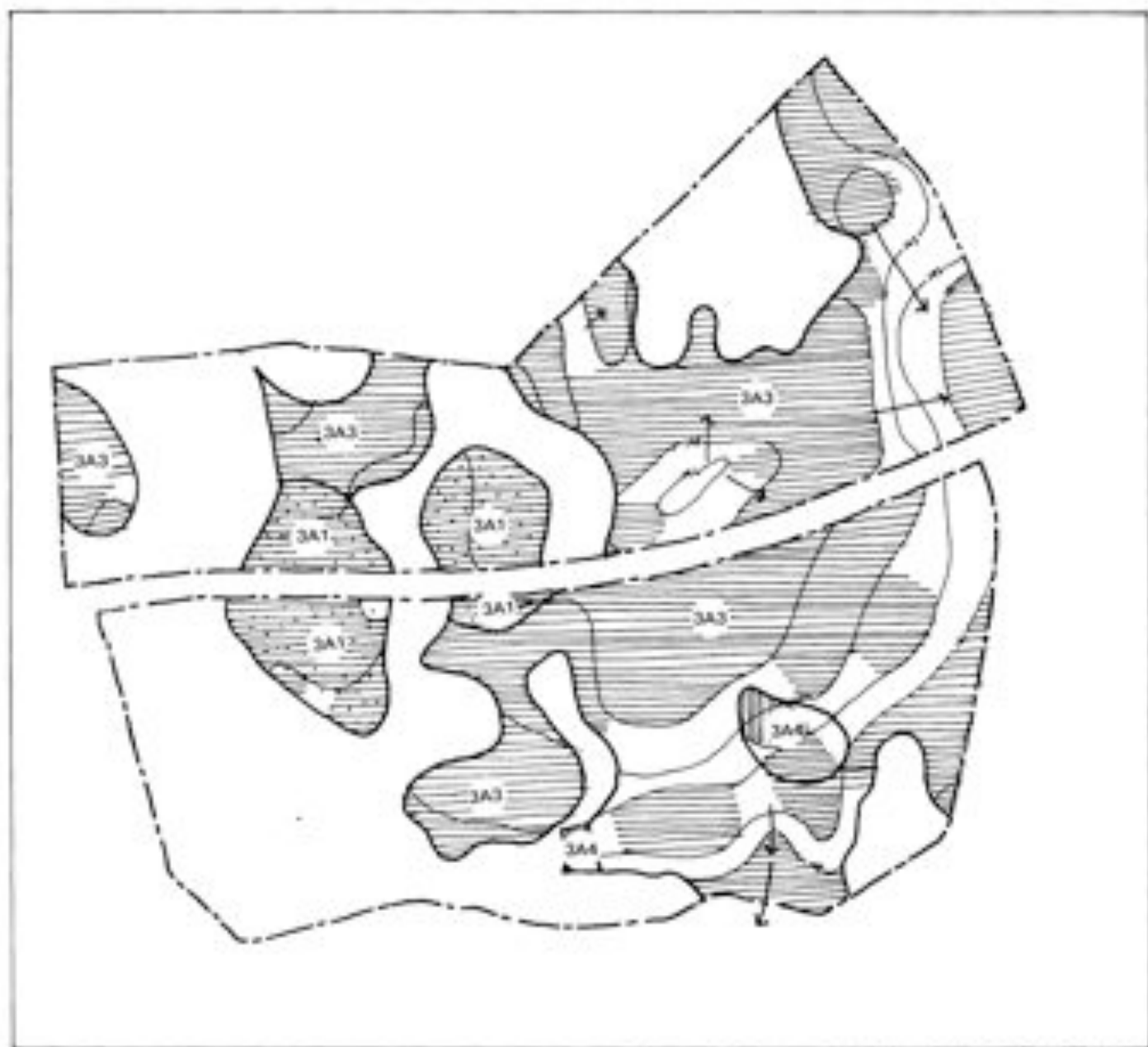
-  Water Ponds
-  50-100 year floodplain of Panther and Spring Creeks
- Soil groups
-  A soils (LA, EU, BL)
-  B soils (BOH, AL, WI)
-  C soils (LU, FU, LEH, CO, COG)
-  D soils (SU, AN, SE, SEG, SPH, SO, SS, TK, BI, TU, CR, WA)



Soil and Drainage Conditions 1 and 2

Identify all soil and drainage conditions which occur on the development parcel by working through the key. Work through the key for each condition which occurs.

