

CHAPTER 14

LANDSCAPING

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DESIGN REFERENCES

1.—AASHTO (Formerly AASHO)

(Note: AASHTO publications are subject to updating and/or revisions changes in concepts and standards develop. Therefore, the designer should ascertain as to the latest edition of the following publications that may be in effect at the time of design).

- a. A Guide for Highway Landscape and Environmental Design.—1970.
- b. A Guide on Safety Rest Areas for the National System of Interstate and Defense Highway.—1968.
- c. Guide for Selecting, Locating and Designing Traffic Barriers, 1977.

2.—U.S. Environmental Protection Agency

Guidelines for Erosion and Sediment Control Planning and Implementation.—1972

3.—Federal Highway Administration (FHWA)

Roadside Safety Design.—1975

4.—National Cooperative Highway Research Program

Report 158, Selection of Safe Roadside Cross Sections. NRC, 1975.

5.—Commonwealth of Puerto Rico, Department of Transportation and Public Works, Survey and Design Area.

Highway Design Manual.—1976.

6.—Commonwealth of Puerto Rico. Puerto Rico Highway Authority.

Standard specifications for Road and Bridge Construction.—1971

7.—Commonwealth of Puerto Rico.—Puerto Rico Water Resources Authority.—

“Siempre Adecuadamente”

8.—Albert L. Little Jr., Frank H. Wadsworth and José Marrero.—

“Arboles Comunes de Puerto Rico e Islas Vírgenes”.—

CHAPTER 14

14.-01 GENERAL

The main purpose of this Chapter is to offer a landscape design guide to the highway landscape designers and to recommend a close cooperation between the landscape and highway design teams.

14.-02 INTEGRATION OF HIGHWAY AND LANDSCAPE DESIGNS

The integration of the principles of highway engineering and landscape design into design of the highways will assist greatly in producing a safe, economic and attractive facility.

Results of this integration in rural areas are the broad medians of varying width and wide areas between the highway slopes and the right of way limits, major contributions to a safe and attractive highway.

In urban areas adequate consideration must be given to the integration of highway engineering, city planning and landscape architecture because of the great impact on the area through which it passes, with special attention to the multiple use and joint development possibilities in areas over, under and adjacent to the highway.

14-03 SCOPE OF LANDSCAPE DESIGN

Highway landscape design should be considered at the earliest stages of corridor development and through all the design stages. Within the scope of landscape design are considerations for conservation of land and waterways areas, preservation of historical features, topography, existing and potential land use, improved perceptual qualities and appearance, appropriate planting and reduced roadside maintenance requirements. All these are broad basic concepts, but there are minor design details to be considered as flattening of cut and embankment slopes and rounding cross sections for the purpose of preventing soil erosion. These minor design details help to mold the highway into the terrain, making it an harmonious part of the natural landscape and to minimize accident severity to vehicles leaving accidentally the roadway.

DESIGN GUIDE

14-04 LANDSCAPE ELEMENTS IN HIGHWAY DESIGN

14-04.01 CONSERVATION OF NATURAL FEATURES AND STRUCTURES

The natural features of the area should be preserved and used as elements of the highway landscape design in rural and urban areas. With a carefull selection of the alignment seashores, ponds, rivers, woodlands, croplands, rocky spots, interesting structures and vistas will be disturbed to a minimum. These features are an important element in highway design.

14-04.02 TOPOGRAPHY

The topography should be carefully studied because of its definite influence in the selected alignment. The highway should be placed where it fits in the natural contour of land, with the advantages of preservation of the natural features and environment, safety and less maintenance and construction costs.

14-04.03 ACTUAL AND POTENCIAL LAND USE

Sufficient land should be acquired with different purposes. Among them, to create a desirable and attractive environment, avoiding splitting of farms and residential developments. Changes in land use should be foreseen and sufficient land acquired for a future appropriate landscape development. The acquisition of remnats may provide areas for planting with different purposes and for the development of rest and recreation areas and overlooks.

14-05 LANDSCAPE AND GEOMETRIC DESIGN

Coordination of the common objectives between the highway design engineer and the landscape designer is of a great importance to the creation of a well integrated highway. This coordination should begin at the earliest phases of the selection of alternate routes and shall continue until the completion of the project. Highway design shares a number of common principles with landscape design and the landscape designer shall be familiar with the highway design principles.

From the standpoint of landscape design, basic elements of highway design are examined in this Section.

14-05.01 RIGHT OF WAY

The right of way width is influenced among others, by the following factors.

- a) Desire to preserve the natural landscape of the area, existing structures and vistas, blending the highway with its environment.
- b) Character and extent of the landscape treatment for a rural or urban situation.
- c) Adequate width for a cross section fitting into the natural contour of land or a rounded cross section with appropriate slopes for planting or prevention of soil erosion.
- d) Necessity of a complete separation of the highway and the adjacent areas.
- e) Considerations given to the amenities of the highway as the development of rest and recreation areas and overlooks and its aesthetic effect upon the adjoining area.
- f) Appropriate space for planting, based on the probable mature size of trees and other plant materials.
- g) Utilization of highway right of way for multiple use-joint development projects.

14-05.02 ALIGNMENT AND PROFILE

In rural areas it is desirable to fit the highway gracefully into the natural contour of land. The independent roadway design permits a pleasing and flowing alignment and profile with medians of variable width offering the advantages of natural drainageways, reduction in construction and maintenance costs and preservation of the natural features. In urban areas the alignment and profile are generally dictated by the existing street pattern. In these areas the landscape design should be carefully studied leaving adequate space for the appropriate landscape development in accordance with the adjacent land values.

14-05.03 CROSS SECTION ELEMENTS AND GRADING

Once the cross section is selected according to the engineering requirements, shall have adequate space for landscape development, providing the planting clearances from the edge of the traffic lanes as established in the subsection 14.-05.07 in this Chapter.

The cross sections shown on Figures No. 14-A and 14-B of this Chapter are examples of the varieties of possibilities for landscape treatments for different conditions of alignment and profiles in urban and rural locations.

In urban areas additional elements such as bridge abutments, concrete mats, piers and retaining walls should receive a special architectural treatment. The whole section deserves a careful study with rounded and warped grading, appropriate slopes and effective drainage and erosion control.

When necessary to establish turf for erosion control the slopes shall be 3:1 or flatter, providing for economy in maintenance, on slopes steeper than 3:1 various groundcovers such as vines and shrubs may be used to prevent erosion. When earth embankments parallel channels, streams or shorelines it is necessary to provide protection against the water erosion. This could be accomplished using planting, riprapping or building different classes of walls. Every situation deserves a careful study.

Existing vegetation and mounds between the shoreline and highway embankments should be saved as a natural protection against erosion. It is desirable to do adjustments to the highway alignment and not to change the stream channel course because of the increasing erosion effects in the area.

Contour grading plans should be used on every project, specially at intersections.

Cross sections of the highway should show the full width of right of way, paved areas, medians, shoulders, gutters, cut and fill slopes, border areas and frontage roads in all areas along the highway, to use them for the landscape design.

14-05.04 SIGHT DISTANCE

As stated in Section 3-02.01 of this Manual, stopping sight distance is the minimum sight distance required by a driver traveling at a given speed to bring his vehicle to a stop before reaching an object in his path. This distance is another control for planting along the highway. Care must be exercised that proposed landscaping do not result in stopping sight distance reduction.

14-05.05 SURFACE DRAINAGE

Drainageways deserve a careful study because of its vital function, safety and appearance in the entire landscape development. No planting, except sodding, should be done in drainageways and its surfaces should be treated with sodding or paving according with the conditions of the specific case. Flat slopes should be provided for safety, for ease of maintenance and for establishment of vegetation. An interesting study of drainage appurtenances is shown on pages 45 to 64 of the publication "Roadside Safety Design" of the U.S. Department of Transportation Federal Highway Administration, november 1975.

In urban areas paved ditches or paved gutters may be used, leading the water to drain inlets connected to the storm sewer system. All efforts should be done to prevent soil from entering the storm sewer system at the earliest construction stages.

Rounded and trapezoidal gutters and channels are generally used for drainage in rural areas. Their surfaces may be sodded or lined depending on the water volume and its velocity. Intercepting channels, ditches, dikes, swales or silting basins should be constructed to control erosion on them. All drainage systems should be as inconspicuous as possible, and blended with the natural or proposed contour lines. Grading and drainage plans are useful to the landscape designer to selected the appropriate location of the plant materials. An example of a grading plan is shown on Figure No. 14-C.

