CHAPTER 3

THE SITE PLAN

3-1. GENERAL. This chapter provides guidance for site planning procedures and for preparing a Site Plan.

3-2. RELATIONSHIP TO THE AREA DEVELOPMENT PLAN. An Area Development Plan may have been prepared which should provide a sketch of the facilities proposed on site. If a specific site was not part of an ADP and no conceptual plan has been prepared, review the ADP process defined in Chapter 2 of this instruction, and develop a Concept Plan for the site. Once the concept plan has been prepared and adopted by installation command, the Site Plan can be prepared.

3-3. THE SITE PLANNING PROCESS. The site planning process includes all of the steps outlined for the ADP process. The difference is in the greater detail that is required for the site plan. The site planning process is designed to occur sequentially, from beginning to end, resulting in the final Site Plan which is a detailed plan that will be used to develop construction drawings. The process involves standard land use planning practices in three major phases: Identification, Evaluation, and Implementation. The process to be followed is described in this section. For this instruction, a Site Plan for an installation Guest Housing Facility will be developed to illustrate the sequence of steps included in the process.

a. Identification. The identification phase includes setting goals and objectives, defining detailed facility and spatial requirements, defining functional relationships, and collecting base data and maps.

(1) Goals and Objectives. The goals and objectives of the site are based upon the goals and objectives of the user mission and installation development. Therefore, preparing goals and objectives requires an in-depth review of the user's mission and definition of how the proposed project is intended to accomplish or support the mission. The goals and objectives become guidelines for the planning process. The goals are more general in nature, while the objectives define specific actions that will achieve the goals.

(a) Goal: Provide for a convenient, well planned guest housing facility.

1/ Objective 1: Provide logical arrangement of Army guest buildings to provide for all rooms to be located within close proximity to office and central storage facility.

2/ Objective 2: Provide central office/check in at main vehicular entry point.

3/ Objective 3. Provide centralized swimming pool and outdoor gathering area.

(b) Goal: Provide adequate parking

1/ Objective 1: Provide 1 ½ parking spaces per guest room, 1 parking space per employee, and 5 parking spaces for the office/check in.

2/ Objective 2: Locate all guest spaces within close proximity to guest rooms.

3/ Objective 3: Provide vehicular service area for laundry and supply vehicles.

(2) Facility and Land Area Requirements. Once the goals and objectives have been reviewed and approved, the actual requirements and spatial needs for the site should also be reviewed. Accurate project requirements are fundamental to organizing and locating project elements on site. Failure to anticipate program and spatial needs can create problems with available land area, compatibility of functions and available utilities. The land area or spatial requirements are determined by the functional requirements of the user. The land area requirements include the building foot print and the other functions that are required to serve the facility, such as vehicular access, service area, staff and visitor parking, pedestrian access and open space.

(3) Functional Relationships. The functional relationships of the proposed facilities should be reviewed and organized in greater detail within the site. This process consists of analyzing the interactions between facilities and activities to determine whether they should be close together or separated in order to function in a compatible manner. Chapter 2, figures 2-2 and 2-3, illustrate typical functional relationships diagrams. Where functional relationships have not been determined, the methodology outlined in Functional Relationships should be followed.

(4) Base Map and Data Collection. The inventory of the site data will occur simultaneously with the definition of project requirements and their functional relationships. This inventory includes the collection of base maps and data about the environmental and manmade characteristics of the site and its environs. Base maps will have been prepared for the area development plan and/or concept plan for the site. These maps may not include the detail required for the preparation of a Site Plan, however, they will serve as useful reference guides during site plan preparation. The base maps and other data that will be required for the Site Plan are as follows:

(a) Base Maps. The base maps used for preparing a Site Plan will typically be prepared at a ratio of no greater than 1:1000. This scale will vary depending upon the size of the site. The base maps that will be collected or prepared include:

1/ Site Base Map. This map should include the following data about the site:

a/ Topographic survey at one meter intervals.

b/ Surveyed location of all existing structures such as paving, fences, and utilities.

2/ Tree Survey Map. A tree survey should be performed to record all trees with a diameter at breast height (DBH) of 10.0 centimeters (4 inches) or greater with their location, common and botanical name, size and condition.

3/ Location Map. A location map is included to show the location of the site in the vicinity in which it is located. Typically, this map includes the primary facilities, major roadways, and other characteristics defining the immediate vicinity of the site.

4/ Utilities Map. Existing and proposed utility locations are shown in the vicinity of the site by size and type.

5/ Transportation Map. Existing and proposed area transportation is shown with existing and proposed carrying capacity of roadways, hierarchy of roads, and any proposed improvements.

6/ Other Maps. Aerial photographs, flood maps, Soil Conservation Service soil surveys, and USGS topographic surveys can provide important data about the area.

(b) Data Collection. Data to be collected falls into three broad categories corresponding to the three environments in which people live and work: The natural environment, the built environment, and the socio-cultural environment. If an ADP and/or concept plan has been prepared, a great deal of data collection and synthesis has already been completed and should be available for the preparation of the Site Plan. The data required for the Site Plan must be site specific and typically in greater detail than that collected and used for area development plans. Site specific data includes the following:

1/ Background data such as the Real Property Master Plan, the Installation Design Guide, installation reports, area development plans and/or concept plans and user information.

2/ Architectural and Engineering Instructions (AEI), Design Criteria, provide site planning information for all facility types. This information includes requirements for non-organizational vehicle (POV) and visitor parking, energy conservation model, utility and fire protection clearances.

3/ Soil borings to determine the type and capacity of the soil to support the proposed facilities.

4/ Geologic and hydrologic analysis using soil borings.

5/ Existing ecological features of the site.

6/ Significant climatic conditions such as wind, sun, or other precipitation.

7/ Significant views to be enhanced or obscured.

8/ Significant architectural or historical features or other preservation requirements.

9/ Proposed improvements and other changes that will impact the site.

(5) Site Visit. A site visit is essential to the preparation of a site analysis. It provides a visual assessment of features such as architectural character, significant views, landscape character, and prominent land features should be inspected and recorded. The AEI provides guidance for the procedures of the visual survey. The site visit provides the opportunity to:

(a) Review and verify existing information. This can be done visually and with photography and sketches.

(b) Evaluate the compatibility of existing on- and off-site conditions.

(c) Discover previously unknown or unrecorded conditions and factors.

(d) Evaluate the design qualities and visual qualities of the site.

b. Evaluation. The evaluation phase includes analyzing the data collected and preparing site opportunities and constraints map.

(1) Site Analysis. After the detailed base maps and data for the site are collected, the data should be recorded on the maps to define in detail the physical and environmental characteristics of the site and its immediate environment. Site analysis at this stage of site planning is a far more detailed analysis of the specific site. Site analysis includes preparing a detailed drawing. This drawing should include all of the detailed information defined in data collection. The map will be an accurate depiction of the site and its characteristics including:

(a) Off-site conditions. Information concerning the surrounding environment. The following information must be obtained to perform an accurate site analysis.

1/ Surrounding Land Use. Surrounding land use should be recorded and the appropriate land use category verified.

2/ Transportation. A Site Traffic Impact Analysis for the area should be prepared. Survey the adjacent roadways showing existing lanes, curb, drainage, and curb cuts. Existing and proposed hierarchy of roadways, carrying capacities, design vehicle, and current traffic counts for a.m. and p.m. peak hour traffic. Future plans should include all proposed new roadways or roadway improvements that would impact the site.

3/ Utilities. Surveyed location of all utilities in the immediate vicinity to the site including the size of the lines, capacities of generation, current and projected demand, and proposed expansion. The utilities to be included are:

a/ Water system with locations of fire hydrants.

b/ Sanitary sewer system.

c/ Storm drainage system and drainage basin with invert elevations.

d/ Electrical, gas, and steam systems.

e/ Telephone system.

f/ Other types of communication systems or specialized utility systems.

4/ Environmental conditions and hazard (AR 200-2 and AR 415-15 provide further guidance on assessing environmental conditions):

a/ Storm drainage patterns indicating watershed boundaries and the direction of flow.

b/ Storm water management areas.

c/ Flood plains.

d/ Wetlands.

e/ Wildlife habitats

f/ Buried Tanks

5/ Historic, cultural and/or archeological resources. Any regulations governing activity near them should be identified.

6/ Safety Hazards. All requirements and distances necessary for safety such as fire codes, flood control, airfield and helipad clear zones, and explosives safety should be identified.

7/ Physical security. Coordinate the physical security requirements with the Physical Security Plan of the installation. Existing or potential threat, high probable risk targets, and current vulnerabilities to deter attack should be determined by consulting with the Provost Marshall.

8/ Sources of Air, Noise and Light Pollution. Any immediate sources of air, noise, and light pollution should be identified and their impact upon the site evaluated.

9/ Visual Enclosure. Desirable or undesirable views from the site should be recorded.

(b) On-site data. All factors within the site which may effect development should be recorded and analyzed as part of the Natural Environment Analysis, the Built Environment Analysis, or the Socio-cultural Environment Analysis. Figure 3-1 illustrates a Natural Environment Analysis for the facility development site within the guest housing facility of the Community Center ADP example from Chapter 2. The following elements should be examined to evaluate potential impacts and connections within the site development.

1/ Topography survey at one-quarter (.25) meter interval contours.

2/ Surveyed location of all existing structures, paved and nonpaved vehicular and pedestrian areas, fences, and utilities.

3/ Surveyed location of all abutting vehicular and pedestrian areas.

4/ Accurate soils identification for all areas of the site.

5/ Surveyed Location of wetlands, drainage ways, lakes, ponds, etc.

6/ Mean high tide and areas prone to flooding.

7/ Surveyed location of all utilities in the immediate vicinity to the site including the size of the lines, capacities of generation or treatment plants, and current and projected utilization, and proposed expansion. The utilities to be included are:

a/ Water system with locations of fire hydrants.

b/ Sanitary sewer system.

c/ Storm drainage system with invert elevations.

d/ Electrical gas system.

e/ Telephone system.

f/ Other types of communication systems.

8/ Surveyed location, common and botanical name, size and condition of all trees with a diameter at breast height (DBH) of 10.0 centimeters (4 inches) or greater.

9/ Surveyed Location of buried tanks, IRP’s and other hazards

10/ Surveyed location of wildlife habitats (especially for threatened and endangered species)

11/ Significant architectural or historical features or other preservation requirements

12/ Significant climatic conditions including:

a/ Average monthly temperature range

b/ Quantity and frequency of precipitation

c/ Midwinter and midsummer sunrise and sunset orientation and angle

d/ Prevailing wind direction throughout the year

13/ Significant views to be enhanced or obscured

14/ Detailed list of safety hazard requirements and distances including:

a/ Fire codes

b/ Barrier-Free Design

c/ Radon

d/ Flood control

e/ Airfield and helicopter clear zones

f/ Explosives safety zones

15/ Visual Survey. Provide an evaluation of the visual character of the site. This may include view boundaries, special visual features, vegetative character, microclimate conditions, or sensory information.

16/ Other proposed improvements and changes that will impact the site.

(2) Opportunities and Constraints. The second step in evaluating the development potential of the site is the preparation of a site opportunities and constraints map. This map is a graphic representation of all of the positive and negative site characteristics analyzed in the site analysis that will influence the location of the elements of the Site Plan. For preparing the site plan, the opportunities and constraints should include detailed analysis of slopes, drainage, trees to be preserved, views to be screened or enhanced, width of roadways and walkways, existing building footprints, size and locations of other on-site and off-site natural or manmade features that will impact the planning of the site. The opportunities and constraints as defined for the site plan should provide the opportunity to “fine tune” the previous map (figure 3-2).

Limited or Confined Site. When a site does not provide adequate space for the requirements that have been defined, the planner will be required to closely coordinate with the user to determine how the facility can be planned to fit within the confines of the site. Some methods may involve reducing the functional requirements, purchasing more land or further simplifying the design. The site analysis should be utilized to determine the appropriateness of the limited or confined site for the proposed uses and the information recorded in the opportunities and constraints analysis.