1. Areas adjacent to Waller Ponds
2. 50-100 year floodplain of Panther and Spring Creeks



Soil and Drainage Conditions 3A1, 3A2, 3A3, 3A4

3. Other than 1 or 2 above

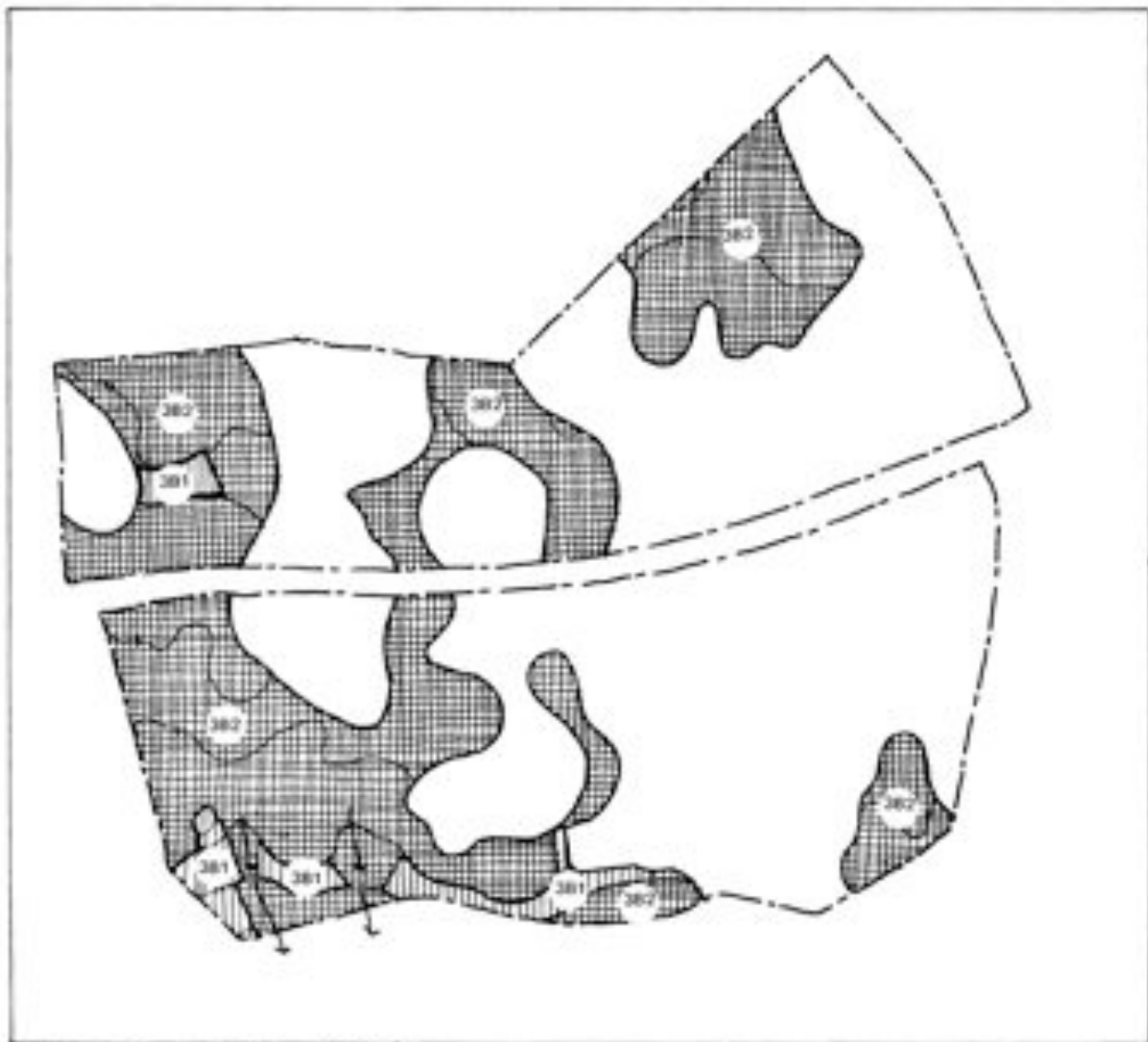
3A. Areas of recharge soils or areas draining to recharge soils

3A1. AB soils (LA, EU, BL, BOH, AL, WI) which receive no runoff from other soils

3A2. AB soils (LA, EU, BL, BOH, AL, WI) with C soils (LU, FU, LEH, CO, COG) and/or D soils (SU, AN, SE, SEG, SPH, SO, SS, BI, TU, CR, WA) where AB soils receive runoff from C and/or D soils

3A3. C soils (LU, FU, LEH, CO, COG) which receive no runoff from other soils

3A4. C soils (LU, FU, LEH, CO, COG) with D soils (SU, AN, SE, SEG, SPH, SO, SS, TK, BI, TU, CR, WA) where C soils receive runoff from D soils