14-05.06 EROSION AND SEDIMENT CONTROL

Planting at the beginning of the construction phase is an effective mean to avoid deterioration of slopes, to prevent siltation of highway drainageways, to prevent soil from entering the storm sewer systems, and to prevent pollution of lakes, rivers and other watercourses in the area.

Grass is planted as an effective mean of erosion control on 3:1 slopes or flatter. On steeper slopes shrubs, trees and vines planting is recommended because of the little maintenance required. Optimum vegetative stability requires slopes 4:1 or less.

A dense vegetation cover of grass, shrubs, vines or trees is very effective in preventing erosion on steep slopes, swales, and along drainageways and impounded waters. It is important to evaluate the vegetation on a proposed development site in terms of its benefit to erosion and sediment control. The vegetative cover along waterways and around impoundments serves as a soil stabilizer and as a filter for sedimentladen water flowing into water courses. Vegetation also dissipates the erosive energy from falling raindrops, a most important contribution to sediment and erosion control.

14-05.07 PLANTING

Planting should be developed along the entire highway corridor with different purposes and according with the requirements of the highway design.

The planting plans should be developed in separate sheets. (1) They may be part of the general construction contract for some projects. For other projects it is desirable to have a separate landscape development contract. They should contain all the planting details, landscaping limits, and plants schedule. Figure No. 14-D contains some examples of planting details and Figure No. 14-E shows a plants schedule.

Areas that need special treatments such as natural growth to be preserved, planting for erosion control, selective thinning, clearing and grubbing, fertilizing or moving should be clearly indicated on the plan sheets.

The planting limits should be shown on the plan sheets using a thin broken line to make correct, faster an easier the staking-out process for planting. An example of a planting plan is shown on Figure No. 14-F.

From the Guide for Highway Landscape and Environmental Design is taken the following valuable information related to the planting purposes:

a. Screening for Headlight Glare

This can be of considerable value in certain areas depending on road alinement, ground forms, existing vegetation, and width of median separation. The screening of headlight glare between an urban highway and the immediately adjacent frontage road is often desirable. In some situations, materials other than plants may be appropriate. Where needed, planting should form a continuous screen and avoid intermittent glare. The method of controlling headlight glare should be determined at an early design stage.

b. Screening for Noise Abatement

The effectiveness of screen planting for noise abatement has not yet been definitely determined. It could depend upon many factors, such as: density of plant foliage, density of plantings, distance from traffic noise, slope of ground, direction of prevailing winds, and highway type and design. The visual obscuring of traffic by planting between the highway and adjacent areas may have a psychological effect of seeming to deminish highway noise. Research is being done on the subject.

c. Screening of Undersirable Views and Objects

This is commonly used and effective method of obscuring undersirable views seen from and toward the highways. In some cases, effective screening with plants will take a period of years to achieve but this should not prevent the accomplishment of such work. The sight lines from and toward the highway to the object to be screened should be studied. Occasionally, there will be an opportunity to utilize existing trees and other growth as the foundation of a screen planting. Action should be taken early in the design stage to take appropriate measures to protect the existing vegetation. In some instances, a year-round screening effect is desirable. Effective screening may be accomplished by using fencing or other structural materials. Whenever possible, consideration should be given to the removal of the objectionable development.

d. Planting for Traffic Indication

Functional planting can assist in making it evident to the motor vehicle operator that a change in alignment of the road is imminent or that the operator is approaching an exit or a bridge. Such plantings should be designed with consideration for traffic safety, inexpensive maintenance and ease of mowing.

e. Planting to Provide Shade

Trees and other plantings should be used to provide shade where desirable. Shade effectiveness should be analyzed carefully in consideration of offset distances and the angle at which shade is cast by the summer sun.

f. Planting to Control Sand Drift

Sand drift presents unusual problems specific to the individual site and may require special consideration.

g. Planting to Provide a Crash Barrier¹

Dense shrub masses, by their slower decelerating effect, cause less damage and injury to car and driver than solid barriers. However, they may require 2 or 3 years to become firmly rooted and well grown. In the median, multiple rows of dense shrubs are effective.

h. Offset Distances for Trees

The following descriptions may vary somewhat from State to State, according to a State's special experiences and safety regulations.

New plantings of trees whose trunk diameter at maturity will exceed 4 inches should not be made closer than 30 feet from the edge of the traveled way except in special circumstances. However, the 30-foot distance for vehicle recovery area is not to be considered a fixed single-control dimension. Variations in cross section design and traffic speed may increase or decrease this dimension. Shrubs and ground cover may be planted or be retained within the recovery area for safety and esthetic purposes. Existing trees may be retained (1) on the high or cut side of the roadway not in the likely path of an uncontrolled vehicle, (2) on the low or fill side if protected by a guardrail or not likely to be hazardous to an out-of-control vehicle, and (3) if important historically or esthetically and protected by a guardrail.

¹ When necessary to provide a crash barrier a careful study should be done to determine the effectiveness of dense planting in lieu of barrier or impact attenuators. In the Guide for Selecting, Locating and Designing Traffic Barrier "AASHTO 1977", the use of vegetative barriers is not included.

Minimum setbacks for newly planted trees with an ultimate trunk diameter of more than 4 inches should be as follows:

(1) 50 MPH or greater design speed²

a) Minimum setback from the edge of the traffic lane should be 30 feet unless one of the following reasons will allow for a lesser distance.

1. Cuts of 3 to 1 or steeper-10 feet behind the point of vertical intersection (P.V.I.) at the toe of the slope.

2. Where concrete barriers, walls, abutments, or other rigid obstructions are used-4' behind the obstructions.

3. Where flexible guardrail (box-beam, W-beam, or cable) is used-6 to 20 feet behind the face of the guardrail, depending upon the type (See NCHRP Report 54, "Location, Selection and Maintenance of Guardrails and Median Barrier". HRB, 1968.)

4. Where there are barrier curbs near a traveled lane-6 feet behind the face of the curb; adjacent to a parking lane-no definite setback distance.

5. Where limited right-of-way or the necessity for planting would result in less clearance, all factors in the particular problem area should be weighed to decide if a special exception is warranted.

(2) 50 MPH or less design speed

Minimum setback from the edge of the traffic lane may be 25 feet unless one of the reasons set forth under (1) will allow for a lesser distance.

(3) On curves, adequate sight distance for the design speed of the highway must be maintained.

(4) Modification of the minimum setback may be required by special considerations. For example:

(a) Occasionally, special conditions may warrant planting slightly closer to the pavement in order to fulfill some limited specific function, but most functional planting should consist of low-growing shrubs below the line of sight.

(b) The characteristics of the plant material used affect the amount of offset needed.

Some conditions may be unfavorable to plant growth in an urban area. Drainage conditions may be inadequate; there may be excess drainage or not enough. Air pollution is often serious, from the fumes of motors and from adjacent factories. Many plants, including most evergreens, cannot survive the polluted and dust-laden atmosphere of severe urban condition. The reflected heat from pavements and buildings further limits the use of many desirable plants. Only those plants which have proved themselves adaptable to the difficult growing conditions found in some urban situations should be used in such locations.

Good planting soil is one of the necessary requirements for successful plantings. Paving stones or bricks laid with open joints, or a metal or concrete grate may be used to keep pedestrian traffic from compacting the soil over the roots. Where practical, areas to be mowed may be topsoiled, graded, seeded, and mulched according to standard practices of the several States."

² The "1977 AASHTO GUIDE FOR SELECTING, LOCATING, AND DESIGNING TRAFFIC BARRIER" recommends minimum distances to obstacles that differ from those recommended in this section. Please see figures IIIA-3, VII-C-1, VII-C-2, VII-C-3, VII-C-4, VII-C-5, and VII-C-6.

The clear distance to obstructions recommended in the Guide for Highway Landscape and Environmental Design should be compatible with the following publications:

1. This Design Manual.
2. Selection of Safe Roadside Cross Sections, NCHRP Report 158.
3. Guide for Selecting, Locating and Designing Traffic Barriers, AASHTO 1977.

The Puerto Rico Highway Authority Standard Specifications for Road and Bridge Construction cover all the subjects related to landscaping.