(3) Alternative Plan Development. Alternative plans are developed as a tool for selecting the most desirable final location of site elements. The process for alternative plan preparation is virtually the same as that described in chapter 2 for ADP’s, but requires more definitive decisions. Each alternative plan should be prepared in sketch form to scale. Figures 3-3, 3-4, and 3-5 illustrate alternative site arrangements for the facility which meet the goals and objectives. Through this site planning process, detailed siting arrangement possibilities can be explored to achieve an optimal design that maintains the integrity of the approved ADP and/or master plan. The rationale for design

decisions made during alternative plan development should be recorded. Notations made directly on each of the alternative plans is an effective recording method. These records will be used to compare and contrast the plans in the selection of a preferred plan.

(4) Alternative Plan Evaluation. Upon completion of the alternative plan, a preferred alternative can be selected. The alternative plan notations and other records can be used to prepare a list of pros and cons for each alternative. These evaluations can then be used to compare the alternatives through the use of a matrix created to compare elements of each alternative plan. Figure 3-6 shows a matrix used to evaluate the alternative plans developed for the guest housing facility. Within the matrix, values are assigned according to how each alternative meets the requirements, goals, and objectives of the project facility.

a/ The alternative plan evaluation process requires comparison of conflicting project demands such as site constraints, ideal solutions, costs, and future expansion needs. The preferred plan will be the one that best addresses these demands while at the same time meets the project goals and objectives outlined at the outset of the Site Plan process. The selection of the preferred plan may require several iterations of alternative plans. The preferred plan may also be a composite of the most desirable aspects of several or all of the alternatives.

b/ The preferred plan selection process should be reviewed by the following personnel to evaluate the planning matrix, the assets and liabilities of each alternative plan and the recommended preferred alternative.

1/ Design team.

2/ Customer.

3/ User.

c/ The review personnel should reach a consensus for selection of the recommended preferred plan or an alternative solution to the preferred plan. If an alternative solution is selected, the review personnel should prepare a definitive analysis of the assets and liabilities of the alternative solution that led to selection over the preferred alternative. The preferred plan must be presented to and approved by the Installation Commander and the Installation Planning Board as the final step in the selection process.

(5) Final Site Plan. Preparing a final Site Plan is the result of the alternative plan evaluation.

(a) Preliminary Site Plan. The preliminary plan will be prepared as a sketch plan. The Preliminary Site Plan will be presented to the installation review team for review and approval before the final Site Plan is prepared. The preliminary Site Plan will show the location of all program elements on the site and indicate land use, circulation, utilities, and access for the site. Figure 3-7 illustrates a typical preliminary Site Plan for the guest housing facility development site.

(b) Final Site Plan. The final Site Plan is prepared from the approved Preliminary Site Plan. In the final Site Plan, the program elements, land use, circulation, utilities, and access are developed in more detail. Figure 3-8 depicts a final Site Plan for the facility development site. The

following information may be included in the final Site Plan.

1/ Location Plan. The location plan can be included as an inset on the Final Site Plan sheet or as a separate drawing. The purpose of the location plan is to illustrate the location of the development area in relation to the surrounding activities.

2/ Final Site Plan. The plan will include a series of plans and maps that depict the final plan configuration as follows:

a/ Site Plan.

b/ Landscape Plan.

c/ Utility Plan.

c. Implementation. AR 415-15 identifies project development and execution procedures. The site plan provides the location, arrangement, and size of all the various elements of the facility. After the site plan is the prepared, the architectural and engineering construction plans, specifications, quantity take-offs, and cost estimates will be prepared.