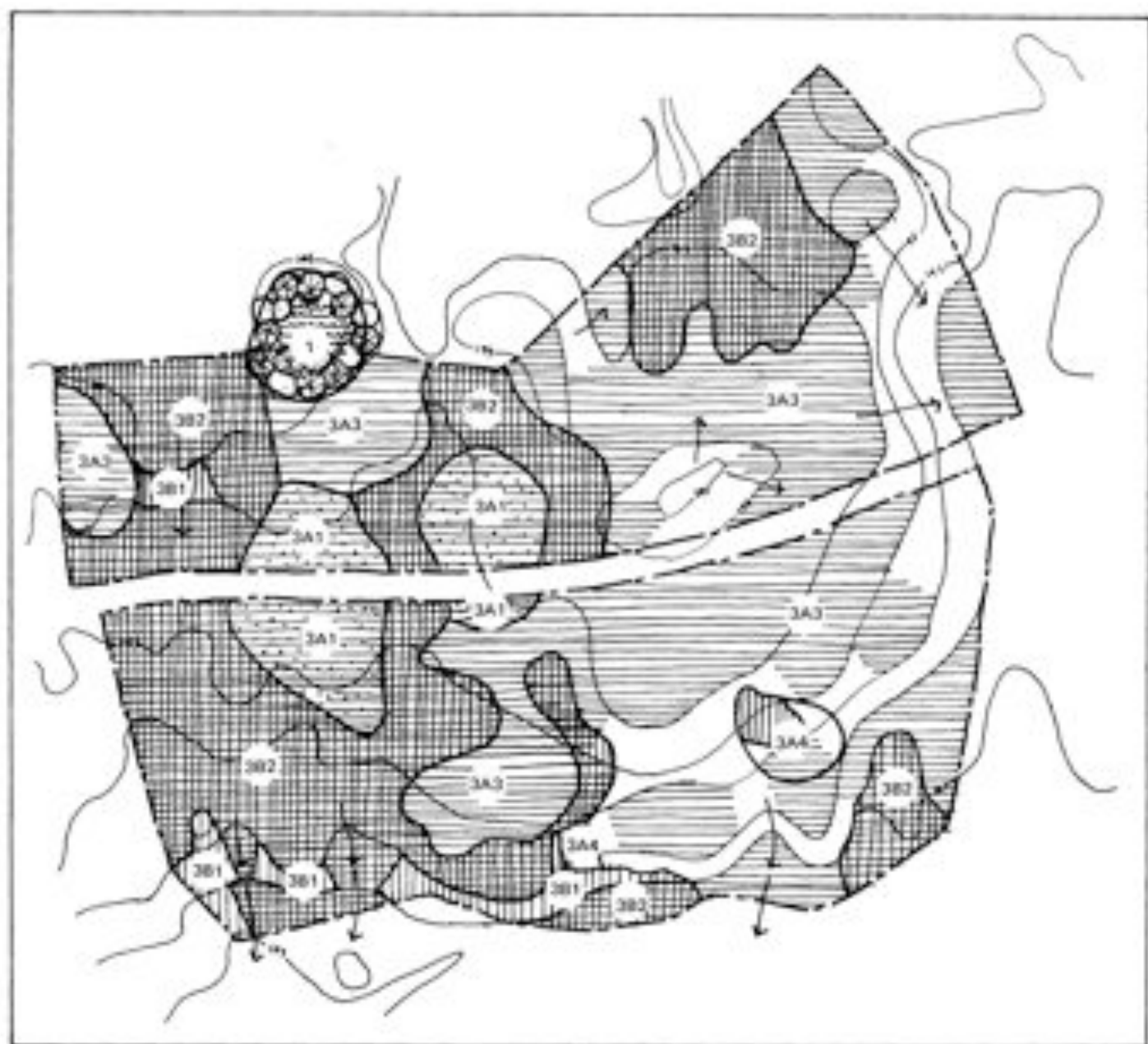


Soil and Drainage Conditions 3B1, 3B2

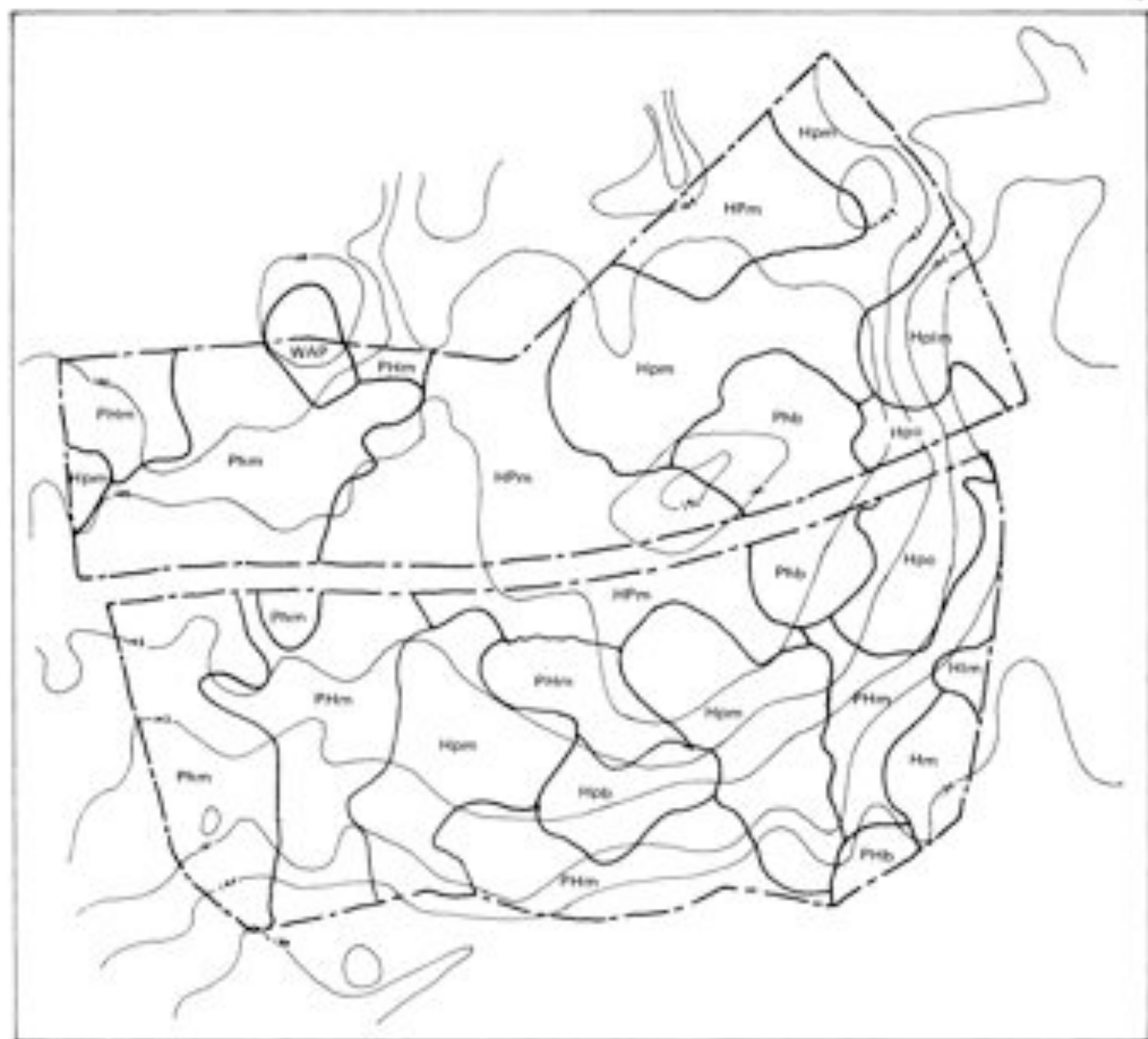
3B. Other than 3A above

3B1. D soils (SU, AN, SE, SEG, SPH, SO, SS, TK, BI, TU, CR, WA) with slope greater than 1% which do not drain to recharge soils

3B2. D soils (SU, AN, SE, SEG, SPH, SO, SS, TK, BI, TU, CR, WA) with slopes less than 1%