14--06 **ADDITIONAL CONSIDERATIONS FOR HIGHWAY LANDSCAPE DESIGN AND MAINTENANCE**

The location and spacing of the plants in the final design should be based on the probable mature size of the plants selected. The size of the plants to be used in the design should be in scale with the size of the areas to be planted and with the structures in the project, creating a balance among all the features in the landscape design.

If the selection of the plant materials is done among the species of plants existing in the area the new planting will help to blend the new facility with the natural landscape of the area. Other species may be used in special locations because of its aesthetic value and to avoid monotony in the design.

An useful aid in the selection of trees for different locations in Puerto Rico is the book "Arboles Comunes de Puerto Rico e Islas Virgenes".

When designing for planting in urban areas the selection of the plants to be used should be done considering the difficult growing conditions found in these areas, providing for then adequate planting spaces. A careful selection of the species of trees and their root growth habits or to develop special planting methods is necessary to avoid damages to sidewalks, street pavements and public utilities under and above the ground level.

Trees should not be planted where they interfere with the highway or street illumination.

The installation of aerial utilities structures should be avoided in areas such as scenic strips, overlocks, rest areas, recreation areas, the right of way of highways adjacent thereto, and the right of ways of sections of highways which pass through public parks and historic sites.

The surrounding environment and the type of highway have a definite influence in the design of bridges, retaining walls, planters and other structures to be used in the desigs of the complete highway and in the selection of the highway hardware which includes bridge railings, luminaries and traffic control signing.

Maintenance is a factor in determining the most effective and economical design for roadside grading, drainage, erosion control and planting appropriate to the local soil, climatic and other conditions.

The final location on the plans of the selected plants should be done providing appropriate space for the maneuvers of the mowing and trimming machines.

In Puerto Rico irrigation is not provided for the highway landscaping projects. Thirty inches annual precipitation in the driest regions of the Southwest areas of the Island permits trees and shrubs planting, if they are selected among the species who have proved themselves adaptable to the growing conditions found in those areas.

Watering during the planting process and until the final acceptance of the job is asked for in our Standard Specifications under Construction Requirements.

Areas of mowing may be reduced by appropriate plantings. This is recommended on steep slopes, small curbed islands, narrow medians and narrow planting strips and some other locations where the mowing operations are difficult or dangerous for the operator of the equipment.

In these locations it is recommended to use vines and groundcovers.

To reduce maintenance costs is desirable to use plants that will grow to an ultimate size without requiring removal, topping or frequent pruning, those who are suitable for the planting requirements and adaptable to roadside conditions are selected.

Roadside project plans should be prepared for some projects showing: mowing limits, areas of naturalization, refertilization schedule, plant and turf reestablishment, utility locations and other management operations. These plans are useful to keep the design concepts, the outstanding vistas and the desired appearance of the Highway for many years. These plans may also be used, with some revisions, as maintenance plans.

14-07 CONSTRUCTION CONSIDERATIONS IN DESIGN

During the preliminary site evaluation the proximity of lakes, rivers, shorelines and other water courses should be evaluated in order to determine what deleterious effect, sedimentation could have on their ecological and physical features. They are aesthetically valuable and should be protected against sediment damages.

With proper planning, borrow pits can be effectively utilized for stormwater retention and sediment collection during construction. Properly constructed, with sufficient area and capacity, it is desirable to preserve them for aesthetic and recreational benefits and for runoff control.

At the completion of the construction works the borrow areas, waste areas, haul roads and any other construction or erosion scar should not be visible from the highway. The affected areas should be revegetated, regraded or in any other way treated to blend them into the roadside landscape.

Suggested practices related to the location and treatment of borrow areas, waste areas and haul roads are:

- a) Provide contour grading plans where feasible and warranted.
- b) Provide adequate space to allow for the conservation of existing screening or permit the installation of screen planting.
- c) Locate them so that the area will not be below the eye level or in exposed locations so that the screening is impossible.
- d) Cover stumps logs and other litter in areas exposed to view from the highway.
- e) Grade, plant, fertilize and mulch exposed borrow areas and waste areas.
- f) Locate access or haul roads at right angles to the highway or against the angle of vision of the motorist.
- g) Place fill around trees in a manner that will not injure or kill them (see Figures number 14-G and 14-H for suggested methods of trees protection)
- h) Place waste material so that it will not interfere with surface drainage.
- i) In certain situations, it may be advisable not to drain borrow pits in order to retain them as ponds or marshy areas.

14-08 SAFETY REST AREAS

Rest areas are integral elements of the highway and serve to provide motorists a greater measure of safety and comfort. These areas may have complete facilities including: access and exit ramps, parking areas for different vehicles, toilet buildings, drinking fountains, picnic tables

and benches, shelters, grills and or fireplaces, walks, information facilities, lighting and landscaped grounds. The necessary systems for water supply, sewage disposal, power supply, and adequate operational and maintenance procedures may also be included. The rest area should be designed as safe, useful, and attractive as possible.

The sizes and locations of their sites, according to the facilities to be provided, should be selected early in the design stage. The right of way acquisition for rest areas should be made concurrently with highway right of way. An example of a rest area is shown on Figure number 14-I.

The 1968, AASHO publication, "A Guide on Safety Rest Areas for the National System of Interstate and Defense Highway" deals with all the subjects related to their design.

Some factors that influence the selection of the site from the standpoint of landscape development are: topography, passive environment, interesting natural features, groups of trees shading the area and outstanding vistas.

If replanting is necessary, the plant materials selected should help to emphasize the distinctive character of the area.

Walks and paths should be built to provide all weather access to the facilities in the site, preventing damages to the lawn and groundcover planted areas.

The design of walks, paths, and other facilities should be done following the guides for the design and construction of facilities for the handicapped.

In some instances, additional lands have been acquired for multiple use and joint development of facilities with public agencies other than the Department of Transportation and Public Works. Where this has been done, there are agreements relating the activities and responsibilities of the concerned agencies for the design, operation and maintenance costs. Parcels, remnants of parcels, and other areas of land may be acquired to provide recreational or other facilities of a limited nature within a rest area.

Rest areas should be included when preparing roadside maintenance plans.

