

CHAPTER 3

CIVIL/SITE DEVELOPMENT ENGINEERING

CHAPTER 3 CIVIL/SITE DEVELOPMENT ENGINEERING – TABLE OF CONTENTS

3.1 GENERAL4

 3.1.1 SCOPE OF WORK.....4

 3.1.2 SPECIFIC REQUIREMENTS4

 3.1.2.1 Site Evaluation.....4

 3.1.2.2 AT/FP SETBACK.....4

3.2 REQUEST FOR PROPOSAL DEVELOPMENT.....4

3.3 DESIGN DEVELOPMENT.....4

 3.3.1 CONCEPT (30%) DESIGN SUBMITTAL REQUIREMENTS4

 3.3.1.1 *Concept Design Analysis*4

 3.3.1.1.1 General4

 3.3.1.1.2 Demolition5

 3.3.1.1.3 Site Geometry5

 3.3.1.1.4 Site Grading6

 3.3.1.1.5 Storm Drainage Design.....6

 3.3.1.1.6 Pavement Design7

 3.3.1.1.7 Utility Design.....7

 3.3.1.1.8 Landscape Design7

 3.3.1.1.9 Sustainable Design.....7

 3.3.1.1.10 Additional Information7

 3.3.1.2 *Concept Drawings*7

 3.3.1.2.1 Aerial Photo8

 3.3.1.2.2 Survey Control Plan.....8

 3.3.1.2.3 Demolition Plans.....8

 3.3.1.2.4 Site Plans.....8

 3.3.1.2.5 Utility Plans9

 3.3.1.2.6 Landscaping Plans9

 3.3.1.2.7 Detail Sheets9

 3.3.1.3 *Concept Specifications*.....9

 3.3.2 INTERIM (60%) DESIGN SUBMITTAL REQUIREMENTS.....9

 3.3.2.1 *Interim Design Analysis*.....9

 3.3.2.1.1 Site Geometry10

 3.3.2.1.2 Site Grading10

 3.3.2.1.3 Storm Drainage Design.....10

 3.3.2.1.4 Stormwater Management.....10

 3.3.2.1.5 Pavement Design10

 3.3.2.1.6 Utility Design.....10

 3.3.2.1.7 Landscaping Design.....11

 3.3.2.1.8 Additional Information11

 3.3.2.2 *Interim Drawings*.....11

 3.3.2.2.1 Index of Drawings11

 3.3.2.2.2 Location Plan and Vicinity Map.....11

 3.3.2.2.3 Aerial Photo11

 3.3.2.2.4 Survey Control Plan.....11

 3.3.2.2.5 Site Photos11

 3.3.2.2.6 Existing Topography Plan11

 3.3.2.2.7 Erosion Control Plans11

 3.3.2.2.8 Demolition Plan11

 3.3.2.2.9 Site Plan12

 3.3.2.2.10 Grading and Storm Drainage Plan.....12

 3.3.2.2.11 Utility Plans13

 3.3.2.2.12 Miscellaneous Site Work Details13

 3.3.2.2.13 Pavement Profile Sheets14

 3.3.2.2.14 Typical Sections.....14

 3.3.2.2.15 Boring Locations and Logs.....14

 3.3.2.2.16 Right of Way Plans14

 3.3.2.2.17 Landscape Plan14

 3.3.2.3 *Interim Specifications*15

 3.3.3 FINAL (90%) DESIGN SUBMITTAL REQUIREMENTS.....15

 3.3.3.1 *General*15

 3.3.3.2 *Specific*15

 3.3.3.1 *Final Design Analysis*.....15

 3.3.3.1.1 Storm Drainage Design.....15

3.3.3.1.2 Pavement Design	15
3.3.3.1.3 Geotechnical Report	15
3.3.3.1.4 Landscaping Design.....	15
3.3.3.2 <i>Final Drawings</i>	16
3.3.3.2.1 Storm Sewer Profiles	16
3.3.3.2.2 Joint Layout Plans.....	16
3.3.3.2.3 Erosion Control Plan.....	16
3.3.3.2.4 Utility Plan	16
3.3.3.2.5 Landscape Plans.....	16
3.3.3.3 <i>Final Specifications</i>	16
3.3.4 CORRECTED FINAL (100%) DESIGN SUBMITTAL REQUIREMENTS	17
3.3.4.1 <i>100% Design Analysis</i>	17
3.3.4.2 <i>100% Design Drawings</i>	17
3.3.4.3 <i>100% Project Specifications and Site Work Quantities</i>	17
3.4 SPECIAL DESIGN/TECHNICAL REQUIREMENTS.....	17
3.4.1 FILL, BORROW OR WASTE MATERIALS	17
3.4.2 DISPOSAL OF EXISTING PAVEMENTS, FOUNDATIONS, FLOORS, ETC.	18
3.4.3 SPECIAL INSTRUCTIONS FOR DESIGNING A LARGE BUILDING COMPLEX, MAJOR ROAD NETWORK OR AIRFIELD PAVEMENTS	18
3.4.4 UTILITY DESIGN CRITERIA	18
3.4.5 LANDSCAPING DESIGN CRITERIA	19
3.4.5.1 General	19
3.4.5.2 Specific.....	19
3.4.6 STORM DRAINAGE DESIGN	19
3.4.7 PAVEMENT DESIGN	19

3.1 GENERAL

3.1.1 SCOPE OF WORK

This chapter states criteria requirements for the civil and site development of the project. Include Using Agency requirements and consider the architecture of adjacent existing and proposed facilities. Accomplish the design according to appropriate design criteria referenced in applicable publications.

Coordinate with applicable disciplines for design of exterior chilled and hot water systems, steam systems, and gas systems.

The USACE proponent for Chapter 3 Civil/Site Development Engineering is Monica Greenwell, 502-315-6360, monica.b.greenwell@usace.army.mil

3.1.2 SPECIFIC REQUIREMENTS

3.1.2.1 Site Evaluation

At the beginning of project design, perform a site evaluation and analysis to determine what impact the site development portion of the project design will have on the existing site conditions. Use UFC 2-100-01 to develop a preliminary approach appropriate to the site and adjacent facilities and integrate sustainable strategies. Research and obtain Installation's master plan, utility maps and as-built record drawings for information related to topography, utility and storm drainage availability, including design approaches used in the project vicinity. Evaluate the potential for abandoned or unmapped utilities. Another primary function of this evaluation is to facilitate low impact development (LID) design by identifying existing site conditions and constraints. Identify protected areas, setbacks, topographic features and other site features that should be protected such as floodplains, steep slopes, and wetlands. Evaluate site constraints such as available space, soil infiltration characteristics, water table, slope, critical habitat, circulation and underground utilities. Delineate the watershed and drainage patterns. Identify applicable stormwater regulations or codes. Prepare a report of this site evaluation, including documentary photographs, and incorporate in the Design Analysis with the first Design Submittal. Be sure to note any critical site features that may threaten the project feasibility.

3.1.2.2 AT/FP SETBACK

At the beginning of the project, designers should review UFC 4-010-01 DoD Minimum Antiterrorism Standoff Distances for Buildings to determine site suitability. Document the proposed exterior building material, building occupancy, windows and curtain walls, structural hardening, and AT/FP setback distance based on UFC guidance in the Design Analysis with the first Design Submittal.