Soil and Drainage Conditions



**Vegetation Types**

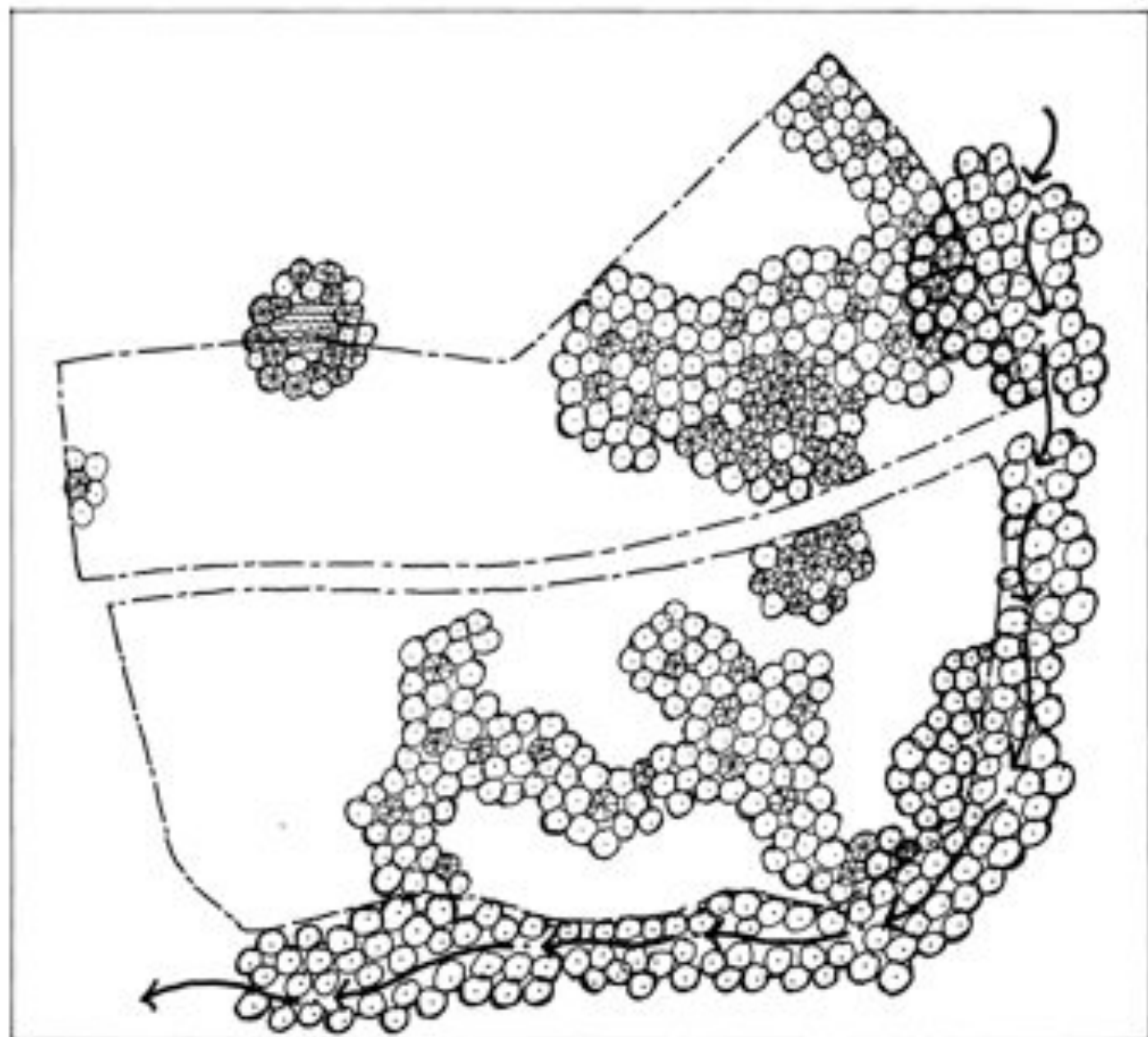
**Vegetation Types**

Identify all vegetation types found within the parcel by referring to the Vegetation Map.

**Determination of Permitted Clearance**





Once soil and drainage conditions and vegetation types have been identified, the permitted clearance for specific areas can be established.

Certain soil and drainage conditions and vegetation types require that vegetation be maintained in stands of minimum size in accordance with specific guidelines.





Site Elements Requiring Restricted Clearance

Preserve vegetation in the following areas as self-maintaining stands. (See Vegetation Guidelines.)

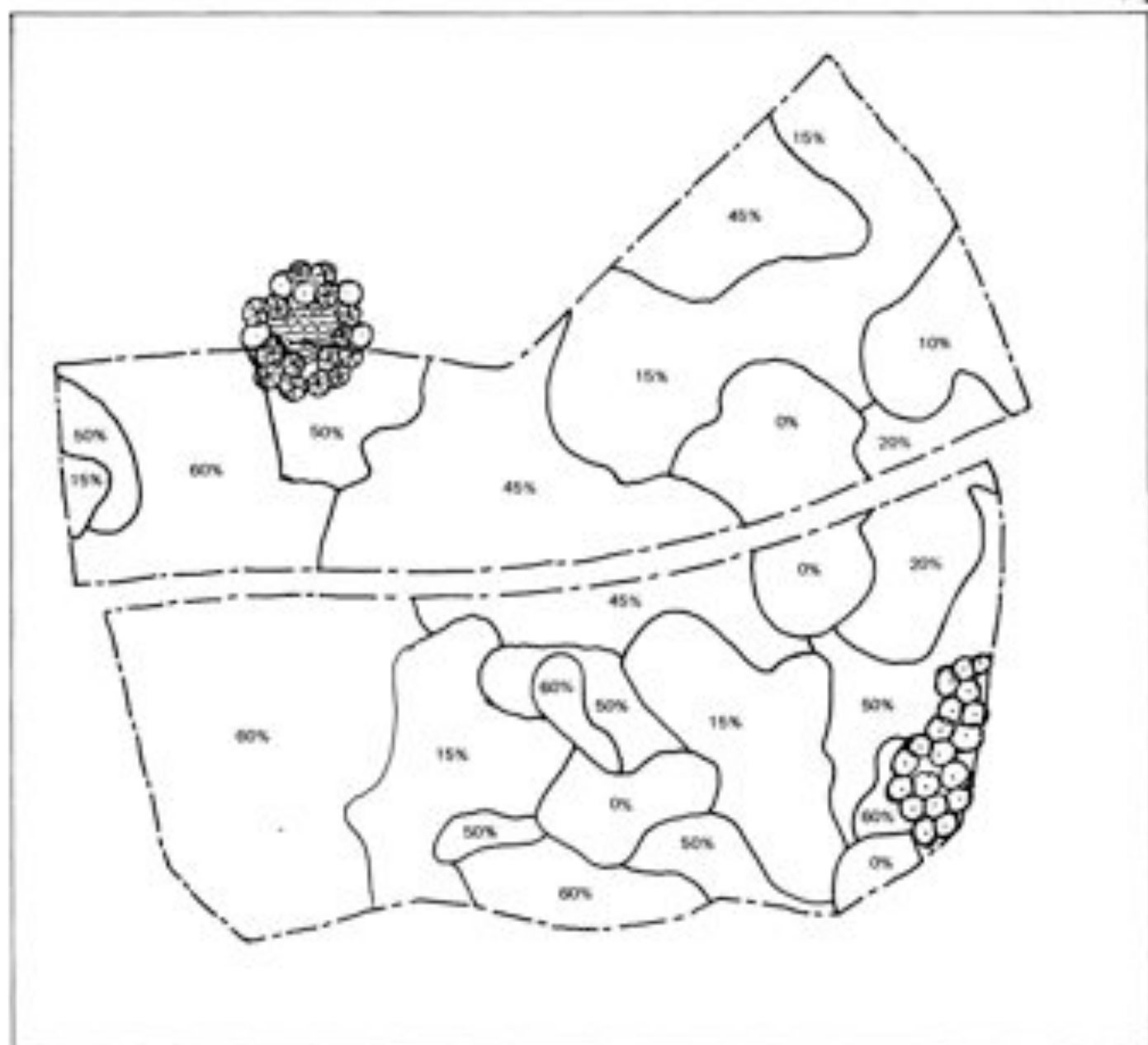
- 
**Areas of prime vegetation:** Hlm and b, Hm and B, Hum and b.
- 
**50-100 year floodplain of Panther and Spring Creeks**
- 
**The undeveloped edge of Waller Ponds**
- 
**Primary drainage channels**