14-09 **SCENIC OVERLOOKS**

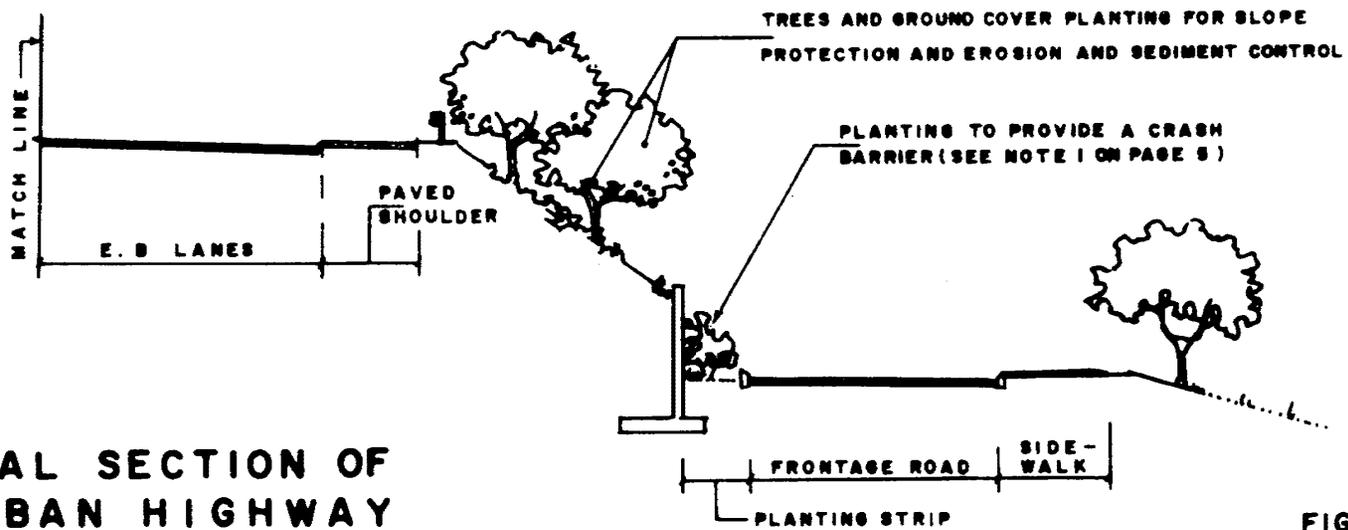
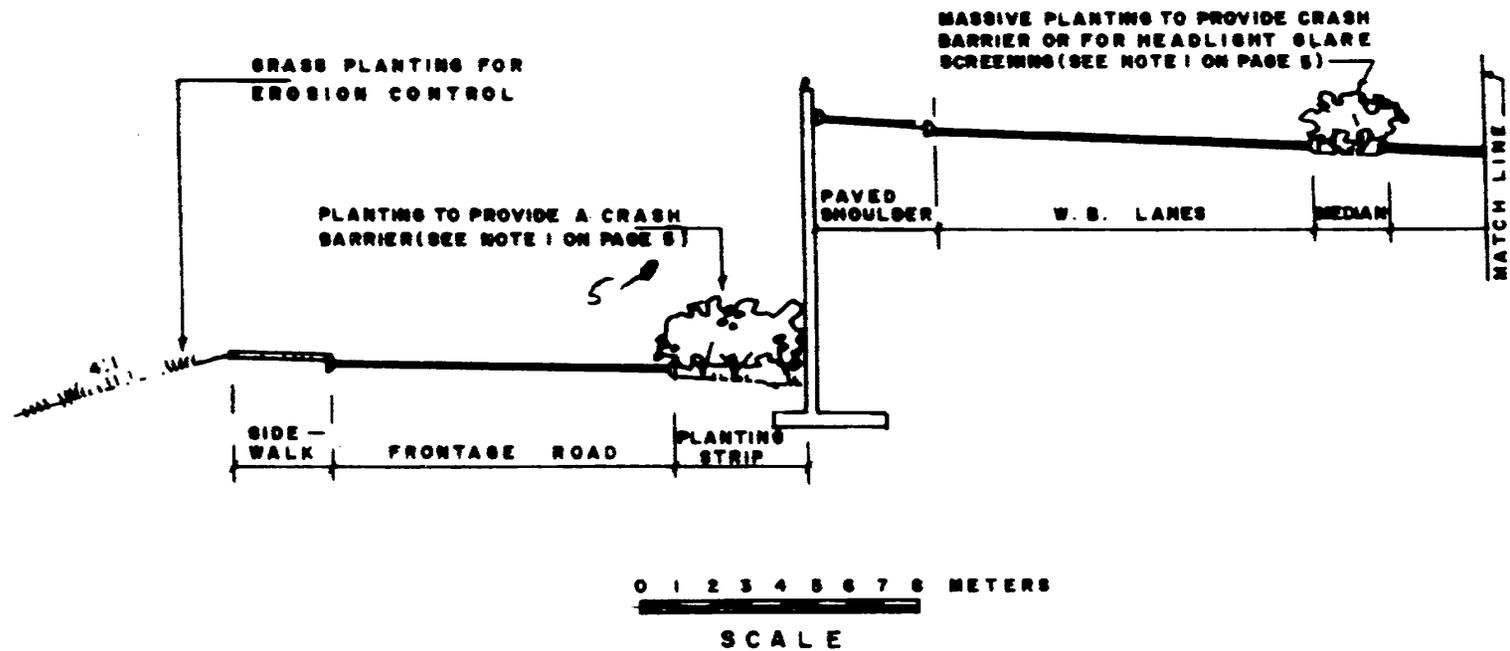
Are special areas, selected primarily to take advantage of a beautiful, spectacular or unique view.

The selection of the site should be done at an early design stage. The size of the site and the topography should determine the facilities to be provided. Adequate 'right of way' acquisition for scenic overlooks should be made concurrently with the highway right of way to preserve and protect the view.

In some overlooks picnic tables, toilets, and drinking fountains may be included. Others provide only the parking spaces, paved ramps for entrance and exit, and the landscape development.

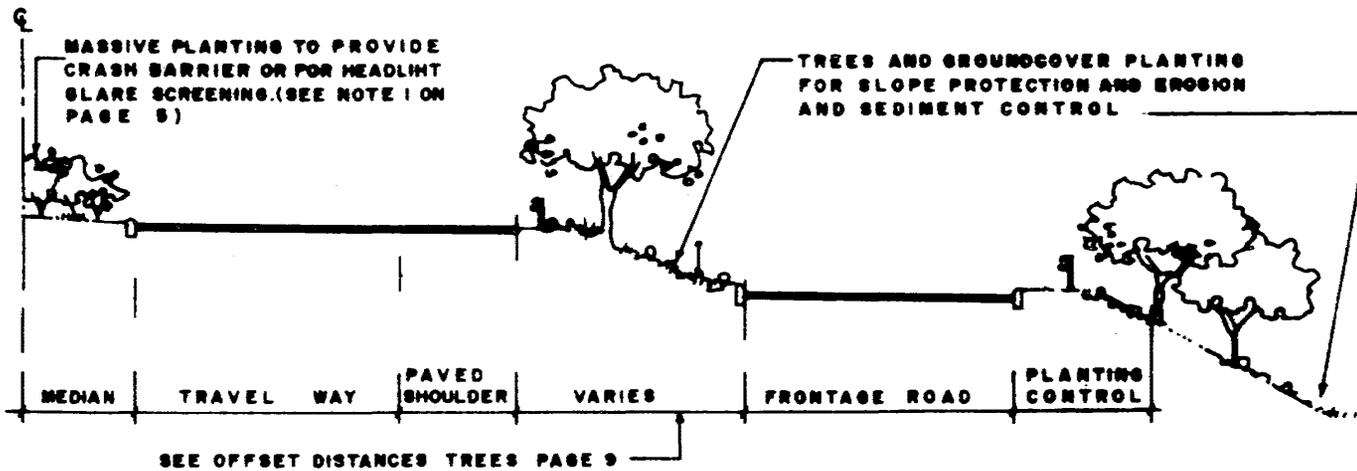
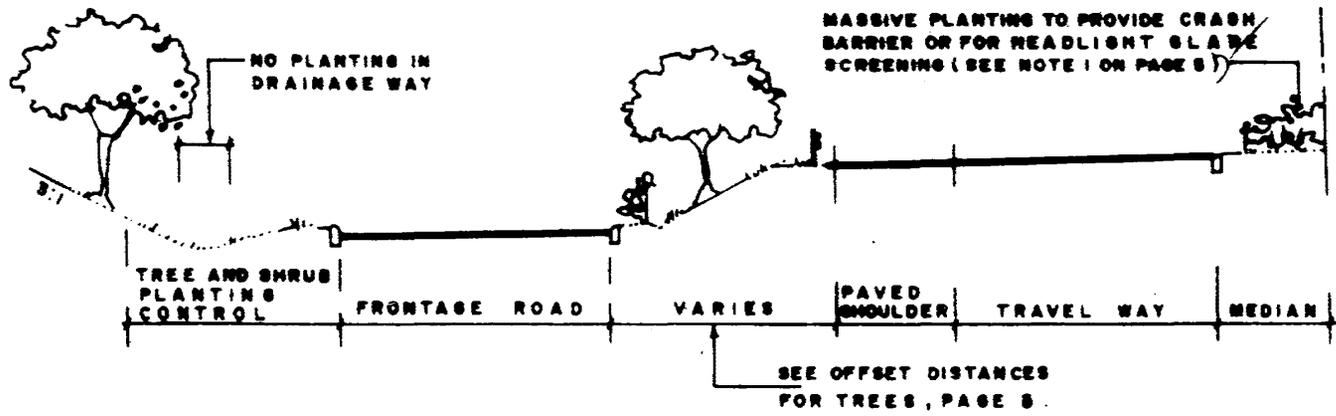
Areas from which photos may be taken should be provided. A plaque shall furnish information of the area viewed.

An example of an overlook is shown on Figure number 14-J.