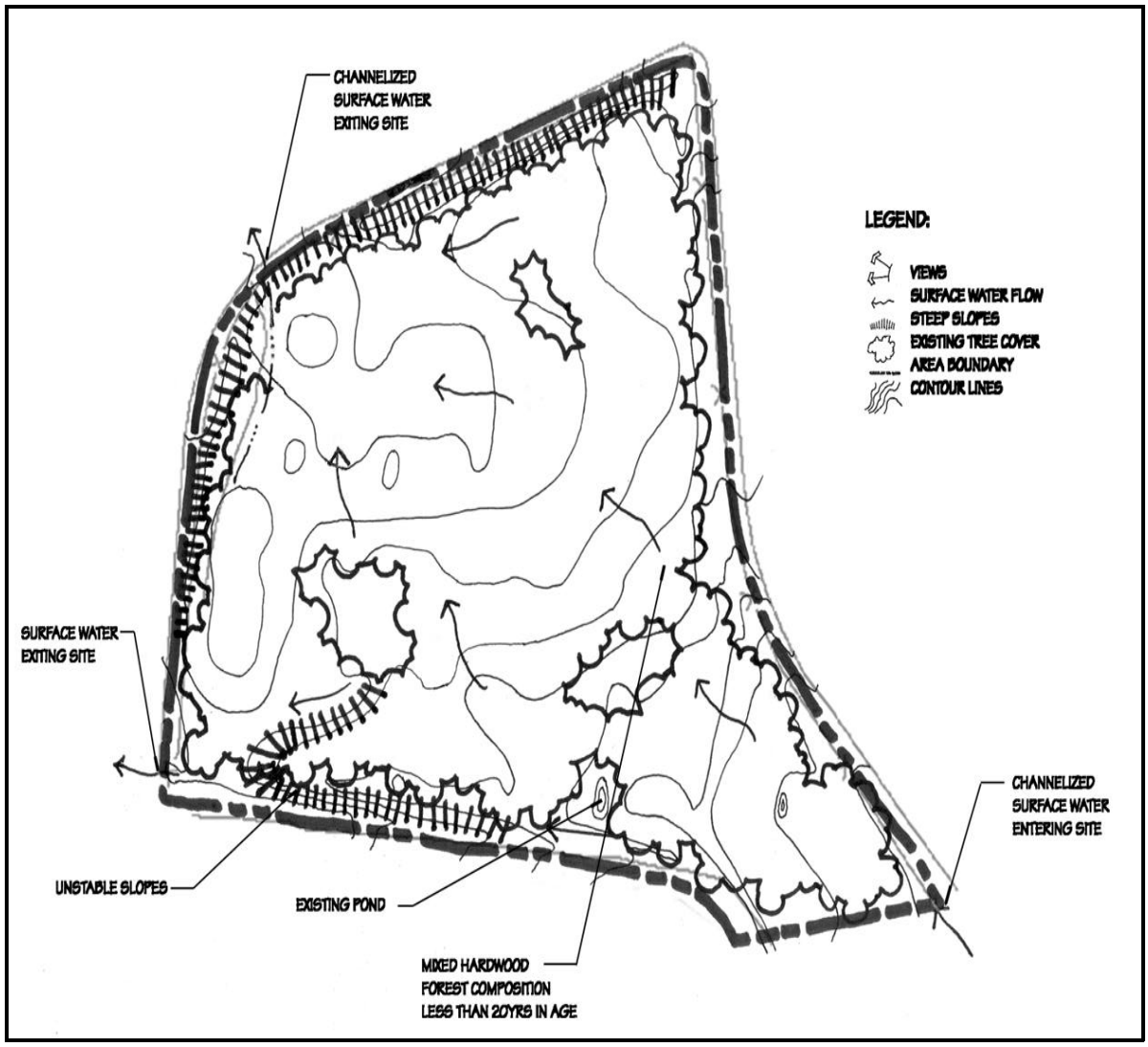

Figure 3-1. Analysis of natural environment

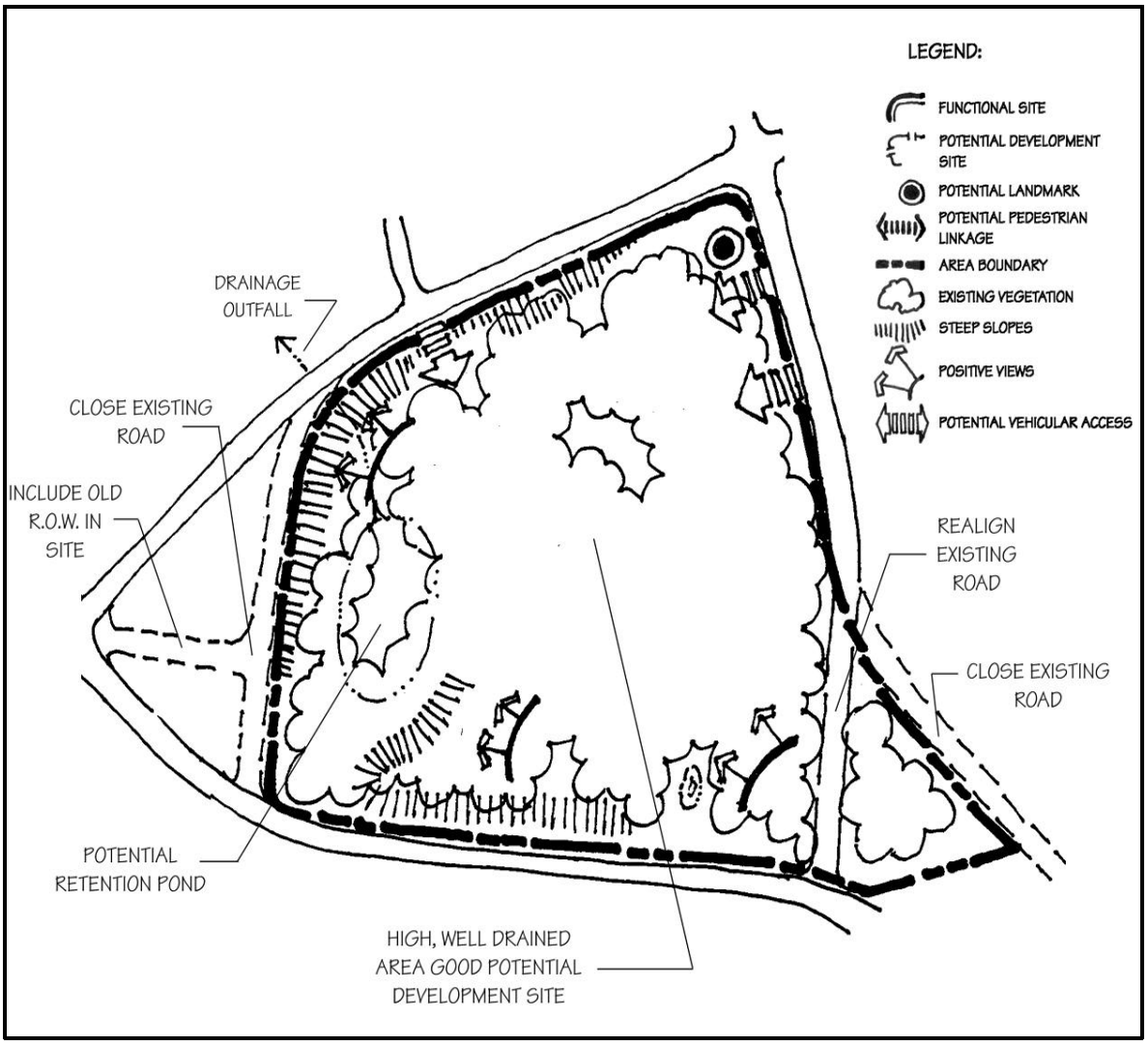

Figure 3-2. Site opportunities and constraints

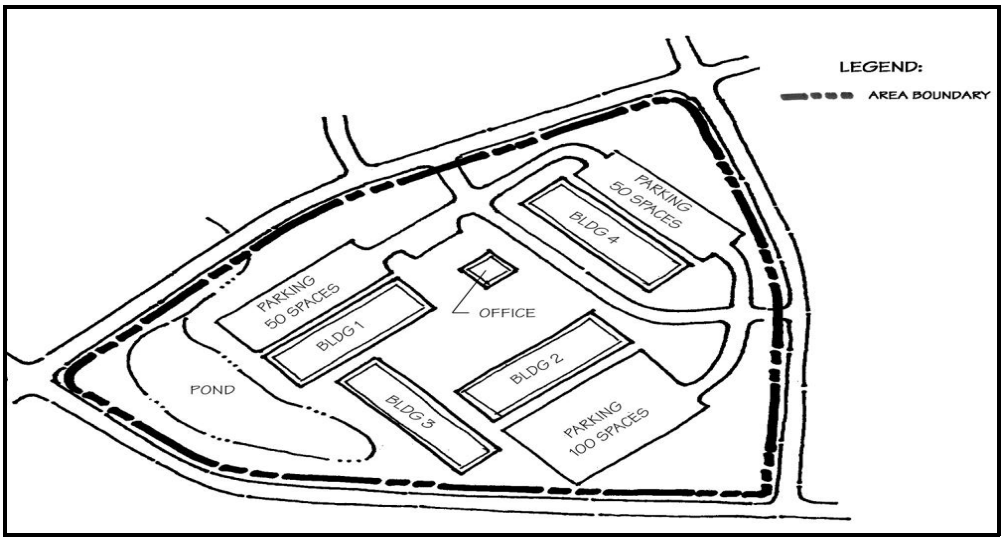

Figure 3-3. Alternative 1

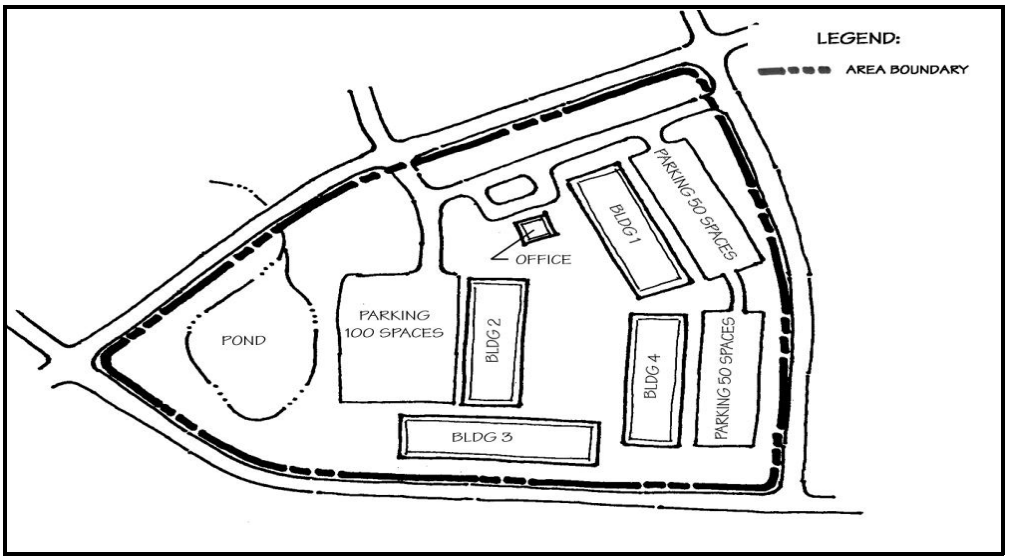

Figure 3-4. Alternative 2

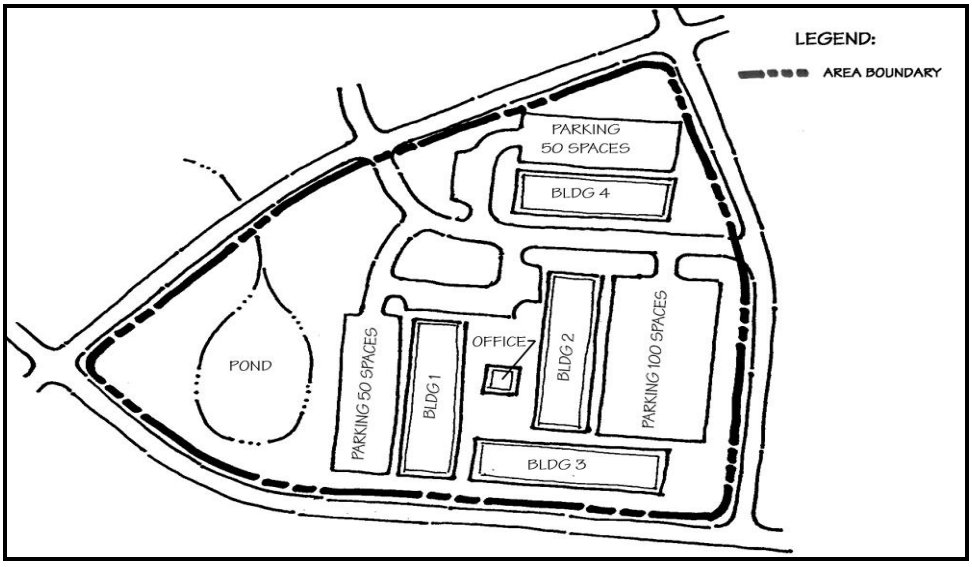

Figure 3-5. Alternative 3

	Alternative 1	Alternative 2	Alternative 3
Provide adequate parking for new facilities	1	1	1
Provide parking with easy access to all rooms	3	2	1
Protection of all Environmentally Sensitive Areas	2	3	1
Modify vehicular circulation to lower accident frequency	3	1	1
Provide connecting roadway	1	5	1
Locate office central to rooms	1	5	2
Modify vehicular access to the site	2	3	1
Separate pedestrian and vehicular circulation	3	3	3
Minimize disturbance to site	1	3	1
TOTALS	17	26	12

(1=Good, 5=Poor)

Figure 3-6. Site evaluation matrix

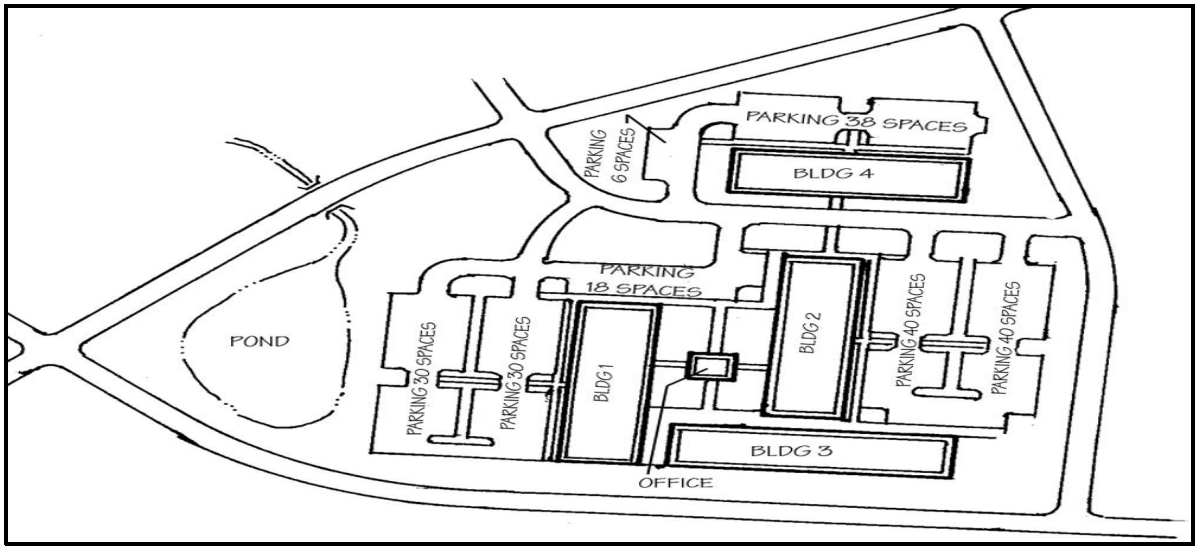

Figure 3-7. Preliminary site plan

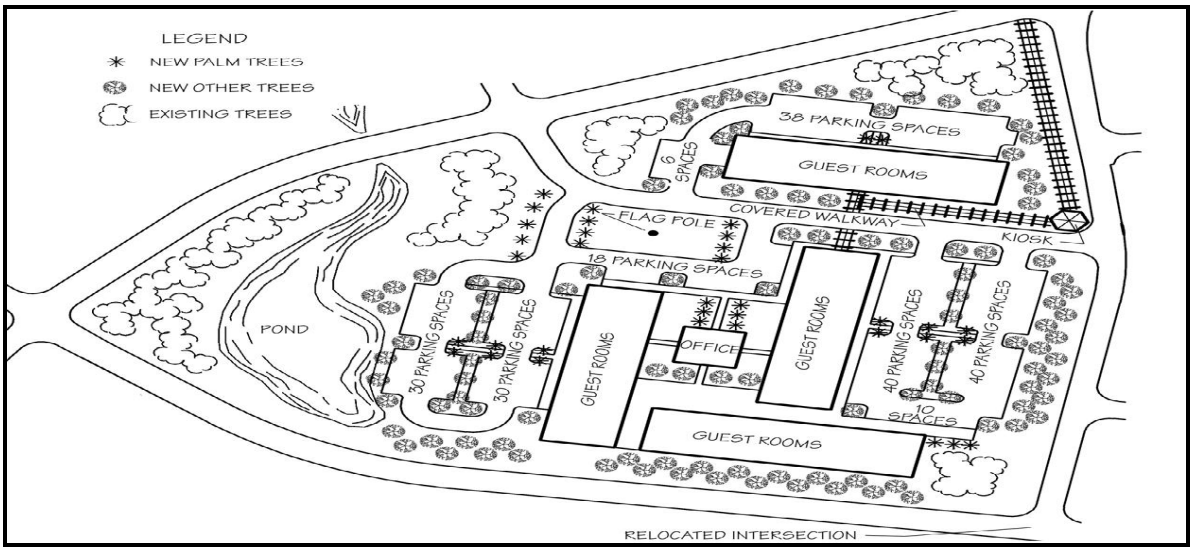

Figure 3-8. Final site plan

CHAPTER 4

DESIGN CRITERIA

4-1. GENERAL. This chapter provides guidance concerning certain design criteria to meet the requirements for design layout. Additional design criteria can be found in the Architectural and Engineering Instructions, Design Criteria and in the Installation Design Guide (IDG). Design criteria should be incorporated into the planning process from the onset. The design criteria should be used during the planning process to provide the requirements that affect the spatial relationships.

4-2. BUILDING DESIGN, LOCATION, AND ORIENTATION. The primary building is usually the most prominent single element and the center of site activity. The building location on the site may be determined by considering the following factors.

a. Dimensional Factors. Dimensional factors include the building dimensions, or footprint, and the following factors:

(1) Buffer Zones. Buffer zones provide setbacks and safety protection from:

(a) Airfield and helipad clearances.

(b) Explosives safety clearances.

(c) Noise abatement.

(d) Physical security clearances.

(e) Storage and handling hazardous material clearances.

(f) Separation of incompatible land use or functions.

(2) Spacing Requirements. Spacing between buildings and functions is normally determined by their:

(a) Functional relationships.

(b) Operational efficiency.

(c) Fire protection clearances.

(d) Physical security requirements.

(e) Parking requirements.

(f) Future expansion.

(g) Open space.

(3) Setbacks (see figure 4-1).

(4) Facility Proximity. A building should be located in accordance with its spatial and functional relationship to its support facilities and to other primary facilities.

(5) Buildable Area. The buildable area is that area established on the site survey for the location of a structure or structures determined in the site analysis and the following guidance (see figure 4-1).

b. Environmental Factors. The location and condition of such elements as geology, soils, drainage, and vegetation may create areas that should be excluded from development because:

(1) They are unbuildable for structural, economic or environmental reasons.

(2) They require protection.

(3) They require preservation.

c. Orientation Factors. Building location may be influenced by orientation to enhance energy conservation.

(1) Solar. Energy conservation criteria is provided in the AEI. Life Cycle Cost Analyses (LCCA) should be provided as required. Special energy conservation studies for nonrenewable resources should be accomplished as required. As illustrated in figure 4-2, these analyses and studies should provide an orientation for facilities to be energy efficient.

(2) Other Siting Factors. Other site-specific conditions can influence building alignment.

(a) Ability to accomplish the mission.

(b) Ability to minimize travel time.

(c) Ability to control access.

(d) Orientation to a slope (figure 4-3).

(e) Orientation to take advantage of or reduce the impact of prevailing winds (figure 4-4).

(f) Microclimate impacts.

d. Visual Factors. The visual survey accomplished during the site visit should provide requirements to reduce negative visual impressions. The elements to be retained or enhanced should be included in the design. The AEI and IDG provide additional guidance (figure 4-5).