3.2 REQUEST FOR PROPOSAL DEVELOPMENT

Design-Build Requests for Proposal (RFP) shall require that the design conform to this design guide and all applicable Federal, DOD, and agency specific criteria. The following shall also be provided in the RFP:

- a. Include expected occupancy for the facility and parking capacity requirements.
- b. Current topographic survey may be provided, but is not required.
- c. Conceptual site layout
- d. Existing utilities plan
- e. Demolition plan

3.3 DESIGN DEVELOPMENT

3.3.1 CONCEPT (30%) DESIGN SUBMITTAL REQUIREMENTS

3.3.1.1 Concept Design Analysis

In the design analysis include a brief narrative covering the following items, as applicable to project design.

3.3.1.1.1 General

- a. Location of and access to the proposed project site, with brief explanation of objectives and factors influencing siting decisions. Describe existing site conditions and advantages/disadvantages in relation to the project, including: general topography, vegetation, acreage, property boundaries, existing structures, unusual subgrade conditions, etc. Discuss former use of the site when major removals, demolition, and salvage are required. Indicate survey information and criteria (dates performed, datum used, control point descriptions, etc.)
- b. General overview of major planned site features, including: building(s), including orientation and location on the site; surface drainage patterns; traffic circulation; parking requirements and pedestrian access, including provisions for the physically handicapped; security requirements; etc. Describe any potential constraints to site development.
- c. Impact of new construction on existing facilities and considerations for future expansion. Discuss Installation preferences and Installation compatibility. Discuss any items of historical significance that may pose a risk to the project or influence project design.
- d. Requirements for flood protection, if applicable.
- e. Indicate locations of borrow and disposal areas.
- f. List all applicable UFC or other design criteria used in developing the project.
- g. Any applicable permits required for connection to existing federal, state or local roads.
- h. If the project location is in a northern climate where snow is an issue, then discuss how snow removal will be addressed for the site layout.

3.3.1.1.2 Demolition

- a. Identify specific items requiring demolition, relocation or salvage. This should include buildings and foundations, pavement, tree clearing, and utilities. Indicate extent of removal and note if any utilities are to be capped and abandoned in place.
- b. Indicate disposition requirements of salvaged and waste materials.
- c. Note any hazardous material removal required or contaminated soil remediation. Note presence of lead-based paints or asbestos containing materials.
- d. Note specific items not to be disturbed or demolished, such as trees or adjacent structures.

3.3.1.1.3 Site Geometry

- a. Provide rationale for locating major site elements.
- b. Describe AT/FP, environmental, and any real estate easement setback requirements. (Reference the "Installation Design Guide" for the particular military Installation, and UFC 4-010-01).
- c. Roads (Location and Layout): Traffic volume and type, when required.
 1. Indicate AASHTO design vehicle(s) for which turning movements are to be provided, and corresponding minimum turning radius required.
 2. Maximum design speed, degree of curvature, vertical grades, and sight distance requirements for road networks, when required.
 3. Lane and shoulder widths and cross slopes, as per AASHTO.
 4. Road embankment slopes and back slopes in cut. Indicate maximum allowable slope.
 5. Requirements for curbs, guardrail, traffic signs and markings, etc.
 6. Intersection(s) or connection(s) to existing roads, streets or parking areas.
 7. Surface drainage features, both existing and proposed.
 8. Easements and Rights-of-way (existing and new).
 9. Maintenance of traffic during construction.
- d. Parking (POV and/or MEP) and Open Storage Areas.
 1. Size, type, and number of vehicles to be accommodated, as estimated by Using Agency or indicated in Facility Standard Design Guide. Indicate the number of personnel served by the facility.
 2. Number and size of individual parking spaces to be provided, including pedestrian access and number and location of parking spaces for the physically disabled, when required. Also include the number of reserved or designated parking spaces for sustainability requirements.
 3. General location of parking or storage areas, including location of entrance and exit drives.

4. Use of 90 degree, 60 degree, or 45 degree parking spaces and relation to anticipated traffic operation. Per UFC 3-201-01, 90-degree parking is preferred; if 90-degree parking is not used, the designer must provide justification that functional requirements are met at an economic benefit to the Government.
 5. Design the parking lot layout according to UFC 3-201-01.
 6. Determine whether motorcycle spaces are required based on user preference and the project. If spaces are required, provide the number of spaces.
- e. Miscellaneous Site Features.
1. Concrete sidewalks, curbs, and combined curbs and gutters (locations and types). Indicate if special items such as pavers are used. Minimize use of curb and gutter to encourage low impact development (LID) stormwater management.
 2. Fencing - justification, type, height, clear zone, and size and location of gates. Indicate if fencing must be constructed in such a way as to maintain security of the enclosed area at all times. Include requirements for mechanical yards. In addition, consider whether fencing should be required around detention basins dependent on depth, slope and proximity of the basin to schools or childcare facilities.
 3. Traffic signs - types and locations.
 4. Pavement markings - types, locations, spacing, and whether or not reflectorized striping will be required.
 5. Guardrail and wheel stops - location, length, and type of material(s).
 6. Location and sizing of dumpster pads.
- f. Railroads or spurs, when specified in project design.
1. Type of service for which track will be provided including loading.
 2. Anticipated volume of rail traffic.
 3. Maximum grade(s) and degree of curvature, as per UFC 4-860-01FA.
 4. Features of track construction such as thickness and type of ballast, weight of rail, dimensions of cross ties, size of turnouts, etc.
 5. Special requirements for track scales, bumpers, signals, grade crossings, derailleurs, etc., as required.

3.3.1.1.4 Site Grading

- a. Existing site features affecting grading, such as: buildings, streets, curbs, walks, fences, water courses, ponds, elevation of anticipated high water, rock outcrop(s), etc.
- b. Design flood frequency and minimum finished floor elevation required to provide the desired level of flood protection.
- c. Unusual excavation requirements
- d. Grading constraints such as maximum parking lot slope (transverse and longitudinal), sidewalk slope (transverse and longitudinal), minimum channel slopes, etc.