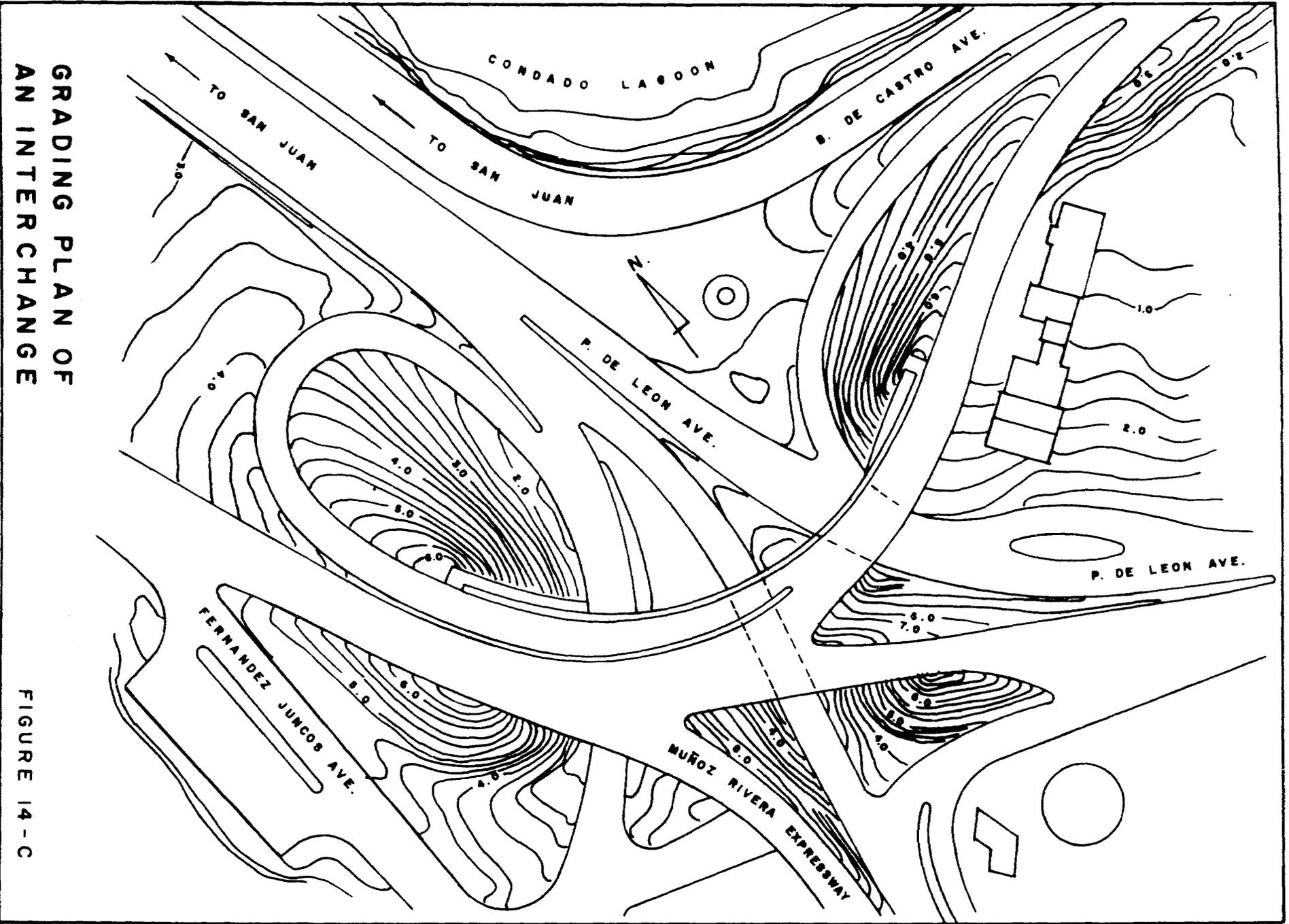
TYPICAL SECTION OF AN URBAN HIGHWAY

FIGURE 14-A



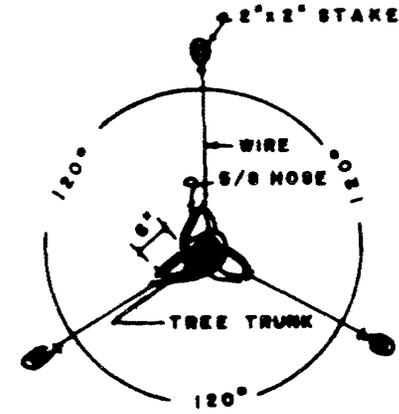
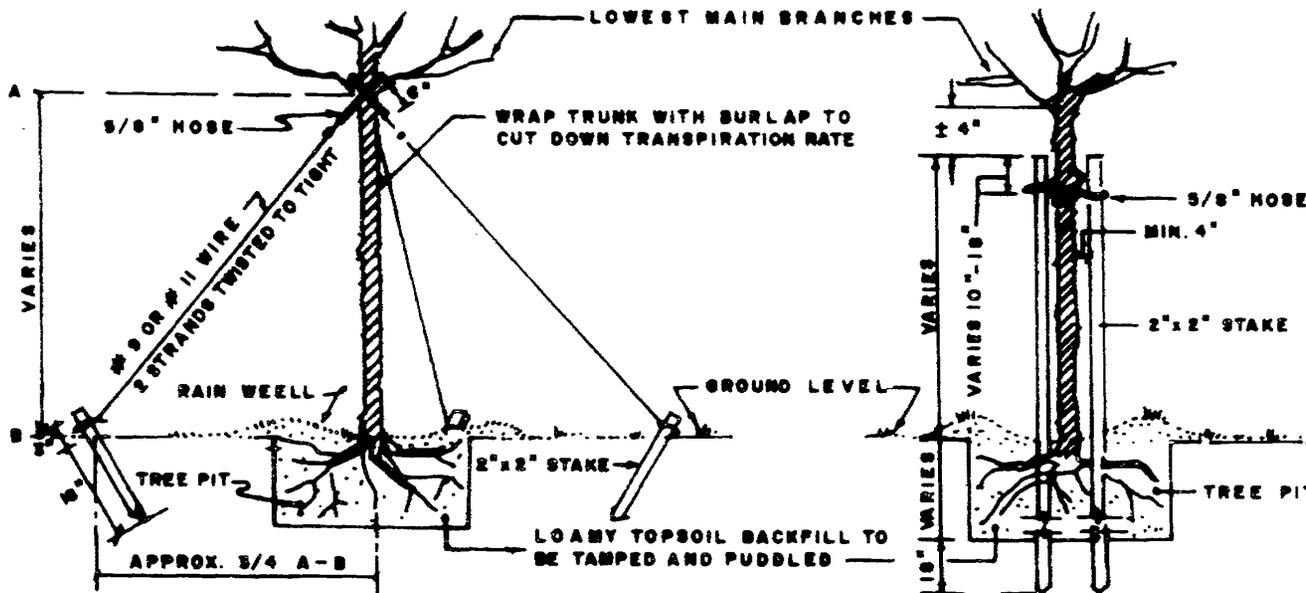
TYPICAL SECTION OF
A RURAL HIGHWAY

FIGURE 14-B



GRADING PLAN OF
AN INTERCHANGE

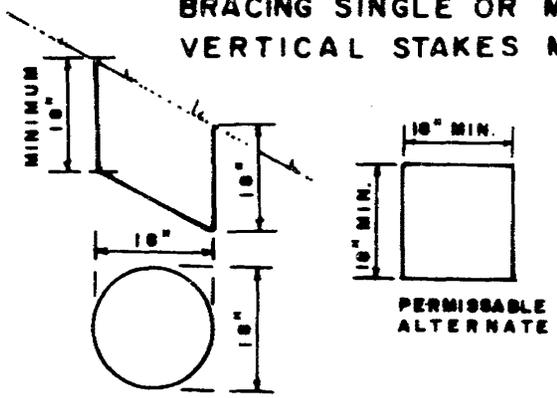
FIGURE 14 - C



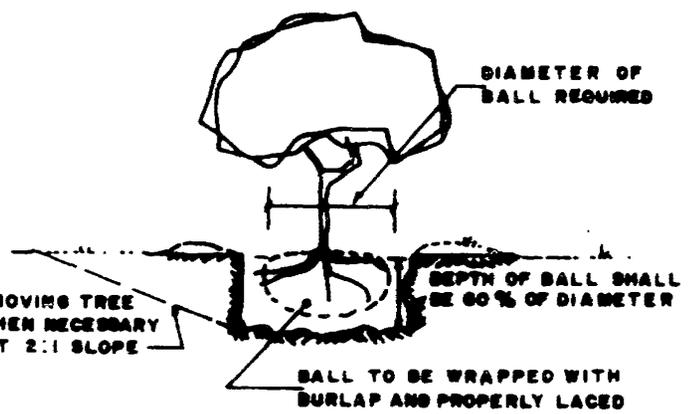
TREES LESS THAN 4" IN CALIPER
BRACING TRIPOD METHOD

USE SINGLE VERTICAL STAKE BRACING FOR TREES 2" CALIPER OR LESS AND OTHER TREES LESS THAN 6' IN HEIGHT; 2 OR 3 VERTICAL STAKES BRACING FOR TREES OVER 2" CALIPER AND OTHER TREES 6' OR MORE IN HEIGHT.