4-3. VEHICULAR CIRCULATION AND PARKING. Circulation should promote safe and efficient movement of vehicles and pedestrians. Maintaining maximum separation of vehicles

and pedestrians helps promote safety. Safe circulation systems have a perceivable hierarchy of movement, lead to a clear destination and do not interrupt other activities. EI 02C800, Design for Non-Organizational or Privately Owned Vehicle (POV) Site Circulation and Parking, provides specific design criteria for vehicular circulation and parking. The AEI provides guidance concerning design vehicle and space allowance and parking stall size. The AEI also provides authorized parking allowances for non-organizational vehicle (POV) and visitor parking allowances by facility type.

a. Vehicular Circulation. The following factors should be considered in the design of vehicular circulation:

(1) Access Intersections. Driveway intersection access should be controlled to minimize the conflicts between through traffic and vehicles entering and exiting the site. Points of conflict can be limited by:

(a) Reducing the number of access drives to one (1) two-way drive or a pair of one-way drives for each site. Drives may be added to the site if the daily traffic volume exceeds 5,000 vehicles per day (both directions) or if traffic using one drive would exceed the capacity of a stop-sign-controlled intersection during the peak (highest) traffic hour.

(b) Increasing the space between drives and between drives and roadway intersections.

(c) Preventing certain maneuvers (e.g., left turns).

(d) Provide left-turn lanes with storage for turning vehicles.

(e) Provide right-turn deceleration and acceleration lanes for right turning vehicles.

(f) Include physical and sight distances which allow safe entry and exit from the access road.

(g) Location away from any elements (e.g., building, topography or vegetation) which block or lessen sight distance.

(h) Adequate views and signage of entry to the site from the access road.

(i) Use of topography, vegetation, and water to define entrances.

(j) Maintenance of maximum spacing between access drives occurring on the same access road.

(k) Alignment of access drives across the primary roadway from each other, or adequate separation of access roads.

(l) Right-angle turns from the access road onto the access drive with adequate turning radii.

(m) Depending upon the size of the project, marginal or medial channelization.

(n) Adequate road width and length at entrances to channel vehicles smoothly into the proper lanes.

(o) Provisions for special use vehicles that require nonstandard turning radii and driveway widths.

(2) Driveways. Driveways provide access to the site to suit specialized needs. Driveway location, design, width, turning radii, terminus, etc., is dependent upon the proposed use and the required site distance. Figure 4-6 illustrates a typical plan for access driveway and vehicular circulation. Access drives should be designed to meet the following criteria:

(a) Take vehicles to their destination and return with minimum interference or travel through parking areas, service areas or emergency zones.

(b) Enter and exit the site at the same point or on the same access road to discourage through traffic on site.

(c) Accommodate two-way traffic since one-way systems can create confusion.

(d) Provide separation of service drives from emergency drives.

(3) Drop-off Areas. Drop-off areas should be provided for office, commercial, educational and community facilities with high use. Drop-off areas should be:

(a) Located at or near the front of the building apart from entries into parking lots.

(b) Designated to provide a separate drop-off area located away from the building for buses and shuttles.

(c) Preferably on a one-way loop to avoid confusion.

(d) Sufficient in size to avoid vehicle conflicts and stoppages of traffic flow. Where a circular turn-around is used, the circle radius should be sized to support the design vehicle.

b. Parking. Parking should occur in lots or structures with a limited number of entrances and exits onto the access road or drive. Entrances and exits into different lots on the same site should be aligned or adequately separated to provide safe sight and maneuvering distances. Parking areas should provide:

(1) Barrier-free parking and pedestrian access must be provided to meet requirements of the Americans with Disabilities Act, Accessibility Guidelines for Buildings and Facilities.

(2) Locate parking within convenient walking distance of a building entrance.

(3) Parking for high turn-over or short-term use (e.g., visitor, outpatient or delivery) should be located in a separate lot or signed and placed nearest the entrance.

(4) Parking aisles aligned towards the building entrance to encourage more organized pedestrian flow and limited places where pedestrian traffic must cross vehicular traffic (figure 4-7).

(5) Parking should not require movement across vehicular paths in areas primarily designed for children such as Child Development Centers.

(6) Parking lot locations can have a strong heat and visual impact from reflected light on adjacent land uses.

c. Emergency Vehicle Access. Emergency vehicle access must be provided as follows:

(1) Emergency (rescue) vehicle access must be provided to all buildings.

(2) Fire truck access must be provided between buildings. This access may be provided on sidewalks, paths, or turf areas designed for the vehicle.

(3) If a special drive is installed to accommodate emergency vehicles, it must provide sufficient room for the vehicle to turn and exit the site and adequate support for the vehicle weight.

d. Service Vehicles. Service vehicles range in size from pickup trucks and vans to garbage and large delivery trucks. These vehicles generally require larger turning radii, more room to maneuver, and holding space while deliveries or service occurs. Service areas should be designed to provide space for the largest service vehicle that would use that area. Service traffic should be separated as much as possible from the traffic aisles of parking lots.

(1) Sanitation Vehicles. The circulation of sanitation vehicles is dictated by the locations of the dumpster pads. Figure 4-8 indicates the primary consideration in locating dumpster pads. Dumpster pads should be located to:

(a) Provide convenient access for pedestrians taking garbage to the dumpster.

(b) Provide direct, convenient access to vehicles emptying the dumpster that will allow the vehicle to drive or back directly to the dumpster with minimal maneuvering.

(c) Reduce visual impact.

(d) Include sufficient screening with plant material, fences or walls.

(e) Provide a continuous route when more than one pad is included.

(f) Be removed physically and visibly from building entrances and major vehicular and pedestrian circulation routes when the dumpster is located in the principal parking lot.

(2) Delivery Vehicles. Special zones for delivery vehicles should be placed in less visible areas of the site, such as the rear or sides of buildings. Space requirements vary according to the type and size of vehicle and the need to access loading docks. Maneuvering room should be provided to allow trucks to back up and turn around to exit the site or to allow

trucks to back up to the loading dock.

(3) Courier Service Vehicles. At least one parking space should be included at the primary or secondary entrance to the facility for courier service trucks.

4-4. PEDESTRIAN CIRCULATION. Pedestrian circulation involves the movement of people by non-motorized means. TM 5-822-2 provides guidance on the geometric design of walks. All pedestrian access shall be designed to meet the requirements of the Americans with Disabilities Act, Uniform Federal Accessibility Standards.

a. Pedestrian Desire Lines. Pedestrian circulation should be based on pedestrians' tendency to follow the most direct route when walking between two points. Figure 4-9 illustrates a typical desire line study. These studies are prepared as follows:

(1) Desire lines are drawn to anticipate pedestrian routes to prevent crisscrossing the site with sidewalks.

(2) Desire lines should be weighted according to the most traveled routes.

(3) More generous paved area should be provided at pathway intersections to allow space for congregation and circulation.

(4) Adequate reception area should be provided at entrances to buildings.

(5) Coordinate circulation routes with building layouts to discourage short cuts by personnel through buildings.

b. Grid, Curvilinear, and Organic Path Systems. Path systems are developed from the desire line study. The system should incorporate required and anticipated access. Three types of systems are suggested to meet varying site demands. All three systems provide functional access between facilities. Figure 4-10 illustrates alternative sidewalk schemes based upon the pedestrian desire lines defined in figure 4-9. Topography and vegetation can be used to direct movement and emphasize sight lines.

(1) A grid path system is composed of straight lines and right angles and tends to provide the most direct access between location. The grid system is appropriate in formal landscapes and in areas with strong architectural definition.

(2) A curvilinear path system is less formal and should be used to encourage pedestrian interaction with the landscape where direct access to facilities is not critical.

(3) Organic sidewalk systems are unique in that the sidewalk patterns are defined by the space outside of the sidewalk and therefore vary in width. Because of this, organic sidewalks are less formal and often respond to natural elements in the surrounding landscape.

c. Pedestrian Concentration. The space required to accommodate pedestrian movement increases at the point of origin and destination, where movement slows. Pedestrian movement is also interrupted when people meet, gather, wait, or sit. In areas of pedestrian concentration (e.g., building entrances, drop-offs and small outdoor spaces between

buildings), the space should be developed to accommodate these needs. General design techniques include:

(1) Widening walkways at the points of origin and destination.

(2) Providing adequate space for people to concentrate outside of the pedestrian flow.

(3) Locating areas for people to sit on the edge or outside of the pedestrian flow.

(4) Providing both shaded and sunny areas for people to congregate or sit.

(5) Providing shelter at congregation areas, especially where waiting is anticipated.

d. Troop Formation Areas. Installations with training facilities require muster areas and circulation routes for troops marching in formation between classrooms, barracks, dining halls and parade grounds. These areas and walkways should be designed to provide adequate sizes and surfacing to accommodate personnel.

4-5. SURFACE WATER MANAGEMENT. The primary functions of surface water management are to establish positive drainage, prevent flooding of roadways, facilities and activities, and prevent erosion. Proper management techniques also provide storm water infiltration, habitat preservation, and recreational opportunities. Surface water management should be designed to replicate natural systems and maintain public safety, health and welfare. The guidelines discussed below refer to general on-site drainage design. Specific criteria developed by local and state agencies should also be consulted. The landscape architect, civil engineer, and hydrologist on the design team should collaborate to address drainage problems and solutions. TM 5-820-4 provides additional guidance on drainage design.

a. Impervious Surface. The placement of facilities on a site changes drainage conditions by increasing impervious surfaces, primarily rooftops and pavements. This results in a greater volume and velocity of water to be managed. The negative effects of impervious surfaces upon the landscape can be reduced through the following:

(1) Avoid creation of unnecessary impervious surfaces.

(2) Evenly diffuse drainage across the site. Avoid concentrating drainage at one point by dividing the site into more than one drainage basin.

(3) Divide large expanses of impervious surface (e.g., a parking lot) into smaller areas to help control runoff, reduce the size of necessary drainage structures (e.g., catch basins), and avoid drainage system back-up. Use areas in between divided spaces for infiltration and introduction of appropriate plant material.

(4) Use Islands, medians, curbs and gutters to control drainage within parking areas. Curbs strategically allow introduction of runoff into designated catch basins for temporary storage or infiltration.

(5) Consider porous surfaces that allow infiltration (e.g., porous asphalt and concrete, gravel, open-cell paving systems, and turf) as paving alternatives.

b. Grading. Topography is the primary determinant in the amount, direction and rate of runoff. Existing drainage patterns should be maintained where possible to preserve topsoil. Facilities and parking areas should be sited to take advantage of existing topography (figure 4-11). Graded slopes should be gradual and avoid abrupt changes in gradient. Where graded slopes meet the existing topography, they should blend into the existing slope. The AEI provides guidance concerning slope gradients.

c. Positive Drainage. Positive drainage should be provided universally across the site. Figure 4-12 illustrates the following basic principles:

(1) Direct water away from structures.

(2) Do not allow water to pond at low points or in low areas.

(3) Locate the finished floor elevations of buildings so that if drainage structures are blocked, the water will not back up into the buildings.

(4) Direct water concentrated in parking lots and along curbs away from major pedestrian areas and routes.

d. Drainage Control. Storm drainage from buildings and other impervious surfaces must be directed to a storm drainage system. This water must be kept from infiltrating into the soils and causing foundation problems for the buildings. It also must be directed away from pedestrian walkways where it causes walking hazards. Runoff should be directed away from landscaped areas not designed to accommodate Storm water runoff to keep from drowning plant material and washing away mulch. Drainage can be controlled, captured and redirected using various methods.

(1) Vegetated swales and ditches are effective in cost and function for moving moderate amounts of runoff. It is recommended that these have a minimum gradient of 2.0% to maintain positive drainage.

(2) Paved swales and ditches are recommended to have a minimum gradient of 1.0% to maintain positive drainage.

(3) Check dams or weirs are used to slow water movement and increase infiltration in porous swales or ditches. Earth, stone, rip rap, gabions, and concrete are generally the best materials for dam and weir construction.

(4) French drains are a cost-effective means of directing small amounts of runoff. They can often be constructed by hand to correct post-construction drainage problems.