3.3.1.1.5 Storm Drainage Design

- a. Discuss all stormwater design requirements. The storm sewer system and stormwater management system shall be designed in accordance with the UFC 3-210-10, UFC 3-201-01, applicable LEED credits, and the applicable requirements of the local regulatory agency with jurisdiction over the Installation.
- b. Stormwater Management Design Objective. The overall design objective is to maintain predevelopment hydrology and prevent any net increase in stormwater runoff. DoD defines “predevelopment hydrology” as the pre-project hydrologic conditions of temperature, rate, volume, and duration of stormwater flow from the project site. The analysis of the predevelopment hydrology must include site-specific factors (such as soil type, ground cover, and ground slope) and use modeling or other recognized tools to establish the design objective for the water volume to be managed from the project site. Manage the increase in runoff between pre and post-development conditions on the project site, to the maximum extent technically feasible, through interception, infiltration, storage, or evapotranspiration processes. Calculations must be performed indicating the difference between post-development hydrology and pre-development hydrology for the design storm event. Calculations must demonstrate “No net increase” in stormwater runoff where technically feasible. Per UFC 3-210-10, the design storm event is the

- 95th percentile rainfall depth and is based on the 24-hour (daily) rainfall depth averaged over a minimum of 10 years, ideally 30 years where 30 or more years of rainfall records are available.
- c. Per UFC 3-201-01, for design of the drainage system, use a minimum 10-year storm frequency, the facility type minimum, or the minimum required by the local governing authority, whichever is more stringent. Maximum spread for DoD roads is ½ driving lane using a minimum 5-year storm frequency. For airfields, a 2-year design storm is usually required instead of the 10-year storm.
 - d. Discuss alternate concepts considered in arriving at the proposed storm drainage plan.
 - e. Discuss considerations for future expansion and any change in land use within the watershed, particularly above the project site.
 - f. Identify principal means of collection and disposal of storm water in the new storm drainage system.
 - g. Indicate method proposed for handling roof runoff from gutter downspouts (splash blocks or roof drain collector system).
 - h. Identify locations and features of special storm drainage structures, when required.
 - i. Indicate types of materials to be specified for storm drains, culverts and structures, allowing full range of options of suitable materials for each installation.
 - j. Document easement requirements, when applicable.

3.3.1.1.6 Pavement Design

State types, thicknesses, and locations of pavements to be used. Reference the Geotechnical section of this Design Guide for guidance related to pavement design.

3.3.1.1.7 Utility Design

- a. Include identification of utility owners, points of contact, and any special considerations related to obtaining services. Provide descriptions of responsibility of project/contractor versus the utility provider. Indicate who provides service lines, meters, tanks, etc. Describe permit requirements and connection fees including delineation of responsibilities for A-E, construction contractor, utility provider, etc. Indicate metering requirements and backflow prevention requirements.
- b. Include conceptual level pipe size calculations. Where project utilities are extensions of existing systems, show the existing infrastructure is adequate for the additional load requirements. Show available supply flow and pressure versus required supply flow and pressure. The method of calculation shall be clearly presented.
- c. Describe the utility systems chosen. For buildings remotored from available utilities, provide life cycle cost analysis to justify utility system selection. Coordinate with other disciplines as necessary. Examples: Justification for water tanks versus extending water mains or justification for lift station/force main versus extending gravity sewer.

3.3.1.1.8 Landscape Design

Include an analysis of existing site conditions, as well as indication of existing plant materials that are to remain on the project site. Point out specific site problems related to proposed development and the rationale for proposed plant selection and locations. Also include a list of suggested types and sizes of plant materials which are to be used, based upon the Installation's approved plant list and the designated functional and visual criteria requirements. Landscape design must meet UFC 1-200-02 and UFC 4-010-01.

3.3.1.1.9 Sustainable Design

Include a discussion of the site sustainable design features. Identify LEED credits which are likely to be achieved and how the site design will include features to obtain these credits. Include a discussion of UFC 1-200-02 requirements and how the site design will satisfy these requirements.

3.3.1.1.10 Additional Information

Designer should develop a tabulation of any design data not received that, in the judgment of the Designer, will be needed in order to proceed to completion of final design and preparation of complete bidding documents without interruption or delay, when directed to proceed with final design.

3.3.1.2 Concept Drawings

Although the major items of work should be shown separately, different items of site work may be shown on the same sheet, provided the presentation is sufficiently clear to permit legible reproduction at half-scale. For less complicated projects some drawings may be combined. Sheets should include general notes, keynotes with reference to appropriate details, and legend. Sheet title blocks shall include project number (PN), P2 number, fiscal year (FY), drawing scale, and list designer, drawer, and checker using first initial and full last name. All plan sheets shall include a graphic scale and a north arrow, with site preferably oriented with North arrow pointing toward the top of the sheet. On all Civil plan sheets, where the proposed work extends over more than one sheet, use neat match lines to indicate breaks in topography. Overlaps, overruns, or repetitions in the layout are not permitted. Use symbols and line weights to differentiate between new and existing site work. New work should be shown dark and existing features should be gray shaded.

Include the following drawings, prepared in accordance with A/E/C CADD standards:

- a. Index of Drawings: Coordinate with other disciplines such that a complete index of drawings is developed. The "Index of Drawings" shall be a separate sheet listing drawing numbers and titles. Ensure the sheet names listed on the Index of Drawings correspond to those found in the title blocks of each individual sheet.
- b. Location Plan and Vicinity Map: Provide an appropriate scaled map, on which the proposed location of the facility being designed will be shown. For projects on a Government Installation, show the location of the project in relation to the overall installation. Indicate location of project site, designated haul routes, and construction contractor's access to the site and the designated borrow and disposal areas. Indicate the location of recycling centers on the Installation, if applicable. If borrow and disposal areas are not available on the military reservation, add appropriate General Notes indicating that Construction waste including waste soil shall go to a State Certified Landfill.
- c. Existing Topography Plan: Provide a plan sheet of the proposed project site showing the "existing" topography. Identify any bordering/adjacent roads and streets, also any "existing" structures, utility lines, or other site feature(s) that may impact the proposed project. At the Conceptual level, if survey information is not available, an aerial photo may be used if available.

3.3.1.2.1 Aerial Photo

When available, include an aerial photo showing the project site, as a separate drawing. Include proposed site features. Label existing roadways and buildings. Note the date of the aerial photograph. Show scale in title block and provide a graphic bar scale.

3.3.1.2.2 Survey Control Plan

Show the survey control points on a site plan, together with detailed information for each reference point (location from known features, horizontal coordinates, elevation, horizontal datum, and vertical datum).

3.3.1.2.3 Demolition Plans.

Develop plans of similar scale to the site plans described below indicating items to be removed. Tree removal and clearing and grubbing limits may also be indicated on the demolition plans. Include an Overall Demolition Plan of similar scale to the Overall Site Plan.

3.3.1.2.4 Site Plans

These plans consist of a "composite" drawing(s) of the separate drawings, at the same scale, preferably 1"=20', and covering the same area as the topographic survey sheets. In addition, include an Overall Site Plan at large enough scale to include the entire site on one sheet (1"=100' or 1"=200').

- a. Show and identify all existing and future buildings, utilities, roads, and other facilities on and adjacent to the project site. Show all existing and proposed driveways, parking areas, sidewalks, fencing, garbage storage and pick-up pads, and any other items necessary for functional and operation adequacy, including typical roadway and pavement sections. Identify building numbers and show all trees that have been determined by field survey to be worth saving and incorporating into the project design. Do not show proposed grading. Indicate the contractor work limits. Show any required AT/FP setback limits.

- b. Show the proposed geometry of the project site plan using a preferred scale of 1"=20'. Provide sufficient geometric information to adequately locate all new site elements. Include the existing topography that will remain after construction is completed.