BRACING SINGLE OR MULTIPLE VERTICAL STAKES METHOD



POCKET HOLES ON SLOPE



SKETCH SHOWING METHOD OF DIGGING AND BALLING TREES

PLANTING DETAILS

FIGURE 14-D

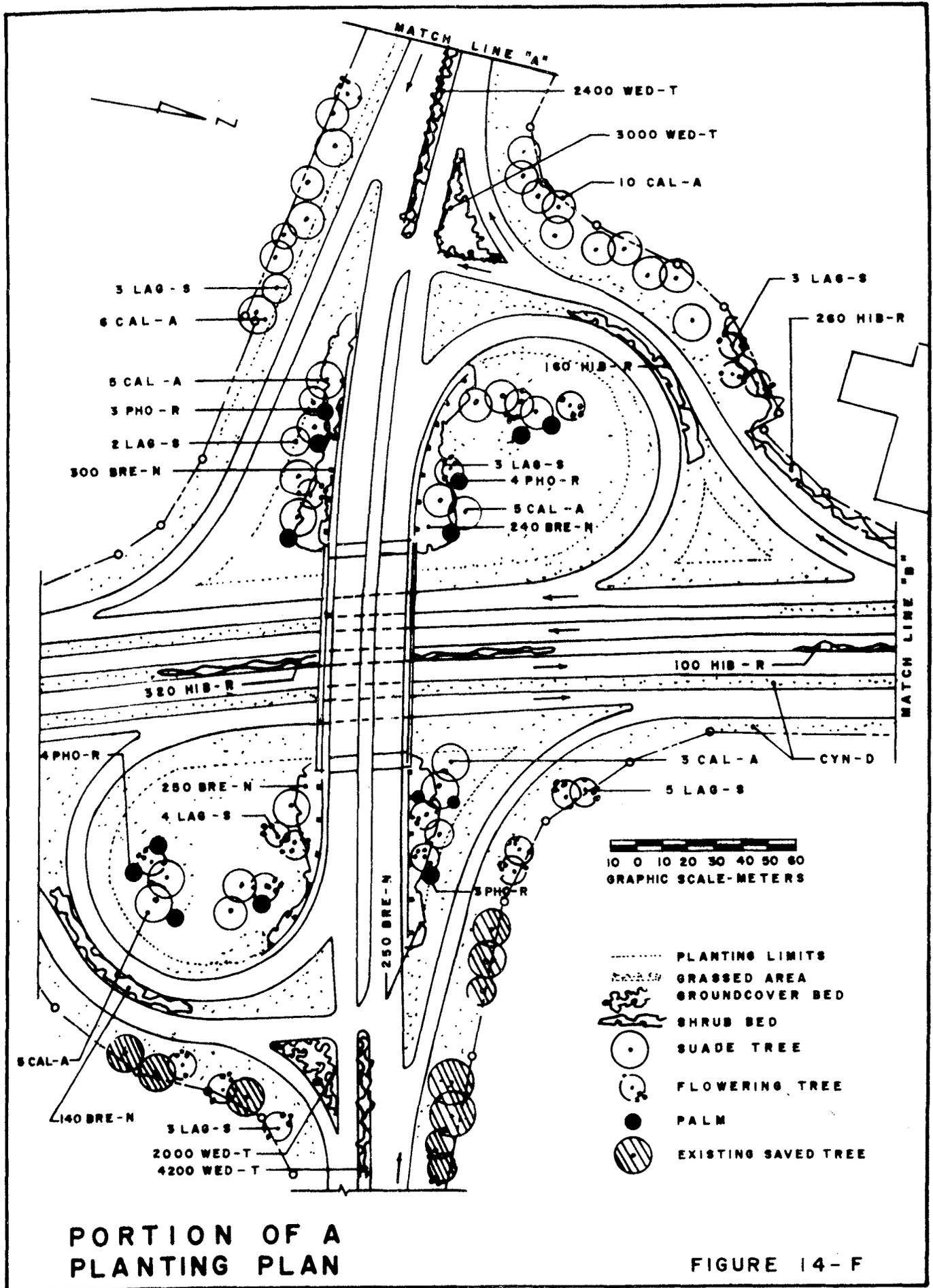
PLANTS SCHEDULE

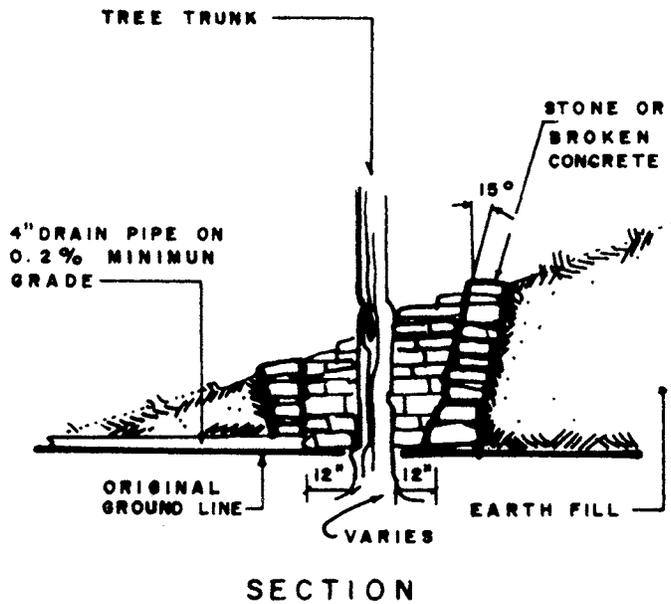
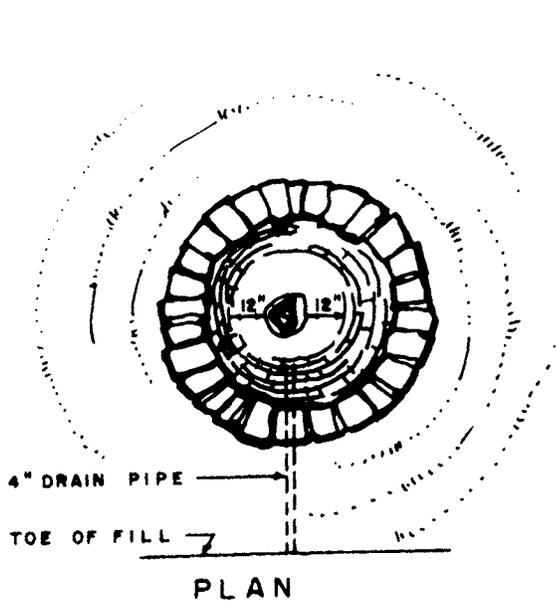
SYMBOL	KEY	BOTANICAL NAME	COMMON NAME	QUANTITY	SPACING	SIZE	DELIVERY	REMARKS
	COC-U	COCCOLOBIS UVI-FERA	SEA GRAPE (UVA DE PLAYA)	255	4'-0" C/C	18"-24"	1 GAL. CAN	FOR PLANTING DETAILS SEE SHEET NO. 159.
	NER-O	NERIUM OLEANDER	OLEANDER (ALELI)	425	4'-0" C/C	18"-24"	1 GAL. CAN	
	BAU-G	BAUHINIA GALPINI	RED ORCHID (ORQUIDEA ROJA)	9	AS SHOWN ON PLAN	18"-24"	1 GAL. CAN	VINE BAUHINIA
	TAB-P	TABEBUIA PENTAPHYLLA	TRUMPET TREE (ROBLE ROSADO)	7	" "	8'-10'	B & B	
	ROY-B	ROYSTONEA BORINCANA	ROYAL PALM (PALMA REAL)	6	" "	8'-10'	B & B	TOTAL HEIGHT
	CYN-D	CYNODON DACTYLON	BERMUDA GRASS (GRAMA BERMUDA)	7700 SQ.FT.	—	—	BLOCKS	
TOP SOIL				80 C. M.				SEE DETAILS ON SHEETS 17 TO 19