Vegetation in the following areas should be preserved in self-maintaining stands, though this is not absolutely essential so long as criteria outlined in the Soil and Drainage Guidelines are met, and so long as clearance does not exceed the permitted percentage.

- 
**Areas of secondary vegetation:** Hplm and b, Hpm and b, Hpum and b, HPb, PHb, Pb,
- 
**Secondary drainage channels**

Whenever possible leave a sufficient area of adjacent vegetation types uncleared to make the stand self-maintaining.





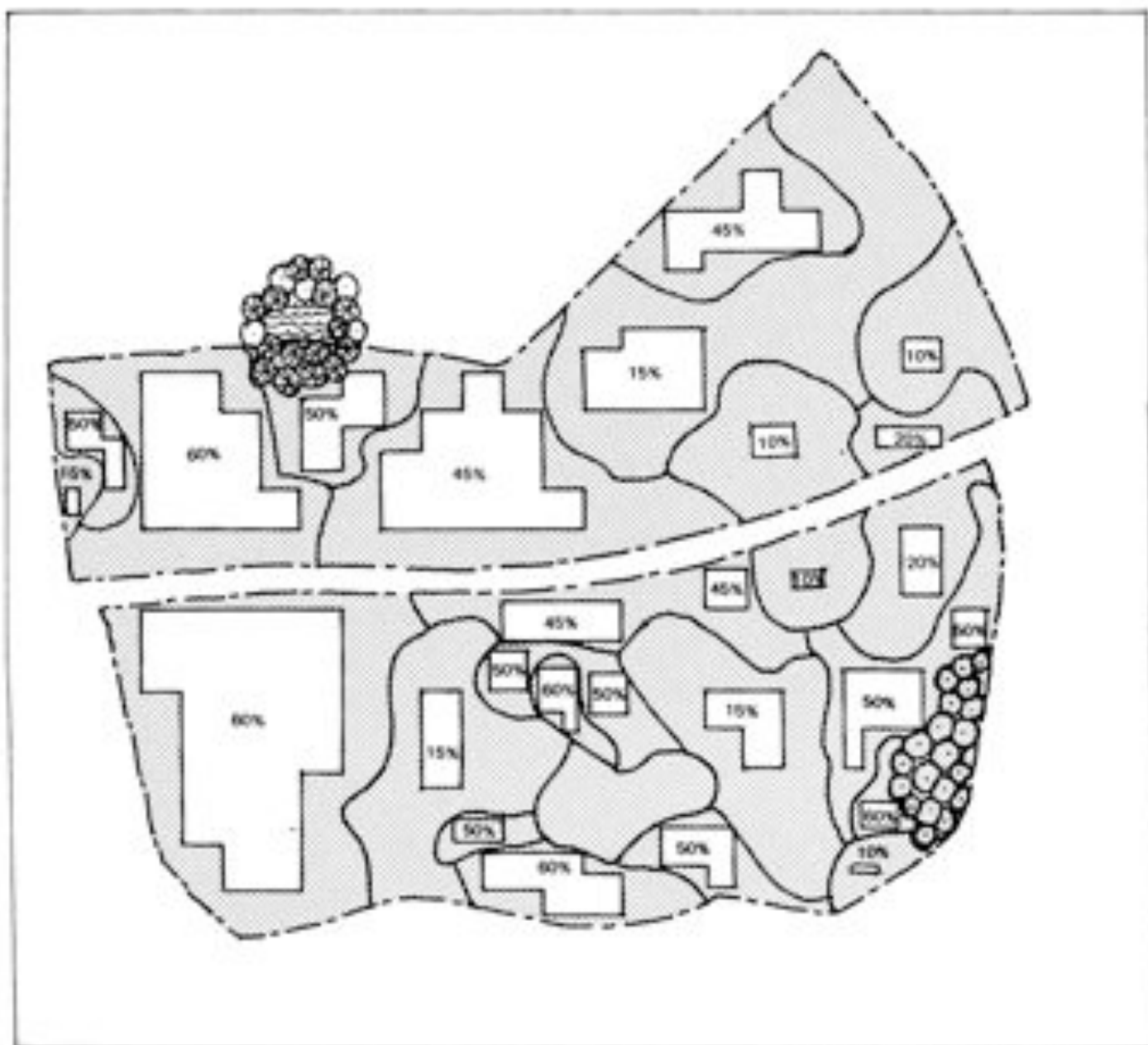
### Percentage Permitted Clearance

For all remaining areas obtain the percentage of permitted clearance/coverage based on soil and vegetation types from Chart 1, p. 39.