3.3.1.2.5 Utility Plans

Show preliminary utility service routing and any possible utility relocations. Include the following:

- a. Show and identify all existing buildings, utilities and other facilities on and adjacent to the project site.
- b. Include existing utilities with the site topography. If necessary for clarity, show removals, relocations, and new work for utilities other than storm drainage on separate plan(s). Show all existing and proposed utility lines and structures required to serve the project, including: water, sanitary sewer, storm drainage, gas service, fuel service, hot and chilled water, and steam. Note, electric service and communication lines are usually shown on electrical site plans. Size these utility lines and structures in the best engineering judgment at this **30%** stage without performing a complete design. Identify each utility by a symbol in a legend on the drawing(s).

3.3.1.2.6 Landscaping Plans.

When required, this consists of a narrative including a list of the major plant types to be in the project design. Also include a drawing showing a small portion (at least one building and one open area) of the project site to indicate the Landscape Architect's ideas or intent. For the overall design approach, as applicable, depict factors which affect existing site features and influence subsequent design proposals. Prepare the **30%** drawing(s) at the same scale and include an appropriate legend, north arrow and graphic scale, same as the project site plan. Indicate areas that are to be landscaped at the 30% phase. At this phase, the actual species and plant schedule need not be completed.

3.3.1.2.7 Detail Sheets

Provide details of items to be constructed or installed, if available at the 30% phase.

3.3.1.3 Concept Specifications

For the 30% submittal, provide in the design analysis a list of Unified Facility Guide Specifications to be used in the Site Development portion of the project design.

3.3.2 INTERIM (60%) DESIGN SUBMITTAL REQUIREMENTS

Include the following items:

- a. Fairly complete Site Plan drawings, including landscaping when required.
- b. Once the proposed building(s) and parking location is finalized after the concept submittal, perform a complete geotechnical investigation. Provide boring logs and locations in the required CADD format.
- c. A list of any additional design criteria not already included in the 30% submittal.
- d. Outline/draft project specifications covering all items of Site Development work shown on the drawings.

Proceed from **30%** to final project design, incorporating approved comments received from review of the **30%** Design Submittal. Consider the following items in the **60%** Design stage:

- a. Coordination: Closely coordinate all disciplines involved in the project design, (i.e., architectural, structural, mechanical, sanitary sewage, water and electrical) with the Site Development (grading and paving layout). Coordinate landscaping with utility layout to ensure that proposed plantings/root structures do not conflict with utilities. Tie locations of sidewalks, drives, and parking areas, as well as finish grade elevations around building(s) into the requirements shown on the architectural drawings. Unless otherwise instructed, concrete pads, electrical substations, cooling towers and other such items as required in the project layout must be shown on the Grading Plan to assure a complete grading design.

3.3.2.1 Interim Design Analysis

Further develop the **30%** Design Analysis to support the **60%** design submittal, showing more detailed analyses and calculations, date of initial preparation and names of designer and checker. In addition to the items required for 30% Design Analysis, also include the following, as applicable:

3.3.2.1.1 Site Geometry

Diagrams illustrating design vehicles can navigate the site layout.

3.3.2.1.2 Site Grading

- a. Ensure that the natural character (aesthetics) of the terrain of project site is preserved by having minimal disturbance to existing ground levels to conserve trees and reduce the extent of potential erosion. Design the site grading to maintain a reasonable balance of cut and fill to reduce cost of removal and disposal of excessive excavation or securing additional borrow. Avoid excessive grades or steps in sidewalks, whenever possible. Where rock is encountered close to the surface, keep the finished grade(s) as high as practicable to reduce cost of excavating utility trenches.
- b. An estimate of cut and fill quantities, plus slope stability analysis (cut and fill) and justification for any slopes steeper than 3H:1V.

3.3.2.1.3 Earthwork Quantities

Provide earthwork quantity calculations to be used for project cost determination.

3.3.2.1.3 Storm Drainage Design

- a. Design the storm drainage system and culverts to conform to the applicable UFC's and state/local storm water management guidelines.
- b. Storm drainage design calculations consistent with the requirements of the applicable UFC's, based on the design values presented in the **30%** design narrative and incorporating approved comments from the **30%** design submittal review.

3.3.2.1.4 Stormwater Management

- a. Description of the pre-development condition
- b. Calculations for pre-development and post-development runoff volumes and rates using the 95th percentile rainfall event to identify the volume of stormwater requiring management and the extent to which the design objective was met.
- c. Documentation of whether Option 1 (Retain the 95th percentile rainfall event) or Option 2 (Site-specific hydrologic analysis) is being used to meet EISA Section 438. If the project delivery team has determined that meeting EISA Section 438 is technically infeasible, provide complete documentation of technical infeasibility to include, but not limited to, engineering calculations, geologic/geotechnical reports, hydrologic analyses, other site conditions. Stormwater practices to infiltrate, evapotranspire and/or harvest and use onsite the maximum amount of stormwater technically feasible shall still be used. All other applicable federal, state, and local stormwater requirements shall still be met. EISA reporting forms shall be filled out and included in the Design Analysis.
- d. Documentation of how Energy Independence and Security Act (EISA), LEED and any state and local stormwater requirements are met, including any necessary calculations.
- e. Documentation of technical constraints, if applicable.
- f. Stormwater management practices used to meet the design objective and whether they were located on-site, off-site or both.
- g. Estimated construction cost to meet the design objective.

3.3.2.1.5 Pavement Design

In addition to the pavement description required for the Concept Submittal, for all new pavement designs describe the approach for providing positive means of draining water from the aggregate base course (drainage layer) to reduce the effects of frost heave.

3.3.2.1.6 Utility Design

- a. Provide updated pipe size calculations. Show flow quantities, pipe sizes, pressure drops, and initial and final pressures. For computer generated calculations, provide inputs and outputs. The method of calculation shall be clearly presented.
- b. Provide sanitary sewer design calculations complying with UFC 3-240-01 and UFC 3-240-02, as referenced in UFC 3-201-01.
- c. Provide capacity calculations for all major items of equipment such as pumps and gas or water tanks. Show manufacturer's make and model number of equipment used for layout purposes.

- d. Provide calculations for thrust restraint.

3.3.2.1.7 Landscaping Design

Further develop the descriptive narrative, list of plant materials, and cost estimate from the 30% design submittal to correspond with the development of the 60% planting plan. Prepare the outline specification(s) and approximate grassing and plant list quantities for the 60% design submittal utilizing the recommended Plant List for the Installation. Include quantities of grassing and plant materials in the 60% cost estimate.

3.3.2.1.8 Additional Information

List any additional information or design criteria that has not been furnished to date that A-E design considers necessary to prepare a complete final design submittal and bidding documents.

3.3.2.2 Interim Drawings

The 60% design submittal requires further development of the **30%** design submittal.

Although the major items of work should be shown separately, different items of site work may be shown on the same sheet, provided the presentation is sufficiently clear to permit legible reproduction at half-scale. For less complicated projects some drawings may be combined. Sheets shall include general notes, keynotes with reference to appropriate details, and legend. Sheet title blocks shall include project number (PN), P2 number, fiscal year (FY), drawing scale, and list designer, drawer, and checker using first initial and full last name. All plan sheets shall include a graphic scale and a north arrow, with site preferably oriented with North arrow pointing toward the top of the sheet. On all Civil plan sheets, where the proposed work extends over more than one sheet, use neat match lines to indicate breaks in topography. Overlaps, overruns, or repetitions in the layout are not permitted. Use symbols and line weights to differentiate between new and existing site work. New work should be shown dark and existing features should be gray shaded.