TO BE INCLUDED IN THE PLANTING PLANS

PLANTS SCHEDULE

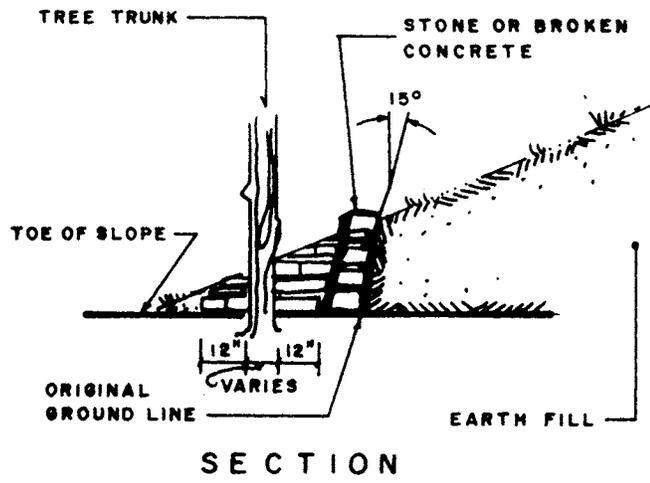
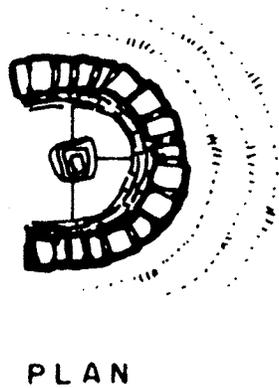
FIGURE 14-E





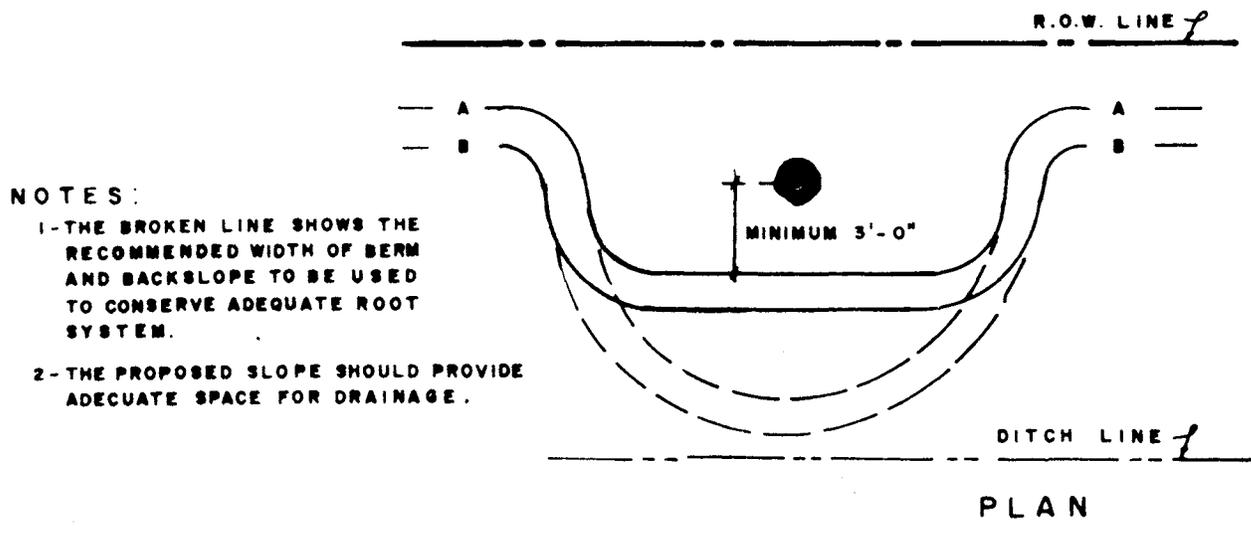
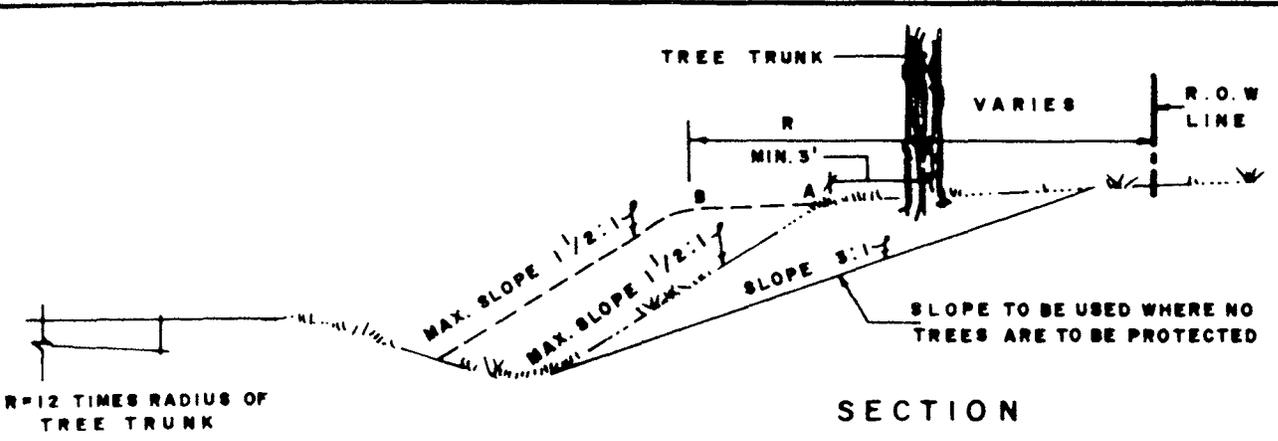
NOTES:

- 1 - HEIGHT OF WELL DEPENDENT ON SLOPE AND DEPTH OF FILL.
- 2 - DRAIN PIPE MAY BE OMITTED IF DISTANCE FROM TREE TO TOE OF SLOPE IS MORE THAN 20 FT. OR LESS THAN 5 FT.
- 3 - THE MINIMUM SIZE OF THE BROKEN CONCRETE OR RUBBLE STONE SHALL BE 4" IN THICKNESS AND 6" IN LENGTH AND WIDTH.



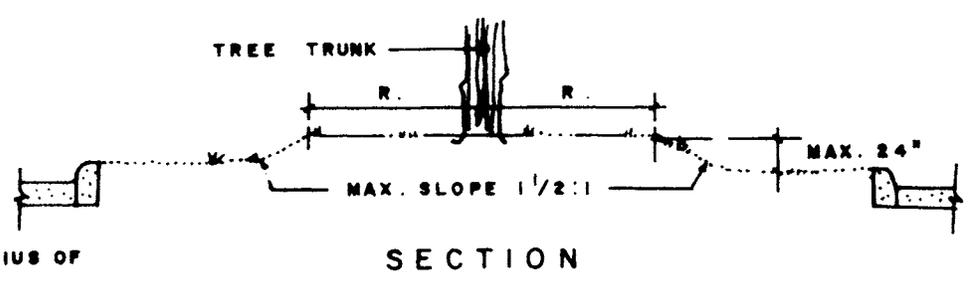
TREE WELLS TO CONSERVE EXISTING TREES

FIGURE 14-G

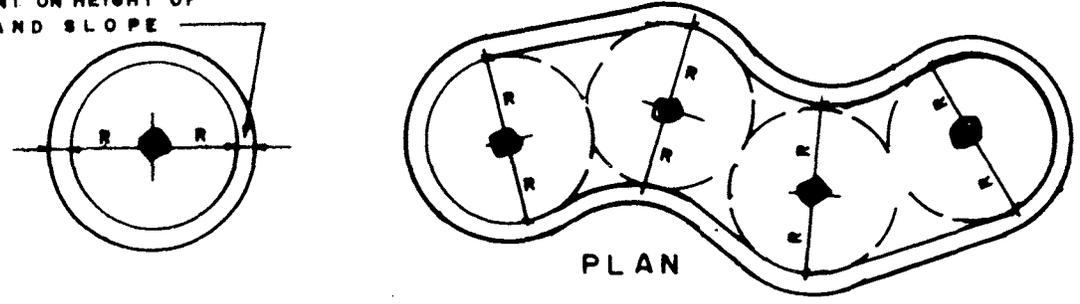


- NOTES:
- 1- THE BROKEN LINE SHOWS THE RECOMMENDED WIDTH OF BERM AND BACKSLOPE TO BE USED TO CONSERVE ADEQUATE ROOT SYSTEM.
 - 2- THE PROPOSED SLOPE SHOULD PROVIDE ADEQUATE SPACE FOR DRAINAGE.