(5) Underground piping by way of sewer lines is the most expensive alternative in terms of materials, construction and maintenance cost. Underground piping is completely effective if the lines are sized correctly; however, changes to the system to suit future needs are difficult and expensive.

e. Detention Ponds, Retention Ponds, and Infiltration Basins. Detention ponds, retention ponds, and infiltration basins are drainage devices used to control the rate of runoff from the increased impervious surfaces resulting from construction. The increase in runoff is held within these ponds and slowly released at rates that are equal to or less than the rates that occurred before construction. The maintenance of pre-construction runoff rates helps prevent flooding, erosion and sedimentation of recipient drainage ways. Ponds and basins can be designed to allow collected runoff to stand long enough for heavier sediments to settle to the bottom, thereby reducing sedimentation downstream.

(1) Detention ponds release all of the collected water at a specific rate. Detention and retention ponds are especially useful during construction when the lack of drainage systems and vegetative cover make it difficult to control Storm water flow and erosion.

(2) Retention ponds function the same as a detentions ponds except they are designed to retain a certain level of water permanently and release all of the collected water above the permanent level at a specific rate.

(3) Infiltration basins retain all of the collected water until it infiltrates or evaporates. Infiltration basins are important for increasing groundwater recharge, especially in highly urbanized areas. Typically, infiltration basins are wide and shallow to facilitate rapid infiltration and evaporation. Basin floors are graded at 0 percent or close to 0 percent and have a permeable base. Infiltration basins are designed to be dry when not in use and can serve other functions as well, such as athletic playing fields.

(4) Local, state and federal jurisdictions are more frequently requiring the use of detention/retention and infiltration ponds a means of maintaining water quality. Requirements for designing detention ponds, retention ponds, and infiltration basins should be verified by local and state agencies.

(5) These ponds and basins should be designed to serve other functions in a development such as a water feature, wildlife habitat, wetland, and wastewater reclamation.

f. Erosion Control. Erosion control evaluation and implementation begins with identifying the causes of erosion and then implementing controls to limit erosion.

(1) Erosion occurs as the result of:

(a) Lack of vegetative cover.

(b) Excessively steep slopes.

(c) Excessive runoff.

(d) Unstable soils.

(e) A combination of the above.

(2) Erosion control can be improved by:

(a) Reducing slope gradients.

(b) Using geotextiles as filtering fabrics.

(c) Establishing or reestablishing vegetative cover.

(d) Introducing mechanical controls such as riprap, gabions, terracing and cribbing.

(3) Banks with steeper than 3:1 slopes are discouraged because they increase the rate of runoff and erosion. When an area involves steep grades, solutions such as retaining walls should be used to reduce erosion and maintenance. Figure 4-14 illustrates methods of erosion control.

4-6. UTILITY SYSTEMS DESIGN. Utility systems should minimize impact to the natural site while meeting basic economic and functional criteria. The AEI provides guidance concerning utility design. Utility systems should be located as follows:

a. Utility corridors should be used to minimize environmental disturbance and simplify maintenance. These corridors should be located along a site's perimeter and not cross a site diagonally or indiscriminately because future realignment of existing systems will increase the costs of future development.

b. Utilities should be placed underground wherever possible to:

(1) Avoid conflicts with vegetation

(2) Provide protection from storm damage.

(3) Enhance the visual quality of the installation

c. To simplify maintenance, utility lines should not be placed under paved areas, but located at the back of the roadway curb. It is extremely important to determine the potential for future expansion and to allow for upgrading the system when locating utilities.

d. Utility transformers and transclosures for underground utilities shall be located to ensure ease of access for maintenance but not obstruct site primary visual relationships. They should be located with adequate setbacks from vehicular circulation and parking areas.

4-7. LIGHTING DESIGN. Outdoor lighting allows such activities as driving and walking to continue at night under safe conditions. On most sites, only enough light to illuminate these functions is necessary. Where physical security is a concern, more lighting may be required. Different types of lighting should be used to meet the needs of the site. The AEI provides guidance concerning electrical design.

4-8. LANDSCAPE DESIGN. Landscape design includes the preservation and enhancement of the environmental and visual quality including plant material, hardscape, lighting and signage. Landscape design is discussed in TM 5-803-13. The Installation Design Guide provides guidelines for installation preferences and establishes goals and objectives for the

visual environment. Landscape design should be considered as part of the total design process rather than as an addition of landscape plant material once construction is complete. Coordination with other elements of the process such as building design and placement, vehicular and pedestrian circulation, parking, lighting, and utilities is critical to the overall success of the project. When properly planned, landscape elements can be used for a variety of functions. Primary functions of landscape design include:

a. Ecological/habitat preservation.

b. Meeting environmental mitigation requirements.

c. Screening incompatible land use or visually unacceptable elements.

d. Modification of environmental conditions such as prevailing wind, sunlight, and excessive moisture.

e. Physical and visual separation of spaces.

f. Soften architectural elements.

g. Visual enhancement.

4-9. PHYSICAL SECURITY. Site design for physical security should be developed to reduce vulnerabilities resulting from identified threats. References for physical security are TM 5-853-2, Security Engineering Concept Design; and TM 5-832-3, Security Engineering Final Design.

a. General. Site design issues for physical security include:

(1) Determine level of threat.

(2) Maintaining adequate distances from uncontrolled areas.

(3) Limiting access to the site and facilities.

(4) Maintaining adequate standoff distances.

(5) Maintaining appropriate clear zones.

(6) Maximizing exposure on the site perimeter to allow discovery of unauthorized approaches.

(7) Minimizing exposure of personnel around the facility.

(8) Blocking sightliness from vantage points.

(9) Siting and orienting buildings to minimize adverse exposure.

(10) Providing barriers to unauthorized pedestrian and vehicle movement.

(11) Providing barriers to mitigate weapons and explosives effects.

(12) Providing exterior electronic security systems.

b. Vehicular Access. Where an identified threat indicates that vehicle control is necessary, access may be limited to specific entry control points that may include the following:

(1) Gate and/or gatehouse, vehicle barriers, or a combination of the two.

(2) Adequate room to permit search of vehicles without interfering with normal traffic flow.

(3) Horizontal and vertical alignment of drives which force a reduction in speed at the approach to the entry control point. Reduction of speed allows more reaction time to breaches of security and reduce the size of vehicle barriers required to stop a vehicle. Reaction time and the location of the barrier also affect whether there is sufficient time to deploy a barrier in response to a threat. Access drives and parking areas may need to be separated from facilities by sufficient distance to mitigate the threat of vehicle bombs.

c. Site Features. In an area where there is an identified threat, topography and vegetation should not obstruct views of surrounding areas.

(1) Topography, vegetation, water and walls can be used to:

(a) Slow movement towards exposed building faces.

(b) Limit exposure of personnel moving between buildings and parking areas.

(c) Block sightliness from vantage points.

(2) Perimeter walls may be used to mitigate blast effects from an explosion, but they must be carefully located with respect to the protected facility. If the perimeter wall is too far away from the facility, it may provide no benefit. If the wall is too close, it may compound the blast.