### Fitting the Program to Permitted Clearance

The permitted clearance/coverage in Parcels 4D and 4E is 17 acres. This figure can now be compared to the program requirements described earlier. Both housing types are assumed to be 2 story units with attached parking and a 10' building zone.

	Lot Size	Required Clearance of Lot	Acres Cleared
40 SFD-High	10,200	47.5%	4.5
100 SFD-Medium	10,200	47.5%	<u>11.6</u>
143 units	Total cleared acres in lots		16.1
	Collector and Access Roads		<u>2.6</u>
	15% of parcel area		18.7
	Permitted Clearance		<u>17.0</u>
	Excess Clearance		1.7

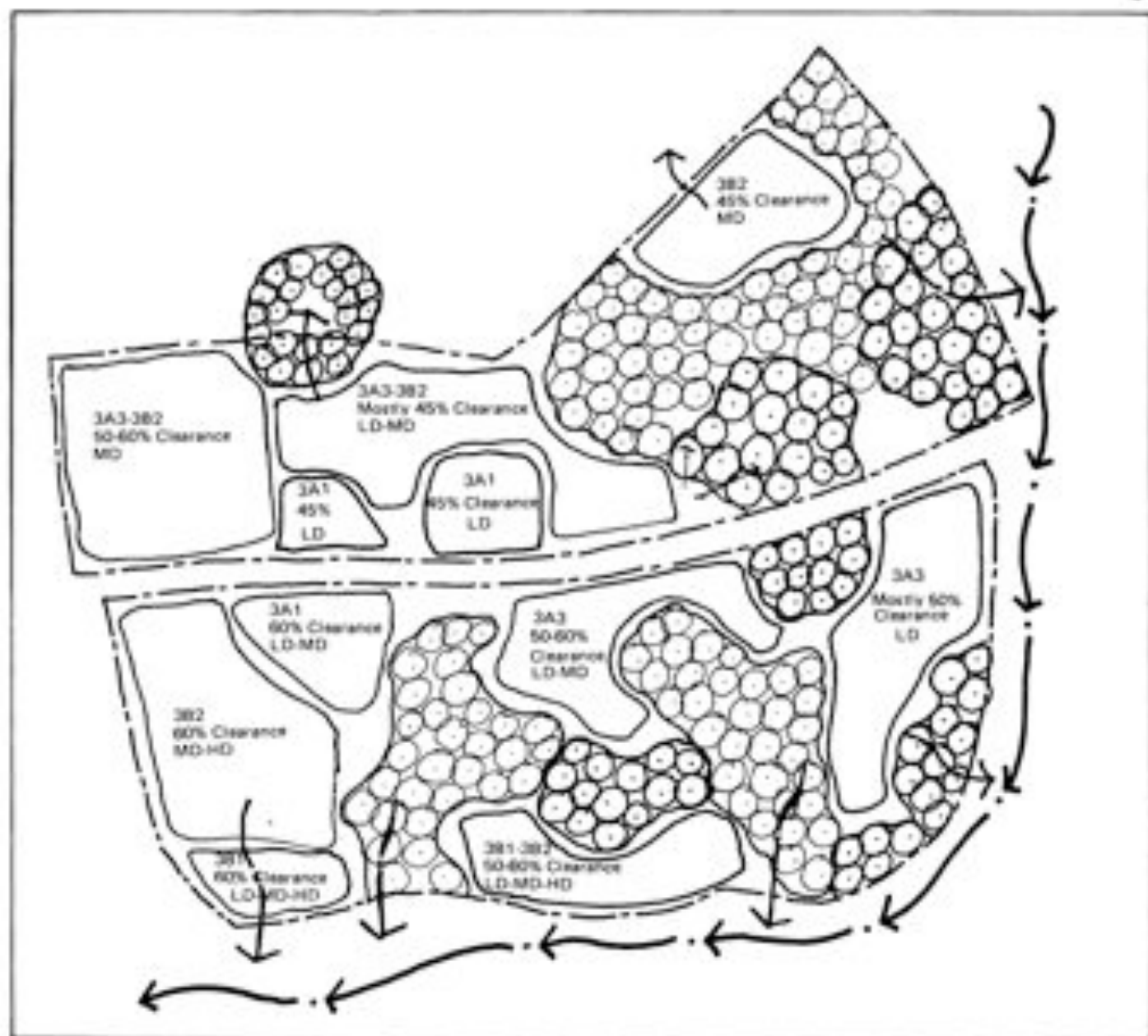


Aggregation of Permitted Clearance

This program exceeds the permitted clearance for Parcels 4D and 4E by 1.7 acres. Therefore, the residential mix option of 20% patio units was tested. 28 patio units (20% of 143 units) require less clearance per lot than the same number of single family detached medium high units, and less collector and access roads are necessary.

From these calculations it is clear that the program option including patio units meets the requirements of permitted clearance specified by site conditions.

	Lot Size	Required Clearance of Lot	Acres Cleared
40 SFD-High	10,200	47.5%	4.5
103 SFD-Medium			
High	10,200	47.5%	8.4
28 Patio-Medium	5,000	62.4%	2.0
143 units	Total Cleared Acres in Lots		14.9
	Collector and Access Roads	14% of parcel area	2.1
	Total Cleared Acres		17.0
	Permitted Clearance		17.0
	Excess clearance		0.0