ROOT PRESERVATION IN BACKSLOPES



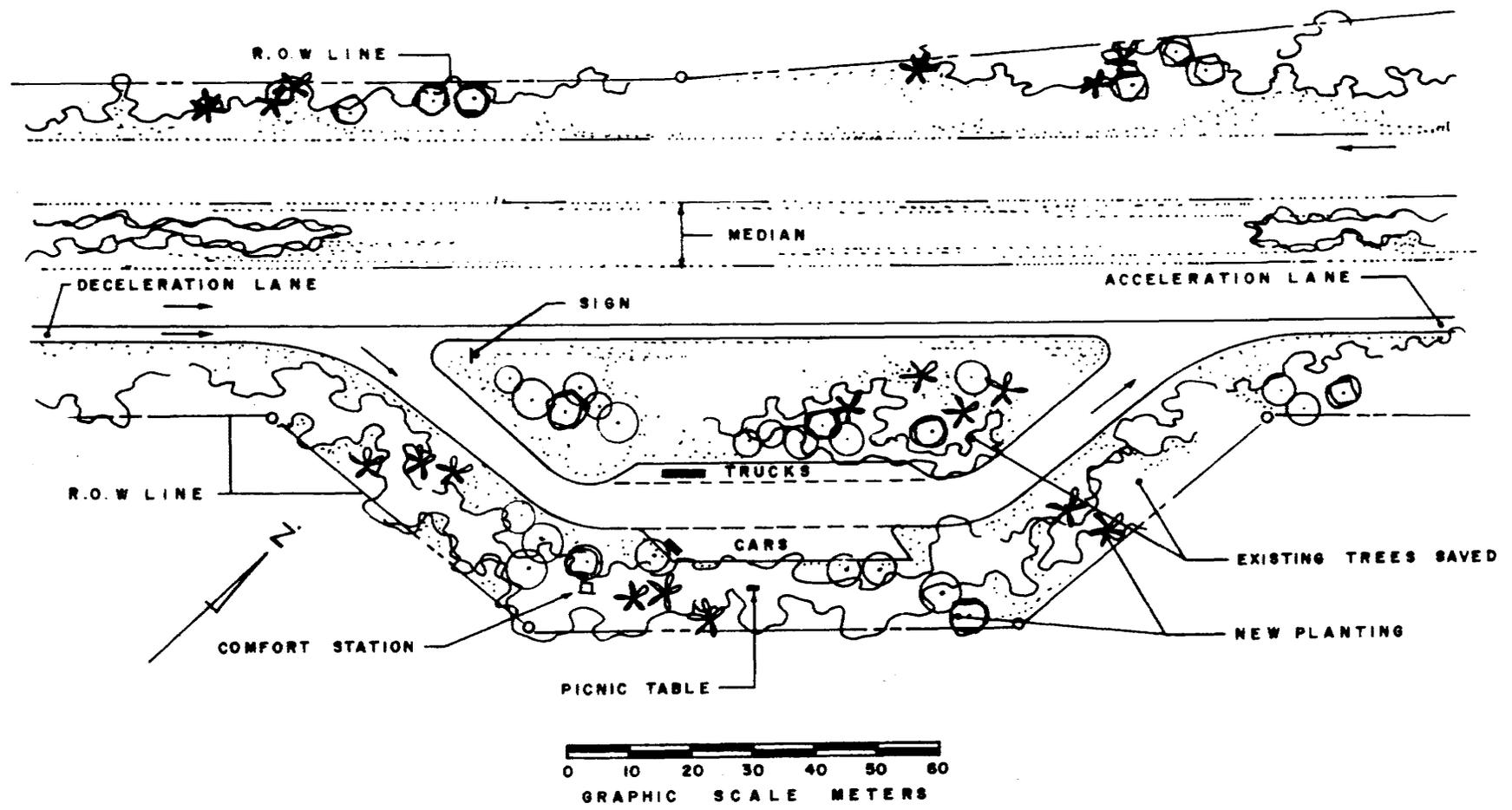
DEPENDENT ON HEIGHT OF MOUND AND SLOPE



ROOT PRESERVATION

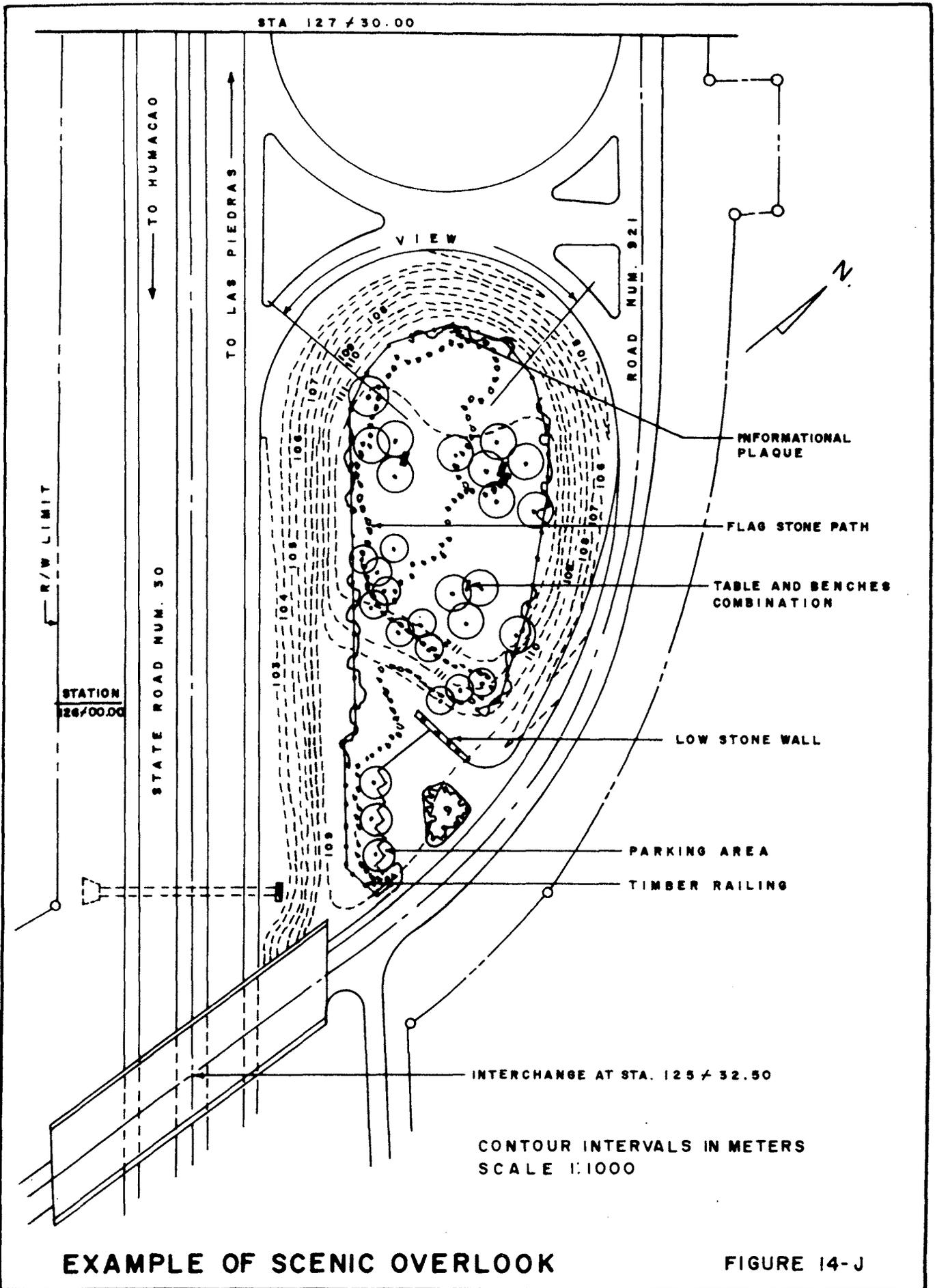
ROOT PRESERVATION SYSTEMS

FIGURE 14- H



EXAMPLE OF SAFETY REST AREA

FIGURE 14-I



EXAMPLE OF SCENIC OVERLOOK

FIGURE 14-J