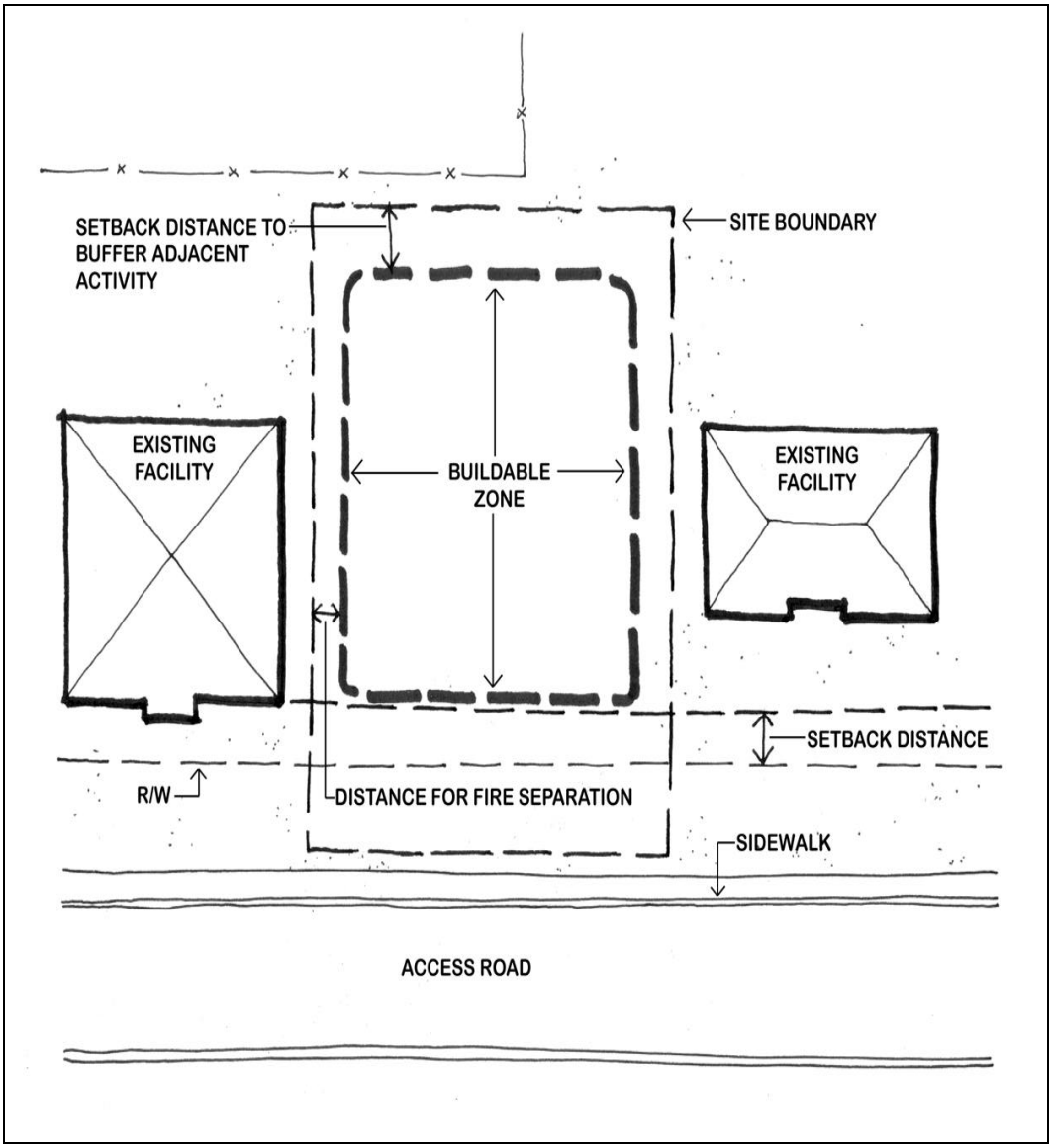

Figure 4-1. Dimensional factors

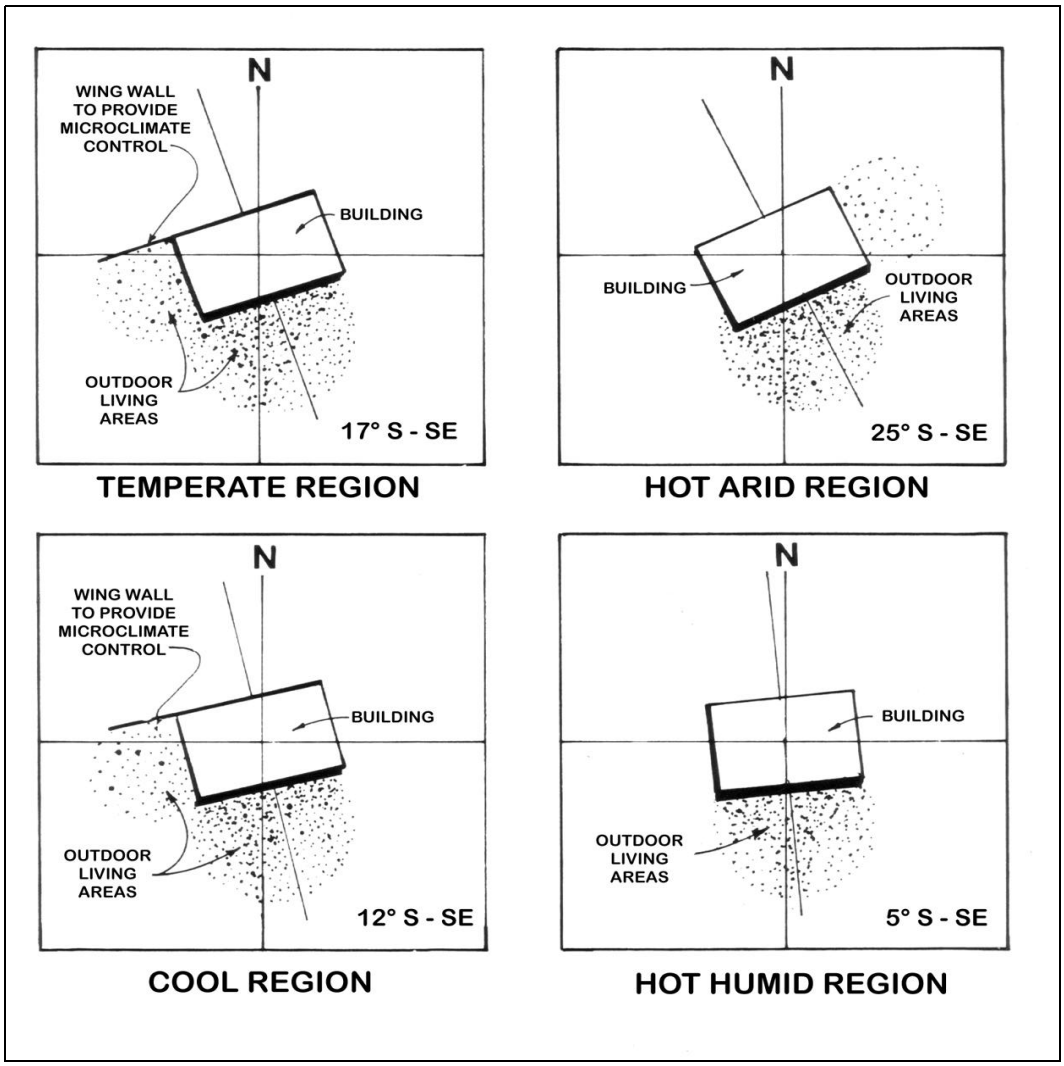

Figure 4-2. Solar orientation

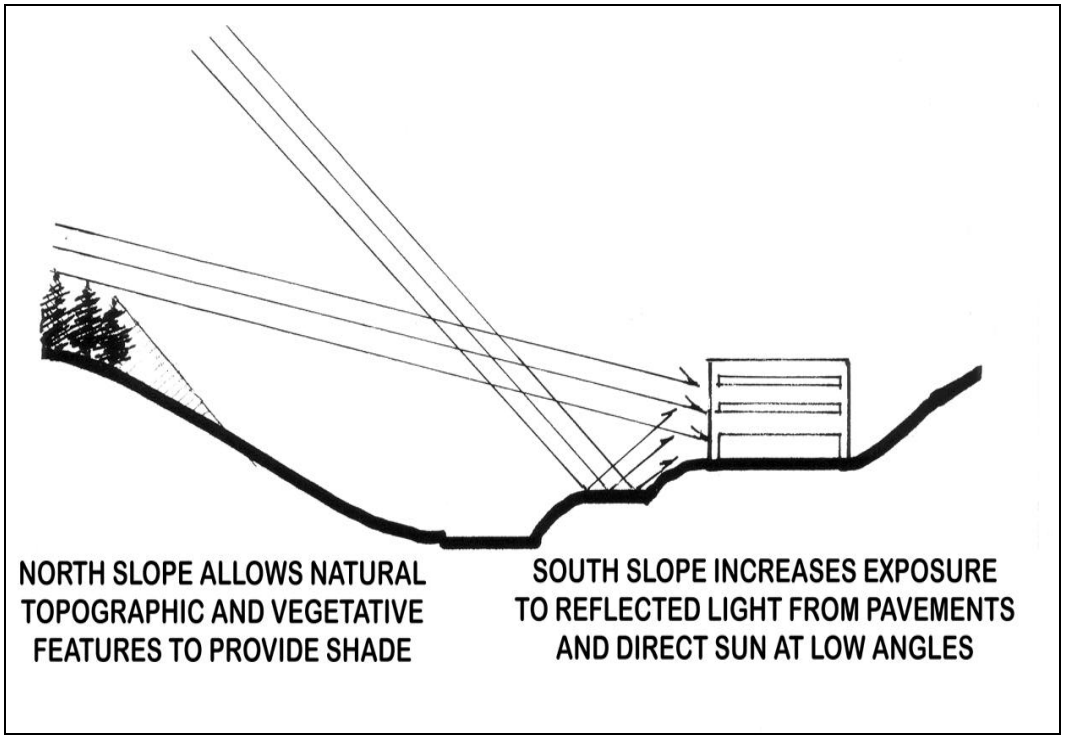

Figure 4-3. Slope orientation

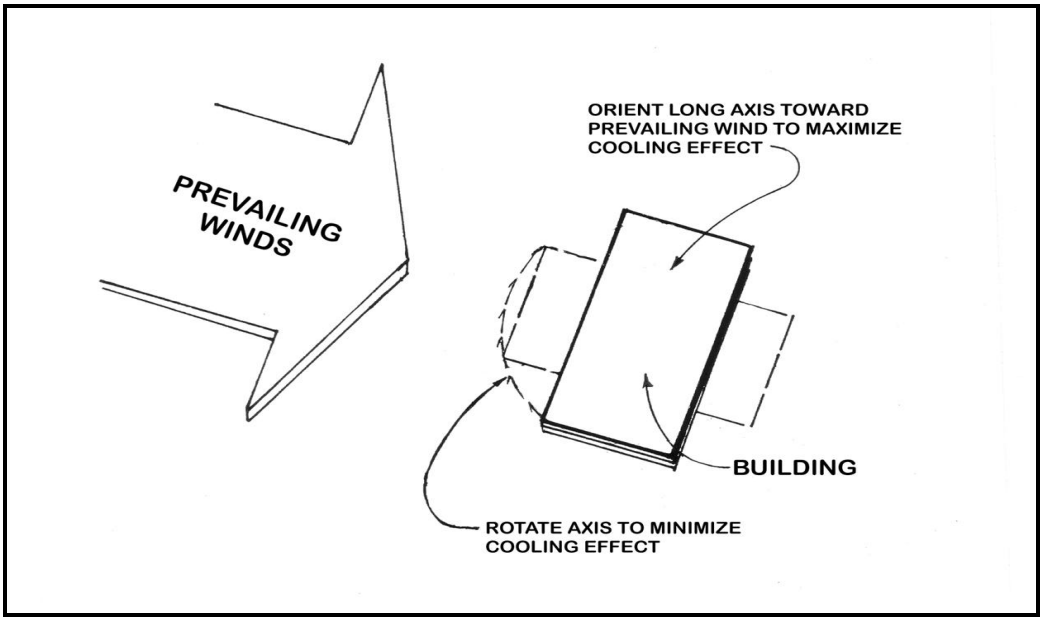

Figure 4-4. Wind orientation

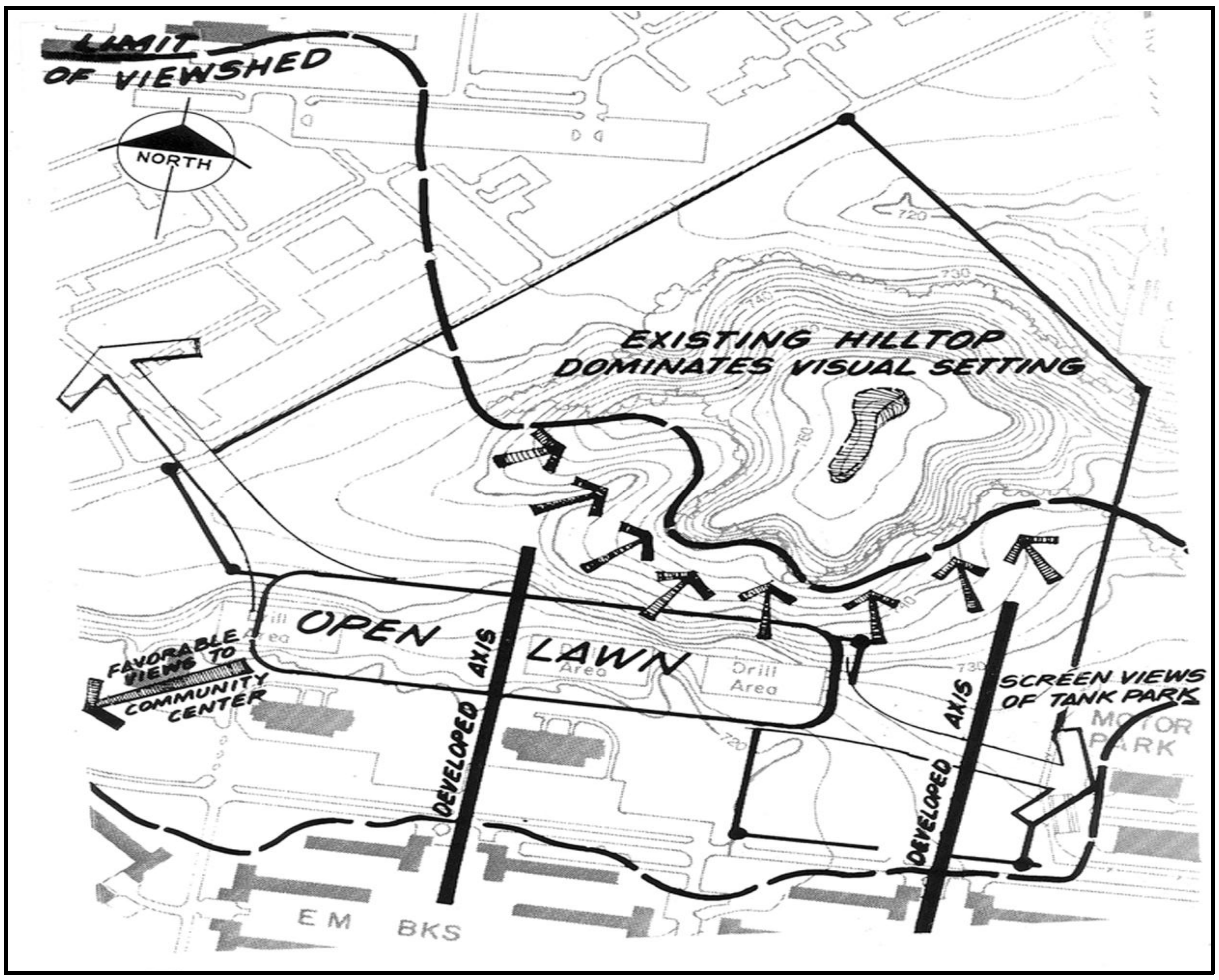

Figure 4-5. Visual factors

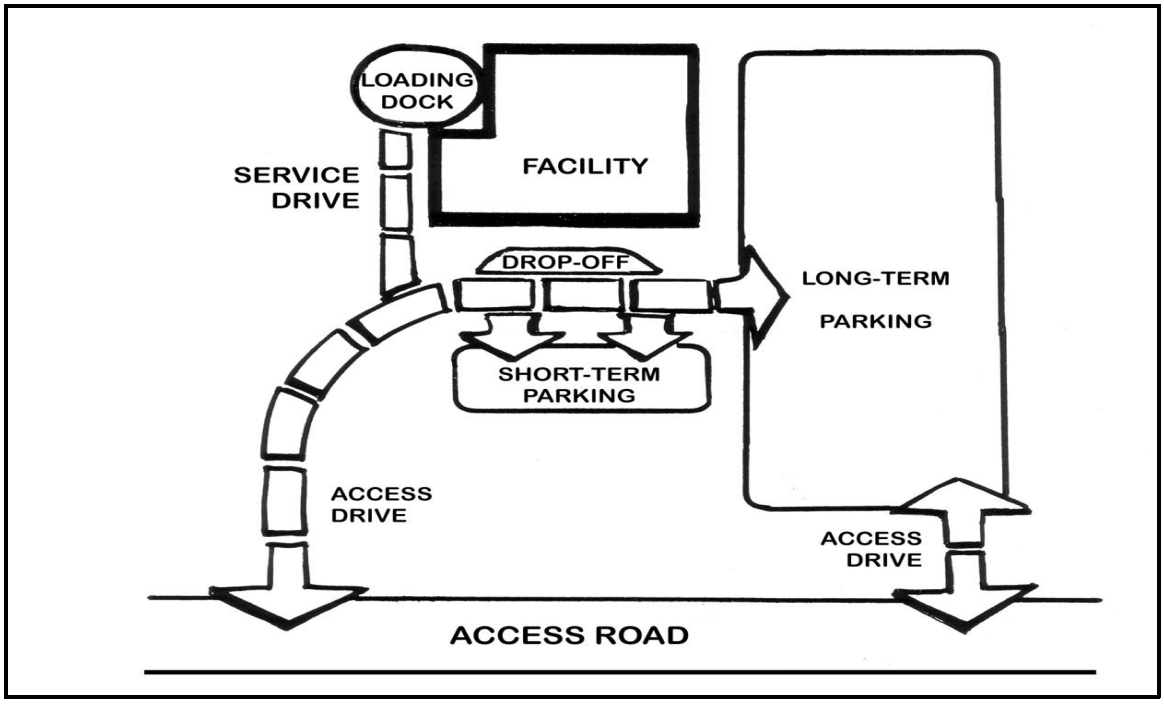

Figure 4-6. Vehicular circulation

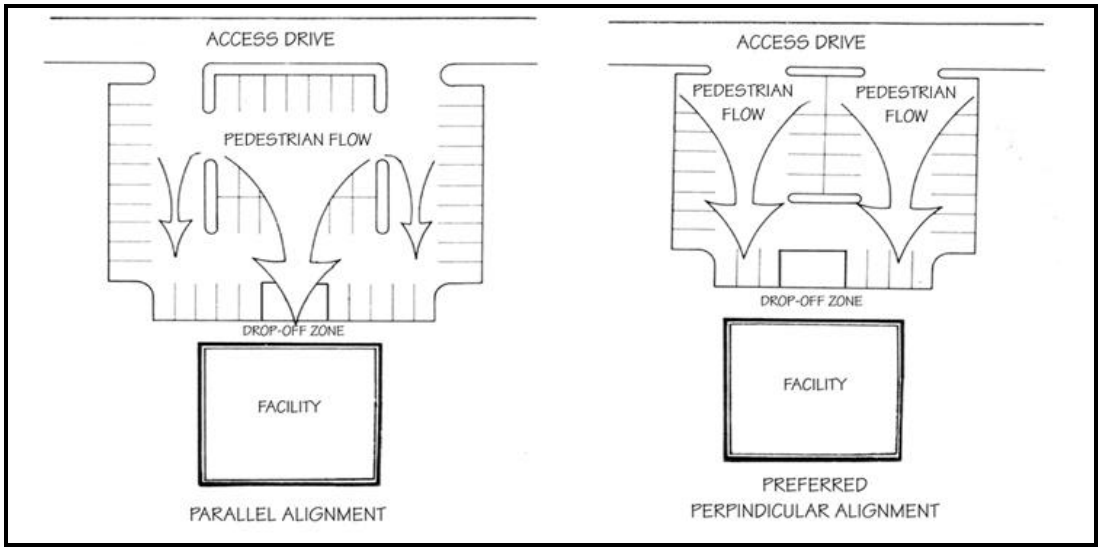

Figure 4-7. Parking

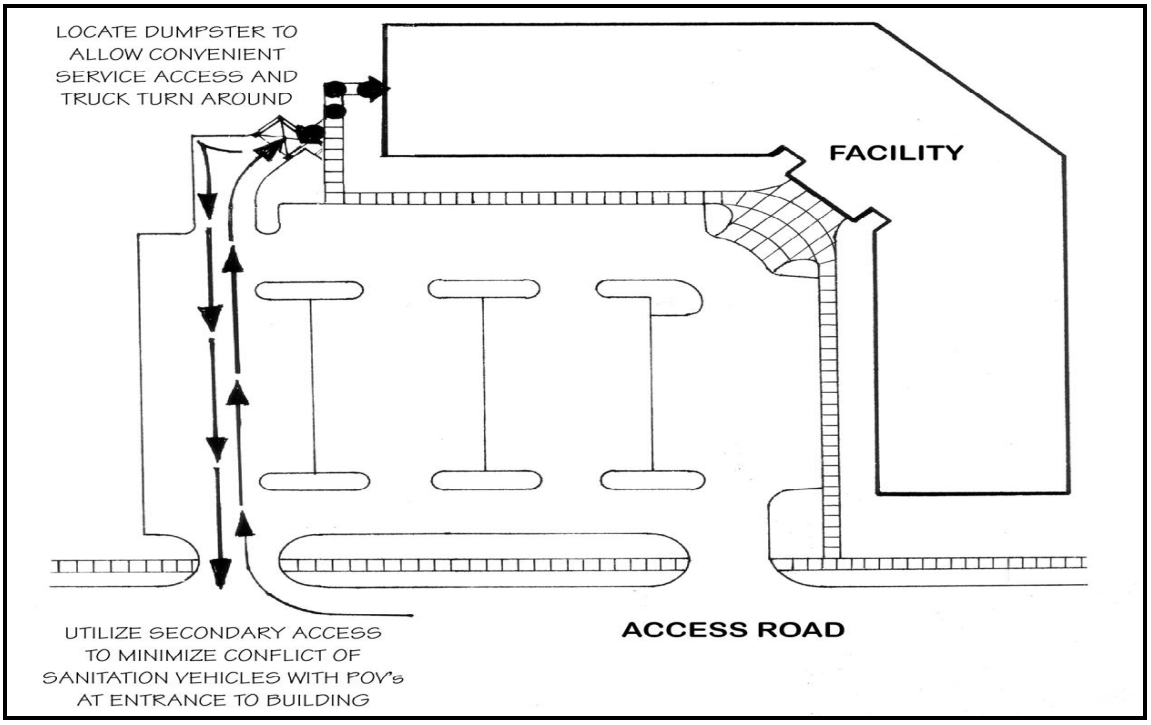