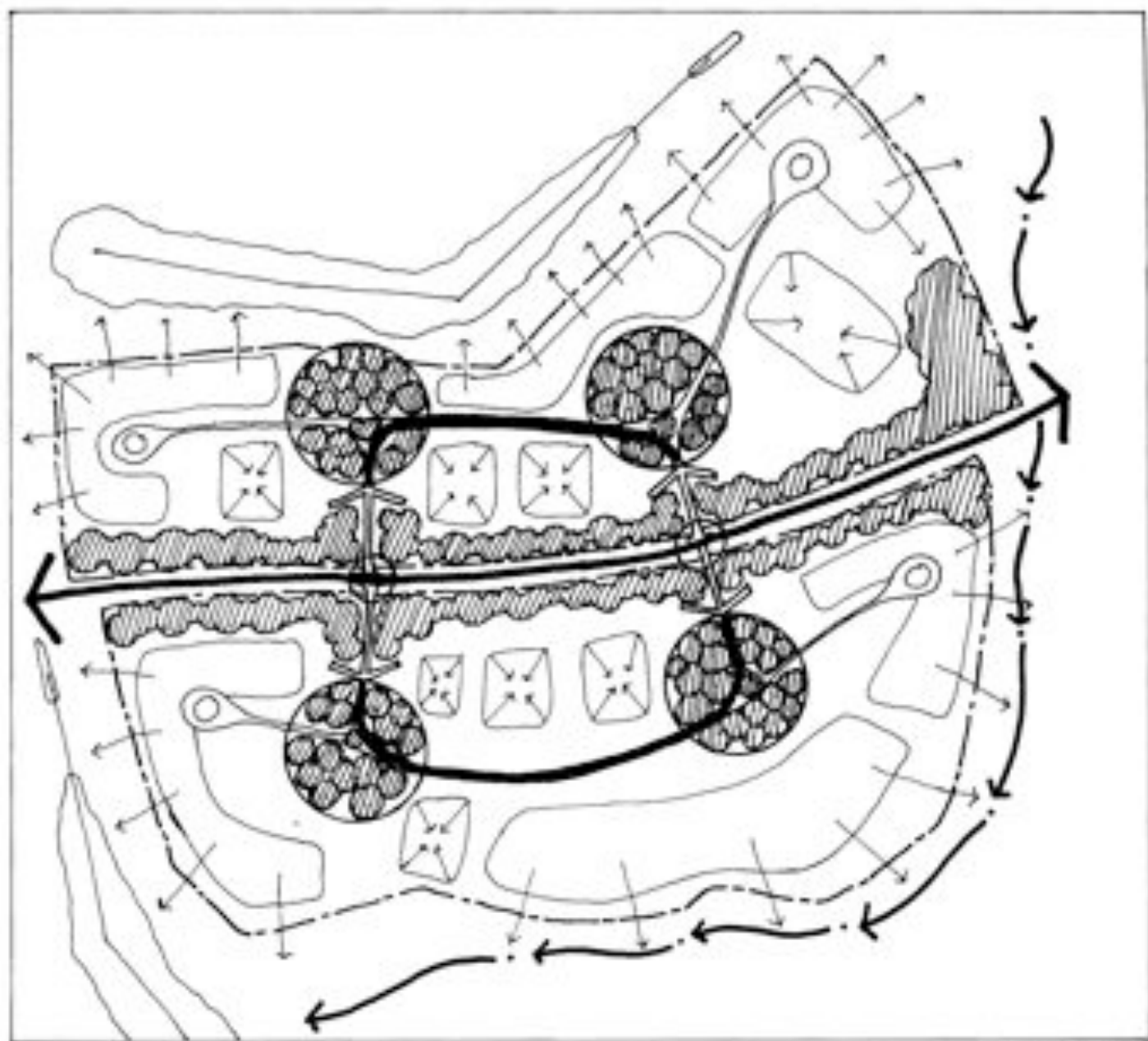


#### Determination of Cleared and Uncleared Areas

Once the percentage of permitted clearance is established for a given area, select the portion which may be cleared. The following guidelines should be considered:

- Match areas of permitted clearance with conditions most easily developed for a given program. For instance, a combination of high permitted clearance (75-100%) and impermeable soils (D) less than 1% slope would be most suitable for a high density program requiring extensive clearing and coverage.
- Match uncleared areas with soils used for recharge.
- Match uncleared areas with those conditions most difficult to develop.
- Preserve vegetation in stands as large as possible, preferably self-maintaining.
- Preserve areas of diverse vegetation (species, density, age).

Refer to the guidelines for soil and drainage conditions, guidelines for vegetation, and general guidelines for site planning.



Design Concept

#### Design Concept

The primary objective of the residential program in Parcels 4D and 4E was to create "a sub-community of distinctive medium high and high priced homes". This objective is complicated by the fact that the two parcels are separated by Millrun Drive. The two entrances to each parcel were therefore located opposite one another, forming an internal loop. This loop, with similar entrance statements, makes a clear vehicular and pedestrian connection between the two parcels.

Each entrance is aligned to focus on a distinctive landscape feature — a fine stand of trees, a Waller Pond, or a wooded drainage swale. The sense of the two parcels as a bucolic residential setting surrounded by amenity is enhanced by the use of wooded buffers and the incorporation of landscape features in the entry sequence.

Small cul-de-sac roads off the main loop — many of them narrow or private streets — form small residential enclaves. These clusters are sited to ensure identity and privacy. Wooded drainage easements