Include the following drawings, prepared in accordance with A/E/C CADD standards:

3.3.2.2.1 Index of Drawings

Provide index of drawings as described in Concept Drawings.

3.3.2.2.2 Location Plan and Vicinity Map

Provide location plan and vicinity map as described in Concept Drawings.

3.3.2.2.3 Aerial Photo

When available, provide an aerial photo as described in Concept Drawings.

3.3.2.2.4 Survey Control Plan

Provide survey control plan as described in Concept Drawings.

3.3.2.2.5 Site Photos

Include a drawing showing photographs of the existing site. Include a location sheet showing photo locations and direction.

3.3.2.2.6 Existing Topography Plan

The Existing Topography Plan consists of a drawing or drawings prepared from the topographic survey sheets at the same scale as the Site Plan, preferably 1"= 20'. This plan should show all existing site features (topography, contours, structures, utilities, roads, etc.), with contours extended a minimum of 50 feet outside site boundaries to show surface drainage, and labeled frequently enough to convey drainage patterns.

3.3.2.2.7 Erosion Control Plans

Provide plans of similar scale to the site plans described below showing the existing topography of the site and illustrating the location of erosion control features to be used by the contractor during construction.

3.3.2.2.8 Demolition Plan

Include a Demolition Plan showing demolition, relocation, and salvage of existing buildings, roads, drainage structures, etc. Create this plan at the same scale as the Site Plan and the Existing Topography Plan. If clearing and grubbing cannot be clearly shown on the Demolition Plan, add separate Clearing and Grubbing Plans and reference the sheets using a note on the Demolition Plan.

3.3.2.2.9 Site Plan

- a. Complete a geometric layout of all items of new site work, located by station and offset from alignments or with coordinates. To limit sheet clutter, coordinate data may be shown on a separate sheet for more complicated projects.
- b. Include references to standard figures, or reference particular details in the "Site Details" for specific items of site work.
- c. Complete the legend to include symbols for all items of site work shown on the Site Layout Plan. Symbols should be consistent between successive drawings.
- d. Exclude proposed contour lines for ease of review.
- e. Indicate pavement types in the Site Layout Plans or on separate pavement plans.
- f. Signage and Pavement Markings. Provide parking stripes in parking areas. Also, when specified, signage, traffic arrows and other pavement markings shall be shown, following requirements in UFC 3-201-01.
- g. Dimensions of vehicle parking spaces, including parking for the physically disabled and parking spaces to satisfy sustainability requirements, when required.
- h. Locations and types of fences, barriers, gates, and bollards to limit site access to restricted areas, when required.
- i. Indicate radii at roadway and street intersections and turnouts dimensioned to edge of pavement or face of curb, unless noted otherwise.
- j. Contractor work limits.

3.3.2.2.10 Grading and Storm Drainage Plan

- a. Indicate all items of new grading work, superimposed on the existing topography.
- b. Develop the Grading and Storm Drainage Plan for each project site with reference to the existing topography, preferably at a scale of 1"= 20'.
 1. Include storm drainage features and pipes on the plans. Include all other utilities, except for storm drainage, on the Utility Plans. However, all existing utilities and features, must be indicated or identified by appropriate symbol in the legend. Locate storm drainage structures using coordinates. Coordinates may be shown on a separate sheet for complicated storm drainage layouts in order to eliminate clutter.
 2. Earth shoulders of appropriate width should generally slope 8% (1 in/ft.). Gravel and paved shoulders of appropriate width should generally slope at 4%. Make cut and fill slopes for overall site work no steeper than 4H:1V, except for unusual conditions or cases where steep slopes are necessary to prevent encroachment on existing structures, or perhaps in remote outfall ditch areas. For roadway projects, consider cut and fill slopes of 4H:1V for fill heights up to 6 ft., 3H:1V for heights of 6 to 10 ft., and 2H:1V for fill heights over 10 ft. Slopes steeper than 3H:1V shall be analyzed for slope stability.
 3. Once grading is complete verify the Contractor Work Limit line (CWL) (minimal 10 ft. beyond top of back slope of cut or toe of fill slope). Verify the CWL on linear projects to ensure sufficient space is provided to allow entry, exit, earthwork staging operations, and generally any movement necessary to access the work site.
 4. Indicate the finished floor elevation of all new building(s) and provide finish grade spot elevations at building corners, along sidewalks, edges of paved areas, etc., to assure positive surface drainage away from the structures. Per UFC 1-200-01, establish a finished floor elevation a minimum of 8 inches above finished grade at the perimeter of the building. Comply with the disability requirements of the DoD Policy Memorandum on Access for People with Disabilities, dated October 31, 2008.
 5. Differentiate clearly between new and existing contours, in accordance with A/E/C CADD Standards. New contour lines are to be heavy and tie into the appropriate existing contours; existing contours and topography are to be gray-shaded. Label contours with adequate frequency to illustrate grading pattern on each sheet. Spot elevations must be

shown at all strategic grading points such as storm drain inlets, grade breaks, pavement corners, at P.C. or P.T. of pavement radii, along sidewalks, and at all points necessary to establish the new grading pattern. For roads and parking lots, provide horizontal and vertical alignments to control profile grades. Spot elevations on the drawings should be sufficient so that interpolation between contours is not required for structures, grading or paved areas. The use of cut or fill symbols in lieu of finish grade contours is not permitted.

- c. Channelized storm water runoff over sidewalks must be avoided by providing diversions, inlets, or cross drain pipe to intercept the runoff. Do not permit transverse runoff originating from extensive earth areas to cross paved parking areas at any time. Intercept such runoff before reaching the pavement.
- d. Indicate existing spot grade elevations at intersections of existing and new pavements to assure construction of smooth tie-ins.
- e. Show the proposed finished floor elevation of all new buildings and critical finish grade spot elevations along sidewalks, edges of paved areas, etc., to assure positive drainage to storm drain inlets.
- f. Locate the new storm drainage system using the symbols included in the legend and indicate the direction of pipe and surface flow. Identify drainage structure with number designations corresponding to same used in the storm sewer profiles, drainage design analysis, and the pipe and structure schedule included in the drawing details. Major drainage ditches or channel relocations may require cross sections.
- g. Locate by coordinates any stormwater management features such as bioretention areas, bioswales, or rain gardens.
- h. Seeding. Specify all newly graded earth areas, slopes, ditches, and other disturbed areas be seeded. Use sod or erosion control mats in areas where slopes are 3:1 or greater in order to minimize soil surface erosion.

3.3.2.2.11 Utility Plans

Coordinate with other disciplines as needed to further develop utility plans for gas systems, chilled and hot water utility systems, and steam utility systems. Update the utility plans for the utilities including sanitary sewer and water systems.