Figure 4-8. Dumpster location

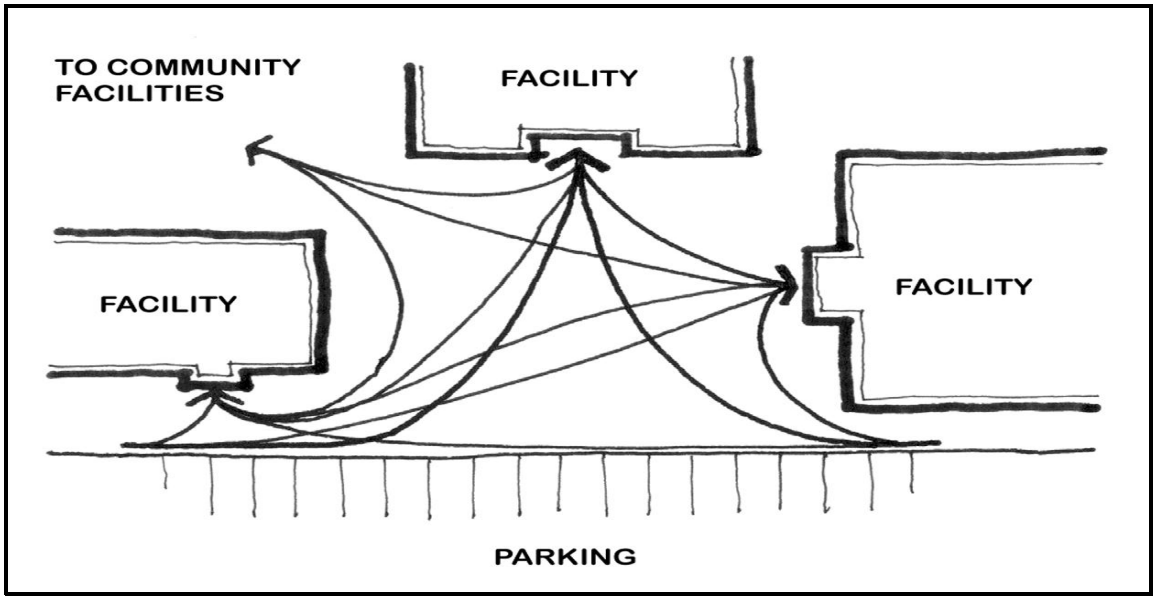

Figure 4-9. Pedestrian circulation

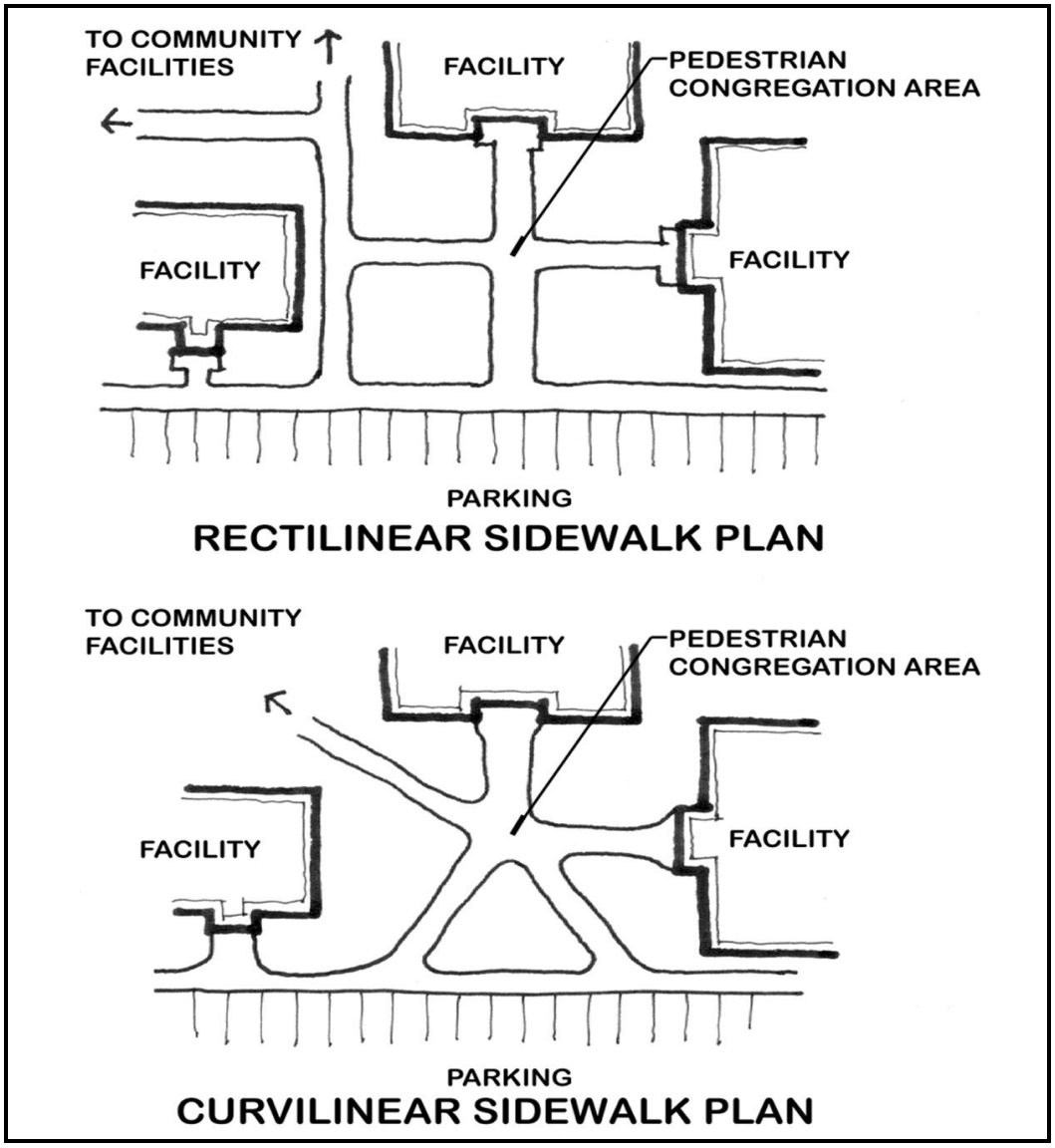

Figure 4-10. Sidewalk plans

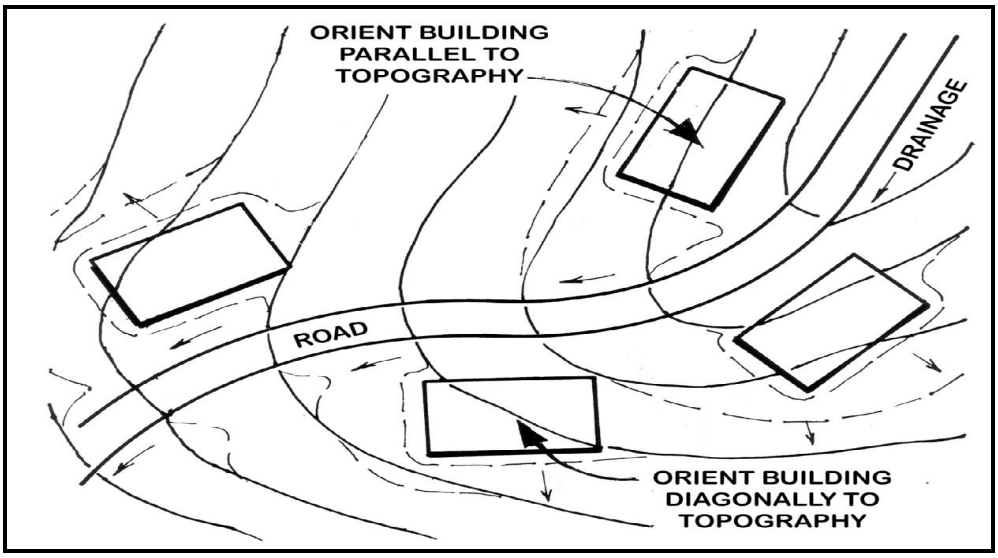

Figure 4-11. Minimize grading

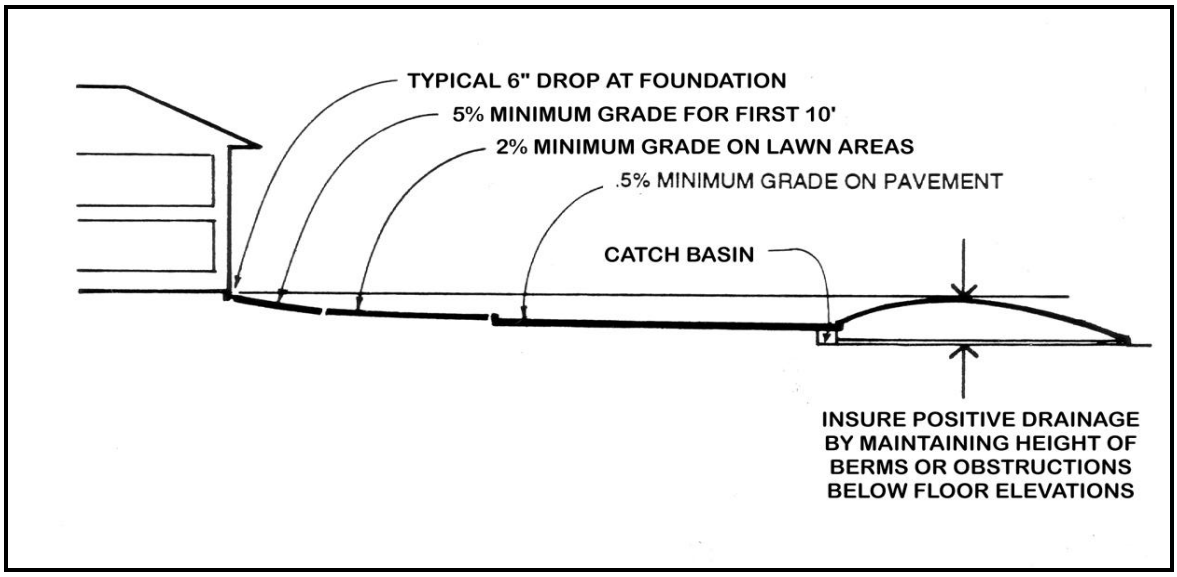

Figure 4-12. Surface water management

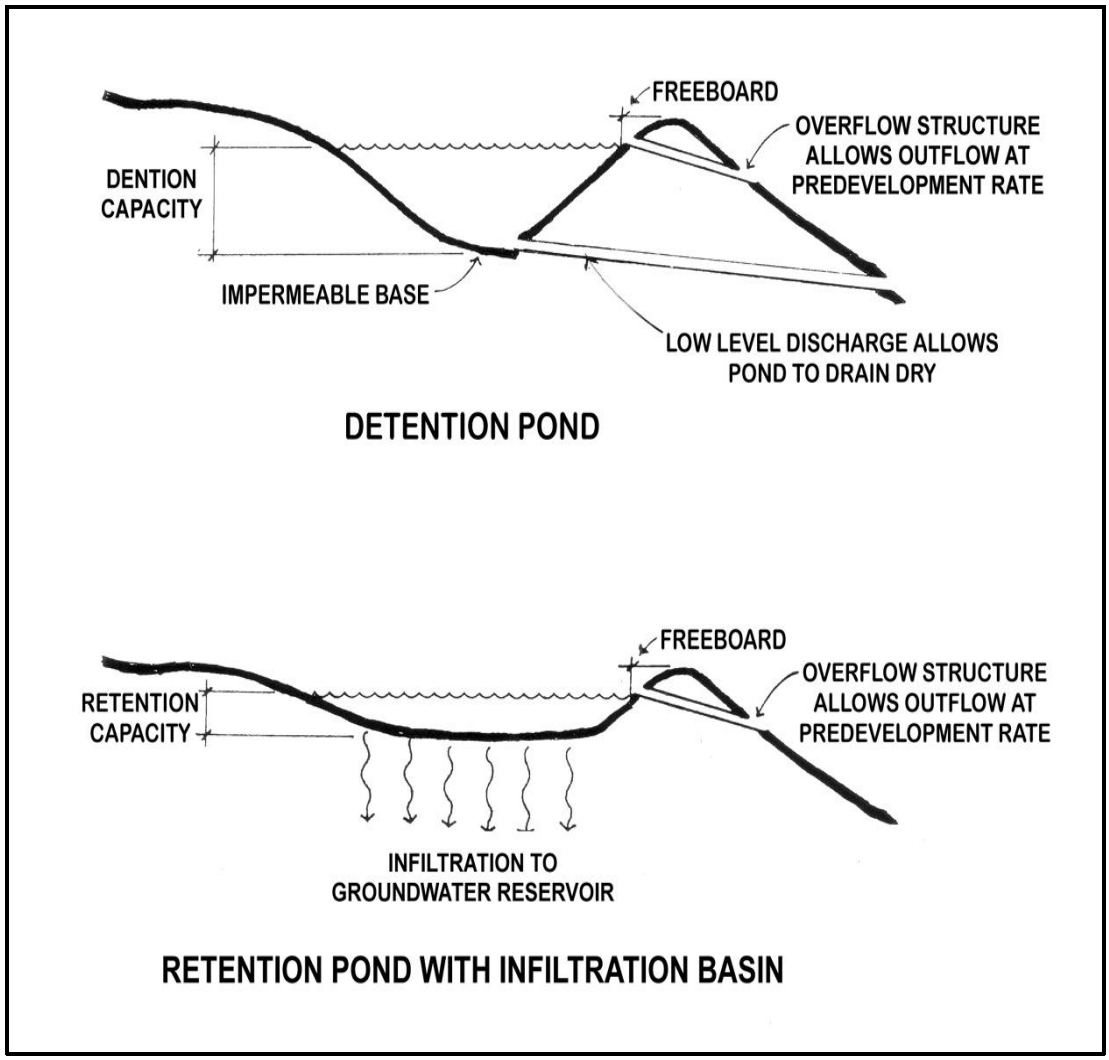

Figure 4-13. Detention, retention, and infiltration principles

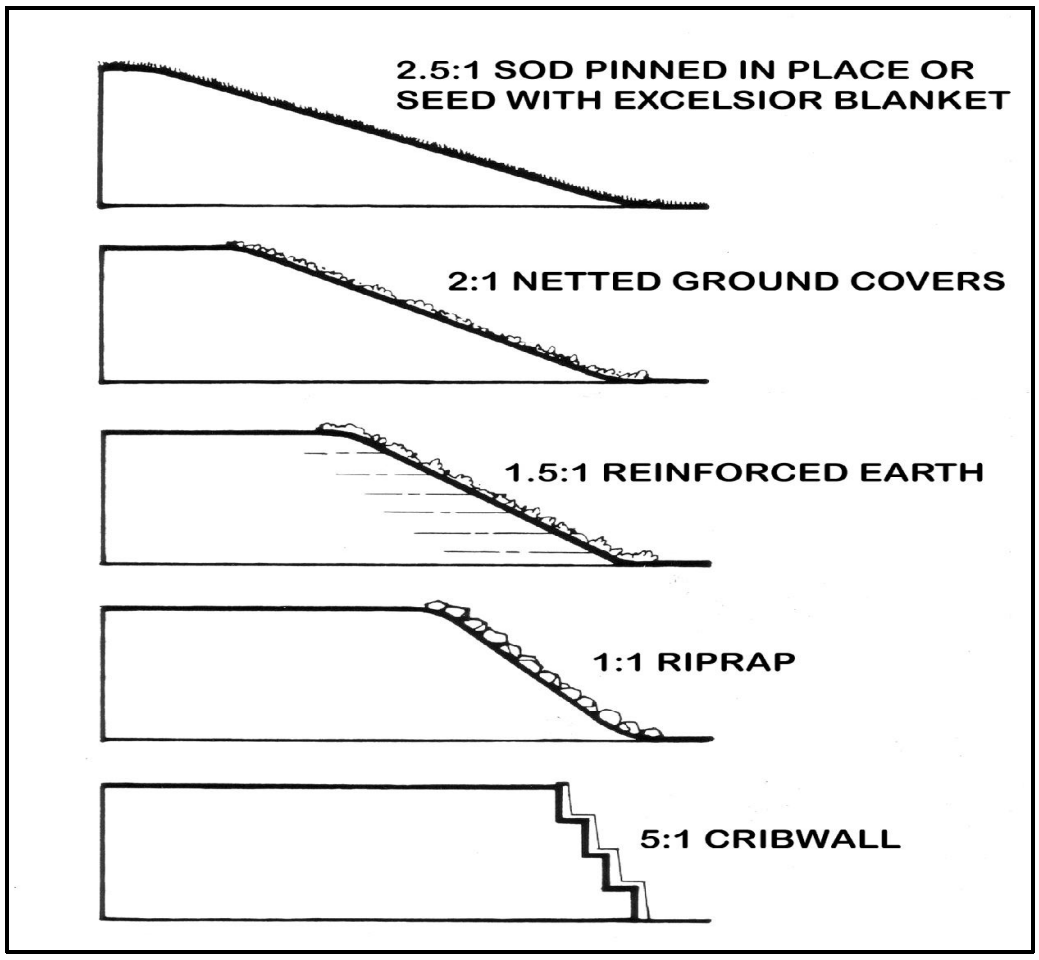

Figure 4-14. Erosion control

APPENDIX A

REFERENCES

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Civil Engineering Research Foundation. "Recommendations for Incorporating Green Building Concepts Into USACE Guidance Documents", Fall, 1995.

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TM 5-803-1	Installation Master Planning
TM 5-803-2	Planning in the Noise Environment
TM 5-803-5	Installation Design
TM 5-803-13	Landscape Design and Planting
TM 5-803-14	Site Planning and Design
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