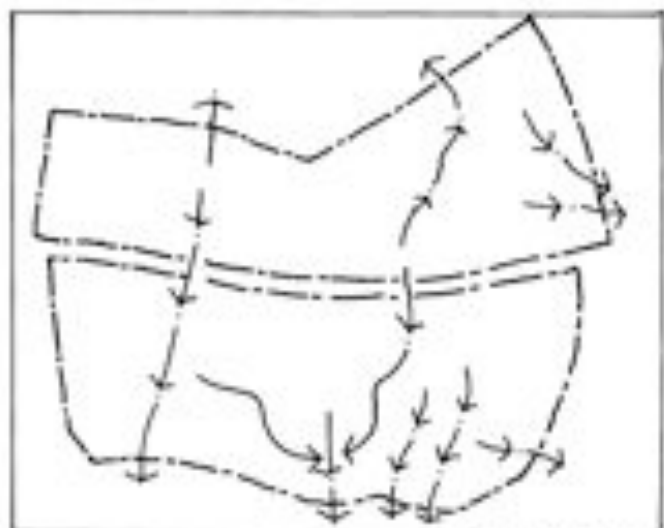


Site Plan

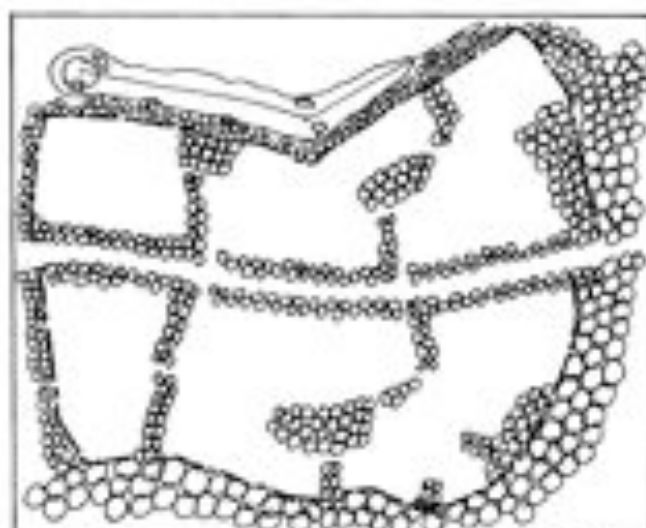
and vegetation buffers provide open space between the clusters of detached single family and patio homes.

The drainage system has been designed so that the roads perpendicular to the slope of the parcel intercept and direct runoff to points where cul-de-sac roads parallel to the slope and natural swales can direct drainage to the primary drainage channel on the eastern and southern boundaries of parcel 4E.

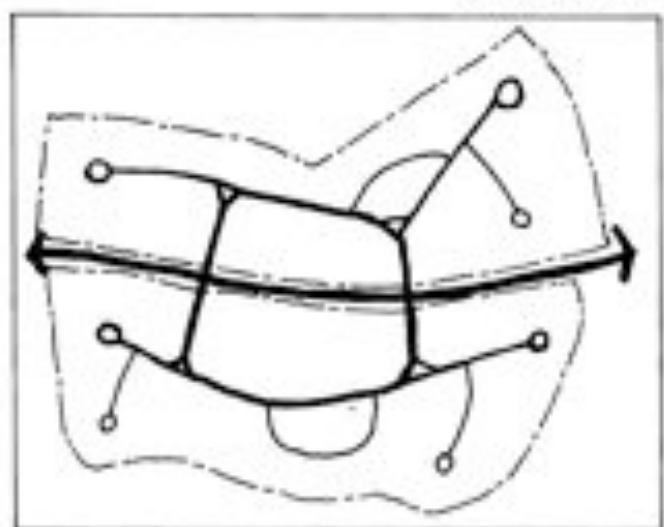




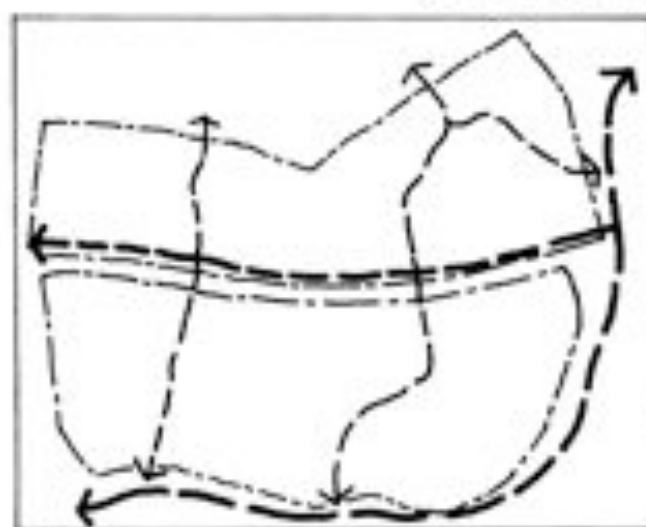
Drainage Pattern



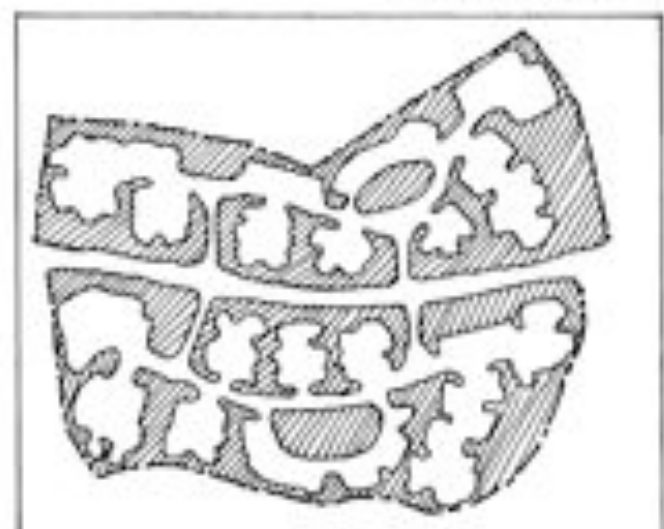
Open Space System



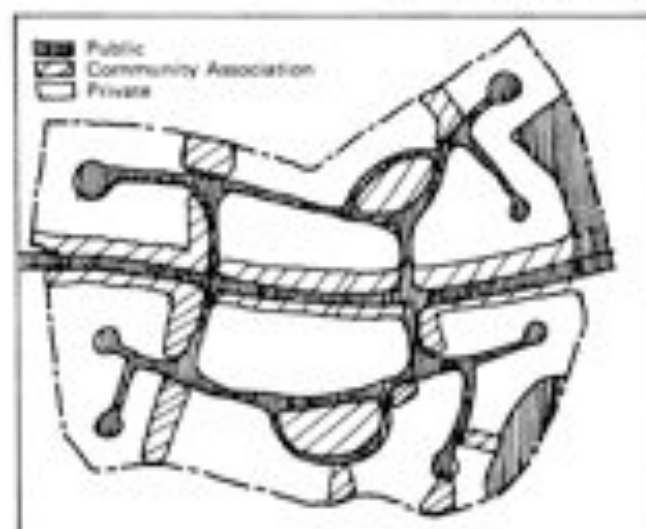
Vehicular Circulation






Pedestrian Circulation



Clearance Pattern



Private and Public Ownership

 Public  
 Community Association  
 Private