- a. Facilities not in a military installation require coordination with the local utility and typically involve separate submittals and permits.
- b. Facilities in military installations that have some or all utilities privatized typically involve separate submittals and compliance with the standards of that utility.
- c. Clearly delineate construction contractor responsibility versus the utility provider responsibility. Example: provision of service lines, meters, regulators, connections, etc.
- d. The utility plans shall show the building and pavement locations with the connection of new utilities from the building to the existing utilities. Indicate the pipe sizes and/or capacities for electricity, gas, water, sewer, chilled and hot water, and steam. Also indicate utility structures and equipment such as power poles, manholes, utility vaults, drains, traps, exterior backflow preventers and meters, fire hydrants, fire department connections, post indicator valves, and shut-off/isolation valves.
- e. Show locations of water flow and test hydrants used for water flow tests.
- f. Show gas delivery pressure and capacity (cubic feet per hour) at the gas regulator.
- g. Show size and capacity for any equipment such as tanks and pumps.
- h. Indicate materials of construction where not adequately addressed by specifications.

3.3.2.2.12 Miscellaneous Site Work Details

Include the following, when applicable:

- a. Standard Details, including curb and gutter and surface inlet(s); manhole frame(s) and cover(s); grate cover(s); headwalls; and sidewalks, as required. Generally, where concrete curb and gutter is used to control surface drainage, curb and gutter inlets are used to intercept runoff from vehicular pavements. Use grate or weir type inlets only in turf areas, but only grates inlets in aircraft pavements. Details from State DOT Standard Drawings, local jurisdiction standard drawings, or utility provider standard drawings if used.

- b. Striping and signage details, including handicapped provision details.
- c. Fencing and gate details, when required.

3.3.2.2.13 Pavement Profile Sheets

For roads, airfield runways or aprons areas, parking lots, or range trail designs provide profiles at the same horizontal scale as the plan view. (Normally, use a vertical exaggeration of 1H:5V, or as appropriate to fit the site terrain). Indicate the "existing" ground line elevation at each centerline station on the profile,

- a. Provide C/L grade elevations at a minimum of every 100 ft. on station.
- b. Indicate the degree (percent) and length of all vertical curves. Include layout data (PVI, PVC, PVT, etc.) for each curve.
- c. Indicate the percentage/degree of slope for all proposed grade lines and provide elevations at points where grade changes occur. Provide special information pertaining to the profile and affecting the design, such as: curb grades, gutter grades, channel invert and top elevations of bridges, etc.
- d. Show correct locations and invert elevation(s) of both new and existing utility crossings on each profile. Indicate size and length of each structure.

3.3.2.2.14 Typical Sections

Provide typical roadway and parking lot sections.

3.3.2.2.15 Boring Locations and Logs

Provide a drawing showing the location of the borings taken in the geotechnical investigation. Also provide boring logs that show graphically the types of soils encountered in the geotechnical investigation. Coordinate these sheets with the geotechnical engineer.

3.3.2.2.16 Right of Way Plans

If the project is located adjacent to private property, provide a separate "Right of Way" plan as required. Provide reference drawings showing all land required for construction of the project.

3.3.2.2.17 Landscape Plan

- a. Further develop the **30%** design by developing an overall planting layout. Furnish the Landscape Architect with information indicating the proposed location of all exterior utilities before beginning Landscaping design. Indicate on the **60%** design drawings and all subsequent plans both existing and proposed building, paved areas, signs, light standards, transformers, dumpster pads, storm drainage lines, and other utilities and structures. Use foundation plants, shrubs, and ground covers to create a desirable setting, and to screen objectionable areas, but not to control traffic and other similar uses. Show all foundation planting(s) at a scale 1"= 20' but not smaller, and indicate the location of doors and windows, and any other feature of the building influencing the landscaping design. Include enlarged detailed plans of specific areas as needed to clarify requirements. Show common plant name, quantity, exterior utilities, north arrow, legend, and scale.
- b. The Landscape Plan is an integral part of the planning and construction of the proposed project. However, AT/FP and sustainability guidelines must be met with the landscaping plan development. In selecting plants, give attention to maintenance, hardiness, ultimate effect and grouping. Make the planting design informal, simple and composed of plants native to the area, with emphasis on trees. Show shade trees, evergreen trees, flowering trees, shrub masses, etc., according to designated functional and visual locations of plantings. Use a scale for the tree planting plan of 1"= 20'. This plan need not indicate wall openings. Include a plant list indicating the sizes of plants recommended for each of the above categories. Indicate each plant as a mature plant by one size and type symbol throughout the project design. Ground cover(s) may be indicated as a mass showing the area to be covered. On the plan, the key symbol for each plant type follows the quantity in a location or grouping; i.e., 4-2 in or 4 in-Q.
- c. Include the **60%** Landscape Plan with the **60%** Design submittal. (If "existing" and "finished" contour elevations are considered critical to the landscaping layout, provide an overlay of the landscaping drawing(s) showing both the "existing" and "finished" grades and elevations). Show grassing limits or notes on Landscaping Plan(s) or on both the Grading Plan and the Landscaping Plan. Unless otherwise directed, always consider the following additional items:

1. Remove existing trees only if absolutely necessary for construction.
2. Specify plant materials that are hardy and require minimum care/upkeep to reduce overall maintenance costs of the new facility.
3. The planting design should reduce noise and glare, modify wind and temperature, control dust and erosion, and be compatible with the proposed exterior lighting plan of the project site. Avoid plantings that block aerial street lights and exhaust vents of building ventilation and air conditioning systems.
4. Locate plants so as not to interfere with underground utility lines. Accordingly, locate major and minor trees no closer than 25 ft. and shrubs no closer than 5 ft. from sanitary sewer lines.
5. Avoid plants interfering with safe sight lines of either pedestrians or drivers at street, road and driveway intersections.
6. Coordinate landscaping plans with "existing" site conditions and the Demolition, Site, Grading, and Pavement Plans; architectural floor plans and elevations; and pertinent aspects of utilities (mechanical, plumbing, and electrical) drawings for proper location of items such as air compressors, fuel oil tanks, electrical transformers, meters, light standards, hose bibs and fire plugs. Coordinate COE and Using Activity (DPW/BCE) requirements before beginning **60%** Design. Contact the Using Activity to substantiate the extent of design requirements and provide planting proposals which correspond with available maintenance capabilities.

3.3.2.3 Interim Specifications

Provide a listing of specifications in the design analysis.

3.3.3 FINAL (90%) DESIGN SUBMITTAL REQUIREMENTS

3.3.3.1 General

Advance the project design to completion, complying with/incorporating approved comments received from review of the previous Design Submittal. Submit the Final as if it is "Ready to Advertise" when received.

3.3.3.2 Specific

Whenever the final design is based on an approved **30%** Design Submittal, refer to paragraph, "**60%** Design Submittal Requirements" for guidance in preparing a complete design, including developing a detailed storm drainage and pavement design analysis, final drawings, draft project specifications, and final site work quantities

3.3.3.1 Final Design Analysis.

Update/revise previously prepared analyses to support final plans and specifications, as noted above, including both original and revised dates of preparation, when applicable, and the names of preparer and checker.

3.3.3.1.1 Storm Drainage Design

If an acceptable storm drainage design analysis was furnished with the **30%** or **60%** design submittal, no additional analysis will be required. However, when revisions are required, the A-E must resubmit the analysis, same as for the storm drainage design, as noted above.

3.3.3.1.2 Pavement Design

If an acceptable pavement design analysis was furnished with the **30%** or **60%** design submittal, no additional analysis will be required. However, when revisions are required, the A-E must resubmit the analysis, same as for the storm drainage, as noted above.

3.3.3.1.3 Geotechnical Report

Provide the geotechnical report.

3.3.3.1.4 Landscaping Design

When required in the design contract, landscaping design consists of preparing "complete" landscape studies, drawings, and specifications. Base the design on all general and specific criteria (standard drawings, manuals, etc.).

3.3.3.2 Final Drawings

Complete all the drawings required at the interim design review stage and incorporate approved comments. Insure correct cross referencing between site plan drawings for appropriate details, sections, match lines, other design disciplines, etc. Eliminate any possible conflicts (horizontal and vertical) between site development and architectural, structural, and utilities drawings by coordinating with other design disciplines. Add the drawings detailed below.

3.3.3.2.1 Storm Sewer Profiles

Provide pipe profiles of the storm system when necessary showing manhole location, pipe sizes and grades and other utility crossings. Storm drain pipe profiles showing existing ground line, finished grades, drainage structures, invert elevations, pipe slope, sizes, materials, and lengths, but not the hydraulic gradient; intersecting sanitary sewers, water lines and other underground utilities crossing the storm drain line on the profile(s) at their proper elevation; adjusted pipes that conflict at crossings, adequately detailed; Include drainage structures such as catch basins, manholes, and drop inlets, and include rim and invert elevation of the structure. Include all storm drainage details.

3.3.3.2.2 Joint Layout Plans

A concrete joint layout plan and joint details are required for concrete pavement areas showing the joint locations, types of joint, dimensions between joints, and identification of slabs required to be reinforced, and joint details conforming to the applicable standard drawing details.

3.3.3.2.3 Erosion Control Plan

Provide erosion control plans with details that show the critical areas that are being protected while the project is under construction. Coordinate the details of this sheet with state and local authorities as required. Coordinate these plans with the SWPPP and any necessary permits such as NPDES, 401 and/or 404.

3.3.3.2.4 Utility Plan

Update plans with additional details as needed. Unified Facilities Criteria (UFC) shall not be referenced on the plans; all requirements for the project shall be explicitly shown in the drawings. Provide completed profiles for gravity sanitary sewer and force mains showing manhole locations, pipe sizes, grades, and other utility crossings. Provide details for connection of new piping to existing piping, valves, hydrants, vaults, manholes, and other appurtenances. Provide details for piping under roads, railroads, parking lots, thrust restraint, etc. Provide details for lift stations, tanks, and the construction of all other major equipment. Provide complete construction details sufficient to allow construction and installation of the work without additional design work by the construction contractor. Label all equipment, valves, hydrants, etc.

3.3.3.2.5 Landscape Plans

Indicate proposed plants by a (+) mark for the plant location and a circle scaled at approximately 2/3 the ultimate canopy growth spread (diameter) of trees and shrubs. Also, include a "complete" schedule or plant list of materials listing both botanical and common name(s), plan symbols, quantities, sizes and condition furnished. Final drawings also include the basic detail sketches for installation of tree, shrub and ground cover plantings, plus any other applicable details for clarification of specific project requirements. Include pertinent notes, applicable to construction requirements, in addition to standard notes. The final landscape plan, plant schedule, details, notes, specifications, and cost estimate must agree.

3.3.3.3 Final Specifications

- a. Insure consistency of terminology between drawings and specifications for specific items of work by appropriate notations on drawings.
- b. Check to insure adequate referencing to standard detail sketches included in the Site Details for construction. Details for Site Development are never included in the specifications, only on the drawings.
- c. Submit specifications covering all proposed items of site development.

- d. Ensure correct cross referencing between specifications.
- e. Ensure specifications are free of bracketed or blank text. All information in the specifications should be completed and applicable to the project.
- f. Ensure specifications include only sections relevant to the project. Sections describing work that is not performed and materials which are not applicable may be omitted.
- g. Ensure specifications include Stormwater Pollution Prevention Plan (SWPPP).
- h. Specifications must not be restrictive or proprietary. The description shall be such that at least three manufacturers can meet the specified requirements. Where trade names and model numbers are listed, provide from at least three manufacturers and indicate OR APPROVED EQUAL with salient features specified.

3.3.3.4 Storm Water Pollution Prevention Plan (SWPPP)

The Stormwater Pollution Prevention Plan and Notice of Intent (NOI) shall be developed by the Designer of Record; otherwise, document in the Design Analysis that the SWPPP and NOI will be the responsibility of the construction contractor after contract award. In the latter case, the contract specifications must clearly assign this responsibility to the construction contractor. Coordinate with the USACE PE/A to determine the party responsible for submitting the SWPPP, NOI and the Notice of Termination (NOT) to the approving agency.

3.3.4 CORRECTED FINAL (100%) DESIGN SUBMITTAL REQUIREMENTS

The 100% design submittal is not considered to be a formal design/review submittal, but will be required in those cases in which the final approved comments indicate revision(s) to correct design error(s) or omission(s) in the final design submittal.

3.3.4.1 100% Design Analysis

Revise the D.A. to support the corrected requirements for site features of the project, by incorporating approved comments received from the Final Design Submittal.

3.3.4.2 100% Design Drawings

Revise thoroughly checked drawings, same as above for the design analysis.

3.3.4.3 100% Project Specifications and Site Work Quantities

Same as above for design analysis and drawings.

3.4 SPECIAL DESIGN/TECHNICAL REQUIREMENTS

3.4.1 FILL, BORROW OR WASTE MATERIALS

Whenever possible, develop site grading to achieve a balance of cut and fill. In computing earthwork quantities, make suitable allowance for swell and shrinkage.

- a. For Projects Located on Military Reservations or Other U.S. Government Property. Determine whether soil borrow or disposal of surplus soil and other waste material will be required, and the quantity of material involved. Develop the earthwork specification(s) to indicate whether soil borrow or disposal of waste material will occur on the military reservation. Coordinate borrow and waste disposal areas with the PE/A to determine the location and limits of borrow areas containing suitable soils, disposal areas, and permissible haul routes through the Installation. (The designated haul route(s) may not always be the most direct route). For spoil, if soil cannot be disposed on Government property, specify that soil be transported to a state-certified landfill.
- b. Unsuitable Soils. Specify removal of all unsuitable soils (trash, organic soils, and highly plastic clay soils) determined by site inspection(s) and boring logs, from areas within the limits of construction for both the building(s) and paved areas. Remove unsuitable soils and dispose as described above. Determine and specify on the drawings the depth and limits of unsuitable soils to be removed. To guide the construction contractor in removal operations, show the limits and extent of the removals by appropriate symbol(s) or notes on the finished profile(s) and cross section(s) in the final contract drawings.

3.4.2 DISPOSAL OF EXISTING PAVEMENTS, FOUNDATIONS, FLOORS, ETC.

Specify that all pavements removed, including floor slabs, footings and chimneys, be broken into pieces sized specific to the project; recycle or salvage as much material as possible. If approved, the broken material may be used as aggregate, recycled for paving, used as grouted riprap for ditch lining to eliminate erosion, etc. Material not recycled or salvaged shall be disposed of as shown in the Plans and Specifications.

3.4.3 SPECIAL INSTRUCTIONS FOR DESIGNING A LARGE BUILDING COMPLEX, MAJOR ROAD NETWORK OR AIRFIELD PAVEMENTS

When a project design consists of a large complex of buildings, major road network, or airfield pavement, the following additional instructions are also applicable;

- a. Unless otherwise specified, reference the project to a state plane coordinate system.
- b. Show finished grade contours in a grading plan.
- c. Unless otherwise instructed, where existing roadway pavement is specified to have overlay pavement, cross section elevations must be taken at station intervals not greater than 50 feet along the C/L and also at the edges of the pavement to establish the minimum and maximum depth of overlay pavement required and the finished profile grade(s). Locate and indicate all "existing" potholes and badly cracked pavement sections. Include details for patching and repair. Road profiles are typically plotted at a scale of 1"= 20' horizontal and 1"= 4' or 5' vertical. (The vertical dimension scale should be determined by the height variation of the existing topography). Other scales may be considered, with prior approval of the District.
- d. Plan and profile drawings are required for all road designs, including family housing, recreation areas, and range complexes. The plan view includes topography taken along the C/L of the proposed road and extending to either side a minimum of 20 feet beyond the end of the estimated cut or fill slopes. Topography of intersecting drainage swales and ditches must be carried a sufficient distance (not less than 200 ft. from C/L of road) to show transition to/from the proposed culvert headwall, graded swales or roadside ditches. The scale of drawings for road designs is typically 1"= 20', and must show existing contours on which the new road is to be placed. Include roadway cross sections in the contract drawings.
- e. Cross sections may be provided in lieu of or in addition to a grading plan for road and airfield projects. Cross sections should not be exaggerated. Cross sections are typically presented at 1"=10' both horizontal and vertical. Pipe sections are typically presented at a scale of 1"=1' both horizontal and vertical.
- f. The need for reasonably accurate earthwork quantities cannot be overemphasized. The engineer must inspect the site of the work and take into account the type of terrain (woods, swamp, pasture, cultivated) and soils, since all these items have a bearing in making assumptions and applying the proper factors in estimating the total quantities of earthwork for the project. When earthwork cross sections are furnished for review, also furnish all backup data and describe in sufficient detail on a specially prepared summary sheet separate from the cross sections the procedure used and the assumptions and reasons established in estimating the earthwork quantities. On the summary sheet show all quantities in cubic yards. Include significant data applicable to the particular project, such as:
 1. Stripping of topsoil, roots, etc., (indicate depth and limits).
 2. Removal of organic or other unsuitable soil (indicate depth and limits).
 3. Earth fill (embankments), including the appropriate shrinkage factor applied to embankment earthfill to compensate for compaction.
 4. Allowance of over-building as a result of subsistence of high fills (indicate depth).
 5. Allowance for backfilling of stump holes, if significant.
- g. Usable soil(s) available for earthfill from the general excavations on the project site.
- h. Location of earth borrow area(s), when sufficient material for earthfill is not available from the general excavations on the project site.

All Corps designed airfield and railroad projects are required to be reviewed by the Transportation Systems Center (TSC) in Omaha. Roadway projects over \$3M are required to be reviewed by the Transportation Systems Center.

3.4.4 UTILITY DESIGN CRITERIA

- a. Avoid designing based on a single manufacturer's product. Multiple manufacturers must be able to compete to provide specified equipment. During design, verify that at least three manufacturers provide equipment meeting specified requirements. Develop a justification and obtain approval through the USACE PE/A for any equipment or system that must come from a single source.

- b. Ensure that systems will be installed in accordance with manufacturer installation requirements and recommendations.
- c. Determine whether expansive soils are present and design piping systems accordingly.
- d. Cathodic protection is required on all underground water and gas lines in areas as defined in UFC 3-570-02A, Cathodic Protection. Cathodic protection is also required for all tanks and piping containing environmentally hazardous materials (i.e. fuel, oil, POL, etc.). Provide cathodic protection to protect tanks and piping in all other areas for which life cycle cost studies justify such an installation.

3.4.5 LANDSCAPING DESIGN CRITERIA

3.4.5.1 General

- a. When landscaping is required in the project design, make field investigation(s) to determine the location and type of existing plants and trees, verify location of sidewalks, drives and parking areas, aerial and underground utilities, and other information including user requests, deemed necessary for complete design of the project. Give specific attention to emphasizing building entrances, screening of utilities, and erosion control, as required by site characteristics.
- b. The final landscape design shall reflect incorporation of all approved review comments, Using Activity requests and/or recommendations resulting from review of all previous design submittals.
- c. The items included for landscaping design require a complete set of drawings IAW with the UFC 3-201-02. If available, also use the Installation Design Guide.
- d. Develop contract specifications primarily from Guide Specification Section entitled "Exterior Plants".

3.4.5.2 Specific

Include the following additional information in the landscape plan:

- a. Existing plantings (to scale as near as possible).
- b. Key Plan (not to scale).
- c. Detailed Final Cost Estimate shall include Final Landscaping Quantities.
- d. Plant List or Schedule, giving botanical and common names, size, caliper (trees only), manner grown and prepared, and quantity. Refer to installation's Acceptable Plant List, or local agricultural office. Plantings should be native to area and tolerant of the local climate.
- e. Graphic or bar scale.

3.4.6 STORM WATER DESIGN

- a. Develop or redevelop facilities to maintain or restore stormwater runoff to the Maximum Extent Technically Feasible with regard to temperature, rate, volume, and duration of flow in accordance with UFC 3-210-10.
- b. All inlet, grate, or weir openings must be checked for size to be certain that the opening(s) will pass the calculated storm runoff draining to each inlet.
- c. Provide watertight joints for storm drainage pipes under all pavements (vehicular and aircraft), especially when the pipe is placed in soils with fluctuating water tables.
- d. Per UFC 3-201-01, minimum pipe diameter for roof drain collector systems(s) shall be 6 inches. Minimum pipe diameter for enclosed storm drain system shall be 12 inches.

3.4.7 PAVEMENT DESIGN

- a. Reference Geotechnical section of the Design Guide for pavement design criteria.
- b. Flexible Pavements - The Louisville District minimum flexible pavement section consists of 1.5 inches asphalt surface course over 2.0 inches asphalt base course over 8 inches aggregate subbase course for light traffic areas such as POV lots, and 2.0 inches asphalt surface course over 3.0 inches asphalt base course over 12 inches aggregate subbase course for heavy traffic areas such as entrance roads and military equipment parking (MEP) areas.
- c. Rigid Pavement - The Louisville District minimum rigid pavement section consists of 6.0 inches PCCP over 8 inches aggregate subbase course. Per UFC 3-250-01FA, rigid pavements for roads, streets, and open storage areas at military installations shall be plain (nonreinforced) concrete except for specific conditions

described in the UFC unless otherwise approved by HQUSACE or the appropriate Air Force Civil Engineer Center(AFCEC).

- d. Military Airfield Pavement - The pavement structure shall be designed in accordance with UFC 3-260-02.

----END OF SECTION----